



UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION
JULY 2010 SESSION

SUBJECT CODE : FED 10402
SUBJECT TITLE : ELECTRICAL DISTRIBUTION
LEVEL : DIPLOMA
TIME / DURATION : 4.00pm – 6.00pm
(2 HOURS)
DATE : 10 NOVEMBER 2010

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.

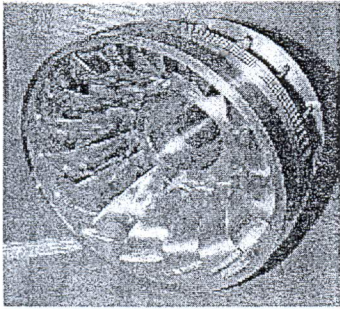
THERE ARE 7 PAGES OF QUESTIONS AND 7 PAGES OF APPENDIXES, EXCLUDING THIS PAGE.

SECTION A (Total: 60 marks)

INSTRUCTION: Answer ALL questions.
Please use the answer booklet provided.

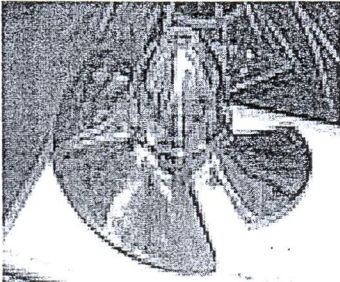
Question 1

- (a) List four sources of electrical energy. (4 marks)
- (b) List three advantages 3-phase system instead of single-phase system. (3 marks)
- (c) Name the type of turbines and their speed of rotation for the respective picture. (6 marks)



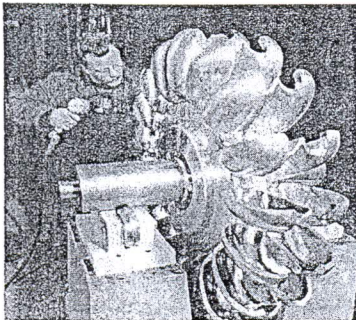
i. Turbines names

Speed of rotation



ii. Turbines names

Speed of rotation



iii. Turbines names

Speed of rotation

Figure 1

- (d) Explain in brief, the generating process of electrical energy in nuclear power generation.
(4 marks)
- (e) Describe the purpose of Uranium 235 and Heavy water in nuclear power generating stations.
(4 marks)
- (f) Lists the three main components of a High Voltage Transmission Line.
(3 marks)
- (g) Explain 2 main problems that Transmission line system must be transmitted in High Voltage range and not in a low voltage range.
(4 marks)
- (h) Briefly explain the effect of corona and give the solution to diminish the corona effect.
(2 marks)

Question 2

(a) Uranium dioxide has a mass of 22 kg when first inserted into a heavy water reactor. If it releases an average of 455 kW of thermal energy during its stay of 250 days in the reactor;

- i. state the Einstein formula. (2 marks)
- ii. calculate total amount of heat released in Joules. (4 marks)
- iii. calculate the reduction in weight of uranium dioxide, due to energy released in grams. (4 marks)

(b) On a particular day, the head of Grand Coulee dam is 280 feet and the generators deliver 6000 MVA at a power factor of 0.9 lagging. Assuming the average turbine efficiency is 0.92 and the average generator efficiency is 0.98.

Calculate :

- i. The active power output [MW] (3 marks)
- ii. The reactive power supplied to the system [MVAR] (2 marks)
- iii. The amount of water flowing through the turbines. [m^3/s] (5 marks)

Hints : 1 foot = 0.3048 m

- (c) A residential consumer has a connection of 15 lamps of 40 watts each and 5 ceiling fans of 60 watts each. Load demand is given in Table 1. Calculate:

Table 1

Time	No of Load	
	Lamps	Fans
6 pm – 7 pm	4	3
7 pm – 8 pm	10	3
8 pm – 10 pm	7	2
10 pm – 12 am	5	No load
12 am – 6 am	2	No load
6 am – 7 am	5	No load
7 am – 12 pm	No load	1
12 pm – 3 pm	No load	4
3 pm – 6 pm	No load	2

- i. the energy consumed per day. (3 marks)
- ii. the maximum demand factor of the overall load? (2 marks)
- iii. the daily load factor for this consumer? (3 marks)
- iv. the monthly consumption bill if the electricity supply company charges RM 0.30 per unit or per kWh. (2 marks)

SECTION B (Total: 40 marks)

INSTRUCTION: Answer TWO (2) questions only.

Please use the answer booklet provided.

Question 3

- (a) Protection devices are designed to disconnect the fault system elements with the electrical sources when there is an abnormal condition, state all 3 abnormal condition. (3 marks)
- (b) States three types of fuses are generally used. (3 marks)
- (c) Explain the advantage of using MCB as compared to fuse. (4 marks)
- (d) Refer to the diagram in Figure 2, explain the working principles of RCD in the healthy and faulty condition.

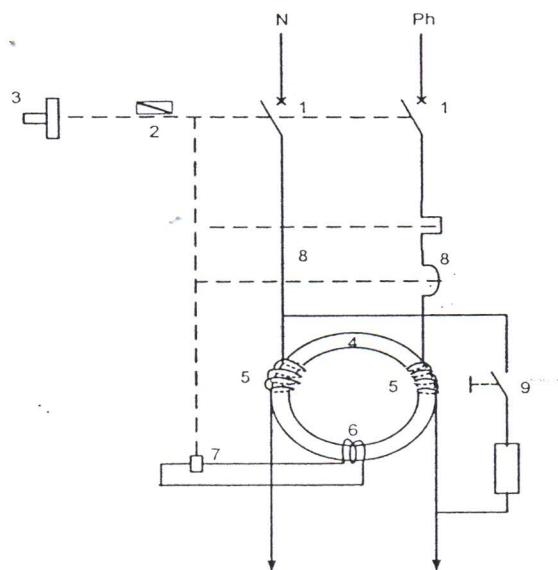


Figure 2

(6 marks)

- (e) Explain the difference between **direct contact** and **indirect contact**. Give only one example.

(4 marks)

Question 4

- (a) Eight similar three-phase circuits are wired in 85°C rubber insulated multicore cables with copper conductors. The circuits are bunched and clipped direct. The protection against over current is provided by MCB Type 2 and the specifications of the installations are as follows:

- Design current (I_b) : 34 A
- Ambient temperature : 50°C

- i. Define the suitable MCB size rating for this installation. (4 marks)
- ii. Calculate the current carrying capacity (I_z) (4 marks)
- iii. Define the tabulated current (I_t) and minimum conductor cross sectional area that can be used. (6 marks)

(Refer to technical data attached for the reference)

- (b) When Ahmad was replacing a broken 13A socket outlet with a new one, he experienced a 240V electric shock for 2 sec. When the incident occurred, he was standing on a rubber mat and his body resistance is 6000 Ω . Discuss the effect of the electric shock on Ahmad. State your assumption(s) and show your calculations. (6 marks)

Question 5

- (a) State five types of earthing systems which have been discussed in IEE Regulation 16th Edition. Draw and explain only one type of the earthing system in detail. (8 marks)
- (b) Describe the meaning of “solidly earthed” in the earthing system. (2 marks)
- (c) Refer to the diagram in Figure 3. The voltage supply in each phase is 130 V.

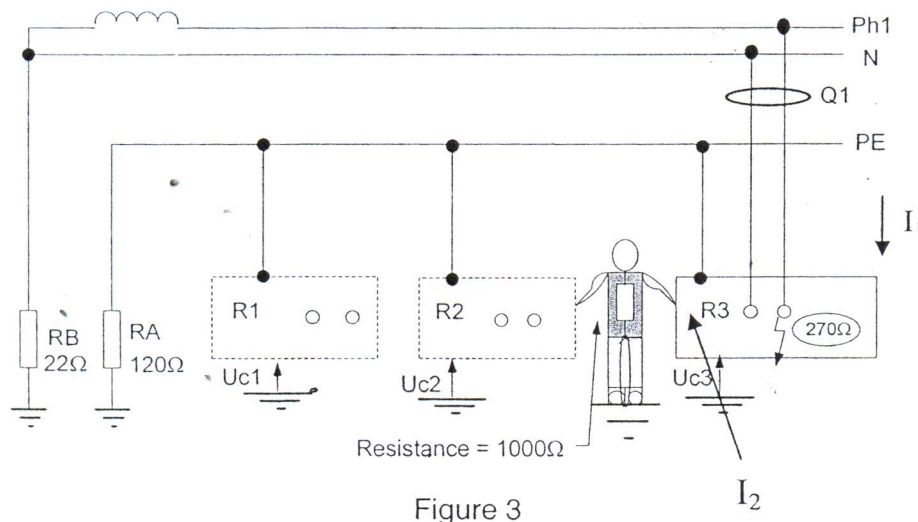


Figure 3

- i. Determine the type of earthing system applied to the diagram in Figure 3. Justify your answer. (4 marks)
- ii. Calculate the value of voltage at Uc 1, Uc 2 and Uc 3 and give the limit voltage for every room, ($U_L 1, U_L 2$ & $U_L 3$). (6 marks)

END OF QUESTION PAPER

APPENDIXES / ATTACHMENT FILE**FED 10402 : 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 4D1A & Table 4D1B
APPENDIX D	Table 4F1A & Table 4F1B
APPENDIX E	Table 4F2A & Table 4F2B
APPENDIX F	Time vs Current characteristics MCB Type 2

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 multicore 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 single-core 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

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

BS 6004
BS 6231
BS 6346

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

CURRENT CARRYING CAPACITY (amperes):

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)		
	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	Trefoil
(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	285	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

COPPER CONDUCTORS

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(a) 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, single-phase a.c.	3 or 4 cables, three-phase a.c.						
		Reference Methods 1 & 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 Methods 1 & 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*)
(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	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
35	1.25	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
50	0.93	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
70	0.63	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
95	0.46	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
120	0.36	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
150	0.29	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
185	0.23	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
240	0.180	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
300	0.135	0.150 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
400	0.105	0.110 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
500	0.086	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
630	0.068	0.093 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
800	0.053	-	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
1000	0.042	-	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

*0.11 m spacings larger than those specified in Method 12 (see table 4(A)) will result in larger voltage drop

APPENDIX D

TABLE 4F1A
Single-core non-armoured cables having 85 °C rubber insulation
(COPPER CONDUCTORS)
BS 6007
BS 6883

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

CURRENT CARRYING CAPACITY (amperes):

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*)									
1	2	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	46	46		46		-		40		40		40		-									
1.5	31	31		31		-		26		26		26		-									
2.5	18	18		18		-		16		16		16		-									
4	12	12		12		-		10		10		10		-									
6	7.7	7.7		7.7		-		6.7		6.7		6.7		-									
10	4.6	4.6		4.6		-		4.0		4.0		4.0		-									
16	2.9	2.9		2.9		-		2.5		2.5		2.5		-									
25	1.80	r	x	z	r	x	z	r	x	z	r	x	z	r	x	z							
		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	1.60	0.175	1.60	1.60	0.25	1.60	1.60	0.32	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	1.15	0.170	1.15	1.15	0.24	1.15	1.15	0.32	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	0.84	0.165	0.86	0.84	0.24	0.88	0.84	0.32	0.90	
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	0.57	0.160	0.60	0.57	0.24	0.62	0.57	0.31	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	0.43	0.155	0.45	0.43	0.23	0.48	0.42	0.31	0.52	
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	0.34	0.155	0.37	0.34	0.23	0.41	0.34	0.30	0.45	
150	0.30	0.33	0.27	0.42	0.31	0.175	0.35	0.31	0.26	0.40	0.29	0.24	0.37	0.27	0.150	0.31	0.27	0.23	0.35	0.27	0.30	0.40	
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	0.22	0.150	0.26	0.22	0.22	0.31	0.22	0.30	0.37	
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	0.170	0.145	0.22	0.170	0.22	0.28	0.170	0.30	0.34	
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	0.135	0.140	0.195	0.135	0.22	0.26	0.135	0.29	0.32	
300	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	0.110	0.140	0.175	0.110	0.21	0.24	0.105	0.29	0.31	
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	0.089	0.135	0.165	0.089	0.21	0.23	0.085	0.29	0.30	
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	0.073	0.135	0.155	0.073	0.21	0.22	0.067	0.28	0.29	

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

APPENDIX E

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

BS 6883

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

CURRENT-CARRYING CAPACITY (amperes):

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

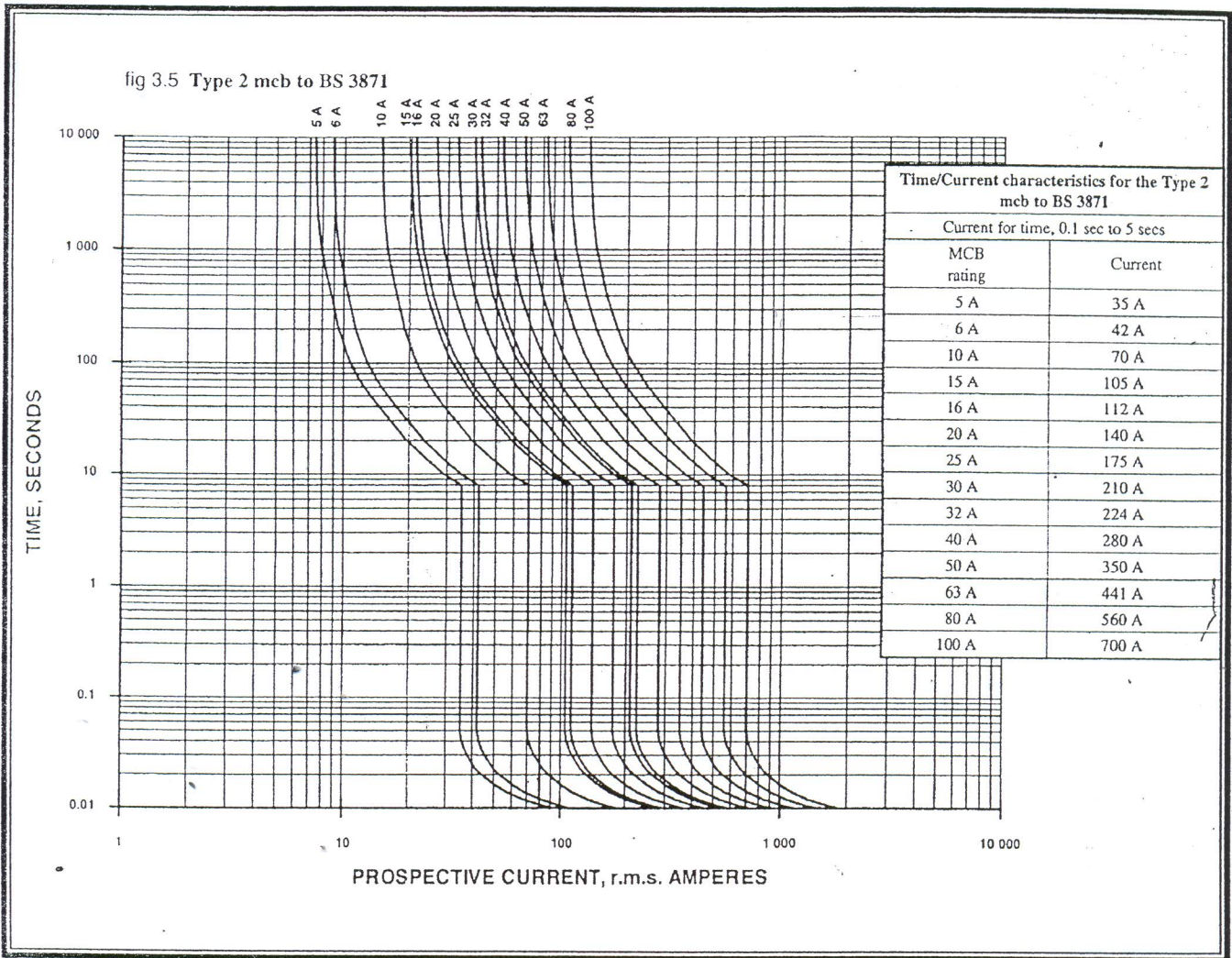
TABLE 4F2B

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.		
	2	3			4		
1	(mV/A/m)	(mV/A/m)			(mV/A/m)		
(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 F



END OF TECHNICAL DOCUMENTATION