



Edited by
Geoffrey Stokes

HANDBOOK OF

Electrical Installation Practice

FOURTH EDITION



Blackwell
Publishing

Contents

<i>Preface</i>	xiii
1 Power Supplies in the UK	1
G.S. FINLAY	
NETA	6
Voltage and frequency	6
System impedance and short-circuit levels	8
Loading effects on the system	9
Superimposed signals	11
Radio teleswitching	12
System and installation earthing	14
Protection	16
Reliability	17
Embedded generation	19
Supply arrangements	21
Intake arrangements	24
Consumers' substations	28
h.v. or l.v. supply	28
Metering	28
2 Substations and Control Rooms	33
D.M. BARR	
Introduction	33
Substations	37
Enclosures	42
Substation cabling	45
Installation	55
Erection procedures	58
3 Site Distribution Systems	67
M.G. TWITCHETT	
Intake arrangements	68
Site distribution networks	70
On-site generation	72
Switchgear	74
Cables	76
Cables installation	77
Provision for maintenance	77

System operation	79
Identification of substations and switchgear	79
Faults level	81
Testing and commissioning	83
4 Cable Management Systems	84
M.J. DYER	
Introduction	84
Decision making	86
Definitions	86
Types of system	87
Underfloor systems	88
Cable tray and cable basket	90
Hybrid systems	91
Conduit and trunking	92
Overall considerations	94
Particular considerations	95
Segregation	96
5 Electricity on Construction Sites	98
G. STOKES	
Equipment design and manufacture	99
Range of equipment	99
Design of system	107
Supply systems	110
Selection of equipment	112
Cable routing	117
Construction site lighting	119
Testing and inspection	120
Installation maintenance	121
6 Standby Power Supplies	122
G.M. MCDOWELL	
Standby diesel generating sets	122
Batteries for static systems	138
d.c. standby systems	140
Alternating current systems	146
Composite standby systems	159
7 Ground Earthing	162
T.E. CHARLTON and J.R. WALES	
Introduction	162
Soil resistivity	163
Resistivity surveying	164
Interpreting measurements	167

Resistance measurement of electrode systems	174
Types of earth electrodes	175
Installation	177
Standards applicable to earthing practice	179
8 Cathodic Protection	180
J. D. THIRKETTLE	
Introduction	180
Principles of cathodic protection	183
Cathodic protection systems	186
Installation practice	188
Equipment	191
Monitoring, inspection and maintenance	193
Interaction	194
Protection of steel in concrete	194
Recent developments	195
Conclusions	195
Further information	195
9 Lightning Protection	197
J. SHERLOCK and P. WOODS	
Introduction	197
Part 1. Protection of structures	197
Strike probability	199
Installation of lightning protection	218
Inspection and testing of a system	219
Part 2. Protecting electronic systems from lightning	219
10 Special Installations or Locations	248
L. D. MARKWELL	
Locations containing a bath tub or a shower basin	249
Swimming pools	252
Hot air saunas	255
Construction site installations	256
Agricultural and horticultural premises	258
Equipment having high protective conductor currents	261
Caravans and motor caravans	261
Caravan site supply arrangements	263
Highway power supplies and street furniture	264
11 Electrical Safety	267
R. T. R. PILLING	
Legislation	267
Safe design and installation	273
Maintenance	274

Training and systems of work	275
Tools	278
Buried cables	279
Overhead lines	280
Electric shock	281
Protection from electric shock	283
Burns	293
Fires	295
Explosions	296
Flammable atmospheres	298
Conclusion	303
12 Standards, Specifications and Codes of Practice	304
M.H. GRAHAM	
British Electrotechnical Committee (BEC)	305
British Standards Institution (BSI)	305
The International Electrotechnical Commission (IEC)	308
European Committee for Electrotechnical Standardisation (CENELEC)	310
The Institution of Electrical Engineers (IEE)	312
Standards and the law	313
European Union (EU)	315
Conclusion	316
13 Distribution Transformers	318
K. FREWIN	
Types of transformer	318
Performance	329
Tappings and connections	339
Cooling	343
Impulse withstand	345
Operation in tropical climates	346
Parallel operation	347
Packaged substations	347
Protection	348
Shipment of transformers	350
Installation	352
Cabling	353
Commissioning	354
Maintenance	354
14 Switchgear	358
A. HEADLEY and R.W. BLOWER	
Definitions	358
Circuit-breaking	360
Medium voltage switchgear	360

Types of switching device	364
Comparison of circuit-breaker types	372
Specification and testing	372
High-voltage circuit-breaker switchboards	380
Erection of switchgear	386
Electrical testing and commissioning	390
15 Rotating Machines	394
G. WALTON	
Motor types	394
Variable-speed drives	407
Motor application	413
Efficiency	417
Storage	418
Installation	418
Commissioning	422
Maintenance	423
16 HBC Fuses and Fusegear in Low Voltage Systems	427
P.G. NEWBERY	
HBC fuselinks design and performance	428
Design of cartridge fuse-links	431
Overload characteristics	436
Fuse-holder	437
Application of HBC fuses	437
Discrimination and co-ordination	440
Fuses in high ambient temperatures	443
Protection against electric shock	443
Domestic fuse applications	446
Semiconductor fuse-links	447
Fuse-links for electricity authority networks	447
Compact fuses to BS 88: Part 6	448
Fuse switchgear	448
Thermal ratings	451
17 Motor Control Gear	453
T. FAIRHALL	
Contactors	454
Contactors selection	456
Product standards for contactors	460
Overload protection	463
Starter types	466
Isolation	471
Enclosures	473

18	Lighting	475
	H.R. KING	
	The nature of light	475
	Units of light measurement	477
	Electric lamps	477
	Control gear and starting	484
	Luminaires (lighting fittings)	485
	Outdoor lighting equipment	489
	Floodlighting calculations	490
	Lighting design for interiors	491
	Emergency lighting	499
19	Mains Cables	502
	T.L. JOURNEAUX	
	Cable specifications	502
	Cable conductors	504
	Insulation	506
	Cable construction	509
	Installation	518
	Jointing and terminating	521
	Cable ratings	525
	Testing and fault finding	527
20	Selection of Wiring Systems	529
	M. COATES	
	Introduction	529
	Wiring systems	531
	Construction of wiring cables and flexibles	536
	Cable enclosure and support systems	538
	Temperature limits	540
	Cable ratings	541
	Factors affecting the selection of types of cable	564
	Installation methods	578
21	Control and Protection of Low Voltage Installations	585
	H.R. LOVEGROVE	
	Isolation and switching	585
	Protection	590
22	Protective Systems	597
	P.R. ROSEN	
	Protective system requirements	597
	Unit and non-unit protection	599
	Graded protection	603

Unit protection	608
Transformer protection	617
Rotating plant	623
Relay accommodation	628
Commissioning tests	631
23 Power Factor Correction and Tariffs	635
T. LONGLAND	
Importance of power factor	635
Theory of power factor correction	636
Power factor improvement	636
Economic considerations	637
Calculation of capacitor size	638
Practical power factor improvement	639
Capacitor size related to tariff	644
Determination of load conditions	647
Reduced CO ₂ emissions	648
Methods of correction	648
Location of capacitors	652
Capacitors and harmonics	653
Installation of capacitors	654
Capacitor maintenance	657
Appendices	
I Main Authoritative Documents	660
II IP Codes of Ingress Protection (BS EN 60947-1: 1998)	661
III British Standards	665
<i>Index</i>	669