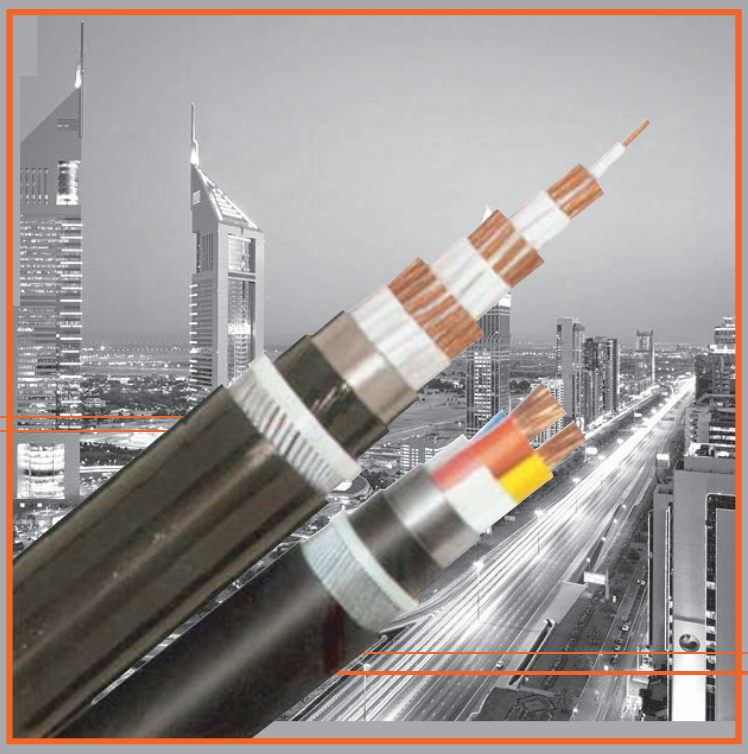
Ducab دوكاب

كابلات الطاقة والتحكم المغلفة بالرصاص

LEADSHEATHED POWER, CONTROL AND AUXILIARY CABLES



حلول متقدمة للكابلات من خلال التقنية والابداع

Advanced Cable Solutions Through Technology and Innovation

BICC

Ducab دوكاب

CONTENTS

Ducab Connect

Ducab has a set up Ducab Connect to offer “a one stop package” of Ducab cables and Ducab Connect accessories. Please refer to the tables shown below to identify the correctly sized glands.

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.

Ducab دوكاب

INTRODUCTION

Ducab - Dubai Cable Company (Pvt.) Ltd., is the leading manufacturer of electric cables in the Middle East. Established in 1979, the company is owned by the Governments of Dubai and Abu Dhabi. Ducab is based in Jebel Ali, but to meet the continuing demand and keep pace with the steady growth of the region, Ducab completed a second factory in Abu Dhabi in 2005. This state of the art facility doubles the production capacity enabling Ducab to better service its customers.

This catalogue provides working information on Ducab's complete range of Low Voltage Lead Sheathed Power, Control & Auxiliary Cables rated on to 3.3 kV. Separate catalogues are available for Ducab's range of Low Voltage Control & Auxiliary Cables, XLPE Power 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 Ducab Lead Sheathed Power, Control & Auxiliary Cables is available from Ducab Sales Offices or direct from Ducab Head Office,
P. O. Box 11529, Dubai, U. A. E., Tel: 971-4-8082500, Fax: 971-4-8082511.
E-mail: ducab@ducab.com Website: www.ducab.com

Ducab دوكاب

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 the British Standards Institution (via BASEC) of the UK. They fully conform to BS 6346 and BS 5467 specifications for PVC and XLPE insulated cables respectively, for electricity supply, up to and including 600/1000 V ratings.

In addition, Ducab was presented with the Dubai Quality Award 1994, for the best local industrial company of the year. Ducab was honoured with the Dubai Quality Award '98 Gold Category. In 2004, Ducab won the DQA Gold category for the second time, the only organisation to achieve such distinction. 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 conductor, insulation and protective 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 damage from chafing or 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.

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.

Joint Winner
MANUFACTURING
INDUSTRY
Sector Award

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. and safety related activities.

Ducab دوكاب

Quality Management System Certified to ISO 9001

Ducab's Quality Management System conforms to the ISO 9001 International Quality System Standard and was certified by the British Standards Institution. Ducab now holds ISO 9001:2000 certificate issued independently by BASEC (British Approval Service for Cables).

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 the 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 9001:2000 standard as it is an independent conformation that it 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 14001

Ducab's Environmental Management System conforms to the ISO 14001 International Environmental Management Standard and is certified by BASEC.

Certification to the ISO 14001 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.

Ducab Shareek

Ducab's customer care programme is designed to ensure that customers receive a consistently high level of service from Ducab's dedicated staff.

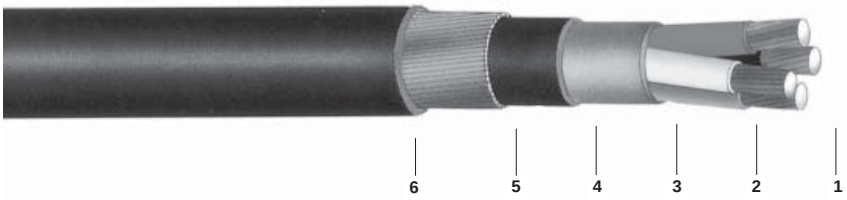
Ducab دوكاب

PRODUCT RANGE

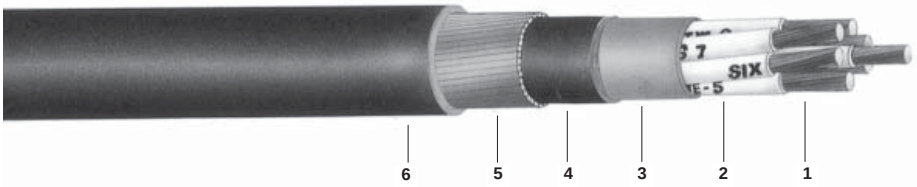
The XLPE insulated, lead sheathed cables detailed in this publication are rated at 600/1000V; 1900/3300V rated cables are also included. The cables comply to IEC 60502 - 1 (XLPE) and BS 5467 (XLPE) specifications and EEMUA publication No. 133. Cables can also be supplied to the National Standards of other countries, details are available upon request. All of the cables in this publication meet the requirements of IEC: 332 Part 1 'Test on electric cables under fire conditions' and BS 4066 Part 1.

SPECIFICATION AND CONSTRUCTION

Lead Sheathed Power Cable



Lead Sheathed Auxiliary Cable



Construction

1 - Plain Copper Conductor

2 - Insulation XLPE or PVC

3 - Lead Sheath

4 - PVC Bedding

5 - Galvanised Steel Wire Armour

6 - PVC Oversheath

The cables detailed in this brochure are designed to facilitate land-based activities in the oil, gas, petroleum and chemical industries where the spillage or seepage of corrosive liquids and vapours pose a threat to circuit integrity. Contaminants such as petroleum-based substances are capable of permeating cable sheaths and passing along and between armour wires, thus the inevitable degradation of insulating materials may not be limited to the proximity of penetration.

To counter the hazard, cables are constructed with an impermeable lead or lead alloy sheath around the core assembly. This lead sheath and its subsequent coverings of PVC bedding, galvanised steel wire armour and outer PVC sheath are the essence of the Engineering Equipment and Materials Users Association (EEMUA) "Specification of Underground Armoured Cables Protected Against Solvent Penetration and Corrosive Attack," Publication No. 133. The purpose of this specification is to establish the degree and manner of protection to be applied over the insulated core assembly of almost any cable such that it is graded suitable for use by the industries concerned in those installation locations with the potential contamination hazards. Please see inside front cover for cable construction.

Note: Dimensions and Performance data for $3^{1/2}$ core cables (not included here) can be furnished on request.

Ducab دوكاب

CONDUCTORS

The conductors used in Ducab's lead sheathed power, control and auxiliary cables are aluminium or high conductivity annealed copper which meet the requirements of BS 6360 "Conductors in insulated cables and cords" and IEC 60228. Where possible, stranded conductors are shaped and compacted to reduce dimensions and give a smoother profile. This compacting sometimes entails a change in the number and size of wires, therefore compacted conductors are designated by nominal cross sectional area rather than by stranding configuration.

INSULATION

The material of insulation is Cross Linked Polyethylene (XLPE). As an insulation material, XLPE has several advantages over PVC, although it is not flame retardant. The good qualities 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 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.

CORE IDENTIFICATION

Core identification is as follows unless otherwise specified:

Number of cor es	Identif ication
Single (Power)	Red or Black
Two (Power/Control)	Red, Black
Three (Power/Control)	Red, Yellow, Blue
Four (Power/Control)	Red, Yellow, Blue, Black
Five (Power)	Red, Yellow, Blue, Black, Green/Yellow
Five or more (Auxiliary)	White cores with number printing in black

Black denotes the neutral and the other colours the phase conductors. Other non-stranded core colours can be considered.

FILLERS

Non-hygroscopic polypropylene fillers are included between laid-up cores where necessary.

A separator tape of non-hygroscopic polypropylene material is applied over XLPE cores.

A PVC bedding under the lead sheath, while not standard, may be included on request.

LEAD SHEATH

This protects the core assembly against moisture, hydrocarbons and corrosive contaminants found below ground, and meets the requirements of BS 801 and EEMUA 133 specifications.

Lead alloy E possesses characteristics as a sheathing material important both in manufacture and installation. For cables buried in the ground the excellent corrosion-resistant properties are particularly important.

The thickness of the lead sheath will comply with EEMUA - 133 for cables to IEC 60502 - 1/ BS 5467 , unless otherwise specified.

BEDDING

A layer of extruded PVC is incorporated into the design to separate the lead sheath from, and provide a sound bedding for, the metallic armour.

ARMOUR

This guards against mechanical damage to the cable and comprises a single layer of spirally applied galvanised steel wires for all multicore cables. Copper wires may be included as necessary to increase the conductivity. Aluminium wire is used in armouring single core cables.

Ducab دوكاب

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 Lo w Acid Fumes (RPLHCL): Retards propagation of flames and gives low emission of hydrochloric acid fumes. (OI = 30 & acid gas emission is less than 18%)
- **Ducab Smokemaster** Low Smoke & Fume (LSF): **Ducab Smokemaster** cables are ideal for installation where the dense black smoke generated by cables with PVC outer sheath in a fire are a danger to people. **Ducab 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. **Ducab Smokemaster** cables are offered to BS 6724.

Ducab Smokemaster LSF CABLES

Ducab can manufacture a dedicated cable called **Ducab Smokemaster LSF** (Low Smoke and Fume) for installations where fire and its associated problems - the emission of smoke and toxic fumes - offer a serious potential threat. **Ducab Smokemaster LSF** compound is free from halogens (fluorine, chlorine and bromine) and when tested to BS 6425 Part 1 and IEC 754 Part 1 the acidic gas evolved during combustion is less than 0.5% by weight of material. Furthermore, when tested in accordance with BS 2782 Method 141D, the oxygen index of both bedding and sheath will not be less than 30. These cables comply with BS 6724.

Ducab Smokemaster LSF Cable:

- is slow to ignite, burns slowly and gives off reduced smoke and fumes which can kill people
- does not produce corrosive halogen acid gases which destroy sensitive electronic equipment
- helps people to escape from a fire - helps them to see and to breathe for longer
- wins time for people to escape and for emergency services to help
- is essential in public buildings, transport or confined areas where larger numbers of people- many of them strangers to the surroundings or infirm - regularly congregate

Ducab Smokemaster LSF cables should be used in any location where the outbreak of fire would constitute an immediate threat to life and to the performance of sensitive electronic equipment.

Note: For technical data for **Ducab Smokemaster LSF** cables, please refer to Ducab Smokemaster catalogue.

INSTALLATION GUIDE

Environment

All cables in this catalogue can be installed and operated indoors, outdoors or underground.

Minimum bending radius

The installation radius for any cable should be as great as possible. For all cables listed in this catalogue, it should not be less than twelve times the overall cable diameter.

Note: For technical detail on Installation guide, please refer to Ducab Drum Handling & Installation Catalogue.

Ducab دوكاب

DIMENSIONS AND WEIGHTS

600/1000V

XLPE INSULATED LEAD SHEATHED COPPER/ALUMINIUM CONDUCTOR POWER & CONTROL CABLES TO IEC 60502-1

Table 1(A)

	Nominal area of conductor mm²	Approximate diameter: Over lead mm	Approximate diameter: Armour wire mm	Approximate diameter: Overall cable mm	Approximate: Cable weight Copper kg/km	Approximate: Cable weight Aluminium kg/km	416AA-· 416AB-( )· 475AA-·	424PB·
SINGLE CORE	50	12.7	1.6	21.5	1308	1013	53T (93T)	55T
	70	14.5	1.6	23.3	1620	1190	54T (94T)	55T
	95	16.3	1.6	25.1	2020	1431	54T (94T)	55T
	120	18.1	1.6	26.9	2372	1629	55T (95T)	56T
	150	19.9	1.6	28.7	2730	1818	56T (96T)	56T
	185	22.3	1.6	31.3	3338	2195	56T (96T)	56T
	240	25.1	2.0	35.3	4271	2767	57T	57T
	300	27.6	2.0	38.0	5029	3143	57T	57T
	400	31.1	2.0	42.1	6262	3865	58T	59T
	500	36.3	2.5	48.7	8093	5035	60T	59T
	630	40.3	2.5	53.1	10000	6014	62T	61T
	800	46.3	2.5	59.5	12736	7597	64T	61T
	1000	50.1	2.5	63.9	15384	9018	65T	61T
TWO CORE	1.5	8.0	0.9	15.4	667	-	51 (91)	52
	2.5	9.2	1.25	17.3	830	-	52 (92)	53
	4	10.6	1.25	18.7	970	-	52 (92)	53
	6	11.7	1.25	19.8	1098	-	52 (92)	53
	10	13.6	1.25	21.7	1321	-	53 (93)	55
	16	15.5	1.6	24.3	1705	-	54 (94)	55
	25	18.9	1.6	27.7	2242	1927	55 (95)	56
	35	21.5	1.6	30.5	2740	2300	56 (96)	56
	D50	19.0	1.6	28.2	2651	2073	55 (95)	56
	70	22.1	2.0	32.5	3286	2456	56 (96)	56
	95	24.0	2.0	34.8	4326	3176	57	57
	120	27.2	2.0	38.4	5217	3769	57	57
	150	30.3	2.5	42.9	6500	4728	58	59
	185	33.7	2.5	46.9	7775	5547	60	59
	240	38.9	2.5	52.7	9776	6848	61	59
	300	42.9	3.15	58.0	12195	8517	62	61
THREE CORE	1.5	8.4	0.9	15.8	707	-	51 (91)	52
	2.5	9.8	1.25	17.9	899	-	52 (92)	53
	4	11.2	1.25	19.3	1045	-	52 (92)	53
	6	12.5	1.25	20.6	1203	-	53 (93)	55
	10	14.2	1.25	22.3	1445	-	54 (94)	55
	16	16.5	1.6	25.3	1940	-	54 (94)	55
	25	20.3	1.6	29.1	2610	2140	56 (96)	56
	35	22.9	1.6	31.9	3200	2540	56(96)	56
	50+	23.8	2.0	34.2	3846	2980	57	57
	70	26.1	2.0	36.9	4770	3525	57	57
	95	29.9	2.0	40.9	5995	4270	58	59
	120	33.4	2.5	46.0	7556	5385	59	59
	150	37.4	2.5	50.4	8970	6315	60	59
	185	42.3	2.5	55.9	11005	7665	62	61
	240	46.8	2.5	61.0	13445	9055	64	61
	300	52.2	2.5	67.0	16130	10610	66	63
	400	57.8	3.15	74.7	20620	13570	68	63
FOUR CORE	1.5	9.2	1.25	17.3	846	-	52 (92)	53
	2.5	10.7	1.25	18.8	932	-	52 (92)	53
	4	12.4	1.25	20.5	1116	-	53 (93)	55
	6	13.7	1.25	21.8	1296	-	53 (93)	55
	10	16.0	1.6	24.8	1755	-	54 (94)	55
	16	18.2	1.6	27.0	2285	-	55 (95)	56
	25+	20.4	1.6	29.4	2840	2200	56 (96)	56
	35	23.4	1.6	32.8	3550	2670	57	57
	50	26.3	2.0	36.9	4630	3420	57	57
	70	30.2	2.0	41.2	5945	4245	58	59
	95	34.4	2.5	47.0	7860	5495	60	59
	120	37.9	2.5	50.9	9350	6382	60	59
	150	42.4	2.5	56.0	11300	7650	62	61
	185	47.6	2.5	61.8	13630	9056	64	61
	240	53.0	2.5	67.8	16930	10913	66	63
	300	58.7	3.15	75.6	21190	13617	68	63
	400	66.1	3.15	84.0	26180	16539	70	64

† 416AA - series - RTL for Lead sheath cable (industrial)
† 416AB - series - RTL E.Exe increased safety Gland
† 475AA - series - RTLF E.Exd flameproof Gland
† 424PB - series - BARR.PB E.Exd Explosion Proof Barrier Gland

Ducab دوكاب

DIMENSIONS AND WEIGHTS

600/1000V | **XLPE INSULATED LEAD SHEATHED COPPER/ALUMINIUM CONDUCTOR AUXILIARY CABLES TO IEC 60502-1** | **Table 1(B)**

	Nominal area of conductor mm²	Approximate diameter			Approximate	416AA-· 416AB-( )· 475AA-·	424PB·
		Over lead mm	Armour wire mm	Overall cable mm	Cable weight kg/km		
FIVE CORE	1.5	10.8	1.25	18.9	982	52 (92)	53
	2.5	11.6	1.25	19.7	1102	52 (92)	53
	4	13.4	1.25	21.1	1210	53 (93)	55
	6	14.9	1.25	23.0	1550	54 (94)	55
	10	17.6	1.60	26.4	2150	55 (95)	56
	16	19.8	1.60	28.6	2610	56 (96)	56
	25	24.8	1.60	34.0	3690	57	57
	35	27.8	2.00	38.2	4740	57	57
No. of cores							
7	Nominal area of conductor 1.5mm²	11.7	1.25	19.8	1085	52 (92)	53
10		14.9	1.25	23.0	1400	54 (94)	55
12		15.3	1.25	23.4	1450	54 (94)	55
19		18.1	1.60	26.9	2000	55 (95)	56
24		21.3	1.60	30.1	2380	56 (96)	56
27		22.0	1.60	30.8	2560	56 (96)	56
37		24.9	1.60	33.9	3093	57	57
48		28.7	2.00	39.1	4065	57	57
No. of cores							
7	Nominal area of conductor 2.5mm²	12.7	1.25	20.8	1242	53 (93)	55
10		16.1	1.60	24.9	1730	54 (94)	55
12		16.7	1.60	25.5	1836	54 (94)	55
19		19.8	1.60	28.6	2355	56 (96)	56
24		23.5	1.60	32.5	2900	57	57
27		24.1	1.60	33.3	3060	57	57
37		27.2	2.00	37.6	3962	57	57
48		31.7	2.00	42.5	4980	59	59
No. of cores							
7	Nominal area of conductor 4.0 mm²	14.6	1.25	22.3	1350	54 (94)	55
12		19.6	1.60	28.4	2132	56 (96)	56
19		23.2	1.60	32.2	2735	56 (96)	56
27		28.1	2.00	38.3	3785	57	57
37		32.0	2.00	42.8	4770	59	59
48		36.2	2.00	47.2	5700	60	59

Explanatory Notes:

1. Lead sheathed thickness of all cables will conform to recommendations of EEMUA - 133
2. Tolerance on the above dimensions are -0.5mm and +0.5mm.
3. The minimum diameter of aluminium wire armour for single core cables is 1.6mm.
4. Cable sizes marked + and higher have sector shaped conductors.
5. Cable sizes marked 'D'and higher have 'D'shaped conductors.

· 416AA - series - RTL for Lead sheath cable (industrial)
· 416AB - series - RTL E.Exe increased safety Gland
· 475AA - series - RTLF E.Exd flameproof Gland
· 424PB - series - BARR.PB E.Exd Explosion Proof Barrier Gland

Ducab دوكاب

DIMENSIONS AND WEIGHTS

600/1000V

XLPE INSULATED LEAD SHEATHED POWER AND CONTROL CABLES TO BS 5467 AND EEMUA 133

Table 2

	Nominal area of conductor	Approximate diameter			Approximate		416AA-· 416AB-( )· 475AA-·	424PB·
		Over lead	Armour wire	Overall cable	Cable weight Copper	Cable weight Aluminium		
	mm^2	mm	mm	mm	kg/km	kg/km		
SINGLE CORE	50*	13.0	1.6	20.8	1300	1005	53T (93T)	55T
	70*	15.0	1.6	22.6	1620	1190	54T (94T)	55T
	95*	16.8	1.6	24.5	2040	1451	54T (94T)	55T
	120*	18.5	1.6	26.2	2380	1621	55T (95T)	56T
	150	20.5	1.6	28.5	2840	1928	56T (96T)	56T
	185	22.8	1.6	30.8	3365	2222	56T (96T)	56T
	240	25.5	1.6	33.5	4180	2676	57T	57T
	300	28.1	1.6	36.4	5060	3174	57T	57T
	400	32.3	2.0	41.8	6400	4003	59T	59T
	500	37.0	2.0	46.6	8000	4942	60T	59T
	630	40.8	2.0	50.8	9720	5734	62T	61T
	800	47.5	2.5	59.2	12700	7561	64T	61T
	1000	52.5	2.5	64.2	15400	9034	66T	63T
TWO CORE	1.5	8.6	0.9	14.0	640	-	51 (91)	52
	2.5	9.5	0.9	15.0	730	-	51 (91)	52
	4	10.8	0.9	16.5	840	-	52 (92)	53
	6	11.6	0.9	17.5	960	-	52 (92)	53
	10	13.7	0.9	19.8	1180	-	53 (93)	55
	16	15.5	1.25	21.8	1540	-	54 (94)	55
	25	18.9	1.25	25.5	2060	1745	55 (95)	56
	35	21.3	1.6	29.4	2670	2230	56 (96)	56
	50+	19.0	1.6	27.2	2640	2062	56 (96)	56
	70	22.2	1.6	30.5	3400	2570	56 (96)	56
	95	24.8	2.0	34.5	4530	3380	57	57
THREE CORE	1.5	9.2	0.9	14.5	700	-	51 (91)	52
	2.5	10.4	0.9	16.0	815	-	52 (92)	53
	4	11.4	0.9	17.0	920	-	52 (92)	53
	6	13.0	0.9	18.5	1080	-	53 (93)	55
	10	14.8	1.25	21.5	1500	-	54 (94)	55
	16	16.5	1.25	23.0	1750	-	54 (94)	55
	25	20.5	1.6	28.6	2650	2180	56 (96)	56
	35	23.0	1.6	31.2	3220	2560	56 (96)	56
	50+	24.0	1.6	32.0	3630	2764	57	57
	70	26.5	1.6	35.0	4560	3315	57	57
	95	30.5	2.0	40.5	6110	4385	58	59
	120	33.5	2.0	43.5	7300	5129	59	59
	150	37.8	2.5	49.4	8980	6325	60	59
	185	42.8	2.5	54.5	10870	7530	62	61
	240	48.2	2.5	60.2	13500	9110	64	61
	300	52.2	2.5	65.2	16150	10630	66	63
FOUR CORE	1.5	10.1	0.9	15.6	765	-	52 (92)	53
	2.5	11.1	0.9	16.8	870	-	52 (92)	53
	4	12.8	0.9	18.5	1030	-	53 (93)	55
	6	13.8	1.25	20.3	1330	-	53 (83)	55
	10	16.5	1.25	22.8	1670	-	54 (94)	55
	16	18.8	1.25	25.5	2120	-	55 (95)	56
	25+	20.5	1.6	28.5	2800	2160	56 (96)	56
	35	23.2	1.6	31.3	3430	2550	56 (96)	56
	50	26.2	1.6	34.6	4260	3050	57	57
	70	30.5	2.0	40.5	5850	4150	58	59
	95	34.8	2.0	44.8	7340	4975	60	59
	120	37.8	2.5	49.8	9400	6432	60	59
	150	43.2	2.5	55.0	11280	7630	62	61
	185	47.8	2.5	60.0	13600	9020	64	61
	240	53.8	2.5	66.5	17000	10980	66	63

* Cable with 1.6mm wire armour, a deviation from BS 5467.
Tolerance on the above dimensions are -0.3mm and +0.5mm.
Cable sizes marked + and higher have sector shaped conductors.

† 416AA - series - RTL for Lead sheath cable (industrial)
† 416AB - series - RTL E.Exe increased safety Gland
† 475AA - series - RTLF E.Exd flameproof Gland
† 424PB - series - BARR.PB E.Exd Explosion Proof Barrier Gland

Ducab دوكاب

DIMENSIONS AND WEIGHTS

600/1000V

LEAD SHEATHED XLPE INSULATED CABLES TO BS 5467 & EEMUA 133

Table 3

No. of Cores	Approximate diameter			Approx. weight kg/km	416AA-· 416AB-( )· 475AA-·	424PB-·
	Over Lead mm	Armour wire mm	Overall cable mm			
Nominal area of conductor 1.5 mm²						
5	10.0	0.9	16.2	780	52 (92)	53
7	11.2	0.9	17.5	875	52 (92)	53
10	13.6	1.25	20.7	1230	53 (93)	55
12	14.2	1.25	21.3	1265	54 (94)	55
19	16.6	1.25	23.9	1620	54 (94)	55
24	19.4	1.6	28.0	2122	55 (95)	56
27	20.1	1.6	28.7	2553	56 (96)	56
32	21.5	1.6	30.1	2567	56 (96)	56
37	22.6	1.6	31.2	2732	56 (96)	56
48	26.3	1.6	35.1	3355	57	57
Nominal area of conductor 2.5 mm²						
5	11.6	0.9	17.8	953	52 (92)	53
7	12.6	0.9	18.8	1080	53 (93)	55
10	16.0	1.25	23.4	1460	54 (94)	55
12	16.8	1.25	24.0	1600	54 (94)	55
19	20.0	1.6	28.5	2318	56 (96)	56
24	23.4	1.6	31.8	2810	57	57
27	24.2	1.6	32.4	3064	57	57
32	26.0	1.6	35.0	3400	57	57
37	27.2	1.6	36.0	3656	57	57
48	31.7	2.0	42.1	4908	59	59
Nominal area of conductor 4.0 mm²						
5	12.9	0.9	19.3	1140	53 (93)	55
7	14.1	1.25	21.2	1370	54 (94)	55
10	18.3	1.6	26.7	2070	55 (95)	56
12	18.9	1.6	27.3	2205	55 (95)	56
19	22.5	1.6	31.1	2990	56 (96)	56
24	26.6	1.6	34.6	3590	57	57
27	27.3	1.6	36.3	3775	57	57
37	30.8	2.0	41.2	4990	58	59
48	35.8	2.0	46.4	6125	60	59

1900/3300V

C0PPER CONDUCTOR XLPE INSULATED LEAD SHEATHED 3 CORE CABLES TO BS 5467 & EEMUA 133

Table 4

Nominal Area of Conductor mm²	Approximate diameter			Approx. weight kg/km	416AA-· 416AB-( )· 475AA-·	424PB-·
	Over Lead mm	Armour wire mm	Overall cable mm			
16	22.5	1.6	31.0	2640	56 (96)	56
25	25.0	1.6	33.5	3230	57	57
35	27.5	1.6	36.0	3775	57	57
50+	26.0	2.0	36.0	4360	57	57
70	31.0	2.0	41.0	5500	58	59
95	35.2	2.0	45.5	6900	60	59
120	37.0	2.5	49.0	8450	60	59
150	41.2	2.5	53.2	9800	62	61
185	44.0	2.5	56.0	11350	63	61
240	49.4	2.5	62.2	14000	64	61
300	53.0	2.5	66.0	16350	66	63

1. Cable marked + and higher have sector shaped conductors
2. Tolerance on the above dimensions are -0.3mm and +0.5mm

+ 416AA - series - RTL for Lead sheath cable (industrial)
+ 416AB - series - RTL E.Exe increased safety Gland
+ 475AA - series - RTLF E.Exd flameproof Gland
+ 424PB - series - BARR.PB E.Exd Explosion Proof Barrier Gland

Ducab دوكاب

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 287. The ratings for 'In Air' installation are taken from IEE Wiring Regulations, 16th Edition.

All the ratings (refer tables 5 to 11) given are for single circuits installed thermally independent of other circuits or any other heat source and the basis of the standard conditions of installation given under the head 'Rating Factors'. For other ambient or ground temperatures, depth of laying, soil thermal resistivity, the rating must be multiplied by relevant rating factors in tables 12 to 22.

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 16th edition - 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.

For guidance and assistance, given below are some of the IEE Wiring Regulation's requirements for cables:

Protection against overload current: (Clause 433-01-01 of the 16th Edition of the IEE Wiring Regulations)

This states the requirements, which effectively determine the sustained current ratios of the cable viz.:

i) The current rating of the cable should not be less than the nominal current or current setting of the device providing protection against overload, which in turn should not be less than the circuit current.
ii) The overload protection should operate at not more than 1.45 times the current rating of the cable.

The second requirement (ii) is met if the first (i) is met when the protective device is any of the standard fuses or MCB's mentioned in the regulations, except rewirable types of fuse to BS 3036.

With fuses to BS 3036, the current ratings of the cable should not be less than 1.38 times the fuse rating to satisfy (ii).

Protection against short circuit: (Clause 434 of the 16th Edition of the IEE Wiring Regulations)

The cable has to have adequate short-circuit capacity for the current let through by the device providing short circuit protection for the time it will flow.

The formula in Section 434-03-03 is effectively that used by cable makers to give the short-circuit ratings in their publications.

If the device providing protection against short circuit is the same as that providing protection against overload, and therefore, has a rating not higher than the rating of the cables, the short circuit capacity of the cable will automatically be adequate, there is no need to check.

Ducab دوكاب

Protection against indirect contact by interruption of supply: (Clause 412 of the 16th Edition of IEE Wiring Regulations)

Protection against shock due to contact with exposed conductive parts of equipment during a fault to earth is deemed to be provided if disconnection due to flow of the fault current through the protective device will occur, either

within 0.4 seconds for final circuits supplying socket outlets. (Table 41A of the 16th Edition of the IEE Wiring Regulations)

or

within 5 seconds for final circuits supplying fixed equipment. (Clause 413-02-12 of the 16th Edition of the IEE Wiring Regulations)

Regulation 413 gives values of earth fault loop impedances, which satisfy these conditions when the standard types of protective devices are used.

Cables make the major contribution to earth fault loop impedance, but the impedance of the supply external to the installation has to be taken into account.

It is not possible to say what maximum length of standard cables may be used in the installation without exceeding the requirements for earth fault loop impedance in the absence of information on the external impedance for the particular installation.

Table 28 give estimated values of the contribution to earth loop impedance by XLPE insulated copper conductor, steel wire armoured cables to BS 5467.

Cross sectional areas of protective conductors: (Clause 543 of the 16th Edition of IEE Wiring Regulations)

Regulation 543 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 under short circuit.

The steel wire armour of standard cables to BS 5467 (XLPE) 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.

Ducab دوكاب

CURRENT RATINGS (ac)

600/1000V **LEAD SHEATHED SINGLE CORE POWER CABLES** **Table 5**

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	0.20	0.30	0.20	540	480	625	0.35	0.38	0.25
500	770	620	918	0.18	0.28	0.18	580	510	714	0.31	0.35	0.22
630	840	670	1027	0.17	0.26	0.17	630	540	801	0.28	0.32	0.20
800	888	692	1119	0.17	0.25	0.17						
1000	942	735	1214	0.16	0.24	0.16						

600/1000V **LEAD SHEATHED 2 CORE POWER CABLES** **Table 6**

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	Installed in air amps	Ground mV	Duct mV	Air mV	Direct in ground amps	In single way ducts amps	Installed in air amps	Ground mV	Duct mV	Air mV
16*	140	115	115	2.9	2.9	2.9						
25*	180	145	152	1.9	1.9	1.9	135	110	112	3.1	3.1	3.1
35*	215	175	188	1.3	1.3	1.3	165	130	138	2.2	2.2	2.2
50	255	210	228	1.0	1.0	1.0	195	155	166	1.7	1.7	1.7
70	315	260	291	0.7	0.7	0.7	240	195	211	1.1	1.1	1.1
95	381	313	354	0.5	0.5	0.5	288	237	254	0.8	0.8	0.8
120	410	344	430	0.4	0.4	0.4						
150	472	384	480	0.4	0.4	0.4						
185	539	432	540	0.3	0.3	0.3						
240	636	504	630	0.2	0.2	0.2						
300	732	560	700	0.2	0.2	0.2						

* Circular conductors, all others are sector shaped

Ducab دوكاب

CURRENT RATINGS (ac)

600/1000V **LEAD SHEATHED 3 CORE POWER CABLES** **Table 7**

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	Installed in air amps	Ground mV	Duct mV	Air mV	Direct in ground amps	In single way ducts amps	Installed in air amps	Ground mV	Duct mV	Air mV
16*	115	94	99	2.5	2.5	2.5	89	72	74	4.2	4.2	4.2
25*	150	125	131	1.7	1.7	1.7	115	98	98	2.7	2.7	2.7
35*	180	150	162	1.2	1.2	1.2	135	120	120	1.9	1.9	1.9
50	215	175	197	0.9	0.9	0.9	165	145	145	1.4	1.4	1.4
70	265	215	251	0.6	0.6	0.6	200	185	185	1.0	1.0	1.0
95	315	260	304	0.5	0.5	0.5	240	224	224	0.7	0.7	0.7
120	360	300	353	0.4	0.4	0.4	275	264	264	0.6	0.6	0.6
150	405	335	406	0.3	0.3	0.3	310	305	305	0.5	0.5	0.5
185	460	380	463	0.3	0.3	0.3	350	350	350	0.4	0.4	0.4
240	530	440	546	0.2	0.2	0.2	410	418	418	0.3	0.3	0.3
300	590	495	628	0.2	0.2	0.2	460	488	488	0.3	0.3	0.3
400	667	570	728	0.2	0.2	0.2	520	562	562	0.2	0.2	0.2

* Circular conductors, all others are sector shaped

600/1000V **LEAD SHEATHED 4 CORE POWER CABLES** **Table 8**

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	Installed in air amps	Ground mV	Duct mV	Air mV	Direct in ground amps	In single way ducts amps	Installed in air amps	Ground mV	Duct mV	Air mV
16*	115	94	99	2.5	2.5	2.5	89	72	74	4.2	4.2	4.2
25	150	125	131	1.7	1.7	1.7	115	94	98	2.7	2.7	2.7
35	180	150	162	1.2	1.2	1.2	135	110	120	1.9	1.9	1.9
50	215	175	197	0.9	0.9	0.9	165	135	145	1.4	1.4	1.4
70	265	215	251	0.6	0.6	0.6	200	165	185	1.0	1.0	1.0
95	315	260	304	0.5	0.5	0.5	240	200	224	0.7	0.7	0.7
120	360	300	353	0.4	0.4	0.4	275	230	264	0.6	0.6	0.6
150	405	335	406	0.3	0.3	0.3	310	255	305	0.5	0.5	0.5
185	460	380	463	0.3	0.3	0.3	350	295	350	0.4	0.4	0.4
240	530	440	546	0.2	0.2	0.2	410	340	418	0.3	0.3	0.3
300	590	495	628	0.2	0.2	0.2	460	385	488	0.3	0.3	0.3
400	667	570	728	0.2	0.2	0.2	520	443	562	0.2	0.2	0.2

* Circular conductors, all others are sector shaped

Ducab دوكاب

CURRENT RATINGS (ac)

1900/3300V

3 CORE LEAD SHEATHED POWER CABLES

Table 9

Nominal area of conductor mm²	Current Ratings (amps) in Air	in Duct	in Ground
16	106	96	114
25	142	124	147
35	168	147	175
50	202	174	207
70	255	214	254
95	312	257	304
120	361	293	345
150	410	328	387
185	471	371	436
240	554	428	502
300	634	480	563

600/1000V

LEAD SHEATHED CONTROL CABLES

Table 10

Installed in free air (Reference Method 11 on cable tray or Method 13 in free air, IEE Wiring Regulations, 16th Edition)

Nominal area of conductor mm²	Two core Current rating metre amp	Two core Volt drop per amp per mV	Three and Four core Current rating metre amp	Three and Four core Volt drop per amp per mV
1.5	29	31	25	27
2.5	39	19	33	16
4	52	12	44	10
6	66	7.9	56	6.8
10	90	4.7	78	4.0

Ratings based on Ambient air temp 30˚C

Table 11

Laid directly in ground, run in single-way ducts

Nominal area of conductor mm²	Two core Current rating In ground amp	Two core Current rating In duct amp	Two core Volt drop per amp per metre mV	Three and Four core Current rating In ground amp	Three and Four core Current rating In duct amp	Three and Four core Volt drop per amp per metre mV
1.5	38	31	31	32	26	27
2.5	49	41	19	42	34	16
4	65	53	12	55	45	10
6	81	67	7.9	69	56	6.8
10	109	89	4.7	92	75	4.0

Ratings based on Ground temp 15˚C, Soil thermal resistivity 1.2˚C m/W
Depth of laying 0.5m. All circuits thermally independent. 100 mm diameter single-way ducts.

Current Ratings for cables having more than four cores are available on request.

Ducab دوكاب

RATING FACTORS

The maximum sustained ac current ratings given in this section are based, where applicable, on ERA Report 69-30:

Part V - sustained current ratings for armoured cables with thermosetting insulation to BS 5467.

Any other current rating will have been calculated using agreed formulae and methods from IEC 287.

Defined conditions of installation

Ambient air temperature:	30˚C
Ground thermal resistivity:	1.2Km/W
Ground temperature:	15˚C
Depth of laying:	
600/1000V cables	0.5m
1.9/ 3.3kV cables	0.8m
Maximum conductor operating temperature:	90˚C

CABLES LAID DIRECTLY IN GROUND

Table 12

RATING FACTORS FOR GROUND TEMPERATURE

Ground temperature	15˚C	20˚C	25˚C	30˚C	35˚C	40˚C	45˚C
Rating Factor	1.0	0.97	0.93	0.89	0.86	0.82	0.76

Table 13

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

Size of cables mm^2	Soil thermal resistivity in Km/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 300	1.15	1.10	1.07	0.92	0.81	0.74	0.67

Ducab دوكاب

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

Table 14

Depth of laying metres	600/1000 Volt			1900/3300 Volt	
	Up to 50mm²	70mm² to 300mm²	Above 300mm²	Up to300mm²	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	0.85	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

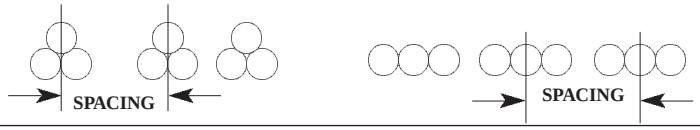
In ERA Report 69-30 Part V, the types of load are classified under three headings, viz:

Type A Cables carrying a constant load throughout the year.
Type B Cables carrying varying loads, maximum in summer period.
Type C Cables carrying varying loads, maximum in winter period.

With knowledge of the type of load to be imposed on the cable it is then possible to determine the soil thermal resistivity along the cable route in accordance with recommendations in ERA Report 69-30.

GROUP RATING FACTORS FOR CIRCUITS OF THREE SINGLE CORE CABLES IN TREFOIL OR LAID FLAT TOUCHING, IN HORIZONTAL FORMATION

Table 15

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.

GROUP RATING FACTORS FOR MULTICORE CABLES IN HORIZONTAL FORMATION

Table 16

	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
1900/3300 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

CABLES INSTALLED IN DUCTS

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

RECOMMENDED DUCT DIMENSIONS AND CABLE SIZES

Table 17

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

Rating factors for ground temperature

Note: Same as for direct in ground, refer to Table 12.

RATING FACTORS OF VARIATION IN THERMAL RESISTIVITY OF SOIL (AVERAGEVALUES)

Table 18

Size of cable mm^2	Soil thermal resistivity in Km/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

Ducab دوكاب

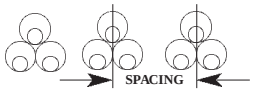
RATING FACTORS FOR DEPTH OF LAYING (TO CENTRE OF DUCT OR TREFOIL GROUP OF DUCTS)

Table 19

Depth of 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

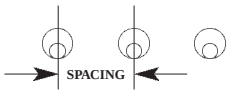
GROUP RATING FACTORS FOR SINGLE CORE CABLES IN TREFOIL SINGLE WAY DUCTS, HORIZONTAL FORMATION (AVERAGE VALUES)

Table 20

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

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

Table 21

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
1900/3300 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

Ducab دوكاب

CABLES INSTALLED IN AIR

It is anticipated that many of the “in air” installations will be in buildings, and the ratings are therefore given on the basis of an ambient air temperature of 30˚C, in accordance with IEE Wiring Regulations for Electrical Installations. This is in contrast to the value of 25˚C used in ERA 69-30 Part III for cables in air. Conversion to this or any other ambient temperature is easily achieved by the use of the rating factors given below.

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 TEMPERATURES **Table 22**

Air temperature	25˚C	30˚C	35˚C	40˚C	45˚C	50˚C	55˚C
Rating Factor	1.04	1.0	0.96	0.91	0.87	0.82	0.76

Defined conditions of installation

The 'in-air' current ratings given in Tables 5 to 11 are based on the installation conditions in air as follows:

a) Single core cables

(1) Two single core cables are installed on 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 20mm 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.

RESISTANCE OF CONDUCTOR, LEAD SHEATH AND ARMOUR

Table 23

XLPE insulated Lead Sheathed Armoured Power Cables to BS 5467 and EEMUA 133

Nominal Area of Conductor mm²	Maximum resistance (ohms) per 1000 metres of cable at 20°C											
	Copper conductor	Aluminium conductor	600/1000V								1900/3300V	
			Single Core		Two Core		Three Core		Four Core		Three Core	
			Lead	Armour	Lead	Armour	Lead	Armour	Lead	Armour	Lead	Armour
1.5	12.1	-	-	-	8.98	6.21	8.54	5.96	7.72	5.59	-	-
2.5	7.41	-	-	-	7.56	5.51	7.09	5.26	6.29	4.84	-	-
4	4.61	-	-	-	6.37	4.88	6.27	4.81	5.41	4.31	-	-
6	3.08	-	-	-	5.85	4.59	5.40	4.31	4.91	3.02	-	-
10	1.83	-	-	-	4.91	4.01	4.71	2.93	4.10	2.63	-	-
16	1.15	-	8.14	0.62	4.29	3.10	4.11	2.64	3.31	2.36	2.42	1.37
25	0.727	1.2	6.63	0.54	3.21	2.64	2.96	1.58	2.93	1.57	1.97	1.22
35	0.524	0.868	6.01	0.50	2.60	1.69	2.41	1.42	2.38	1.41	1.68	1.13
50	0.384	0.641	5.24	0.47	3.19	1.88	2.37	1.40	1.96	1.27	1.61	0.84
70	0.268	0.443	4.56	0.42	2.52	1.64	1.95	1.27	1.59	0.87	1.54	0.81
95	0.193	0.320	4.07	0.39	2.10	1.14	1.60	0.87	1.30	0.77	1.37	0.77
120	0.153	0.253	3.30	0.35	1.89	1.04	1.32	0.78	1.11	0.57	1.10	0.54
150	0.124	0.206	3.03	0.32	1.58	0.95	1.13	0.58	0.88	0.51	1.00	0.52
185	0.0991	0.164	2.48	0.29	1.33	0.69	0.89	0.52	0.75	0.47	0.86	0.48
240	0.0754	0.125	2.03	0.26	1.02	0.61	0.76	0.47	0.61	0.42	0.73	0.43
300	0.0601	0.100	1.86	0.24	0.87	0.55	0.62	0.42	0.53	0.38	0.61	0.40
400	0.0470	0.0778	1.41	0.17	-	-	0.53	0.39	0.43	0.26	0.53	0.37
500	0.0366	0.0605	1.16	0.15	-	-	-	-	-	-	-	-
630	0.0283	0.469	0.98	0.13	-	-	-	-	-	-	-	-
800	0.0221	0.0367	0.76	0.09	-	-	-	-	-	-	-	-
1000	0.0176	0.0291	0.65	0.08	-	-	-	-	-	-	-	-

Ducab دوكاب

SHORT CIRCUIT RATINGS – CONDUCTORS

Table 24

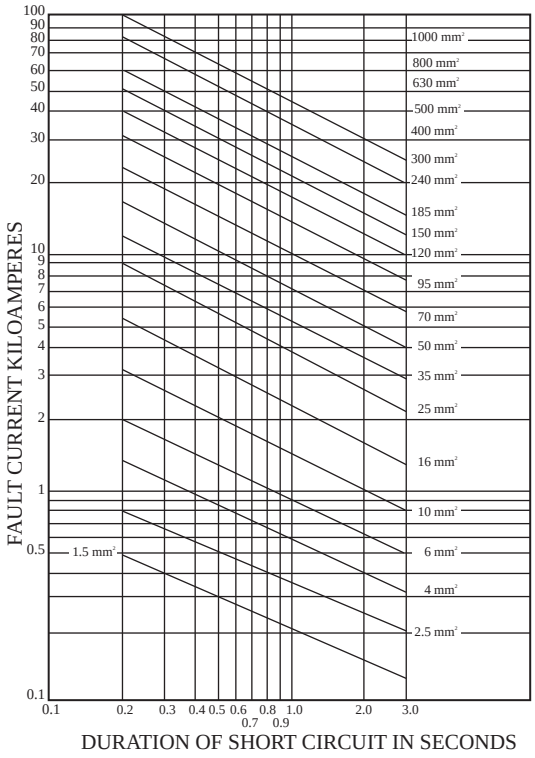
Conductor size mm^2	Short circuit ratings for 1 second in KA	
	Copper conductor	Aluminium Conductor
1.5	0.21	0.14
2.5	0.36	0.24
4	0.57	0.38
6	0.86	0.56
10	1.43	0.94
16	2.29	1.50
25	3.58	2.35
35	5.00	3.29
50	7.15	4.70
70	10.01	6.58
95	13.59	8.93
120	17.16	11.28
150	21.45	14.10
185	26.46	17.39
240	34.32	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 $\sqrt{t}$

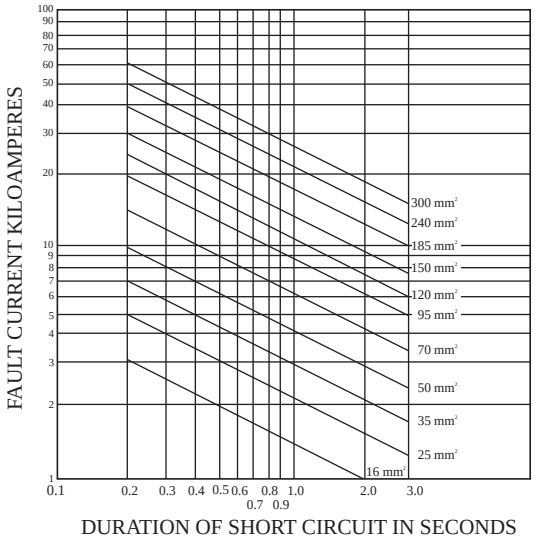
The values of fault current given in the graph are based on the cable being fully loaded at the start of the short circuit (conductor temperature 90˚C) and a final conductor temperature of 250 ˚C. It should be ensured that the accessories associated with the cables are also capable of operation at these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

For Lead Sheathed Power Cables

Table 25

Conductor size	Single Core		Two Core		Three Core		Four Core	
mm^2	Lead amps	Armour amps	Lead amps	Armour amps	Lead amps	Armour amps	Lead amps	Armour amps
1.5	-	-	573	1003	604	1038	665	1109
2.5	-	-	682	1125	724	1177	817	1284
4	-	-	808	1274	821	1288	951	1438
6	-	-	879	1355	954	1441	1049	2200
10	-	-	1049	1551	1093	2271	1255	2529
16	-	-	1198	2439	1251	2524	1552	2810
25	-	-	1604	2837	1737	4002	1757	4038
35	-	-	1980	4186	2137	4452	2161	4493
50	980	6080	1613	3772	2173	4514	2626	4981
70	1129	6760	2045	4295	2633	4993	3233	7113
95	1264	7373	2452	5987	3211	7071	3954	7996
120	1558	8157	2727	6524	3885	7879	4652	11160
150	1694	8874	3262	7164	4657	10991	5826	12339
185	2078	9846	3878	10065	5805	12303	6872	13629
240	2532	10934	5042	11407	6804	13513	8438	15149
300	2769	11782	5881	12543	8352	15016	9756	16564
400	3633	17029	-	-	9638	16388	12042	23796
500	4441	19212	-	-	-	-	14168	25719
630	5259	21192	-	-	-	-	-	-
800	6728	30596	-	-	-	-	-	-
1000	7912	33810	-	-	-	-	-	-

Table 26

SHORT CIRCUIT RATINGS - LEAD SHEATH AND ARMOUR

For Lead Sheathed Auxiliary Cables

Conductor size	5 Core		7 Core		12 Core		19 Core		27 Core		37 Core		48 Core	
mm^2	Lead amps	Armour amps	Lead amps	Armour amps	Lead amps	Armour amps	Lead amps	Armour amps	Lead amps	Armour amps	Lead amps	Armour amps	Lead amps	Armour amps
1.5	728	1181	806	1271	1053	2206	1271	2608	1666	3870	2071	4340	2611	4958
2.5	879	1982	979	2123	1284	3424	1689	3913	2208	4573	2744	6586	3352	7330
4	1027	1525	1125	2322	1604	3756	2128	4437	2706	5108	3696	7557	4428	8382

Ducab دوكاب

VOLTAGE DROP

Voltage Drop is normally only if importance for cables of voltage rating 600/1000V or below. If the installation is to be in compliance with Regulation 525 of the 16th Edition of the IEE Wiring 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. 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 2.5 per cent of the nominal voltage of the supply, disregarding starting conditions."

(Note: Diversity can be taken into account when calculating voltage drop.)

Since the actual power factor of the load is often not 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 table have been based on this assumption. For conductor sizes up to and including 120 mm the figures provided apply with sufficient accuracy where the power factor lies between 0.6 lagging and 1.0 and for cables where the power factor 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.

The values of voltage drop for 600/1000V 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 cables are only approximate; for a more accurate assessment, allowance should be made for the change in conductor resistance with operating temperature. Refer to following page and Table 27 for details. 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, 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 able to carry.

Examples: 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.

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

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

Assume maximum permissible volt drop = 2.5 per cent of 415 volts = 10.38 volts

Substitute for current, route length and maximum permissible volt drop

$$\text{Then } mV = \frac{10.38 \times 1000}{200 \times 100} = 0.52$$

Select a cable from the relevant Current Rating Table 8 such that "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 0.5 giving a cable size of 95 mm^2.

Note: Please refer to following 2 pages for additional information on voltage drop.

Ducab دوكاب

XLPE CABLE DATA FOR PARTIAL LOADS

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 27 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 27 as shown in example (3) in the following:

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

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

where Vd = maximum acceptable volt drop (in volts)
I = current per phase (in amps)
mV = appropriate volt drop (in mV/amp/metre)
L = route length (in metres)

Examples: At standard defined conditions:

1) 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

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

From Table 27, 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

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

2) 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 per cent. (defined by system)
3 per cent of 380 V = 11.4 V
Substitute for current, route length and maximum volt drop

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

Selecting a voltage drop corresponding to the maximum rating the size would be 150 mm^2 but selecting from Table 27 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 12 to 22 for site conditions other than standard defined conditions)

Examples: At site conditions other than standard defined conditions

3) Consider example (1) but at an ambient temperature of 45˚C. Derating factor for this temp. = 0.87 (see Table 22). 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 (1) 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 27 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

Ducab دوكاب

XLPE INSULATED CABLES - COPPER CONDUCTORS

VOLTAGE DROP DATA FOR DIFFERENT LOADS

600/1000 V **THREE AND FOUR CORE ARMOURED, PVC SHEATHED CABLES** **Table 27**

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

Installation conditions for above ratings:

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

For other installation conditions, apply the appropriate rating factors. For installation in air, refer to table 22 and in ground, refer to tables 12 to 16.

Ducab دوكاب

CONTRIBUTION BY CABLE TO EARTH FAULT LOOP IMPEDANCE

The following table gives the estimated impedance of copper phase conductor and steel wire armour in series, i.e. the contribution to earth fault loop impedance by the cable, allowing for the estimated increase in temperature due to the flow of the earth fault current. The earth fault current is taken to be that which gives interruption in five seconds when the protective device is a standard type having a rating not higher than the current rating of the cable.

600/1000 V

COPPER CONDUCTOR, XLPE INSULATED ARMOURED CABLES TO BS 5467

Table 28

Conductor mm^2	Contribution by cable to earth fault loop impedance milli ohms/metre		
	2 core	3 core	4 core
16	6.67	6.42	5.91
25	5.87	4.35	4.10
35	4.02	3.77	3.39
50	3.55	3.17	2.92
70	2.98	2.73	1.98
95	2.11	1.98	1.73
120	-	1.79	1.25
150	-	1.23	1.10
185	-	1.10	0.98
240	-	0.97	0.86
300	-	0.89	0.78
400	-	-	0.60

Note: For information on maximum length of cable that meets the earth fault loop impedance requirement for 5 second disconnection, refer to Ducab's Technical Department.

CABLE SUPPORT SPACING

As per clause 522-08-04 of the 6th Edition of 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.

Ducab دوكاب

Ducab Offices and Joint Ventures

Ducab (Abu Dhabi) Factory
P.O. Box 9171, Abu Dhabi, United Arab Emirates
Tel: (971-2) 502 7777, Fax: (971-2) 502 7888
E-mail: ducab@ducab.com

Ducab Connect
P.O. Box 11529, Dubai, United Arab Emirates
Tel: (971-4) 808 2524, Fax: (971-4) 808 2599
E-mail: DucabConnect@ducab.com

Northern Emirates Sales Office (NESO)
P.O. Box 683, Dubai, United Arab Emirates
Tel: (971-4) 266 7400, Fax: (971-4) 266 8955
E-mail: neso@ducab.com

Ducab Factory (M2)
P.O. Box 9171, Abu Dhabi, United Arab Emirates
Tel: (971-2) 550 0774, Fax: (971-2) 550 0979
E-mail: ADsalesoffice@ducab.com

Ducab-Oman
P.O. Box 3542, 112 Ruwi, Muscat, Sultanate of Oman
Tel: (968) 24 565 177, Fax: (968) 24 564 302
E-mail: ducabomn@omantel.net.om

JBK DUCAB W.L.L.
P.O. Box 14039, Doha, Qatar
Tel: (974) 442 1924, Fax: (974) 441 9003
E-mail: mail@jbkducab.com.qa

BICC MET W.L.L.
P.O. Box 11413, Manama, Kingdom of Bahrain
Tel: (973) 177 270 71, Fax: (973) 177 280 27
E-mail: bicc@batelco.com.bh

Ref No: PCXP/13 0108 (2000 cps)

دوكاب – ص.ب: ١١٥٢٩ دبي الإمارات العربية المتحدة، هاتف: ٨٠٨٢٥٠٠(٤-٩٧١)، فاكس: ٨٠٨٢٥١١(٤-٩٧١)
Ducab P.O.Box 11529, Dubai, United Arab Emirates, Tel: (971-4) 8082500, Fax: (971-4) 8082511
e-mail: ducab@ducab.com, website: www.ducab.com, Toll Free: 800-Ducab (800-382222)