

(3 Hours)

[Total Marks :80

- N.B. :** (1) Question No. 1 is compulsory.
 (2) Answer any **three** out of remaining
 (3) **Assume data** if necessary and justify the same.

1. (a) Explain soft starters 5
 (b) Explain any one type of battery 5
 (c) Explain difference between conventional choke and electronic choke 5
 (d) Explain APFC 5
2. (a) Explain Benchmarking and its types 10
 (b) Discuss different types of distribution systems and their criterion 10
3. (a) The distribution transformer caters to the loads, the details of which are as follows 10

	Type of load	Kw	η	pf	Lf	Df
(i)	Machine shop	600	0.8	0.85	0.8	0.8
(ii)	Paint shop	200	0.7	0.8	0.7	0.8
(iii)	Auxiliary plant	300	0.8	0.7	0.8	0.7
(iv)	Misc. Load	200	0.7	0.7	0.7	0.5

- (a) Calculate the rating of transformer
 (b) Draw SLD indicating different type of metering, protections etc.
- (b) Define energy audit. Explain its types in details. 10
4. (a) Explain energy efficient lighting controls in detail 10
 (b) Explain fuel and energy substitution 10
5. (a) Explain step by step approach in load management. 10
 (b) A sewing factory is to be illuminated at 500lux. The hall measures 30m x 20m x 5m. Calculate number of fixtures required and also draw lightning layout. Different design consideration made. 10
6. (a) Explain EMS in details 10
 (b) A 20 HP, 400V, 3 phase, 0.85 efficiency, 0.86 pf lag, 1440rpm, delta connected motor is to be supplied from a MCC by a cable of length 50m. The grouping factor is 0.86. Ambient temperature is 45°C. Fault level at that point is 20kA. Select the size of cable. State assumptions. 10

Type of cable	Value of k(cu)	Value of k(Al)
PVC cable < 300 mm ²	115	76
PVC cable > 300mm ²	103	68
XLPE cable < 300mm ²	114	92

TABLE 11
(IEE-Table 9 A)

Recommended methods of installation for cables and conductors

Type	Description	Example
I 'ENCLOSED'		
A	Single-core and multicore cables (enclosed in conduit).	
B	Single-core and multicore cables (enclosed in cable trunking).	
C	Single-core and multicore cables (enclosed in underground conduit, or ducts, or cable ducting).	
D	Two or more single-core cables (contained in separate bores of a multicore conduit and intended to be solidly embedded in concrete or plaster or generally incorporated in the building structure (may be used as a prefabricated wiring system).)	

TABLE 10
CURRENT RATINGS (ac) FOR TWO, THREE & FOUR CORE 650/1100 Volts, Armoured or un-Armoured Aluminium Conductor Cables as per IS : 3961 (PART III) - 1967.

Nominal Area of Conductor mm ²	LAID DIRECT			
	IN THE GROUND	IN DUCTS	IN AIR	
	2 Core	3, 3½ & 4 Core	2 Core	3, 3½ & 4 Core
1.5	18	16	16	13
2.5	25	21	21	18
4	32	28	27	23
6	40	35	34	30
10	55	46	45	40
16	70	60	58	51
25	90	76	76	70
35	110	92	92	86
50	135	110	115	105
70	160	135	140	130
95	190	165	170	155
120	210	185	190	180
150	240	210	210	205
185	275	235	240	240
240	320	275	275	280
300	355	305	305	315
400	385	335	345	375

CONDITIONS OF INSTALLATION

Maximum Conductor Temperature	70 °C
Ambient Air Temperature	40 °C
Ground Temperature	30 °C
Depth of Laying for Cables in Ground	75 Cmt.
Thermal Resistivity of soil	150 Cm/Watt.
Method of Installation	Singly

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TABLE 11 (Continued)

II OPEN AND CLIPPED DIRECT


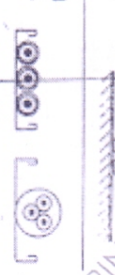
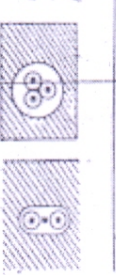

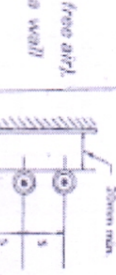
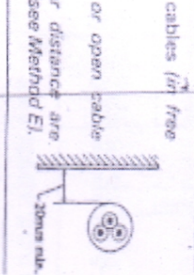
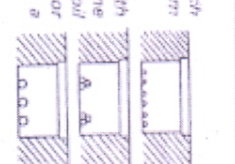
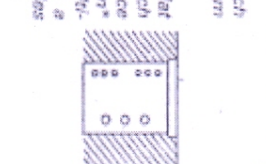
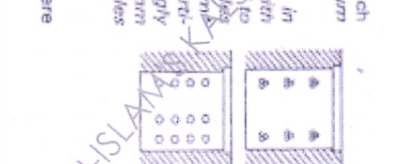
E	<p>Sheathed single-core and multicore cables (clipped direct to or lying on a non-metallic surface).</p> 
F	<p>Sheathed single-core and multicore cables (in a cable tray, bunched and unenclosed).</p> 
G	<p>Sheathed cables (embedded direct in plaster other than special thermally insulating plasters).</p> 
H	<p>Sheathed single-core and multicore cables (suspended from or incorporating a catenary wire).</p> 
<p>III 'DEFINED CONDITIONS'</p>	
J	<p>Sheathed single core cables (in free air). Example : Vertical surface of a wall or open cable trench.</p> 
K	<p>Sheathed twin and multicore cables (in free air). Example : 1. Vertical surface of a wall or open cable trench. 2. Cables spaced by a lesser distance are assumed to be 'clipped direct' (see Method E).</p> 

TABLE 11 (Continued)

IV ENCLOSED TRENCHES

L	<p>Single and multicore cables (enclosed trench 450mm wide by 300mm deep (minimum dimensions) including 100mm cover). Example : Two single-core cables with surfaces separated by a distance equal to one diameter, or three single-core cables in trefoil and touching throughout. Multicore cables or groups of single-core cables separated by a minimum distance of 50mm.</p> 
M	<p>Single and multicore cables (enclosed trench 450mm wide by 500mm deep (minimum dimensions) including 100mm cover). Example : Single-core cables arranged in flat groups of two or three on the vertical trench wall with surfaces separated by a distance equal to one diameter with a minimum* separation of 50mm between groups. Multicore cables installed singly separated by a minimum* distance of 75mm. All cables spaced at least 25mm from the trench wall.</p> 
N	<p>Single and multicore cables (in enclosed trench 600mm wide by 760mm (300mm minimum dimensions) including 100mm cover). Example : Single-core cables* clipped in groups of two or three in flat formation with the surfaces separated by a distance equal to one diameter or in trefoil formation with cables touching. Groups separated by a minimum* distance of 50mm either horizontally or vertically. Multicore cables installed singly separated by a minimum* distance of 75mm either horizontally or vertically. All cables spaced at least 25mm from the trench wall. * Larger spacings to be used where practicable.</p> 

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Data for Illumination Design problems

K	Rc=0.7			Rc=0.5			Rc=0.3		
	Rw=0.5	Rw=0.3	Rw=0.1	Rw=0.5	Rw=0.3	Rw=0.1	Rw=0.5	Rw=0.3	Rw=0.1
0	0	0	0	0	0	0	0	0	0
0.6	0.43	0.39	0.36	0.42	0.38	0.36	0.41	0.38	0.36
0.8	0.45	0.41	0.38	0.44	0.40	0.38	0.43	0.40	0.38
1.00	0.51	0.47	0.44	0.55	0.47	0.44	0.49	0.46	0.40
1.25	0.55	0.51	0.49	0.53	0.50	0.48	0.52	0.50	0.48
1.50	0.57	0.54	0.52	0.56	0.53	0.51	0.54	0.52	0.50
2.00	0.61	0.58	0.56	0.59	0.57	0.55	0.57	0.56	0.54
2.50	0.63	0.61	0.59	0.61	0.59	0.57	0.59	0.58	0.56
3.00	0.65	0.63	0.61	0.63	0.61	0.59	0.61	0.59	0.58
4.00	0.67	0.65	0.63	0.64	0.63	0.62	0.62	0.61	0.59
5.00	0.68	0.67	0.65	0.65	0.64	0.63	0.63	0.62	0.61

Sr.No	Type of Lamp	Wattage	Lumen output
1	GLS	25	230
		40	415
		60	710
		100	1340
		200	3000
2	Tungsten Halogen	50 (Miniature Dichroic)	900
		300	5100
		500	9000
		1000	22000
3	Fluorescent (T8/ T5)	18 (Halo phosphate)	1015
		36 (Halo phosphate)	2450
		18 (82/84/86)	1300
		36 (82/84/86)	3250
		28 (T5)	2800
4	CFL	9	600
		11	760
		13	920
		18	1200

[Turn Over

TABLE 12
IEE-Table 9D

Correction factors for cables installed in enclosed trenches
(Installation methods L, M and N of Table 11)

The correction factors tabulated below relate to dispositions of cables illustrated in items L, M, and N of Table 11 and are applicable to current-carrying capacities and volt drops for installation methods J and K of Table 11

Nominal Cross Sectional area of conductor cable(s)	Correction factors									
	Type L of Table 11				Type M of Table 11			Type N of Table 11		
	Two Single-core cables, or one 3- or 4-core cables	Three single-core cables, or two twin cables	Four single-core cables, or two 3- or 4-core cables	Six single-core cables, four twin cables, or three 3- or 4-core cables	Six Single-core cables, four twin cables, or three 3- or 4-core cables	Eight Single-core cables, or four 3- or 4-core cables	Twelve Single-core cables, eight twin cables or six 3- or 4-core cables	Twelve Single-core cables, eight twin cables or six 3- or 4-core cables	Eighteen Single-core cables, twelve twin cables, or nine 3- or 4-core cables	Twentyfour Single-core cables, sixteen twin cables, or twelve 3- or 4-core cables
1	2	3	4	5	6	7	8	9	10	11
mm ²										
4	0.93	0.90	0.87	0.82	0.86	0.83	0.78	0.81	0.74	0.69
5	0.92	0.89	0.86	0.81	0.86	0.82	0.75	0.80	0.73	0.68
10	0.91	0.88	0.85	0.80	0.85	0.80	0.74	0.78	0.72	0.66
16	0.91	0.87	0.84	0.78	0.83	0.78	0.71	0.76	0.70	0.64
25	0.90	0.86	0.82	0.76	0.81	0.76	0.69	0.74	0.67	0.62
35	0.89	0.85	0.81	0.75	0.80	0.74	0.68	0.72	0.66	0.60
50	0.88	0.84	0.79	0.74	0.78	0.73	0.66	0.71	0.64	0.59
70	0.87	0.82	0.78	0.72	0.77	0.72	0.64	0.70	0.62	0.57
95	0.86	0.81	0.76	0.70	0.75	0.70	0.63	0.68	0.60	0.55
120	0.85	0.80	0.75	0.69	0.73	0.68	0.61	0.66	0.58	0.53
150	0.84	0.78	0.74	0.67	0.72	0.67	0.59	0.64	0.57	0.51
185	0.83	0.77	0.73	0.66	0.70	0.65	0.58	0.63	0.55	0.49
240	0.82	0.76	0.71	0.63	0.69	0.63	0.56	0.61	0.53	0.48
300	0.81	0.74	0.69	0.62	0.68	0.62	0.54	0.59	0.52	0.46
400	0.80	0.73	0.67	0.59	0.66	0.60	0.52	0.57	0.50	0.44
500	0.78	0.72	0.66	0.58	0.64	0.58	0.51	0.56	0.48	0.43
630	0.77	0.71	0.65	0.56	0.63	0.57	0.48	0.54	0.47	0.41

TABLE 13
IEE-Table 9D1

Current-carrying capacities and associated voltage drops for single-core p.v.c.-insulated cables, non-armoured, with or without sheath (copper conductors)

Conductor operating temperature: 70°C

conductor cross sectional area	Installation methods A to C of Table 11 (Enclosed)				Installation methods E to H of Table 11 (Clipped direct)				Installation method J of Table 11 (Defined conditions)					
	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.		Flat or vertical (2 cables, single phase a.c., or d.c. or 3 or 4 cables three-phase)			Trench (3 cables three-phase)		
	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre		Current carrying capacity	Volt drop per ampere per metre	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
mm ²	A	mV	A	mV	A	mV	A	mV	A	mV	mV	mV	A	mV
1.0	14	42	12	37	14	42	16	37	14	42	42	42	14	42
1.5	17	28	14	24	17	28	20	24	17	28	28	28	17	28
2.5	24	17	21	15	24	17	26	15	24	17	17	17	24	15
4	32	11	29	9.2	32	11	36	9.2	32	11	11	11	32	9.2
6	41	7.1	37	6.9	41	7.1	45	6.2	41	7.1	7.1	7.1	41	6.2
10	55	4.2	51	3.7	55	4.2	61	3.7	55	4.2	4.2	4.2	55	3.7
16	74	2.7	66	2.3	74	2.7	81	2.3	74	2.7	2.7	2.7	74	2.3
25	97	1.7	87	1.5	97	1.7	106	1.5	97	1.7	1.7	1.7	97	1.5
35	119	1.3	106	1.1	119	1.3	130	1.1	119	1.3	1.3	1.3	119	1.1
50	145	0.97	125	0.84	145	0.93	160	0.82	145	0.95	0.91	0.85	145	0.80
70	185	0.71	160	0.62	185	0.65	200	0.59	185	0.68	0.63	0.62	185	0.59
95	230	0.56	195	0.48	230	0.48	240	0.45	230	0.52	0.45	0.48	230	0.42
120	260	0.48	220	0.42	260	0.46	280	0.38	260	0.44	0.38	0.43	260	0.34
150	300	0.41	240	0.36	300	0.44	320	0.34	300	0.41	0.34	0.39	300	0.29
185	350	0.35	260	0.31	350	0.39	365	0.30	350	0.39	0.29	0.38	350	0.29
240	400	0.29	280	0.26	400	0.35	400	0.27	400	0.35	0.24	0.38	400	0.25
300	460	0.24	300	0.22	460	0.24	470	0.22	460	0.26	0.18	0.38	460	0.22
400	560	0.22	340	0.20	560	0.22	560	0.20	560	0.26	0.14	0.35	560	0.19
500	660	0.20	380	0.18	660	0.20	610	0.18	660	0.26	0.12	0.33	660	0.17
630	800	0.18	420	0.16	800	0.18	710	0.16	800	0.28	0.11	0.31	800	0.16
800	910	0.17	460	0.15	910	0.17	820	0.15	1040	0.26	0.085	0.30	880	0.15

FOR AMBIENT TEMPERATURE
Ambient temperature
Correction factor

CORRECTION FACTORS

25°C	35°C	40°C	45°C	50°C	55°C	60°C	65°C
1.00	0.94	0.87	0.79	0.71	0.61	0.50	0.31

TABLE 14
IEE-Table 9D2
Current-carrying capacities and associated voltage drops for twin and multicore p.v.c.-insulated cables, non-armoured (copper conductors)

Conductor operating temperature : 70°C

Conductor cross sectional area	Installation methods A to C of Fig. 1 ('Enclosed')				Installation methods E to H of Fig. 1 ('Clipped direct')				Installation method K of Fig. 1 ('Defined conditions')			
	One twin cable With or without protective conductor single-phase a.c. or d.c.		One three-core cable with or without protective conductor or one four-core cable, three phase		One twin cable With or without protective conductor single-phase a.c. or d.c.		One three-core cable with or without protective conductor or one four-core cable, three phase		One twin cable With or without protective conductor single-phase a.c. or d.c.		One three-core cable with or without protective conductor or one four-core cable, three phase	
	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre
1	2	3	4	5	6	7	8	9	10	11	12	13
mm ²	A	mV	A	mV	A	mV	A	mV	A	mV	A	mV
1.0	14	42	12	37	16	42	13	37	-	-	-	-
1.5	18	28	16	24	20	28	17	24	-	-	-	-
2.5	24	17	21	15	28	17	24	15	-	-	-	-
4	32	11	29	9.2	36	11	32	9.2	-	-	-	-
6	40	7.1	36	6.2	46	7.1	40	6.2	-	-	-	-
10	53	4.2	49	3.7	64	4.2	54	3.7	-	-	-	-
16	70	2.7	62	2.3	85	2.7	71	2.3	-	-	-	-
25	79	1.8	70	1.6	109	1.8	90	1.6	114	1.8	95	1.6
35	96	1.3	86	1.1	132	1.3	115	1.1	139	1.3	122	1.1
50	-	-	-	-	163	0.92	140	0.81	172	0.92	148	0.81
70	-	-	-	-	207	0.65	176	0.57	218	0.65	186	0.57
95	-	-	-	-	251	0.48	215	0.42	265	0.48	227	0.42
120	-	-	-	-	290	0.40	251	0.34	306	0.40	265	0.34
150	-	-	-	-	330	0.32	287	0.29	348	0.32	302	0.29
185	-	-	-	-	380	0.29	330	0.24	400	0.29	348	0.24
240	-	-	-	-	450	0.25	392	0.20	474	0.25	413	0.20
300	-	-	-	-	520	0.23	450	0.18	548	0.23	474	0.18
400	-	-	-	-	600	0.22	520	0.17	632	0.22	548	0.17

CORRECTION FACTORS

FOR AMBIENT TEMPERATURE
Ambient temperature
Correction factor

25°C	35°C	40°C	45°C	50°C	55°C	60°C	65°C
1.06	0.94	0.87	0.79	0.71	0.61	0.50	0.35

TABLE 15
IEE-Table 9D3
Current-carrying capacities and associated voltage drops for twin and multicore armoured p.v.c.-insulated cables (copper conductors)

Conductor operating temperature : 70°C

Conductor cross sectional area	Installation method E, F and G of Table 11 ('Clipped direct')				Installation method K of Table 11 ('Defined conditions')			
	One twin cable single phase a.c. or d.c.		One three- or four-core cable three-phase		One twin cable single phase a.c. or d.c.		One three- or four-core cable three-phase	
	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre
1	2	3	4	5	6	7	8	9
mm ²	A	mV	A	mV	A	mV	A	mV
1.5	20	29	16	25	-	-	-	-
2.5	29	18	24	16	-	-	-	-
4	37	12	31	9.6	-	-	-	-
6	48	7.4	41	6.3	50	7.3	42	6.3
10	66	4.3	56	3.8	69	4.3	58	3.8
16	86	2.7	73	2.3	90	2.7	77	2.3
25	115	1.8	97	1.6	121	1.8	102	1.6
35	142	1.3	119	1.1	149	1.3	125	1.1
50	168	0.92	147	0.81	180	0.92	155	0.81
70	209	0.65	180	0.57	230	0.65	190	0.57
95	257	0.48	219	0.42	270	0.48	230	0.42
120	295	0.36	257	0.34	310	0.40	270	0.34
150	337	0.32	295	0.29	355	0.37	310	0.29
185	390	0.29	333	0.24	410	0.29	350	0.24
240	461	0.25	399	0.20	485	0.25	420	0.20
300	523	0.23	451	0.18	550	0.23	475	0.18
400	589	0.22	523	0.17	620	0.22	550	0.17

CORRECTION FACTORS

FOR AMBIENT TEMPERATURE
Ambient temperature
Correction factor

25°C	35°C	40°C	45°C	50°C	55°C	60°C	65°C
1.06	0.94	0.87	0.79	0.71	0.61	0.50	0.35

TABLE 14
IEE-Table 9D2
Current-carrying capacities and associated voltage drops for twin and multicore p.v.c.-insulated cables, non-armoured (copper conductors)

Conductor operating temperature : 70°C

Conductor cross sectional area	Installation methods A to C of Fig. 1 ('Enclosed')				Installation methods E to H of Fig. 1 ('Clipped direct')				Installation method K of Fig. 1 ('Defined conditions')			
	One twin cable With or without protective conductor single-phase a.c. or d.c.		One three-core cable with or without protective conductor or one four-core cable, three phase		One Twin cable With or without protective conductor single-phase a.c. or d.c.		One three-core cable with or without protective conductor or one four-core cable, three phase		One Twin cable With or without protective conductor single-phase a.c. or d.c.	One three-core cable with or without protective conductor or one four-core cable, three phase		
	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre	Volt drop per ampere per metre	
1	2	3	4	5	6	7	8	9	10	11	12	13
mm ²	A	mV	A	mV	A	mV	A	mV	A	mV	mV	
1.0	14	42	12	37	16	42	13	37	-	-	-	-
1.5	18	28	16	24	20	28	17	24	-	-	-	-
2.5	24	17	21	15	28	17	24	15	-	-	-	-
4	32	11	29	9.2	36	11	32	9.2	-	-	-	FLAT
6	40	7.1	36	6.5	46	7.1	40	6.5	-	-	-	CA
10	53	4.2	49	3.7	64	4.2	54	3.7	-	-	-	CA
16	70	2.7	62	2.3	85	2.7	71	2.3	-	-	-	CA
25	79	1.8	70	1.6	108	1.8	90	1.6	114	1.8	95	1.6
35	98	1.3	88	1.1	132	1.3	115	1.1	139	1.3	122	1.1
50	-	-	-	-	163	0.92	140	0.81	172	0.92	148	0.81
70	-	-	-	-	207	0.65	176	0.57	218	0.65	186	0.57
95	-	-	-	-	251	0.48	215	0.42	265	0.48	227	0.42
120	-	-	-	-	290	0.40	251	0.34	306	0.40	265	0.34
150	-	-	-	-	330	0.32	287	0.29	348	0.32	302	0.29
185	-	-	-	-	380	0.29	330	0.24	400	0.29	348	0.24
240	-	-	-	-	450	0.25	392	0.20	474	0.25	413	0.20
300	-	-	-	-	520	0.23	450	0.18	548	0.23	474	0.18
400	-	-	-	-	600	0.22	520	0.17	632	0.22	548	0.17

CORRECTION FACTORS

FOR AMBIENT TEMPERATURE	25°C	35°C	40°C	45°C	50°C	55°C	60°C	65°C
Ambient temperature	25°C	35°C	40°C	45°C	50°C	55°C	60°C	65°C
Correction factor	1.06	0.94	0.87	0.79	0.71	0.61	0.50	0.35

TABLE 15
IEE-Table 9D3
Current-carrying capacities and associated voltage drops for twin and multicore armoured p.v.c.-insulated cables (copper conductors).

Conductor operating temperature : 70°C

Conductor cross sectional area	Installation method E, F and G of Table 11 ('Clipped direct')				Installation method K of Table 11 ('Defined conditions')			
	One twin cable single phase a.c. or d.c.		One three- or four-core cable three-phase		One twin cable single phase a.c. or d.c.		One three- or four-core cable three-phase	
	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre
1	2	3	4	5	6	7	8	9
mm ²	A	mV	A	mV	A	mV	A	mV
1.5	20	29	18	25	-	-	-	-
2.5	29	18	24	16	-	-	-	-
4	37	12	31	9.0	-	-	-	-
6	48	7.4	41	6.3	50	7.3	42	6.0
10	66	4.9	56	3.8	69	4.3	58	3.8
16	86	3.2	73	2.3	90	2.7	77	2.3
25	118	2.3	97	1.8	121	1.8	102	1.8
35	142	1.7	119	1.1	149	1.3	125	1.1
50	168	0.92	147	0.81	180	0.92	155	0.81
70	200	a.c. 0.65, d.c. 0.64	180	0.57	220	a.c. 0.65, d.c. 0.64	180	0.57
95	257	0.48	219	0.42	270	0.48	230	0.42
120	295	0.40	257	0.34	310	0.40	270	0.34
150	337	0.32	295	0.29	355	0.32	310	0.29
185	390	0.29	333	0.24	410	0.29	359	0.24
240	431	0.25	399	0.20	485	0.25	420	0.20
300	523	0.23	451	0.18	550	0.23	475	0.18
400	589	0.22	523	0.17	620	0.22	550	0.17

CORRECTION FACTORS

FOR AMBIENT TEMPERATURE	25°C	35°C	40°C	45°C	50°C	55°C	60°C	65°C
Ambient temperature	25°C	35°C	40°C	45°C	50°C	55°C	60°C	65°C
Correction factor	1.06	0.94	0.87	0.79	0.71	0.61	0.50	0.35

TABLE 18
IEE-Table 9H2
Current-carrying capacities and associated volt drops for 85°C or 150°C rubber-insulated flexible cables
Conductor operating temperature : 75°C

Nominal cross sectional area of conductor 1	Maximum diameter of wires forming conductor 2	Current-carrying capacity		Volts drop per ampere per metre		
		d.c. or single-phase a.c. (one twin cable, with or without earth-continuity conductor, or two single-core cables bunched) 3	Three-phase a.c. (one three, four, or five core cable) 4	d.c. 5	Single-phase a.c. 6	Three-phase a.c. 7
mm ²	mm	A	A	mV	mV	mV
4	0.31	40	34	13.0	13.0	11.5
6	0.31	51	44	7.9	7.9	7.2
10	0.41	70	60	4.6	4.6	4.2
16	0.41	93	81	2.9	2.9	2.6
25	0.41	120	105	1.9	1.9	1.7
35	0.41	145	125	1.3	1.3	1.2
50	0.41	185	160	0.93	0.95	0.85
70	0.51	225	195	0.65	0.68	0.61
95	0.51	270	235	0.49	0.53	0.47
120	0.51	305	270	0.38	0.43	0.38
150	0.51	355	305	0.31	0.36	0.31
185	0.51	405	350	0.26	0.32	0.27
240	0.51	465	405	0.20	0.27	0.22
300	0.51	530	470	0.16	0.24	0.19
400	0.51	630		0.12	0.21	
500	0.61	720		0.10	0.20	
630	0.61	830		0.08	0.19	

CORRECTION FACTOR FOR AMBIENT TEMPERATURE

85°C rubber-insulated cables Ambient temperature	35°C	40°C	45°C	50°C	55°C	60°C	65°C	70°C		
Correction factor	0.93	0.86	0.80	0.72	0.64	0.54	0.44	0.31		
150°C rubber-insulated cables Ambient temperature	35°C	100°C	105°C	110°C	115°C	120°C	125°C	130°C	135°C	140°C
Correction factor	1.0	0.94	0.88	0.82	0.77	0.71	0.64	0.56	0.48	0.39

Note: BS 6007 does not include 150°C rubber-insulated cables above 16mm² nominal cross-sectional area

TABLE 19
IEE-Table 9J1

Current-carrying capacities and associated volt drops for heavy duty mineral-insulated cables (copper conductors and sheath)
(BS 6207, Part 1) exposed to touch or having an overall covering of p.v.c.
Sheath operating temperature : 70°C

Nominal Cross sectional area of conductor 1	Two single-core cables, single-phase a.c., or d.c.		Three or four single-core cables, three phase a.c.		One twin cable single-phase a.c., or d.c.		One three-core cable, three-phase a.c.		One four-core cable, three-phase a.c.		One seven-core cable, all cores fully loaded	
	Current carrying capacity 2	Volt drop per ampere per metre 3	Current carrying capacity 4	Volt drop per ampere per metre 5	Current carrying capacity 6	Volt drop per ampere per metre 7	Current carrying capacity 8	Volt drop per ampere per metre 9	Current carrying capacity 10	Volt drop per ampere per metre 11	Current carrying capacity 12	Volt drop per ampere per metre 13, 14
mm ²	A	mV	A	mV	A	mV	A	mV	A	mV	A	mV mV
1.0	23	42	20	36	19	42	16	36	16	36	11	42 36
1.5	29	28	26	24	24	28	20	24	20	24	14	28 24
2.5	39	17	34	14	32	17	26	14	27	14	19	17 14
4	50	10	44	9.0	41	10	34	9.0	35	9.0	24	10 9.0
6	63	6.9	55	6.0	53	6.9	44	6.0	45	6.0	-	-
10	85	4.2	75	3.6	71	4.2	59	3.6	61	3.6	-	-
16	110	2.6	99	2.3	94	2.6	78	2.3	81	2.3	-	-
25	150	1.7	130	1.4	124	1.7	105	1.4	110	1.4	-	-
35	180	1.3	160	1.0	-	-	-	-	-	-	-	-
50	225	0.83	200	0.72	-	-	-	-	-	-	-	-
70	275	0.59	240	0.51	-	-	-	-	-	-	-	-
95	350	0.44	290	0.38	-	-	-	-	-	-	-	-
120	380	0.35	335	0.30	-	-	-	-	-	-	-	1.ph. 3.ph.
150	440	0.28	385	0.24	-	-	-	-	-	-	-	a.c., or d.c.

CORRECTION FACTORS FOR AMBIENT TEMPERATURE

Ambient temperature	25°C	35°C	40°C	50°C	60°C
Correction factor for cables exposed to touch	1.06	1.0	0.85	0.68	0.46
Correction factor for cables having overall p.v.c. covering	1.16	1.1	0.94	0.75	0.51

TABLE 20
IEE-Table 9K1
Current-carrying capacities and associated voltage drops for single-core p.v.c.-insulated cables, non-armoured, with sheath (Aluminium conductors)

Conductor operating temperature : 70°C

Cross sectional area of conductor	Installation methods A to C † of Table 11 (Enclosed)					Installation methods E to H † of Table 11 (Clipped direct)					Installation method J of Table 11 (Defined conditions)					
	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.			Flat or vertical (2 cables, single-phase a.c. or d.c. or 3 or 4 cables three-phase)			Trestle (3 cables three-phase)		
	Current carrying capacity	Volt drop per ampere per metre		Current carrying capacity	Volt drop per ampere per metre		Current carrying capacity	Volt drop per ampere per metre		Current carrying capacity	Volt drop per ampere per metre		Current carrying capacity	Volt drop per ampere per metre		
1	2	a.c. 3	d.c. 4	5	6	7	a.c. 8	d.c. 9	10	11	12	13	14	15	16	17
mm ²	A	mV	mV	A	mV	A	mV	mV	A	mV	A	mV	mV	mV	A	mV
16	60	4.5	4.5	52	3.9	72	4.5	4.5	65	3.9	-	-	-	-	-	-
25	78	2.9	2.8	67	2.5	94	2.8	2.8	85	2.5	-	-	-	-	-	-
35	96	2.1	2.0	83	1.8	115	2.1	2.0	105	1.8	-	-	-	-	-	-
50	120	1.6	1.5	100	1.4	143	1.5	1.5	123	1.3	155	1.5	1.5	1.34	148	1.3
70	150	1.2	1.0	125	1.0	181	1.1	1.0	158	0.93	190	1.1	1.0	0.95	180	0.90
95	175	0.93	0.75	150	0.80	223	0.77	0.75	193	0.69	235	0.80	0.75	0.72	205	0.67
120	205	0.80	0.60	175	0.70	261	0.62	0.60	225	0.58	275	0.65	0.60	0.60	235	0.54
150	235	0.73	0.49	200	0.64	298	0.51	0.49	259	0.48	320	0.55	0.49	0.51	270	0.45
185	-	-	-	-	-	345	0.42	0.39	290	0.40	370	0.46	0.39	0.45	310	0.37
240	-	-	-	-	-	411	0.34	0.29	351	0.34	440	0.43	0.29	0.43	370	0.30
300	-	-	-	-	-	476	0.29	0.23	419	0.30	510	0.38	0.23	0.39	435	0.25
380	-	-	-	-	-	554	0.26	0.19	465	0.28	584	0.35	0.19	0.37	490	0.22
480	-	-	-	-	-	643	0.23	0.15	541	0.26	677	0.42	0.15	0.34	570	0.20
600	-	-	-	-	-	737	0.21	0.12	618	0.24	776	0.49	0.12	0.33	648	0.18

FOR AMBIENT TEMPERATURE
Ambient temperature
Correction factor

CORRECTION FACTORS

25°C	35°C	40°C	45°C	50°C	55°C	60°C	65°C
1.06	0.94	0.87	0.79	0.71	0.61	0.50	0.36

TABLE 21
IEE-Table 9K2
Current-carrying capacities and associated voltage drops for twin and multicore armoured p.v.c.-insulated cables, non-armoured (Aluminium conductors)

Conductor operating temperature : 70°C

Conductor cross sectional area	Installation method E, to H † of Table 11 (Clipped direct)				Installation method K of Table 11 (Defined conditions)			
	One twin cable single phase a.c. or d.c.		One three- or four-core cable, three-phase		One twin cable, single phase a.c. or d.c.		One three- or four-core cable, three-phase	
	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre
1	2	3	4	5	6	7	8	9
mm ²	A	mV	A	mV	A	mV	A	mV
16	62	4.5	53	3.9	65	4.5	55	3.9
25	82	2.9	70	2.5	86	2.9	74	2.5
35	102	2.1	86	1.8	107	2.1	91	1.8
50	120	1.5	106	1.3	125	1.5	110	1.3
70	150	1.1	133	0.93	158	1.1	139	0.93
95	185	0.79	163	0.68	195	0.79	172	0.68
120	-	-	190	0.54	-	-	200	0.54
150	-	-	217	0.45	-	-	227	0.45
185	-	-	247	0.37	-	-	260	0.37
240	-	-	296	0.29	-	-	311	0.29
300	-	-	340	0.25	-	-	358	0.25

FOR AMBIENT TEMPERATURE
Ambient temperature
Correction factor

CORRECTION FACTORS

25°C	35°C	40°C	45°C	50°C	55°C	60°C	65°C
1.06	0.94	0.87	0.79	0.71	0.61	0.50	0.36

TABLE 22
(IEE-Table 9K2)

Current-carrying capacities and associated voltage drops for twin and multicore p.v.c.-insulated cables, non-armoured (aluminium conductors)

Conductor operating temperature: 70°C

Cross-sectional area of conductor	Installation methods E, F and G of Table II ('Clipped direct')				Installation method K of Table II ('Defined conditions')					
	One twin cable, single-phase a.c., or d.c.		One three- or four-core cable, three-phase		One twin cable, single-phase a.c., or d.c.		One three- or four-core cable, three-phase			
	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre		
1	2	a.c. 3	d.c. 4	5	6	7	a.c. 8	d.c. 9	10	11
mm ²	A	mV	mV	A	mV	A	mV	mV	A	mV
16	63	4.5	4.5	55	3.9	66	4.5	4.3	58	3.9
25	83	2.9	2.9	67	2.5	87	2.9	2.9	71	2.5
35	100	2.1	2.0	88	1.8	105	2.1	2.0	93	1.8
50	124	1.6	1.5	105	1.3	130	1.6	1.5	110	1.3
70	157	1.1	1.0	138	0.93	165	1.1	1.0	145	0.93
95	185	0.79	0.77	166	0.68	195	0.79	0.77	175	0.68
120	-	-	-	195	0.54	-	-	-	205	0.54
150	-	-	-	219	0.45	-	-	-	230	0.45
185	-	-	-	257	0.37	-	-	-	270	0.37
240	-	-	-	304	0.30	-	-	-	320	0.30
300	-	-	-	347	0.25	-	-	-	365	0.25

CORRECTION FACTORS

FOR AMBIENT TEMPERATURE

Ambient temperature	25°C	35°C	40°C	45°C	50°C	55°C	60°C	65°C
Correction factor	1.06	0.94	0.87	0.79	0.71	0.61	0.50	0.35

TABLE 23
(IEE-Table 9K3)

Current-carrying capacities and associated voltage drops for twin and multicore armoured p.v.c. insulated cables (Aluminium conductors) BS 6346

Conductor operating temperature: 70°C

Nominal Cross Sectional area of conductor	Installation methods E, F and G of Table 9A ('Clipped direct')				Installation method K of Table 9A ('Defined conditions')					
	One twin cables, single-phase a.c., or d.c.		One three- or four-core cable, three-phase		One twin cable single-phase a.c., or d.c.		One Three- or four-core cable, three-phase			
	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre	Current carrying capacity	Volt drop per ampere per metre		
1	2	a.c. 3	d.c. 4	5	6	7	a.c. 8	d.c. 9	10	11
mm ²	A	mV	mV	A	mV	A	mV	mV	A	mV
16	63	4.5	4.5	55	3.9	66	4.5	4.3	58	3.9
25	83	2.9	2.9	67	2.5	87	2.9	2.9	71	2.5
35	100	2.1	2.0	88	1.8	105	2.1	2.0	93	1.8
50	124	1.6	1.5	105	1.3	130	1.6	1.5	110	1.3
70	157	1.1	1.0	138	0.93	165	1.1	1.0	145	0.93
95	185	0.79	0.77	166	0.68	195	0.79	0.77	175	0.68
120	-	-	-	195	0.54	-	-	-	205	0.54
150	-	-	-	219	0.45	-	-	-	230	0.45
185	-	-	-	257	0.37	-	-	-	270	0.37
240	-	-	-	304	0.30	-	-	-	320	0.30
300	-	-	-	347	0.25	-	-	-	365	0.25

CORRECTION FACTORS

FOR AMBIENT TEMPERATURE

Ambient temperature	25°C	35°C	40°C	45°C	50°C	55°C	60°C	65°C
Correction factor	1.06	0.94	0.87	0.79	0.71	0.61	0.50	0.35