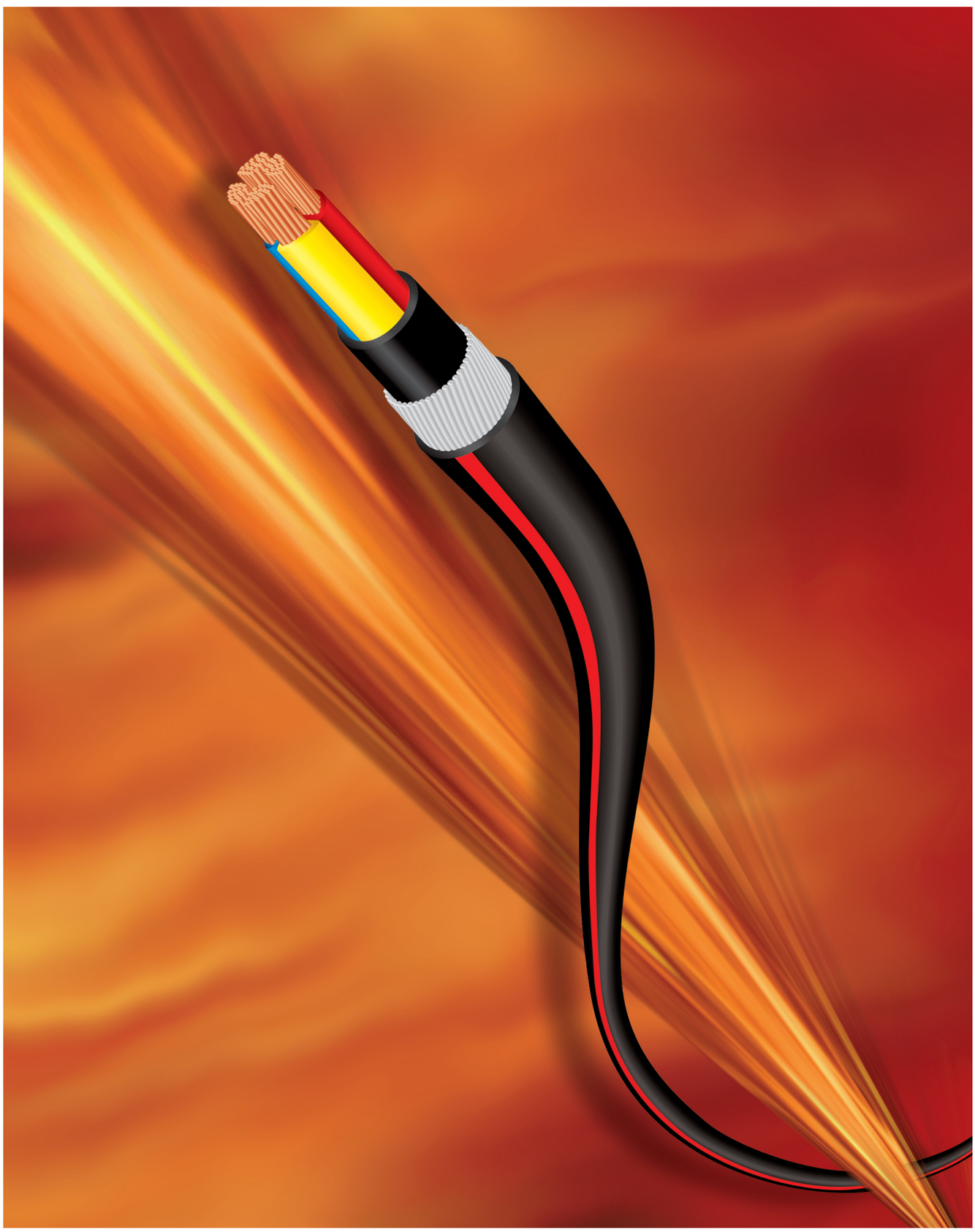
The Flamosafe Range

of fire performance electric cables

ABERDARE

A MEMBER OF HENGTONG GROUP

ENLIGHTENING THE FUTURE



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COMPANY PROFILE

Aberdare Cables is Southern Africa's largest cable manufacturer and leading supplier of intelligent energy inter connection cable products and services in Africa. Established in 1946, the company offers cable designs, product development, installation support, commissioning and diagnostic testing through their Aberdare Engineering division. In 2021, Aberdare Cables celebrated its 75th Anniversary and since its humble beginnings, the organisation has grown significantly through mergers and acquisitions. In 2016, Aberdare Cables was acquired by Hengtong as a majority shareholder. The Hengtong group operates in 147 countries, with 11 overseas manufacturing bases and owns 7 brands, including Aberdare.

Our Empowerment partner, Golden Consortium Africa (Pty) Ltd, is a 100% women-owned consortium and has a 25.1% shareholding in Aberdare (South African operations). Empowerdex ratings places Aberdare Cables at a Level 1 broad based black economic empowerment company and is 55% black owned with 30% black-women ownership.

Aberdare Cables has two manufacturing sites, Eastern Cape and KwaZulu-Natal. Aberdare Cables headquarters is in Meadowdale, Gauteng. The Meadowdale facility serves as a centralised distribution to South Africa to enable reduced lead times.

The company offers cable and cabling solutions to the mining, utility, building, construction, large industry, renewable energy, retail, original-equipment manufacturer, agriculture and transport sectors.

The company has amongst the most highly trained and experienced employees in the industry. As a technology leader, it is driven by cutting-edge Research and Development (R&D), providing world-class innovative solutions, processes, products and customer service.

The company's 48 000 m^2 Stanford road facility in Port Elizabeth was the original Aberdare site and manufactures XLPE medium and high voltage cables, paper insulated lead covered medium voltage cables, overhead conductors, medium voltage aerial bundled conductor (ABC) and large low voltage PVC mains cables.

The 38 820 m^2 Aberdare Pietermaritzburg facility manufactures low voltage ABC, Rubber trailing cables and Nitrile welding cables, as well as low voltage cables compromising of wiring cables: Housewire, Surfix®, Flat twin, and earth cables. The range also includes Armadac®, Airdac® and Saferdac® cables as well as the Flamosafe® range of PVC and XLPE insulated armoured and unarmoured cables.

The Aberdare Group's product range and services are wide but specialised. Tried and tested, and carrying the South African Bureau of Standards (SABS) safety and compliance certification marks and complying with International Standards as applicable.

In addition to the organisation's cable portfolio is the long awaited entry of a competitor into the South African high voltage cable market. This strategic move in capital investment by the company, enhances its current cable portfolio of low and medium voltage cables, conductors and specialty cables and is ensuring sustainability and an increase in the company's market presence. d in turn create a talent pool of future employees in our company.

Aberdare has opened the HV cable offering to initially supply the traditionally accepted (CSA) Corrugated Seamless Aluminum Sheathed cable and plans to add alternative designs and improvements to its portfolio. The goal for the HV project is to establish Abedare Cables as a competent South African high voltage cable manufacturer and solutions provider. To this end, the organisation manufactures HV cables and supplies HV accessories. The organisation will also commission and maintain HV cables (old and new) and install HV cables and all accessories. In addition, the company vision is that it will be accepted as a leading expert in HV systems (design of the system, providing add-ons such as DTS, etc.) The wholly owned company Aberdare Engineering fulfills the role as enabler of the HV Strategy.

As a cable manufacturer for over 76 years, we know that quality and reliability of cable systems and risk mitigation are of primary importance to our customers. For this reason, Aberdare's plan to enter the HV market was carefully considered, so as to uphold these standards and principals.

At Aberdare, we are people-centric and believe that our people are our greatest asset. We understand that an engaged workforce, delivers on our strategic goals and helps us achieve the impossible. We also understand what motivates our staff and we reciprocate with challenging but rewarding work; a wide range of opportunities for continuous individual learning and growth through robust incentive programmes, including career succession and progression. We know that our duty extends further to the greater population and we take pride in being an active agent of social change and transformation which is evident in our BEE Level 1 rating. Our ongoing socio-economic development initiatives have been commended by the Presidency and we are continuously working hard to make a difference in the communities in which we operate.

At Aberdare, education, training and development are seen as a foundation for economic productivity and as crucial tools to build empowered and dedicated employees. In this regard, our company actively promotes and follows a number of educational programmes, including adult education, apprentices, trainees, learnerships and formal education assistance.

Socio- Economic Development demonstrates the 'heart' of our company and through our efforts we strive to make a difference in the communities in which we operate. We believe that this can change the world one step at a time. We have always been an active supporter and pillar of strength for the communities in which we operate. Contributing to the national Socio-Economic Transformation agenda is also amongst our top priorities. Our company is therefore championing a number of social investment initiatives across our country.

We have recently launched AberSchool, which is a program that aims to raise the level of Maths and Science amongst some of the high schools in Pietermaritzburg. The project is aimed at partnering with the Department of Education to offer extra tuition to Grade 9, 10 and 11 pupils in English, Mathematics & Science.

The programme is geared towards developing future engineers and technically oriented individuals not only for the Aberdare workforce, but the greater country in general.

We provide an ongoing supply of equipment to the AberCare Centre, an organization based in Pietermaritzburg that provides a sense of self-sufficiency and pride to mentally and physically disabled people. The primary focus is to provide the physically challenged individuals with a workplace. The daily tasks they do are simple but they receive stimulation and therapy and contribute to the economy. Aberdare has been assisting the facility annually with the donation of appliances or any of their operational needs, as well as sponsoring annual Christmas events for the residents.

In addition, in 2021, Aberdare engaged the Mathematics Foundation of South Africa and initiated the My Maths Buddy project at the Fundokuhle High School in PMB. The purpose of the project was to get learners to understand that Maths is part of their lives and a much-needed subject for their future and to show learners that Maths is a language which has its own terminology. This is a unique approach that the My Maths Buddy project applies, which helps learners acquire a new approach to learning Maths. A maths dictionary containing important terminology is provided to each learner and assists them with understanding the subject if read and applied. Aberdare believes that Mathematics is a critical subject for future engineers and those pursuing technical degrees and will assist in developing and growing learners in these fields, and in turn create a talent pool of future employees in our company.

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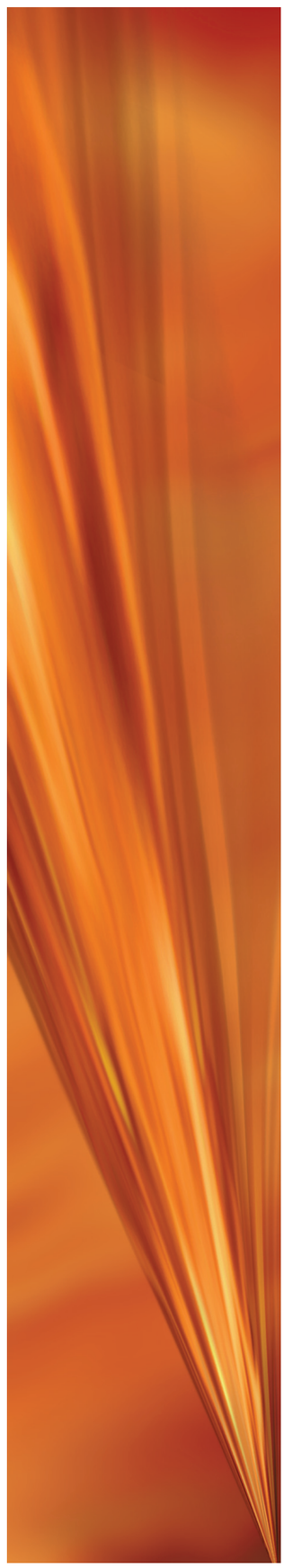

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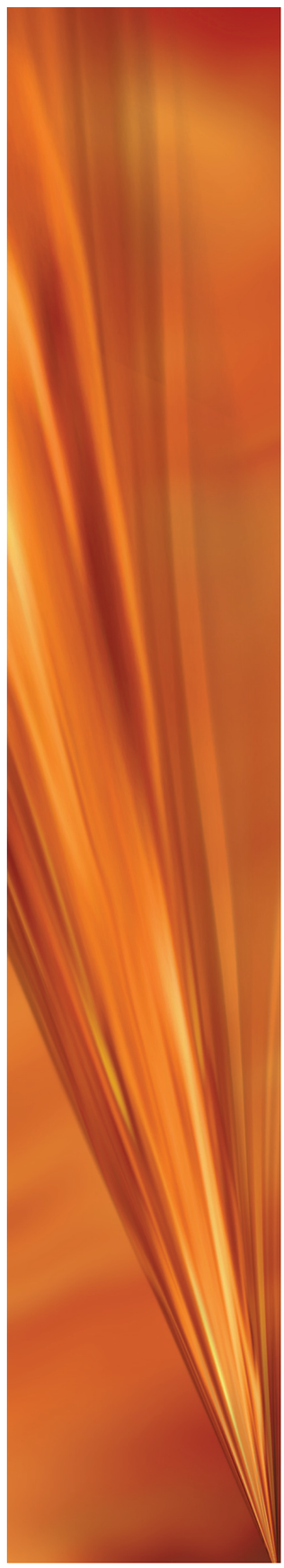


1. Cables in fire situations

The Flamosafe range of fire performance electric cables

FYRGARD®

Flame Retardant Cable

LOHAL®

Low Halogen Cable

LOTOX®

Halogen Free Cable

1.1 Introduction

Throughout the industrial world, all modern buildings, whether they be domestic, commercial or industrial, contain a large quantity of electric cable.

These cables provide energy, information and control and are distributed throughout the buildings in ducts, tunnels and in basement and ceiling cavities, linking every part of the building.

By their very nature therefore, electric cables are able to propagate fires along their length, and allow rapid spreading of a fire throughout the cable network and the associated buildings. In addition to the spread of fire, the generation of smoke may prevent the escape of persons trapped in a fire situation.

A further concern is that the smoke and gases liberated by the fire. contain toxic and corrosive elements, causing harm to both people and equipment.

Appropriate selection of a suitable cable type from the Aberdare Flamosafe range of specially designed fire situation cables, will minimise the extent of damage and reduce the dangers associated with fires.

This brochure provides guidelines to enable the selection of an appropriate cable type to address each of the four major areas of concern in fire situations i.e. flame propagation, generation of smoke, generation of toxic and corrosive gas and fire survival.

1.2 Fire Performance Optimisation

The four major concerns described in this brochure have been the subject of considerable national and international debate and research.

The solutions proposed, and the types of cables developed for each fire hazard, have been engineered to optimise the performance of the cable for that particular hazard.

It has been possible to improve flame retardancy, to reduce or even entirely eliminate the generation of hydrogen chloride and to reduce the evolution of smoke.

It has also been possible to engineer the selection of cable materials and the construction of the cable in order to maintain electrical circuit integrity while the cable is burning.

Unfortunately the optimisation process is a compromise, and enhancement of performance for any particular hazard is often accompanied by a decline in performance in other areas. Examples of this compromise are the mechanical performance (sheath tear strength and oil resistance) and the cable cost. Generally it can be said that the higher the performance of the cable materials the higher will be the financial cost.

As a result it is important to correctly evaluate the potential fire hazards, and select the appropriate cable type accordingly.

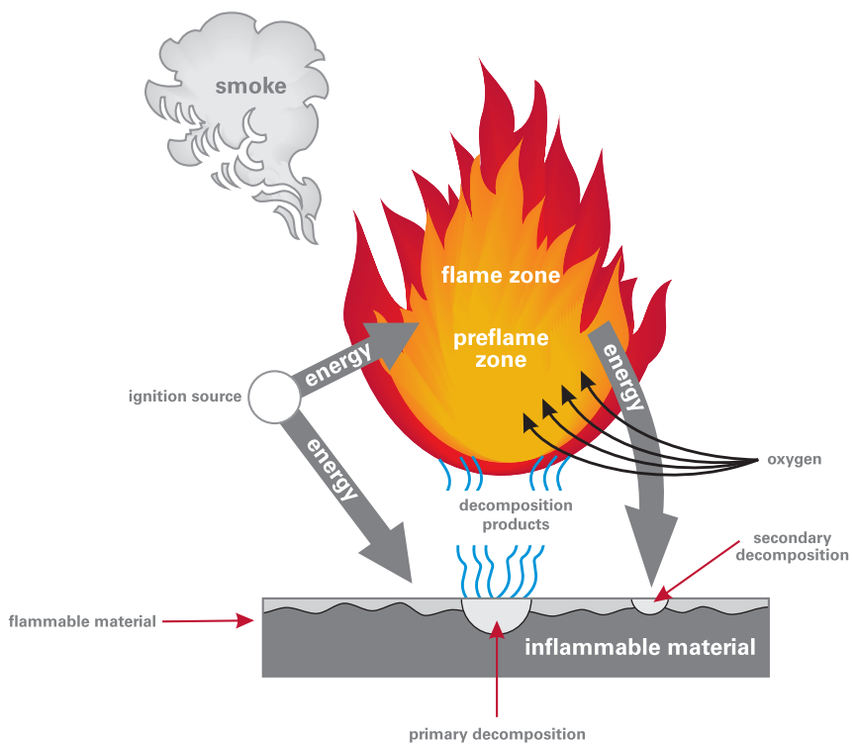
Installation details will further modify the fire performance aspects of a cable installation. For example the fire performance of cables installed on a vertical ladder would be different to the performance of the same cables installed on a horizontal ladder.

Protective intumescent coatings can further improve the performance.

1.3 Flame Propagation

Flammability describes the ability of a material or a combination of materials to catch and sustain fire. It is non-linear and multi-dimensional in nature, and in practice is very difficult to predict.

The flammability cycle can be represented as shown below:



Flame retardance is the property of a substance, or a treatment applied to a material, whereby the propagation of flame is markedly retarded. This is achieved by interfering with one or more of the processes of the flammability cycle in the following ways:

- **Condensed Phase:**
  Formation of carbonaceous char on the surface. This hampers the release of the by-products of the decomposition of the cable surface. Decomposition as a result of the application of heat is known as pyrolysis.

- **Vapour Phase:**
  Halogenated additives reduce the concentration of oxygen in the vicinity of the by-products of pyrolysis, as does the formation of non-flammable gases. Formation of free-radical quenchers will also slow down the reactions.

- **Heat Absorbing:**
  Certain chemicals containing water of hydration will on heating release the water, which on evaporating will absorb energy. Also intumescent coatings will absorb energy, reducing the energy available to continue the cycle.

1.4 Toxicity

All combustible materials release smoke and gases when burning. The gases consist of carbon monoxide, carbon dioxide, and other gases specific to the materials being burned.

When polyvinyl chloride (PVC) compound burns, a large quantity (± 30% by mass) of hydrogen chloride gas is released. This gas is highly toxic and can cause extensive injury to people trapped in such situations. (further details on page 31)

1.5 Corrosive Gas Emission

Hydrogen chloride gas is not only toxic, but it is also corrosive, and can cause extensive damage to machinery and to people trapped in fire situations. Machinery, electric and electronic equipment and any exposed metalwork may suffer corrosion as a result of exposure to hydrogen chloride.

The development of a special range of PVC compounds, the low halogen compounds, has partially overcome this problem by dramatically reducing the amount of hydrogen chloride gas liberated during combustion (typically < 15%). However, the only way to completely eliminate hydrogen chloride gas emission from burning cables is to remove all PVC from the cable construction.

Alternative materials that are free of chlorine are available, and in the case of insulation, polyethylene is a suitable substitute. While this material possesses excellent dielectric properties, its thermal properties are insufficient for use as power cable insulation. Cross linked polyethylene, or XLPE, provides enhanced mechanical and thermal properties, and allows the materials to be used as a non-halogenated insulation.

PVC bedding and outer sheathing material on an electric cable can be replaced by ethylene vinyl acetate (EVA), another material containing no halogen. This material is expensive and adds substantially to the selling price of the cable.

1.6 Smoke Emission

Smoke is an airborne mixture of heated gases, liquid droplets, and particles evolved during combustion. It causes opacity, it is toxic and facilitates heat transfer. Smoke obscuration is a potential killer in most fires, and this can be made worse as the smoke can accumulate remotely in areas that are far from fires. Smoke also attacks mucous membranes by the formation of acids.

Smoke can be chemically suppressed by the use of specific polymers, such as XLPE, which produce little smoke on burning. Smoke can also be reduced by the use of fillers or reactive additives, or even by the use of intumescent coatings.

2. Flamosafe® Cables

The Flamosafe range of fire performance electric cables

So far we have covered various dangerous aspects of fires, as well as the tests that simulate them. Real fires are impossible to simulate because of the unique and unpredictable nature of each fire, and cables for which enhanced fire performance is claimed, are therefore rated in accordance with standard and repeatable tests.

Aberdare has developed the FLAMOSAFE® range of low voltage fire performance cables that pass these tests. Seldom, however, is a cable required that is capable of passing only one such test. Rather, cables are required to pass a combination of tests in a hierarchy ranging from the least capable to the most. All cables in the FLAMOSAFE® range are at the very least fire (flame) retardant. More advanced cables address the problems of emission of toxic and acid gasses, and still more advanced cables address the problems of smoke emission. The top of the FLAMOSAFE® range, are cables capable of continuing to operate under defined fire and abuse, while still maintaining reliable circuit integrity.

The cables available in the FLAMOSAFE® range are FYRGARD®, LOHAL®, LOTOX® and FYRSURE®.

The fire characteristics that each cable type addresses are summarised in the following table:

Cable Type	ID Stripe (in South Africa)	Fire Characteristics*				
		Flame Retardancy	Toxicity	Corrosive Gas Emission	Smoke Emission	Circuit Integrity
FYRGARD	Red	Yes	Toxic	High	High	No
	Orange	Yes better than Red Stripe	Toxic	High	High	No
LOHAL	Blue	Yes	Low Toxicity	Mediocre	High	No
LOTOX	White	Yes	Non-Toxic	Low	Low	No
FYRSURE	None	Yes	Non-Toxic	Low	Low	Yes CWZ or equivalent
* As defined by the relevant test method						

In South Africa, where most of the Aberdare factories are located, fire performance cables covered by national specifications are identified by a colour stripe on the sheath as shown on the table. For cables used outside South Africa this can be changed to suit local requirements. In general the FLAMOSAFE® cables pass all the tests covered in this brochure in their specific categories.

3. Fyrgard® Cables

The Flamosafe range of fire performance electric cables

3.1 Purpose

The Aberdare FYRGARD® range of electric power, telecommunication and control cables, is specially designed to reduce the propagation of fire along the cable. Use of flame retardant PVC (FR) outer sheathing material provides a cost effective performance improvement.

FYRGARD® cable is designed to provide a cost effective solution for situations where reduced flame propagation is required, and it is therefore not intended to address other aspects of fire. This cable type should not be used in situations where reduced smoke, toxic gas, corrosive gas, or prolonged circuit integrity is required.

3.2 Specification

Conductors	Stranded copper, stranded or solid aluminium
Sizes	1,5 mm^2 to 1000 mm^2
Number of cores	1, 2, 3, 4, 5, 7, 19, 37*
Insulation materials	PVC or XLPE
Bedding material	Flame retardant PVC
Armour	Armoured or unarmoured, SWA or AWA*
Outer serving	Flame retardant PVC
Cables specification	IEC 60502, SANS 1507, BS 6346, BS 5467
Additional test methods (Flame propagation)	IE 60332-1, IEC 60332-3-24 SANS 60332-1, SANS 60332-3-24, SANS 6139 BS EN 60332-1, BS EN 50266-2-4

* As appropriate for conductor size and number of cores.

3.3 Application

FYRGARD® cable is designed to reduce the spread of fire along a cable tray or duct. The outer serving, and when required the bedding, of the cables is manufactured from a flame retardant grade of PVC. This cable is only slightly more expensive than general purpose cable, and may be widely used without incurring a prohibitive price penalty.

3.4 Key Marks

In South Africa FYRGARD® cable is identified by the presence of a red stripe or the letters FR embossed onto the sheath. Where the bedding is also flame retardant the sheath is marked with an orange stripe. The cable can also be marked in accordance with customer requirements.

FYRGARD® Multi-Core Cables

Electrical and Physical Properties

Description: Plain Annealed Copper Conductors, PVC or XLPE Insulation, PVC (FR) Bedding, Galvanised Steel Wire Armoured, PVC (FR) Sheath

Cable size	Electrical Properties										Physical Properties													
	PVC					XLPE					Nominal Overall Diameter						Approximate Mass							
	Current ratings		Imped-ance	Volt drop	Volt drop	Current ratings		Imped-ance	Volt drop	Volt drop	PVC			XLPE			PVC			XLPE				
	Ducts	Air		2 C	3 & 4 C	Ducts	Air		2 C	3 & 4 C	2 C	3 C	4 C	2 C	3 C	4 C	2 C	3 C	4 C	2 C	3 C	4 C		
(mm²)	(A)	(A)	(Ω/km)	(mV/A/m)	(mV/A/m)	(A)	(A)	(Ω/km)	(mV/A/m)	(mV/A/m)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(kg/km)	(kg/km)	(kg/km)	(kg/km)	(kg/km)	(kg/km)		
1.5	20	20	14.48	28.96	25.08	24	25	15.43	30.86	26.73	12.3	12.8	13.5	12.5	13.0	14.0	360	420	490	300	350	400		
2.5	26	26	8.87	17.74	15.36	32	33	9.45	18.90	16.37	13.6	14.1	15.0	13.6	14.1	15.0	480	530	600	350	400	450		
4	34	36	5.52	11.04	9.56	42	45	5.88	11.76	10.18	15.1	15.8	17.8	14.7	15.3	16.4	590	670	700	400	450	550		
6	43	45	3.69	7.38	6.39	52	56	3.93	7.86	6.81	16.5	18.0	19.2	15.9	16.6	18.7	710	810	940	500	550	800		
10	58	62	2.19	4.38	3.79	70	78	2.34	4.68	4.05	20.1	21.2	22.8	18.0	19.5	21.1	970	1100	1300	650	850	1050		
16	75	82	1.38	2.76	2.39	89	102	1.47	2.94	2.55	21.9	23.1	26.3	20.0	21.2	22.9	1200	1400	1900	750	1000	1250		
25	99	108	0.87	1.74	1.51	116	132	0.93	1.86	1.61	21.2	25.0	27.3	20.0	23.7	25.4	1365	1785	2165	1210	1615	1965		
35	119	131	0.63	1.26	1.09	139	161	0.67	1.34	1.16	22.8	26.6	29.8	22.1	25.3	27.7	1650	2165	2695	1500	1985	2450		
50	141	160	0.47	0.94	0.81	166	196	0.50	1.00	0.86	26.5	29.7	33.1	24.6	27.5	30.9	2115	2800	3730	1905	2520	3180		
70	172	200	0.33	0.66	0.57	202	244	0.35	0.70	0.60	28.8	33.9	37.9	27.4	31.2	36.2	2605	3740	4680	2425	3280	4375		
95	206	244	0.24	0.48	0.41	242	298	0.25	0.50	0.43	32.1	38.1	42.7	31.2	35.9	39.8	3525	4760	5995	3235	4385	5500		
120	234	281	0.20	0.40	0.34	276	345	0.21	0.42	0.36	34.6	40.6	46.1	33.9	38.8	44.9	4140	5610	7635	3840	5265	7135		
150	264	323	0.16	0.32	0.27	311	398	0.17	0.34	0.29	38.6	45.7	51.4	37.0	43.8	49.0	4945	7245	9155	4605	6785	8570		
185	297	369	0.14	0.28	0.24	351	456	0.15	0.30	0.25	42.0	49.8	56.0	41.8	47.8	53.6	6320	8605	10975	5905	8080	10240		
240	342	432	0.12	0.24	0.20	405	535	0.12	0.24	0.20	46.4	55.3	62.0	45.5	52.7	59.3	7695	10690	13605	7185	9965	12730		
300	384	492	0.10	0.20	0.17	454	609	0.10	0.20	0.17	51.6	60.2	68.7	49.6	57.4	65.5	9290	12830	16515	8640	12005	15430		
400	438	562	0.09	0.18	0.15	512	701	0.09	0.18	0.15	57.2	67.8	75.7	55.1	65.0	73.5	11705	16395	21805	10915	15415	20520		

Ambient air temperature = 30°C

Soil temperature = 25°C

Operating temperature : XLPE insulated = 90°C; PVC insulated = 70°C

FYRGARD® PVC Single-Core Armoured Cables

Electrical and Physical Properties

Description: Plain Annealed Copper Conductors, PVC Insulation, PVC (FR) Bedding, Aluminium Wire Armour, PVC (FR) Sheath

Cable Size	Electrical Properties						Physical Properties		
	Current Ratings (Trefoil, Touching)			Impedance	Volt Drop		Insulation Thickness	Nominal Overall Diameter	Approximate Mass
	Ground	Ducts	Air		1Φ	3Φ			
(mm²)	(A)	(A)	(A)	(Ω/km)	(mV/A/m)		(mm)	(mm)	(kg/km)
25	129	117	119	0.87	1.74	1.50	1.2	16.1	560
35	155	140	145	0.63	1.26	1.09	1.2	17.1	680
50	182	164	175	0.47	0.94	0.81	1.4	18.9	860
70	222	200	219	0.33	0.66	0.57	1.4	20.5	1130
95	264	237	269	0.25	0.50	0.43	1.6	23.7	1525
120	300	268	310	0.21	0.42	0.36	1.6	25.1	1780
150	334	298	352	0.18	0.36	0.31	1.8	26.9	2135
185	375	334	403	0.15	0.30	0.25	2.0	29.3	2580
240	431	382	475	0.13	0.26	0.22	2.2	32.3	3175
300	476	420	543	0.12	0.24	0.20	2.4	37.3	4125
400	529	465	619	0.11	0.22	0.19	2.6	40.9	5120
500	582	510	692	0.10	0.20	0.17	2.8	43.5	6190
630	624	543	778	0.09	0.18	0.15	2.8	51.8	8265

Ambient air temperature = 30°C

Soil temperature = 25°C

Operating temperature = 70°C

FYRGARD® XLPE Single-Core Armoured Cables

Electrical and Physical Properties

Description: Plain Annealed Copper Conductors, XLPE Insulation, PVC (FR) Bedding, Aluminium Wire Armour, PVC (FR) Sheath

Cable Size	Electrical Properties						Physical Properties		
	Current Ratings (Trefoil, Touching)			Impedance	Volt Drop		Insulation Thickness	Nominal Overall Diameter	Approximate Mass
	Ground	Ducts	Air		1Φ	3Φ			
(mm²)	(A)	(A)	(A)	(Ω/km)	(mV/A/m)		(mm)	(mm)	(kg/km)
25	154	139	150	0.93	1.86	1.61	0.9	16.0	530
35	183	166	183	0.67	1.34	1.16	0.9	17.2	655
50	216	195	220	0.50	1.00	0.86	1.0	18.6	805
70	263	237	275	0.35	0.70	0.60	1.1	20.2	1070
95	314	282	337	0.26	0.52	0.45	1.1	22.2	1355
120	354	317	389	0.22	0.44	0.38	1.2	24.6	1695
150	395	354	443	0.18	0.36	0.31	1.4	26.4	2030
185	444	397	508	0.16	0.32	0.27	1.6	28.7	2450
240	511	456	602	0.13	0.26	0.22	1.7	31.8	3010
300	565	502	689	0.12	0.24	0.20	1.8	36.6	3910
400	630	557	786	0.11	0.22	0.19	2.0	40.2	4870
500	695	613	882	0.10	0.20	0.17	2.2	42.8	5905
630	749	655	997	0.09	0.18	0.15	2.4	51.2	7950

Ambient air temperature = 30°C

Ground temperature = 25°C

Conductor operating temperature = 90°C

4. Lohal® Cables

The Flamosafe range of fire performance electric cables

4.1 Purpose

The Aberdare LOHAL® range of electric power, telecommunication and control cables, is specially designed to reduce the emission of corrosive halogen acid gas to below 15% during combustion. The range is also designed to reduce the propagation of fire along the cable. LOHAL® cable is designed to provide a cost effective solution for situations where both reduced flame propagation and low corrosive gas is required. This cable type does not eliminate corrosive gas and these cables should not be used in situations where no corrosive gas, reduced smoke emission, or prolonged circuit integrity is required.

4.2 Specification

Conductors	Stranded copper, stranded or solid aluminium
Sizes	1,5 mm^2 to 1000 mm^2
Number of cores	1, 2, 3, 4, 5, 7, 19, 37*
Insulation materials	PVC or XLPE
Bedding material	Flame retardant PVC
Armour	Armoured or unarmoured, SWA or AWA*
Outer serving	Flame retardant PVC
Cables specification	IEC 60502, SANS 1507, BS 6724, BS 5467
Test methods	IEC 60754-1, SANS 60754-1, SANS 5956 BS EN 50267-1 / BS EN 50267-2-1
Additional test methods (Flame propagation)	IE 60332-1, IEC 60332-3-24 SANS 60332-1, SANS 60332-3-24, SANS 6139 BS EN 60332-1, BS EN 50266-2-4

* As appropriate for conductor size and number of cores.

This cable type is not specifically tested for reduced toxicity, although it is clear that with the lowering of hydrogen chloride gas emission, toxicity is lowered.

4.3 Application

This cable type is intended for situations that require a cost effective reduction of halogen gas emission, as opposed to the elimination of all halogen gas.

4.4 Key Marks

LOHAL® cable is identified in South Africa by the presence of a longitudinal blue stripe or the letters LHFR embossed on the outer sheath. The cable can also be marked in accordance with customer requirements.

LOHAL® Multi-Core Cables

Electrical and Physical Properties

Description: Plain Annealed Copper Conductors, PVC or XLPE Insulation, PVC (FR LH) Bedding, Galvanised Steel Wire Armoured, PVC (FR LH) Sheath

Cable size	Electrical Properties										Physical Properties											
	PVC					XLPE					Nominal Overall Diameter						Approximate Mass					
	Current ratings		Imped-ance	Volt drop	Volt drop	Current ratings		Imped-ance	Volt drop	Volt drop	PVC			XLPE			PVC			XLPE		
	Ducts	Air	(Ω/km)	2 C	3 & 4 C	Ducts	Air	(Ω/km)	2 C	3 & 4 C	2 C	3 C	4 C	2 C	3 C	4 C	2 C	3 C	4 C	2 C	3 C	4 C
(mm²)	(A)	(A)		(mV/A/m)	(mV/A/m)	(A)	(A)		(mV/A/m)	(mV/A/m)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)	(kg/km)	(kg/km)	(kg/km)	(kg/km)	(kg/km)	(kg/km)
1.5	20	20	14.48	28.96	25.08	24	25	15.43	30.86	26.73	12.3	12.8	13.5	12.5	13.0	14.0	360	420	490	300	350	400
2.5	26	26	8.87	17.74	15.36	32	33	9.45	18.90	16.37	13.6	14.1	15.0	13.6	14.1	15.0	480	530	600	350	400	450
4	34	36	5.52	11.04	9.56	42	45	5.88	11.76	10.18	15.1	15.8	17.8	14.7	15.3	16.4	590	670	700	400	450	550
6	43	45	3.69	7.38	6.39	52	56	3.93	7.86	6.81	16.5	18.0	19.2	15.9	16.6	18.7	710	810	940	500	550	800
10	58	62	2.19	4.38	3.79	70	78	2.34	4.68	4.05	20.1	21.2	22.8	18.0	19.5	21.1	970	1100	1300	650	850	1050
16	75	82	1.38	2.76	2.39	89	102	1.47	2.94	2.55	21.9	23.1	26.3	20.0	21.2	22.9	1200	1400	1900	750	1000	1250
25	99	108	0.87	1.74	1.51	116	132	0.93	1.86	1.61	21.2	25.0	27.3	20.0	23.7	25.4	1340	1830	2195	1205	1675	2005
35	119	131	0.63	1.26	1.09	139	161	0.67	1.34	1.16	22.8	26.6	29.8	22.1	25.3	27.7	1605	2180	2710	1455	2010	2455
50	141	160	0.47	0.94	0.81	166	196	0.50	1.00	0.86	26.5	29.7	33.1	24.6	27.5	30.9	2140	2845	3495	1935	2565	3195
70	172	200	0.33	0.66	0.57	202	244	0.35	0.70	0.60	28.8	33.9	37.9	27.4	31.2	36.2	2650	3550	4720	2425	3305	4405
95	206	244	0.24	0.48	0.41	242	298	0.25	0.50	0.43	32.1	38.1	42.7	31.2	35.9	39.8	3310	4825	6035	3035	4425	5560
120	234	281	0.20	0.40	0.34	276	345	0.21	0.42	0.36	34.6	40.6	46.1	33.9	38.8	44.9	3940	5700	7220	3905	5285	6715
150	264	323	0.16	0.32	0.27	311	398	0.17	0.34	0.29	38.6	45.7	51.4	37.0	43.8	49.0	4970	6830	9255	4640	6405	8690
185	297	369	0.14	0.28	0.24	351	456	0.15	0.30	0.25	42.0	49.8	56.0	41.8	47.8	53.6	5900	8665	11025	5505	8165	10260
240	342	432	0.12	0.24	0.20	405	535	0.12	0.24	0.20	46.4	55.3	62.0	45.5	52.7	59.3	7295	10715	13660	7220	9990	12725
300	384	492	0.10	0.20	0.17	454	609	0.10	0.20	0.17	51.6	60.2	68.7	49.6	57.4	65.5	9240	12805	16580	8570	11995	15430
400	438	562	0.09	0.18	0.15	512	701	0.09	0.18	0.15	57.2	67.8	75.7	55.1	65.0	73.5	11650	16445	21625	10815	15415	19635

Ambient air temperature = 30°C

Soil temperature = 25°C

Operating temperature : XLPE insulated = 90°C; PVC insulated = 70°C

LOHAL® Single-Core Unarmoured Cables

Electrical and Physical Properties

Description: Plain Annealed Copper Conductors, Flame Retardant Cross Linked Non-Halogenated Insulation, 450/750 V

Cable size	Electrical Properties						Physical Properties		
	Current Ratings				Clipped Direct		Nominal Insulation Thickness	Nominal Overall Diameter	Approximate Mass
	Enclosed in conduit in thermally insulating wall		Enclosed in conduit on a wall or in trunking						
	2 Cables, Single Phase A.C. or D.C.	3 or 4 Cables, Three Phase A.C.	2 Cables, Single Phase A.C. or D.C.	3 or 4 Cables, Three Phase A.C.	2 Cables, Single Phase A.C. or D.C. Flat & Touching	3 or 4 Cables, Three Phase A.C. Flat & Touching or Trefoil			
(mm²)	(A)	(A)	(A)	(A)	(A)	(A)	(mm)	(mm)	(kg/km)
1.5	18	17	22	19	25	23	0.7	3.4	21
2.5	24	23	30	25	35	30	0.8	4.2	33
4	33	30	40	35	45	40	0.8	4.8	49
6	43	39	50	45	60	55	0.8	5.4	70
10	58	53	70	65	80	75	1.0	6.8	112
16	76	70	95	85	110	100	1.0	8.0	170
25	100	90	125	110	145	130	1.2	8.4	260
35	125	110	155	140	175	160	1.2	9.4	350
50	150	135	190	170	230	210	1.4	11.0	475
70	190	170	240	215	295	270	1.4	12.6	700
95	225	205	290	260	355	325	1.6	14.8	950
120	265	235	335	300	415	380	1.6	16.2	1180
150	300	270	375	325	475	435	1.8	18.0	1475
185	340	306	425	370	545	500	2.0	20.1	1830
240	400	358	500	435	645	590	2.2	23.1	2325
300	460	410	515	495	745	680	2.4	26.3	2960
400	-	-	685	585	870	795	2.6	29.5	3780
500	-	-	785	665	990	905	2.8	32.1	4735
630	-	-	900	765	1130	1030	2.8	38.6	6270

Ambient air temperature = 30°C

Conductor operating temperature = 90°C

LOHAL® PVC Single-Core Armoured Cables

Electrical and Physical Properties

Description: Plain Annealed Copper Conductors, PVC Insulation, PVC (FR LH) Bedding, Aluminium Wire Armour, PVC (FR LH) Sheath

Cable Size	Electrical Properties						Physical Properties		
	Current Ratings (Trefoil, Touching)			Impedance	Volt Drop		Insulation Thickness	Nominal Overall Diameter	Approximate Mass
	Ground	Ducts	Air		1Φ	3Φ			
(mm²)	(A)	(A)	(A)	(Ω/km)	(mV/A/m)		(mm)	(mm)	(kg/km)
25	129	117	119	0.87	1.74	1.50	1.2	16.1	565
35	155	140	145	0.63	1.26	1.09	1.2	17.1	685
50	182	164	175	0.47	0.94	0.81	1.4	18.9	865
70	222	200	219	0.33	0.66	0.57	1.4	20.5	1135
95	264	237	269	0.25	0.50	0.43	1.6	23.7	1535
120	300	268	310	0.21	0.42	0.36	1.6	25.1	1790
150	334	298	352	0.18	0.36	0.31	1.8	26.9	2145
185	375	334	403	0.15	0.30	0.25	2.0	29.3	2590
240	431	382	475	0.13	0.26	0.22	2.2	32.3	3190
300	476	420	543	0.12	0.24	0.20	2.4	37.3	4135
400	529	465	619	0.11	0.22	0.19	2.6	40.9	5150
500	582	510	692	0.10	0.20	0.17	2.8	43.5	6220
630	624	543	778	0.09	0.18	0.15	2.8	51.8	8285

Ambient air temperature = 30°C

Ground temperature = 25°C

Conductor operating temperature = 70°C

LOHAL® XLPE Single-Core Armoured Cables

Electrical and Physical Properties

Description: Plain Annealed Copper Conductors, XLPE Insulation, PVC (FR LH) Bedding, Aluminium Wire Armour, PVC (FR LH) Sheath

Cable Size	Electrical Properties						Physical Properties		
	Current Ratings (Trefoil, Touching)			Impedance	Volt Drop		Insulation Thickness	Nominal Overall Diameter	Approximate Mass
	Ground	Ducts	Air		1Φ	3Φ			
(mm²)	(A)	(A)	(A)	(Ω/km)	(mV/A/m)		(mm)	(mm)	(kg/km)
25	154	139	150	0.93	1.86	1.61	0.9	16.0	535
35	183	166	183	0.67	1.34	1.16	0.9	17.2	785
50	216	195	220	0.50	1.00	0.86	1.0	18.6	875
70	263	237	275	0.35	0.70	0.60	1.1	20.2	1075
95	314	282	337	0.26	0.52	0.45	1.1	22.2	1360
120	354	317	389	0.22	0.44	0.38	1.2	24.6	1700
150	395	354	443	0.18	0.36	0.31	1.4	26.4	2040
185	444	397	508	0.16	0.32	0.27	1.6	28.7	2460
240	511	456	602	0.13	0.26	0.22	1.7	31.8	3025
300	565	502	689	0.12	0.24	0.20	1.8	36.6	3920
400	630	557	786	0.11	0.22	0.19	2.0	40.2	4890
500	695	613	882	0.10	0.20	0.17	2.2	42.8	5925
630	749	655	997	0.09	0.18	0.15	2.4	51.5	7975

Ambient air temperature = 30°C

Ground temperature = 25°C

Conductor operating temperature = 90°C

5. Lotox® Cables

The Flamosafe range of fire performance electric cables

5.1 Purpose

The Aberdare LOTOX® range of electric power, telecommunication and control cables, is specially designed to eliminate the emission of corrosive halogen acid gas during combustion. As a spin off of the materials used, LOTOX® cable also emits little smoke during combustion, and reduces propagation of fire. This cable type should not be used in situations where prolonged circuit integrity is required.

5.2 Specification

Conductors	Stranded copper, stranded or solid aluminium
Sizes	1,5 mm^2 to 1000 mm^2
Number of cores	1, 2, 3, 4, 5, 7, 19, 37*
Insulation materials	XLPE
Bedding material	EVA
Armour	Armoured or unarmoured, SWA or AWA*
Outer serving	EVA
Cables specification	IEC 60502, SANS 1507, BS 7211, BS 6724, BS 6346, BS 5467
Test methods	IEC 60754-1, SANS 60754-1, SANS 5956 BS EN 50267-1 / BS EN 50267-2-1
Additional test methods (Flame propagation)	IEC 60332-1, IEC 60332-3-24 SANS 60332-1, SANS 60332-3-24, SANS 6139 BS EN 60332-1, BS EN 50266-2-4
Additional test methods (Reduced smoke)	IEC 61034, SANS 61034, SANS 6140, BS EN 61034

* As appropriate for conductor size and number of cores.

5.3 Application

LOTOX® cable is intended for situations where large numbers of people may be present, where people are confined due to limited access, where escape may be difficult, and where sensitive or expensive equipment is installed.

5.4 Key Marks

LOTOX® cable is identified in South Africa by the presence of a longitudinal white stripe or the letters NHLSFR embossed on the outer sheath. The cable can also be marked in accordance with customer requirements.

LOTOX® Multi-Core Cables

Electrical and Physical Properties

Description: Plain Annealed Copper Conductors, XLPE Insulation, EVA Bedding, Galvanised Steel Wire Armour, EVA Sheath

Cable Size	Electrical Properties					Physical Properties					
	Current Ratings		Impedance	Volt Drop	Volt Drop	Nominal Overall Diameter			Approximate Mass		
	Ducts	Air	(Ω/km)	2 C	3 & 4 C	2 C	3 C	4 C			
(mm²)	(A)	(A)		(mV/A/m)	(mV/A/m)	(mm)	(mm)	(mm)	(kg/km)	(kg/km)	(kg/km)
1.5	24	25	15.43	30.86	26.73	12.5	13.0	14.0	310	360	405
2.5	32	33	9.45	18.90	16.37	13.6	14.1	15.0	365	400	455
4	42	45	5.88	11.76	10.18	14.7	15.3	16.4	435	485	560
6	52	56	3.93	7.86	6.81	15.9	16.6	18.7	515	590	780
10	70	78	2.34	4.68	4.05	18.0	19.5	21.1	675	905	1055
16	89	102	1.47	2.94	2.55	20.0	21.2	22.9	1005	1190	1410
25	116	132	0.93	1.86	1.61	20.0	23.7	25.4	1195	1625	1950
35	139	161	0.67	1.34	1.16	22.1	25.3	27.7	1485	1965	2430
50	166	196	0.50	1.00	0.86	24.6	27.5	30.9	1890	2505	3155
70	202	244	0.35	0.70	0.60	27.4	31.2	36.2	2405	3255	4345
95	242	298	0.25	0.50	0.43	31.2	35.9	39.8	3215	4365	5470
120	276	345	0.21	0.42	0.36	33.9	38.8	44.9	3815	5235	7095
150	311	398	0.17	0.34	0.29	37.0	43.8	49.0	4575	6745	8525
185	351	456	0.15	0.30	0.25	41.8	47.8	53.6	5870	8030	10190
240	405	535	0.12	0.24	0.20	45.5	52.7	59.3	7145	9905	12665
300	454	609	0.10	0.20	0.17	49.6	57.4	65.5	8555	11975	15355
400	512	701	0.09	0.18	0.15	55.1	65.0	73.5	10855	15345	20405

Ambient air temperature = 30°C

Soil temperature = 25°C

Conductor operating temperature = 90°C

LOTOX® Single-Core Unarmoured Cables

Electrical and Physical Properties

Description: Plain Annealed Copper Conductors, XLPE Insulation, EVA Sheath

Cable Size	Electrical Properties						Physical Properties		
	Current Ratings				Clipped Direct		Nominal Insulation Thickness	Nominal Overall Diameter	Approximate Mass
	Enclosed in conduit in thermally insulating wall		Enclosed in conduit on a wall or in trunking						
	2 Cables, Single Phase A.C. or D.C.	3 or 4 Cables, Three Phase A.C.	2 Cables, Single Phase A.C. or D.C.	3 or 4 Cables, Three Phase A.C.	2 Cables, Single Phase A.C. or D.C. Flat & Touching	3 or 4 Cables, Three Phase A.C. Flat & Touching or Trefoil			
(mm^2)	(A)	(A)	(A)	(A)	(A)	(A)	(mm)	(mm)	(kg/km)
1.5	18	17	22	19	25	23	0.7	5.2	40
2.5	24	23	30	25	35	30	0.7	5.6	50
4	33	30	40	35	45	40	0.7	6.4	75
6	43	39	50	45	60	55	0.7	7.1	95
10	58	53	70	65	80	75	0.7	8.1	135
16	76	70	95	85	110	100	0.7	9.2	195
25	100	90	125	110	145	130	0.9	11.4	300
35	125	110	155	140	175	160	0.9	12.8	400

Ambient air temperature = 30°C

Conductor operating temperature = 90°C

LOTOX® Single-Core Armoured Cables

Electrical and Physical Properties

Description: Plain Annealed Copper Conductors, XLPE Insulation, EVA Sheath

Cable Size	Electrical Properties						Physical Properties		
	Current Ratings (Trefoil, Touching)			Impedance	Volt Drop		Insulation Thickness	Nominal Overall Diameter	Approximate Mass
	Ground	Ducts	Air		1Φ	3Φ			
(mm²)	(A)	(A)	(A)	(Ω/km)	(mV/A/m)		(mm)	(mm)	(kg/km)
25	153	139	149	0.93	1.86	1.61	1.0	15.7	525
35	182	165	181	0.67	1.34	1.16	1.0	16.7	640
50	215	194	217	0.50	1.00	0.86	1.0	17.9	780
70	262	236	273	0.35	0.70	0.60	1.1	19.7	1055
95	313	281	334	0.26	0.52	0.45	1.1	21.7	1340
120	354	318	386	0.21	0.42	0.36	1.2	23.3	1610
150	395	354	440	0.18	0.36	0.31	1.4	25.7	1990
185	443	396	505	0.16	0.32	0.27	1.6	28.1	2405
240	511	455	598	0.13	0.26	0.22	1.7	30.9	2935
300	572	508	689	0.12	0.24	0.20	1.8	34.2	3655
400	630	558	784	0.11	0.22	0.19	2.0	38.9	4725
500	693	611	880	0.10	0.20	0.17	2.2	42.2	5840
630	765	670	1010	0.09	0.18	0.15	2.4	48.8	7550

Ambient air temperature = 30°C

Ground temperature = 25°C

Conductor operating temperature = 90°C

6. Common Tests

The Flamosafe range of fire performance electric cables

Numerous standards exist worldwide covering various tests that address the five fields of fire performance covered so far. Many of these tests owe their origins to common standards, or are simply copies or overwrites of other standards. As a result the methods frequently do not vary much from standard to standard. In this brochure we include general details of tests that address each field of fire performance.

The following table lists the standards tests, by field, addessed by the FLAMOSAFE® range of cables:

Test	Standards
Flame Propagation	IEC 60332 SANS 60332 SANS 6139 BS EN 50265 BS EN 50266
Corrosive Gas Emission	IEC 60754 SANS 60754 SANS 5956 BS EN 50267
Smoke Emission	IEC 61034 SANS 61034 SANS 6140 BS EN 61034
Toxicity	NES 713

The following pages give details of each field of fire performance tests. We have expanded on the circuit integrity tests to include details of the fire alone, fire with water and fire with mechanical shock tests.

6.1 Flame Propagation Tests

General

The test for flame propagation differs little from standard to standard. In each case a sample is mounted vertically and subjected to a standard flame for a defined time. The sample is either a single cable, or a bunched collection of cables that meet the combustible material volume requirements for a particular category. In the case of the single cable, the test is carried out in a laboratory using fairly standard equipment. In the case of the bunched cables, a far more elaborate test rig is required with a burn chamber 1 m wide by 2 m long by 4 m high.

In all the tests covered here the categories used for the bunched cables tests are the same (see the table on page 26). A cable is rated for a particular category when it passes the test with sufficient cables mounted together in the test chamber to ensure that the volume of combustible material per linear metre corresponds to that quoted for the category.

In each case after a specified time, or after the cable has extinguished itself naturally, the length of the damage including the char is measured. In order to pass the test, this char may only extend a defined length.

StandardTests

IEC 60332: Tests on electric cables under fire conditions. In Parts 1 and 2 this standard covers 1 kW "bunsen burner type" tests on single vertical cables, and in Part 3 covers larger scale 20 kW tests on bunched vertical cables. Part 3 has been split into different Sections, the first covering the apparatus and the others each covering a specific category.

SANS 60332: Overwrite of IEC 60332. This standard is revised from time to time in accordance with the IEC specification.

SANS 6139: Resistance of cables and cords to flame propagation: Bunched cables and cords. This standard is similar to an older version of Part 3 of the IEC standard.

BS EN 50265: Common test methods for cables under fire conditions. Test for resistance to vertical flame propagation for a single insulated conductor or cable. This standard replaces BS 4066 Parts 1 and 2, which have been withdrawn.

BS EN 50266: Common test methods for cables under fire conditions. Test for vertical flame spread of vertically mounted bunched wires or cables. This standards replaces BS 4066 Part 3, which has been withdrawn.

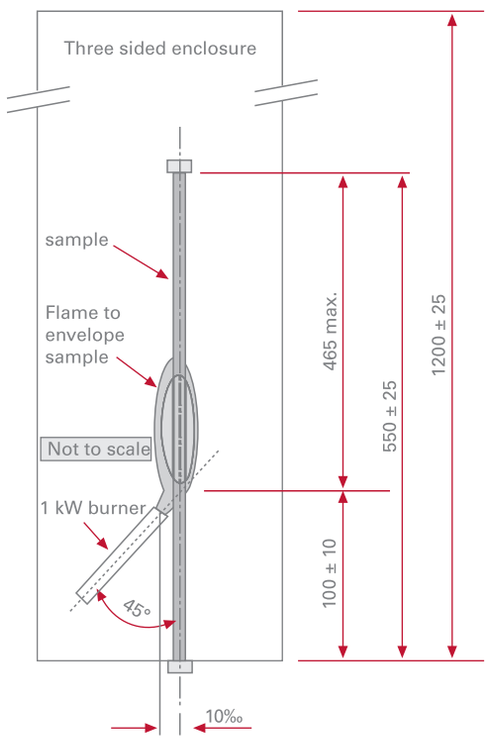
The following table shows the categories covered by each standard.

Specifications, Parts and Sections (1)					Category	Type (2)	Volume (2)	Burner	Burn Time	Char Lenght
IEC 60332	SANS 60332	SANS 6139	BS EN 50265	BS EN 50266			l/m			m
Part 1	Part 1	--	Part 1	-	Single	A		1 kW	> 1	0,5 (4)
Part 1	Part 1	-	Part 2-1	-		P				
Part 2	Part 2	-	Part 1	-	Small Single	A		1 kW	~20s (4)	0,5 (4)
Part 2	Part 2	-	Part 2-2	-		P				
Part 3-10	Part 3	included	-	Part 1	Bunched	A	-	20 kW	-	2,5
Part 3-21	Part 3	-	-	Part 2-1	A F/R	P	7,0 l/m		40 minutes	
Part 3-22	Part 3	included	-	Part 2-2	A	P	7,0 l/m		40 minutes	
Part 3-23	Part 3	included	-	Part 2-3	B	P	3,5 l/m		40 minutes	
Part 3-24	Part 3	included	-	Part 2-4	C	P	1,5 l/m		40 minutes	
Part 3-25	Part 3	-	-	Part 2-5	D	P	0,5 l/m		40 minutes	

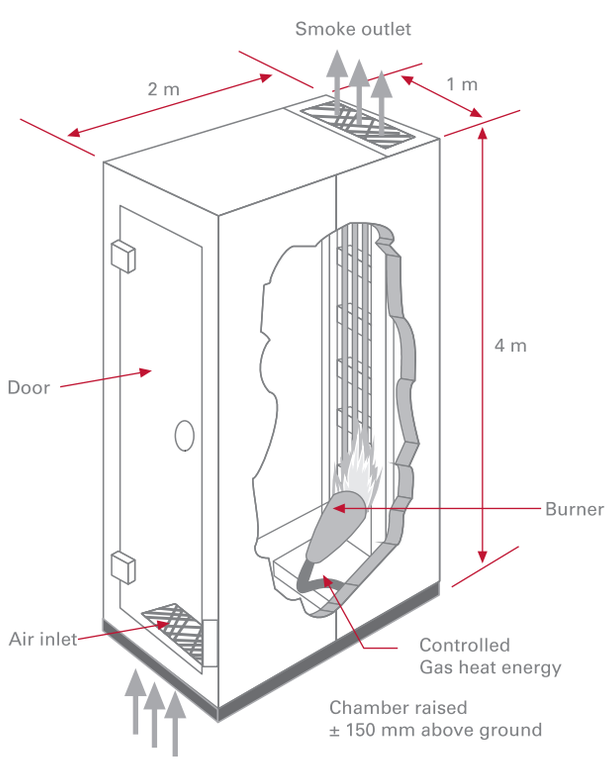
Notes:

1. Accurate at date of publication. Most specifications are being modified.
2. Type A - apparatus. Type P - procedure
3. Volume of combustible material per linear metre of the test setup.
4. For information only - refer to specification for details

Arrangement for 1 kW burner tests (Measurement in mm)



Enclosure used for 20 kW burner tests



6.2 Corrosive Gas Emission Tests

General

These tests are performed on the materials that make up a cable to determine the quantity of corrosive halogen acid gas (HCl) given off when the material is burned completely. The standards described here all cover two tests, one for materials that release more than 0,5 mg/g of HCl, and those that release less. For both tests a special controlled furnace is require that will heat up samples in a tube. Air is fed in one side of the tube and the resulting gasses are drawn off the other. These gasses are then bubbled through two or three wash bottles, and the amount of halogen gas that dissolved in the water is measured.

In the case of the test where the amount of gas released is greater than 0,5 mg/g, the actual amount of HCl is measured by titration. Where the amount of HCl is smaller than this figure, the amount is determined by measuring the pH and conductivity of the water in the wash bottles.

In South Africa, cables made from materials that release less than 15 mg/g of HCl , as measured by the first test, are classified as low halogen. For a cable to be regarded as halogen free the pH of water in the wash bottles must be greater than 4,3 and the conductivity must be less than 10m S/mm. (as determined by the 2nd test)

Standard Tests

IEC 60754: "Tests on gasses evolved during combustion of materials from cables." Part 1 covers the method using titration, while Part 2 covers the method requiring the measurement of pH and conductivity. In the case of the latter there are two methods for arriving at the results, one quick and the other more elaborate.

SANS 60754: An overwrite of IEC 60754. This standard is revised from time to time in accordance with the IEC specification.

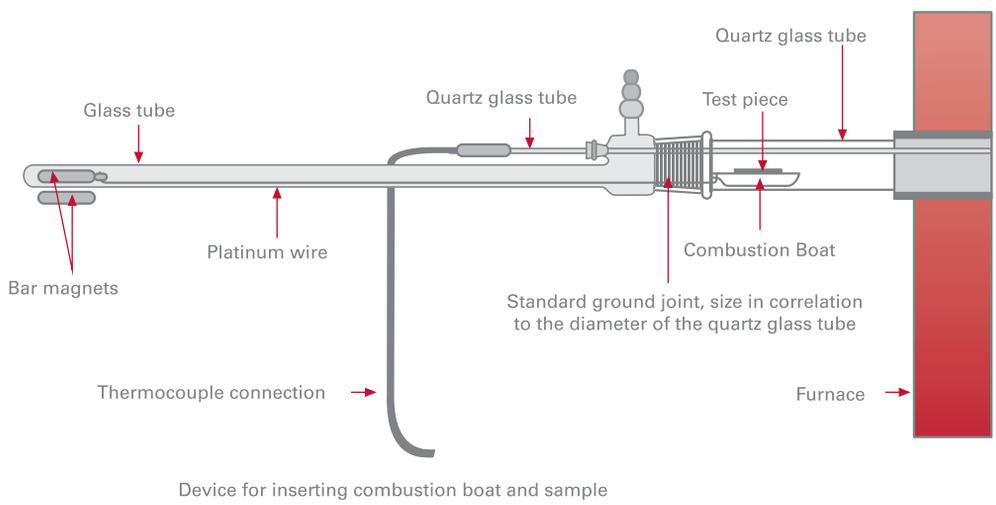
SANS 5956: This standard is similar to the IEC standard. The two different methods are covered as methods A and B.

BS EN 50267: This standard replaces the older BS 6425, which has been withdrawn. It has been split into two parts, with Part 1 covering the apparatus and Part 2 the procedures. Part 2 has been further divided into three sections, the first covering the titration method. The second covers the determination of the pH and conductivity using the quick method and the third does the same using the more elaborate method.

Typical Test Apparatus

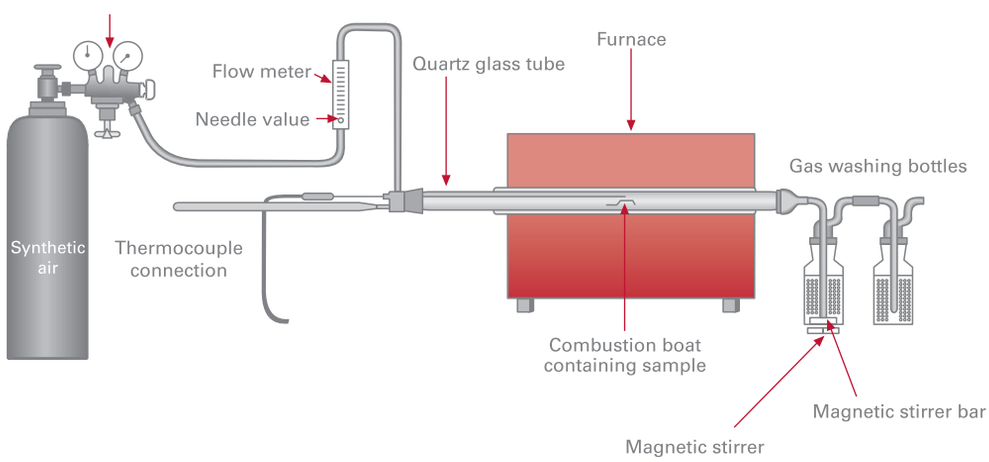
The Flamosafe range of fire performance electric cables

Synthetic air filtered and dried



The above shows the recommended arrangement for inserting the test piece in the furnace. Once the test equipment has been set up correctly the test piece is inserted using the bar magnets shown on the right, ensuring that the interior of the test rig is not exposed to the laboratory atmosphere. The small grey tube depicted inside the furnace is for a thermocouple.

Pressure reducing value



A schematic diagram of the complete test rig. The "synthetic air" may also be dried and filtered laboratory air. Once the test piece has been thoroughly burned, the inside of the furnace pipe and all the other pipes are rinsed with distilled water, which is then added to the water from the wash bottles. The total volume collected is then made up to a standard volume using more distilled water, and the resultant solution is ready for analysis.

6.3 Smoke Emission Tests

General

Cables are burned in a standard 3 m cubic enclosure and assessed on the quantity of smoke emitted. In order to avoid introducing smoke from other sources, the cable sample is clamped over an alcohol flame. The atmosphere is controlled within the enclosure to ensure standardisation and repeatability.

In order to assess the smoke, a beam of light is shone across the cube and the light received on the far side is measured. The test continues until either there is no decrease in light transmission over a 5 minute period, or 40 minutes has lapsed after ignition of the alcohol. The light transmitted through the smoke (*It*) must remain above a specified minimum, or alternatively the standard absorbance (*A*0) must remain below a specified maximum.

The light transmitted is related to the standard absorbance by the following equation:

$$A_0 = \frac{V}{n \cdot l} \cdot \log_{10}\left(\frac{l_0}{l_t}\right)$$

Where:
- A_0 = Standard absorbance
- V = Test chamber volume, m³
- n = Number of test pieces in the sample
- l = Length of the light path, m
- l_0 = Initial transmittance
- l_t = Measured transmittance

Standard Tests

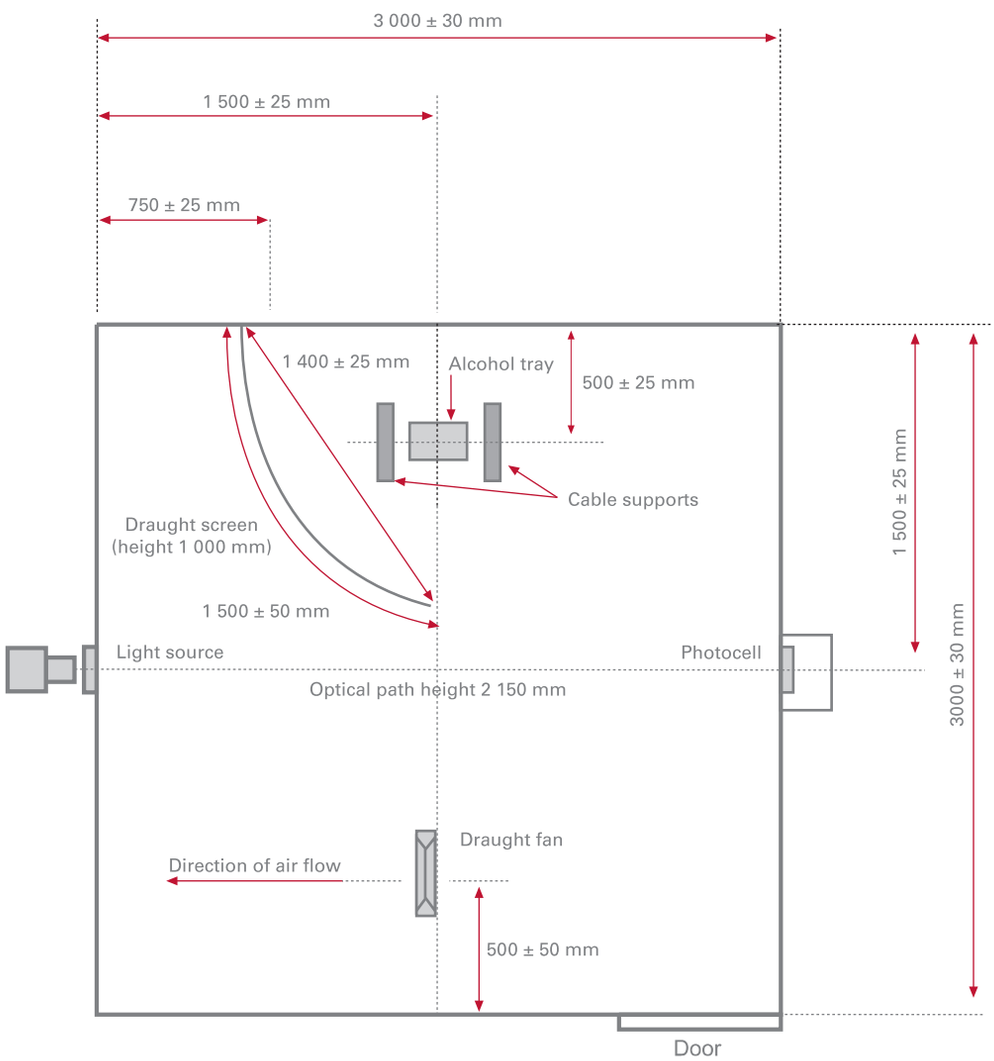
IEC 61034: "Measurement of smoke density of electric cables burning under defined conditions." Part 1 covers the apparatus while Part 2 covers the procedure. It is noted that the criteria for passing should be given by the relevant cable standard, but the recommendation is that the light transmittance should not be less than 60%.

SANS 61034: An overwrite of IEC 61034. This standard is revised from time to time in accordance with the IEC specification.

SANS 6140: This standard was based on BS 6724, which includes a test method for smoke density measurement. The test determines the figure for standard absorbance, and gives figures that should not be exceeded.

BS EN 61034: This standard is similar to IEC 61034 and replaces BS 7622, which has been withdrawn. Part 1 covers the apparatus, while Part 2 covers the procedure. The criteria for passing should be given by the relevant cable standard, but failing this the recommendation is that the light transmittance should not be less than 60%.

Plan of a typical smoke chamber.



The height of the chamber is 3 000 ± 30 mm. The door has an inspection window as well as a shutter to exclude all outside light from the chamber during the measurements.

6.4 Toxicity Tests

The test used for the FLAMOSAFE® range is the British naval engineering standard NES 713, for determining the toxicity index of small specimens of materials.

The apparatus consists of a test chamber of specified volume having a hinged or sliding access door.

A test specimen is supported in the chamber over a burner placed at the centre of the test chamber . A fan ensures the mixing of products of combustion with the air in the chamber. These conditions should be maintained for 1 minute after which the burner is extinguished.

Samples of the atmosphere from the test chamber are analysed to determine the quantity of specified gases. The concentration of each gas is then adjusted to the value, in parts per million, that would be given off if 100 g of the original cable sample was burnt to completion in 1 m^3 of air.

The toxicity index is calculated by summating the fractions of the concentration calculated to the lethal dose for each gas.

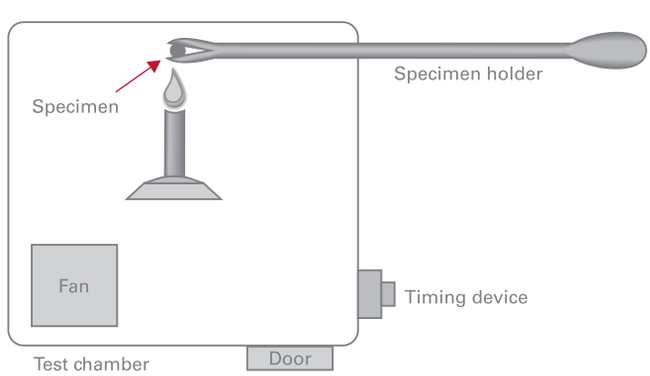
The lethal doses in parts per million of various gasses is as follows:

Carbon Dioxide	100 000
Carbon Monoxide	4 000
Hydrogen Sulphide	750
Ammonia	750
Formaldehyde	500
Hydrogen Chloride	500
Acrylonitrile	400
Sulphur Dioxide	400
Nitrogen Oxides	250
Hydrogen Cyanide	150
Hydrogen Bromide	150
Hydrogen Fluoride	100

$$\text{Toxicity Index} = TI = \sum_{n=1}^{N} \frac{C_n}{C_{fn}}$$

Where
TI = Toxicity Index. (A TI of 1 equates to a fatality in 30 minutes.)
n = Reference for each gas detected.
C_n = Concentration in ppm for gas n, as calculated above.
C_{fn} = Lethal concentration for gas n in ppm, as given in above table.

Test chamber layout



Product Range
Our Services are Wide but Specialised

The Aberdare Group's product range and services are wide but specialised. Tried and tested and carrying South African Bureau of Standards (SABS) marks and complying with International Standards, we stand by our products.

Medium Voltage XLPE Cables (6.6 kV to 33 kV)
- Individually Screened
- Copper or Aluminium Conductors up to 300 mm² (3 core) & 1000 mm² (Single Core)

Paper Insulated Cables (6.6 kV to 33 kV)
- Screened or belted
- Fully impregnated, general purpose, heavy duty or drained
- Copper or Aluminium conductors up to 400 mm² (3 core) & 1000 mm² (single core)

High Voltage XLPE Insulated Cables (44 kV to 132 kV)
- Corrugated seamless Aluminium (CSA Sheath)
- Copper or aluminium conductors up to 1000 mm² (single core)

Elastomeric Cables (300/500 V to 19/33 kV)
- Flexible Cable (Types HO5 RN-F,HO7 RN-F)
- General Welding Cable
- Mining Trailing Cable (Up to 33 kV)

Overhead Aluminium Conductors
- AAC (All Aluminium Conductors)
- AAAC (All Aluminium Alloy Conductors)
- ACSR (Aluminium Conductor Steel Reinforced)
- Hard Drawn Copper

General Wire Insulated & Bare Copper Wire (300/500 V & 600/1000 V)
- Surfix Cable
- Flat Twin and Earth Cable
- Cabtyre Cable
- Submersible Pump Cable
- Audio cord (Ripcord)
- Welding cable
- Panel Flex Cable
- Illumination Cable
- PVC Nitrile Panel Cable
- Nitrile Trailing Cable
- Bare Copper
- Single Core PVC 1 kV Cable
- Single Core XLPE PVC 3.3 kV Cable

Low Voltage Armoured Cables (600/1000 V & 1.9/3.3 kV)
- Bells and Mains Cable
- Multicore Cable
- Single Core Cable

Electrodac Cables (600/1000 V)
- Aerial Bundle Conductor (ABC) (LV & MV)
- Airdac SNE Cable
- Airdac CNE Cable
- SaferDac CNE and SNE Cables

Intermediate Voltage Cables (1.9/3.3 kV)
- Armadac Cable
- Farmadac Cable

Specialised Cables
- Solar PV Cable (1.5/1.5 kV)

Theft Prevention Technology
- Unique Cable and Conductor Marking

NOTICE TO THE USER OF ELECTRIC CABLE PRODUCTS MANUFACTURED BY ABERDARE CABLES:

- **"WARNING: Electrical equipment (including cable) and installations which form part of a facility, whether fixed, mobile or moveable are by nature inherently dangerous when energized with electrical power as contact with un-insulated or damaged components of such a facility may result in injury, loss of life and damage to property. Only qualified persons should attend to the installation of such electrical equipment, the maintenance thereof, and the repair of any faulty facilities which have an electrical component."**

- Selection and Installation of the product must be carried out as per the applicable compulsory specifications by appropriately qualified persons and certified by a competent person so authorized by law prior to being put into service. All fixed electrical Low Voltage installations must have a valid Certificate of Compliance (COC)

- Low voltage electrical installations up to 600/1000 V must conform to the compulsory specification SANS 10142-1 "The Wiring of Premises Part 1: Low voltage installations"

- SA Legislation determines that the User or Lessor is responsible for the safety of the electrical installation.

- All Medium Voltage installations above 1 kV must conform to the specification SANS 10198 "The Selection, Handling and installation of electric power cables of rating not exceeding 33 kV", and where applicable SABS 10142-2 "The wiring of premises Part 2: Medium voltage installations above 1 kV a.c. and not exceeding 22kV a.c. and up to and including 3 000 kW installed capacity".

- The following Compulsory Safety Standards are applicable to Electric Cables manufactured, imported and used in South Africa and no product may be used which does not comply to the applicable standard:

  - (VC 8075) SANS 1507: Electric Cables with solid dielectric insulation for fixed installations (300/500 V to 1900/3300 V)
  - (VC 8077) SANS 1339: Electric Cables Cross linked Polyethylene (XLPE) insulated cables for rated voltages 3,8/6,6 kV to 19/33 kV
  - (VC 8077) SANS 97: Electric Cables Impregnated paper insulated metal sheathed cables for rated voltages 3,3/3,3 kV to 19/33 kV
  - (VC8006) SANS 1574: Electric Flexible Cables with solid dielectric insulation.

- All cables manufactured to a compulsory safety standard must be clearly marked with the applicable SANS standard number as well as the Manufacturer's name.

- Aberdare Cables manufactures all Electric Cables made to Compulsory standards under the SABS Mark scheme. Products manufactured under the SABS mark scheme carries the wording "SABS" to show that the manufacturer is a licensed Mark Holder. The SABS Mark gives the user the assurance that the South African Bureau of Standards monitors the quality of the products which carries this mark and verifies the quality system used by Aberdare Cables to manufacture these products, on an ongoing basis.

- Compulsory specifications (VC's) may be downloaded for free from the SABS website **www.sabs.co.za.**

- The user of electric cable products has the right to take up any issue of concern with the National Regulator of Compulsory Specifications at +27(0)12 428 5000

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