

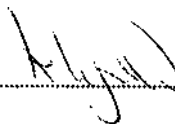
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Business Process Document

Specification for ancillary wiring of electrical distribution equipment on a.c. and d.c. electrified lines

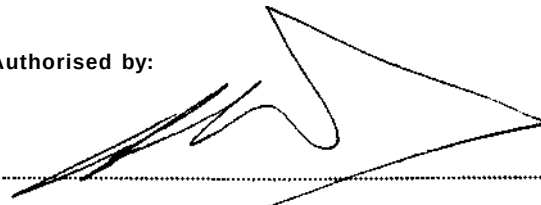
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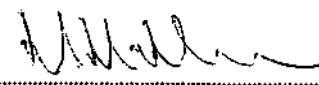
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Issue record

Issue	Date	Comments
3	February 2006	Now includes the requirements of RT/E/C/27004 which is now withdrawn.

Implementation

4 February 2006

Compliance

This Network Rail specification is mandatory and must be complied with by Network Rail and its contractors from 4 February 2006

When this specification is implemented, it is permissible for all projects, which have formally completed GRIP Level 4, to continue to comply with the Issue of any relevant Network Rail standards current when GRIP Level 4 was reached and not to comply with requirements contained herein unless the head of electrification and fixed plant has stipulated otherwise in the accompanying briefing note.

Where the head of electrification and fixed plant has specified that all projects will comply with the requirements, specific authority not to comply can be sought in the usual manner using the appropriate non-compliance authority processes described in Network Rail standard, [NR/SP/STP/045](#) *Managing the process for non-compliance authority* (formerly RT/LS/P/045).

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I Purpose

This specification states the requirements for the design, manufacture, installation and testing of ancillary wiring BETWEEN main items of electrical distribution equipment including SCADA outstation equipment on A.C. and D.C. Electrified Lines together with the preparation of associated documentation. Where necessary, the requirements for wiring WITHIN an item of electrical distribution equipment will be specified in the procurement specification.

The document is to be read in conjunction with the relevant procurement specification.

2 Scope

This specification applies to new ancillary wiring at traction substations, track paralleling huts, feeder stations, track sectioning cabins/locations and similar equipment locations.

3 Reference documentation

NR/SP/ELP/21032	Network Rail specification for earthing systems for d.c. traction substations, track paralleling huts and similar equipment locations
BS 5467	Electric cables. Thermosetting insulated, armoured cables for voltages of 600/1000 V and 1900/3300 V
BS 6004	Electric cables. PVC-insulated, non-armoured cables for voltages up to and including 450/750 V, for electric power, lighting and internal wiring
BS 6231	Specification for PVC-insulated cables for switchgear and controlgear wiring
BS 6724	Electric cables. Thermosetting insulated, armoured cables for voltages of 600/1000 V and 1900/3300 V, having low emission of smoke and corrosive gases when affected by fire
BS 7211	Electric cables. Thermosetting insulated, non-armoured cables for voltages up to and including 450/750 V, for electric power, lighting and internal wiring, and having low emission of smoke and corrosive gases when affected by fire
BS 7430	Code of practice for earthing
BS 7671	Requirements for electrical installations: IEE Wiring Regulations

4 Definitions and abbreviations

4.1 Definitions

For the purpose of this specification the following definitions shall apply:

British Standard	A standard published by the British Standards Institution. Its alphanumeric identity is prefixed by BS.
Equipment	The complete protective relay installation at a specified location, including all relays, component parts, accessories and software.
European Standard	A standard published by the European Committee for Standardisation or by the European Committee for Electrotechnical Standardisation. Its alphanumeric identity is prefixed by EN.
International Standard	A standard published by the International Electrotechnical Commission. Its alphanumeric identity is prefixed by IEC.
Network Rail Standard	A collective term for a Network Rail documents published by a directorate of Network Rail PLC. Its alphanumeric identity is prefixed by NR/, followed by a unique reference.
Procurement Specification	The contract specific Network Rail documentation, such as, Invitation to Tender or Technical Worksopce.

4.2 Abbreviations

For the purpose of this specification the following abbreviations shall apply:

DNO	Distribution Network Operator
UPS	Uninterruptible power supplies
SCADA	Supervisory control and data acquisition.

5 General clauses

5.1 Safety

At all times the equipment shall be safe. Measures shall be taken to ensure the safety of persons concerned in its installation, operation, maintenance, repair and its eventual disposal. All apparatus and connections for the safe and satisfactory operation, control and protection of the equipment concerned, shall be provided whether or not specifically mentioned.

The equipment shall be adequately earthed, insulated, screened, enclosed etc.. Safe and appropriate access shall be provided for operation and maintenance purposes.

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5.2 Design, manufacture and workmanship

All material shall be of the quality and of the type most suitable for working under the conditions specified for the full service life of the equipment.

5.3 Spare parts and consumables

The supplier shall make recommendations to the purchaser for holdings of spare parts and consumables based on estimated replacement rates and delivery periods to ensure that the equipment complies with this specification throughout its specified service life. The supplier shall indicate the extent of commonality with equipment previously supplied.

5.4 Drawings

Drawings of the equipment covering each of the following aspects shall be submitted to the purchaser for scrutiny:

- a) general arrangement of the layout of the wiring routes;
- b) detailed wiring diagram or schedules including the identity code, colour, size and type of each wire and the identity of each terminal.

All drawings shall be of good, legible quality. Four copies of each drawing or as varied by the procurement specification shall be provided.

Where it is essential for clear understanding of the circuits, block or circuit diagrams shall include details of components which are existing or are not being provided by the supplier. Wiring diagrams shall include any unused wires, contacts, plugs, sockets, terminals and the like.

As an alternative to separate circuit and wiring diagrams, combined diagrams may be provided. In this case, the position of each wire termination shall be indicated either on the drawing or by means of a schedule of terminations.

A short description of each revision shall be provided under consecutive revision letters or numbers together with the date.

Wherever feasible, some means shall be used to identify the location of the most recent revision, for instance by circling the locations.

All drawings shall be brought up to date as necessary, to provide a permanent as-fitted record and shall be supplied in the software format specified in the procurement specification.

5.5 Instruction manual

The supplier shall produce a comprehensive and specific instruction manual covering all aspects of the design, installation, operation and maintenance and eventual disposal, and shall supply the number of copies stated in the procurement specification. The manual shall provide guidance to enable all work to be carried out safely and efficiently. The manual shall contain only relevant information and shall include:

- a) a description of the construction, installation, functioning and rating of the equipment;
- b) operating instructions, including safety and isolation procedure;
- c) routine maintenance including any special precautions, fault finding and major overhaul procedures and periodicity;
- d) full details of recommended adjustments and settings for the equipment and its protective devices where appropriate;
- e) instructions for eventual disposal including safety and handling precautions and recommendations;
- f) drawings, illustrations and data enabling all component parts to be readily identified and to allow procurement for replacement purposes;
- g) the drawings listed in clause entitled 'Drawings';
- h) a list of locations.

The manual shall be of loose leaf design with at least four retaining rings and with oil resistant hard covers. It shall be of A4 size and include drawings reduced to A3 or A4 size. Drawings reduced in size shall remain clearly legible. The purchaser may accept drawings larger than A3 subject to suitable, clearly labelled protective drawing storage folders being provided for inclusion in the manual.

Three copies of the draft manual shall be submitted to the purchaser not later than the end of the third quarter of the period between the contract date and scheduled installation date and in sufficient time to enable any modifications to be incorporated and the full quantity of final copies to be available prior to commissioning.

Before the purchaser takes over full responsibility for the equipment, for example, at the expiry of the maintenance period, any necessary modifications shall be made and sufficient copies provided to the purchaser for incorporating into the full quantity of manuals supplied.

6 Compliance with standards

6.1 European, International and British Standards etc.

The design, installation and equipment shall comply with relevant European Standards whether or not reference is made to them.

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In the absence of European Standards, International Standards or national standards having currency within the European Community shall apply subject to the prior agreement of the purchaser.

The editions of standards current at the date of tender shall apply.

6.2 Specific equipment standards

The equipment and installation shall be designed, manufactured, installed and tested in accordance with [BS 5467](#), [BS 6004](#), [BS 6231](#), [BS 6724](#), [BS 7211](#), [BS 7430](#), [BS 7671](#) and all other relevant standards.

7 Performance requirements

7.1 General

The equipment shall be fit for its intended purpose when in service.

The equipment shall be complete with all items necessary for service operation.

7.2 Environmental conditions

The equipment shall be suitable for its rated characteristics when installed at locations adjacent to railway tracks.

The following service conditions shall apply unless specified otherwise in the procurement specification:

- a) for indoor equipment, the temperature of ambient air is not below -5 °C and not above +40 °C and not exceeding +35 °C average over any 24 hour period;
- b) for outdoor equipment, the temperature of ambient air is not below -25 °C and not above +40 °C and not exceeding +30 °C average over any 24 hour period;
- c) the ambient air is polluted by the presence of airborne iron dust from train brakes;
- d) the equipment is subject to strong magnetic fields emanating from adjacent electrical equipment and to vibration caused by passing trains;
- e) hand-held portable radio transmitter/receiver apparatus will be used near the equipment;
- f) any additional conditions as stated in the procurement specification.

7.3 Maintainability

The equipment shall not require any significant maintenance during its full service life.

7.4 Reliability and availability

For critical items of the equipment offered the supplier shall state the mean time to failure, the mean time to repair and the mean time to preventive maintenance to maintain full operational performance. For equipment with novel features or where insufficient historical data is available the supplier shall state the methods used to determine reliability performance.

7.5 Service life

The equipment including components, but excluding consumable items, shall be capable of complying with this specification, including performing its intended purpose, for at least thirty years, without deterioration in reliability and without preventive maintenance requirements in excess of those stated in clause entitled 'Maintainability'.

7.6 Interchangeability

All like equipment shall be interchangeable as a whole and also as regards its parts. Any such change or replacement shall not reduce the capability of the equipment to conform to the requirements of this specification.

7.7 Finish and resistance to corrosion

Enclosures, equipment metalwork, components, accessories, fittings and fastenings (e.g. nuts, bolts, washers etc.) shall be protected against corrosion, including galvanic corrosion of dissimilar materials, for the life of the equipment at the specified location with a minimum of periodic restoration work.

7.8 Earthing

Provision shall be made for the exposed-conductive-parts and extraneous-conductive parts of the equipment to enable these to be connected to the earth system.

8 Inspection and testing

The equipment and the installation shall be made available for routine inspections, and on completion for final inspection, and where appropriate, for prototype inspection at the manufacturer's works by the purchaser. The supplier shall give the purchaser notice in writing that the equipment is ready for inspection in accordance with the period specified in the procurement specification.

The completed installation shall be subject to final inspection and the following tests:

- routine and type tests in accordance with all relevant European Standards, International Standards or British Standards;
- performance tests to verify the performance requirements;

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- c) functional tests;
- d) any additional tests as specified in the procurement specification.

The tests may be witnessed by the purchaser and shall include those listed in Appendix B.

The supplier shall carry out all tests in accordance with a testing procedure agreed in advance with the purchaser.

Test equipment used for measuring test values shall be calibrated and have valid calibration certificates from an accredited calibration service.

Any inspection or witnessing of testing by the purchaser shall not absolve the supplier from his liability to conform to the requirements of this specification.

8.1 Test certificates

The supplier shall provide satisfactory evidence that the equipment and the installation have been satisfactorily tested. Test certificates shall be provided in duplicate or as varied by the procurement specification, and shall include test results and other relevant data.

9 Wiring

9.1 General

Wire colours shall be in accordance with Appendix A and all wire codes shall be in accordance with Appendix C.

All wiring, terminations and terminal blocks shall possess suitable electrical and mechanical characteristics to ensure reliable performance.

Except where specified otherwise in the procurement specification, wiring shall be PVC insulated and shall comply with [BS 6231](#). Where multicore cables are used, cables requiring mechanical protection shall comply with BS 4667 and those that do not shall comply with BS 6004.

Where the procurement specification specifies insulation with low emission of smoke and corrosive gases when affected by fire, wiring shall comply with [BS 7211](#) and or [BS 6724](#).

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Wires ,individual or as part of a multicore cable, shall be stranded or flexible as appropriate and, except where specified otherwise in the procurement specification, shall not be less than 1.5 mm². Solid conductors shall not be used. Twisted pairs shall be used between analogue transducers and the SCADA outstation equipment. Where mechanically protected and securely glanded multicore cable is used between electronic circuit terminals, between marshalling terminals or between marshalling terminal and equipment terminal, all cores shall not be less than 0.5 mm² ,have minimum of 7 strands and capable of carrying worst case load without affecting the operation of equipment

Each wire, termination and terminal block shall have a current and voltage rating adequate for its duty and shall meet the dielectric test voltage values specified in Appendix B.

Ancillary wiring between items of equipment shall start at the terminal block of each item. The ancillary wiring shall be connected to one side of the terminal block and the equipment internal wiring to the other side.

If an extension, alteration or repair is made to an installation, the interface between existing and new wiring must be managed in accordance with BS 7671.

9.2 Terminal blocks

Terminal blocks shall be of robust modular form suitable for assembling collectively on a rail to give the required number of ways, and shall have the sections tightly fitted one to another to prevent collection of dirt forming tracking paths to earth or between terminals. Cross connection facilities shall be provided for paralleling adjacent blocks. Terminal screws shall be contained within the moulding and not project above the moulding when fully released. Assembly rails shall be firmly supported.

Terminals shall be numbered, preferably from top to bottom or left to right starting at 1, at least every fifth terminal e.g. 1, 5, 10 etc..

Protection against direct contact with live conductors and indirect contact shall be provided in accordance with BS 7671. Protection against unintentional contact with live conductors shall be provided.

Terminal blocks shall be readily accessible and have two separate means of securing the crimp lug in position. Where multicore cables are used and are securely glanded, a single means of securing with screw clamp terminals may be used.

Terminals connected directly or indirectly to the same source of supply shall be grouped together and segregated from groups connected to other sources of supply by either physical separation or separators. Each group shall be clearly labelled with the operating voltage.

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Where specified in the procurement specification, facilities shall be provided to remove from service items of equipment at agreed points. These shall take the form of links or disconnection points, and shall form an integral part of the terminal block.

9.3 Wire terminations

All wire terminations shall be compatible with the means of securing employed by the terminal block.

9.4 Double ferruling

Each wire interfacing with an equipment internal wire shall bear its own wire code and additionally the wire code with which it interfaces.

Double ferruling will be provided by the DNO immediately on the DNO side of the interface between the DNO and Network Rail.

9.5 Installation of wiring

Wiring routes shall be neatly installed, securely fixed and provide access to wiring and terminals.

Wires shall be mechanically protected by means of trunking, conduit or similar.

The number of wires in any one bunch shall be limited such that visual identification, and access to individual wires, is practicable. Any derated current value shall not be exceeded.

Wires shall not be teed or joined between terminals or doubled back on themselves within trunking or conduit to absorb slack.

Wires shall not be twisted or crossed in positions where not visible.

Wiring shall be protected against damage arising from flexing at hinges, abrasion and tension etc..

Wire at terminations shall have sufficient slack to enable them to be withdrawn from their terminals, no more than two wires being connected to a terminal.

Where a multicore cable is terminated, each core shall have sufficient spare length to allow making off at least twice after initial installation.

Spare wires shall be identified, terminated onto spare terminals and earthed.

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9.6 Segregation of circuits

Circuits operating at a potential derived from a d.c. traction supply shall be segregated from all other wiring and run in separate multicore cable, trunking or conduit.

Protection circuits shall be segregated from other wiring and run in separate multicore cable, trunking or conduit.

230 V a.c. domestic circuits, switchgear spring charge motor circuits and similar shall be segregated from other wiring and run in separate multicore cable, trunking or conduit.

Unless specified otherwise in the procurement specification, supervisory (SCADA) circuits and data communication circuits for intelligent protection relays shall be protected from being affected by inductive interference by the segregation of supervisory control, indication and alarm circuits and relay communication circuits from all other circuits or protected by other means.

At d.c. traction substations and track paralleling huts and similar equipment locations, earthing connections shall, in addition, comply with [NR/SP/ELP/21032](#).

10 Identification of wires

Unless specified otherwise in the procurement specification, each wire shall be identified in Appendix C.

Identical wire identification markers shall be provided at each end of each wire.

Wire markers shall be white with a clear permanent black inscriptions with a finish which minimises the adhesion of dirt. Markers shall be of a secure type such that the code is not lost during flexing or disconnection of wires during the full life of the wiring.

The wire code shall be arranged such that it is read in the correct sequence starting from the end nearest to the terminal.

11 Three phase circuit breaker current transformers

The primary markings P1 and P2 of current transformers of 11/22/33/66 kV, three phase switchgear shall be arranged such that the P2 marking is the nearer to the protected zone. Where protection is non-directional, the current transformers primary markings shall be arranged such that the P2 marking is the nearer to the circuit breaker bearing the A suffix letter.

The wire from the earthed terminal of the current transformer shall bear an even number.

The current transformer secondary terminal S2 shall be earthed.