WCD 2015 Issue 5

Specification for Zerohal® Sheathed Multicore Cables

November 2012

AEROSPACE, DEFENSE & MARINE

Specification for Zerohal® Sheathed Multicore Cables

Report Number:	**WCD 2015**
Issue Number:	Issue 5
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Summary

This specification details the requirements for limited fire hazard cables producing low levels of noxious fumes , smoke and corrosive products when burnt. Cables shall be flame retarded and be suitable for continuous use and storage in the temperature range of -30℃ to + 105℃. Cables shall be suitable for use in applications where the fluids as defined in this specification are present.

Table of Contents

1 INTRODUCTION

This specification details the requirements for limited fire hazard cables producing low levels of noxious fumes, smoke and corrosive products when burnt. Cables shall be flame retarded and be suitable for continuous use and storage in the temperature range of -30℃ to + 105℃. Cables shall be suitable for use in applications where the fluids as defined in this specification are present.

The cable shall withstand normal installation techniques and shall be compatible with standard glanding, supporting, banding and clipping techniques. Cables shall be suitable for terminating using standard techniques, including heat recoverable components, using recovery temperatures up to 200℃.

This specification contains a comprehensive range of test requirements for evaluating multiconductor cables. Some tests may not therefore apply to specific cable constructions.

2 SPECIFIC CABLE CONSTRUCTIONS

The cable construction shall be defined by an Engineering Product Design (EPD) drawing prepared by the supplier. Component wires and constructions may be referenced to a separate Specification Control Drawing (SCD) or detailed directly onto the cable drawing.

If additional materials not specified within this specification are used, then they shall be defined in the individual EPD or SCD as applicable. In any case, the drawing shall also reference the applicable specification(s) to which it is supplied, and any additional test requirements specific to that product.

Some cable requirements outlined in Section 6.1 of this specification vary with cable construction. In these cases the requirements shall be detailed on the EPD.

In the event of conflict between this specification and the EPD, the EPD shall take precedence.

3 RELATED DOCUMENTS

Reference is made in this document to issue in effect of the following specifications:

ASTM D 570	Test method for water absorption of plastics
ASTM D 3137	Test method for rubber property – hydrolytic stability
BS EN ISO 9001	Quality management standard.
BS EN 50117-2-2 BS EN 50117-2-3 BS EN 50117-2-4 BS EN 50117-2-5	Specification for radio-frequency cables. General requirements and tests. British Government Services requirements
BS 5099	Spark testing of electrical cables.
BS 6469: Section 99.2	Insulation and sheathing materials of electric cables. Electrical tests.
DEF STAN 61-12 (Part 31)/2	Wires, cords and cables, electrical – metric units
DEF STAN 02-641/2	Determination of the vertical flammability of electric cables
IEC 62153-4-6 EN 50289-1-6	Radio frequency cables - general requirements and measuring methods.
IEC 60228	Conductors of insulated cables.
IEC 60216-1	Guide for the preparation of test procedures for evaluating the thermal endurance of electrical insulating materials.
ISO 37	Rubber vulcanised - determination of tensile stress/strain properties.
MIL-DTL-17	Cables, radio frequency, flexible and semi-rigid.
MIL-DTL-915	Cable and cord - electrical - for shipboard use.
SAE AS 85485	Cable, electric, filter line, radio frequency absorptive

4 QUALITY ASSURANCE PROVISIONS

All quality assurance provisions shall be in accordance with BS EN ISO 9001.

4.1 Quality Assurance

The supplier is responsible for performing all inspection tests stated in this specification. The supplier may use his own or any other approved inspection facility. Verification of materials and construction is performed at the appropriate stages of the manufacturing process. Inspection records will be kept complete and made available to the purchaser on request.

4.2 Test Frequency

Tests are divided into four frequency categories. These are routine, batch, quality and qualification tests.

4.2.1 Routine Tests

Performed on 100% of the production length.

4.2.2 Batch Tests

These are performed on each production batch. A batch is any quantity of material manufactured on a substantially continuous basis, under conditions that are presumed uniform.

4.2.3 Production Quality Tests

These are performed periodically on representative samples, the repetition frequency is defined in Section 6 of this specification.

4.2.4 Qualification Tests

These are performed:

i) Prior to first shipment of a new material.

ii) Whenever any significant change is made to the materials or manufacturing process, full or selected qualification tests will be conducted as appropriate to the significance of the change and its possible effects in accordance with Tyco Electronics UK Ltd procedure ELE-3EPT-006

5 CABLE CONSTRUCTIONS AND MATERIALS

5.1 Conductors and Braiding Wires

5.1.1 Copper Conductors and Braiding Wire

Strands shall be clean, bright and free from surface irregularities. Constructions shall show no kinks, joints or other irregularities in the completed conductor. They shall comply with Section 6 and the cable drawings described in Section 2 of this specification.

5.2 Insulation

The insulation system shall be extruded to cover the conductor uniformly in one or more layers and be homogeneous, smooth and free from flaws. The insulation shall not be loose, but be capable of stripping cleanly without damage to the conductor.
Wire Identification

The insulation shall be capable of identification by application of marks, stripes or bands onto the standard base colours. The colours shall be defined as detailed below.

Reference	Colour
1	Brown
1L	Tan
2	Red
2L	Pink
3	Orange
4	Yellow
5	Green

Reference	Colour
6	Blue
6L	Light Blue
7	Violet
8	Grey
9	White
0	Black

An additional number after the base colour indicates a stripe or band. If more than one stripe is applied, then the first number after the base number indicates the thickest stripe on the wire.

A mark can be a number, letter or a combination of both. For marking and striping of wires, the preferred base colour shall be white. Any such marking requirements shall be defined in the cable drawings described in Section 2 of this specification.

5.3 Fillers

Fillers may be used to provide firmness and roundness of completed cables.
Fillers used shall be selected with due consideration to the general requirements defined in Section 1 of this specification.
They shall be non-hygroscopic and shall be readily removable from insulators, insulating tapes and shields without the aid of solvents, cleansers or tools.

5.4 Strength Members

Strength members shall generally be of steel wire or aramid fibre and shall be sheathed if required. They shall show no kinks or other irregularities and shall comply with the requirements defined on the EPD cable drawing if applicable.

5.5 Armours

Armours shall be of stainless steel wire, galvanised steel wire, copper alloy wire or aramid fibres. They shall comply with the requirements defined on the EPD cable drawing if applicable

5.6 General Cable Construction

Construction of the finished cable shall be in full accordance with the EPD cable drawing. The cable drawing shall take precedence over this Section in the case of conflict.

Unless otherwise specified the cable components shall be laid up such that each layer is in an alternate direction, the outer layer being a left-hand lay.

The lay length of all the components (including twisted pairs, triples, etc.) in each layer shall generally be between eight and sixteen times the diameter over their layer and shall be laid up in such a way that the assembly has a firm, tight and circular cross-section.

5.7 Wrapping Tapes and Binders

5.7.1 Wrapping Tapes

Wrapping tapes are to be wrapped helically with a nominal overlap of 30%. The tape shall be removable without damage to the insulation of the individual components within the completed cable.

5.7.2 Binders

Binders may be used over the cable layers to provide firmness and shall be of aramid fibre or other suitable materials.

5.8 Waterblocking Compound

Where waterblocking compound is used in cable and shield interstices it shall be compatible with all other cable materials.

5.9 Screening

Where a screen is specified, a tape may be applied over the laid up cores prior to the application of the screen, plus a tape applied over the screen if required for manufacturing purposes.
Joints in the braiding wire are to be woven in or twisted so that the wire ends turn outwards. There are to be no joints in the completed braid.
Where minimum braid coverage is specified the minimum coverage shall be calculated from the formulae:-

1) $K = (2F - F^2)x100$ 2) $F = \frac{(NPd)}{Sin\ a}$ 3) $Tan\ a = \frac{[2\pi(D+2d)P]}{C}$

where:

K = coverage
P = number of picks in 1 inch
C = number of carriers
N = number of strands
d = diameter of a single strand (inches)
D = effective diameter under the shield (inches)
F = filling factor
a = braid angle

5.9.1 Component Screen Insulation

Component screen insulation, where required, shall be a homogeneous extrusion of polymeric material which shall provide adequate electrical isolation of the screens. The extruded layer shall further provide environmental and mechanical abuse resistance during service and shall be selected with due consideration to the general cable requirements defined in Section 1 of this specification.
During manufacture all components are passed through a high voltage source as defined in BS 5099 and subjected to a 50/60 Hz spark or impulse test at the appropriate voltage as defined by the individual wire specification. No breakdown of the insulation shall occur.

5.9.2 Surface Transfer Impedance (Z_t)

Where an optimised screen is specified the cable shall meet the Surface Transfer Impedance requirements as detailed in Section 6.1.1 of this specification, or on the EPD cable drawings described in Section 2 of this specification.

5.10 Sheathing Materials

Sheathing materials shall meet all the test requirements of Section 6.2 of this specification. The sheath shall be reasonably smooth so as not to degrade any cable glanding. It shall be easily removed from the finished cable without adhesion or damage to screens or cores.
Unless otherwise specified on the individual cable drawing the sheath shall be black and uniformly coloured.

5.11 Overall Dimensions

All finished diameters shall be quoted as nominal values with a tolerance of ± 5% unless otherwise specified on the EPD cable drawings described in Section 2 of this specification.
All cable sheaths shall have a concentricity of 70% minimum. The concentricity shall be calculated as the ratio of maximum to minimum wall thickness of the sheath material.
The minimum sheath wall at any point shall be calculated.

For outer sheaths it shall be:	0.85 x nominal wall - 0.1 mm
and for inner sheaths it shall be:	0.80 x nominal wall - 0.1 mm

5.12 Cable Marking

Components and sheaths shall be identified as specified on the EPD cable drawings described in Section 2 of this specification. Any sheath markings shall be durable and able to withstand normal handling without loss of legibility.

6 TEST REQUIREMENTS

When tested in accordance with Section 7 of this specification, the finished cable and sheath material shall meet the requirements defined in tables 6.1, 6.1.1 and 6.2 below.

6.1 Tests on Completed cable

Property/Test	***Clause***	***Requirement***	***Test Frequency***
Spark test (Screened cables only)	7.1.1	No failures	Routine
Constructional details	5.6	See Section 2	Batch
Component dielectric test	7.1.2	No breakdown	Batch
Dimensions	5.10	See Section 2	Batch
Concentricity	5.11	70% minimum	Batch
Insulation resistance	7.1.3	1.0 MΩ.Km minimum	Quality/Monthly
. Heat shock and shrinkage 4 hours at 150°± 3℃	7.1.4	No cracks or flowing 3 mm maximum shrinkage	Batch
Cold bend -30 ± 3℃	7.1.5	No cracks	Quality/Monthly
Capacitance unbalanced	7.1.6	See Section 2	Batch
Screen coverage	5.9	85% minimum	Batch
Surface transfer impedance (Zt)	7.1.7	See Section 6.1.1	Quality/Quarterly
Impedance (Zo)	7.1.8	See Section 2	Batch
Vertical flammability	7.1.9	No damage to sheath 250 mm from top of cable	Qualification
Breaking load of strength members	7.1.10	See Section 2	Quality
Breaking load of armour wires	7.1.11	See Section 2	Quality

6.1.1 Optimised Screening Levels

Cables having optimised braids specified on the EPD cable engineering drawing described in Section 2 shall meet the surface transfer impedance limits detailed below.

Type of Screen	***Diameter Under Screen (mm)***	***Surface Transfer Impedance (Zt) at 30 MHz maximum.***
Single optimised braid	≤ 7.5	100 mΩ/m
	>7.5	50 mΩ/m
Double optimised braid	≤ 7.5	10 mΩ/m
	>7.5	5 mΩ/m
Superscreened	≤ 7.5	100 μΩ/m
(2 braids and 1 wrap)	>7.5	50 μΩ/m
Double superscreened	All sizes	10 μΩ/m
(3 braids and 2 wraps)		

6.2 Tests on Sheath Material

The sheath material shall be approved to and meet the full test requirements of the latest issue of DEF STAN 61-12 (Part 31). The requirements at issue date of this specification are summarised below. Approval certification to DEF STAN 61-12 (Part 31) shall be made available on request.

Property/Test	***DEF STAN 61-12 (Part 31) Clause***	***Requirement***	***Frequency***
Tensile strength	9.1	8.0 MPa minimum	Batch
Elongation	9.1	200% minimum	Batch
Sheath tear strength	9.2	5 N/mm minimum	Batch
Thermal endurance	9.3	40,000 hours at 85℃	Qualific ation
Accelerated ageing	9.4	As agreed between supplier & MoD	Quality
Critical oxygen index	9.5	29 minimum	Qualification
Temperature index	9.6	250℃ minimum	Qualification
Toxicity index	9.7	5 maximum	Qualification
Halogen content	9.8	Negative result for halogens	Qualification
Smoke index	9.9	20 maximum	Qualification
Fluid resistance	9.10	See table 6.2.1	Qualification
Cold elongation	9.11	20% minimum	Qualification
Heat shock	9.12	No cracks	Qualification
Insulation resistance	9.13	0.1 MΩ.km	Qualification
Hot-set test	9.14	175% maximum elongation 25% max. permanent elongation	Qualification
Pressure test	9.15	50% maximum indentation	Qualification
Ozone resistance	9.16	No cracks	Qualification
UV Stability	9.17	50% Retention TS & EB	Qualification

6.2.1 Fluid Resistance to DEF STAN 61-12 (Part 31)

Test Fluid	***Test***		***After Immersion***		
	Temp (℃)	***Time (Days)***	***Tensile Strength Retention (min)***	***Elongation at Break Retention (min)***	***Volume Swell (max)***
Fuel Oil					
Dieso 47/20,NATO F-76 or DERV	20 ± 3	28	60%	60%	25%
Hydraulic Fluids					
OX-30	50 ± 3	28	60%	60%	15%
HS-200X	50 ± 3	28	60%	60%	15%
Lubricating Oils					
OMD-113	50 ± 3	28	60%	60%	10%
OX-28	50 ± 3	28	60%	60%	50%
Waters					
Deionised	50 ± 3	28	80%	80%	10%
Deionised with 3.5% NaCl	50 ± 3	28	80%	80%	10%

6.2.2 Additional Sheath Requirements

Property/Test	***Clause***	***Requirements***	***Test Frequency***
Water uptake	7.2.4	4% maximum	Qualification
Hydrolytic Stability	7.2.5	No visual cracks 60% minimum retention of Tensile Strength and Elongation	Qualification

7 TESTS AND TEST METHODS

7.1 Tests on Completed Cables

7.1.1 Spark Test (Screened Cables Only)

This test shall be carried out in accordance with BS 5099.
During manufacture 100% of all screened and sheathed cables shall be passed through a high voltage source. The applied voltage level varies with sheath thickness and is defined in BS 5099. Faults in the sheath shall be removed by cutting back to a maximum of 500 mm each side of the fault.

7.1.2 Component Dielectric Test

Unless otherwise specified, the components shall be subjected to a core to core and core to screen test of at least 1.5 kV, 40 - 60 Hz for a minimum of 1 minute.

7.1.3 Insulation Resistance

This test shall be carried out in accordance with BS 6469: Section 99.2 on a 5m sample of collectively screened cable which has no tape over the screen.
The sample shall be immersed in water for 12 hours at 20℃ ± 5℃ with a length of 250 mm at each end of the cable protruding above the water. A DC voltage of 500 ± 50 volts is applied between screen and water and the insulation resistance measured 1 minute after application of the voltage. The insulation resistance constant (K) is calculated from the equation below:

$$K = \frac{LR}{1000.\log\left(\frac{D}{d}\right)} \quad \text{MΩ.Km}$$

where:
D = diameter over sheath (mm)
d = diameter over screen (mm)
L = immersed length of cable (m)
R = insulation resistance of the cable (MΩ)

7.1.4 Cable Heat Shock and Shrinkage

Two 300 mm lengths of completed cable shall be placed in an air-circulating oven for the times and temperatures specified in Section 6.1 of this specification. After cooling to room temperature, the shrinkage of the sheath from the ends of the cable shall be measured and added together. This total shrinkage shall not exceed that specified in Section 6.1 of this specification.
After measurement of shrinkage, the sample shall be bent around a mandrel whose diameter is 10 times the cable diameter. After straightening it shall be visually inspected with normal vision and shall meet the requirements of Section 6.1 of this specification.

7.1.5 Cold Bend

A 1.5 m specimen of finished cable shall be straightened and placed in the cold chamber. If necessary, the specimen may be secured to keep it straight during the conditioning. The chamber shall be lowered to a temperature of -30℃ at a rate not to exceed 50℃ per minute. The specimen shall be conditioned at this temperature for 4 hours. At the end of this period, the specimen shall be removed from the chamber and immediately bent 180° around a mandrel. The mandrel diameter shall be 12 times the nominal cable diameter, rounded up to the nearest 12.5 mm for mandrel diameters greater than 100 mm. The time required for bending around 180° of the mandrel sha ll be 0.5 of a minute at a uniform rate of speed. The specimen shall then be removed from the mandrel without straightening and visually inspected without magnification for cracks.

7.1.6 Capacitance Unbalanced

Capacitance and capacitance unbalanced shall be measured in accordance with MIL DTL 17 paragraphs 4.8.10 and 4.8.12. Unless otherwise specified, this test shall be performed at 1 kHz. A 2 m (minimum) sample shall have all shields removed for 25 mm from each end. The centre conductor and screen shall be attached to a capacitance bridge and the capacitance values recorded. The sample length shall be defined as the length of the shielded cable. The value obtained shall comply with the requirements specified on the EPD cable drawing.

7.1.7 Surface Transfer Impedance (Zt)

This test shall be generally performed in accordance with IEC 62153-4-6, EN 50289-1-6, BS EN 50117-2, SAE AS 85485. A suitable length of the cable under test is mounted in the test apparatus. A current at the test frequency is passed through the outer co-axial circuit. Due to transfer of energy through the screens a voltage can be detected on the wire. The ratio of measured voltage to applied current is defined as the surface transfer impedance (Zt). The values obtained shall not exceed the maximum values quoted in Section 6.1.1 of this specification.

7.1.8 Impedance (Zo)

7.1.8.1 Coaxial Cables with Zo between 40 – 60 ohms at greater than 10 MHz

This test is derived from MIL DTL 17 paragraph 4.8.7. A precision air line of the same nominal characteristic impedance as the sample under test shall be connected between the TDR and the sample.

The characteristic impedance of the sample shall be measured in comparison with the precision air line. The value obtained shall comply with the requirements specified on the EPD cable drawing.

7.1.8.2 Coaxial Cables with Zo less than 40 ohms or greater than 60 ohms at greater than 10 MHz

This test is derived from MIL DTL 17 paragraphs 4.8.7 and 4.8.11.

A minimum of 2 m of cable shall have the mutual capacitance measured using a capacitance bridge and the velocity of propagation measured using a spectrum analyser. The characteristic impedance at the specified frequency shall be calculated from the formula below and shall meet the requirements specified on the ASC or EPD cable drawing.

$$Zo = \frac{333579}{VC}$$

where: Z_0 = impedance in Ω
V = velocity of propagation in %
C = capacitance in ρF per metre

7.1.8.3 Coaxial Cables for frequencies less than 10 MHz

This test is derived from MIL-DTL-915G and MIL-DTL-17.
Using a 1 MHz bridge, the capacitance shall be measured. The end of the sample under test shall be shorted and the inductance measured at the same frequency.
The characteristic impedance at the specified frequency shall be calculated from the formula below and shall meet the requirements specified on the EPD cable drawing.

$$Zo = \sqrt{\frac{L}{C}}$$

where: Z_0 = impedance in Ω
L = inductance in ηH per metre
C = capacitance in ρF per metre

7.1.9 Vertical Flammability Test

This test shall be performed in accordance with DEF STAN 02-641, clause 12.8.
The test specimen shall consist of one complete cable length or a number of cable lengths twisted together depending upon the overall diameter, as shown in the table below.

Cable Diameter (D)			***Number of Cable lengths***
	D	< 4	5
4 ≤	D	< 10	3
10 ≤	D	<70	1
	D	≥ 70	This diameter cannot be tested

The test specimen with a length of 850 mm ± 10 mm length in the finished condition (and a lay length of 275 mm ± 10 mm for twisted cables) is mounted vertically in the stainless steel chimney above a conical fuel tray.
The complete assembly shall be positioned in a draught-free enclosure with a minimum size of 25 m^3.

The burn time (*t*) and fuel quantity is calculated from the following :-

$$t = k + \left(\frac{D}{6}\right) \text{ minutes}$$

where :-

k	=	1 when the cable used to form the test specimen has a total cross Sectional conductor area up to and including 2.5 mm^2.
	=	2 when the cable used to form the test specimen has a total cross Sectional conductor area greater than 2.5 mm^2.
D	=	Circumscribed diameter of the overall test specimen in mm.

and Fuel Quantity = 10 x *t* ml.
The fuel shall then be added to the tray and ignited. The fuel and cable shall then be allowed to burn, undisturbed until all burning and glowing of the test specimen has ceased. The specimen shall then be removed and inspected for the extent of damage to the inside of the sheath.
The test shall be repeated on two further test specimens.

7.1.10 Strength Member - Breaking Load

The breaking load of a single end of the strength member shall be tested by mounting a 250 mm sample in the test machine and pulling at a separation speed of 8 ± 2 mm/minute to breaking point.
The load required to break the sample shall not be less than that specified in the EPD cable drawings described in Section 2 of this specification. This test shall be performed as an incoming material quality check unless otherwise stated on the individual EPD cable drawing.

7.1.11 Armour Wire - Breaking Load

A tensile test machine with a jaw separation speed of 50 ± 10 mm/minute shall be used. The single strand shall be clamped in the test machine and the load to break measured. From this value, the tensile strength shall be calculated and shall comply with the relevant material specification for the wire type. This test shall be performed as an incoming material quality check unless otherwise stated on the individual EPD cable drawing.

7.2 Tests on Sheath Material

7.2.1 Tensile Strength

This test shall be carried out in accordance with ISO 37, except that the maximum load on the sample shall be measured. Type 2 test samples shall be cut longitudinally from the cable sheath. The sample shall be clamped centrally in the machine grips and stretched to breaking point.

The test shall be carried out at a temperature of 20℃ ± 5℃. The maximum load shall be recorded. From the maximum load the tensile strength shall be calculated and shall meet the requirements of Section 6.2 of this specification.

7.2.2 Elongation

This test shall be carried out in accordance with ISO 37. Type 2 test samples shall be cut longitudinally from the cable sheath. The sample shall be clamped centrally in the machine grips and stretched to breaking point.
The test shall be carried out at a temperature of 20℃ ± 5℃. The elongation at break shall be recorded and shall meet the requirements of Section 6.2 of this specification.

7.2.3 Sheath Tear Strength

This test shall be carried out in accordance with DEF STAN 61-12 (Part 31) Clause 9.2. A ‘trouser tear’ test sample, 50 mm in length, shall be cut longitudinally from the cable sheath and cut down the middle to a distance of 3.8 mm from the wide end. The cut halves shall be clamped centrally in the test machine and separated at a speed of 500 mm per minute. The load required to tear the sample is measured.
The tear resistance is obtained by dividing the maximum load measured by the sample thickness and expressed in N/mm. The value obtained shall not be less than the minimum value quoted in Section 6.2 of this specification.

7.2.4 Water Uptake

This test shall be carried out in accordance with ASTM D 570. The prepared samples shall be immersed in distilled water for 672 hours at 70° C. After the test, surface water shall be wiped off and the water uptake calculated as a percentage increase in weight over the pre-immersion value.
The weight uptake shall not exceed the values specified in Section 6.2.2 of this specification.

7.2.5 Hydrolytic Stability

This test shall be carried out in accordance with ASTM D 3137. Dumbbells cut to ISO 37, type 2, shall be suspended in a suitable container of distilled water at a temperature of 85±1℃, for a period of 96 hours. The container sha ll then be cooled to ambient temperature and the samples removed and conditioned for 16 to 24 hours at ambient temperature and relative humidity of 50%.
The tensile values shall be measured after the test and be compared with the initial values. The minimum retention shall exceed the values quoted in Section 6.2.2 of this specification.

7.3 Cable Components - definitions

This specification defines the test criteria for the insulation systems used on components within multiconductor cables. Conductors may vary depending on specific wire designs.

Cable components are defined as:

Primary Wire	Any insulated conductor using standard AWG conductor or metric equivalent. (size number).
Power Cable	Any insulated conductor with conductors complying with IEC 60228 class 5 or 6.
Coaxial Component	Any component having controlled impedance and capacitance requirements.
Fibre Optic	Any component consisting of a single fibre with appropriate protective layers.
Special Component	Any component not defined above, shall be specified on the individual drawings described in Section 2 of this specification.

7.3.1 Tests on Primary Wires

Primary wires shall meet the full test requirements of the individual Specification Control Drawings as described in Section 2 of this specification. In addition the wires shall meet any additional test requirements specified on the EPD cable drawing.

7.3.2 Tests on Power Cables

Power cables shall meet the full test requirements of the individual Specification Control Drawing as described in Section 2 of this specification. In addition the cables shall meet any additional test requirements specified on the EPD cable drawing.

7.3.3 Tests on Coaxial cables

Coaxial cables shall meet the full test requirements of the individual Specification Control Drawing as described in Section 2 of this specification. In addition the cables shall meet any additional test requirements specified on the EPD cable drawing.

7.3.4 Tests on Fibre Optics

Fibre optic components shall meet the full test requirements of the individual Specification Control Drawing as described in Section 2 of this specification. In addition the cables shall meet any additional test requirements specified on the EPD cable drawing.

7.3.5 Tests on Special Components

Any special component shall be defined in the individual EPD cable drawing and shall meet all the test requirements detailed therein.

8 PACKAGING

The finished cable shall be spooled in discrete lengths onto spools for shipping. Each length shall be fault-free and the open ends capped to prevent ingress of moisture.
Each reel shall bear a label showing:

(i) Manufacturer's name
(ii) Cable description
(iii) Cable batch number
(iv) Order number
(v) Length of each discrete cable length

9 REVISION HISTORY

Issue No.	*Change Request No.*	*Date*	*Incorporated by*
3	CR03-DP-377	December 2003	Dave Durston
4		March 2010	Andrew Caswell
5	CR12-DP-168	November 2012	Guy Mundy