Low Voltage Cables

Flexible Cables Product Catalogue

Tai Sin®

CONTENTS

INTRODUCTION

Since our incorporation in 1980 as Tai Sin Electric Cables Manufacturer Pte Ltd, we have expanded and diversified over the past three decades to establish ourselves as the present Tai Sin Electric Limited. To cater for the robust growth in the regional market, Tai Sin now operates three cable manufacturing plants located in Singapore, Malaysia and Vietnam, all of which are fully equipped with the latest manufacturing facilitates and technologies to meet increasing demands.

Tai Sin stocks the widest range of the Power, Control, Instrumentation and Safety Cables for use in all areas of electrical and instrumentation installation for commercial, residential, industrial and infrastructure projects. Our cables and wires are manufactured under strict quality control and designed to perform within fixed parameters of electrical, mechanical and environmental tolerances and we assure you that our products will not present a safety hazard if used with care.

For 30 years, we have grown steadily based on a sound business philosophy of providing quality products using leading edge technology, backed by unfailing excellence in customer service and faster turnaround time to maintain customer loyalty. These are the beliefs and values that give us the strength and confidence to continue to grow, excel and succeed in the exciting years ahead.

This catalogue illustrates the construction of our standard range of PVC & XLPE Cables & Wires, our Eco-Friendly, Non-Toxic range of Low Smoke Zero Halogen Flame Retardant Cables and our range of Low Smoke Zero Halogen Flame Retardant Fire Resistant Cables comply to various local and international standards.

Every possible effort has been made to ensure that the information contained in this publication is correct and current at the time of printing. Tai Sin reserves the right to change the information and/or specifications at any time without notice in light of technical improvement and continued development.

Reference to or extracts from the Singapore Standards (SS), British Standards (BS), International Electrotechnical Commission Standards (IEC), Singapore Productivity & Standard Board CP5:1998 manual, current IEE Wiring Regulations or other regulatory bodies are made with the belief that they are true and accurate. Users are recommended to verify such claims with the respective organisations independently.

Tables and data in Appendices A, B & C in this catalogue have been extracted with thanks from the IEE Wiring Regulations, 17th Edition and BS 7671: 2008.

We hope that this catalogue will be useful to engineers and end-users to serve as their full reference guidelines.

HOW TO READ THIS CATALOGUE

This catalogue consists of three types of Low Voltage Cables and they are categorized into three different sections, 1) PVC & XLPE Insulated Cables, 2) Low Smoke Zero Halogen Flame Retardant Cables and 3) Low Smoke Zero Halogen Flame Retardant Fire Resistant Cables. In each section, the cables are further categorized by its electrical component and conductor sizes, which ranges from 0.5mm^2 to 1000mm^2, armoured and non- armoured and with or without copper-taped screened.

In this catalogue we have given each cable a name accompanied with the various short and long descriptions based on its material used.

For example:

FR-XSH

CU / MGT / XLPE / LSZH / SWA / LSZH **(2 CORES - 5 CORES)** ← ***This is the short description***

Mica Taped, XLPE Insulated, LSZH Bedded, Galvanised Steel Wire Armoured, LSZH Sheathed Cable, 600/1000V, BS7846 ← ***Full description on the third line***

To better understand the contents of the cable, we have included a 3-dimensional image plus a cross-sectional image of the cable for easy reference of its structure and components. The technical specifications and figures are provided by our quality team to ensure the accurate use of our products. Technical properties such as Current Rating Factor and Voltage drop, and other essential technical details are provided in the Appendices at the last section of this catalogue. The latest Cable Installation Methods as well as the new harmonized wiring colour codes (as per IEE Wiring Regulations, 17th Edition) are also provided in our Appendices for your easy reference.

For all other enquiries, please feel free to contact our friendly customer service hotline for further assistance.

APPLICABLE STANDARDS

Below are the applicable standards that are used as reference in the construction of our low voltage cables.

ASTM D 2863
Measuring the minimum oxygen concentration to support candle-like combustion of plastic (oxygen index).

BS2004 (Specification Withdrawn)
PVC insulated cables and flexible cords for electric power and lighting.

BS6231
Electric cables, single-core PVC insulated flexible cables of rated voltage 600/1000V for switchgear and control-gear wiring.

BS6346 (Specification Withdrawn)
(withdrawn with no replacement) Electric cables, PVC insulated, armoured cables for voltages of 600/1000V and 1900/3300V.

BS6360
(withdrawn and replaced by BS EN60228:2005) Specification for conductors in insulated cables and cords.

BS6387 / SS299
Performance requirements for cables required to maintain circuit integrity under fire conditions.

BS6724
600/1000V armoured electric cables having thermosetting insulation and low emission of smoke and corrosive gases when affect by fire.

APPLICABLE STANDARDS

Below are the applicable standards that are used as reference in the construction of our low voltage cables.

BS7629-1
300/500V fire-resistant screened cables having low emission of smoke and corrosive gases when affect by fire.
Part 1: Multicore and Multi-pair Cables.

BS7846
600/1000V armoured fire-resistant electric cables having low emission of smoke and corrosive gases when affected by fire.

BS EN50288-7
Multi-element metallic cables use in analogue and digital communication and control.
Part 7: Sectional specification for instrumentation and control cables.

BS EN50525-2-31
Single core non-sheathed cables with thermoplastic PVC insulation.

BS EN50525-3-41
Single core non-sheathed cables with halogen-free crosslinked insulation, and low emission of smoke.

BS EN60228
Conductors of insulated cables.

IEC60227-3
Polyvinyl Chloride insulated cables of rated voltages up to and including 450/750V
Part 3: Non-sheathed cables for fixed wiring.

IEC60228
Conductors of insulated cables.

IEC60331
Fire-resistant characteristics of electric cables.

IEC60332-1 / BS EN60332-1
Tests in electric cables under fire conditions.
Part 1: Method of test on a single vertical insulated wire or cable.

IEC60332-3-22 / BS EN60332-3-22
Tests on electric and optical fibre cables under fire conditions.
Part 3-22: Test for vertical flame spread of vertically-mounted bunched wires or cables (Category A).

IEC60332-3-24 / BS EN60332-3-24
Tests on electric and optical fibre cables under fire conditions.
Part 3-24: Test for vertical flame spread of vertically-mounted bunched wires or cables (Category C).

IEC60502-1
Power cables with extruded insulation and their accessories for rated voltages from 1kV up to 30kV.
Part 1: Cables for Rated Voltages of 1kV and 30kV.

IEC60754-1 / BS EN60754-1
Tests on gases evolved during the combustion of materials from cables.
Part 1: Methods of determination of amount of halogen acid gas evolved during combustion of polymeric materials taken from cables.

IEC60754-2 / BS EN60754-2
Tests on gases evolved during combustion of materials from cables.
Part 2: Determination of degree of acidity (corrosive) of gases by measuring pH and conductivity.

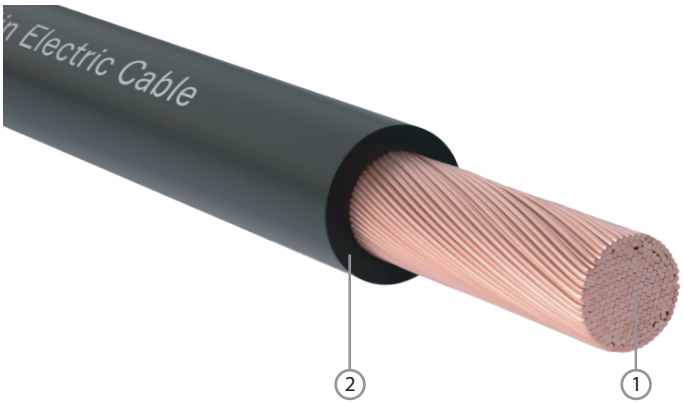
IEC61034-2 / BS EN61034-2
Measurement of smoke density of electric cables burning under defined conditions.
Part 2: Test procedure and requirements.

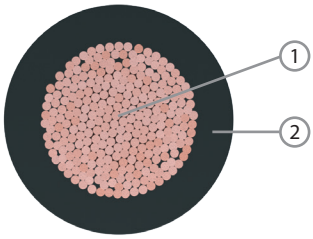
SS358-3
Polyvinyl Chloride insulated cables of rated voltages up to and including 450/750V.
Part 3: Non-sheathed cables for fixed wiring.

FRT-Z-F

CU / LSZH (SINGLE CORE)

Cross-Linked LSZH Insulated Non-Sheathed Cable, 450/750V (600/1000V*), BS EN50525-3-41





Component
1. Plain Annealed Copper Wire
2. Low Smoke Zero Halogen (LSZH) Compound

CONSTRUCTION

Conductor:	Plain Annealed Flexible Copper, Class 5 Stranded Circular
Insulation:	Cross-linked Low Smoke Zero Halogen (LSZH) Compound with Anti-Termite Characteristic and UV Resistant
Insulation Colour:	Black / Other colour upon request

REFERENCE STANDARDS

Design Specification:	BS EN50525-3-41
Conductor:	IEC60228, BS EN60228
Flame Retardancy:	IEC60332-3-24, BS EN60332-3-24
Low Smoke Zero Halogen:	IEC61034-2, BS EN61034-2 IEC60754-1, IEC60754-2 BS EN60754-1, BS EN60754-2

ELECTRICAL CHARACTERISTICS

Operating Voltage:	450/750V (600/1000V*)
Operating Temperature:	-15°C to 90°C
Final Short Circuit Temperature:	250°C
Test Voltage:	3.5kV for 5 minutes

INSTALLATION REFERENCE

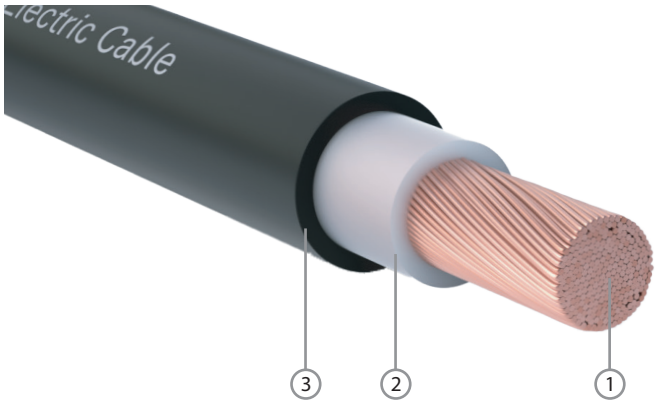
Min. Bending Radius (mm):	6 x cable overall diameter
Max. Pulling Tension (N/mm^2):	15

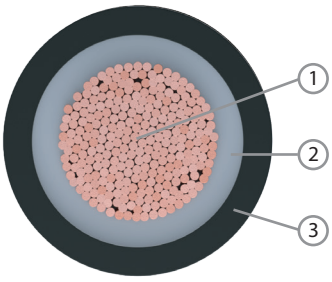
	Nominal Conductor Area (mm^2)	Approx Conductor Diameter (mm)	Insulation Thickness (mm)	Approx Cable Overall Diameter (mm)	Approx Cable Weight (kg/km)	Current Rating 1 or 3 Phase a.c [Air 30°C] (A)	Voltage Drop (V/A/km)	Minimum Insulation Resistance at Ambient (MΩ.km)	Maximum Conductor Resistance at 20°C (Ω/km)
SINGLE CORE	1 x 1.5	1.5	0.7	3.0	19	22	29.40	2000	13.3
	1 x 2.5	2.0	0.8	3.7	31	30	17.60	2000	7.98
	1 x 4	2.5	0.8	4.2	45	40	10.90	2000	4.95
	1 x 6	3.5	0.8	5.2	69	51	7.29	2000	3.30
	1 x 10	4.5	1.0	6.7	114	70	4.22	2000	1.91
	1 x 16	5.7	1.0	8.0	175	94	2.68	2000	1.21
	1 x 25	7.5	1.2	10.1	265	125	1.74	2000	0.780
	1 x 35	8.9	1.2	11.5	359	155	1.24	2000	0.554
	1 x 50	10.5	1.4	13.5	509	196	0.88	2000	0.386
	1 x 70	12.6	1.4	15.6	704	248	0.63	2000	0.272
	1 x 95	14.1	1.6	17.5	903	298	0.49	1000	0.206
	1 x 120	16.0	1.6	19.4	1170	354	0.40	1000	0.161
	1 x 150	18.4	1.8	22.2	1455	409	0.34	1000	0.129
	1 x 185	19.8	2.0	24.0	1768	470	0.30	1000	0.106
	1 x 240	22.8	2.2	27.4	2320	565	0.25	1000	0.0801

FRT-ZH-F

CU / EPR / LSZH (SINGLE CORE)

EPR Insulated, LSZH Sheathed Cable, 600/1000V, IEC60502-1





Component
1. Plain Annealed Copper Wire
2. Ethylene Propylene Rubber (EPR)
3. Low Smoke Zero Halogen (LSZH) Compound

CONSTRUCTION

Conductor:	Plain Annealed Flexible Copper, Class 5 Stranded Circular
Insulation:	Ethylene Propylene Rubber (EPR)
Insulation Colour:	Natural
Outer Sheath:	Low Smoke Zero Halogen (LSZH) Compound with Anti-Termite Characteristic and UV Resistant
Outer Sheath Colour:	Black / Other colour upon request

ELECTRICAL CHARACTERISTICS

Operating Voltage:	600/1000V
Operating Temperature:	-15°C to 90°C
Final Short Circuit Temperature:	250°C
Test Voltage:	3.5kV for 5 minutes

REFERENCE STANDARDS

Design Specification:	IEC60502-1
Conductor:	IEC60228, BS EN60228
Flame Retardancy:	IEC60332-3-24, BS EN60332-3-24
Low Smoke Zero Halogen:	IEC61034-2, BS EN61034-2 IEC60754-1, IEC60754-2 BS EN60754-1, BS EN60754-2

INSTALLATION REFERENCE

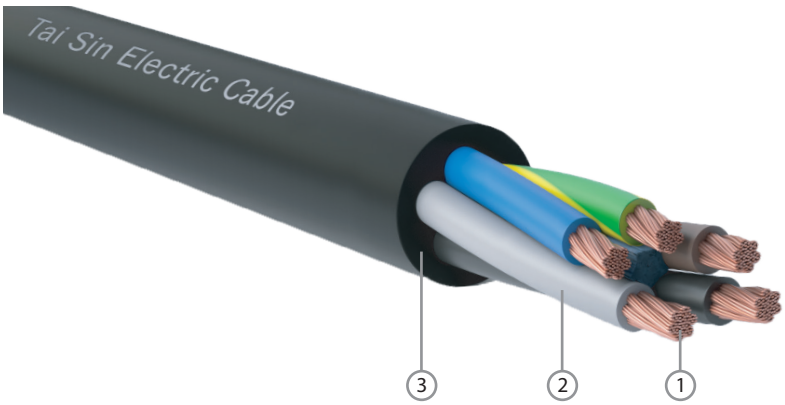
Min. Bending Radius (mm):	6 x cable overall diameter
Max. Pulling Tension (N/mm^2):	15

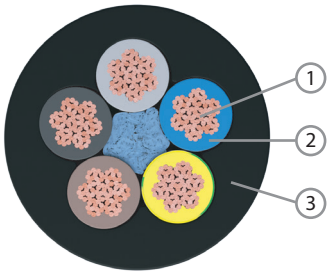
	Nominal Conductor Area (mm^2)	Approx Conductor Diameter (mm)	Insulation Thickness (mm)	Overall Sheath Thickness (mm)	Approx Cable Overall Diameter (mm)	Approx Cable Weight (kg/km)	Current Rating 1 or 3 Phase a.c [Air 30°C] (A)	Voltage Drop (V/A/km)	Minimum Insulation Resistance at Ambient (MΩ.km)	Maximum Conductor Resistance at 20°C (Ω/km)
SINGLE CORE	1 x 1.5	1.5	0.7	1.4	5.9	46	22	29.40	2000	13.3
	1 x 2.5	2.0	0.7	1.4	6.4	58	30	17.60	2000	7.98
	1 x 4	2.5	0.7	1.4	6.9	75	40	10.90	2000	4.95
	1 x 6	3.5	0.7	1.4	7.9	103	51	7.29	2000	3.30
	1 x 10	4.5	0.7	1.4	8.9	145	70	4.22	2000	1.91
	1 x 16	5.7	0.7	1.4	10.2	210	94	2.68	2000	1.21
	1 x 25	7.5	0.9	1.4	12.5	310	125	1.74	2000	0.780
	1 x 35	8.9	0.9	1.4	14.1	415	155	1.24	2000	0.554
	1 x 50	10.5	1.0	1.4	15.9	565	196	0.88	2000	0.386
	1 x 70	12.6	1.1	1.4	18.2	771	248	0.63	2000	0.272
	1 x 95	14.1	1.1	1.5	19.7	984	298	0.49	1000	0.206
	1 x 120	16.0	1.2	1.5	21.8	1235	354	0.40	1000	0.161
	1 x 150	18.4	1.4	1.6	24.8	1533	409	0.34	1000	0.129
	1 x 185	19.8	1.6	1.6	26.6	1846	470	0.30	1000	0.106
	1 x 240	22.8	1.7	1.7	30.0	2401	565	0.25	1000	0.0801
	1 x 300	25.5	1.8	1.8	33.1	2962	650	0.23	1000	0.0641
	1 x 400	29.3	2.0	1.9	37.5	3869	780	0.20	1000	0.0486
	1 x 500	32.6	2.2	2.0	41.4	4777	903	0.19	1000	0.0384
	1 x 630	36.7	2.4	2.2	46.3	6032	1052	0.18	1000	0.0287

FRT-ZH-F

CU / EPR / LSZH (MULTICORE)

EPR Insulated, LSZH Sheathed Cable, 600/1000V, IEC60502-1





Component
1. Plain Annealed Copper Wire
2. Ethylene Propylene Rubber (EPR)
3. Low Smoke Zero Halogen (LSZH) Compound

CONSTRUCTION

Conductor:	Plain Annealed Flexible Copper, Class 5 Stranded Circular
Insulation:	Ethylene Propylene Rubber (EPR)
Insulation Colour:	2 Cores: Brown, Blue 3 Cores: Brown, Blue, Green/Yellow 4 Cores: Brown, Black, Grey, Green/Yellow 5 Cores: Brown, Black, Grey, Blue, Green/Yellow
Outer Sheath:	Low Smoke Zero Halogen (LSZH) Compound with Anti-Termite Characteristic and UV Resistant
Outer Sheath Colour:	Black / Other colour upon request

ELECTRICAL CHARACTERISTICS

Operating Voltage:	600/1000V
Operating Temperature:	-15°C to 90° C
Final Short Circuit Temperature:	250°C
Test Voltage:	3.5kV for 5 minutes

REFERENCE STANDARDS

Design Specification:	IEC60502-1
Conductor:	IEC60228, BS EN60228
Flame Retardancy:	IEC60332-3-24, BS EN60332-3-24
Low Smoke Zero Halogen:	IEC61034-2, BS EN61034-2 IEC60754-1, IEC60754-2 BS EN60754-1, BS EN60754-2

INSTALLATION REFERENCE

Min. Bending Radius (mm):	6 x cable overall diameter
Max. Pulling Tension (N/mm^2):	15

	Nominal Conductor Area (mm^2)	Approx Conductor Diameter (mm)	Insulation Thickness (mm)	Overall Sheath Thickness (mm)	Approx Cable Overall Diameter (mm)	Approx Cable Weight (kg/km)	Current Rating 1 or 3 Phase a.c [Air 30°C] (A)	Voltage Drop (V/A/km)	Minimum Insulation Resistance at Ambient (MΩ.km)	Maximum Conductor Resistance at 20°C (Ω/km)
2 CORES	2 x 1.5	1.5	0.7	1.8	9.7	119	25	29.40	2000	13.3
	2 x 2.5	2.0	0.7	1.8	10.6	151	33	17.60	2000	7.98
	2 x 4	2.5	0.7	1.8	11.7	198	44	10.90	2000	4.95
	2 x 6	3.5	0.7	1.8	13.7	277	56	7.29	2000	3.30
	2 x 10	4.5	0.7	1.8	15.7	390	79	4.22	2000	1.91
	2 x 16	5.7	0.7	1.8	18.1	554	106	2.68	2000	1.21
	2 x 25	7.4	0.9	1.8	22.5	845	141	1.73	2000	0.780
	2 x 35	8.8	0.9	1.8	25.3	1112	174	1.23	2000	0.554
	2 x 50	10.5	1.0	1.8	28.9	1508	219	0.87	2000	0.386
	2 x 70	12.6	1.1	1.8	33.5	2088	276	0.62	2000	0.272
	2 x 95	14.1	1.1	1.9	37.1	2670	330	0.48	1000	0.206
	2 x 120	16.0	1.2	2.0	40.8	3318	391	0.38	1000	0.161

FRT-ZH-F

CU / EPR / LSZH (MULTICORE)

EPR Insulated, LSZH Sheathed Cable, 600/1000V, IEC60502-1

	Nominal Conductor Area (mm²)	Approx Conductor Diameter (mm)	Insulation Thickness (mm)	Overall Sheath Thickness (mm)	Approx Cable Overall Diameter (mm)	Approx Cable Weight (kg/km)	Current Rating 1 or 3 Phase a.c [Air 30°C] (A)	Voltage Drop (V/A/km)	Minimum Insulation Resistance at Ambient (MΩ.km)	Maximum Conductor Resistance at 20°C (Ω/km)
3 CORES	3 x 1.5	1.5	0.7	1.8	10.2	137	21	29.40	2000	13.3
	3 x 2.5	2.0	0.7	1.8	11.2	178	29	17.60	2000	7.98
	3 x 4	2.5	0.7	1.8	12.3	237	37	10.90	2000	4.95
	3 x 6	3.5	0.7	1.8	14.5	336	47	7.29	2000	3.30
	3 x 10	4.5	0.7	1.8	16.6	482	67	4.22	2000	1.91
	3 x 16	5.7	0.7	1.8	19.2	694	89	2.68	2000	1.21
	3 x 25	7.4	0.9	1.8	24.0	1059	119	1.73	2000	0.780
	3 x 35	8.8	0.9	1.8	27.0	1406	149	1.23	2000	0.554
	3 x 50	10.5	1.0	1.8	30.9	1927	187	0.87	2000	0.386
	3 x 70	12.6	1.1	1.9	35.9	2679	235	0.62	2000	0.272
	3 x 95	14.1	1.1	2.0	39.7	3449	282	0.48	1000	0.206
	3 x 120	16.0	1.2	2.1	43.8	4308	333	0.38	1000	0.161
	3 x 150	18.4	1.4	2.6	51.4	5564	383	0.32	1000	0.129
	3 x 185	19.8	1.6	2.8	55.9	6736	436	0.27	1000	0.106
	3 x 240	22.8	1.7	3.3	63.7	8835	519	0.23	1000	0.0801
	3 x 300	25.5	1.8	3.6	70.6	10917	593	0.20	1000	0.0641
	3 x 400	29.3	2.0	3.7	79.7	14160	702	0.17	1000	0.0486
4 CORES	4 x 1.5	1.5	0.7	1.8	11.0	160	21	29.40	2000	13.3
	4 x 2.5	2.0	0.7	1.8	12.1	211	29	17.60	2000	7.98
	4 x 4	2.5	0.7	1.8	13.4	285	37	10.90	2000	4.95
	4 x 6	3.5	0.7	1.8	15.8	407	47	7.29	2000	3.30
	4 x 10	4.5	0.7	1.8	18.2	590	67	4.22	2000	1.91
	4 x 16	5.7	0.7	1.8	21.1	859	89	2.68	2000	1.21
	4 x 25	7.4	0.9	1.8	26.5	1312	119	1.73	2000	0.780
	4 x 35	8.8	0.9	1.8	29.9	1750	149	1.23	2000	0.554
	4 x 50	10.5	1.0	1.8	34.2	2409	187	0.87	2000	0.386
	4 x 70	12.6	1.1	2.0	40.2	3396	235	0.62	2000	0.272
	4 x 95	14.1	1.1	2.1	44.2	4359	282	0.48	1000	0.206
	4 x 120	16.0	1.2	2.3	49.1	5499	333	0.38	1000	0.161
	4 x 150	18.4	1.4	2.8	57.4	7033	383	0.32	1000	0.129
	4 x 185	19.8	1.6	3.0	62.4	8521	436	0.27	1000	0.106
	4 x 240	22.8	1.7	3.3	70.6	11107	519	0.23	1000	0.0801
	4 x 300	25.5	1.8	3.6	78.2	13732	593	0.20	1000	0.0641
	4 x 400	29.3	2.0	3.9	89.0	17965	702	0.17	1000	0.0486
5 CORES	5 x 1.5	1.5	0.7	1.8	11.8	190	21	29.40	2000	13.3
	5 x 2.5	2.0	0.7	1.8	13.1	253	29	17.60	2000	7.98
	5 x 4	2.5	0.7	1.8	14.5	345	37	10.90	2000	4.95
	5 x 6	3.5	0.7	1.8	17.2	496	47	7.29	2000	3.30
	5 x 10	4.5	0.7	1.8	19.9	725	67	4.22	2000	1.91
	5 x 16	5.7	0.7	1.8	23.1	1060	89	2.68	2000	1.21
	5 x 25	7.4	0.9	1.8	29.1	1628	119	1.73	2000	0.780
	5 x 35	8.8	0.9	1.8	32.9	2177	149	1.23	2000	0.554
	5 x 50	10.5	1.0	1.9	38.0	3074	187	0.87	2000	0.386
	5 x 70	12.6	1.1	2.1	44.6	4257	235	0.62	2000	0.272
	5 x 95	14.1	1.1	2.2	49.1	5465	282	0.48	1000	0.206
	5 x 120	16.0	1.2	2.4	55.0	6943	333	0.38	1000	0.161

APPENDIX A

Table A1.1: Short Circuit Ratings

Short Circuit Ratings for Low Voltage Cables

Nominal Conductor Area	Short Circuit Rating for 1 second XLPE & XLSZH	Short Circuit Rating for 1 second PVC
(mm^2)	(kA)	(kA)
1.5	0.2145	0.1725
2.5	0.3575	0.2875
4	0.572	0.46
6	0.858	0.69
10	1.43	1.15
16	2.288	1.84
25	3.575	2.875
35	5.005	4.025
50	7.15	5.75
70	10.01	8.05
95	13.585	10.925
120	17.16	13.8
150	21.45	17.25
185	26.455	21.275
240	34.32	27.6
300	42.9	34.5
400	57.2	41.2
500	71.5	51.5
630	90.09	64.89
800	114.4	82.4
1000	143	103

The maximum permissible short circuit current of cables up to 1kV with copper conductors could be calculated with the following formula

$$I\,(kA) = \frac{S}{\sqrt{t}} \times K$$

Where I = Short Circuit Rating (kA)

S = Nominal Conductor Area (mm^2)

t = Duration of Short Circuit (Sec)

K = Insulation Material Specific Constant

XLPE & Cross-linked Polyolefin (XLSZH) Insulated Cable

$K = 0.143$

PVC Insulated Cable

$K = 0.115$ ($S \leq 300\ mm^2$)

$K = 0.103$ ($S > 300 mm^2$)

APPENDIX B

Rating Factor for Ambient Temperature

The current-carrying capacities in this work standard are based upon the following reference ambient temperatures:

i) For non-sheathed and sheathed cables in air, irrespective of the installation method : 30°C

ii) For buried cables, either directly in the soil or in ducts in the ground : 15°C

When the ambient temperature in the intended location of the non-sheathed or sheathed cables differs from the reference ambient temperature, please refer to the appropriate rating factors as below table (Table C1.1 and C1.2).

Table B1.1

Rating factors for ambient air temperatures other than 30°C to be applied to the current-carrying capacities for cables in free air.

Ambient Temperature °C	PVC	XLPE
25	1.03	1.02
30	1.00	1.00
35	0.94	0.96
40	0.87	0.91
45	0.79	0.87
50	0.71	0.82
55	0.61	0.76
60	0.50	0.71
65	–	0.65
70	–	0.58
75	–	0.50
80	–	0.41
85	–	–
90	–	–
95	–	–

Table B1.2

Rating factors for ambient ground temperatures other than 15°C to be applied to the current-carrying capacities for cables buried to ground.

Ground Temperature °C	PVC	XLPE
10	–	1.04
15	1.00	1.00
20	0.95	0.96
25	0.90	0.93
30	0.85	0.91
35	0.80	0.87
40	0.74	0.83
45	0.67	–
50	0.60	–
55	–	–
60	–	–
65	–	–
70	–	–
75	–	–
80	–	–

APPENDIX B

Table B1.3: Rating Factor for Soil Thermal Resistivities

Rating factors for cables buried direct in the ground or in an underground conduit system for soil thermal resistivities other than 1.2K.m/W to be applied to the current-carrying capacities for Reference Method D

Thermal resistivity K.m/W	0.8	0.9	1.0	1.2	1.5	2.0	2.5	3.0
Rating factor for cables in buried ducts	1.03	1.02	1.02	1.00	0.95	0.88	0.83	0.78
Rating factor for direct buried cables	1.09	1.07	1.04	1.00	0.92	0.81	0.74	0.69

Note:
1. The rating factors given have been averaged over the range of conductor sizes and types of installation included in the relevant tables in this appendix. The overall accuracy of rating factors is within ± 5%.
2. The rating factors are applicable to cables drawn into buried ducts For cables laid direct in the ground the rating factors for thermal resistivities less than 1.2K.m/W will be higher. Where more precise values, are required they may be calculated by methods given in BS7769 (BS IEC60287).
3. The rating factors are applicable to ducts buried at depths of up to 0.8 m.

Table B2.1

Rating factors for one circuit or one multicore cable or for a group of circuits, or a group of multicore cables, to be used with current-carrying capacities of Tables B1.1 to Tables B1.8.

Arrangement (cables touching)	Number of circuits or multicore cables												To be used with current-carrying capacities, Reference
	1	2	3	4	5	6	7	8	9	12	16	20	
Bunched in air, on a surface, embedded or enclosed	1.00	0.80	0.70	0.65	0.60	0.57	0.54	0.52	0.50	0.45	0.41	0.38	Methods A to F
Single layer on wall or floor	1.00	0.85	0.79	0.75	0.73	0.72	0.72	0.71	0.70	0.70	0.70	0.70	Method C
Single layer multicore on a perforated horizontal or vertical tray cable system	1.00	0.88	0.82	0.77	0.75	0.73	0.73	0.72	0.72	0.72	0.72	0.72	Methods E and F
Single layer multicore on cable ladder system or cleats, etc	1.00	0.87	0.82	0.80	0.80	0.79	0.79	0.78	0.78	0.78	0.78	0.78	

Note:
1. These factors are applicable to uniform groups of cables, equally loaded.
2. Where horizontal clearances between adjacent cables exceeds twice their overall diameter, no rating factor need be applied.
3. The same factors are applied to:
   - groups of two or three single-core cables:
   - multicore cables.
4. If a system consists of both two- and three-core cables, the total number of cables is taken as the number of circuits, and the corresponding factor is applied to the tables for two loaded conductors for the two-core cables, and to the Tables for three loaded conductors for the three-core cables.
5. If a group consists of n single-core cables it may either be considered as n/2 circuits of two loaded conductors or n/3 circuits of three loaded conductors.
6. The rating factors given have been averaged over the range of conductor sizes and types of installation included in Tables B1.1 to B1.8 the overall accuracy of tabulated values is within 5%.
7. For some installations and for other methods not provided for in the above table, it may be appropriate to use factors calculated for specific cases, see for example Table C3.1 to C3.2.
8. When cables having differing conductor operating temperature are grouped together, the current rating is to be based upon the lowest operating temperature of any cable in the group.
9. If, due to known operating conditions, a cable is expected to carry not more than 30 % of its grouped rating, it may be ignored for the purpose of obtaining the rating factor for the rest of the group. For example, a group of N loaded cables would normally required a group rating factor of Cg applied to the tabulated It. However, if M cables in the group carry loads which are not greater than 0.3 CgIt amperes the other cables can be sized by using the group rating factor corresponding to (N-M) cables.

APPENDIX B

Table B1.3: Rating Factor for Soil Thermal Resistivities

Rating factors for cables buried direct in the ground or in an underground conduit system for soil thermal resistivities other than 1.2K.m/W to be applied to the current-carrying capacities for Reference Method D

Thermal resistivity K.m/W	0.8	0.9	1.0	1.2	1.5	2.0	2.5	3.0
Rating factor for cables in buried ducts	1.03	1.02	1.02	1.00	0.95	0.88	0.83	0.78
Rating factor for direct buried cables	1.09	1.07	1.04	1.00	0.92	0.81	0.74	0.69

Note:
1. The rating factors given have been averaged over the range of conductor sizes and types of installation included in the relevant tables in this appendix. The overall accuracy of rating factors is within ± 5%.
2. The rating factors are applicable to cables drawn into buried ducts For cables laid direct in the ground the rating factors for thermal resistivities less than 1.2K.m/W will be higher. Where more precise values, are required they may be calculated by methods given in BS7769 (BS IEC60287).
3. The rating factors are applicable to ducts buried at depths of up to 0.8 m.

Table B2.1

Rating factors for one circuit or one multicore cable or for a group of circuits, or a group of multicore cables, to be used with current-carrying capacities of Tables B1.1 to Tables B1.8.

Arrangement (cables touching)	Number of circuits or multicore cables												To be used with current-carrying capacities, Reference
	1	2	3	4	5	6	7	8	9	12	16	20	
Bunched in air, on a surface, embedded or enclosed	1.00	0.80	0.70	0.65	0.60	0.57	0.54	0.52	0.50	0.45	0.41	0.38	Methods A to F
Single layer on wall or floor	1.00	0.85	0.79	0.75	0.73	0.72	0.72	0.71	0.70	0.70	0.70	0.70	Method C
Single layer multicore on a perforated horizontal or vertical tray cable system	1.00	0.88	0.82	0.77	0.75	0.73	0.73	0.72	0.72	0.72	0.72	0.72	Methods E and F
Single layer multicore on cable ladder system or cleats, etc	1.00	0.87	0.82	0.80	0.80	0.79	0.79	0.78	0.78	0.78	0.78	0.78	

Note:
1. These factors are applicable to uniform groups of cables, equally loaded.
2. Where horizontal clearances between adjacent cables exceeds twice their overall diameter, no rating factor need be applied.
3. The same factors are applied to:
   - groups of two or three single-core cables:
   - multicore cables.
4. If a system consists of both two- and three-core cables, the total number of cables is taken as the number of circuits, and the corresponding factor is applied to the tables for two loaded conductors for the two-core cables, and to the Tables for three loaded conductors for the three-core cables.
5. If a group consists of n single-core cables it may either be considered as n/2 circuits of two loaded conductors or n/3 circuits of three loaded conductors.
6. The rating factors given have been averaged over the range of conductor sizes and types of installation included in Tables B1.1 to B1.8 the overall accuracy of tabulated values is within 5%.
7. For some installations and for other methods not provided for in the above table, it may be appropriate to use factors calculated for specific cases, see for example Table C3.1 to C3.2.
8. When cables having differing conductor operating temperature are grouped together, the current rating is to be based upon the lowest operating temperature of any cable in the group.
9. If, due to known operating conditions, a cable is expected to carry not more than 30 % of its grouped rating, it may be ignored for the purpose of obtaining the rating factor for the rest of the group. For example, a group of N loaded cables would normally required a group rating factor of Cg applied to the tabulated It. However, if M cables in the group carry loads which are not greater than 0.3 CgIt amperes the other cables can be sized by using the group rating factor corresponding to (N-M) cables.

APPENDIX B

Table B2.2

Rating factors for more than one circuit, cables laid directly in the ground
- Reference Method D in Tables A1.1 to A1.5. Single-core or multicore cables.

Number of circuits	Cable-to-cable clearance (a)				
	Nil (cables touching)	One cable diameter	0.125m	0.25m	0.5m
2	0.75	0.80	0.85	0.90	0.90
3	0.65	0.70	0.75	0.80	0.85
4	0.60	0.60	0.70	0.75	0.80
5	0.55	0.55	0.65	0.70	0.80
6	0.50	0.55	0.60	0.70	0.80

Multicores Cables

Single-Core Cables

Note:
1. Values given apply to an installation depth of 0.7m and a soil thermal resisitivity of 2.5K.m/W. These are average values for the range of cable sizes and types quoted for Table B1.1 to B1.8. The process of averaging, together with rounding off, can result in some cases in errors of up to ± 10%. (Where more precise values are required they may be calculated by methods given in BS7769 (BS IEC60287)).
2. In case of a thermal resistivity lower than 2.5 K.m/W the rating factors can, in general, be increased and can be calculated by the methods given in BS7769 (BS IEC60287).

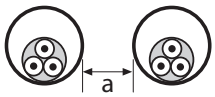
Table B2.3

Rating factors for more than one circuit, cables laid in ducts in the ground
- Reference Method D in Tables B1.1 to B1.8

i. Multicore Cables in a Single-Way Ducts

Number of cables	Duct-to-duct Clearance (a)			
	Nil (ducts touching)	0.25m	0.5m	1.0m
2	0.85	0.90	0.95	0.95
3	0.75	0.85	0.90	0.95
4	0.70	0.80	0.85	0.90
5	0.65	0.80	0.85	0.90
6	0.60	0.80	0.80	0.90

Multicores Cables

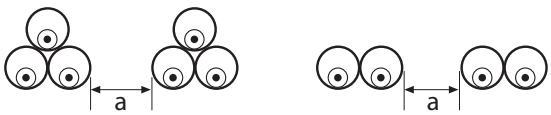


Note:
1. Values given apply to an installation depth of 0.7m and a soil thermal resisitivity of 2.5K.m/W. These are average values for the range of cable sizes and types quoted for Table B1.1 to B1.8. The process of averaging, together with rounding off, can result in some cases in errors of up to ± 10%. (Where more precise values are required they may be calculated by methods given in BS7769 (BS IEC60287).
2. In case of a thermal resistivity lower than 2.5 K.m/W the rating factors can, in general, be increased and can be calculated by the methods given in BS7769 (BS IEC60287).

ii. Single-Core Cables in Non-Ferrous Single-Way Ducts

Number of single-core circuits of 2 or 3 cables	Duct-to-duct Clearance (a)			
	Nil (ducts touching)	0.25m	0.5m	1.0m
2	0.80	0.90	0.90	0.95
3	0.70	0.80	0.85	0.90
4	0.65	0.75	0.80	0.90
5	0.60	0.70	0.80	0.90
6	0.60	0.70	0.80	0.90

Single-Cores Cables

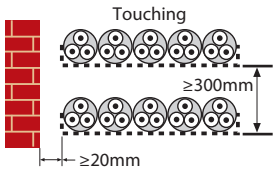
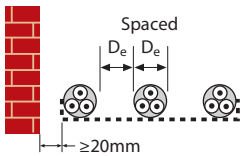
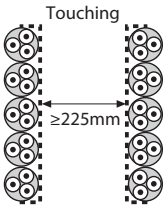
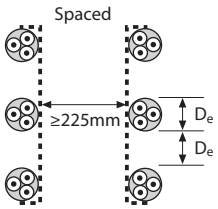
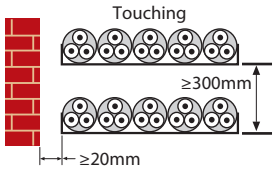
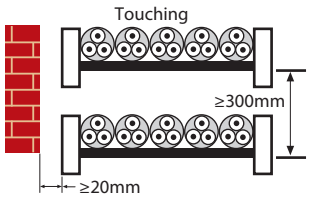
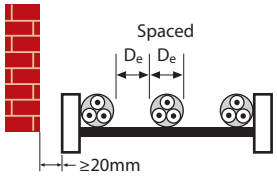


Note:
1. Values given apply to an installation depth of 0.7m and a soil thermal resistivity of 2.5K.m/W. These are average values for the range of cable sizes and types quoted for Table B1.1 to B1.8. The process of averaging, together with rounding off, can result in some cases in errors of up to ± 10%. (Where more precise values are required they may be calculated by methods given in BS7769 (BS IEC60287)).
2. In case of a thermal resistivity lower than 2.5 K.m/W the rating factors can, in general, be increased and can be calculated by the methods given in BS7769 (BS IEC60287).

APPENDIX B

Table B3.1

Rating factors for groups of more than one multicore cables, to be applied to reference current-carrying capacities for multicore cables in free air
- Reference Method E in Tables B 1.1 to B1.8

Installation Method in Table A1.1 to A1.5			Number of trays or ladders	Number of cables per tray or ladder					
				1	2	3	4	6	9
Perforated cable tray systems (Note 3)	31		1	See item 4 of Table C2.1					
			2	1.00	0.87	0.80	0.77	0.73	0.68
			3	1.00	0.86	0.79	0.76	0.71	0.66
			6	1.00	0.84	0.77	0.73	0.68	0.64
Perforated cable tray systems (Note 3)	31		1	1.00	1.00	0.98	0.95	0.91	–
			2	1.00	0.99	0.96	0.92	0.87	–
			3	1.00	0.98	0.95	0.91	0.85	–
Vertical perforated cable tray systems (Note 4)	31		1	See item 4 of Table C2.1					
			2	1.00	0.88	0.81	0.76	0.71	0.70
Vertical perforated cable tray systems (Note 4)	31		1	1.00	0.91	0.89	0.88	0.87	–
			2	1.00	0.91	0.88	0.87	0.85	–
Unperforated cable tray systems	30		1	0.97	0.84	0.78	0.75	0.71	0.68
			2	0.97	0.83	0.76	0.72	0.68	0.63
			3	0.97	0.82	0.75	0.71	0.66	0.61
			6	0.97	0.81	0.73	0.69	0.63	0.58
Cable ladder systems, cleats, wire mesh tray, etc (Note 3)	32 33 34		1	See item 4 of Table C2.1					
			2	1.00	0.86	0.80	0.78	0.76	0.73
			3	1.00	0.85	0.79	0.76	0.73	0.70
			6	1.00	0.84	0.77	0.73	0.68	0.64
Cable ladder systems, cleats, wire mesh tray, etc (Note 3)	32 33 34		1	1.00	1.00	1.00	1.00	1.00	–
			2	1.00	0.99	0.98	0.97	0.96	–
			3	1.00	0.98	0.97	0.96	0.93	–

Note 1: Values given are averages for the cable types and range of conductor sizes considered in Tables B1.1 to B1.8. The spread of values is generally less than 5%.

Note 2: Factors apply to single layer groups of cables as shown above and do not apply when cables are installed in more than one layer touching each other. Values for such installations may be significantly lower and must be determined by an appropriate method.

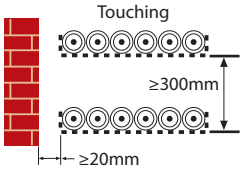
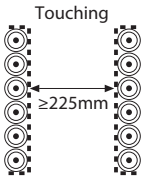
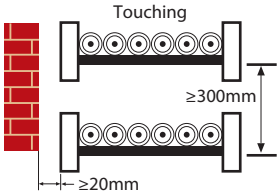
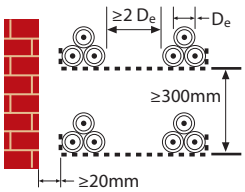
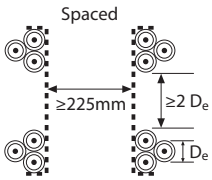
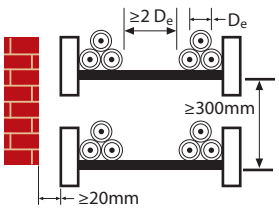
Note 3: Values are given for the vertical spacing between cable tras of 300mm and at least 20mm between cable trays and wall. For closer spacing the factors should be reduced.

Note 4: Values are given for horizontal spacing between cable trays of 225mm with cable trays mounted back to back. For closer spacing the factors should be reduced.

APPENDIX B

Table B3.2

Rating factors for groups of one or more circuits of single-core cables to be applied to reference current-carrying capacity for one circuit of single-core cables in free air
- Reference Method F in Tables B1.1 to B1.8

Installation Method in Table A1.1 to A1.5			Number of trays or ladders	Number of Three-Phase circuits per tray or ladder			Use as a multiplier to rating for:
				1	2	3	
Perforated cable tray systems (Note 3)	31		1	0.98	0.91	0.87	Three cables in horizontal formation
			2	0.96	0.87	0.81	
			3	0.95	0.85	0.78	
Vertical perforated cable tray systems (Note 4)	31		1	0.96	0.86	–	Three cables in vertical formation
			2	0.95	0.84	–	
Cable ladder systems, cleats, wire mesh tray, etc. (Note 3)	32 33 34		1	1.00	0.97	0.96	Three cables in horizontal formation
			2	0.98	0.93	0.89	
			3	0.97	0.90	0.86	
Perforated cable tray systems (Note 3)	31		1	1.00	0.98	0.96	Three cables in trefoil formation
			2	0.97	0.93	0.89	
			3	0.96	0.92	0.86	
Vertical perforated cable tray systems (note 4)	31		1	1.00	0.91	0.89	Three cables in trefoil formation
			2	1.00	0.90	0.86	
Cable ladder systems, cleats, wire mesh tray, etc. (Note 3)	32 33 34		1	1.00	1.00	1.00	Three cables in trefoil formation
			2	0.97	0.95	0.93	
			3	0.96	0.94	0.90	

Note 1: Values given are averages for the cable types and range of conductor sizes considered in Tables B1.1 to B1.8. The spread of values is generally less than 5%.

Note 2: Factors apply to single layer groups of cables (or trefoil groups) as shown above and do not apply when cables are installed in more than one layer touching each other. Values for such installations may be significantly lower and must be determined by an appropriate method.

Note 3: Values are given for vertical spacing between cable trays of 300mm and at least 20mm between cable trays and wall. For closer spacing the factors should be reduced.

Note 4: Values are given for horizontal spacing between cable trays of 225mm with cable trays mounted back to back. For closer spacing the factors should be reduced.

Note 5: For circuits having more than one cable in parallel per phase, each three-phase set of conductors is to be considered as a circuit for the purpose of this table.

APPENDIX C

A GUIDE TO FIRE PERFORMANCE TESTS & STANDARDS FOR CABLES

Cables and wires are like blood vessels in the body which keep us alive. They supply the essential energy to every part of residential, public, commercial and industrial buildings as well as vital infrastructure facilities, to provide power for lighting, computer systems, electrical appliances and machinery, etc. Comply with various relevant performance standards to ensure integrity and reliability.

This guide provides you with an idea of the mandated tests and standards to ensure cables and wires meet international fire performance requirements.

TYPES OF FIRE PERFORMANCE CABLES

It is important for cables to have fire survival properties because they are widely distributed throughout a building and can be the main cause of fire transmission to unaffected areas. There are 2 types of characteristics for Fire Performance: Active - which ensures the cable, continues to transmit power and signals during a fire, and Passive ñ which limits the spread of fire that can cause severe damage to property and reduces the emission of fumes and toxic gases that can lead to loss of human lives.

These safety features are necessary to allow occupants of buildings and facilities to have the time to evacuate without being hurt or overcome by fire, toxic gases and fumes.

In Europe and the United States, where most of the fire performance standards originated, there is a slight difference in concerns over fire behaviour. The European countries are concerned about all aspects of fire-affected cables, including harmful halogen, smoke and gas contents, whereas the concern over in the United States is the flame spread and smoke characteristics from cables.

Cables are therefore rated for their various Fire Resistant, Flame Retardant, Low Smoke Zero Halogen (LSZH) and Low Smoke Fume (LSF) characteristics.

FLAME RETARDANT CABLES

Flame Retardant cables are designed to minimise the spread of flame in the event of a fire. Whether it is a single wire or a bundled wire cable, it is supposed to retard flame spread so that the fire may ideally be limited to a small area and allow for emergency response to put it out. Our PVC-based cables have this characteristic and are widely used for their low cost.

LOW SMOKE AND FUME CABLES (LSF)

LSF cables are slow to ignite and they burn slowly. LSF cables emit much smaller amount of smoke and fumes, with characteristics similar to that of LSZH-FRT cables. Although its emission will still have halogen but the content is much lesser than that from PVC cables. To ensure better fire performance, LSF cables are manufactured with flame retardant PVC blended with HCL and smoke absorbent material for maximum efficiency. Low Smoke Zero Halogen Flame Retardant Cables (LSZH-FRT)

Halogens are harmful non-metal elements such as fluorine (F), chlorine (Cl), bromine (Br), iodine (I), and astatine (At). FRT cables are designed with special materials not only with self-extinguishing property, but also with low smoke and fume emissions without halogens, as well as an absence of toxic gas emission in case of combustion. Thus, LSZH-FRT cables outperform PVC and LSF cables with additional protection from fire spread and the emission of toxic gas and corrosive elements. These cables are suitable for use in inadequately ventilated areas such as those in aircraft, ships, and military facilities.

FIRE RESISTANT CABLES

Fire Resistant cables are designed with superior fire resistant property to continue to operate in the event of a fire for a specific period of time (usually between 30 and 180 minutes). They are specified for used in vital installations and essential support facilities, such as a fire alarm system, as they are designed to withstand fire and maintain circuit integrity. In such cables the stranded annealed copper conductor is sealed with a fire-resisting mica tape wrap, so that even after the insulation has been burnt phase-to phase and phase-to-earth contact can be prevented. They are also designed to withstand mechanical shock and perform under wet condition.

STANDARDS FOR FLAME RETARDANCY (European & British Standards)

There are three classes of tests for flame propagation in cables. They are the IEC60332-1, IEC60332-2 and IEC60332-3 standards. The European Committee for Electromechanical Standardization (CENELEC) - which adopts the standards of the International Electro-technical Committee (IEC) - uses the first two to assess flame propagation characteristics of a single wire, and the IEC60332-3 for similar characterist ics test for bundled cables, which is more stringent.

The British Standards for flame propagation test for single wire and bundled wires and cables are the BS EN60332-1 (formerly k nown as BS4066-1) and BS EN50266-2 (formerly known as BS4066-3).

FLAME TEST ON SINGLE VERTICAL INSULATED WIRE/CABLE (IEC60332-1, BS EN60332-1)

The flame propagation characteristic of a single wire or cable is tested using a 60cm cable specimen that is fixed vertically in a metal chamber. A calibrated gas burner adjusted with the recommended flow rates of gas and air is lighted and applied at 45-degree angle on the surface of the test sample at 475 mm (+/- 5mm) from the lower edge of the upper horizontal clamp. The flame is applied continuously for a duration (60 - 480 sec) corresponding to the diameter of the wire/cable. After the flame has been extinguished, the specimen is cleaned and examined. It passes the test if the charring does not reach 50mm from the lower edge of the top clamp, or the charring does not extend beyond 475mm from the point of flame application.

FLAME TEST ON BUNCHED WIRES/CABLES (IEC60332-3, BS EN50266-2)

This test comprises four categories (A, B, C & D) according to the volume of combustible material per metre of cable. It determines the bunched cable's ability to limit flame spread.

The test sample consists of several pieces of cable each 3.5 m long, in order to have the required quantity of combustible material per metre of specimen. The cables are installed in a metal chamber on the front of a vertical ladder and are subjected to a gas burner flame for a specified time under controlled air flow. At the end of the specified duration, the burnt and charred portion of the cable must not be more than 2.5 m from the burner point.

APPENDIX C

STANDARDS FOR FIRE RESISTANCE

IEC60331-11 (APPARATUS 750°C)
IEC60331-21 (CABLES RATED UP TO 0.6/1.0kV)
To verify circuit integrity in the event of a fire, the cable sample is held on a flame at about 750°C for 3 hours under its rated voltage. The sample must then be re-energised in not less than 12 hours after the test, and to pass, the specimen must not breakdown and circuit integrity must be maintained.

BS6387
This test is performed to investigate the cableís ability to maintain circuit integrity under three conditions - fire only, fire with spray of water, and fire with mechanical shock.

Resistance to fire - the cable while performing at its rated voltage is subjected to gas burner fire at the specified temperature for the respective categories - Category A - 3 hours at 650°C, Category B - 3 hours at 750°C and Category C - 3 hours at 950°C.

Resistance to fire and water (Category W) is another cable specimen with rated voltage running is exposed for 15 minutes to flame at 650° C and a further 15 minutes to fire and a continuous spray of water.

Resistance to fire and mechanical shock in this test a new cable sample with rated voltage running is mounted on a vertical panel which is struck with a steel bar for 15 minutes while subjected to a flame. The burning temperatures required for the respective categories are Category X (650°C), Category Y (750°C) and Category Z (950°C).

STANDARDS FOR HALOGEN, SMOKE EMISSION, CORROSIVITY AND TOXICITY

SMOKE DENSITY
(IEC61034-2, BS EN61034-2)
To measure the density of smoke from a burning cable, samples are placed horizontally in a 3 square metre metal cabinet and burned by flame from 100 cubic cm of alcohol in a metal tray. A fan is used to ensure uniformity of the smoke and light transmittance is measured by a photometric system in the cabinet. The result is expressed as percentage light transmittance and the specimen is rated to have passed the test if the value is more than 60%, as the higher the percentage the less smoke is emitted.

HALOGEN EMISSION
(IEC60754-1, BS EN60754-1)
To determine the amount of corrosive gases, such as fluorine, chlorine, bromine, astatine and iodine released by the cable, samples of non-metallic materials (1g) are burned in a tubular oven at up to 800°C. Controlled air flow inside the chamber absorbs the resulting gases in water, which is tested for its acidity. If the specimen yields less than 5 mg/g of hydrochloric acid it is rated Halogen Free, but if the yield is between 5 mg/g and 15 mg/g it is classed as Low Smoke & Fumes. The results do not determine whether the specimen is totally halogen free.

SMOKE CORROSIVELY
(IEC60754-2, BS EN60754-2)
This method determines the corrosiveness of the gases released from the cables by burning the insulation material in a furnace at ≤935°C with rated air supply for 30 minutes. The effluent gases are absorbed into distilled water, which is then measured for its pH and conductivity. A pH-value of above 4.3 and conductivity of over 10µS / mm must be achieved.

TOXICITY INDEX
(ES713)
This Naval Engineering Standard method is used to analyse noxious gas emitted from the burning specimen and the amount that each of the gas can cause fatality. Sample of the cable insulating material (~1.0 g) is burned in a chamber with a volume of 0.7-1m³ and the ga ses emitted during combustion are detected and collected in order to determine the quantities of the elements, such as carbon dioxide, carbon monoxide, sulphur dioxide, nitric oxide, acids, ammonia, etc. The Toxicity Index is derived from the calculated quantity of each gas produced when 100g (scaled up) of the material is burnt in air in a volume of 1m³ and the particular resulting concentration fatal to human when exposed to it for 30 minutes, thus determining the critical toxicity factor. The higher the index, the more toxic the insulating material when burnt in a fire. For example, the toxicity index of a FRT cable is generally known to be lower than 5.

OTHER RELEVANT STANDARDS

LIMITING OXYGEN INDEX (LOI)
(BS EN ISO4589-2)
LOI is defined as the minimum concentration of oxygen required to support flaming combustion in a flowing air mixture of oxygen and nitrogen (in this instance, the downward burning of a vertically-mounted test specimen such as a candle.) The oxygen concentration is recorded as volume percentage. A higher LOI value (oxygen concentration) means better flame retardancy. For example, with 21% oxygen index the material will burn by itself automatically at room temperature; LSZH cables require a higher index between 33% and 42%. The test method allows accuracy of + 0.5% to be achieved.

TEMPERATURE INDEX (TI)
(BS EN ISO4589-3)
Research has shown that compared to the conventional oxygen index, higher temperature at which a material will burn in air is a better determinant of combustibility. When air temperature rises, the Oxygen Index Value falls, thus, the test for Temperature Index (TI) has been developed from the LOI method. The apparatus used for the TI test is essentially similar to that of the LOI test but the incoming combustion gas is heated. It tests the flammability of the sample with a small flame to find the optimum temperature at which the specimen will burn automatically. When a specimen burns automatically in the air with 21% oxygen, the temperature at this point is known as the TI. In the case of coal, the oxygen index will drop to 21% and it will burn automatically when the air temperature reaches 150°C. This temperature for coal is recorded as its TI.

TERMS & CONDITIONS OF SALES

1. **APPLICATION OF TERMS & CONDITIONS**
   These conditions govern the sales and purchase of goods ordered by Buyer from Seller ("the goods") and shall override any terms and conditions whether previously or hereafter stipulated incorporated or referred to by Buyer whether orally in its purchase order or other documents.
2. **DELIVERY**
   a. Any time for delivery named by Seller is an estimate only and Seller is not liable to make good any damage or loss arising out of any such delay.
   b. Delivery shall be deemed to have been made if seller delivers the goods to the location specificed by the Buyer and Delivery Order is endorsed by any person present thereat. Seller not responsible to ensure the goods have been delivered to or is collected by Buyer or its authorized personnel and shall not be liable for any loss or damage to Buyer by reason of unauthorized collection of the goods.
   c. Should Buyer fail to take delivery of goods, Seller shall be entitled (without derogation of its rights under Law) to charge Buyer for storage and insurance for the goods calculated from the date fixed for delivery.
   d. The Seller reserves the right to deliver goods by installments and each installment shall be deemed to have been sold under a separate contract. Failure to deliver any installment shall not entitle the buyer to repudiate the contract.
   e. Off loading and/or handling will in all events be the responsibility of the Buyer.
   f. If the goods to be delivered are, at the Buyer's discretion, delivered to the destination other than the Buyer's premises, the Seller will arrange such delivery for the Buyer and all costs for carriage and insurance will be to the Buyer's account.
   g. Availability of the goods when offered ex-stock is subject to such goods being sold in another transaction between the date when the Seller advises the goods are available, and the date when it receives the Buyer's order. Any delivery time offered for products made to special customer order is indicative only, and the Seller shall not be liable for any loss or damage whatsoever arising as a consequence or result of any such failure to deliver.
3. **PRICE**
   The quoted price for the goods are subject to change in the event of any imposition or increase in taxes, levies or duties whatsoever on the goods, its components or raw materials.
4. **PAYMENT**
   Payments for the goods shall be made within the time stipulated in the invoice. Interest at 1.5% per month will be charged on late payment.
5. **TIME OF THE ESSENCE**
   Time within which the Buyer is to pay for the goods shall be of the essence of this Contract.
6. **ACCEPTANCE**
   Buyer shall inspect the goods immediately upon delivery. Unless Seller receives notice that the goods are not in accordance with the Buyer's order and the goods returned to Seller within 24 hours from the date of delivery, the goods shall be deemed to have been accepted by the Buyer PROVIDED ALWAYS Seller will not accept return of used goods and Buyer shall not reject any goods which are in accordance with the Buyer's order.
7. **DESCRIPTION**
   Notwithstanding any description of the goods given by the Seller or Buyer, no sale of goods shall constitute or be construed as a sale by description.
8. **WARRANTIES**
   Save and except for written warranties (if any) given by Seller, the Seller does not give any warranties as to the quality, state, condition or fitness of the goods or their suitability for any purpose or for use under any specific conditions, notwithstanding that such purpose or condition may be known or made known to Seller.
9. **DEFECTS**
   Save and except as notified pursuant to Clause 6) above, Seller shall be under no liability to Buyer either in contract or tort for loss, injury or damage sustained by Buyer or any third party by reason of defects in the goods whether latent or otherwise but Buyer will keep Seller indemnified against any such claim.
10. **TITLE**
    Title to the goods remains vested in Seller receives the full purchase price. If such payment is overdue, the Seller may without prejudice to any other rights sue for the purchase price, recover or re-sell the goods and the Buyer grants the Seller, its servants/agents the right and/or license to enter the Buyer's premise and/or any other premise where the goods are stored. If any of the goods are sold by Buyer before title has passed to Buyer, Buyer shall hold the proceeds of sale and all rights against purchaser in trust for Seller.
11. **RISK**
    Risk passes to Buyer upon delivery of goods to Buyer.
12. **DEFAULT**
    If Buyer fail to pay Seller on due date, commits a breach of any of its obligation herein, becomes insolvent or commits an act of bankruptcy, Seller may without prejudice to its other rights and without giving any notice, suspend/cancel further deliveries, stop any delivery in transit under this Contract or any other contracts and/or limit/cancel the Buyer's credit as to time and/or amount for executed, executory or future orders, and/or request for securities or guarantees. Seller shall not be liable to Buyer for any damages which Buyer may suffer or incur by reason thereof.
13. **CANCELLATION OF CREDIT**
    Notwithstanding anything herein contained, Seller reserves the right to limit/cancel the credit of the Buyer as to time and/or amount without giving any reasons thereof and to demand full settlement immediately of all sums that may be owing by Buyer notwithstanding that the credit period has not expired.
14. **FORCE MAJEURE**
    Seller shall not be liable to Buyer for failure to deliver the goods by reason of any breakdown of plant, fire, explosion, Act of God, or outbreak of hostilities, national emergency, industrial disputes, shortage of labour, raw materials, energy or any causes beyond Seller's control and which seller is unable to prevent by the exercise of reasonable diligence, whether of the class of causes enumerated herein or not.
15. **APPROPRIATION OF PAYMENTS**
    All payments received from the Buyer will be applied towards settlement of the Buyer's oldest debts comprising the earliest invoices, debit notes (including debit notes for overdue interest) and other charges howsoever arising PROVIDED ALWAYS Seller may appropriate any payments towards account of interest before principal in respect of any debt as the Seller shall in its absolute discretion deem fit.
16. **STATEMENT OF ACCOUNT**
    All amounts stated in the invoices and statement of accounts of Seller shall be conclusive of the amounts due and owing by Buyer to Seller and shall be binding against Buyer in any legal proceedings.
17. **RIGHTS OF SET-OFF**
    Seller entitled to set-off against Buyer's debts all monies now or hereafter standing to the credit of Buyer's account with Seller and for this purpose Buyer shall give irrevocable authority to Seller to collect on behalf of Buyer and give valid receipt and discharge in respect of all such monies owing to the Buyer.
18. **WAIVER**
    No failure or delay by the Seller in exercising any rights hereunder shall operate as a waiver hereof nor shall any single or partial exercise of right preclude any further exercise thereof or the exercises of any other right.
19. **SALE OF GOODS ACT ("the Act")**
    The terms and conditions in favour of the Seller hereunder shall be in addition to and not in substitution for any term condition warranty expressed or implied in favour of the Seller under the Act or any statutory and re-enactment thereto for the time being enforced.
20. **INFRINGEMENT OF PATENTS DESIGNS**
    Buyer shall indemnify Seller against all damages, claims, costs and expenses which Seller may become liable as a result or work done or goods sold in accordance with Buyer's specifications which involve infringement of any patents, registered designs or trademarks.
21. **NOTICES**
    Any notices, communications or demands shall be deemed to have been sufficiently given if sent by prepaid post to the address of the addressee stated herein or to the addressee's last known place of business and shall be presumed to have reached the address in ordinary course of post.

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Tai Sin®
Cables & Wires