



UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION
SEPTEMBER 2014 SESSION

SUBJECT CODE	:	FED10402
SUBJECT TITLE	:	ELECTRICAL DISTRIBUTION
LEVEL	:	DIPLOMA
TIME / DURATION	:	12.45 PM – 2.45PM (2 HOURS)
DATE	:	31 DECEMBER 2014

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper **CAREFULLY**.
2. This question paper is printed on both sides of the paper.
3. Please write your answers on the answer booklet provided.
4. Answers should be written in blue or black ink except for sketching, graphic and illustration.
5. This question paper consists of **TWO (2)** sections. Section A and B. Answer all questions in Section A. For Section B, answer two (2) questions only.
6. Answer all questions in English.

THERE ARE 6 PAGES OF QUESTIONS EXCLUDING THIS PAGE AND APPENDICES.

SECTION A (Total: 60 marks)

INSTRUCTION: Answer ALL questions.

Please use the answer booklet provided.

Question 1

- (a) Names three (3) types of turbines that mainly used in hydroelectric power station. (3 marks)

- (b) State the type of generating power station in a **Figure 1**. Names the blanks parts from i to v in the system below. (7 marks)

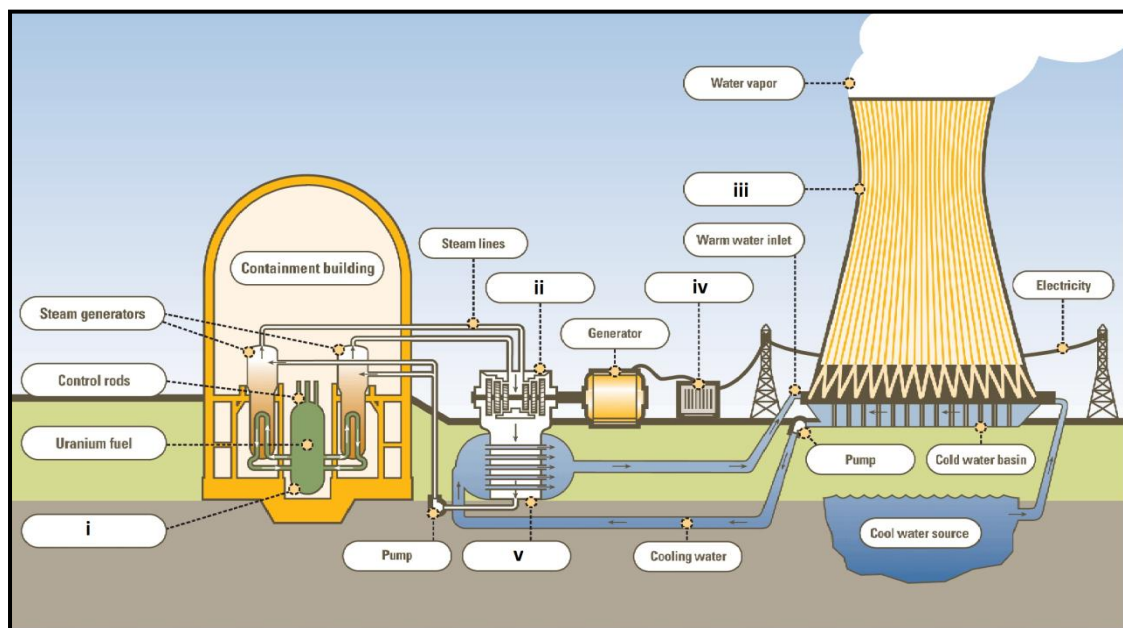


Figure 1

- (c) List three (3) advantages of using three phase system upon the single phase system. (3 marks)
- (d) List three (3) advantages of thermal power plants compared to the other power plants. (3 marks)
- (e) List four (4) types of generating system can be categorized as the electrical renewable energy. (4 marks)

Question 2

- (a) List four (4) general procedures the electrical designer needs to follow in designing an electrical system for large installations.

(4 marks)

- (b) A consumer lives in a bungalow with a detached garage and workshop, as shown in **Figure 2**. The mains electrical power supply is at high level, and comprises an 80 A BS 3871 230 V main MCB type 2 and a seven-way 80 A distribution board with MCB type 2 as follows :

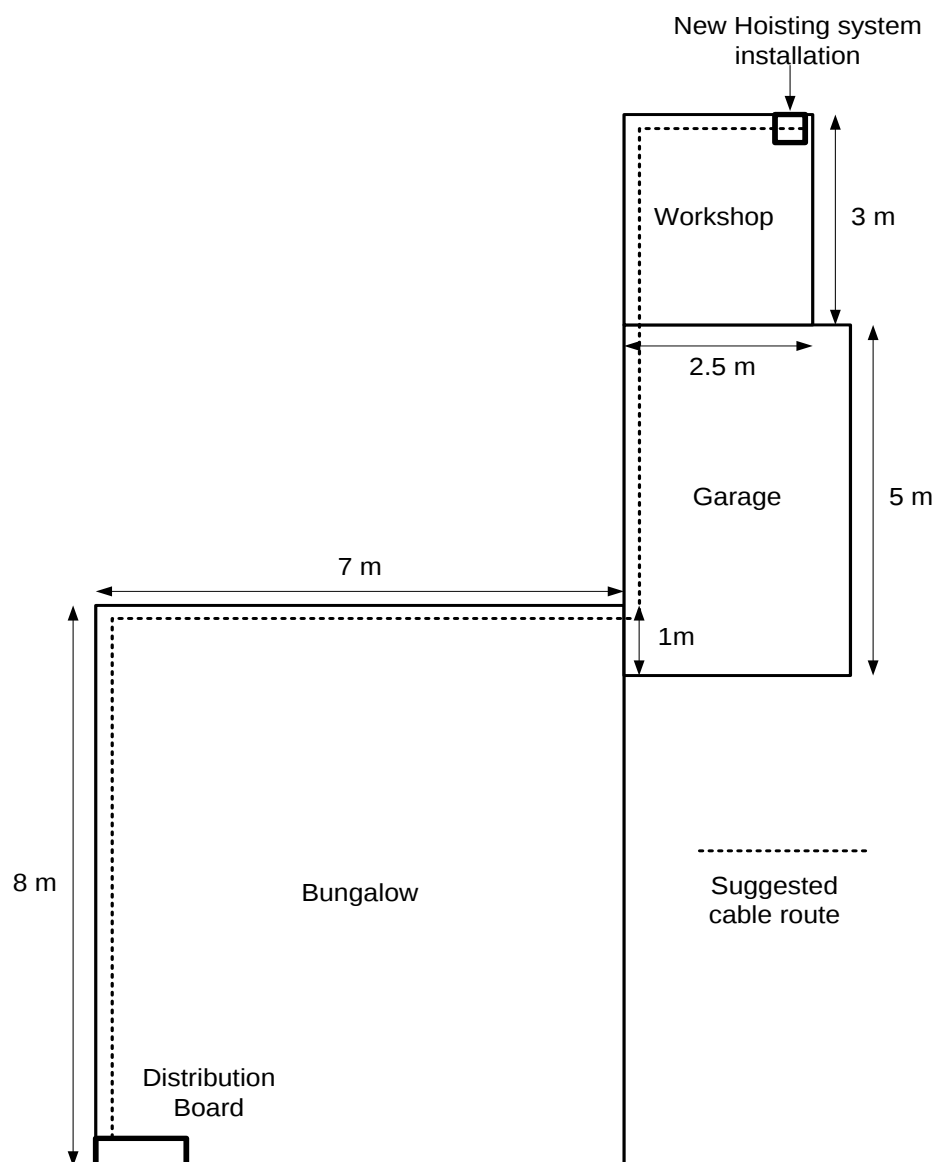


Figure 2

- Switch socket outlet ring circuit with 30 A rated MCB
- 10 nos 40W fluorescent lamps
- 4 nos 60 W ceiling fan
- 1 unit of 3 kW instantaneous water heater
- 1 unit of 5 kW cooker unit + 5A Switch socket outlet
- 1 unit of 2 Hp air conditioner
- Spare way

- (i) Calculate the design current (I_b) for the whole installation in the house. (10 marks)
- (ii) Determine the nominal current (I_N) value suitable for overall circuit. (3 marks)
- (iii) Calculate the current carrying capacity value (I_z) if the ambient temperature at installation is 34°C and not group with another cable. (4 marks)
- (iv) Determine the tabulated current (I_t) as shown in table 4D1A (**refer to appendix**) and also the right cable sizing for this main installation by using clipped direct. (4 marks)
- (v) The consumers wishes to install an hoisting system in his workshop with capacity maximum 6 kW, 230 V. Calculate the I_b , I_N , I_z (C_a at 34°C), cable sizing for this new load and new maximum demand for the entire building. (10 marks)
- (vi) Calculate also the voltage drop of the new design installation.

$$\text{Hint : } V_d = \frac{\frac{mV}{A} \times I_b \times L}{1000} \text{ V}$$

(5 marks)

(Refer to technical data attached for reference)

SECTION B (Total: 40 marks)**INSTRUCTION: Answer TWO (2) questions only.****Please use the answer booklet provided.****Question 3**

- (a) A hydroelectric power plant is supplied from a reservoir 10^7 m^3 at a head of 100 m. Find out the energy available if the overall efficiency is 70 %.

(8 marks)

- (b) The rating of nuclear power plant is 6 MW. Overall thermal efficiency is 29%. The fuel is U^{235} . Calculate the amount of natural uranium required to generate the power if the average energy release per fission for the fuel is 190 MeV.

(12 marks)

Hints :

$$1 \text{ eV} = 1.6 \times 10^{-19} \text{ J}$$

$$1 \text{ W} = 1 \text{ J/s} = 6.24 \times 10^{12} \text{ MeV/s}$$

$$\text{Avogadro's number} = 6.02 \times 10^{23}$$

Question 4

- (a) Draw the schematic wiring diagram for :
- (i) light up 2 number of incandescent lamps by using one way switch.
(5 marks)
 - (ii) power up 2 number of Switch Socket outlet (SSO 13 A) by using ring circuit.
(5 marks)
- (b) State the types of tripping unit inside the circuit breaker. Names three types of circuit breaker used in the High Voltage applications.
(5 marks)
- (c) Explain briefly the operation of residual current devices (RCD) in the healthy and abnormal electricity condition.
(5 marks)

Question 5

- (a) State five types of earthing systems which have been discussed in IEE Regulation 16th Edition. Draw and explain one type of the earthing system in detail. (6 Marks)
- (b) State three (3) reasons why earthing system is important in electrical installations. (4 Marks)
- (c) Refer to the diagram in **Figure 3**. The voltage supply in each phase is 130 V.

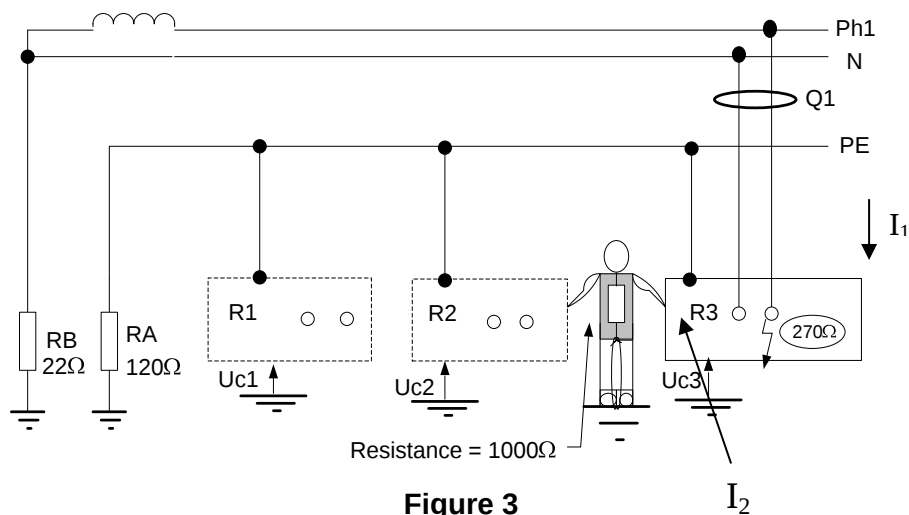


Figure 3

- i. Determine the type of earthing system applied to the diagram in **Figure 3**. Justify your answer. (3 marks)
- ii. Calculate the value of voltage at U_{c1} , U_{c2} and U_{c3} and give the limit voltage for every room, (U_{L1} , U_{L2} & U_{L3}). (4 marks)
- iii. Calculate the value of current I_2 which flow through the body of victim. (3 marks)

END OF QUESTION PAPER

APPENDICES / ATTACHMENT FILE

FED10402 : ELECTRICAL DISTRIBUTION

LIST	CONTENTS
APPENDIX A	Table of Correction Factors for Ca,Cg & Ci
APPENDIX B	Table of Corrections Factors of Mineral insulated and Allowance for Diversity
APPENDIX C	Table 4A : Method of wiring installation
APPENDIX D	Table 4A : Method of wiring installation continued
APPENDIX E	Table 4D1A & Table 4D1B
APPENDIX F	Table 4D4A & Table 4D4B
APPENDIX G	Table 4F1A & Table 4F1B
APPENDIX H	Table 4F2A & Table 4F2B
APPENDIX I	Figure A : Time vs Current characteristics fuses to BS
APPENDIX J	Time vs Current characteristics MCB Type 1& Type 2 to BS 3871
APPENDIX K	Time vs Current characteristics MCB Type 3 & Type B to BS 3871
APPENDIX L	MCB Catalogue

APPENDIX A

TABLE 4C1

Correction factors for ambient temperature where protection is against short-circuit

NOTE: This table applies where the associated overcurrent protective device is intended to provide short-circuit protection only. Except where the device is a semi-enclosed fuse to BS 3036 the table also applies where the device is intended to provide overload protection.

Type of insulation	Operating temperature	Ambient temperature (°C)															
		25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	
Rubber (flexible cables only)	60 °C	1.04	1.0	0.91	0.82	0.71	0.58	0.41	-	-	-	-	-	-	-	-	
General purpose pvc	70 °C	1.03	1.0	0.94	0.87	0.79	0.71	0.61	0.50	0.35	-	-	-	-	-	-	
Paper	80 °C	1.02	1.0	0.95	0.89	0.84	0.77	0.71	0.63	0.55	0.45	0.32	-	-	-	-	
Rubber	85 °C	1.02	1.0	0.95	0.90	0.85	0.80	0.74	0.67	0.60	0.52	0.43	0.30	-	-	-	
Heat resisting pvc*	90 °C	1.03	1.0	0.97	0.94	0.91	0.87	0.84	0.80	0.76	0.71	0.61	0.50	0.35	-	-	
Thermosetting	90 °C	1.02	1.0	0.96	0.91	0.87	0.82	0.76	0.71	0.65	0.58	0.50	0.41	0.29	-	-	
Mineral	70 °C sheath	1.03	1.0	0.93	0.85	0.77	0.67	0.57	0.45	0.31	-	-	-	-	-	-	
	105 °C sheath	1.02	1.0	0.96	0.92	0.88	0.84	0.80	0.75	0.70	0.65	0.60	0.54	0.47	0.40	0.32	

NOTES:

1. Correction factors for flexible cords and for 85 °C and 180 °C rubber-insulated flexible cables are given in the relevant table of current-carrying capacity.
2. This table also applies when determining the current-carrying capacity of a cable.
3. * These factors are applicable only to ratings in columns 2 to 5 of Table 4D1A.

TABLE 4B1

Correction factors for groups of more than one circuit of single-core cables, or more than one multicore cable (to be applied to the corresponding current-carrying capacity for a single circuit in Tables 4D1 to 4D4, 4E1 to 4E4, 4F1 and 4F2, 4J1, 4K1 to 4K4, 4L1 to 4L4)**

Reference method of installation (see Table 4A)		Correction factor (C _g)														
		Number of circuits or multicore cables														
		2	3	4	5	6	7	8	9	10	12	14	16	18	20	
Enclosed (Method 3 or 4) or bunched and clipped direct to a non-metallic surface (Method 1)		0.80	0.70	0.65	0.60	0.57	0.54	0.52	0.50	0.48	0.45	0.43	0.41	0.39	0.38	
Single layer clipped to a non-metallic surface (Method 1)	Touching	0.85	0.79	0.75	0.73	0.72	0.72	0.71	0.70	-	-	-	-	-	-	
	Spaced*	0.94	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
Single layer <i>multicore</i> on a perforated metal cable tray, vertical or horizontal (Method 11)	Touching	0.86	0.81	0.77	0.75	0.74	0.73	0.73	0.72	0.71	0.70	-	-	-	-	
	Spaced*##	0.91	0.89	0.88	0.87	0.87	-	-	-	-	-	-	-	-	-	
Single layer <i>single-core</i> on a perforated metal cable tray, touching (Method 11)	Horizontal	0.90	0.85	-	-	-	-	-	-	-	-	-	-	-	-	
	Vertical	0.85	-	-	-	-	-	-	-	-	-	-	-	-	-	
Single layer multicore touching on ladder supports (Method 13)		0.86	0.82	0.80	0.79	0.78	0.78	0.78	0.77	-	-	-	-	-	-	

* Spaced by a clearance between adjacent surfaces of at least one cable diameter (D_c). Where the horizontal clearances between adjacent cables exceeds 2 D_c no correction factor need be applied.

** When cables having differing conductor operating temperatures are grouped together, the current rating shall be based upon the lowest operating temperature of any cable in the group.

- Correction factor not tabulated.

Not applicable to mineral insulated cables see Table 4B2.

Table 52A : Cable surrounded by thermal insulation (Ci)

Length in insulation mm	Derating factor
50	0.89
100	0.81
200	0.68
400	0.55

APPENDIX B

Table 4B2 : Corrections factors for Mineral insulated cables installed on Performed Tray								
Tray Orientation	Arrangement of Cables	Number of Trays	Number of multicore cables of circuits					
			1	2	3	4	6	9
Horizontal	Multiconductor cables touching	1	1.0	0.90	0.80	0.80	0.75	0.75
Horizontal	Multiconductor cables spaced	1	1.0	1.0	1.0	0.95	0.90	-
Vertical	Multiconductor cables touching	1	1.0	0.90	0.80	0.75	0.75	0.70
Vertical	Multiconductor cables spaced	1	1.0	0.90	0.90	0.90	0.85	-
Horizontal	Multiconductor cables trefoil separated	1	1.0	1.0	0.95			
Vertical	Multiconductor cables trefoil separated	1	1.0	0.90	0.90			

Maximum demand = Diversity allowance x Sum of total connected load

Table 6.2 - Allowance for diversity

Note the following abbreviations :
 X is the full load current of the largest appliance or circuit
 Y is the full load current of the second largest appliance or circuit
 Z is the full load current of the remaining appliances or circuits

Type of final circuit	Type of premises		
	Households	Small shops, stores, offices	Hotels, guest houses
Lighting	66% total demand	90% total demand	75% total demand
Heating and power	100% up to 10 A + 50% balance	100%X + 75%(Y+Z)	100%X + 80%Y + 60%Z
Cookers	10 A + 30% balance + 5 A for socket	100%X + 80%Y + 60%Z	100%X + 80%Y + 60%Z
Motors (but not lifts)		100%X + 80%Y + 60%Z	100%X + 50%(Y+Z)
Instantaneous water heaters	100%X + 100%Y + 25%Z	100%X + 100%Y + 25%Z	100%X + 100%Y + 25%Z
Thermostatic water heaters	100%	100%	100%
Floor warming installations	100%	100%	100%
Thermal storage heating	100%	100%	100%
Standard circuits	100%X + 40%(Y+Z)	100%X + 50%(Y+Z)	100%X + 50%(Y+Z)
Sockets and stationary equip.	100%X + 40%(Y+Z)	100%X + 75%(Y+Z)	100%X + 75%Y + 40%Z

APPENDIX C

TABLE 4A (continued)

Installation method		Examples	Appropriate Reference Method for determining current-carrying capacity
Number	Description		
1	2	3	4
6	Sheathed cables in conduit in a thermally insulating wall etc. (otherwise as Reference Method 4)		Method 4
7	Cables in conduit embedded in masonry, brickwork, concrete, plaster or the like (other than thermally insulating materials)		Method 3
In trunking:			
8	Cables in trunking on a wall or suspended in the air		Method 3
9	Cables in flush floor trunking		Method 3
10	Single-core cables in skirting trunking		Method 3
On trays:			
11	Sheathed cables on a perforated cable tray, bunched and unenclosed. A perforated cable tray is a ventilated tray in which the holes occupy 30 % or more of the surface area		Method 11

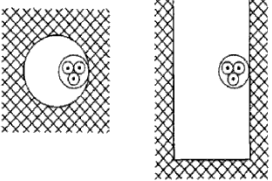
TABLE 4A
Schedule of Installation Methods of Cables (Including Reference Method)

Installation method		Examples	Appropriate Reference Method for determining current-carrying capacity
Number	Description		
1	2	3	4
Open and clipped direct:			
1	Sheathed cables clipped direct to or lying on a non-metallic surface		Method 1
Cables embedded direct in building materials:			
2	Sheathed cables embedded directly in masonry, brickwork, concrete, plaster or the like (other than thermally insulating materials)		Method 1
In conduit:			
3	Single-core non-metallic or non-metallic conduit on a wall or ceiling		Method 3
4	Single-core non-sheathed cables in metallic or non-metallic conduit in a thermally insulating wall or above a thermally insulating ceiling, the conduit being in contact with a thermally conductive surface on one side †		Method 4
5	Multicore cables having non-metallic sheath, in metallic or non-metallic conduit on a wall or ceiling		Method 3

† The wall is assumed to consist of an outer weatherproof skin, thermal insulation and an inner skin of plasterboard or wood-like material having a coefficient of heat transfer not less than 10 W/m²K. The conduit is fixed so as to be close to, but not necessarily touching, the inner skin. Heat from the cables is assumed to escape through the inner skin only.

APPENDIX D

TABLE 4A (continued)

Installation method		Examples	Appropriate Reference Method for determining current-carrying capacity
Number	Description		
1	2	3	4
16	Sheathed cables in ducts or voids formed by the building structure, other than thermally insulating materials		Method 4 Where the cable has a diameter D_c and the duct has a diameter not greater than $5 D_c$ or a perimeter not greater than $20 D_c$ Method 3 Where the duct has either a diameter greater than $5 D_c$ or a perimeter greater than $20 D_c$ NOTE 1 - Where the perimeter is greater than $60 D_c$, installation Methods 18 to 20, as appropriate, should be used. NOTE 2 - D_c is the overall cable diameter. For groups of cables D_c is the sum of the cable diameters.

Cables in trenches:

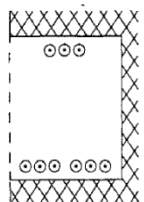
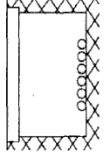
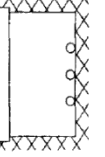
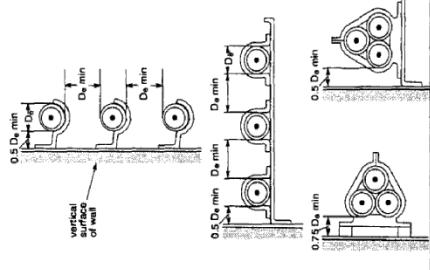
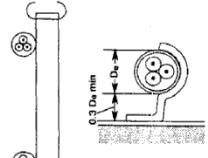
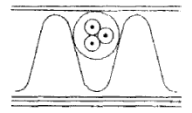
17	Cables supported on the wall of an open or ventilated trench, with spacings as indicated for Reference Method 12 or 13 as appropriate		Method 12 or 13, as appropriate
18	Cables in enclosed trench 450 mm wide by 300 mm deep (minimum dimensions) including 100 mm cover	Two single-core cables with surfaces separated by a minimum of one cable diameter.  Three single-core cables in trefoil and touching throughout.  Multicore cables or groups of single-core cables with surfaces separated by a minimum of 50 mm 	Method 18 Use rating factors in Table 4B3

TABLE 4A (continued)

Installation method		Examples	Appropriate Reference Method for determining current-carrying capacity
Number	Description		
1	2	3	4
In free air, on cleats, brackets or a ladder:			
12	Sheathed single-core cables in free air (any supporting metalwork under the cables occupying less than 10 % of the plan area): Two or three cables vertically one above the other, minimum distance between cable surfaces equal to the overall cable diameter (D_c); distance from the wall not less than $0.5 D_c$ Two or three cables horizontally, with spacings as above Three cables in trefoil, distance between wall and surface of nearest cable $0.5 D_c$, or nearest cables $0.75 D_c$		Method 12
13	Sheathed multicore cables on ladder or brackets, separation greater than $2 D_c$ Sheathed multicore cables in free air distance between wall and cable surface not less than $0.5 D_c$ Any supporting metalwork under the cables occupying less than 10 % of the plan area		Method 13
14	Cables suspended from or incorporating a catenary wire		Method 12 or 13, as appropriate
Cables in building voids:			
15	Sheathed cables installed directly in a thermally insulating wall or above a thermally insulating ceiling, the cable being in contact with a thermally conductive surface on one side (otherwise as Reference Method 4)		Method 4

APPENDIX E

TABLE 4D1A
Single-core pvc-insulated cables, non-armoured, with or without sheath
(COPPER CONDUCTORS)

CURRENT-CARRYING CAPACITY (amperes):						BS 6004 BS 6231 BS 6346						Ambient temperature: 30 °C Conductor operating temperature: 70 °C	
Conductor cross-sectional area	Reference Method 4 (enclosed in conduit in thermally insulating wall etc.)		Reference Method 3 (enclosed in conduit on a wall or in trunking etc.)		Reference Method 1 (clipped direct)		Reference Method 11 (on a perforated cable tray horizontal or vertical)		Reference Method 12 (free air)		Trefoil		
	2 cables, single-phase a.c. or d.c.	3 or 4 cables, three-phase a.c.	2 cables, single-phase a.c. or d.c.	3 or 4 cables, three-phase a.c.	2 cables, single-phase a.c. or d.c. flat and touching	3 or 4 cables, three-phase a.c. flat and touching or trefoil	2 cables, single-phase a.c. or d.c. flat and touching	3 or 4 cables, three-phase a.c. flat and touching or trefoil	Horizontal flat spaced	Vertical flat spaced			
1	2	3	4	5	6	7	8	9	10	11	12		
(mm ²)	(A)	(A)	(A)	(A)	(A)	(A)	(A)	(A)	(A)	(A)	(A)		
1	11	10.5	13.5	12	15.5	14	-	-	-	-	-		
1.5	14.5	13.5	17.5	15.5	20	18	-	-	-	-	-		
2.5	19.5	18	24	21	27	25	-	-	-	-	-		
4	26	24	32	28	37	33	-	-	-	-	-		
6	34	31	41	36	47	43	-	-	-	-	-		
10	46	42	57	50	65	59	-	-	-	-	-		
16	61	56	76	68	87	79	-	-	-	-	-		
25	80	73	101	89	114	104	126	112	146	130	110		
35	99	89	125	110	141	129	156	141	181	162	137		
50	119	108	151	134	182	167	191	172	219	197	167		
70	151	136	192	171	234	214	246	223	281	254	216		
95	182	164	232	207	284	261	300	273	341	311	264		
120	210	188	269	239	330	303	349	318	396	362	308		
150	240	216	300	262	381	349	404	369	456	419	356		
185	273	245	341	296	436	400	463	424	521	480	409		
240	320	286	400	346	515	472	549	504	615	569	485		
300	367	328	458	394	594	545	635	584	709	659	561		
400	-	-	546	467	694	634	732	679	852	795	656		
500	-	-	626	533	792	723	835	778	982	920	749		
630	-	-	720	611	904	826	953	892	1138	1070	855		
800	-	-	-	-	1030	943	1086	1020	1265	1188	971		
1000	-	-	-	-	1154	1058	1216	1149	1420	1337	1079		

NOTES:

- Where the conductor is to be protected by a semi-enclosed fuse to BS 3036, see item 6.2 of the preface to this appendix.
- The current-carrying capacities in columns 2 to 5 are also applicable to flexible cables to BS 6004 table 1(e) and to 90 °C heat resisting pvc cables to BS 6231 tables 8 and 9 where the cables are used in fixed installations.

TABLE 4D1B

VOLTAGE DROP (per ampere per metre):

Conductor operating temperature: 70 °C

Conductor cross-sectional area	2 cables d.c.	2 cables, single-phase a.c.									3 or 4 cables, three-phase a.c.											
		Reference Methods 3 & 4 (enclosed in conduit etc. in or on a wall)			Reference Methods 1 & 11 (clipped direct or on trays, touching)			Reference Method 12 (spaced*)			Reference Methods 3 & 4 (enclosed in conduit etc. in or on a wall)			Reference Methods 1, 11 & 12 (in trefoil)			Reference Methods 1 & 11 (flat and touching)			Reference Method 12 (flat spaced*)		
		3			4			5			6			7			8			9		
(mm ²)	(mV/A/m)	(mV/A/m)			(mV/A/m)			(mV/A/m)			(mV/A/m)			(mV/A/m)			(mV/A/m)			(mV/A/m)		
1	44	44			44			44			38			38			38			38		
1.5	29	29			29			29			25			25			25			25		
2.5	18	18			18			18			15			15			15			15		
4	11	11			11			11			9.5			9.5			9.5			9.5		
6	7.3	7.3			7.3			7.3			6.4			6.4			6.4			6.4		
10	4.4	4.4			4.4			4.4			3.8			3.8			3.8			3.8		
16	2.8	2.8			2.8			2.8			2.4			2.4			2.4			2.4		
25	1.75	r	x	z	r	x	z	r	x	z	r	x	z	r	x	z	r	x	z	r	x	z
35	1.25	1.80	0.33	1.80	1.75	0.20	1.75	1.75	0.29	1.80	1.50	0.29	1.55	1.50	0.175	1.50	1.50	0.25	1.55	1.50	0.32	1.55
50	0.93	1.30	0.31	1.30	1.25	0.195	1.25	1.25	0.28	1.30	1.10	0.27	1.10	1.10	0.170	1.10	1.10	0.24	1.10	1.10	0.32	1.15
70	0.63	0.95	0.30	1.00	0.93	0.190	0.95	0.93	0.28	0.97	0.81	0.26	0.85	0.80	0.165	0.82	0.80	0.24	0.84	0.80	0.32	0.86
95	0.46	0.65	0.29	0.72	0.63	0.185	0.66	0.63	0.27	0.69	0.56	0.25	0.61	0.55	0.160	0.57	0.55	0.24	0.60	0.55	0.31	0.63
120	0.36	0.49	0.28	0.56	0.47	0.180	0.50	0.47	0.27	0.54	0.42	0.24	0.48	0.41	0.155	0.43	0.41	0.23	0.47	0.40	0.31	0.51
150	0.29	0.39	0.27	0.47	0.37	0.175	0.41	0.37	0.26	0.45	0.33	0.23	0.41	0.32	0.150	0.36	0.32	0.23	0.40	0.32	0.30	0.44
185	0.23	0.31	0.27	0.41	0.30	0.175	0.34	0.29	0.26	0.39	0.27	0.23	0.36	0.26	0.150	0.30	0.26	0.23	0.34	0.26	0.30	0.40
240	0.180	0.25	0.27	0.37	0.24	0.170	0.29	0.24	0.26	0.35	0.22	0.23	0.32	0.21	0.145	0.26	0.21	0.22	0.31	0.21	0.30	0.36
300	0.145	0.195	0.26	0.33	0.185	0.165	0.25	0.185	0.25	0.31	0.17	0.23	0.29	0.160	0.145	0.22	0.160	0.22	0.27	0.160	0.29	0.34
400	0.105	0.160	0.26	0.31	0.150	0.165	0.22	0.150	0.25	0.29	0.14	0.23	0.27	0.130	0.140	0.190	0.130	0.22	0.25	0.130	0.29	0.32
500	0.086	0.130	0.26	0.29	0.120	0.160	0.20	0.115	0.25	0.27	0.12	0.22	0.25	0.105	0.140	0.175	0.105	0.21	0.24	0.100	0.29	0.31
630	0.068	0.110	0.26	0.28	0.098	0.155	0.185	0.093	0.24	0.26	0.10	0.22	0.25	0.086	0.135	0.160	0.086	0.21	0.23	0.081	0.29	0.30
800	0.053	0.094	0.25	0.27	0.081	0.155	0.175	0.076	0.24	0.25	0.08	0.22	0.24	0.072	0.135	0.150	0.072	0.21	0.22	0.066	0.28	0.29
1000	0.042	-	-	-	0.068	0.150	0.165	0.061	0.24	0.25	-	-	-	0.060	0.130	0.145	0.060	0.21	0.22	0.053	0.28	0.29
		-	-	-	0.059	0.150	0.160	0.050	0.24	0.24	-	-	-	0.052	0.130	0.140	0.052	0.20	0.21	0.044	0.28	0.28

NOTE: * Spacings larger than those specified in Method 12 (see table 4A) will result in larger voltage drop.

APPENDIX F

TABLE 4D4A
Multicore armoured pvc-insulated cables
(COPPER CONDUCTORS)

BS 6346

Ambient temperature: 30 °C
Conductor operating temperature: 70 °C

CURRENT-CARRYING CAPACITY (amperes):

Conductor cross-sectional area	Reference Method 1 (clipped direct)		Reference Method 11 (on a perforated horizontal or vertical cable tray) or Reference Method 13 (free air)	
	1 two-core cable, single-phase a.c. or d.c.	1 three- or four-core cable, three-phase a.c.	1 two-core cable, single-phase a.c. or d.c.	1 three- or four-core cable, three-phase a.c.
1	2	3	4	5
(mm ²)	(A)	(A)	(A)	(A)
1.5	21	18	22	19
2.5	28	25	31	26
4	38	33	41	35
6	49	42	53	45
10	67	58	72	62
16	89	77	97	83
25	118	102	128	110
35	145	125	157	135
50	175	151	190	163
70	222	192	241	207
95	269	231	291	251
120	310	267	336	290
150	356	306	386	332
185	405	348	439	378
240	476	409	516	445
300	547	469	592	510
400	621	540	683	590

NOTE:
Where the conductor is to be protected by a semi-enclosed fuse to BS 3036, see item 6.2 of the preface to this appendix.

TABLE 4D4B

VOLTAGE DROP (per ampere per metre):

Conductor operating temperature: 70 °C

Conductor cross-sectional area	Two-core cable, d.c.	Two-core cable, single-phase a.c.			Three- or four-core cable, three-phase a.c.		
1	2	3			4		
(mm ²)	(mV/A/m)	(mV/A/m)			(mV/A/m)		
1.5	29	29			25		
2.5	18	18			15		
4	11	11			9.5		
6	7.3	7.3			6.4		
10	4.4	4.4			3.8		
16	2.8	2.8			2.4		
		r	x	z	r	x	z
25	1.75	1.75	0.170	1.75	1.50	0.145	1.50
35	1.25	1.25	0.165	1.25	1.10	0.145	1.10
50	0.93	0.93	0.165	0.94	0.80	0.140	0.81
70	0.63	0.63	0.160	0.65	0.55	0.140	0.57
95	0.46	0.47	0.155	0.50	0.41	0.135	0.43
120	0.36	0.38	0.155	0.41	0.33	0.135	0.35
150	0.29	0.30	0.155	0.34	0.26	0.130	0.29
185	0.23	0.25	0.150	0.29	0.21	0.130	0.25
240	0.180	0.190	0.150	0.24	0.165	0.130	0.21
300	0.145	0.155	0.145	0.21	0.135	0.130	0.185
400	0.105	0.115	0.145	0.185	0.100	0.125	0.160

APPENDIX G

TABLE 4F1A
Single-core non-armoured cables having 85 °C rubber insulation
(COPPER CONDUCTORS)

BS 6007

BS 6883

CURRENT-CARRYING CAPACITY (amperes):

Ambient temperature: 30 °C
Conductor operating temperature: 85 °C

Conductor cross-sectional area	Reference Method 3 (enclosed in conduit etc. in or on a wall)		Reference Method 1 (clipped direct)		Reference Method 11 (on a perforated cable tray) Horizontal or Vertical		Reference Method 12 (free air)	
	2 cables, single-phase a.c. or d.c.	3 or 4 cables, three-phase a.c.	2 cables, single-phase a.c. or d.c. flat and touching	3 or 4 cables, three-phase a.c. flat and touching or trefoil	2 cables, single-phase a.c. or d.c. flat and touching	3 or 4 cables, three-phase a.c. flat and touching or trefoil	2 cables, single-phase a.c. or d.c. or 3 or 4 cables, three-phase a.c. flat spaced horizontal or vertical	3 cables trefoil, three-phase a.c.
1	2	3	4	5	6	7	8	9
(mm ²)	(A)	(A)	(A)	(A)	(A)	(A)	(A)	(A)
1	17	15	19	17.5	-	-	-	-
1.5	22	19.5	25	23	-	-	-	-
2.5	30	27	34	31	-	-	-	-
4	40	36	45	42	-	-	-	-
6	52	46	59	54	-	-	-	-
10	72	63	81	75	-	-	-	-
16	96	85	108	100	-	-	-	-
25	127	112	143	133	153	140	154	134
35	157	138	177	164	189	174	192	167
50	190	167	215	199	229	211	235	204
70	242	213	274	254	293	269	303	262
95	293	258	332	308	356	327	370	320
120	339	298	384	357	412	379	431	373
150	372	334	442	411	475	437	499	432
185	428	379	519	469	542	499	573	495
240	510	443	607	553	639	589	679	587
300	593	506	695	636	735	679	786	680
400	719	602	827	755	860	798	929	799
500	835	689	946	865	989	918	1081	919
630	975	791	1088	996	1143	1062	1263	1060

TABLE 4F1B

VOLTAGE DROP (per ampere per metre):

Conductor operating temperature: 85 °C

Conductor cross-sectional area	2 cables, d.c.	2 cables, single-phase a.c.						3 or 4 cables, three-phase a.c.					
		Reference Method 3 (enclosed in conduit etc. in or on a wall)	Reference Methods 1 & 11 (clipped direct or on trays, touching)	Reference Method 12 (spaced*)	Reference Method 3 (enclosed in conduit etc. in or on a wall)	Reference Methods 1, 11 & 12 (in trefoil touching)	Reference Methods 1 & 11 (flat and touching)	Reference Method 12 (flat spaced*)	Reference Method 3 (enclosed in conduit etc. in or on a wall)	Reference Methods 1, 11 & 12 (in trefoil touching)	Reference Methods 1 & 11 (flat and touching)	Reference Method 12 (flat spaced*)	Reference Method 12 (flat spaced*)
1	2	3	4	5	6	7	8	9	10	11	12	13	14
(mm ²)	(mV/A/m)	(mV/A/m)	(mV/A/m)	(mV/A/m)	(mV/A/m)	(mV/A/m)	(mV/A/m)	(mV/A/m)	(mV/A/m)	(mV/A/m)	(mV/A/m)	(mV/A/m)	(mV/A/m)
1	46	46	46	-	40	40	40	-	40	40	40	-	-
1.5	31	31	31	-	26	26	26	-	26	26	26	-	-
2.5	18	18	18	-	16	16	16	-	16	16	16	-	-
4	12	12	12	-	10	10	10	-	10	10	10	-	-
6	7.7	7.7	7.7	-	6.7	6.7	6.7	-	6.7	6.7	6.7	-	-
10	4.6	4.6	4.6	-	4.0	4.0	4.0	-	4.0	4.0	4.0	-	-
16	2.9	2.9	2.9	-	2.5	2.5	2.5	-	2.5	2.5	2.5	-	-
25	1.80	1.85	0.32	1.90	1.85	0.20	1.85	1.85	0.29	1.85	1.60	0.28	1.65
35	1.30	1.35	0.31	1.40	1.30	0.195	1.35	1.30	0.28	1.35	1.15	0.27	1.20
50	0.95	1.00	0.30	1.05	0.97	0.190	0.99	0.97	0.28	1.00	0.87	0.26	0.91
70	0.65	0.68	0.29	0.74	0.66	0.185	0.69	0.66	0.27	0.72	0.60	0.25	0.65
95	0.48	0.51	0.28	0.58	0.49	0.180	0.52	0.49	0.27	0.56	0.44	0.25	0.51
120	0.38	0.40	0.27	0.49	0.39	0.175	0.43	0.39	0.26	0.47	0.35	0.24	0.43
150	0.30	0.33	0.27	0.42	0.31	0.175	0.36	0.31	0.26	0.40	0.29	0.24	0.37
185	0.25	0.27	0.27	0.38	0.25	0.170	0.30	0.25	0.26	0.36	0.23	0.23	0.33
240	0.190	0.21	0.26	0.33	0.195	0.165	0.26	0.195	0.25	0.32	0.180	0.23	0.29
300	0.150	0.170	0.26	0.31	0.155	0.165	0.23	0.155	0.25	0.29	0.150	0.23	0.27
400	0.115	0.140	0.26	0.30	0.125	0.160	0.20	0.120	0.25	0.28	0.130	0.22	0.26
500	0.091	0.115	0.26	0.28	0.100	0.155	0.185	0.097	0.24	0.26	0.105	0.22	0.24
630	0.072	0.100	0.25	0.27	0.082	0.155	0.175	0.077	0.24	0.25	0.085	0.22	0.24
700	0.065	0.090	0.24	0.26	0.075	0.145	0.165	0.070	0.23	0.24	0.078	0.21	0.23
800	0.058	0.080	0.23	0.25	0.068	0.135	0.155	0.063	0.22	0.23	0.070	0.20	0.22
900	0.052	0.072	0.22	0.24	0.062	0.125	0.145	0.058	0.21	0.22	0.065	0.19	0.21
1000	0.047	0.065	0.21	0.23	0.057	0.115	0.135	0.053	0.20	0.21	0.060	0.18	0.20

NOTE: * Spacings larger than those specified in Method 12 (see table 4A) will result in larger voltage drop.

APPENDIX H

TABLE 4F2A
Multicore, sheathed and non-armoured cables having 85 °C rubber insulation
(COPPER CONDUCTORS)

BS 6883

CURRENT-CARRYING CAPACITY (amperes):

 Ambient temperature: 30 °C
 Conductor operating temperature: 85 °C

Conductor cross-sectional area	Reference Method 3 (enclosed)		Reference Method 1 (clipped direct)		Reference Method 11 (on a perforated cable tray) or Reference Method 13 (free air)	
	1 two-core cable, single-phase a.c. or d.c.	1 three- or four-core cable, three-phase a.c.	1 two-core cable, single-phase a.c. or d.c.	1 three- or four-core cable, three-phase a.c.	1 two-core cable, single-phase a.c. or d.c.	1 three- or four-core cable, three-phase a.c.
1	2	3	4	5	6	7
(mm ²)	(A)	(A)	(A)	(A)	(A)	(A)
1	16.5	14.5	18	16	19.5	17.5
1.5	21	18.5	23	20	25	22
2.5	29	25	32	28	34	30
4	38	33	43	37	46	40
6	48	43	55	48	59	52
10	66	58	76	66	81	71
16	87	77	103	88	109	94
25	114	100	136	117	144	123
35	139	122	168	144	177	151
50	167	147	201	174	213	186
70	211	185	256	222	272	237
95	254	222	310	269	329	287
120	292	256	359	312	381	333
150	320	287	413	359	438	383
185	368	326	470	409	499	437
240	439	381	553	482	587	515
300	509	436	636	555	675	593

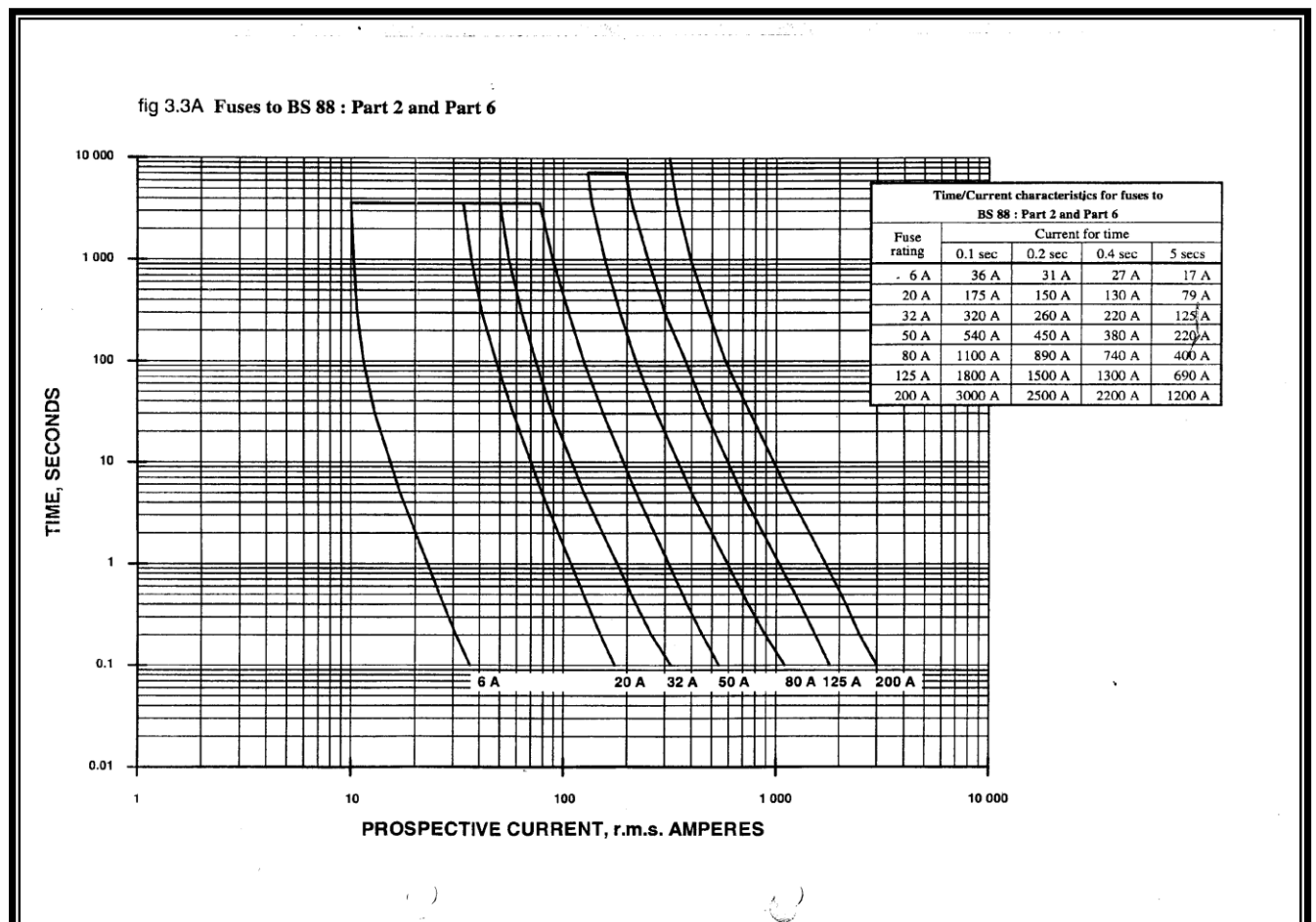
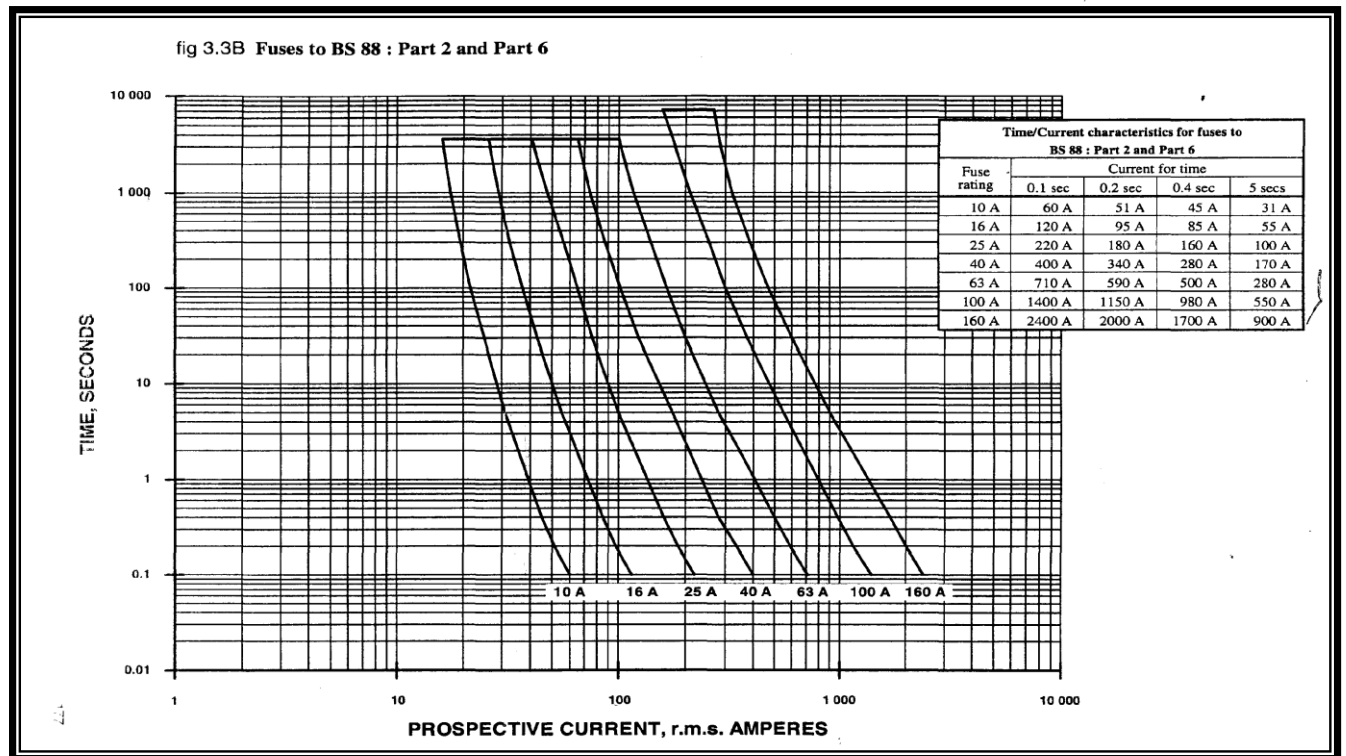
TABLE 4F2B

VOLTAGE DROP (per ampere per metre):

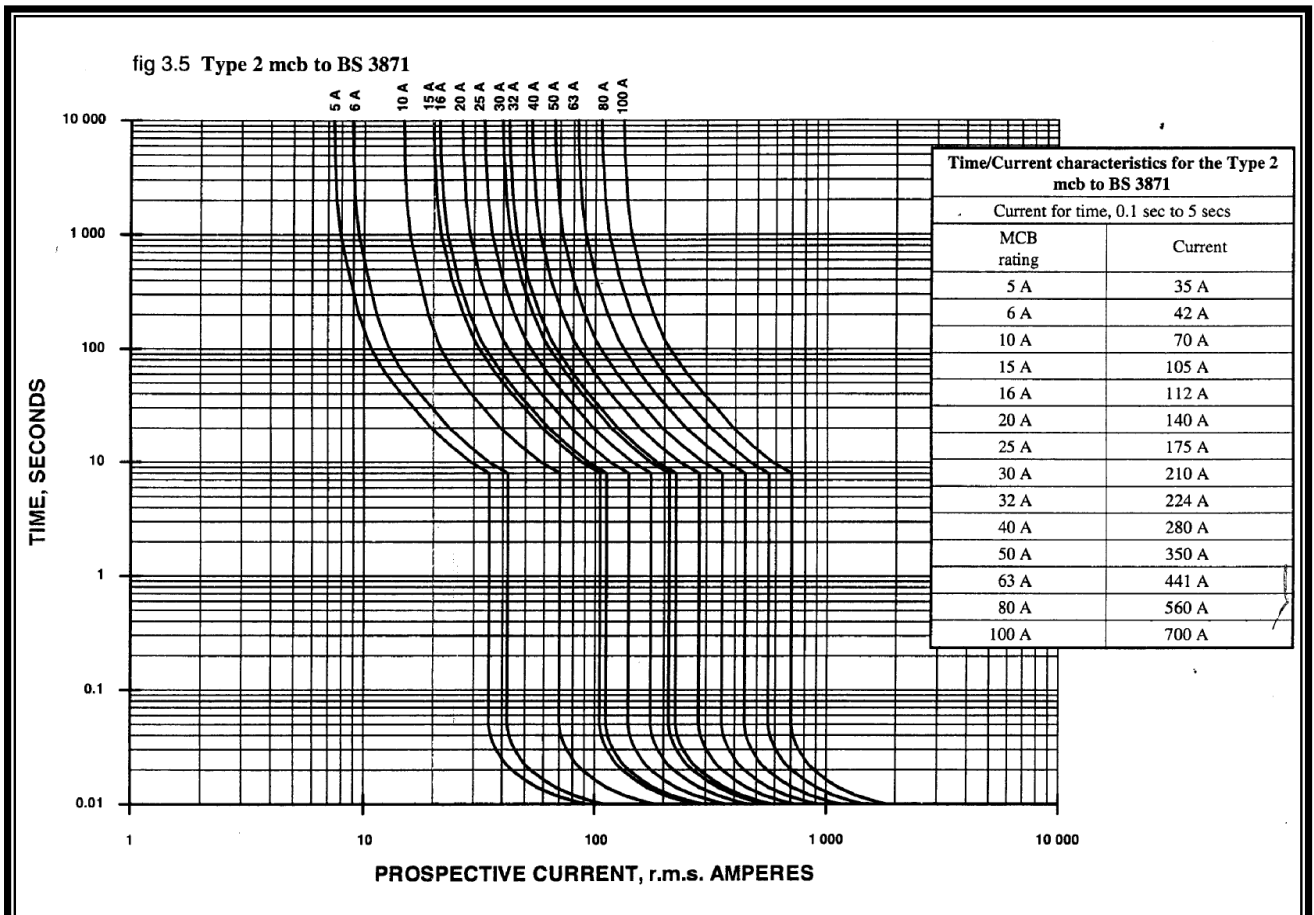
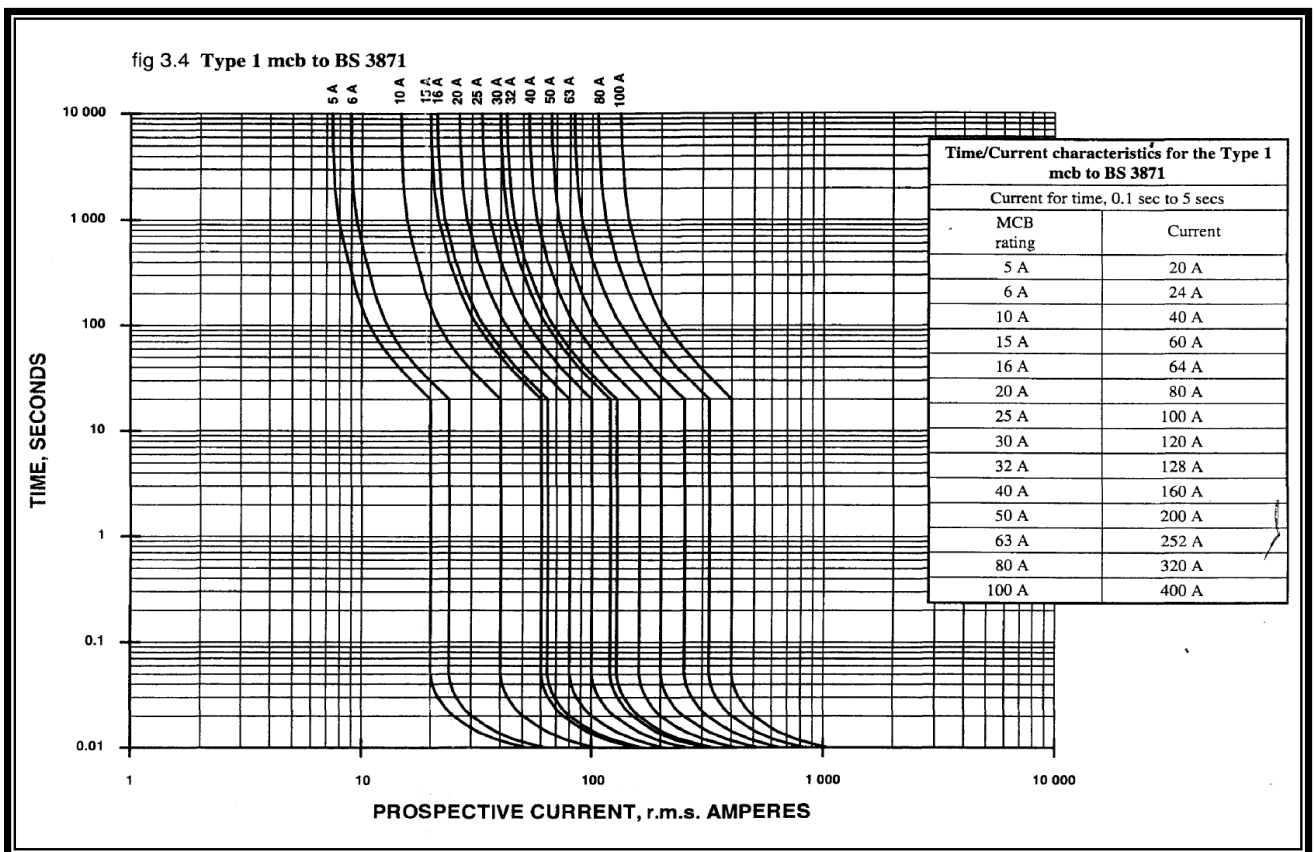
Conductor operating temperature: 85 °C

Conductor cross-sectional area	Two-core cable, d.c.	Two-core cable, single-phase a.c.			Three- or four-core cable, three-phase a.c.		
1	2	3			4		
(mm ²)	(mV/A/m)	(mV/A/m)			(mV/A/m)		
1	46	46			40		
1.5	31	31			26		
2.5	19	19			16		
4	12	12			10		
6	7.7	7.7			6.7		
10	4.6	4.6			4.0		
16	2.9	2.9			2.5		
		r	x	z	r	x	z
25	1.80	1.85	0.175	1.85	1.60	0.150	1.60
35	1.30	1.30	0.170	1.35	1.15	0.150	1.15
50	0.95	0.97	0.170	0.99	0.84	0.145	0.86
70	0.65	0.66	0.165	0.68	0.58	0.140	0.59
95	0.48	0.49	0.160	0.52	0.43	0.140	0.45
120	0.38	0.39	0.160	0.42	0.34	0.135	0.36
150	0.30	0.31	0.155	0.35	0.27	0.135	0.30
185	0.25	0.25	0.155	0.30	0.22	0.130	0.26
240	0.190	0.195	0.150	0.25	0.170	0.130	0.22
300	0.150	0.155	0.150	0.22	0.135	0.130	0.185

APPENDIX I



APPENDIX J



APPENDIX K

fig 3.6 Type 3 mcb to BS 3871

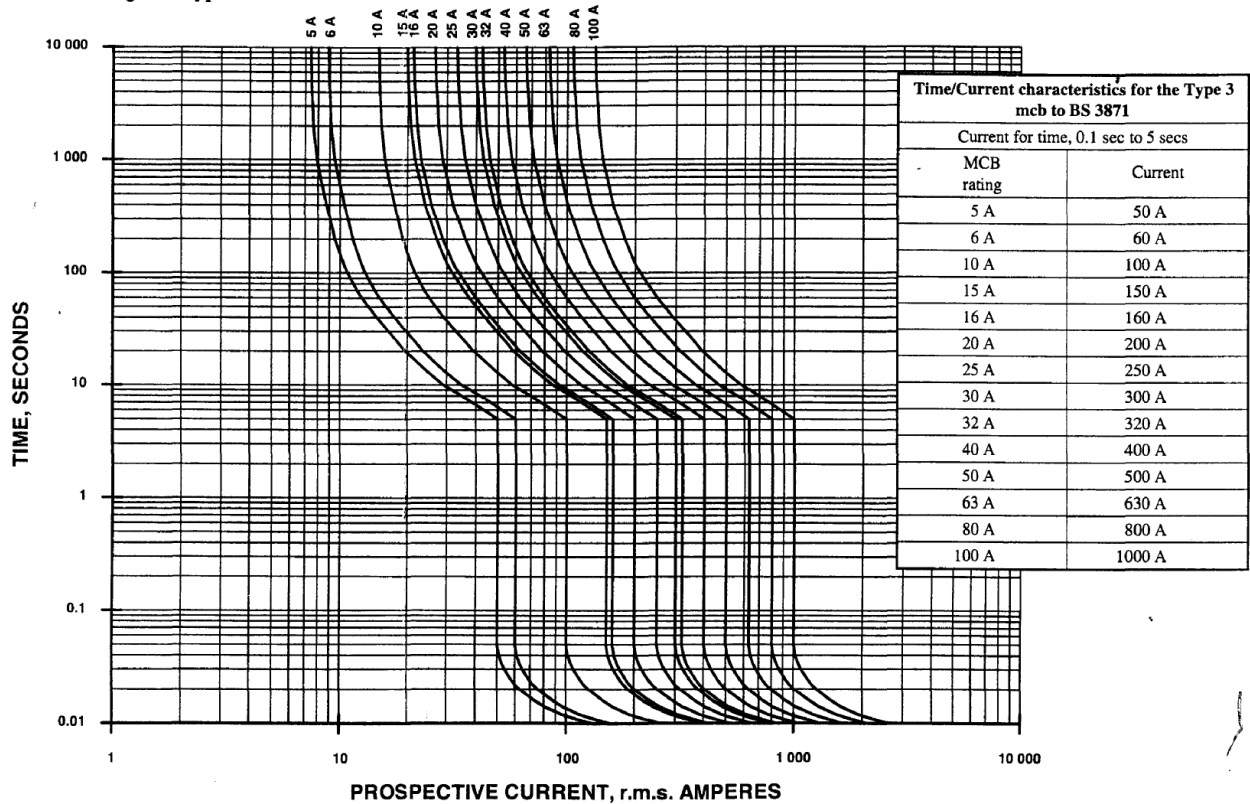
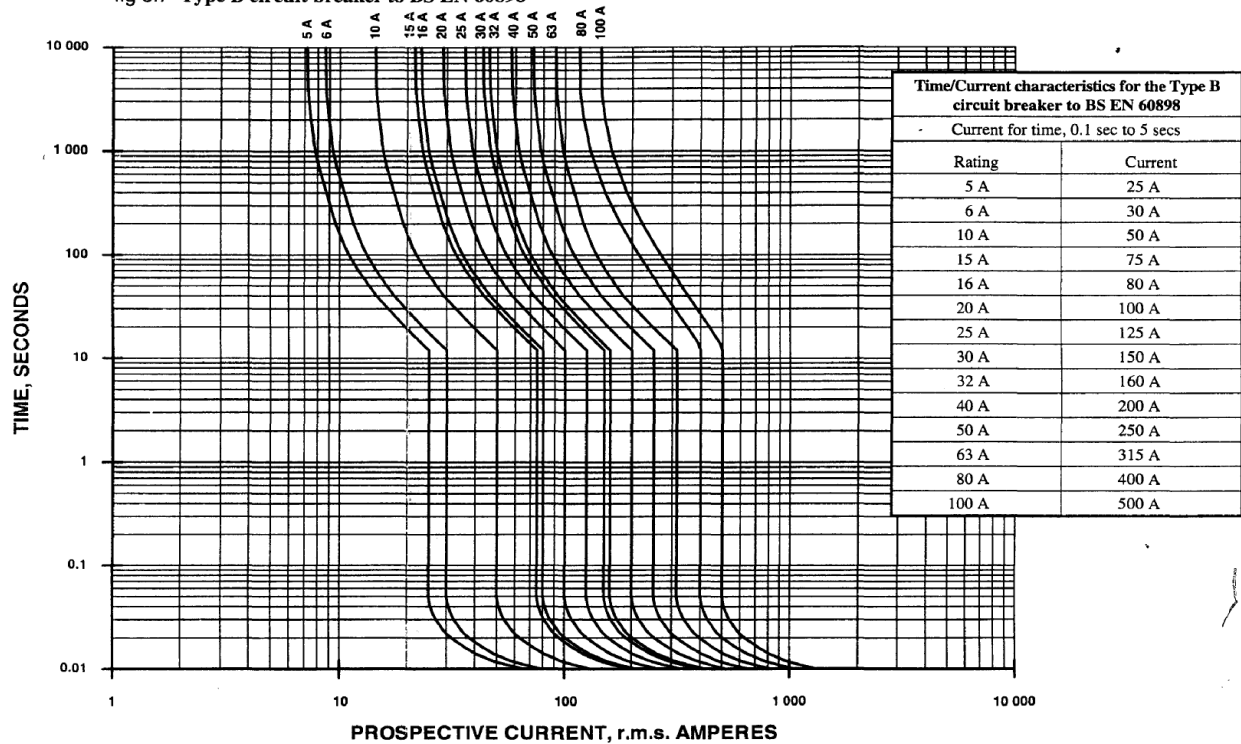


fig 3.7 Type B circuit breaker to BS EN 60898



APPENDIX L



F202, F672



F204, F674

Residual current devices

Breaker	GF trip level	Rated current	Catalog number	List price	Delivery class	Suggested order qty	Wgt. oz (1 Pc.)
F202 F672 Two pole 480Y/277VAC	10mA	16	F202AC-16/O.01	\$ 600	B	1	13.8
		25	F202AC-25/O.03	300			
		40	F202AC-40/O.03	400			
		63	F202AC-63/O.03	550			
		80	F672-80/O.03	1600			
		100	F672-100/O.03	2200			
	100mA	25	F202AC-25/O.1	300			
		40	F202AC-40/O.1	400			
		63	F202AC-63/O.1	550			
		80	F672-80/O.1	1600			
		100	F672-100/O.1	2200			
	300mA	25	F202AC-25/O.3	300			
		40	F202AC-40/O.3	400			
		63	F202AC-63/O.3	550			
		80	F672-80/O.3	1300			
		100	F672-100/O.3	1800			
F204 F674 Four pole 480Y/277VAC	30mA	25	F204AC-25/O.03	350	B	1	19.0
		40	F204AC-40/O.03	450			
		63	F204AC-63/O.03	600			
		80	F674-80/O.03	1300			
		100	F674-100/O.03	1800			
		125	F674-125/O.03	1800			
	100mA	25	F204AC-25/O.1	350			
		40	F204AC-40/O.1	450			
		63	F204AC-63/O.1	600			
		80	F674-80/O.1	1300			
		100	F674-100/O.1	1800			
		125	F674-125/O.1	1800			
	300mA	25	F204AC-25/O.3	350			
		40	F204AC-40/O.3	450			
		63	F204AC-63/O.3	600			
		80	F674-80/O.3	1200			
		100	F674-100/O.3	1600			
		125	F674-125/O.3	1600			
	500mA	25	F204AC-25/O.5	450			
		40	F204AC-40/O.5	600			
		63	F204AC-63/O.5	650			

Above devices are UL 1053 recognized and IEC 1008 approved.

Delivery Class

- A - Standard item, stock to 2 weeks lead time
- B - Stock to 4 weeks lead time
- C - 6 to 8 week lead time

END OF TECHNICAL DOCUMENTATION