

Letter of instruction

Information for users

The following document:

NR/L2/ELP/40045 Issue 6

has had changes made to it, most recently, with effect from **1 September 2011**.

Instructions for use

It is essential that you first read and understand each letter of instruction pertaining to the standard before proceeding to use the standard. You must then apply the requirements of each letter to the standard.

NR/BS/LI/106	Issue 2	01 September 2011	Proceed to letter ►
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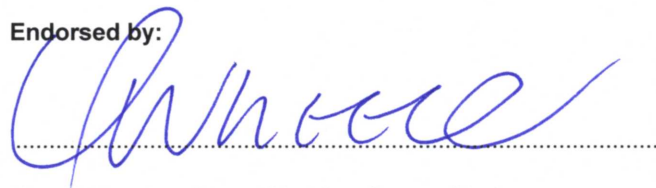
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Level 2

Electric point heating

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Accepted for issue by:



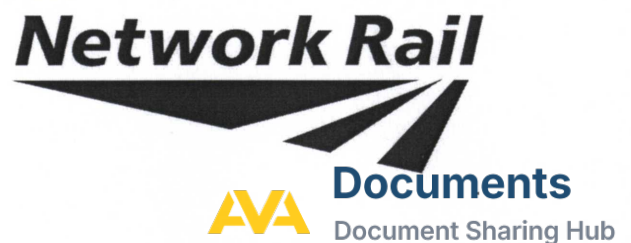
Mick McManus, National Standards Manager

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Issue record

Issue	Date	Comments
5	December 2005	Re-issued as a SAF3 Business Process Document
6	August 2008	Amended with specified roles changed in line with phase 2a reorganisation disposition statements

Compliance

This Network Rail standard is mandatory and shall be complied with by Network Rail and its contractors if applicable from 26 August 2008.

When this standard is implemented, it is permissible for all projects that have formally completed GRIP Stage 4 to continue to comply with the Issue of any relevant Network Rail Standards current when GRIP Stage 4 was reached and not to comply with requirements contained herein, unless the designated Standard Owner has stipulated otherwise in the accompanying Briefing Note.

Reference documentation

See Clause 3

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1 Purpose

This Specification states the minimum requirements for the components and systems comprising the electric point heating installations for use on Network Rail infrastructure.

This Specification is to be read in conjunction with [RT/LS/P/029](#) Product Acceptance.

2 Scope

This Specification is applicable to all electric points heating installations on operational infrastructure.

The requirements of this Specification apply to the design, manufacture, testing and documentation relating to each of the major components, which constitute the Electric Point Heating system.

3 Reference documentation

RT/E/C/11821	Siting Requirements for Lineside Apparatus Housings
RT/E/S/21085	Design of Earthing and Bonding in 25kV AC Electrified Areas
NR/SP/ELP/27238	Maintenance Specification for Fixed Plant Equipment
RT/LS/P/029	Product Acceptance
RT/E/C/11210	Signalling Installation Handbook, in particular appendix 2A05
GI/RT7004	Requirements for the Design, Operation and Maintenance of Points
GI/RT7007	Low Voltage Electrical Installations
GI/RC7607	Recommendations for Low Voltage Installations
BS EN 287	Approval Testing of Welders for Fusion Welding
BS EN 288	Specification and Approval of Welding Procedures for Metallic Materials
BS EN 485	Aluminium and Aluminium Alloys, Sheet, Strip & Plate
BS EN 10088	Stainless Steels
BS EN 50081-2	Electromagnetic Compatibility – Generic Emission Standard – Industrial Environment.
BS EN 50082	Electromagnetic Compatibility – Generic Immunity Standard – Industrial Environment
BS EN 60529	Specification for Degrees of Protection Provided by Enclosures
BS EN 60417-2	Graphical Symbols for use on Equipment - Symbol Originals
BS EN 60529	Specification for Degrees of Protection Provided by Enclosures
BS EN 61558	Safety of Power Transformers, Power Supply Units & Similar.
BS EN ISO 1460	General Requirements & Tests
BS 476	Fire Test on Building Materials and Structures
BS 1706	Method for Specifying Electroplated Coatings of Zinc and Cadmium on Iron and Steel
BS 4573	Specification for 2-pin Reversible Plugs and Shaver Socket Outlets

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BS 4618	Recommendations for the Presentation of Plastics Design Data – Mechanical Properties
BS 5378	Safety Signs and Colours
BS 5467	Specification for 600/1000V and 1900/3300V Armoured Electric Cables having Thermosetting Insulation
BS 6007	Specification for Rubber Insulated Cables for Electric Power and Lighting
BS 6231	Specification for PVC Insulated Cables for Switchgear and Controlgear Wiring
BS 6346	Specification for 600/1000V and 1900/3300V Armoured Electric Cables having PVC Insulation
BS 6360	Specification for Conductors in Insulated Cables & Cords
BS 6399-2	Code of Practice for wind loads
BS 6500	Specification for Flexible Insulated Cables & Cords
BS 6746C	Colour chart for PVC insulation and sheath of electric cables
BS 7324	Guide to Graphical Symbols for use on Equipment
BS 7430	Guidance Note for Earthing
BS 7655	Specification for Insulating and Sheathing Materials for Cables
BS 7671	Requirements for Electrical Installations
IEC 60800	Heating cables with a rated voltage of 300/500 V for comfort heating and prevention of ice formation

4 Definitions

British Standard	A standard published by the British Standards Institution. BS prefixes its numeric identity.
Cess	The space alongside the railway line(s).
Clamplock Heater	A cartridge type heater, which is fitted into the clamplock mechanism operating the point blades.
Equipment	Equipment including all component parts and accessories.
European Standard	A standard published by the European Committee for Electrotechnical Standardisation. Its numeric identity is prefixed by EN.
Four Foot	The space on the track between the running rails.
International Standard	A standard published by the International Electrotechnical Commission. Its numeric identity is prefixed by IEC.
Railway Group Standard	A standard produced by Railway Safety Ltd, which is mandated upon all Railway Group Members. The Standard is prefixed G.

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Specification The contract specific Network Rail technical document to be used with the relevant Network Rail Company Standard(s) for contract works.

Tamping A process used to consolidate the ballast beneath the sleepers.

Track circuit An electrical device using the rails in an electrical circuit which detects the absence of trains on a defined section of line. It is a high integrity device and a fundamental part of the signalling safety system.

°C Degree Celsius

AC Alternating Current

CPC Circuit Protective Conductor

CSA Cross Sectional Area

DC Direct Current

DNO Distribution Network Operator

EPR Ethylene Propylene Rubber

HV High Voltage

Hz Hertz

KVA Kilo Volt Ampere

MCB Miniature Circuit Breaker

MTTF Mean Time To Failure

mV/A/m Millivolts per Ampere per metre

N Newton

OD Overall Diameter

OHLE 25kV AC Overhead Line Equipment

P Way Permanent Way

PCB Polychlorinated Biphenyl

PCP Polychloroprene

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PVC	Polyvinyl Chloride
RCD	Residual Current Device
RMS	Root Mean Square
SP&SN	Single Phase and Switched Neutral
SWA	Steel Wire Armour
TP&SN	Three Phase and Switched Neutral
UIC	Union Internationale des Chemins de fer
W/m	Watts per metre
XLPE	Cross Linked Polyethylene
Zn	Zinc

5 European, International and British Standards etc.

Except where specifically stated otherwise, the equipment shall comply with the relevant European, International and British Standards whether or not reference is made to them. The current edition shall apply. Where more than one Standard exists then the order of precedence shall be taken as follows:

- First European Standard
- Second International Standard
- Third British Standard

Where a British Standard only is quoted, an equivalent European or International Standard will be accepted subject to the prior agreement of Network Rail.

Where reference is made to other Standards, Specifications etc., the current edition shall apply.

6 System overview

6.1 Requirement for electric point heating

Electric point heaters are critical for the operational integrity of the railway network during adverse weather conditions. Their purpose is to keep points and associated mechanisms operating satisfactorily during all but exceptionally severe adverse weather conditions.

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6.2 Performance requirements

The severity of the winter weather conditions in Britain varies geographically and seasonally. To provide electric point heaters which will perform satisfactorily under even the most exceptional conditions would require large quantities of heat and therefore an increase in capital and running costs. These costs cannot be justified for every point. It is likely that under such severe conditions the railway line would be impassable in any event, possibly requiring the use of a mechanical snow and ice clearing machine.

An effective electric point heating installation shall operate in light wind to an ambient air temperature of down to -25 °C, and against a precipitation rate of up to 150mm/hour, so that:

- a) under frost or freezing rain conditions the switch rail does not freeze to the stock rail or its supports;
- b) under snow or hailstone conditions, the improper closure of the points is prevented by addressing the accumulation on the rail support or between the switch and stock rails.

At locations where drifting snow could substantially reduce the effectiveness of an electric point heating installation where the switch must be kept at a temperature of up to +3°C, suitable snow fences shall be erected, where reasonably practicable, and the use of windshields considered

6.3 Types of system

This Specification refers to cartridge heater, constant wattage strip heater, self-regulating strip heater and parallel constant wattage strip heater systems.

Because of the difficulties incurred during the replacement of railchair pad heaters, it is not Network Rail policy to install new railchair pad heater systems and so therefore, these heaters are not included within this Specification.

Cartridge heaters are positioned horizontally in the jaw-blocks attached to the point stock rail and heat the railchairs and stock rail.

Constant wattage, self-regulating and parallel constant wattage strip heaters shall be positioned in the most effective location on the point rails as required to maintain the optimum functional operation of the point.

For new installations, strip heaters shall be fitted, and the option shall be taken to replace cartridge heaters with strip heaters at every available opportunity.

Other products can be used in conjunction with the heaters fitted to the switch and stock rails to provide additional protection. These include heat-retaining shields, slide chair heaters, stretcher bar heaters and windshields.

6.4 System description

Sensors are used to detect rail and/or weather conditions that could effect the operation of the point(s).

When the monitored condition(s) reach a pre-determined value, the electric point heating shall be automatically energised.

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The electric point heating system shall operate such that the point rail temperature and operating mechanisms are sufficient to maintain the functional integrity of the point(s) by the most energy efficient means.

The heating circuit comprises track-mounted heating elements and associated supply cables. A required facility is a remote monitoring system. This system is used to control and/or determine the status of the electric point heating system.

All components shall comply with European Directive [89/336/EEC](#), relevant Electromagnetic Compatibility Regulations, Statutory Instrument No. 2372 and the requirements of [BS EN 50081-2](#) and [BS EN 50082-2](#) for EMC emission and immunity.

The control cubicle contains the electric point heating system distribution circuitry and is fed by the supply cubicle or supply source point. A manual override facility is also provided.

All new points heating installations are required to have the facility for remote monitoring. The equipment shall only be fitted where a business case demonstrates the benefits. This system is used to control and/or determine the status of the electric point heating system.

7 Electrical installation

The whole of the electric point heating installation shall comply with the requirements of [BS 7671](#): 2001.

For 110V heater installations, the maximum voltage drop from the sealed end of the heater element to the secondary winding output terminals of the step-down transformer shall be nominally 4%.

For self-regulating strip heater installations, the minimum operating voltage at the sealed end of the heater element shall be 110V-18%.

7.1 Signalling infrastructure interface

Some types of equipment are sensitive to both AC and DC signals and it is therefore necessary to replace them on electrically heated points. As a guide, signalling track circuits fitted in electrified line areas are normally sufficiently immune to traction system current to also be immune to electric point heating system currents. For example, AC heater element operation in 25kV AC electrified areas, and DC heater element operation in 3rd rail electrified areas, gives acceptable systems interface immunity between the heater element and the signalling track circuit.

The vulnerability to signalling track circuits to mal-operation by stray leakage currents from electric point heating systems, in both normal and fault operating condition modes, is an issue which shall be mitigated against as far as practicable.

To achieve this, the following requirements shall be adhered to:

- a) all 110V heater elements shall be tested immediately prior to installation so that there is a minimum insulation resistance value of $1M\Omega$ between each conductor and the outer sheath at a minimum of four points along the length of the heater. Any heater element which has an insulation resistance less than this value shall not be fitted;

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- b) all temperature sensors shall be tested immediately prior to installation;
- c) prior to any electric point heating installation design, the relevant Principal Maintenance Support Engineer (Signals & Telecomms) shall be consulted to ascertain either the absence, or presence and type of signalling track circuit(s) in use where electric point heating is to be fitted and to instruct which is the common rail for the installation of the temperature probes;
- d) no transformer or transformer/rectifier shall be used to feed point heating equipment contained within the confines of more than one train detection or track circuit area;
- e) transformers fitted with double wound secondary windings shall be installed;
- f) the following types of heating supply shall be provided where signalling track circuits are present:

Signalling track circuit type	Heating Supply to be provided
AC-immune DC	AC
AC on rails DC ('Quick Release')	Prohibited
AC on rails DC immune ('White Receiver Quick Release')	DC
AC Vane Relay	DC
HVI	AC or DC
Low Voltage DC	Prohibited
Reed	AC or DC
TI21	AC or DC
FS 2600	AC or DC

Table 1 – Signalling track circuit and electric point heating supply relationship

Where a DC heating element is specified, and conversion from an AC waveform is required, a full wave rectifier shall be fitted at the non-heater end lead connection terminals. The rectifier shall be sized, as a minimum, to 1.5 times the heater load it is connected to and be able to accommodate the AC waveform peak input voltage.

8 Heating of in-sleeper point operating machines

Where in-sleeper point operating machines (in steel bearers) are provided with electric heaters, additional isolation arrangements for these supplies may be required.

- a) AC on rails DC ('Quick Release') track circuit may be converted to AC on rails DC immune ('White Receiver Quick Release') track circuit, and DC heating elements fitted;
- b) Low Voltage DC track circuit may be converted to AC-immune DC track circuit and AC heating elements fitted;
- c) Other types of train detection system satisfying the compatibility criteria.

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9 Power supply

Depending upon the number of points being heated at a given location, a power supply of suitable type and capacity shall be obtained to meet the required electrical demand. For one or two number point ends, a 1 phase 230V 50Hz supply is appropriate, for three and above number point ends, a 3 phase 400V 50Hz supply is recommended.

10 Earthing arrangements

The use of final circuit RCDs for electric point heating equipment shall be avoided. Where an electric point heating installation is located in a DC electrified area, a DC immune RCD shall be installed to protect all socket outlets fed from the same supply point. Additionally, a 470 ohm 10 watt resistor will be required to be fitted between the socket outlet earth and earth potential.

Where any part of an electric point heating installation, in any plane, is within 2.5m of the OHLE, or is located directly vertically below a return conductor, a bare live feed conductor, or an earth wire conductor, then the installation shall comply in accordance with [RT/E/S/21085](#) Design of Earthing and Bonding Systems for 25kV AC Electrified Lines.

In accordance with the above clause, wherever possible, the main earthing terminal (MET) of the installation shall be securely bonded at one point only to the OHLE traction earth system.

The whole of the system including metal cubicles, metal cable sheaths, distribution boards, metal barriers, up to and including the trackside transformers shall be continuously, permanently and effectively bonded to earth.

A bonding conductor shall be provided throughout the installation connecting the equipment earth termination points to the main earth terminal bar.

All equipment necessary to provide an effective earth system such as copper bars 25 x 6 mm CSA, earth cable, earth braids, gland earth rings, earth studs, earth rods, nuts, bolts, washers and fittings as necessary shall be fitted to complete the installation.

All joints and connections shall be protected against corrosion.

The earthing system shall comply with [BS 7430](#) and [BS 7671](#) : 2001.

The destination of any separate CPC shall be identified by a label attached to it at the point of termination. Care shall be taken to avoid creating parallel earth paths in the vicinity of high voltage electric traction systems.

10.1 Earthing and bonding in overhead line electrified areas (OHLE)

In 25kV AC electrified line areas, in order to provide adequate earth fault protection, a CPC with a minimum 16 mm² CSA copper conductor shall be installed throughout the installation from the earth point at which a traction system earth bond is attached. A traction system earth bond shall be connected between the installation main earth

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point and the nearest running rail, or available OHLE earth bonding point, in accordance with [RT/E/S/21085](#) Design of Earthing and Bonding Systems for 25kV AC Electrified Lines . Each electrical system shall have only one traction earth bond.

For installations where the supply source does not already have a traction earth bond then one shall be installed from the control cubicle to the nearest running rail or available OHLE earth bonding point.

Cables distributed from the control cubicle shall incorporate a CPC with a minimum 16 mm² CSA copper conductor. Bonding within the control cubicle from the outgoing cable CPCs to the traction system earth bond point shall be by use of a CPC with a minimum CSA of 16 mm² copper conductor.

11 Identification labels and warning notices

Labels shall be provided in accordance with [BS 5378](#). The display shall be easy to read, concise and unambiguous.

The label materials and markings used shall have properties giving permanence of legibility throughout the life of the equipment. Etched, engraved, die stamped or other markings of at least similar durability shall be used. The method of attaching labels to equipment shall be chosen so that the labels cannot become detached during the life of the equipment.

Identification labels shall have black lettering on a white background where voltages less than or equal to 110 V are present at the equipment.

Identification labels shall have red lettering on a white background where voltages greater than 110 V are present at the equipment.

Where symbols are used, these shall conform to [BS EN 60417-2](#) and [BS 7324](#).

Warning notices, showing the symbol of a black downward pointing flash on a yellow background in a triangle with a black border under which is the legend DANGER 230 VOLTS or DANGER 400 VOLTS as appropriate shall be fitted to the inside and outside of all access doors.

Cubicle location identification labels shall be fitted to the outside of each cubicle.

Warning labels shall be fitted to all removable covers and shall be attached to all equipment or, if this is not practicable, as near as possible to the equipment.

All transformer outgoing terminals and equipment into which heater leads are connected, shall have a permanent label attached with the wording "Due to signalling equipment immunity, wiring must not be altered".

12 Supply and control cubicles

The power supply for the electric point heating installation is brought from the supply source to the control cubicle. From the control cubicle it shall be distributed to the heaters. The cubicles shall be adequately sized with allowance made for future expansion.

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Each cubicle shall have suitable equipment mounting backplate(s) or backboard(s) fitted. Where wood is used for the equipment mounting backboard it shall be a minimum of 18mm thickness, constructed of marine plywood and suitably treated.

A minimum of two of each type of 'as fitted' General Arrangement and Electrical Schematic drawings shall be supplied with each cubicle.

Each cubicle shall have fixed secure facilities for internal protective storage of drawings.

12.1 Mechanical requirements

12.1.1 General

The cubicles shall be suitable for use outdoors at a trackside location with a minimum life cycle period of 15 years, and located where a safe access and working area can be provided at a minimum of 700mm wide on all sides of the cubicle. The area around the cubicle shall be horizontal, level, non-slip and capable of carrying a uniformly distributed load of 5kN/m².

The cubicles and associated supports shall be sufficiently robust to withstand a maximum overturning moment of 2kNm and wind gusts of up to 54m s⁻¹ in accordance with [BS 6399](#) Part 2.

The minimum standard of ingress protection shall be to [BS EN 60529](#) classification IP54.

The cubicles shall be constructed from one of the following:

- steel of a minimum thickness of 2.5mm and hot dip galvanised to [BS EN ISO 1460](#);
- stainless steel minimum grade 304 of minimum thickness 2.5mm complying with the relevant parts of [BS EN 10088](#). The cubicle shall be finished both internally and externally to reduce sunlight glare reflectivity;
- aluminium of minimum thickness 3.5mm to [BS EN 485](#).

Each door shall be of the lift off type with heavy duty corrosion resistant hinges and furnished with stays or pins for securing the door in an open position of 90 degrees or greater from the closed position. The door handle shall be of robust construction incorporating a latching mechanism with top and bottom catches.

The cubicle shall have an effective air venting system to prevent internal condensation and allow heat dissipation.

The cubicle shall be securely fixed to its permanent base. Appropriate sealing shall be provided between the cubicle and its fixing position. At the cubicle base, methods shall be adopted to prevent vermin and moisture ingress. Adequate facilities for water drainage shall also be provided.

12.1.2 Welding

All welding shall be carried out in accordance with [BS EN 287](#) and [BS EN 288](#).

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12.1.3 Lifting

Provision shall be made in its construction for lifting the cubicle when fully fitted out. Lifting eyes shall not be fitted. Temporary gross weight, identified in kilograms, shall be fitted to the cubicle for the purpose of aiding transit requirements to site.

12.2 Supply cubicles

The cubicle doors locking method shall be a top and bottom latching mechanism and the door handle shall facilitate the fitting of a dual locking bar.

In as far as is reasonable practicable, the supply cubicle shall be sited at a location away from a Red Zone to allow authorised non-railway industry staff (e.g. meter readers) access to the cubicle without encroachment onto Network Rail infrastructure. If necessary consideration shall be given to fences and/ or gated compounds to achieve this.

12.3 Control cubicles

The control cubicle shall contain as a minimum, but not be limited to, the following:

- a) an incoming supply isolator;
- b) contactor(s) or electronic load switching devices which are energised by the point heating controller and provide power to the heating circuits;
- c) a point heating controller;
- d) a manual / auto switch which overrides the control circuit;
- e) a protective device for each outgoing circuit;
- f) circuit distribution arrangement with circuit protective devices for auxiliary equipment;
- g) provision for remote monitoring equipment and appropriate interface;
- h) an appropriately rated anti-condensation heater;
- i) a light fitting mounted in a suitable position inside the cubicle;
- j) an adequately sized main earthing terminal bar of copper construction;
- k) a "Heating On" indicator provided external to the cubicle to give indication of the electric point heating installation working.

Except for clamplock heaters, the control cubicle shall not control different types of heater elements. The only exception to this is where short-length strip heater elements are fitted to replace existing failed cartridge heater elements.

12.3.1 Earthing and bonding

Except for glass fibre reinforced plastic constructed cubicles, all cubicles shall have an M16 brass or equivalent material double-, or continuously threaded stud passing through the cubicle, attached to both the inner and outer sides. The stud attachment method shall be such that a continuous electrical conductivity path is formed between the cubicle body and the stud, which is capable of carrying an alternating peak current of 12kA for 1s.

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All earth cables connected to the main earth terminal (MET) bar shall have a minimum conductor CSA of 16 mm² copper or equivalent. The M16 stud shall be electrically connected to the MET bar.

The cubicle doors shall be effectively earth bonded to the cubicle body using appropriate flexible supplementary bonding conductors.

12.3.2 Cables

All cable ends shall be identified by numbered cable marker sleeves in full accordance with the supplied 'as fitted' drawings.

All cable connections shall be made at fixed terminals. 'In-line' connectors shall not be used to join cables.

The spare cores of all cables shall be terminated and earthed.

12.3.3 Terminals and terminations

Terminals shall be provided for all outgoing cables.

Gland plates shall be located at a height from the base of the cubicle sufficient to allow the easy termination of cables on site taking cognisance of the minimum bending radii of connected cables.

Gland plates shall be sufficiently robust to support all cables terminations and cables without any deformation and shall allow for future cable installation.

The cable termination gland plate for the main supply cable shall be capable of accepting and supporting a 185mm² 4-core SWA Cu conductor or equivalent cable.

All steel wire armour cable glands shall be fitted with brass earthing rings.

Separate outgoing terminals shall be provided for portable tool transformer(s).

Power circuit cable terminations shall be adequately segregated from all other terminations used for other purposes.

12.3.4 Inspection and testing

A manufacturer's test plan shall be submitted to Network Rail at least two weeks prior to any test for approval testing taking place. In addition, a factory simulated full load test shall be carried out to prove the following:

operation of the main isolating switch;

operation of the main load-switching device when the test facility on the point heating controller is activated.

A full report of the simulated full load test results shall be made available and the date of test identified within the cubicle.

12.3.5 Supply and control cubicles

The cubicle complete with all its components, shall be installed on a suitable, level, concrete base which shall not be located closer than 3.5m from the nearest running rail and be situated in a safe location providing access for maintenance. Safe cress areas shall not be obstructed.

A sealing compound shall be used between the base and the cubicle to prevent ingress of water.