

WT 2387 Issue 1

# Test Data to Support Rail Zero Halogen Product Compliance to DIN 5510-2

January 2012



Report Number: **WT 2387**

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Issue Number: **Issue 1**

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**Test Data to Support Rail Zero Halogen Product Compliance to  
DIN 5510-2**

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Author: **Tony Dixon**

Signed:



Approved by:

**Guy Mundy**

Signed:



Date: **January 2012**

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## Summary

This report details testing performed by independent Test Houses on TE Connectivity zero halogen products typically used in Rail applications to determine compliance to DIN-5510-2 Table 6 and Annex C Table C3.

Products tested to DIN-5510-2 met all the requirements of DIN-5510-2 Table 6 and Annex C Table C3.

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Proprietary Information



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## 1 INTRODUCTION

This report details testing performed on TE Connectivity Wire and Cable Rail, zero halogen products to determine compliance to DIN-5510-2 Issue 05-2009 Table 6 and Annex C Table C3

## 2 SAMPLES

EPD114322A (containing 100G0111-1.00 and with a Zerohal EN jacket)  
ZHPCG-15-4.0-0  
100G0111-1.50  
100G0111-2.50  
100G1141-1.50 (containing 100G0111-1.50 and with a Zerohal jacket)

## 3 CONCLUSION

Reports shown in Section 7 show that the samples submitted to the independent test houses met the requirements of DIN-5510-2 Table 6 and Annex C Table C3

It is normal procedure to demonstrate compliance by similarity via a tested size/construction. It should be noted that approval bodies do not require all the sizes/constructions to be tested and instead tests are carried out on representative samples.

The products submitted for testing were selected as being representative of:

Multicore cables containing Type 100G wire and having a Zerohal sheath material  
Multicore cables containing Type 100G wire and having a Zerohal EN sheath material  
Type 100G0111 of sizes  $\geq 1.50\text{mm}^2$   
Type 100G11X1 product family, all sizes  
ZHPCG product family, all sizes

and therefore all the above can be considered as compliant.

## 4 TABLE 6

## Requirements on electric cables and wires

No.	Vehicle parts requiring certification	Fire protection level as in DIN 5510-1	Test standards	Requirements	Remarks
1	Wiring and cables including data cables (fibre optic cables, data cables, coaxial cables)	1 to 4	DIN EN 60332-1-2 (VDE 0482-332-1-2)	Single wires and cables are deemed to have passed the test if the distance between the lower end of the upper clamp and the start of the charred section is greater than 50mm. If the flame extends for more than 540mm downwards from the lower end of the upper clamp, this shall be deemed to be a non-conformity. If one failed test is recorded, two further tests shall be carried out. If these two tests are subsequently passed, the wire or cable is deemed to have passed the test.	Thin fibre optic cables or single wires and cables with cross-sections of less than 0.5mm <sup>2</sup> shall be tested as described in DIN EN 60332-2-2 (VDE 0482-332-2-2) if the conductor breaks or melts before the end of the test when tested as defined in DIN EN 60332-1-2 (VDE 0482-332-1-2)
2	Wires and cables (except for data cables)	2 to 4	DIN EN 50266-2-4 (VDE 0482-266-2-4)	Test category C for cable diameters $\geq 12$ mm. At the end of the test the greatest distance of the charred section, measured on the sample and from the lower edge of the burner, shall not have reached a height of 2.5m on either side of the conductors.	Can also be tested on reference cross-sections as described in: DIN EN 50306-1 (VDE 0260-306-1) or DIN EN 50264-1 (VDE 0260-264-1)
			DIN EN 50266-2-5 (VDE 0482-266-2-5) See Note 1 Page 4	Test category D for cable diameters $> 6$ mm and $< 12$ mm. At the end of the test the greatest distance of the charred section, measured on the sample and from the lower edge of the burner, shall not have reached a height of 2.5m on either side of the conductors.	Can also be tested on reference cross-sections as described in: DIN EN 50306-1 (VDE 0260-306-1) or DIN EN 50264-1 (VDE 0260-264-1)
			DIN EN 50266-2-5 (VDE 0482-266-2-5) See Note 2 Page 4	Test category D for cable diameters $\leq 6$ mm. Set up according to DIN EN 50306-1 (VDE 0260-306-1):2003-05, 8.2.3 or DIN EN 50264-1 (VDE 0260-264-1):2003-06, 8.2.3, whichever is appropriate. At the end of the test the greatest distance of the charred section, measured on the sample and from the lower edge of the burner, shall not have reached a height of 1.5m on either side of the conductors.	Can also be tested on reference cross-sections as described in: DIN EN 50306-1 (VDE 0260-306-1) or DIN EN 50264-1 (VDE 0260-264-1)
3	Wiring and cables including data cables (fibre optic cables, data cables, coaxial cables)	2 to 4	DIN EN 61034-1 (VDE 0482-1034-1) See Note 3 Page 4	Within the first 20 minutes the light transmittance shall not drop to below 60%	This does not apply to interconnecting cables located on the exterior between vehicles. Can also be tested on reference cross-sections as described in: DIN EN 50306-1 (VDE 0260-306-1) or DIN EN 50264-1 (VDE 0260-264-1)

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## 4.1 EXPLANATORY NOTES

### Note 1 - DIN EN 50266-2-5 – Test Category D for cables with diameters >6mm and <12mm

Can also be tested on reference cross-sections as described in DIN EN 50306-1.

DIN 50306-1 Clause 8.2.2 states that the completed cable shall be tested in accordance with 9.1.1 of EN 50305.

Clause 9.1.1 of EN 50305 states the test shall be carried out as for EN 50266-2-4 except that the nominal total volume of non-metallic material (NMV) shall be 0.5 l/m (this is equivalent to EN 50266-2-5)

### Note 2 - DIN EN 50266-2-5 - Test Category D for cables with diameters ≤6mm

Set up according to DIN EN 50306-1. DIN 50306-1 Clause 8.2.3 states that the completed cable shall be tested in accordance with 9.1.2 of EN 50305

EN 50305 clause 9.1.2 states the test shall be carried out as for EN 50266-2-4 except that the ladder loading shall be bundles of cable of approximate diameter 20mm spaced by half the bundle diameter and the nominal total volume of non-metallic material (NMV) shall be 0.5 l/m (this is equivalent to EN 50266-2-5)

### Note 3 - DIN EN 61034-1

DIN EN 61034-1 details the test apparatus. DIN EN 61034-2 specifies the test method.

## 5 TEST REPORTS INDEX

<b>ZHPCG-15-4.0-0</b>				<b>Page</b>
Interscience	ICL/H11/974	BS EN 50266-2-4	Flame Propagation	8
Interscience	ICL/H11/986	EN 61034-2	Smoke Density	15
Interscience	ICL/H11/983	IEC 60332-1-2	Flame Propagation	20
Interscience	ICL/H11/991	EN 50267-2-2	pH and Conductivity	23
Interscience	ICL/H11/994	EN 60684-2	Fluorine content	26
Interscience	ICL/H11/997	BS EN 50305 Cl 9.2	Toxicity ITC	29
<b>100G0111-1.00</b>				
Interscience	ICL/H11/989	EN 50267-2-2	pH and Conductivity	33
Interscience	ICL/H11/992	EN 60684-2	Fluorine content	36
Interscience	ICL/H11/995	BS EN 50305 Cl 9.2	Toxicity ITC	39
MPA Dresden	2010-B-5342/01	DIN EN 60332-1-2	Flame Propagation	43
MPA Dresden	2010-B-5342/03	EN 61034-2	Smoke Density	45
<b>100G0111-1.50</b>				
VDE	640400-9021-0001/111978-5	DIN EN 60332-1-2	Flame Propagation	48
		DIN EN 61034-2	Smoke Density	
		DIN EN 50266-2-5	Flame Propagation	
<b>100G0111-2.50</b>				
SGS	AJD201100984-1	DIN EN 60332-3-25	Flame Propagation	55
<b>Zerohal sheath</b>				
Interscience	ICL/H11/1084	EN 50267-2-2	pH and Conductivity	57
Interscience	ICL/H11/1085	EN 60684-2	Fluorine content	60
Interscience	ICL/H11/1086	BS EN 50305 Cl 9.2	Toxicity ITC	63
<b>Zerohal EN sheath</b>				
Interscience	ICL/H11/990	EN 50267-2-2	pH and Conductivity	67
Interscience	ICL/H11/993	EN 60684-2	Fluorine content	70
Interscience	ICL/H11/996	BS EN 50305 Cl 9.2	Toxicity ITC	73
<b>100G0111-1.50 cores and Zerohal sheath (100G1141-1.50)</b>				
Interscience	ICL/H11/975	BS EN 50266-2-4	Flame Propagation	77
Interscience	ICL/H11/987	EN 61034-2	Smoke Density	84
Interscience	ICL/H11/984	IEC 60332-1-2	Flame Propagation	89
<b>100G0111-1.00 cores and ZH EN sheath (EPD114322A)</b>				
Interscience	ICL/H11/976	BS EN 50266-2-4	Flame Propagation	92
Interscience	ICL/H11/985	IEC 60332-1-2	Flame Propagation	99
Interscience	ICL/H11/988	EN 61034-2	Smoke Density	102

## 6 SUMMARY OF EXTERNAL TEST REPORT RESULTS

Sample	Report reference	Test	Requirement	Result	
ZHPCG-15-4.0	ICL/H11/974	Flame Propagation	<1.5m	0.8m	Pass
	ICL/H11/986	Smoke Density	≥60% (min)/≥60% (20')	78.9%/86.3%	Pass
	ICL/H11/983	Flame Propagation	>50mm	425mm	Pass
	ICL/H11/991	pH & Conductivity	pH ≥4.3/<10μS	pH 5.23/0.18μS	Pass
	ICL/H11/994	Fluorine content	0.1% max	<0.1% w/w	Pass
	ICL/H11/997	Toxicity ITC	10 max	ITC 3.20	Pass
100G0111-1.00	ICL/H11/989	pH & Conductivity	pH ≥4.3/<10μS	pH 5.22/0.23μS	Pass
	ICL/H11/992	Fluorine content	0.1% max	<0.1% w/w	Pass
	ICL/H11/995	Toxicity ITC	10 max	ITC 4.52	Pass
	2010-B-5342/01	Flame Propagation	>50mm	335mm	Pass
	2010-B-5342/03	Smoke Density	≥60% (min)/≥60% (20')	96.3%	Pass
100G0111-1.50	640400-9021-0001/111978-5	Flame Propagation	>50mm	369mm	Pass
		Smoke Density	≥60% (min)/≥60% (20')	97%	Pass
		Flame Propagation	<1.5m	1.35m	Pass
100G0111-2.50	AJD201100984-1	Flame Propagation	<1.5m	0.8m	Pass
Zerohal	ICL/H11/1084	pH & Conductivity	pH ≥4.3/<10μS	pH 5.02/0.174μS	Pass
	ICL/H11/1085	Fluorine content	0.1% max	<0.1% w/w	Pass
	ICL/H11/1086	Toxicity ITC	5 max	ITC 4.47	Pass
Zerohal EN	ICL/H11/990	pH & Conductivity	pH ≥4.3/<10μS	pH 5.32/0.34μS	Pass
	ICL/H11/993	Fluorine content	0.1% max	<0.1% w/w	Pass
	ICL/H11/996	Toxicity ITC	5 max	ITC 2.21	Pass
100G0111-1.50 cores, Zerohal sheath (100G1141-1.50)	ICL/H11/975	Flame Propagation	<1.5m	1.2m	Pass
	ICL/H11/987	Smoke Density	≥60% (min)/≥60% (20')	96.0%/96.7%	Pass
	ICL/H11/984	Flame Propagation	>50mm	420mm	Pass
100G0111-1.00 cores, ZH EN sheath (EPD114322A)	ICL/H11/976	Flame Propagation	<2.5m	1.3m	Pass
	ICL/H11/985	Flame Propagation	>50mm	415mm	Pass
	ICL/H11/988	Smoke Density	≥60% (min)/≥60% (20')	96.9%/87.6%	Pass



## **7 APPENDIX**

External Test Reports

Page references are detailed on page 5



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**Test Report No: ICL/H11/974**

**BS EN 50305: July 2002 Clause 9.1.2 Flame Propagation Test**

**Sponsored By**

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Page 1 of 7





**Test Report No: ICL/H11/974**

**BS EN 50266-2-4  
BS EN 50305: July 2002 Clause 9.1.2 Flame Propagation Test**

**Sponsored By**  
TE connectivity  
Faraday Road,  
Dorcan , Swindon  
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### **Purpose of Test**

To determine the performance of a cable when subjected to the test called up and detailed BS EN 50305: July 2002 Clause 9.1.2. This requires the test to be carried out in accordance with the procedures specified in BS EN 50266-2-4 "Common test methods for cables under fire conditions- Test for vertical flame spread of vertically-mounted bunched wires or cables -Part 2-4: Procedures — Category C" but with the number of cables and their arrangement on the test ladder to be in accordance with BS EN 50305: July 2002 Clause 9.1.2.

### **Scope of Test**

BS EN 50266-2-4 specifies a test procedure to assess the flame spread characteristic of bunched cables. The results being expressed as flame spread measured from the point of flame application.

### **Description of Test Specimen**

The description of the product given below has been prepared from information provided by the sponsor of the test. All values quoted are nominal, unless tolerances are given.

The product was a thin wall insulated conductor referenced "ZHPCG-15-4.0-0" having an overall diameter of 4.7mm and consisting of a multi-strand copper conductor , white insulation and black sheath.

The outer sheath of the cable was marked "Raychem ZHPCG-15-4.0-0".

The specimens were received on 15 September 2011.



### Conditioning of Test Specimens

The test specimens were conditioned by maintaining them in indoor ambient conditions for a minimum period of 16 hours at  $20 \pm 10^{\circ}\text{C}$ .

### Date of Test

The test was performed on 4 October 2011.

### Test Procedure

The test was performed in accordance with the procedure specified in BS EN 50266-2-4 Category C amended as per BS EN 50305 Clause 9.1.2 and this report should be read in conjunction with this Standard.

### Amendment:

#### 9.1.2 Cables with overall diameter not greater than 6 mm

The test shall be carried out as for EN 50266-2-4 except that the ladder loading shall be bundles of cable of approximate diameter 20 mm spaced by half the bundle diameter, and:

- a) a minimum of two bundles shall be tested;
- b) the number of bundles shall be determined as that necessary to give a nominal total volume of non-metallic material (NMV) of 0,5 l/m subject to a) above;
- c) the bundle length shall be 2,5 m;
- d) the bundle formation shall be as given below;
- e) the number of bundles tested and NMV of each shall be recorded;
- f) the cable to be tested shall be selected such that the total volume of non-metallic material (NMV) in the bundles to be tested is  $> 0,4$  l/m and  $\leq 0,6$  l/m.

The number of cables in each bundle shall be as follows:

Cable diameter (mm)	Number of cables in a bundle
$d \leq 3,3$	37
$3,3 < d \leq 4,3$	19
$4,3 < d \leq 6$	12

The cables in the bundle shall be laid in the formation given and then subjected to a uni-directional twist to give a lay length of approximately 15 D (where D is the bundle diameter).

**Number of the cables in the test array:**

3 bundles of 12 cables each were tied on to the ladder with a gap of 9mm between bundles.

**Test Results**

The test results relate only to the behaviour of the specimens of the product under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential smoke hazard of the product in use.

The test results relate only to the specimens of the product in the form in which they were tested. Small differences in the composition or thickness of the product may significantly affect the performance during the test and may therefore invalidate the test results. Care should be taken to ensure that any product, which is supplied or used, is fully represented by the specimens, which were tested.

Maximum flame spread measured from the bottom of the burner: 0.8m

Visual observations are given in Annex 1.

**Requirements**

Maximum height of charring above burner < 1.5m

**Conclusion**

The cable tested satisfies the requirements of the standard.

**Prepared by**

A handwritten signature in black ink, appearing to read "Chong", written over a horizontal line.

**C. B. Chong**  
Fire Scientist

**Approved by**

A handwritten signature in black ink, appearing to read "S. Kumar", written over a horizontal line.

**S. Kumar**  
Technical Manager

**Date of Issue: 20 October 2011**

**Annex 1****Visual observations**

<b>Time (min-sec)</b>	<b>Observations</b>
1-00	Flames reaching a height of 0.25m. Sheath swelling.
6-30	Flames reaching a height of 0.5m
7-30	Flames reaching a height of 0.6m
9-30	Flames reaching a height of 0.75m
12-30	Flames reaching a height of 0.75m
17-00	Flaming subsiding reaching a height of 0.6m
19-00	Flaming off cables ceases
20-00	Burner turned off. No after flaming observed.



**Annex 2**



**Photo 1: Cables before test**



**Photo 2: Cables after test.**







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**Test Report**  
**Report No: ICL/H11/986**

**EN 61034-2 – Measurement of Smoke Density of Electric Cables**  
**Burning Under Defined Conditions**  
**Part 2: Test Procedure and Requirements**

**Sponsored By**

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## Test Report

Report No: ICL/H11/986

### EN 61034-2 – Measurement of Smoke Density of Electric Cables Burning Under Defined Conditions Part 2: Test Procedure and Requirements

**Sponsored By**  
TE connectivity  
Faraday Road,  
Dorcan , Swindon  
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#### **1 Purpose Of Test**

To determine the performance of a cable when subjected to the conditions of the test specified in EN 61034-2 Measurement of Smoke Density of Electric Cables Burning Under Defined Conditions - Part 2: Test Procedure and Requirements and assess the results against the performance requirements given in DIN 5510-2: 2009 Table 6.

#### **2 Scope Of Test**

EN 61034 Part 2 specifies a method of test for the determination the smoke emission characteristics of a cable burning under defined conditions of test

#### **3 Description of the cable**

The description of the cable given below has been prepared from information provided by the sponsor of the test. All values quoted are nominal, unless tolerances are given.

The product was a thin wall insulated conductor referenced "ZHPCG-15-4.0-0" having an overall diameter of 4.7mm and consisting of a multi-strand copper conductor, white insulation and black sheath.

The outer sheath of the cable was marked "Raychem ZHPCG-15-4.0-0".

The cable was supplied by the sponsor of the test on 15 September 2011 and Interscience Communications Ltd was not involved in any selection or sampling procedures.

#### **4 Date Of Test**

The test was performed on 5 October 2011.

#### **5 Test Procedure**

The test was performed in accordance with the procedure specified in EN 61034 Part 2 and this report should be read in conjunction with that Standard.



Test specimen consisted of three bundles of seven cables each.

## 6 Test Results

The test results relate only to the behaviour of the specimens under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential hazard of the product in use.

The test results relate only to the specimens of the cable component in the form in which they were tested. Small differences in the composition of the product may significantly affect the performance during the test and may therefore invalidate the test results. Care should be taken to ensure that any product, which is supplied or used, is fully represented by the specimens, which were tested.

Visual observations are given in Appendix 1.

The change in transmission with time was recorded and a chart is given in Appendix 2.

Minimum transmission was: 78.9 %

Minimum transmission in the first 20 minutes of the test: 86.3%

## 7 Requirements

The following requirements are given in Annex B (Informative) of EN 61034-2:2005

Transmission value: minimum 60%

The following requirements are given in DIN 5510-2:2009 Table 6

Transmission value in the first 20 minutes of the test: Minimum 60%

## 8 Conclusion

The cable satisfies the requirement given in Annex B of EN 61034-2 and requirements of minimum 60% transmission given in DIN 5510-2:2009 Table 6.

Prepared by

Handwritten signature of C. B. Chong in black ink.

**C. B. Chong**  
Fire Scientist

Approved by

Handwritten signature of S. Kumar in black ink.

**S. Kumar**  
Technical Manager

**Date of Issue: 5 December 2011**



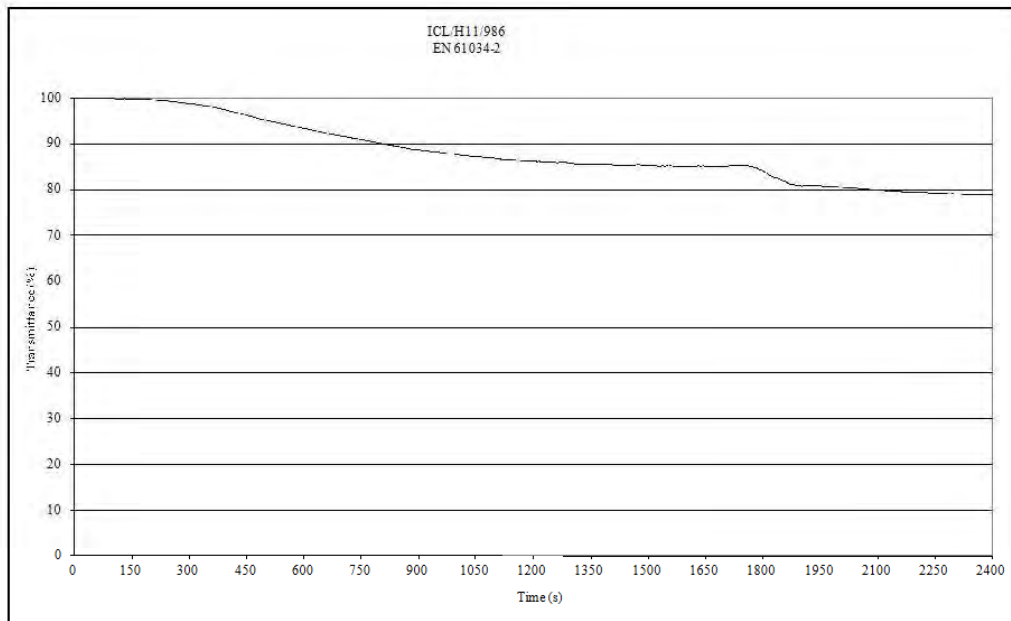
### Appendix 1

#### Visual Observations

<b>Time Mins-Sec</b>	<b>Observations</b>
1 – 27	Sagging and swelling observed on edge of cable
1 – 58	Ignition of cable sheathing
8 – 20	Flameout of cable
26 – 00	Fuel source goes out
30 – 00	No change
40 – 00	End of test



**Appendix 2**



**Graph showing the change in transmission with time**





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**Test Report No: ICL/H11/983**

**IEC 60332-1-2: 2004**

**Tests on electric and optical fibre cables under fire conditions-  
Part 1-2 Test for vertical flame propagation for single insulated wire or cable-  
Procedure for 1kW pre-mixed flame.**

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**Test Report No: ICL/H11/983**

**IEC 60332-1-2: 2004**

**Tests on electric and optical fibre cables under fire conditions-  
Part 1-2 Test for vertical flame propagation for single insulated wire or cable-  
Procedure for 1kW pre-mixed flame.**

**Sponsored By**  
TE connectivity  
Faraday Road,  
Dorcan , Swindon  
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### **Purpose Of Test**

To determine the performance of a specimen of a cable when it is subjected to the conditions of test specified in IEC 60332-1-2 Tests on electric and optical fibre cables under fire conditions- Part 1-2 Test for vertical flame propagation for single insulated wire or cable- Procedure for 1kW pre-mixed flame.

### **Scope Of Test**

IEC 60332-1-1:2004 details a method of test for the assessment of the flame propagation characteristics of a single wire or cable. The specimen is deemed to have met the performance requirements of the Standard, if after burning has ceased, the charred or affected portion does not reach within 50mm of the lower edge of the top clamp. In addition, a failure is recorded if charring extends down words to a point greater than 540mm from the lower edge of the top support.

### **Description Of Test Specimen**

The description of the specimen given below has been prepared from information provided by the sponsor of the test. All values quoted are nominal, unless tolerances are given.

The product was a thin wall insulated conductor referenced "ZHPCG-15-4.0-0" having an overall diameter of 4.7mm and consisting of a multi-strand copper conductor, white insulation and black sheath.

The outer sheath of the cable was marked "Raychem ZHPCG-15-4.0-0".

### **Conditioning Of Specimen**

The specimen was received on 15 September 2011.

Prior to the test the specimen was conditioned at a temperature of  $25 \pm 5^{\circ}\text{C}$  for a minimum period of 16 hours.



### **Date Of Test**

The test was performed on 4 October 2011.

### **Test Procedure**

The test was performed in accordance with the procedure specified in IEC 60332-1-2 and this report should be read in conjunction with that Standard.

The burner was applied for 60 seconds.

### **Test Results**

The test results relate only to the behaviour of the specimen of the cable under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential fire hazard of the product in use.

The test results relate only to the specimen of the cable in the form in which they were tested. Small differences in the composition or thickness of the cable may significantly affect the performance during the test and may therefore invalidate the test results. Care should be taken to ensure that any cable which is supplied or used is fully represented by the specimens which were tested.

Distance between the lower edge of the top support and the onset of charring (mm): 425

### **Recommended performance requirement (Annex A : Informative)**

The insulated conductor or cable shall pass the test if the distance between the lower edge of the top support and the onset of charring is greater than 50mm.

In addition, a failure shall be recorded if the burning extends downwards to a point greater than 540mm from the lower edge of the top support.

### **Conclusion**

The specimen meets the performance requirement given in Annex A of IEC 60332-1-2:2004.

#### **Prepared by**

A handwritten signature in black ink, appearing to read "Chong".

**C. B. Chong**  
Fire Scientist

#### **Approved by**

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**S. Kumar**  
Technical Manager

**Date of Issue: 5 December 2011.**





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**Test Report**  
**Report No: ICL/H11/991**

**EN 50267-2-2**

**Common Test Methods for Cables Under Fire Conditions –  
Tests on Gases Evolved During Combustion of Materials From Cables - Part 2-2:  
Procedures - Determination of Degree of Acidity of Gases for Materials by Measuring pH  
and Conductivity**

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**Test Report**  
**Report NO. ICL/H11/991**

**EN 50267-2-2: 1999**

**Common Test Methods for Cables Under Fire Conditions –  
Tests on Gases Evolved During Combustion of Materials From Cables - Part 2-2:  
Procedures - Determination of Degree of Acidity of Gases for Materials by Measuring pH  
and Conductivity**

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**1 Purpose of Test**

To determine the performance of specimens of a material when they are subjected to the conditions of the test specified in EN 50267-2-2 :1999 Common Test Methods for Cables Under Fire Conditions – Tests on Gases Evolved During Combustion of Materials From Cables - Part 2-2: Procedures - Determination of Degree of Acidity of Gases for Materials by Measuring pH and Conductivity.

**2 Scope of Test**

EN 50267-2-2 specifies a method of test for the determination of the degree of acidity of gases evolved during the combustion of compounds taken from cable constructions.

**3 Material tested**

The description of the material given below has been prepared from information provided by the sponsor of the test. All values quoted are nominal, unless tolerances are given.

The product was a cable referenced “Raychem ZHPCG-15-4.0-0”, batch number D985104040.

The insulation consisted of a black outer layer and cream coloured inner (in contact with the conductor) layer. This insulation was tested as one material.

The sponsor of the test did not supply further details relating to the composition of the material tested.

The sample was supplied by the sponsor of the test on 15 September 2011, and Interscience Communications Ltd was not involved in any selection or sampling procedure.

**Report No: ICL/H11/991**  
**Page 2 of 3**





#### 4 Date of Test

The test was performed on 10 October 2011.

#### 5 Test Procedure

The test was performed in accordance with the procedure specified in EN 50267-2-2:1999 and this report should be read in conjunction with that Standard.

#### 6 Test Results

The test results relate only to the behaviour of the specimens under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential hazard of the product in use.

The test results relate only to the specimens of the cable component in the form in which they were tested. Small differences in the composition of the product may significantly affect the performance during the test and may therefore invalidate the test results. Care should be taken to ensure that any product, which is supplied or used, is fully represented by the specimens, which were tested.

The results obtained are given in Table 1.

**TABLE 1**

Run No	Mass before (g)	Mass after (g)	pH	Conductivity ( $\mu$ S)
1	1.0001	0.1401	5.19	0.19
2	0.9997	0.1697	5.26	0.18
Mean			5.23	0.18

#### 7 Conclusion

The recommended compliance criteria give in EN 50267-2-2: 1999 annex A (informative) is a pH value not less than 4.3 and conductivity value of less than 10  $\mu$ S. The material therefore satisfies the requirement of the standard.

Prepared by

**C. B. Chong**  
Fire Scientist

Approved by

**S. Kumar**  
Technical Manager

Date of Issue: 5 December 2011

Report No: ICL/H11/991  
Page 3 of 3



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**Test Report**  
**Report No: ICL/H11/994**

**EN 60684-2 Clause 45.2**  
**Flexible insulating sleeving — Part 2: Methods of test**  
**(includes amendment A1:2003)**  
**(IEC 60684-2:1997/A1:2003)**

**45.2 Determination of low levels of fluorine**

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**Test Report**  
**Report NO. ICL/H11/993**

**EN 60684-2 Clause 45.2**  
**Flexible insulating sleeving — Part 2: Methods of test**  
**(includes amendment A1:2003)**  
**(IEC 60684-2:1997/A1:2003)**

**45.2 Determination of low levels of fluorine**

**Sponsored By**  
TE connectivity  
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**1 Purpose of Test**

To determine the performance of specimens of a material when they are subjected to the conditions of the test specified in EN 60684-2 : 1997 ‘Flexible insulating sleeving — Part 2: Methods of test (includes amendment A1:2003) (IEC 60684-2:1997/A1:2003) clause 45.2 Determination of low levels of fluorine

**2 Scope of Test**

EN 560684-2 Clause 45.2 specifies a method of test for the determination the low level presence of fluorine. The sample is burnt in an oxygen flask, and the resulting solution is used to measure the fluorine content

**3 Material tested**

The description of the material given below has been prepared from information provided by the sponsor of the test. All values quoted are nominal, unless tolerances are given.

The product was a cable referenced “Raychem ZHPCG-15-4.0-0”, batch number D985104040.

The insulation consisted of a black outer layer and cream coloured inner (in contact with the conductor) layer. This insulation was tested as one material.

The sample was supplied by the sponsor of the test on 15 September 2011, and Interscience Communications Ltd was not involved in any selection or sampling procedure.

**Report No: ICL/H11/994**  
**Page 2 of 3**





**4**     **Date of Test**

The test was performed on 20 October 2011.

**5**     **Test Procedure**

The test was performed in accordance with the procedure specified in EN 60684-2: 1997 clause 45.2, and this report should be read in conjunction with that Standard.

**6**     **Test Results**

The test results relate only to the behaviour of the specimens under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential hazard of the product in use.

The test results relate only to the specimens of the cable component in the form in which they were tested. Small differences in the composition of the product may significantly affect the performance during the test and may therefore invalidate the test results. Care should be taken to ensure that any product, which is supplied or used, is fully represented by the specimens, which were tested.

The results obtained show Fluorine contents, expressed as % wt/wt, of < 0.1.

**Prepared by**

A handwritten signature in black ink, appearing to read "C. B. Chong".

**C. B. Chong**  
Fire Scientist

**Approved by**

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**S. Kumar**  
Technical Manager

**Date of Issue: 5 December 2011**

**Report No: ICL/H11/994**  
**Page 3 of 3**



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**Test Report No: ICL/H11/997**  
**BS EN 50305: 2002 Clause 9.2 "Toxicity test"**  
**Railway applications -**  
**Railway rolling stock cables having special fire performance -**  
**Test methods**

**Sponsored by:**

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Report: ICL /H11/997

Page 1 of 4





**TEST REPORT NO: ICL/H11/997**  
**BS EN 50305: 2002 Clause 9.2 "Toxicity test"**  
**Railway applications -**  
**Railway rolling stock cables having special fire performance -**  
**Test methods**

**Sponsored by**  
TE connectivity  
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**Introduction**

To assess the fire characteristics of a cable insulation material in accordance with the procedures specified in BS EN 50305: 2002 Railway applications -Railway rolling stock cables having special fire performance -Test methods Clause 9.2 and determine a toxicity Index in accordance with this standard.

**Product Description**

The description of the specimen given below has been prepared from information provided by the sponsor of the test. All values quoted are nominal, unless tolerances are given. The sponsor of the test did not supply further details relating to the composition of the product

The product was a cable referenced "Raychem ZHPCG-15-4.0-0", batch number D985104040.

The insulation consisted of a black outer layer and cream coloured inner (in contact with the conductor) layer. This insulation was tested as one material.

The specimens were received on 15 September 2011.

**Conditioning of Test Specimens**

All test samples were conditioned to constant mass at  $23 \pm 2^{\circ}\text{C}$  and a relative humidity of  $50 \pm 5\%$  as required in section 8.2 of the standard.

**Date of Test**

The test was performed on 13 October 2011.





### Test Procedure

Test was carried out in accordance with the procedures specified in BS EN 50305: 2002 Railway applications - Railway rolling stock cables having special fire performance -Test methods Clause 9.2.

### Test Results

The test results relate only to the behavior of the specimens of the product under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential hazard of the product in use.

Qualitative analysis for determining the presence of nitrogen and sulfur using molten sodium were carried out in accordance with the procedures detailed in Clause 9.2.1 and shows the presence of:

Nitrogen

Quantitative analysis was carried out in accordance with the procedure specified in Clause 9.2.2 and the test results are as follows.

Gas	mg/g	CC <sub>z</sub>	ITC
Carbon monoxide	43.97	1750	2.51
Carbon dioxide	619.20	90000	0.69
Sulphur dioxide	-	260	-
Nitrogen oxides	-	90	-
Hydrogen cyanide	-	55	-
<b>ITC</b>			3.20

$$ITC = \frac{100}{m} * \sum \frac{M_z}{CC_z}$$

where

m = weight of the sample, g;

Mz = weight of gas z produced by the sample combustion, mg;

CCz = critical concentration for a 30 min exposure for gas z, mg/m<sup>3</sup> given in Table 6 of the standard



**Conclusion**

The samples of polymeric material tested shows an ITC of 3.20.

**Prepared by**

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**C. B. Chong**  
**Fire Scientist**

**Date of Issue: 5 December 2011**

**Authorised by**

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**S. Kumar**  
**Technical Manager**



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**Test Report**  
**Report No: ICL/H11/989**

**EN 50267-2-2**

**Common Test Methods for Cables Under Fire Conditions –  
Tests on Gases Evolved During Combustion of Materials From Cables - Part 2-2:  
Procedures - Determination of Degree of Acidity of Gases for Materials by Measuring pH  
and Conductivity**

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**Test Report**  
**Report NO. ICL/H11/989**

**EN 50267-2-2: 1999**

**Common Test Methods for Cables Under Fire Conditions –  
Tests on Gases Evolved During Combustion of Materials From Cables - Part 2-2:  
Procedures - Determination of Degree of Acidity of Gases for Materials by Measuring pH  
and Conductivity**

**Sponsored By**  
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**1 Purpose of Test**

To determine the performance of specimens of a material when they are subjected to the conditions of the test specified in EN 50267-2-2 :1999 Common Test Methods for Cables Under Fire Conditions – Tests on Gases Evolved During Combustion of Materials From Cables - Part 2-2: Procedures - Determination of Degree of Acidity of Gases for Materials by Measuring pH and Conductivity

**2 Scope of Test**

EN 50267-2-2 specifies a method of test for the determination of the degree of acidity of gases evolved during the combustion of compounds taken from cable constructions.

**3 Material tested**

The description of the material given below has been prepared from information provided by the sponsor of the test. All values quoted are nominal, unless tolerances are given.

The product was an insulated conductor taken from the inner core a complete cable referenced "Raychem EPD 114322A – 2010".

The inner sheath insulation of the conductor had no markings. The insulation was removed from the conductor and tested.

The sponsor of the test did not supply further details relating to the composition of the material tested.

The sample was supplied by the sponsor of the test on 19 September 2011, and Interscience Communications Ltd was not involved in any selection or sampling procedure.

**Report No: ICL/H11/989**  
**Page 2 of 3**





#### 4 Date of Test

The test was performed on 10 October 2011.

#### 5 Test Procedure

The test was performed in accordance with the procedure specified in EN 50267-2-2:1999 and this report should be read in conjunction with that Standard.

#### 6 Test Results

The test results relate only to the behaviour of the specimens under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential hazard of the product in use.

The test results relate only to the specimens of the cable component in the form in which they were tested. Small differences in the composition of the product may significantly affect the performance during the test and may therefore invalidate the test results. Care should be taken to ensure that any product, which is supplied or used, is fully represented by the specimens, which were tested.

The results obtained are given in Table 1.

**TABLE 1**

Run No	Mass before (g)	Mass after (g)	pH	Conductivity ( $\mu$ S)
1	1.0000	0.1365	5.04	0.24
2	1.0001	0.1369	5.40	0.22
Mean			5.22	0.23

#### 7 Conclusion

The recommended compliance criteria give in EN 50267-2-2: 1999 annex A (informative) is a pH value not less than 4.3 and conductivity value of less than 10  $\mu$ S. The material therefore satisfies the requirement of the standard.

Prepared by

**C. B. Chong**  
Fire Scientist

Approved by

**S. Kumar**  
Technical Manager

Date of Issue: 5 December 2011

Report No: ICL/H11/989  
Page 3 of 3



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**Test Report**  
**Report No: ICL/H11/992**

**EN 60684-2 Clause 45.2**  
**Flexible insulating sleeving — Part 2: Methods of test**  
**(includes amendment A1:2003)**  
**(IEC 60684-2:1997/A1:2003)**

**45.2 Determination of low levels of fluorine**

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**Test Report**  
**Report NO. ICL/H11/992**

**EN 60684-2 Clause 45.2**  
**Flexible insulating sleeving — Part 2: Methods of test**  
**(includes amendment A1:2003)**  
**(IEC 60684-2:1997/A1:2003)**

**45.2 Determination of low levels of fluorine**

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**1 Purpose of Test**

To determine the performance of specimens of a material when they are subjected to the conditions of the test specified in EN 60684-2 : 1997 “Flexible insulating sleeving — Part 2: Methods of test (includes amendment A1:2003) (IEC 60684-2:1997/A1:2003) clause 45.2 Determination of low levels of fluorine.

**2 Scope of Test**

EN 560684-2 Clause 45.2 specifies a method of test for the determination the low level presence of fluorine. The sample is burnt in an oxygen flask, and the resulting solution is used to measure the fluorine content

**3 Material tested**

The description of the material given below has been prepared from information provided by the sponsor of the test. All values quoted are nominal, unless tolerances are given.

The product was an insulated conductor taken from the inner core a complete cable referenced “Raychem EPD 114322A – 2010”.

The inner sheath insulation of the conductor had no markings. The insulation was removed from the conductor and tested.

The sponsor of the test did not supply further details relating to the composition of the material tested.

The sample was supplied by the sponsor of the test on 19 September 2011, and Interscience Communications Ltd was not involved in any selection or sampling procedure.

**Report No: ICL/H11/992**  
**Page 2 of 3**





**4**     **Date of Test**

The test was performed on 20 October 2011.

**5**     **Test Procedure**

The test was performed in accordance with the procedure specified in EN 60684-2: 1997 clause 45.2, and this report should be read in conjunction with that Standard.

**6**     **Test Results**

The test results relate only to the behaviour of the specimens under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential hazard of the product in use.

The test results relate only to the specimens of the cable component in the form in which they were tested. Small differences in the composition of the product may significantly affect the performance during the test and may therefore invalidate the test results. Care should be taken to ensure that any product, which is supplied or used, is fully represented by the specimens, which were tested.

The results obtained show Fluorine contents, expressed as % wt/wt, of < 0.1.

**Prepared by**

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**C. B. Chong**  
Fire Scientist

**Approved by**

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**S. Kumar**  
Technical Manager

**Date of Issue: 5 December 2011**





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**Test Report No: ICL/H11/995**  
**BS EN 50305: 2002 Clause 9.2 "Toxicity test"**  
**Railway applications -**  
**Railway rolling stock cables having special fire performance -**  
**Test methods**

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**TEST REPORT NO: ICL/H11/995**  
**BS EN 50305: 2002 Clause 9.2 "Toxicity test"**  
**Railway applications -**  
**Railway rolling stock cables having special fire performance -**  
**Test methods**

**Sponsored by**  
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**Introduction**

To assess the fire characteristics of a cable insulation material in accordance with the procedures specified in BS EN 50305: 2002 Railway applications -Railway rolling stock cables having special fire performance -Test methods Clause 9.2 and determine a toxicity Index in accordance with this standard.

**Product Description**

The description of the specimen given below has been prepared from information provided by the sponsor of the test. All values quoted are nominal, unless tolerances are given. The sponsor of the test did not supply further details relating to the composition of the product

The product was an insulated conductor taken from the inner core a complete cable referenced "Raychem EPD 114322A – 2010".

The inner sheath insulation of the conductor had no markings. The insulation was removed from the conductor and tested.

The specimens were received on 19 September 2011.

**Conditioning of Test Specimens**

All test samples were conditioned to constant mass at  $23 \pm 2^{\circ}\text{C}$  and a relative humidity of  $50 \pm 5\%$  as required in section 8.2 of the standard.

**Date of Test**

The test was performed on 11 October 2011.



### Test Procedure

Test was carried out in accordance with the procedures specified in BS EN 50305: 2002 Railway applications - Railway rolling stock cables having special fire performance -Test methods Clause 9.2.

### Test Results

The test results relate only to the behavior of the specimens of the product under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential hazard of the product in use.

Qualitative analysis for determining the presence of nitrogen and sulfur using molten sodium were carried out in accordance with the procedures detailed in Clause 9.2.1 and shows the presence of:

Nitrogen

Quantitative analysis was carried out in accordance with the procedure specified in Clause 9.2.2 and the test results are as follows.

Gas	mg/g	CC <sub>z</sub>	ITC
Carbon monoxide	51.75	1750	2.96
Carbon dioxide	1411.20	90000	1.57
Sulphur dioxide	-	260	-
Nitrogen oxides	-	90	-
Hydrogen cyanide	-	55	-
<b>ITC</b>			4.52

$$ITC = \frac{100}{m} * \sum \frac{M_z}{CC_z}$$

where

m = weight of the sample, g;

M<sub>z</sub> = weight of gas z produced by the sample combustion, mg;

CC<sub>z</sub> = critical concentration for a 30 min exposure for gas z, mg/m<sup>3</sup> given in Table 6 of the standard



**Conclusion**

The samples of polymeric material tested shows an ITC of 4.52.

**Prepared by**

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**C. B. Chong  
Fire Scientist**

**Date of Issue: 5 December 2011**

**Authorised by**

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**S. Kumar  
Technical Manager**

Bauaufsichtlich anerkannte Prüf-, Überwachungs- und Zertifizierungsstelle  
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 DIN EN 17020: DAP-IS-4347.00  
 ZLS-P-860/09; ZLS-ZE-707/09  
 Notified Body no. 0767  
 Mitglied des VMPA e.V.



## Test Report

### No. 2010-B-5342/01

#### 1. Ausfertigung

**Client:** Nanjing Smart Products service co., Ltd  
 1622/16F Deying Mansion,  
 No. 118, Middle Jiangdong Road  
 Nanjing city, Jiangsu province  
 China

**Manufacturer:** Raychem (Shanghai) Co., LTD  
 No. 307, QinJiang Road  
 CaoHejing Development Zone  
 Shanghai  
 China

**Order of:** 14<sup>th</sup> December 2010

**Incoming Date :** 14<sup>th</sup> December 2010

**Content of Order:** Test for vertical flame propagation for a single insulated wire or cable according to DIN EN 60332-1-2:2005-06

**Test material:** 100G0111-1.00-0CK0226 Cable

**Trade name:** Raychem

**Sampling:** MPA Dresden GmbH was not involved in any selection or sampling procedure.

**Approval No.:** EBA -024/06/09-



This test report contains 3 pages.

Publications of test reports also in the form of extracts and references to tests for advertising need in every case the written agreement of the test institute. Every page of these test report is stamped with the official seal of the test institute.

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USt-IdNr. DE234220069  
 IBAN DE68 8705 2000 3115 0246 72  
 BIC WELADED1FGX



## 1 Kind of Test

Test for vertical flame propagation for a single insulated wire or cable according to DIN EN 60332-1-2: 2005-06.

## 2 Description of Test Sample

The cable: 100G0111-1.00-0CK0226 Cable, with an outside diameter of ca 1.7 mm, was delivered by the client to the MPA Dresden GmbH.

## 3 Test procedure

One test sample of the cable with a length of 60 cm was produced by employees of the test institute. The test sample was straightened and stored at room temperature.

The test sample was attached in the test chamber according to DIN EN 60332-1-1 and burned with a flame.

The test sample was located in accordance with DIN EN 60332-1-2.

The applying of the flame corresponded to aforementioned standard.

The temperature inside the test chamber was 20°C at the beginning of the test.

The test rig stands in a testing hall so that external wind speed can be neglected.

All other requirements of the above mentioned test standard was fulfilled.

The test flame was applied for 60 seconds.

The test was carried out at 04<sup>th</sup> of January 2011.

## 4 Evaluation

After the flame application time of 60 seconds the burner was turned off. The burning was ceased after the completion of the test flame period.

Afterwards the test sample was taken from the test rig. There were damages at the test samples.

The maximum extent had reached a height of 335 mm from the bottom edge of the top mounting to the start of the damage range. The minimum allowable extent of 50 mm was surpassed.

The damage to the bottom, measured from the upper fixing was 530 mm. The limit of 540 mm was not exceeded.

The test cable has passed the test on electric cable under fire conditions according to DIN EN 60332-1-2:2005-06.

## 5 Special Comments


This test report is only valid for the described cable (see clause 2). All designations were given by the manufacturer.

This test report is valid up to the 17<sup>th</sup> of February 2014. The validity can be prolonged by application.

Freiberg, 18<sup>th</sup> February 2011

  
Dipl.-Ing. Hübler  
Managing Director



  
Dipl.-Ing. Neubert  
Test Engineer

Bauaufsichtlich anerkannte Prüf-, Überwachungs- und Zertifizierungsstelle  
 Amtlich anerkannte Prüfstelle für Feuerlöschmittel und -geräte  
 DIN EN ISO/IEC 17025: DAP-PL-1137.00; DIN EN 45011: DAP-ZE-4348.00;  
 DIN EN 17020: DAP-IS-4347.00  
 ZLS-P-860/09; ZLS-ZE-707/09  
 Notified Body no. 0767  
 Mitglied des VMPA e.V.



# Test Report

## No. 2010-B-5342/03

### 1. Ausfertigung

**Client:** Nanjing Smart Products service co., Ltd  
 1622/16F Deying Mansion,  
 No. 118, Middle Jiangdong Road  
 Nanjing city, Jiangsu province  
 China

**Manufacturer:** Raychem (Shanghai) Co., LTD  
 No. 307, QinJiang Road  
 CaoHejing Development Zone  
 Shanghai  
 China

**Order of:** 14<sup>th</sup> December 2010

**Incoming Date :** 14<sup>th</sup> December 2010

**Content of Order:** Measurement of smoke density of cables burning under defined conditions according to DIN EN 61034-1: 2006-03 (Apparatus) and DIN EN 61034-2: 2006-03 (Test procedure)

**Test material:** 100G0111-1.00-0CK0226 Cable

**Trade name:** Raychem

**Sampling:** MPA Dresden GmbH was not involved in any selection or sampling procedure.

**Approval No.:** EBA -024/06/09-



This test report contains 2 pages.

Publications of test reports also in the form of extracts and references to tests for advertising need in every case the written agreement of the test institute. Every page of these test report is stamped with the official seal of the test institute.

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USI-IcNr. DE234220069  
 IBAN DE68 8705 2000 3115 0246 72  
 BIC WELADED1FGX



## 1 Kind of Test

Measurement of smoke density of cables burning under defined conditions according to DIN EN 61034-1: 2006-03 and DIN EN 61034-2: 2006-03.

## 2 Description of Test Sample

The cable: 100G0111-1.00-0CK0226 Cable, with an outside diameter of ca 1.7 mm, was delivered by the client to the MPA Dresden GmbH.

## 3 Test procedure

Eight bunches, consisting of seven cables, was produced from the delivered sample cable ( $D_a=1.7$  mm) by employees of the MPA Dresden GmbH. This number was determined with the formula  $N_2 = \frac{45}{3D} \text{ bundle}$  fixed in the test standard for cable outside diameter  $1 < D \leq 5$ . The bundle was produced according to test standard and stored at room temperature.

Before beginning of the test the cable bunches was put into the test chamber over the container with the alcohol and at both ends mounted. Subsequently the ventilator was started to the smoke distribution. Parallel to the ignition of the alcohol the before calibrated photometric system was started. The ambient temperature of test chamber agreed with the standard. The temperature inside the test chamber was 25 °C at the beginning of the test. All other requirements of the above mentioned test standard was fulfilled.

The test was finished after 40:00 minutes. The burning of alcohol was expired after 31 test minutes. The test was carried out at 04<sup>th</sup> of January 2011.

## 4 Evaluation

The minimum value of the light transmission was determined with 96.3 % in the 15<sup>th</sup> test minute.

In the appendix B of the DIN EN 61034-2 were specified as limit value for the minimum permissible light transmission a value of 60 % for the case that there is no performance requirement in the associated cable or conductor standard. This was kept with this examination.

## 5 Special Comments

This test report is only valid for the described cable (see clause 2). All designations were given by the manufacturer.

This test report is valid up to the 17<sup>th</sup> of February 2014. The validity can be prolonged by application.

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Dipl.-Ing. Hübler  
Managing Director



  
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## VDE Prüf- und Zertifizierungsinstitut



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Tyco Electronics Raychem GmbH  
Finsinger Feld 1  
85521 Ottobrunn

Offenbach, 2009-10-21

Ihr Zeichen  
Claudia  
Trautenberg

Ihr Schreiben  
2008-11-25

Unser Zeichen - bitte angeben  
640400-9021-0001/111978-5  
FG41/hz

Ansprechpartner  
Herr Herzog  
Tel (069) 83 06-419  
Fax (069) 83 06-745  
reinhard.herzog@vde.com

### Prüfbericht zur Information des Auftraggebers *Test Report for the Information of the applicant*

Dieser Prüfbericht enthält das Ergebnis einer einmaligen Untersuchung an dem zur Prüfung vorgelegten Erzeugnis. Ein Muster dieses Erzeugnisses wurde geprüft, um die Übereinstimmung mit den nachfolgend aufgeführten Normen bzw. Abschnitten von Normen festzustellen. Die Prüfung wurde durchgeführt von 2009-09-02 bis 2009-09-10.

*This test report contains the result of a singular investigation carried out on the product submitted. A sample of this product was tested to found the accordance with the thereafter listed standards or clauses of standards resp.*

*The testing was carried out from 2009-09-02 to 2009-09-10.*

Der Prüfbericht berechtigt Sie nicht zur Benutzung eines Zertifizierungszeichens des VDE und berücksichtigt ausschließlich die Anforderungen der unten genannten Regelwerke.

*The test report does not entitle for the use of a VDE Certification Mark and considers solely the requirements of the specifications mentioned below.*

Wenn gegenüber Dritten auf diesen Prüfbericht Bezug genommen wird, muss dieser Prüfbericht in voller Länge an gleicher Stelle verfügbar gemacht werden.

*Whenever reference is made to this test report towards third party, this test report shall be made available on the very spot in full length.*



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Nach dem Geräte- und Produktsicherheitsgesetz (GPSG) benannte Stelle für technische Arbeitsmittel und Verbraucherprodukte. Nach der EMV-Richtlinie 2004/108/EG benannte Stelle für elektromagn. Verträglichkeit (EMV) von Geräten. Von Akkreditierungsstellen im DAR nach DIN EN ISO/IEC 17020, 17021, 17025 und DIN EN 45011 akkreditiert. Akkreditiert durch: IEC – Internationale Elektrotechnische Kommission – IECEE/CB, IECC und CENELEC – Europ. Komitee für elektrotechn. Normung – CCA, HAR, ENEC.





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Unser Zeichen: 640400-9021-0001/111978-5  
FG41/hz

Eingang der Prüfmuster: 26. Juni 2009

Prüfzeitraum: 02.09.2009 bis 10.09.2009

Prüfört: VDE Prüf- und Zertifizierungsinstitut  
Fachgebiet FG 41  
Merianstraße 28  
63069 Offenbach

**Übersicht:**

Abschnitt 1	Beschreibung des Prüflings
Abschnitt 2	Durchführung der Prüfungen
Abschnitt 3	Kennzeichnung
Abschnitt 4	Aufbau
Abschnitt 5	Prüfung der vertikalen Flammenausbreitung am Kabel
Abschnitt 6	Prüfung der senkrechten Flammenausbreitung
Abschnitt 7	Messung der Rauchdichte

**1 Beschreibung des Prüflings**

Vom Auftraggeber wurden ca. 1300 m Sonderleitung

Typ: 100G0111-1.50-9

zur Prüfung eingereicht.

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## 2 Durchführung der Prüfungen

Der Einsender beauftragte, an dem eingereichten Muster folgende Prüfung durchzuführen:

- Prüfung der vertikalen Flammenausbreitung an einer Ader, einer isolierten Leitung oder einem Kabel  
Prüfverfahren – 1-kW-Flamme mit Gas-Luft-Gemisch  
nach DIN EN 60332-1-2 (VDE 0482-332-1-2): 2005-06
- Prüfung der senkrechten Flammenausbreitung von senkrecht angeordneten Bündeln von Kabeln und isolierten Leitungen - Prüfverfahren - Prüfmart D (0,5 l/m)  
nach DIN EN 50266-2-5 (VDE 0482 Teil 266-2-5): 2001-09 und  
DIN EN 50305 (VDE 0260 Teil 305): 2003-03; Abschnitt 9.1.2
- Messung der Rauchdichte von Kabeln und isolierten Leitungen beim Brennen unter definierten Bedingungen  
nach DIN EN 61034-2 (VDE 0482-1034-2): 2006-03

## 3 Kennzeichnung

- Muster ohne Kennzeichnung -

## 4 Aufbau

- Leiter: flexibler Kupferleiter, metallbeschichtet  
Einzeldrahtdurchmesser (0,21 bis 0,22) mm
- Isolierung: Kunststoff, beige  
Außendurchmesser 2,1 mm

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## 5 Prüfung der vertikalen Flammenausbreitung am Kabel nach DIN EN 60332-1-2 (VDE 0482-332-1-2) 1-kW-Flamme mit Gas-Luft-Gemisch

### 5.1 Konditionierung

Die Prüfung wurde an 3 Proben von je 600 mm Länge durchgeführt.

Vor der Prüfung wurden die Prüflinge > 16 h bei einer relativen Luftfeuchte von (50±20) % und einer Temperatur von (23±5) °C konditioniert.

### 5.2 Prüfergebnisse

Einwirkzeit der Prüf Flamme 60 s

	Muster 1	Muster 2	Muster 3
Beginn der Verkohlung*			
oben (mm)	377	369	369
unten (mm)	519	521	519
Nachbrennzeit (s)	0	0	0

\* gemessen ab dem unteren Ende der oberen Befestigung

### 5.3 Prüfanforderung

Bei Leitungen und Kabeln gilt die Prüfung als bestanden,

- wenn der Abstand zwischen dem unteren Ende der oberen Befestigung und dem Beginn der Verkohlung mehr als 50 mm beträgt,
- wenn der Abstand zwischen dem unteren Ende der oberen Befestigung und dem unteren Ende der Verkohlung nicht mehr als 540 mm beträgt.

### 5.4 Auswertung

**Die Prüfanforderungen wurden erfüllt**

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## 6 Prüfung der senkrechten Flammenausbreitung

nach DIN EN 50266-2-5 (VDE 0482 Teil 266-2-5) und  
DIN EN 50305 (VDE 0260 Teil 305): Abschnitt 9.1.2

### Konditionierung

Die Probestücke, die die Probe bilden, wurden vor der Prüfung bei einer Temperatur von  $(20 \pm 10)^\circ\text{C}$  > 16 h gelagert. Die Probestücke waren trocken.

### 6.1 Prüfparameter

- Volumen der nicht metallenen Werkstoffe: ( $> 0,4$  und  $\leq 0,6$ ) l/m
- errechnetes Gesamtvolumen: 0,00163 l/m
- Probestücke: 8 Bündel (jedes Bündel 37 Adern) = 0,48 l/m
- Bündeldurchmesser: ca. 14 mm
- Abstand der Bündel zueinander: ca. 7 mm
- Lagen: 1 Lage
- Belegbreite: 166 mm
- Einwirkzeit: 20 Minuten
- Energiemenge: Pressluft  $(77,7 \pm 4,8)$  l/min  
Propan  $(13,5 \pm 0,5)$  l/min

### 6.2 Prüfergebnis

- Nach 20 Minuten Einwirkzeit der Prüf Flamme
- verbrauchte Energie Pressluft 77,2 l/min  
Propan 13,4 l/min
  - Nachbrennzeit: - keine -
  - größte Brennweite: **135 cm**  
(gemessen ab Brennerunterkante)

### 6.3 Auswertung

Die größte Ausdehnung des verrußten Teils, gemessen an der Probe, darf weder auf der Vorder- noch auf der Rückseite der Leiter, bezogen auf die untere Kante des Brenners, eine Höhe von über 1,5 m erreicht haben.  
(Anforderung aus DIN EN 50306-1; Abschnitt 8.2.3)

**Die Prüfanforderung wurde erfüllt.**

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Unser Zeichen: 640400-9021-0001/111978-5  
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## 7 **Messung der Rauchdichte** DIN EN 61034-2 (VDE 0482-1034-2)

### 7.1 Konditionierung

Vor der Prüfung wurden die Proben geradegerichtet und anschließend > 16 h bei (23±5) °C gelagert.

### 7.2 Prüfbedingungen

- Proben im Lieferzustand
- Probenanzahl: N<sub>2</sub> = 7 Bündel (49 Proben)
- Temperatur im Prüfraum: 22 °C (vor der Prüfung)

### 7.3 Prüfergebnis

Nach Verlöschen der Feuerquelle und innerhalb der Prüfdauer von 40 Minuten ergab sich ein Mindestwert der

**Lichtdurchlässigkeit von 97 %.**

### 7.4 Empfohlene Leistungsanforderungen

Die Leistungsanforderungen für bestimmte Typen oder Klassen von isolierten Leitungen oder Kabeln sollten vorzugsweise in den jeweiligen Kabel- und Leitungsnormen festgelegt sein. Fehlen sie völlig, wird empfohlen, einen Wert von 60 % der Lichtdurchlässigkeit einzuführen, als kleinsten Wert für alle Kabel und Leitungen, die nach dieser Norm geprüft werden.

**Die Prüfanforderung wurde erfüllt.**

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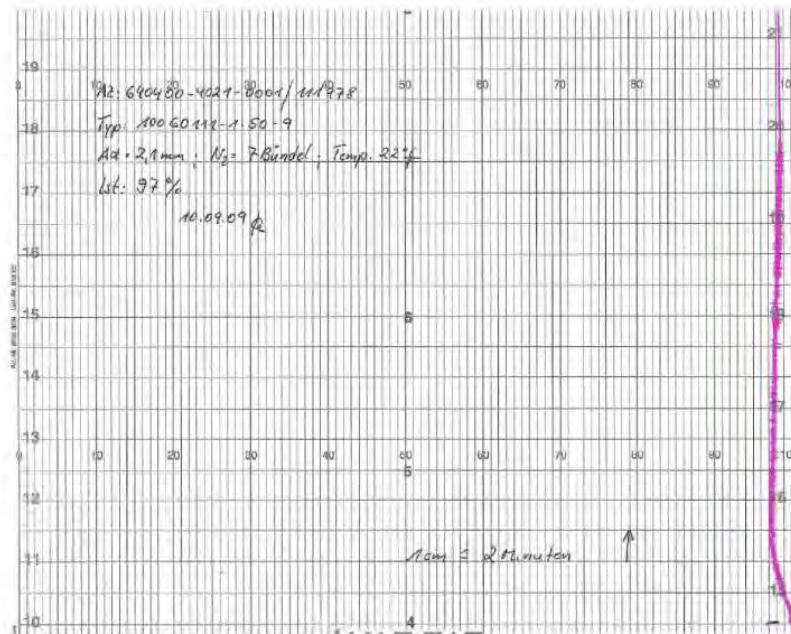




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Unser Zeichen: 640400-9021-0001/111978-5  
FG41/hz

7.5 Kurvenverlauf der Lichtdurchlässigkeit



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i. A. *D. Banowski*  
Dietmar Banowski

i. A. *R. Herzog*  
Reinhard Herzog



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Nach dem Geräte- und Produktsicherheitsgesetz (GPSG) benannte Stelle für technische Arbeitsmittel und Verbraucherprodukte. Nach der EMV-Richtlinie 2004/108/EG benannte Stelle für elektromagn. Verträglichkeit (EMV) von Geräten. Von Akkreditierungsstellen im DAR nach DIN EN ISO/IEC 17020, 17021, 17025 und DIN EN 45011 akkreditiert. Akkreditiert durch: IEC – Internationale Elektrotechnische Kommission – IECEE/CB, IECCQ und GENELEC – Europ. Komitee für elektrotechn. Normung – CCA, HAR, ENEC.







No. AJD201100984-1

Date: MAR.24, 2011

Page 2 of 3

**I. Test conducted**

This test was conducted as per DIN EN 60332-3-25:2010 Tests on electric and optical fibre cables under fire conditions - Part 3-25: Test for vertical flame spread of vertically-mounted bunched wires or cables - Category D.

Test category D for cable diameter ≤ 6mm, Set-up according to DIN EN 50306-1.

**II. Sample details**

Color	Black
Overall Diameter	2.63mm

**III. Preparation of sample**

<b>bundle length:</b> 2.5 m
<b>Number of bundles: N1= 5 and Number of cables in bundle N2=37</b>

**Conditioning:**

Prior to testing, the test pieces forming the test sample was conditioned at a temperature of (20±10) °C for at least 16 h.

**Mounting of the test sample:**

The test specimen will be binded to bundles in according to 9.1.2of DIN EN50305.

Test pieces were attached to the front of the standard ladder in touching formation in one layer, and to each rung of the ladder by means of metal wire (steel) with 0.5 mm in diameter.

The first test pieces was positioned approximately in the centre of the ladder and further flat arrays of test pieces added on either side so the test sample is approximately centred on the ladder, bundles of cable of spaced by half bundle diameter.

**Number of burner: 1**


**IV. Test results**

Flame application time: 20 min

Burn length (max.) (m)	0.8
Duration of afterflame (min)	0

To be continued....

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# SGS

## Test Report

No. AJD201100984-1

Date: MAR.24, 2011

Page 3 of 3

**Requirements:**

Burn length (max.) < 1.5 m

**Comment:**

The tested sample meets above specified requirement.

**Statements:**

The test results relate to the behaviour of the test specimens of a product under the particular conditions of the test; they are not intended to be the sole criterion for assessing the potential fire, smoke and toxicity hazard of the product in use.

The specimen was supplied by the sponsor and SGS-CSTC ANJI Branch was not involved in any selection or sampling procedure.

**Photo Appendix:**



\*\*\*End of Report\*\*\*

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**Test Report**  
**Report No: ICL/H11/1084**

**EN 50267-2-2**

**Common Test Methods for Cables Under Fire Conditions –  
Tests on Gases Evolved During Combustion of Materials From Cables - Part 2-2:  
Procedures - Determination of Degree of Acidity of Gases for Materials by Measuring pH  
and Conductivity**

**Sponsored By**

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**Test Report  
Report NO. ICL/H11/1084**

**EN 50267-2-2: 1999**

**Common Test Methods for Cables Under Fire Conditions –  
Tests on Gases Evolved During Combustion of Materials From Cables - Part 2-2:  
Procedures - Determination of Degree of Acidity of Gases for Materials by Measuring pH  
and Conductivity**

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**1 Purpose of Test**

To determine the performance of specimens of a material when they are subjected to the conditions of the test specified in EN 50267-2-2 :1999 Common Test Methods for Cables Under Fire Conditions – Tests on Gases Evolved During Combustion of Materials From Cables - Part 2-2: Procedures - Determination of Degree of Acidity of Gases for Materials by Measuring pH and Conductivity.

**2 Scope of Test**

EN 50267-2-2 specifies a method of test for the determination of the degree of acidity of gases evolved during the combustion of compounds taken from cable constructions.

**3 Material tested**

The description of the material given below has been prepared from information provided by the sponsor of the test. All values quoted are nominal, unless tolerances are given.

The product was outer sheath material taken from outer sheath of cable referenced "100G1141-1.50-0/2/6/9-0 batch no. Q865477107".

The outer sheath material of the cable had no visible markings. The sheathing was removed from the cable and tested.

The sponsor of the test did not supply further details relating to the composition of the material tested.

The sample was supplied by the sponsor of the test on 15 September 2011, and Interscience Communications Ltd was not involved in any selection or sampling procedure.

**Report No: ICL/H11/1084  
Page 2 of 3**





#### 4 Date of Test

The test was performed on 23 November 2011.

#### 5 Test Procedure

The test was performed in accordance with the procedure specified in EN 50267-2-2:1999 and this report should be read in conjunction with that Standard.

#### 6 Test Results

The test results relate only to the behaviour of the specimens under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential hazard of the product in use.

The test results relate only to the specimens of the cable component in the form in which they were tested. Small differences in the composition of the product may significantly affect the performance during the test and may therefore invalidate the test results. Care should be taken to ensure that any product, which is supplied or used, is fully represented by the specimens, which were tested.

The results obtained are given in Table 1.

**TABLE 1**

Run No	Mass before (g)	Mass after (g)	pH	Conductivity ( $\mu$ S)
1	1.0004	0.2704	5.03	0.172
2	1.0001	0.1801	5.00	0.176
Mean			5.02	0.174

#### 7 Conclusion

The recommended compliance criteria give in EN 50267-2-2: 1999 annex A (informative) is a pH value not less than 4.3 and conductivity value of less than 10  $\mu$ S. The material therefore satisfies the requirement of the standard.

Prepared by

**C. B. Chong**  
Fire Scientist

Approved by

**S. Kumar**  
Technical Manager

Date of Issue: 5 December 2011

Report No: ICL/H11/1084  
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**Test Report**  
**Report No: ICL/H11/1085**

**EN 60684-2 Clause 45.2**  
**Flexible insulating sleeving — Part 2: Methods of test**  
**(includes amendment A1:2003)**  
**(IEC 60684-2:1997/A1:2003)**

**45.2 Determination of low levels of fluorine**

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**Test Report**  
**Report NO. ICL/H11/1085**

**EN 60684-2 Clause 45.2**  
**Flexible insulating sleeving — Part 2: Methods of test**  
**(includes amendment A1:2003)**  
**(IEC 60684-2:1997/A1:2003)**

**45.2 Determination of low levels of fluorine**

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**1 Purpose of Test**

To determine the performance of specimens of a material when they are subjected to the conditions of the test specified in EN 60684-2: 1997 “Flexible insulating sleeving — Part 2: Methods of test (includes amendment A1:2003) (IEC 60684-2:1997/A1:2003) clause 45.2 Determination of low levels of fluorine.

**2 Scope of Test**

EN 560684-2 Clause 45.2 specifies a method of test for the determination the low level presence of fluorine. The sample is burnt in an oxygen flask, and the resulting solution is used to measure the fluorine content

**3 Material tested**

The description of the material given below has been prepared from information provided by the sponsor of the test. All values quoted are nominal, unless tolerances are given.

The product was outer sheath material taken from outer sheath of cable referenced “100G1141-1.50-0/2/6/9-0 batch no. Q865477107”.

The outer sheath material of the cable had no visible markings. The sheathing was removed from the cable and tested.

The sample was supplied by the sponsor of the test on 15 September 2011, and Interscience Communications Ltd was not involved in any selection or sampling procedure.



**4 Date of Test**

The test was performed on 23 November 2011.

**5 Test Procedure**

The test was performed in accordance with the procedure specified in EN 60684-2: 1997 clause 45.2, and this report should be read in conjunction with that Standard.

**6 Test Results**

The test results relate only to the behaviour of the specimens under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential hazard of the product in use.

The test results relate only to the specimens of the cable component in the form in which they were tested. Small differences in the composition of the product may significantly affect the performance during the test and may therefore invalidate the test results. Care should be taken to ensure that any product, which is supplied or used, is fully represented by the specimens, which were tested.

The results obtained show Fluorine contents, expressed as % wt/wt, of < 0.1.

**Prepared by**

A handwritten signature in black ink, appearing to read "C. B. Chong".

**C. B. Chong**  
Fire Scientist

**Approved by**

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**S. Kumar**  
Technical Manager

**Date of Issue: 5 December 2011**

**Report No: ICL/H11/1085**

**Page 3 of 3**





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**Test Report No: ICL/H11/1086**  
**BS EN 50305: 2002 Clause 9.2 "Toxicity test"**  
**Railway applications -**  
**Railway rolling stock cables having special fire performance -**  
**Test methods**

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**TEST REPORT NO: ICL/H11/1086**  
**BS EN 50305: 2002 Clause 9.2 "Toxicity test"**  
**Railway applications -**  
**Railway rolling stock cables having special fire performance -**  
**Test methods**

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**Introduction**

To assess the fire characteristics of a cable insulation material in accordance with the procedures specified in BS EN 50305: 2002 Railway applications -Railway rolling stock cables having special fire performance -Test methods Clause 9.2 and determine a toxicity Index in accordance with this standard.

**Product Description**

The description of the specimen given below has been prepared from information provided by the sponsor of the test. All values quoted are nominal, unless tolerances are given. The sponsor of the test did not supply further details relating to the composition of the product

The product was outer sheath material taken from outer sheath of cable referenced "100G1141-1.50-0/2/6/9-0 batch no. Q865477107".

The outer sheath material of the cable had no visible markings. The sheathing was removed from the cable and tested.

The specimens were received on 19 September 2011.

**Conditioning of Test Specimens**

All test samples were conditioned to constant mass at  $23 \pm 2^\circ\text{C}$  and a relative humidity of  $50 \pm 5\%$  as required in section 8.2 of the standard.

**Date of Test**

The test was performed on 11 October 2011.



### Test Procedure

Test was carried out in accordance with the procedures specified in BS EN 50305: 2002 Railway applications - Railway rolling stock cables having special fire performance -Test methods Clause 9.2.

### Test Results

The test results relate only to the behavior of the specimens of the product under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential hazard of the product in use.

Qualitative analysis for determining the presence of nitrogen and sulfur using molten sodium were carried out in accordance with the procedures detailed in Clause 9.2.1 and shows the presence of:

Nitrogen

Quantitative analysis was carried out in accordance with the procedure specified in Clause 9.2.2 and the test results are as follows.

Gas	mg/g	CC <sub>z</sub>	ITC
Carbon monoxide	65.04	1750	3.72
Carbon dioxide	676.80	90000	0.75
Sulphur dioxide	-	260	-
Nitrogen oxides	-	90	-
Hydrogen cyanide	-	55	-
<b>ITC</b>			<b>4.47</b>

$$ITC = \frac{100}{m} * \sum \frac{M_z}{CC_z}$$

where

m = weight of the sample, g;

M<sub>z</sub> = weight of gas z produced by the sample combustion, mg;

CC<sub>z</sub> = critical concentration for a 30 min exposure for gas z, mg/m<sup>3</sup> given in Table 6 of the standard



**Conclusion**

The samples of polymeric material tested shows an ITC of 4.47.

**Prepared by**

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**C. B. Chong**  
**Fire Scientist**

**Date of Issue: 5 December 2011**

**Authorised by**

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**S. Kumar**  
**Technical Manager**



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**Test Report**  
**Report No: ICL/H11/990**

**EN 50267-2-2**

**Common Test Methods for Cables Under Fire Conditions –  
Tests on Gases Evolved During Combustion of Materials From Cables - Part 2-2:  
Procedures - Determination of Degree of Acidity of Gases for Materials by Measuring pH  
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**Test Report**  
**Report NO. ICL/H11/990**

**EN 50267-2-2: 1999**

**Common Test Methods for Cables Under Fire Conditions –  
Tests on Gases Evolved During Combustion of Materials From Cables - Part 2-2:  
Procedures - Determination of Degree of Acidity of Gases for Materials by Measuring pH  
and Conductivity**

**Sponsored By**  
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**1 Purpose of Test**

To determine the performance of specimens of a material when they are subjected to the conditions of the test specified in EN 50267-2-2 :1999 Common Test Methods for Cables Under Fire Conditions – Tests on Gases Evolved During Combustion of Materials From Cables - Part 2-2: Procedures - Determination of Degree of Acidity of Gases for Materials by Measuring pH and Conductivity.

**2 Scope of Test**

EN 50267-2-2 specifies a method of test for the determination of the degree of acidity of gases evolved during the combustion of compounds taken from cable constructions.

**3 Material tested**

The description of the material given below has been prepared from information provided by the sponsor of the test. All values quoted are nominal, unless tolerances are given.

The product was outer sheath material taken from outer sheath of cable referenced "Raychem EPD 114322A – 2010".

The outer sheath material of the cable was marked "Raychem EPD 114322A-2010". The sheathing was removed from the cable and tested.

The sponsor of the test did not supply further details relating to the composition of the material tested.

The sample was supplied by the sponsor of the test on 19 September 2011, and Interscience Communications Ltd was not involved in any selection or sampling procedure.

**Report No: ICL/H11/990**  
**Page 2 of 3**





#### 4 **Date of Test**

The test was performed on 10 October 2011.

#### 5 **Test Procedure**

The test was performed in accordance with the procedure specified in EN 50267-2-2:1999 and this report should be read in conjunction with that Standard.

#### 6 **Test Results**

The test results relate only to the behaviour of the specimens under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential hazard of the product in use.

The test results relate only to the specimens of the cable component in the form in which they were tested. Small differences in the composition of the product may significantly affect the performance during the test and may therefore invalidate the test results. Care should be taken to ensure that any product, which is supplied or used, is fully represented by the specimens, which were tested.

The results obtained are given in Table 1.

**TABLE 1**

Run No	Mass before (g)	Mass after (g)	pH	Conductivity ( $\mu$ S)
1	1.0001	0.2401	5.32	0.33
2	1.0001	0.2803	5.32	0.35
Mean			5.32	0.34

#### 7 **Conclusion**

The recommended compliance criteria give in EN 50267-2-2: 1999 annex A (informative) is a pH value not less than 4.3 and conductivity value of less than 10  $\mu$ S. The material therefore satisfies the requirement of the standard.

Prepared by

**C. B. Chong**  
Fire Scientist

Approved by

**S. Kumar**  
Technical Manager

Date of Issue: 5 December 2011

Report No: ICL/H11/990  
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**Test Report**  
**Report No: ICL/H11/993rev1**

**EN 60684-2 Clause 45.2**  
**Flexible insulating sleeving — Part 2: Methods of test**  
**(includes amendment A1:2003)**  
**(IEC 60684-2:1997/A1:2003)**

**45.2 Determination of low levels of fluorine**

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**Test Report**  
**Report NO. ICL/H11/993**

**EN 60684-2 Clause 45.2**  
**Flexible insulating sleeving — Part 2: Methods of test**  
**(includes amendment A1:2003)**  
**(IEC 60684-2:1997/A1:2003)**

**45.2 Determination of low levels of fluorine**

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TE connectivity  
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**1 Purpose of Test**

To determine the performance of specimens of a material when they are subjected to the conditions of the test specified in EN 60684-2 : 1997 ‘Flexible insulating sleeving — Part 2: Methods of test (includes amendment A1:2003) (IEC 60684-2:1997/A1:2003) clause 45.2 Determination of low levels of fluorine

**2 Scope of Test**

EN 560684-2 Clause 45.2 specifies a method of test for the determination the low level presence of fluorine. The sample is burnt in an oxygen flask, and the resulting solution is used to measure the fluorine content

**3 Material tested**

The description of the material given below has been prepared from information provided by the sponsor of the test. All values quoted are nominal, unless tolerances are given.

The product was outer sheath material taken from outer sheath of cable referenced “Raychem EPD 114322A – 2010”.

The outer sheath material of the cable was marked “Raychem EPD 114322A-2010”. The sheathing was removed from the cable and tested.

The sample was supplied by the sponsor of the test on 19 September 2011, and Interscience Communications Ltd was not involved in any selection or sampling procedure.



**4 Date of Test**

The test was performed on 20 October 2011.

**5 Test Procedure**

The test was performed in accordance with the procedure specified in EN 60684-2: 1997 clause 45.2, and this report should be read in conjunction with that Standard.

**6 Test Results**

The test results relate only to the behaviour of the specimens under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential hazard of the product in use.

The test results relate only to the specimens of the cable component in the form in which they were tested. Small differences in the composition of the product may significantly affect the performance during the test and may therefore invalidate the test results. Care should be taken to ensure that any product, which is supplied or used, is fully represented by the specimens, which were tested.

The results obtained show Fluorine contents, expressed as % wt/wt, of < 0.1.

**Prepared by**

A handwritten signature in black ink, appearing to read "C. B. Chong", written over a horizontal line.

**C. B. Chong**  
Fire Scientist

**Approved by**

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Technical Manager

**Date of Issue: 27 January 2012**



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**Test Report No: ICL/H11/996**  
**BS EN 50305: 2002 Clause 9.2 "Toxicity test"**  
**Railway applications -**  
**Railway rolling stock cables having special fire performance -**  
**Test methods**

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**TEST REPORT NO: ICL/H11/996**  
**BS EN 50305: 2002 Clause 9.2 "Toxicity test"**  
**Railway applications -**  
**Railway rolling stock cables having special fire performance -**  
**Test methods**

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**Introduction**

To assess the fire characteristics of a cable insulation material in accordance with the procedures specified in BS EN 50305: 2002 Railway applications -Railway rolling stock cables having special fire performance -Test methods Clause 9.2 and determine a toxicity Index in accordance with this standard.

**Product Description**

The description of the specimen given below has been prepared from information provided by the sponsor of the test. All values quoted are nominal, unless tolerances are given. The sponsor of the test did not supply further details relating to the composition of the product

The product was outer sheath material taken from outer sheath of cable referenced "Raychem EPD 114322A – 2010".

The outer sheath material of the cable was marked "Raychem EPD 114322A-2010". The sheathing was removed from the cable and tested.

The specimens were received on 19 September 2011.

**Conditioning of Test Specimens**

All test samples were conditioned to constant mass at  $23 \pm 2^\circ\text{C}$  and a relative humidity of  $50 \pm 5\%$  as required in section 8.2 of the standard.

**Date of Test**

The test was performed on 11 October 2011.



### Test Procedure

Test was carried out in accordance with the procedures specified in BS EN 50305: 2002 Railway applications - Railway rolling stock cables having special fire performance -Test methods Clause 9.2.

### Test Results

The test results relate only to the behavior of the specimens of the product under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential hazard of the product in use.

Qualitative analysis for determining the presence of nitrogen and sulfur using molten sodium were carried out in accordance with the procedures detailed in Clause 9.2.1 and shows the presence of:

Nitrogen

Quantitative analysis was carried out in accordance with the procedure specified in Clause 9.2.2 and the test results are as follows.

Gas	mg/g	CC <sub>z</sub>	ITC
Carbon monoxide	22.44	1750	1.28
Carbon dioxide	835.20	90000	0.93
Sulphur dioxide	-	260	-
Nitrogen oxides	-	90	-
Hydrogen cyanide	-	55	-
<b>ITC</b>			2.21

$$ITC = \frac{100}{m} * \sum \frac{M_z}{CC_z}$$

where

m = weight of the sample, g;

M<sub>z</sub> = weight of gas z produced by the sample combustion, mg;

CC<sub>z</sub> = critical concentration for a 30 min exposure for gas z, mg/m<sup>3</sup> given in Table 6 of the standard



**Conclusion**

The samples of polymeric material tested shows an ITC of 2.21.

**Prepared by**

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**C. B. Chong**  
**Fire Scientist**

**Date of Issue: 5 December 2011**

**Authorised by**

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**S. Kumar**  
**Technical Manager**



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**Test Report No: ICL/H11/975**

**BS EN 50305: July 2002 Clause 9.1.2 Flame Propagation Test**

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**Test Report No: ICL/H11/975****BS EN 50266-2-4  
BS EN 50305: July 2002 Clause 9.1.2 Flame Propagation Test**

**Sponsored By**  
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Faraday Road,  
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**Purpose of Test**

To determine the performance of a cable when subjected to the test called up and detailed BS EN 50305: July 2002 Clause 9.1.2. This requires the test to be carried out in accordance with the procedures specified in BS EN 50266-2-4 "Common test methods for cables under fire conditions- Test for vertical flame spread of vertically-mounted bunched wires or cables -Part 2-4: Procedures — Category C" but with the number of cables and their arrangement on the test ladder to be in accordance with BS EN 50305: July 2002 Clause 9.1.2.

**Scope of Test**

BS EN 50266-2-4 specifies a test procedure to assess the flame spread characteristic of bunched cables. The results being expressed as flame spread measured from the point of flame application.

**Description of Test Specimen**

The description of the product given below has been prepared from information provided by the sponsor of the test. All values quoted are nominal, unless tolerances are given.

The product was a four core cable referenced "100G-1141-1.5" having an overall diameter of 5.6mm and consisting of copper conductors, polymeric insulation, braid and black sheath.

The outer sheath of the cable was marked "PRO. 18221166713 (100G-1141-1.5)".

The specimens were received on 15 September 2011.





### Conditioning of Test Specimens

The test specimens were conditioned by maintaining them in indoor ambient conditions for a minimum period of 16 hours at  $20 \pm 10^{\circ}\text{C}$ .

### Date of Test

The test was performed on 5 October 2011.

### Test Procedure

The test was performed in accordance with the procedure specified in BS EN 50266-2-4 Category C amended as per BS EN 50305 Clause 9.1.2 and this report should be read in conjunction with this Standard.

### Amendment:

#### 9.1.2 Cables with overall diameter not greater than 6 mm

The test shall be carried out as for EN 50266-2-4 except that the ladder loading shall be bundles of cable of approximate diameter 20 mm spaced by half the bundle diameter, and:

- a) a minimum of two bundles shall be tested;
- b) the number of bundles shall be determined as that necessary to give a nominal total volume of non-metallic material (NMV) of 0,5 l/m subject to a) above;
- c) the bundle length shall be 2,5 m;
- d) the bundle formation shall be as given below;
- e) the number of bundles tested and NMV of each shall be recorded;
- f) the cable to be tested shall be selected such that the total volume of non-metallic material (NMV) in the bundles to be tested is  $> 0,4$  l/m and  $\leq 0,6$  l/m.

The number of cables in each bundle shall be as follows:

Cable diameter (mm)	Number of cables in a bundle
$d \leq 3,3$	37
$3,3 < d \leq 4,3$	19
$4,3 < d \leq 6$	12

The cables in the bundle shall be laid in the formation given and then subjected to a uni-directional twist to give a lay length of approximately 15 D (where D is the bundle diameter).

**Number of the cables in the test array:**

3 bundles of 12 cables each, were tied on to the ladder with a gap of 11mm between bundles.

**Test Results**

The test results relate only to the behaviour of the specimens of the product under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential smoke hazard of the product in use.

The test results relate only to the specimens of the product in the form in which they were tested. Small differences in the composition or thickness of the product may significantly affect the performance during the test and may therefore invalidate the test results. Care should be taken to ensure that any product, which is supplied or used, is fully represented by the specimens, which were tested.

Maximum flame spread measured from the bottom of the burner: 1.2m

Visual observations are given in Annex 1.

**Requirements**

Maximum height of charring above burner < 1.5m

**Conclusion**

The cable tested satisfies the requirements of the standard.

**Prepared by**

A handwritten signature in black ink, appearing to read "C. B. Chong".

**C. B. Chong**  
Fire Scientist

**Approved by**

A handwritten signature in black ink, appearing to read "S. Kumar".

**S. Kumar**  
Technical Manager

**Date of Issue: 5 December 2011**

**Annex 1****Visual observations**

<b>Time (min-sec)</b>	<b>Observations</b>
2-00	Flames reaching a height of 0.5m.
3-20	Flames reaching a height of 0.75m
5-40	Flames reaching a height of 1m
6-48	Flames reaching a height of 1.25m
8-50	Flaming on cables ceases.
20-00	Burner turned off. No after flaming observed.



**Annex 2**



**Photo 1: Cables before test**



**Photo 2: Cables after test.**





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**Test Report**  
**Report No: ICL/H11/987**

**EN 61034-2 -- Measurement of Smoke Density of Electric Cables**  
**Burning Under Defined Conditions**  
**Part 2: Test Procedure and Requirements**

**Sponsored By**

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## Test Report

Report No: ICL/H11/987

### EN 61034-2 – Measurement of Smoke Density of Electric Cables Burning Under Defined Conditions Part 2: Test Procedure and Requirements

**Sponsored By**  
TE connectivity  
Faraday Road,  
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Wilshire, SN3 5HH

#### **1 Purpose Of Test**

To determine the performance of a cable when subjected to the conditions of the test specified in EN 61034-2 Measurement of Smoke Density of Electric Cables Burning Under Defined Conditions - Part 2: Test Procedure and Requirements and assess the results against the performance requirements given in DIN 5510-2: 2009 Table 6.

#### **2 Scope Of Test**

EN 61034 Part 2 specifies a method of test for the determination the smoke emission characteristics of a cable burning under defined conditions of test

#### **3 Description of the cable**

The description of the cable given below has been prepared from information provided by the sponsor of the test. All values quoted are nominal, unless tolerances are given.

The product was a four core cable referenced "1009-1141-1.5" having an overall diameter of 5.6mm and consisting of copper conductors, polymeric insulation, braid and black sheath.

The outer sheath of the cable was marked "PRO. 18221166713 (1009-1141-1.5)".

The cable was supplied by the sponsor of the test on 15 September 2011 and Interscience Communications Ltd was not involved in any selection or sampling procedures.

#### **4 Date Of Test**

The test was performed on 5 October 2011.

#### **5 Test Procedure**

The test was performed in accordance with the procedure specified in EN 61034 Part 2 and this report should be read in conjunction with that Standard.



Test specimen consisted of seven 1 m lengths.

**6 Test Results**

The test results relate only to the behaviour of the specimens under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential hazard of the product in use.

The test results relate only to the specimens of the cable component in the form in which they were tested. Small differences in the composition of the product may significantly affect the performance during the test and may therefore invalidate the test results. Care should be taken to ensure that any product, which is supplied or used, is fully represented by the specimens, which were tested.

Visual observations are given in Appendix 1.

The change in transmission with time was recorded and a chart is given in Appendix 2.

Minimum transmission was: 96.0 %

Minimum transmission in the first 20 minutes of the test: 96.7%

**7 Requirements**

The following requirements are given in Annex B (Informative) of EN 61034-2:2005

Transmission value: Minimum 60%

The following requirements are given in DIN 5510-2:2009 Table 6

Transmission value in the first 20 minutes of the test: Minimum 60%

**8 Conclusion**

The cable satisfies the requirement given in Annex B of EN 61034-2 and requirements of minimum 60% transmission given in DIN 5510-2:2009 Table 6.

**Prepared by**

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**C. B. Chong**  
Fire Scientist

**Approved by**

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**S. Kumar**  
Technical Manager

**Date of Issue: 5 December 2011**





**Appendix 1**

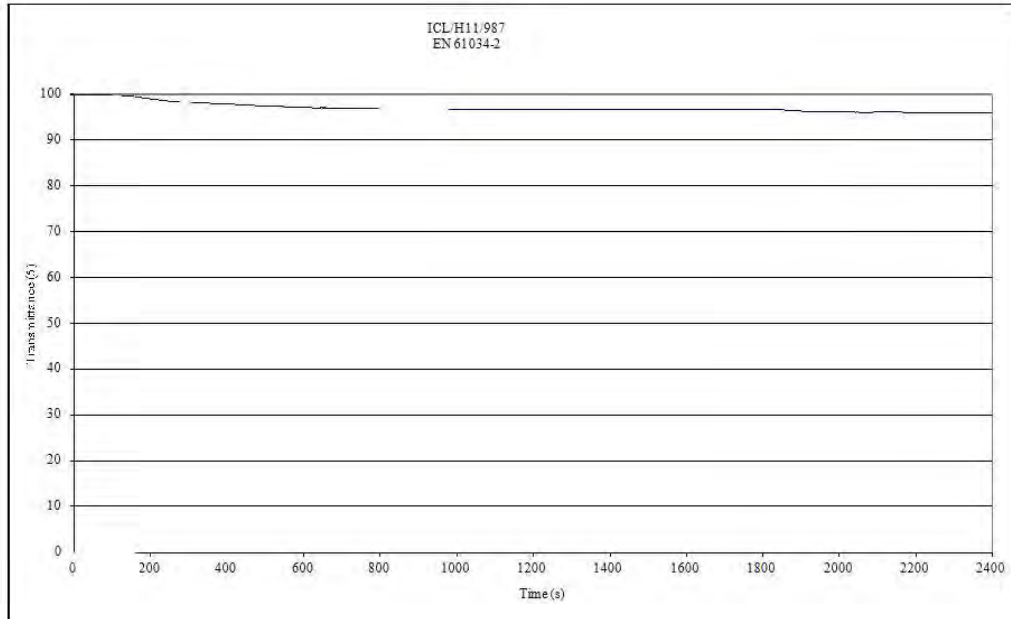
**Visual Observations**

<b>Time Mins-Sec</b>	<b>Observations</b>
1 – 19	Ignition of cable
5 – 50	Flaming of cable goes out





**Appendix 2**



**Graph showing the change in transmission with time**





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**Test Report No: ICL/H11/984**

**IEC 60332-1-2: 2004**

**Tests on electric and optical fibre cables under fire conditions-  
Part 1-2 Test for vertical flame propagation for single insulated wire or cable-  
Procedure for 1kW pre-mixed flame.**

**Sponsored By**  
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Page 1 of 3





**Test Report No: ICL/H11/984**

**IEC 60332-1-2: 2004**

**Tests on electric and optical fibre cables under fire conditions-  
Part 1-2 Test for vertical flame propagation for single insulated wire or cable-  
Procedure for 1kW pre-mixed flame.**

**Sponsored By**

TE connectivity  
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**Purpose Of Test**

To determine the performance of a specimen of a cable when it is subjected to the conditions of test specified in IEC 60332-1-2 Tests on electric and optical fibre cables under fire conditions- Part 1-2 Test for vertical flame propagation for single insulated wire or cable- Procedure for 1kW pre-mixed flame.

**Scope Of Test**

IEC 60332-1-1:2004 details a method of test for the assessment of the flame propagation characteristics of a single wire or cable. The specimen is deemed to have met the performance requirements of the Standard, if after burning has ceased, the charred or affected portion does not reach within 50mm of the lower edge of the top clamp. In addition, a failure is recorded if charring extends down words to a point greater than 540mm from the lower edge of the top support.

**Description Of Test Specimen**

The description of the specimen given below has been prepared from information provided by the sponsor of the test. All values quoted are nominal, unless tolerances are given.

The product was a four core cable referenced "100G-1141-1.5" having an overall diameter of 5.6mm and consisting of copper conductors, polymeric insulation, braid and black sheath.

The outer sheath of the cable was marked "PRO. 18221166713 (100G-1141-1.5)".

**Conditioning Of Specimen**

The specimen was received on 15 September 2011.

Prior to the test the specimen was conditioned at a temperature of  $25 \pm 5^{\circ}\text{C}$  for a minimum period of 16 hours.



### **Date Of Test**

The test was performed on 4 October 2011.

### **Test Procedure**

The test was performed in accordance with the procedure specified in IEC 60332-1-2 and this report should be read in conjunction with that Standard.

The burner was applied for 60 seconds.

### **Test Results**

The test results relate only to the behaviour of the specimen of the cable under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential fire hazard of the product in use.

The test results relate only to the specimen of the cable in the form in which they were tested. Small differences in the composition or thickness of the cable may significantly affect the performance during the test and may therefore invalidate the test results. Care should be taken to ensure that any cable which is supplied or used is fully represented by the specimens which were tested.

Distance between the lower edge of the top support and the onset of charring (mm): 420

### **Recommended performance requirement (Annex A : Informative)**

The insulated conductor or cable shall pass the test if the distance between the lower edge of the top support and the onset of charring is greater than 50mm.

In addition, a failure shall be recorded if the burning extends downwards to a point greater than 540mm from the lower edge of the top support.

### **Conclusion**

The specimen meets the performance requirement given in Annex A of IEC 60332-1-2:2004.

#### **Prepared by**

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**C. B. Chong**  
Fire Scientist

#### **Approved by**

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Technical Manager

**Date of Issue: 5 December 2011**



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**Test Report No: ICL/H11/976**

**BS EN 50305: July 2002 Clause 9.1.2 Flame Propagation Test**

**Sponsored By**

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**Test Report No: ICL/H11/976**

**BS EN 50266-2-4  
BS EN 50305: July 2002 Clause 9.1.2 Flame Propagation Test**

**Sponsored By**  
TE connectivity  
Faraday Road,  
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### **Purpose of Test**

To determine the performance of a cable when subjected to the test called up and detailed BS EN 50305: July 2002 Clause 9.1.2. This requires the test to be carried out in accordance with the procedures specified in BS EN 50266-2-4 "Common test methods for cables under fire conditions- Test for vertical flame spread of vertically-mounted bunched wires or cables -Part 2-4: Procedures — Category C" amended in accordance with the requirements given in BS NE 50305:2002 Clause 9.1.1 for Cables with overall diameter greater than 6 mm and less than 12 mm.

### **Scope of Test**

BS EN 50266-2-4 specifies a test procedure to assess the flame spread characteristic of bunched cables. The results being expressed as flame spread measured from the point of flame application.

### **Description of Test Specimen**

The description of the product given below has been prepared from information provided by the sponsor of the test. All values quoted are nominal, unless tolerances are given.

The product was a four core cable referenced "EPD 114322A" having an overall diameter of 6.9mm and consisting of copper conductors, polymeric insulation, tape, braid and black sheath.

The outer sheath of the cable was marked "Raychem – EPD 114322A-2010".

The specimens were received on 15 September 2011.



### **Conditioning of Test Specimens**

The test specimens were conditioned by maintaining them in indoor ambient conditions for a minimum period of 16 hours at  $20 \pm 10^{\circ}\text{C}$ .

### **Date of Test**

The test was performed on 4 October 2011.

### **Test Procedure**

The test was performed in accordance with the procedure specified in BS EN 50266-2-4 Category C amended as per BS EN 50305 Clause 9.1.1 and this report should be read in conjunction with this Standard.

### **Amendment:**

#### **BS NE 50305:2002 Clause 9.1.1**

##### **Cables with overall diameter greater than 6 mm and less than 12 mm**

The test shall be carried out as for EN 50266-2-4 except that the nominal total volume of non-metallic material (NMV) shall be 0,5 l/m.

Cable mounting shall be in one (or more) layer(s) up to a maximum of 300 mm width on the 500 mm width ladder

### **Number of the cables in the test array:**

17 cables were tied on to the ladder touching.

### **Test Results**

The test results relate only to the behaviour of the specimens of the product under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential smoke hazard of the product in use.

The test results relate only to the specimens of the product in the form in which they were tested. Small differences in the composition or thickness of the product may significantly affect the performance during the test and may therefore invalidate the test results. Care should be taken to ensure that any product, which is supplied or used, is fully represented by the specimens, which were tested.

Maximum flame spread measured from the bottom of the burner: 1.3m

Visual observations are given in Annex 1.





**Requirements**

The recommended performance given in IEC 60332-3-24 Annex B states that the maximum extent of the charred portion measured on the sample shall not have reached a height exceeding 2,5 m above the bottom edge of the burner.

**Conclusion**

The cable tested satisfies the requirements of the standard.

**Prepared by**

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**C. B. Chong**  
**Fire Scientist**

**Approved by**

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**S. Kumar**  
**Technical Manager**

**Date of Issue: 5 December 2011**

**Annex 1****Visual observations**

<b>Time (min-sec)</b>	<b>Observations</b>
2-00	Flames reaching a height of 0.5m. Sheath swelling.
3-00	Flames reaching a height of 0.6m
3-20	Flames reaching a height of 0.75m
4-00	Flames reaching a height of 1m
6-00	Flames reaching a height of 1.5m
9-10	Flaming of cables ceases.
20-00	Burner turned off. No after flaming observed.



**Annex 2**



**Photo 1: Cables before test**





**Photo 2: Cables after test.**





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**Test Report No: ICL/H11/985**

**IEC 60332-1-2: 2004**

**Tests on electric and optical fibre cables under fire conditions-  
Part 1-2 Test for vertical flame propagation for single insulated wire or cable-  
Procedure for 1kW pre-mixed flame.**

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Page 1 of 3





**Test Report No: ICL/H11/985**

**IEC 60332-1-2: 2004**

**Tests on electric and optical fibre cables under fire conditions-  
Part 1-2 Test for vertical flame propagation for single insulated wire or cable-  
Procedure for 1kW pre-mixed flame.**

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### **Purpose Of Test**

To determine the performance of a specimen of a cable when it is subjected to the conditions of test specified in IEC 60332-1-2 Tests on electric and optical fibre cables under fire conditions- Part 1-2 Test for vertical flame propagation for single insulated wire or cable- Procedure for 1kW pre-mixed flame.

### **Scope Of Test**

IEC 60332-1-1:2004 details a method of test for the assessment of the flame propagation characteristics of a single wire or cable. The specimen is deemed to have met the performance requirements of the Standard, if after burning has ceased, the charred or affected portion does not reach within 50mm of the lower edge of the top clamp. In addition, a failure is recorded if charring extends down words to a point greater than 540mm from the lower edge of the top support.

### **Description Of Test Specimen**

The description of the specimen given below has been prepared from information provided by the sponsor of the test. All values quoted are nominal, unless tolerances are given.

The product was a four core cable referenced "EPD 114322A" having an overall diameter of 6.9mm and consisting of copper conductors, polymeric insulation, tape, braid and black sheath.

The outer sheath of the cable was marked "Raychem – EPD 114322A-2010".

### **Conditioning Of Specimen**

The specimen was received on 15 September 2011.

Prior to the test the specimen was conditioned at a temperature of  $25 \pm 5^{\circ}\text{C}$  for a minimum period of 16 hours.



### **Date Of Test**

The test was performed on 4 October 2011.

### **Test Procedure**

The test was performed in accordance with the procedure specified in IEC 60332-1-2 and this report should be read in conjunction with that Standard.

The burner was applied for 60 seconds.

### **Test Results**

The test results relate only to the behaviour of the specimen of the cable under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential fire hazard of the product in use.

The test results relate only to the specimen of the cable in the form in which they were tested. Small differences in the composition or thickness of the cable may significantly affect the performance during the test and may therefore invalidate the test results. Care should be taken to ensure that any cable which is supplied or used is fully represented by the specimens which were tested.

Distance between the lower edge of the top support and the onset of charring (mm): 415

### **Recommended performance requirement (Annex A : Informative)**

The insulated conductor or cable shall pass the test if the distance between the lower edge of the top support and the onset of charring is greater than 50mm.

In addition, a failure shall be recorded if the burning extends downwards to a point greater than 540mm from the lower edge of the top support.

### **Conclusion**

The specimen meets the performance requirement given in Annex A of IEC 60332-1-2:2004.

#### **Prepared by**

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**Date of Issue: 5 December 2011**



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**Test Report**  
**Report No: ICL/H11/988**

**EN 61034-2 – Measurement of Smoke Density of Electric Cables**  
**Burning Under Defined Conditions**  
**Part 2: Test Procedure and Requirements**

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Company Registration 1896939 VAT No. GB 407 519 5 54







## Test Report

Report No: ICL/H11/988

### EN 61034-2 – Measurement of Smoke Density of Electric Cables Burning Under Defined Conditions Part 2: Test Procedure and Requirements

**Sponsored By**  
TE connectivity  
Faraday Road,  
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Wilshire, SN3 5HH

#### **1** Purpose Of Test

To determine the performance of a cable when subjected to the conditions of the test specified in EN 61034-2 Measurement of Smoke Density of Electric Cables Burning Under Defined Conditions - Part 2: Test Procedure and Requirements and assess the results against the performance requirements given in DIN 5510-2: 2009 Table 6.

#### **2** Scope Of Test

EN 61034 Part 2 specifies a method of test for the determination the smoke emission characteristics of a cable burning under defined conditions of test

#### **3** Description of the cable

The description of the cable given below has been prepared from information provided by the sponsor of the test. All values quoted are nominal, unless tolerances are given.

The product was a four core cable referenced "EPD 114322A" having an overall diameter of 6.9mm and consisting of copper conductors, polymeric insulation, tape, braid and black sheath.

The outer sheath of the cable was marked "Raychem – EPD 114322A-2010".

The cable was supplied by the sponsor of the test on 19 September 2011 and Interscience Communications Ltd was not involved in any selection or sampling procedures.

#### **4** Date Of Test

The test was performed on 5 October 2011.

#### **5** Test Procedure

The test was performed in accordance with the procedure specified in EN 61034 Part 2 and this report should be read in conjunction with that Standard.



Test specimen consisted of six 1 m lengths.

**6 Test Results**

The test results relate only to the behaviour of the specimens under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential hazard of the product in use.

The test results relate only to the specimens of the cable component in the form in which they were tested. Small differences in the composition of the product may significantly affect the performance during the test and may therefore invalidate the test results. Care should be taken to ensure that any product, which is supplied or used, is fully represented by the specimens, which were tested.

Visual observations are given in Appendix 1.

The change in transmission with time was recorded and a chart is given in Appendix 2.

Minimum transmission was: 86.9 %

Minimum transmission in the first 20 minutes of the test: 87.6%

**7 Requirements**

The following requirements are given in Annex B (Informative) of EN 61034-2:2005

Transmission value: Minimum 60%

The following requirements are given in DIN 5510-2:2009 Table 6

Transmission value in the first 20 minutes of the test: Minimum 60%

**8 Conclusion**

The cable satisfies the requirement given in Annex B of EN 61034-2 and requirements of minimum 60% transmission given in DIN 5510-2:2009 Table 6.

**Prepared by**

A handwritten signature in black ink, appearing to read "Chong", written over a horizontal line.

**C. B. Chong**  
Fire Scientist

**Approved by**

A handwritten signature in black ink, appearing to read "S. Kumar", written over a horizontal line.

**S. Kumar**  
Technical Manager

**Date of Issue: 5 December 2011**



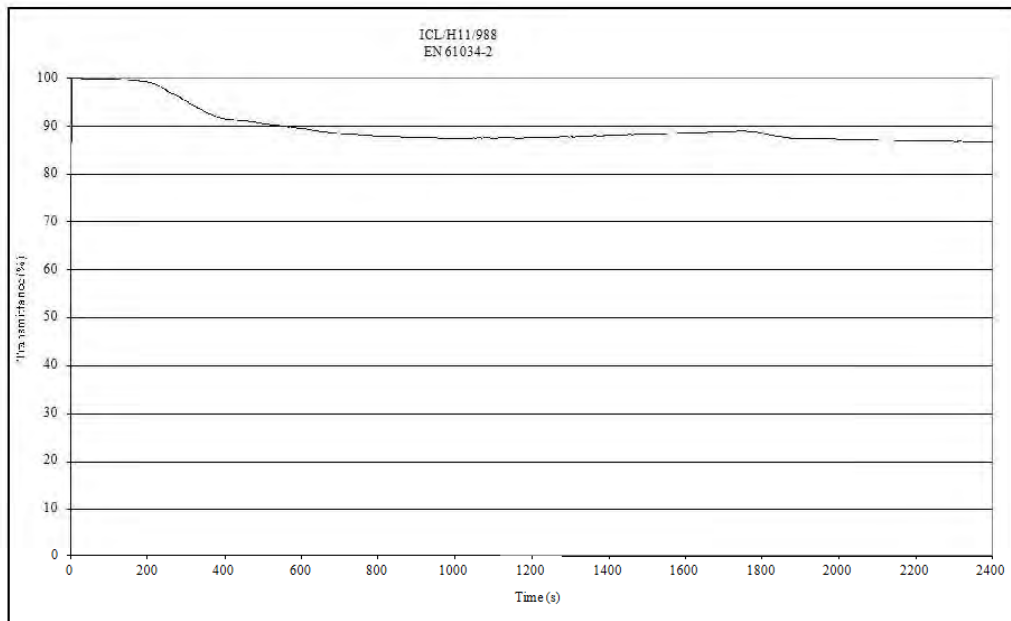
**Appendix 1**  
**Visual Observations**

<b>Time Mins-Sec</b>	<b>Observations</b>
1 – 58	Ignition of cable





**Appendix 2**


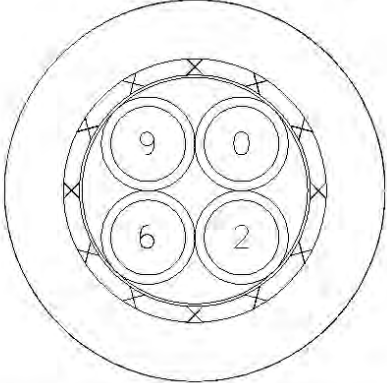


**Graph showing the change in transmission with time**



## 8 SAMPLE DRAWINGS

### 8.1 EPD114322A

		Class 2	<b>Engineering Product Design</b>		REV 1
<i>Product Construction:</i> ROHS Compliant 4 Conductor Cable Shielded and Jacketed			<i>Product Description</i> <b>EPD 114322</b>		Issue A S'sedes
<i>Designer</i> Tony Dixon	<i>Date</i> 30/04/10	<i>Product Manager</i> John Wadeley	<i>Date</i> 04/06/10	Page 1 of 1	
			Controlled Customer Copy TRANSTECH OY FINLAND		
			Specifications WSD 1889		
			The copyright in this drawing is the property of Tyco Electronics UK Limited. The drawing is issued on condition it is not copied, reproduced or disclosed to a third party either in whole or in part without prior written consent of Tyco Electronics UK Limited.		
<i>Layer Type / Operation</i>		<i>Component Details</i> Part Numbers refer to issue in effect at date of issue of this EPD.		<i>Nominal O.D. mm</i>	
Components: Wire		4 of 100G0111-1.00 Colours as above			
Cabling: Layer 1		4 of 100G0111-1.00		4.2	
Wrap:		Mylar		4.3	
Shield: Braid		Tin Plated Copper		4.9	
Jacket: Extrusion 1		Zerohal EN - Black. Marked 'Raychem - EPD 114322A - Year of Manufacture'		7.1 ±0.4	
<i>Maximum Surface Transfer Impedance</i>		<i>Notes</i>		<i>Calculated nom. weight (Kg/Km)</i>	
		* - Raychem Trademark		91	

**Lengths:** Unless otherwise specified on your order this cable may be supplied in the following maximum number of continuous lengths:

Order Quantity (m)      + One other length  
 100

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**Proprietary Information**



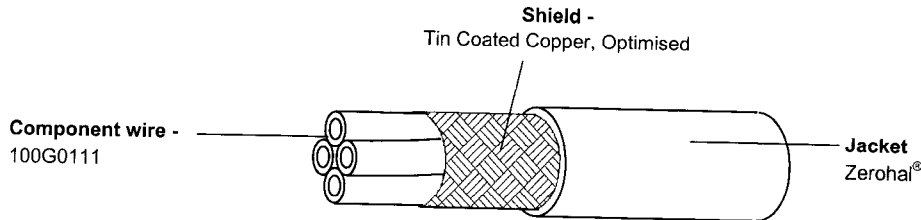
8.2 100G1141

**tyco** / Electronics / Raychem

100G1141  
Issue 9  
28th June 2004

FOUR CONDUCTOR CABLE, HALOGEN FREE INSULATION, SHIELDED AND HALOGEN FREE JACKETED,  
750/1300 VOLT AC, 105°C

The complete requirements for procuring the wire described herein shall consist of this document.



Part Number	Nominal Cross Sectional Area (mm <sup>2</sup> )	Shield Size (mm)	Jacket Thickness (mm)		Overall Diameter (mm)		Maximum Weight (kg/ km)
			Min.	Nom.	Nom.	Max.	
100G1141-0.15-*/**/*	0.15	0.13	0.22	0.30	3.65	3.79	27.0
100G1141-0.25-*/**/*	0.25	0.13	0.22	0.30	3.89	4.04	32.6
100G1141-0.40-*/**/*	0.40	0.13	0.22	0.30	4.38	4.53	41.6
100G1141-0.50-*/**/*	0.50	0.13	0.22	0.30	4.58	4.73	48.7
100G1141-0.60-*/**/*	0.60	0.13	0.22	0.30	4.82	4.99	54.0
100G1141-0.75-*/**/*	0.75	0.13	0.22	0.30	5.12	5.29	61.3
100G1141-1.00-*/**/*	1.00	0.13	0.22	0.30	5.36	5.51	70.3
100G1141-1.20-*/**/*	1.20	0.13	0.22	0.30	5.81	5.96	84.7
100G1141-1.50-*/**/*	1.50	0.13	0.22	0.30	6.17	6.32	96.7
100G1141-2.00-*/**/*	2.00	0.13	0.35	0.48	7.21	7.36	127
100G1141-2.50-*/**/*	2.50	0.13	0.35	0.48	7.70	7.85	152
100G1141-3.00-*/**/*	3.00	0.13	0.35	0.48	8.22	8.37	178
100G1141-4.00-*/**/*	4.00	0.13	0.35	0.48	8.97	9.12	235

\*Zerohal is a registered trademark of Tyco Electronics Corporation

**COLOUR CODE:** The '\*' in the part number shall be replaced by a standard colour code designator in accordance with Mil Std 681.  
e.g. 100G1141-1.00-0/2/6/9-0, cores black, red, blue and white, jacket black

**PERFORMANCE REQUIREMENTS** To be tested and meet the requirements of the issue in effect of Raychem Specification WCD 2015, except that the minimum jacket elongation at break shall be 125%.

This product will have components available in the full colour range and may be marked or unmarked in accordance with the order. Standard outer jacket black but other colours available on request.

DESIGN	PROD. MAN.	TECHNICAL	MANUFACTURE
<i>[Signature]</i> 8th July 2004	<i>[Signature]</i> 8/7/04	<i>[Signature]</i> 29 JUNE 04	<i>[Signature]</i> 7/7/04

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### 8.3 ZHPCG-15

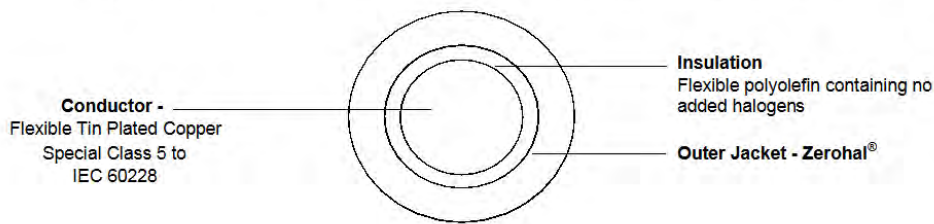


Specification Control Drawing

ZHPCG-15  
Issue 8  
10th October 2007  
Page 1 of 2  
Page 2 is for internal use only

750 VOLT ZERO HALOGEN POWER CABLE

The complete requirements for procuring the cable described herein shall consist of this document.



Part Number	CONDUCTOR		Max Resist @20 °C (ohms/km)	FINISHED WIRE		Maximum Weight (kg/km)
	Maximum diameter of strands (mm)	Maximum Diameter (mm)		Outer Diameter		
				Lower Spec Limit	Upper Spec Limit	
ZHPCG-15-1.0-#	0.21	1.25	20.0	3.62	4.00	28
ZHPCG-15-1.5-#	0.26	1.49	13.7	3.64	4.00	36
ZHPCG-15-2.5-#	0.26	1.97	8.21	4.07	4.50	45
ZHPCG-15-4.0-#	0.31	2.56	5.09	4.39	4.89	60
ZHPCG-15-6.0-#	0.31	3.05	3.39	5.06	5.56	85
ZHPCG-15-10.0-#	0.41	4.05	1.95	6.23	6.88	135
ZHPCG-15-16.0-#	0.41	5.20	1.24	7.63	8.48	195
ZHPCG-15-25.0-#	0.41	7.00	0.795	9.20	10.30	300
ZHPCG-15-35.0-#	0.41	7.75	0.565	10.70	11.90	443
ZHPCG-15-50.0-#	0.41	9.2	0.393	12.90	14.10	623
ZHPCG-15-70.0-#	0.51	11.5	0.277	14.90	16.30	847
ZHPCG-15-95.0-#	0.51	13.0	0.210	17.40	18.80	1119
ZHPCG-15-120.0-#	0.51	14.8	0.164	19.10	20.50	1445
ZHPCG-15-150.0-#	0.51	16.7	0.132	21.10	22.90	1775
ZHPCG-15-185.0-#	0.51	18.7	0.108	23.50	25.30	2115
ZHPCG-15-240.0-#	0.51	21.9	0.0817	26.90	28.70	2762
ZHPCG-15-300.0-#	0.51	26.9	0.0654	30.10	32.30	3452
ZHPCG-15-400.0-#	0.51	31.0	0.0495	34.10	36.30	4474

**COLOUR CODE:** The '#' in the part number represents the outer jacket colour. e.g. ZHPCG-15-10.0-0 is 10mm<sup>2</sup> conductor size, with black jacket. Standard colour black but other colours available on request.

**PERFORMANCE REQUIREMENTS:** To be tested to and meet the requirements of the issue in effect of WSD 1265.

**APPROVAL:** Electronic sign off - no signatures will appear.

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Proprietary Information



8.4 100G0111



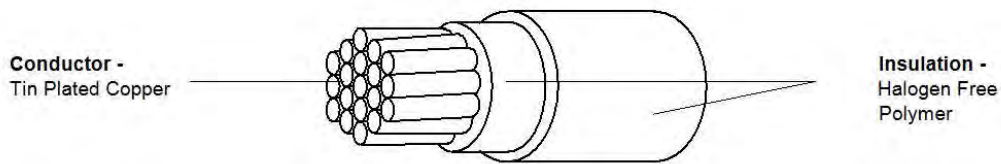
Customer Drawing

100G0111  
Issue 7  
5th July 2011  
Page 1 of 2

Page 2 is for internal use only

WIRE, HALOGEN FREE, THIN WALL,  
750/1300 VOLT AC, 125°C

The complete requirements for procuring the wire described herein shall consist of this document.



Part Description	Nominal Cross Sectional Area (mm <sup>2</sup> )	Nominal Conductor Stranding No./Diam. (mm)	Conductor Diameter (mm)		Maximum Resistance @ 20°C (ohms/km)	FINISHED WIRE Diameter (mm)			Maximum Weight (kg/km)
			Min.	Max.		Lower Spec Limit	Target	Upper Spec Limit	
100G0111-0.15-*	0.15	19/0.10	0.45	0.50	132.9	0.98	1.03	1.08	2.59
100G0111-0.25-*	0.25	19/0.13	0.55	0.63	84.32	1.09	1.14	1.19	3.59
100G0111-0.40-*	0.40	19/0.16	0.73	0.79	50.5	1.28	1.33	1.38	5.18
# 100G0111-0.50-*	0.50	19/0.18	0.82	0.90	40.1	1.37	1.40	1.45	6.6
# 100G0111-0.60-*	0.60	19/0.20	0.95	1.01	31.1	1.47	1.52	1.57	7.4
# 100G0111-0.75-*	0.75	19/0.23	1.04	1.15	26.7	1.59	1.60	1.65	8.9
# 100G0111-1.00-*	1.00	19/0.25	1.17	1.26	20.0	1.69	1.75	1.80	10.7
# 100G0111-1.20-*	1.20	19/0.29	1.32	1.42	15.3	1.88	1.93	1.98	13.6
# 100G0111-1.50-*	1.50	37/0.23	1.46	1.58	13.7	2.03	2.08	2.13	16.0
# 100G0111-2.00-*	2.00	37/0.25	1.68	1.82	10.5	2.31	2.36	2.41	20.3
# 100G0111-2.50-*	2.50	37/0.29	1.85	2.01	8.21	2.50	2.55	2.63	25.7
100G0111-3.00-*	3.00	37/0.32	2.12	2.24	6.58	2.70	2.78	2.86	31.0
100G0111-4.00-*	4.00	56/0.30	2.41	2.57	4.89	3.01	3.09	3.17	43.6

**COLOUR CODE:** The '\*' in the part number shall be replaced by a standard colour code designator in accordance with Mil Std 681.  
eg: 100G0111-1.00-2 Red insulation

**PERFORMANCE REQUIREMENTS:** All sizes shall be tested and meet the requirements of the issue in effect of WSD 912  
Sizes Indicated with # shall also meet the requirements of the issue in effect of ENG-SYS-825-904

This product will be available in the full colour range and may be marked or unmarked in accordance with the order.

**APPROVAL:** Electronic sign off - no signatures will appear.

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