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Issue	4
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Business Process Document

Telecommunications Optical Fibre Cable (formerly RT/E/PS/00014)

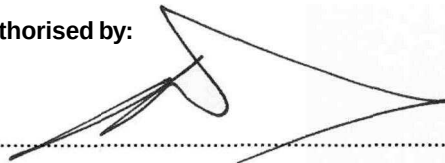
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Issue record

Issue	Date	Comments
1	August 2001	Rebadge of GK/RT0312, includes contents of BR1935, BR1927, BR1822. References updated. Duct cable and PMD included. Double sided sheath marking, optional meterage. Multimode fibre deleted. 12 fibre cable included. MSDS required for fibre/coatings. Supplier to state min bend radius. 30 year service life. Alternatives to steel tape armour permitted. Fire safety requirements updated
2	April 2002	Update of Issue 1. References updated. 24-fibre cable with 6 element construction added. Superior cladding non-circularity. Exclusion of water swellable tapes. Inclusion of tests for impact and torsion resistance. Continuous production monitoring of proof stress, attenuation, spark test and sheath thickness. Inclusion of cabled cut-off wavelength.
3	June 2003	Minor changes to reflect change of name to "Network Rail", including sheath markings.
4	April 2006	Document re-numbered as part of standards framework process and revised in line with template.

Implementation

This standard shall be implemented from April 2006.

Compliance

This Network Rail Product Specification is mandatory and must be complied with by Network Rail and its Contractors from April 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 designated Head of Telecoms has stipulated otherwise in the accompanying Briefing Note.

Where the Head of Telecoms 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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on its own to ensure safe systems of work or operation. Users are reminded of their own duties under health and safety legislation.

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1 Purpose

This document is for use in procuring polyethylene sheathed and ZHLS sheathed optical fibre trunk telecommunications cables.

2 Scope

2.1

This document specifies the requirements for optical fibre cables for external use containing step-index optical fibres supporting singlemode propagation in accordance with ITU-T Recommendation G.652. The requirements of this specification are mandatory.

2.2

Armoured, single-sheathed duct and ZHLS versions are specified. The type of cable and the number of fibres will be specified on the order.

3 Reference documentation

Reference is made in this specification to the following publications:

NR/CS/ACC/029 (RT/LS/P/029)	Product Acceptance
GE/RC8505	Recommendations for the Fire Safety of Materials at Operational Premises.
BS 3573	Polyolefin Copper-Conductor Telecommunications Cables.
BS 4727-3	Glossary of Electrotechnical, Power, Telecommunication, Electronics, Lighting and Colour Terms. Terms Particular to Telecommunications and Electronics. Group 13: Optical Fibre Communication.
BS 5099	Specification for Spark Testing of Electric Cables.
BS 6234	Specification for Polyethylene Insulation and Sheath of Electric Cables.
BS 6469-99.2	Insulating and Sheathing Materials of Electric Cables. Test Methods used in the United Kingdom but not Specified in BS EN 60811 or Other Parts of BS 6469. Electrical Tests.
BS 6724 (1990)	Specification for Armoured Cables for Electricity Supply having Thermosetting Insulation with Low Emission of Smoke and Corrosive Gases when Affected by Fire.
BS EN ISO 62	Plastics. Determination of Water Absorption.

BS EN 187 000	Generic Specification for Optical Fibre Cables.
BS EN 188 000	Generic Specification for Optical Fibres.
BS EN 50268-1: 2000	Common Test Methods for Cables Under Fire Conditions – Measurement of Smoke Density of Cables Burning Under Defined Conditions. Part 1: Apparatus.
BS EN 50268-2: 2000	Common Test Methods for Cables Under Fire Conditions – Measurement of Smoke Density of Cables Burning Under Defined Conditions. Part 2: Procedure.
Defence Standard 81-20	Drums, Cable – Metric Units.
IEC 60332-3	Tests on Electric Cables under Fire Conditions. Part 3: Tests on Bunched Wires of Cables.
IEC 60793-1-30	Measurement methods and test procedures: Fibre proof test
IEC 60793-1-32	Measurement methods and test procedures: Coating strippability
IEC/TS 61941	Optical Fibres – Polarisation Mode Dispersion Measurement Techniques for Singlemode Optical Fibres.
ITU-T Recommendation G.652	Characteristics of a Singlemode Optical Fibre Cable.
NS/G/1235/W/100025	General Approval for Connection of Cable, Wiring and Wiring Accessories for Connection Between Certain Telecommunications Apparatus.
Health and Safety at Work etc. Act 1974.	
Railways and other Transport Systems (Approval of Works, Plant and Equipment) Regulations 1994.	
The Telecommunications Act 1984.	

In the case of references to the above documents, the latest issue is to be used unless stated otherwise. The Manufacturer is entirely responsible for ensuring that they are in possession of the correct issue of any document.

4 Definitions

For the purpose of this specification only the definitions given in BS 4727-3: Group 13 (IEC 60050-731) shall apply.

5 Optical Fibres

5.1 General

5.1.1

The optical fibres shall be step-index singlemode fibres in accordance with ITU-T Recommendation G.652.

5.1.2

All fibres shall be continuous, i.e. no splices are allowed.

5.1.3

All fibres supplied for a contract shall be from the same manufacturing source and shall be to the same manufacturing specification.

5.2 Refractive Index Profile

5.2.1

The optical fibre shall consist of a cladding, which is generally high-grade silica, and a core that is doped silica.

5.2.2

The refractive index of the cladding with respect to the refractive index of the core shall ensure total internal reflection for wavelengths within the range of 848 nm to 1640 nm.

5.2.3

A typical refractive index profile for the optical fibre shall be available, and the group index of refraction at 1310 nm and 1550 nm shall be stated.

5.3 Coating Materials

5.3.1

The waveguide coating may consist of two or more layers. The refractive index of the coating layers shall ensure mode stripping of the cladding modes in a short length of fibre. Some of the coatings may be coloured for fibre identification purposes in order to comply with the requirements of section 5.5.

5.3.2

The coating materials shall be sufficiently durable and stable such that the performance of the fibre in the completed cable is maintained within the limits of this specification for at least its 30 year life when installed in its intended environment.

5.3.3

The coating materials shall prevent moisture from coming into contact with the waveguide for at least its 30 year life when installed in its intended environment.

5.3.4

The primary coating shall bond to the surface of the silica. The bond strength shall not vary by more than 50 % over the following conditions, and the manufacturer shall specify a suitable test to prove the adequacy of the bond strength:

- a) Temperatures ranging from -20°C to +60°C.
- b) Humidity ranging from ambient to 100 %.

5.3.5

The primary coating shall be removable without damaging the silica waveguide and without hazard to personnel. The tensile force required to remove a 20 mm length of coating shall be tested in accordance with IEC 60793-1-32 and shall not exceed 5 Newtons over the following conditions:

- a) Temperatures ranging from 0°C to +30°C.
- b) Relative humidity in the range 60 + 25 %.

5.3.6

The primary coating shall be fully cured. The test for cure and the acceptance criteria shall be stated on the Product Acceptance application.

5.3.7

The maximum amount of Hydrogen that could be evolved from the primary coating over its 30 year life shall be stated on the Product Acceptance application. The temperature and duration of the test used to determine the amount of Hydrogen shall be stated.

5.3.8

A Material Safety Data Sheet (MSDS) shall be provided for the complete manufactured fibre including any coating materials.

5.4 Proof Test

5.4.1

All fibres shall be subjected to a proof test of a level and duration to ensure that a fibre lifetime of 30 years without fracture may be assured.

5.4.2

The standard proof test shall conform to IEC 60793-1-30 and shall subject every section of fibre to a strain of at least 1.0 % for a minimum duration.

5.4.3

The Static Fatigue Constant (n-value) for the fibre must be stated on the Product Approval application.

5.5 Fibre Colour Coding

The fibres shall be colour coded as indicated in Tables 2-1 and 2-2. A sample of each coloured fibre shall be provided at the Product Approval stage.

Fibre Colour	Blue	Orange	Green	Brown
Fibre Number	1	2	3	4
	5	6	7	8
	9	10	11	12
	13	14	15	16
	17	18	19	20
	21	22	23	24

Table 5-1: 4 Fibres per Tube Cables with up to 24 Fibres in steps of 4 Fibres

Fibre Colour	Blue	Orange	Green	Brown	Grey	Yellow	Red	Violet
Fibre Number	1	2	3	4	5	6	7	8
	9	10	11	12	13	14	15	16
	17	18	19	20	21	22	23	24
	25	26	27	28	29	30	31	32
	33	34	35	36	37	38	39	etc.

Table 5-2: 8 Fibres per Tube Cables with 48 or 96 Fibres

5.6 Geometric Requirements

5.6.1

The maximum value of core non-circularity shall be 6.0 %.

5.6.2

The concentricity error between the core and the reference surface shall not exceed 0.80 μm and the mean value of measurements taken on a sample of at least 50 fibre ends shall not exceed 0.40 μm .

5.6.3

The cladding diameter shall be $125.0 + 2.0 \mu\text{m}$.

5.7

The maximum value of cladding non-circularity shall be 1.0.

5.7.1

The outside diameter of the primary coated fibre shall be $250.0 + 15.0 \mu\text{m}$. All primary coatings, and any colouring layers if appropriate, shall be included in this measurement.

5.7.2

The concentricity error between the surface of the primary coating and the reference surface shall be less than 15.0 μm .

5.7.3

The maximum value of coating non-circularity shall be 10.0 %.

5.8 Singlemode Waveguide Requirements

5.8.1

The mode field diameter (spot size) measured in the far-field domain (Petermann II definition) shall be $9.2 + 0.5 \mu\text{m}$ at a wavelength of 1310 nm.

5.8.2

The wavelength at which the first higher mode cuts off shall be in the range 1170 nm to 1270 nm. Only the HE_{11} mode shall naturally and freely propagate at wavelengths longer than the cut-off wavelength.

5.8.3

The magnitude of total dispersion shall not exceed:

- a) 3.5 ps/nm.km at a wavelength of 1290 nm.
- b) 3.5 ps/nm.km at a wavelength of 1330 nm.
- c) 18.0 ps/nm.km at a wavelength of 1550 nm.

5.8.4

The slope of the dispersion curve at the zero dispersion wavelength shall not exceed 0.093 ps/nm².km.

5.8.5

The polarisation mode dispersion of the cabled fibre shall be determined in accordance with IEC 60794-3 and shall not exceed 0.50 ps/km^{0.5} (maximum) with an average value of 0.30 ps/km^{0.5}.

5.9 Attenuation Requirements

5.9.1

The optical attenuation of every fibre in the completed cable shall meet the requirements of section 9.14.

5.9.2

OTDR measurements shall be made at a wavelength near the centre of the 1310 nm window and also near the centre of the 1550 nm window using a pulse width not exceeding 1 µs. The traces shall be straight and the following shall apply:

- a) Localised discontinuities (steps) shall not exceed 0.1 dB.
- b) Changes of slope shall not exceed 0.1 dB/km on any single length of fibre.

5.9.3

Any fibre, when wound at low tension around a mandrel of diameter 60 mm for at least 20 complete turns, shall show an excess loss of no more than 0.005 dB per turn at 1550 nm.

6 Polyethylene Sheathed Armoured Cable

6.1 Service Life

The design and construction of the cable shall be such that when installed in a trackside concrete cable troughing route, buried duct route or direct buried, it shall have a service life in excess of 30 years.