

6TH
EDITION

BUILDING SERVICES HANDBOOK

Fred Hall & Roger Greeno

INCORPORATING
CURRENT BUILDING
& CONSTRUCTION
REGULATIONS

**B
H**

CONTENTS

Preface xiii

Part One Introduction 1

The industry	2
Construction team	3
Legislative and support documents	4
Health and Safety at Work etc. Act	5
The Building Act	10
The Water Industry Act	11
British Standards	14
European Standards	14
International Standards	14
Building Research Establishment	15
Loss Prevention Certification Board	15
Design and installation standards	16

Part Two Cold Water and Supply Systems 19

Rain cycle – sources of water supply	20
Acidity and alkalinity in water	21
Filtration of water	22
Sterilisation and disinfection	23
Storage and distribution of water	24
Water mains	28
Valves and taps	32
Joints on water pipes	38
Pipe jointing materials	39
Direct system of cold water supply	40
Indirect system of cold water supply	41
Hard and soft water	43
Water softening	45
Water conditioning and treatment	47
Backflow protection	52
Secondary backflow protection	53
Cold water storage cisterns	55
Cold water storage calculations	59
Boosted cold water systems	60
Delayed action float valve	63
Pump laws	66

Pipe sizing 68
Hydraulics and fluid flow 73

Part Three Hot Water Supply Systems 79

Direct system of hot water supply 82
Indirect system of hot water supply 83
Unvented hot water storage system 84
Expansion and temperature relief valves 87
Hot water storage cylinders 90
Prismatic hot water storage cylinder 91
Medium and high rise building supply systems 92
Sealed indirect hot water system for a high rise building 94
Primary thermal stores 95
Types of boiler 97
Secondary circulation 102
Duplication of plant 103
Electric and gas water heaters 104
Solar heating of water 111
Hot water storage capacity 118
Boiler rating 119
Pipe sizing 120
Pressurized Systems 121
Circulation pump rating 123
Legionnaires' disease in hot water systems 124
SEDBUK 125
Galvanic or electrolytic action 128
Water treatment 129

Part Four Heating Systems 133

Heat emitters 134
Low temperature, hot water heating systems 137
Panel and underfloor heating 144
Expansion facilities in heating systems 150
Expansion vessels 151
Solar space heating 152
High temperature, pressurised hot water systems 154
Steam heating systems 156
District heating 161
Combined heat and power 164
Pipework expansion 165
Thermostatic control of heating systems 167
Timed control of heating systems 168
Zoned controls 174

Energy management systems 178
Warm air heating system 181
Heating design 182
Domestic heating circulator/pump 192

Part Five Fuel Characteristics and Storage 199

Fuels – factors affecting choice 200
Solid fuel – properties and storage 201
Domestic solid fuel boilers 203
Solid fuel – biomass 204
Solid fuel – flues 207
Oil – properties 210
Oil – storage and supply 212
Oil-fired burners and appliances 217
Oil – flues 221
Natural gas – properties 223
Liquid petroleum gas – properties and storage 224
Electric boiler 226
Electricity – electrode boiler 227

Part Six Ventilation Systems 229

Ventilation requirements 231
Guide to ventilation rates 232
Domestic accommodation 233
Mechanical ventilation 239
Types of fan 245
Fan laws 246
Sound attenuation in ductwork 247
Air filters 248
Low velocity air flow in ducts 251
Air diffusion 252
Ventilation design 253
Resistances to air flow 261

Part Seven Air Conditioning 265

Air conditioning – principles and applications 266
Central plant system 267
Air processing unit 268
Humidifiers 269
Variable air volume 270
Induction (air/water) system 271
Fan-coil (air/water) unit and induction diffuser 272

- Dual duct system 273
- Chilled beams and ceilings 274
- Cooling systems 275
- Refrigerant and system characteristics 276
- Packaged air conditioning systems 280
- Psychrometrics – processes and applications 282
- Heat pumps 290
- Heat recovery devices 294
- Health considerations and building related illnesses 296

Part Eight Drainage Systems, Sewage Treatment and Refuse Disposal 299

- Combined and separate systems 300
- Partially separate system 301
- Rodding point system 302
- Sewer connection 303
- Drainage ventilation 304
- Unventilated spaces 306
- Drain laying 307
- Means of access 308
- Bedding of drains 313
- Drains under or near buildings 315
- Drain pipe materials 316
- Joints used on drain pipes 317
- Anti-flood devices 318
- Garage drainage 319
- Drainage pumping 320
- Subsoil drainage 323
- Tests on drains 326
- Soakaways 327
- Cesspools and septic tanks 328
- Drainage fields and mounds 333
- Rainwater management 337
- Drainage design 341
- Waste and refuse processing 352

Part Nine Sanitary Fitments and Appliances: Discharge and Waste Systems 359

- Flushing cisterns, troughs and valves 360
- Water closets 365
- Bidets 367
- Showers 368
- Baths 374
- Sinks 375
- Wash basins and troughs 377
- Unplugged appliances 379

Thermostatic temperature control 380
Urinals 386
Hospital sanitary appliances 388
Sanitary conveniences 389
Sanitary conveniences for disabled people 393
Traps and waste valve 396
Single stack system and variations 400
One- and two-pipe systems 404
Pumped waste system 406
Wash basins – waste arrangements 407
Waste pipes from washing machines and dishwashers 408
Air test 409
Sanitation – data 410
Offsets 412
Ground floor appliances – high rise buildings 413
Fire stops and seals 414
Flow rates and discharge units 415
Sanitation design – discharge stack sizing 417

Part Ten Gas Installation, Components and Controls 421

Natural gas – combustion 422
Mains gas supply and installation 423
Gas service pipe intake 425
Meters 429
Gas controls and safety features 431
Gas ignition devices 437
Purging and testing 438
Gas appliances 441
Balanced flue appliances 444
Open flue appliances 448
Flue blocks 451
Open flue terminals 452
Stainless steel flue lining 454
Shared flues 455
Fan assisted gas flues 459
Ventilation requirements 461
Combusted gas analysis 464
Gas laws 465
Gas consumption 469
Gas pipe and flue sizing 470

Part Eleven Electrical Supply and Installations 475

Three-phase generation and supply 476
Electricity distribution 477

Electricity intake to a building 479
Earthing systems and bonding 480
Consumer unit 485
Power and lighting circuits 489
Overload protection 497
Electric wiring 500
Testing completed installation 502
Cable rating 504
Diversity 505
Industrial installations 506
Electric space heating 509
Controls for electric night storage space heaters 514
Construction site electricity 515
Light sources, lamps and luminaires 517
Lighting controls 526
Extra-low-voltage lighting 528
Lighting design 530
Daylighting 532
Telecommunications installation 537

Part Twelve Mechanical Conveyors – Lifts, Escalators and Travelators 539

Planning lift installations 540
Roping systems for electric lifts 542
Controls 544
Lift doors 547
Lift machine room and equipment 548
Lift safety features 549
Installation details 550
Typical single lift dimensions 551
Paternoster lifts 552
Oil-hydraulic lifts 553
Lift performance 556
Estimating the number of lifts required 557
Firefighting lifts 558
Vertical transportation for the disabled 560
Builders' and electricians' work 562
Escalators 564
Travelators 566
Stair lifts 567

Part Thirteen Fire Prevention and Control Services 569

Sprinklers 570
Drenchers 582
Hose reel installations 583

Hydrants 584
Foam installations 587
Gas extinguishers 588
Fire alarms 591
Smoke, fire and heat detectors 593
Fire detection electrical circuits 597
Fire prevention in ventilating systems 599
Fire dampers in ductwork 600
Pressurisation of escape routes 601
Smoke extraction, ventilation and control 602
Portable fire extinguishers 605
Carbon monoxide detectors 609

Part Fourteen Security Installations 613

Physical security 614
Intruder alarms 615
Micro-switch and magnetic reed 618
Radio sensor, pressure mat and taut wiring 619
Acoustic, vibration and inertia detectors 620
Ultrasonic and microwave detectors 621
Active infra-red detector 622
Passive infra-red detector 623
Lightning protection systems 625

Part Fifteen Accommodation for Building Services 629

Ducts for engineering services 630
Notching and holing joists 631
Floor and skirting ducts 633
Medium and large vertical ducts 634
Medium and large horizontal ducts 635
Subways or walkways 636
Penetration of fire structure by pipes 637
Raised access floors 638
Suspended and false ceilings 639

Part Sixteen Alternative and Renewable Energy 641

Energy production 642
Alternative energy 643
Renewable energy 644
Anaerobic digestion 645
Biogas 646
Wind power 647

Wind power and fuel cells	649
Water power	650
Geothermal power	651
Micro-combined heat and power	653
Solar power	654
Photovoltaic systems	656
Biomass or biofuel	658
Underground coal gasification	659

Part Seventeen Appendices 661

Appendix 1 - Glossary of common abbreviations	662
Appendix 2 - Abbreviations for pipework	664
Appendix 3 - Abbreviations for pipework components	665
Appendix 4 - Abbreviations used for drainage systems	666
Appendix 5 - Abbreviations used for sanitation systems	667
Appendix 6 - Graphical symbols for pipework	668
Appendix 7 - Identification of pipework	669
Appendix 8 - Graphical symbols for electrical installation work	671
Appendix 9 - Metric units	672
Appendix 10 - Water pressure and head - Comparison of units	675
Appendix 11 - Conversion of common imperial units to metric	676

Index 679