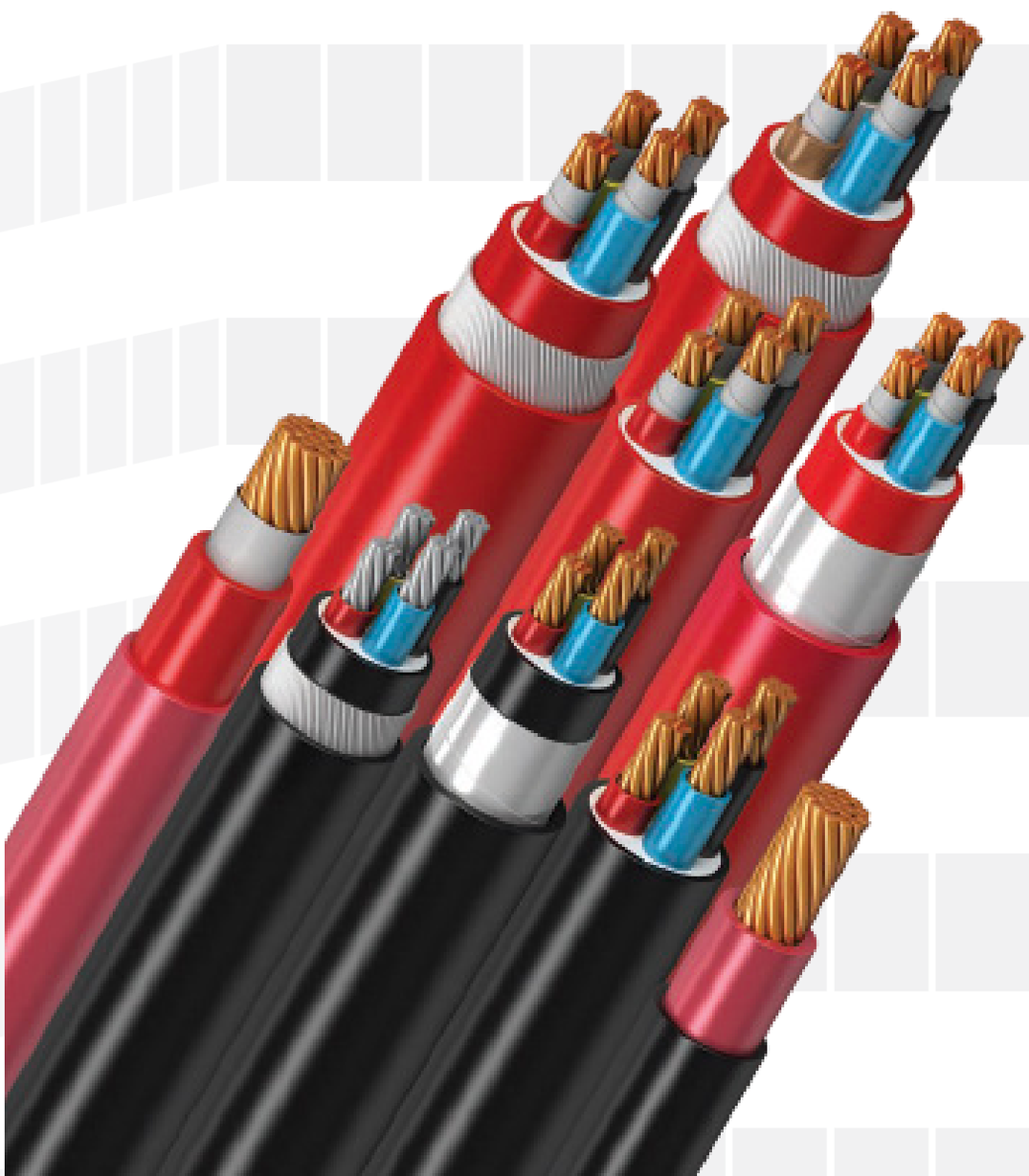
Fire Survival

Cables and Wires



Technical Catalogue

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Fire Survival

Cables and Wires

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Preface

alfanar Fire Survival Cables (Low-smoke Halogen-Free - LSHF) are used in various indoor and outdoor applications in which maintenance of power supply during a fire is required and in areas where smoke and acid gas evolution could pose a hazard to personnel or sensitive equipment in high-rise buildings, schools, hospitals, hotels, shopping centers, subways, etc.

Our products conform to various IEC and BS standards. They are tested at leading laboratories and are approved by many utility companies, ministries and major industries.

alfanar Cables and Wires are a manifestation of alfanar's constant endeavor for providing a comprehensive range of construction materials to satisfy its customers with products of the highest quality standard and safety, coupled with prompt services.

Our cables factory is one of the major industrial units in the ultramodern, fully-integrated alfanar Industrial Complex.

Industries

alfanar Industrial Complex – located in Riyadh – houses several industrial units for manufacturing medium/low voltage products, wires and cables, transformers, wooden reels (for coiling cables) and PVC compounds (for insulation and jacketing materials).
Apart from the manufacturing units, the Industrial Complex also houses a commercial zone, a data/communication center and other facilities.
The Industrial Complex is a symbol of alfanar's consistent growth representing its bright future.

Group Overview

From its headquarters in Riyadh, Saudi Arabia, alfanar operates a fully-integrated global network of manufacturing facilities, design and development centers, and branches in Dubai (UAE), Doha (Qatar), Cairo (Egypt), Damascus (Syria), Chennai (India) and many other places.
Our major businesses and services include: Electrical Manufacturing, Electrical Construction, Marketing and Distribution, Building Industry, Real Estate Development, Information Technology and Communication.

Fire Survival Cables

Fire Safety of Cables and Wires

Electrical cables and wires are a significant fire safety issue in today's buildings and installations:

- If the insulating or jacket ing materials in cables catch fire, they can represent a significant quantity of fuel for fire, because of the sheer volume of cables in modern buildings (electrical, telephone, computer connections … etc.).

- If cables are not fire safe, then they are highly susceptible to be the cause of fire, making overheating of wires, arcing, short circuits or electrical faults develop into flames of burning insulating material.

- Furthermore, cables are often the culprit in spreading fire through a building, as they cross fireproof walls, linking occupied spaces to service areas, ceiling voids and other parts of the building.

Electrical systems are estimated to be the cause of around one fifth of all fires. Cables can contribute significantly not only to the cause of fires, but also to the spread of fire and to heat emission (fire load) in case of fire, they also can result in:

- Increased smoke emission (sufficient to limit visibility and inhibit escape).

- Increased carbon monoxide production (the most lethal gas in fires).

- Release of irritant gases (depending on the materials used, hydrochloric acid HCl, hydro fluoric acid HF, carbonyl fluoride COF2, and acrolein).

For these reasons, fire testing methods and building safety standards define specific fire safety requirements applicable to cables. Fire safety of cables can be achieved by different methods, depending on the degree of fire resistance required for the given application.

LSHF Cables and Wires

Have you been wondering about whether or not you need a Low Smoke Halogen Free (LSHF) cable for your application?
Perhaps more so today than ever before, the issues of health, safety, and environmental impact are top priorities for manufacturers of all types. With the increasing demand for safe buildings, more attention is being paid to the types of cables being installed, and the potential risks in the event of fire.

PVC: Problems and Perils

Polyvinyl chloride (PVC) is the most commonly used type of insulation and jacketing materials for power cables. However, in the event of fire, when ordinary or even enhanced flame retardant PVC burns it:

- Emits a dense smoke that will obscure fire exit routes with fumes choking and suffocating people.
- Releases poisonous and hazardous gases due to the presence of halogen element (chlorine) in the PVC compound.
- Causes long term corrosion damage to computer, security/access control equipment, building management systems, lifts and just about anything else with a circuit board.

Clearly, this creates a hazardous situation wherever an accidental fire can occur. The fire may have been extinguished within minutes with no great risk to life but the damage to equipment may be colossal.

Fire Survival Cables

What are Halogens?

On the periodic table of elements there are specific groups that several elements belong to. Halogens are one of these groups and the family of elements includes fluorine, chlorine, bromine, iodine and astatine.

When present in a fire, halogens are a class of chemical elements that can form poisonous and hazardous gasses. These gaseous compounds are not only hazardous when they have burned and are in the air, but also in contact with water (like the moisture found in lungs, eyes, and throats) they can condense into caustic acids (such as hydrochloric acid).

For the wires and cables industry, chlorine, fluorine and bromine halogens pose the most concern. Certain polymers contain halogens as part of their basic chemical structure, for example chlorine in PVC and fluorine in FEP.

alfanar LSHF Cables: The Safe Alternative

It is now recognized that smoke and poisonous gases are often a far greater risk to life and property than the fire itself. Low Smoke Halogen Free (LSHF) cables are the safe choice for locations in which there is fire potential and the potential for people to be near that fire.

alfanar LSHF Cables and Wires: Green, Safe and Healthy

In order to meet the latest demands for environmentally friendly cables, and those with increased safety in the event of a fire, alfanar Cables has continued to develop its range of low smoke halogen free cables and wires products.

The emphasis is on quality and the materials used are tested to the highest standards to ensure their reliability.

Why use alfanar LSHF Cables and Wires?

Green, Safe and Healthy
It offers the added benefit of being more environmentally-friendly.

Halogen Free Products
Eliminates the threat of forming caustic acids (such as hydrochloric acid) and contributes to less corrosion damage to equipments near the fire.

No Emission of Toxic Gasses
Eliminates the threat of inhaling toxic gasses which reducing the damage to the human respiratory system.

Reduces the Smoke Emission to the Minimum
No releases of dense smoke that impairs visibility of the fire exit routes and hampers rescues operations.

Resistant to ignition
It takes much more time than traditional cables to catch a fire, which facilitating the evacuation procedures.

Reduces the Flame Propagation
Its excellent flame retardant property prevents the fire from spreading through the place.

Easy to Install
LSHF jackets have a lower coefficient of friction than some non-LSHF jackets, which can make the cable installation easier.

Fire Survival Cables

alfanar LSHF cables are perfect for applications that require high performance and reliability while offering outstanding safety, so it can be typically used for:

Places inhabited by people with limited mobility

- Care Homes
- Foster Homes
- Hospitals & Clinics
- Retirement Homes

Places with unfamiliar building's layout

- Shopping Malls
- Public Buildings
- Airport Terminals
- Cinemas & Theaters

Places which are regularly densely populated

- Hotel
- Commercial Offices
- Schools & Universities
- Residential Compounds

The blend of low pollution, toxicity, and corrosion levels and outstanding product quality makes **alfanar** LSHF cables an option that should be considered by anyone purchasing wires and cables products.

alfanar Low Smoke Halogen Free (LSHF) Cables….breathe deeply…see clearly…even in a fire.

Flame Retardant Cables

Cables can, depending upon their location, construction and method of installation, affect a fire in a number of different ways. The cables may propagate (spread) flames from one area to another as they quite often form distinct links between separate offices, floors within a building, or even in some cases between buildings themselves.

Flame retardant cables are designed for use in fire situations where the spread of flames along a cable route needs to be retarded.

This is achieved through the use of jacketing materials that do not readily burn and will tend to self-extinguish. Normally, for this type of cables, flame retardant Polyvinyl chloride (PVC) jackets are used, where they tend to have excellent fire performance properties.

The typical application for alfanar flame retardant cables with flame retardant PVC outer jacket is in places where flame retardancy is desirable, but smoke and acid gas evolution is not considered to pose a serious hazard to personnel or sensitive equipment.

Due to relative low cost, flame retardant cables are widely used as fire survival cables.

Fire Resistant Cables

The Resistance-to-fire (of a cable) is the term used to describe how long a cable continues to operate in a fire. This may be of primary concern, for instance, in life safety of fire fighting installations.

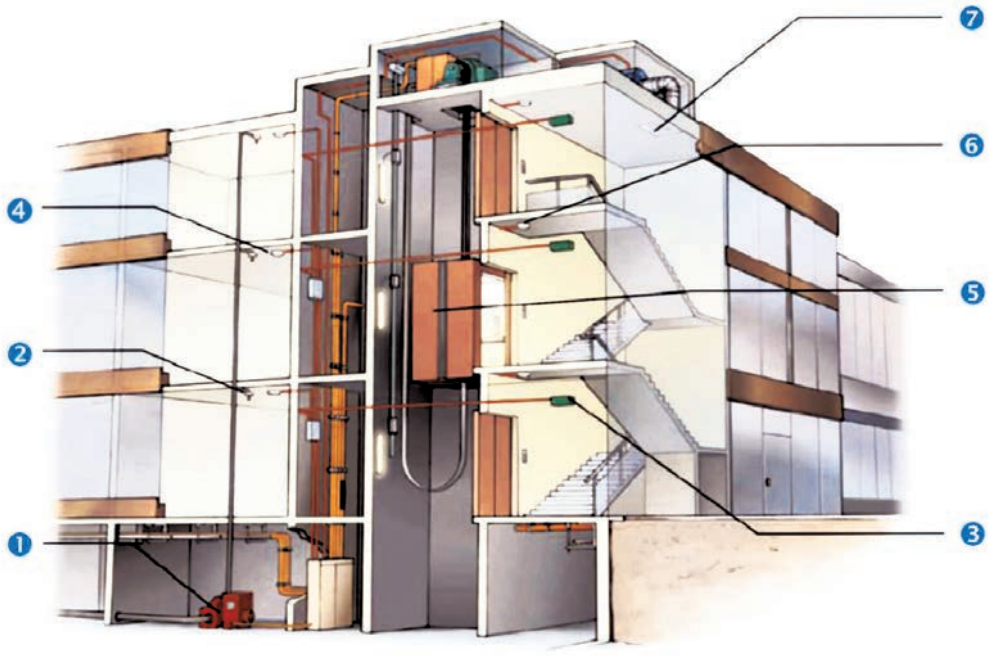
The Resistance-to-Fire performance of cables is indicated in terms of survival time: the times are 15, 20, 90, 120 and 180 minutes of operation in a standardized fire condition.

The best safety and rescue equipment cannot work without secured power supply. If the power supply is adversely affected, the systems themselves will have no power to provide their own critical functions.

alfanar Fire resistant cables are designed to maintain circuit integrity of those vital safety and rescue equipment during the fire. In addition to maintaining circuit integrity under fire conditions, alfanar Fire resistant cables have limited evolution of smoke and corrosive gases when assessed under the fire conditions, thus safeguarding human life and protecting equipment.

alfanar Fire resistant cables are intended for applications requiring circuit integrity during a fire, such as;

1. Booster pump systems
2. Sprinkler systems
3. Emergency lighting - speakers
4. Fire and smoke detector systems
5. Rescue elevators
6. Alarm horns
7. Smoke exhaust system for aeration and ventilation.



Levels of Cables Fire Performance

A wide spectrum of fire performance is available from the many types of cables on the market. This can range from cables at one extreme which have no enhanced fire properties, which are readily ignitable and burn with ease, to, at the other extreme, fire survival cables.

The choice of cable for a given application depends on the degree of hazard which can be tolerated and the level of performance required. The level of fire performance and the potential hazard resulting from the combustion of a given cable depend on the materials from which the cable is made and the cable construction.

The below table summarizes the different levels of performance that can be achieved by different categories of cables, along with typical areas of application.

Cable Type	Fire Characteristics	Application
Fires Resistant Cable, with (LSHF) materials	• Fire survival • Flame retardant • No acid gas emission • Low smoke emission	For maintaining essential circuits such as emergency lighting and fire alarms, circuits for the safe shutdown of critical processes, etc.
Fires Resistant Cable, with (halogen containing) materials	• Fire survival • Flame retardant	As above, but with increased hazard from smoke and acid gas emission.
(LSHF) Cables and Wires	• Flame retardant • No acid gas emission • Low smoke emission	For installation in areas where smoke and acid gas evolution could pose a hazard to personnel or sensitive equipment, but where circuit integrity is not needed.
PVC or chlorinated polymer	• Flame retardant	Where flame retardancy is desirable, but smoke and acid gas evolution is not considered to pose a serious hazard.
Non-flame retardant **(e.g. polyethylene)**	• Readily combustible	In situations when fire performance requirements are low and where cable combustion poses little hazard.

alfanar Fire Testing Facilities

The fundamental feature of having a leading fire testing facility is that it allows cables to be observed throughout the development process. The cables can be observed during the whole test process. This allows our R&D team to record any changes during different stages of testing and then make calculated judgments on how well the cables performed, and how they can be improved, if needed.

In house fire testing laboratories allow us to run quality assessments on existing cables, new cables and materials, type approval for products or contracts, customer service demonstrations, and development of new first specifications for the industry.

alfanar State-of-the-Art fire testing laboratory was designed to test the performance of cables in the event of fire. The test facility is indispensable in the design and test of new products and/or development of products in line with prevailing standards.

Performance of Cables in the Event of Fire

It is clear that the hazard from cables involved in a fire can take many forms, from the ease of ignition and flame propagation to the evolution of smoke and toxic gases. Many tests have been developed over the years in an attempt to evaluate the potential performance of both individual materials and complete cables.

Fire test methods relating to cables can be split into two categories, those which test the whole cable and those which evaluate individual component materials. The tests on materials are not specific to cable standards but are often specified therein.

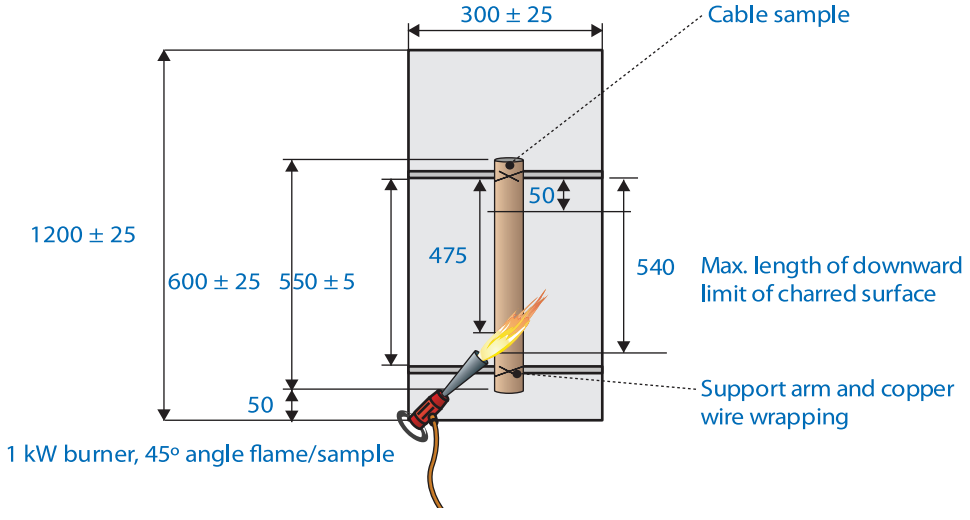
The performance of cables under fire conditions is defined in a number of international standards, the outline of which is as follows:-

Flame Propagation Test: (IEC 60332-1, BS EN 60332-1)

This test is used to measure the resistance to vertical flame propagation for a single vertical electrical insulated conductor or cable under fire conditions.

A 600 mm long cable sample is suspended vertically in a draught-free enclosure and the lower end is exposed to a gas burner angled at 45 ° to the horizontal. The flame application time is from 1-8 min depending on the cable diameter.

The single insulated conductor or cable shall pass the test if the distance between the lower edge of the top support and the onset of charring is greater than 50 mm. In addition, a failure shall be recorded if charring extends downwards to a point greater than 540 mm from the lower edge of the top support.



Vertical flame propagation test for a single insulated wire or cable (IEC 60332-1)

Flame Spread Test: (IEC 60332-3, BS EN 60332-3)

This series of standards covered by parts 3-22, 3-23, 3-24 and 3-25 define the tests used to measure the resistance to vertical flame spread of vertically-mounted bunched wires or cables under fire conditions.

This test attempts to simulate a real installation environment and uses bunched cables, 3.5m long, fixed in a vertical arrangement. The ignition source is a ribbon type propane/air burner with a fuel input of 73.7 MJ/hour. The burner is arranged horizontally at the foot of the ladder to which the cables are fastened and is applied for 20 or 40 minutes, depending on the category.

The test categories are distinguished by test duration, the volume of non-metallic material of the test sample and the method of mounting the sample for the test as follows:

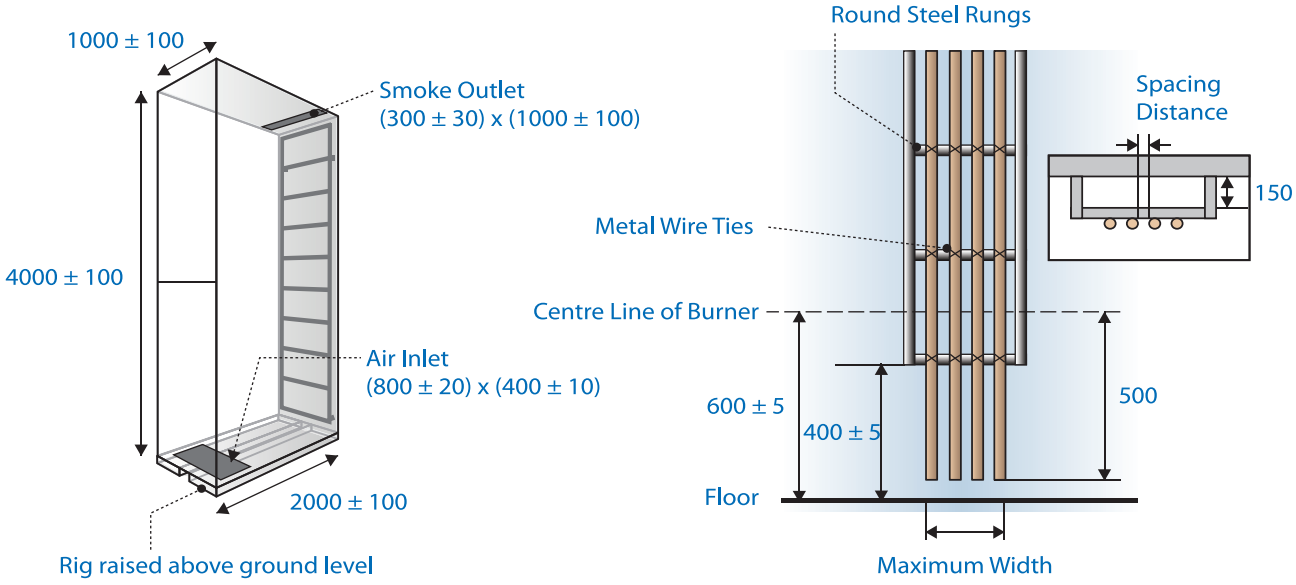
IEC 60332-3-22 (Category A): The number of test pieces required to provide a total volume of 7.0 l/m of non-metallic material shall be bunched on a ladder exposed to flame for 40 minutes.

IEC 60332-3-23 (Category B): The number of test pieces required to provide a total volume of 3.5 l/m of non-metallic material shall be bunched on a ladder exposed to flame for 40 minutes.

IEC 60332-3-24 (Category C): The number of test pieces required to provide a total volume of 1.5 l/m of non-metallic material shall be bunched on a ladder exposed to flame for 20 minutes.

IEC 60332-3-25 (Category D): The number of test pieces required to provide a total volume of 0.5 l/m of non-metallic material shall be bunched on a ladder exposed to flame for 20 minutes.

The bunched wires or cables shall pass the test if the maximum extent of the charred portion measured on the samples shall not have reached a height exceeding 2.5 m above the bottom edge of the burner.



Vertical flame spread test for vertically-mounted bunched wires or cables (IEC 60332-3)

Performance of Cables in the Event of Fire

Fire resistance test (IEC 60331-21)

Fire Resistance Test: (IEC 60331, BS 6387)

This test is intended to evaluate cables which are designed as fire survival cables to be used for fire alarm circuits, emergency lighting, and cables for other emergency services. The test establishes whether a cable can maintain electrical circuit integrity for a time up to 3 hours at temperatures ranging from 650 °C up to in excess of 950 °C.

The energized cable (at the rated voltage) is mounted horizontally in a test chamber and is exposed to a gas flame from a ribbon type burner, adjusted to give the appropriate temperature. There are many variations of this test using different conditions and a cable is rated depending on how the cable performs in the various categories. These categories can be summarized as follows:

Resistance to Fire Alone

IEC 60331-21: Cables are subjected to fire at 750 °C for 90 minutes followed by a 15 min cooling period.
BS 6387 (Category A): Cables are subjected to fire at 650 °C for 180 minutes.
BS 6387 (Category B): Cables are subjected to fire at 750 °C for 180 minutes.
BS 6387 (Category C): Cables are subjected to fire at 950 °C for 180 minutes.
BS 6387 (Category S): Cables are subjected to fire at 950 °C for 20 minutes (short duration).

Resistance to Fire with Water

Resistance to Fire with Water

BS 6387 (Category W): Cables are subjected to fire at 650 °C for 15 minutes, then at 650°C with water spray for further 15 minutes.

Resistance to Fire with Mechanical Shock

IEC 60331-31: Cables are subjected to fire at 830 °C with mechanical shock for 120 minutes.
BS 6387 (Category X): Cables are subjected to fire at 650 °C with mechanical shock for 15 minutes.
BS 6387 (Category Y): Cables are subjected to fire at 750 °C with mechanical shock for 15 minutes.
BS 6387 (Category Z): Cables are subjected to fire at 950 °C with mechanical shock for 15 minutes.

The cable will possess the characteristics for providing circuit integrity so long as during the course of the test; the voltage is maintained i.e. no fuse fails or circuit-breaker is interrupted and a conductor does not rupture, i.e. the lamp is not extinguished.

Performance of Cables in the Event of Fire

Acid Gas Emission Tests: (IEC 60754, BS EN 50267)

These tests use a tube furnace to generate fire gases, which are then analyzed by a variety of methods. Several subsidiary parts of these standards set out methods for the determination of halogen and other acid gases.

Determination of the Halogen Acid Gas Content

IEC 60754-1 and BS EN 50267-2-1 Standards specify a test for determination of the halogen acid gas other than the hydrofluoric acid evolved during combustion of compound based on halogenated polymers and compounds containing halogenated additives taken from cable constructions.

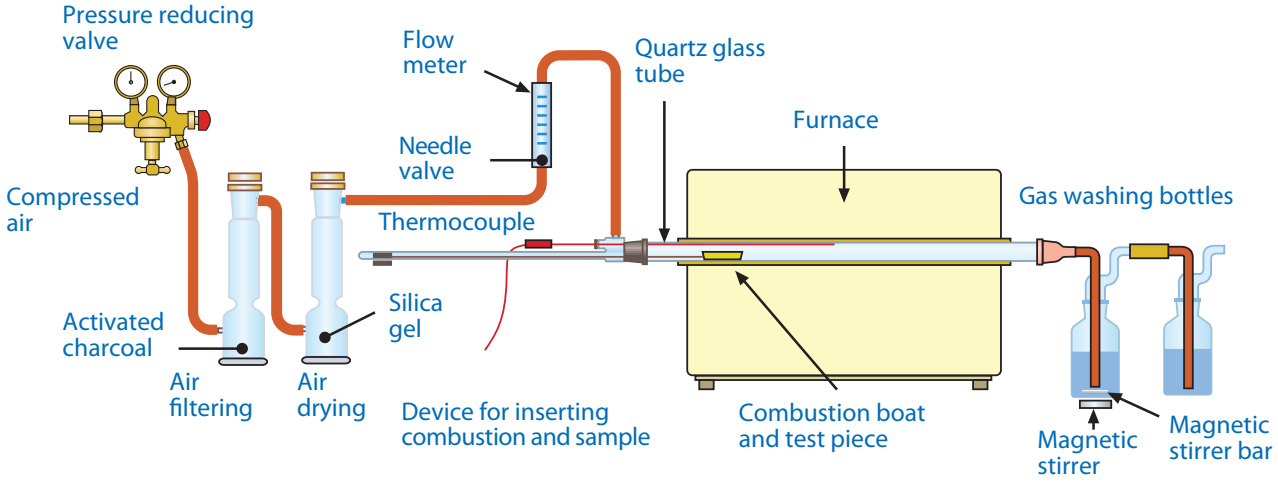
In this test, when the burner is heated to 800 °C, 1g sample is placed inside and the HCL is absorbed into water inside the chamber fed with air flow. The water is then tested with its acidity. If the hydrochloric acid yield is less than 5 mg/g, the cable specimen is categorized as LSHF.

IEC 60754-1 standard cannot be used for measuring the exact HCL yield if the yield is less than 5mg/g. This test cannot determine if the cable is 100% halogen free or not. To determine if the cable specimen is 100% halogen free or not, IEC 60754-2 has to be employed.

Determination of Acidity

IEC 60754-2 and BS EN 50267-2-2 Standards specify a test for the determination of degree of acidity of gases evolved during combustion of the cable specimen by measuring its pH and ionic conductivity.

The specimen is deemed to pass this test if the pH value is not less than 4.3 when related to 1 litre of water and the weighted value of conductivity is less than10 µS/mm.



Acid gas emission test apparatus (IEC 60754)

Smoke Emission Test: (IEC 61034, BS EN 61034)

Smoke evolution is another critical performance indicator which needs to be evaluated on a laboratory scale and there are a number of methods used, based either on gravimetric or optical techniques.

IEC 61034 and BS EN 61034 Standards specify a test for determination of smoke density. The 3 meter cube test measures the generation of smoke from electric cables during fire. A light beam emitted from a window is projected across the enclosure to a photocell connected to a recorder at the opposite window. The recorder is adjusted to register from 0% for complete obscuration to 100% luminous transmissions.

A one-meter length of cable is placed in the 3 m^3 enclosure, and a fire is then generated within the container and the minimum light transmission is recorded. The result is expressed as percentage of light transmitted.

The specimen is deemed to pass this test if the value is greater than 60%. The higher the light transmittance, the less smoke emitted during a fire.

Smoke density 3 m test cube (IEC 61034)

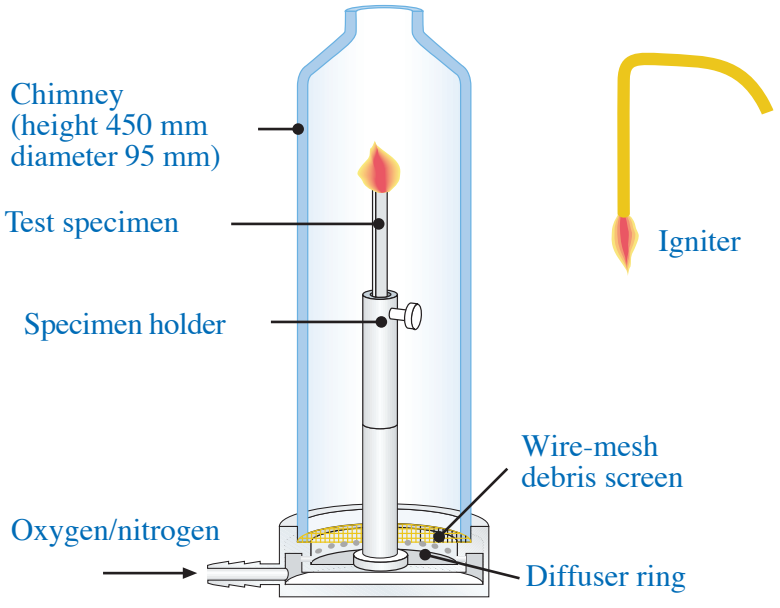
Performance of Cables in the Event of Fire

Limiting Oxygen Index (LOI): (BS EN ISO 4589, ASTM D 2863)

Oxygen index is perhaps the most widely used indicator of a material's flammability. It is the minimum percentage of oxygen in an oxygen/nitrogen mixture required to support combustion of a given material at room temperature.

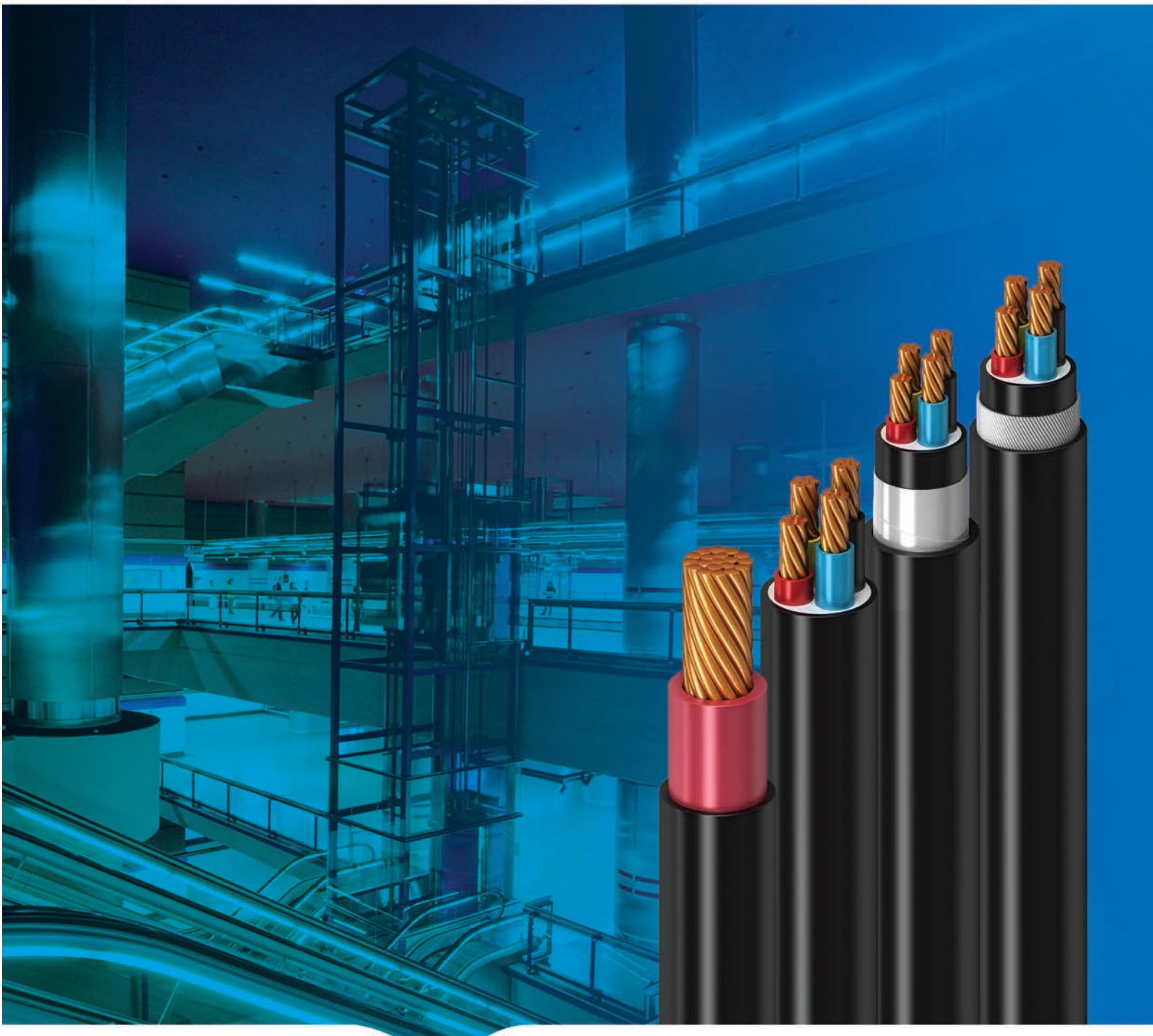
BS EN ISO 4589 and ASTM D 2863 Standards Specify methods for the determination the minimum concentration of oxygen, in a mixture with nitrogen, which will support combustion of small vertical test specimens under specified test conditions over a range of temperatures between 25 °C and 150 °C. The results are defined as oxygen index values at the test temperature.

Flame retardant materials require a level of oxygen higher than that normally present in the atmosphere (21%) for burning to be maintained and a material having an oxygen index of 26 or above is considered to be self-extinguishing. In general, the oxygen index of flame retardant PVC jacketed cables ranges from 28% to 32%, and for LSHF cables ranges from 33% to 45%.



Fire Survival Cables

Low-Smoke Halogen Free Cables & Wires



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Single-Core Cables, with Stranded Copper Conductors, XLPE Insulated and LSHF Sheathed

APPLICATIONS

Suitable for use in fixed installations, in areas where smoke and acid gas evolution could pose a hazard to personnel or sensitive equipment in schools, hospitals, hotels, shopping centers, subways, etc., and in applications where mechanical protection is not required or mechanical damages are not expected to occur.

CABLE CHARACTERISTICS

Max. Operating temperature

Max. Short circuit temperature

Flame propagation IEC 60332-1

Flame spread IEC 60332-3-24 (C)

Low smoke emission IEC 61034

Halogen free IEC 60754-1

Acidity and toxicity IEC 60754-2

APPLICABLE STANDARDS

alfanar Low Smoke Halogen Free (LSHF) cables are designed and tested to meet or exceed the requirements of IEC 60502-1 standard. However, **alfanar** can also supply a range of alternative designs to meet customer-specified requirements.

CABLE CONSTRUCTION

Conductor

Plain annealed stranded circular or circular compacted copper conductor (Class 2).

Insulation

Extruded layer of halogen free cross-linked polyethylene (XLPE).

Core Identification

Red

Outer Jacket

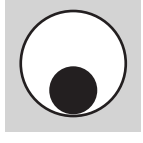
Extruded layer of low smoke halogen free (LSHF) compound.

Note: *The core identification color shown above is the most common. However, any other color can be provided upon a customer's request.*

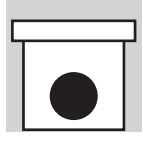
CABLE INSTALLATION

In ground with protection

In free air Ladders / Trays



In duct



In trench

Internal cabling

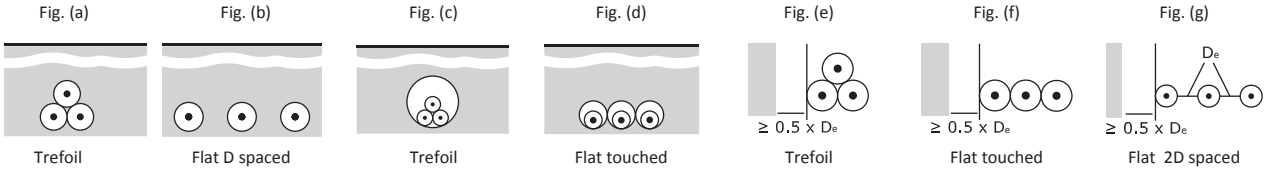
LSHF CABLES / IEC 60502-1

CU / XLPE / LSHF

0.6 / 1 kV

Nominal cross sectional area	ELECTRICAL DATA									DIMENSIONS AND WEIGHTS		Cable Code
	Max. Conductor Resistance		Continuous Current Ratings							Approx. overall diameter	Approx. overall weight	
			Buried direct in ground		In buried ducts		In free air					
	DC at 20 °C	AC at 90 °C	(a)	(b)	(c)	(d)	(e)	(f)	(g)			
mm²	Ω / km	Ω / km	A	A	A	A	A	A	A	mm	Kg / km	
4	4.6100	5.8782	46	46	34	38	40	41	53	6.8	85	C212XA10100LB51IMR
6	3.0800	3.9274	57	57	42	48	50	52	68	7.3	105	C213XA10100LB51IMR
10	1.8300	2.3335	75	75	56	63	68	70	91	7.9	140	C314XA10100LB51IMR
16	1.1500	1.4665	97	97	73	82	91	93	121	8.9	200	C315XA10100LB51IMR
25	0.7270	0.9273	124	124	96	106	122	125	161	10.5	305	C316XA10100LB51IMR
35	0.5240	0.6686	149	149	117	128	150	154	198	11.5	400	C317XA10100LB51IMR
50	0.3870	0.4941	175	176	140	153	183	189	240	12.9	530	C318XA10100LB51IMR
70	0.2680	0.3428	214	215	174	188	233	240	304	14.7	730	C319XA10100LB51IMR
95	0.1930	0.2476	257	256	212	227	288	297	374	16.5	980	C345XA10100LB51IMR
120	0.1530	0.1970	291	292	243	260	335	346	434	18.0	1225	C346XA10100LB51IMR
150	0.1240	0.1605	327	327	277	295	388	400	499	20.1	1490	C347XA10100LB51IMR
185	0.0991	0.1294	369	369	316	336	450	464	577	22.2	1870	C348XA10100LB51IMR
240	0.0754	0.1002	425	426	371	393	536	553	688	24.9	2420	C349XA10100LB51IMR
300	0.0601	0.0817	479	473	422	447	620	641	797	27.7	3020	C350XA10100LB51IMR
400	0.0470	0.0663	539	540	482	512	720	743	928	30.9	3855	C351XA10100LB51IMR
500	0.0366	0.0545	604	606	549	587	834	862	1084	34.9	4985	C352XA10100LB51IMF
630	0.0283	0.0454	674	673	619	668	955	986	1257	39.3	6290	C353XA10100LB51IMF
800	0.0221	0.0390	739	741	688	750	1078	1116	1440	43.8	8090	C354XA10100LB51IMF
1000	0.0176	0.0253	807	808	766	841	1234	1276	1674	52.2	10145	C355XA10100LB51IMF

The above data is approximate and subjected to manufacturing tolerance. We reserve the right to change as a result of product development and/or changes in standard.



Trefoil | Flat D spaced | Trefoil | Flat touched | Trefoil | Flat touched | Flat 2D spaced

Laying Conditions: Ambient air temperature of **40 °C**, Ambient ground temperature of **35 °C**, Soil thermal resistivity of **1.5 K·m/W** and Depth of laying of **0.5 m**. In case of different laying conditions, appropriate correction (derating) factors from ***Annex C*** have to be applied to cater for the actual installation conditions.

Single-Core Cables, with Stranded Aluminum Conductors, XLPE Insulated and LSHF Sheathed

APPLICATIONS

Suitable for use in fixed installations, in areas where smoke and acid gas evolution could pose a hazard to personnel or sensitive equipment in schools, hospitals, hotels, shopping centers, subways, etc., and in applications where mechanical protection is not required or mechanical damages are not expected to occur.

CABLE CHARACTERISTICS

Max. Operating temperature

Max. Short circuit temperature

Flame propagation IEC 60332-1

Flame spread IEC 60332-3-24 (C)

Low smoke emission IEC 61034

Halogen free IEC 60754-1

Acidity and toxicity IEC 60754-2

APPLICABLE STANDARDS

alfanar Low Smoke Halogen Free (LSHF) cables are designed and tested to meet or exceed the requirements of IEC 60502-1 standard. However, **alfanar** can also supply a range of alternative designs to meet customer-specified requirements.

CABLE CONSTRUCTION

Conductor

Stranded circular or circular compacted aluminum conductor (Class 2).

Insulation

Extruded layer of halogen free Cross-linked polyethylene (XLPE).

Core Identification

Red

Outer Jacket

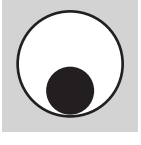
Extruded layer of low smoke halogen free (LSHF) compound.

Note: *The core identification color shown above is the most common. However, any other color can be provided upon a customer's request.*

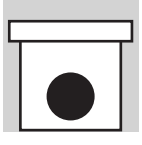
CABLE INSTALLATION

In ground with protection

In free air Ladders / Trays



In duct



In trench

Internal cabling

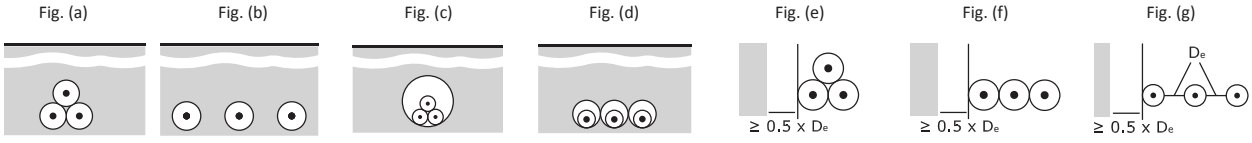
LSHF CABLES / IEC 60502-1

AL / XLPE / LSHF

0.6 / 1 kV

Nominal cross sectional area	ELECTRICAL DATA									DIMENSIONS AND WEIGHTS		Cable Code
	Max. Conductor Resistance		Continuous Current Ratings							Approx. overall diameter	Approx. overall weight	
			Buried direct in ground		In buried ducts		In free air					
	DC at 20 °C	AC at 90 °C	(a)	(b)	(c)	(d)	(e)	(f)	(g)			
mm²	Ω / km	Ω / km	A	A	A	A	A	A	A	mm	Kg / km	
10	3.0800	3.9489	60	60	45	50	54	55	72	7.9	85	A314XA10100LB51IMR
16	1.9100	2.4489	75	75	57	63	70	72	94	8.9	105	A315XA10100LB51IMR
25	1.2000	1.5387	96	96	75	83	94	97	125	10.5	150	A316XA10100LB51IMR
35	0.8680	1.1131	116	116	90	99	116	120	153	11.5	185	A317XA10100LB51IMR
50	0.6410	0.8222	136	136	109	118	142	146	186	12.9	235	A318XA10100LB51IMR
70	0.4430	0.5686	166	167	135	146	181	186	236	14.7	310	A319XA10100LB51IMR
95	0.3200	0.4112	199	199	164	176	224	230	290	16.5	405	A345XA10100LB51IMR
120	0.2530	0.3255	226	227	189	202	261	269	337	18.0	495	A346XA10100LB51IMR
150	0.2060	0.2656	254	254	215	229	301	311	387	20.1	605	A347XA10100LB51IMR
185	0.1640	0.2121	288	288	247	261	351	362	449	22.2	740	A348XA10100LB51IMR
240	0.1250	0.1627	333	335	291	307	421	434	536	24.9	945	A349XA10100LB51IMR
300	0.1000	0.1314	378	378	333	350	489	505	622	27.7	1160	A350XA10100LB51IMR
400	0.0778	0.1038	430	431	385	404	575	594	730	30.9	1465	A351XA10100LB51IMR
500	0.0605	0.0828	490	492	445	468	676	699	861	34.9	1855	A352XA10100LB51IMF
630	0.0469	0.0666	557	556	511	539	789	815	1008	39.3	2355	A353XA10100LB51IMF
800	0.0367	0.0551	622	623	579	614	907	938	1171	43.8	2990	A354XA10100LB51IMF
1000	0.0291	0.0391	692	693	657	702	1058	1094	1386	52.2	3760	A355XA10100LB51IMF

The above data is approximate and subjected to manufacturing tolerance. We reserve the right to change as a result of product development and/or changes in standard.



Trefoil | Flat D spaced | Trefoil | Flat touched | Trefoil | Flat touched | Flat 2D spaced

Laying Conditions: Ambient air temperature of **40 °C**, Ambient ground temperature of **35 °C**, Soil thermal resistivity of **1.5 K·m/W** and Depth of laying of **0.5 m**. In case of different laying conditions, appropriate correction (derating) factors from ***Annex C*** have to be applied to cater for the actual installation conditions.

Multi-Core Cables, with Stranded Copper Conductors, XLPE Insulated and LSHF Sheathed

APPLICATIONS

Suitable for use in fixed installations, in areas where smoke and acid gas evolution could pose a hazard to personnel or sensitive equipment in schools, hospitals, hotels, shopping centers, subways, etc., and in applications where mechanical protection is not required or mechanical damages are not expected to occur.

CABLE CHARACTERISTICS

Max. Operating temperature

Max. Short circuit temperature


Flame propagation IEC 60332-1


Flame spread IEC 60332-3-24 (C)


Low smoke emission IEC 61034


Halogen free IEC 60754-1


Acidity and toxicity IEC 60754-2

APPLICABLE STANDARDS

alfanar Low Smoke Halogen Free (LSHF) cables are designed and tested to meet or exceed the requirements of IEC 60502-1 standard. However, **alfanar** can also supply a range of alternative designs to meet customer-specified requirements.

CABLE CONSTRUCTION

Conductor

Plain annealed stranded circular (rm) or sector shaped (sm) copper conductor (Class 2).

Insulation

Extruded layer of halogen free Cross-linked polyethylene (XLPE).

Core Identification

- Red, Black
- Red, Yellow, Blue
- Red, Yellow, Blue, Black

Assembly

Cores are assembled together using Non-hygroscopic halogen free filler if needed.

Outer Jacket

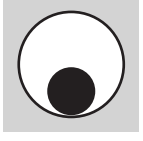
Extruded layer of low smoke halogen free (LSHF) compound.

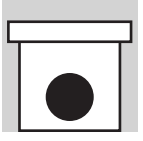
Note: *The core identification color(s) shown above is/are the most common. However, any other color can be provided upon a customer's request.*

CABLE INSTALLATION


In ground with protection


In free air Ladders / Trays


In duct


In trench


Internal cabling

LSHF CABLES / IEC 60502-1

CU / XLPE / LSHF

0.6 / 1 kV

Nominal cross sectional area		ELECTRICAL DATA					DIMENSIONS AND WEIGHTS		Cable Code
		Max. Conductor Resistance		Continuous Current Ratings			Approx. overall diameter	Approx. overall weight	
		DC at 20 °C	AC at 90 °C	Laid in ground	Laid in ducts	Laid in free air			
mm²		Ω / km	Ω / km	A	A	A	mm	kg / km	
Two Core Cables									
1.5	rm	12.1000	15.4287	33	22	28	9.6	130	C208XA10200LB01IMR
2.5	rm	7.4100	9.4485	43	29	36	10.4	165	C210XA10200LB01IMR
4	rm	4.6100	5.8783	56	38	48	11.6	215	C212XA10200LB01IMR
6	rm	3.0800	3.9274	69	48	61	12.6	275	C213XA10200LB01IMR
10	rm	1.8300	2.3336	91	63	82	13.8	360	C314XA10200LB01IMR
16	rm	1.1500	1.4667	118	83	110	15.8	515	C315XA10200LB01IMR
25	rm	0.7270	0.9275	153	110	149	19.0	780	C316XA10200LB01IMR
35	rm	0.5240	0.6688	183	133	183	21.0	1015	C317XA10200LB01IMR
Three Core Cables									
1.5	rm	12.1000	15.4287	27	18	23	10.1	150	C208XA10300LB04IMR
2.5	rm	7.4100	9.4485	35	24	30	10.9	195	C210XA10300LB04IMR
4	rm	4.6100	5.8783	46	31	40	12.2	260	C212XA10300LB04IMR
6	rm	3.0800	3.9274	57	39	51	13.3	335	C213XA10300LB04IMR
10	rm	1.8300	2.3336	75	53	70	15.1	425	C314XA10300LB04IMR
16	rm	1.1500	1.4667	97	69	93	17.3	605	C315XA10300LB04IMR
25	rm	0.7270	0.9275	126	92	126	20.7	910	C316XA10300LB04IMR
35	sm	0.5240	0.6688	144	105	141	20.0	1150	C417XA10300LB04IMR
Four Core Cables									
1.5	rm	12.1000	15.4287	27	18	23	10.9	180	C208XA10400LB08IMR
2.5	rm	7.4100	9.4485	35	24	30	11.8	230	C210XA10400LB08IMR
4	rm	4.6100	5.8783	46	31	40	13.3	320	C212XA10400LB08IMR
6	rm	3.0800	3.9274	57	39	51	14.5	415	C213XA10400LB08IMR
10	rm	1.8300	2.3336	75	53	70	16.4	535	C314XA10400LB08IMR
16	rm	1.1500	1.4667	97	69	93	18.9	770	C315XA10400LB08IMR
25	rm	0.7270	0.9275	126	92	126	22.7	1175	C316XA10400LB08IMR
35	sm	0.5240	0.6688	144	105	141	23.0	1505	C417XA10400LB08IMR
50	sm	0.3870	0.4944	171	127	173	26.5	2010	C418XA10400LB08IMR
70	sm	0.2680	0.3431	209	159	220	30.8	2860	C419XA10400LB08IMR
95	sm	0.1930	0.2481	251	193	271	33.5	3840	C445XA10400LB08IMR
120	sm	0.1530	0.1976	286	223	317	37.6	4855	C446XA10400LB08IMF
150	sm	0.1240	0.1612	319	252	360	42.1	5910	C447XA10400LB08IMF
185	sm	0.0991	0.1302	361	288	416	47.1	7480	C448XA10400LB08IMF
240	sm	0.0754	0.1012	417	339	495	52.9	9665	C449XA10400LB08IMS
300	sm	0.0601	0.0829	470	386	570	58.5	12015	C450XA10400LB08IMS
400	sm	0.0470	0.0676	533	444	665	67.1	15485	C451XA10400LB08IMS
500	sm	0.0366	0.0561	598	505	764	74.6	20030	C452XA10400LB08IMS
Four Core Cables with Reduced Neutral									
35 sm	16 rm	0.5240 / 1.1500	0.6688 / 1.4667	144	105	141	23.0	1325	C435XA10400LB08IMR
50 sm	25 rm	0.3870 / 0.7270	0.4944 / 0.9275	171	127	173	26.5	1810	C436XA10400LB08IMR
70 sm	35 sm	0.2680 / 0.5240	0.3431 / 0.6688	209	159	220	29.1	2505	C437XA10400LB08IMR
95 sm	50 sm	0.1930 / 0.3870	0.2481 / 0.4944	251	193	271	33.0	3385	C438XA10400LB08IMR
120 sm	70 sm	0.1530 / 0.2680	0.1976 / 0.3431	286	223	317	35.9	4335	C439XA10400LB08IMF
150 sm	70 sm	0.1240 / 0.2680	0.1612 / 0.3431	319	252	360	39.7	5130	C440XA10400LB08IMF
185 sm	95 sm	0.0991 / 0.1930	0.1302 / 0.2481	361	288	416	44.6	6585	C441XA10400LB08IMF
240 sm	120 sm	0.0754 / 0.1530	0.1012 / 0.1976	417	339	495	49.9	8450	C442XA10400LB08IMS
300 sm	150 sm	0.0601 / 0.1240	0.0829 / 0.1612	470	386	570	55.2	10485	C443XA10400LB08IMS
400 sm	185 sm	0.0470 / 0.0991	0.0676 / 0.1302	533	444	665	63.1	13505	C444XA10400LB08IMS
500 sm	240 sm	0.0366 / 0.0754	0.0561 / 0.1012	598	505	764	70.3	17420	C466XA10400LB08IMS

The above data is approximate and subjected to manufacturing tolerance. We reserve the right to change as a result of product development and/or changes in standard.

Laying Conditions: Ambient air temperature of **40 °C**, Ambient ground temperature of **35 °C**, Soil thermal resistivity of **1.5 K·m/W** and Depth of laying of **0.5 m**. In case of different laying conditions, appropriate correction (derating) factors from ***Annex C*** have to be applied to cater for the actual installation conditions.

Multi-Core Cables, with Stranded Aluminum Conductors, XLPE Insulated and LSHF Sheathed

APPLICATIONS

Suitable for use in fixed installations, in areas where smoke and acid gas evolution could pose a hazard to personnel or sensitive equipment in schools, hospitals, hotels, shopping centers, subways, etc., and in applications where mechanical protection is not required or mechanical damages are not expected to occur.

CABLE CHARACTERISTICS

Max. Operating temperature

Max. Short circuit temperature


Flame propagation IEC 60332-1


Flame spread IEC 60332-3-24 (C)


Low smoke emission IEC 61034


Halogen free IEC 60754-1


Acidity and toxicity IEC 60754-2

APPLICABLE STANDARDS

alfanar Low Smoke Halogen Free (LSHF) cables are designed and tested to meet or exceed the requirements of IEC 60502-1 standard. However, **alfanar** can also supply a range of alternative designs to meet customer-specified requirements.

CABLE CONSTRUCTION

Conductor

Stranded circular (rm) or sector shaped (sm) aluminum conductor (Class 2).

Insulation

Extruded layer of halogen free Cross-linked polyethylene (XLPE).

Core Identification

Red, Black
Red, Yellow, Blue
Red, Yellow, Blue, Black

Assembly

Cores are assembled together using Non-hygroscopic halogen free filler if needed.

Outer Jacket

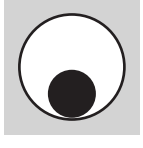
Extruded layer of low smoke halogen free (LSHF) compound.

Note: *The core identification color(s) shown above is/are the most common. However, any other color can be provided upon a customer's request.*

CABLE INSTALLATION


In ground with protection


In free air Ladders / Trays


In duct


In trench


Internal cabling

LSHF CABLES / IEC 60502-1

AL / XLPE / LSHF

0.6 / 1 kV

Nominal cross sectional area		ELECTRICAL DATA					DIMENSIONS AND WEIGHTS		Cable Code
		Max. Conductor Resistance		Continuous Current Ratings			Approx. overall diameter	Approx. overall weight	
		DC at 20 °C	AC at 90 °C	Laid in ground	Laid in ducts	Laid in free air			
mm²		Ω / km	Ω / km	A	A	A	mm	kg / km	
Two Core Cables									
10	rm	3.0800	3.9490	70	49	63	13.8	245	A314XA10200LB01IMR
16	rm	1.9100	2.4490	91	64	85	15.8	325	A315XA10200LB01IMR
25	rm	1.2000	1.5388	118	85	116	19.0	475	A316XA10200LB01IMR
35	rm	0.8680	1.1133	142	103	142	21.0	590	A317XA10200LB01IMR
Three Core Cables									
10	rm	3.0800	3.9490	58	41	53	15.1	250	A314XA10300LB04IMR
16	rm	1.9100	2.4490	75	54	72	17.3	320	A315XA10300LB04IMR
25	rm	1.2000	1.5388	98	71	98	20.7	450	A316XA10300LB04IMR
35	sm	0.8680	1.1133	111	82	109	20.0	525	A417XA10300LB04IMR
Four Core Cables									
10	rm	3.0800	3.9490	58	41	53	16.4	305	A314XA10400LB08IMR
16	rm	1.9100	2.4490	75	54	72	18.9	395	A315XA10400LB08IMR
25	rm	1.2000	1.5388	98	71	98	22.7	560	A316XA10400LB08IMR
35	sm	0.8680	1.1133	111	82	109	23.0	680	A417XA10400LB08IMR
50	sm	0.6410	0.8224	133	99	134	26.5	870	A418XA10400LB08IMR
70	sm	0.4430	0.5688	163	123	171	30.8	1250	A419XA10400LB08IMR
95	sm	0.3200	0.4115	195	150	210	33.5	1555	A445XA10400LB08IMR
120	sm	0.2530	0.3259	222	173	246	37.6	1945	A446XA10400LB08IMF
150	sm	0.2060	0.2660	248	196	280	42.1	2405	A447XA10400LB08IMF
185	sm	0.1640	0.2126	282	225	325	47.1	2925	A448XA10400LB08IMF
240	sm	0.1250	0.1634	327	265	388	52.9	3730	A449XA10400LB08IMS
300	sm	0.1000	0.1321	370	304	449	58.5	4635	A450XA10400LB08IMS
400	sm	0.0778	0.1047	424	354	530	67.1	6055	A451XA10400LB08IMS
500	sm	0.0605	0.0838	484	408	618	74.6	7450	A452XA10400LB08IMS
Four Core Cables with Reduced Neutral									
35 sm	16 rm	0.8680 / 1.9100	1.1133 / 2.4490	111	82	109	23.0	615	A435XA10400LB08IMR
50 sm	25 rm	0.6410 / 1.2000	0.8224 / 1.5388	133	99	134	26.5	800	A436XA10400LB08IMR
70 sm	35 sm	0.4430 / 0.8680	0.5688 / 1.1133	163	123	171	29.1	1050	A437XA10400LB08IMR
95 sm	50 sm	0.3200 / 0.6410	0.4115 / 0.8224	195	150	210	33.0	1385	A438XA10400LB08IMR
120 sm	70 sm	0.2530 / 0.4430	0.3259 / 0.5688	222	173	246	35.9	1725	A439XA10400LB08IMF
150 sm	70 sm	0.2060 / 0.4430	0.2660 / 0.5688	248	196	280	39.7	2080	A440XA10400LB08IMF
185 sm	95 sm	0.1640 / 0.3200	0.2126 / 0.4115	282	225	325	44.6	2580	A441XA10400LB08IMF
240 sm	120 sm	0.1250 / 0.2530	0.1634 / 0.3259	327	265	388	49.9	3265	A442XA10400LB08IMS
300 sm	150 sm	0.1000 / 0.2060	0.1321 / 0.2660	370	304	449	55.2	4070	A443XA10400LB08IMS
400 sm	185 sm	0.0778 / 0.1640	0.1047 / 0.2126	424	354	530	63.1	5260	A444XA10400LB08IMS
500 sm	240 sm	0.0605 / 0.1250	0.0838 / 0.1634	484	408	618	70.3	6630	A466XA10400LB08IMS

The above data is approximate and subjected to manufacturing tolerance. We reserve the right to change as a result of product development and/or changes in standard.

Laying Conditions: Ambient air temperature of **40 °C**, Ambient ground temperature of **35 °C**, Soil thermal resistivity of **1.5 K·m/W** and Depth of laying of **0.5 m**. In case of different laying conditions, appropriate correction (derating) factors from ***Annex C*** have to be applied to cater for the actual installation conditions.

Multi-Core Cables, with Stranded Copper Conductors, XLPE Insulated, Steel Tape Armoured and LSHF Sheathed

APPLICATIONS

Suitable for use in fixed installations, in areas where smoke and acid gas evolution could pose a hazard to personnel or sensitive equipment in schools, hospitals, hotels, shopping centers, subways, etc., and in applications where mechanical protection is required or mechanical damages are expected to occur.

CABLE CHARACTERISTICS

Max. Operating temperature

Max. Short circuit temperature


Flame propagation IEC 60332-1


Flame spread IEC 60332-3-24 (C)


Low smoke emission IEC 61034


Halogen free IEC 60754-1


Acidity and toxicity IEC 60754-2

APPLICABLE STANDARDS

alfanar Low Smoke Halogen Free (LSHF) cables are designed and tested to meet or exceed the requirements of IEC 60502-1 standard. However, **alfanar** can also supply a range of alternative designs to meet customer-specified requirements.

CABLE CONSTRUCTION

Conductor

Plain annealed stranded circular (rm) or sector shaped (sm) copper conductor (Class 2).

Insulation

Extruded layer of halogen free Cross-linked polyethylene (XLPE).

Core Identification


Red, Black


Red, Yellow, Blue

Red, Yellow, Blue, Black

Assembly

Cores are assembled together using Non-hygroscopic halogen free filler if needed.

Bedding

Extruded layer of low smoke halogen free (LSHF) compound.

Armouring

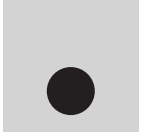
Double layers of galvanized steel tapes.

Outer Jacket

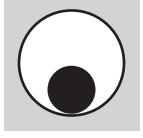
Extruded layer of low smoke halogen free (LSHF) compound.

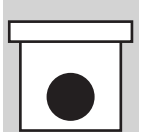
Note: *The core identification color(s) shown above is/are the most common. However, any other color can be provided upon a customer's request.*

CABLE INSTALLATION


In ground


In free air Ladders / Trays


In duct


In trench


Internal / external cabling

LSHF CABLES / IEC 60502-1

CU / XLPE / STA / LSHF

0.6 / 1 kV

Nominal cross sectional area		ELECTRICAL DATA					DIMENSIONS AND WEIGHTS		Cable Code
		Max. Conductor Resistance		Continuous Current Ratings			Approx. overall diameter	Approx. overall weight	
		DC at 20 °C	AC at 90 °C	Laid in ground	Laid in ducts	Laid in free air			
mm²		Ω / km	Ω / km	A	A	A	mm	kg / km	
Two Core Cables									
6	rm	3.0800	3.9274	67	49	62	15.4	425	C213XA1020GLB01IMR
10	rm	1.8300	2.3336	89	65	83	16.6	525	C314XA1020GLB01IMR
16	rm	1.1500	1.4667	114	84	110	18.6	700	C315XA1020GLB01IMR
25	rm	0.7270	0.9275	148	111	148	21.8	1005	C316XA1020GLB01IMR
35	rm	0.5240	0.6688	177	134	180	23.8	1265	C317XA1020GLB01IMR
Three Core Cables									
6	rm	3.0800	3.9274	55	40	52	16.1	495	C213XA1030GLB04IMR
10	rm	1.8300	2.3336	74	54	70	17.9	605	C314XA1030GLB04IMR
16	rm	1.1500	1.4667	95	70	93	20.1	810	C315XA1030GLB04IMR
25	rm	0.7270	0.9275	123	92	124	23.5	1155	C316XA1030GLB04IMR
35	sm	0.5240	0.6688	140	106	140	22.8	1370	C417XA1030GLB04IMR
Four Core Cables									
6	rm	3.0800	3.9274	55	40	52	17.3	590	C213XA1040GLB08IMR
10	rm	1.8300	2.3336	74	54	70	19.2	730	C314XA1040GLB08IMR
16	rm	1.1500	1.4667	95	70	93	21.7	995	C315XA1040GLB08IMR
25	rm	0.7270	0.9275	123	92	124	25.5	1440	C316XA1040GLB08IMR
35	sm	0.5240	0.6688	140	106	140	25.8	1760	C417XA1040GLB08IMR
50	sm	0.3870	0.4944	166	128	171	29.5	2320	C418XA1040GLB08IMR
70	sm	0.2680	0.3431	203	159	215	34.0	3210	C419XA1040GLB08IMR
95	sm	0.1930	0.2481	243	193	263	38.1	4580	C445XA1040GLB08IMF
120	sm	0.1530	0.1976	278	224	310	42.6	5735	C446XA1040GLB08IMF
150	sm	0.1240	0.1612	310	252	349	47.1	6895	C447XA1040GLB08IMF
185	sm	0.0991	0.1302	349	287	402	52.1	8580	C448XA1040GLB08IMS
240	sm	0.0754	0.1012	402	335	473	58.3	10960	C449XA1040GLB08IMS
300	sm	0.0601	0.0829	452	380	541	63.9	13445	C450XA1040GLB08IMS
400	sm	0.0470	0.0676	511	435	627	72.9	17195	C451XA1040GLB08IMS
500	sm	0.0366	0.0561	570	491	713	81.8	22725	C452XA1040GLB08IMS
Four Core Cables with Reduced Neutral									
35 sm	16 rm	0.5240 / 1.1500	0.6688 / 1.4667	140	106	140	25.8	1595	C435XA1040GLB08IMR
50 sm	25 rm	0.3870 / 0.7270	0.4944 / 0.9275	166	128	171	29.3	2120	C436XA1040GLB08IMR
70 sm	35 sm	0.2680 / 0.5240	0.3431 / 0.6688	203	159	215	32.5	2895	C437XA1040GLB08IMR
95 sm	50 sm	0.1930 / 0.3870	0.2481 / 0.4944	243	193	263	37.4	4140	C438XA1040GLB08IMF
120 sm	70 sm	0.1530 / 0.2680	0.1976 / 0.3431	278	224	310	40.5	5175	C439XA1040GLB08IMF
150 sm	70 sm	0.1240 / 0.2680	0.1612 / 0.3431	310	252	349	44.7	6100	C440XA1040GLB08IMF
185 sm	95 sm	0.0991 / 0.1930	0.1302 / 0.2481	349	287	402	49.6	7670	C441XA1040GLB08IMF
240 sm	120 sm	0.0754 / 0.1530	0.1012 / 0.1976	402	335	473	55.5	9745	C442XA1040GLB08IMS
300 sm	150 sm	0.0601 / 0.1240	0.0829 / 0.1612	452	380	541	60.6	11880	C443XA1040GLB08IMS
400 sm	185 sm	0.0470 / 0.0991	0.0676 / 0.1302	511	435	627	68.5	15090	C444XA1040GLB08IMS
500 sm	240 sm	0.0366 / 0.0754	0.0561 / 0.1012	570	491	713	76.1	19260	C466XA1040GLB08IMS

The above data is approximate and subjected to manufacturing tolerance. We reserve the right to change as a result of product development and/or changes in standard.

Laying Conditions: Ambient air temperature of **40 °C**, Ambient ground temperature of **35 °C**, Soil thermal resistivity of **1.5 K·m/W** and Depth of laying of **0.5 m**. In case of different laying conditions, appropriate correction (derating) factors from ***Annex C*** have to be applied to cater for the actual installation conditions.

Multi-Core Cables, with Stranded Aluminum Conductors, XLPE Insulated, Steel Tape Armoured and LSHF Sheathed

APPLICATIONS

Suitable for use in fixed installations, in areas where smoke and acid gas evolution could pose a hazard to personnel or sensitive equipment in schools, hospitals, hotels, shopping centers, subways, etc., and in applications where mechanical protection is required or mechanical damages are expected to occur.

CABLE CHARACTERISTICS

Max. Operating temperature

Max. Short circuit temperature


Flame propagation IEC 60332-1


Flame spread IEC 60332-3-24 (C)


Low smoke emission IEC 61034


Halogen free IEC 60754-1


Acidity and toxicity IEC 60754-2

APPLICABLE STANDARDS

alfanar Low Smoke Halogen Free (LSHF) cables are designed and tested to meet or exceed the requirements of IEC 60502-1 standard. However, **alfanar** can also supply a range of alternative designs to meet customer-specified requirements.

CABLE CONSTRUCTION

Conductor

Stranded circular (rm) or sector shaped (sm) aluminum conductor (Class 2).

Insulation

Extruded layer of halogen free Cross-linked polyethylene (XLPE).

Core Identification

Red, Black
Red, Yellow, Blue
Red, Yellow, Blue, Black

Assembly

Cores are assembled together using Non-hygroscopic halogen free filler if needed.

Bedding

Extruded layer of low smoke halogen free (LSHF) compound.

Armouring

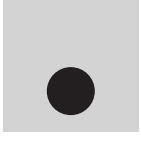
Double layers of galvanized steel tapes.

Outer Jacket

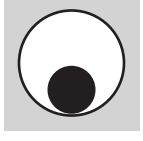
Extruded layer of low smoke halogen free (LSHF) compound.

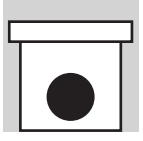
Note: *The core identification color(s) shown above is/are the most common. However, any other color can be provided upon a customer's request.*

CABLE INSTALLATION


In ground


In free air Ladders / Trays


In duct


In trench


Internal / external cabling

LSHF CABLES / IEC 60502-1

AL / XLPE / STA / LSHF

0.6 / 1 kV

Nominal cross sectional area		ELECTRICAL DATA					DIMENSIONS AND WEIGHTS		Cable Code
		Max. Conductor Resistance		Continuous Current Ratings			Approx. overall diameter	Approx. overall weight	
		DC at 20 °C	AC at 90 °C	Laid in ground	Laid in ducts	Laid in free air			
mm²		Ω / km	Ω / km	A	A	A	mm	kg / km	
Two Core Cables									
10	rm	3.0800	3.9490	68	50	64	16.6	410	A314XA1020GLB01IMR
16	rm	1.9100	2.4490	89	65	85	18.6	510	A315XA1020GLB01IMR
25	rm	1.2000	1.5388	115	86	115	21.8	695	A316XA1020GLB01IMR
35	rm	0.8680	1.1133	138	104	140	23.8	835	A317XA1020GLB01IMR
Three Core Cables									
10	rm	3.0800	3.9490	57	41	54	17.9	430	A314XA1030GLB04IMR
16	rm	1.9100	2.4490	73	54	72	20.1	525	A315XA1030GLB04IMR
25	rm	1.2000	1.5388	95	72	97	23.5	695	A316XA1030GLB04IMR
35	sm	0.8680	1.1133	108	82	108	22.8	750	A417XA1030GLB04IMR
Four Core Cables									
10	rm	3.0800	3.9490	57	41	54	19.2	495	A314XA1040GLB08IMR
16	rm	1.9100	2.4490	73	54	72	21.7	620	A315XA1040GLB08IMR
25	rm	1.2000	1.5388	95	72	97	25.5	825	A316XA1040GLB08IMR
35	sm	0.8680	1.1133	108	82	108	25.8	935	A417XA1040GLB08IMR
50	sm	0.6410	0.8224	129	99	132	29.5	1180	A418XA1040GLB08IMR
70	sm	0.4430	0.5688	158	124	167	34.0	1605	A419XA1040GLB08IMR
95	sm	0.3200	0.4115	189	150	204	38.1	2300	A445XA1040GLB08IMF
120	sm	0.2530	0.3259	217	174	241	42.6	2825	A446XA1040GLB08IMF
150	sm	0.2060	0.2660	241	196	272	47.1	3390	A447XA1040GLB08IMF
185	sm	0.1640	0.2126	274	255	314	52.1	4025	A448XA1040GLB08IMS
240	sm	0.1250	0.1634	317	264	372	58.3	5025	A449XA1040GLB08IMS
300	sm	0.1000	0.1321	357	301	428	63.9	6065	A450XA1040GLB08IMS
400	sm	0.0778	0.1047	410	349	503	72.9	7765	A451XA1040GLB08IMS
500	sm	0.0605	0.0838	464	400	580	81.8	10145	A452XA1040GLB08IMS
Four Core Cables with Reduced Neutral									
35 sm	16 rm	0.8680 / 1.9100	1.1133 / 2.4490	108	82	108	25.8	885	A435XA1040GLB08IMR
50 sm	25 rm	0.6410 / 1.2000	0.8224 / 1.5388	129	99	132	29.3	1110	A436XA1040GLB08IMR
70 sm	35 sm	0.4430 / 0.8680	0.5688 / 1.1133	158	124	167	32.5	1440	A437XA1040GLB08IMR
95 sm	50 sm	0.3200 / 0.6410	0.4115 / 0.8224	189	150	204	37.4	2140	A438XA1040GLB08IMR
120 sm	70 sm	0.2530 / 0.4430	0.3259 / 0.5688	217	174	241	40.5	2565	A439XA1040GLB08IMF
150 sm	70 sm	0.2060 / 0.4430	0.2660 / 0.5688	241	196	272	44.7	3055	A440XA1040GLB08IMF
185 sm	95 sm	0.1640 / 0.3200	0.2126 / 0.4115	274	255	314	49.6	3665	A441XA1040GLB08IMF
240 sm	120 sm	0.1250 / 0.2530	0.1634 / 0.3259	317	264	372	55.5	4560	A442XA1040GLB08IMS
300 sm	150 sm	0.1000 / 0.2060	0.1321 / 0.2660	357	301	428	60.6	5465	A443XA1040GLB08IMS
400 sm	185 sm	0.0778 / 0.1640	0.1047 / 0.2126	410	349	503	68.5	6845	A444XA1040GLB08IMS
500 sm	240 sm	0.0605 / 0.1250	0.0838 / 0.1634	464	400	580	76.1	8470	A466XA1040GLB08IMS

The above data is approximate and subjected to manufacturing tolerance. We reserve the right to change as a result of product development and/or changes in standard.

Laying Conditions: Ambient air temperature of **40 °C**, Ambient ground temperature of **35 °C**, Soil thermal resistivity of **1.5 K·m/W** and Depth of laying of **0.5 m**. In case of different laying conditions, appropriate correction (derating) factors from ***Annex C*** have to be applied to cater for the actual installation conditions.

Multi-Core Cables, with Stranded Copper Conductors, XLPE Insulated, Steel Wire Armoured and LSHF Sheathed

APPLICATIONS

Suitable for use in fixed installations, in areas where smoke and acid gas evolution could pose a hazard to personnel or sensitive equipment in schools, hospitals, hotels, shopping centers, subways, etc., and in applications where mechanical protection is required or mechanical damages are expected to occur.

CABLE CHARACTERISTICS

Max. Operating temperature

Max. Short circuit temperature


Flame propagation IEC 60332-1


Flame spread IEC 60332-3-24 (C)


Low smoke emission IEC 61034


Halogen free IEC 60754-1


Acidity and toxicity IEC 60754-2

APPLICABLE STANDARDS

alfanar Low Smoke Halogen Free (LSHF) cables are designed and tested to meet or exceed the requirements of IEC 60502-1 standard. However, **alfanar** can also supply a range of alternative designs to meet customer-specified requirements.

CABLE CONSTRUCTION

Conductor

Plain annealed stranded circular (rm) or sector shaped (sm) copper conductor (Class 2).

Insulation

Extruded layer of halogen free Cross-linked polyethylene (XLPE).

Core Identification

Red, Black
Red, Yellow, Blue
Red, Yellow, Blue, Black

Assembly

Cores are assembled together using Non-hygroscopic halogen free filler if needed.

Bedding

Extruded layer of low smoke halogen free (LSHF) compound.

Armouring

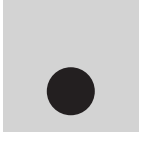
Single layer of galvanized steel wires.

Outer Jacket

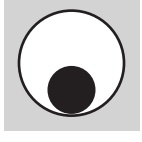
Extruded layer of low smoke halogen free (LSHF) compound.

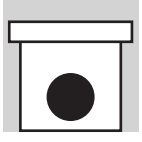
Note: *The core identification color(s) shown above is/are the most common. However, any other color can be provided upon a customer's request.*

CABLE INSTALLATION


In ground


In free air Ladders / Trays


In duct


In trench


Internal / external cabling

LSHF CABLES / IEC 60502-1

CU / XLPE / SWA / LSHF

0.6 / 1 kV

Nominal cross sectional area		ELECTRICAL DATA					DIMENSIONS AND WEIGHTS		Cable Code
		Max. Conductor Resistance		Continuous Current Ratings			Approx. overall diameter	Approx. overall weight	
		DC at 20 °C	AC at 90 °C	Laid in ground	Laid in ducts	Laid in free air			
mm²		Ω / km	Ω / km	A	A	A	mm	kg / km	
Two Core Cables									
2.5	rm	7.4100	9.4485	42	31	38	14.5	390	C210XA1020WLB01IMR
4	rm	4.6100	5.8783	55	40	51	15.7	470	C212XA1020WLB01IMR
6	rm	3.0800	3.9274	68	50	64	16.7	550	C213XA1020WLB01IMR
10	rm	1.8300	2.3336	90	67	87	18.8	770	C314XA1020WLB01IMR
16	rm	1.1500	1.4667	116	87	114	20.8	985	C315XA1020WLB01IMR
25	rm	0.7270	0.9275	151	114	154	24.7	1490	C316XA1020WLB01IMR
35	rm	0.5240	0.6688	180	138	188	26.7	1785	C317XA1020WLB01IMR
Three Core Cables									
2.5	rm	7.4100	9.4485	35	25	32	15.0	430	C210XA1030WLB04IMR
4	rm	4.6100	5.8783	45	33	42	16.3	525	C212XA1030WLB04IMR
6	rm	3.0800	3.9274	56	41	53	17.4	625	C213XA1030WLB04IMR
10	rm	1.8300	2.3336	75	56	73	20.1	870	C314XA1030WLB04IMR
16	rm	1.1500	1.4667	96	72	96	22.3	1115	C315XA1030WLB04IMR
25	rm	0.7270	0.9275	125	95	130	26.4	1680	C316XA1030WLB04IMR
35	sm	0.5240	0.6688	142	109	145	25.7	1865	C417XA1030WLB04IMR
Four Core Cables									
2.5	rm	7.4100	9.4485	35	25	32	15.9	490	C210XA1040WLB08IMR
4	rm	4.6100	5.8783	45	33	42	17.4	605	C212XA1040WLB08IMR
6	rm	3.0800	3.9274	56	41	53	19.5	850	C213XA1040WLB08IMR
10	rm	1.8300	2.3336	75	56	73	21.4	1020	C314XA1040WLB08IMR
16	rm	1.1500	1.4667	96	72	96	24.6	1460	C315XA1040WLB08IMR
25	rm	0.7270	0.9275	125	95	130	28.4	2000	C316XA1040WLB08IMR
35	sm	0.5240	0.6688	142	109	145	28.9	2345	C417XA1040WLB08IMR
50	sm	0.3870	0.4944	169	132	177	32.6	2990	C418XA1040WLB08IMR
70	sm	0.2680	0.3431	206	163	222	37.6	4290	C419XA1040WLB08IMR
95	sm	0.1930	0.2481	246	197	271	40.3	5395	C445XA1040WLB08IMF
120	sm	0.1530	0.1976	279	226	314	45.8	7025	C446XA1040WLB08IMF
150	sm	0.1240	0.1612	311	255	356	50.3	8330	C447XA1040WLB08IMF
185	sm	0.0991	0.1302	349	290	407	55.3	10160	C448XA1040WLB08IMS
240	sm	0.0754	0.1012	400	336	470	61.5	12750	C449XA1040WLB08IMS
300	sm	0.0601	0.0829	446	378	541	67.1	15405	C450XA1040WLB08IMS
400	sm	0.0470	0.0676	499	427	620	77.8	20315	C451XA1040WLB08IMS
500	sm	0.0366	0.0561	546	474	695	85.5	25460	C452XA1040WLB08IMS
Four Core Cables with Reduced Neutral									
35 sm	16 rm	0.5240 / 1.1500	0.6688 / 1.4667	142	109	145	28.7	2175	C435XA1040WLB08IMR
50 sm	25 rm	0.3870 / 0.7270	0.4944 / 0.9275	169	132	177	32.4	2790	C436XA1040WLB08IMR
70 sm	35 sm	0.2680 / 0.5240	0.3431 / 0.6688	206	163	222	35.9	3910	C437XA1040WLB08IMR
95 sm	50 sm	0.1930 / 0.3870	0.2481 / 0.4944	246	197	271	39.6	4935	C438XA1040WLB08IMF
120 sm	70 sm	0.1530 / 0.2680	0.1976 / 0.3431	279	226	314	42.7	6035	C439XA1040WLB08IMF
150 sm	70 sm	0.1240 / 0.2680	0.1612 / 0.3431	311	255	356	47.9	7485	C440XA1040WLB08IMF
185 sm	95 sm	0.0991 / 0.1930	0.1302 / 0.2481	349	290	407	52.8	9200	C441XA1040WLB08IMF
240 sm	120 sm	0.0754 / 0.1530	0.1012 / 0.1976	400	336	470	58.7	11440	C442XA1040WLB08IMS
300 sm	150 sm	0.0601 / 0.1240	0.0829 / 0.1612	446	378	541	63.8	13755	C443XA1040WLB08IMS
400 sm	185 sm	0.0470 / 0.0991	0.0676 / 0.1302	499	427	620	73.4	18065	C444XA1040WLB08IMS
500 sm	240 sm	0.0366 / 0.0754	0.0561 / 0.1012	546	474	695	81.2	22570	C466XA1040WLB08IMS

The above data is approximate and subjected to manufacturing tolerance. We reserve the right to change as a result of product development and/or changes in standard.

Laying Conditions: Ambient air temperature of **40 °C**, Ambient ground temperature of **35 °C**, Soil thermal resistivity of **1.5 K·m/W** and Depth of laying of **0.5 m**. In case of different laying conditions, appropriate correction (derating) factors from ***Annex C*** have to be applied to cater for the actual installation conditions.

Multi-Core Cables, with Stranded Aluminum Conductors, XLPE Insulated, Steel Wire Armoured and LSHF Sheathed

APPLICATIONS

Suitable for use in fixed installations, in areas where smoke and acid gas evolution could pose a hazard to personnel or sensitive equipment in schools, hospitals, hotels, shopping centers, subways, etc., and in applications where mechanical protection is required or mechanical damages are expected to occur.

CABLE CHARACTERISTICS

Max. Operating temperature

Max. Short circuit temperature


Flame propagation IEC 60332-1


Flame spread IEC 60332-3-24 (C)


Low smoke emission IEC 61034


Halogen free IEC 60754-1


Acidity and toxicity IEC 60754-2

APPLICABLE STANDARDS

alfanar Low Smoke Halogen Free (LSHF) cables are designed and tested to meet or exceed the requirements of IEC 60502-1 standard. However, **alfanar** can also supply a range of alternative designs to meet customer-specified requirements.

CABLE CONSTRUCTION

Conductor
Stranded circular (rm) or sector shaped (sm) aluminum conductor (Class 2).

Insulation
Extruded layer of halogen free Cross-linked polyethylene (XLPE).

Core Identification
Red, Black
Red, Yellow, Blue
Red, Yellow, Blue, Black

Assembly
Cores are assembled together using Non-hygroscopic halogen free filler if needed.

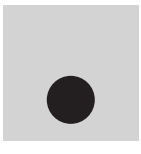
Bedding
Extruded layer of low smoke halogen free (LSHF) compound.

Armouring
Single layer of galvanized steel wires.

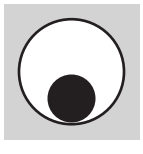
Outer Jacket
Extruded layer of low smoke halogen free (LSHF) compound.

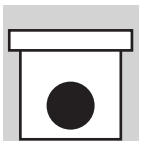
Note: *The core identification color(s) shown above is/are the most common. However, any other color can be provided upon a customer's request.*

CABLE INSTALLATION


In ground


In free air Ladders / Trays


In duct


In trench


Internal / external cabling

LSHF CABLES / IEC 60502-1

AL / XLPE / SWA / LSHF

0.6 / 1 kV

Nominal cross sectional area		ELECTRICAL DATA					DIMENSIONS AND WEIGHTS		Cable Code
		Max. Conductor Resistance		Continuous Current Ratings			Approx. overall diameter	Approx. overall weight	
		DC at 20 °C	AC at 90 °C	Laid in ground	Laid in ducts	Laid in free air			
mm²		Ω / km	Ω / km	A	A	A	mm	kg / km	
Two Core Cables									
10	rm	3.0800	3.9490	69	51	67	18.8	655	A314XA1020WLB01IMR
16	rm	1.9100	2.4490	90	67	88	20.8	795	A315XA1020WLB01IMR
25	rm	1.2000	1.5388	117	89	120	24.7	1180	A316XA1020WLB01IMR
35	rm	0.8680	1.1133	140	107	146	26.7	1355	A317XA1020WLB01IMR
Three Core Cables									
10	rm	3.0800	3.9490	57	43	56	20.1	700	A314XA1030WLB04IMR
16	rm	1.9100	2.4490	74	56	74	22.3	830	A315XA1030WLB04IMR
25	rm	1.2000	1.5388	97	74	101	26.4	1215	A316XA1030WLB04IMR
35	sm	0.8680	1.1133	110	85	113	25.7	1245	A417XA1030WLB04IMR
Four Core Cables									
10	rm	3.0800	3.9490	57	43	56	21.4	790	A314XA1040WLB08IMR
16	rm	1.9100	2.4490	74	56	74	24.6	1085	A315XA1040WLB08IMR
25	rm	1.2000	1.5388	97	74	101	28.4	1385	A316XA1040WLB08IMR
35	sm	0.8680	1.1133	110	85	113	28.9	1520	A417XA1040WLB08IMR
50	sm	0.6410	0.8224	131	102	137	32.6	1850	A418XA1040WLB08IMR
70	sm	0.4430	0.5688	160	127	173	37.6	2680	A419XA1040WLB08IMR
95	sm	0.3200	0.4115	191	153	211	40.3	3115	A445XA1040WLB08IMF
120	sm	0.2530	0.3259	218	176	245	45.8	4115	A446XA1040WLB08IMF
150	sm	0.2060	0.2660	243	199	278	50.3	4825	A447XA1040WLB08IMF
185	sm	0.1640	0.2126	274	228	320	55.3	5605	A448XA1040WLB08IMS
240	sm	0.1250	0.1634	317	265	376	61.5	6815	A449XA1040WLB08IMS
300	sm	0.1000	0.1321	356	301	430	67.1	8025	A450XA1040WLB08IMS
400	sm	0.0778	0.1047	404	346	501	77.8	10885	A451XA1040WLB08IMS
500	sm	0.0605	0.0838	452	393	574	85.5	12880	A452XA1040WLB08IMS
Four Core Cables with Reduced Neutral									
35 sm	16 rm	0.8680 / 1.9100	1.1133 / 2.4490	110	85	113	28.7	1460	A435XA1040WLB08IMR
50 sm	25 rm	0.6410 / 1.2000	0.8224 / 1.5388	131	102	137	32.4	1780	A436XA1040WLB08IMR
70 sm	35 sm	0.4430 / 0.8680	0.5688 / 1.1133	160	127	173	35.9	2455	A437XA1040WLB08IMR
95 sm	50 sm	0.3200 / 0.6410	0.4115 / 0.8224	191	153	211	39.6	2935	A438XA1040WLB08IMR
120 sm	70 sm	0.2530 / 0.4430	0.3259 / 0.5688	218	176	245	42.7	3425	A439XA1040WLB08IMF
150 sm	70 sm	0.2060 / 0.4430	0.2660 / 0.5688	243	199	278	47.9	4435	A440XA1040WLB08IMF
185 sm	95 sm	0.1640 / 0.3200	0.2126 / 0.4115	274	228	320	52.8	5195	A441XA1040WLB08IMF
240 sm	120 sm	0.1250 / 0.2530	0.1634 / 0.3259	317	265	376	58.7	6255	A442XA1040WLB08IMF
300 sm	150 sm	0.1000 / 0.2060	0.1321 / 0.2660	356	301	430	63.8	7340	A443XA1040WLB08IMS
400 sm	185 sm	0.0778 / 0.1640	0.1047 / 0.2126	404	346	501	73.4	9820	A444XA1040WLB08IMS
500 sm	240 sm	0.0605 / 0.1250	0.0838 / 0.1634	452	393	574	81.2	11780	A466XA1040WLB08IMS

The above data is approximate and subjected to manufacturing tolerance. We reserve the right to change as a result of product development and/or changes in standard.

Laying Conditions: Ambient air temperature of **40 °C**, Ambient ground temperature of **35 °C**, Soil thermal resistivity of **1.5 K·m/W** and Depth of laying of **0.5 m**. In case of different laying conditions, appropriate correction (derating) factors from ***Annex C*** have to be applied to cater for the actual installation conditions.

Single-Core Non-sheathed Cables, with Solid, Stranded or Flexible Copper Conductors and LSHF Insulated

APPLICATIONS

Suitable for use in fixed and protected installations in metallic or non-metallic conduits, ducts or trunks for use in/on lighting fittings, switch and control devices, control panels and similar applications, in areas where smoke and acid gas evolution could pose a hazard to personnel or sensitive equipments in residential buildings, schools, hospitals, hotels, shopping centers, subways, etc.

CABLE CHARACTERISTICS

Max. Operating temperature

Max. Short circuit temperature

Flame propagation BS EN 60332-1

Low smoke emission BS EN 61034

Halogen free BS EN 50267-2-1

Acidity and toxicity BS EN 50267-2-2

APPLICABLE STANDARDS

alfanar Low Smoke Halogen Free (LSHF) single-core, non-sheathed cables are designed and tested to meet or exceed the requirements of BS 7211 standard. However, **alfanar** can also supply a range of alternative designs to meet customer-specified requirements.

CABLE CONSTRUCTION

Conductor

Plain annealed solid (Class 1), stranded (Class 2) or flexible (Class 5) circular copper conductor.

Insulation

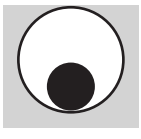
Extruded layer of Cross-linkable low smoke halogen free (LSHF) compound.

Core Identification

In addition to the standard core identification colors, other colors are available on request.

CABLE INSTALLATION

In free air Ladders / Trays



In duct

Encased or in surface conduit

Electrical panels

Internal wiring

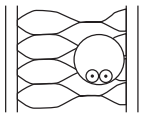
LSHF INDOOR WIRES / BS 7211

CU / LSHF

450 / 750 V

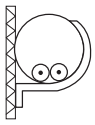
Nominal cross sectional area	ELECTRICAL DATA									DIMENSIONS AND WEIGHTS		Cable Code
	Max. Conductor Resistance		Continuous Current Ratings							Approx. overall diameter	Approx. overall weight	
	DC at 20 °C	AC at 90 °C	2 loaded conductors (Single-Phase circuit)			3 loaded conductors (Three-Phase circuit)						
mm²	Ω / km	Ω / km	(a)	(b)	(c)	(d)	(e)	(f)	(g)	mm	Kg / km	
			A	A	A	A	A	A	A			
a. Solid Conductors												
1.5	12.1000	15.4287	17	20	-	-	-	-	-	2.8	20	C108ZB101000X00BXX
2.5	7.4100	9.4485	23	28	-	-	-	-	-	3.4	35	C110ZB101000X00BXX
4	4.6100	5.8783	31	38	-	-	-	-	-	3.9	50	C112ZB101000X00BXX
6	3.0800	3.9274	40	49	-	-	-	-	-	4.4	65	C113ZB101000X00BXX
10	1.8300	2.3336	55	68	-	-	-	-	-	5.6	110	C114ZB101000X00BXX
b. Stranded Conductors												
1.5	12.1000	15.4287	17	20	-	-	-	-	-	3.0	25	C208ZB101000X00BXX
2.5	7.4100	9.4485	23	28	-	-	-	-	-	3.6	35	C210ZB101000X00BXX
4	4.6100	5.8783	31	38	-	-	-	-	-	4.2	50	C212ZB101000X00BXX
6	3.0800	3.9274	40	49	-	-	-	-	-	4.7	70	C213ZB101000X00BXX
10	1.8300	2.3336	55	68	-	-	-	-	-	5.7	110	C314ZB101000X00BXX
16	1.1500	1.4666	73	91	-	-	-	-	-	6.7	165	C315ZB101000X00BXX
25	0.7270	0.9274	96	121	146	122	128	165	146	8.3	255	C316ZB101000X00BXX
35	0.5240	0.6688	119	149	182	153	160	205	182	9.3	345	C317ZB101000X00BXX
50	0.3870	0.4943	143	180	220	188	196	250	223	10.9	465	C318ZB101000X00BXX
70	0.2680	0.3430	182	230	282	243	253	321	289	12.5	660	C319ZB101000X00BXX
95	0.1930	0.2479	219	278	343	298	311	391	353	14.5	910	C345ZB101000X00BXX
120	0.1530	0.1974	252	322	397	348	364	455	413	15.8	1140	C346ZB101000X00BXX
150	0.1240	0.1610	289	-	458	404	422	525	479	17.7	1400	C347ZB101000X00BXX
185	0.0991	0.1299	329	-	523	464	485	601	550	19.8	1760	C348ZB101000X00BXX
240	0.0754	0.1008	385	-	617	552	576	710	654	22.5	2305	C349ZB101000X00BXX
300	0.0601	0.0824	442	-	712	639	669	820	758	25.3	2880	C350ZB101000X00BXX
400	0.0470	0.0671	-	-	855	748	789	987	917	28.3	3685	C351ZB101000X00BXX
500	0.0366	0.0555	-	-	985	860	908	1140	1063	32.1	4775	C352ZB101000X00BXX
630	0.0283	0.0468	-	-	1141	990	1047	1323	1239	35.7	6050	C353ZB101000X00BXX
c. Flexible Conductors												
1.5	13.3000	16.9588	17	20	-	-	-	-	-	3.0	25	C508ZB101000X00BXX
2.5	7.9800	10.1753	23	28	-	-	-	-	-	3.7	35	C510ZB101000X00BXX
4	4.9500	6.3118	31	38	-	-	-	-	-	4.1	50	C512ZB101000X00BXX
6	3.3000	4.2079	40	49	-	-	-	-	-	4.6	70	C513ZB101000X00BXX
10	1.9100	2.4356	55	68	-	-	-	-	-	6.0	115	C514ZB101000X00BXX
16	1.2100	1.5431	73	91	-	-	-	-	-	7.6	180	C515ZB101000X00BXX
25	0.7800	0.9950	96	121	146	122	128	165	146	9.5	275	C516ZB101000X00BXX
35	0.5540	0.7070	119	149	182	153	160	205	182	11.0	375	C517ZB101000X00BXX
50	0.3860	0.4931	143	180	220	188	196	250	223	12.6	540	C518ZB101000X00BXX
70	0.2720	0.3482	182	230	282	243	253	321	289	14.6	730	C519ZB101000X00BXX
95	0.2060	0.2645	219	278	343	298	311	391	353	17.0	980	C545ZB101000X00BXX
120	0.1610	0.2077	252	322	397	348	364	455	413	18.9	1235	C546ZB101000X00BXX
150	0.1290	0.1674	289	-	458	404	422	525	479	21.2	1540	C547ZB101000X00BXX
185	0.1060	0.1387	329	-	523	464	485	601	550	23.4	1880	C548ZB101000X00BXX
240	0.0801	0.1068	385	-	617	552	576	710	654	26.9	2475	C549ZB101000X00BXX

Fig. (a)



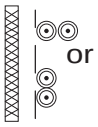
In conduit in a thermally insulated wall

Fig. (b)



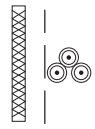
In conduit on a wooden wall

Fig. (c)



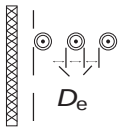
Horizontal or vertical flat touched in free air

Fig. (d)



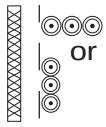
Trefoil in free air

Fig. (e)



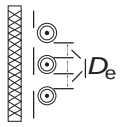
Horizontal flat spaced in free air

Fig. (f)



Horizontal or vertical flat touched in free air

Fig. (g)



Vertical flat spaced in free air

Laying Conditions: Ambient air temperature of **40 °C**, Ambient ground temperature of **35 °C**, Soil thermal resistivity of **1.5 K·m/W** and Depth of laying of **0.5 m**. In case of different laying conditions, appropriate correction (derating) factors from ***Annex C*** have to be applied to cater for the actual installation conditions.

Multi-Core Cables, with Stranded Copper Conductors, XLPE Insulated, Steel Wire Armoured and LSHF Sheathed

APPLICATIONS

Suitable for use in fixed installations, in areas where smoke and acid gas evolution could pose a hazard to personnel or sensitive equipment in schools, hospitals, hotels, shopping centers, subways, etc., and in applications where mechanical protection is required or mechanical damages are expected to occur.

CABLE CHARACTERISTICS

Max. Operating temperature

Max. Short circuit temperature


Flame propagation BS EN 60332-1


Flame spread BS EN 60332-3-24(C)


Low smoke emission BS EN 61034


Halogen free BS EN 50267-2-1


Acidity and toxicity BS EN 50267-2-2

APPLICABLE STANDARDS

alfanar Low Smoke Halogen Free (LSHF) cables are designed and tested to meet or exceed the requirements of BS 6724 standard. However, **alfanar** can also supply a range of alternative designs to meet customer-specified requirements.

CABLE CONSTRUCTION

Conductor

Plain annealed stranded circular (rm) or sector shaped (sm) copper conductor (Class 2).

Insulation

Extruded layer of halogen free Cross-linked polyethylene (XLPE).

Core Identification

- Brown, Blue
- Brown, Black, Grey
- Brown, Black, Grey, Blue

Assembly

Cores are assembled together using Non-hygroscopic halogen free filler if needed.

Bedding

Extruded layer of low smoke halogen free (LSHF) compound.

Armouring

Single layer of galvanized steel wires.

Outer Jacket

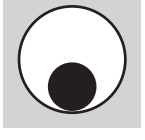
Extruded layer of low smoke halogen free (LSHF) compound.

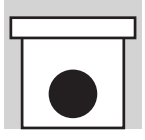
Note: *The core identification color(s) shown above is/are the most common. However, any other color can be provided upon a customer's request.*

CABLE INSTALLATION


In ground


In free air Ladders / Trays


In duct


In trench


Internal / external cabling

LSHF CABLES / BS 6724

CU / XLPE / SWA / LSHF

600 / 1000 V

Nominal cross sectional area		ELECTRICAL DATA					DIMENSIONS AND WEIGHTS		Cable Code
		Max. Conductor Resistance		Continuous Current Ratings			Approx. overall diameter	Approx. overall weight	
		DC at 20 °C	AC at 90 °C	Laid in ground	Laid in ducts	Laid in free air			
mm²		Ω / km	Ω / km	A	A	A	mm	kg / km	
Two Core Cables									
2.5	rm	7.4100	9.4485	42	31	38	13.5	370	C210XA1020WLB03BMR
4	rm	4.6100	5.8783	55	40	51	14.7	445	C212XA1020WLB03BMR
6	rm	3.0800	3.9274	68	50	64	15.7	520	C213XA1020WLB03BMR
10	rm	1.8300	2.3336	90	67	87	17.1	640	C314XA1020WLB03BMR
16	rm	1.1500	1.4667	116	87	114	19.8	930	C315XA1020WLB03BMR
25	rm	0.7270	0.9275	151	114	154	23.2	1290	C316XA1020WLB03BMR
35	rm	0.5240	0.6688	180	138	188	26.5	1770	C317XA1020WLB03BMR
50	sm	0.3870	0.4944	204	158	211	27.0	1925	C418XA1020WLB03BMR
70	sm	0.2680	0.3431	247	193	259	29.2	2355	C419XA1020WLB03BMR
95	sm	0.1930	0.2481	296	235	320	33.4	3320	C445XA1020WLB03BMF
120	sm	0.1530	0.1976	336	270	372	36.9	3950	C446XA1020WLB03BMF
150	sm	0.1240	0.1612	375	304	421	39.7	4610	C447XA1020WLB03BMF
185	sm	0.0991	0.1302	424	349	489	45.9	6130	C448XA1020WLB03BMF
240	sm	0.0754	0.1012	485	403	569	49.8	7385	C449XA1020WLB03BMS
300	sm	0.0601	0.0829	538	451	639	53.4	8830	C450XA1020WLB03BMS
400	sm	0.0470	0.0676	598	504	719	56.9	10655	C451XA1020WLB03BMS
Three Core Cables									
2.5	rm	7.4100	9.4485	35	25	32	14.0	405	C210XA1030WLB71BMR
4	rm	4.6100	5.8783	45	33	42	15.3	500	C212XA1030WLB71BMR
6	rm	3.0800	3.9274	56	41	53	16.4	595	C213XA1030WLB71BMR
10	rm	1.8300	2.3336	75	56	73	19.1	815	C314XA1030WLB71BMR
16	rm	1.1500	1.4667	96	72	96	21.5	1065	C315XA1030WLB71BMR
25	rm	0.7270	0.9275	125	95	130	26.2	1665	C316XA1030WLB71BMR
35	sm	0.5240	0.6688	142	109	145	25.7	1865	C417XA1030WLB71BMR
50	sm	0.3870	0.4944	169	132	177	28.7	2365	C418XA1030WLB71BMR
70	sm	0.2680	0.3431	206	163	222	32.2	3085	C419XA1030WLB71BMR
95	sm	0.1930	0.2481	246	197	271	36.4	4295	C445XA1030WLB71BMF
120	sm	0.1530	0.1976	279	226	314	39.8	5185	C446XA1030WLB71BMF
150	sm	0.1240	0.1612	311	255	356	44.1	6550	C447XA1030WLB71BMF
185	sm	0.0991	0.1302	349	290	407	48.1	7910	C448XA1030WLB71BMF
240	sm	0.0754	0.1012	400	336	470	53.2	9825	C449XA1030WLB71BMS
300	sm	0.0601	0.0829	446	378	541	58.3	11925	C450XA1030WLB71BMS
400	sm	0.0470	0.0676	499	427	620	65.5	14915	C451XA1030WLB71BMS
Four Core Cables									
2.5	rm	7.4100	9.4485	35	25	32	14.9	460	C210XA1040WLB11BMR
4	rm	4.6100	5.8783	45	33	42	16.4	575	C212XA1040WLB11BMR
6	rm	3.0800	3.9274	56	41	53	18.5	795	C213XA1040WLB11BMR
10	rm	1.8300	2.3336	75	56	73	20.4	960	C314XA1040WLB11BMR
16	rm	1.1500	1.4667	96	72	96	23.1	1280	C315XA1040WLB11BMR
25	rm	0.7270	0.9275	125	95	130	28.2	1990	C316XA1040WLB11BMR
35	sm	0.5240	0.6688	142	109	145	28.7	2335	C417XA1040WLB11BMR
50	sm	0.3870	0.4944	169	132	177	32.4	2975	C418XA1040WLB11BMR
70	sm	0.2680	0.3431	206	163	222	37.4	4270	C419XA1040WLB11BMR
95	sm	0.1930	0.2481	246	197	271	40.1	5375	C445XA1040WLB11BMF
120	sm	0.1530	0.1976	279	226	314	45.4	6980	C446XA1040WLB11BMF
150	sm	0.1240	0.1612	311	255	356	49.9	8280	C447XA1040WLB11BMF
185	sm	0.0991	0.1302	349	290	407	54.9	10105	C448XA1040WLB11BMF
240	sm	0.0754	0.1012	400	336	470	60.9	12660	C449XA1040WLB11BMS
300	sm	0.0601	0.0829	446	378	541	66.5	15305	C450XA1040WLB11BMS
400	sm	0.0470	0.0676	499	427	620	77.2	20200	C451XA1040WLB11BMS

The above data is approximate and subjected to manufacturing tolerance. We reserve the right to change as a result of product development and/or changes in standard.

Laying Conditions: Ambient air temperature of **40 °C**, Ambient ground temperature of **35 °C**, Soil thermal resistivity of **1.5 K·m/W** and Depth of laying of **0.5 m**. In case of different laying conditions, appropriate correction (derating) factors from ***Annex C*** have to be applied to cater for the actual installation conditions.

Fire Survival Cables

Fire Resistant Cables

الفنار
alfanar

www.alfanar.com

Single-Core Cables, with Stranded Copper Conductors, Mica Glass Tape, XLPE Insulated and LSHF Sheathed

APPLICATIONS

Suitable for use in fixed installations, in applications where maintenance of power supply during a fire is required for a defined period of time such as for essential safety circuits, fire alarm systems and sprinkler systems, etc., in areas where smoke and acid gas evolution could pose a hazard to personnel or sensitive equipment in high-rise buildings, schools, hospitals, hotels, shopping centers, subways, etc.

CABLE CHARACTERISTICS

Max. Operating temperature

Max. Short circuit temperature


Flame spread IEC 60332-3-24 (C)


Fire resistant IEC 60331, BS 6387


Low smoke emission IEC 61034


Halogen free IEC 60754-1


Acidity and toxicity IEC 60754-2

APPLICABLE STANDARDS

alfanar Fire Resistant cables are designed and tested to meet or exceed the requirements of IEC 60502-1, IEC 60331-21 and BS 6387 Category (CWZ) standards. However, **alfanar** can also supply a range of alternative designs to meet customer-specified requirements.

CABLE CONSTRUCTION

Conductor

Plain annealed stranded circular or circular compacted copper conductor (Class 2).

Fire Resistant Barrier

Mica glass tape applied helically over the conductor with suitable overlap.

Insulation

Extruded layer of halogen free Cross-linked polyethylene (XLPE).

Core Identification

○ Red

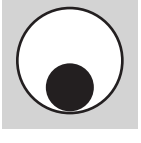
Outer Jacket

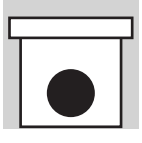
Extruded layer of low smoke halogen free (LSHF) compound.

Note: *The core identification color shown above is the most common. However, any other color can be provided upon a customer's request.*

CABLE INSTALLATION


In free air Ladders / Trays


In duct


In trench


Encased or in surface conduit


Internal cabling

FIRE RESISTANT CABLES / IEC 60502-1

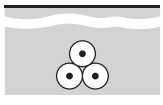
CU / MICA / XLPE /LSHF

0.6 / 1 kV

Nominal cross sectional area	ELECTRICAL DATA									DIMENSIONS AND WEIGHTS		Cable Code
	Max. Conductor Resistance		Continuous Current Ratings							Approx. overall diameter	Approx. overall weight	
			Buried direct in ground		In buried ducts		In free air					
	DC at 20 °C	AC at 90 °C	(a)	(b)	(c)	(d)	(e)	(f)	(g)			
mm²	Ω / km	Ω / km	A	A	A	A	A	A	A	mm	Kg / km	
4	4.6100	5.8782	46	46	34	38	40	41	53	8.4	110	C212KA10100LR51IMR
6	3.0800	3.9274	57	57	42	48	50	52	68	9.0	140	C213KA10100LR51IMR
10	1.8300	2.3335	75	75	56	63	68	70	91	9.6	180	C314KA10100LR51IMR
16	1.1500	1.4665	97	97	73	82	91	93	121	10.6	245	C315KA10100LR51IMR
25	0.7270	0.9273	124	124	96	106	122	125	161	12.1	345	C316KA10100LR51IMR
35	0.5240	0.6685	149	149	117	128	150	154	198	13.2	445	C317KA10100LR51IMR
50	0.3870	0.4940	175	176	140	153	183	189	240	14.6	570	C318KA10100LR51IMR
70	0.2680	0.3426	214	215	174	188	233	240	304	16.4	785	C319KA10100LR51IMR
95	0.1930	0.2474	257	256	212	227	288	297	374	18.0	1040	C345KA10100LR51IMR
120	0.1530	0.1968	291	292	243	260	335	346	434	19.5	1285	C346KA10100LR51IMR
150	0.1240	0.1603	327	327	277	295	388	400	499	21.4	1550	C347KA10100LR51IMR
185	0.0991	0.1291	369	369	316	336	450	464	577	23.5	1925	C348KA10100LR51IMR
240	0.0754	0.0999	425	426	371	393	536	553	688	26.0	2475	C349KA10100LR51IMR
300	0.0601	0.0815	479	473	422	447	620	641	797	28.6	3055	C350KA10100LR51IMR
400	0.0470	0.0660	539	540	482	512	720	743	928	31.8	3890	C351KA10100LR51IMR
500	0.0366	0.0542	604	606	549	587	834	862	1084	35.8	5015	C352KA10100LR51IMF
630	0.0283	0.0452	674	673	619	668	955	986	1257	40.1	6375	C353KA10100LR51IMF
800	0.0221	0.0387	739	741	688	750	1078	1116	1440	44.5	8215	C354KA10100LR51IMF
1000	0.0176	0.0252	807	808	766	841	1234	1276	1674	53.1	10255	C355KA10100LR51IMF

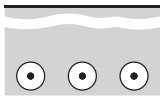
The above data is approximate and subjected to manufacturing tolerance. We reserve the right to change as a result of product development and/or changes in standard.

Fig. (a)



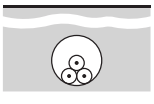
Trefoil

Fig. (b)



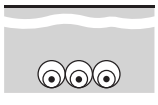
Flat D spaced

Fig. (c)



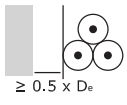
Trefoil

Fig. (d)



Flat touched

Fig. (e)

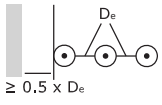


Trefoil

Fig. (f)

Flat touched

Fig. (g)



Flat 2D spaced

Laying Conditions: Ambient air temperature of **40 °C**, Ambient ground temperature of **35 °C**, Soil thermal resistivity of **1.5 K·m/W** and Depth of laying of **0.5 m**. In case of different laying conditions, appropriate correction (derating) factors from ***Annex C*** have to be applied to cater for the actual installation conditions.

Multi-Core Cables, with Stranded Copper Conductors, Mica Glass Tape, XLPE Insulated and LSHF Sheathed

APPLICATIONS

Suitable for use in fixed installations, in applications where maintenance of power supply during a fire is required for a defined period of time such as for essential safety circuits, fire alarm systems and sprinkler systems, etc., in areas where smoke and acid gas evolution could pose a hazard to personnel or sensitive equipment in high-rise buildings, schools, hospitals, hotels, shopping centers, subways, etc.

CABLE CHARACTERISTICS

Max. Operating temperature

Max. Short circuit temperature


Flame spread IEC 60332-3-24 (C)


Fire resistant IEC 60331, BS 6387


Low smoke emission IEC 61034


Halogen free IEC 60754-1


Acidity and toxicity IEC 60754-2

APPLICABLE STANDARDS

alfanar Fire Resistant cables are designed and tested to meet or exceed the requirements of IEC 60502-1, IEC 60331-21 and BS 6387 Category (CWZ) standards. However, **alfanar** can also supply a range of alternative designs to meet customer-specified requirements.

CABLE CONSTRUCTION

Conductor

Plain annealed stranded circular (rm) or sector shaped (sm) copper conductor (Class 2).

Fire Resistant Barrier

Mica glass tape applied helically over the conductor with suitable overlap.

Insulation

Extruded layer of halogen free Cross-linked polyethylene (XLPE).

Core Identification

- Red, Black
- Red, Yellow, Blue
- Red, Yellow, Blue, Black

Assembly

Cores are assembled together using Non-hygroscopic halogen free filler if needed.

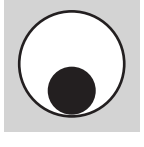
Outer Jacket

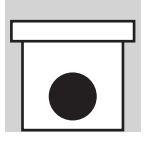
Extruded layer of low smoke halogen free (LSHF) compound.

Note: *The core identification color(s) shown above is/are the most common. However, any other color can be provided upon a customer's request.*

CABLE INSTALLATION


In free air Ladders / Trays


In duct


In trench


Encased or in surface conduit


Internal cabling

FIRE RESISTANT CABLES / IEC 60502-1

CU / MICA / XLPE / LSHF

0.6 / 1 kV

Nominal cross sectional area		ELECTRICAL DATA					DIMENSIONS AND WEIGHTS		Cable Code
		Max. Conductor Resistance		Continuous Current Ratings			Approx. overall diameter	Approx. overall weight	
		DC at 20 °C	AC at 90 °C	Laid in ground	Laid in ducts	Laid in free air			
mm²		Ω / km	Ω / km	A	A	A	mm	kg / km	
Two Core Cables									
1.5	rm	12.1000	15.4287	33	22	28	11.2	175	C208KA10200LR01IMR
2.5	rm	7.4100	9.4485	43	29	36	12.2	215	C210KA10200LR01IMR
4	rm	4.6100	5.8783	56	38	48	13.2	265	C212KA10200LR01IMR
6	rm	3.0800	3.9274	69	48	61	14.4	335	C213KA10200LR01IMR
10	rm	1.8300	2.3336	91	63	82	15.6	430	C314KA10200LR01IMR
16	rm	1.1500	1.4666	118	83	110	17.6	595	C315KA10200LR01IMR
25	rm	0.7270	0.9274	153	110	149	20.6	860	C316KA10200LR01IMR
35	rm	0.5240	0.6687	183	133	183	22.8	1110	C317KA10200LR01IMR
Three Core Cables									
1.5	rm	12.1000	15.4287	27	18	23	11.8	195	C208KA10300LR04IMR
2.5	rm	7.4100	9.4485	35	24	30	12.9	245	C210KA10300LR04IMR
4	rm	4.6100	5.8783	46	31	40	14.0	315	C212KA10300LR04IMR
6	rm	3.0800	3.9274	57	39	51	15.3	400	C213KA10300LR04IMR
10	rm	1.8300	2.3336	75	53	70	17.1	490	C314KA10300LR04IMR
16	rm	1.1500	1.4666	97	69	93	19.2	710	C315KA10300LR04IMR
25	rm	0.7270	0.9274	126	92	126	22.5	1010	C316KA10300LR04IMR
35	sm	0.5240	0.6687	144	105	141	21.8	1240	C417KA10300LR04IMR
Four Core Cables									
1.5	rm	12.1000	15.4287	27	18	23	12.8	230	C208KA10400LR08IMR
2.5	rm	7.4100	9.4485	35	24	30	14.0	295	C210KA10400LR08IMR
4	rm	4.6100	5.8783	46	31	40	15.2	375	C212KA10400LR08IMR
6	rm	3.0800	3.9274	57	39	51	16.7	485	C213KA10400LR08IMR
10	rm	1.8300	2.3336	75	53	70	18.6	660	C314KA10400LR08IMR
16	rm	1.1500	1.4666	97	69	93	21.0	905	C315KA10400LR08IMR
25	rm	0.7270	0.9274	126	92	126	24.7	1260	C316KA10400LR08IMR
35	sm	0.5240	0.6687	144	105	141	25.2	1650	C417KA10400LR08IMR
50	sm	0.3870	0.4943	171	127	173	28.7	2150	C418KA10400LR08IMR
70	sm	0.2680	0.3430	209	159	220	33.0	3010	C419KA10400LR08IMR
95	sm	0.1930	0.2479	251	193	271	35.7	4020	C445KA10400LR08IMR
120	sm	0.1530	0.1974	286	223	317	39.8	5035	C446KA10400LR08IMF
150	sm	0.1240	0.1610	319	252	360	44.3	6155	C447KA10400LR08IMF
185	sm	0.0991	0.1299	361	288	416	49.3	7660	C448KA10400LR08IMF
240	sm	0.0754	0.1009	417	339	495	55.1	9900	C449KA10400LR08IMS
300	sm	0.0601	0.0825	470	386	570	60.7	12340	C450KA10400LR08IMS
400	sm	0.0470	0.0673	533	444	665	69.3	15785	C451KA10400LR08IMS
500	sm	0.0366	0.0557	598	505	764	76.8	20405	C452KA10400LR08IMS
Four Core Cables with Reduced Neutral									
35 sm	16 rm	0.5240 / 1.1500	0.6687 / 1.4666	144	105	141	25.2	1465	C435KA10400LR08IMR
50 sm	25 rm	0.3870 / 0.7270	0.4943 / 0.9274	171	127	173	28.7	1945	C436KA10400LR08IMR
70 sm	35 sm	0.2680 / 0.5240	0.3430 / 0.6687	209	159	220	31.3	2675	C437KA10400LR08IMR
95 sm	50 sm	0.1930 / 0.3870	0.2479 / 0.4943	251	193	271	34.2	3570	C438KA10400LR08IMR
120 sm	70 sm	0.1530 / 0.2680	0.1974 / 0.3430	286	223	317	38.1	4540	C439KA10400LR08IMF
150 sm	70 sm	0.1240 / 0.2680	0.1610 / 0.3430	319	252	360	41.9	5390	C440KA10400LR08IMF
185 sm	95 sm	0.0991 / 0.1930	0.1299 / 0.2479	361	288	416	46.8	6770	C441KA10400LR08IMF
240 sm	120 sm	0.0754 / 0.1530	0.1009 / 0.1974	417	339	495	52.1	8660	C442KA10400LR08IMS
300 sm	150 sm	0.0601 / 0.1240	0.0825 / 0.1610	470	386	570	57.4	10790	C443KA10400LR08IMS
400 sm	185 sm	0.0470 / 0.0991	0.0673 / 0.1299	533	444	665	65.3	13780	C444KA10400LR08IMS
500 sm	240 sm	0.0366 / 0.0754	0.0557 / 0.1009	598	505	764	72.5	17180	C466KA10400LR08IMS

The above data is approximate and subjected to manufacturing tolerance. We reserve the right to change as a result of product development and/or changes in standard.

Laying Conditions: Ambient air temperature of **40 °C**, Ambient ground temperature of **35 °C**, Soil thermal resistivity of **1.5 K·m/W** and Depth of laying of **0.5 m**. In case of different laying conditions, appropriate correction (derating) factors from ***Annex C*** have to be applied to cater for the actual installation conditions.

Multi-Core Cables, with Stranded Copper Conductors, Mica Glass Tape, XLPE Insulated, Steel Tape Armoured and LSHF Sheathed

APPLICATIONS

Suitable for use in fixed installations, in applications where maintenance of power supply during a fire is required for a defined period of time such as for essential safety circuits, fire alarm systems and sprinkler systems, etc., in areas where smoke and acid gas evolution could pose a hazard to personnel or sensitive equipment in high-rise buildings, schools, hospitals, hotels, shopping centers, subways, etc.

CABLE CHARACTERISTICS

Max. Operating temperature

Max. Short circuit temperature


Flame spread IEC 60332-3-24 (C)


Fire resistant IEC 60331, BS 6387


Low smoke emission IEC 61034


Halogen free IEC 60754-1


Acidity and toxicity IEC 60754-2

APPLICABLE STANDARDS

alfanar Fire Resistant cables are designed and tested to meet or exceed the requirements of IEC 60502-1, IEC 60331-21 and BS 6387 Category (CWZ) standards. However, **alfanar** can also supply a range of alternative designs to meet customer-specified requirements.

CABLE CONSTRUCTION

Conductor

Plain annealed stranded circular (rm) or sector shaped (sm) copper conductor (Class 2).

Fire Resistant Barrier

Mica glass tape applied helically over the conductor with suitable overlap.

Insulation

Extruded layer of halogen free Cross-linked polyethylene (XLPE).

Core Identification


Red, Black


Red, Yellow, Blue


Red, Yellow, Blue, Black

Assembly

Cores are assembled together using Non-hygroscopic halogen free filler if needed.

Bedding

Extruded layer of low smoke halogen free (LSHF) compound.

Armouring

Double layers of galvanized steel tapes.

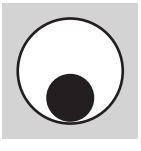
Outer Jacket

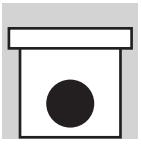
Extruded layer of low smoke halogen free (LSHF) compound.

Note: *The core identification color(s) shown above is/are the most common. However, any other color can be provided upon a customer's request.*

CABLE INSTALLATION


In free air Ladders / Trays


In duct


In trench


Encased or in surface conduit


Internal / external cabling

FIRE RESISTANT CABLES / IEC 60502-1

CU / MICA / XLPE / STA / LSHF

0.6 / 1 kV

Nominal cross sectional area		ELECTRICAL DATA					DIMENSIONS AND WEIGHTS		Cable Code
		Max. Conductor Resistance		Continuous Current Ratings			Approx. overall diameter	Approx. overall weight	
		DC at 20 °C	AC at 90 °C	Laid in ground	Laid in ducts	Laid in free air			
mm²		Ω / km	Ω / km	A	A	A	mm	kg / km	
Two Core Cables									
6	rm	3.0800	3.9274	67	49	62	17.2	505	C213KA1020GLR01IMR
10	rm	1.8300	2.3336	89	65	83	18.4	620	C314KA1020GLR01IMR
16	rm	1.1500	1.4666	114	84	110	20.4	805	C315KA1020GLR01IMR
25	rm	0.7270	0.9274	148	111	148	23.4	1110	C316KA1020GLR01IMR
35	rm	0.5240	0.6687	177	134	180	25.6	1385	C317KA1020GLR01IMR
Three Core Cables									
6	rm	3.0800	3.9274	55	40	52	18.1	585	C213KA1030GLR04IMR
10	rm	1.8300	2.3336	74	54	70	19.9	695	C314KA1030GLR04IMR
16	rm	1.1500	1.4666	95	70	93	22.0	945	C315KA1030GLR04IMR
25	rm	0.7270	0.9274	123	92	124	25.3	1280	C316KA1030GLR04IMR
35	sm	0.5240	0.6687	140	106	140	24.6	1480	C417KA1030GLR04IMR
Four Core Cables									
6	rm	3.0800	3.9274	55	40	52	19.5	690	C213KA1040GLR08IMR
10	rm	1.8300	2.3336	74	54	70	21.4	880	C314KA1040GLR08IMR
16	rm	1.1500	1.4666	95	70	93	23.8	1155	C315KA1040GLR08IMR
25	rm	0.7270	0.9274	123	92	124	27.5	1555	C316KA1040GLR08IMR
35	sm	0.5240	0.6687	140	106	140	28.0	1895	C417KA1040GLR08IMR
50	sm	0.3870	0.4943	166	128	171	31.7	2450	C418KA1040GLR08IMR
70	sm	0.2680	0.3430	203	159	215	36.2	3380	C419KA1040GLR08IMR
95	sm	0.1930	0.2479	243	193	263	40.3	4815	C445KA1040GLR08IMR
120	sm	0.1530	0.1974	278	224	310	44.8	5965	C446KA1040GLR08IMF
150	sm	0.1240	0.1610	310	252	349	49.3	7210	C447KA1040GLR08IMF
185	sm	0.0991	0.1299	349	287	402	54.3	8835	C448KA1040GLR08IMS
240	sm	0.0754	0.1009	402	335	473	60.5	11270	C449KA1040GLR08IMS
300	sm	0.0601	0.0825	452	380	541	66.1	13845	C450KA1040GLR08IMS
400	sm	0.0470	0.0673	511	435	627	75.1	17585	C451KA1040GLR08IMS
500	sm	0.0366	0.0557	570	491	713	84.0	23220	C452KA1040GLR08IMS
Four Core Cables with Reduced Neutral									
35 sm	16 rm	0.5240 / 1.1500	0.6687 / 1.4666	140	106	140	28.0	1770	C435KA1040GLR08IMR
50 sm	25 rm	0.3870 / 0.7270	0.4943 / 0.9274	166	128	171	31.5	2290	C436KA1040GLR08IMR
70 sm	35 sm	0.2680 / 0.5240	0.3430 / 0.6687	203	159	215	34.7	3105	C437KA1040GLR08IMR
95 sm	50 sm	0.1930 / 0.3870	0.2479 / 0.4943	243	193	263	38.6	4365	C438KA1040GLB08IMF
120 sm	70 sm	0.1530 / 0.2680	0.1974 / 0.3430	278	224	310	42.7	5440	C439KA1040GLR08IMF
150 sm	70 sm	0.1240 / 0.2680	0.1610 / 0.3430	310	252	349	46.9	6435	C440KA1040GLR08IMF
185 sm	95 sm	0.0991 / 0.1930	0.1299 / 0.2479	349	287	402	51.8	7925	C441KA1040GLR08IMF
240 sm	120 sm	0.0754 / 0.1530	0.1009 / 0.1974	402	335	473	57.7	10035	C442KA1040GLR08IMS
300 sm	150 sm	0.0601 / 0.1240	0.0825 / 0.1610	452	380	541	62.8	12270	C443KA1040GLR08IMS
400 sm	185 sm	0.0470 / 0.0991	0.0673 / 0.1299	511	435	627	70.7	15455	C444KA1040GLR08IMS
500 sm	240 sm	0.0366 / 0.0754	0.0557 / 0.1009	570	491	713	78.3	19115	C466KA1040GLR08IMS

The above data is approximate and subjected to manufacturing tolerance. We reserve the right to change as a result of product development and/or changes in standard.

Laying Conditions: Ambient air temperature of **40 °C**, Ambient ground temperature of **35 °C**, Soil thermal resistivity of **1.5 K·m/W** and Depth of laying of **0.5 m**. In case of different laying conditions, appropriate correction (derating) factors from ***Annex C*** have to be applied to cater for the actual installation conditions.

Multi-Core Cables, with Stranded Copper Conductors, Mica Glass Tape, XLPE Insulated, Steel Wire Armoured and LSHF Sheathed

APPLICATIONS

Suitable for use in fixed installations, in applications where maintenance of power supply during a fire is required for a defined period of time such as for essential safety circuits, fire alarm systems and sprinkler systems, etc., in areas where smoke and acid gas evolution could pose a hazard to personnel or sensitive equipment in high-rise buildings, schools, hospitals, hotels, shopping centers, subways, etc.

CABLE CHARACTERISTICS

Max. Operating temperature

Max. Short circuit temperature


Flame spread IEC 60332-3-24 (C)


Fire resistant IEC 60331, BS 6387


Low smoke emission IEC 61034


Halogen free IEC 60754-1


Acidity and toxicity IEC 60754-2

APPLICABLE STANDARDS

alfanar Fire Resistant cables are designed and tested to meet or exceed the requirements of IEC 60502-1, IEC 60331-21 and BS 6387 Category (CWZ) standards. However, **alfanar** can also supply a range of alternative designs to meet customer-specified requirements.

CABLE CONSTRUCTION

Conductor

Plain annealed stranded circular (rm) or sector shaped (sm) copper conductor (Class 2).

Fire Resistant Barrier

Mica glass tape applied helically over the conductor with suitable overlap.

Insulation

Extruded layer of halogen free Cross-linked polyethylene (XLPE).

Core Identification

 Red, Black

 Red, Yellow, Blue

 Red, Yellow, Blue, Black

Assembly

Cores are assembled together using Non-hygroscopic halogen free filler if needed.

Bedding

Extruded layer of low smoke halogen free (LSHF) compound.

Armouring

Single layer of galvanized steel wires.

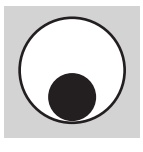
Outer Jacket

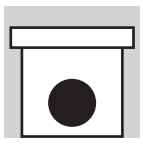
Extruded layer of low smoke halogen free (LSHF) compound.

Note: *The core identification color(s) shown above is/are the most common. However, any other color can be provided upon a customer's request.*

CABLE INSTALLATION


In free air Ladders / Trays


In duct


In trench


Encased or in surface conduit


Internal / external cabling

FIRE RESISTANT CABLES / IEC 60502-1

CU / MICA / XLPE / SWA / LSHF

0.6 / 1 kV

Nominal cross sectional area		ELECTRICAL DATA					DIMENSIONS AND WEIGHTS		Cable Code
		Max. Conductor Resistance		Continuous Current Ratings			Approx. overall diameter	Approx. overall weight	
		DC at 20 °C	AC at 90 °C	Laid in ground	Laid in ducts	Laid in free air			
mm²		Ω / km	Ω / km	A	A	A	mm	kg / km	
Two Core Cables									
2.5	rm	7.4100	9.4485	42	31	38	16.3	485	C210KA1020WLR01IMR
4	rm	4.6100	5.8783	55	40	51	17.3	555	C212KA1020WLR01IMR
6	rm	3.0800	3.9274	68	50	64	18.5	650	C213KA1020WLR01IMR
10	rm	1.8300	2.3336	90	67	87	20.6	895	C314KA1020WLR01IMR
16	rm	1.1500	1.4666	116	87	114	22.6	1120	C315KA1020WLR01IMR
25	rm	0.7270	0.9274	151	114	154	26.3	1615	C316KA1020WLR01IMR
35	rm	0.5240	0.6687	180	138	188	28.5	1945	C317KA1020WLR01IMR
Three Core Cables									
2.5	rm	7.4100	9.4485	35	25	32	17.0	530	C210KA1030WLR04IMR
4	rm	4.6100	5.8783	45	33	42	18.1	620	C212KA1030WLR04IMR
6	rm	3.0800	3.9274	56	41	53	19.4	735	C213KA1030WLR04IMR
10	rm	1.8300	2.3336	75	56	73	22.1	1005	C314KA1030WLR04IMR
16	rm	1.1500	1.4666	96	72	96	24.2	1290	C315KA1030WLR04IMR
25	rm	0.7270	0.9274	125	95	130	28.2	1845	C316KA1030WLR04IMR
35	sm	0.5240	0.6687	142	109	145	27.5	2030	C417KA1030WLR04IMR
Four Core Cables									
2.5	rm	7.4100	9.4485	35	25	32	18.1	600	C210KA1040WLR08IMR
4	rm	4.6100	5.8783	45	33	42	19.3	710	C212KA1040WLR08IMR
6	rm	3.0800	3.9274	56	41	53	21.7	990	C213KA1040WLR08IMR
10	rm	1.8300	2.3336	75	56	73	23.6	1210	C314KA1040WLR08IMR
16	rm	1.1500	1.4666	96	72	96	26.7	1680	C315KA1040WLR08IMR
25	rm	0.7270	0.9274	125	95	130	30.4	2175	C316KA1040WLR08IMR
35	sm	0.5240	0.6687	142	109	145	31.1	2540	C417KA1040WLR08IMR
50	sm	0.3870	0.4943	169	132	177	34.8	3180	C418KA1040WLR08IMR
70	sm	0.2680	0.3430	206	163	222	39.8	4535	C419KA1040WLR08IMR
95	sm	0.1930	0.2479	246	197	271	42.5	5680	C445KA1040WLR08IMF
120	sm	0.1530	0.1974	279	226	314	48.0	7355	C446KA1040WLR08IMF
150	sm	0.1240	0.1610	311	255	356	52.5	8745	C447KA1040WLR08IMF
185	sm	0.0991	0.1299	349	290	407	57.5	10510	C448KA1040WLR08IMS
240	sm	0.0754	0.1009	400	336	470	63.7	13120	C449KA1040WLR08IMS
300	sm	0.0601	0.0825	446	378	541	69.3	15870	C450KA1040WLR08IMS
400	sm	0.0470	0.0673	499	427	620	80.0	20810	C451KA1040WLR08IMS
500	sm	0.0366	0.0557	546	474	695	87.7	26035	C452KA1040WLR08IMS
Four Core Cables with Reduced Neutral									
35 sm	16 rm	0.5240 / 1.1500	0.6687 / 1.4666	142	109	145	30.9	2395	C435KA1040WLR08IMR
50 sm	25 rm	0.3870 / 0.7270	0.4943 / 0.9274	169	132	177	34.6	3015	C436KA1040WLR08IMR
70 sm	35 sm	0.2680 / 0.5240	0.3430 / 0.6687	206	163	222	38.1	4195	C437KA1040WLR08IMR
95 sm	50 sm	0.1930 / 0.3870	0.2479 / 0.4943	246	197	271	40.8	5200	C438KA1040WLR08IMF
120 sm	70 sm	0.1530 / 0.2680	0.1974 / 0.3430	279	226	314	44.9	6360	C439KA1040WLR08IMF
150 sm	70 sm	0.1240 / 0.2680	0.1610 / 0.3430	311	255	356	50.1	7875	C440KA1040WLR08IMF
185 sm	95 sm	0.0991 / 0.1930	0.1299 / 0.2479	349	290	407	55.0	9515	C441KA1040WLR08IMF
240 sm	120 sm	0.0754 / 0.1530	0.1009 / 0.1974	400	336	470	60.9	11795	C442KA1040WLR08IMS
300 sm	150 sm	0.0601 / 0.1240	0.0825 / 0.1610	446	378	541	66.0	14205	C443KA1040WLR08IMS
400 sm	185 sm	0.0470 / 0.0991	0.0673 / 0.1299	499	427	620	75.6	18535	C444KA1040WLR08IMS
500 sm	240 sm	0.0366 / 0.0754	0.0557 / 0.1009	546	474	695	83.4	22535	C466KA1040WLR08IMS

The above data is approximate and subjected to manufacturing tolerance. We reserve the right to change as a result of product development and/or changes in standard.

Laying Conditions: Ambient air temperature of **40 °C**, Ambient ground temperature of **35 °C**, Soil thermal resistivity of **1.5 K·m/W** and Depth of laying of **0.5 m**. In case of different laying conditions, appropriate correction (derating) factors from ***Annex C*** have to be applied to cater for the actual installation conditions.

Multi-Core Cables, with Stranded Copper Conductors, Mica Glass Tape, XLPE Insulated, Steel Wire Armoured and LSHF Sheathed

APPLICATIONS

Suitable for use in fixed installations, in applications where maintenance of power supply during a fire is required for a defined period of time such as for essential safety circuits, fire alarm systems and sprinkler systems, etc., in areas where smoke and acid gas evolution could pose a hazard to personnel or sensitive equipment in high-rise buildings, schools, hospitals, hotels, shopping centers, subways, etc.

CABLE CHARACTERISTICS

Max. Operating temperature

Max. Short circuit temperature


Flame spread BS EN 60332-3-24 (C)


Fire resistant BS 7846 (F2)


Low smoke emission BS EN 61034


Halogen free BS EN 50267-2-1


Acidity and toxicity BS EN 50267-2-2

APPLICABLE STANDARDS

alfanar Fire Resistant cables are designed and tested to meet or exceed the requirements of BS 7846 Category (F2) standard. However, **alfanar** can also supply a range of alternative designs to meet customer-specified requirements.

CABLE CONSTRUCTION

Conductor

Plain annealed stranded circular (rm) or sector shaped (sm) copper conductor (Class 2).

Fire Resistant Barrier

Mica glass tape applied helically over the conductor with suitable overlap.

Insulation

Extruded layer of halogen free Cross-linked polyethylene (XLPE).

Core Identification

- Brown, Blue
- Brown, Black, Grey
- Brown, Black, Grey, Blue

Assembly

Cores are assembled together using Non-hygroscopic halogen free filler if needed.

Bedding

Extruded layer of low smoke halogen free (LSHF) compound.

Armouring

Single layer of galvanized steel wires.

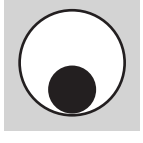
Outer Jacket

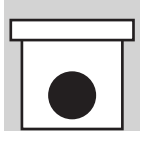
Extruded layer of low smoke halogen free (LSHF) compound.

Note: *The core identification color(s) shown above is/are the most common. However, any other color can be provided upon a customer's request.*

CABLE INSTALLATION


In free air Ladders / Trays


In duct


In trench


Encased or in surface conduit


Internal / external cabling

FIRE RESISTANT CABLES / BS 7846

CU / MICA / XLPE / SWA / LSHF

600 / 1000 V

Nominal cross sectional area		ELECTRICAL DATA					DIMENSIONS AND WEIGHTS		Cable Code
		Max. Conductor Resistance		Continuous Current Ratings			Approx. overall diameter	Approx. overall weight	
		DC at 20 °C	AC at 90 °C	Laid in ground	Laid in ducts	Laid in free air			
mm²		Ω / km	Ω / km	A	A	A	mm	kg / km	
Two Core Cables									
2.5	rm	7.4100	9.4485	42	31	38	15.3	445	C210KA1020WLR03BMR
4	rm	4.6100	5.8783	55	40	51	16.3	515	C212KA1020WLR03BMR
6	rm	3.0800	3.9274	68	50	64	17.5	605	C213KA1020WLR03BMR
10	rm	1.8300	2.3336	90	67	87	18.9	735	C314KA1020WLR03BMR
16	rm	1.1500	1.4666	116	87	114	21.6	1055	C315KA1020WLR03BMR
25	rm	0.7270	0.9274	151	114	154	24.8	1415	C316KA1020WLR03BMR
35	rm	0.5240	0.6687	180	138	188	28.3	1930	C317KA1020WLR03BMR
50	sm	0.3870	0.4943	204	158	211	28.8	1980	C418KA1020WLR03BMR
70	sm	0.2680	0.3430	247	193	259	31.0	2465	C419KA1020WLR03BMR
95	sm	0.1930	0.2479	296	235	320	35.2	3435	C445KA1020WLR03BMF
120	sm	0.1530	0.1974	336	270	372	38.7	4115	C446KA1020WLR03BMF
150	sm	0.1240	0.1610	375	304	421	41.5	4815	C447KA1020WLR03BMF
185	sm	0.0991	0.1299	424	349	489	47.7	6300	C448KA1020WLR03BMF
240	sm	0.0754	0.1009	485	403	569	51.6	7615	C449KA1020WLR03BMS
300	sm	0.0601	0.0825	538	451	639	55.2	9070	C450KA1020WLR03BMS
400	sm	0.0470	0.0673	598	504	719	58.7	10930	C451KA1020WLR03BMS
Three Core Cables									
2.5	rm	7.4100	9.4485	35	25	32	16.0	490	C210KA1030WLR71BMR
4	rm	4.6100	5.8783	45	33	42	17.1	580	C212KA1030WLR71BMR
6	rm	3.0800	3.9274	56	41	53	18.4	690	C213KA1030WLR71BMR
10	rm	1.8300	2.3336	75	56	73	21.1	940	C314KA1030WLR71BMR
16	rm	1.1500	1.4666	96	72	96	23.4	1230	C315KA1030WLR71BMR
25	rm	0.7270	0.9274	125	95	130	28.0	1830	C316KA1030WLR71BMR
35	sm	0.5240	0.6687	142	109	145	27.5	2030	C417KA1030WLR71BMR
50	sm	0.3870	0.4943	169	132	177	30.5	2505	C418KA1030WLR71BMR
70	sm	0.2680	0.3430	206	163	222	34.0	3270	C419KA1030WLR71BMR
95	sm	0.1930	0.2479	246	197	271	38.2	4505	C445KA1030WLR71BMF
120	sm	0.1530	0.1974	279	226	314	40.5	5345	C446KA1030WLR71BMF
150	sm	0.1240	0.1610	311	255	356	45.8	6850	C447KA1030WLR71BMF
185	sm	0.0991	0.1299	349	290	407	49.9	8165	C448KA1030WLR71BMF
240	sm	0.0754	0.1009	400	336	470	54.9	10120	C449KA1030WLR71BMS
300	sm	0.0601	0.0825	446	378	541	60.1	12300	C450KA1030WLR71BMS
400	sm	0.0470	0.0673	499	427	620	67.3	15270	C451KA1030WLR71BMS
Four Core Cables									
2.5	rm	7.4100	9.4485	35	25	32	17.1	560	C210KA1040WLR11BMR
4	rm	4.6100	5.8783	45	33	42	18.3	665	C212KA1040WLR11BMR
6	rm	3.0800	3.9274	56	41	53	20.7	930	C213KA1040WLR11BMR
10	rm	1.8300	2.3336	75	56	73	22.6	1145	C314KA1040WLR11BMR
16	rm	1.1500	1.4666	96	72	96	25.2	1470	C315KA1040WLR11BMR
25	rm	0.7270	0.9274	125	95	130	30.2	2155	C316KA1040WLR11BMR
35	sm	0.5240	0.6687	142	109	145	30.9	2525	C417KA1040WLR11BMR
50	sm	0.3870	0.4943	169	132	177	34.6	3160	C418KA1040WLR11BMR
70	sm	0.2680	0.3430	206	163	222	39.6	4515	C419KA1040WLR11BMR
95	sm	0.1930	0.2479	246	197	271	42.3	5655	C445KA1040WLR11BMF
120	sm	0.1530	0.1974	279	226	314	47.6	7305	C446KA1040WLR11BMF
150	sm	0.1240	0.1610	311	255	356	52.1	8690	C447KA1040WLR11BMF
185	sm	0.0991	0.1299	349	290	407	57.1	10450	C448KA1040WLR11BMS
240	sm	0.0754	0.1009	400	336	470	63.1	13020	C449KA1040WLR11BMS
300	sm	0.0601	0.0825	446	378	541	68.7	15765	C450KA1040WLR11BMS
400	sm	0.0470	0.0673	499	427	620	79.4	20685	C451KA1040WLR11BMS

The above data is approximate and subjected to manufacturing tolerance. We reserve the right to change as a result of product development and/or changes in standard.

Laying Conditions: Ambient air temperature of **40 °C**, Ambient ground temperature of **35 °C**, Soil thermal resistivity of **1.5 K·m/W** and Depth of laying of **0.5 m**. In case of different laying conditions, appropriate correction (derating) factors from ***Annex C*** have to be applied to cater for the actual installation conditions.

Annex A: Guides to Use

A.1 Aim

The aim of this annex is to inform users of characteristics and limitations of electric cables and thereby to minimize their misuse.

It is assumed that the design of installation and the specification, purchase and installation of cables is entrusted to suitably skilled and competent people.

In cases of doubt as to the suitability of cables for a particular use further specific information should be obtained from the manufacturer.

A.2 Cable Selection and Design

A.2.1 The products specified in this catalogue are intended to be used for the supply of electrical energy up to rated voltage of 0.6/1 (1.2) kV. This rating should not be exceeded.

A.2.2 These cables are intended for use within a nominal power frequency range of 49 Hz to 61 Hz.

A.2.3 In addition to the current ratings, due regard should be given to:

a. The capability of the cable to withstand the worst anticipated fault condition of the system.
b. The earth loop impedance.
c. The operating characteristics of the connected equipment.
d. The voltage drop requirements during normal load or motor starting conditions.
e. The voltage drop requirements under fire conditions.

A.2.4 The possible effects of transient over-voltages should be recognized as they can be detrimental to cables.

A.3 Environment and Application

A.3.1 Reasonable protection against mechanical damage, appropriate to the choice of cable and the installation conditions, should be provided.

A.3.2 Cables can be harmed by exposure to corrosive products or solvent substances, especially petroleum based chemicals or their vapours.

A.3.3 Cables specified in this catalogue are not specifically designed for use:

a. As self-supporting aerial cables.
b. As submarine cable or for laying in water-logged conditions.
c. Where subsidence is likely, unless special precautions are taken to minimize damage.
d. Where any exposure to excessive heat under normal operating conditions is involved.
e. Where the sheath is subjected to a voltage test after installation.

A.3.4 If cables are exposed to localized heat, solar radiation or high temperature ambient conditions, the current carrying capacity will be reduced.

A.3.5 The standard sheathing compounds (LSHF) supplied in these cables do not provide protection against damage by rodents, termites etc.

A.3.6 Loaded cables can have surface temperatures which require protection against accidental contact.

Annex A: Guides to Use

A.4 Installation (Please refer to Annex C for more information)

A.4.1 Precautions should be taken to avoid mechanical damage to the cables before and during installation.

A.4.2 Exceeding the manufacturer's recommended maximum pulling tensions can result in damage to the cable.

A.4.3 If cables are to be installed in ducts, the correct size of duct should be used.

A.4.4 The type of jointing and filling compounds employed should be chemically compatible with the cable materials.

A.4.5 The cable support system should be such as to avoid damage or danger under normal or fault conditions, and it should be ensured that ladder racks, trays, cleats and brackets etc. used are made of a material that can also support the cable during a fire (e.g. steel).

A.4.6 Cables specified in this catalogue are designed for fixed installations only; for example they are not for use as trailing or reeling cables.

A.4.7 Repeated over-voltage testing can lead to premature failure of the cable.

A.4.8 The selection of cable glands, accessories and any associated tools should take account of all aspects of intended use.

A.5 Storage and handling of drums (Please refer to Annex C for more information)

A.5.1 Cable drums should be regularly inspected during storage to assess their physical condition.

A.5.2 Battens, where applied, should not be removed from drums until the cable is about to be installed.

A.5.3 When handling drums, reasonable precautions should be taken to avoid injury. Due regard should be paid to the weight, method and direction of rolling, lifting, protruding nails and splinters.

A.5.4 Care should be taken to avoid deterioration of drums or their becoming a hazard to the general public.

Annex B: Continuous Current Ratings

B.1 General

This annex deals solely with the installation conditions used to calculate the steady-state continuous current ratings of single-core and multi-core cables having extruded insulation. The tabulated current ratings provided in this catalogue have been calculated for cables having a rated voltage of 0.6/1 kV and constructions as detailed in each relevant type.

The tabulated current ratings in this catalogue have been calculated using the methods set out in IEC 60287.

B.2 Temperatures

The maximum conductor temperature for which the tabulated current ratings have been calculated is 90 °C.

The reference ambient temperatures assumed are as follows:

- For cables in free air: 40 °C
- For buried cables, either directly in the soil or in ducts in the ground: 35 °C

Derating factors for other ambient temperatures are given in Tables C.1 and C.2.

The current ratings for cables in air do not take account of the increase, if any, due to solar or other infra-red radiation. Where the cables are subject to such radiation, the current rating should be derived by the methods specified in IEC 60287.

B.3 Soil thermal resistivity

The tabulated current ratings in this catalogue for cables in ducts or direct in the ground relate to a soil thermal resistivity of 1.5 °C.m/W. Derating factors for other values of thermal resistivity are given in tables C.4 to C.7.

It is assumed that the soil properties are uniform; no allowance has been made for the possibility of moisture migration, which can lead to a region of high thermal resistivity around the cable. If partial drying-out of the soil is foreseen, the permissible current rating should be derived by the methods specified in IEC 60287.

B.4 Methods of installation

Current ratings tabulated in this catalogue are for cables installed in the following conditions.

B.4.1 Single-core cables buried direct

Current ratings are given for cables buried direct in the ground at a depth of 0.5 m (derating factors for other values of burial depth are given in table C.3) under the following conditions:

1. Three cables in trefoil formation touching throughout their length Fig. (a).
2. Three cables in horizontal flat formation with a clearance of one cable diameter, De Fig. (b).

The cable depth is measured to the cable axis or centre of the trefoil group.

Annex B: Continuous Current Ratings

B.4.2 Single-core cables in polyvinyl chloride (PVC) ducts

Current ratings are given for cables in polyvinyl chloride (PVC) ducts buried at a depth of 0.5 m (derating factors for other values of burial depth are given in table C.3) with one cable per duct as follows:

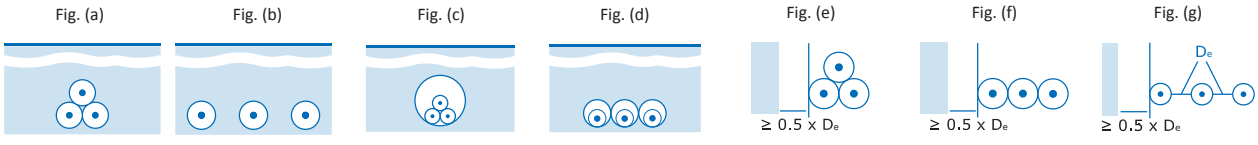
1. Three cables in trefoil formation in single duct Fig. (c).
2. Three cables in horizontal flat formation, ducts touching throughout their length Fig. (d).

The ducts are assumed to be polyvinyl chloride (PVC) having an inside diameter of 1.5 times the outside diameter of the cable and a wall thickness equal to 6 % of the duct inside diameter. The ratings are based on the assumption that the ducts are air filled. The tabulated ratings may be applied to cables in ducts having an inside diameter of between 1.2 and 2 times the outside diameter of the cables. For this range of diameters, the variation in the rating is less than 2 % of the tabulated value.

B.4.3 Single-core cables in air

The cables are assumed to be spaced at least 0.5 times the cable diameter De from any vertical surface and installed on brackets or ladder racks as follows:

1. Three cables in trefoil formation touching throughout their length Fig. (e).
2. Three cables in horizontal flat formation touching throughout their length Fig. (f).
3. Three cables in horizontal flat formation with a clearance of one cable diameter De Fig. (g).



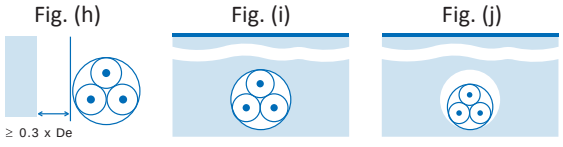
B.4.4 Three-core cables

Current ratings are given for multi-core cables installed under the following conditions:

1. Single cable in air spaced at least 0.3 times the cable diameter De from any vertical surface Fig. (h).

2. Single cable buried direct in the ground at a depth of 0.5 m (derating factors for other values of burial depth are given in table C.3) Fig. (i).

3. Single cable in a buried polyvinyl chloride (PVC) duct having dimensions calculated in the same manner as for the single-core cables in ducts. The depth of burial of the duct is 0.5 m (derating factors for other values of burial depth are given in table C.3) Fig. (j).



Annex B: Continuous Current Ratings

B.5 Cable loading

The tabulated ratings relate to circuits carrying a balanced three-phase load at a rated frequency of 60 Hz. However, the tabulated ratings can be safely used with circuits carrying a balanced three-phase load at a rated frequency of 50 Hz, where the continuous current rating values are slightly higher in case of rated frequency of 50 Hz.

B.6 Rating factors for grouped circuits

The tabulated current ratings apply to a set of three single-core cables or one multi-core cable forming either a single-phase circuit (two core cables) or a three-phase circuit. When a number of circuits are installed in close proximity, the rating should be reduced by the appropriate factor from tables C.8 to C.12.

These rating factors should also be applied to groups of parallel cables forming the same circuit. In such cases, attention should also be given to the arrangement of the cables to ensure that the load current is shared equally between the parallel cables.

B.7 Derating factors

The derating factors given in tables C.1 to C.12 for temperature, installation conditions and grouping are averages over a range of conductor sizes and cable types. For particular cases, the derating factor may be calculated using the methods in IEC 60287.

Annex C: Derating Factors

Table C.1

Derating factors for ambient ground temperature

Max. Conductor temperature	Ambient ground temperature ºC									
	10	15	20	25	30	35	40	45	50	55
90 ºC	1.20	1.17	1.12	1.08	1.04	1.00	0.96	0.90	0.85	0.80

Table C.2

Derating factors for ambient air temperature

Max. Conductor temperature	Ambient ground temperature ºC									
	15	20	25	30	35	40	45	50	55	60
90 ºC	1.23	1.19	1.14	1.10	1.05	1.00	0.96	0.90	0.84	0.78

Table C.3

Derating factors for depth of laying

Depth of laying (mt.)	Cables cross section		
	Up to 70 mm²	95 up to 240 mm²	300 mm² & above
0.50	1.00	1.00	1.00
0.60	0.99	0.98	0.97
0.80	0.97	0.96	0.94
1.00	0.95	0.93	0.92
1.25	0.94	0.92	0.89
1.50	0.93	0.90	0.87
1.75	0.92	0.89	0.86
2.00	0.91	0.88	0.85

Annex C: Derating Factors

Table C.4

Derating factors for soil thermal resistivities for direct buried single-core cables

Nominal area of conductor mm²	Values of soil thermal resistivity °C.m / Watt							
	0.7	0.8	0.9	1.0	1.5	2.0	2.5	3.0
4	1.29	1.24	1.19	1.15	1.00	0.89	0.82	0.75
6	1.29	1.24	1.19	1.15	1.00	0.89	0.82	0.75
10	1.29	1.24	1.19	1.15	1.00	0.89	0.82	0.75
16	1.29	1.24	1.19	1.15	1.00	0.89	0.82	0.75
25	1.30	1.25	1.20	1.16	1.00	0.89	0.81	0.75
35	1.30	1.25	1.21	1.16	1.00	0.89	0.81	0.75
50	1.32	1.26	1.21	1.16	1.00	0.89	0.81	0.74
70	1.33	1.27	1.22	1.17	1.00	0.89	0.81	0.74
95	1.34	1.28	1.22	1.18	1.00	0.89	0.80	0.74
120	1.34	1.28	1.22	1.18	1.00	0.88	0.80	0.74
150	1.35	1.28	1.23	1.18	1.00	0.88	0.80	0.74
185	1.35	1.29	1.23	1.18	1.00	0.88	0.80	0.74
240	1.36	1.29	1.23	1.18	1.00	0.88	0.80	0.73
300	1.36	1.30	1.24	1.19	1.00	0.88	0.80	0.73
400	1.37	1.30	1.24	1.19	1.00	0.88	0.79	0.73
500	1.37	1.30	1.24	1.19	1.00	0.88	0.79	0.73
630	1.37	1.30	1.24	1.19	1.00	0.88	0.79	0.73
800	1.37	1.30	1.24	1.19	1.00	0.88	0.79	0.73
1000	1.37	1.30	1.24	1.19	1.00	0.88	0.79	0.73

Annex C: Derating Factors

Table C.5

Derating factors for soil thermal resistivities for single-core cables in buried ducts

Nominal area of conductor mm²	Values of soil thermal resistivity °C.m / Watt							
	0.7	0.8	0.9	1.0	1.5	2.0	2.5	3.0
4	1.20	1.17	1.14	1.11	1.00	0.92	0.85	0.79
6	1.20	1.17	1.14	1.11	1.00	0.92	0.85	0.79
10	1.20	1.17	1.14	1.11	1.00	0.92	0.85	0.79
16	1.20	1.17	1.14	1.11	1.00	0.92	0.85	0.79
25	1.21	1.17	1.14	1.12	1.00	0.91	0.85	0.79
35	1.21	1.18	1.15	1.12	1.00	0.91	0.84	0.79
50	1.21	1.18	1.15	1.12	1.00	0.91	0.84	0.78
70	1.22	1.19	1.15	1.12	1.00	0.91	0.84	0.78
95	1.23	1.19	1.16	1.13	1.00	0.91	0.84	0.78
120	1.23	1.20	1.16	1.13	1.00	0.91	0.84	0.78
150	1.24	1.20	1.16	1.13	1.00	0.91	0.83	0.78
185	1.24	1.20	1.17	1.13	1.00	0.91	0.83	0.78
240	1.25	1.21	1.17	1.14	1.00	0.90	0.83	0.77
300	1.25	1.21	1.17	1.14	1.00	0.90	0.83	0.77
400	1.25	1.21	1.17	1.14	1.00	0.90	0.83	0.77
500	1.25	1.21	1.17	1.14	1.00	0.90	0.83	0.77
630	1.25	1.21	1.17	1.14	1.00	0.90	0.83	0.77
800	1.25	1.21	1.17	1.14	1.00	0.90	0.83	0.77
1000	1.25	1.21	1.17	1.14	1.00	0.90	0.83	0.77

Annex C: Derating Factors

Table C.6

Derating factors for soil thermal resistivities for direct buried multi-core cables

Nominal area of conductor mm²	Values of soil thermal resistivity °C.m / Watt							
	0.7	0.8	0.9	1.0	1.5	2.0	2.5	3.0
1.5	1.23	1.19	1.16	1.13	1.00	0.91	0.84	0.78
2.5	1.23	1.19	1.16	1.13	1.00	0.91	0.84	0.78
4	1.23	1.19	1.16	1.13	1.00	0.91	0.84	0.78
6	1.23	1.19	1.16	1.13	1.00	0.91	0.84	0.78
10	1.23	1.19	1.16	1.13	1.00	0.91	0.84	0.78
16	1.23	1.19	1.16	1.13	1.00	0.91	0.84	0.78
25	1.24	1.20	1.16	1.13	1.00	0.91	0.84	0.78
35	1.25	1.21	1.17	1.13	1.00	0.91	0.83	0.78
50	1.25	1.21	1.17	1.14	1.00	0.91	0.83	0.77
70	1.26	1.21	1.18	1.14	1.00	0.90	0.83	0.77
95	1.26	1.22	1.18	1.14	1.00	0.90	0.83	0.77
120	1.26	1.22	1.18	1.14	1.00	0.90	0.83	0.77
150	1.27	1.22	1.18	1.15	1.00	0.90	0.83	0.77
185	1.27	1.23	1.18	1.15	1.00	0.90	0.83	0.77
240	1.28	1.23	1.19	1.15	1.00	0.90	0.83	0.77
300	1.28	1.23	1.19	1.15	1.00	0.90	0.82	0.77
400	1.28	1.23	1.19	1.15	1.00	0.90	0.82	0.76
500	1.28	1.23	1.19	1.15	1.00	0.90	0.82	0.76

Annex C: Derating Factors

Table C.7

Derating factors for soil thermal resistivities for multi-core cables in buried ducts

Nominal area of conductor mm²	Values of soil thermal resistivity °C.m / Watt							
	0.7	0.8	0.9	1.0	1.5	2.0	2.5	3.0
1.5	1.12	1.11	1.09	1.08	1.00	0.94	0.89	0.84
2.5	1.12	1.11	1.09	1.08	1.00	0.94	0.89	0.84
4	1.12	1.11	1.09	1.08	1.00	0.94	0.89	0.84
6	1.12	1.11	1.09	1.08	1.00	0.94	0.89	0.84
10	1.12	1.11	1.09	1.08	1.00	0.94	0.89	0.84
16	1.12	1.11	1.09	1.08	1.00	0.94	0.89	0.84
25	1.14	1.12	1.10	1.08	1.00	0.94	0.89	0.84
35	1.14	1.12	1.10	1.08	1.00	0.94	0.88	0.84
50	1.14	1.12	1.10	1.08	1.00	0.94	0.88	0.84
70	1.15	1.13	1.11	1.09	1.00	0.94	0.88	0.83
95	1.15	1.13	1.11	1.09	1.00	0.94	0.88	0.83
120	1.15	1.13	1.11	1.09	1.00	0.93	0.88	0.83
150	1.16	1.13	1.11	1.09	1.00	0.93	0.88	0.83
185	1.16	1.14	1.11	1.09	1.00	0.93	0.87	0.83
240	1.16	1.14	1.12	1.10	1.00	0.93	0.87	0.82
300	1.17	1.14	1.12	1.10	1.00	0.93	0.87	0.82
400	1.17	1.14	1.12	1.10	1.00	0.92	0.86	0.81
500	1.17	1.14	1.12	1.10	1.00	0.92	0.86	0.81

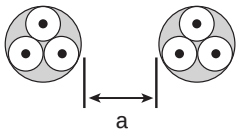
Annex C: Derating Factors

Table C.8

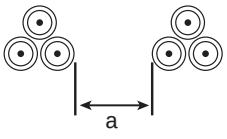
Derating factors for more than one circuit of cables laid directly in the ground (Fig. a)

Number of circuits	Circuit to circuit clearance (a)				
	Cables touching	One cable diameter	0.125 m	0.25 m	0.5 m
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

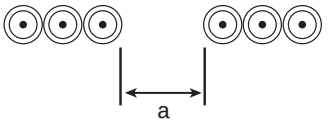
Fig. a



Multi-core cables laid in horizontal formation



Single-core cables laid in trefoil formation



Single-core cables laid in flat formation

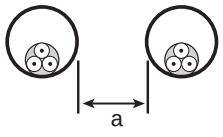
Annex C: Derating Factors

Table C.9

Derating factors for more than one circuit of multi-core cables laid in single-way ducts in the ground (Fig. b)

Number of circuits	Duct to duct clearance (a)			
	Ducts touching	0.25 m	0.5 m	1.0 m
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

Fig. b



Multi-core cables in ducts laid in horizontal formation

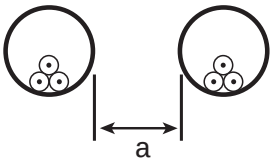
Annex C: Derating Factors

Table C.10

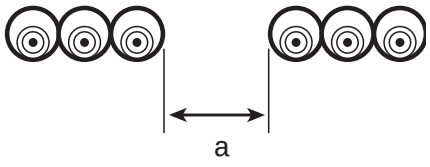
Derating factors for more than one circuit of single-core cables laid in ducts in the ground (Fig. c)

Number of circuits	Duct to duct clearance (a)			
	Ducts touching	0.25 m	0.5 m	1.0 m
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

Fig. c



Single-core cables laid in trefoil formation in duct



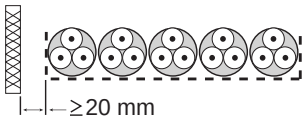
Single-core cables in single-way ducts laid in flat formation

Annex C: Derating Factors

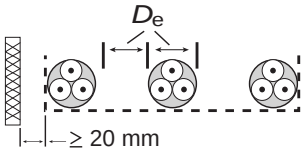
Table C.11

Derating factors for group of more than one multi-core cable in free air

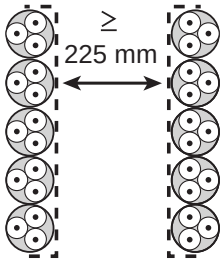
Cables on horizontal perforated trays (touching)							Laying form
Clearance from the wall ≥ 20 mm	Number of cables (three-phase circuits)						
Number of trays	1	2	3	4	6	9	
1	1.00	0.88	0.82	0.79	0.76	0.73	
2	1.00	0.87	0.80	0.77	0.73	0.68	
3	1.00	0.86	0.79	0.76	0.71	0.66	



Cables on horizontal perforated trays (spaced)							Laying form
Clearance = cable diameter (De) Clearance from the wall ≥ 20 mm	Number of cables (three-phase circuits)						
Number of trays	1	2	3	4	6	9	
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	-	

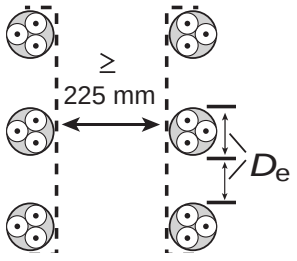


Cables on vertical perforated trays (touching)							Laying form
Clearance betw. trays ≥ 225 mm	Number of cables (three-phase circuits)						
Number of trays	1	2	3	4	6	9	
1	1.00	0.88	0.82	0.78	0.73	0.72	
2	1.00	0.88	0.81	0.76	0.71	0.70	
3	-	-	-	-	-	-	

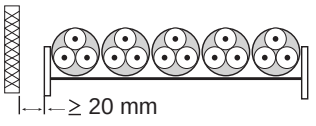


Annex C: Derating Factors

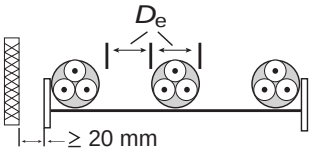
Cables on vertical perforated trays (spaced)							Laying form
Clearance = cable diameter (De) Clearance betw. trays ≥ 225 mm	Number of cables (three-phase circuits)						
Number of trays	1	2	3	4	6	9	
1	1.00	0.91	0.89	0.88	0.87	-	
2	1.00	0.91	0.88	0.87	0.85	-	
3	-	-	-	-	-	-	



Cables on ladder supported, cleats, etc. (touching)							Laying form
Clearance from the wall ≥ 20 mm	Number of cables (three-phase circuits)						
Number of trays	1	2	3	4	6	9	
1	1.00	0.87	0.82	0.80	0.79	0.78	
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	



Cables on ladder supported, cleats, etc. (spaced)							Laying form
Clearance = cable diameter (De) Clearance from the wall ≥ 20 mm	Number of cables (three-phase circuits)						
Number of trays	1	2	3	4	6	9	
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 have to be applied to the current carrying capacity for one multi-core cable in free air.

NOTE 2 : Values given are averages for the cable types and range of conductor sizes considered in this catalogue. The spread of values is generally less than 5 %.

NOTE 3 : 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 4 : Values are given for vertical spacing between trays of 300 mm and at least 20 mm between trays and wall. For closer spacing, the factors should be reduced.

NOTE 5 : Values are given for horizontal spacing between trays of 225 mm with trays mounted back to back. For closer spacing, the factors should be reduced.

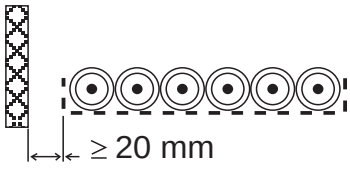
Annex C: Derating Factors

Table C.12

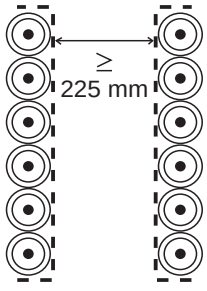
Derating factors for groups of more than one circuit of single-core cables in free air

(Note 3)

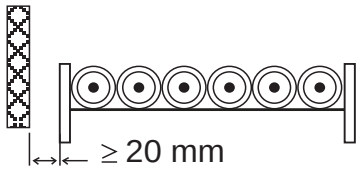
Cables on horizontal perforated trays (touching) (Note 4)				Laying form
Clearance from the wall ≥ 20 mm	Number of three-phase circuits (Note 6)			
Number of trays	1	2	3	
1	0.98	0.91	0.87	
2	0.96	0.87	0.81	
3	0.95	0.85	0.78	



Cables on vertical perforated trays (touching) (Note 5)				Laying form
Clearance betw. trays ≥ 225 mm	Number of three-phase circuits (Note 6)			
Number of trays	1	2	3	
1	0.96	0.86	-	
2	0.95	0.84	-	
3	-	-	-	

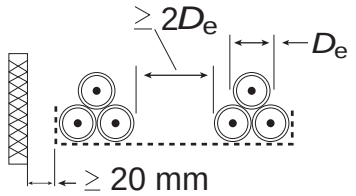


Cables on ladder supported, cleats, etc. (touching) (Note 4)				Laying form
Clearance from the wall ≥ 20 mm	Number of three-phase circuits (Note 6)			
Number of trays	1	2	3	
1	1.00	0.97	0.96	
2	0.98	0.93	0.89	
3	0.97	0.90	0.86	

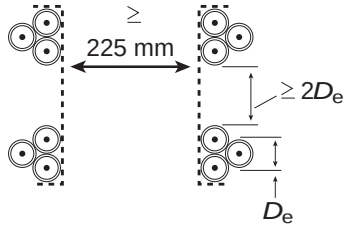


Annex C: Derating Factors

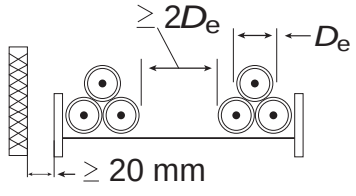
Cables on horizontal perforated trays (spaced) (Note 4)				Laying form
Clearance = 2 cable diameter (De) Clearance from the wall ≥ 20 mm	Number of three-phase circuits (Note 6)			
Number of trays	1	2	3	
1	1.00	0.98	0.96	
2	0.97	0.93	0.89	
3	0.96	0.92	0.86	



Cables on vertical perforated trays (spaced) (Note 5)				Laying form
Clearance = 2 cable diameter (De) Clearance betw. trays ≥ 225 mm	Number of three-phase circuits (Note 6)			
Number of trays	1	2	3	
1	1.00	0.91	0.89	
2	1.00	0.90	0.86	
3	-	-	-	



Cables on ladder supported, cleats, etc. (spaced) (Note 4)				Laying form
Clearance = 2 cable diameter (De) Clearance from the wall ≥ 20 mm	Number of three-phase circuits (Note 6)			
Number of trays	1	2	3	
1	1.00	1.00	1.00	
2	0.97	0.95	0.93	
3	0.96	0.94	0.90	



NOTE 1 : Values given have to be applied to the current carrying capacity for one three-phase circuit of single-core cables in free air, either in trefoil or horizontal (flat) formation.

NOTE 2 : Values given are averages for the cable types and range of conductor sizes considered. The spread of values is generally less than 5 %.

NOTE 3 : Factors are given for single layers of cables (or trefoil groups) as shown in the table 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 should be determined by an appropriate method.

NOTE 4 : Values are given for vertical spacing between trays of 300 mm. For closer spacing, the factors should be reduced.

NOTE 5 : Values are given for horizontal spacing between trays of 225 mm with trays mounted back to back. For closer spacing, the factors should be reduced.

NOTE 6 : For circuits having more than one cable in parallel per phase, each three phase set of conductors should be considered as a circuit for the purpose of this table.

Annex D: Formulas

D.1 Resistance

The values of conductor DC resistance given in the previous tables are based on 20 °C. In case the DC resistance is required at any other temperature, the following formula is used:

$$R_\theta = R_{20} \times [1 + \alpha\ (\theta - 20)] \qquad \Omega/Km$$

Where

R_θ	Conductor DC resistance at θ °C	Ω/Km
R_{20}	Conductor DC resistance at 20 °C	Ω/Km
θ	Operating temperature	$°C$
α	Resistance temperature coefficient = 0.00393 for Copper = 0.00403 for Aluminum	$1/°C$

To get the AC resistance of the conductor at its operating temperature, the following formula is used:

$$R_{a.c} = R_\theta \times (1 + y_p + y_s) \qquad \Omega/Km$$

Where

y_p and y_s are the proximity and skin effect factors, respectively, which depend on the laying and operating frequency of the cable.

D.2 Inductance

Self and mutual inductance are formulated as follows:

$$L = K + 0.2\ In\ \left(\frac{2S}{d}\right) \qquad mH/Km$$

Where

L	Inductance	mH/Km
K	Constant depends on the conductors' number of wires	
d	Conductor diameter	mm
S	Axial spacing between cables = 1 x S in case of trefoil formation = 1.26 X S in case of flat formation	mm

D.3 Capacitance

$$C = \frac{\epsilon_r}{18\ In\ \frac{D}{d}} \qquad \mu F/Km$$

Where

C	Capacitance	$\mu F/Km$
ϵ_r	Relative permittivity of insulation	
D	Diameter over insulation,	mm
d	Diameter under insulation	mm

Annex D: Formulas

D.4 Insulation Resistance

$$R = k \ln \left(\frac{D}{d} \right) \qquad M\Omega.km$$

Where

R	Insulation resistance	$M\Omega.km$
K	Constant depends on the insulation	
d	Diameter of the conductor	mm
D	Diameter of the insulated core	mm

D.5 Charging Current

The charging current is the capacitive current which flows when an AC voltage is applied to the cables as a result of the capacitance between the conductor and earth, and for a multi-core cable in which cores are not screened, between conductors. The value can be derived from following the equation:

$$I_c = U_o \, \omega C \, 10^{-6} \qquad A/km$$

Where

I_c	Charging current	A/km
U_o	Phase voltage	V
ω	$2 \pi f$	
f	Operating frequency	Hz
C	Capacitance to neutral	$\mu F/Km$

D.6 Dielectric Losses

The dielectric losses of an AC cable are proportional to the capacitance, the frequency, the phase voltage and the power factor. The value can be derived from the following equation:

$$W_d = \omega C \, U_o^2 \tan \delta \, 10^{-6} \qquad W/km/Ph$$

Where

W_d	Dielectric Losses	$W/km/Ph$
ω	$2 \pi f$	
f	Operating frequency	Hz
C	Capacitance to neutral	$\mu F/Km$
U_o	Phase voltage	V
$\tan \delta$	Dielectric power factor	

Annex D: Formulas

D.7 Short Circuit Capacity

Tables F.1 and F.2 give the short circuit current for conductor based on the following conditions:

1. Short circuit starts from the maximum operating conductor temperature of 90 °C
2. Maximum temperature during short circuit is 250 °C
3. Maximum short circuit duration is 5 seconds.

If the short circuit current is required at duration not mentioned in the catalogue, it is obtained by dividing the short circuit current for 1 second by the square root of the required duration as follows:

$$I_{s.c.t} = \frac{I_{s.c.1}}{\sqrt{t}}$$

Where

$I_{s.c.t.}$	Short circuit current for t second	*kA*
$I_{s.c.1}$	Short circuit current for 1 second	*kA*
t	Duration	*Sec.*

D.8 Voltage Drop

When current flows in a cable conductor there is a voltage drop between the ends of the conductors, which is the product of the current and the impedance. The following equations should be used to calculate the voltage drop:

A. Single phase circuit:

$$V_d = 2I\ell (R \cos \Phi + X \sin \Phi) \qquad V$$

B. Three phase circuit:

$$V_d = \sqrt{3}I\ell (R \cos \Phi + X \sin \Phi) \qquad V$$

Where

V_d	Voltage drop	*V*
I	Load current	*A*
ℓ	Route length	*Km*
R	AC Resistance	*Ω/Km*
X	Reactance	*Ω/Km*
$\cos \Phi$	Power factor	

Where

$$X = \omega L\ 10^{-3} \qquad \Omega/Km$$

Where

ω	2 π f	
f	Operating frequency	*Hz*
L	inductance	*mH/Km*

Relation between cos Φ and sin Φ:

cos Φ	1.0	0.9	0.85	0.8	0.6
sin Φ	0.0	0.44	0.53	0.6	0.8

- LV cabling system should be planned so as not to exceed voltage drop of 3-5% in normal operating conditions.
- Voltage drop data for LV single and multi core cables are tabulated in table I.1.

Annex E: Electrical Parameters Of Cables

Table E.1

Low Smoke Halogen Free (LSHF) Power Cables

Nominal area of conductor	Copper Conductors				
	Max. Conductor Resistance		Reactance at (60 Hz, Trefoil)	Impedance at (90 °C, 60 Hz)	Capacitance
	DC at 20 °C	AC at 90 °C			
mm²	Ω / Km	Ω / Km	Ω / Km	Ω / Km	µF / Km
Single-core Cables					
1.5	12.1000	15.4287	0.175	15.430	0.212
2.5	7.4100	9.4485	0.161	9.450	0.264
4	4.6100	5.8782	0.150	5.880	0.309
6	3.0800	3.9274	0.141	3.930	0.379
10	1.8300	2.3335	0.134	2.337	0.433
16	1.1500	1.4665	0.125	1.472	0.533
25	0.7270	0.9273	0.121	0.935	0.505
35	0.5240	0.6686	0.115	0.678	0.599
50	0.3870	0.4941	0.108	0.506	0.629
70	0.2680	0.3428	0.104	0.358	0.679
95	0.1930	0.2476	0.102	0.268	0.781
120	0.1530	0.1970	0.100	0.221	0.797
150	0.1240	0.1605	0.100	0.189	0.767
185	0.0991	0.1294	0.098	0.162	0.753
240	0.0754	0.1002	0.096	0.139	0.807
300	0.0601	0.0817	0.095	0.125	0.858
400	0.0470	0.0663	0.094	0.115	0.870
500	0.0366	0.0545	0.092	0.107	0.904
630	0.0283	0.0454	0.092	0.102	0.928
800	0.0221	0.0390	0.091	0.099	0.976
1000	0.0176	0.0253	0.088	0.092	1.105
Multi-core Cables					
1.5	12.1000	15.4287	0.128	15.429	0.212
2.5	7.4100	9.4485	0.118	9.449	0.264
4	4.6100	5.8783	0.113	5.879	0.309
6	3.0800	3.9274	0.106	3.929	0.379
10	1.8300	2.3336	0.103	2.336	0.433
16	1.1500	1.4667	0.098	1.470	0.533
25	0.7270	0.9275	0.099	0.933	0.505
35	0.5240	0.6688	0.096	0.676	0.599
50	0.3870	0.4944	0.092	0.503	0.629
70	0.2680	0.3431	0.090	0.355	0.679
95	0.1930	0.2481	0.088	0.263	0.781
120	0.1530	0.1976	0.087	0.216	0.797
150	0.1240	0.1612	0.088	0.183	0.767
185	0.0991	0.1302	0.088	0.157	0.753
240	0.0754	0.1012	0.087	0.133	0.807
300	0.0601	0.0829	0.086	0.119	0.858
400	0.0470	0.0676	0.085	0.109	0.870
500	0.0366	0.0561	0.085	0.102	0.904

Annex E: Electrical Parameters Of Cables

Table E.2

Low Smoke Halogen Free (LSHF) Power Cables

Nominal area of conductor	Aluminum Conductors				
	Max. Conductor Resistance		Reactance at (60 Hz, Trefoil)	Impedance at (90 °C, 60 Hz)	Capacitance
	DC at 20 °C	AC at 90 °C			
mm²	Ω / Km	Ω / Km	Ω / Km	Ω / Km	µF / Km
Single-core Cables					
10	3.0800	3.9489	0.134	3.951	0.433
16	1.9100	2.4489	0.125	2.452	0.533
25	1.2000	1.5387	0.121	1.543	0.505
35	0.8680	1.1131	0.115	1.119	0.599
50	0.6410	0.8222	0.108	0.829	0.629
70	0.4430	0.5686	0.104	0.578	0.679
95	0.3200	0.4112	0.102	0.424	0.781
120	0.2530	0.3255	0.100	0.341	0.797
150	0.2060	0.2656	0.100	0.284	0.767
185	0.1640	0.2121	0.098	0.234	0.753
240	0.1250	0.1627	0.096	0.189	0.807
300	0.1000	0.1314	0.095	0.162	0.858
400	0.0778	0.1038	0.094	0.140	0.870
500	0.0605	0.0828	0.092	0.124	0.904
630	0.0469	0.0666	0.092	0.114	0.928
800	0.0367	0.0551	0.091	0.106	0.976
1000	0.0291	0.0391	0.088	0.097	1.105
Multi-core Cables					
10	3.0800	3.9490	0.103	3.950	0.433
16	1.9100	2.4490	0.098	2.451	0.533
25	1.2000	1.5388	0.099	1.542	0.505
35	0.8680	1.1133	0.096	1.117	0.599
50	0.6410	0.8224	0.092	0.827	0.629
70	0.4430	0.5688	0.090	0.576	0.679
95	0.3200	0.4115	0.088	0.421	0.781
120	0.2530	0.3259	0.087	0.337	0.797
150	0.2060	0.2660	0.088	0.280	0.767
185	0.1640	0.2126	0.088	0.230	0.753
240	0.1250	0.1634	0.087	0.185	0.807
300	0.1000	0.1321	0.086	0.157	0.858
400	0.0778	0.1047	0.085	0.135	0.870
500	0.0605	0.0838	0.085	0.119	0.904

Annex E: Electrical Parameters of Cables

Table E.3

Low Smoke Halogen Free (LSHF) Fire Resistant Cables

Nominal area of conductor	Copper Conductors				
	Max. Conductor Resistance		Reactance at (60 Hz, Trefoil)	Impedance at (90 °C, 60 Hz)	Capacitance
	DC at 20 °C	AC at 90 °C			
mm²	Ω / Km	Ω / Km	Ω / Km	Ω / Km	µF / Km
Single-core Cables					
1.5	12.1000	15.4287	0.194	15.430	0.102
2.5	7.4100	9.4485	0.180	9.450	0.120
4	4.6100	5.8782	0.166	5.881	0.147
6	3.0800	3.9274	0.156	3.930	0.170
10	1.8300	2.3335	0.148	2.338	0.193
16	1.1500	1.4665	0.138	1.473	0.236
25	0.7270	0.9273	0.131	0.937	0.267
35	0.5240	0.6685	0.125	0.680	0.300
50	0.3870	0.4940	0.118	0.508	0.331
70	0.2680	0.3426	0.113	0.361	0.372
95	0.1930	0.2474	0.108	0.270	0.427
120	0.1530	0.1968	0.106	0.224	0.452
150	0.1240	0.1603	0.105	0.191	0.463
185	0.0991	0.1291	0.102	0.165	0.478
240	0.0754	0.0999	0.099	0.141	0.523
300	0.0601	0.0815	0.097	0.127	0.567
400	0.0470	0.0660	0.096	0.116	0.594
500	0.0366	0.0542	0.094	0.109	0.636
630	0.0283	0.0452	0.093	0.104	0.686
800	0.0221	0.0387	0.092	0.100	0.715
1000	0.0176	0.0252	0.090	0.093	0.829
Multi-core Cables					
1.5	12.1000	15.4287	0.146	15.429	0.102
2.5	7.4100	9.4485	0.136	9.450	0.120
4	4.6100	5.8783	0.127	5.880	0.147
6	3.0800	3.9274	0.120	3.929	0.170
10	1.8300	2.3336	0.115	2.336	0.193
16	1.1500	1.4666	0.109	1.471	0.236
25	0.7270	0.9274	0.107	0.934	0.267
35	0.5240	0.6687	0.103	0.677	0.300
50	0.3870	0.4943	0.098	0.504	0.331
70	0.2680	0.3430	0.096	0.356	0.372
95	0.1930	0.2479	0.093	0.265	0.427
120	0.1530	0.1974	0.092	0.218	0.452
150	0.1240	0.1610	0.092	0.185	0.463
185	0.0991	0.1299	0.091	0.159	0.478
240	0.0754	0.1009	0.090	0.135	0.523
300	0.0601	0.0825	0.088	0.121	0.567
400	0.0470	0.0673	0.088	0.111	0.594
500	0.0366	0.0557	0.087	0.103	0.636

Annex F: Short Circuit Capacity

F.1 Permissible short circuit current

The short circuit capacity of a current carrying component of a cable is determined by the following factors:

- The temperature prior to the short circuit, generally taken to be that corresponding with the maximum conductor operating temperature under normal conditions
- The energy produced by the short circuit, a function of both the magnitude and the duration of the current
- The limiting final temperature, generally determined by all materials in direct contact with the conducting component

The short circuit current ratings given below in Tables F.1 and F.2 are calculated in accordance with the following formula as given in IEC 60949:

$$I = \frac{K\ x\ S}{\sqrt{t}} \sqrt{Ln\left(\frac{\theta_f\ +\ \beta}{\theta_i\ +\ \beta}\right)}$$

Where

I	:	Permissible Short circuit current *(A)*
t	:	Duration of short circuit *(seconds)*
S	:	Cross-sectional area of the current-carrying component *(mm^2)*
K	:	Constant depending on the material of the current-carrying component *($As^{½} / mm^2$)*
θ_i	:	Initial temperature before short circuit in *(°C)*
θ_f	:	Final temperature at short circuit in *(°C)*
β	:	Reciprocal of temperature coefficient of resistance of the current carrying component at 0 °C

The short circuit current ratings given below are the symmetrical currents which will cause the conductor temperature to rise from the normal operating value of 90 °C to the maximum short circuit temperature of 250 °C in the time stated, assuming adiabatic conditions (i.e. neglecting heat loss).

Annex F: Short Circuit Capacity

Table F.1

Short circuit current (kA) – Copper conductor – XLPE Insulated

Nominal area of conductor	Short circuit duration sec.									
mm^2	0.1	0.2	0.3	0.4	0.5	1.0	2.0	3.0	4.0	5.0
1.5	0.68	0.48	0.39	0.34	0.30	0.21	0.15	0.12	0.11	0.10
2.5	1.13	0.80	0.65	0.57	0.51	0.36	0.25	0.21	0.18	0.16
4	1.81	1.28	1.04	0.90	0.81	0.57	0.40	0.33	0.29	0.26
6	2.71	1.92	1.57	1.36	1.21	0.86	0.61	0.50	0.43	0.38
10	4.52	3.20	2.61	2.26	2.02	1.43	1.01	0.83	0.72	0.64
16	7.2	5.1	4.2	3.6	3.2	2.3	1.6	1.3	1.1	1.0
25	11.3	8.0	6.5	5.7	5.1	3.6	2.5	2.1	1.8	1.6
35	15.8	11.2	9.1	7.9	7.1	5.0	3.5	2.9	2.5	2.2
50	22.6	16.0	13.1	11.3	10.1	7.2	5.1	4.1	3.6	3.2
70	31.7	22.4	18.3	15.8	14.2	10.0	7.1	5.8	5.0	4.5
95	43.0	30.4	24.8	21.5	19.2	13.6	9.6	7.8	6.8	6.1
120	54.3	38.4	31.3	27.1	24.3	17.2	12.1	9.9	8.6	7.7
150	67.9	48.0	39.2	33.9	30.4	21.5	15.2	12.4	10.7	9.6
185	83.7	59.2	48.3	41.9	37.4	26.5	18.7	15.3	13.2	11.8
240	108.6	76.8	62.7	54.3	48.6	34.3	24.3	19.8	17.2	15.4
300	135.7	96.0	78.4	67.9	60.7	42.9	30.4	24.8	21.5	19.2
400	181.0	128.0	104.5	90.5	80.9	57.2	40.5	33.0	28.6	25.6
500	226.2	160.0	130.6	113.1	101.2	71.5	50.6	41.3	35.8	32.0
630	285.1	201.6	164.6	142.5	127.5	90.1	63.7	52.0	45.1	40.3
800	362.0	256.0	209.0	181.0	161.9	114.5	80.9	66.1	57.2	51.2
1000	452.5	319.9	261.2	226.2	202.4	143.1	101.2	82.6	71.5	64.0

Annex F: Short Circuit Capacity

Table F.2

Short circuit current (kA) – Aluminum conductor – XLPE Insulated

Nominal area of conductor	Short circuit duration sec.									
mm^2	0.1	0.2	0.3	0.4	0.5	1.0	2.0	3.0	4.0	5.0
10	2.99	2.11	1.73	1.49	1.34	0.94	0.67	0.55	0.47	0.42
16	4.8	3.4	2.8	2.4	2.1	1.5	1.1	0.9	0.8	0.7
25	7.5	5.3	4.3	3.7	3.3	2.4	1.7	1.4	1.2	1.1
35	10.5	7.4	6.0	5.2	4.7	3.3	2.3	1.9	1.7	1.5
50	14.9	10.6	8.6	7.5	6.7	4.7	3.3	2.7	2.4	2.1
70	20.9	14.8	12.1	10.5	9.4	6.6	4.7	3.8	3.3	3.0
95	28.4	20.1	16.4	14.2	12.7	9.0	6.3	5.2	4.5	4.0
120	35.9	25.4	20.7	17.9	16.0	11.3	8.0	6.5	5.7	5.1
150	44.8	31.7	25.9	22.4	20.0	14.2	10.0	8.2	7.1	6.3
185	55.3	39.1	31.9	27.6	24.7	17.5	12.4	10.1	8.7	7.8
240	71.7	50.7	41.4	35.9	32.1	22.7	16.0	13.1	11.3	10.1
300	89.6	63.4	51.8	44.8	40.1	28.3	20.0	16.4	14.2	12.7
400	119.5	84.5	69.0	59.8	53.4	37.8	26.7	21.8	18.9	16.9
500	149.4	105.6	86.3	74.7	66.8	47.2	33.4	27.3	23.6	21.1
630	188.2	133.1	108.7	94.1	84.2	59.5	42.1	34.4	29.8	26.6
800	239.0	169.0	138.0	119.5	106.9	75.6	53.4	43.6	37.8	33.8
1000	298.8	211.3	172.5	149.4	133.6	94.5	66.8	54.6	47.2	42.3

Annex G: Effect of Fire Temperature on Cables

G.1 Effect on Cable Size

When a cable is involved in a fire, the conductor temperature will rise above the maximum conductor temperature upon which tabulated current rating and voltage drop data is based.

In carrying a set current, a cable with its conductor temperature at 850 °C will experience a greater temperature rise due to current loading than a cable with its conductor temperature at 90 °C. However, the additional temperature rise due to this factor will be less than 50 °C and is not significant in relation to the temperature rise caused by the fire.

The voltage drop at typical fire temperatures will be higher than at 90 °C and this can be significant for certain types of load. Assuming a worst case of the total length of cable run in the fire, it would be necessary to increase the conductor size by approximately two sizes.

It is possible to calculate the voltage drop for cables involved in a fire by assuming the cable temperature in a fire and cable length affected. Example of the calculations is given in Annex H.

The process of cable sizing and selection for fire-resistant cable should take into account the effects on the cable performance resulting from the increased operating temperature above its normal maximum ambient temperature likely to be experienced under fire conditions (e.g. 850 °C).

The voltage drop and impedance of the cable increase with temperature, and therefore care should be taken while selecting the appropriate cable for the load being fed.

G.2 Areas of Special Fire Risk

Research has confirmed that where there are ventilation limitations and/or very large fire sizes (e.g. in underground car parks and loading bays), temperatures can reach as high as 1200 °C. Such areas therefore need special consideration.

Areas that can be classified as areas of special fire risk include:

- High bay warehouses.
- Loading bays.
- Underground car parks.
- Large basement storage.
- Hydro carbons fuel storage.
- Self-storage buildings/units.

As a general principle, cables for life safety and fire-fighting systems should not be installed within areas of special fire risk. However, there will be occasions where this cannot be avoided. In these situations, the cables used should be Category 3 cables as defined in BS 8519 standard (120 minute fire survival time), and should additionally be protected by a fire-resisting enclosure that has been shown to be suitable for the anticipated maximum temperatures, with a survival time at least equal to that of the cable. Any fixings should have suitable protection, e.g. intumescent coverings, appropriate for the anticipated maximum temperatures.

Annex H: Voltage Drop Calculations

H.1 Voltage drop calculations for cables in normal operation

In order to calculate the voltage drop of a cable in normal operation, the following factors need to be known or assumed:

Total cable length.
Current to be carried.
Voltage drop per amp per meter of the cable at its max. permitted operating temperature (90 °C).

The process of calculating the voltage drop of a cable under a given operating conditions is normally straightforward. The tabulated values in Table I.1 for voltage drop per amp per meter are multiplied by the length of run and current to be carried, to give the expected voltage drop.
The tabulated values assume that the cable conductor temperature is at its maximum permitted operating temperature (90 °C).

H.2 Voltage drop calculations for cables in a fire

If a cable is involved in a fire, the conductor temperature and hence the resistance would be higher, therefore the voltage drop would be higher.

In order to calculate the voltage drop of a cable in a fire, in addition to the factors needed to calculate the voltage drop of a cable in normal operation, the following factors also need to be known or assumed:

Correction factor for voltage drop from 90 °C to cable temperature in the fire.
Temperature of that part of the cable that is in the fire
Length of that part of the cable that is in the fire

The voltage drop correction factor can be calculated based on the following formula:

$$F = \frac{1 + \alpha\,(\theta_f - 20)}{1 + \alpha\,(\theta_i - 20)}$$

Where

F	:	Voltage drop correction factor
α	:	Temperature coefficient of resistance per °C
θ_i	:	Initial conductor temperature before fire in °C
θ_f	:	Final conductor temperature at fire in °C

The following values of correction factor are based on a copper conductor with a resistance temperature coefficient of 0.00393 per °C:

90 °C to 650 °C = 2.7260.
90 °C to 750 °C = 3.0342.
90 °C to 850 °C = 3.3424.
90 °C to 950 °C = 3.6506.

The problem in determining the voltage drop for a run of cable in a fire is to know the conductor temperature at each point along its length. Therefore assumptions have to be made in calculating what the voltage drop would be. The below example will be used to illustrate the effect of assuming different lengths of cable being involved in a fire.

Annex H: Voltage Drop Calculations

H.3 Example

Assume a 4-core 10 mm² cable with copper conductors and XLPE insulated, carrying a load current of 20 A over 60 m route length.

H.3.1 At normal operation:

At normal operation the voltage drop would be:

3.53 x 20 x 60 x 0.001 = 4.236 V

Where 3.53 is the tabulated value in Table I.1 for the voltage drop per amp per meter (mV/A/m) of this cable at its maximum permitted operating temperature (90 °C).

H.3.2 At fire conditions assuming part of the cable run is subjected to fire:

Rework the same example but with assuming that only 5 m of the total cable run are at 750 °C and the rest of the cable run is at 90 °C, the voltage drop would be:

(3.53 x 20 x 55 x 0.001) + (3.53 x 20 x 5 x 0.001 x 3.0342) = 4.954 V

Where 3.53 is the tabulated value in Table I.1 for the voltage drop per amp per meter (mV/A/m) of this cable at its maximum permitted operating temperature (90 °C) and 3.0342 is the voltage drop correction factor from 90 °C to 750 °C for copper (Cu).

H.3.3 At fire conditions assuming all the cable run is subjected to fire:

Rework the same example but with assuming that all 60 m are at 750 °C, the voltage drop would be:

3.53 x 20 x 60 x 0.001 x 3.0342 = 12.853 V

Where 3.53 is the tabulated value in Table I.1 for the voltage drop per amp per meter (mV/A/m) of this cable at its maximum permitted operating temperature (90 °C) and 3.0342 is the voltage drop correction factor from 90 °C to 750 °C for copper (Cu).

It can be seen from these examples, although the voltage drop has increased from normal operation, with part of a cable or all the cable in a fire, the percentage drop from a 240 V single phase supply does not increase significantly.

That is to say: The above example would give a voltage drop of 1.77%, 2.06% and 5.36% respectively.

From these percentages of volt drop values, it would seem unlikely that a fire would have a significant effect on most equipment being supplied by the cable, even in the example of the worst case given above when assuming that all the cable run is subjected to fire.

From the above it is possible to calculate the voltage drop for cables involved in a fire by assuming the cable temperature in the fire and the cable length affected, following the examples previously given.

In most cases it is unrealistic to assume that all of the cable length is involved in a fire. If a cable size was selected for a maximum of 2% voltage drop in normal operation, the voltage drop of this cable would be a maximum of 4%, even assuming that the part of the cable length subjected to fire is at 950 °C.

Annex I: Voltage Drop Values

Table I.1

Voltage drop for XLPE insulated cables

Nominal area of conductor	Voltage drop (mV/Amp/Meter)					
	Single-core cables				Multi-core cables	
mm²	Copper		Aluminum		Copper	Aluminum
	Flat	Trefoil	Flat	Trefoil		
1.5	22.892	22.875	-	-	22.832	-
2.5	14.075	14.058	-	-	14.019	-
4	8.808	8.792	-	-	8.758	-
6	5.927	5.912	-	-	5.879	-
10	3.574	3.558	5.952	5.937	3.530	5.908
16	2.290	2.274	3.736	3.720	2.249	3.695
25	1.492	1.476	2.392	2.376	1.456	2.356
35	1.106	1.090	1.760	1.744	1.073	1.724
50	0.843	0.827	1.326	1.310	0.812	1.295
70	0.617	0.600	0.949	0.933	0.588	0.920
95	0.474	0.458	0.715	0.699	0.446	0.686
120	0.398	0.382	0.587	0.571	0.371	0.560
150	0.344	0.328	0.499	0.483	0.318	0.472
185	0.296	0.280	0.418	0.402	0.272	0.394
240	0.252	0.236	0.344	0.328	0.229	0.320
300	0.223	0.207	0.296	0.281	0.201	0.273
400	0.200	0.184	0.255	0.239	0.178	0.232
500	0.181	0.165	0.223	0.206	0.161	0.201
630	0.167	0.151	0.198	0.183	-	-
800	0.157	0.141	0.180	0.165	-	-
1000	0.135	0.118	0.155	0.138	-	-

NOTE: *The above values for cables voltage drop per ampere per meter were calculated based on the following conditions:*

- Maximum permitted operating temperature for conductor : 90 °C
- Power factor : 0.85
- Rated frequency : 60 Hz

Annex J: Cable Installation Practice

J.1 General

This annex provides installation methods commonly encountered in industrial, residential and electric power utility applications and should be used in conjunction with the engineer's installation specifications and all applicable codes/standards.

The cables included in this catalogue are intended, based on their field of applications, for installation in air, and are expected to be used primarily in such locations.

However, there will be occasions where part of the cable route is to be laid in any other environment, e.g. direct buried in the ground or in buried ducts. In such occasions, the relevant clauses of this annex related to cables installations in ground should be followed.

J.2 Pre-installation

To ensure safety during cable installation and reliability once the cable is installed, you should confirm the following prior to installation.

The cable selected is proper for your application
The cable has not been damaged in transit or storage

Review all applicable local, state, provincial, and national codes to verify that the cable selected is appropriate for the installation job.

Any existing cable damage must be identified and any further damage prevented from occurring. This is done through proper cable inspection, handling and storage.

J.2.1 Cable Inspection

Inspect every reel of cable for damage before accepting the shipment. Be particularly alert for cable damage if:

A reel is laying flat on its flange side
Several reels are stacked on top of each other
Other freight is stacked on top of a reel
Nails have been driven into reel flanges to secure shipping blocks
A reel flange is damaged
A reel has been dropped (hidden damage likely)
A cable covering has been removed, or is stained or damaged
A cable end seal has been removed or is damaged

J.2.2 Cable Storage

Cables should be stored on hard surfaces so that reel flanges cannot sink. Small reels may weight several hundred kilograms while large reels can exceed several thousand kilograms.

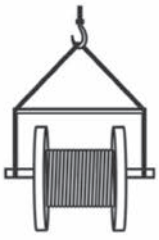
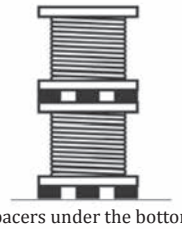
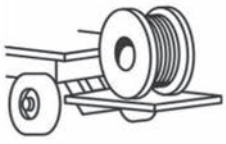
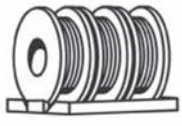
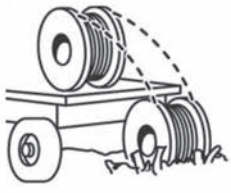
Impact damage can be prevented by the following precautions:

Aligning reels flange to flange
Using guards across flanges when different reel sizes are stored together
Maintaining adequate aisles and barricades to prevent equipment from hitting the cable

Annex J: Cable Installation Practice

J.2.3 Drum Handling

The following recommendations for the storage and handling of cables that are packed on wooden cable drums suitable for storage outdoors should be followed.

Yes	No
	
Cradle both reel flanges between forks	Do not lift by top flange. Cable or reel
	
through both flanges	the reel flanges and mashing the cable
	
Place spacers under the bottom flange and between reels to create a space to insert the forks	Upended heavy reels will often arrive damaged. Refuse or receive subject to inspection for hidden damage
	
Lower reels from truck using hydraulic gate, hoist or fork lift. LOWER CAREFULLY.	Never allow forks to touch cable surface or reel wrap
	
Always load with flanges on edge and chock and block securely	Never drop reels

Annex J: Cable Installation Practice

J.2.4 Prevention of moisture ingress

Care should be exercised during installation to avoid any damage to cable coverings. This is important in wet or other aggressive environments. The protective end cap should not be removed from the ends of the cable until immediately prior to termination or jointing, especially for cables that do not have an extruded bedding. When the caps have been removed, the unprotected ends of the cable should not be exposed to moisture.

J.3 Installation

A high percentage of cable failures are due to mechanical damage, which typically occurs during transportation, handling and installation.

In fact, most cables are subjected to more mechanical stress during installation than they ever experience in actual operation. Needless to say, handling and installing the cable according to the manufacturer's recommendations is extremely important.

When cables are installed in a raceway, underground electrical duct or cable tray, the following factors must be considered:

Conductor configuration
Raceway or cable tray fill
Physical limitations of cables
Installation equipment
Ambient temperature and conditions

Similarly, when cable is installed as exposed wiring or as messenger-supported wiring, all of the above factors except raceway or cable tray fill must be considered as well as the requirements for securing and supporting the cables.

J.3.1 Minimum installation radius

None of the cables included in this catalogue should be bent during installation to a radius smaller than the following:

Single-core cables

Unarmoured : 15 Ø

Multi-core cables

Unarmoured : 12 Ø
Armoured : 12 Ø

Where Ø is the overall diameter of the cable.

Wherever possible, larger installation radius should be used, except that the minimum bending radius where the cables are placed in position adjacent to joints and terminations may be reduced to that values given below, provided that the bending is carefully controlled, e.g. by the use of a former.

Annex J: Cable Installation Practice

Single-core cables

Unarmoured : 8 Ø

Multi-core cables

Unarmoured : 6 Ø
Armoured : 6 Ø

J.3.2 Minimum temperature during installation

It is recommended that the cables should be installed only when both the cable and ambient temperature are above 0 °C and have been so for the previous 24 hours, or where special precautions have been taken to maintain the cable above this temperature.

J.3.3 Maximum pulling tension

The maximum pulling tension is depending on the cable design, the mechanical limitations, the conductor material, and the method of laying and pulling the cables. The maximum permissible pulling force can be calculated based on the method of pulling as follows:

J.3.3.1 Pulling eye attached to the conductor

With pulling eye attached to copper conductors, the maximum pulling tension should not exceed 0.036 times circular-mil area of conductor (C_m). With pulling eye attached to aluminum conductors, the maximum pulling tension should not exceed 0.027 times circular-mil area of conductor (C_m). Or in other words

$$T_m = 0.036 \ X \ n \ X \ C_m \qquad (Copper)$$

$$T_m = 0.027 \ X \ n \ X \ C_m \qquad (Aluminum)$$

Where

T_m : Maximum pulling tension in N
n : The number of conductors
C_m : Circular mil area of each conductor

The maximum limitation for this calculation is 22240 N (2268 kgf) for single conductor (1/C) cables, and 44480 N (4536 kgf) for multi core cables. This limitation is due to unequal distribution of tension forces when pulling multiple conductors.

When the calculated pulling tension is close to (or within 10 % of) the maximum pulling tension, the use of a tension gauge during the pulling is recommended.

Annex J: Cable Installation Practice

J.3.3.2 Cable grip over lead sheath

With cable grip over lead sheath, with commercial lead, the maximum pulling tension on the lead sheath should not exceed 10.33 N/mm^2 (1500 lbf/in^2).

J.3.3.3 Cable grip over non-leaded cable

With cable grip over non-leaded cable, the maximum pulling tension on should not exceed 4400 N (1000 lbf).

J.3.4 Side wall pressure

One of the limitations to be considered in the installation of electrical cables is sidewall pressure. The sidewall pressure is the force exerted on the insulation and sheath of the cable at a bend point when the cable is under tension, and is normally the limiting factor in an installation where cable bends are involved. The sidewall pressure in general is expressed as the tension out of a bend expressed in newtons divided by the inside radius of the bend expressed in meters.

$$P = \left[\frac{T_o}{r} \right]$$

Where

P : Sidewall pressure in N/m (lbf/ft)
T_o : Tension leaving the bend in N (lbf)
r : Inside radius of conduit in m (ft)

The normal maximum sidewall pressure per meter (foot) of radius is as given below. However, in order to minimize cable damage because of excessive sidewall pressure, the installer should check the proper recommendations for each type of cables to be installed.

Cable Type	Maximum Sidewall Pressure	
	(N/m)	(lbf/ft)
Non-shielded multi-core cables	7300	500
Single-core cables	7300	500
Armoured cables	4400	300

Annex J: Cable Installation Practice

J.3.5 Installation of fire resistant cables

When installing cables that are required to maintain circuit integrity under fire conditions, the resistance to fire of the cable fixings, cable containment system and any joints should be at least equivalent to the survival time required for the cable.

Cables should be installed in accordance with the following recommendations.

a) Where fire-resistant cables have by their method of construction adequate mechanical protection (e.g. metallic armour), they should either be fixed directly to the building structure, or be installed such that they are enclosed in or carried upon cable management or containment systems (see item b). If the cables are fixed directly to the building, the fixings should provide adequate support in the presence of the potential hazards.

b) Where fire-resistant cables require additional mechanical protection, they should be enclosed in or carried upon cable management or containment systems. Such systems should provide adequate support and maintain necessary mechanical protection in the presence of the potential hazards. The supports should be oversized to cater for the reduction in the tensile strength of steel when exposed to the effects of fire.

c) Cable management or containment systems that are not used as a primary means of support or to provide necessary mechanical protection should not compromise the defined performance of the cables in the presence of the potential hazards.

d) Any glands used in the termination of fire-resistant cables into equipment should not compromise the defined performance of the cables in the presence of the potential hazards.

e) Joints should be avoided where possible and minimized in their use. Where conditions require that a joint has to be used, it should be of a type that has the same performance as the cable in the presence of the potential hazards.

f) Where practicable, the fire-resistant route should be arranged to be one of the upper tiers of the coordinated high level services.

NOTE 1 *When coordinating the route for the fire-resistant cables, it needs to be recognized that some of the other services, such as pipes ducts, busbars and other cable routes, are likely not to be designed to maintain their integrity under fire conditions and could collapse during a fire. The result of the collapse could be the overloading of the fire-resistant cable containment system, which itself could then fail.*

g) In order to maximize the integrity of the fire-resistant cable system, fire-resistant and non fire-resistant cable routes should be segregated.

Annex K: Coding Key

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18

The type designation provides information on the type of cable, the conductor material, the insulation and sheath materials, the no. of cores, and the principle design features in abbreviated and simpli ed form.

The type designation is made up of 18 digits or characters. The type of the conductor is speci ed rst and then the cable construction from inside to outside.

You can order our product either by giving the AES item code stated in the catalogue or if the required cable construction is not included in our catalogue, you can use the following codes to determine the type of cable you require.

1. Type of conductor material

C:	Copper
A:	Aluminum

2. Type of conductor

1 :	Solid
2 :	Stranded - Circular round
3 :	Stranded - Circular compacted
4 :	Stranded - Sector shaped
5 :	Flexible
6 :	Extra- exible

3 & 4. Size of conductor

08 :	1.5 mm^2
10 :	2.5 mm^2
12 :	4 mm^2
13 :	6 mm^2
14 :	10 mm^2
15 :	16 mm^2
16 :	25 mm^2
17 :	35 mm^2
18 :	50 mm^2
19 :	70 mm^2
32 :	3 x 10 + 6 mm^2
33 :	3 x 16 + 10 mm^2
34 :	3 x 25 + 16 mm^2
35 :	3 x 35 + 16 mm^2
36 :	3 x 50 + 25 mm^2
37 :	3 x 70 + 35 mm^2
38 :	3 x 95 + 50 mm^2
39 :	3 x 120 + 70 mm^2
40 :	3 x 150 + 70 mm^2
41 :	3 x 185 + 95 mm^2
42 :	3 x 240 + 120 mm^2
43 :	3 x 300 + 150 mm^2
44 :	3 x 400 + 185 mm^2
45 :	95 mm^2
46 :	120 mm^2
47 :	150 mm^2
48 :	185 mm^2
49 :	240 mm^2
50 :	300 mm^2
51 :	400 mm^2
52 :	500 mm^2
53 :	630 mm^2
54 :	800 mm^2
55 :	1000 mm^2

5. Type of insulation material

X:	XLPE Insulation
P :	PVC Insulation rated 70 °C
H :	PVC Insulation rated 85 °C

6. Rated voltage

A:	0.6 / 1 kV

7. Cable construction

1 :	Cores
2 :	Pairs

8 & 9. Number of cores

01 :	1 Core
02 :	2 Cores
03 :	3 Cores
04 :	4 Cores
05 :	5 Cores
≈	≈
37 :	37 Cores

10. Shielding

N:	Copper tape
C:	Copper wires
0 :	Without shielding

11. Armouring

0 :	Without armouring
L:	Pure lead sheathed
N:	Lead alloy sheathed
A:	Aluminum wire armoured
B:	Aluminum tape armoured
G:	Galvanized steel tape armoured
W:	Galvanized steel wire armoured
T:	Non-Galva. steel tape armoured
S:	Lead + G. steel tape armoured
D:	Lead + G. steel wire armoured
X:	Lead + Aluminum wire armoured
R:	Lead + Aluminum tape armoured

12. Outer sheath material

C:	PVC Sheath rated 80 °C
M:	PVC Sheath rated 90 °C
L:	LSHF Sheath rated 90 °C

13. Outer sheath color

B:	Black
R:	Red
E:	Grey
L:	Blue
N:	Brown
G:	Green
O:	Orange
M:	Green / Yellow

14 & 15. Core identification

51 :	1C - Red
01 :	2C - Red, Black
04 :	3C - Red, Yellow, Blue
08 :	4C - Red, Yellow, Blue, Black
12 :	5C - Red, Yellow, Blue, Black, G/Y
21 :	6C & Above - Black + No.

Note: The mentioned colors are the most common for core identification. However, any other colors for core identification can be used upon a customer's request.

16. Design standard

I:	IEC Standard
B:	BS Standard
C:	Customer request

17. Packing type

M:	Wooden drum
T:	Steel drum

18. Cutting length

S:	250 Meter
F:	500 Meter
R:	1000 Meter

Note: The mentioned cutting lengths are the most common. However, any other cutting lengths can be supplied as per a customer's drum schedule.

Annex L: Conversion Table

Multiply	By	To obtain
Weight-Imperial		
Ounces	28.3495	grams
Pounds(Av)	453.59	grams
Pounds(Av)	0.45359	Kilograms
Tons (short)	907.19	Kilograms
Tons (long)	1016.05	Kilograms
Weight-Metric		
Grams	0.03527	Ounces
Grams	0.002205	Pounds
Kilograms	35.274	Ounces
Kilograms	2.2046	Pounds
kilograms	0.001102	Tons (short)
Kilograms	0.0009842	Tons (long)
Miscellaneous-Imperial		
Pounds per 1000 feet	1.48816	kg/km
Pounds per mile	0.28185	kg/km
Pounds per square inch	0.0007031	kg. per square mm
Pounds per square inch	0.07031	kg. per square cm
Pounds per cubic	27.68	grams per cubic cm
Feet per second	18.288	meters per minute
Feet per second	1.09728	Kilometers per hour
Miles per hour	1.60935	Kilometers per hour
Ohms per 1000 feet	3.28083	Ohms per Kilometer
Ohms per mile	0.62137	Ohms per Kilometer
Decibels per 1000 feet	3.28083	Decibels per kilomter
Decibels per mile	0.62137	Decibels per kilomter
Decibels	0.1153	nepers
Miscellaneous-Metric		
kg/km	0.67197	Pounds per 1000 feet
kg/km	3.54795	Pounds per mile
kg.per square mm	1422.34	Pounds per square inch
kg.per square cm	14.2234	Pounds per square inch
Grams per cubic cm	0.03613	Pounds per cubic inch
Meters per minute	0.05468	Feet per second
Kilometers per hour	0.91134	Feet per second
Kilometer per hour	0.62137	Miles per hour
Ohms per Kilometer	0.3048	Ohms per 1000 feet
Ohms per Kilometer	1.6093	Ohms per mile
Decibels per kilomter	0.3048	Decibels per 1000 feet
Decibels per kilometer	1.6093	Decibels per mile
Temperature		
° Fahrenheit	5/9(°F)-32	°Celsius
°Celsius	9/5(°C)+32	°Fahrenheit
Lenght-Imperial		
Mils	0.001	inches
Mils	0.0254	mm
inches	1000	Mils
inches	25.40	mm
inches	2.54	cm
Feet	30.48	cm
Feet	0.3048	Meters
Feet (thousand of)	0.3048	kilometers
Yards	0.9144	Meters
Miles	1.6093	kilometers
Length-Metric		
Millimeters	39.37	Mils
Millimeters	0.03937	inches
Centimeters	0.3937	inches
Centimeters	0.032808	Feet
Meters	39.37	inches
Meters	3.2808	Feet
Meters	1.0936	Yards
Kilometers	3280.83	Feet
Kilometers	0.62137	Miles
Area-Imperial		
Square mils	1.2732	Circular mils
Square mils	0.000001	Square inches
Circular mils	0.7854	Square mils
Circular mils	0.0000007854	Square inches
Square mils	0.0005067	Square mm
Square inches	1000000	Square mils
Square inches	1273240	Circular mils
Square inches	645.16	Square mm
Square inches	6.4516	Square cm
Square feet	0.09290	Square meters
Square yards	0.8361	Square meters
Area-Metric		
Square millimeters	1973.52	Circular mils
Square millimeters	0.00155	Square inches
Square centimeters	0.155	Square inches
Square meters	10.7639	Square feet
Square meters	1.19599	Square yards
Volume-Imperial		
Cubic inches	16.38706	Cubic cm
Cubic feet	0.028317	Cubic meters
Gallons	4.54609	Liters
Volume-U.S.		
Quarts (liquid)	0.9463	Liters
Gallons	3.7854	Liters
Volume-Metric		
Cubic cm	0.06102	Cubic inches
Cubic meters	35.3145	Cubic feet
Liters	1.05668	quarts (liquid U.S)
Liters	0.26417	gallons (U.S.)

Certificates

Type Test Certificates (KEMA)

- Bare Copper Conductors
- Non-Armored Single- Core L.V Power Cable
- Non-Armored- Multi- Core L.V Power Cable
- Armored Multi- Core L.V Power Cable
- L.V Control Cable
- Fire Resistant and Low Smoke Halogen Free Power Cables Cat.(CWZ)

Quality Certificates

SASO

- For L.V Power Cable, Fire Resistant Cables and LSHF Cables

BASEC

- Certificate of Conformity, ISO 9001: 2008
- Product Certification License

Notes

Notes

Notes

Product Range

alfanar manufactures a wide range of low, medium and high voltage electrical products under 50 categories. Listed below is alfanar's comprehensive product classification:

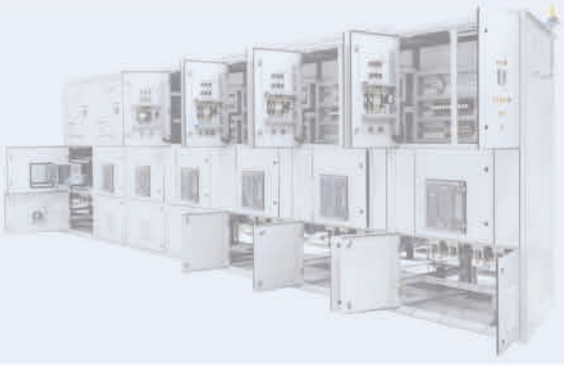
POWER & CONTROL

Low Voltage Products

- Load Center
- Circuit Breaker Enclosures
- Busbar Chamber
- Breakers

Low Voltage Systems

- Switch Boards – MF Type
- Distribution Boards – MB Type
- Motor Control Centres
- Capacitor Banks – Power Factor Correction Panels
- Automatic Transfer Switch (ATS Panels)
- Distribution Boards for Substations
- Synchronizing Panels
- Control & Automation Panels



Package & Unit Substations

- Indoor Package Substation
- Outdoor Package Substation
- Indoor Unit Substation
- Outdoor Unit Substation

Medium Voltage Systems

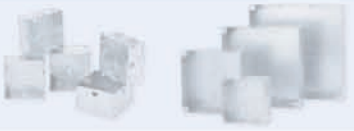
- Switchgear (Metal clad, Metal enclosed)
- Control gear
- Ring Main Unit (RMU)
- Retrofit solution

METAL ENCLOSURES

Metal Enclosures IP65
Modular Enclosures
Extendable Cubicles
Telephone Box

METAL ACCESSORIES

Switch Boxes
Junction Boxes



CABLES & WIRES

Building Wires

- American Standards (UL) Wires
- British Standards (BS) Wires
- International Electro-technical Commission Standards (IEC) Wires
- Low Smoke, Halogen Free Wires

Overhead conductors

- Bare Stranded Soft Drawn Copper Conductors (SDC)
- Bare Stranded Hard Drawn Copper Conductors (HDC)
- All Aluminum Conductors (AAC)
- All Aluminum Alloy Conductors (AAAC)
- Aluminum Conductors, Steel Reinforced (ACSR)
- Aluminum Conductors, Aluminum-Clad Steel Reinforced (ACSR / AW)
- Aluminum Conductors, Aluminum-Alloy Reinforced (ACAR)
- Weather Resistant XLPE Insulated Service Drop Cables

Power Cables

- Low Voltage Power & Control Cables
- Medium Voltage Power Cables
- High Voltage Power Cables
- Low Smoke, Halogen Free Cables
- Cables for Special Applications

Signal, Communication & Data Cables

- Telephone Cables
- Coaxial Cables (RG6 / U)
- Local Area Network Cables (LAN)

LIGHTING

- **Halogen**
- **Fluorescent**
- **Energy Saving**

WIRING ACCESSORIES (SWITCH & SOCKET)

- **Farah**
- **Omnia**
- **alf**
- **Mira**
- **Sidra**

COMMUNICATION SYSTEMS

- **Audio Intercom**

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