



Flame Retardant Multi Loose Tube Fiber Optic Cables

APPLICATION

The multi loose tube non metallic cables are designed for outside plant, which is prone to electrical interference. They are mainly installed inside buildings, tunnels, subways or closed areas in general, specially designed to guarantee the signal transmission even in case of fire. The cable can also be used for direct burial for armoured version.

STANDARDS

Basic design adapted to Telcordia GR-20 / RUS 7 CFR 1755.900 (REA PE-90) / ICEA S 87-640

FIRE PERFORMANCE

Flame Retardance (Single Vertical Wire Test)	EN 60332-1-2; IEC 60332-1-2; BS EN 60332-1-2; VDE 0482-332-1 ; NBN C 30-004 (cat. F1); NF C32-070-2.1(C2); CEI 20-35/1-2; EN 50265-2-1*; DIN VDE 0482-265-2-1*
Reduced Fire Propagation (Vertically-mounted bundled wires & cable test)	EN 60332-3-24 (cat. C); IEC 60332-3-24; BS EN 60332-3-24; VDE 0482-332-3; NBN C 30-004 (cat. F2); NF C32-070-2.2(C1); CEI 20-22/3-4; EN 50266-2-4*; DIN VDE 0482-266-2-4
Halogen Free	IEC 60754-1; EN 50267-2-1; DIN VDE 0482-267-2-1; CEI 20-37/2-1 ; BS 6425-1*
No Corrosive Gas Emission	IEC 60754-2; EN 50267-2-2; DIN VDE 0482-267-2-2; CEI 20-37/2-2 ; BS 6425-2*
Minimum Smoke Emission	IEC 61034-1&2; EN 61034 -1&2; DIN VDE 0482-1034-1&2; CEI 20-37/3-1&2; EN 50268-1&2*; BS 7622-1&2*
No Toxic gases	NES 02-713; NF C 20-454

Note: Asterisk * denotes superseded standard.

CABLE CONSTRUCTION

Fibers: Singlemode and multimode fibers, with loose tube technology.

Structure: The cable consists of 5 to 36 fibers containing tubes or fillers stranded in up to 3 layers around a central strength member and bound under a LSZH sheath. Each tube contains 4 -12 fibers, which is filled with water blocking gel.

Central Strength Member: Solid or stranded steel wire coated with polyethylene is usually used as central strength member. Fiber glass reinforced plastics (FRP) will be used as central strength member if non metallic construction is required.

Water Blocking: The jelly filled tube is waterblocked by using swellable tape and thread.

Reinforcement: Either aramid yarn or fiber glass is wound around the tube to provide physical protection and tensile strength, with added fire protection.

Inner Sheath (optional): The cable can be jacketed with either PE or Thermoplastic LSZH inner sheath. PE is the preferred option in outdoor environment for water protection purpose.

Armouring(optional): For direct burial, either galvanized steel wire braid, corrugated steel tape armour or galvanized steel wire armour is applied over an inner polyethylene or LSZH sheath.

For steel tape armour, the 0.15mm thick steel tape is coated with a copolymer and applied with an overlap. For steel wire braid or armour, single layer of galvanized steel wire braid or armour is applied.

Moisture Barrier Tape (optional): An aluminum moisture tape can be incorporated under the sheath for water blocking and shielding purpose.

Ripcord (optional): An optional ripcord can be located under the jacket to facilitate jacket removal.

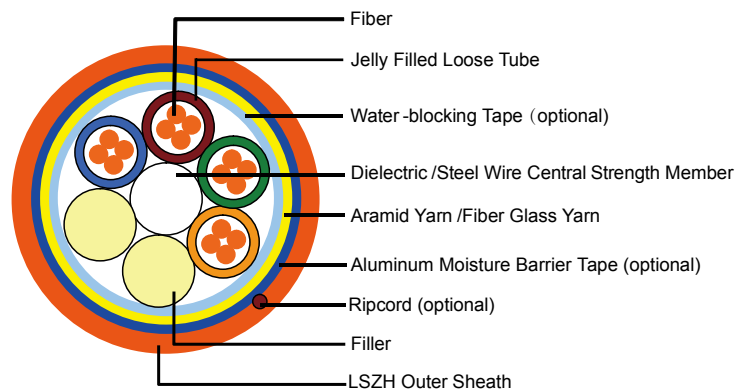
Outer Sheath: Thermoplastic LSZH compound type LTS3 as per BS 7655-6.1 (Thermosetting LSZH compound type SW2-SW4 as per BS 7655-2.6 can be offered.). UV resistance, hydrocarbon resistance, oil resistance, anti rodent and anti termite properties can be offered as option.

FIBER COLOUR CODE

Fiber colour code	1	Red	7	Brown
	2	Green	8	Violet
	3	Blue	9	Turquoise
	4	Yellow	10	Black
	5	White	11	Orange
	6	Grey	12	Pink

CONSTRUCTION

UNARMoured TYPE

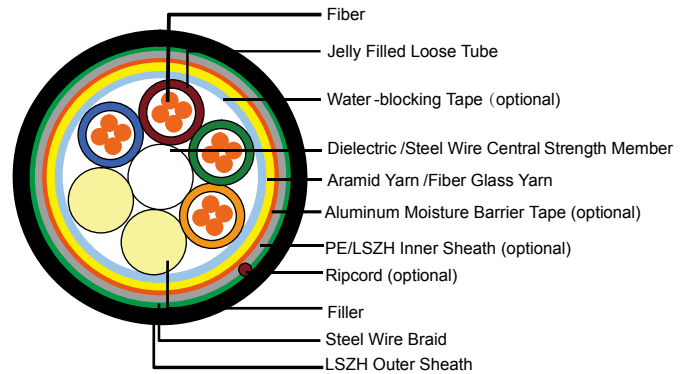


CONSTRUCTION PARAMETERS

Cable Code	Fiber Count	Tube Diameter	Nominal Overall Diameter	Approx. Weight	Tension load	Crush
	(n°)	mm	mm	kg/km	N	N/100mm
MLA-B-C×D-F-H-J	72	2.5	15.0	230	4000	3000
MLA-B-C×D-F-H-J	96	2.5	16.5	250	4000	3000
MLA-B-C×D-F-H-J	144	2.5	20.5	280	4000	3000



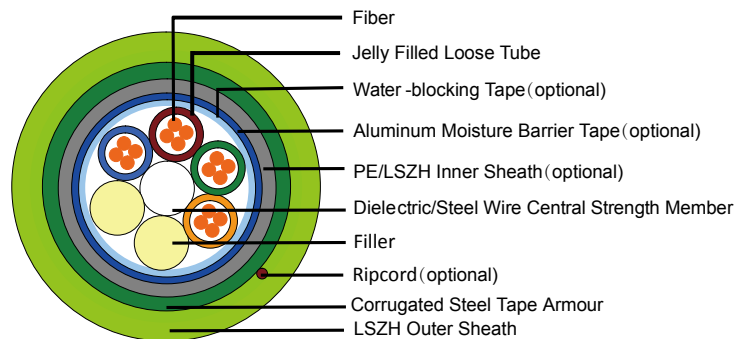
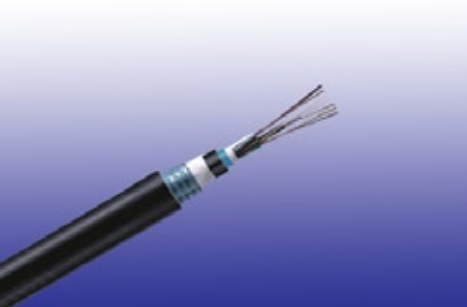
STEEL WIRE BRAID



CONSTRUCTION PARAMETERS

Cable Code	Fiber Count	Tube Diameter	Nominal Overall Diameter	Approx. Weight	Tension load	Crush
	(n°)	mm	mm	kg/km	N	N/100mm
MLA-B-C×D-F-2Y(SWB)H-J	72	2.5	15.0	280	3000	3500
MLA-B-C×D-F-2Y(SWB)H-J	96	2.5	17.5	310	3000	3500
MLA-B-C×D-F-2Y(SWB)H-J	144	2.5	21.5	350	3500	3500

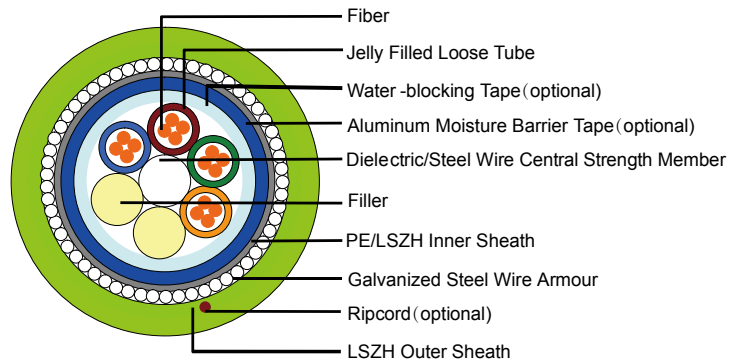
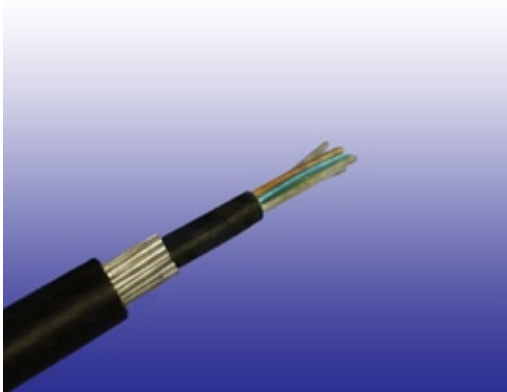
CORRUGATED STEEL TAPE ARMOUR



CONSTRUCTION PARAMETERS

Cable Code	Fiber Count	Tube Diameter	Nominal Overall Diameter	Approx. Weight	Tension load	Crush
	(n°)	mm	mm	kg/km	N	N/100mm
MLA-B-C×D-F-2Y(STA)H-J	72	2.5	16.5	290	3000	7500
MLA-B-C×D-F-2Y(STA)H-J	96	2.5	18.5	350	3000	7500
MLA-B-C×D-F-2Y(STA)H-J	144	2.5	22.5	450	3500	7500

STEEL WIRE ARMOUR



CONSTRUCTION PARAMETERS

Cable Code	Fiber Count	Tube Diameter	Nominal Overall Diameter	Approx. Weight	Tension load	Crush
	(n°)	mm	mm	kg/km	N	N/100mm
MLA-B-C×D-F-2Y(SWA)H-J	72	2.0	15.0	360	3500	5000
MLA-B-C×D-F-2Y(SWA)H-J	96	2.0	16.5	390	4000	5000
MLA-B-C×D-F-2Y(SWA)H-J	144	2.0	18.5	430	4500	5000

PHYSICAL AND THERMAL PROPERTIES

Temperature range during operation (fixed state): -20°C - +60°C

Temperature range during installation (mobile state): 0°C - +50°C

Minimum Installation Bending Radius: 20 times the outer diameter

Minimum Operation Bending Radius: 10 times the outer diameter for unarmoured cables
20 times the outer diameter for armoured cables

MECHANICAL PROPERTIES

Maximum Compressive Load:	4000N for unarmoured cables 6000N for armoured cables
Repeated Impact:	4.4 N.m (J)
Twist (Torsion):	180×10 times, 125×OD
Cyclic Flexing:	25 cycles for armoured cables 100 cycles for unarmoured cables
Crush Resistance:	220N/cm(125lb/in)



FIBER COMPLIANCE

Temperature Cycling	IEC60794-1-2-F2
Tensile Strength	IEC60794-1-2-E1A
Crush	IEC60794-1-2-E3
Impact	IEC60794-1-2-E4
Repeated Bending	IEC60794-1-2-E6
Torsion	IEC60794-1-2-E7
Kink	IEC60794-1-2-E10
Cable Bend	IEC60794-1-2-E11
Cool Bend	IEC60794-1-2-E11



TYPE CODES

MLA-B-Cx D-E-F-G-H-I

Water blocking gel in tubes
 X: No water-blocking J: Water blocking gel between jackets;
 D: Dry water-blocking between cable jackets

Outer Sheath
 H: LSZH

Armour
 Blank: No armour
 STA: Corrugated steel tape
 SWA: Steel wire
 SWB: Armour steel wire braided

Inner Sheath
 2Y: PE
 Y: PVC
 H: LSZH

Central strength member
 S: Solid steel
 SR: Stranded steel
 F: Fiber reinforced plastic(FRP)

Fiber per Tubes: 2-12

C No of tubes: 1-36

Fiber Type
 4: 50/125 um(OM3) 7: NZDS SM fiber per ITU-T G.656
 5: 50/125 um(OM2) 8: NZDS SM fiber per ITU-T G.655
 6: 62.5/125um(OM1) 9: Standard SM fiber per ITU-T G.652.D

Loose Tube Diameter
 A: 2.0mm D: 3.0mm
 B: 2.5mm E: 3.2mm
 C: 2.8mm



Standard



Standard



Flame Retardancy
 NF C32-070-2.1(C2)
 IEC60332-1-2/EN50265-2-1



Reduced Fire Propagation
 NF C32-070-2.2(C1)
 IEC60332-3-24
 EN50266-2-4



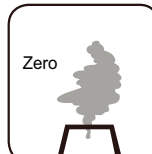
Low Toxicity
 NES 02-713/NF C 20-454



Low Corrosivity
 IEC60754-2
 EN50267-2-2/3
 NF C 32-074



Low Smoke Emission
 IEC 61034-1&2
 EN 50268-1&2/NF C32-073



Halogen Free
 IEC60754-1
 EN50267-2-1



Technical Information For Fiber Optic Cables

Optical & Geometrical Properties for Single Mode Fibers

Parameter		Standard Single Mode Fiber per ITU-T G.652D	Non-zero Dispersion Shifted fiber per ITU-T G.655	Non-zero Dispersion Shifted fiber per ITU-T G.656	Units
Fiber Code		9	8	7	
Attenuation, Loose Tube Cables		Standard	Metro Area	Long Haul	
	@1310nm	≤0.35	-	-	dB/km
	@1550nm	≤0.22	≤0.22	≤0.22	dB/km
	@1625nm	≤0.25	≤0.26	≤0.26	dB/km
Attenuation, Tight Buffer or Semi-Tight Cables					
	@1310nm	≤0.38	-	-	dB/km
	@1550nm	≤0.28	-	-	dB/km
Chromatic Dispersion	between 1260 and 1360nm (O Band)	≤3.5	NA-	-	ps/(nm*km)
	between 1460 and 1530nm (S Band)	-	-	2.0-7.0	ps/(nm*km)
	between 1530 and 1565nm (C Band)	≤18	1.0-10.0	7.0-10.0	ps/(nm*km)
	between 1565 and 1625nm (L Band)	≤22	7.0-12.0	10.0-14.0	ps/(nm*km)
Zero Dispersion Wavelength		1310±11	≤1520	≤1420	nm
Zero Dispersion Slope		0.093	0.093	0.093	ps/(nm ² .km)
Point Discontinuity at 1300nm & 1550nm		0.1	0.1	0.1	dB
Mode Field Diameter	@1300nm	9.3±0.5	-		um
	@1550nm	10.4±0.8	8.5±0.6	9.0±0.5	um
Cable Cut-off Wavelength		≤1260	≤1450	≤1310	nm
PMD (Individual fiber)		≤0.2	≤0.2	≤0.2	ps/km 1/2
Cladding Diameter		125±1	125±1	125±1	um

Core/Cladding Concentricity Error	≤0.5	≤0.5	≤0.6	um
Cladding Non-Circularity	≤1.0	≤1.0	≤1.0	%
Coating Non-Circularity	≤6.0	≤6.0	≤6.0	%
Primary Coating Diameter	245±10	245±10	245±10	um
Proof-Test Level	100 (0.7)	100 (0.7)	100 (0.7)	Kpsi/GN/m ²
Fatigue Coefficient	≥20	≥20	≥20	
Temperature Dependence between 0°C ~ +70°C @ 1310 & 1550nm	0.1	0.1	0.1	Db/km

Optical & Geometrical Properties for Multimode Fibers

Parameter		50/125		62.5/125	Units
Fiber Code		5	4	6	-
ISO/IEC 11801 Classification(2)		OM2	OM3	OM1	-
Attenuation, Loose Tube Cables					
@850nm		≤3.0		≤3.0	dB/km
@1300nm		≤0.8		≤0.8	dB/km
Attenuation, Tight Buffer and Semi-tight Cables					
@850nm		≤3.0		≤3.5	dB/km
@1300nm		≤1.0		≤1.0	dB/km
Bandwidth*	@850nm	≥500	≥2000	≥200	MHz*km
	@1300nm	≥800/500	≥500	≥500/600	MHz*km
Numerical Aperture		0.20±0.015		0.275±0.015	-
Core Diameter		50±3		62.5±3	um
Cladding Diameter		125±2		125±2	um
Core/Cladding Concentricity		≤1.5		≤1.5	um
Core Non-Circularity		≤6		≤6	%
Cladding Non-Circularity		≤2 1		≤2 1	%
Core/Cladding Offset		≤3		≤3	um
Coating Diameter		245±10		245±10	um
Proof-Test Level		100 (0.7)		100 (0.7)	Kpsi (GN/m ²)
Fatigue Coefficient		≥20		≥20	
Temperature Dependence between 0°C ~ +70°C		0.1		0.1	dB



Mechanical & Environmental Properties for Single Mode Fiber

Testing Parameters	EIA/ TIA-455 FOTP Number	IEC-794-1 Test Method	EN 187000 Test Method	Maximum Increased loss
Tensile Load & Bending	33	E1	501	<0.05dB (90%); <0.15dB (100%)
Low & High Temperature Bend	37	E11		<0.05dB (90%); <0.15dB (100%)
Compression loading (Crush)	41	E3	504	<0.05dB (90%); <0.15dB (100%) 440N/km(250lb/in) load
Impact Resistance	25	E4	505	<0.05dB (90%); <0.15dB (100%)
Twist (Torson)	85	E7	508	<0.05dB (90%); <0.15dB (100%)
Cyclic Flexing (Repeated Bending)	104	E6	509	<0.05dB (90%); <0.15dB (100%)
External freezing	98	F6		<0.05dB (90%); <0.15dB (100%)
Temperature Cycling	3	F1	601	<0.05dB (90%); <0.15dB (100%)
Fiber Stripability	178	B6		<8.9N(2lbf) on unaged and aged fiber; >1.3N(0.3lbf) on unaged and aged fiber
Cable Aging	82	F5		<0.1dB (90%); <0.25dB (100%)
Water Penetration	82	F5		No flow after 24 hours from 1 meter length of cable
Compound Flow (Drip)	81	E14		80°C 24 hours duration, no drip

Mechanical & Environmental Properties for Multi Mode Fiber

Testing Parameters	EIA/TIA-455 FOTP Number	IEC-794-1 Test Method	EN 187000 Test Method	Maximum Increased loss
Tensile Load & Bending	33	E1	501	<0.2dB
Low & High Temperature Bend	37	E11		<0.4dB
Compression loading (Crush)	41	E3	504	<0.2dB 440N/km(250lb/in) load
Cyclic Impact	25	E4	505	<0.4dB
Twist (Torsion)	85	E7	508	<0.2dB
Cyclic Flexing (Repeated Bending)	104	E6	509	<0.2dB
External freezing	98	F6		<0.2dB
Temperature Cycling	3	F1	601	<0.05dB (90%); <0.15dB (100%)
Fiber Stripability	178	B6		<13.4N(3lbf) on unaged fiber
Cable Aging	82	F5		<0.1dB (90%); <0.25dB (100%)
Water Penetration	82	F5		No flow after 24 hours from 1 meter length of cable
Compound Flow (Drip)	81	E14		80°C 24 hours duration, no drip



Technical Information

FLAME RETARDANCE IN ACCORDANCE WITH DIFFERENT STANDARDS

The following standards specify a method for flame propagation test for single core cables. The single cable sample undergoes the flame action of a bunsen burner. The test only lasts few minutes.

The IEC 60332-1 standards are taken over as EN standards and transferred to national standards Example: IEC 60332-1 becomes EN 60332-1 and introduced in Germany as DIN EN 60332-1.

Flame Retardance in accordance with EN 60332:2004

EN 60332:2004 Tests on electrical and optical cables under fire conditions. The standard applies to single insulated wires (cables) and requires a vertical flame test with a maximum flame climb of 450mm. The test lasts between 1 and 8 minutes, depending on the cable diameter.

EN 60332-1-1:2004 / BS EN 60332-1-1:2004 / IEC 60332-1-1:2004 / DIN EN 60332-1-1:2004 / VDE 0482-1-1:2005-06 Test on electrical and optical cables under fire conditions. Test for a vertical flame propagation for a single insulated wire or cables.

EN 60332-1-2:2004 / BS EN 60332-1-2:2004 / IEC 60332-1-2:2004 / DIN EN 60332-1-2:2004 / VDE 0482-1-2:2005-06 / CEI 60332-1-2(CEI 20-35/1-2) Tests on electrical and optical fiber cables under fire conditions. Test for a vertical flame propagation for a single insulated wire or cable – Procedure for 1kW premixed flame.

This standard specifies a method of test for resistance to vertical flame propagation for a single insulated wire or cable. Part 1-1 specifies the test apparatus and Part 1-2 specifies the test procedure.

The cable sample is deemed to 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 burning extends downward to a point greater than 540mm from the lower edge of the top support.

EN 60332-1-2:2004 specifies the use of 1kW premix flame and is for general use, except that the procedure may not be suitable for the testing of small insulated conductors or cables of less than 0.5mm sq cross section because the conductor melts before the test is completed, or for the testing of small optic fiber cables because the fiber will be broken before the test is completed. In this case, the procedure given by EN 60332-2-1/2 is recommended.

EN 60332-2-1:2004 / BS EN 60332-2-1:2004 / IEC 60332-2-1:2004 / DIN EN 60332-2-1:2004 / VDE 0482-2-1:2005-06 Tests on electrical and optical cables under fire conditions. Test for a vertical flame propagation for a single small insulated wire or cable.

EN 60332-2-2:2004 / BS EN 60332-2-2:2004 / IEC60332-2-2:2004 / DIN EN 60332-2-2:2004 / VDE 0482-2-2:2005-06 / CEI 60332-2-2 (CEI 20-35/2-2) Test on electric and optical fiber cables under fire conditions. Tests for vertical flame propagation for a single small insulated wire or cable. Procedure for diffusion flame.

This test applies to small dimensions cables.

This standard specifies a method of test for resistance to vertical flame propagation for a single

insulated wire or cable. Part 2-1 specifies the test apparatus and Part 2-2 specifies the test procedure.

Flame Retardance in accordance with NF C32-070-2.1(C2)

NF C32-070:2001 Insulated conductors and cables for installation - Classification tests on conductors and cables with regard to fire behavior.

NF C32-070 2.1 Procedure for 1 kW pre-mixed flame.

The NF F 32070 2.1 (Category C2) and IEC 60332-1-2 are very similar. The sole difference is the time during which the flame is applied.

Flame Retardance in accordance with EN 50265-1:1999 (replaced by EN 60332)

EN 50265-1:1999 / BS EN 50265-1:1999 / DIN EN 50265-1:1999 / VDE 0482-265-1:1999-04 – Common test methods for cables under fire conditions. Test for resistance to a vertical flame propagation for a single insulated conductor or cable. Apparatus (Replaced by EN 60332-1-1:2004 and EN 60332-2-1:2004).

EN 50265-2-1:1999 / BS EN 50265-2-1:1999 / DIN EN 50265-2-1:1999 / VDE 0482-265-2-1:1999-04 – Common test methods for cables under fire conditions. Test for resistance to a vertical flame propagation for a single insulated conductor or cable. Part 2-1: Procedure 1kW pre-mixed flame (Replaced by EN 60332-1-2:2004).

EN 50265-2-2:1999 / BS EN 50265-2-2:1999 / DIN EN 50265-2-2:1999 / VDE 0482-265-2-2:1999-04 – Common test methods for cables under fire conditions. Test for resistance to a vertical flame propagation for a single insulated conductor or cable. Part 2-2: Procedure Diffusion flame (Replaced by EN 60332-2-2:2004).

Flame Retardance in accordance with BS 4066 Part 1 & 2 (replaced by EN 60332)

BS 4066-2:1980 (superseded) – Tests on electric cables under fire conditions. Method of test on a single vertical insulated wire or cable.

This standard is no longer in force and is replaced by BS EN 50265-2-1 which was also superseded by BS EN 60332-1:2009.

Flame Retardance in accordance with NBN C 30-004 (cat. F1)

NBN C 32-004 specifies a method of test for measuring the vertical flame propagation characteristics of a single wire or cable. The cable specimen is deemed to have passed the test and categorized as F1 if after burning has ceased, the charred or affected portion does not reach within 50mm of the lower edge of the top clamp which is equivalent to 425mm above the point of flame application.

Flame Retardance in accordance with IEEE 383

In the IEEE 383 test, cables are supported by a one foot wide vertical rack eight feet high. The cables are positioned in the centre six inches of the rack, spaced one-half diameter apart. The rack is centered in an eight foot enclosure. A ten inch ribbon burner ignites the cable with a 21 kW (70000 BTU). The burner is positioned 2 feet above the floor and 9 to 12 inches of cables are exposed to direct flames for 20 minutes. Cables on which flame extends above the top of the 8 foot rack fail the test.



REDUCED FIRE PROPAGATION IN ACCORDANCE WITH DIFFERENT STANDARDS

These standards specify a method for fire propagation test for vertically mounted bunched cables. These tests simulate the chimney effect in vertical installation of bunch of cables. A certain number of cable sections with a length of 3.5 m is fastened to a vertical ladder in an adapted chamber. The amount of combustible materials for cables and duration of flame application depends on the category the cable has to meet.

Resistance of the wires bundle arranged vertically to the spread of the flame should be such that after a certain time and stopping the source of ignition, flame is extinguished by itself and the length of charred fragments will not exceed 2.5 m in height measured above the lower edge of the burner.



Reduced Fire Propagation in accordance with IEC 60332-3

This test is the most common one to verify the behaviour of a cables for the fire propagation. The cables are installed on a bunch of vertical ladder inside a metal cabinet and undergo the action of a ribbon flame at 750°C. The standard is subdivided in several parts that differ one from the other for the quantity of cable to be installed, the installation mode and the flame application time.

EN 60332-3-10:2009 / BS EN 60332-3-10:2009 / IEC 60332-3-10 ed1.1 / DIN EN 60332-3-10:2009 / VDE 0482-332-3-10:2010-08 – Common test methods for cables under fire conditions. Tests on electric and optical fiber cables under fire conditions - Part 3-10: Test for vertical flame spread of vertically mounted bunched wires or cables.

EN 60332-3-21:2009 / BS EN 60332-3-21:2009 / IEC 60332-3-21 ed1.1 / DIN EN 60332-3-21 / VDE 0482-332-3-21:2010-08 / CEI EN 60332-3-21:2009 (CEI 20-22/3-1)– Procedures. Tests on electric and optical fiber cables under fire conditions - Part 3-21: Test for vertical flame spread of vertically-mounted bunched wires or cables - Category A . F/R

- Installation In one layer (front).

- Installation In two layers (front and rear)

- The quantity of the Installed cable is equal to 7 litres/m of combustible materials for cables

- The time of application of the flame is 40 minutes

EN 60332-3-22:2009 / BS EN 60332-3-22:2009 / IEC 60332-3-22 ed1.1 / DIN EN 60332-3-22:2009 / VDE 0482-332-3-22:2010-08 / CEI EN 60332-3-22:2009 (CEI 20-22/3-2)– Procedures. Tests on electric and optical fiber cables under fire conditions - Part 3-22: Test for vertical flame spread of vertically-mounted bunched wires or cable - Category A

- Installation In one layer (front).

- The quantity of the installed cable is equal to 7 litres/m of combustible materials for cables

- The time of application of the flame is 40 minutes

EN 60332-3-23:2009 / BS EN 60332-3-23:2009 / IEC 60332-3-23 ed1.1 / DIN EN 60332-3-23:2009 / VDE 0482-332-3-23:2010-08 / CEI EN 60332-3-23:2009 (CEI 20-22/3-3)– Procedures. Tests on

electric and optical fiber cables under fire conditions - Part 3-23: Test for vertical flame spread of vertically-mounted bunched wires or cables - Category B

- Installation In one layer (front).
- The quantity of the installed cable is equal to 3.5 litres/m of combustible materials for cables
- The time of application of the flame is 40 minutes

EN 60332-3-24:2009 / BS EN 60332-3-24:2009 / IEC 60332-3-24 ed1.1 / DIN EN 60332-3-24:2009 / VDE 0482-332-3-24:2010-08 / CEI EN 60332-3-24:2009 (CEI 20-22/3-4) – Procedures. Tests on electric and optical fiber cables under fire conditions - Part 3-24: Test for vertical flame spread of vertically-mounted bunched wires or cables - Category C

- Installation In one layer (front).
- The quantity of the installed cable is equal to 1.5 litres/m of combustible materials for cables
- The time of application of the flame is 20 minutes

EN 60332-3-25:2009 / BS EN 60332-3-25:2009 / IEC 60332-3-25 ed1.1 / DIN EN 60332-3-25: 2009 / VDE 0482-332-3-25:2010-08 / CEI EN 60332-3-25:2009 (CEI 20-22/3-5)– Procedures. Tests on electric and optical fiber cables under fire conditions - Part 3-25: Test for vertical flame spread of vertically-mounted bunched wires or cables - Category D

- Installation In one layer (front).
- The quantity of the installed cable is equal to 0.5 litres/m of combustible materials for cables
- The time of application of the flame is 20 minutes.



Summary of test condition:

IEC	60332-3-21	60332-3-22		60332-3-23		60332-3-24		60332-3-25	
BS EN 50266	50266-2-1	50266-2-2		50266-2-3		50266-2-4		50266-2-5	
CEI	20-22/3-1	20-22/3-2		20-22/3-3		20-22/3-4		20-22/3-5	
Category	AF/R	A		B		C		D	
Conductor cross-sections mm ²	>35	>35	≤35	>35	≤35	>35	≤35	>35	≤35
NMV(litres per metre of cable)	7	7		3.5		1.5		0.5	
Minimum length of test pieces(m)	3.5	3.5		3.5		3.5		3.5	
Standard ladder (500 mm wide): • number of layers • maximum width of test sample	1front+1rear 300mm	≥1front 300mm	1front 300mm	- -	≥1front 300mm	1front 300mm	≥1front 300mm	1front 300mm	≥1front 300mm



Wide ladder (800 mm wide): • number of layers • maximum width of test sample	- -	- -	- -	1 front 600mm	- -	- -	- -	- -
Positioning of test pieces	Spaced 0.5×Diameter cable (Max.20mm)	Touching	Spaced 0.5×Diameter cable (Max.20mm)	Touching	Spaced 0.5×Diameter cable (Max.20mm)	Touching	Spaced 0.5×Diameter cable (Max.20mm)	Touching
Number of burners	1	1	1	2	1	1	1	1
Ladder mounting	Front and rear	Front, Wider ladder for larger cables			Front	Front		Front
Flame application time(min)	40	40	40		40	40	40	40
Test conditions	Wind speed: <8 m/s; Temperature: 5°C - +40°C							
Extent of the charred portion	≤2.5m above the bottom edge of the burner, neither at the front nor at the rear of the ladder.							

Reduced fire propagation in accordance with NF C32-070-2.2(C1)

NF C32-070 :2001 Insulated conductors and cables for installation.

-Classification tests on conductors and cables with regard to fire behavior.

A 1600mm vertically installed bundled of cable is exposed to the effects of a radiating oven (approx 830°C) and forced ventilation. Pilot flames arranged above the oven burn off the emitted gases. The test duration is 30 minutes, with the ventilation stopped for every 10 minutes during the flame application period. The cable sample is classified under Category C1 according to NF F 32070-2.2 if the carbonised part of the cable sample does not extend more than 0.8m above the upper base of the oven.

Depending on the damaged length, they can be further classified into 4 classes A, B, C and D according to NF F 16-101 as follows:

Category	Test Result
A	No damaged length from top of the oven in upper position.
B	Damaged length from top of oven in upper position not extending more than 50mm.
C	Damaged length from top of oven in upper position not extending more than 300mm
D	Damaged length from top of oven in upper position not extending above the top of the chimney

Reduced Fire Propagation in accordance to EN 50266-1, EN 50266-2-2, EN 50266-2-3, EN 50266-2-4.

EN 50266-1:2001 / BS EN 50266-1:2001 / DIN EN 50266-1:2001 / VDE 0482-266-1:2001-09– Common test methods for cables under fire conditions. Test for vertical flame spread of vertically mounted bunched wires or cables - Part 1: Apparatus (Replaced by EN 60332-3-10:2009)

EN 50266-2-1:2001 / BS EN 50266-2-1:2001 / DIN EN 50266-2-1:2001 / VDE 0482-266-2-1:2001-09 / CEI EN 50266-2-1– Common test methods for cables under fire conditions. Test for vertical flame spread of vertically mounted bunched wires or cables - Part 2-1 : Procedures. Category A F/R (Replaced by EN 60332-3-21:2009)

EN 50266-2-2:2001 / BS EN 50266-2-2:2001 / DIN EN 50266-2-2:2001 / VDE 0482-266-2-2:2001-09 / CEI EN 50266-2-2– Common test methods for cables under fire conditions. Test for vertical flame spread of vertically mounted bunched wires or cables - Part 2-2: Procedures. Category A (Replaced by EN 60332-3-22:2009)

EN 50266-2-3:2001 / BS EN 50266-2-3:2001 / DIN EN 50266-2-3:2001 / VDE 0482-266-2-3:2001-09 / CEI EN 50266-2-1– Common test methods for cables under fire conditions. Test for vertical flame spread of vertically mounted bunched wires or cables - Part 2-3: Procedures. Category B (Replaced by EN 60332-3-23:2009)



EN 50266-2-4:2001 / BS EN 50266-2-4:2001 / DIN EN 50266-2-4:2001 / VDE 0482-266-2-4:2001-09 / CEI EN 50266-2-4:2001 – 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 (Replaced by EN 60332-3-24:2009).

Reduced Fire Propagation in accordance with BS 4066-3

BS 4066-3:1994 (superseded) – Tests on electric cables under fire conditions. Tests on bunched wires or cables.

This standard is no longer in force and is replaced by the BS EN 50266-1:2001

Reduced Fire Propagation in accordance with NBN C 32-004 (F2)

NBN C 32-004 specifies a method of test for measuring the vertical flame propagation characteristics of a bunch of cables. The cable specimen is deemed to have passed the test and categorized as F2 if after burning has ceased, the extent of charred or affected portion does not reach a height exceeding 2.5m above the bottom edge of the burner.

HALOGEN CONTENT TEST IN ACCORDANCE WITH DIFFERENT STANDARDS

In the event of a fire, many fumes are produced. This test is concerned with the possibilities of corrosive acid gases being released from halogen containing cables and the damage such cables can cause (to equipments). These standards specify a method for determination of the amount of halogen acid gas, evolved during combustion of compound.



Halogen Content Test in accordance with EN 50267-2-1

EN 50267-2-1:1998 / BS EN 50267-2-1:1999 / DIN EN 50267-2-1:1999 / VDE 0482-267-2-1:1999-04 / CEI EN 50267-2-1:1999 (CEI 20-37/2-1) Common test methods for cables under fire conditions- Test on gases evolved during combustion of materials from cables- Part 2-1: Procedures. Determination of the amount of halogen acid gas.

This part of the standard defines the method to measure the amount of halogen acid evolved and



which should be expressed in hydrochloric acid. The amount of halogen acid contained in the test solution is determined by a titration method.

If the cables are described as zero halogen or halogen free, it is recommended that the hydrochloric acid yield should be less than 0.5%.

Halogen Content Test in accordance with IEC 60754-1

IEC 60754-1 ed 2.0 Common test methods for cables under fire conditions. Test on gases evolved during combustion of materials from cables. Part 1: Procedures. Determination of the amount of halogen acid gas.

Basically, this is same as EN 50267-2-1.

Halogen Content Test in accordance with BS 6425-1

BS 6425-1:1990(superseded): Test on gases evolved during the combustion of materials from cables. Method for determination of amount of halogen acid gas evolved during combustion of polymeric materials taken from cables.

This standard is no longer in force and is replaced by the EN 50267-2-1.

ACID GAS EMISSION TEST IN ACCORDANCE WITH DIFFERENT STANDARDS

The following standards specify a method for determination of acidity of gas evolved during combustion of cables by measuring PH and conductivity. This test allows to determine the corrosivity of the acid gases generally halogens, that develop during the electric cable combustion.

Acid Gas Emission Test in accordance with EN 50267-2-2

EN 50267-2-2:1999 / BS EN 50267-2-2:1999 / DIN EN 50267-2-2:1999 / VDE 0482-267-2-2:1999-04 / CEI EN 50267-2-2:1999 (CEI 20-37/2-2). Common test methods for cables under fire conditions- Test 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

The standard states that the pH and the conductivity of a test solution should be measured, using calibrated PH and conductivity meters.

If the cables are described as zero halogen or halogen free, it is recommended that at least both of the following requirements should be met for each of the individual materials of a cable:

- The PH value should not be less than 4.3 when related to 1 litre of water

- The conductivity should not be less than 10us/mm when related to 1 litre of water



EN 50267-2-3:1999 / BS EN 50267-2-3:1999 / DIN EN 50267-2-3:1999 / VDE 0482-267-2-3:1999-04 / CEI EN 50267-2-3:1999 (CEI 20-37/2-3). Common test methods for cables under fire conditions- Test on gases evolved during combustion of materials from cables- Part 2-3:Procedures. Determination of degree of acidity of gases for cables by determination of the weighted average of pH and conductivity.

The standard states that the pH and the conductivity of a test solution should be measured, using calibrated pH and conductivity meters. The results from the different components of the cable are then weighted.

Acid Gas Emission Test in accordance with IEC 60754-2

IEC 60754-2 ed1.0 Test on gases evolved during combustion of electric cables - Part 2 : Determination of degree of acidity of gases evolved during combustion of materials taken from electric cables by measuring pH and conductivity.

Acid Gas Emission Test in accordance with NF C32-074

NF C32-074 Common test methods for cables under fire conditions - Test on gases evolved during combustion of materials from cables. This standard is equivalent to IEC 60754-2

Acid Gas Emission Test in accordance with BS 6425-2

BS 6425-2:1993 (superseded) Test on gases evolved during the combustion of materials from cables.

Determination of degree of acidity (corrosivity) of gases by measuring pH and conductivity.

This standard is no longer in force and is replaced by the EN 50267-2-2:1999.

Acid Gas Emission Test in accordance with DIN VDE 0472-813 / VDE 0472-813:1994

DIN VDE 0472-813 / VDE 0472-813:1994 Corrosivity of combustion gases.

The standards are no longer in force and are replaced by the EN 50267-2-2 & VDE 0482-267-2-2.

SMOKE DENSITY TEST IN ACCORDANCE WITH DIFFERENT STANDARDS

The smoke density measurement taken from a material under fire conditions gives an indication of the visibility through the smoke. This is important as reduced visibility in a real fire situation makes it more difficult to escape from the fire thus increasing the threat to human life from the toxic gas, fumes and heat

The following standards specify the method for measuring the generation of smoke from cables during fire.

Smoke Density Test in accordance with IEC 61034-1 & IEC 61034-2

IEC 61034-1:2005 / EN 61034-1:2005 / BS EN 61034-1:2005 / DIN EN 61034-1:2006 / VDE 0482-1034-1:2006 Measurement of smoke density of cables burning under defined conditions. Part 1: Test apparatus



IEC 61034-2:2005 / EN 61034-2:2005 / BS EN 61034-2:2005 / DIN EN 61034-2:2006 / VDE 0482-1034-2:2006 / CEI EN 61034-2:2006 (CEI 20-37/3-1) Measurement of smoke density of cables burning under defined conditions.
Part 2: Test procedure and requirements.

The standard specifies a method of measurement of smoke density of cables. Part 1 specifies the



test apparatus and Part 2 specifies the test procedure.

The test is usually performed inside a chamber of 3m x3m x3m and the test is sometimes described as 3 metre cube test. The test is performed by monitoring the transmittance reduction of a white light beam, running from one side of the chamber to the other, at a set height, thus monitoring the build up of smoke inside the chamber. The minimum percentage of light transmittance is often used to determine if the cable has passed or failed the test, often a minimum light transmittance of 60% is applied in order to classify a cable as low smoke.

Smoke Density Test in accordance with NF C32- 073

NF C32 073 Common test methods for cables under fire conditions.

- Measurement of smoke density of cables burning under defined conditions.

This standard is equivalent to IEC 61034-2

Smoke Density Test in accordance with BS 7622-1 & BS 7622-2

BS 7622-1:1993 (superseded) – Measurement of smoke density of electric cables burning under defined conditions. Test apparatus.

BS 7622-2:1993 (superseded) – Measurement of smoke density of electric cables burning under defined conditions. Test procedure and requirements.

The standards are no longer in force and were replaced by the EN 50268-1:2000 and EN 50268-2:2000 even though they too were superseded by EN 61034-1:2005 and EN 61034-2:2005.

Smoke Density Test in accordance with EN 50268-1 & EN 50268-2

EN 50268-1:2000 / BS EN 50268-1:2000 / DIN EN 50268-1:2000 / VDE 0482-268-1:2000 (superseded) – Common test methods for cables under fire conditions. Measurement of smoke density of cable burning under defined conditions. Part 1: Apparatus

EN 50268-2:2000 / BS EN 50268-2:2000 / DIN EN 50268-2:2000 / VDE 0482-268-2:2000 (superseded) – Common test methods for cables under fire conditions. Measurement of smoke density of cable burning under defined conditions. Part 2: Procedure.

The standards are no longer in force and are replaced by the EN 61034-1:2005 and EN 61034-2:2005. Although these standards have been withdrawn, they are still called upon in some specification documents such as in the London Underground specification 1-085.

Smoke Density Test In Accordance with DIN VDE 0472-816 / VDE 0472-816:1994

DIN VDE 0472-816/VDE 0472-816:1994 Testing of cables, wires and flexible cords. Smoke Density.

The standards are no longer in force and are replaced by the EN 50268-1, VDE 0482-268-1, EN 50268-2 & VDE 0482-268-2 which are also replaced by the EN 61034-1:2005 and EN 61034-2:2005.

OXYGEN INDEX TEST IN ACCORDANCE WITH DIFFERENT STANDARDS

The oxygen index is defined as the minimum concentration of oxygen, expressed as volume percentage, in a mixture of oxygen and nitrogen that will just support combustion of a material initially at room temperature under specified test conditions.

Oxygen Index Test in accordance with ASTM D 2863

ASTM D 2863-10 Measuring the minimum oxygen concentration to support candle-like combustion of plastics (Oxygen Index).

The test is performed in accordance with the procedure specified in ASTM 2863-95 using test piece cut from the outer sheath of the cable. The apparatus holds a small specimen which is clamped vertically in a tube in an atmosphere where the relative concentration of oxygen and nitrogen can be changed. The aim is to test the flammability of the sample with a small pilot flame to find the minimum oxygen concentration required to just sustain combustion of the sample.



Oxygen Index Test in accordance with ISO 4589-2

ISO4589-2:1996 Determination of burning behaviour by oxygen index Part 2: Ambient temperature test.

Specimens measuring 100mm long by 6mm wide are used for testing. The test is performed in accordance with the procedure specified in the standard.

TEMPERATURE INDEX TEST IN ACCORDANCE WITH DIFFERENT STANDARDS

This is a test for assessing the performance of a material when it is tested in accordance with BS2782: Part 1: Method 143a and 143b. The oxygen index of a material will drop when the temperature rises. When the temperature rises and the oxygen index drops to 21%, the material will burn automatically. This temperature is defined as temperature index. For example, the oxygen index of the coal at room temperature is 50% and when the temperature climbs to 150°C, it's oxygen index drops to 21°C and the coal will burn by itself automatically. The temperature index of the coal is defined as 150°C. In general, the temperature index of fire retardant cable exceeds 250°C.



Temperature Index Test in accordance with BS 2782

BS 2782: Part 1:1989 Method 143a and 143b Temperature of materials. Determination of flammability.

Specimens measuring nominally 100mm long by 6.5mm wide by 3mm thick are used for testing. The specimens are then tested in accordance with the test procedure specified in the standard.

Temperature Index Test in accordance with ISO 4589-3

ISO4589-3:1996 Determination of burning behaviour by oxygen index Part 3: Elevated temperature test.

Specimens measuring 100mm long by 6mm wide are used for testing. The test is performed in accordance with the procedure specified in the standard.

TOXICITY TEST IN ACCORDANCE WITH DIFFERENT STANDARDS

Toxicity test in accordance with NES 02-713

Measuring a fume from a material exposed to a controlled fire conditions gives an indication of the



fumes which may be produced in a real fire situation. A standard method of test for determining the toxicity of materials under fire condition is Defense Standard NES 02-713- Toxicity. This method gives the level of toxicity of the fumes produced from the material under test. During the test, the test specimen is heated via direct flame application at 1150°C.

The flame is applied via a bunsen burner with a flame height of between 100mm and 125mm formed with a methane gas and an external supply of compressed air. The specimen toxicity is determined from accurate pre-analysis weight (4pp) colorimetric tubes and ion chromatography.

The test may determine the following species: Hydrogen Bromide, Hydrochloric Acid, Hydrogen Fluoride, Formaldehyde, Nitrous gases, Carbon Monoxide, Carbon Dioxide, Acrylonitrile, Phenol, Hydrogen Sulphide, Sulphur Dioxide, Hydrocyanic Acid, Ammonia. The concentration in ppm for each gas detected are provided. The toxicity index of the specimens summates the toxic gases, taking into account of their level of danger to humans. The smaller the toxicity index, the better the product. A limit of 5 is often applicable.

Toxicity test in accordance with NF C 20-454

NF C 20-454 base environmental testing procedures. Fire behaviour. Analysis and titration of gases evolved during pyrolysis or combustion of materials used in electrotechnics. Exposure to abnormal heat or fire. Tube furnace method.



The test defined by this standard serves to define the conventional toxicity index (cti) of the gases emitted by the insulating or sleeving materials during combustion at 800°C.

Toxicity test in accordance with NF X 70-100

NF X 70-100 Fire Tests; Analysis of gaseous effluents.

The test is conducted within a tube furnace where the temperature is set at either 400°C, 600°C, 800°C (commonly 600°C is used for most of the materials or 800°C for some electrical products) for 40 minutes throughout the test by analysis of the toxicity index of the gases including CO, CO₂, HCL, HBr, HCN, HF and SO₂.



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