

TABLE OF CONTENTS

About This Textbook	xi
How to Use the <i>National Electrical Code</i>	1
Article 90—Introduction to the <i>National Electrical Code</i>	7
90.1 Purpose of the <i>NEC</i>	7
90.2 Scope of the <i>NEC</i>	9
90.3 Code Arrangement	12
90.7 Examination of Equipment for Product Safety	13
CHAPTER 1—GENERAL RULES	15
Article 100—Definitions	17
100 Definitions	17
Article 110—Requirements for Electrical Installations	27
110.1 Scope	27
110.3 Examination, Identification, Installation, Use, and Product Listing (Certification) of Equipment	27
110.5 Conductors	29
110.9 Interrupting Overcurrent Protection Rating	29
Available Short-Circuit Current	30
110.11 Deteriorating Agents	31
110.14 Conductor Termination and Splicing	32
110.16 Arc-Flash Hazard Warning	37
110.21 Markings	38
110.24 Available Fault Current	40
110.26 Spaces About Electrical Equipment	40
CHAPTER 2—WIRING AND PROTECTION	51
Article 210—Branch Circuits	53
210.1 Scope	53
210.3 Other Articles	54
210.4 Multiwire Branch Circuits	54
210.5 Identification for Branch Circuits	58
210.7 Multiple Branch Circuits	60
210.8 GFCI Protection	60
210.11 Branch Circuits Required	68
210.12 Arc-Fault Circuit-Interrupter Protection	71
210.18 Branch-Circuit Rating	72
210.52 Dwelling Unit Receptacle Outlet Requirements	73
210.64 Service Equipment Indoors—Receptacle	82
210.70 Lighting Outlet Requirements	83
210.71 Meeting Rooms	86
Article 215—Feeders	89
215.1 Scope	89
215.2 Minimum Rating	90
Article 220—Branch-Circuit, Feeder, and Service Load Calculations	95
220.1 Scope	95
220.12 General Lighting	96
220.87 Determining Existing Loads	97
Article 225—Outside Branch Circuits and Feeders	99
225.1 Scope	99
225.17 Masts as Supports	100
225.19 Clearances from Buildings	101
225.22 Raceways on Exterior Surfaces	102
225.27 Raceway Seals	103
225.30 Number of Feeder Supplies	103
225.36 Type of Disconnecting Means	104
Article 230—Services	105
230.1 Scope	106
230.7 Service Conductors Separate from Other Conductors	106
230.9 Clearance from Building Openings	107
230.10 Vegetation as Support	108
230.29 Supports over Buildings	109
230.42 Size and Rating	109
230.53 Raceways to Drain	111
230.54 Overhead Service Locations	111
230.66 Marking for Service Equipment	112

230.82 Connected on Supply Side of the Service Disconnect 113

230.91 Location 115

Article 240—Overcurrent Protection 117

240.1 Scope 117

240.6 Standard Ampere Ratings 118

240.24 Location of Overcurrent Protection Devices 119

240.87 Arc Energy Reduction 121

Article 250—Grounding and Bonding 123

250.1 Scope 123

250.4 Performance Requirements for Grounding and Bonding ... 123

Earth Shells 128

250.6 Objectionable Current 130

Objectionable Current 131

Dangers of Objectionable Current 133

250.24 Service Equipment—Grounding and Bonding 134

250.30 Separately Derived Systems—Grounding and Bonding 140

250.52 Grounding Electrode Types 147

250.53 Grounding Electrode Installation Requirements 151

Measuring the Ground Resistance 154

Soil Resistivity 155

250.60 Lightning Protection Electrode 156

250.64 Grounding Electrode Conductor Installation 157

250.66 Sizing Grounding Electrode Conductor 161

250.68 Termination to the Grounding Electrode 162

250.80 Service Raceways and Enclosures 165

250.86 Other Enclosures 166

250.94 Bonding Communications Systems 167

250.102 Grounded Conductor, Bonding Conductors,
and Jumpers 169

250.104 Bonding of Piping Systems and Exposed
Structural Metal 172

250.118 Types of Equipment Grounding Conductors 176

250.122 Sizing Equipment Grounding Conductor 180

250.148 Continuity and Attachment of Equipment Grounding
Conductors in Metal Boxes 184

CHAPTER 3—WIRING METHODS AND MATERIALS 187

Article 300—General Requirements for Wiring Methods and Materials 191

300.1 Scope 191

300.3 Conductors 192

300.5 Underground Installations 194

300.7 Raceways Exposed to Different Temperatures 201

300.11 Securing and Supporting 202

300.12 Mechanical Continuity 204

300.19 Supporting Conductors in Vertical Raceways 205

300.22 Wiring in Ducts and Plenums Spaces 206

Article 310—Conductors for General Wiring 211

310.1 Scope 211

310.10 Uses Permitted 212

310.15 Conductor Ampacity 215

Article 312—Cabinets, Cutout Boxes, and Meter Socket Enclosures 225

312.1 Scope 225

312.8 Overcurrent Protection Device Enclosures 226

Article 314—Outlet, Device, Pull, and Junction Boxes; Conduit Bodies; and Handhole Enclosures 229

314.1 Scope 229

314.15 Damp or Wet Locations 230

314.16 Number of Conductors in Boxes and Conduit Bodies 230

314.17 Conductors That Enter Boxes or Conduit Bodies 235

314.20 Flush-Mounted Box Installations 237

314.23 Support of Boxes and Conduit Bodies 238

314.27 Outlet Box 240

314.28 Sizing Boxes and Conduit Bodies—Conductors 4 AWG
and Larger 243

Article 320—Armored Cable (Type AC) 249

320.1 Scope 249

320.6 Listing Requirements 249

320.30 Securing and Supporting 250

Article 330—Metal-Clad Cable (Type MC) 253

330.1 Scope 253

330.6 Listing Requirements 253

330.15 Exposed Work 254

330.30 Securing and Supporting 254

Article 334—Nonmetallic-Sheathed Cable (Types NM and NMC) 257

334.1 Scope 257

334.6	Listing Requirements	257
334.12	Uses Not Permitted.....	258
334.30	Securing and Supporting.....	259

Article 336—Power and Control Tray Cable (Type TC)

336.1	Scope.....	261
336.6	Listing Requirements	261
336.10	Uses Permitted.....	262

Article 338—Service-Entrance Cable (Types SE and USE).....

338.1	Scope.....	263
338.6	Listing Requirements	263
338.10	Uses Permitted.....	264

Article 340—Underground Feeder and Branch-Circuit Cable (Type UF).....

340.1	Scope.....	267
340.6	Listing Requirements	267

Article 342—Intermediate Metal Conduit (Type IMC)

342.1	Scope.....	269
342.10	Uses Permitted.....	269

Article 344—Rigid Metal Conduit (Type RMC)

344.1	Scope.....	271
344.10	Uses Permitted.....	271
344.14	Dissimilar Metals.....	272

Article 348—Flexible Metal Conduit (Type FMC)

348.1	Scope.....	273
348.30	Securing and Supporting.....	273

Article 350—Liquidtight Flexible Metal Conduit (Type LFMC)

350.1	Scope.....	275
350.28	Trimming.....	275
350.30	Securing and Supporting.....	276

Article 356—Liquidtight Flexible Nonmetallic Conduit (Type LFNC).....

356.1	Scope.....	279
356.30	Securing and Supporting.....	279

Article 358—Electrical Metallic Tubing (Type EMT).....

358.1	Scope.....	281
358.10	Uses Permitted.....	281

Article 362—Electrical Nonmetallic Tubing (Type ENT).....

362.1	Scope.....	283
362.30	Securing and Supporting.....	283

Article 376—Metal Wireways.....

376.1	Scope.....	285
376.20	Conductors Connected in Parallel.....	285
376.22	Number of Conductors and Ampacity	286
376.56	Splices, Taps, and Power Distribution Blocks.....	287

Article 392—Cable Trays

392.1	Scope.....	289
392.22	Number of Conductors or Cables.....	289

CHAPTER 4—EQUIPMENT FOR GENERAL USE

Article 400—Flexible Cords and Flexible Cables

400.1	Scope.....	293
400.12	Uses Not Permitted.....	294

Article 404—Switches

404.1	Scope.....	297
404.2	Switch Connections.....	297
404.9	Switch Faceplates	300
404.22	Electronic Lighting Switches	302

Article 406—Receptacles, Cord Connectors, and Attachment Plugs (Caps).....

406.1	Scope.....	303
406.2	Definitions.....	303
406.3	Receptacle Rating and Type	304
406.4	General Installation Requirements.....	305
406.5	Receptacle Mounting.....	309
406.6	Receptacle Faceplates.....	312
406.12	Tamper-Resistant Receptacles	312

Article 408—Switchboards, Switchgear, and Panelboards	315
408.1 Scope.....	315
408.4 Field Identification.....	315

Article 410—Luminaires, Lampholders, and Lamps	317
410.1 Scope.....	317
410.62 Cord-Connected Luminaires	318

Article 411—Low-Voltage Lighting	319
411.1 Scope	319

Article 422—Appliances	321
422.1 Scope.....	321
422.5 Ground-Fault Circuit-Interrupter (GFCI) Protection for Personnel.....	321
422.6 Listing Required	323
422.16 Flexible Cords	323
422.18 Support of Ceiling Paddle Fans.....	325
422.21 Covering of Combustible Material at Outlet Boxes	326
422.31 Permanently Connected Appliance Disconnects	327
422.33 Disconnection of Cord-and-Plug-Connected or Attachment Fitting-Connected Appliances	327

Article 424—Fixed Electric Space-Heating Equipment	329
424.1 Scope.....	329
424.38 Area Restrictions	330
424.39 Clearance from Other Objects and Openings	330

Article 430—Motors, Motor Circuits, and Controllers	331
430.1 Scope.....	331
430.99 Available Fault Current	332

Article 440—Air-Conditioning and Refrigeration Equipment	333
440.1 Scope.....	333
440.9 Grounding and Bonding.....	333
440.10 Short-Circuit Current Rating	334

Article 445—Generators	335
445.1 Scope.....	335
445.13 Ampacity of Conductors	336
445.18 Disconnecting Means and Shutdown of Prime Mover.....	337
445.20 GFCI for Receptacles on 15 kW or Smaller Portable Generators	338

Article 480—Storage Batteries	339
480.1 Scope.....	339
480.3 Listing Requirement	340
480.4 Battery and Cell Terminations.....	340
480.9 Battery Support Systems.....	341

CHAPTER 5—SPECIAL OCCUPANCIES..... 343

Article 500—Hazardous (Classified) Locations	345
500.1 Scope—Articles 500 Through 504	346
500.2 Definitions.....	346

Article 501—Class I Hazardous (Classified) Locations	347
501.1 Scope.....	347
501.10 Wiring Methods.....	347
501.15 Raceway and Cable Seals	350
501.115 Enclosures	356
501.145 Receptacles and Attachment Plugs.....	357

Article 511—Commercial Garages, Repair, and Storage	359
511.1 Scope.....	359
511.3 Classification of Hazardous Areas.....	360
511.8 Underground Wiring	360

Article 514—Motor Fuel Dispensing Facilities	363
514.1 Scope.....	363
514.8 Underground Wiring	364
514.9 Raceway Seal.....	365
514.11 Circuit Disconnects	366

Article 517—Health Care Facilities	367
517.1 Scope.....	368
517.2 Definitions.....	368
517.13 Grounding of Equipment in Patient Care Spaces.....	370
517.16 Isolated Ground Receptacles	374

Article 525—Carnivals, Circuses, Fairs, and Similar Events	377	Article 620—Elevators, Escalators, and Moving Walks	407
525.1 Scope.....	377	620.1 Scope.....	408
525.23 GFCI-Protected Receptacles and Equipment.....	378	620.16 Short-Circuit Current Rating	408
Article 547—Agricultural Buildings	379	620.23 Branch Circuit for Machine Room/Machinery Space.....	409
547.1 Scope.....	379	620.24 Branch Circuit for Hoistway Pit Lighting and Receptacles	410
547.2 Definitions.....	380	620.51 Disconnecting Means.....	411
Article 550—Mobile Homes, Manufactured Homes, and Mobile Home Parks	381	620.85 GFCI-Protected Receptacles	412
550.1 Scope.....	381	Article 625—Electric Vehicle Charging System	413
550.2 Definitions.....	382	625.1 Scope.....	414
550.13 Receptacle Outlets	382	625.2 Definitions.....	414
550.25 AFCI Protection.....	384	625.5 Listed	416
Article 555—Marinas, Boatyards, and Commercial and Noncommercial Docking Facilities	385	625.40 Electric Vehicle Branch Circuit	416
555.1 Scope.....	385	Article 630—Welders	419
555.3 Ground-Fault Protection	386	630.1 Scope.....	419
555.24 Electric Shock Hazard Signage.....	386	630.6 Listing.....	420
Article 590—Temporary Installations	389	Article 640—Audio Signal Processing, Amplification, and Reproduction Equipment	421
590.1 Scope.....	389	640.1 Scope.....	421
590.4 General	390	640.3 Locations and Other Articles.....	422
590.6 Ground-Fault Protection for Personnel.....	393	640.22 Wiring of Equipment Racks and Enclosures.....	423
CHAPTER 6—SPECIAL EQUIPMENT	395	640.25 Loudspeakers in Fire-Resistance-Rated Partitions, Walls, and Ceilings	423
Article 600—Electric Signs and Outline Lighting ..	397	Article 645—Information Technology Equipment ... 425	
600.1 Scope.....	397	645.1 Scope.....	425
600.2 Definitions.....	398	645.3 Other Articles	426
600.3 Listing.....	399	645.4 Special Requirements	426
600.4 Markings.....	400	645.5 Supply Circuits and Interconnecting Cables.....	427
600.6 Disconnecting Means.....	400	Article 680—Swimming Pools, Spas, Hot Tubs, Fountains, and Similar Installations	431
600.24 Class 2 Power Sources.....	403	680.1 Scope.....	432
600.34 Photovoltaic (PV) Powered Sign	403	680.2 Definitions.....	432
Article 604—Manufactured Wiring Systems	405	680.4 Approval of Equipment	434
604.1 Scope.....	405	680.7 Grounding and Bonding Terminals.....	435
604.6 Listing Requirements	405	680.11 Underground Wiring	435
		680.12 Equipment Rooms and Pits.....	436
		680.14 Corrosive Environment	437
		680.21 Motors	438

680.22 Lighting, Receptacles, and Equipment 439

680.23 Underwater Luminaires 441

680.25 Feeders 444

680.26 Equipotential Bonding 445

680.28 Gas-Fired Water Heaters 449

680.42 Outdoor Installations 449

680.74 Equipotential Bonding 450

Part VIII. Electrically Powered Pool Lifts

680.80—680.85 451

Article 695—Fire Pumps 453

695.1 Scope 453

695.14 Control Wiring 454

695.15 Surge Protection 454

CHAPTER 7—SPECIAL CONDITIONS 455

Article 700—Emergency Systems 457

700.1 Scope 457

700.3 Tests and Maintenance 458

700.5 Transfer Equipment 458

700.10 Wiring 459

700.12 General Requirements 460

700.25 Branch Circuit Emergency Lighting Transfer Switch 463

Article 701—Legally Required Standby Systems .. 465

701.1 Scope 465

701.3 Tests and Maintenance 465

701.5 Transfer Equipment 466

Article 702—Optional Standby Systems 467

702.1 Scope 467

702.5 Transfer Equipment 468

Article 725—Remote-Control, Signaling, and Power-Limited Circuits 469

725.1 Scope 469

725.3 Other Articles 470

725.121 Power Sources for Class 2 and Class 3 Circuits 473

725.144 Transmission of Power and Data 474

725.179 Listing and Marking of Class 2 and Class 3 Cables 475

Article 760—Fire Alarm Systems 477

760.1 Scope 477

760.3 Other Articles 478

760.179 Listing and Marking of Power-Limited Fire Alarm Cables (PLFA) and Insulated Continuous Line-Type Fire Detectors 480

Article 770—Optical Fiber Cables and Raceways 483

770.1 Scope 483

770.2 Definitions 484

770.24 Mechanical Execution of Work 484

CHAPTER 8—COMMUNICATIONS SYSTEMS 487

Article 800—Communications Circuits 489

800.1 Scope 489

800.2 Definitions 490

800.24 Mechanical Execution of Work 490

800.100 Cable and Primary Protector Bonding and Grounding 492

800.133 Installation of Communications Wires, Cables, and Equipment 495

Article 810—Radio and Television Satellite Equipment 499

810.1 Scope 499

810.15 Metal Antenna Supports—Grounding 500

Article 820—Community Antenna Television (CATV) and Radio Distribution Systems (Coaxial Cable) 501

820.1 Scope 501

820.2 Definitions 502

820.24 Mechanical Execution of Work 503

820.100 Bonding and Grounding Methods 504

820.133 Installation of Coaxial Cables and Equipment 508

FINAL EXAM 511

About the Author 523

About the Illustrator 524

About the Mike Holt Team 525