

Ref:	NR/L2/SIG/11201 – Mod B12
Issue:	4
Date:	04/06/2011
Compliance date:	03/09/2011

Level 2

Signalling Design: Module B12 -

Transmission Systems – (Cable terminations & Cable routes)

Endorsement and Authorisation

For endorsement and authorisation, please refer to NR/L2/SIG/11201

This document is the property of Network Rail. It shall not be reproduced in whole or part nor disclosed to a third party without the written permission of Network Rail.

© Copyright 2011 Network Rail.

Uncontrolled copy once printed from its electronic source.

Published and Issued by Network Rail, Kings Place, 90 York Way, London. N1 9AG.



Ref:	NR/L2/SIG/11201 – Mod B12
Issue:	4
Date:	04/06/2011
Compliance date:	03/09/2011

Issue record

Issue	Date	Comments
4	June 2011	Modularisation of handbook and guidance notes, contains content of former NR/GN/SIG/11600, Part J & Appendix J1.

Compliance

This Module is mandatory and shall be complied with by Network Rail and its contractors if applicable from 03/09/2011.

When this standard is implemented, it is permissible for all projects that have formally completed GRIP Stage 3 (Option Selection) to continue to comply with the issue of any relevant Network Rail standards current when GRIP Stage 3 was completed and not to comply with requirements contained herein, unless stipulated otherwise in the scope of this standard.

Disclaimer

In issuing this document for its stated purpose, Network Rail makes no warranties, express or implied, that compliance with all or any documents it issues is sufficient on its own to confirm safe systems of work or operation. Users are reminded of their own duties under health and safety legislation.

Supply

Copies of documents are available electronically, within Network Rail's organisation. Hard copies of this document may be available to Network Rail people on request to the relevant controlled publication distributor. Other organisations may obtain copies of this document from IHS. Tel: 01344 328039.

Ref:	NR/L2/SIG/11201 – Mod B12
Issue:	4
Date:	04/06/2011
Compliance date:	03/09/2011

Contents

1 INTRODUCTION	4
2 DESIGN PRINCIPLES	5
3 REQUIREMENTS	6
4 APPLICATION	10
5 RAILWAY SIGNALLING CABLE	14
6 TERMINATIONS	17
7 CABLE ROUTES	20
8 SPECIAL ARRANGEMENTS	21
9 EARTH AND EQUIPOTENTIAL BONDING CONDUCTORS	22
10 TYPICAL LOOP RESISTANCE AND CURRENT CARRYING CAPACITIES	24

Ref:	NR/L2/SIG/11201 – Mod B12
Issue:	4
Date:	04/06/2011
Compliance date:	03/09/2011

1 INTRODUCTION

1.1

This module applies to the design of Transmission Systems (including Cables, Terminations and Cable Routes).

1.2

Transmission systems (including cables) are provided as a means of interconnecting systems, sub-systems or items of equipment. Additionally, cables (commonly, but not universally single core) are provided as part of the internal circuitry of individual items of equipment.

1.3

Cables fall into four broad areas of application:

- a) internal wires within an installation or sub-system (predominantly single core);
- b) main cables providing external transmission between installations or sub-systems including power distribution, direct-wired, remote control and datalink systems;
- c) tail cables providing connection from lineside equipment housings to trackside or on-track equipment (sometimes via disconnection boxes), including track circuit connections and lineside operational telephone cables;
- d) bonding cables (usually single core) provided for track circuit, earth and equipotential bonding.

1.4

Terminations are provided as a means of interfacing between differing types and/or sizes of cable and also in order to provide circuit disconnection and/or test facilities.

1.5

Cable routes are provided as a means of constraining cables and also protecting them from their environment.

1.6

This Part may not be applicable to the internal wiring of sealed manufactured units. In this case alternative arrangements should be agreed as part of the approval process.

1.7

Where it entirely addresses the situation under consideration, the use of this Company Standard, is an alternative to an approved form of risk-based assessment. However, where the particular application or intended environment for the system introduces additional risks, these should be subject to separate assessment.

The Design Principles in Section 2 give the minimum requirements, even when the risk-based approach is used. These principles are mandated in [NR/L2/SIG/11201](#).

Ref:	NR/L2/SIG/11201 – Mod B12
Issue:	4
Date:	04/06/2011
Compliance date:	03/09/2011

1.8

The following guidelines and specifications should satisfy the principles encompassed within the Company Standard:

- a) details of approved railway signalling cable in specifications [NR/L2/SIG/00005](#) and [BR 880](#);
- b) details of approved railway signalling cable with preformed ends in specifications [NR/LS/CAT006](#) and [BR1974](#);
- c) details of approved railway signalling cable for aerial use in specification BR 818;
- d) details of cables for railway telecommunications in specifications [NR/L3/TEL/00014](#)
- e) details of cable for data links in specification [BR1932](#);
- f) details of coaxial cables in specification [NR/LS/CAT006](#);
- g) guidelines on the construction of cable routes in [BR1612](#), [NR/L3/SIG/11303](#) (Appendix 2A05) and the drawings listed in [NR/LS/CAT004](#); and
- h) guidelines on the installation of cables in [NR/L3/SIG/11303](#) (Appendices 2A10 & 2A15).

2 DESIGN PRINCIPLES

These principles are mandated in [NR/L2/SIG/11201](#).

2.1

The choice of transmission systems (including cables) should be appropriate to the safety integrity level of the systems and circuits which are carried over them.

2.2

The design of transmission(including cable) systems should address the following potential hazards:

- a) cable route / cable route systems (both internal and external) -
 - level of protection
 - compatibility of cable type and route type
 - vandalism / rodent protection
 - access and security arrangements
 - capacity;
- b) environment
 - route location
 - atmospheric
 - ambient temperature
 - ground conditions / spillage;

Ref:	NR/L2/SIG/11201 – Mod B12
Issue:	4
Date:	04/06/2011
Compliance date:	03/09/2011

- c) facilities over which there is no direct control (e.g. equipment of a service provider);
- d) stress and vibration;
- e) labelling and marking (identification);
- f) type of cables -
 - conductor materials
 - insulation materials;
- g) method of interconnecting with other cables and systems / equipment;
- h) method of running / recovering cable;
- i) mixing of transmission systems within cables and cable routes;
- j) screening, earthing and immunisation;
- k) spare capacity requirement;
- l) spare capacity requirement;
- m) screening, earthing and immunisation;
- n) stress and vibration;
- o) mixing of transmission systems within cables and cable routes;
- p) sub-system compatibility;
- q) type of cables -
 - conductor materials
 - insulation materials;
- r) over-current protection and isolation facilities.

3 REQUIREMENTS

3.1 GENERAL

- a) All transmission systems and cables used for the signalling and operational telecommunications system should be of approved types.
- b) The choice of cable type/cable route construction should take account of the minimum bending radii of the cables.
- c) Since the life of a cable is reduced by exposure to high ambient temperatures, attention should be given to its anticipated environment. Cables should not be exposed to ambient temperatures in excess of 25°C for any significant period.
- d) The size of conductor should be chosen such that the maximum designed current which will flow should not exceed the rating of the cable. The required rating should take account of whether current flow is continuous or intermittent. Typical Loop resistance and current carrying capacities are given in Section 10. Conductors (including Earth and equipotential bonding) should, where

Ref:	NR/L2/SIG/11201 – Mod B12
Issue:	4
Date:	04/06/2011
Compliance date:	03/09/2011

practicable, be adequately rated so as to survive beyond fault clearance times. It may not be practicable to cater for significant traction faults.

- e) The risk of a fault condition causing damage should be addressed by providing over-current protection.
- f) Transmission systems should be terminated such that the connection is electrically and mechanically robust.
- g) Design should minimise the number of joints within any cable. Cable joints should not in any way reduce the ability of the cable to meet the requirements of this part. Where through joints are provided, the conductors should generally be connected like-to-like (i.e. core-2 to core-2 or colour to colour). Where this requirement cannot be met, a cable core plan showing full details of the joint should be provided.
- h) Spare cores should be provided as specified by Network Rail. The number of spare cores in main cables should be not less than two in cables exceeding 10 cores and not less than four in cables exceeding 30 cores. There is no minimum requirement for tail cables.
- i) Consideration should be given to the need to de-rate the current carrying capacity of cables which are grouped.
- j) The insulation of any cable should be sufficient as to enable the cable to withstand the applied voltage and any foreseeable transient over-voltages. The insulation should also be sufficient to withstand the applied voltage within any other cable with which it comes into direct contact, in particular where mixed with power cables.
- k) Twisted pair cables should be used where it is a requirement of the technology of the signalling and operational telecommunications system. Where a twisted pair cable is used, each circuit should utilise conductors within the same pair.
- l) The feed and return legs of any circuit should be transmitted in the same cable / system.
- m) The design should avoid the potential for electrochemical effects arising from the mixing of differing conductor materials where cables interface with other cables or terminations.
- n) All cables associated with designated sub-surface railway stations should meet the requirements of [RIS-7700-INS](#).
- o) Cables used within apparatus housings should generally be zero halogen, low smoke (ZHLS). Where it is necessary for non-ZHLS cables to enter an apparatus housing, only a minimum practicable length should be permitted before interface is made with the internal cables.
- p) Use of ZHLS cables should be restricted to those applications where that requirement is necessary.
- q) PVC insulated cables used internally should be run in trunking containing only PVC insulated cables. This is to avoid the possibility of plasticiser migration between differing insulation materials. See [NR/GN/SIG/19012](#).

Ref:	NR/L2/SIG/11201 – Mod B12
Issue:	4
Date:	04/06/2011
Compliance date:	03/09/2011

- r) Buried routes, where permitted, should meet the requirements of [NR/L2/INI/CP0047](#) and [NR/L2/AMG/1030](#) . HSE guidance booklet HS(G)47 should also be followed.
- s) Where it is not practicable to retain cables within trunking and there is a risk of them becoming trapped (e.g. in doors, points or other moving parts), the cables/conductors should be secured by means of plastic-ties or spiral wrapping. Plastic lacing of cables/conductors should not be used. Plastic-ties may be used only to secure sheathed cables, thus cables without a sheath should not be used where treeing is likely to take place. This latter requirement does not apply to PVC insulated cables.
- t) Any work involving communication networks (including cables) should accord with [NR/L2/SIG/10064 \(E041\)](#) & [NR/L2/TEL/30067](#).
- u) Screening, earthing and immunisation should comply with [BR13422](#).

For problems with cables, see [NR/GN/SIG/19012](#).

3.2 SPECIAL CABLES

Wiring of certain specific signalling and operational telecommunications system facilities and equipment requires the use of special cables as designated and detailed by the manufacturer in the equipment/system application manual. Such special cables are dealt with in the Part of this Company Standard related to the specific equipment.

Approval of the cable type and application should be an integral part of the approval for the related equipment and should when appropriate, detail the method of segregation from general signalling and operational telecommunications cables.

3.3 CORE IDENTIFICATION

The outer face of core insulation should be identified, either by numbering or colour coding.

Where identification is by numbering, the sequence should start with number one for the core at the centre of the cable, with the sequence progressing towards the outside of the cable such that the highest number is contained within the outer layer.

Where identification is by colour coding, the identification standard should be as specified on the design. For two core cables, the identification may be by colouring the outer face of the insulation of one core red, and the other black.

Telecommunications type cables are commonly constructed in unit twin or concentric twin form. See specification [NR/L3/TEL/00015](#).

In unit twin construction, 5 or 10 pairs are twisted and bound to form a unit. Units are then combined to form the size of cable required. Thus a 50 pair cable will have 5 x 10 pair units, arranged either as a single layer of 5 x (10) or a centre layer of 1 x (10) and an outer layer of 4 x (10).

In concentric twin construction, two or more pairs are combined to form the centre of the cable. Additional pairs are then laid up around the centre in various layers to