Ducab دوكاب

كابلات الجهد المنخفض
XLPE Insulated Low Voltage Cables

حلول متقدمة للكابلات من خلال التقنية والابداع
Advanced Cable Solutions Through Technology and Innovation

BICC

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Ducab is listed in the following publication issued by the Department of Trade and Industry of the United Kingdom.

"THE DTI QA REGISTER - PRODUCTS AND SERVICES LIST"

Only those companies whose quality system is assessed and certified by U.K. accredited certification bodies appear in the above publication.

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INTRODUCTION

Established in 1979, Ducab is the leading cable manufacturing company in the region and is equally owned by the Governments of Dubai and Abu Dhabi. Ducab has five manufacturing facilities that support it's continuous growth.

To meet the growing demand of customers around the region and the world, Ducab continues to expand its world -class facilities across the Middle East, North Africa, Europe and India. Ducab prides itself on setting and maintaining the highest quality standards of power cables. Experienced and highly skilled employees operate state-of-the-art equipment, and conduct extensive testing at every phase of production.

This catalogue provides working information on Ducab's complete range of XLPE Power Cables rated up to 3.3 kV and also includes data on components. Separate catalogues are available for Ducab's range of Wiring Cables, Low Voltage Control and Auxilary Cables, Lead Sheathed Cables, Ducab Smokemaster - LSF Wires and Cables, Ducab Powerplus Medium Voltage Cables, Ducab Powerplus Medium Voltage Cables for Oil, Gas and Petrochemical Industries and Drum Handling & Installation of Cables.

Due to the wide range of cables in the catalogue, it is advisable, when ordering, to provide as much information as possible. Please use the following table as a guide:

ORDERING ADVICE

The following details will ensure that your enquiries and orders are dealt with quickly and efficiently:

1. Length of cables required and individual drum lengths.*
2. Voltage designation.
3. Relevant British or International Standard.
4. Number of cores.
5. Conductor size and, where applicable, size of reduced neutral conductor.
6. Conductor material i.e. copper, aluminium.
7. Type of insulation.
8. Type of bedding.
9. Type of armour.
10. Type of outer sheath.
11. Any other special requirement, e.g. circular conductors, special PVC sheath material, drum weight limitation, etc.

* Cables are normally supplied in lengths of 300 metres, 500 metres and 1000 metres depending on conductor size. Other lengths can be supplied if required.

TECHNICAL ADVISORY SERVICE

Specialist advice and assistance on all matters concerning XLPE insulated power cables is available from Technical Department, Dubai Cable Company (Private) Limited, P. O. Box 11529, Dubai, U. A. E., Tel: 971-4-8082500, Fax: 971-4-8082511.

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CUSTOMER SERVICE

Ducab is the premier cable manufacturer in the United Arab Emirates and, since 1979, has been meeting the requirements of customers throughout the Middle and Far East. Ducab's cables are used by some of the most demanding utilities in the world, for the following reasons:

PRODUCT QUALITY

Ducab is committed to supplying its customers with the highest quality of product and of service. Ducab's Power cables have been type approved by Lloyd's Register of the UK and have undergone rigorous type testing by BASEC (British Approvals Service for Cables). They fully conform to BS 6004 and BS 5467 specifications for PVC and XLPE insulated cables respectively, for electricity supply, up to and including 3.3kV ratings.

In addition, Ducab was presented with the Dubai Quality Award 1994, for the best local industrial company of the year. Four years later, Ducab was presented with the Dubai Quality Award '98 Gold Category. The Gold Award rewards the most distinguished companies which are judged to be world class.

RELIABILITY

Specifying the right cable for a particular application is the first step. The key to reliability however, is in the manufacturing process. The cable must be free from material and manufacturing defects, and weaknesses that will be revealed in service.

Ducab constantly monitors its manufacturing processes and operates stringent quality assurance procedures to give long term reliability. This is of vital significance where cables are to be installed in locations where future access would be difficult and this is where Ducab's reputation and the resources give peace of mind.

PERFORMANCE

Optimum cable performance can be provided only by a company such as Ducab, with access to the latest developments in materials technology. In addition, Ducab's knowledge of application requirements throughout the Middle and Far East is an assurance of high performance.

Where required, Ducab can incorporate special features, for example to give the cable low smoke and fume (LSF) or reduced flame propagation characteristics, or to resist abrasion and impacts.

Our experienced Technical Staff can provide guidance on cable selection and installation and can ensure that you get the right cable for the job.

SAFETY

Ducab is able to maintain a close watch on world developments in cable technology and regulations and therefore ensure that its products are designed and constructed to be hazard-free under the prescribed conditions of use.

Ducab uses only tried and tested materials and processes in full compliance with all relevant British and International Standards. Our cables are therefore manufactured for safe use without risk to health on the understanding that users will exercise the same degree of care in their selection and application.

RoSPA 20 02
Joint Winner
MANUFACTURING
INDUSTRY
Sector Award

Safety is an important issue for Ducab, and the strictest standards are adhered to throughout the company. Ducab is proud of its safety record and has been awarded RoSPA (Royal Society for the Prevention of Accidents) Gold Awards for safety from 1991 to 1999. From 2000 onward, Ducab was awarded the prestigious President's Award for Health and Safety which is a recognition of Ducab winning 10 consecutive annual Gold awards and acknowledges Ducab's total commitment to health and safety. In 2002, Ducab was declared the joint winner of the Manufacturing Industry Sector Award from RoSPA.

Ducab is the first organisation in the Middle East to receive accreditation to OHSAS 18001 by the BASEC (British Approvals Service for Cables). Certification to OHSAS 18001 provides a recognisable Occupational Health and Safety Management standard against which an organisation's management systems can be assessed and certified. Based on the structure of ISO 14001, the standard requires continual improvement in health and safety related activities.

QUALITY MANAGEMENT SYSTEM CERTIFIED TO ISO 9001

Ducab's Quality Management System conforms to the ISO 9001:1994 International Quality System Standard and is certified by BASEC (British Approvals Service for Cables) who are an internationally recognised quality authority accredited in the UK and throughout the world.

Certification to the ISO 9001 International standard demonstrates that Ducab has drawn up written procedures to ensure full compliance with all requirements of the standard and that these procedures are followed by every department in the company, thus ensuring that goods leaving Ducab's factory are of the highest quality and meet each customer's requirements in every respect.

Ducab is particularly proud to have achieved certification to the stringent ISO 9001:1994 standard as it is an independent conformation that the company designs, manufactures and tests cables consistently to accepted standards. ISO 9001 is widely used throughout Europe, and is therefore a reassurance to Ducab's customers that the products and service supplied by the company are equal to the best in the world.

ENVIRONMENTAL MANAGEMENT SYSTEM CERTIFIED TO ISO 9001

Ducab's Environmental Management System conforms to the ISO 14001:2004 International Environmental Management Standard and is certified by BASEC who are an internationally recognised certifying authority accredited in the UK and throughout Europe.

Certification to the ISO 14001:2004 International standard shows that Ducab has a well defined structure and established working practices aimed at limiting its impact on the environment. Measurement and monitoring of effects, issuing work instructions, training of personnel and taking corrective actions are all essential elements to limiting the impact on the environment. Ducab has set improvement targets to reduce the significant environmental impacts associated with its activities.

Ducab is proud to be the first cable manufacturer in the region to achieve certification to ISO 14001 and this certification along with its quality, business success and safety record demonstrates that Ducab is a world class organisation and can hold its head up to any business community throughout the world.

BASEC CERTIFICATION

Ducab is also proud to hold a Product Marketing Licence issued by BASEC (British Approvals Service for Cables) for several cables in its product range.

DUCAB SHAREEK

Ducab's customer satisfaction programme, 'The Value Edge' is designed to ensure that customers receive a consistently high level of service from Ducab's dedicated staff.

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PRODUCT RANGE

Voltage range: 0.6/1kV and 1.9/3.3 kV

CABLE TYPES

1) Armoured/unarmoured XLPE insulated cables
2) Lead sheathed cables
3) Copper or Aluminium PE tape (with drain wire) shielded

CABLE SIZES

Single core up to and including 1000 mm^2
2 core up to and including 300 mm^2
3 core up to and including 400 mm^2
4 core up to and including 500 mm^2
5 core up to and including 95 mm^2

SPECIFICATION

BS 5467.....for XLPE insulated armoured cables
BS 7889.....for XLPE insulated single core unarmoured cables
IEC 60502 (Part 1).....for XLPE insulated single/multicore armoured/unarmoured cables
Any other International Specification as per VDE/DIN, GOST and as per customer's specifications.

SPECIFICATION AND CONSTRUCTION

CONDUCTORS

It is the current carrying component of the cable.

Material

Plain, stranded, compacted copper as per BS 6360/IEC: 60228
Aluminium, stranded, compacted conductors

INSULATION

The rated voltage level of the cable depends on the dielectric strength and thickness of the insulation.

Material

Cross-linked polyethylene (XLPE) Type GP8 as per BS 7655:Section 1.3.

Colour Masterbatch

Ultra-violet (UV) resistant polyethylene masterbatch is used for colouring of insulation. This protects the insulation from deterioration when exposed to continuous sunlight.

CORE IDENTIFICATION

Core identification is by colour as follows (unless otherwise agreed):

No. of cores	Core Colours
1	Red or Black
2	Red and Black
3	Red, Yellow and Blue
4	Red, Yellow, Blue and Black
5	Red, Yellow, Blue, Black and Green/Yellow

** Cables to new colour scheme of BS 5467 eg. Blue, Brown, Black, Grey could also be supplied on special request*

FILLERS

For providing circular shape to the cable, non-hygroscopic compatible fillers (wherever necessary) are included between laid up cores.

METALLIC SCREEN

If required by the customer screening may be provided for electrical shielding.

Material

Copper tape / Copper laminate / Aluminium laminate
Aluminium PE tape along with tinned copper drain wire (for providing screen continuity).

Note: Special constructions other than stated above may be provided on request.

BARRIER TAPE

Material

Polypropylene/PETP tape is used as a barrier tape over the laid up cores.

Functions

Holds the cores together and prevents them from opening out.
Works as a separator between different polymers used in a cable.

BEDDING

Extruded bedding serves as a bedding for the armour and as a protection for the laid-up cores.

Material

Extruded PVC Type 9 Compound as per BS 7655.

Reduced propagation flame retardant (RPLHCL)/RP PVC Compound for reduced flame propagation characteristics.

Smokemaster Low smoke and fume for installations where fire hazards exist. (Cables as per BS 6724)

ARMOUR

Armour provides mechanical protection to the cable. It also serves as an Earth Continuity Conductor (ECC).

One layer of round wire is applied helically over the bedding.

Material

Galvanised round steel wire (GSW).
Galvanised round steel wire (GSW) **along with tinned copper wires (TCW) for maintaining specified conductivity of armour (if required by the customer).**
Aluminium round wire armour (AWA) is generally used for single core ac circuits as aluminium is a non-magnetic material and this will reduce losses due to armour.

Note: Aluminium glands should be used in conjunction with cables having aluminium wire armour.

OVERSHEATH - FINISH

Following types of materials may be specified for oversheathing.

- **General Purpose:** Extruded PVC Type 9 Compound as per BS 7655.
- **Medium Density Polythylene (MDPE):** Offers higher protection from water ingress and mechanical abrasion.
- **Anti Termite:** Termite resistance can be built in both types described above by compounding with proper additives.
- **Reduced Propagation (RP):** Retards propagation of flame in fire situation. (Oxygen Index ≈ 30)
- **Reduced Propagation and Low Acid Fumes (RPLHCL):** Retards propagation of flames and gives low emission of hydrochloric acid fumes. (OI ≈ 30 & acid gas emission is less than 18%)
- **Smokemaster Low Smoke & Fume (LSF):** Smokemaster cables are ideal for installations where the dense black smoke generated by PVC cables in a fire are a danger to people. Smokemaster is characterised by the features as Oxygen Index greater than 35, acid-gas liberation almost nil (<0.5%) and smoke density within controllable limit of 40% smoke density. Smokemaster cables are offered to BS 6724.

SALIENT FEATURES OF DUCAB CABLE DESIGN

(1) XLPE insulation Ultra-violet (UV) colour masterbatch

Ultra-violet (UV) resistant polyethylene masterbatch is used for colouring of insulation. This protects the insulation from deterioration when exposed to continuous sunlight.

(2) Polypropylene/PETP tape over the laid up cores

Acts as a separator between different polymers used in a cable.

(3) Fillers

For ensuring proper circular shape to the cable, non-hygroscopic compatible fillers (wherever necessary) are included between laid up cores.

(4) Special requirements

Ducab cables can be custom designed to incorporate special requirements of the client as follows:

(a) Screening: Copper tape or Aluminium PE tape (along with tinned copper drain wire) can be used for shielding purposes.

(b) Tinned copper wire can be used along with galvanised round steel wires to maintain specified armour conductivity requirements.

(c) Reduced propagating flame retardant bedding (RPLHCL/RP) and outersheath material can be offered to meet reduced flame propagation characteristics and low hydrogen acid gas emission.

(d) Cable with bedding and outersheath material of special LSF (low smoke and fume) compound can be offered for installations where fire and its associated problems - the emission of smoke and toxic fumes - offer a serious potential threat. (For details on LSF cables refer our smoke master cable cataloge)

(e) In water logged areas or where the cables are required to be abrasion resistant, cable with medium density polyethylene (MDPE) can be offered.

(f) For protection from insects, anti-termite protection can be added to the outersheath.

(g) For protection against solvent penetration & corrosive attack cable with lead sheath can be offered. (For details on lead sheath cables refer our lead sheath power, control and auxilary cable catalogue)

Cables sheathed with general purpose PVC Type 9 meet fire test requirement of IEC 60332-1. Cables with varying fire performance requirements are manufactured by Ducab. The details on this are provided on request.

INSTALLATION

Whichever form of conductor is used, XLPE insulated cables are simple to handle, install and joint. All the cables described in this publication can be used indoors or outdoors, but some reservations are necessary concerning cables for direct burial in the ground or for use in sustained wet conditions as follows:

(i) Unarmoured cables are not generally recommended for laying directly in the ground.

(ii) Cables laid directly in the ground, particularly in sustained wet conditions, should have extruded bedding and preferably MDPE - Medium Density Polyethylene - as the outersheath material.

Other important factors to be taken into account are:

SHEATH DAMAGE

Care should be taken to ensure that the oversheath is not damaged during installation. This is especially important where aluminium wire armour is used, as ingress of moisture could lead to corrosion or ultimate loss of earth continuity.

MINIMUM INSTALLATION RADIUS

Cable should not be bent during installation to a radius smaller than that recommended below. Wherever possible larger installation radii should be used.

Table 1

Type of Cable	Overall Diameter (D)	Minimum internal radius of bend
Circular copper conductors armoured or unarmoured	Any	6D
Shaped copper or aluminium conductors, armoured or unarmoured	Any	8D
For lead sheathed cables	Any	12D

CONNECTORS

The use of compression type connectors is recommended for XLPE insulated cables since the use of soldered connectors would limit the maximum short circuit temperature of the cable to 160˚C (and consequently reduce the final short circuit current by approximately 30%).

OVERHEAD TERMINATIONS

Ultra violet resistant sleeving or taping should be provided on XLPE insulated cores to avoid degradation due to exposure to solar rays.

ARMOURED SINGLE CORE CABLES FOR AC OPERATION

The current rating provided for single core cables is based on armour bonded / earthed at both ends. Armour bonding at both ends results in circulating current in the armour.

Higher current rating may be achieved in case the armour is bonded / earthed at single end. However single end bonding results in an induced voltage at the unearthed end of the armour. The magnitude of induced voltage is directly proportional to the current through the conductor and length of the cable. At times the magnitude of induced voltage could pose potential risk if no limiting device is connected at the open end. For this purpose sheath voltage limiters are in use.

Ducab strongly recommends use of an insulated adopter in the cable gland, while terminating single core cables for AC operation.

Single core cables for AC operation should not pass through steel conduit or steel gland plate, as it produces a heating effect.

CABLE SUPPORT SPACING

As per IEE Wiring Regulations where the cable is not continuously supported it shall be supported by suitable means at appropriate intervals in such a manner that the cable does not suffer damage by its own weight.

CURRENT RATINGS

Current ratings for XLPE insulated cables for 'ground' and 'duct' installation are derived from the latest issue of ERA Report 69-30 Part 5 which is based upon IEC Publication 60287. The ratings for 'In Air' installation are taken from IEE Wiring Regulations.

All the ratings given are for single circuits installed thermally independent of other circuits or any other heat source and on the basis of the standard conditions of installation given in relevant Tables between 16 to 28 For other ambient or ground temperatures, depth of laying, soil thermal resistivity, the rating must be multiplied by relevant rating factors in Tables 2 to 6 and 8 to 12.

It should be noted that if XLPE insulated cables, are subjected to operating temperatures appreciably higher than the 90˚C permissible for continuous operation, the insulation will undergo premature ageing thus affecting the normal life of the cable. However, limiting maximum conductor temperature to 105˚C during overloads with duration not exceeding 4 hours on any one occasion, or a maximum of 100 hours in any 12 consecutive months, or a total of 500 hours in the cable's lifetime, would be tenable.

IEE WIRING REGULATIONS - REQUIREMENT FOR CABLES

The IEE Wiring Regulations for installation and selection of cables cannot be approached in isolation from the other equipment in the installation. In particular the devices providing protection against overload, short circuit, shock by indirect contact and over-heating of protective conductors during an earth fault, affect the selection of cables.

CROSS SECTIONAL AREAS OF PROTECTIVE CONDUCTORS
(IEE Wiring Regulations)

IEE wiring regulation explains how the cross sectional area of the circuit protective conductor should be calculated to avoid it over-heating during a fault to earth. Again the area required depends on the characteristics of the device providing protection against short circuit.

The steel wire armour of standard cables to BS 5467 (XLPE) and BS 6346 (PVC) provides the required area, or more, when the protective device is one of the standard fuses or MCB's with a rating not higher than the current rating of the cable (assuming disconnection within 5 seconds).

For the most of the cables the armour is still adequate when the fuse rating is one or two steps, or even more, above the current rating of the cable, the margins being greater for the small sizes and 4 core cables than for the larger sizes and two core cables.

VOLTAGE DROP

Voltage drop is normally only of importance for cables of voltage rating 600/1000V or below. IEE Wiring Regulations, stipulate that "the voltage drop within the installation does not exceed a value appropriate to the safe functioning of the associated equipment in normal service. The requirement is deemed to be satisfied if the drop in voltage from the origin of the installation (usually supply terminals) and the fixed current using equipment does not exceed 4 per cent of the nominal voltage of the supply, disregarding starting conditions."

The values of voltage drop for 600/1000 V rated cables are given in the current rating tables.

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 also 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 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.

Example1: Consider a route of 200 metres of 4 Core armoured cable to be installed in air and to carry 100 amperes load per phase, with the supply voltage being 415 volts, three phase 50 Hz and the cable to be Copper XLPE/SWA/PVC.

Using the Tables:

Let Vd be the voltage drop in volts.

Formula:- $Vd = \frac{mV \times I \times L}{1000}$ or $mV = \frac{Vd \times 1000}{I \times L}$

where I = Current in amperes, L = Route length in metres, mV = Approximate volt drop/ampere/metre

Assume maximum permissible volt drop = 4 per cent of 415 volts = 16.6 volts

Substitute for current, route length and maximum permissible volt drop

then $mV = \frac{16.6 \times 1000}{200 \times 100} = 0.83$

Select a cable from the relevant Current Rating Table 24 such that the "mV value" from the voltage drop column is equal to or less than the 0.83 mV calculated, ensuring that it will carry the current. It will be seen that this value is 0.6 giving a cable size of 70mm^2. However, 100 Amp load could be less than 80% current carrying capacity of 50mm^2 cable, in which case of 50 mm^2 cable will suffice.

For installations where XLPE insulated cables are not fully loaded and conductor operating temperatures are below 90˚C.

The current ratings given in relevant tables of this publication assume that cables are fully loaded i.e. conductor operating temperature is 90˚C and conductor resistances at this temperature have been used in the tabulated figures of volt drop per ampere per metre for various sizes of cables.

In many situations the conductor size which is ultimately chosen may not be carrying its maximum permissible current (i.e. its full rated current) and consequently it will not be operating at its maximum designed temperature. Table 26 shows the reduced voltage drop / ampere / metre data corresponding to reduced operating temperature due to reduced load currents. The first line is applicable to 90˚C conductor temperature. Examples are given below to illustrate situations where over-designing can be avoided. "Standard conditions" in the following refer to those obtained in the United Kingdom on which the current rating / voltage drop tables are based. For situations other than "standard conditions" such as those in the Middle East, suitable rating factors can be applied for utilising data in Table 26 as shown in following example.

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

Example 2: At standard defined conditions:–

Consider a route of 120 metres of four core copper XLPE/SWA/PVC to be installed in air (at standard conditions) and to carry 300 amps per phase at 415 volts. Maximum voltage drop to be 2.5 per cent.

2.5 per cent of 415 V = 10.4 V

Substitute for current, route length and maximum volt drop

$$mV = \frac{10.4 \times 1000}{300 \times 120} = 0.289 \text{ mV/A/m}$$

From Table 26, the first line of figures per conductor size (corresponding to IEE Wiring Regulations) and giving a voltage drop value less than 0.289 is 185 mm^2. By studying the table to find a voltage drop value equal to, or less than the 0.289 calculated, but at the same time representing the 300 A load required, it will be seen that a voltage drop of 0.280 corresponds to a current of 305 A and a reduced conductor size of 150 mm^2. Therefore it is possible to select a 150 mm^2 cable rather than the 185 mm^2 cable first indicated.
The actual volt drop of this installation is

$$Vd = \frac{300 \text{ X } 120 \text{ X } 0.280}{1000} = 10.1V$$

Example 3:
Consider a route of 130 metres of four core copper XLPE/SWA/PVC cable to be installed partly in air, partly underground, and to carry 260 amps per phase at 380 V. Maximum voltage drop to be 3%. 3% of 380 V = 11.4 V

Substitute for current, route length and maximum volt drop

$$mV = \frac{11.4 \text{ X } 1000}{260 \text{ X } 130} = 0.337 \text{ mV/A/m}$$

Selecting a voltage drop corresponding to the maximum rating the size would be 150 mm^2 but selecting from Table 26 such that mV/A/m is equal to, or less than the 0.337 calculated and is capable of carrying 260 A (in ground and in air), it will be seen that this value is 0.333 for a 120 mm^2 cable (instead of 150 mm^2).

and the actual voltage drop $= \frac{260 \times 130 \times 0.333}{1000} = 11.3$ V

(See Tables 2 to 12 for site conditions other than standard defined conditions)

Example 4: At site conditions other than standard defined conditions:–

Consider example (2) but at an ambient temperature of 45˚C. Derating factor for this temp. = 0.87 (see Table 12). Using this factor, calculate the 'equivalent current' at standard conditions by dividing the actual current by the derating factor.

Thus 'equivalent current' $= \frac{300}{0.87} = 345$ A

and from previous example (2) the mV/A/m figure needs to be 0.289 or less.
Selecting a cable from Max Rating figures as previously - the cable would be 185 mm^2.
However selecting from Table 26 with a current of 345A and a volt drop of 0.289 (or less), gives a cable size of 150 mm^2 with a voltage drop value of 0.288 mV/A/m at 345A. (instead of the 185 mm^2).

and the actual voltage drop $= \frac{300 \times 120 \times 0.288}{1000} = 10.4$ V

RATING FACTORS

Where the conditions of installation differ from those defined in the current rating tables, the following rating factors may be used for cables size selection. (Reference ERA report)

CABLES LAID DIRECTLY IN GROUND

Ratings for cables installed directly in the ground are based on values of soil temperature and soil thermal resistivity which are generally representative of conditions in the United Kingdom. Rating factors to take account of variation in ground temperatures are given in Table 2. Where conditions of operation can be fairly accurately estimated and knowledge of the soil along the route is available, it is possible to determine the ratings more precisely by the use of the soil thermal resistivity factors, grouping factors, and factors for the depths of laying given in Tables 3 to 6.

RATING FACTORS FOR GROUND TEMPERATURE

Table 2

Ground 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

RATING FACTORS FOR VARIATION IN THERMAL RESISTIVITY OF SOIL (AVERAGE VALUES)

Table 3

Size of cables mm^2	Soil thermal resistivity in ˚C m/W						
	0.8	**0.9**	**1.0**	**1.5**	**2.0**	**2.5**	**3.0**
	Single core cables						
Up to 150	1.16	1.12	1.07	0.91	0.81	0.73	0.66
From 185 to 300	1.17	1.12	1.07	0.91	0.80	0.73	0.66
From 400 to 1000	1.17	1.12	1.07	0.91	0.80	0.73	0.66
	Multicore cables						
Up to 16	1.12	1.08	1.05	0.93	0.84	0.77	0.72
From 25 to 150	1.14	1.10	1.06	0.92	0.82	0.75	0.69
From 185 to 500	1.15	1.10	1.07	0.92	0.81	0.74	0.67

RATING FACTORS FOR DEPTH OF LAYING (TO CENTRE OF CABLE OR TREFOIL GROUP OF CABLES)

Table 4

Depth of laying m	600/1000 Volt			1900/3300 Volt	
	Up to 50mm^2	70mm^2 to 300mm^2	Above 300mm^2	Up to 300mm^2	Above 300mm^2
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	0.85	0.92	0.89
2.50	0.90	0.87	0.84	0.91	0.88
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 OR LAID FLAT TOUCHING, IN HORIZONTAL FORMATION

Table 5

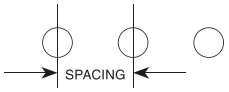
Number of Circuits							
		Spacing of Circuits					
		Touching**					
		Trefoil	Laid flat	0.15 m*	0.30 m	0.45 m	0.60 m
600/1000 Volt cables	2	0.78	0.81	0.83	0.88	0.91	0.93
	3	0.66	0.70	0.73	0.79	0.84	0.87
	4	0.61	0.64	0.68	0.73	0.81	0.85
	5	0.56	0.60	0.64	0.73	0.79	0.85
	6	0.53	0.57	0.61	0.71	0.78	0.82
1900/3300 Volt cables	2	0.78	0.80	0.82	0.86	0.89	0.91
	3	0.66	0.68	0.71	0.77	0.80	0.83
	4	0.59	0.62	0.65	0.72	0.77	0.80
	5	0.55	0.58	0.61	0.68	0.74	0.78
	6	0.52	0.55	0.58	0.66	0.72	0.76

* This spacing will not be possible for some of the larger diameter cables.

** For high current carrying cables (i.e. large size) it is advisable to allow spacing between circuits. Alternatively the most appropriate group rating factor must be applied when determining the cable size and required number of cables in parallel.

GROUP RATING FACTORS FOR MULTICORE CABLES IN HORIZONTAL FORMATION

Table 6

Number of Cables in Group						
		Spacing				
		Touching*	0.15 m	0.30 m	0.45 m	0.60 m
600/1000 volt cables	2	0.81	0.87	0.91	0.93	0.95
	3	0.70	0.78	0.84	0.88	0.90
	4	0.63	0.74	0.81	0.86	0.89
	5	0.59	0.70	0.78	0.84	0.87
	6	0.55	0.68	0.77	0.83	0.87
1900/3000 volt cables	2	0.80	0.85	0.89	0.91	0.93
	3	0.68	0.76	0.81	0.84	0.87
	4	0.62	0.71	0.77	0.81	0.84
	5	0.57	0.66	0.73	0.78	0.82
	6	0.54	0.64	0.71	0.77	0.81

* For high current carrying cables (i.e. large size) it is advisable to allow spacing between circuits. Alternatively the most appropriate group rating factor must be applied when determining the cable size and required number of cables in parallel.

CABLES INSTALLED IN DUCTS

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

RECOMMENDED DUCT DIMENSIONS AND CABLE SIZES

Table 7

Overall cable diameter mm	Duct	
	Inside diameter mm	Outside diameter mm
Up to and including 65	100	130
Above 65 up to and including 90	125	160

Ratings for cables installed in single way ducts, underground, have been based on values of soil temperature and soil thermal resistivity which are generally representative of conditions in the United Kingdom. Rating factors to take account of variations in ground temperatures are given in Table 2. Where conditions of operation can be fairly accurately estimated, and knowledge of the soil along the route is available, it is possible to determine the ratings more precisely by the use of estimated maximum ground temperature, the soil thermal resistivity factors, grouping factors, and factors for the depths of laying given in Tables 8 to 11.

RATING FACTORS FOR GROUND TEMPERATURE

Note: Same as for direct in ground, refer to Table 2.

RATING FACTORS OF VARIATION IN THERMAL RESISTIVITY OF SOIL (AVERAGE VALUES)

Table 8

Size of cable mm²	Soil thermal resistivity in °C m/W						
	0.8	0.9	1.0	1.5	2.0	2.5	3.0
	Single Core Cable						
Up to 150	1.10	1.07	1.04	0.94	0.86	0.80	0.76
From 185 to 300	1.11	1.08	1.05	0.93	0.85	0.79	0.75
From 400 to 1000	1.12	1.08	1.05	0.93	0.84	0.78	0.74
	Multicore Cables						
Up to 16	1.04	1.03	1.02	0.97	0.92	0.88	0.86
From 25 to 150	1.06	1.04	1.03	0.95	0.90	0.85	0.81
From 185 to 500	1.07	1.05	1.03	0.95	0.88	0.83	0.78

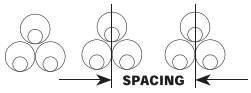
RATING FACTORS OF DEPTH OF LAYING (TO CENTRE OF DUCT OR TREFOIL GROUP OF DUCTS)

Table 9

Depth in laying m	600/1000 Volt		1900/3300 Volt	
	Single Core	Multicore	Single Core	Multicore
0.50	1.00	1.00	-	-
0.60	0.98	0.99	-	-
0.80	0.95	0.98	1.00	1.00
1.00	0.93	0.96	0.98	0.99
1.25	0.91	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
3.00 or more	0.85	0.91	0.88	0.92

GROUP RATING FACTORS FOR SINGLE CORE CABLES IN TREFOIL SINGLE WAY DUCTS, HORIZONTAL FORMATION (AVERAGE VALUES)

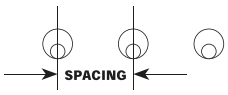
Table 10

Number of Circuits				
		Spacing		
		Touching*	0.45 m	0.60 m
600/1000 Volt Cables	2	0.87	0.91	0.93
	3	0.78	0.84	0.87
	4	0.74	0.81	0.85
	5	0.70	0.79	0.83
	6	0.69	0.78	0.82
1900/3300 Volt Cables	2	0.85	0.88	0.90
	3	0.75	0.80	0.83
	4	0.70	0.77	0.80
	5	0.67	0.74	0.78
	6	0.64	0.72	0.76

* For high current carrying cables (i.e. large size) it is advisable to allow spacing between circuits. Alternatively the most appropriate group rating factor must be applied when determining the cable size and required number of cables in parallel.

GROUP RATING FACTORS FOR MULTICORE CABLES IN SINGLE WAY DUCTS, HORIZONTAL FORMATION (AVERAGE VALUES)

Table 11

Number of Ducts in Ground		 Spacing			
		Touching*	0.30 m	0.45 m	0.60 m
600/1000 volt cables	2	0.90	0.93	0.95	0.96
	3	0.83	0.88	0.91	0.93
	4	0.79	0.85	0.89	0.92
	5	0.75	0.83	0.88	0.91
	6	0.73	0.82	0.87	0.90
1900/3000 volt cables	2	0.88	0.91	0.93	0.94
	3	0.80	0.85	0.88	0.90
	4	0.76	0.81	0.85	0.88
	5	0.72	0.78	0.83	0.86
	6	0.69	0.76	0.81	0.85

* For high current carrying cables (i.e. large size) it is advisable to allow spacing between circuits. Alternatively the most appropriate group rating factor must be applied when determining the cable size and required number of cables in parallel.

CABLES INSTALLED IN AIR

It is anticipated that many of the "in air" installations will be in buildings, and the ratings are therefore given in accordance with IEE Wiring Regulations for Electrical Installations.

It should be noted that all ratings for cables run in free air have been based on the assumption that they are shielded from the direct rays of the sun without restriction of ventilation. The rating for cables subjected to direct sunlight should be reduced to take account of this factor and further guidance on this subject is available on request.

RATING FACTORS FOR OTHER AMBIENT AIR TEMPERATURES

Table 12

Air Temperature	25˚C	30˚C	35˚C	40˚C	45˚C	50˚C	55˚C
XLPE Insulated	1.02	1.0	0.96	0.91	0.87	0.82	0.76

DEFIND CONDITIONS OF INSTALLATION

The 'in-air' current ratings given in relevant Tables between 16 to 28 are based on the installation conditions in air as follows:

(a) Single core cables

(1) Two single core cables are installed one above the other, fixed to the vertical surface of a wall or open cable trench, the distance between the wall and the surface of the cable being not less than 20mm.

Cables are installed at a distance between centres of twice the overall diameter of the cable, i.e. 2D, where D = overall diameter of cable.

(2) Three single core cables are installed in trefoil formation, fixed to the vertical surface of a wall or open cable trench, the cables touching throughout and the distance between the wall and the surface of the nearest cable being not less than 20mm. The cables are assumed to be remote from iron, steel or ferro-concrete, other than the cable supports. Single core armoured cables to be electrically bonded at each end of the run.

(b) Multicore Cables

Cables of all types other than single core cables are installed singly, fixed to the vertical surface of a wall or open cable trench, the distance between the surface of the cable and the wall being not less than 20 mm in every instance.

If it is necessary for cables to be installed at distances less than those described above, then the values tabulated under the heading “Clipped direct to a surface...” in the IEE Wiring Regulations should be employed.

SHORT CIRCUIT RATINGS - CONDUCTORS

Table 13

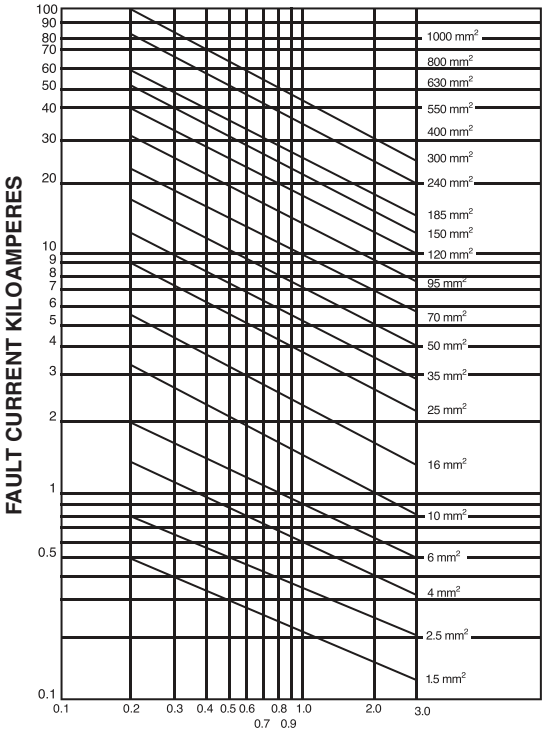
Conductor Size mm²	Short circuit ratings for 1 second in KA	
	Copper Conductor	Aluminium Conductor
1.5	0.21	0.14
2.5	0.36	0.24
4	0.57	0.38
6	0.86	0.56
10	1.43	0.94
16	2.29	1.50
25	3.58	2.35
35	5.00	3.29
50	7.15	4.70
70	10.01	6.58
95	13.59	8.93
120	17.16	11.28
150	21.45	14.10
185	26.46	17.39
240	34.32	22.56
300	42.90	28.20
400	57.20	37.60
630	90.09	59.22
800	114.40	75.20
1000	143.00	94.00

Note: For any other duration ‘t’ seconds divide the given value by $\sqrt{t}$

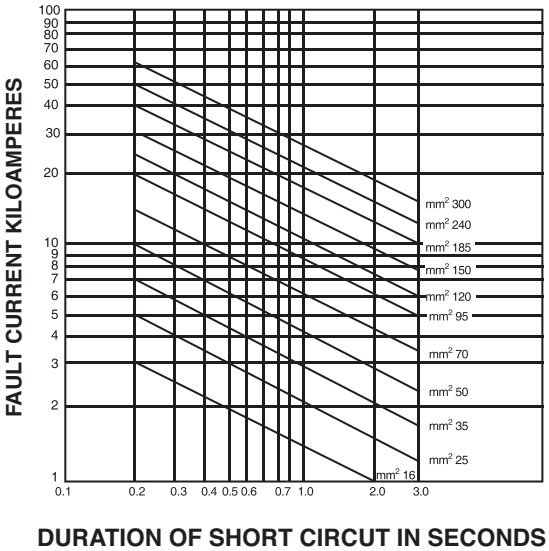
The values of fault current given in the graph are based on the cable being fully loaded at the start of the short circuit (conductor temperature 90˚C) and a final conductor temperature of 250 ˚C. It should be ensured that the accessories associated with the cables are also capable of operation at these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

Note: With XLPE cables the use of soldered type connectors (instead of the compression type) is not recommended since their use in the system would limit the final conductor temperature to 160 ˚C (and consequently reduce the fault current rating by approximately 30 per cent).

Copper Conductors



Aluminium Conductors



SHORT CIRCUIT RATINGS - ARMOUR

XLPE INSULATED CABLES

ARMOUR FAULT CURRENTS TO EARTH (FOR A FAULT DURATION OF 1 SECOND)

Table 14

Nominal Area of Conductor	Aluminium Wire Armour		Steel Wire Armour				
	600/1000 V	1900/3300 V	600/1000 V				1900/3300 V
	Single Core amp	Single Core amp	Two Core amp	Three Core amp	Four Core amp	Four Core (reduced neutral)** amp	Three Core amp
mm^2	XLPE	XLPE	XLPE	XLPE	XLPE	XLPE	XLPE
16	-	-	1800	2000	2200	-	3700
25	-	-	1900	2800	3200	3200	4200
35	-	-	2800	3200	3600	3400	4700
50	4000*	4700*	3100	3500	4100	3900	5600
70	4700*	5200*	3600	4100	6000	5900	6200
95	5200*	5700*	5100	5800	6700	6600	6900
120	5700*	6100	-	6400	9400	7500	9400
150	6400	6400	-	9200	10500	10000	10100
185	7100	7100	-	10100	11700	11500	10800
240	7900	7800	-	11500	13200	12800	11900
300	8800	8500	-	12300	14600	13900	13000
400	12400	12000	-	-	20700	20700	16700
500	13800	13300	-	-	22500	22500	-
630	15400	14900	-	-	-	-	-
800	21300	-	-	-	-	-	-
1000	23400	-	-	-	-	-	-

* Based on wire diameters larger than those specified in BS 5467. Refer to Table 15 and 27 for single core cable armour wire diameter.

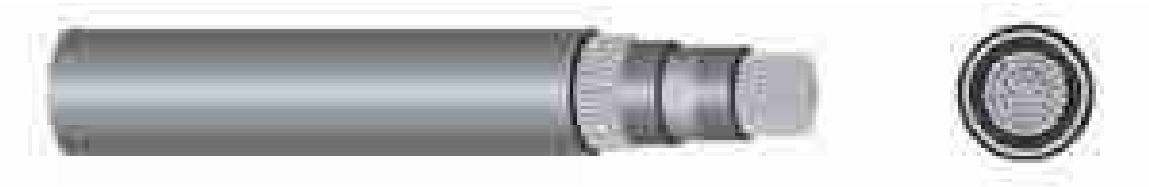
** Values based on IEC 60502-1

Notes: 1. The ratings given in the Table above are based on a fault duration of one second and an armour temperature rise from 80˚C at commencement of the fault to a final temperature of 200˚C.

2. The asymmetrical fault rating of the smaller sizes may be decided by the short circuit capability of the conductor rather than the armour rating. It is therefore necessary to compare the two ratings.

XLPE INSULATED CABLES TO BS 5467 & IEC-60502 - 1

DIMENSION AND WEIGHTS



STRANDED COPPER & ALUMINIUM CONDUCTORS - SINGLE CORE CABLES

UNARMOURED AND ARMOURED, PVC SHEATHED CABLES

600/1000 V **Table 15**

Nominal area of conductor mm²	Thickness of insulation mm	*Unarmoured Cables (approximate values)			Armoured Cables (approximate values)				
		Cable diameter overall mm	Cable weight Aluminium kg/km	Cable weight Copper kg/km	Diameter under armour mm	Armour** wire diameter mm	Cable diameter overall mm	Cable weight Aluminium kg/km	Cable weight Copper kg/km
50	1.0	14.2	250	540	12.6	1.6***	18.4	460	800
70	1.1	16.2	330	760	14.5	1.6***	20.2	560	990
95	1.1	18.3	430	1020	16.4	1.6***	22.3	690	1280
120	1.2	20.2	510	1270	18.0	1.6***	24.2	800	1550
150	1.4	22.4	630	1560	19.8	1.6	27.4	970	1900
185	1.6	24.7	760	1930	22.0	1.6	30.0	1150	2320
240	1.7	27.7	970	2510	24.6	1.6	32.8	1380	2930
300	1.8	30.6	1190	3120	27.3	1.6	35.6	1640	3580
400	2.0	34.2	1500	3970	31.2	2.0	40.5	2130	4600
500	2.2	38.0	1900	4980	36.0	2.0	44.2	2610	5680
630	2.4	42.9	2420	6400	40.0	2.0	48.8	3180	7160
800	2.6	47.8	3120	8210	45.8	2.5	55.4	4230	9315
1000	2.8	53.0	3780	10275	50.8	2.5	60.6	5000	11490

* Single core unarmoured cables are as per BS 7889.
** Aluminium wire armour for AC system.
*** Wire diameters are larger than those specified in BS 5467.

Note: Cables with Stranded Aluminium Conductors conform to IEC 60502 - 1.

CURRENT RATINGS (AC)

STRANDED COPPER & ALUMINIUM CONDUCTORS - SINGLE CORE CABLES

600/1000 V — ARMOURED PVC SHEATHED CABLES — Table 16

Nominal area of conductor mm²	Stranded Copper Conductors						Stranded Aluminium Conductors					
	Current Ratings			Approximate voltage drop per ampere per metre			Current Ratings			Approximate voltage drop per ampere per metre		
	Direct in ground amps	In single way ducts amps	3D Installed in air amps	Ground mV	Duct mV	Air mV	Direct in ground amps	In single way ducts amps	3D Installed in air amps	Ground mV	Duct mV	Air mV
50	235	235	222	0.87	0.93	0.87	175	180	162	1.40	1.60	1.40
70	290	280	285	0.62	0.70	0.62	220	220	207	0.98	1.00	0.98
95	345	330	346	0.47	0.56	0.47	260	260	252	0.72	0.79	0.74
120	390	370	402	0.39	0.48	0.39	295	295	292	0.58	0.66	0.60
150	435	405	463	0.33	0.43	0.33	330	330	337	0.48	0.57	0.49
185	490	440	529	0.28	0.39	0.28	375	365	391	0.39	0.49	0.41
240	560	500	625	0.24	0.35	0.24	435	410	465	0.31	0.42	0.34
300	630	550	720	0.21	0.32	0.21	490	455	540	0.27	0.38	0.29
400	700	580	815	0.195	0.30	0.195	540	480	625	0.35	0.38	0.25
500	770	620	918	0.180	0.28	0.180	580	510	714	0.31	0.35	0.22
630	840	670	1027	0.170	0.26	0.170	630	540	801	0.28	0.32	0.20
800	888	692	1119	0.165	0.25	0.165	-	-	-	-	-	-
1000	942	735	1214	0.155	0.24	0.155	-	-	-	-	-	-

600/1000 V — UNARMOURED PVC SHEATHED CABLES — Table 17

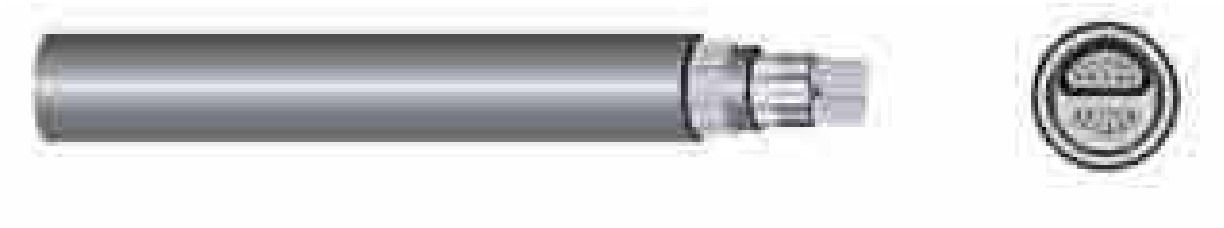
Nominal area of conductor mm²	Stranded Copper Conductors						Aluminium Conductors					
	Current Ratings			Approximate voltage drop per ampere per metre			Current Ratings			Approximate voltage drop per ampere per metre		
	Direct in ground amps	In single way ducts amps	3D Installed in air amps	Ground mV	Duct mV	Air mV	Direct in ground amps	In single way ducts amps	3D Installed in air amps	Ground mV	Duct mV	Air mV
50	230	240	209	0.85	0.93	0.87	175	180	159	1.40	1.50	1.45
70	285	295	268	0.61	0.70	0.61	215	220	206	0.98	1.10	0.98
95	335	345	326	0.45	0.56	0.45	255	260	253	0.71	0.79	0.73
120	385	395	379	0.36	0.48	0.37	295	300	296	0.57	0.66	0.59
150	435	445	436	0.31	0.43	0.31	325	335	343	0.47	0.57	0.47
185	490	500	500	0.26	0.39	0.26	370	375	395	0.39	0.49	0.39
240	570	580	590	0.22	0.35	0.22	430	440	471	0.31	0.42	0.32
300	650	650	681	0.19	0.32	0.195	490	510	544	0.26	0.38	0.27
400	740	750	793	0.17	0.30	0.175	550	570	638	0.36	0.38	0.23
500	840	850	904	0.16	0.28	0.160	620	640	743	0.33	0.35	0.20
630	960	960	1033	0.15	0.26	0.150	690	730	849	0.28	0.32	0.185
800	1120	1130	1179	0.15	0.25	0.145	-	-	-	-	-	-
1000	1300	1320	1323	0.14	0.24	0.140	-	-	-	-	-	-

Direct in ground - Trefoil touching
Single way ducts - ducts touching
Spacing in air - As shown above (D = Cable diameter)
Non magnetic wire armour bonded at both ends

Installation conditions for above ratings:
Ambient air temperature:30ºC
Ground temperature: 15ºC
Depth of laying:0.5 m, Soil thermal resistivity: 1.2ºC m/W
Maximum conductor operating temperature at rated current is 90ºC, For rating factors see Tables 2 to 6 and 8 to 12

XLPE INSULATED CABLES TO BS 5467 & IEC-60502 - 1

DIMENSION AND WEIGHTS



STRANDED COPPER & ALUMINIUM CONDUCTORS - TWO CORE CABLES

600/1000 V UNARMOURED AND ARMOURED, PVC SHEATHED CABLES **Table 18**

Nominal area of conductor mm²	Thickness of insulation mm	Unarmoured Cables (approximate values)			Armoured Cables (approximate values)				
		Cable diameter overall mm	Cable weight Aluminium kg/km	Cable weight Copper kg/km	Diameter under armour mm	Armour wire diameter mm	Cable diameter overall mm	Cable weight Aluminium kg/km	Cable weight Copper kg/km
16*	0.7	17.0	-	475	15.2	1.25	20.4	-	900
25*	0.9	20.2	415	740	18.5	1.25	24.1	915	1240
35*	0.9	22.5	480	955	21.5	1.60	27.7	1255	1710
50	1.0	20.4	497	1100	18.7	1.60	25.8	1430	1800
70	1.1	23.1	690	1520	21.5	1.60	29.0	1780	2320
95	1.1	26.5	850	2050	24.6	2.00	33.1	1950	3150
120	1.2	28.4	1170	2610	26.8	2.00	36.1	2440	3880
150	1.4	31.7	1450	3220	29.7	2.00	39.3	3050	4820
185	1.6	35.1	1810	4030	33.3	2.50	44.7	3690	5920
240	1.7	40.3	2280	5200	38.1	2.50	49.0	4380	7300
300	1.8	44.3	2760	6430	42.3	2.50	53.5	5100	8770

* Circular conductor, all others are sector shaped.

Note: Unarmoured cables & cables with Stranded Aluminium Conductors conform to IEC 60502 - 1.

CURRENT RATINGS (AC)

STRANDED COPPER & ALUMINIUM CONDUCTORS - TWO CORE CABLES

ARMOURED PVC SHEATHED CABLES

600/1000 V **Table 19**

Nominal area of conductor mm^2	Stranded Copper Conductors				Aluminium Conductors			
	Current Ratings			Approximate voltage drop per ampere per metre	Current Ratings			Approximate voltage drop per ampere per metre
	Direct in ground amps	In single way ducts amps	Installed in air amps	Ground / Duct / Air mV	Direct in ground amps	In single way ducts amps	Installed in air amps	Ground / Duct / Air mV
16	140	115	115	2.90	-	-	-	-
25	180	145	152	1.90	135	110	112	3.10
35	215	175	188	1.35	165	130	138	2.20
50	255	210	228	1.00	195	155	166	1.65
70	315	260	291	0.69	240	195	211	1.15
95	381	313	354	0.52	288	237	254	0.84
120	410	344	410	0.42	-	-	-	-
150	472	384	472	0.35	-	-	-	-
185	539	432	539	0.29	-	-	-	-
240	632	504	636	0.24	-	-	-	-
300	708	560	732	0.21	-	-	-	-

UNARMOURED PVC SHEATHED CABLES

600/1000 V **Table 20**

Nominal area of conductor mm^2	Stranded Copper Conductors				Aluminium Conductors			
	Current Ratings			Approximate voltage drop per ampere per metre	Current Ratings			Approximate voltage drop per ampere per metre
	Direct in ground amps	In single way ducts amps	Installed in air amps	Ground / Duct / Air mV	Direct in ground amps	In single way ducts amps	Installed in air amps	Ground / Duct / Air mV
16	140	115	115	2.90	-	-	-	-
25	180	140	149	1.90	135	105	108	3.10
35	215	170	185	1.35	165	130	135	2.20
50	255	205	225	1.00	195	150	164	1.65
70	315	255	289	0.69	240	195	211	1.15
95	380	311	352	0.52	285	235	257	0.84
120	410	344	410	0.42	-	-	-	-
150	473	384	473	0.35	-	-	-	-
185	542	432	542	0.29	-	-	-	-
240	641	504	641	0.24	-	-	-	-
300	741	560	741	0.21	-	-	-	-

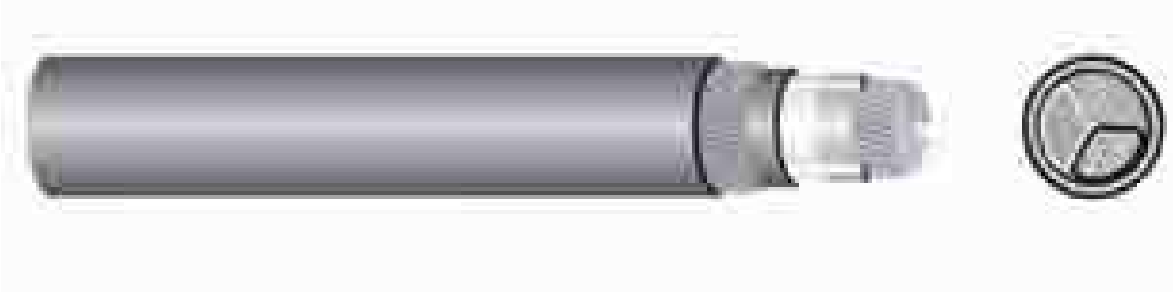
Direct in ground - Cables touching
Single way ducts - ducts touching

Note: Unarmoured cables are as per IEC 60502 - 1

Installation conditions for above ratings:
Ambient air temperature:30°C
Ground temperature: 15°C
Depth of laying: 0.5 m
Soil thermal resistivity: 1.2°C m/W
Maximum conductor operating temperature at rated current is 90°C
For rating factors see Tables 2 to 6 and 8 to 12

XLPE INSULATED CABLES TO BS 5467 & IEC-60502 - 1

DIMENSIONS AND WEIGHTS



STRANDED COPPER & ALUMINIUM CONDUCTORS
THREE CORE CABLES

UNARMOURES AND ARMOURED, PVC SHEATHED CABLES

600/1000 V **Table 21**

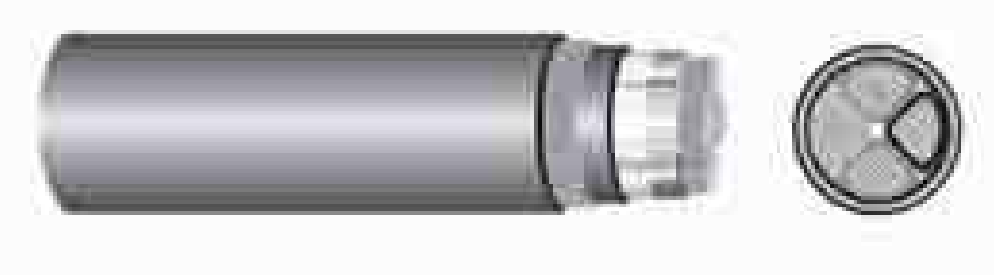
Nominal area of conductor mm²	Thickness of insulation mm	Unarmoured Cables (approximate values)			Armoured Cables (approximate values)				
		Cable diameter overall mm	Cable weight Aluminium kg/km	Cable weight Copper kg/km	Diameter under armour mm	Armour wire diameter mm	Cable diameter overall mm	Cable weight Aluminium kg/km	Cable weight Copper kg/km
16*	0.7	18.0	-	675	16.0	1.25	21.6	-	1130
25*	0.9	21.5	500	990	20.0	1.6	26.7	1220	1710
35*	0.9	24.0	610	1295	22.7	1.6	29.4	1415	2100
50	1.0	24.6	740	1640	23.0	1.6	28.5	1550	2450
70	1.1	28.0	1050	2220	26.0	1.6	32.2	1810	3120
95	1.1	31.0	1170	2980	30.0	2.0	37.0	2500	4310
120	1.2	34.8	1440	3730	32.8	2.0	40.4	2870	5160
150	1.4	38.5	2300	5195	36.8	2.5	45.5	3660	7160
185	1.6	44.0	2750	6470	41.5	2.5	49.8	4320	8600
240	1.7	49.5	3020	8380	46.0	2.5	55.1	5170	10755
300	1.8	53.5	3660	10420	51.5	2.5	60.2	6100	13080
400	2.0	59.2	3730	11575	56.4	2.5	66.6	7050	15810

* Circular conductors, all others are sector shaped.

Note: (1) Unarmoured cables & cables with Stranded Aluminium Conductors conform to IEC 60502 - 1.
(2) For current ratings & voltage drop data, please refer table 24 & 25 on page 25.

XLPE INSULATED CABLES TO BS 5467 & IEC-60502 - 1

DIMENSIONS AND WEIGHTS



STRANDED COPPER & ALUMINIUM CONDUCTORS
FOUR CORE CABLES

UNARMOURED AND ARMOURED, PVC SHEATHED CABLES

600/1000 V

Table 22

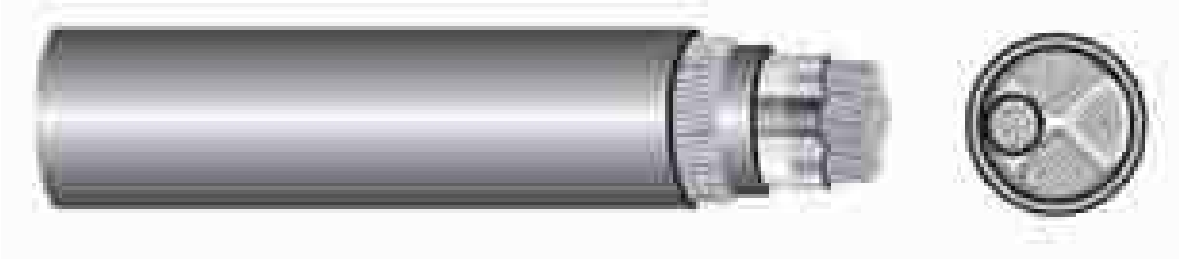
Nominal area of conductor mm²	Thickness of insulation mm	Unarmoured Cables (approximate values)			Armoured Cables (approximate values)				
		Cable diameter overall mm	Cable weight Aluminium kg/km	Cable weight Copper kg/km	Diameter under armour mm	Armour wire diameter mm	Cable diameter overall mm	Cable weight Aluminium kg/km	Cable weight Copper kg/km
16*	0.7	20.0	-	780	18.0	1.25	23.4	-	1320
25	0.9	21.0	520	1160	20.0	1.6	26.1	1200	1840
35	0.9	24.5	650	1540	22.8	1.6	28.6	1420	2310
50	1.0	26.5	900	2100	25.5	1.6	32.0	1770	2970
70	1.1	31.0	1210	2950	29.5	2.0	37.7	2500	4240
95	1.1	35.2	1550	3970	33.5	2.0	41.7	2980	5400
120	1.2	39.0	1910	4960	37.5	2.5	47.1	3950	7000
150	1.4	43.5	2410	6160	41.5	2.5	51.4	4600	8350
185	1.6	49.0	2990	7690	46.0	2.5	56.6	5430	10130
240	1.7	54.5	3890	10070	52.5	2.5	63.0	6660	12840
300	1.8	61.0	4730	12490	57.5	2.5	68.8	7770	15530
400	2.0	67.5	5780	15620	65.0	3.15	78.1	10380	19950
500**	2.2	74.2	7500	19900	72.6	3.15	82.0	12200	24360

* Circular conductors, all others are sector shaped.
** Cable as per IEC 60502 - 1.

Note: (1) Unarmoured cables & cables with Stranded Aluminium Conductors conform to IEC 60502 - 1.
(2) For current ratings & voltage drop data, please refer table 24 & 25 on page 25.

XLPE INSULATED CABLES TO IEC-60502 - 1

DIMENSIONS AND WEIGHTS



STRANDED COPPER & ALUMINIUM CONDUCTORS
FOUR CORE CABLES WITH REDUCED NEUTRAL CONDUCTOR

600/1000 V UNARMOURED AND ARMOURED, PVC SHEATHED CABLES **Table 23**

Nominal area of conductor mm²	Nominal area of neutral conductor mm²	Thickness of insulation (phase) mm	Unarmoured Cables (approximate values)			Armoured Cables (approximate values)				
			Cable diameter overall mm	Cable weight Aluminium kg/km	Cable weight Copper kg/km	Diameter under armour mm	Armour wire diameter mm	Cable diameter overall mm	Cable weight Aluminium kg/km	Cable weight Copper kg/km
25	16*	0.9	21.4	-	1070	19.5	1.6	25.4	-	1802
35	16*	0.9	23.2	-	1360	22.1	1.6	28.0	-	2179
50	25*	1.0	26.1	860	1920	24.5	1.6	30.7	**1700**	2762
70	35*	1.1	30.4	1080	2610	28.1	2.0	35.4	**2327**	3848
95	50	1.1	34.8	1390	3500	31.4	2.0	38.9	**2772**	4886
120	70	1.2	39.4	1820	4540	34.9	2.0	42.7	**3304**	5998
150	70*	1.4	42.5	2190	5440	38.6	2.5	47.6	**4311**	7675
185	95	1.6	47.7	2630	6760	42.8	2.5	52.2	**4990**	9071
240	120*	1.7	53.4	3500	8900	49.0	2.5	58.7	**6076**	11403
300	150*	1.8	59.0	4240	11000	53.2	2.5	63.1	**7044**	13694
400	185*	2.0	67.0	5560	13900	61.7	3.15	73.4	**9511**	18262
500	240*	2.2	74.0	6700	17560	68.8	3.15	83.9	**11200**	22000

* Circular stranded conductors, all others are sector shaped.

Note: For current ratings & voltage drop data, please refer table 24 & 25 on page 25.

CURRENT RATINGS (AC)

STANDARD COPPER & ALUMINIUM CONDUCTORS - THREE CORE CABLES, FOUR CORE CABLES & FOUR CORE CABLES WITH REDUCED NEUTRAL CONDUCTOR

600/1000 V — ARMOURED PVC SHEATHED CABLES — Table 24

Nominal area of conductor	Stranded Copper Conductors				Stranded Aluminium Conductors			
	Current Ratings			Approximate voltage drop per ampere per metre	Current Ratings			Approximate voltage drop per ampere per metre
mm²	Direct in ground amps	In single way ducts amps	Installed in air amps	Ground / Duct / Air mV	Direct in ground amps	In single way ducts amps	Installed in air amps	Ground / Duct / Air mV
16	115	94	99	2.5	89	72	74	4.2
25	150	125	131	1.65	115	94	98	2.7
35	180	150	162	1.15	135	110	120	1.95
50	215	175	197	0.87	165	135	145	1.45
70	265	215	251	0.60	200	165	185	0.97
95	315	260	304	0.45	240	200	224	0.72
120	360	300	353	0.37	275	230	264	0.58
150	405	335	406	0.30	310	255	305	0.47
185	460	380	463	0.26	350	295	350	0.39
240	530	440	546	0.21	410	340	418	0.31
300	590	495	628	0.185	460	385	488	0.26
400	667	570	728	0.165	520	443	562	0.25
500	720	605	800	0.165	561	470	618	0.20

600/1000 V — UNARMOURED PVC SHEATHED CABLES — Table 25

Nominal area of conductor	Stranded Copper Conductors				Stranded Aluminium Conductors			
	Current Ratings			Approximate voltage drop per ampere per metre	Current Ratings			Approximate voltage drop per ampere per metre
mm²	Direct in ground amps	In single way ducts amps	Installed in air amps	Ground / Duct / Air mV	Direct in ground amps	In single way ducts amps	Installed in air amps	Ground / Duct / Air mV
16	120	93	100	2.5	89	72	77	4.2
25	145	125	127	1.65	115	92	97	2.7
35	180	145	158	1.15	135	110	120	1.95
50	215	175	192	0.87	165	135	146	1.45
70	265	215	246	0.60	200	165	187	0.97
95	315	255	298	0.45	240	195	227	0.72
120	365	300	346	0.37	275	225	263	0.58
150	405	330	399	0.30	310	255	304	0.47
185	465	380	456	0.26	350	290	347	0.39
240	540	440	538	0.21	415	340	409	0.31
300	600	500	621	0.185	465	385	471	0.26
400	675	575	741	0.165	523	443	570	0.25
500	730	610	814	0.165	565	470	626	0.20

Direct in ground - Cables touching
Single way ducts - ducts touching

Note: **(1)** Unarmoured cables are as per IEC 60502 - 1.
(2) Current rating values are for main power conductor.

Installation conditions for above ratings:
Ambient air temperature:30℃
Ground temperature: 15℃, Depth of laying:0.5 m
Soil thermal resistivity: 1.2℃ m/W
Maximum conductor operating temperature at rated current is 90℃
For rating factors see Tables 2 to 6 and 8 to 12

XLPE INSULATED CABLES TO BS 5467

CURRENT RATINGS (AC) AND VOLT DROPS
STRANDED COPPER CONDUCTORS

600/1000 V THREE AND FOUR CORE ARMOURED, PVC SHEATHED CABLES **Table 26**

Conductor size mm²	Current in air A	Voltage drop mV/A/m	Current in ground A	Conductor size mm²	Current in air A	Voltage drop mV/A/m	Current in ground A	Conductor size mm²	Current in air A	Voltage drop mV/A/m	Current in ground A
	99	2.50	115		251	0.607	265		463	0.255	460
	97	2.50	112		240	0.599	260		450	0.252	450
	93	2.47	110		230	0.589	250		430	0.249	435
	89	2.43	105		220	0.580	245		415	0.246	420
16	84	2.39	100	**70**	210	0.572	235	**185**	395	0.243	405
	80	2.35	97		195	0.562	225		370	0.240	390
	74	2.31	94		185	0.554	215		345	0.237	375
	68	2.27	89		170	0.545	205		320	0.235	355
	62	2.23	84		150	0.536	195		290	0.232	335
	131	1.65	150		304	0.446	315		546	0.211	530
	130	1.59	145		295	0.439	305		530	0.208	515
	125	1.56	140		290	0.433	300		510	0.206	500
	120	1.54	135		270	0.427	290		490	0.204	485
25	110	1.51	130	**95**	255	0.421	280	**240**	465	0.203	470
	105	1.49	125		240	0.415	270		440	0.200	450
	99	1.46	120		225	0.408	255		410	0.199	430
	91	1.44	115		210	0.402	245		375	0.197	410
	82	1.41	110		190	0.396	230		340	0.195	385
	162	1.15	180		353	0.366	360		628	0.185	590
	155	1.15	175		340	0.357	350		605	0.183	575
	150	1.13	170		325	0.352	340		580	0.181	560
	145	1.11	165		310	0.347	330		555	0.180	540
35	135	1.09	160	**120**	300	0.342	320	**300**	530	0.179	520
	130	1.08	150		280	0.337	305		500	0.177	500
	120	1.06	145		260	0.333	295		465	0.176	480
	110	1.04	140		240	0.328	280		430	0.174	455
	100	1.02	130		215	0.323	260		390	0.174	430
	197	0.865	215		406	0.303	405		728	0.166	667
	190	0.852	210		395	0.299	395		715	0.163	640
	180	0.839	200		375	0.295	385		685	0.162	620
	175	0.826	195		365	0.292	370		655	0.161	600
50	165	0.813	190	**150**	345	0.288	360	**400**	620	0.160	580
	155	0.800	185		325	0.284	345		585	0.159	560
	145	0.787	175		305	0.280	330		545	0.158	535
	135	0.774	165		280	0.277	315		500	0.157	505
	120	0.761	155		250	0.273	295		450	0.156	475

Installation conditions for above ratings:

Ambient temperature: 30˚C
Ground Temperature: 15˚C
Soil Thermal resistivity: 1.2˚Cm/W
Depth of laying: 0.5 m

XLPE INSULATED CABLES TO BS 5467

DIMENSIONS AND WEIGHTS

1900/3300 V — **ARMOURED PVC SHEATHED CABLES** — **Table 27**

Stranded Copper Conductors - Single core cables						Stranded Copper Conductors - Three core cables ***					
Approximate Values						Approximate Values					
Nominal area of conductor mm^2	Thickness of insulation mm	Diameter under armour mm	Armour** wire diameter mm	Cable diameter overall mm	Cable weight copper kg/km	Nominal area of conductor mm^2	Thickness of insulation mm	Diameter under armour mm	Armour wire diameter mm	Cable diameter overall mm	Cable weight copper kg/km
50	2.0	15.0	1.6*	20.6	810	16	2.0	21.5	1.6	27.5	1604
70	2.0	16.6	1.6*	22.4	1040	25	2.0	24.5	1.6	30.4	2023
95	2.0	18.4	1.6*	24.3	1330	35	2.0	26.5	1.6	32.8	2448
120	2.0	19.8	1.6	27.2	1680	50	2.0	28.9	2.0	36.2	3164
150	2.0	21.2	1.6	28.8	1970	70	2.0	32.6	2.0	40.1	4033
185	2.0	23.0	1.6	30.8	2370	95	2.0	35.8	2.0	43.5	5004
240	2.0	25.5	1.6	33.5	2960	120	2.0	39.1	2.5	47.9	6308
300	2.0	27.7	1.6	36.1	3610	150	2.0	42.4	2.5	51.4	7353
400	2.0	31.0	2.0	40.5	4600	185	2.0	46.0	2.5	55.4	8711
500	2.2	36.0	2.0	44.2	5680	240	2.0	51.2	2.5	60.7	10764
630	2.4	40.0	2.0	48.8	7160	300	2.0	56.2	2.5	66.1	12956
800	2.6	45.8	2.5	55.4	9150	400	2.0	61.4	2.5	71.7	15760
1000	2.8	50.8	2.5	60.6	11270	-	-	-	-	-	-

CURRENT RATINGS

1900/3300 V — **ARMOURED PVC SHEATHED CABLES** — **Table 28**

Stranded Copper Conductors - Single core cables				Stranded Copper Conductors - Three core cables			
Nominal area of conductor mm^2	Direct in ground amps	In single way ducts amps	3D Installed in air amps	Nominal area of conductor mm^2	Direct in ground amps	In single way ducts amps	Installed in air amps
50	222	219	228	16	114	96	106
70	271	264	285	25	147	124	142
95	324	310	350	35	175	147	168
120	366	342	407	50	207	174	202
150	409	376	463	70	254	214	255
185	460	414	528	95	304	257	312
240	528	464	623	120	345	293	361
300	589	506	710	150	387	328	410
400	651	535	808	185	436	371	471
500	720	579	915	240	502	428	554
630	789	624	1030	300	563	480	634
800	831	650	1119	400	641	512	704
1000	880	689	1214	-	-	-	-

Direct in ground - Trefoil touching
Single way ducts - ducts touching
Spacing in air - As shown above (D=Cable diameter)
*Wire diameters are larger than those specified in BS 5467
**Aluminium wire armour for AC system
*** As per IEC 60502-1

Installation conditions for above ratings:
Ambient air temperature: 30˚C
Ground temperature: 15˚C
Depth of laying: 0.5 m
Soil thermal resistivity: 1.2˚C m/W
Maximum conductor operating temperature at rated current is 90˚C
For rating factors see Tables 2 to 6 and 8 to 12

CONDUCTOR / ARMOUR RESISTANCE AND REACTANCE VALUES

SINGLE AND MULTICORE CABLES HAVING WIRE ARMOUR

600/1000 V

Table 29

Nominal Area of Conductor mm²	Maximum resistance of Conductor and Armour in ohms/km at 20°C									Inductive reactance (approx) per core of 3 phase circuite in ohm/km @ 50 Hz		
	Copper Conductor *	Aluminium Conductor	Single Core		Two core	Three Core		Four Core** (equal neutral)	Four Core (reduced neutral)			
			Aluminium wire armour		Galvanised Steel Wire Armour							
			With stranded copper conductor 600/1000 V	With stranded aluminium conductor 600/1000 V	600/ 1000 V	600/ 1000 V	1900/ 3300 V	600/ 1000 V	600/ 1000 V	Single core cable	Two core cable	Three & Four core cable
16	1.15	1.910	-	-	3.70	3.50	1.90	3.10	-	-	0.081	0.081
25	0.727	1.200	-	-	3.70	2.50	1.70	2.30	2.30	-	0.079	0.079
35	0.524	0.868	-	-	2.60	2.30	1.80	2.00	2.10	-	0.077	0.077
50	0.387	0.641	1.30	0.75	2.30	2.00	1.30	1.80	1.90	0.106	0.076	0.076
70	0.268	0.443	0.75	0.67	2.00	1.80	1.20	1.20	1.30	0.103	0.075	0.075
95	0.193	0.320	0.67	0.61	1.40	1.30	1.10	1.10	1.10	0.098	0.073	0.073
120	0.153	0.253	0.61	0.42	1.30	1.20	0.76	0.76	0.96	0.096	0.072	0.072
150	0.124	0.206	0.42	0.39	1.20	0.78	0.71	0.68	0.71	0.097	0.073	0.073
185	0.0991	0.164	0.38	0.37	0.82	0.71	0.65	0.61	0.63	0.096	0.073	0.073
240	0.0754	0.125	0.34	0.34	0.73	0.63	0.59	0.54	0.56	0.092	0.072	0.072
300	0.0601	0.100	0.31	0.31	0.67	0.58	0.55	0.49	0.52	0.09	0.072	0.072
400	0.0470	0.0778	0.22	0.22	0.59	0.52	0.50	0.35	0.46	0.09	0.072	0.07
500	0.0366	0.0605	0.20	0.20	-	-	-	-	-	0.089	-	-
630	0.0283	0.0469	0.18	0.18	-	-	-	-	-	0.086	-	-
800	0.0221	0.0367	0.13	0.13	-	-	-	-	-	0.083	-	-
1000	0.0176	0.0291	0.12	0.12	-	-	-	-	-	0.08	-	-

* The values given are for plain annealed copper conductors. For tinned conductors reference should be made to BSEN 60228

** Multicore cables with stranded Aluminium conductor have same Armour resistances as those with Copper conductors.

ADVANTAGES OF XLPE INSULATED CABLES

1. Does not soften beyond the normal range of conductor operating temperatures and is called THERMOSETTING insulation.
2. Due to greater capacity to withstand heat, the permissible maximum continuous conductor operating temperature is 90˚C and for momentary short circuits the permissible temperature is 250˚C.
3. Higher insulation strength and superior mechanical properties allow lower insulation thickness. The insulation resistance value of the cable does not appreciably change with conductor operating temperature.
4. XLPE insulation dissipates heat from conductors much faster as its thermal resistivity is 3.5˚C m/W.
5. Heat generation in the insulation itself is low due to very low “loss angle”.
6. Due to the foregoing reasons, an XLPE cable can carry 15% to 30% higher current than a PVC cable with the same conductor size.
7. Density of XLPE is 0.92 to 0.94 gm/ml and due to lower insulation thickness, XLPE insulated cables are lighter and easier to install.
8. Jointing and terminating of XLPE insulated cables does not require any special techniques.

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