Fixed power & control cables

CAFCA

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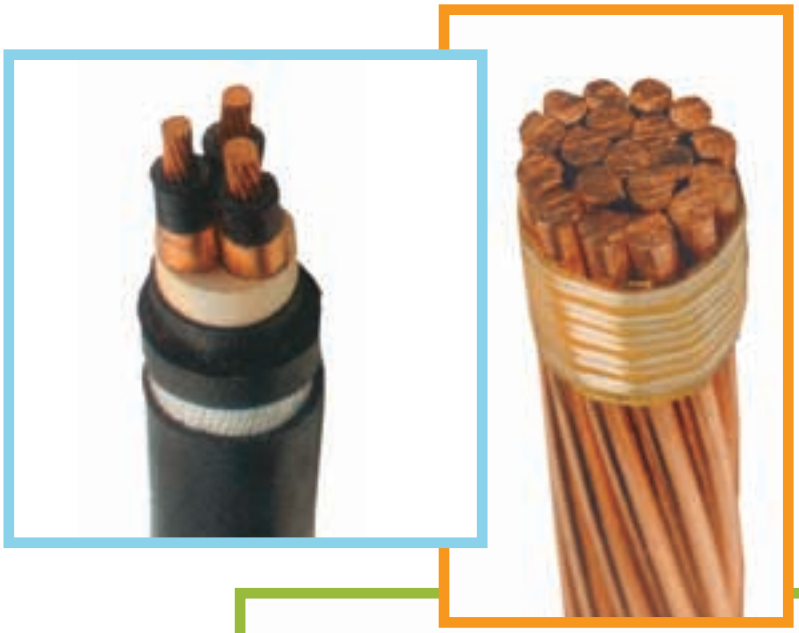
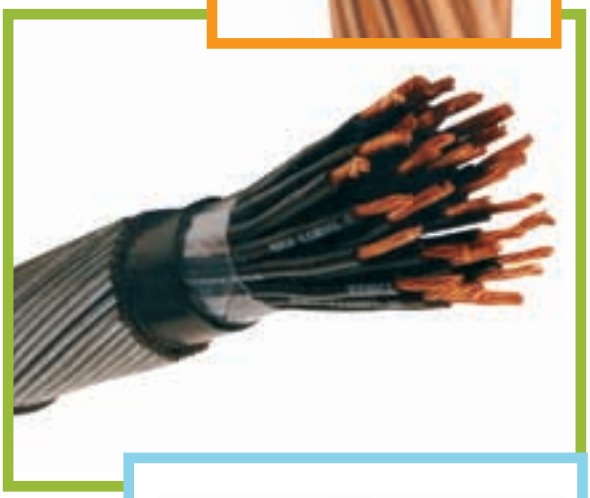




Attention to quality is one of the reasons for our continued success.
At all levels we put our best endeavours into achieving product performance, safety and reliability. We monitor, control, document and regularly review all company activities from design, through to production, inspection and under regular review.
We hold quality systems and product approvals from a number of authorities both national and international.

CORPORATE

CAFCA is the only cable manufacturer in Zimbabwe. It was established in 1947 and is listed on the Zimbabwe, Johannesburg and London stock exchanges. CAFCA is part of CBI Electric African Cables (RSA), which in turn is owned by Reunert Limited (RSA). It has been at the forefront of the cable industry in the region for more than 60 years, supplying large volumes of cable to power and telecommunication utilities as well as the mining, agricultural and industrial sectors.

PRODUCTS & MARKETS

CAFCA manufactures and supplies cable and allied products for the transmission and distribution of electrical energy and information primarily in Southern and Central Africa. We manufacture over nine hundred cabling products including 11kV XLPE cables.

CAFCA offers a toll manufacturing option to all its customers who can access key raw materials such as copper and aluminium, which are converted at cost plus value added. We are engaged in toll manufacturing for the South African cable market through CBI Electric African Cables.

CAFCA also recovers decommissioned cables for recycling within a legal and environmentally friendly framework. Recovered cables can be exchanged for other products within our manufacturing range.

MANUFACTURING

STANDARDS

Standards Association of Zimbabwe (SAZ)
SAZ 240-Electrical cables with extruded solid dielectric 300/500V, 1900/3300V
South African National Standards (SANS, formerly SABS)
SANS 1507-PVC distribution cable rated 300/500V and 1900/3300V
SANS 1418-2 aerial bundled conductor
SANS 1339-XLPE insulated cable rated 3.8/6.6kV and 19/33kV

British Standards (BS)
BS 215 Part 1:1970 – Specification for aluminium conductors

International Electro-technical Commission (IEC)
IEC 502-Extruded solid dielectric insulated power cables 1kV and 30kV

South African Post Office (SAPO)
BS 215 Part 1:1970 – Specification for aluminium conductors

British Post Office (BPO)
BPO CW 1127 – Aerial distribution telephone cable (self-supporting)
BPO CW 1128 – Jelly-filled cellular polyethylene telephone cable

Post & Telecommunications (PTC)
Underground cables and aerial distribution copper cables
We also make product to customer's own specification.

QUALITY MANAGEMENT STANDARDS

Accredited to ISO 9001: 2000
(First company to gain accreditation in Zimbabwe: year 1999)

ENVIRONMENT MANAGEMENT STANDARDS

Accredited to ISO 9002:2000
(Design and manufacture)
(First cable company in sub-Saharan Africa to achieve the international quality standard.)

Accredited to ISO 14001:2004
(First company to gain accreditation in Zimbabwe: year 1999)

OCCUPATIONAL HEALTH AND SAFETY STANDARD

Accredited to OHSAS 18,001:2007

MILESTONES

CAFCA was the first company in Zimbabwe to achieve ISO 9002 accreditation, later upgraded to ISO 9001:2000, which enables us to design as well as produce cabling to international standards

In 1999 CAFCA became the first cable company in sub-Saharan Africa to be awarded the environmental standard, ISO 14,001:2004.

Zimbabwe Electricity Supply Authority annual supply contracts
- Low voltage armoured cables: 1985-98, 2000-03
- All aluminium conductor: 1988-99, 2001-03
- Aluminium conductor steel reinforced 1988-99, 2001-03

Anglo American Corporation annual supply contract 1985-2000

BHP annual supply contract 1996-1999

Botswana Power Corporation
- Split concentric annual supply contract 2000-2004

Botswana Ministry of Health
- Annual supply of low smoke and fume white stripe cables 2002-2004

African Cables (South Africa)
- Monthly delivery of 600/1000V red stripe to SANS 1507 2003 specifications to date

Confederation of Zimbabwe Industries (CZI)
- Industrial Exporter of the Year 1st Runner up 2005

Product group
Bare copper conductor, solid or stranded

Salient features and applications
Available as either hard drawn or annealed for equipment and circuit earthing or sold out to enamellers for motor and transformer and motor wire.

Product group
Flexible cords (cabtyre) and welding cables

Salient features and applications
Flexible cords for connecting portable equipment and for use in internal wiring.

Product group
Auto and instrument wire

Salient features and applications
Bunched fine wire conductors insulated for use as auto or instrument wire.

Product group
Indoor switchboard cable

Salient features and applications
Telephone cable for wiring distribution boards and switchboards.

Product group
Single cores

Salient features and applications
Colour coded and used in internal wiring of fixtures.

Product group
Armoured cables

Salient features and applications
Available from 1.5mm2 to 300mm2, 2 – 4 cores and in the 0.6/1kV and 3.3kV ranges. Other options available are flame retardant, low-tox or zerotox to meet various safety considerations in the case of a fire.

Product group
Jumper and blasting wire

ent features and applications
sted pair or triple PVC insulated ductors for electronic panel ng or for use as blasting wire.

Product group
Underground petroleum jelly-filled cables

Salient features and applications
Cross-linked polyethylene insulated communication cables with petroleum jelly as an agent against moisture ingress.

Product range

Product group
Aluminium conductors (with or without steel reinforcement)
AAC and ACSR

Salient features and applications
Overhead conductor for HT and LV power transmission and distribution.

Product group
Coaxial cable

Salient features and applications
Radio frequency cables, available in the 50 and 75 ohm specifications

Product group
Aerial distribution cable

Salient features and applications
Overhead conductor for HT and LV power transmission and distribution.
Self-supporting overhead telephone service cable (polythene insulated)

Product group
Aerial bundled conductor

Salient features and applications
Twisted and insulated overhead aluminium conductor for overhead distribution

Product group
Medium voltage XLPE cables

Salient features and applications
XLPE insulated cable rated up to 11kV for underground power distribution networks.

Product group
Multi-core cables

Salient features and applications
Cables for control, panel wiring and signalling.

Product group
14.4mm copper rod

Salient features and applications
For equipment earthing or further drawing down to smaller wire for various applications.

OTHER PRODUCTS IN OUR RANGE

Aerial distribution cable – Self-supporting (with caternary wire) overhead service cable, polyethylene insulated.
Coaxial cables – Radio frequency cables available in the 50 and 75 ohm specifications.
Aerial bundled conductor – Twisted and insulated aluminium conductor for overhead power distribution.
Copper rod – We convert copper cathode into 14.4 mm copper rod.

Fixed power and control cables

Conductors

The conductors in CAFCA's fixed power and control cables are made of high conductivity copper to SANS 1411 or high-purity aluminium to BS 6360 – "Conductors in insulated cables and cords specifications".

Dependent upon the actual cable type, they may be of stranded or solid copper or aluminium. Smaller sizes are circular in profile, larger conductors being shaped or lightly compacted to reduce their physical size.

Insulation

According to its particular standard specification a cable will be insulated with either: Flame Retardant Polyvinyl Chloride (FR PVC) or XLPE (cross-linked polyethylene). FR PVC is a clean, easy to handle material with good electrical characteristics and reasonable resistance to a range of possible contaminants such as water, oils and chemicals. It is inherently flame-retardant and is suitable for a PVC FR maximum continuous conductor operating temperature of 70°C.

XPLE matches all these attributes but goes a stage or two further. The good attributes of polyethylene are retained but at high temperatures the toughness and physical properties are improved. In particular there is greatly-enhanced resistance to deformation.

Having superior thermal and mechanical properties compared with FR PVC, XLPE also has higher insulation resistance, enabling its thickness to be reduced, leading to a corresponding reduction in the overall diameter and weight of a finished cable.

The main comparative consideration, however, is that XLPE permits the operating temperature of cables to be raised substantially without suffering thermal deformation or degradation.

The continuous current ratings of XPLE insulated cables are based upon a maximum conductor temperature of 90°C as opposed to 70°C for PVC insulated types.

Short-circuit ratings are also higher, XLPE accepting 250°C as a final conductor temperature at the end of a short circuit compared with 140/160°C for PVC insulated cables. As a result, in situations where conductor sizes are governed by current rating rather than voltage drop, it may be possible to use a smaller conductor size.

CAFCA also produces cables with an oversheath of LSF (low smoke and fume) for installation where fire and its associated problems – the emission of smoke and toxic fumes – offer a serious threat to human life. A coloured stripe on the oversheath acts as a distinguishing mark to indicate the type of materials used in relation to the smoke and fire nerves of the cable. Stripe colours coding are as tabulated below. (Table 2).

Core identification

Cores are identified durably and distinctly by colouring or numbering the insulation.

a) Colour coding:
Where colour coding is used, the colours are as given in Table 2.

b) Numbering: Where numbers are used, the markings are a contrasting colour to that of the insulation.

Table 2. Core insulation colour coding

XLPE, PVC and LSF cables have coloured cores for cable up to 3.3kV

1	2	3	4
Number of phase cores	**Colour(s) of phase cores**	**Colour of neutral core**	**Colour of earthing core (if present and not bare)**
One	red	black	green/yellow
Two	red and yellow	black	green/yellow
Three	red, yellow and blue	black	green/yellow
Four or more	Any base colour except green, with serial numbers (numerals or words)	Number as for phase core	green/yellow

Bedding

A layer of taped or extruded FR PVC around the core assembly separates the heart of the core from – and provides a secure bedding for – the metallic armour. In the range of fire performance cables to SANS 1507 a special LSF (low smoke and fume) compound is used.

Armour

Steel wire armour is necessary to guard against mechanical damage to the cable.

Steel wire armour consists of galvanised steel wires applied spirally over the bedding and may, where necessary, include tinned copper wires to increase the conductance. Alternatively, armour may take the form of of spirally applied wires, strips of aluminium, or tapes of steel.

Single core cables for ac systems are never provided with steel armour because of its effect in increasing the losses. Where necessary, however, we can provide suitable protection, including non-magnetic aluminium wire.

	Type of compound used			
Stripe colour	Insulation	Bedding	Sheath	Smoke and fire emissions
Red	FR PVC	FR PVC	FR PVC	High
Blue	FR PVC	LHC	LHC	Mild
White	XLPE	LSF	LSF	Nil

NOTE Control cables have uniquely coloured or numbered cores or both

Sheath

CAFCA also produces cables with an over-sheath of LSF for insulation where fire and its associated hazards - emission of toxic fumes - offer a serious threat to human life. A colour stripe on the over sheath acts as a distinguishing mark to indicate the type of material used in relation to the smoke and fume hazard of the cable in case of fire.

Sheath damage

Care should be taken to ensure that the oversheath is not damaged during installation. This is especially important where steel armour is used since increase of moisture could lead to corrosion and ultimate loss of earth continuity.

Current ratings

The maximum sustained current (ac) for copper and aluminium conductor cables given in this publication is based on SAZ Wiring Rules, SAZ 400 and/or calculated by agreed formulae and methods in IEC 60287 Part 2.

Voltage drop

Voltage drop is normally only of importance for cables of voltage rating of 600/1000V or below. If the installation is to be in compliance with Regulation 525-01 of the 16th edition of the IEE Regulations, it is stipulated that: "the voltage drop within the installation does not exceed a value appropriate to the safe functioning of the associated equipment in normal service. For final circuits protected by an overcurrent protective device having a normal current not exceeding 100A, this requirement is deemed to be satisfied if the drop in the voltage from the original of the circuit does not exceed 2.5 per cent of the normal voltage of the current design, disregarding starting conditions."
Note: Diversity can be taken into account when calculating voltage drop.

Since the actual power factor of the load is often now known, the most practical approach to the question of voltage drop is to assume the worst conditions, i.e. where the phase angle of the load is equal to that of the cable. The voltage drop values in the tables have been based on this assumption. For conductor sizes up to and including 120mm^2 the figures provided apply with sufficient accuracy where the power factor lies between 0.6 lagging and 1.0, and for larger cables where the power factor of the load does not exceed 0.8 lagging. Where the phase angles of the loads fall outside this range, the voltage drop deducted from the tables may be unduly conservative and more exact methods of calculation should be employed.

In those cases where the actual current differs greatly from the tabulated current rating, the results obtained from the tables are only approximate; for a more accurate assessment, allowance should be made for the change in conductor resistance with operating temperature.

It should be ensured that the cable size ultimately selected is capable of carrying the required current under the site conditions of installation.

Values of voltage drop are tabulated for a current of one ampere for a 1 metre run, i.e. for a distance of 1 metre along the route taken by the cables, and represent the effect of the voltage drop in all the circuit conductors. For balanced three phase ac circuits, the values relate to the line voltage. For any given run the values need to be multiplied by the length of the run (in metres) and by the current (in amperes) that the cables are to carry.

Example:
Consider a route of 200 metres of three core wire armoured cable to be installed in air, and to carry 100 amperes per phase load, the supply voltage being 415V, three phases 50Hz.

Using the tables:

Let Vd be the voltage drop in volts.

$$\frac{Vd = mV \times I \times L}{1000} \quad \text{or} \quad mV = \frac{Vd \times 1000}{I \times L}$$

Where I = current in amperes (per phase)
L = route length in metres
mV = approximate volt drop/ampere/metre

Maximum permissible volt drop = 2.5 per cent of 415V
= 10.4V

Substitute for current, route length and maximum permissible volt drop.
then mV = $\frac{10.4 \times 1000}{100 \times 200} = 0.52mV$

Select a cable from the relevant Current Rating Table such that the "mV value" from the voltage drop column is equal to or less than the 0.52 mV calculated, ensuring that it will carry the current.

It will be seen that this value is 0.42, giving a cable size of 95mm^2.

Environment

All the cables described in this publication can be used indoors or outdoors but some reservations are necessary concerning cables without metal sheaths for direct burial e.g. (i) Unarmoured cables are not recommended for laying direct in the ground;

(ii) Cables for laying direct in the ground, particularly in sustained wet conditions, should have extended bedding,

(iii) For installations where there is direct waterlogging or where it is likely to occur advice should be obtained from our technical department.

It may be desirable to recommend an alternative type of cable.

Temperature

To avoid risk of damage during handling, cables should only be installed when both they and the ambient temperatures are above 0°C and have been so kept for 24 hours or when special precautions have been taken to maintain the cable above this temperature. It should be noted that even at 0°C there can be some damage to bitumen servings, and it is preferable that the cable is at a higher temperature. LSF compound is more flexible than PVC at low temperatures thus allowing the cable to be installed at temperatures down to –10°C.

Minimum installation bending radius

Although cables to SAZ 1507 and IEC 502 are designed to have a certain flexibility, it is necessary that the bending (and any subsequent straightening) be done slowly and carefully. The radii bending given in table C.1 (measured on the inside of the bent cable) represents recommended minimum values and should be exceeded wherever possible.

Table C.1: Recommended minimum installation bending radii

1	2	3	4
Construction of cable	**Cable diameter D, mm**		**Minimum installation bending radius**
	Exceeding	**Not exceeding**	
Insulated only	-	10	3D
Insulated only	10	25	4D
Insulated only	25	40	6D
Insulated only	40	-	8D
Sheathed only	-	-	8D
Armoured	-	-	10D
Lead sheath	-	-	15D

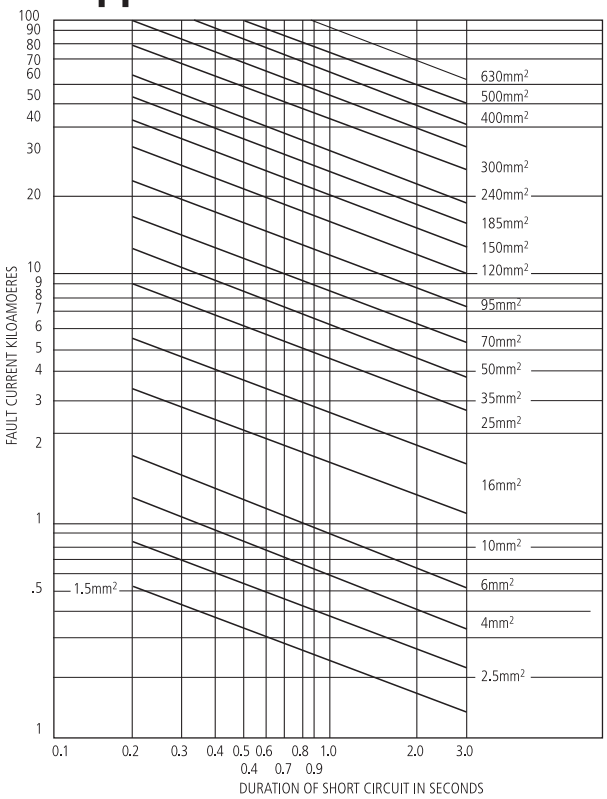
XLPE insulated cables

The values of fault current given in the graph are based on the cable being fully loaded at the start of the short circuit (conductor temperature 90ºC) and a final conductor temperature of 250ºC. It should be ensured that the accessories associated with the cables are also capable of operation at these values of fault current and temperature.

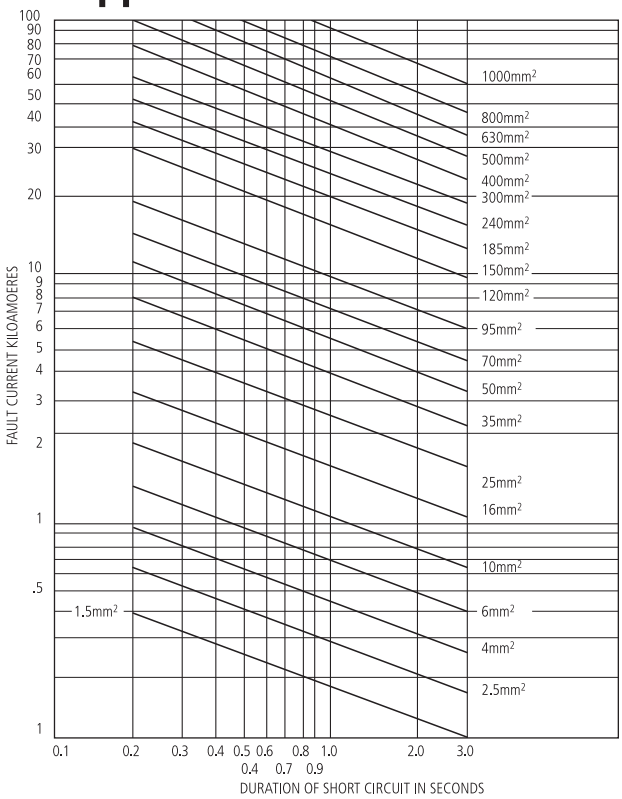
PVC insulated cables

The values of fault current given in the graph are based on the cable being fully loaded at the start of the short circuit (conductor temperature 70ºC) and a final conductor temperature of 160ºC for conductor sizes up to and including 300mm^2, and 140ºC for conductor sizes above 300mm^2.

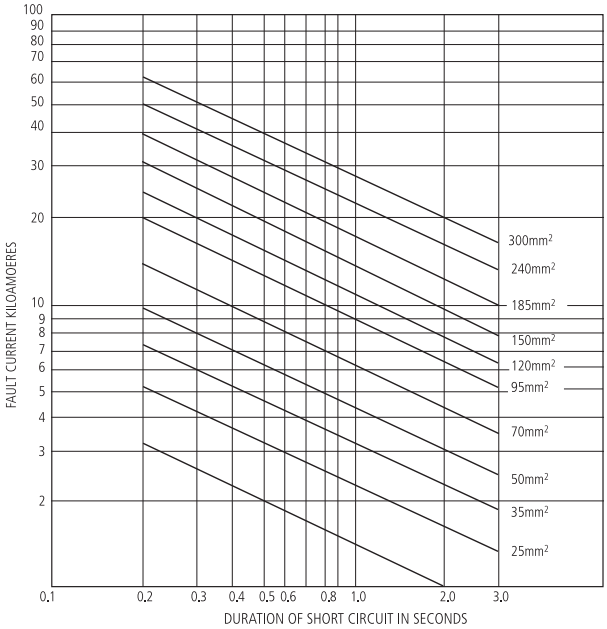
Copper conductors



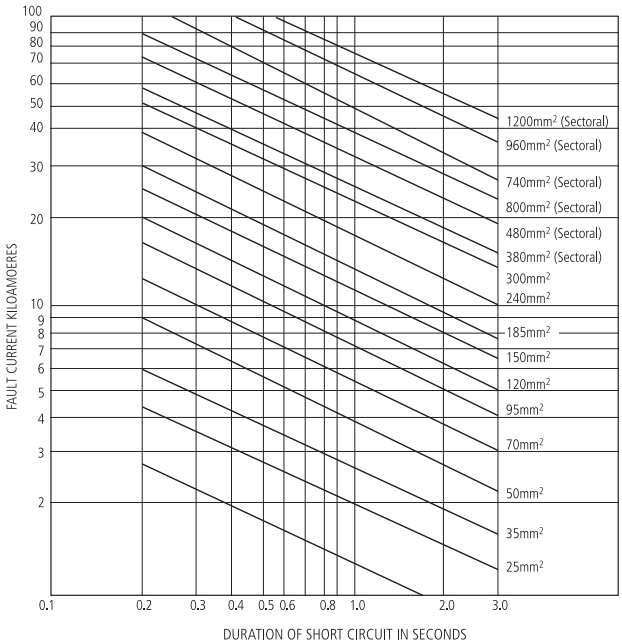
Copper conductors



Aliminium conductors



Aliminium conductors



Cable derating factors

Conditions of installation

Maximum conductor operating temperature at rated current –
XLPE and XLPE-LSF cables 90°C
PVC insulated cables 70°C

Cables installed in air

Ambient air temperature –
XLPE cables to SANS 1507 (IEE Wiring Regulations)
PVC cables to SANS 1507 (16th Edition)
LSF cables to SANS 1507 30°C (Table 4E3A)

Rating factors for air temperature

Ambient air temperature	25°C	30°C	35°C	40°C	45°C	50°C	55°C
Cable type	Rating factor						
XLPE and LSF cable up to 3.3kV	1.02	1.00	0.96	0.91	0.87	0.82	0.76
PVC insulated cable	1.03	1.00	0.94	0.87	0.79	0.71	0.61

Cables laid direct in ground

Ground temperature 15°C
Thermal resistivity of ground: 1.2 K.m/W
Adjacent circuits: at least 1.8 m distance for thermal independence
Standard depth of laying*-
(a) Voltages up to 1000V: 0.5m
(b) Voltages above 1000V: 0.8m

* Measured from ground surface to the centre of a cable, or to the centre of a trefoil group.

Rating factors for ground temperature

Cround temperature	15°C	20°C	25°C	30°C	35°C	40°C	45°C
Cable type	Rating factor						
XLPE insulated	1.0	0.97	0.93	0.89	0.86	0.82	0.76
PVC insulated	1.0	0.95	0.90	0.85	0.80	0.74	0.67

Rating factors for variation in thermal resistivity of soil (average values)

	Soil thermal resistivity in K.m/W					
Size of cable mm²	0.8	0.9	1.0	1.5	2.0	2.5
Single core cables						
up to 150	1.15	1.11	1.06	0.91	0.81	0.73
from 185 to 300	1.17	1.12	1.07	0.90	0.80	0.72
from 400 to 630	1.17	1.12	1.07	0.90	0.79	0.71
Multicore cables						
up to 16	1.09	1.06	1.04	0.93	0.84	0.77
from 25 to 150	1.12	1.09	1.05	0.92	0.82	0.75
from 185 to 400	1.14	1.10	1.06	0.92	0.81	0.74

Rating factors of depth of laying (to centre of cable or trefoil group of cables)

Depth of laying	600/1000volt cables			1900/3300 volt cables	
m	up to 50mm²	70mm² 300mm²	above 300mm²	up to 300mm²	above 300mm²
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	1.00
1.00	0.95	0.93	0.92	0.98	0.97
1.25	0.94	0.92	0.89	0.96	0.95
1.50	0.93	0.90	0.87	0.95	0.93
1.75	0.92	0.89	0.86	0.94	0.91
2.00	0.91	0.88	0.86	0.92	0.89
2.50	0.90	0.87	0.84	0.91	0.l88
3.00 or more	0.89	0.85	0.82	0.90	0.86

Group rating factors for circuits of three single core cables, in trefoil and laid flat touching, horizontal formation (average values)

	Number of circuits	Spacing of circuits					
		Touching	0.15*	0.3m	0.45m	0.6m	
		Trefoil laid flat					
600/1000 volt cables	2	0.77	0.80	0.82	0.88	0.90	0.93
	3	0.65	0.68	0.72	0.79	0.83	0.87
	4	0.59	0.63	0.67	0.75	0.81	0.85
	5	0.55	0.58	0.63	0.72	0.78	0.83
	6	0.52	0.56	0.60	0.70	0.77	0.82
1900/3300 volt cables	2	0.78	0.80	0.81	0.85	0.88	0.90
	3	0.66	0.68	0.71	0.76	0.80	0.83
	4	0.59	0.62	0.65	0.72	0.76	0.80
	5	0.55	0.58	0.61	0.68	0.73	0.77
	6	0.52	0.55	0.58	0.66	0.72	0.76

* This configuration, at 0.15m spacing, may not be practical for the larger size cables.

Group rating factors for multicore cables in horizontal formation (average values)

	Number of cables in group	Spacing				
		Touching	0.15	0.3m	0.45m	0.6m
600/1000 volt cables	2	0.81	0.87	0.91	0.93	0.94
	3	0.70	0.78	0.84	0.87	0.90
	4	0.63	0.74	0.81	0.86	0.89
	5	0.59	0.70	0.78	0.83	0.87
	6	0.55	0.67	0.76	0.82	0.86
1900/3300 volt cables	2	0.80	0.85	0.89	0.90	0.92
	3	0.68	0.75	0.80	0.84	0.86
	4	0.62	0.70	0.77	0.80	0.84
	5	0.57	0.66	0.73	0.78	0.81
	6	0.55	0.63	0.71	0.76	0.80

Copper installed in ducts

The term ducts applies to single earthenware, fibre or ferrous pipes.

Ground temperature: 15°C
Thermal resistivity of ground: 1.2 K.m/W
Adjacent circuits: at least 1.8 m distance for thermal independence

Standard depth of laying*.
(a) Voltages up to 1000V: 0.5m
(b) Voltages above 1000V up to 22000V: 0.8m

* Measured from ground surface to the centre of a duct, or to the centre of a trefoil group of ducts.

Rating factors for depth of laying (to centre of duct or trefoil group of ducts – average values)

Depth of laying	600/1000 volt cables		1900/3300 volt cables	
m	Single core	Multicore	Single core	Multicore
0.50	1.00	1.00	-	-
0.60	0.98	0.99	-	-
0.80	0.95	0.97	1.00	1.00
1.00	0.93	0.96	0.98	0.99
1.25	0.90	0.95	0.95	0.97
1.50	0.89	0.94	0.93	0.96
1.75	0.88	0.94	0.92	0.95
2.00	0.87	0.93	0.90	0.94
2.50	0.86	0.92	0.89	0.93

Rating factors for variation in thermal resistivity of soil (average values)

Soil thermal resistivity in K.m/W						
Size of cable mm^2	0.8	0.9	1.0	1.5	2.0	2.5
Single core cables						
up to 150	1.08	1.06	1.04	0.94	0.86	0.80
from 185 to 300	1.10	1.07	1.04	0.93	0.85	0.78
from 380 to 1000	1.11	1.08	1.05	0.93	0.83	0.76
Multicore cables						
up to 16	1.03	1.02	1.02	0.97	0.91	0.87
from 25 to 150	1.05	1.03	1.02	0.95	0.89	0.83
from 185 to 400	1.07	1.05	1.03	0.94	0.86	0.81

Group rating factors for single core cables in trefoil single way ducts, horizontal formation (average values)

	Number of cables in group	Spacing		
		Touching	0.45m	0.6m
600/1000 volt cables	2	0.86	0.90	0.93
	3	0.77	0.83	0.87
	4	0.73	0.81	0.85
	5	0.70	0.78	0.83
	6	0.68	0.77	0.82
1900/3300 volt cables	2	0.85	0.88	0.90
	3	0.75	0.80	0.83
	4	0.70	0.76	0.80
	5	0.67	0.73	0.77
	6	0.64	0.71	0.76

Group rating factors for multicore cables in single way ducts, horizontal formation (average values)

	Number of cables in group	Spacing			
		Touching	0.30m	0.45m	0.6m
600/1000 volt cables	2	0.90	0.93	0.95	0.96
	3	0.82	0.87	0.90	0.93
	4	0.78	0.85	0.89	0.91
	5	0.75	0.82	0.87	0.90
	6	0.72	0.81	0.86	0.90
1900/3300 volt cables	2	0.88	0.91	0.93	0.94
	3	0.80	0.84	0.87	0.89
	4	0.75	0.81	0.84	0.87
	5	0.71	0.77	0.82	0.85
	6	0.69	0.75	0.80	0.84

Grouping factors

Grouping

Correction factors (C_g) for groups of cables are as follows:

	Correction of factor (C_g) Number of circuits or multicore cables													
Arrangement of cables	2	3	4	5	6	7	8	9	10	12	14	16	18	20
Enclosed in conduit or trunking or bunched and clipped direct	0.80	0.70	0.65	0.60	0.57	0.54	0.52	0.50	0.48	0.45	0.43	0.41	0.39	0.38
Single layer clipped direct to or lying on a non-metallic surface														
Touching	0.85	0.79	0.75	0.73	0.72	0.72	0.71	0.70	-	-	-	-	-	-
Spaced*	0.94	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Single layer on a perforated metal cable tray vertical or horizontal														
Touching	0.86	0.81	0.77	0.75	0.74	0.73	0.73	0.73	0.72	0.71	0.70	-	-	-
Spaced*	0.91	0.89	0.88	0.87	0.87	-	-	-	-	-	-	-	-	-

* "Spaced" means a clearance between adjacent surfaces of at least one cable diameter.
(D_e). Where the horizontal clearance between adjacent cables exceeds twice their overall diameter, no correction factor need be applied.

Note of grouping

1. The factors in the table are applicable to uniform groups of cables, equally loaded.
2. If, due to known operating conditions, a cable is expected to carry a current not more than 30 per cent of its grouped rating, it may be ignored for the purpose of obtaining the rating factor for the rest of the group. For example, a group of N loaded cables would normally require a group reduction factor of C_g applied to the tabulated current capacity (I_t). However, if M cables in the group carry loads which are not greater than $0.3C_gI_t$ amperes the other cables can be sized by using the group rating factor corresponding to (N-M) cables.
3. The factors have been calculated on the basis of prolonged steady-state operation at 100 per cent load factor for all live conductors.

Thermal insulation

For cable installed in a thermally insulating ceiling, and being in contact with a thermally conductive surface on one side, the rating factor to be applied may, in the absence of more precise information, be taken at 0.75 times the current carrying capacity for that cable when clipped direct to a surface and unenclosed. For a cable likely to be totally surrounded by thermally insulating material, the applicable rating factor may be as low as 0.5.

Temperature rating factors

For ambient temperatures other than 30°C, the tabulated rating must be adjusted by temperature rating factors as follows:

Ambient temperature °C	25	30	35	40	45	50	55	60	65
Semi-enclosed fuse to BS3036 (formerly coarse excess current protection)	1.03	1.0	0.97	0.94	0.91	0.87	0.84	0.69	0.48
Fused to BS88 or BS1361, or circuit breaker to BS3871 - part 1 (formerly close excess current protection)	1.03	1.0	0.94	0.87	0.79	0.71	0.61	0.50	0.35

Resistance of copper and aluminium conductors in single-core and multi-core cables to SANS 1411

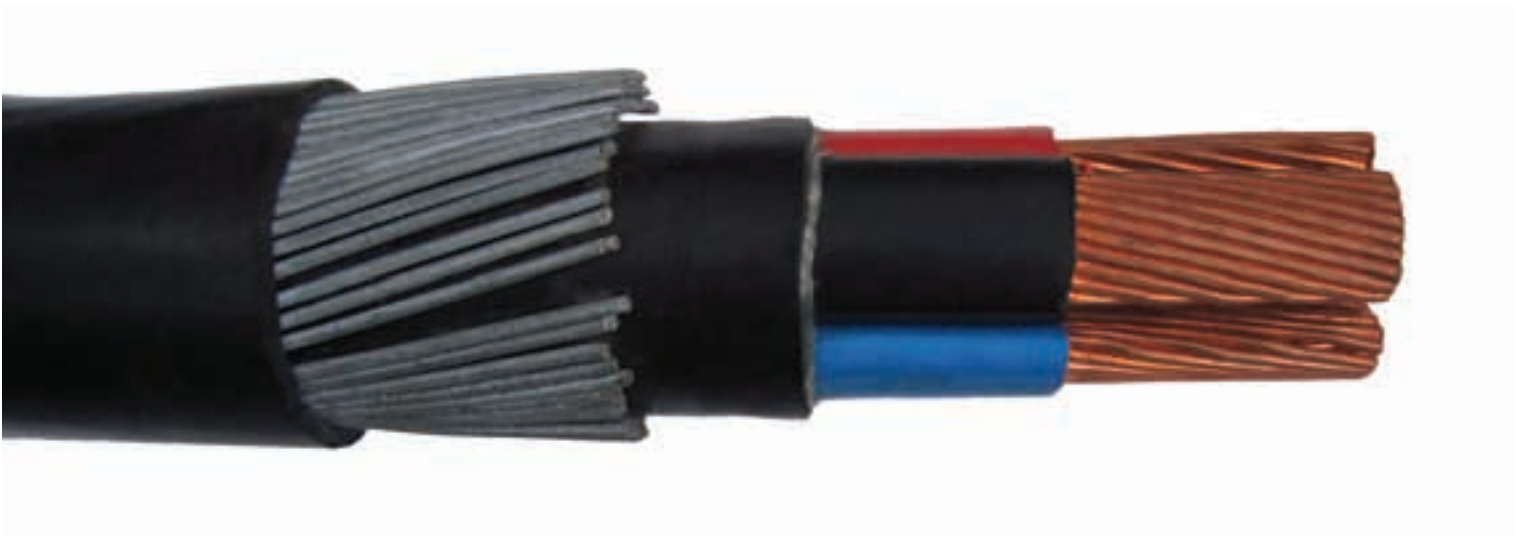
Conductor size mm^2	Maximum resistance per km of cable at 20°C (ohms)		
	Pnnealed copper conductor[a]		
	Plain wires	Metal-coated	Aluminium conductor
1.5	12.1	12.2	-
2.5	7.41	7.56	-
4	4.61	4.70	-
6	3.08	3.11	-
10	1.83	1.84	-
16	1.15	1.16	1.91
25	0.727	0.734	1.20
35	0.524	0.529	0.868
50	0.387	0.391	0.641
70	0.268	0.270	0.443
95	0.193	0.195	0.320
120	0.153	0.154	0.253
150	0.124	0.126	0.206
185	0.0991	0.100	0.164
240	0.0754	0.0762	0.125
300	0.0601	0.0607	0.100

a To obtain the maximum resistance of a hard-drawn copper conductor, divide the value in column 2 or 3 (as applicable) by 0.97

Armour wire sizes for SANS 1507 and IEC 502 cables

Nominal diameter over core or laid up cores	Nominal diameter of armour wire[a]		
		Without lead sheath	With lead sheath
mm		mm	mm
	≤ 0	0.9[b]	1.6
> 10	≤ 10	0.9[b]	1.6
> 15	≤ 20	1.6[c]	1.6
> 20	≤ 25	1.6	2
> 25	≤ 30	2	2
> 30	≤ 35	2	2
> 35	≤ 40	2.5	2
> 40	≤ 45	2.5	2.5
> 45	≤ 50	2.5	2.5
> 50	≤ 60	2.5	3.15
> 60		3.15	3.15

[a] Larger diameter wires may be used if agreed with the purchaser
[b] Armour wires may be of diameter 0.9mm or 1.25mm
[c] Armour wires may be of diameter 1.25mm or 1.60mm



Current ratings

PVC armoured cables
(maximum conductor temperature 70°C)

Installed in free air

Nominal area of conductor	Two core		Three and four core	
	Current rating	Volt crop per amp per metre	Current rating	Volt crop per amp per metre
mm²	amp	mV	amp	mV
1.5	22	29	19	25
2.5	31	18	26	15
4	41	11	35	9.50
8	58	7.30	45	6.40
10	72	4.40	62	3.80
16	97	2.80	83	2.40

Ambient temperature 30°C

Layed direct in ground/run in single-way ducts

Nominal area of conductor	Two core			Three and four core		
	Current rating		Volt crop per amp per metre	Current rating		Volt crop per amp per metre
mm²	In ground amp	In duct amp	mV	In ground amp	In duct amp	mV
1.5	32	29	29	27	22	25
2.5	41	34	18	35	29	15
4	55	45	11	47	38	9.50
6	69	57	7.30	59	48	6.40
10	92	76	4.40	78	64	3.80
16	119	98	2.80	101	83	2.40

Ground temp. 15°C
Ground thermal resistivity 1.2k.m/w
Depth of laying 0.5m
All circuits thermally independent
100mm diameter single-way ducts
Ratings for cables having more than four cores are available on request.

LSF and XLPE armoured cables
(maximum conductor temperature 90°C)

Two core		Three and four core	
Current rating	Volt crop per amp per metre	Current rating	Volt crop per amp per metre
mm²	mV	amp	mV
24	31	21	27
33	19	29	17
44	12	39	10
57	7.90	51	6.80
80	4.78	78	4.10

Two core			Three and four core		
Current rating		Volt crop per amp per metre	Current rating		Volt crop per amp per metre
In ground amp	In duct amp	mV	In ground amp	In duct amp	mV
37	30	31	30	24	27
50	40	18	40	38	17
64	57	12	52	43	10
80	65	7.90	65	62	6.80
108	87	4.70	88	72	4.10

For further specification, construction and electrical data concerning these cables refer to pages 1-8

LSF armoured cables are primarily designed for installation.

XLPE insulated cables to SANS 1507-4
1900/3300v - Stranded copper conductors
Single wire armoured, PVC sheathed

Nominal area of conductor	Direct in ground		In single way ducts		In free air	
	Single core Three cables trefoil touching	Three core	Single core Three cables ducts trefoil touching	Three core	Single core Three cables Trefoil touching	Three core
mm^2	amp	amp	amp	amp	amp	amp
16		115		95		105
25		145		120		138
35		175		145		166
50	225	205	220	175	233	200
70	275	255	270	215	290	252
95	325	305	315	255	352	309
120	370	345	345	295	409	361
150	415	385	380	330	466	409
185	465	435	420	370	532	470
240	530	500	470	425	627	551
300	590	560	510	480	713	627
400	660		540		817	
500	720		580		912	
630	790		630		1026	

Ambient air temperature 30°C
Ground temperature 15°C
Ground thermal resistivity 1.2 K.m/W

Depth of laying 0.8
All circuits thermally independent
Single core cables solidly bonded

XLPE insulated cables to SANS 1507-4
1900/3300v Stranded copper conductors
Single wire armoured, PVC sheathed

Number of cores		PVC armoured						LSF armoured						XLPE armoured					
		Nominal conductor area (mm^2)						Nominal conductor area (mm^2)											
		1.5	2.5	4	6	10	16	1.51	2.5	4	6	10	16	1.5	2.5	4	6	10	16
2 core	A	8.26	9.10	10.96	11.98	13.76	15.72	7.84	8.68	9.70	10.77	12.50	14.46	7.84	8.68	9.70	10.72	12.50	14.46
	B	10.76	11.60	13.46	14.48	16.26	18.22	10.34	11.18	12.20	13.22	15.00	16.96	10.34	11.18	12.20	13.22	15.00	16.96
	C	13.99	14.83	16.69	17.71	19.70	21.66	13.57	14.41	15.43	16.45	18.23	20.40	13.57	14.41	15.43	16.45	18.23	20.40
	D	470.58	534.38	672.69	768.54	981.13	1213.11	435.39	496.35	574.85	674.10	854.09	1084.00	441.32	441.32	582.46	682.71	864.61	1097.21
3 core	A	8.78	9.69	11.70	12.80	14.72	17.70	8.33	9.24	10.34	11.44	13.36	15.48	8.33	9.24	10.34	11.44	13.36	15.48
	B	11.28	12.19	14.20	15.30	17.22	20.20	10.83	11.74	12.84	13.94	15.86	17.98	10.83	11.73	12.84	13.94	15.86	17.98
	C	14.51	15.42	17.42	18.74	20.66	23.68	14.05	14.96	16.06	17.17	19.30	21.42	14.05	14.96	16.06	17.17	19.30	21.42
	D	475.19	559.38	683.73	795.29	1008.20	1320.72	439.63	501.52	592.70	687.91	901.49	1147.15	44471	507.04	598.76	694.51	909.39	1156.13
4 core	A	9.60	10.61	12.85	14.08	16.23	19.45	9.09	10.11	11.34	12.57	14.71	17.93	9.09	10.11	11.34	12.57	14.71	17.93
	B	12.10	13.11	15.35	16.58	18.73	21.95	11.59	12.61	13.84	15.07	17.21	30.43	11.59	12.61	13.83	15.07	17.21	20.43
	C	15.33	16.34	18.79	20.02	22.17	25.61	14.82	15.83	17.06	18.51	20.65	24.09	14.82	15.83	17.06	18.51	20.65	24.09
		532.78	629.06	799.34	923.94	1185.00	1565.83	490.67	463.70	671.89	809.02	1057.74	1455.79	496.12	569.64	678.44	816.52	1066.32	1468.06
7 core	A	11.53	12.79	15.58	14.08	20.64	23.58	10.90	12.16	13.69	12.57	18.75	21.69	10.90	12.16	13.69	12.57	18.75	21.69
	B	14.03	15.29	16.58	16.58	23.14	27.58	13.40	14.66	16.19	15.07	21.25	24.19	13.40	14.66	16.19	15.07	21.25	25.69
	C	7.26	18.73	21.52	20.02	26.80	31.45	16.63	17.89	19.63	18.51	24.91	27.85	16.63	17.89	19.63	18.51	24.91	29.56
	D	678.15	380.47	1074.09	1220.13	1738.63	2744.33	616.87	732.03	901.25	1001.74	1541.65	2009.52	623.21	738.98	909.32	1009.23	1603.13	2491.10

A = Diameter under armour (mm)
B = Diameter over armour (mm)
C = Approximate overall diameter (mm)
D = Approximate cable weight (kg/km)

Physical parameters

PVC armoured

PVC insulated, PVC bedded, single wire armoured and PVC sheathed power and auxiliary control cables to SANS 1507

600/1000V PVC FR insulated cable to SANS 1507 (red stripe)

	Nominal area of conductor	Unarmoured		Armoured			
				Approximate diameter			Approximate cable weight
		Overall cable diameter	Cable weight	Under armour	Over armour	Overall	
	mm^2	mm	kg/km	mm	mm	mm	kg/km
2 core	16	15.41	506.05	13.26	15.76	19.20	956.10
	25	18.06	744.96	15.91	18.41	21.85	1216.66
	35	19.73	950.10	18.44	22.44	26.09	1967.34
	50	23.17	1319.49	21.88	25.88	29.75	2504.70
	70	25.63	1737.32	23.91	27.91	31.78	2986.27
3 core	16	17.01	706.11	14.86	17.36	20.80	1202.30
	25	20.06	1054.74	18.77	22.77	26.42	2074.55
	35	22.03	1357.08	20.74	24.74	28.40	2467.17
	50	26.45	1927.84	24.73	28.73	32.60	3207.68
	70	28.58	2508.71	27.13	31.13	35.43	3944.60
	95	32.75	3290.19	31.46	35.46	40.19	4851.24
	120	37.44	4181.12	35.72	39.72	44.45	5897.05
	150	40.54	4998.23	39.25	44.25	49.41	7366.04
	185	43.48	6169.53	42.19	47.19	52.35	8690.20
	240	49.38	8118.72	47.66	52.66	58.25	10950.04
	300	54.95	10324.04	52.80	57.80	63.82	13345.14
4 core	16	19.06	910.66	27.77	20.27	23.93	1504.69
	25	22.60	1370.01	21.31	25.31	29.18	2525.50
	35	25.39	1797.98	23.67	27.67	31.54	3045.23
	50	30.05	2518.68	28.76	32.76	37.06	3909.53
	70	32.93	3289.26	31.64	35.64	40.37	4852.16
	95	37.92	4365.31	36.20	40.20	45.36	6135.63
	120	43.00	5497.16	41.71	46.71	51.87	8012.02
	150	47.04	6631.46	45.32	50.32	55.91	6317.20
	185	50.87	8246.29	48.72	53.72	59.31	11073.79
	240	57.73	10839.50	55.15	60.15	66.60	13938.25
	300	64.21	13771.97	61.20	66.20	72.65	16913.32

LSF armoured

XLPE insulated, LSF bedded, single wire armoured and LSF sheathed power and auxiliary control cables to SANS 1507

1900/3300V PVC insulated cables to SANS 1507

	Nominal area of conductor	Armour wire diameter	Approximate diameter			Approximate cable weight
			Under armour	Over armour	Overall	
	mm^2	mm	mm	mm	mm	kg/km
3 core	16	1.25	21.04	23.54	27.19	1621.37
	25	2.00	23.20	27.20	31.07	2388.47
	35	2.00	25.18	29.18	33.05	2776.52
	50	2.00	28.70	32.70	37.00	3530.41
	70	2.00	31.11	35.11	39.84	4271.52
	95	2.00	34.12	38.12	42.85	5165.85
	120	2.50	38.81	43.81	48.97	6716.62
	150	2.50	41.03	46.03	51.19	7605.86
	185	2.50	43.07	48.07	53.23	8797.04
	240	2.50	47.66	52.66	58.25	10911.01
	300	2.50	52.80	57.80	63.82	13414.29

XLPE insulated cables to SANS 1507
600/1000V Stranded copper conductors
Unarmoured and armoured, PVC sheathed

	Nominal area of conductor	Unarmoured		Armoured			
				Approximate diameter			
		Overall cable diameter	Cable weight	Under armour	Over armour	Overall	Approximate cable weight
	mm^2	mm	kg/km	mm	mm	mm	kg/km
2 core	16	14.15	448.36	12.00	14.50	17.77	852.42
	25	16.80	669.16	14.65	17.15	20.59	1152.60
	35	18.47	865.03	16.32	20.32	23.97	1715.43
	50	21.49	1194.54	202.20	24.20	27.86	2272.17
	70	24.37	1611.27	2265	26.675	30.52	2797.02
	95	120	150	185	240	300	
3 core	16	15.68	625.33	13.53	16.03	19.47	1084.40
	25	18.73	946.76	16.58	20.58	24.23	1822.67
	35	20.71	1235.17	19.42	23.42	27.07	2281.36
	50	24.68	1746.04	22.96	26.96	30.83	2958.16
	70	27.52	2325.83	25.80	29.80	33.67	3657.12
	95	10.54	3016.04	29.25	33.25	37.55	4603.90
	120	15.67	3886.72	33.95	37.95	42.68	5700.64
	150	18.77	4652.60	37.05	41.05	46.21	6470.16
	185	41.70	5770.16	40.41	45.41	50.57	8176.49
	240	47.16	7596.75	45.44	50.44	56.03	10305.10
	300	5.29	5668.05	50.14	55.14	61.16	12635.35
4 core	16	17.62	806.46	15.47	17.97	21.41	1322.27
	25	21.16	1229.55	19.87	23.87	27.52	2303.69
	35	38.52	1611.21	22.23	26.23	30.10	2819.43
	50	28.13	2281.49	26.41	30.41	34.71	3679.79
	70	31.48	3049.38	30.91	34.19	38.49	4670.24
	95	15.51	4003.69	33.79	37.79	42.52	5815.82
	120	41.08	5110.43	39.79	44.79	49.95	7784.01
	150	44.68	6124.86	43.39	48.39	53.55	5683.44
	185	48.52	7661.74	46.80	51.80	57.39	10424.00
	240	54.90	10085.48	52.75	57.75	63.77	13199.03
	300	60.89	12833.94	58.31	63.31	69.76	15982.22

600/1000v XLPE insulated cables to SANS 1507

	Nominal area of conductor	Armour wire diameter	Approximate diameter			Approximate cable weight
			Under armour	Over armour	Overall	
	mm^2	mm	mm	mm	mm	kg/km
3 core	16	1.25	20.15	22.65	26.31	1453.87
	25	2.00	22.31	26.31	30.18	2193.07
	35	2.00	24.29	28.29	32.16	2561.02
	50	2.00	27.39	31.39	35.69	3213.00
	70	2.00	30.22	34.22	38.52	3954.20
	95	2.00	33.24	37.24	41.97	4835.65
	120	2.00	37.50	41.50	46.66	5912.52
	150	2.50	40.14	45.14	50.30	7218.58
	185	2.50	42.19	47.19	52.35	8388.97
	240	2.50	46.77	51.77	57.36	10455.37
	300	2.50	51.03	56.03	62.05	12755.03

Physical perameters

LSF armoured

XLPE insulated, LSF bedded, single wire armoured and LSF sheathed power and auxiliary control cables to SANS 1507

1900/3300V PVC insulated cables to SANS 1507

	Nominal area of conductor	Armoured			
		Approximate diameter			
		Under armour	Over armour	Overall	Approximate cable weight
	mm^2	mm	mm	mm	kg/km
2 core	16	12.00	14.50	17.72	807.16
	25	14.65	17.15	20.59	1086.31
	35	16.32	20.32	23.97	1880.46
	50	22.65	24.20	27.86	2259.19
	70	22.65	26.65	30.52	2782.10
3 core	16	13.53	16.03	19.47	1028.38
	25	16.58	20.58	24.23	1912.79
	35	19.42	23.42	27.07	2768.83
	50	22.96	26.96	30.83	2943.06
	70	25.80	29.80	33.67	3640.33
	95	29.25	33.25	37.55	4582.56
	120	33.95	37.95	42.68	5475.19
	150	37.05	41.05	46.21	6440.33
	185	40.41	45.41	50.57	8142.06
	240	45.44	50.44	56.03	10264.73
	300	50.14	55.14	61.16	12588.95
4 core	16	15.47	17.97	21.41	1265.34
	25	19.87	23.87	27.52	2290.90
	35	22.23	26.23	30.10	2804.75
	50	26.41	30.41	34.71	3661.42
	70	30.19	34.19	38.49	4648.27
	95	33.79	37.79	42.52	5590.48
	120	39.79	43.79	48.95	7054.81
	150	43.39	48.39	53.55	8646.67
	185	46.80	51.80	57.39	10382.52
	240	52.75	57.75	63.77	13111.44
	300	58.31	63.31	69.76	15926.33

Installed in free air

Nominal area of conductor	Single core Two cables spaced *		Three cables trefoil touching						Two core			Three and four core		
	Current rating		Approx. volt drop per amp per metre		Current rating		Approx. volt drop per amp per metre		Current rating		Approx. volt drop per amp per metre	Current rating		Approx. volts drop per amp per metre
	Unarmed	Armed	Unarmed	Armed	Unarmed	Armed	Unarmed	Armed	Unarmed	Armed		Unarmed	Armed	
mm	amp	amp	mV	mV	amp	amp	mV	mV	amp	amp	mV	amp	amp	mV
16									115	115	2.70	96	99	2.50
25									150	152	190	130	131	1.65
35									180	188	1.35	160	162	1.15
50	255	271	1.00	1.00	215	222	0.87	0.87	225	228	1.00	190	197	0.87
70	330	342	0.73	0.75	270	285	0.65	0.62	280	291	0.69	245	261	0.60
95	410	410	0.56	0.60	340	346	0.45	0.47	350	354	0.52	300	304	0.45
120	480	485	0.47	0.51	400	402	0.37	0.39	405	410	0.42	350	353	0.37
150	550	542	0.41	0.45	460	463	0.31	0.33	465	472	0.35	410	406	0.30
185	640	618	0.36	0.40	630	529	0.28	0.28	540	539	0.29	465	463	0.26
240	788	722	0.31	0.36	630	625	0.22	0.24	630	636	0.24	560	546	0.21
300	900	817	0.29	0.32	790	720	0.20	0.21	740	732	0.21	630	620	0.19
400	1060	893	0.27	0.30	870	815	0.18	0.20				740	740	0.16
600	1250	988	0.26	0.29	1020	918	0.16	0.18						
630	1480	1090	0.25	0.27	1140	1027	0.15	0.17						

* Adjacent cable surfaces separated by one cable diametre

Current rating (ac)

Laid direct in ground/run in single-way - single wire armoured cables

Nominal area of conductor	Single core Two cables spaced		Three cables trefoil touching						Two core			Three and four core		
	Current rating		Approx. volt drop per amp per metre		Current rating		Approx. volt drop per amp per metre		Current rating		Approx. volt drop per amp per metre	Current rating		Approx. volts drop per amp per metre
	in ground	in duct	in ground	in duct	in ground	in duct	in ground	in duct	in ground	in duct		in ground	in duct	
mm	amp	amp	mV	mV	amp	amp	mV	mV	amp	amp	mV	amp	amp	mV
16									140	115	2.90	115	94	2.40
25									180	145	1.90	150	125	1.65
35									215	175	1.30	180	150	1.15
50	275	255	1.00	1.10	235	235	0.87	0.93	255	210	1.00	213	175	0.87
70	340	310	0.71	0.80	290	280	0.62	0.70	315	260	0.69	265	215	0.60
95	405	365	0.63	0.65	345	330	0.47	0.56	380	310	0.52	315	260	0.45
120	460	410	0.43	0.55	390	370	0.39	0.48	0430	355	0.42	360	300	0.37
150	510	445	0.87	0.50	435	405	0.33	0.43	480	400	0.35	405	335	0.30
185	580	485	0.32	0.45	490	440	0.28	0.39	540	455	0.29	460	380	0.26
240	670	550	0.27	0.40	560	500	0.24	0.35	630	520	0.24	530	440	0.21
300	750	610	0.24	0.37	630	560	0.21	0.32	700	500	0.21	590	496	0.19
400	830	640	0.22	0.35	700	580	0.20	0.30				660	550	0.16
500	910	690	0.20	0.33	770	620	0.18	0.28						
600	1000	750	0.19	0.30	840	670	0.17	0.26						

Ambient air temperature 30°C
Ground temperature 15°C
Ground thermal resistivity 1.2k.m/W

Depth of laying 0.5m
All circuits thermally independent
Single core cables solidly bonded

For the selection and operation of armoured PVC insulated cables

Bright wire armoured cables:

Bright wire armour without further covering should only be used for cables to be installed in air in non-corrosive atmospheres.

Voltage ratings:

The selection of standard cables of appropriate voltage designation for particular systems depends on the type of system purpose, systems have been divided into two categories, as follows:

Category 1:

This category comprises those systems where one of the following applies:

(1) The neutral point or mid-point connection is earthed in such a manner that, even under fault conditions, the maximum voltage that can occur between any conductor and earth does not exceed 0.8 E.
(E is the voltage between lines);

(2) A device is installed for automatically and instantly cutting out any part of the system that becomes accidentally earthed.

(3) (Applies to ac systems only).
The neutral point is earthed through an arc suppression coil,
with arrangements for isolation within an hour of the occurrence of a fault.

For systems in this category, the rated voltage E_O (E_O is the voltage to neutral) of the cable should not be less than the system voltage to neutral or mid-point and the rated voltage E of the cable should not be less than the system voltage between lines.

Category 2:

This category comprises one wire (earth-return) systems, insulated two-wire systems, two-wire systems having one pole earthed, insulated multi-wire and polyphase systems and all other systems that do not fall into Category 1.

For systems in this category, both the rated voltage E_O and E of the cable should be not less than the system voltage between lines.

For the selection and operation of armoured PVC insulated cables

Advice on cable selection

When ordering a specific cable it is important to give complete details of the type and size required. This will avoid any confusion and subsequent delay.

Where you would like us to recommend a cable for a particular application we will need the following information to ensure the correct cable is selected.

1. The system

(i) Supply system details, e.g. voltage, number of phases, frequency, etc.;

(ii) Maximum voltage drop permissible for the cable under consideration;

(iii) Type and magnitude of load;

(iv) Rating and type of protective device;

(v) Special requirements of the load, e.g. short circuit ratings.

Installation details

(i) Route length;

(ii) Whether laid direct in the ground, down into ducts, or run in air – in the open, inside a building, or in a tunnel;

(iii) Whether exposed to direct sunlight;

(iv) For cables in tunnels: dimensions of tunnel, loading and details of any other load carrying cables, details of any other heat source, e.g. steam pipes;

(v) Whether the installation is subject to any national regulations, e.g. IEE Wiring Regulations, Mines and Quarries Regulations, etc. (Details of these regulations should be given whenever possible);

(vi) Specific installation details if they differ from standard conditions as quoted in the accompanying tables, e.g. ambient or ground temperature, depth of laying, class of excess current protection, grouping of cables;

(vii) Chemical hazards;

(viii) Any other abnormal climatic or local conditions.

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