Code☑Check® for the 2023 NEC®

An Illustrated Reference for Electrical Codes

Designed for use with Adobe Acrobat or Acrobat Reader

BY DOUGLAS HANSEN, REDWOOD KARDON, SKIP WALKER & GLENN MATHEWSON

Based on the 2023 National Electrical Code® and 2024 International Residential Code®
including annotated changes from the previous code editions

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INTERNATIONAL CODE COUNCIL®

Organization of this a particular code rule. Figures and tables accompany the t ount of information into a relatively small book, we use mar

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THE BUTTONS AT THE TOP OF EACH PAGE ARE LINKS THAT TAKE YOU TO THE DESCRIBED DESTINATIONS (LINKS NOT ACTIVE IN THESE SAMPLE SCREEN SHOTS)

Setting Up Adobe Acrobat Reader

Using the eBook Navigation Features

Saving notes and comments in your personalized version

- The easiest way to find a particular topic is to start at the table of contents. Every line in each table of contents is a link to the section it describes.
- Figures and tables are referenced in the text by the letters **F** and **T** followed by the figure or table number.
- Within the text of this book, every figure reference, page reference, and table reference is also a link. When the text references a figure or table on a different page, clicking on the reference number takes you to that reference, and clicking on the red "Return to Previous Page" button at the top of the screen takes you back to where you had been in the text.

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Thanks and appreciation to Ryan Jackson.

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EACH LINE IN THE TABLE OF CONTENTS IS A LINK. FOR EXAMPLE, FROM WHEREVER YOU ARE IN THE BOOK, IF YOU DECIDE TO LOOK AT "MULTIWIRE BRANCH CIRCUITS" YOU WOULD CLICK THE TABLE OF CONTENTS BUTTON, GOT TO "PANELBOARDS & CABINETS" AND THEN TO THE LINE FOR MULTIWIRE BRANCH CIRCUITS. CLICKING ON IT WILL TAKE YOU TO THAT PAGE. TO RETURN TO WHERE YOU HAD BEEN, CLICK THE RED "RETURN TO PREVIOUS PAGE" BUTTON.

ABBREVIATIONS (Acronyms)

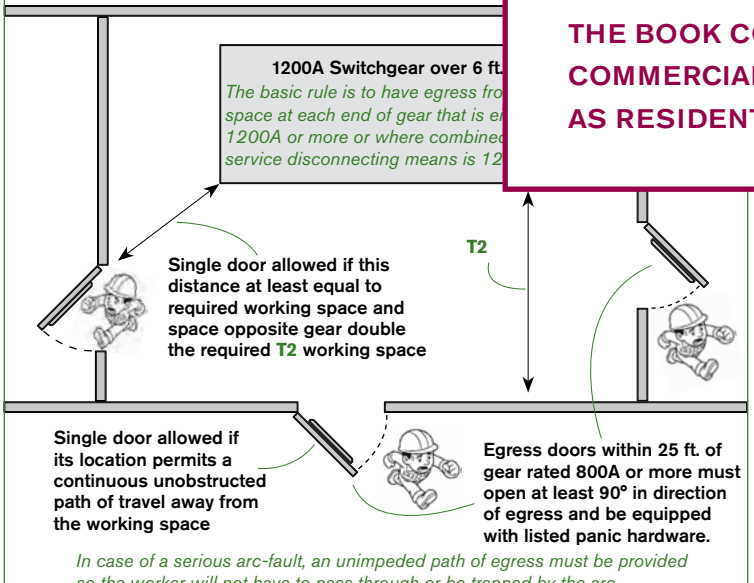
< = less than
≤ = less than or equal to
> = greater than
≥ = greater than or equal to
Ω = Ohms (unit of electrical resistance)
1FD = Single Family Dwelling
1&2FD = 1- & 2-Family Dwellings
A = amp(s), amperage, amps
AC = alternating current
AC = type AC armored cable, a.k.a. "BX"
AFC = available fault current
AFCI = arc-fault circuit interrupter
AFF = above finished floor or grade
AHJ = authority having jurisdiction
AIC = ampere interrupting capacity (see IR)
AL = aluminum
AMI = in accordance w/ manufacturer's instructi
ASCE = American Society of Civil Engineers
AWG = American Wire Gauge (#8 = 8 AWG)
BJ = bonding jumper
CCA = copper-clad aluminum
CSA = cross sectional area
CSST = corrugated stainless steel gas tubing
cu. = cubic, as in cu. in.
Cu = copper
DC = direct current
DW = dishwasher
e.g. = ***exemplia gratia*** – "for example"
EGC = equipment grounding conductor
EMS = energy management system
EMT = electrical metallic tubing
ENT = electrical nonmetallic tubing
ESS = energy storage system
EV = electric vehicle
EVSE = electric vehicle supply equipment
EXC = exception(s) (in following line)
Fe = ferrous
FLA = full load amperage
FLC = full load current
FMC = flexible metal conduit
ft. = foot, feet
GEC = grounding electrode conductor
GES = grounding electrode system
kcmil = 1,000 circular mil units (wire size)
KO = knockout
kVA = kilovolt-amperes (1,000's of VAs)
kW = kilowatts (1,000s of Watts)
kWh = kilowatt hours
L&L = listed & labeled, listing & labeling
lb. = pound(s)
LED = light-emitting diode
LFMC = liquidtight flexible metal conduit
LFNC = liquidtight flexible nonmetallic conduit
mA = milliamp (1,000th of an amp)
max = maximum
MBJ = main bonding jumper
MC = metal-clad cable
MCC = motor control center
MCS = microgrid control system
MFD = multifamily dwelling
MFR = manufacturer(s)
MID = microgrid interconnect device
min = minimum
MWBC = multiwire branch circuit
n/a = not applicable
NEC = National Electrical Code
NEMA® = National Electrical Manufacturers Association
NFPA® = National Fire Protection Association
NM = nonmetallic-sheathed cable
= outlet branch circuit AFCI
= current protection device
= (as in see ***p.29***)
= rical personal protective equipment
= ovoltaic
= polyvinyl chloride conduit
= otovoltaic rapid shutdown equipment ***p.101***
= metal conduit
= nonmetallic conduit (PVC)
= orced thermosettting resin conduit
= m bonding jumper
= circuit current rating
= seismic design category
SE = service entrance (cable)
SPD = surge protective device
sq. = square, as in sq. in.
SS = stainless steel
SSBJ = supply side bonding jumper
temp = temperature
TR = tamper-resistant
UF = underground feeder cable
UL® = UL Solutions (formerly Underwriters Laboratories)
USE = type USE underground service entrance cable
V = volt(s), such as a 120V circuit
VA = volt-ampere(s), units of apparent power
VD = voltage drop
VFD = variable frequency drive (adjustable speed drive)
W = watt(s), units of true (useful) power
w/ = with
w/o = without
WR = weather-resistant
WSAF = weight-supporting attachment fitting
WSCR = weight-supporting ceiling receptacle
XFMR = transformer

Abbreviations are always accessible from the button at the top of every page. If an abbreviation is not familiar, you can look it up from here and then return to your place in the text with the red "RETURN TO PREVIOUS PAGE" button.

Entrance to and Egress From Working Space — 23 NEC

- ☐ Min one entrance for access & egress from working space _____ 110.26C1
- ☐ Large equipment = equipment more than 6 ft. wide & rated 1,200A or more (or if combined rating of service disconnects 1,200A or more) ___ 110.26C2
- ☐ Egress min 24 in. wide & 78 in. high required at each end of working space of large equipment EXC _____ 110.26C1
  - • Single egress **F6** OK if continuous & unobstructed path _____ 110.26C2a
  - • Single egress **F6** OK if working space distance **T2** doubled & distance between equipment & nearest edge of entrance min **T2** _____ 110.26C2b
- ☐ Egress doors within 25 ft. of working space containing electrical equipment rated 800A or more require listed panic hardware ____ 110.26C3

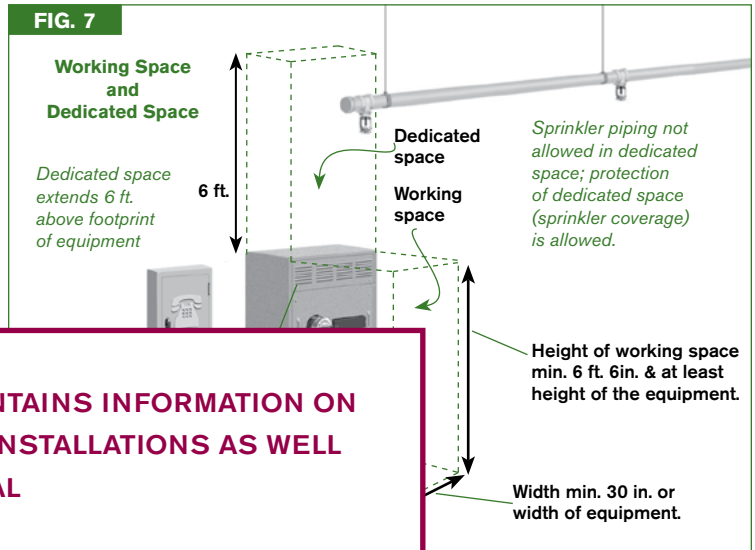
FIG. 6 Egress from Working Space of Large E



In case of a serious arc-fault, an unimpeded path of egress must be provided so the worker will not have to pass through or be trapped by the arc.

THE BOOK CONTAINS INFORMATION ON COMMERCIAL INSTALLATIONS AS WELL AS RESIDENTIAL

FIG. 7



Dedicated Space F5,F7 — 24 IRC — 23 NEC

Dedicated space is necessary to allow room for future re-entries to electrical equipment, and to protect it from leaks or other contamination.

- ☐ Dedicated space is from the equipment footprint to floor below it & for 6 ft. above it or to structural ceiling _____ 3405.3&4 110.26E1a
- ☐ No piping, ducts, or other systems foreign to the electrical system are allowed in dedicated space EXC _____ 3405.3&4 110.26E1a
  - • Suspended ceilings w/ removable panels OK _____ 3405.3X 110.26E1aX
- ☐ Foreign systems allowed above dedicated space if leak protection supplied more than 6 ft. above equipment ____ 3405.3 110.26F1b
- ☐ Foreign systems allowed above dedicated space if leak protection supplied above dedicated space and at least 6 ft. above the equipment being protected _____ 3405.3 110.26F1b
- ☐ Sprinkler protection (but not sprinkler head & piping) allowed in dedicated space _____ n/a 110.26E1c

UNDERGROUND WIRING

The interior of an underground conduit is a wet location. When there is a significant difference in elevation from one end to the other of the conduit, drain boxes may be needed. Joint trenches may include communication cables; separation of these from power conductors is typically per agreement of the parties (utilities).

General	24 IRC	23 NEC
☐ Cover to finish grade per T3,F12	3803.1	300.5A
☐ Measure cover from top of cable or conduit T3,F12	T3803.1	T300.5A
☐ Backfill w/ smooth granular material, no rocks, cinders, or paving ma		
☐ Provide running boards if subjec		
☐ Direct-buried splices & taps O listed for the purpose		

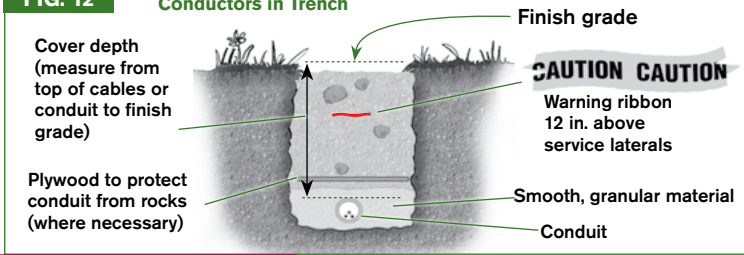
The eBook contains 106 illustrations and 60 tables. The text lines contain links to these illustrations and tables. When the link takes you to a different page, you can quickly return with the "RETURN TO PREVIOUS PAGE" button at the top.

Underground Raceways		
☐ Provide for earth movement (se “S” loops, flexible connections,		
☐ Cables & raceways installed w/ directional boring require approval for the purpose (specialized fittings)	n/a	300.5K
☐ Interior of underground raceways considered wet location	3803.10	300.5B
☐ Conductors underground must be L&L for wet locations	3803.10	310.10C
☐ Seal underground raceway entries at either or both ends	3803.6	300.5G
☐ Sealants must be identified for use w/ cable insulation	3803.6	300.5G
☐ Spare or unused raceways to also be sealed	3803.6	300.5G
☐ Bushing required at end of conduit ending underground	3803.7	300.5H
☐ Expansion fittings in risers if soil movement likely	3803.9	300.5J

Parallel Raceways		
☐ Parallel raceways must each contain all conductors & EGC of the circuit EXC	3803.8X	300.5(I)X1
• Isolated phase conductors in nonmetallic raceways	n/a	300.5(I)X2
(isolated phase installations may not be allowed by local AHJ or utility)		
☐ Maintain spacing between raceways	n/a	310.15C2

NEC Informative Annex B contains examples of spacing for duct banks, as well as information on performance of Neher/McGrath calculations.

FIG. 12 Conductors in Trench



REQUIREMENTS ◆ IRC T3803.1 NEC 300.5

		RMC or IMC	EMT[A] or PVC	GFCI max. 20A Circuit	Not more than 30V[B]
		6 in.	18 in.	12 in.	6 in.
		6 in.	12 in.	6 in.	6 in.
		0	0	0[C]	0[C]
min. 4 in. slab min. 6 in. past conductors and no vehicle traffic	18 in.	4 in.	4 in.	6 in. 4 in. raceway	6 in. 4 in. raceway
Streets, Driveways, Lots	24 in.	24 in.	24 in.	24 in.	24 in.
1&2FD Driveway	18 in.	18 in.	18 in.	12 in.	18 in.

A. Direct-buried EMT requires protection from corrosion per 358.10[23]
B. Applies to central irrigation or landscape lighting in UF cable or a raceway. Listed low-voltage lighting OK per installation instructions at lesser depths. Listed pool, spa, or fountain lighting ≤30V OK in nonmetallic raceway w/ 6 in. cover.
C. Applies to raceways & MC or MI cable identified for direct burial or concrete encasement.

Service Laterals	24 IRC	23 NEC
☐ Size, depth, material & testing (mandrel) per utility	utility	utility
☐ Sewer not in joint trench	utility	utility
☐ Warning ribbon min 12 in. above service conductors that are 18 in. or more below grade unless encased in concrete F12	3803.2	300.5D3
☐ Seal underground raceways (see left column)	3601.5	230.8

23. Directly buried EMT is new to the table in this edition, and requires corrosion-protection.

EQUIPMENT GROUNDING CONDUCTORS (EGCs)

Equipment grounding provides a low-impedance path so the overcurrent device will open the circuit in a fault. The purpose of equipment grounding is completely different than that of earth grounding; earth plays no part in helping to clear [illegible]

Purpose & Routing	24 IRC	23
☐ Effective ground-fault current path must be established	3908.4	25
☐ Earth is not an effective ground-fault current path	3908.5	25
☐ GEC not to be used as an EGC EXC	n/a	250.1
• Where complies w/ both & no objectionable current	n/a	250.11
☐ Metal building frame or structure not allowed as EGC	n/a	250.
☐ EGCs must run w/ other conductors of circuit EXC	3908.10	250.134
• Replacement of nongrounding receptacles (see ***p.60***)	n/a	250.130C

Objectionable Currents		
☐ Arrange connections to avoid objectionable currents	n/a	250.6A
Continuous current on an EGC is an example of objectionable current.		
☐ Temporary current from a ground fault or current from connections required by code are not considered objectionable currents	n/a	250.6C[27]

Types of EGCs		
☐ Wire EGCs can be Cu, AL, Cu-clad AL, solid or stranded, bare, covered, or insulated,	3908.9(1)	250.118
☐ RMC, IMC, EMT, AC cable armor, electrically continuous raceways & surface metal raceways allowed as EGC EXC	3908.9	250.118
• Wire-type EGC required in outdoor raceways w/ compression-type fittings when supplying rooftop air conditioning	n/a	440.9
☐ Raceways & cable armor as EGC must approved fittings; all joints, fittings & connections to be made tight	3908.12	250.120A
☐ FMC as EGC w/ listed fittings, max 20A OCPD, max length of FMC & LFMC in same fault-current path 6 ft., max trade size 1¼ in., no vibration or flexibility after installation	3908.9.1	250.118(5)
☐ LFMC same as FMC & 60A OCPD allowable in trade sizes ¾–1¼ EXC	3908.9.2	250.118(6)
•If SS core, install wire EGC or a bonding jumper	3908.9.2	250.118(6)

27. An example of current on a required connection is to find amperage on a grounding electrode conductor, where current is commonly found because it is in parallel with the service neutral.

Code changes are highlighted in the text and the change is further explained in the footnotes at the bottom of the page.

Identification & Size	24 IRC	24 NEC
☐ #6 and smaller conductors must be bare or factory insulated w/ green or green w/ yellow stripes	3407.2.1	250.119A
☐ #4 and larger can have green coloring or tape encircling their		
		50.119B
		50.119A
		50.122A
based on largest OCPD of conductors in raceway	3908.13.1	250.122C
☐ If ungrounded conductors increased in size for other than derating, EGCs must be increased in size proportionately	n/a	250.122B

TABLE 5 MIN. EQUIPMENT GROUNDING CONDUCTOR (EGC) SIZE ◆ IRC T3908.13 ◆ NEC T250.122

Max. Rating of OCPD (Amps)	Size of Cu EGC (AWG)	Size of AL EGC (AWG)
15	14	12
20	12	10
25–60	10	8
70–100	8	6
110–200	6	4
225–300	4	2
400	3	1
500	2	1/0
600	1	2/0
800	1/0	3/0
1000	2/0	4/0
1200	3/0	250 kcmil
1600	4/0	350 kcmil
2000	250 kcmil	400 kcmil

Equipment. A general term including fittings, devices, appliances, luminaires, apparatus, machinery, and the lie used as part of or in connection with an electrical system.

Equipment Bonding Jumper. The connection between two or more portions of the equipment grounding conductor.

Equipment grounding conductor (EGC). A wire or conductive path that is part of an effective ground-fault current path and connects normally non-current-carrying metal parts of equipment together and to the system grounded conductor or to the grounding electrode conductor, or both. F22,23,24

Exothermic Welding. Irreversible joining of metallic parts, such as a grounding electrode conductor and a ground rod, by means of tools designed to weld them together.

Exposed (as applied to live parts). Capable of
approached nearer than a safe distance by a p

Exposed (as applied to wiring methods). On
panels designed to allow access. Wiring above
a ceiling tile is removed.

Fault Current. The current delivered at a point on
condition. See *p.16*.

Feeders. All circuit conductors between the servi
derived system, or other power supply source
device. The conductors between a service panel and subpanel are feeders.

Generating Capacity. The sum of parallel-connected inverter maximum continuous output power at 40°C expressed in kW or VA.

Ground. The earth.

Grounded. Connected to ground or to a conductive body that extends the ground connection, such as the grounded neutral in a residential electrical system.

Ground Fault. An unintentional electrically conductive connection between an ungrounded conductor of an electrical circuit and the normally non-current-carrying conductors, metal enclosures, metal equipment, or earth. F66

Ground-Fault Circuit Interrupter (GFCI). A device intended for the protection of personnel that functions to de-energize a circuit or portion thereof within an established period of time when a ground-fault current exceeds the values established for a Class A device. Per UL 943, Class A GFCIs must open the circuit when an imbalance of 6 milliamps or more is detected. F65,66

Ground-Fault Circuit Interrupter, Special Purpose (SPGFCI). A device intended for the detection of ground-fault currents, used in circuits with voltage to ground greater than 150V, and within an established period of time when a ground-fault current exceeds the values established for Class C, D, or E devices. An example would be a 480V 3-phase commercial dishwasher.

THE GLOSSARY IS ALWAYS AVAILABLE FROM THE BUTTON AT THE TOP OF THE SCREEN.

Ground-Fault Current Path. An electrically conductive path from the point of a ground fault on a wiring system through normally non-current-carrying conductors, grounded conductors, equipment, or the earth to the electrical supply source. An ***Effective Ground-Fault Current Path*** is an intentionally constructed, low-impedance electrically conductive path designed and intended to carry current during ground-fault events and that facilitates operation of the OCPD or ground-fault detectors. Earth is not an effective ground fault current path.

Ground-Fault Detector-Interrupter, DC (GFDI). A device that provides protection for PV system DC circuits by detecting a ground fault and interrupting the fault path in the DC circuit.

Ground-Fault Protection of Equipment (GFPE). A system intended to protect equipment
ult currents by de-energizing the circuit. This protection is
of the OCPD that protects conductors, and at a higher
provide personnel protection. ***p.38***

r circuit conductor that is intentionally grounded. In resi-
grounded conductor.

ing object through which a direct connection to earth is

(GEC). A conductor that connects the system grounded
grounding electrode or to a point on the grounding elec-

Grounding Electrode System (GES). F13 The conductive metallic elements installed in the earth and bonded together to form a grounding electrode system.

Grounded, Functionally. A photovoltaic system that has an electrical ground reference for operational purposes that is not solidly grounded.

Habitable Room. A room in a building for living, eating, sleeping, or cooking but excluding bathrooms, toilet rooms, closets, hallways, storage or utility spaces, and similar areas.

Harmonic Currents. A sinusoidal wave whose frequency is an integer multiple of the fundamental frequency. These frequencies are produced by equipment with non-linear loads, including computers, rectifiers, electronic ballasts for discharge lighting, and similar equipment. Because of harmonic currents, the neutral conductor of a 4-wire 3-phase system can carry as much or more current than the phase conductors.

Hermetic Refrigerant Motor-Compressor. A combination consisting of a compressor and motor, both of which are enclosed in the same housing, with no external shaft or shaft seals, with the motor operating in the refrigerant.

Hydromassage Bathtub. A permanently installed bathtub equipped with a circulating piping system, pump, and associated equipment, and designed to accept, circulate, and discharge water upon each use. F85