

TABLE OF CONTENTS

About This Textbook	x	CHAPTER 2—WIRING AND PROTECTION 41
About the National Electrical Code	xiv	Article 250—Grounding and Bonding 43
About the Author	xix	Part I. General 43
About the Illustrator	xx	250.1 Scope 43
About the Team	xi	250.2 Definition 43
Article 90—Introduction to the National Electrical Code 1		250.4 General Requirements for Grounding and Bonding .. 44
90.1 Purpose of the <i>NEC</i> 1		250.6 Objectionable Current 50
90.2 Scope of the <i>NEC</i> 3		250.8 Termination of Grounding and Bonding Conductors . 54
90.3 <i>Code Arrangement</i> 5		250.10 Protection of Fittings 55
90.4 Enforcement 6		250.12 Clean Surfaces 55
90.5 Mandatory Requirements and Explanatory Material... 8		Part II. System Grounding and Bonding 55
90.6 Formal Interpretations 8		250.20 Systems Required to Be Grounded 55
90.7 Examination of Equipment for Product Safety 8		250.21 Ungrounded Systems—50V to 1,000V 57
90.9 Units of Measurement 9		250.24 Service Equipment—Grounding and Bonding 57
Article 90 Practice Questions 10		250.28 Main Bonding Jumper and System Bonding Jumper 62
CHAPTER 1—GENERAL 13		250.30 Separately Derived Systems—Grounding and Bonding 64
Article 100—Definitions 15		250.32 Buildings Supplied by a Feeder 70
Definitions 15		250.34 Generators—Portable and Vehicle-Mounted 72
Article 110—Requirements for Electrical Installations 29		250.35 Permanently Installed Generators 73
110.2 Approval of Conductors and Equipment 29		250.36 High-Impedance Grounded Systems 73
110.3 Examination, Identification, Installation, and Use of Equipment 30		Part III. Grounding Electrode System and Grounding Electrode Conductor 74
110.5 Copper Conductors 30		250.50 Grounding Electrode System 74
110.6 Conductor Sizes 30		250.52 Grounding Electrode Types 75
110.12 Mechanical Execution of Work 31		250.53 Grounding Electrode Installation Requirements 79
110.14 Conductor Terminations and Splicing 31		250.54 Auxiliary Grounding Electrodes 84
Chapter 1 Practice Questions 34		250.60 Lightning Protection Electrode 85
		250.62 Grounding Electrode Conductor 85
		250.64 Grounding Electrode Conductor Installation 86
		250.66 Sizing Grounding Electrode Conductor 90
		250.68 Termination to the Grounding Electrode 91
		250.70 Grounding Electrode Conductor Termination Fittings 93

Part IV. Grounding Enclosure, Raceway, and Service	
Cable Connections	93
250.80 Service Raceways and Enclosures	93
250.86 Other Enclosures	93
Part V. Bonding	94
250.90 General	94
250.92 Bonding Equipment for Services	94
250.94 Intersystem Bonding Termination	97
250.96 Bonding Other Enclosures	98
250.97 Bonding Metal Parts Containing 277V and 480V Circuits	99
250.98 Bonding Loosely Jointed Metal Raceways	99
250.100 Bonding in Hazardous (Classified) Locations	100
250.102 Bonding Conductors and Jumpers	100
250.104 Bonding of Piping Systems and Exposed Structural Metal	102
250.106 Lightning Protection System	106
Part VI. Equipment Grounding and Equipment Grounding Conductors	107
250.110 Fixed Equipment Connected by Permanent Wiring Methods—General	107
250.112 Specific Equipment Fastened in Place or Connected by Permanent Wiring Methods	107
250.114 Cord-and-Plug-Connected Equipment	108
250.118 Types of Equipment Grounding Conductors	108
250.119 Identification of Equipment Grounding Conductors	112
250.120 Equipment Grounding Conductor Installation	114
250.121 Use of Equipment Grounding Conductors	114
250.122 Sizing Equipment Grounding Conductor	115
Part VII. Methods of Equipment Grounding	118
250.130 Equipment Grounding Conductor Connections	118
250.134 Equipment Connected by Permanent Wiring Methods	118
250.136 Equipment Considered Grounded	119
250.138 Cord-and-Plug-Connected Equipment	119
250.140 Ranges, Ovens, and Clothes Dryers	119
250.142 Use of Neutral Conductor for Equipment Grounding	120
250.146 Connecting Receptacle Grounding Terminal to Metal Enclosure	121
250.148 Continuity and Attachment of Equipment Grounding Conductors in Metal Boxes	123
Part VIII. Direct-Current Systems	125
250.166 Sizing Direct-Current Grounding Electrode Conductor	125
Chapter 2 Practice Questions	126
CHAPTER 3—WIRING METHODS AND MATERIALS	145
Article 300—General Requirements for Wiring Methods and Materials	149
300.1 Scope	149
300.3 Conductors	149
300.10 Electrical Continuity	151
Article 314—Outlet, Device, Pull, and Junction Boxes; Conduit Bodies; and Handhole Enclosures	153
314.1 Scope	153
314.3 Nonmetallic Boxes	153
314.4 Metal Boxes	154
314.25 Covers and Canopies	154
314.28 Boxes and Conduit Bodies for Conductors 4 AWG and Larger	155
314.30 Handhole Enclosures	155
Article 320—Armored Cable (Type AC)	157
320.1 Scope	157
320.2 Definition	157
320.108 Equipment Grounding Conductor	157
Article 330—Metal-Clad Cable (Type MC)	159
330.1 Scope	159
330.2 Definition	159
330.108 Equipment Grounding Conductor	160
Article 334—Nonmetallic-Sheathed Cable (Types NM and NMC)	161
334.1 Scope	161
334.2 Definition	161
334.108 Equipment Grounding Conductor	161
Article 348—Flexible Metal Conduit (Type FMC)	163
348.1 Scope	163
348.2 Definition	163
348.60 Grounding and Bonding	163

Article 350—Liquidtight Flexible Metal Conduit (Type LFMC)	165	CHAPTER 4—EQUIPMENT FOR GENERAL USE	183
350.1 Scope	165		
350.2 Definition	165		
350.60 Grounding and Bonding	166		
Article 352—Rigid Polyvinyl Chloride Conduit (Type PVC)	167	Article 404—Switches	185
352.1 Scope	167	404.1 Scope	185
352.2 Definition	167	404.9 Switch Faceplates	185
352.60 Equipment Grounding Conductor	167		
Article 356—Liquidtight Flexible Nonmetallic Conduit (Type LFNC)	169	Article 406—Receptacles, Cord Connectors, and Attachment Plugs (Caps)	187
356.1 Scope	169	406.1 Scope	187
356.2 Definition	169	406.3 Receptacle Rating and Type	187
356.60 Equipment Grounding Conductor	169	406.4 General Installation Requirements	188
Article 358—Electrical Metallic Tubing (Type EMT)	171	406.6 Receptacle Faceplates	190
358.1 Scope	171		
358.2 Definition	171	Article 408—Switchboards and Panelboards	191
358.60 Grounding	171	408.1 Scope	191
Article 362—Electrical Nonmetallic Tubing (Type ENT)	173	408.40 Equipment Grounding Conductor	191
362.1 Scope	173		
362.2 Definition	173	Article 410—Luminaires, Lampholders, and Lamps	193
362.60 Equipment Grounding Conductor	174	410.1 Scope	193
Article 386—Surface Metal Raceways	175	410.30 Supports	193
386.1 Scope	175	410.44 Methods of Grounding	194
386.2 Definition	175		
386.60 Equipment Grounding Conductor	176	Article 450—Transformers	197
Article 392—Cable Trays	177	450.1 Scope	197
392.1 Scope	177	450.10 Grounding and Bonding	197
392.2 Definition	177		
392.60 Equipment Grounding Conductor	177	Chapter 4 Practice Questions	198
Chapter 3 Practice Questions	179		
CHAPTER 5—SPECIAL OCCUPANCIES	201		
Article 501—Class I Hazardous (Classified) Locations	203		
501.1 Scope	203		
501.30 Grounding and Bonding	203		
Article 502—Class II Hazardous (Classified) Locations	205		
502.1 Scope	205		
502.30 Grounding and Bonding	205		

Article 503—Class III Hazardous (Classified)	
Locations	207
503.1 Scope	207
503.30 Grounding and Bonding	207
Article 517—Health Care Facilities	209
517.1 Scope	210
517.2 Definitions	210
517.13 Grounding of Equipment in Patient Care Spaces	211
517.16 Isolated Ground Receptacles	214
Article 525—Carnivals, Circuses, Fairs, and Similar Events	215
525.1 Scope	215
525.30 Equipment Bonding	215
525.31 Equipment Grounding	215
525.32 Portable Equipment Grounding Conductor Continuity	216
Article 547—Agricultural Buildings	217
547.1 Scope	217
547.2 Definitions	217
547.5 Wiring Methods	218
547.10 Equipotential Planes	218
Article 555—Marinas and Boatyards	221
555.1 Scope	221
555.15 Grounding	221
Chapter 5 Practice Questions	222
CHAPTER 6—SPECIAL EQUIPMENT	227
Article 600—Electric Signs and Outline	
Lighting	229
600.1 Scope	229
600.7 Grounding and Bonding	230
Article 640—Audio Signal Processing, Amplification, and Reproduction Equipment	233
640.1 Scope	233
640.7 Grounding and Bonding	233
Article 645—Information Technology Equipment	235
645.1 Scope	235
645.14 System Grounding	235
645.15 Equipment Grounding and Bonding	236
Article 680—Swimming Pools, Spas, Hot Tubs, Fountains, and Similar Installations	237
680.1 Scope	238
680.2 Definitions	238
680.21 Motors	238
680.23 Underwater Luminaires	240
680.24 Junction Box, Transformer, or GFCI Enclosure	241
680.25 Feeders	241
680.26 Equipotential Bonding	242
680.42 Outdoor Installations	245
680.43 Indoor Installations	245
680.55 Methods of Equipment Grounding	246
680.74 Equipotential Bonding	246
Article 690—Solar Photovoltaic (PV) Systems	247
690.1 Scope	247
690.2 Definitions	247
690.41 PV System Grounding	249
690.43 Equipment Grounding	249
690.45 Size of Equipment Grounding Conductors	250
690.46 Array Equipment Grounding Conductors	251
690.47 Grounding Electrode System	252
690.48 Continuity of Equipment Grounding	254
690.49 Continuity of System Grounding	254
Chapter 6 Practice Questions	255

CHAPTER 8—COMMUNICATIONS SYSTEMS	261
Article 810—Radio and Television Equipment	263
810.1 Scope	263
810.15 Metal Antenna Supports—Grounding	264
810.20 Antenna Discharge Unit	264
810.21 Bonding Conductor and Grounding Electrode Conductors	264
810.57 Antenna Discharge Units	268
810.58 Bonding Conductor or Grounding Electrode Conductors	268
Article 820—Community Antenna Television (CATV) and Radio Distribution Systems	269
820.1 Scope	269
820.2 Definitions	270
820.49 Metallic Entrance Conduit Grounding	270
820.93 Grounding of the Outer Conductive Shield of Coaxial Cables	270
820.100 Bonding and Grounding Methods	271
Chapter 8 Practice Questions	275
APPENDIX A—GROUNDING VS. BONDING ANALYSIS OF THE <i>CHANGES TO THE NEC 2014</i>	279
INDEX	291