A PRACTICAL GUIDE
TO THE WIRING
REGULATIONS

17th EDITION IEE WIRING
REGULATIONS (BS 7671:2008)

Fourth Edition

Eur Ing Geoffrey Stokes
BSc (Hons), CEng, FIEE, FCIBSE

Eur Ing John Bradley
BSc, CEng, MIEE, FCIBSE

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Contents

About the authors xvii
Preface to the Fourth Edition xix
Acknowledgements xxi
Notation xxiii

1 Plan and terminology of BS 7671:2008 and supporting publications 1
1.1 Plan of BS 7671:2008 1
1.2 Terminology of BS 7671:2008 5
1.3 Supporting publications 6

2 Electricity, the law, standards and codes of practice 7
2.1 General 7
2.2 Electricity: the hazards 7
2.3 The law 12
2.3.1 Electricity Safety, Quality and Continuity Regulations 2002 12
2.3.2 The Electricity at Work Regulations 1989 (EWR) 12
2.4 Standards and codes of practice 13
2.4.1 The IEE Wiring Regulations: BS 7671 13
2.4.2 Electric signs and high-voltage luminous-discharge-tube installations: BS 559 and BS EN 50107 13
2.4.3 Emergency lighting: BS 5266 13
2.4.4 Electrical equipment for explosive gas atmospheres: BS EN 60079 13
2.4.5 Electrical equipment for use in the presence of combustible dust: BS EN 50281 and BS EN 61241 13
2.4.6 Electrical installations in opencast mines and quarries: BS 6907 13
2.4.7 Fire detection and alarm systems for buildings: BS 5839 14
2.4.8 Telecommunications systems: BS 6701 14
2.4.9 Electric surface heating: BS 6351 14
2.4.10 Lightning protection: BS EN 62305 14
2.4.11 Lift installations: BS 5655 and BS EN 81-1 15
3 Scope, object and fundamental principles

3.1 General
3.2 Scope
   3.2.1 General
   3.2.2 Exclusions from the scope
   3.2.3 Equipment
   3.2.4 Relationship with statutory authorities
   3.2.5 Installations in premises subjected to licensing
3.3 Object and effects
   3.3.1 General
   3.3.2 New materials and inventions
3.4 Fundamental principles
   3.4.1 General
   3.4.2 Electric shock: basic protection
   3.4.3 Electric shock: fault protection
   3.4.4 Protection against thermal effects
   3.4.5 Protection against overcurrent
   3.4.6 Protection against fault current
   3.4.7 Protection against voltage disturbances and measures against electromagnetic influences
   3.4.8 Protection against supply interruption
   3.4.9 Additions and alterations to an installation
   3.4.10 Design
   3.4.11 Selection of electrical equipment
   3.4.12 Erection, initial verification of electrical installations, and periodic inspection and testing

4 Assessment of general characteristics

4.1 General
4.2 Loading, maximum demand and diversity
   4.2.1 General
   4.2.2 Lighting: loading and diversity
   4.2.3 Heating: loading and diversity
   4.2.4 Cookers: loading and diversity
   4.2.5 Water heaters: loading and diversity
   4.2.6 Motors: loading and diversity
   4.2.7 Stationary equipment: loading and diversity
   4.2.8 Conventional circuits: loading and diversity
   4.2.9 Socket-outlet circuits other than conventional circuits: loading and diversity
4.3 Arrangement of live conductors and type of earthing
   4.3.1 Arrangement of live conductors
   4.3.2 Type of earthing
4.4 Nature of supply

4.4.1 General

4.4.2 Voltage

4.4.3 The nature of current and frequency

4.4.4 Prospective short-circuit current

4.4.5 External earth fault loop impedance

4.4.6 Suitability of supply

4.4.7 Type and rating of overcurrent device at the origin

4.5 Supplies for safety services and standby purposes

4.6 Installation circuit arrangements

4.7 External influences

4.8 Compatibility

4.9 Maintainability

5 Protection against electric shock

5.1 General

5.2 Provisions for basic protection

5.2.1 General

5.2.2 Basic insulation of live parts

5.2.3 Barriers or enclosures

5.3 Protective measure: automatic disconnection of supply

5.3.1 General

5.3.2 Basic protection in ADS

5.3.3 General requirements for fault protection in ADS

5.3.4 Fault protection in ADS: for TN systems

5.3.5 Fault protection in ADS: for TT systems

5.3.6 Fault protection in ADS: for IT systems

5.3.7 Functional extra-low voltage

5.3.8 Reduced low-voltage systems

5.4 Protective measure: double or reinforced insulation

5.5 Protective measure: electrical separation

5.6 Protective measure: extra-low voltage provided by SELV or PELV

5.7 Additional protection

5.8 Obstacles and placing out of reach

5.8.1 Obstacles

5.8.2 Protection by placing out of reach

5.9 Protective measures for application only where the installation is controlled or under the supervision of skilled or instructed persons

5.9.1 Non-conducting location

5.9.2 Protection by earth-free local equipotential bonding

5.9.3 Electrical separation for the supply to more than one item of current-using equipment

6 Protection against thermal effects

6.1 General
6.2  Fire caused by electrical equipment  
   6.2.1  Surface temperature  
   6.2.2  Arcs, sparks and high-temperature particles  
   6.2.3  Position of equipment embodying heat sources  
   6.2.4  Flammable liquids  
   6.2.5  Construction of enclosures  
   6.2.6  Live conductors  

6.3  Precautions where particular risks of danger of fire exist  
   6.3.1  General  
   6.3.2  Conditions for evacuation in an emergency  
   6.3.3  Locations with risks of fire due to the nature of processed or stored materials  
   6.3.4  Combustible constructional materials  
   6.3.5  Fire-propagating structures  
   6.3.6  Selection and erection of installations in locations of national, commercial, industrial or public significance  

6.4  Burns  

7  Protection against overcurrent, undervoltage and overvoltage  
   7.1  General  
   7.2  Nature of protective devices  
   7.3  Protection against overload  
       7.3.1  General  
       7.3.2  Protection against overload: motors  
       7.3.3  Ring final circuits  
   7.4  Protection against fault current  
   7.5  Determination of prospective fault current  
       7.5.1  General  
       7.5.2  Calculation of inductive reactance  
       7.5.3  Evaluation of $k$ for different temperatures  
       7.5.4  Calculation of impedance of steel enclosures  
       7.5.5  Resistance and inductive reactance values  
       7.5.6  Temperature adjustments to resistance values  
       7.5.7  Line-to-neutral short-circuits  
       7.5.8  Line-to-line short-circuits  
       7.5.9  Three-phase short-circuit  
       7.5.10  Line-to-earth faults  
       7.5.11  Fault current at the origin of an installation  
   7.6  Characteristics of protective devices  
   7.7  Overcurrent protection of conductors in parallel  
   7.8  Coordination of overload and fault current protection  
   7.9  Protection according to the nature of circuits and distribution systems  
   7.10  Protection against undervoltage  
   7.11  Protection against overvoltage  
       7.11.1  General
7.11.2 Temporary overvoltages due to earth faults in the high-voltage system or faults in the low-voltage system 137
7.11.3 Overvoltages of atmospheric origin or due to switching 138

8 Isolation and switching 139
8.1 General 139
8.2 Main switch 143
8.3 Isolation 145
8.4 Switching off for mechanical maintenance 151
8.5 Emergency switching and other forms of switching for safety 153
  8.5.1 General 153
  8.5.2 The firefighter’s switch 157
8.6 Emergency stopping 157
8.7 Functional switching 158
8.8 Identification and notices 160

9 Equipment selection: common rules 161
9.1 General 161
9.2 Compliance with standards 161
9.3 Operational conditions, external influences and accessibility 162
9.4 Identification and notices 164
9.5 Mutual detrimental influences 176
9.6 Compatibility 178
9.7 Operation and maintenance manual 179

10 Wiring systems 181
10.1 Wiring systems 181
  10.1.1 Wiring systems: general 181
  10.1.2 Fire performance of wiring systems 184
10.2 External influences 185
  10.2.1 External influences: general 185
  10.2.2 Temperature 193
  10.2.3 Water 194
  10.2.4 Solid foreign bodies 194
  10.2.5 Corrosive and polluting substances 194
  10.2.6 Mechanical damage: general 195
  10.2.7 Mechanical damage: concealed and buried cables 196
  10.2.8 Damage by fauna, flora and mould growth 197
  10.2.9 Building design considerations 199
  10.2.10 Solar radiation 199
10.3 Proximity to other services: general 199
  10.3.1 Proximity of electrical wiring systems to other electrical systems 202
  10.3.2 Proximity of electrical wiring systems to communications cables 202
  10.3.3 Proximity of electrical wiring systems to nonelectrical systems 204
10.4 Methods of installation of cables 205
### 10.4 Current-carrying capacities, cross-sectional area of conductors and conductor operating temperatures

- **10.4.1 General** 205
- **10.4.2 Current-carrying capacities, cross-sectional area of conductors and conductor operating temperatures** 205
- **10.4.3 Voltage drop** 214
- **10.4.4 Grouping** 217

### 10.5 Resistances of copper conductors

- 217

### 10.6 Electrical connections

- 218

### 10.7 Cable supports and cable management systems

- **10.7.1 General** 224
- **10.7.2 Maximum cable support spacings** 224
- **10.7.3 Overhead cables between buildings** 224
- **10.7.4 Supports for conduits** 224
- **10.7.5 Minimum bending radii of cables** 224
- **10.7.6 Maximum cable trunking support spacings** 229
- **10.7.7 Other cable management systems** 229

### 10.8 Minimizing the risk of fire

- 230

### 10.9 Electromagnetic and electromechanical effects

- 231

### 10.10 Conduit and trunking cable capacities

- **10.10.1 Conduit capacities** 233
- **10.10.2 Trunking capacities** 236

### 10.11 Maintainability

- 238

### 11 Switchgear, protective devices and other equipment

- **11.1 Switchgear and protective devices: general** 241
- **11.2 Switchgear and controlgear** 241
- **11.2.1 Switchgear and controlgear: general** 241
- **11.2.2 Switchgear and controlgear: forms of assembly** 243
- **11.3 Selection of devices for overload and fault current protection: general** 243
- **11.4 Overcurrent protective devices** 247
- **11.4.1 Fuses: general** 253
- **11.4.2 Semi-enclosed fuses to BS 3036** 256
- **11.4.3 High breaking capacity fuses to BS 88** 256
- **11.4.4 High breaking capacity fuses to BS 1361** 259
- **11.4.5 Cartridge fuses to BS 1362** 259
- **11.4.6 Miniature circuit-breakers to BS 3871 and BS EN 60 898** 259
- **11.4.7 Moulded case circuit-breakers to BS EN 60947-2** 260
- **11.5 Residual current devices** 261
- **11.5.1 Residual current devices: general** 261
- **11.5.2 Residual current devices: principles of operation** 268
- **11.5.3 Residual current monitors** 270
- **11.6 Identification of overcurrent protective devices** 271
- **11.7 Discrimination** 272
- **11.7.1 Discrimination: general** 272
- **11.7.2 Discrimination: high breaking capacity–high breaking capacity fuses** 272
11.7.3 Discrimination: miniature circuit-breakers–miniature circuit-breakers 273
11.7.4 Discrimination: miniature circuit-breakers–fuse 275
11.7.5 Discrimination: residual current devices 275

11.8 Other equipment 279
11.8.1 Accessories 279
11.8.2 Luminaires and lighting points 279
11.8.3 Heaters for liquids and other substances, including water 279
11.8.4 Heating conductors and electric surface heating systems 281
11.8.5 Transformers 281
11.8.6 Rotating machines 281

12 Protective conductors, earthing and equipotential bonding 289

12.1 Protective conductors 289
12.1.1 Protective conductors: general 289
12.1.2 Protective conductors: types 290
12.1.3 Protective conductors: thermal withstand 293
12.1.4 Protective conductors: sizes 294
12.1.5 Protective conductors: for combined protective and functional purposes 298
12.1.6 Protective conductors: electrical continuity 300
12.1.7 Protective conductors: formed by steel conduit, trunking, etc 300
12.1.8 Protective conductors: mineral-insulated cables 301
12.1.9 Protective conductors of ring final circuits 301
12.1.10 Protective conductors: armouring 302
12.1.11 Protective conductors: ‘clean’ earths 305
12.1.12 Protective conductors: proving and monitoring 306

12.2 Earthing 307
12.2.1 Earthing: general 307
12.2.2 Earthing: responsibilities 307
12.2.3 Earthing: connection to Earth and system arrangements 308
12.2.4 Earthing conductors 308
12.2.5 Earthing electrodes 311
12.2.6 Main earthing terminals 313
12.2.7 Earthing: accessories and other equipment 314

12.3 Earthing requirements for the installation of equipment having high protective conductor currents 314
12.3.1 General 314
12.3.2 Additional requirements for earthing of equipment in TN and TT systems 315
12.3.3 Minimum cross-sectional area of protective conductors of final and distribution circuits 317
12.3.4 Residual current device compatibility 317
12.3.5 IT systems 318

12.4 Protective bonding 318
12.4.1 Main protective bonding 318
12.4.2 Supplementary bonding
12.4.3 Bonding clamps

13 Specialized installations

13.1 General
13.2 Emergency lighting
13.3 Fire detection and alarm systems
13.4 Petrol filling stations and liquid petroleum gas stations
13.5 Installations in dusty environments
13.6 Installations in underground and multistorey car parks, etc
13.7 Installations in multi-occupancy blocks of flats
13.8 Installations in ‘Section 20 buildings’
13.9 Installations in churches
13.10 Installations in thatched properties
13.11 Extra-low voltage lighting
13.12 Outdoor lighting installations, highway power supplies and street furniture
  13.12.1 General
  13.12.2 Protection against electric shock
  13.12.3 Isolation and switching
  13.12.4 Cable installation and identification
13.13 Security lighting
13.14 Welding equipment
13.15 Entertainers’ equipment
13.16 Generator sets

14 Safety services

14.1 Safety services: general
14.2 Common sources
14.3 Parallel and nonparallel sources
14.4 Circuit and equipment requirements
14.5 Protection against overcurrent and electric shock under fault conditions

15 The smaller installation

15.1 Scope
15.2 The IEE On-Site Guide and the NICEIC Domestic Electrical Installation Guide
15.3 User’s requirements
15.4 Wiring systems
15.5 Electricity distributor’s requirements
15.6 Assessment of supply characteristics
15.7 ‘Meter tails’
15.8 System earthing arrangements
15.9 Main protective bonding
15.10 Minimum cross-sectional area of earthing and main protective bonding conductors
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>15.11</td>
<td>Supplementary bonding</td>
<td>362</td>
</tr>
<tr>
<td>15.12</td>
<td>Devices for protection against overcurrent and for fault protection</td>
<td>362</td>
</tr>
<tr>
<td>15.13</td>
<td>Devices for isolation and switching</td>
<td>363</td>
</tr>
<tr>
<td>15.14</td>
<td>Final circuit design</td>
<td>363</td>
</tr>
<tr>
<td>15.15</td>
<td>Remote buildings</td>
<td>384</td>
</tr>
<tr>
<td>15.16</td>
<td>Minimum number of socket-outlets in domestic premises</td>
<td>385</td>
</tr>
<tr>
<td>15.17</td>
<td>Modifications to existing installations</td>
<td>385</td>
</tr>
<tr>
<td>15.18</td>
<td>Inspection, testing, verification and certification of the smaller installation</td>
<td>387</td>
</tr>
</tbody>
</table>

### 16 Special installations and locations

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>16.1</td>
<td>General</td>
<td>389</td>
</tr>
<tr>
<td>16.2</td>
<td>Locations containing a bath or shower</td>
<td>389</td>
</tr>
<tr>
<td></td>
<td>16.2.1 General</td>
<td>389</td>
</tr>
<tr>
<td></td>
<td>16.2.2 Zonal arrangements</td>
<td>391</td>
</tr>
<tr>
<td></td>
<td>16.2.3 Degrees of ingress protection</td>
<td>393</td>
</tr>
<tr>
<td></td>
<td>16.2.4 Equipment permitted in and outside the various zones</td>
<td>393</td>
</tr>
<tr>
<td></td>
<td>16.2.5 Electric shock</td>
<td>393</td>
</tr>
<tr>
<td></td>
<td>16.2.6 Supplementary bonding</td>
<td>395</td>
</tr>
<tr>
<td></td>
<td>16.2.7 Shaver supply units and socket-outlets</td>
<td>397</td>
</tr>
<tr>
<td></td>
<td>16.2.8 Mobile and nonfixed current-using equipment</td>
<td>397</td>
</tr>
<tr>
<td></td>
<td>16.2.9 Electric heating embedded in the floor</td>
<td>398</td>
</tr>
<tr>
<td></td>
<td>16.2.10 Other equipment</td>
<td>398</td>
</tr>
<tr>
<td>16.3</td>
<td>Swimming pools and other basins</td>
<td>398</td>
</tr>
<tr>
<td></td>
<td>16.3.1 General</td>
<td>398</td>
</tr>
<tr>
<td></td>
<td>16.3.2 Additional requirements relating to electric shock</td>
<td>399</td>
</tr>
<tr>
<td></td>
<td>16.3.3 Additional requirements relating to selection and erection of equipment</td>
<td>399</td>
</tr>
<tr>
<td>16.4</td>
<td>Rooms and cabins containing sauna heaters</td>
<td>407</td>
</tr>
<tr>
<td></td>
<td>16.4.1 General</td>
<td>407</td>
</tr>
<tr>
<td>16.5</td>
<td>Construction-site installations</td>
<td>407</td>
</tr>
<tr>
<td></td>
<td>16.5.1 General</td>
<td>407</td>
</tr>
<tr>
<td></td>
<td>16.5.2 Protection against electric shock</td>
<td>409</td>
</tr>
<tr>
<td></td>
<td>16.5.3 Selection of equipment</td>
<td>411</td>
</tr>
<tr>
<td></td>
<td>16.5.4 Isolation and switching</td>
<td>412</td>
</tr>
<tr>
<td>16.6</td>
<td>Agricultural and horticultural premises</td>
<td>413</td>
</tr>
<tr>
<td></td>
<td>16.6.1 General</td>
<td>413</td>
</tr>
<tr>
<td></td>
<td>16.6.2 Protection against electric shock</td>
<td>413</td>
</tr>
<tr>
<td></td>
<td>16.6.3 Fire and harmful thermal effects</td>
<td>416</td>
</tr>
<tr>
<td></td>
<td>16.6.4 Selection of equipment</td>
<td>417</td>
</tr>
<tr>
<td></td>
<td>16.6.5 Automatic life support for high-density livestock rearing</td>
<td>417</td>
</tr>
<tr>
<td></td>
<td>16.6.6 RCDs in series</td>
<td>421</td>
</tr>
<tr>
<td>16.7</td>
<td>Conducting locations with restricted movement</td>
<td>421</td>
</tr>
<tr>
<td></td>
<td>16.7.1 General</td>
<td>421</td>
</tr>
<tr>
<td></td>
<td>16.7.2 Protection against electric shock</td>
<td>422</td>
</tr>
<tr>
<td>16.8</td>
<td>Electrical installations in caravan/camping parks and similar locations</td>
<td>422</td>
</tr>
<tr>
<td></td>
<td>16.8.1 General</td>
<td>422</td>
</tr>
<tr>
<td>Section</td>
<td>Title</td>
<td>Page</td>
</tr>
<tr>
<td>---------</td>
<td>-----------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>16.8.2</td>
<td>Requirements for safety</td>
<td>424</td>
</tr>
<tr>
<td>16.8.3</td>
<td>Equipment: selection and erection</td>
<td>424</td>
</tr>
<tr>
<td>16.8.4</td>
<td>Typical caravan park distribution layout</td>
<td>424</td>
</tr>
<tr>
<td>16.9</td>
<td>Marinas and similar locations</td>
<td>429</td>
</tr>
<tr>
<td>16.9.1</td>
<td>General</td>
<td>429</td>
</tr>
<tr>
<td>16.9.2</td>
<td>Protection against electric shock</td>
<td>429</td>
</tr>
<tr>
<td>16.9.3</td>
<td>External influences</td>
<td>430</td>
</tr>
<tr>
<td>16.9.4</td>
<td>Equipment: selection and erection</td>
<td>430</td>
</tr>
<tr>
<td>16.10</td>
<td>Exhibition shows and stands</td>
<td>430</td>
</tr>
<tr>
<td>16.10.1</td>
<td>General</td>
<td>430</td>
</tr>
<tr>
<td>16.10.2</td>
<td>Definitions</td>
<td>430</td>
</tr>
<tr>
<td>16.10.3</td>
<td>Protection against electric shock and protection against fire</td>
<td>435</td>
</tr>
<tr>
<td>16.10.4</td>
<td>Equipment: selection and erection</td>
<td>435</td>
</tr>
<tr>
<td>16.11</td>
<td>Solar photovoltaic power supply systems</td>
<td>435</td>
</tr>
<tr>
<td>16.11.1</td>
<td>General</td>
<td>435</td>
</tr>
<tr>
<td>16.11.2</td>
<td>Definitions</td>
<td>439</td>
</tr>
<tr>
<td>16.11.3</td>
<td>Earthing a live conductor on the d.c. side</td>
<td>440</td>
</tr>
<tr>
<td>16.11.4</td>
<td>Protection against electric shock, overcurrent and electromagnetic interference</td>
<td>440</td>
</tr>
<tr>
<td>16.11.5</td>
<td>Equipment: selection and erection</td>
<td>440</td>
</tr>
<tr>
<td>16.12</td>
<td>Mobile or transportable units</td>
<td>440</td>
</tr>
<tr>
<td>16.12.1</td>
<td>General</td>
<td>440</td>
</tr>
<tr>
<td>16.12.2</td>
<td>Source of supply</td>
<td>444</td>
</tr>
<tr>
<td>16.12.3</td>
<td>Protection against electric shock</td>
<td>444</td>
</tr>
<tr>
<td>16.12.4</td>
<td>Equipment: selection and erection</td>
<td>445</td>
</tr>
<tr>
<td>16.13</td>
<td>Electrical installations in caravans and motor caravans</td>
<td>445</td>
</tr>
<tr>
<td>16.13.1</td>
<td>General</td>
<td>445</td>
</tr>
<tr>
<td>16.13.2</td>
<td>Requirements for safety</td>
<td>447</td>
</tr>
<tr>
<td>16.13.3</td>
<td>Wiring systems</td>
<td>448</td>
</tr>
<tr>
<td>16.13.4</td>
<td>Main isolating switch, caravan inlets and connection leads</td>
<td>448</td>
</tr>
<tr>
<td>16.13.5</td>
<td>Luminaires and accessories</td>
<td>450</td>
</tr>
<tr>
<td>16.13.6</td>
<td>Annex A of Section 721: guidance on 12 V d.c. installations</td>
<td>450</td>
</tr>
<tr>
<td>16.14</td>
<td>Temporary electrical installations for structures, amusement devices and booths at fairgrounds, amusement parks and circuses</td>
<td>451</td>
</tr>
<tr>
<td>16.14.1</td>
<td>General</td>
<td>451</td>
</tr>
<tr>
<td>16.14.2</td>
<td>Electrical supplies and protection against electric shock</td>
<td>451</td>
</tr>
<tr>
<td>16.14.3</td>
<td>Motors: protection against excess temperature</td>
<td>452</td>
</tr>
<tr>
<td>16.14.4</td>
<td>Equipment: selection and erection</td>
<td>452</td>
</tr>
<tr>
<td>16.15</td>
<td>Floor and ceiling heating systems</td>
<td>452</td>
</tr>
<tr>
<td>16.15.1</td>
<td>General</td>
<td>452</td>
</tr>
<tr>
<td>16.15.2</td>
<td>Heating units</td>
<td>455</td>
</tr>
<tr>
<td>16.15.3</td>
<td>Protection against electric shock</td>
<td>456</td>
</tr>
<tr>
<td>16.15.4</td>
<td>Protection against harmful thermal effects</td>
<td>456</td>
</tr>
<tr>
<td>16.15.5</td>
<td>Heating-free areas</td>
<td>457</td>
</tr>
<tr>
<td>16.15.6</td>
<td>Wiring systems</td>
<td>457</td>
</tr>
<tr>
<td>16.15.7</td>
<td>Identification and notices</td>
<td>457</td>
</tr>
</tbody>
</table>
17 Inspection, testing, certification and reporting 459

17.1 Inspection, testing, certification and reporting: general 459
17.2 Test instruments 459
  17.2.1 General 459
  17.2.2 Insulation test instruments 461
  17.2.3 Continuity test instruments 461
  17.2.4 Earth loop impedance test instruments 461
  17.2.5 Applied voltage test instruments 461
  17.2.6 Earth electrode test instruments 461
  17.2.7 Residual current device test instruments 462
  17.2.8 Voltage indication 462
  17.2.9 Phase sequence test instruments 462
17.3 Safety in electrical testing 462
17.4 Test methods 463
  17.4.1 General 463
  17.4.2 Insulation tests 464
  17.4.3 Barriers and enclosures 465
  17.4.4 Non-conducting location tests 467
  17.4.5 Polarity tests 467
  17.4.6 Continuity tests 469
  17.4.7 Earth loop impedance and prospective fault current tests 471
  17.4.8 Applied voltage tests 476
  17.4.9 Earth electrode tests 477
  17.4.10 Residual current device tests 480
  17.4.11 Protection by SELV, PELV or electrical separation 481
  17.4.12 Verification of phase sequence 481
  17.4.13 Functional testing 481
  17.4.14 Verification of voltage drop 483
17.5 Initial verification 483
  17.5.1 General 483
  17.5.2 Inspection 484
  17.5.3 Testing 493
  17.5.4 Initial certification: general 493
  17.5.5 Initial certification: caravans 512
  17.5.6 Initial certification: minor works 512
17.6 Periodic inspection and testing 512
  17.6.1 General 512
  17.6.2 Intervals between periodic inspection and testing 516
  17.6.3 Approximate age of an installation 518
  17.6.4 Periodic inspection and testing 519
  17.6.5 Reporting 523
17.7 Alterations and additions 534
  17.7.1 General 534
  17.7.2 Inspection 534
  17.7.3 Testing 534
  17.7.4 Certification 534
17.8 Inspection, testing and certification of specialized installations 535
   17.8.1 Fire detection and alarm systems in buildings 535
   17.8.2 Emergency lighting 535
   17.8.3 Petrol filling stations 535

Appendix Standards to which reference has been made 537

Bibliography 545

Index of figures 547

Index of tables 551

Index of regulation numbers 557

Subject index 579
About the authors

Geoffrey Stokes BSc (Hons), CEng, FIEE, FCIBSE was the author of the first three editions of this Guide. For many years he was the Principal Engineer of the National Inspection Council for Electrical Installation Contracting. Before that he was Technical Regulations Manager at the Institution of Electrical Engineers, which is now the Institution of Engineering and Technology (IET). Geoffrey has served for many years on many BSI, CENELEC and IEC Technical Committees and now represents the IET on the joint IET/BSI Committee JPEL/64, which is responsible for the technical content of the Wiring Regulations (BS 7671). He is also a Member of the IET’s Wiring Regulations Policy Committee.

Geoffrey left the National Inspection Council in 2005 to set up a new electrical safety consultancy (Benchmark Electrical Safety Technology Ltd) and to assist in the development work of a new innovative revolution in automated electrical installation testing technology (Test Marshal).

John Bradley BSc, CEng, MIEE, FCIBSE updated this Guide to the 17th Edition of the Wiring Regulations. He is the Principal Engineer at the Electrical Safety Council (formerly the National Inspection Council for Electrical Installation Contracting), where he has special responsibilities for the Council’s technical standards and publications. John has also worked in electrical contracting and as a consulting engineer, putting the requirements of the Wiring Regulations into practice.

He serves on a number of CENELEC and IEC technical committees and on the joint IET/BSI Committee JPEL/64 which is responsible for the technical content of the Wiring Regulations (BS 7671) and European and international standards for electrical installations. John is the Chairman of Panel C of JPEL/64 (protection against electric shock, and isolation and switching).
Preface to the Fourth Edition

This fourth edition of *A Practical Guide to the Wiring Regulations* takes account of the requirements of BS 7671:2008 Requirements for Electrical Installations (*IEE Wiring Regulations Seventeenth Edition*).

BS 7671:2008 was issued on 1 January 2008 and came into effect on 1 July 2008. It replaces BS 7671:2001 (*IEE Wiring Regulations Sixteenth Edition*) as the national standard for electrical installation work, and its requirements are to be complied within all electrical installation work designed after 30 June 2008.

The content of BS 7671:2008 has undergone extensive changes and additions compared with that of BS 7671:2001. The numbering of the regulations has also been revised to follow the pattern and corresponding references of International Electrotechnical Commission (IEC) Standard 60364. Account has been taken in BS 7671:2008 of the technical intent of a significant number of revised and new CENELEC harmonization documents (HDs). Indeed, of the 28 HDs listed in the preface of BS 7671:2008, 17 are revised compared with the versions used in BS 7671:2001, as finally amended, and seven are newly introduced to BS 7671.

The revised HDs have led to changes in, amongst other things, the various protective measures specified in Part 4 of BS 7671 and the requirements for special installations or locations. Not the least of the changes are those affecting the general requirements for protection against electric shock, which have been restructured and are subject to new terminology. Another notable change is that it is now permitted to install general-purpose socket-outlets in locations containing a bath or shower, provided these outlets are at least 3 m horizontally outside the boundary of zone 1 and the circuit supplying them is provided with additional protection by an RCD having specified characteristics (as must be all the circuits of the special location).

The newly introduced HDs have led to the addition of new sections in BS 7671 relating to: marinas and similar locations; exhibitions, shows and stands; solar photovoltaic power supply systems; mobile or transportable units; caravans and motor caravans (previously covered in Section 608 of BS 7671:2001); temporary installations for structures, amusement devices and booths at fairgrounds, amusement parks and circuses; and floor and ceiling heating systems.

While many changes have been associated with CENELEC HDs, a number of modifications made have been initiated in the United Kingdom. These primarily relate to cables concealed in walls and/or partitions in installations that are not intended to be under the supervision of a skilled or instructed person. In many cases, such cables are now required
to be provided with additional protection by an RCD having specified characteristics, unless other specified protective provisions are employed.

In their professional experience the authors of this Guide have been asked, and attempted to answer, numerous questions over the years relating to the regulatory requirements and their implementation. While most practitioners will recognise where a proposed solution will not, or does not, meet the requirements, many find it difficult to attribute a precise regulation number to the deficiencies they believe to exist or to decide what action to take in solving the problem. This is not surprising since the subject of electrical installations is vast and complex. Those that believe that all issues are crystal clear (or black and white) and that there is only one possible solution to a design problem are deluding themselves. As there are many ways of killing a cat (besides electrocution) so too are there many design and installation options so long as the basic constraints are met.

An attempt has been made in this Guide to make life a little easier and topics are addressed with the pertinent Regulation numbers listed where appropriate. However, the Guide will be most useful to those who have at least a working knowledge of earlier editions of the National Standard. This Guide is not intended for use by the DIY enthusiast unless, of course, he or she happens to be competent in this field.

Where considered necessary by the authors, some background guidance is given together with worked examples embodied in the text at the appropriate place. It is hoped that this Guide will serve both as a useful aid to designers, installers and verifiers of electrical installations and to others not directly professionals in the industry but who have an interest in the safety aspects of electrical installations perhaps as ‘duty holders’ as defined by the Electricity at Work Regulations 1989. It is also expected that it will be of use to those students of the industry who are endeavouring to come to grips with all the many facets of electrical safety.

Extensive use has been made of tables which draw together the various relevant Regulations and options. Where appropriate, tables have also been employed as check lists for reference for those who find such listings useful in their day-to-day activities. Similarly, numerous figures have been used to more clearly identify specific points that the authors have thought worthy of mention.

No single book can ever cover all the aspects of this topic and the authors have had to take the view that this Guide should include guidance on the issues that are more frequently encountered, leaving aside some of the more esoteric aspects. Inspection, testing, verification, certification and reporting come in for special attention as the authors believe many electrical contractors would welcome some guidance in this respect.

The views expressed here are the authors’ own and should not be regarded as coinciding with those of any authoritative body, though the authors believe they do not differ materially.

Geoffrey Stokes and John Bradley
Acknowledgements

Geoffrey Stokes acknowledges with gratitude the initial encouragement and subsequent support given to him by his dear friend and former colleague Brian D. Jenkins, who also reviewed the final draft of the First Edition of this Guide.

Geoffrey also wishes to record the considerable assistance given to him by his friends in the industry and, in particular, his former NICEIC colleagues both at Head Office and three Inspecting Engineers in the field. He particularly wishes to acknowledge with gratitude the contributions made, by way of constructive criticism and comment on the drafts, by: Bill Holdway, IEng, MIEIE, NICEIC Inspecting Engineer, Staffordshire; Brian D. Jenkins, BSc, CEng, FIEE; Keith Morriss, BSc, CEng, MIEE, Technical Director, AVO International Ltd; Terry Morrow, IEng, MIEIE, NICEIC Inspecting Engineer, Northern Ireland; Nick Piper, NICEIC Inspecting Engineer, West Midlands; Ted Smithson, BSc, CEng, MIEE, Engineering Manager, AVO: Megger Instruments Ltd.

John Bradley acknowledges the encouragement and support given to him by Geoffrey Stokes in the considerable task of updating this Guide to align with the requirements of the Seventeenth Edition of the IEE Wiring Regulations. John also records his appreciation of his employer, The Electrical Safety Council, for its support and permission to reproduce certain copyright material. He also wishes to acknowledge with gratitude the assistance given to him by his colleague Martyn Allen, BEng Hons, CEng, MIET, Senior Engineer at The Electrical Safety Council, who reviewed the final draft of the Fourth Edition of this Guide and provided many helpful comments.

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Grateful acknowledgement is made to the Institution of Engineering and Technology for its permission to reproduce copyright material from the Seventeenth Edition of the IEE Wiring Regulations and related Guidance Notes.
### Acronyms and abbreviations

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BCMC</td>
<td>British Cable Makers’ Confederation</td>
</tr>
<tr>
<td>BS</td>
<td>British Standard</td>
</tr>
<tr>
<td>BS EN</td>
<td>Harmonized European Standard</td>
</tr>
<tr>
<td>BSI</td>
<td>British Standards Institution</td>
</tr>
<tr>
<td>CENELEC</td>
<td>Comité Européen de Normalisation Electrotechnique (European Committee for Electrotechnical Standardization)</td>
</tr>
<tr>
<td>CIBSE</td>
<td>Chartered Institution of Building Services Engineers</td>
</tr>
<tr>
<td>CONSAC</td>
<td>Concentric Solid Aluminium Core (cable)</td>
</tr>
<tr>
<td>ccc</td>
<td>current-carrying capacity</td>
</tr>
<tr>
<td>cpc</td>
<td>circuit protective conductor</td>
</tr>
<tr>
<td>csa</td>
<td>cross-sectional area</td>
</tr>
<tr>
<td>DCL</td>
<td>device for connecting a luminaire</td>
</tr>
<tr>
<td>DoE</td>
<td>Department of Environment (now incorporated into Department for Environment, Food and Rural Affairs (Defra))</td>
</tr>
<tr>
<td>DOL</td>
<td>direct-on-line</td>
</tr>
<tr>
<td>DP</td>
<td>double-pole</td>
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<tr>
<td>ED</td>
<td>electricity distributor</td>
</tr>
<tr>
<td>ADS</td>
<td>automatic disconnection of supply</td>
</tr>
<tr>
<td>EIILC</td>
<td>Electrical Installation Industry Liaison Committee</td>
</tr>
<tr>
<td>EL</td>
<td>emergency lighting</td>
</tr>
<tr>
<td>ELV</td>
<td>extra-low voltage</td>
</tr>
<tr>
<td>ESC</td>
<td>The Electrical Safety Council</td>
</tr>
<tr>
<td>ESQCR</td>
<td>Electricity Safety, Quality and Continuity Regulations 2002, as amended</td>
</tr>
<tr>
<td>ESR</td>
<td>Electricity Supply Regulations 1988, as amended</td>
</tr>
<tr>
<td>EWR</td>
<td>Electricity at Work Regulations 1989</td>
</tr>
<tr>
<td>FA</td>
<td>fire alarm</td>
</tr>
<tr>
<td>FELV</td>
<td>functional extra-low voltage (see definition in the Wiring Regulations)</td>
</tr>
<tr>
<td>HBC</td>
<td>high breaking capacity</td>
</tr>
<tr>
<td>HD</td>
<td>harmonized document</td>
</tr>
<tr>
<td>HSE</td>
<td>Health and Safety Executive</td>
</tr>
<tr>
<td>HV</td>
<td>high voltage</td>
</tr>
<tr>
<td>ICEL</td>
<td>Industry Committee for Emergency Lighting</td>
</tr>
<tr>
<td>IEC</td>
<td>International Electrotechnical Commission</td>
</tr>
<tr>
<td>IEE</td>
<td>Institution of Electrical Engineers</td>
</tr>
<tr>
<td>IET</td>
<td>Institution of Engineering and Technology</td>
</tr>
</tbody>
</table>
L line
LPG liquefied petroleum gas
LSC luminaire supporting coupler
LSHF low smoke, halogen free
LV low voltage
M maintained (emergency lighting)
MCB miniature circuit-breaker
MCCB moulded case circuit-breaker
MET main earthing terminal
MICC mineral-insulated copper cable
NHBC National House-Building Council
NICEIC NICEIC Group Limited
NM Nonmaintained (emergency lighting)
PELV protective extra-low voltage (see definition in the Wiring Regulations)
PEN protective earth and neutral (conductor)
PME protective multiple earthing
PRCD portable residual current device
PVC polyvinyl chloride
RCD residual current device
RCCB residual current circuit-breaker
RCBO combined MCB and RCD
SELV separated extra-low voltage (see definition in the Wiring Regulations)
SP single-pole
SP&N single-pole and neutral
TDM time-division-multiplexing
TP triple-pole
TP&N triple-pole and neutral
TTA type-tested assembly
XLPE cross-linked polyethylene or ethylene propylene rubber insulation
4P four-pole

Variables

\[
\begin{align*}
\alpha_{20} & \quad \text{resistance/temperature coefficient at } 20^\circ\text{C} \\
B & \quad \text{reciprocal of temperature coefficient of resistivity} \\
C_a & \quad \text{rating factor for ambient temperature} \\
C_c & \quad \text{rating factor for the type of protective device or installation condition} \\
C_g & \quad \text{rating factor for grouping of conductors} \\
C_i & \quad \text{rating factor for conductors embedded in thermal insulated materials} \\
\cos \phi & \quad \text{power factor} \\
C_t & \quad \text{factor for the operating temperature of the conductor} \\
D_e & \quad \text{cable diameter (mm)} \\
I_a & \quad \text{current causing automatic disconnection within stated time (A)} \\
I_b & \quad \text{design current of circuit (A)} \\
I_d & \quad \text{first-fault fault current of circuit (IT systems) (A)} \\
I_{\Delta n} & \quad \text{rated residual current of an RCD (A or mA)} \\
I_F & \quad \text{fault current (both short-circuit and earth fault depending on the context in which it is used) (A)} \\
I_{FLC} & \quad \text{full-load current (A)}
\end{align*}
\]
Notation

$I_{\text{inst}}$ current causing instantaneous (within 100 ms) operation of protective device (A)

$I_L$ earth-leakage current (mA)

$I_{L(T)}$ total earth-leakage current (mA or A)

$I_n$ rated current of protective device (A)

$I_{pf}$ prospective fault current (A)

$I_t$ tabulated current-carrying capacity (A)

$I_{t(\text{min})}$ minimum tabulated current-carrying capacity required (A)

$I^{2}t$ energy let-through ($A^2$ s)

$I^{2}t_{(\text{pa})}$ pre-arcing energy let-through ($A^2$ s)

$I^{2}t_{(t)}$ total energy let-through ($A^2$ s)

$I_{(\text{sec})}$ transformer secondary current (A)

$I_z$ effective current-carrying capacity (A)

$I_2$ current causing effective operation of protective device on overload (A)

$j$ imaginary part of a complex variable ($j = \sqrt{-1}$)

$k$ a constant attributed to a particular conductor

$L, l$ length (m)

$\ln$ log to the base e

$\pi$ pi, geometric constant (3.1416)

$P$ active power (W or kW)

$\Phi$ diameter (mm)

$\phi$ phase angle

$Q$ reactive power (VA or kVA)

$Q_c$ volumetric heat capacity of a conductor ($J/(^{\circ}\text{C m m}^3)$)

$Q_{20}$ electrical resistivity of conductor material at 20\(^{\circ}\text{C}$ ($\Omega$ mm)

$\rho$ resistivity ($\Omega$ m)

$R$ resistance (generally) ($\Omega$)

$R_A$ sum of the resistances of the installation earth electrode and protective conductor ($\Omega$)

$R_n$ circuit neutral conductor resistance ($\Omega$)

$R_t$ conductor resistance at temperature $t$ ($\Omega$)

$R_1$ circuit line conductor resistance ($\Omega$)

$R_2$ circuit protective conductor resistance ($\Omega$)

$R_{20}$ conductor resistance at temperature of 20\(^{\circ}\text{C}$ ($\Omega$)

$S$ apparent power (V A or kV A)

$S_p$ conductor cross-sectional area ($\text{mm}^2$)

$S_p$ protective conductor cross-sectional area ($\text{mm}^2$)

$\theta_i$ initial temperature of conductor ($^{\circ}\text{C}$)

$\theta_f$ final temperature of conductor ($^{\circ}\text{C}$)

$t$ temperature ($^{\circ}\text{C}$)

$t$ time (s)

$T_d$ time delay (s)

$t_p$ maximum permitted operating temperature ($^{\circ}\text{C}$)

$U_n$ nominal voltage (V)

$U_o$ nominal voltage to Earth (V)

$U_t$ touch voltage (V)

$V_d$ voltage drop (V or mV)

$V_{d(t)}$ resistive voltage drop (V or mV)
<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{d(x)}$</td>
<td>reactive voltage drop (V or mV)</td>
</tr>
<tr>
<td>$V_{FL}$</td>
<td>full-load voltage (V)</td>
</tr>
<tr>
<td>$V_{L-L}$</td>
<td>line-to-line voltage (V)</td>
</tr>
<tr>
<td>$V_{NL}$</td>
<td>no-load voltage (V)</td>
</tr>
<tr>
<td>$Z_{dpc}$</td>
<td>impedance of distribution circuit protective conductor (Ω)</td>
</tr>
<tr>
<td>$Z_e$</td>
<td>external line–earth loop impedance (Ω)</td>
</tr>
<tr>
<td>$Z_L$</td>
<td>line impedance (Ω)</td>
</tr>
<tr>
<td>$Z_{L-N}$</td>
<td>line–neutral impedance (Ω)</td>
</tr>
<tr>
<td>$Z_{pu}$</td>
<td>per unit impedance</td>
</tr>
<tr>
<td>$Z_1$</td>
<td>impedance of circuit line conductor (Ω)</td>
</tr>
<tr>
<td>$Z_2$</td>
<td>impedance of circuit protective conductor (Ω)</td>
</tr>
<tr>
<td>$Z_s$</td>
<td>line–earth fault loop impedance (Ω)</td>
</tr>
<tr>
<td>$Z_s^*$</td>
<td>line–earth fault loop impedance (IT systems) (Ω)</td>
</tr>
<tr>
<td>$Z_{s(max)}$</td>
<td>maximum permitted line–earth fault loop impedance (Ω)</td>
</tr>
<tr>
<td>$X$</td>
<td>reactance (Ω)</td>
</tr>
<tr>
<td>$X_L$</td>
<td>inductive reactance (Ω)</td>
</tr>
<tr>
<td>$X_C$</td>
<td>capacitive reactance (Ω)</td>
</tr>
</tbody>
</table>
1

Plan and terminology of BS 7671:2008 and supporting publications

1.1 Plan of BS 7671:2008

BS 7671:2008 is based, as was the 2001 version, on the International Electrotechnical Commission’s (IEC’s) publication 60364, the international rules for electrical installations. The pattern of BS 7671:2008 uses a similar logical plan to that of earlier versions, although there are some minor changes to detail. Table 1.1 illustrates the plan and shows the main routes through the various parts to assimilate all the necessary requirements for the electrical design. The routes shown should not be regarded as exhaustive or the only feasible routes; indeed, reference to other parts and sections, on an iterative basis, will always be necessary.

Although the plan of BS 7671 does follow a logical sequence, it may not follow the generally accepted sequence undertaken by designers. For example, a designer’s sequence may take the form of:

- assessment of general characteristics (Part 3);
- assessment of the number and types of circuit (Part 3, Section 314);
- selection of wiring system(s) (Chapter 52);
- assessments of design currents, including taking account of diversity, where appropriate, and any special operating conditions (Sections 311 and 433);
- assessment of environmental conditions, including external influences (Section 522);
- selection of overcurrent protective devices (Section 533);
- selection of devices for fault protection by automatic disconnection of supply (Regulation Groups 531.1–531.6);
- determination of current-carrying capacities (Section 523);
- assessment of voltage drop (Section 525);
- assessment of isolation and switching requirements (Section 537);
Table 1.1  Plan of BS 7671:2008

<table>
<thead>
<tr>
<th>PART 1: SCOPE OBJECT AND FUNDAMENTAL REQUIREMENTS FOR SAFETY</th>
<th>PART 2: DEFINITIONS</th>
<th>PART 3: ASSESSMENT OF GENERAL CHARACTERISTICS</th>
<th>PART 4: PROTECTION FOR SAFETY</th>
<th>PART 5: SELECTION AND ERECTION OF EQUIPMENT</th>
<th>PART 6: INSPECTION AND TESTING</th>
<th>PART 7: SPECIAL INSTALLATIONS OR LOCATIONS</th>
<th>APPENDICES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Chapter 31:</strong> Purposes, supplies and structure</td>
<td><strong>Chapter 41:</strong> Protection against electric shock</td>
<td><strong>Chapter 51:</strong> Common rules</td>
<td><strong>Chapter 61:</strong> Initial verification</td>
<td></td>
<td></td>
<td></td>
<td><strong>Appendix 1:</strong> British Standards to which reference is made in the regulations</td>
</tr>
<tr>
<td><strong>Chapter 32:</strong> Classification of external influences</td>
<td><strong>Chapter 42:</strong> Protection against thermal effects</td>
<td><strong>Chapter 52:</strong> Selection and erection of wiring systems</td>
<td><strong>Chapter 62:</strong> Periodic inspection and testing</td>
<td></td>
<td></td>
<td></td>
<td><strong>Section 701:</strong> Locations containing a bath tub or shower basin</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Appendix 2:</strong> Statutory regulations and associated memoranda</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Section 702:</strong> Swimming pools and other basins</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Appendix 3:</strong> Time/current characteristics of overcurrent protective devices and residual current devices</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Section 703:</strong> Rooms and cabins containing sauna heaters</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>Appendix 4:</strong> Current-carrying capacity and voltage drop for cables and flexible cords</td>
</tr>
</tbody>
</table>