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Test report for the fire testing of a Teldor Cables & Systems Ltd. 'LDB-9-16x12-D-ZHRH-DD#STR' cable

Prepared for:
Teldor Cables & Systems Ltd
Ein-Dor
Kibbutz Ein-Dor 19335
Israel

ATL Technology Limited
16/F
Guangdong Finance Building
88 Connaught Road West
Hong Kong

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UKAS TESTING

0578

Protecting People, Property and the Planet

Prepared on behalf of BRE Global by

Name Ewan MacDonald

Position Consultant

Signature 

Approved on behalf of BRE Global by

Name Dave Hoare

Position Senior Consultant

Date 27 July 2011

Signature 

BRE Global
Bucknalls Lane
Watford
Herts
WD25 9XX
T + 44 (0) 1923 664100
F + 44 (0) 1923 664994
E enquiries@breglobal.com
www.breglobal.com

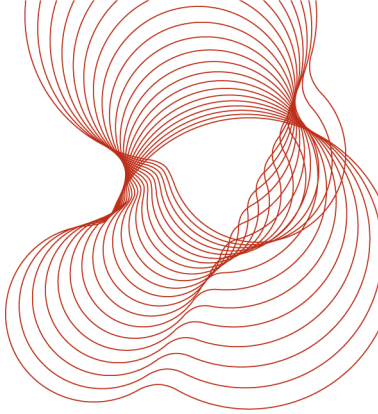
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1 Introduction

The requirement of the work was to determine the performance of a cable when tested to IEC 60331-25:1999 [1], IEC 60332-1-2:2004 [2], IEC 60332-3-24:2000+A1:2008 [3], IEC 61034-2:2005 [4], IEC 60754-1:1994 [5], IEC 60754-2:1997 [6], BS EN ISO 4589-2:1996 [7] and BS EN ISO 4859-3:1996 [8].

The client for this work was Teldor Cables & Systems Ltd., Kibbutz Ein-Dor 19935, Israel. The client's purchase order number was EPO1102245.

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2 Details of sample received and tests carried out

The cable tested was an 18.9mm diameter, 16 tube fibre optic cable comprising a central strength member, 4 off filled tubes (each tube filled with 12 off buffered fibre and gel) and 2 off filler rods, cord and tapes, 12 off filled tubes, water barrier tape, E- glass yarns, cords, bedding, corrugated steel armouring, cord and over sheath. The over sheath had the following printed marking:

'TELDOR F.O. CABLE LDB-9-16X12-D-ZHRH-D 1101471'

Product information was supplied in Teldor Cables & Systems Ltd specification 'LDB-F-TTxNN-D-ZHRH-DD#S TR'. The client's reference for the cable was ''LDB-9-16x12-D-ZHRH-DD#STR with a 999999M270-289 sheath'.

The test specimen was supplied by the client and received on 18 July 2011. BRE Global was not involved in the sample selection process and therefore cannot comment upon the relationship between samples supplied for test and the product supplied to market.

The client requested that the following tests were undertaken:

1. IEC 60331-25:1999
2. IEC 60332-1-2:2004
3. IEC 60332-3-24:2000+A1:2008
4. IEC 61034-2:2005
5. IEC 60754-1:1994 (999999M270-289 Sheathing compound only)
6. IEC 60754-2:1997 (999999M270-289 Sheathing compound only)
7. BS EN ISO 4589-2:1999 (999999M270-289 Sheathing compound only)
8. BS EN ISO 4859-3:1996 (999999M270-289 Sheathing compound only)

The tests were conducted between 19 July 2011 and 21 July 2011. Prior to the tests being carried out, the samples were conditioned as required by the test standards.

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3 Test results

3.1 IEC 60331-25:1999 - Fire resistance

3.1.1 Test procedure

The client specified a minimum flame temperature of 750°C and an application time of 90 minutes with a 15 minute cool down period. The burner temperature was 768°C verified in accordance with the procedure given in IEC 60331-11:1999 [9].

3.1.2 Test Result

The maximum change in attenuation recorded during the test was 0.11dB. The graph of attenuation verses time is given in Figure 1.

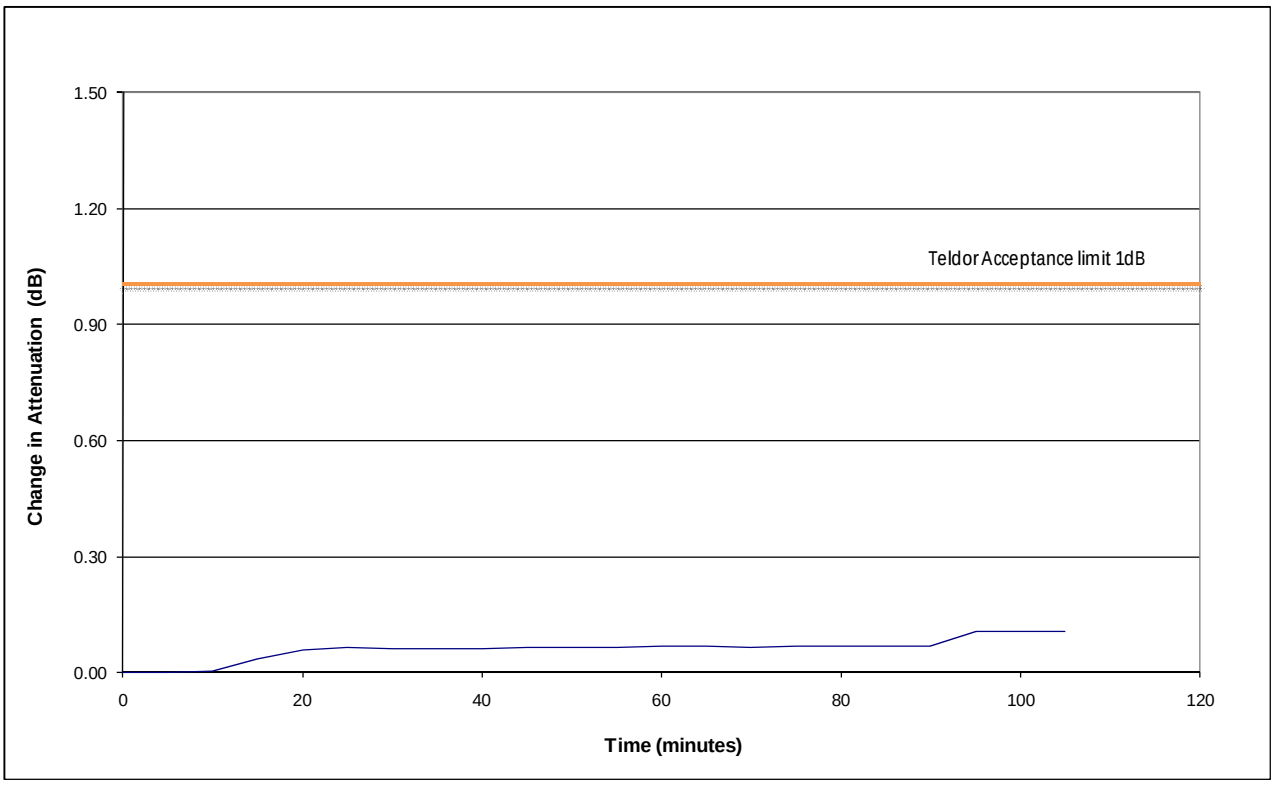


Figure 1 - Attenuation versus time - Teldor Cables & Systems Ltd. 'LDB-9-16x12-D-ZHRH-DD#STR' cable

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3.2 IEC 60332-1-2:2004 - Single cable flammability

Cable Diameter (mm)	Duration burner applied to cable (seconds)	Onset of charring (mm)	Extent of downward charring from the lower edge of top support (mm)
18.9	60	430	500

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3.3 IEC 60332-3-24:2000+A1:2008 - Multiple cable flammability

3.3.1 Determination of cable quantity

The non-metallic volume of the cable, calculated as defined in IEC 60332-3-24:2000+A1:2008, was found to be 0.1960 l/m. IEC 60332-3-24:2000+A1:2008 defines a non-metallic volume for the cable of 1.5 l/m. Therefore 8 lengths of cable were tested.

The cables were fixed to a 500 mm wide ladder. The cable's diameter required a single layer of 8 touching cables within the 300 mm wide array across the centre of the ladder.

A single 20 kW gas burner was used with a flame application time of 20 minutes.

3.3.2 Test result

The burner was switched off after 20 minutes. All flaming ceased 11 minutes later (31 minutes after the start of the test).

The maximum extent of charring on the sample, measured after the test, was 0.71m above the bottom edge of the burner.

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3.4 IEC 61034-2:2005 - Smoke emission

3.4.1 Test procedure

IEC 61034-2:2005 defines that for a cable with a diameter greater than 10mm but less than 20mm, the number lengths of samples in the test array shall be 3 cables.

3.4.2 Test results

The minimum light transmittance recorded during the test was 64.1%. A copy of the light transmission versus time graph is given in Figure 2.

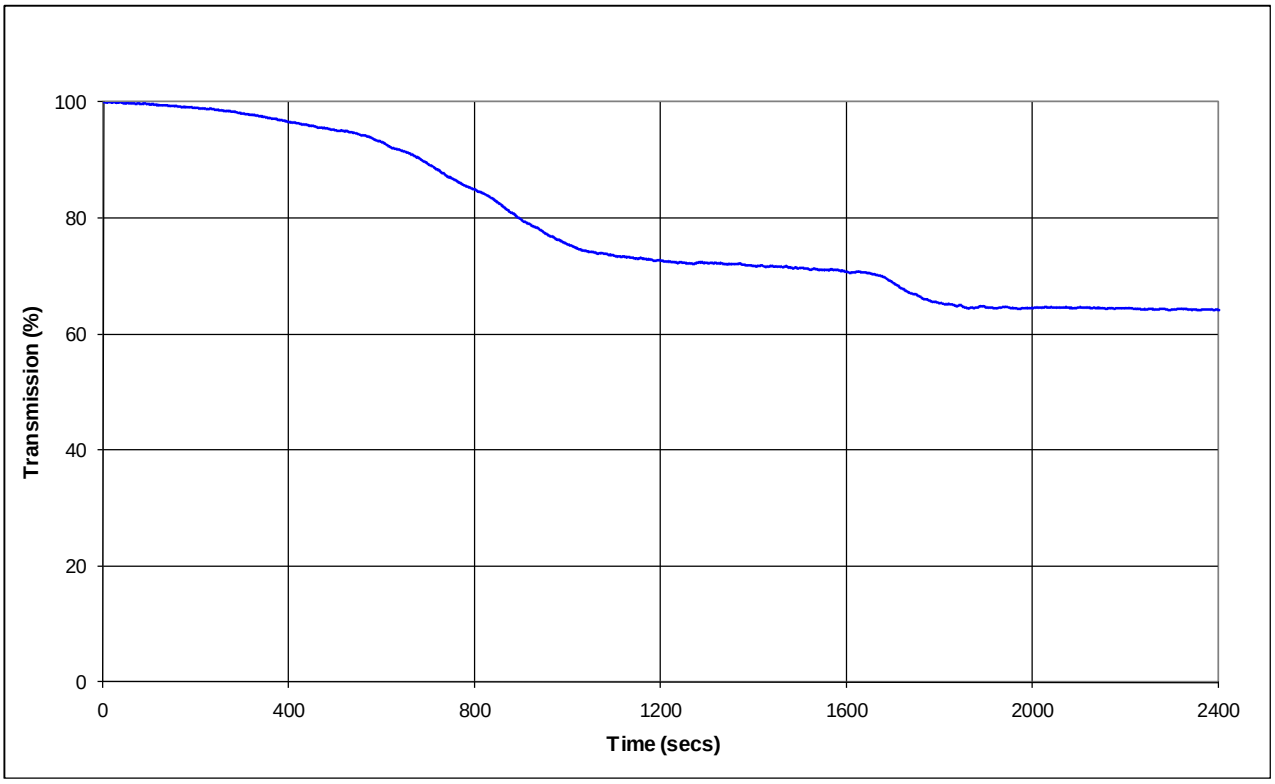
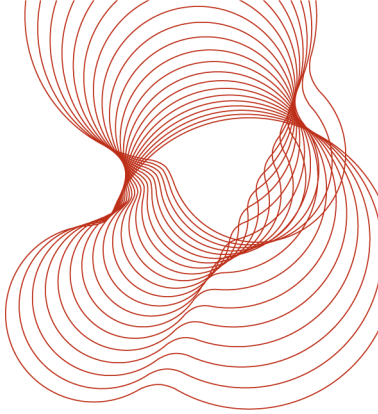


Figure 2 Light transmission against time – Teldor Cables & Systems Ltd. 'LDB-9-16x12-D-ZHRH-DD#STR' cable

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3.5 IEC 60754-1:1994 - Acid gas emission

The client requested that only the 999999M270-289 outer sheath material was tested to IEC 60754-1:1994

Component	%HCl per gram of sample
999999M270-289 Compound	<0.5%

3.6 IEC 60754-2:1997 - pH and conductivity

The client requested that only the 999999M270-289 outer sheath material was tested to IEC 60754-2:1997

Component	pH	Conductivity
999999M270-289 Compound	5.88	0.270µS/mm

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3.7 BS EN ISO 4859-2:1999 - Oxygen Index

3.7.1 Test Procedure

The tests were carried out on a sample of the 999999M270-289 sheath material taken from the finished cable in accordance with BS EN ISO 4589-3:1996, using the apparatus specified in BS EN ISO 4589-3:1996 and Procedure A and test specimen form IV specified in BS EN ISO 4539-2:1999. The dimensions of the samples were 100mm long by 6.5mm wide. The thickness of the material was a nominal 1.6mm.

3.7.2 Test result

The oxygen index for the 1.6mm thickness of sample tested was 34.5%. The details of the testing are given in the following summary.

It should be noted that BS EN ISO 4589-2:1999 Specimen form IV requires a material thickness of 3.0mm ±0.25mm and that the sheath material tested was taken from the competed cable and tested with the thickness of sample as received.

The test result relates only to behaviour of the test specimens of the product under the particular conditions of test, they are not intended to be the sole criteria for assessing the potential fire hazard of the product in use.

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Determination of the preliminary oxygen concentration from one pair of "X" and "O" response at ≤1% O_2 concentration interval

Oxygen concentration (%)	35.0	34.0					
Burning period (s)	>180	50					
Length burnt (mm)	>50	30.0					
Response (X or O)	X	O					

Preliminary oxygen concentration (%) = 34.0

Determination of the oxygen index value

	N_T series measurements									
	N_L series measurements					c_F				
Oxygen concentration (%)	34.0	34.2	34.4	34.6		34.6	34.4	34.6	34.4	34.6
Burning period (s)	50	50	50	>180		>180	50	>180	50	>180
Length burnt (mm)				>50			30	>50	30	50
Response (X or O)	O	O	O	X		X	O	X	O	X

k value (from table 4 of the standard) = -0.45

Oxygen index = cf + k.d

= 34.6+ (-0.45x0.2)

= **34.51**

Determination of the estimated standard deviation

$$\sigma' = \left(\frac{\sum(cI - OI)^2}{n-1} \right)^{½}$$

where

cI represents, in turn, each of the percent oxygen concentrations used during measurement of the last six responses in the N_T series of measurements;

OI is the oxygen index value;

n is the number of measurements of oxygen concentration contributing to $\sum(cI - OI)^2$

$$= \left(\frac{0.061}{5} \right)^{½}$$

= 0.11

The oxygen index value is valid if $2\sigma'/3 < d < 3\sigma'/2$ or if $d > 3\sigma'/2$ and d = 0.2

d > 0.1651 d = 0.2

Hence oxygen index is valid

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3.8 BS EN ISO 4589-3:1996 - Temperature Index

3.8.1 Test Procedure

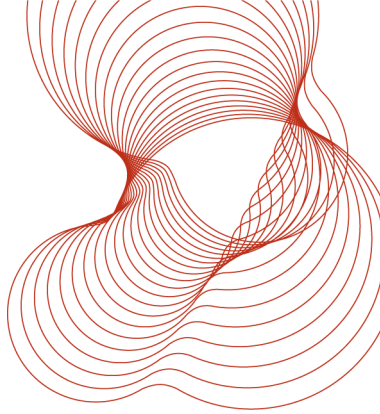
The tests were carried out on a sample of the 999999M270-289 sheath material taken from the finished cable in accordance with BS EN ISO 4589-3:1996, using the apparatus specified in BS EN ISO 4589-3:1996 and Procedure A and test specimen form IV specified in BS EN ISO 4539-2:1999. The dimensions of the samples were 100mm long by 6.5mm wide. The thickness of the material was a nominal 1.6mm.

3.8.2 Test result

The flammability temperature was found to be >282ºC. The client only required the sample to be tested at a temperature in excess of 282ºC.

The test result relates only to behaviour of the test specimens of the product under the particular conditions of test, they are not intended to be the sole criteria for assessing the potential fire hazard of the product in use.

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4 Conclusions

The test standard recommended performance criteria or the client's performance requirements for each test are listed below:

1. IEC 60331-25:1999: Teldor requirement - Maximum change in light attenuation <1dB
2. IEC 60332-1-2:2004 Annex A: Requirement - Onset of char >50mm, Extent of char <540mm
3. IEC 60332-3-24:2000+A1:2008 Annex B: Requirement - Maximum extent of char <2.5m
4. IEC 61034-2:2005 Annex B: Requirement - Minimum light transmission >60%
5. IEC 60754-1:1994: Teldor requirement <0.5% HCl
6. IEC 60754-2:1997: Requirement - pH>4.5, conductivity <10µS/mm
7. BS EN ISO 4589-2:1999: Teldor requirement >35% (Teldor Specification)
8. BS EN ISO 4589-3:1996: Teldor Requirement >280°C

The Teldor Cables & Systems Ltd. 'LDB-9-16x12-D-ZHRH-DD#STR' cable satisfied the recommended performance criteria given in IEC 60332-1-2:2004, IEC 60332-3-24:2000+A1:2008, IEC 61034-2:2005 and the clients performance criteria in IEC 60331-25:1999.

The 999999M270-289 sheath material used in the 'LDB-9-16x12-D-ZHRH-DD#STR' cable meet the recommended performance criteria of IEC 60754-2:1997, the client's performance criteria for IEC 60754-1:1994 and BS EN ISO 4589-3:1996 and when tested to BS EN ISO 4589-2:1999 achieved an oxygen index of 34.5%.

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5 References

1. IEC 60331-25:1999, 'Tests for electric cables under fire conditions - Circuit integrity - Part 25: Procedures and requirements - Optical fibre cables', International Electrotechnical Commission, Geneva, Switzerland, 1999.

2. IEC 60332-1-2:2004, 'Tests on electric and optical fibre cables under fire conditions – Part 1-2: Test for vertical flame propagation for a single insulated wire or cable – Procedure for 1 kW premixed flame', International Electrotechnical Commission, Geneva, 2004.

3. IEC 60332-3-24:2000+A1:2008, 'Tests on electric cables under fire conditions. Part 3-24: Tests for vertical flame spread of vertically mounted bunched wires or cables – Category C', International Electrotechnical Commission, Geneva, 2008.

4. IEC 61034-2:2005, 'Measurement of smoke density of cables burning under defined conditions – Part 2: – Test procedure and requirements', International Electrotechnical Commission, Geneva 2005.

5. IEC 60754-1:1994, 'Test on gases evolved during combustion of material from cables. Part 1: Determination of the amount of halogen acid gases', International Electrotechnical Commission, Geneva, Switzerland, 1994.

6. IEC 60754-2:1997, 'Test on gases evolved during combustion of electric cables. Part 2: Determination of degree of acidity of gases evolved during the combustion of materials taken from electric cables by measuring pH and conductivity', International Electrotechnical Commission, Geneva, 1997.

7. BS EN ISO 4589-3:1996, 'Plastics – Determination of burning behaviour by oxygen index Part 3: Elevated – temperature test', British Standard Institution, London, 1996.

8. BS EN ISO 4589-2:1999, 'Plastics – Determination of burning behaviour by oxygen index Part 2: Ambient – temperature test', British Standard Institution, London, 1999.

9. IEC 60331-11:1999, Tests for electric cables under fire conditions - Circuit integrity - Part 11: Apparatus - Fire alone at a temperature of at least 750 °C', International Electrotechnical Commission, Geneva, Switzerland, 1999.

==========REPORT ENDS==========

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