



National Fire Protection Association

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WORKING DRAFT OF CODE-MAKING **PANEL MEETING OUTPUT**

**CONTENT NOT FINAL –SUBJECT TO REVISION
PRIOR TO LETTER BALLOT AND PUBLICATION OF
FIRST DRAFT REPORT**

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This is a working draft, prepared by NFPA staff, to record the output generated at the Code-Making Panel's First Draft Meetings. It includes draft copies of the First Revisions and any Global Revisions.

It is being made available to Committee members for the purpose of facilitating early review, particularly for those Committee members who may be seeking input from their respective organizations in preparation for the Letter Ballot of the Committee.

**First Revision No. 7968-NFPA 70-2018 [Annex B]****Informative Annex B** Application Information for Ampacity Calculation

This informative annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

B.1 Equation Application Information.

This informative annex provides application information for ampacities calculated under engineering supervision.

B.2 Typical Applications Covered by Tables.

Typical ampacities for conductors rated 0 through 2000 volts are shown in Table B.310.15(B)(2)(1) through Table B.310.15(B)(2)(10). Table B.310.15(B)(2)(11) provides the adjustment factors for more than three current-carrying conductors in a raceway or cable with load diversity. Underground electrical duct bank configurations, as detailed in Figure B.310.15(B)(2)(3), Figure B.310.15(B)(2)(4), and Figure B.310.15(B)(2)(5), are utilized for conductors rated 0 through 5000 volts. In Figure B.310.15(B)(2)(2) through Figure B.310.15(B)(2)(5), where adjacent duct banks are used, a separation of 1.5 m (5 ft) between the centerlines of the closest ducts in each bank or 1.2 m (4 ft) between the extremities of the concrete envelopes is sufficient to prevent derating of the conductors due to mutual heating. These ampacities were calculated as detailed in the basic ampacity paper, AIEE Paper 57-660, *The Calculation of the Temperature Rise and Load Capability of Cable Systems*, by J. H. Neher and M. H. McGrath. For additional information concerning the application of these ampacities, see IEEE STD 835-1994, *Standard Power Cable Ampacity Tables*.

Typical values of thermal resistivity (ρ) are as follows:

Average soil (90 percent of USA) = 90

Concrete = 55

Damp soil (coastal areas, high water table) = 60

Paper insulation = 550

Polyethylene (PE) = 450

Polyvinyl chloride (PVC) = 650

Rubber and rubber-like = 500

Very dry soil (rocky or sandy) = 120

Thermal resistivity, as used in this informative annex, refers to the heat transfer capability through a substance by conduction. It is the reciprocal of thermal conductivity and is normally expressed in the units°C-cm/watt. For additional information on determining soil thermal resistivity (ρ), see ANSI/ IEEE STD 442-1996, *Guide for Soil Thermal Resistivity Measurements*.

B.3 Criteria Modifications.

Where values of load factor and Rho are known for a particular electrical duct bank installation and they are different from those shown in a specific table or figure, the ampacities shown in the table or figure can be modified by the application of factors derived from the use of Figure B.310.15(B)(2)(1).

Where two different ampacities apply to adjacent portions of a circuit, the higher ampacity can be used beyond the point of transition, a distance equal to 3 m (10 ft) or 10 percent of the circuit length calculated at the higher ampacity, whichever is less.

Where the burial depth of direct burial or electrical duct bank circuits are modified from the values shown in a figure or table, ampacities can be modified as shown in (a) and (b) as follows.

(a) Where burial depths are increased in part(s) of an electrical duct run to avoid underground obstructions, no decrease in ampacity of the conductors is needed, provided the total length of parts of the duct run increased in depth to avoid obstructions is less than 25 percent of the total run length.

(b) Where burial depths are deeper than shown in a specific underground ampacity table or figure, an ampacity derating factor of 6 percent per increased 300 mm (foot) of depth for all values of Rho can be utilized. No rating change is needed where the burial depth is decreased.

B.4 Electrical Ducts.

The term *electrical duct(s)* is defined in 310.311.60 2.

B.5 Table B.310.15(B)(2)(6) and Table B.310.15(B)(2)(7).

(a) To obtain the ampacity of cables installed in two electrical ducts in one horizontal row with 190-mm (7.5-in.) center-to-center spacing between electrical ducts, similar to Figure B.310.15(B)(2)(2), Detail 1, multiply the ampacity shown for one duct in Table B.310.15(B)(2)(6) and Table B.310.15(B)(2)(7) by 0.88.

(b) To obtain the ampacity of cables installed in four electrical ducts in one horizontal row with 190-mm (7.5-in.) center-to-center spacing between electrical ducts, similar to Figure B.310.15(B)(2)(2), Detail 2, multiply the ampacity shown for three electrical ducts in Table B.310.15(B)(2)(6) and Table B.310.15(B)(2)(7) by 0.94.

B.6 Electrical Ducts Used in Figure B.310.15(B)(2)(2).

If spacing between electrical ducts, as shown in Figure B.310.15(B)(2)(2), is less than as specified where electrical ducts enter equipment enclosures from underground, the ampacity of conductors contained within such electrical ducts need not be reduced.

B.7 Examples Showing Use of Figure B.310.15(B)(2)(1) for Electrical Duct Bank Ampacity Modifications.

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Figure B.310.15(B)(2)(1) is used for interpolation or extrapolation for values of Rho and load factor for cables installed in electrical ducts. The upper family of curves shows the variation in ampacity and Rho at unity load factor in terms of I_1 , the ampacity for Rho = 60, and 50 percent load factor. Each curve is designated for a particular ratio I_2/I_1 , where I_2 is the ampacity at Rho = 120 and 100 percent load factor.

The lower family of curves shows the relationship between Rho and load factor that will give substantially the same ampacity as the indicated value of Rho at 100 percent load factor.

As an example, to find the ampacity of a 500-kcmil copper cable circuit for six electrical ducts as shown in Table B.310.15(B)(2)(5): At the Rho = 60, LF = 50, $I_1 = 583$; for Rho = 120 and LF = 100, $I_2 = 400$. The ratio $I_2/I_1 = 0.686$. Locate Rho = 90 at the bottom of the chart and follow the 90 Rho line to the intersection with 100 percent load factor where the equivalent Rho = 90. Then follow the 90 Rho line to I_2/I_1 ratio of 0.686 where $F = 0.74$. The desired ampacity = $0.74 \times 583 = 431$, which agrees with the table for Rho = 90, LF = 100.

To determine the ampacity for the same circuit where Rho = 80 and LF = 75, using Figure B.310.15(B)(2)(1), the equivalent Rho = 43, $F = 0.855$, and the desired ampacity = $0.855 \times 583 = 498$ amperes. Values for using Figure B.310.15(B)(2)(1) are found in the electrical duct bank ampacity tables of this informative annex.

Where the load factor is less than 100 percent and can be verified by measurement or calculation, the ampacity of electrical duct bank installations can be modified as shown. Different values of Rho can be accommodated in the same manner.

Table B.310.15(B)(2)(1) Ampacities of Two or Three Insulated Conductors, Rated 0 Through 2000 Volts, Within an Overall Covering (Multiconductor Cable), in Raceway in Free Air Based on Ambient Air Temperature of 30°C (86°F)*

Size (AWG or kcmil)	Temperature Rating of Conductor. [See Table 310.104(A).]						Size (AWG or kcmil)
	60°C	75°C	90°C	60°C	75°C	90°C	
	(140°F)	(167°F)	(194°F)	(140°F)	(167°F)	(194°F)	
	Types TW, UF	Types RHW, THHW, THW, THWN, XHHW, ZW	Types THHN, THHW, THW-2, THWN-2, RHH, RWH-2, USE-2, XHHW, XHHW-2, ZW-2	Type TW	Types RHW, THHW, THW, THWN, XHHW	Types THHN, THHW, THW-2, THWN-2, RHH, RWH-2, USE-2, XHHW, XHHW-2, ZW-2	
	COPPER			ALUMINUM OR COPPER-CLAD ALUMINUM			
14**	16	18	21	=	=	=	14
12**	20	24	27	16	18	21	12
10**	27	33	36	21	25	28	10
8	36	43	48	28	33	37	8
6	48	58	65	38	45	51	6
4	66	79	89	51	61	69	4
3	76	90	102	59	70	79	3
2	88	105	119	69	83	93	2
1	102	121	137	80	95	106	1
1/0	121	145	163	94	113	127	1/0
2/0	138	166	186	108	129	146	2/0
3/0	158	189	214	124	147	167	3/0
4/0	187	223	253	147	176	197	4/0
250	205	245	276	160	192	217	250
300	234	281	317	185	221	250	300
350	255	305	345	202	242	273	350
400	274	328	371	218	261	295	400

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<u>Size (AWG or kcmil)</u>	<u>Temperature Rating of Conductor. [See Table 310.104(A).]</u>						<u>Size (AWG or kcmil)</u>
	<u>60°C</u>	<u>75°C</u>	<u>90°C</u>	<u>60°C</u>	<u>75°C</u>	<u>90°C</u>	
	<u>(140°F)</u>	<u>(167°F)</u>	<u>(194°F)</u>	<u>(140°F)</u>	<u>(167°F)</u>	<u>(194°F)</u>	
	<u>Types TW, UF</u>	<u>Types RHW, THHW, THW, THWN, XHHW, ZW</u>	<u>Types THHN, THHW, THW-2, THWN-2, RHH, RWH-2, USE-2, XHHW, XHHW-2, ZW-2</u>	<u>Type TW</u>	<u>Types RHW, THHW, THW, THWN, XHHW</u>	<u>Types THHN, THHW, THW-2, THWN-2, RHH, RWH-2, USE-2, XHHW, XHHW-2, ZW-2</u>	
	<u>COPPER</u>			<u>ALUMINUM OR COPPER-CLAD ALUMINUM</u>			
<u>500</u>	<u>315</u>	<u>378</u>	<u>427</u>	<u>254</u>	<u>303</u>	<u>342</u>	<u>500</u>
<u>600</u>	<u>343</u>	<u>413</u>	<u>468</u>	<u>279</u>	<u>335</u>	<u>378</u>	<u>600</u>
<u>700</u>	<u>376</u>	<u>452</u>	<u>514</u>	<u>310</u>	<u>371</u>	<u>420</u>	<u>700</u>
<u>750</u>	<u>387</u>	<u>466</u>	<u>529</u>	<u>321</u>	<u>384</u>	<u>435</u>	<u>750</u>
<u>800</u>	<u>397</u>	<u>479</u>	<u>543</u>	<u>331</u>	<u>397</u>	<u>450</u>	<u>800</u>
<u>900</u>	<u>415</u>	<u>500</u>	<u>570</u>	<u>350</u>	<u>421</u>	<u>477</u>	<u>900</u>
<u>1000</u>	<u>448</u>	<u>542</u>	<u>617</u>	<u>382</u>	<u>460</u>	<u>521</u>	<u>1000</u>

*Refer to 310.15(B)(2) for the ampacity correction factors where the ambient temperature is other than 30°C (86°F).

**Refer to 240.4(D) for conductor overcurrent protection limitations.

Table B.310.15(B)(2)(3) Ampacities of Multiconductor Cables with Not More Than Three Insulated Conductors, Rated 0 Through 2000 Volts, in Free Air Based on Ambient Air Temperature of 40°C (104°F) (for Types TC, MC, MI, UF, and USE Cables)*

Temperature Rating of Conductor. [See Table 310.104(A).]									
Size (AWG or kcmil)	60°C	75°C	85°C	90°C	60°C	75°C	85°C	90°C	Size (AWG or kcmil)
	(140°F)	(167°F)	(185°F)	(194°F)	(140°F)	(167°F)	(185°F)	(194°F)	
	COPPER				ALUMINUM OR COPPER-CLAD ALUMINUM				
18	=	=	=	11	=	=	=	=	18
16	=	=	=	16	=	=	=	=	16
14**	18	21	24	25	=	=	=	=	14
12**	21	28	30	32	18	21	24	25	12
10**	28	36	41	43	21	28	30	32	10
8	39	50	56	59	30	39	44	46	8
6	52	68	75	79	41	53	59	61	6
4	69	89	100	104	54	70	78	81	4
3	81	104	116	121	63	81	91	95	3
2	92	118	132	138	72	92	103	108	2
1	107	138	154	161	84	108	120	126	1
1/0	124	160	178	186	97	125	139	145	1/0
2/0	143	184	206	215	111	144	160	168	2/0

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<u>60</u>	<u>90</u>	<u>120</u>	<u>60</u>	<u>90</u>	<u>120</u>	<u>60</u>	<u>90</u>	<u>120</u>	<u>60</u>	<u>90</u>	<u>120</u>	<u>60</u>	<u>90</u>	<u>120</u>	<u>60</u>	<u>90</u>	<u>120</u>		
-																			
<u>LF</u>	<u>LF</u>	<u>LF</u>	<u>LF</u>	<u>LF</u>	<u>LF</u>	<u>LF</u>	<u>LF</u>	<u>LF</u>	<u>LF</u>	<u>LF</u>	<u>LF</u>	<u>LF</u>	<u>LF</u>	<u>LF</u>	<u>LF</u>	<u>LF</u>	<u>LF</u>		
--																			
<u>50</u>	<u>100</u>	<u>100</u>	<u>50</u>	<u>100</u>	<u>100</u>	<u>50</u>	<u>100</u>	<u>100</u>	<u>50</u>	<u>100</u>	<u>100</u>	<u>50</u>	<u>100</u>	<u>100</u>	<u>50</u>	<u>100</u>	<u>100</u>		
-																			
<u>250</u>	<u>410</u>	<u>344</u>	<u>327</u>	<u>386</u>	<u>295</u>	<u>275</u>	<u>369</u>	<u>270</u>	<u>252</u>	<u>320</u>	<u>269</u>	<u>256</u>	<u>302</u>	<u>230</u>	<u>214</u>	<u>288</u>	<u>211</u>	<u>197</u>	<u>250</u>
<u>350</u>	<u>503</u>	<u>418</u>	<u>396</u>	<u>472</u>	<u>355</u>	<u>330</u>	<u>446</u>	<u>322</u>	<u>299</u>	<u>393</u>	<u>327</u>	<u>310</u>	<u>369</u>	<u>277</u>	<u>258</u>	<u>350</u>	<u>252</u>	<u>235</u>	<u>350</u>
<u>500</u>	<u>624</u>	<u>511</u>	<u>484</u>	<u>583</u>	<u>431</u>	<u>400</u>	<u>545</u>	<u>387</u>	<u>360</u>	<u>489</u>	<u>401</u>	<u>379</u>	<u>457</u>	<u>337</u>	<u>313</u>	<u>430</u>	<u>305</u>	<u>284</u>	<u>500</u>
<u>750</u>	<u>794</u>	<u>640</u>	<u>603</u>	<u>736</u>	<u>534</u>	<u>494</u>	<u>674</u>	<u>469</u>	<u>434</u>	<u>626</u>	<u>505</u>	<u>475</u>	<u>581</u>	<u>421</u>	<u>389</u>	<u>538</u>	<u>375</u>	<u>347</u>	<u>750</u>
<u>1000</u>	<u>936</u>	<u>745</u>	<u>700</u>	<u>864</u>	<u>617</u>	<u>570</u>	<u>776</u>	<u>533</u>	<u>493</u>	<u>744</u>	<u>593</u>	<u>557</u>	<u>687</u>	<u>491</u>	<u>453</u>	<u>629</u>	<u>432</u>	<u>399</u>	<u>1000</u>
<u>1250</u>	<u>1055</u>	<u>832</u>	<u>781</u>	<u>970</u>	<u>686</u>	<u>632</u>	<u>854</u>	<u>581</u>	<u>536</u>	<u>848</u>	<u>668</u>	<u>627</u>	<u>779</u>	<u>551</u>	<u>508</u>	<u>703</u>	<u>478</u>	<u>441</u>	<u>1250</u>
<u>1500</u>	<u>1160</u>	<u>907</u>	<u>849</u>	<u>1063</u>	<u>744</u>	<u>685</u>	<u>918</u>	<u>619</u>	<u>571</u>	<u>941</u>	<u>736</u>	<u>689</u>	<u>863</u>	<u>604</u>	<u>556</u>	<u>767</u>	<u>517</u>	<u>477</u>	<u>1500</u>
<u>1750</u>	<u>1250</u>	<u>970</u>	<u>907</u>	<u>1142</u>	<u>793</u>	<u>729</u>	<u>975</u>	<u>651</u>	<u>599</u>	<u>1026</u>	<u>796</u>	<u>745</u>	<u>937</u>	<u>651</u>	<u>598</u>	<u>823</u>	<u>550</u>	<u>507</u>	<u>1750</u>
<u>2000</u>	<u>1332</u>	<u>1027</u>	<u>959</u>	<u>1213</u>	<u>836</u>	<u>768</u>	<u>1030</u>	<u>683</u>	<u>628</u>	<u>1103</u>	<u>850</u>	<u>794</u>	<u>1005</u>	<u>693</u>	<u>636</u>	<u>877</u>	<u>581</u>	<u>535</u>	<u>2000</u>
? <u>Ambient</u>																		<u>Ambient</u>	
<u>Temp.</u>																		<u>Temp.</u>	
<u>(°C)</u>	<u>Correction Factors</u>																	<u>(°F)</u>	
<u>6–10</u>	<u>1.09</u>			<u>1.09</u>			<u>1.09</u>			<u>1.09</u>			<u>1.09</u>			<u>1.09</u>			<u>43–50</u>
<u>11–15</u>	<u>1.04</u>			<u>1.04</u>			<u>1.04</u>			<u>1.04</u>			<u>1.04</u>			<u>1.04</u>			<u>52–59</u>
<u>16–20</u>	<u>1.00</u>			<u>1.00</u>			<u>1.00</u>			<u>1.00</u>			<u>1.00</u>			<u>1.00</u>			<u>61–68</u>
<u>21–25</u>	<u>0.95</u>			<u>0.95</u>			<u>0.95</u>			<u>0.95</u>			<u>0.95</u>			<u>0.95</u>			<u>70–77</u>
<u>26–30</u>	<u>0.90</u>			<u>0.90</u>			<u>0.90</u>			<u>0.90</u>			<u>0.90</u>			<u>0.90</u>			<u>79–86</u>

Table B.310.15(B)(2)(6) Ampacities of Three Insulated Conductors, Rated 0 Through 2000 Volts, Within an Overall Covering (Three-Conductor Cable) in Underground Electrical Ducts (One Cable per Electrical Duct) Based on Ambient Earth Temperature of 20°C (68°F), Electrical Duct Arrangement in Accordance with Figure B.310.15(B)(2)(2), Conductor Temperature 75°C (167°F)

<u>Size (AWG or kcmil)</u>	<u>1 Electrical Duct</u>	<u>3 Electrical Ducts</u>	<u>6 Electrical Ducts</u>	<u>1 Electrical Duct</u>	<u>3 Electrical Ducts</u>	<u>6 Electrical Ducts</u>	<u>Size (AWG or kcmil)</u>
<u>[Fig.]</u>	<u>[Fig.]</u>	<u>[Fig.]</u>	<u>[Fig.]</u>	<u>[Fig.]</u>	<u>[Fig.]</u>	<u>[Fig.]</u>	
<u>B.310.15(B)(2)(2).</u>	<u>B.310.15(B)(2)(2).</u>	<u>B.310.15(B)(2)(2).</u>	<u>B.310.15(B)(2)(2).</u>	<u>B.310.15(B)(2)(2).</u>	<u>B.310.15(B)(2)(2).</u>	<u>B.310.15(B)(2)(2).</u>	
<u>Detail 1]</u>	<u>Detail 2]</u>	<u>Detail 3]</u>	<u>Detail 1]</u>	<u>Detail 2]</u>	<u>Detail 3]</u>		

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<u>Types RHW,</u> <u>THHW,</u> <u>THW,</u> <u>THWN,</u> <u>XHHW, USE</u>			<u>Types RHW,</u> <u>THHW,</u> <u>THW,</u> <u>THWN,</u> <u>XHHW, USE</u>			<u>Types RHW,</u> <u>THHW,</u> <u>THW,</u> <u>THWN,</u> <u>XHHW, USE</u>			<u>Types RHW,</u> <u>THHW,</u> <u>THW,</u> <u>THWN,</u> <u>XHHW, USE</u>			<u>Types RHW,</u> <u>THHW,</u> <u>THW,</u> <u>THWN,</u> <u>XHHW, USE</u>			<u>Types RHW,</u> <u>THHW,</u> <u>THW,</u> <u>THWN,</u> <u>XHHW, USE</u>				
<u>COPPER</u>									<u>ALUMINUM OR COPPER-CLAD</u> <u>ALUMINUM</u>										
<u>RHO</u>	<u>RHO</u>	<u>RHO</u>	<u>RHO</u>	<u>RHO</u>	<u>RHO</u>	<u>RHO</u>	<u>RHO</u>	<u>RHO</u>	<u>RHO</u>	<u>RHO</u>	<u>RHO</u>	<u>RHO</u>	<u>RHO</u>	<u>RHO</u>	<u>RHO</u>	<u>RHO</u>	<u>RHO</u>		
<u>60</u>	<u>90</u>	<u>120</u>	<u>60</u>	<u>90</u>	<u>120</u>	<u>60</u>	<u>90</u>	<u>120</u>	<u>60</u>	<u>90</u>	<u>120</u>	<u>60</u>	<u>90</u>	<u>120</u>	<u>60</u>	<u>90</u>	<u>120</u>		
<u>LF</u>	<u>LF</u>	<u>LF</u>	<u>LF</u>	<u>LF</u>	<u>LF</u>	<u>LF</u>	<u>LF</u>	<u>LF</u>	<u>LF</u>	<u>LF</u>	<u>LF</u>	<u>LF</u>	<u>LF</u>	<u>LF</u>	<u>LF</u>	<u>LF</u>	<u>LF</u>		
<u>50</u>	<u>100</u>	<u>100</u>	<u>50</u>	<u>100</u>	<u>100</u>	<u>50</u>	<u>100</u>	<u>100</u>	<u>50</u>	<u>100</u>	<u>100</u>	<u>50</u>	<u>100</u>	<u>100</u>	<u>50</u>	<u>100</u>	<u>100</u>		
<u>8</u>	<u>58</u>	<u>54</u>	<u>53</u>	<u>56</u>	<u>48</u>	<u>46</u>	<u>53</u>	<u>42</u>	<u>39</u>	<u>45</u>	<u>42</u>	<u>41</u>	<u>43</u>	<u>37</u>	<u>36</u>	<u>41</u>	<u>32</u>	<u>30</u>	<u>8</u>
<u>6</u>	<u>77</u>	<u>71</u>	<u>69</u>	<u>74</u>	<u>63</u>	<u>60</u>	<u>70</u>	<u>54</u>	<u>51</u>	<u>60</u>	<u>55</u>	<u>54</u>	<u>57</u>	<u>49</u>	<u>47</u>	<u>54</u>	<u>42</u>	<u>39</u>	<u>6</u>
<u>4</u>	<u>101</u>	<u>93</u>	<u>91</u>	<u>96</u>	<u>81</u>	<u>77</u>	<u>91</u>	<u>69</u>	<u>65</u>	<u>78</u>	<u>72</u>	<u>71</u>	<u>75</u>	<u>63</u>	<u>60</u>	<u>71</u>	<u>54</u>	<u>51</u>	<u>4</u>
<u>2</u>	<u>132</u>	<u>121</u>	<u>118</u>	<u>126</u>	<u>105</u>	<u>100</u>	<u>119</u>	<u>89</u>	<u>83</u>	<u>103</u>	<u>94</u>	<u>92</u>	<u>98</u>	<u>82</u>	<u>78</u>	<u>92</u>	<u>70</u>	<u>65</u>	<u>2</u>
<u>1</u>	<u>154</u>	<u>140</u>	<u>136</u>	<u>146</u>	<u>121</u>	<u>114</u>	<u>137</u>	<u>102</u>	<u>95</u>	<u>120</u>	<u>109</u>	<u>106</u>	<u>114</u>	<u>94</u>	<u>89</u>	<u>107</u>	<u>79</u>	<u>74</u>	<u>1</u>
<u>1/0</u>	<u>177</u>	<u>160</u>	<u>156</u>	<u>168</u>	<u>137</u>	<u>130</u>	<u>157</u>	<u>116</u>	<u>107</u>	<u>138</u>	<u>125</u>	<u>122</u>	<u>131</u>	<u>107</u>	<u>101</u>	<u>122</u>	<u>90</u>	<u>84</u>	<u>1/0</u>
<u>2/0</u>	<u>203</u>	<u>183</u>	<u>178</u>	<u>192</u>	<u>156</u>	<u>147</u>	<u>179</u>	<u>131</u>	<u>121</u>	<u>158</u>	<u>143</u>	<u>139</u>	<u>150</u>	<u>122</u>	<u>115</u>	<u>140</u>	<u>102</u>	<u>95</u>	<u>2/0</u>
<u>3/0</u>	<u>233</u>	<u>210</u>	<u>204</u>	<u>221</u>	<u>178</u>	<u>158</u>	<u>205</u>	<u>148</u>	<u>137</u>	<u>182</u>	<u>164</u>	<u>159</u>	<u>172</u>	<u>139</u>	<u>131</u>	<u>160</u>	<u>116</u>	<u>107</u>	<u>3/0</u>
<u>4/0</u>	<u>268</u>	<u>240</u>	<u>232</u>	<u>253</u>	<u>202</u>	<u>190</u>	<u>234</u>	<u>168</u>	<u>155</u>	<u>209</u>	<u>187</u>	<u>182</u>	<u>198</u>	<u>158</u>	<u>149</u>	<u>183</u>	<u>131</u>	<u>121</u>	<u>4/0</u>
<u>250</u>	<u>297</u>	<u>265</u>	<u>256</u>	<u>280</u>	<u>222</u>	<u>209</u>	<u>258</u>	<u>184</u>	<u>169</u>	<u>233</u>	<u>207</u>	<u>201</u>	<u>219</u>	<u>174</u>	<u>163</u>	<u>202</u>	<u>144</u>	<u>132</u>	<u>250</u>
<u>350</u>	<u>363</u>	<u>321</u>	<u>310</u>	<u>340</u>	<u>267</u>	<u>250</u>	<u>312</u>	<u>219</u>	<u>202</u>	<u>285</u>	<u>252</u>	<u>244</u>	<u>267</u>	<u>209</u>	<u>196</u>	<u>245</u>	<u>172</u>	<u>158</u>	<u>350</u>
<u>500</u>	<u>444</u>	<u>389</u>	<u>375</u>	<u>414</u>	<u>320</u>	<u>299</u>	<u>377</u>	<u>261</u>	<u>240</u>	<u>352</u>	<u>308</u>	<u>297</u>	<u>328</u>	<u>254</u>	<u>237</u>	<u>299</u>	<u>207</u>	<u>190</u>	<u>500</u>
<u>750</u>	<u>552</u>	<u>478</u>	<u>459</u>	<u>511</u>	<u>388</u>	<u>362</u>	<u>462</u>	<u>314</u>	<u>288</u>	<u>446</u>	<u>386</u>	<u>372</u>	<u>413</u>	<u>314</u>	<u>293</u>	<u>374</u>	<u>254</u>	<u>233</u>	<u>750</u>
<u>1000</u>	<u>628</u>	<u>539</u>	<u>518</u>	<u>579</u>	<u>435</u>	<u>405</u>	<u>522</u>	<u>351</u>	<u>321</u>	<u>521</u>	<u>447</u>	<u>430</u>	<u>480</u>	<u>361</u>	<u>336</u>	<u>433</u>	<u>291</u>	<u>266</u>	<u>1000</u>
<u>Ambient Temp.</u>																			<u>Ambient Te</u>
<u>Correction Factors</u>																			
<u>(°C)</u>																			<u>(°F)</u>
<u>6–10</u>	<u>1.09</u>			<u>1.09</u>			<u>1.09</u>			<u>1.09</u>			<u>1.09</u>			<u>1.09</u>			<u>43–50</u>
<u>11–15</u>	<u>1.04</u>			<u>1.04</u>			<u>1.04</u>			<u>1.04</u>			<u>1.04</u>			<u>1.04</u>			<u>52–59</u>
<u>16–20</u>	<u>1.00</u>			<u>1.00</u>			<u>1.00</u>			<u>1.00</u>			<u>1.00</u>			<u>1.00</u>			<u>61–68</u>
<u>21–25</u>	<u>0.95</u>			<u>0.95</u>			<u>0.95</u>			<u>0.95</u>			<u>0.95</u>			<u>0.95</u>			<u>70–77</u>
<u>26–30</u>	<u>0.90</u>			<u>0.90</u>			<u>0.90</u>			<u>0.90</u>			<u>0.90</u>			<u>0.90</u>			<u>79–86</u>

Table B.310.15(B)(2)(7) Ampacities of Three Single Insulated Conductors, Rated 0 Through 2000 Volts, in Underground Electrical Ducts (Three Conductors per Electrical Duct) Based on Ambient Earth Temperature of 20°C (68°F), Electrical Duct Arrangement in Accordance with Figure B.310.15(B)(2)(2), Conductor Temperature 75°C (167°F)

<u>1 Electrical Duct</u>	<u>3 Electrical Ducts</u>	<u>6 Electrical Ducts</u>	<u>1 Electrical Duct</u>	<u>3 Electrical Ducts</u>	<u>6 Electrical Ducts</u>

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[Fig.]	[Fig.]	[Fig.]	[Fig.]	[Fig.]	[Fig.]
B.310.15(B) (2)(2),	B.310.15(B) (2)(2),	B.310.15(B) (2)(2),	B.310.15(B) (2)(2),	B.310.15(B) (2)(2),	B.310.15(B) (2)(2),
Detail 1]	Detail 2]	Detail 3]	Detail 1]	Detail 2]	Detail 3]

Size (<u>AWG</u> or <u>kcmil</u>)	<u>Types RHW,</u>	<u>Types RHW,</u>	<u>Types RHW,</u>	<u>Types RHW,</u>	<u>Types RHW,</u>	<u>Types RHW,</u>	Size (<u>AWG</u> or <u>kcmil</u>)
	<u>THHW,</u>	<u>THHW,</u>	<u>THHW,</u>	<u>THHW,</u>	<u>THHW,</u>	<u>THHW,</u>	
	<u>THW,</u>	<u>THW,</u>	<u>THW,</u>	<u>THW,</u>	<u>THW,</u>	<u>THW,</u>	
	<u>THWN,</u>	<u>THWN,</u>	<u>THWN,</u>	<u>THWN,</u>	<u>THWN,</u>	<u>THWN,</u>	
	<u>XHHW, USE</u>	<u>XHHW, USE</u>	<u>XHHW, USE</u>	<u>XHHW, USE</u>	<u>XHHW, USE</u>	<u>XHHW, USE</u>	
	<u>COPPER</u>			<u>ALUMINUM OR COPPER-CLAD</u> <u>ALUMINUM</u>			

RHO RHO RHO	RHO RHO RHO	RHO RHO RHO	RHO RHO RHO	RHO RHO RHO	RHO RHO RHO	RHO RHO RHO
---	---	---	---	---	---	---

60 90 120	60 90 120	60 90 120	60 90 120	60 90 120	60 90 120
---	---	---	---	---	---

LF LF LF	LF LF LF	LF LF LF	LF LF LF	LF LF LF	LF LF LF	LF LF LF
--	--	--	--	--	--	--

50 100 100	50 100 100	50 100 100	50 100 100	50 100 100	50 100 100	50 100 100
--	--	--	--	--	--	--

8	63 58 57	61 51 49	57 44 41	49 45 44	47 40 38	45 34 32	8
6	84 77 75	80 67 63	75 56 53	66 60 58	63 52 49	59 44 41	6
4	111 100 98	105 86 81	98 73 67	86 78 76	79 67 63	77 57 52	4
3	129 116 113	122 99 94	113 83 77	101 91 89	83 77 73	84 65 60	3
2	147 132 128	139 112 106	129 93 86	115 103 100	108 87 82	101 73 67	2
1	171 153 148	161 128 121	149 106 98	133 119 115	126 100 94	116 83 77	1
1/0	197 175 169	185 146 137	170 121 111	153 136 132	144 114 107	133 94 87	1/0
2/0	226 200 193	212 166 156	194 136 126	176 156 151	165 130 121	151 106 98	2/0
3/0	260 228 220	243 189 177	222 154 142	203 178 172	189 147 138	173 121 111	3/0
4/0	301 263 253	280 215 201	255 175 161	235 205 198	219 168 157	199 137 126	4/0
250	334 290 279	310 236 220	281 192 176	261 227 218	242 185 172	220 150 137	250
300	373 321 308	344 260 242	310 210 192	293 252 242	272 204 190	245 165 151	300
350	409 351 337	377 283 264	340 228 209	321 276 265	296 222 207	266 179 164	350
400	442 376 361	394 302 280	368 243 223	349 297 284	321 238 220	288 191 174	400
500	503 427 409	460 341 316	412 273 249	397 338 323	364 270 250	326 216 197	500
600	552 468 447	511 371 343	457 296 270	446 373 356	408 296 274	365 236 215	600
700	602 509 486	553 402 371	492 319 291	488 408 389	443 321 297	394 255 232	700
750	632 529 505	574 417 385	509 330 301	508 425 405	461 334 309	409 265 241	750
800	654 544 520	597 428 395	527 338 308	530 439 418	481 344 318	427 273 247	800
900	692 575 549	628 450 415	554 355 323	563 466 444	510 365 337	450 288 261	900
1000	730 605 576	659 472 435	581 372 338	597 494 471	538 385 355	475 304 276	1000

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<u>Ambient Temp.</u>	<u>Correction Factors</u>						<u>Ambient Te</u>
<u>(°C)</u>							<u>(°F)</u>
<u>6–10</u>	<u>1.09</u>	<u>1.09</u>	<u>1.09</u>	<u>1.09</u>	<u>1.09</u>	<u>1.09</u>	<u>43–50</u>
<u>11–15</u>	<u>1.04</u>	<u>1.04</u>	<u>1.04</u>	<u>1.04</u>	<u>1.04</u>	<u>1.04</u>	<u>52–59</u>
<u>16–20</u>	<u>1.00</u>	<u>1.00</u>	<u>1.00</u>	<u>1.00</u>	<u>1.00</u>	<u>1.00</u>	<u>61–68</u>
<u>21–25</u>	<u>0.95</u>	<u>0.95</u>	<u>0.95</u>	<u>0.95</u>	<u>0.95</u>	<u>0.95</u>	<u>70–77</u>
<u>26–30</u>	<u>0.90</u>	<u>0.90</u>	<u>0.90</u>	<u>0.90</u>	<u>0.90</u>	<u>0.90</u>	<u>79–86</u>

Table B.310.15(B)(2)(8) Ampacities of Two or Three Insulated Conductors, Rated 0 Through 2000 Volts, Cabled Within an Overall (Two- or Three-Conductor) Covering, Directly Buried in Earth, Based on Ambient Earth Temperature of 20°C (68°F), Electrical Duct Arrangement in Accordance with Figure B.310.15(B)(2)(2), 100 Percent Load Factor, Thermal Resistance (Rho) of 90

Size (AWG or kcmil)	1 Cable		2 Cables		1 Cable		2 Cables		Size (AWG or kcmil)
	[Fig. B.310.15(B) (2)(2),		[Fig. B.310.15(B) (2)(2),		[Fig. B.310.15(B) (2)(2),		[Fig. B.310.15(B) (2)(2),		
	Detail 5]		Detail 6]		Detail 5]		Detail 6]		
	60°C	75°C	60°C	75°C	60°C	75°C	60°C	75°C	
	(140°F)	(167°F)	(140°F)	(167°F)	(140°F)	(167°F)	(140°F)	(167°F)	
	TYPES				TYPES				
	UF	RHW, THHW, THW, THWN, XHHW, USE	UF	RHW, THHW, THW, THWN, XHHW, USE	UF	RHW, THHW, THW, THWN, XHHW, USE	UF	RHW, THHW, THW, THWN, XHHW, USE	
COPPER				ALUMINUM OR COPPER-CLAD ALUMINUM					
8	64	75	60	70	51	59	47	55	8
6	85	100	81	95	68	75	60	70	6
4	107	125	100	117	83	97	78	91	4
2	137	161	128	150	107	126	110	117	2
1	155	182	145	170	121	142	113	132	1
1/0	177	208	165	193	138	162	129	151	1/0
2/0	201	236	188	220	157	184	146	171	2/0
3/0	229	269	213	250	179	210	166	195	3/0
4/0	259	304	241	282	203	238	188	220	4/0
250	—	333	—	308	—	261	—	241	250
350	—	401	—	370	—	315	—	290	350
500	—	481	—	442	—	381	—	350	500
750	—	585	—	535	—	473	—	433	750
1000	—	657	—	600	—	545	—	497	1000
Ambient Temp.	Correction Factors								Ambient Temp.

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(°C)									(°F)
6–10	1.12	1.09	1.12	1.09	1.12	1.09	1.12	1.09	43–50
11–15	1.06	1.04	1.06	1.04	1.06	1.04	1.06	1.04	52–59
16–20	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	61–68
21–25	0.94	0.95	0.94	0.95	0.94	0.95	0.94	0.95	70–77
26–30	0.87	0.90	0.87	0.90	0.87	0.90	0.87	0.90	79–86

Note: For ampacities of Type UF cable in underground electrical ducts, multiply the ampacities shown in the table by 0.74.

Table B.310.15(B)(2)(9) Ampacities of Three Triplexed Single Insulated Conductors, Rated 0 Through 2000 Volts, Directly Buried in Earth Based on Ambient Earth Temperature of 20°C (68°F), Electrical Duct Arrangement in Accordance with Figure B.310.15(B)(2)(2), 100 Percent Load Factor, Thermal Resistance (Rho) of 90

Size (AWG or kcmil)	See Fig. B.310.15(B)(2)(2).		See Fig. B.310.15(B)(2)(2).		See Fig. B.310.15(B)(2)(2).		See Fig. B.310.15(B)(2)(2).		Size (AWG or kcmil)
	Detail 7		Detail 8		Detail 7		Detail 8		
	60°C	75°C	60°C	75°C	60°C	75°C	60°C	75°C	
	(140°F)	(167°F)	(140°F)	(167°F)	(140°F)	(167°F)	(140°F)	(167°F)	
	TYPES				TYPES				
	UF	USE	UF	USE	UF	USE	UF	USE	
	COPPER				ALUMINUM OR COPPER-CLAD ALUMINUM				
8	72	84	66	77	55	65	51	60	8
6	91	107	84	99	72	84	66	77	6
4	119	139	109	128	92	108	85	100	4
2	153	179	140	164	119	139	109	128	2
1	173	203	159	186	135	158	124	145	1
1/0	197	231	181	212	154	180	141	165	1/0
2/0	223	262	205	240	175	205	159	187	2/0
3/0	254	298	232	272	199	233	181	212	3/0
4/0	289	339	263	308	226	265	206	241	4/0
250	—	370	—	336	—	289	—	263	250
350	—	445	—	403	—	349	—	316	350
500	—	536	—	483	—	424	—	382	500
750	—	654	—	587	—	525	—	471	750
1000	—	744	—	665	—	608	—	544	1000
Ambient Temp. (°C)	Correction Factors								Ambient Temp. (°F)
6–10	1.12	1.09	1.12	1.09	1.12	1.09	1.12	1.09	43–50
11–15	1.06	1.04	1.06	1.04	1.06	1.04	1.06	1.04	52–59
16–20	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	61–68
21–25	0.94	0.95	0.94	0.95	0.94	0.95	0.94	0.95	70–77
26–30	0.87	0.90	0.87	0.90	0.87	0.90	0.87	0.90	79–86

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Table B.310.15(B)(2)(10) Ampacities of Three Single Insulated Conductors, Rated 0 Through 2000 Volts, Directly Buried in Earth Based on Ambient Earth Temperature of 20°C (68°F), Electrical Duct Arrangement in Accordance with Figure B.310.15(B)(2)(2), 100 Percent Load Factor, Thermal Resistance (Rho) of 90

Size (AWG or kcmil)	See Fig. B.310.15(B)(2)(2).		See Fig. B.310.15(B)(2)(2).		See Fig. B.310.15(B)(2)(2).		See Fig. B.310.15(B)(2)(2).		Size (AWG or kcmil)
	Detail 9		Detail 10		Detail 9		Detail 10		
	60°C	75°C	60°C	75°C	60°C	75°C	60°C	75°C	
	(140°F)	(167°F)	(140°F)	(167°F)	(140°F)	(167°F)	(140°F)	(167°F)	
	TYPES				TYPES				
	UF	USE	UF	USE	UF	USE	UF	USE	
	COPPER				ALUMINUM OR COPPER-CLAD ALUMINUM				
8	84	98	78	92	66	77	61	72	8
6	107	126	101	118	84	98	78	92	6
4	139	163	130	152	108	127	101	118	4
2	178	209	165	194	139	163	129	151	2
1	201	236	187	219	157	184	146	171	1
1/0	230	270	212	249	179	210	165	194	1/0
2/0	261	306	241	283	204	239	188	220	2/0
3/0	297	348	274	321	232	272	213	250	3/0
4/0	336	394	309	362	262	307	241	283	4/0
250	=	429	=	394	=	335	=	308	250
350	=	516	=	474	=	403	=	370	350
500	=	626	=	572	=	490	=	448	500
750	=	767	=	700	=	605	=	552	750
1000	=	887	=	808	=	706	=	642	1000
1250	=	979	=	891	=	787	=	716	1250
1500	=	1063	=	965	=	862	=	783	1500
1750	=	1133	=	1027	=	930	=	843	1750
2000	=	1195	=	1082	=	990	=	897	2000
Ambient Temp. (°C)	Correction Factors								Ambient Temp. (°F)
6–10	1.12	1.09	1.12	1.09	1.12	1.09	1.12	1.09	43–50
11–15	1.06	1.04	1.06	1.04	1.06	1.04	1.06	1.04	52–59
16–20	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	61–68
21–25	0.94	0.95	0.94	0.95	0.94	0.95	0.94	0.95	70–77
26–30	0.87	0.90	0.87	0.90	0.87	0.90	0.87	0.90	79–86

Table B.310.15(B)(2)(11) Adjustment Factors for More Than Three Current-Carrying Conductors in a Raceway or Cable with Load Diversity

<u>Number of Conductors*</u>	<u>Percent of Values in Tables as Adjusted for Ambient Temperature if Necessary</u>
<u>4–6</u>	<u>80</u>
<u>7–9</u>	<u>70</u>
<u>10–24</u>	<u>70**</u>

<u>Number of Conductors*</u>	<u>Percent of Values in Tables as Adjusted for Ambient Temperature if Necessary</u>
25–42	60**
43–85	50**

*Number of conductors is the total number of conductors in the raceway or cable adjusted in accordance with 310.15(B)(4) and (5).

**These factors include the effects of a load diversity of 50 percent.

Informational Note: The ampacity limit for 10 through 85 current-carrying conductors is based on the following equation. For more than 85 conductors, special calculations are required that are beyond the scope of this table.

$$A_2 = \left[\sqrt{\frac{0.5N}{E}} \times (A_1) \right] \text{ or } A_1, \text{ whichever is less} \quad [\text{B.310.15(B)(7)}]$$

where:

A_1 = ampacity from Table 310.15(B)(16), Table 310.15(B)(18), Table B.310.15(B)(2)(1), Table B.310.15(B)(2)(6), or Table B.310.15(B)(2)(7) multiplied by the appropriate adjustment factor from Table B.310.15(B)(2)(11).

N = total number of conductors used to select adjustment factor from Table B.310.15(B)(2)(11)

E = number of conductors carrying current simultaneously in the raceway or cable

A_2 = ampacity limit for the current-carrying conductors in the raceway or cable

Example 1

Calculate the ampacity limit for twelve 14 AWG THWN current-carrying conductors (75°C) in a raceway that contains 24 conductors that may, at different times, be current-carrying.

$$\begin{aligned} A_2 &= \sqrt{\frac{(0.5)(24)}{12}} \times 20(0.7) \\ &= 14 \text{ amperes (i.e., 50 percent diversity)} \end{aligned} \quad [\text{B.310.15(B)(7)}]$$

Example 2

Calculate the ampacity limit for eighteen 14 AWG THWN current-carrying conductors (75°C) in a raceway that contains 24 conductors that may, at different times, be current-carrying.

$$A_2 = \sqrt{\frac{(0.5)(24)}{18}} \times 20(0.7) = 11.5 \text{ amperes} \quad [\text{B.310.15(B)(7)}]$$

Figure B.310.15(B)(2)(1). Interpolation Chart for Cables in a Duct Bank. I_1 = ampacity for $Rho = 60$, 50 LF; I_2 = ampacity for $Rho = 120$, 100 LF (load factor); desired ampacity = $F \times I_1$.

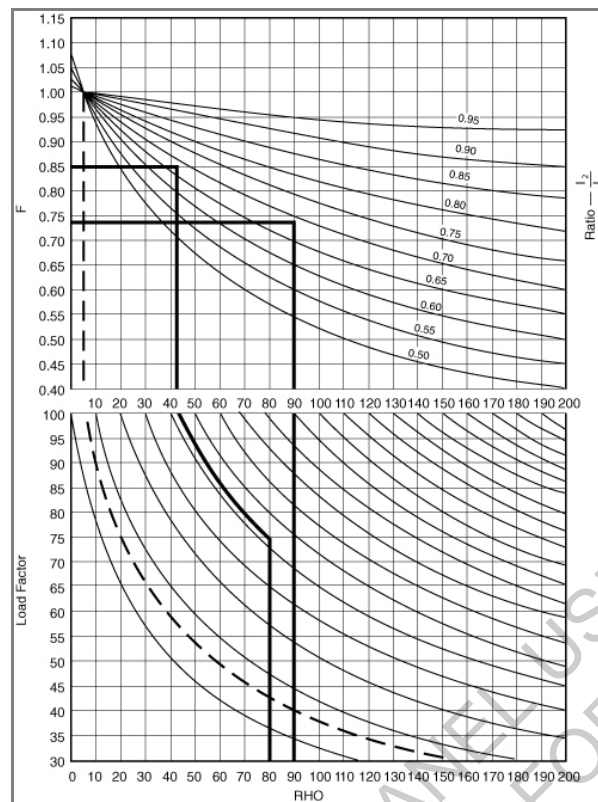


Figure B.310.15(B)(2)(2) Cable Installation Dimensions for Use with Table B.310.15(B)(2)(5) Through Table B.310.15(B)(2)(10).

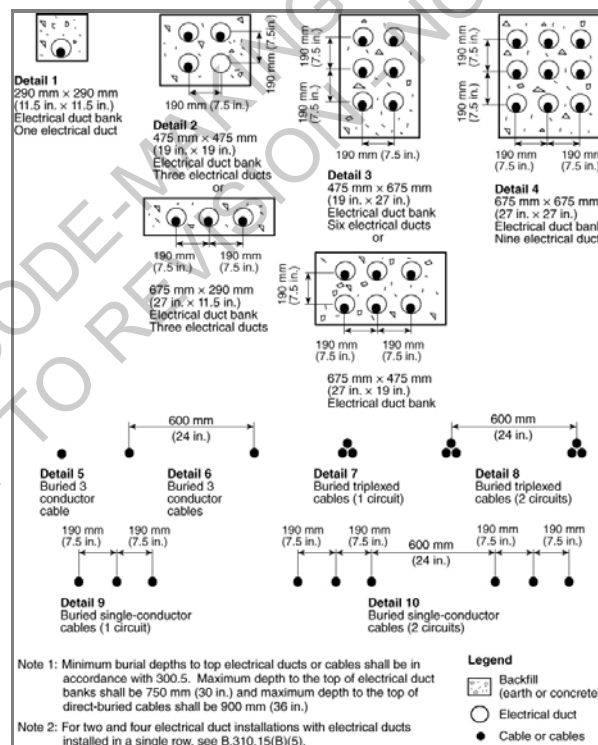


Figure Informational Note Figure B.310.15(B)(2)(3) Ampacities of Single Insulated Conductors Rated 0 Through 5000 Volts in Underground Electrical Ducts (Three Conductors per Electrical Duct), Nine Single-Conductor Cables per Phase Based on Ambient Earth Temperature of 20°C (68°F), Conductor Temperature 75°C (167°F).

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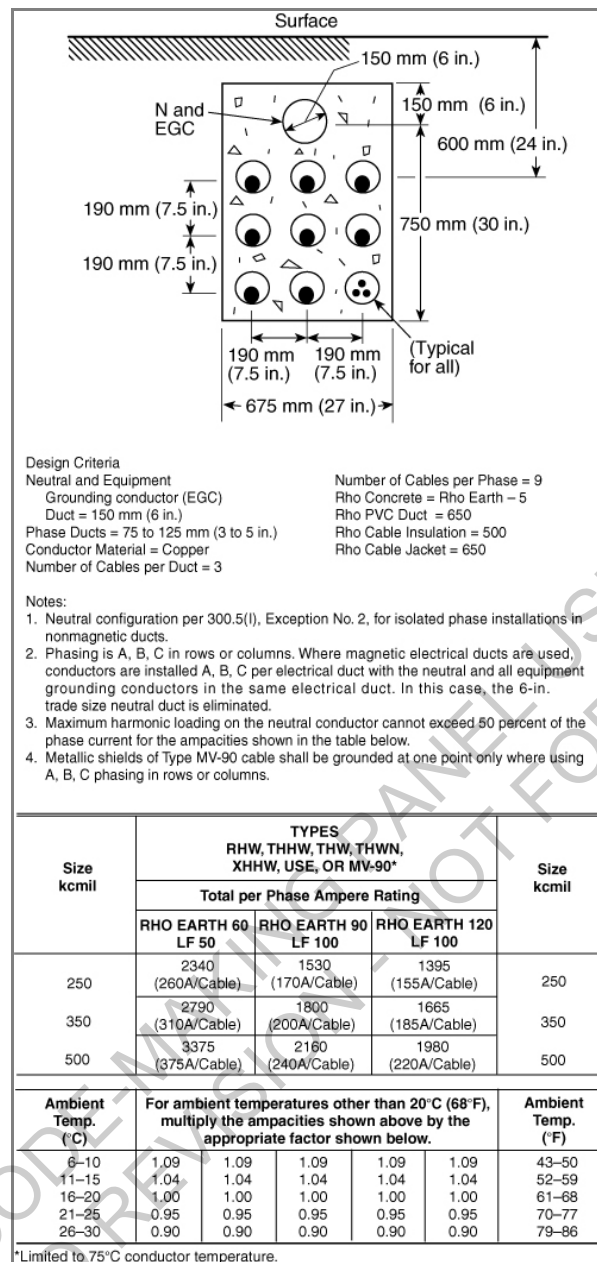


Figure Informational Note Figure B.310.15(B)(2)(4) Ampacities of Single Insulated Conductors Rated 0 Through 5000 Volts in Nonmagnetic Underground Electrical Ducts (One Conductor per Electrical Duct), Four Single-Conductor Cables per Phase Based on Ambient Earth Temperature of 20°C (68°F), Conductor Temperature 75°C (167°F).

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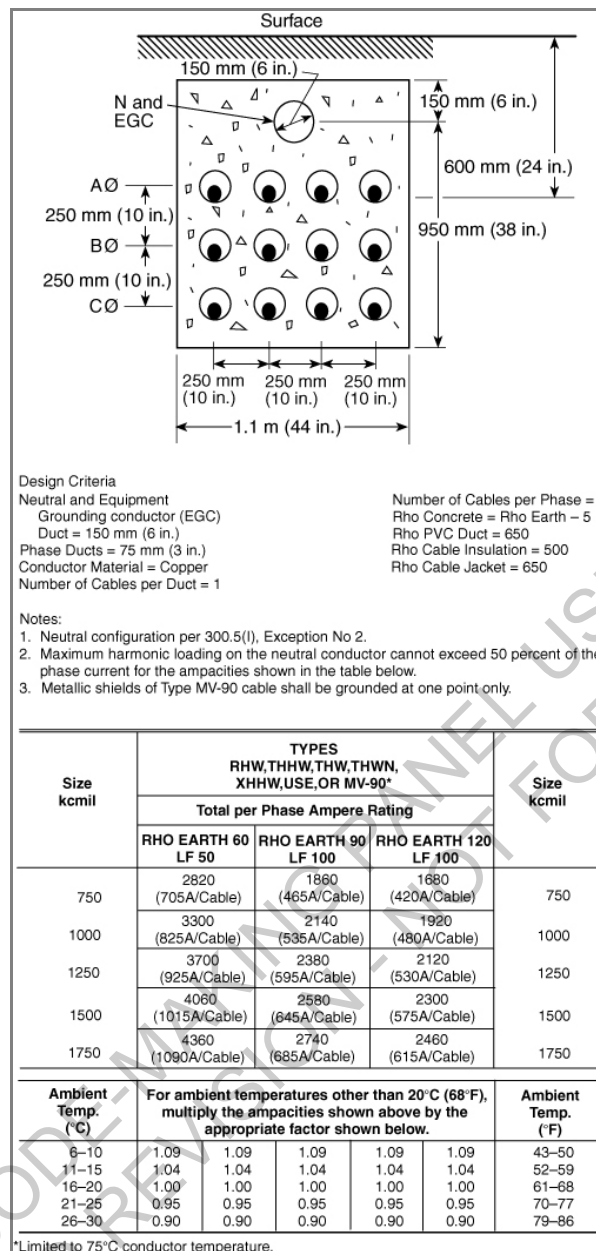
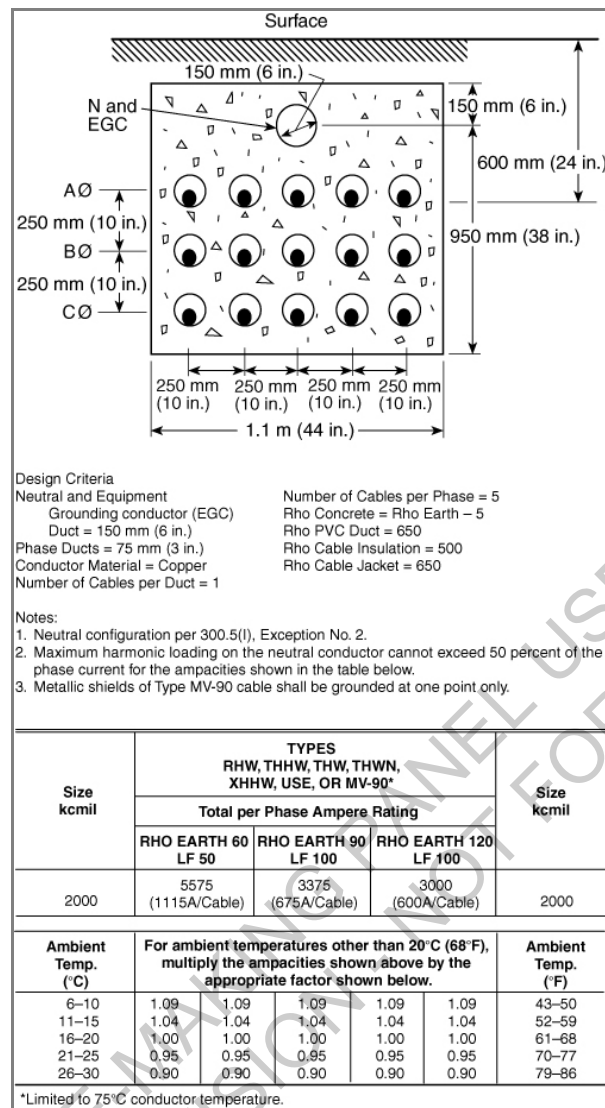


Figure Informational Note Figure B.310.15(B)(2)(5) Ampacities of Single Insulated Conductors Rated 0 Through 5000 Volts in Nonmagnetic Underground Electrical Ducts (One Conductor per Electrical Duct), Five Single-Conductor Cables per Phase Based on Ambient Earth Temperature of 20°C (68°F), Conductor Temperature 75°C (167°F).

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Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 06

Organization: [Not Specified]

Street Address:

City:

State:

Zip:

Submittal Date: Thu Jan 11 13:47:22 EST 2018

Committee Statement and Meeting Notes

Committee Statement: The dates were removed to reflect current editions. The reference in B.4 was updated to reflect the new Article 311.

Response Message:[Public Input No. 365-NFPA 70-2017 \[Annex B\]](#)

Editorial Comment

WORKING DRAFT OF CMP MEETING OUTPUT - NATIONAL ELECTRICAL CODE - NFPA 70
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SUBJECT TO REVISION - NOT FOR PUBLICATION

**First Revision No. 7860-NFPA 70-2018 [Definition: Copper-Clad Aluminum****Conductors.]****100. Copper-Clad Aluminum Conductors.**

Conductors drawn from a copper-clad aluminum rod, with the copper metallurgically bonded to an aluminum core, where the copper forms a minimum of 10 percent of the cross-sectional area of a solid conductor or each strand of a stranded conductor. _ (CMP-6)

Submitter Information Verification**Submitter Full Name:** NEC-CMP Panel 06**Organization:** [Not Specified]**Street Address:****City:****State:****Zip:****Submittal Date:** Wed Jan 10 16:27:18 EST 2018

Make Editorial Changes
Based on Committee
Text

Committee Statement and Meeting Notes

Committee Statement: Section 2.3.2.1 of the NFPA Manual of style states that definitions shall only describe the term being used and section 2.3.2.3 states that definitions shall not contain requirements. The present definition contains a requirement that the copper-clad aluminum have a minimum 10 percent of the cross-sectional area being copper.

Response Message:

Public Input No. 2110-NFPA 70-2017 [Definition: Copper-Clad Aluminum Conductors.]



First Revision No. 7971-NFPA 70-2018 [Definition: Example D7 Sizing of Service

Conductors for Dwe...]

Example D7 Sizing of Service Conductors for Dwelling(s)

Service conductors and feeders for certain dwellings are permitted to be sized in accordance with 310.15(B)(7) 12.

With No Required Adjustment or Correction Factors. If a 175-ampere service rating is selected, a service conductor is then sized as follows:

$$175 \text{ amperes} \times 0.83 = 145.25 \text{ amperes per } 310.15(B)(7) 12.$$

If no other adjustments or corrections are required for the installation, then, in accordance with Table 310.15(B)(16), a 1/0 AWG Cu or a 3/0 AWG Al meets this rating at 75°C (167°F).

With Required Temperature Correction Factor.

If a 175-ampere service rating is selected, a service conductor is then

$$175 \text{ amperes} \times 0.83 = 145.25 \text{ amperes per } 310.15(B)(7) 12.$$

If the conductors are installed in an ambient temperature of 40°C–38°C (104°F–100°F), the conductor ampacity must be multiplied by the appropriate correction factor in Table 310.15(B)(2)(a). In this case, we will use an XHHW-2 conductor, so we use a correction factor of 0.91 to find the minimum conductor ampacity and size:

$$145.25/0.91 = 159.6 \text{ amperes}$$

In accordance with Table 310.15(B)(16), a 2/0 AWG Cu or a 4/0 AWG Al would be required.

If no temperature correction or ampacity adjustment factors are required, the following table includes conductor sizes calculated using the requirements in 310.15(B)(7) 12. This table is based on 75°C terminations and without any adjustment or correction factors.

<u>Service or Feeder Rating (Amperes)</u>	<u>Conductor (AWG or kcmil)</u>	
	<u>Copper</u>	<u>Aluminum or Copper-Clad Aluminum</u>
100	4	2
110	3	1
125	2	1/0
150	1	2/0
175	1/0	3/0
200	2/0	4/0
225	3/0	250
250	4/0	300
300	250	350
350	350	500
400	400	600

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 06

Organization: [Not Specified]

Street Address:

City:

State:

Zip:

Make Editorial Changes
Based on Committee Text

Submittal Date: Thu Jan 11 13:57:40 EST 2018**Committee Statement and Meeting Notes**

Committee Statement: The table references were updated to align with the reorganization of Article 310. The ambient temperature value was changed to avoid confusion with table headings.

Response Message:

FOR CODE-MAKING PANEL USE ONLY
SUBJECT TO REVISION - NOT FOR PUBLICATION

**First Revision No. 8036-NFPA 70-2018 [Global Input]**

****Insert New Article 337 Per Attached Word Doc****

Supplemental Information

<u>File Name</u>	<u>Description</u>	<u>Approved</u>
New_Article_337.docx	New Article 337	✓

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 06

Organization: [Not Specified]

Street Address:

City:

State:

Zip:

Submittal Date: Fri Jan 12 00:36:35 EST 2018

Make Editorial Changes
Based on Committee
Text

Committee Statement and Meeting Notes

Committee Statement: Type P (IEEE-1580/UL-1309) Marine Shipboard Cable is flexible and rugged and is highly suitable for petrochemical applications and oil and gas well drilling land based rigs because of its ability to resist various chemicals, abrasives, and petroleum based additives as well as its ability to resist damage from vibration, shaking, and movement that occurs in many processes have a long successful history of more than 4 decades in installations in the most adverse conditions.

They are particularly applicable to land based oil and gas well drilling where units are often "rigged down" and transported and where rigid conduit and Type MC-HL cables are not suitable.

These cables are also available with a metallic basket-weave braided armor that effectively enhances their durability, and for use in Division 1 and Zone 1 applications.

Based on cable performance and requirements for some land based operations, this cable type has been proposed to be added to the 2020 NEC for hazardous area applications.

**Response
Message:**

Public Input No. 4309-NFPA 70-2017 [New Article after 336]

ARTICLE 337
Type P

Part I. General

337.1 Scope.

This article covers the use, installation, and construction specifications for 600 V Type P cable (armored and unarmored), for use in hazardous (classified) locations as permitted in this Code.

337.2 Definition.

The definition in this section shall apply within this article and throughout the code.

Type P.

A factory assembly of two or more insulated flexible tinned copper conductors, with associated bare or covered grounding conductors, impervious sheath, braided metallic armored or unarmored cable. See Part III.

337.6 Listing Requirements.

Type P cables and associated fittings shall be listed.

Part II. Installation

337.10 Uses Permitted. In industrial locations under engineering supervision where the conditions of maintenance and supervision ensure that only qualified persons service the installation, Type P cable shall be permitted for use in hazardous (classified) location and to transition between hazardous (classified) location and a non-hazardous (classified) location as follows:

- (1) For services, feeders, and branch circuits.
- (2) For power, lighting, control, and signal circuits
- (3) Indoors
- (4) Outdoors where identified for such use.
- (4) Exposed or concealed
- (5) For direct burial where identified for such use.
- (6) In cable tray where identified for such use.
- (7) In any raceway
- (8) In wet locations
- (9) Between a cable tray and the utilization equipment or device(s), provided all of the following apply:
 - a. The cable is installed in industrial establishments where the conditions of maintenance and supervision ensure that only qualified persons service the installation.
 - b. The cable is continuously supported and protected against physical damage using mechanical protection such as struts, angles, or channels.
 - c. The cable is secured at intervals not exceeding 1.4 m (4.5 ft).
 - d. Equipment grounding for the utilization equipment is provided by a- bare equipment grounding conductor within the cable.

Exception to (12): Where not subject to physical damage, Type P shall be permitted to transition between cable trays and between cable trays and utilization equipment or devices for a distance not to exceed 1.8 m (6 ft) without continuous support. The cable shall be mechanically supported where exiting the cable tray to ensure that the minimum bending radius is not exceeded.

337.12 Uses Not Permitted.

Type P cable shall not be installed or used as follows:

- (1) Installed where it will be exposed to physical damage

337.24 Bending Radius.

Bends in Type P cable shall be made such that the cable will not be damaged. The radius of the curve of the inner edge of any bend shall not be less than required in 337.24(A) through (B).

(A) Unarmored Cable.

- (1) Four times the overall diameter for cables 25 mm (1 in.) or less in diameter
- (2) Five times the overall diameter for cables larger than 25 mm (1 in.) but not more than 50 mm (2 in.) in diameter
- (3) Six times the overall diameter for cables larger than 50 mm (2 in.) in diameter

(B) Armored Cable.

- (1) Ten times the external diameter of the metallic armor for cable not more than 19 mm (3/4 in.) in external diameter
- (2) Twelve times the external diameter of the metallic armor for cable more than 19 mm (3/4 in.) in external diameter

337.30 Securing and Supporting.

Type P cable shall be supported and secured by cable ties listed and identified for securement and support; straps, hangers, or similar fittings; or other approved means designed and installed so as not to damage the cable.

(A) Securing. Unless otherwise provided, cables shall be secured at intervals not exceeding 1.4 m (4.5 ft). Cables containing four or fewer conductors sized no larger than 10 AWG shall be secured within 300 mm (12 in.) of every box, cabinet, fitting, or other cable termination. In vertical installations, cables with ungrounded conductors 250 kcmil and larger shall be permitted to be secured at intervals not exceeding 3 m (10 ft.).

(B) Supporting. Unless otherwise provided, cables shall be supported at intervals not exceeding 1.4 m (4.5 ft.). Horizontal runs of Type P cable installed in wooden or metal framing members or similar supporting means shall be considered supported and secured where such support does not exceed 1.4 m (4.5 ft) intervals.

(C) Unsupported Cables. Type P cable shall be permitted to be unsupported and unsecured where the cable complies with any of the following:

- (1) Is fished between access points through concealed spaces in finished buildings or structures and supporting is impractical.
- (2) Is not more than 1.4 m (4.5 ft) in length from the last point of cable support to the point of connection to luminaires or other electrical equipment and the cable and point of connection are within an accessible ceiling.
- (3) Is in lengths not exceeding 900 mm (3 ft) from the last point where it is securely fastened and is used to connect equipment where flexibility is necessary to minimize the transmission of vibration from equipment or to provide flexibility for equipment that requires movement after installation.

337.31 Single Conductors.

Where single-conductor cables are used, the installation shall comply with 300.20.

337.80 Ampacity.

The ampacity of Type P cable shall be determined in accordance with 310.15 for 14 AWG and larger conductors and in accordance with Table 402.5 for 18 AWG and 16 AWG conductors. When installed in cable tray the ampacities shall be determined in accordance with 392.80. The installation shall not exceed the temperature ratings of terminations and equipment.

Part III. Construction Specifications

337.104 Conductors.

Conductors shall be of tinned copper. Conductors shall employ flexible stranding. The minimum conductor size shall be 18 AWG.

337.108 Equipment Grounding Conductor. An equipment grounding conductor complying with 250.122 shall be provided within the cable.

An uninsulated equipment grounding conductor shall be provided in cable marked Type P-HL.

337.112 Insulation.

Insulated conductors shall comply with 337.112(A) or (B).

Insulated conductors in sizes 18 AWG and 16 AWG shall be type FFHH-2 as listed in Table 402.3, Conductors larger than 16 AWG shall be type XHHW or XHHW-2 as listed in Table 310. 4(A)

337.116 Sheath.

The sheath or outer covering shall comply with 337.116(A) or (B).

(A) Armored. An overall nonmetallic jacket impervious to moisture and corrosion-resistant shall be provided over the armor. The armor or metallic covering shall be a braided basket weave type consisting of wire laid closely together, flat and parallel, and forming a basket weave that shall firmly grip the cable. The wire shall be commercial bronze. The armor shall not be used as a current-carrying conductor.

(B) Unarmored. An overall flame-retardant, nonmetallic material impervious to moisture and corrosion resistant shall be provided over the cable core. A metallic sheath or armor as defined in 337.116 shall not be permitted either under or over the nonmetallic jacket. Metallic shield(s) shall be permitted over groups of conductors, under the outer jacket, or both.

337.120 Marking.

Type P cable shall be marked in accordance with 310.8. Armored cable shall be marked as Type P-HL.

**First Revision No. 8030-NFPA 70-2018 [Global Input]**

****Insert New Article 311 Per Attached Word Doc****

****Insert Revised and Reorganized Article 310 Per Attached Word Doc****

****Article 338 will be relocated to Article 311****

Article 311 Medium Voltage Cable**Part I. General**

311.1 Scope. This article covers the use, installation, construction specifications and ampacities for medium voltage conductors and cable, Type MV. These requirements do not apply to conductors that form an integral part of equipment, such as motors, motor controllers, and similar equipment, or to conductors specifically provided for elsewhere in this Code.

311.2 Definitions.

Medium Voltage Cable, Type MV. A single or multiconductor solid dielectric insulated cable rated 2001 volts up to and including 35,000 volts, nominal.

Electrical Ducts. Electrical conduits, or other raceways round in cross section, that are suitable for use underground or embedded in concrete.

Thermal Resistivity. As used in this Code, the heat transfer capability through a substance by conduction.

Informational Note: Thermal resistivity is the reciprocal of thermal conductivity and is designated Rho, which is expressed in the units °C-cm/W.

311.6 Listing Requirements. Type MV cables and associated fittings shall be listed.

Part II. Construction Specifications

311.10 Conductor Constructions and Applications. Type MV cables shall comply with the applicable provisions as follows:

(A) Conductor Application and Insulation. Conductor Application and Insulation Rated 2001 Volts and Higher shall comply with Table 311.10(A).

(B) Thickness of Insulation and Jacket for Nonshielded Insulated Conductors. Thickness of Insulation and Jacket for Nonshielded Solid Dielectric Insulated Conductors Rated 2001 to 5000 Volts shall comply with Table 311.10(B).

(C) Thickness of Insulation for Shielded Insulated Conductors. Thickness of Insulation for Shielded Solid Dielectric Insulated Conductors Rated 2001 to 35,000 Volts shall comply with Table 311.10(C) and the following:

(1) 100 Percent Insulation Level. Cables in this category shall be permitted to be applied where the system is provided with relay protection such that ground faults will be cleared as rapidly as possible but, in any case, within 1 minute. While these cables are applicable to the great majority of cable installations that are on grounded systems, they shall be permitted to be used also on other systems for which the application of cables is acceptable, provided the above clearing requirements are met in completely de-energizing the faulted section.

(2) 133 Percent Insulation Level. This insulation level corresponds to that formerly designated for ungrounded systems. Cables in this category shall be permitted to be applied in situations where the clearing time requirements of the 100 percent level category cannot be met and yet there is adequate assurance that the faulted section will be de-energized in a time not exceeding 1 hour. Also, they shall be permitted to be used in 100 percent insulation level applications where additional insulation is desirable.

(3) 173 Percent Insulation Level. Cables in this category shall be permitted to be applied under all of the following conditions:

- (1) In industrial establishments where the conditions of maintenance and supervision ensure that only

qualified persons service the installation

(2) Where the fault clearing time requirements of the 133 percent level category cannot be met

(3) Where an orderly shutdown is essential to protect equipment and personnel

(4) There is adequate assurance that the faulted section will be de-energized in an orderly shutdown

Also, cables with this insulation thickness shall be permitted to be used in 100 or 133 percent insulation level applications where additional insulation strength is desirable.

INSERT --> Table 311.10(A) Conductor Application and Insulation Rated 2001 Volts and Higher

INSERT --> Table 311.10(B) Thickness of Insulation and Jacket for Nonshielded Solid Dielectric Insulated Conductors Rated 2001 to 5000 Volts

INSERT --> Table 311.10(C) Thickness of Insulation for Shielded Solid Dielectric Insulated Conductors Rated 2001 to 35,000 Volts

311.12 Conductors.

(A) Minimum Size of Conductors. The minimum size of conductors shall be as shown in Table 311.12(A), except as permitted elsewhere in this Code.

INSERT --> Table 311.12(A) Minimum Size of Conductors

(B) Conductor Material. Conductors shall be of aluminum, copper-clad aluminum, or copper unless otherwise specified.

(C) Stranded Conductors. Where installed in raceways, conductors not specifically permitted or required elsewhere in this Code to be solid, shall be stranded.

311.14 Conductor Identification.

Conductors that are intended for use as ungrounded conductors, whether used as a single conductor or in multiconductor cables, shall be finished to be clearly distinguishable from grounded and grounding conductors. Distinguishing markings shall not conflict in any manner with the surface markings required by 311.16(B)(1). Branch-circuit ungrounded conductors shall be identified in accordance with 210.5(C). Feeders shall be identified in accordance with 215.12.

311.16 Marking.

(A) Required Information. All conductors and cables shall be marked to indicate the following information, using the applicable method described in 311.16(B):

- (1) The maximum rated voltage.
- (2) The proper type letter or letters for the type of wire or cable as specified elsewhere in this Code.
- (3) The manufacturer's name, trademark, or other distinctive marking by which the organization responsible for the product can be readily identified.
- (4) The AWG size or circular mil area.

Informational Note: See Conductor Properties, Table 8 of Chapter 9, for conductor area expressed in SI units for conductor sizes specified in AWG or circular mil area.

(B) Method of Marking.

(1) Surface Marking. conductors and cables shall be durably marked on the surface. The AWG size or circular mil area shall be repeated at intervals not exceeding 610 mm (24 in.). All other markings shall be repeated at intervals not exceeding 1.0 m (40 in.).

(2) Marker Tape. Metal-covered multiconductor cables shall employ a marker tape located within the cable and running for its complete length.

(3) Tag Marking. Metal-covered, single-conductor cables shall be marked by means of a printed tag attached to the reel.

(4) Optional Marking of Wire Size. The information required in 310.120(A)(4) shall be permitted to be marked on the surface of the individual insulated conductors for multiconductor Type MC cable.

(C) Optional Markings. All conductors and cables contained in Chapter 3 shall be permitted to be surface marked to indicate special characteristics of the cable materials. These markings include, but are not limited to, markings for limited smoke, sunlight resistant, and so forth.

Part III. Installation

311.30 Installation. Type MV cable shall be installed, terminated, and tested by qualified persons.

Informational Note: Information about accepted industry practices and installation procedures for medium-voltage cable are described in ANSI/NECA/NCSCB 600-2014, Standard for Installing and Maintaining Medium-Voltage Cable and in IEEE 576-2000, Recommended Practice for Installation, Termination, and Testing of Insulated Power Cables as Used in Industrial and Commercial Applications

311.32 Uses Permitted. Type MV cable shall be permitted for use on power systems rated up to and including 35,000 volts, nominal, as follows:

- (1) In wet or dry locations.
- (2) In raceways.
- (3) In cable trays, where identified for the use, in accordance with 392.10, 392.20(B), (C), and (D), 392.22(C), 392.30(B)(1), 392.46, 392.56, and 392.60. Type MV cable that has an overall metallic sheath or armor, complies with the requirements for Type MC cable, and is identified as "MV or MC" shall be permitted to be installed in cable trays in accordance with 392.10(B)(2).
- (4) In messenger-supported wiring in accordance with Part II of Article 396.
- (5) As exposed runs in accordance with 300.37. Type MV cable that has an overall metallic sheath or armor, complies with the requirements for Type MC cable, and is identified as "MV or MC" shall be permitted to be installed as exposed runs of metal-clad cable in accordance with 300.37.
- (6) Corrosive conditions where exposed to oils, greases, vapors, gases, fumes, liquids, or other substances having a deleterious effect on the conductor or insulation shall be of a type suitable for the application.
- (7) Conductors in parallel in accordance with 310.10(H).
- (8) Type MV Cable used where exposed to direct sunlight shall be identified for the use.

Informational Note: The "Uses Permitted" is not an all-inclusive list.

311.36 Direct-Burial Conductors. Type MV cables used for direct burial applications shall be of a type identified for such use and installed in accordance with 300.50.

Cables shall be shielded.

Exception No. 1: Nonshielded multiconductor cables rated 2001– 2400 volts shall be permitted if the cable has an overall metallic sheath or armor.

The metallic shield, sheath, or armor shall be connected to a grounding electrode conductor, grounding busbar, or a grounding electrode.

Exception No. 2: Airfield lighting cable used in series circuits that are rated up to 5000 volts and are powered by regulators shall be permitted to be nonshielded.

Informational Note to Exception No. 2: Federal Aviation Administration (FAA) Advisory Circulars (ACs) provide additional practices and methods for airport lighting.

311.40 Support. Type MV cable terminated in equipment or installed in pull boxes or vaults shall be secured and supported by metallic or nonmetallic supports suitable to withstand the weight by cable ties listed and identified for securement and support, or other approved means, at intervals not exceeding 1.5 m (5 ft) from terminations or a maximum of 1.8 m (6 ft) between supports.

311.44 Shielding. Nonshielded, ozone-resistant insulated conductors with a maximum phase-to-phase voltage of 5000 volts shall be permitted in Type MC cables in industrial establishments where the conditions of maintenance and supervision ensure that only qualified persons service the installation. For other establishments, solid dielectric insulated conductors operated above 2000 volts in permanent installations shall have ozone resistant insulation and shall be shielded. All metallic insulation shields shall be connected to a grounding electrode conductor, a grounding busbar, an equipment grounding conductor, or a grounding electrode.

Informational Note: The primary purposes of shielding are to confine the voltage stresses to the insulation, dissipate insulation leakage current, drain off the capacitive charging current, and carry ground-fault current to facilitate operation of ground-fault protective devices in the event of an electrical cable fault.

Exception No. 1: Nonshielded insulated conductors listed by a qualified testing laboratory shall be permitted for use up to 2400 volts under the following conditions:

- (a) Conductors shall have insulation resistant to electric discharge and surface tracking, or the insulated conductor(s) shall be covered with a material resistant to ozone, electric discharge, and surface tracking.
- (b) Where used in wet locations, the insulated conductor(s) shall have an overall nonmetallic jacket or a

continuous metallic sheath.

(c) Insulation and jacket thicknesses shall be in accordance with Table 311.10(B).

Exception No. 2: Nonshielded insulated conductors listed by a qualified testing laboratory shall be permitted for use up to 5000 volts to replace existing nonshielded conductors, on existing equipment in industrial establishments only, under the following conditions:

(a) Where the condition of maintenance and supervision ensures that only qualified personnel install and service the installation.

(b) Conductors shall have insulation resistant to electric discharge and surface tracking, or the insulated conductor(s) shall be covered with a material resistant to ozone, electric discharge, and surface tracking.

(c) Where used in wet locations, the insulated conductor(s) shall have an overall nonmetallic jacket or a continuous metallic sheath.

(d) Insulation and jacket thicknesses shall be in accordance with Table 311.10(B).

Informational Note: Relocation or replacement of equipment may not comply with the term existing as related to this exception.

Exception No. 3: Where permitted in 311.36, Exception No. 2.

Part IV Ampacities

311.60 Conductors Rated 2001 to 35,000 Volts.

(A) Ampacities of Conductors Rated 2001 to 35,000 Volts. Ampacities for solid dielectric-insulated conductors shall be permitted to be determined by tables or under engineering supervision, as provided in 311.60(B) and (C).

The ampacity of Type MV cable installed in cable tray shall be determined in accordance with 392.80(B).

(1) Selection of Ampacity. Where more than one calculated or tabulated ampacity could apply for a given circuit length, the lowest value shall be used.

Exception: Where two different ampacities apply to adjacent portions of a circuit, the higher ampacity shall be permitted to be used beyond the point of transition, a distance equal to 3.0 m (10 ft) or 10 percent of the circuit length calculated at the higher ampacity, whichever is less.

Informational Note: See 110.40 for conductor temperature limitations due to termination provisions.

(B) Engineering Supervision. Under engineering supervision, conductor ampacities shall be permitted to be calculated by using the following general equation:

INSERT -->

[311.60(B)]

where:

T_c = conductor temperature ($^{\circ}\text{C}$)

T_a = ambient temperature ($^{\circ}\text{C}$)

ΔT_d = dielectric loss temperature rise

R_{dc} = dc resistance of conductor at temperature T_c

Y_c = component ac resistance resulting from skin effect and proximity effect

R_{ca} = effective thermal resistance between conductor and surrounding ambient

Informational Note: The dielectric loss temperature rise (ΔT_d) is negligible for single circuit extruded dielectric cables rated below 46 kV.

(C) Tables. Ampacities for conductors rated 2001 to 35,000 volts shall be as specified in Table 311.60(C)(67) through Table 311.60(C)(86). Ampacities for ambient temperatures other than those specified in the ampacity tables shall be corrected in accordance with 311.60(D)(4).

Informational Note No. 1: For ampacities calculated in accordance with 311.60(A), reference IEEE 835-1994, Standard Power Cable Ampacity Tables, and the references therein for availability of all factors and constants.

Informational Note No. 2: Ampacities provided by this section do not take voltage drop into consideration. See 210.19(A), Informational Note No. 4, for branch circuits and 215.2(A), Informational Note No. 2, for feeders.

(D) Ampacity Adjustment

(1) Grounded Shields. Ampacities shown in Table 311.60(C)(69), Table 311.60(C)(70), Table 311.60(C)(81), and Table 311.60(C)(82) shall apply for cables with shields grounded at one point only. Where shields for these cables are grounded at more than one point, ampacities shall be adjusted to take into consideration the heating due to shield currents.

Informational Note: Tables other than those listed contain the ampacity of cables with shields grounded at multiple points.

(2) Burial Depth. Where the burial depth of direct burial or electrical duct bank circuits is modified from the values shown in a figure or table, ampacities shall be permitted to be modified as indicated in (B)(2)(a) and (B)(2)(b). No ampacity adjustments shall be required where the burial depth is decreased.

(a) Where burial depths are increased in part(s) of an electrical duct run, a decrease in ampacity of the conductors shall not be required, provided the total length of parts of the duct run increased in depth is less than 25 percent of the total run length.

(b) Where burial depths are deeper than shown in a specific underground ampacity table or figure, an ampacity derating factor of 6 percent per 300 mm (1 ft) increase in depth for all values of rho shall be permitted.

(3) Electrical Ducts Entering Equipment Enclosures. At locations where electrical ducts enter equipment enclosures from underground, spacing between such ducts, as shown in Figure 311.60(F)(6), shall be permitted to be reduced without requiring the ampacity of conductors therein to be reduced.

(4) Ambient Temperature Correction. Ampacities for ambient temperatures other than those specified in the ampacity tables shall be corrected in accordance with Table 311.60(D)(4) or shall be permitted to be calculated using the following equation:

INSERT -->

[311.60(D)(4)]

where:

I' = ampacity corrected for ambient temperature

I = ampacity shown in the table for T_c and T_a

T_c = temperature rating of conductor ($^{\circ}\text{C}$)

T_a' = new ambient temperature ($^{\circ}\text{C}$)

T_a = ambient temperature used in the table ($^{\circ}\text{C}$)

INSERT --> Table 311.60(D)(4) Ambient Temperature Correction Factors

(E) Ampacity in Air. Ampacities for conductors and cables rated 2001 to 35,000 volts in air shall be as specified in Table 311.60(C)(67) through Table 311.60(C)(76). Ampacities are based the following:

(1) Conductor Temperatures of 90°C (194°F) and 105°C (221°F)

(2) Ambient Air Temperature of 40°C (104°F)

Informational Note: See 311.60(D)(4) where the ambient air temperature is other than 40°C (104°F).

(F) Ampacity in Underground Electrical Ducts and Direct Buried in Earth. Ampacities for conductors and cables rated 2001 to 35,000 volts in underground electrical ducts and direct buried in earth shall be as specified in Table 311.60(C)(78) through Table 311.60(C)(86). Ampacities are based on the following:

(1) Ambient Earth Temperature of 20°C (68°F)

(2) Arrangement per Figure 310.60(C)(3)

(3) 100 Percent Load Factor

(4) Thermal Resistance (RHO) of 90

(5) Conductor Temperatures 90°C (194°F) and 105°C (221°F)

(6) Arrangement in accordance with Figure 310.60(F)(6)

(7) Minimum burial depths to the top electrical ducts or cables shall be in accordance with 300.50.

(8) Maximum depth to the top of electrical duct banks shall be 750 mm (30 in.) and maximum depth to the top of direct-buried cables shall be 900 mm (36 in.).

INSERT --> Table 311.60(C)(67) Ampacities of Insulated Single Copper Conductor Cables
Triplexed in Air Thru Table 311.60(C)(86) Ampacities of Three Triplexed Single Insulated
Aluminum Conductors Directly Buried in Earth

INSERT --> FIGURE 311.60(F)(6) Cable Installation Dimensions

Supplemental Information

<u>File Name</u>	<u>Description</u>	<u>Approved</u>
NEC-Article_311_Medium_Voltage_Cable.docx	New Article 311	✓
NEC_Article_310_Reorganized_and_Revised.docx	Revised and Reorganized Article 310	✓

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 06

Organization: [Not Specified]

Street Address:

City:

State:

Zip:

Submittal Date: Thu Jan 11 23:37:26 EST 2018

Make Editorial Changes
Based on Committee Text

Committee Statement and Meeting Notes

Committee Statement: Article 311 Substantiation:

In order to consolidate the medium voltage requirements found in Articles 310 and 328, and to improve the usability of the code, the requirements are being combined into a new article 311.

Article 310 Substantiation:

These requirements Article 338 were moved to new Article 311.

The article is reorganized to increase the usability of the article. The ampacity requirements over the years have become increasingly difficult to use making Article 310 more difficult to use.

This reorganization includes moving the MV Cable requirements into a new article which also includes moving the requirements out of Article 328. Text was moved for clarity with redundant text deleted.

New types, first recognized in the 2017 NEC, XHHN, XHWN and XHWN-2 were added to the list of acceptable wire types for dry and damp locations.

New types, first recognized in the 2017 NEC, XHWN and XHWN-2 were added to the list of acceptable wire types for wet locations.

New text allows for the interpolation of ampacities for sizes not found in the ampacity tables under engineering supervision. Informational note was added to use conductor areas in Chapter 9 Table 8. DLO is not a recognized wiring method within the NEC, and therefore will not be added to any ampacity table.

For clarity, added Informational note that ampacity for cords are found in 400.5. Also added note for fixture wire ampacities in 402.5

Provide clarity to the user by removing the term allowable from allowable ampacities based on work done by the Ampacity Task Group.

Clarified that raceways and cables are not required to be installed a minimum distance above a roof.

Corrected reference in exception.

310.15(B)(3)(a)(4)a through c (NEC 2017)

Added XHHN and XHWN, XHWN-2 to ampacity tables based on appropriate temperature rating.

Replaced ampacity with ampere which is the appropriate term to correspond with 240.6(A). Also added "for fuses and inverse time circuit breakers" to provide additional guidance to user.

Added Dwelling Table from Annex D, Example D7 and Note that table shall be permitted if there are no temperature correction or adjustment factors.

Changed column heading from "Trade Name" to "Trade Designation" to more accurately describe the column. Trade designation was used because not all types are insulation.

Added XHWN and XHHN to list of conductor types and requirement that copper-clad aluminum conductors shall use AA-8000 series aluminum. Construction requirements for copper-clad aluminum were moved from the definition in Article 100. The definition that will remain in Article 100 includes metallurgically bonded. Markings are provided for insulated conductors and cable wiring methods and not for the conductor metal. The marking MB is unnecessary since the construction requirements in this code require all copper-clad conductors to be metallurgically bonded.

The revised wording now includes all types of grounding and bonding conductors in 310.6(C).

Article 338 Substantiation:

Relocate Article 338 into Article 311 to improve the usability of the code.

Response

Message:

[Public Input No. 459-NFPA 70-2017 \[Section No. 310.60\(A\)\(1\)\]](#)

[Public Input No. 1308-NFPA 70-2017 \[New Section after 310.15\(A\)\(2\)\]](#)

[Public Input No. 800-NFPA 70-2017 \[Section No. 310.60\(C\)\(4\)\]](#)

[Public Input No. 3085-NFPA 70-2017 \[Section No. 310.15\(B\) \[Excluding any Sub-Sections\]\]](#)

[Public Input No. 3087-NFPA 70-2017 \[Section No. 310.10\(C\)\]](#)

[Public Input No. 3529-NFPA 70-2017 \[Section No. 310.15\(B\)\(7\)\]](#)

[Public Input No. 3093-NFPA 70-2017 \[Section No. 310.106\(B\)\]](#)

[Public Input No. 3202-NFPA 70-2017 \[Global Input\]](#)

[Public Input No. 931-NFPA 70-2017 \[Section No. 310.15\(B\) \[Excluding any Sub-Sections\]\]](#)

[Public Input No. 1788-NFPA 70-2017 \[Section No. 310.15\(B\)\(7\)\]](#)

[Public Input No. 520-NFPA 70-2017 \[Section No. 310.15\(B\)\(7\) Single...\]](#)

[Public Input No. 932-NFPA 70-2017 \[Section No. 310.15\(B\)\(3\)\]](#)

[Public Input No. 3088-NFPA 70-2017 \[Section No. 310.15\(B\)\(3\)\]](#)

[Public Input No. 2122-NFPA 70-2017 \[Section No. 310.106\(B\)\]](#)

[Public Input No. 2439-NFPA 70-2017 \[Section No. 310.15\(A\)\(1\)\]](#)

[Public Input No. 2185-NFPA 70-2017 \[Section No. 328.2\]](#)

[Public Input No. 2750-NFPA 70-2017 \[Section No. 310.15\(B\)\(3\)\]](#)

[Public Input No. 3086-NFPA 70-2017 \[Section No. 310.10\(B\)\]](#)

[Public Input No. 2628-NFPA 70-2017 \[Global Input\]](#)

[Public Input No. 2646-NFPA 70-2017 \[Section No. 310.104\]](#)

[Public Input No. 1742-NFPA 70-2017 \[Section No. 310.15\(B\)\(3\)\]](#)

[Public Input No. 3340-NFPA 70-2017 \[Section No. 310.110\(C\)\]](#)

[Public Input No. 950-NFPA 70-2017 \[Section No. 310.15\(B\)\(7\)\]](#)

[Public Input No. 822-NFPA 70-2017 \[Section No. 310.60\(C\)\]](#)

WORKING DRAFT OF CMP MEETING OUTPUT - NATIONAL ELECTRICAL CODE - NFPA 70
JANUARY 8 - 20, 2018 - SUBJECT TO REVISION - NOT FOR PUBLICATION

[Public Input No. 559-NFPA 70-2017 \[Section No. 310.15\(B\)\(7\) Single...\]](#)

[Public Input No. 4290-NFPA 70-2017 \[New Section after 310.15\(C\)\]](#)

[Public Input No. 2945-NFPA 70-2017 \[Section No. 310.15\(B\)\(7\)\]](#)

[Public Input No. 2633-NFPA 70-2017 \[Article 328\]](#)

[Public Input No. 2510-NFPA 70-2017 \[Section No. 310.104\]](#)

[Public Input No. 2650-NFPA 70-2017 \[Section No. 328.14\]](#)

[Public Input No. 626-NFPA 70-2017 \[Section No. 310.15\(B\)\]](#)

[Public Input No. 3476-NFPA 70-2017 \[Section No. 310.110\(B\)\]](#)

[Public Input No. 930-NFPA 70-2017 \[Section No. 310.15\(A\)\(3\)\]](#)

[Public Input No. 3095-NFPA 70-2017 \[Section No. 310.106\(C\)\]](#)

FOR CODE-MAKING PANEL USE ONLY
SUBJECT TO REVISION - NOT FOR PUBLICATION

Article 311 Medium Voltage Conductors and Cable

Part I. General

311.1 Scope. [moved from 328.1]

Commented [BS1]: Any section with green is moved and this is how it will appear if all PI changes go through.

This article covers the use, installation, ~~and~~ construction specifications and ampacities for medium voltage conductors and cable, Type MV. These requirements do not apply to conductors that form an integral part of equipment, such as motors, motor controllers, and similar equipment, or to conductors specifically provided for elsewhere in this Code.

311.2 Definitions.

The definitions in this section shall apply within this article and throughout the code.

Medium Voltage Cable, Type MV. [moved from 328.2]

A single or multiconductor solid dielectric insulated cable rated 2001 volts up to and including 35,000 volts, nominal ~~or higher~~.

Electrical Ducts. [moved from 310.2]

Electrical conduits, or other raceways round in cross section, that are suitable for use underground or embedded in concrete.

Thermal Resistivity. [moved from 310.2]

As used in this Code, the heat transfer capability through a substance by conduction.

Informational Note: Thermal resistivity is the reciprocal of thermal conductivity and is designated Rho, which is expressed in the units °C-cm/W.

311.6 Listing Requirements. [moved from 328.6]

Type MV cables and associated fittings shall be listed.

Part II. Construction Specifications [moved and reworked based on 310]

311.10 ~~Conductor~~ Constructions and Applications.

Type MV cables shall comply with the applicable provisions as follows:

(A) Conductor Application and Insulation.

Conductor Application-application and Insulation-insulation ~~Rated 2001 Volts and Higher~~ shall comply with Table 311.10(A).

(B) Thickness of Insulation and Jacket for Nonshielded Insulated Conductors.

Thickness of ~~Insulation-insulation~~ and ~~Jacket-jacket~~ for ~~Nonshielded-nonshielded Solid-solid Dielectric dielectric Insulated-insulated Conductors-conductors Rated-rated~~ 2001 volts to 5000 ~~Volts-volts~~ shall comply with Table 311.10(B).

(C) Thickness of Insulation for Shielded Insulated Conductors.

Thickness of ~~Insulation-insulation~~ for ~~Shielded-shielded Solid-solid Dielectric-dielectric Insulated insulated~~ Cconductors ~~Rated-rated~~ 2001 volts to 35,000 ~~Volts-volts~~ shall comply with Table 311.10(C) ~~and the following: and 311(C) (1) through (C)(3).~~

(1) 100 Percent Insulation Level.

Cables in this category shall be permitted to be applied where the system is provided with relay protection such that ground faults will be cleared as rapidly as possible but, in any case, within 1 minute. While these cables are applicable to the great majority of cable installations that are on grounded systems, they shall be permitted to be used also on other systems for which the application of cables is acceptable, provided the above clearing requirements are met in completely de-energizing the faulted section.

(2) 133 Percent Insulation Level.

This insulation level corresponds to that formerly designated for ungrounded systems. Cables in this category shall be permitted to be applied in situations where the clearing time requirements of the 100 percent level category cannot be met and yet there is adequate assurance that the faulted section will be de-energized in a time not exceeding 1 hour. Also, they shall be permitted to be used in 100 percent insulation level applications where additional insulation is desirable.

(3) 173 Percent Insulation Level.

Cables in this category shall be permitted to be applied under all of the following conditions:

- (1) In industrial establishments where the conditions of maintenance and supervision ensure that only qualified persons service the installation
- (2) Where the fault clearing time requirements of the 133 percent level category cannot be met
- (3) Where an orderly shutdown is essential to protect equipment and personnel
- (4) ~~Where~~ ~~There~~ is adequate assurance that the faulted section will be de-energized in an orderly shutdown

Also, cables with this insulation thickness shall be permitted to be used in 100 or 133 percent insulation level applications where additional insulation strength is desirable.

INSERT --> Table 311.10(A) Conductor Application and Insulation Rated 2001 Volts and Higher

Trade Name	Type Letter	Maximum Operating Temperature	Application Provision	Insulation	Outer Covering
Medium voltage solid dielectric	MV-90	90°C	Dry or wet locations	Thermoplastic or thermosetting	Jacket, sheath, or armor
	MV-105*	105°C			

*Where design conditions require maximum conductor temperatures above 90°C.

INSERT --> Table 311.10(B) Thickness of Insulation and Jacket for Nonshielded Solid Dielectric Insulated Conductors Rated 2001 Volts to 5000 Volts

Conductor Size (AWG or kcmil)	Dry Locations, Single Conductor						Wet or Dry Locations					
	Without Jacket Insulation		With Jacket				Single Conductor				Multiconductor Insulation*	
	mm	mils	mm	mils	mm	mils	mm	mils	mm	mils	mm	mils
8	2.79	110	2.29	90	0.76	30	3.18	125	2.03	80	2.29	90
6	2.79	110	2.29	90	0.76	30	3.18	125	2.03	80	2.29	90
4-2	2.79	110	2.29	90	1.14	45	3.18	125	2.03	80	2.29	90
1-2/0	2.79	110	2.29	90	1.14	45	3.18	125	2.03	80	2.29	90
3/0-4/0	2.79	110	2.29	90	1.65	65	3.18	125	2.41	95	2.29	90
213-500	3.05	120	2.29	90	1.65	65	3.56	140	2.79	110	2.29	90
501-750	3.30	130	2.29	90	1.65	65	3.94	155	3.18	125	2.29	90
751-1000	3.30	130	2.29	90	1.65	65	3.94	155	3.18	125	2.29	90
1001-1250	3.56	140	2.92	115	1.65	65	4.32	170	3.56	140	2.92	115
1251-1500	3.56	140	2.92	115	2.03	80	4.32	170	3.56	140	2.92	115
1501-2000	3.56	140	2.92	115	2.03	80	4.32	170	3.94	155	3.56	140

*Under a common overall covering such as a jacket, sheath, or armor.

INSERT --> Table 311.10(C) Thickness of Insulation for Shielded Solid Dielectric Insulated Conductors Rated 2001 Volts to 35,000 Volts

Conductor Size (AWG or kcmil)	2001-5000 Volts		5001-8000 Volts				8001-15,000 Volts				15,001-25,000 Volts			
	100		100		133		100		133		100		133	
	Percent Insulation Level [±]		Percent Insulation Level [±]		Percent Insulation Level [±]		Percent Insulation Level [±]		Percent Insulation Level [±]		Percent Insulation Level [±]		Percent Insulation Level [±]	
	mm	mils	mm	mils	mm	mils	mm	mils	mm	mils	mm	mils	mm	mils
8	2.29	90	—	—	—	—	—	—	—	—	—	—	—	—
6-4	2.29	90	2.92	115	3.14	125	4.17	165	—	—	—	—	—	—
2	2.29	90	2.92	115	3.14	125	4.17	165	5.22	210	6.26	250	—	—
1	2.29	90	2.92	115	3.14	125	4.17	165	5.22	210	6.26	250	8.32	330
1/0-2000	2.29	90	2.92	115	3.14	125	4.17	165	5.22	210	6.26	250	8.32	330

Conductor Size (AWG or kcmil)	25,001-28,000 Volts						28,001-35,000 Volts					
	100		133		173		100		133		173	
	Percent Insulation Level [±]		Percent Insulation Level [±]		Percent Insulation Level [±]		Percent Insulation Level [±]		Percent Insulation Level [±]		Percent Insulation Level [±]	
	mm	mils	mm	mils	mm	mils	mm	mils	mm	mils	mm	mils
1	7.11	280	8.76	345	11.30	445	—	—	—	—	—	—
1/0-2000	7.11	280	8.76	345	11.30	445	8.76	345	10.67	420	14.73	580

311.12 Conductors. [is taken from 310.106, but also moving to 310.3]

(A) Minimum Size of Conductors.

The minimum size of conductors shall be as shown in Table 311.12(A), except as permitted elsewhere in this Code.

INSERT --> Table 311.12(A) Minimum Size of Conductors

Table 311.12(A) Minimum Size of Conductors

Conductor Voltage Rating (Volts)	Minimum Conductor Size (AWG)	
	Copper ¹	Aluminum ¹ or Copper-Clad Aluminum
0-2000	14	12
2001-5000	8	8
5001-8000	6	6

Commented [BS2]: Any highlighted text is also being moved in 310. If the 310 changes go through, then this will be considered as new text. If moves are not done in 310, then 311 will appear with legislative text as shown.

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Conductor Voltage Rating (Volts)	Minimum Conductor Size (AWG)	
	Copper ^a	Aluminum ^a or Copper-Clad Aluminum
8001–15,000	2	2
15,001–28,000	1	1
28,001–35,000	1/0	1/0

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(B) Conductor Material.

Conductors shall be of aluminum, copper-clad aluminum, or copper unless otherwise specified.

(C) Stranded Conductors.

Where installed in raceways, conductors not specifically permitted or required elsewhere in this Code to be solid, shall be stranded.

311.14 Conductor Identification. [text only from 310.110(C)]

Conductors that are intended for use as ungrounded conductors, whether used as a single conductor or in multiconductor cables, shall be finished to be clearly distinguishable from grounded and grounding conductors. Distinguishing markings shall not conflict in any manner with the surface markings required by 311.16(B)(1). Branch-circuit ungrounded conductors shall be identified in accordance with 210.5(C). Feeders shall be identified in accordance with 215.12.

311.16 Marking. [is taken from 310.120, but also moving to 310.8]

(A) Required Information.

All conductors and cables shall be marked to indicate the following information, using the applicable method described in 311.16(B):

- (1) The maximum rated voltage.
- (2) The proper type letter or letters for the type of wire or cable as specified elsewhere in this Code.
- (3) The manufacturer's name, trademark, or other distinctive marking by which the organization responsible for the product can be readily identified.
- (4) The AWG size or circular mil area.

Informational Note: See ~~Conductor Properties~~, Table 8 of Chapter 9, Conductor Properties, for conductor area expressed in SI units for conductor sizes specified in AWG or circular mil area.

- (5) ~~Cable assemblies where the neutral conductor is smaller than the ungrounded conductors shall be so marked.~~

(B) Method of Marking.

One or more of the following methods shall be used for marking of cable:

(1) Surface Marking.

~~The following conductors and cables~~ shall be durably marked on the surface. The AWG size or circular mil area shall be repeated at intervals not exceeding 610 mm (24 in.). All other markings shall be repeated at intervals not exceeding 1.0 m (40 in.).

- ~~(1) Single-conductor and multiconductor rubber and thermoplastic-insulated wire and cable~~
- ~~(2) Nonmetallic-sheathed cable~~
- ~~(3) Service-entrance cable~~
- ~~(4) Underground-feeder and branch-circuit cable~~
- ~~(5) Tray cable~~
- ~~(6) Irrigation cable~~
- ~~(7) Power-limited-tray cable~~
- ~~(8) Instrumentation-tray cable~~

(2) Marker Tape.

Metal-covered multiconductor cables shall employ a marker tape located within the cable and ~~running for~~along its complete length.

Exception No. 1: Type MI cable.

Exception No. 2: Type AC cable.

Exception No. 3: The information required in 310.120(A) shall be permitted to be durably marked on the outer nonmetallic covering of Type MC, Type ITC, or Type PLTC cables at intervals not exceeding 1.0 m (40 in.).

Exception No. 4: The information required in 310.120(A) shall be permitted to be durably marked on a nonmetallic covering under the metallic sheath of Type ITC or Type PLTC cable at intervals not exceeding 1.0 m (40 in.).

Informational Note: Included in the group of metal-covered cables are Type AC cable (Article 320), Type MC cable (Article 330), and lead-sheathed cable.

(3) Tag Marking.

Metal-covered, single-conductor cables shall be marked by means of a printed tag attached to the reel. ~~The following conductors and cables shall be marked by means of a printed tag attached to the coil, reel, or carton:~~

- ~~(1) Type MI cable~~
- ~~(2) Switchboard wires~~
- ~~(3) Metal-covered, single-conductor cables~~
- ~~(4) Type AC cable~~

(4) Optional Marking of Wire Size.

The information required in ~~310.311~~420.16(A)(4) shall be permitted to be marked on the surface of the individual insulated conductors for ~~the following~~ multiconductor Type MC cables:

- ~~(1) — Type MC cable~~
- ~~(2) — Tray cable~~
- ~~(3) — Irrigation cable~~
- ~~(4) — Power-limited tray cable~~
- ~~(5) — Power-limited fire alarm cable~~
- ~~(6) — Instrumentation tray cable~~

~~(C) — Suffixes to Designate Number of Conductors:~~

~~A type letter or letters used alone shall indicate a single insulated conductor. The letter suffixes shall be indicated as follows:~~

- ~~(1) — D — For two insulated conductors laid parallel within an outer nonmetallic covering~~
- ~~(2) — M — For an assembly of two or more insulated conductors twisted spirally within an outer nonmetallic covering~~

(~~B~~C) Optional Markings.

~~Cables shall be permitted. All conductors and cables contained in Chapter 3 shall be permitted to be surface-~~marked to indicate special characteristics of the cable materials. These markings include, but are not limited to, markings for limited smoke, sunlight resistant, and so forth.

Part III. Installation

311.30 Installation. ~~[moved from 328.14]~~

Type MV cable shall be installed, terminated, and tested by qualified persons.

Informational Note ~~No. 1~~: Information about accepted industry practices and installation procedures for medium-voltage cable are described in ANSI/NECA/NCSCB 600-~~2014~~, Standard for Installing and Maintaining Medium-Voltage Cable and in IEEE 576-~~2000~~, Recommended Practice for Installation, Termination, and Testing of Insulated Power Cables as Used in Industrial and Commercial Applications

Informational Note No.2: Where medium-voltage cable is used for direct-current (dc) circuits, low frequency polarization can create hazardous voltages. When handling the cable these voltages may be present or may develop on dc stressed cable while the circuit is energized. Solidly grounding the cable prior to contacting, cutting or disconnecting cables in dc circuits is a method to discharge these voltages.

311.32 Uses Permitted. **[moved from 328.10]**

Type MV cable shall be permitted for use on power systems rated up to and including 35,000 volts, nominal, as follows:

(1) In wet or dry locations.

(2) In raceways.

(3) In cable trays, where identified for the use, in accordance with 392.10, 392.20(B), (C), and (D), 392.22(C), 392.30(B)(1), 392.46, 392.56, and 392.60. Type MV cable that has an overall metallic sheath or armor, complies with the requirements for Type MC cable, and is identified as "MV or MC" shall be permitted to be installed in cable trays in accordance with 392.10(B)(2).

~~(4) Direct buried in accordance with 300.50.~~

(4) In messenger-supported wiring in accordance with Part II of Article 396.

(5) As exposed runs in accordance with 300.37. Type MV cable that has an overall metallic sheath or armor, complies with the requirements for Type MC cable, and is identified as "MV or MC" shall be permitted to be installed as exposed runs of metal-clad cable in accordance with 300.37.

(6) Corrosive conditions where exposed to oils, greases, vapors, gases, fumes, liquids, or other substances having a deleterious effect on the conductor or insulation shall be of a type suitable for the application.

~~(7) Conductors in parallel in accordance with 310.10(H).~~

~~(8) Type MV Cable used where exposed to direct sunlight shall be identified for the use.~~

Informational Note: The "Uses Permitted" is not an all-inclusive list.

311.36 Direct-Burial Conductors. **[moved from 310.10(F), but also renumbered as 310.10(E)]**

Type MV cables ~~Conductors~~ used for direct burial applications shall be of a type identified for such use and installed in accordance with 300.50.

Cables rated above 2000 volts shall be shielded.

Exception No. 1: Nonshielded multiconductor cables rated 2001—volts to 2400 volts shall be permitted if the cable has an overall metallic sheath or armor.

The metallic shield, sheath, or armor shall be connected to a grounding electrode conductor, grounding busbar, or a grounding electrode.

Exception No. 2: Airfield lighting cable used in series circuits that are rated up to 5000 volts and are powered by regulators shall be permitted to be nonshielded.

Informational Note to Exception No. 2: Federal Aviation Administration (FAA) Advisory Circulars (ACs) provide additional practices and methods for airport lighting.

~~Informational Note No. 1: See 300.5 for installation requirements for conductors rated 1000 volts or less.~~
~~Informational Note No. 2: See 300.50 for installation requirements for conductors rated over 1000 volts.~~

311.40 Support. [moved from 328.30]

Type MV cable terminated in equipment or installed in pull boxes or vaults shall be secured and supported by metallic or nonmetallic supports suitable to withstand the weight by cable ties listed and identified for securement and support, or other approved means, at intervals not exceeding 1.5 m (5 ft) from terminations or a maximum of 1.8 m (6 ft) between supports.

311.44 Shielding. [moved from 310.10(E)]

Nonshielded, ozone-resistant insulated conductors with a maximum phase-to-phase voltage of 5000 volts shall be permitted in Type MC cables in industrial establishments where the conditions of maintenance and supervision ensure that only qualified persons service the installation. For other establishments, solid dielectric insulated conductors operated above 2000 volts in permanent installations shall have ozone resistant insulation and shall be shielded. All metallic insulation shields shall be connected to a grounding electrode conductor, a grounding busbar, an equipment grounding conductor, or a grounding electrode.

Informational Note: The primary purposes of shielding are to confine the voltage stresses to the insulation, dissipate insulation leakage current, drain off the capacitive charging current, and carry ground-fault current to facilitate operation of ground-fault protective devices in the event of an electrical cable fault.

Exception No. 1: Nonshielded insulated conductors listed by a qualified testing laboratory shall be permitted for use up to 2400 volts under the following conditions:

- (a) Conductors shall have insulation resistant to electric discharge and surface tracking, or the insulated conductor(s) shall be covered with a material resistant to ozone, electric discharge, and surface tracking.*
- (b) Where used in wet locations, the insulated conductor(s) shall have an overall nonmetallic jacket or a continuous metallic sheath.*
- (c) Insulation and jacket thicknesses shall be in accordance with Table 311.10(B).*

Exception No. 2: Nonshielded insulated conductors listed by a qualified testing laboratory shall be permitted for use up to 5000 volts to replace existing nonshielded conductors, on existing equipment in industrial establishments only, under the following conditions:

- (a) Where the condition of maintenance and supervision ensures that only qualified personnel install and service the installation.*
- (b) Conductors shall have insulation resistant to electric discharge and surface tracking, or the insulated conductor(s) shall be covered with a material resistant to ozone, electric discharge, and surface tracking.*
- (c) Where used in wet locations, the insulated conductor(s) shall have an overall nonmetallic jacket or a continuous metallic sheath.*
- (d) Insulation and jacket thicknesses shall be in accordance with Table 311.10(B).*

Informational Note: Relocation or replacement of equipment may not comply with the term existing as related to this exception.

Exception No. 3: Where permitted in 311.36, Exception No. 2.

Part IV Ampacities

311.60 Ampacities of Conductors.~~Conductors Rated 2001 to 35,000 Volts.~~

(A) General

(1) Tables or Engineering Supervision. Ampacities of Conductors Rated 2001 to 35,000 Volts.

Ampacities for solid dielectric-insulated conductors shall be permitted to be determined by tables or under engineering supervision, as provided in 311.60(B) and (C).

The ampacity of Type MV cable installed in cable tray shall be determined in accordance with 392.80(B).

(2) Selection of Ampacity.

Where more than one calculated or tabulated ampacity could apply for a given circuit length, the lowest value shall be used.

Exception: Where ~~two~~ different ampacities apply to ~~adjacent~~ portions of a circuit, the higher ampacity shall be permitted to be used ~~beyond the point of transition, a distance equal if the total portion(s) of the circuit with the lower ampacity does not exceed the lesser of~~ 3.0 m (10 ft) or 10 percent of the total circuit ~~length calculated at the higher ampacity, whichever is less.~~

Informational Note: See 110.40 for conductor temperature limitations due to termination provisions.

(B) Engineering Supervision.

Under engineering supervision, conductor ampacities shall be permitted to be calculated by using the following general equation:

INSERT --> **[311.60(B)]**

where:

T_c = conductor temperature ($^{\circ}\text{C}$)

T_a = ambient temperature ($^{\circ}\text{C}$)

ΔT_d = dielectric loss temperature rise

R_{dc} = dc resistance of conductor at temperature T_c

Y_c = component ac resistance resulting from skin effect and proximity effect

R_{ca} = effective thermal resistance between conductor and surrounding ambient

Informational Note: The dielectric loss temperature rise (ΔT_d) is negligible for single circuit extruded dielectric cables rated below 46 kV.

(C) Tables.

Ampacities for conductors rated 2001 ~~volts~~ to 35,000 volts shall be as specified in Table 311.60(C)(67) through Table 311.60(C)(86). Ampacities for ambient temperatures other than those specified in the ampacity tables shall be corrected in accordance with 311.60(D)(4).

Informational Note No. 1: For ampacities calculated in accordance with 311.60(A), reference IEEE 835-~~1994~~, Standard Power Cable Ampacity Tables, and the references therein for availability of all factors and constants.

Informational Note No. 2: Ampacities provided by this section do not take voltage drop into consideration. See 210.19(A), Informational Note No. 4, for branch circuits and 215.2(A), Informational Note No. 2, for feeders.

(D) Ampacity Adjustment.

(1) Grounded Shields. [moved out of (C)]

Ampacities shown in Table 311.60(C)(69), Table 311.60(C)(70), Table 311.60(C)(81), and Table 311.60(C)(82) shall apply for cables with shields grounded at one point only. Where shields for these cables are grounded at more than one point, ampacities shall be adjusted to take into consideration the heating due to shield currents.

Informational Note: Tables other than those listed contain the ampacity of cables with shields grounded at multiple points.

(2) Burial Depth of ~~Underground Circuits~~. [moved out of (C)]

Where the burial depth of direct burial or electrical duct bank circuits is modified from the values shown in a figure or table, ampacities shall be permitted to be modified as indicated in (B)(2)(a) and (B)(2)(b). No ampacity adjustments shall be required where the burial depth is decreased.

(a) Where burial depths are increased in part(s) of an electrical duct run, a decrease in ampacity of the conductors shall not be required, provided the total length of parts of the duct run increased in depth is less than 25 percent of the total run length.

(b) Where burial depths are deeper than shown in a specific underground ampacity table or figure, an ampacity derating factor of 6 percent per 300 mm (1 ft) increase in depth for all values of rho shall be permitted.

No ampacity adjustments shall be required where the burial depth is decreased.

(3) Electrical Ducts ~~in Entering Equipment Enclosures~~ Figure 310.60(C)(3).

At locations where electrical ducts enter equipment enclosures from underground, spacing between such ducts, as shown in Figure 311.60(F)(6), shall be permitted to be reduced without requiring the ampacity of conductors therein to be reduced.

(4) Ambient Temperature Correction.

Ampacities for ambient temperatures other than those specified in the ampacity tables shall be corrected in accordance with Table 311.60(D)(4) or shall be permitted to be calculated using the following equation:

$$I' = I \sqrt{\frac{T_c - T_a'}{T_c - T_a}} \quad \text{INSERT} \rightarrow \quad [311.60(D)(4)]$$

where:

I' = ampacity corrected for ambient temperature

I = ampacity shown in the table for T_c and T_a

T_c = temperature rating of conductor ($^{\circ}\text{C}$)

Ta' = new ambient temperature (°C)

Ta = ambient temperature used in the table (°C)

INSERT --> **Table 311.60(D)(4) Ambient Temperature Correction Factors**

For ambient temperatures other than 40°C (104°F), multiply the allowable ampacities specified in the ampacity tables by the appropriate factor shown below.			
Ambient Temperature (°C)	Temperature Rating of Conductor		Ambient Temperature (°F)
	90°C	105°C	
10 or less	1.26	1.21	50 or less
11–15	1.22	1.18	51–59
16–20	1.18	1.14	60–68
21–25	1.14	1.11	69–77
26–30	1.10	1.07	78–86
31–35	1.05	1.04	87–95
36–40	1.00	1.00	96–104
41–45	0.95	0.96	105–113
46–50	0.89	0.92	114–122
51–55	0.84	0.88	123–131
56–60	0.77	0.83	132–140
61–65	0.71	0.78	141–149
66–70	0.63	0.73	150–158
71–75	0.55	0.68	159–167
76–80	0.45	0.62	168–176
81–85	0.32	0.55	177–185
86–90	—	0.48	186–194
91–95	—	0.39	195–203
96–100	—	0.28	204–212

(E) Ampacity in Air.

Ampacities for conductors and cables ~~rated 2001 to 35,000 volts~~ in air shall be as specified in Table 311.60(C)(67) through Table 311.60(C)(76). Ampacities ~~are~~ shall be based on the following:

(1) Conductor ~~T~~temperatures of 90°C (194°F) and 105°C (221°F)

(2) Ambient ~~Air T~~temperature of 40°C (104°F)

Informational Note: See 311.60(D)(4) where the ambient air temperature is other than 40°C (104°F).

(F) Ampacity in Underground Electrical Ducts and Direct Buried in Earth.

Ampacities for conductors and cables ~~rated 2001 to 35,000 volts~~ in underground electrical ducts and direct buried in earth shall be as specified in Table 311.60(C)(787) through Table 311.60(C)(86). Ampacities ~~are~~ shall be based on the following:

(1) Ambient ~~E~~earth ~~T~~temperature of 20°C (68°F)

(2) Arrangement ~~in accordance with~~ per Figure 310.1.60(CF)(3)

(3) 100 ~~P~~percent ~~L~~load ~~F~~factor

(4) Thermal ~~R~~esistance (RHO) of 90

(5) Conductor ~~T~~emperatures 90°C (194°F) and 105°C (221°F)

~~(6) Arrangement in accordance with Figure 310.60(F)(6)~~

~~(76)~~ Minimum burial depths to the top electrical ducts or cables shall be in accordance with 300.50.

~~(87)~~ Maximum depth to the top of electrical duct banks shall be 750 mm (30 in.) and maximum depth to the top of direct-buried cables shall be 900 mm (36 in.).

INSERT —> Table 311.60(C)(67) Ampacities of Insulated Single Copper Conductor Cables Triplexed in Air Thru Table 311.60(C)(86) Ampacities of Three Triplexed Single Insulated Aluminum Conductors Directly Buried in Earth

Conductor Size (AWG or kcmil)	Temperature Rating of Conductor {See Table 311.10(A).}			
	2001–5000 Volts Ampacity		5001–35,000 Volts Ampacity	
	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105
8	65	74	—	—
6	90	99	100	110
4	120	130	130	140
2	160	175	170	195
1	185	205	195	225
1/0	215	240	225	255
2/0	250	275	260	295
3/0	290	320	300	340
4/0	335	375	345	390
250	375	415	380	430

Conductor Size (AWG or kcmil)	Temperature Rating of Conductor {See Table 311.10(A).}			
	2001–5000 Volts Ampacity		5001–35,000 Volts Ampacity	
	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105
350	465	515	470	525
500	580	645	580	650
750	750	835	730	820
1000	880	980	850	950

Note: Refer to 311.60(D)(4E) for the ampacity, 311.10(A) for conductor maximum operating temperature and application, and 311.60(D)(4) for the ampacity correction factors where the ambient air temperature is other than 40°C (104°F).

Table 311.60(C)(68) Ampacities of Insulated Single Aluminum Conductor Cables Triplexed in Air Based on Conductor Temperatures of 90°C (194°F) and 105°C (221°F) and Ambient Air Temperature of 40°C (104°F)

Conductor Size (AWG or kcmil)	Temperature Rating of Conductor {See Table 311.10(A).}			
	2001–5000 Volts Ampacity		5001–35,000 Volts Ampacity	
	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105
8	50	57	—	—
6	70	77	75	84
4	90	100	100	110
2	125	135	130	150
1	145	160	150	175
1/0	170	185	175	200
2/0	195	215	200	230
3/0	225	250	230	265
4/0	265	290	270	305
250	295	325	300	335
350	365	405	370	415
500	460	510	460	515
750	600	665	590	660
1000	715	800	700	780

Informational Note: Refer to 311.60(E) for the ampacity, 311.10(A) for conductor maximum operating temperature and application, and 311.60(D)(4) for the ampacity correction factors where the ambient air temperature is other than 40°C (104°F).

Note: Refer to 311.60(D)(4) for the ampacity correction factors where the ambient air temperature is other than 40°C (104°F).

Table 311.60(C)(69) Ampacities of Insulated Single Copper Conductor Isolated in Air Based on Conductor Temperatures of 90°C (194°F) and 105°C (221°F) and Ambient Air Temperature of 40°C (104°F)

Conductor Size (AWG or kcmil)	Temperature Rating of Conductor {See Table 311.10(A).}					
	2001–5000 Volts Ampacity		5001–15,000 Volts Ampacity		15,001–35,000 Volts Ampacity	
	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105
8	83	93	—	—	—	—
6	110	120	110	125	—	—
4	145	160	150	165	—	—
2	190	215	195	215	—	—
1	225	250	225	250	225	250
1/0	260	290	260	290	260	290
2/0	300	330	300	335	300	330
3/0	345	385	345	385	345	380
4/0	400	445	400	445	395	445
250	445	495	445	495	440	490
350	550	615	550	610	545	605
500	695	775	685	765	680	755
750	900	1000	885	990	870	970
1000	1075	1200	1060	1185	1040	1160
1250	1230	1370	1210	1350	1185	1320
1500	1365	1525	1345	1500	1315	1465
1750	1495	1665	1470	1640	1430	1595
2000	1605	1790	1575	1755	1535	1710

Informational Note: Refer to 311.60(E) for the ampacity, 311.10(A) for conductor maximum operating temperature and application, and 311.60(D)(4) for the ampacity correction factors where the ambient air temperature is other than 40°C (104°F).

Note: Refer to 311.60(D)(4) for the ampacity correction factors where the ambient air temperature is other than 40°C (104°F).

Table 311.60(C)(70) Ampacities of Insulated Single Aluminum Conductor Isolated in Air Based on Conductor Temperatures of 90°C (194°F) and 105°C (221°F) and Ambient Air Temperature of 40°C (104°F)

Conductor Size (AWG or kcmil)	Temperature Rating of Conductor {See Table 311.10(A).}					
	2001–5000 Volts Ampacity		5001–15,000 Volts Ampacity		15,001–35,000 Volts Ampacity	
	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105
8	64	71	—	—	—	—
6	85	95	87	97	—	—
4	115	125	115	130	—	—
2	150	165	150	170	—	—
1	175	195	175	195	175	195
1/0	200	225	200	225	200	225
2/0	230	260	235	260	230	260
3/0	270	300	270	300	270	300
4/0	310	350	310	350	310	345

Conductor Size (AWG or kcmil)	Temperature Rating of Conductor {See Table 311.10(A).}					
	2001–5000 Volts Ampacity		5001–15,000 Volts Ampacity		15,001–35,000 Volts Ampacity	
	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105
250	345	385	345	385	345	380
350	430	480	430	480	430	475
500	545	605	535	600	530	590
750	710	790	700	780	685	765
1000	855	950	840	940	825	920
1250	980	1095	970	1080	950	1055
1500	1105	1230	1085	1215	1060	1180
1750	1215	1355	1195	1335	1165	1300
2000	1320	1475	1295	1445	1265	1410

Informational Note: Refer to 311.60(E) for the ampacity, 311.10(A) for conductor maximum operating temperature and application, and 311.60(D)(4) for the ampacity correction factors where the ambient air temperature is other than 40°C (104°F).

Note: Refer to 311.60(D)(4) for the ampacity correction factors where the ambient air temperature is other than 40°C (104°F).

Table 311.60(C)(71) Ampacities of an Insulated Three-Conductor Copper Cable Isolated in Air Based on Conductor Temperatures of 90°C (194°F) and 105°C (221°F) and Ambient Air Temperature of 40°C (104°F)

Conductor Size (AWG or kcmil)	Temperature Rating of Conductor {See Table 311.10(A).}			
	2001–5000 Volts Ampacity		5001–35,000 Volts Ampacity	
	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105
8	59	66	—	—
6	79	88	93	105
4	105	115	120	135
2	140	154	165	185
1	160	180	185	210
1/0	185	205	215	240
2/0	215	240	245	275
3/0	250	280	285	315
4/0	285	320	325	360
250	320	355	360	400
350	395	440	435	490
500	485	545	535	600
750	615	685	670	745
1000	705	790	770	860

Informational Note: Refer to 311.60(E) for the ampacity, 311.10(A) for conductor maximum operating temperature and application, and 311.60(D)(4) for the ampacity correction factors where the ambient air temperature is other than 40°C (104°F).

Note: Refer to 311.60(D)(4) for the ampacity correction factors where the ambient air temperature is other than 40°C (104°F).

Table 311.60(C)(72) Ampacities of an Insulated Three-Conductor Aluminum Cable Isolated in Air Based on Conductor Temperatures of 90°C (194°F) and 105°C (221°F) and Ambient Air Temperature of 40°C (104°F)

Conductor Size (AWG or kcmil)	Temperature Rating of Conductor [See Table 311.10(A).]			
	2001–5000 Volts Ampacity		5001–35,000 Volts Ampacity	
	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105
8	46	51	—	—
6	61	68	72	80
4	81	90	95	105
2	110	120	125	145
1	125	140	145	165
1/0	145	160	170	185
2/0	170	185	190	215
3/0	195	215	220	245
4/0	225	250	255	285
250	250	280	280	315
350	310	345	345	385
500	385	430	425	475
750	495	550	540	600
1000	585	650	635	705

Informational Note: Refer to 311.60(E) for the ampacity, 311.10(A) for conductor maximum operating temperature and application, and 311.60(D)(4) for the ampacity correction factors where the ambient air temperature is other than 40°C (104°F).

Note: Refer to 311.60(C)(4) for the ampacity correction factors where the ambient air temperature is other than 40°C (104°F).

Table 311.60(C)(73) Ampacities of an Insulated Triplexed or Three Single-Conductor Copper Cables in Isolated Conduit in Air Based on Conductor Temperatures of 90°C (194°F) and 105°C (221°F) and Ambient Air Temperature of 40°C (104°F)

Conductor Size (AWG or kcmil)	Temperature Rating of Conductor [See Table 311.10(A).]			
	2001–5000 Volts Ampacity		5001–35,000 Volts Ampacity	
	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105
8	55	61	—	—
6	75	84	83	93
4	97	110	110	120
2	130	145	150	165
1	155	175	170	190
1/0	180	200	195	215
2/0	205	225	225	255
3/0	240	270	260	290
4/0	280	305	295	330
250	315	355	330	365
350	385	430	395	440
500	475	530	480	535

Conductor Size (AWG or kcmil)	Temperature Rating of Conductor {See Table 311.10(A).}			
	2001–5000 Volts Ampacity		5001–35,000 Volts Ampacity	
	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105
750	600	665	585	655
1000	690	770	675	755

Informational Note: Refer to 311.60(E) for the ampacity, 311.10(A) for conductor maximum operating temperature and application, and 311.60(D)(4) for the ampacity correction factors where the ambient air temperature is other than 40°C (104°F).

Note: Refer to 311.60(C)(4) for the ampacity correction factors where the ambient air temperature is other than 40°C (104°F).

Table 311.60(C)(74) Ampacities of an Insulated Triplexed or Three Single-Conductor Aluminum Cables in Isolated Conduit in Air Based on Conductor Temperatures of 90°C (194°F) and 105°C (221°F) and Ambient Air Temperature of 40°C (104°F)

Conductor Size (AWG or kcmil)	Temperature Rating of Conductor {See Table 311.10(A).}			
	2001–5000 Volts Ampacity		5001–35,000 Volts Ampacity	
	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105
8	43	48	—	—
6	58	65	65	72
4	76	85	84	94
2	100	115	115	130
1	120	135	130	150
1/0	140	155	150	170
2/0	160	175	175	200
3/0	190	210	200	225
4/0	215	240	230	260
250	250	280	255	290
350	305	340	310	350
500	380	425	385	430
750	490	545	485	540
1000	580	645	565	640

Informational Note: Refer to 311.60(E) for the ampacity, 311.10(A) for conductor maximum operating temperature and application, and 311.60(D)(4) for the ampacity correction factors where the ambient air temperature is other than 40°C (104°F).

Note: Refer to 311.60(C)(4) for the ampacity correction factors where the ambient air temperature is other than 40°C (104°F).

Table 311.60(C)(75) Ampacities of an Insulated Three-Conductor Copper Cable in Isolated Conduit in Air Based on Conductor Temperatures of 90°C (194°F) and 105°C (221°F) and Ambient Air Temperature of 40°C (104°F)

Conductor Size (AWG or kcmil)	Temperature Rating of Conductor {See Table 311.10(A).}			
	2001–5000 Volts Ampacity		5001–35,000 Volts Ampacity	
	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105
8	52	58	—	—
6	69	77	83	92
4	91	100	105	120

Conductor Size (AWG or kcmil)	Temperature Rating of Conductor			
	{See Table 311.10(A).}			
	2001–5000 Volts Ampacity		5001–35,000 Volts Ampacity	
	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105
2	125	135	145	165
1	140	155	165	185
1/0	165	185	195	215
2/0	190	210	220	245
3/0	220	245	250	280
4/0	255	285	290	320
250	280	315	315	350
350	350	390	385	430
500	425	475	470	525
750	525	585	570	635
1000	590	660	650	725

Informational Note: Refer to 311.60(E) for the ampacity, 311.10(A) for conductor maximum operating temperature and application, and 311.60(D)(4) for the ampacity correction factors where the ambient air temperature is other than 40°C (104°F).

Note: Refer to 311.60(C)(4) for the ampacity correction factors where the ambient air temperature is other than 40°C (104°F).

Table 311.60(C)(76) Ampacities of an Insulated Three-Conductor Aluminum Cable in Isolated Conduit in Air Based on Conductor Temperatures of 90°C (194°F) and 105°C (221°F) and Ambient Air Temperature of 40°C (104°F)

Conductor Size (AWG or kcmil)	Temperature Rating of Conductor			
	{See Table 311.10(A).}			
	2001–5000 Volts Ampacity		5001–35,000 Volts Ampacity	
	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105
8	41	46	—	—
6	53	59	64	71
4	71	79	84	94
2	96	105	115	125
1	110	125	130	145
1/0	130	145	150	170
2/0	150	165	170	190
3/0	170	190	195	220
4/0	200	225	225	255
250	220	245	250	280
350	275	305	305	340
500	340	380	380	425
750	430	480	470	520
1000	505	560	550	615

Informational Note: Refer to 311.60(E) for the ampacity, 311.10(A) for conductor maximum operating temperature and application, and 311.60(D)(4) for the ampacity correction factors where the ambient air temperature is other than 40°C (104°F).

Note: Refer to 311.60(C)(4) for the ampacity correction factors where the ambient air temperature is other than 40°C (104°F).

Table 311.60(C)(77) Ampacities of Three Single-Insulated Copper Conductors in Underground Electrical Ducts (Three Conductors per Electrical Duct) ~~Based on Ambient Earth Temperature of 20°C (68°F), Electrical Duct Arrangement in Accordance with Figure 311.60(C)(3), 100 Percent Load Factor, Thermal Resistance (RHO) of 90, Conductor Temperatures of 90°C (194°F) and 105°C (221°F)~~

Conductor Size (AWG or kcmil)	Temperature Rating of Conductor {See Table 311.10(A).}			
	2001–5000 Volts Ampacity		5001–35,000 Volts Ampacity	
	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105
One Circuit [See Figure 311.60(F), Detail 1.]				
8	64	69	—	—
6	85	92	90	97
4	110	120	115	125
2	145	155	155	165
1	170	180	175	185
1/0	195	210	200	215
2/0	220	235	230	245
3/0	250	270	260	275
4/0	290	310	295	315
250	320	345	325	345
350	385	415	390	415
500	470	505	465	500
750	585	630	565	610
1000	670	720	640	690
Three Circuits [See Figure 311.60(G)(3E), Detail 2.]				
8	56	60	—	—
6	73	79	77	83
4	95	100	99	105
2	125	130	130	135
1	140	150	145	155
1/0	160	175	165	175
2/0	185	195	185	200
3/0	210	225	210	225
4/0	235	255	240	255
250	260	280	260	280
350	315	335	310	330
500	375	405	370	395
750	460	495	440	475
1000	525	565	495	535
Six Circuits [See Figure 311.60(G)(3E), Detail 3.]				
8	48	52	—	—

Conductor Size (AWG or kcmil)	Temperature Rating of Conductor (See Table 311.10(A).)			
	2001–5000 Volts Ampacity		5001–35,000 Volts Ampacity	
	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105
6	62	67	64	68
4	80	86	82	88
2	105	110	105	115
1	115	125	120	125
1/0	135	145	135	145
2/0	150	160	150	165
3/0	170	185	170	185
4/0	195	210	190	205
250	210	225	210	225
350	250	270	245	265
500	300	325	290	310
750	365	395	350	375
1000	410	445	390	415

Informational Note: Refer to 311.60(F) for basis of ampacities and table 311.10(A) for the temperature rating of the conductor.

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Table 311.60(C)(78) Ampacities of Three Single-Insulated Aluminum Conductors in Underground Electrical Ducts (Three Conductors per Electrical Duct) Based on Ambient Earth Temperature of 20°C (68°F), Electrical Duct Arrangement in Accordance with Figure 311.60(C)(3), 100 Percent Load Factor, Thermal Resistance (RHO) of 90, Conductor Temperatures of 90°C (194°F) and 105°C (221°F)

Conductor Size (AWG or kcmil)	Temperature Rating of Conductor (See Table 311.10(A).)			
	2001–5000 Volts Ampacity		5001–35,000 Volts Ampacity	
	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105
One Circuit [See Figure 311.60(E)(3E), Detail 1.]				
8	50	54	—	—
6	66	71	70	75
4	86	93	91	98
2	115	125	120	130
1	130	140	135	145
1/0	150	160	155	165
2/0	170	185	175	190
3/0	195	210	200	215
4/0	225	245	230	245
250	250	270	250	270
350	305	325	305	330
500	370	400	370	400
750	470	505	455	490
1000	545	590	525	565

Conductor Size (AWG or kcmil)	Temperature Rating of Conductor {See Table 311.10(A).}			
	2001–5000 Volts Ampacity		5001–35,000 Volts Ampacity	
	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105
Three Circuits [See Figure 311.60(C)(79), Detail 2.]				
8	44	47	—	—
6	57	61	60	65
4	74	80	77	83
2	96	105	100	105
1	110	120	110	120
1/0	125	135	125	140
2/0	145	155	145	155
3/0	160	175	165	175
4/0	185	200	185	200
250	205	220	200	220
350	245	265	245	260
500	295	320	290	315
750	370	395	355	385
1000	425	460	405	440
Six Circuits [See Figure 311.60(C)(79), Detail 3.]				
8	38	41	—	—
6	48	52	50	54
4	62	67	64	69
2	80	86	80	88
1	91	98	90	99
1/0	105	110	105	110
2/0	115	125	115	125
3/0	135	145	130	145
4/0	150	165	150	160
250	165	180	165	175
350	195	210	195	210
500	240	255	230	250
750	290	315	280	305
1000	335	360	320	345

Informational Note: Refer to 311.60(F) for basis of ampacities and table 311.10(A) for the temperature rating of the conductor.

Table 311.60(C)(79) Ampacities of Three Insulated Copper Conductors Cabled Within an Overall Covering (Three-Conductor Cable) in Underground Electrical Ducts (One Cable per Electrical Duct) Based on Ambient Earth Temperature of 20°C (68°F), Electrical Duct Arrangement in Accordance with Figure 311.60(C)(3), 100 Percent Load Factor, Thermal Resistance (RHO) of 90, Conductor Temperatures of 90°C (194°F) and 105°C (221°F)

Conductor Size (AWG or kcmil)	Temperature Rating of Conductor (See Table 311.10(A).)			
	2001–5000 Volts Ampacity		5001–35,000 Volts Ampacity	
	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105
One Circuit [See Figure 311.60(E)(3E), Detail 1.]				
8	59	64	—	—
6	78	84	88	95
4	100	110	115	125
2	135	145	150	160
1	155	165	170	185
1/0	175	190	195	210
2/0	200	220	220	235
3/0	230	250	250	270
4/0	265	285	285	305
250	290	315	310	335
350	355	380	375	400
500	430	460	450	485
750	530	570	545	585
1000	600	645	615	660
Three Circuits [See Figure 311.60(E)(3E), Detail 2.]				
8	53	57	—	—
6	69	74	75	81
4	89	96	97	105
2	115	125	125	135
1	135	145	140	155
1/0	150	165	160	175
2/0	170	185	185	195
3/0	195	210	205	220
4/0	225	240	230	250
250	245	265	255	270
350	295	315	305	325
500	355	380	360	385
750	430	465	430	465
1000	485	520	485	515
Six Circuits [See Figure 311.60(E)(3E), Detail 3.]				
8	46	50	—	—
6	60	65	63	68
4	77	83	81	87
2	98	105	105	110

Conductor Size (AWG or kcmil)	Temperature Rating of Conductor (See Table 311.10(A).)			
	2001–5000 Volts Ampacity		5001–35,000 Volts Ampacity	
	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105
1	110	120	115	125
1/0	125	135	130	145
2/0	145	155	150	160
3/0	165	175	170	180
4/0	185	200	190	200
250	200	220	205	220
350	240	270	245	275
500	290	310	290	305
750	350	375	340	365
1000	390	420	380	405

Informational Note: Refer to 311.60(F) for basis of ampacities and table 311.10(A) for the temperature rating of the conductor.

Table 311.60(C)(80) Ampacities of Three Insulated Aluminum Conductors Cabled Within an Overall Covering (Three-Conductor Cable) in Underground Electrical Ducts (One Cable per Electrical Duct) Based on Ambient Earth Temperature of 20°C (68°F), Electrical Duct Arrangement in Accordance with Figure 311.60(C)(3), 100 Percent Load Factor, Thermal Resistance (RHO) of 90, Conductor Temperatures of 90°C (194°F) and 105°C (221°F)

Conductor Size (AWG or kcmil)	Temperature Rating of Conductor (See Table 311.10(A).)			
	2001–5000 Volts Ampacity		5001–35,000 Volts Ampacity	
	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105
One Circuit [See Figure 311.60(C)(3E), Detail 1.]				
8	46	50	—	—
6	61	66	69	74
4	80	86	89	96
2	105	110	115	125
1	120	130	135	145
1/0	140	150	150	165
2/0	160	170	170	185
3/0	180	195	195	210
4/0	205	220	220	240
250	230	245	245	265
350	280	310	295	315
500	340	365	355	385
750	425	460	440	475
1000	495	535	510	545

Conductor Size (AWG or kcmil)	Temperature Rating of Conductor {See Table 311.10(A).}			
	2001–5000 Volts Ampacity		5001–35,000 Volts Ampacity	
	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105
Three Circuits [See Figure 311.60(C)(3E), Detail 2.]				
8	41	44	—	—
6	54	58	59	64
4	70	75	75	81
2	90	97	100	105
1	105	110	110	120
1/0	120	125	125	135
2/0	135	145	140	155
3/0	155	165	160	175
4/0	175	185	180	195
250	190	205	200	215
350	230	250	240	255
500	280	300	285	305
750	345	375	350	375
1000	400	430	400	430
Six Circuits [See Figure 311.60(C)(3E), Detail 3.]				
8	36	39	—	—
6	46	50	49	53
4	60	65	63	68
2	77	83	80	86
1	87	94	90	98
1/0	99	105	105	110
2/0	110	120	115	125
3/0	130	140	130	140
4/0	145	155	150	160
250	160	170	160	170
350	190	205	190	205
500	230	245	230	245
750	280	305	275	295
1000	320	345	315	335

Informational Note: Refer to 311.60(F) for basis of ampacities and table 311.10(A) for the temperature rating of the conductor.

Table 311.60(C)(81) Ampacities of Single Insulated Copper Conductors Directly Buried in Earth Based on Ambient Earth Temperature of 20°C (68°F), Arrangement per Figure 311.60(C)(3), 100 Percent Load Factor, Thermal Resistance (RHO) of 90, Conductor Temperatures of 90°C (194°F) and 105°C (221°F)

Conductor Size (AWG or kcmil)	Temperature Rating of Conductor (See Table 311.10(A).)			
	2001–5000 Volts Ampacity		5001–35,000 Volts Ampacity	
	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105
One Circuit, Three Conductors [See Figure 311.60(C)(3E), Detail 9.]				
8	110	115	—	—
6	140	150	130	140
4	180	195	170	180
2	230	250	210	225
1	260	280	240	260
1/0	295	320	275	295
2/0	335	365	310	335
3/0	385	415	355	380
4/0	435	465	405	435
250	470	510	440	475
350	570	615	535	575
500	690	745	650	700
750	845	910	805	865
1000	980	1055	930	1005
Two Circuits, Six Conductors [See Figure 311.60(C)(3E), Detail 10.]				
8	100	110	—	—
6	130	140	120	130
4	165	180	160	170
2	215	230	195	210
1	240	260	225	240
1/0	275	295	255	275
2/0	310	335	290	315
3/0	355	380	330	355
4/0	400	430	375	405
250	435	470	410	440
350	520	560	495	530
500	630	680	600	645
750	775	835	740	795
1000	890	960	855	920

Informational Note: Refer to 311.60(F) for basis of ampacities and table 311.10(A) for the temperature rating of the conductor.

Table 311.60(C)(82) Ampacities of Single Insulated Aluminum Conductors Directly Buried in Earth Based on Ambient Earth Temperature of 20°C (68°F), Arrangement per Figure 311.60(C)(3), 100 Percent Load Factor, Thermal Resistance (RHO) of 90, Conductor Temperatures of 90°C (194°F) and 105°C (221°F)

Conductor Size (AWG or kcmil)	Temperature Rating of Conductor (See Table 311.10(A).)			
	2001-5000 Volts Ampacity		5001-35,000 Volts Ampacity	
	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105
One Circuit, Three Conductors [See Figure 311.60(C)(3E), Detail 9.]				
8	85	90	—	—
6	110	115	100	110
4	140	150	130	140
2	180	195	165	175
1	205	220	185	200
1/0	230	250	215	230
2/0	265	285	245	260
3/0	300	320	275	295
4/0	340	365	315	340
250	370	395	345	370
350	445	480	415	450
500	540	580	510	545
750	665	720	635	680
1000	780	840	740	795
Two Circuits, Six Conductors [See Figure 311.60(C)(3E), Detail 10.]				
8	80	85	—	—
6	100	110	95	100
4	130	140	125	130
2	165	180	155	165
1	190	200	175	190
1/0	215	230	200	215
2/0	245	260	225	245
3/0	275	295	255	275
4/0	310	335	290	315
250	340	365	320	345
350	410	440	385	415
500	495	530	470	505
750	610	655	580	625
1000	710	765	680	730

Informational Note: Refer to 311.60(F) for basis of ampacities and table 311.10(A) for the temperature rating of the conductor.

Table 311.60(C)(3) Ampacities of Three Insulated Copper Conductors Cabled Within an Overall Covering (Three-Conductor Cable), Directly Buried in Earth Based on Ambient Earth Temperature of 20°C (68°F), Arrangement per Figure 311.60(C)(3), 100 Percent Load Factor, Thermal Resistance (RHO) of 90, Conductor Temperatures of 90°C (194°F) and 105°C (221°F)

Conductor Size (AWG or kcmil)	Temperature Rating of Conductor (See Table 311.10(A))			
	2001–5000 Volts Ampacity		5001–35,000 Volts Ampacity	
	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105
One Circuit [See Figure 311.60(C)(3), Detail 5.]				
8	85	89	—	—
6	105	115	115	120
4	135	150	145	155
2	180	190	185	200
1	200	215	210	225
1/0	230	245	240	255
2/0	260	280	270	290
3/0	295	320	305	330
4/0	335	360	350	375
250	365	395	380	410
350	440	475	460	495
500	530	570	550	590
750	650	700	665	720
1000	730	785	750	810
Two Circuits [See Figure 311.60(C)(3), Detail 6.]				
8	80	84	—	—
6	100	105	105	115
4	130	140	135	145
2	165	180	170	185
1	185	200	195	210
1/0	215	230	220	235
2/0	240	260	250	270
3/0	275	295	280	305
4/0	310	335	320	345
250	340	365	350	375
350	410	440	420	450
500	490	525	500	535
750	595	640	605	650
1000	665	715	675	730

Informational Note: Refer to 311.60(F) for basis of ampacities and table 311.10(A) for the temperature rating of the conductor.

Table 311.60(C)(84) Ampacities of Three Insulated Aluminum Conductors Cabled Within an Overall Covering (Three-Conductor Cable), Directly Buried in Earth Based on Ambient Earth Temperature of 20°C (68°F), Arrangement per Figure 311.60(C)(3), 100 Percent Load Factor, Thermal Resistance (RHO) of 90, Conductor Temperatures of 90°C (194°F) and 105°C (221°F)

Conductor Size (AWG or kcmil)	Temperature Rating of Conductor (See Table 311.10(A))			
	2001-5000 Volts Ampacity		5001-35,000 Volts Ampacity	
	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105
One Circuit [See Figure 311.60(C)(3), Detail 5.]				
8	65	70	—	—
6	80	88	90	95
4	105	115	115	125
2	140	150	145	155
1	155	170	165	175
1/0	180	190	185	200
2/0	205	220	210	225
3/0	230	250	240	260
4/0	260	280	270	295
250	285	310	300	320
350	345	375	360	390
500	420	450	435	470
750	520	560	540	580
1000	600	650	620	665
Two Circuits [See Figure 311.60(C)(3), Detail 6.]				
8	60	66	—	—
6	75	83	80	95
4	100	110	105	115
2	130	140	135	145
1	145	155	150	165
1/0	165	180	170	185
2/0	190	205	195	210
3/0	215	230	220	240
4/0	245	260	250	270
250	265	285	275	295
350	320	345	330	355
500	385	415	395	425
750	480	515	485	525
1000	550	590	560	600

Informational Note: Refer to 311.60(F) for basis of ampacities and table 311.10(A) for the temperature rating of the conductor.

Table 311.60(C)(85) Ampacities of Three Triplexed Single Insulated Copper Conductors Directly Buried in Earth Based on Ambient Earth Temperature of 20°C (68°F), Arrangement per Figure 311.60(C)(3), 100 Percent Load Factor, Thermal Resistance (RHO) of 90, Conductor Temperatures 90°C (194°F) and 105°C (221°F)

Conductor Size (AWG or kcmil)	Temperature Rating of Conductor {See Table 311.10 (A)-}			
	2001-5000 Volts Ampacity		5001-35,000 Volts Ampacity	
	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105
One Circuit, Three Conductors [See Figure 311.60(C)(3E), Detail 7.]				
8	90	95	—	—
6	120	130	115	120
4	150	165	150	160
2	195	205	190	205
1	225	240	215	230
1/0	255	270	245	260
2/0	290	310	275	295
3/0	330	360	315	340
4/0	375	405	360	385
250	410	445	390	410
350	490	580	470	505
500	590	635	565	605
750	725	780	685	740
1000	825	885	770	830
Two Circuits, Six Conductors [See Figure 311.60(C)(3E), Detail 8.]				
8	85	90	—	—
6	110	115	105	115
4	140	150	140	150
2	180	195	175	190
1	205	220	200	215
1/0	235	250	225	240
2/0	265	285	255	275
3/0	300	320	290	315
4/0	340	365	325	350
250	370	395	355	380
350	445	480	425	455
500	535	575	510	545
750	650	700	615	660
1000	740	795	690	745

Informational Note: Refer to 311.60(F) for basis of ampacities and table 311.10(A) for the temperature rating of the conductor.

Table 311.60(C)(86) Ampacities of Three Triplexed Single Insulated Aluminum Conductors Directly Buried in Earth Based on Ambient Earth Temperature of 20°C (68°F), Arrangement per Figure 311.60(C)(3), 100 Percent Load Factor, Thermal Resistance (RHO) of 90, Conductor Temperatures 90°C (194°F) and 105°C (221°F)

Conductor Size (AWG or kcmil)	Temperature Rating of Conductor {See Table 311.10(A).}			
	2001–5000 Volts Ampacity		5001–35,000 Volts Ampacity	
	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105	90°C (194°F) Type MV-90	105°C (221°F) Type MV-105
One Circuit, Three Conductors [See Figure 311.60(G)(3E), Detail 7.]				
8	70	75	—	—
6	90	100	90	95
4	120	130	115	125
2	155	165	145	155
1	175	190	165	175
1/0	200	210	190	205
2/0	225	240	215	230
3/0	255	275	245	265
4/0	290	310	280	305
250	320	350	305	325
350	385	420	370	400
500	465	500	445	480
750	580	625	550	590
1000	670	725	635	680
Two Circuits, Six Conductors [See Figure 311.60(G)(3E), Detail 8.]				
8	65	70	—	—
6	85	95	85	90
4	110	120	105	115
2	140	150	135	145
1	160	170	155	170
1/0	180	195	175	190
2/0	205	220	200	215
3/0	235	250	225	245
4/0	265	285	255	275
250	290	310	280	300
350	350	375	335	360
500	420	455	405	435
750	520	560	485	525
1000	600	645	565	605

Informational Note: Refer to 311.60(F) for basis of ampacities and table 311.10(A) for the temperature rating of the conductor.

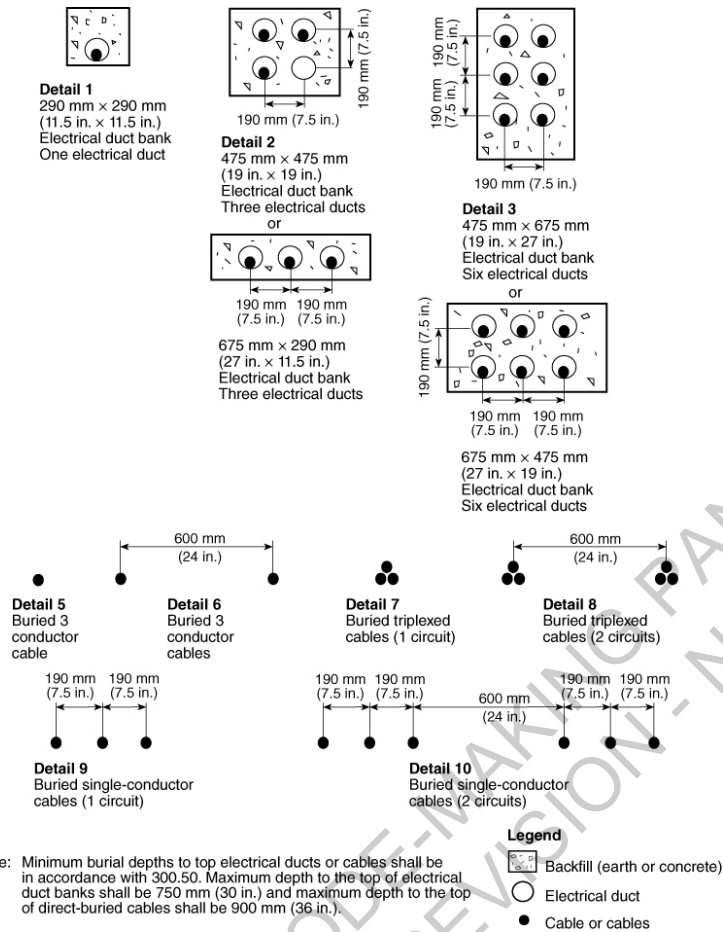


FIGURE 311.60(FC)(6) Cable Installation Dimensions for Use with Table 311.60(C)(77) Through Table 311.60(C)(86).

Article 310

Conductors for General Wiring

Part I. General

310.1 Scope.

This article covers general requirements for conductors **rated up to and including 2000 volts** and their type designations, insulations, markings, mechanical strengths, ampacity ratings, and uses. These requirements do not apply to conductors that form an integral part of equipment, such as motors, motor controllers, and similar equipment, or to conductors specifically provided for elsewhere in this Code.

Informational Note: For flexible cords and cables, see Article 400. For fixture wires, see Article 402.

310.3 Conductors **[moved from 310.106]**

(A) Minimum Size of Conductors.

The minimum size of conductors for voltage ratings up to and including 2000 volts shall be 14 AWG copper or 12 AWG aluminum or copper-clad aluminum, except as permitted elsewhere in this Code.

(B) Conductor Material.

Conductors in this article shall be of aluminum, copper-clad aluminum, or copper unless otherwise specified.

Solid aluminum conductors 8, 10, and 12 AWG shall be made of an AA-8000 series electrical grade aluminum alloy conductor material. Stranded aluminum conductors 8 AWG through 1000 kcmil marked as Type RHH, RHW, XHHW, XHHN, XHWN, THW, THHW, THWN, THHN, service-entrance Type SE Style U, and SE Style R shall be made of an AA-8000 series electrical grade aluminum alloy conductor material.

For a copper-clad aluminum conductor, the copper shall form a minimum of 10 percent of the cross-sectional area of a solid conductor or each strand of a stranded conductor. The aluminum core of a copper-clad aluminum conductor shall be made of an AA-8000 series electric grade aluminum alloy conductor material.

(C) Stranded Conductors.

Where installed in raceways, conductors 8 AWG and larger shall be stranded, ~~not unless~~ specifically permitted or required elsewhere in this Code to be solid, ~~shall be stranded~~.

(D) Insulated.

Conductors, not specifically permitted elsewhere in this Code to be covered or bare, shall be insulated.

Informational Note: See 250.184 for insulation of neutral conductors of a solidly grounded high-voltage system.

Part II. Construction Specifications [moved from Part III, 310.104]

310.4 Conductor Constructions and Applications. [moved from 310.104]

Insulated conductors shall comply with the applicable provisions of Table 310.4(A) and Table 310.4(B).

Informational Note: Thermoplastic insulation may stiffen at temperatures lower than -10C (+14F). Thermoplastic insulation may also be deformed at normal temperatures where subjected to pressure, such as at points of support.

Table 310.4(A) Conductor Applications and Insulations Rated 600 Volts¹

Trade Designation	Type Letter	Maximum Operating Temperature	Application Provisions	Insulation	Thickness of Insulation				Outer Covering ²	
					AWG or kcmil	mm	mils			
Fluorinated ethylene propylene	FEP or FEPB	90°C (194°F)	Dry and damp locations	Fluorinated ethylene propylene	14–10	0.51	20		None	
		200°C (392°F)	Dry locations — special applications ³	Fluorinated ethylene propylene	8–2	0.76	30		Glass braid	
					14–8	0.36	14			
					6–2	0.36	14			Glass or other suitable braid material
Mineral insulation (metal sheathed)	MI	90°C (194°F)	Dry and wet locations	Magnesium oxide	18–164	0.58	23		Copper or alloy steel	
		250°C (482°F)	For special applications ³		16–10	0.91	36			
					9–4	1.27	50			
					3–500	1.40	55			
Moisture-, heat-, and oil-resistant thermoplastic	MTW	60°C (140°F)	Machine tool wiring in wet locations	Flame-retardant, moisture-, heat-, and oil-resistant	22–12	(A)	(B)	(A)	(B)	(A) None
		90°C	Machine tool wiring			0.76	0.38	30	15	(B) Nylon jacket or equivalent

Commented [DM1]: TG2-12

Trade Designation	Type Letter	Maximum Operating Temperature	Application Provisions	Insulation	Thickness of Insulation					Outer Covering ²
		(194°F)			AWG or kcmil	mm	mils			
			in dry locations.	thermoplastic	10	0.76	0.51	30	20	
					8	1.14	0.76	45	30	
					6	1.52	0.76	60	30	
					4-2	1.52	1.02	60	40	
			Informational Note: See NFPA 79.		1-4/0	2.03	1.27	80	50	
					213-500	2.41	1.52	95	60	
					501-1000	2.79	1.78	110	70	
Paper		85°C (185°F)	For underground service conductors, or by special permission	Paper						Lead sheath
Perfluoroalkoxy	PFA	90°C (194°F) 200°C (392°F)	Dry and damp locations Dry locations — special applications ³	Perfluoroalkoxy	14-10 8-2 1-4/0	0.51 0.76 1.14		20 30 45		None
Perfluoroalkoxy	PFAH	250°C (482°F)	Dry locations only. Only for leads within apparatus or within raceways	Perfluoroalkoxy	14-10 8-2 1-4/0	0.51 0.76 1.14		20 30 45		None

Trade Designation	Type Letter	Maximum Operating Temperature	Application Provisions	Insulation	Thickness of Insulation			Outer Covering ²	
					AWG or kcmil	mm	mils		
Thermoset	RHH	90°C (194°F)	connected to apparatus (nickel or nickel-coated copper only) Dry and damp locations		14–10	1.14	45	Moisture - resistant, flame-retardant, nonmetallic covering 2	
					8–2	1.52	60		
					1–4/0	2.03	80		
					213–500	2.41	95		
					501–1000	2.79	110		
					1001 – 2000	3.18	125		
Moisture-resistant thermoset	RHW	75°C (167°F)	Dry and wet locations	Flame-retardant, moisture-resistant thermoset	14–10	1.14	45	Moisture - resistant, flame-retardant, nonmetallic covering	
					8–2	1.52	60		
					1–4/0	2.03	80		
	RHW-2	90°C (194°F)			213–500	2.41	95		
					501–1000	2.79	110		
					1001 – 2000	3.18	125		
Silicone	SA	90°C (194°F)	Dry and damp locations	Silicone rubber	14–10	1.14	45	Glass or other suitable	
					8–2	1.52	60		

Trade Designation	Type Letter	Maximum Operating Temperature	Application Provisions	Insulation	Thickness of Insulation			Outer Covering ²
					AWG or kcmil	mm	mils	
		200°C (392°F)	For special application 3		1–4/0 213–500 501–1000 1001–2000	2.03 2.41 2.79 3.18	80 95 110 125	braid material
Thermoset	SIS	90°C (194°F)	Switchboard and switchgear wiring only	Flame-retardant thermoset	14–10 8–2 1–4/0	0.76 1.14 2.41	30 45 55	None
Thermoplastic and fibrous outer braid	TBS	90°C (194°F)	Switchboard and switchgear wiring only	Thermoplastic	14–10 8 6–2 1–4/0	0.76 1.14 1.52 2.03	30 45 60 80	Flame-retardant, nonmetallic covering
Extended polytetrafluoroethylene	TFE	250°C (482°F)	Dry locations only. Only for leads within apparatus or within raceways connected to apparatus, or as open wiring (nickel or nickel-coated	Extruded polytetrafluoroethylene	14–10 8–2 1–4/0	0.51 0.76 1.14	20 30 45	None

Trade Designation	Type Letter	Maximum Operating Temperature	Application Provisions	Insulation	Thickness of Insulation			Outer Covering ²
					AWG or kcmil	mm	mils	
			copper only)					
Heat-resistant thermoplastic	THHN	90°C (194°F)	Dry and damp locations	Flame-retardant, heat-resistant thermoplastic	14–12	0.38	15	Nylon jacket or equivalent
					10	0.51	20	
					8–6	0.76	30	
					4–2	1.02	40	
					1–4/0	1.27	50	
					250–500	1.52	60	
					501–1000	1.78	70	
Moisture- and heat-resistant thermoplastic	THHW	75°C (167°F)	Wet location	Flame-retardant, moisture- and heat-resistant thermoplastic	14–10	0.76	30	None
					8	1.14	45	
					6–2	1.52	60	
		90°C (194°F)	Dry location		1–4/0	2.03	80	
					213–500	2.41	95	
					501–1000	2.79	110	
					1001–2000	3.18	125	
Moisture- and heat-resistant thermoplastic	THW	75°C (167°F)	Dry and wet locations	Flame-retardant, moisture- and heat-resistant thermoplastic	14–10	0.76	30	None
					8	1.14	45	
		90°C (194°F)	Special applications within		6–2	1.52	60	
					1–4/0	2.03	80	

Trade Designation	Type Letter	Maximum Operating Temperature	Application Provisions	Insulation	Thickness of Insulation			Outer Covering ²
					AWG or kcmil	mm	mils	
			electric discharge lighting equipment. Limited to 1000 open-circuit volts or less. (Size 14-8 only as permitted in 410.68.)		213-500	2.41	95	
					501-1000	2.79	110	
	THW-2	90°C (194°F)	Dry and wet locations		1001-2000	3.18	125	
Moisture- and heat-resistant thermoplastic	THW-N	75°C (167°F)	Dry and wet locations	Flame-retardant, moisture- and heat-resistant thermoplastic	14-12	0.38	15	Nylon jacket or equivalent
					10	0.51	20	
					8-6	0.76	30	
					4-2	1.02	40	
	THW-N-2	90°C (194°F)			1-4/0	1.27	50	
					250-500	1.52	60	
Moisture-resistant thermoplastic	TW	60°C (140°F)	Dry and wet locations	Flame-retardant, moisture-resistant thermoplastic	501-1000	1.78	70	None
					14-10	0.76	30	
					8	1.14	45	
					6-2	1.52	60	
					1-4/0	2.03	80	
					213-500	2.41	95	

Trade Designation	Type Letter	Maximum Operating Temperature	Application Provisions	Insulation	Thickness of Insulation			Outer Covering ²
					AWG or kcmil	mm	mils	
					501–1000	2.79	110	
					1001–2000	3.18	125	
Underground feeder and branch-circuit cable — single conductor (for Type UF cable employing more than one conductor, see Article 340).	UF	60°C	See Article 340.	Moisture-resistant	14–10	1.52	606	Integral with insulation
		(140°F)			8–2	2.03	806	
		75°C (167°F) ⁵		Moisture- and heat-resistant	1–4/0	2.41	956	
Underground service-entrance cable — single conductor (for Type USE cable employing more than one conductor, see Article 338).	USE	75°C	See Article 338.	Heat- and moisture-resistant	14–10	1.14	45	Moisture-resistant nonmetallic covering (See 338.2.)
					8–2	1.52	60	
					1–4/0	2.03	80	
					213–500	2.41	95.7	
					501–1000	2.79	110	
					1001–2000	3.18	125	
	USE-2	90°C (194°F)	Dry and wet locations					
Thermoset	XHH	90°C	Dry and damp locations	Flame-retardant thermoset	14–10	0.76	30	None
					8–2	1.14	45	
		(194°F)			1–4/0	1.40	55	

Trade Designation	Type Letter	Maximum Operating Temperature	Application Provisions	Insulation	Thickness of Insulation			Outer Covering ²
					AWG or kcmil	mm	mils	
					213–500	1.65	65	
					501–1000	2.03	80	
					1001–2000	2.41	95	
Thermoset	XHHN	90°C (194°F)	Dry and damp locations	Flame-retardant thermoset	14–12	0.38	15	Nylon jacket or equivalent
					10	0.51	20	
					8–6	0.76	30	
					4–2	1.02	40	
					1–4/0	1.27	50	
					250–500	1.52	60	
					501–1000	1.78	70	
Moisture-resistant thermoset	XHHW	90°C (194°F)	Dry and damp locations		14–10	0.76	30	None
					8–2	1.14	45	
		75°C (167°F)	Wet locations	Flame-retardant, moisture-resistant thermoset	1–4/0	1.40	55	
					213–500	1.65	65	
					501–1000	2.03	80	
					1001–2000	2.41	95	
Moisture-resistant thermoset	XHHW-2	90°C (194°F)	Dry and wet locations	Flame-retardant, moisture-	14–10	0.76	30	None
					8–2	1.14	45	

Trade Designation	Type Letter	Maximum Operating Temperature	Application Provisions	Insulation	Thickness of Insulation			Outer Covering ²		
					AWG or kcmil	mm	mils			
				resistant thermoset	1–4/0	1.40	55			
					213–500	1.65	65			
					501–1000	2.03	80			
					1001–2000	2.41	95			
Moisture-resistant thermoset	XHW N	75°C (167°F)	Dry and wet locations	Flame-retardant, moisture-resistant thermoset	14–12	0.38	15	Nylon jacket or equivalent		
					10	0.51	20			
					8–6	0.76	30			
	XHW N-2	90°C (194°F)			4–2	1.02	40			
					1–4/0	1.27	50			
					250–500	1.52	60			
			501–1000	1.78	70					
Modified ethylene tetrafluoro-ethylene	Z	90°C (194°F)	Dry and damp locations	Modified ethylene tetrafluoro-ethylene	14–12	0.38	15	None		
		150°C (302°F)	Dry locations — special applications ³		10	0.51	20			
					8–4	0.64	25			
					3–1	0.89	35			
					1/0–4/0	1.14	45			
Modified ethylene tetrafluoro-ethylene	ZW	75°C (167°F)	Wet locations	Modified ethylene tetrafluoro-ethylene	14–10	0.76	30	None		
		90°C (194°F)	Dry and damp locations		8–2	1.14	45			

Trade Designation	Type Letter	Maximum Operating Temperature	Application Provisions	Insulation	Thickness of Insulation			Outer Covering ²
		150°C (302°F)	Dry locations — special applications ³		AWG or kcmil	mm	mils	
	ZW-2	90°C (194°F)	Dry and wet locations					

¹ Conductors shall be permitted to be rated up to 1000 V if listed and marked.

² Outer coverings shall not be required where listed without a covering.

³ Where design conditions require maximum conductor operating temperatures above 90°C (194°F).

⁴ For signaling circuits permitting 300-volt insulation.

⁵ For ampacity limitation, see 340.80.

⁶ Includes integral jacket.

⁷ Insulation thickness shall be permitted to be 2.03 mm (80 mils) for listed Type USE conductors that have been subjected to special investigations. The nonmetallic covering over individual rubber-covered conductors of aluminum-sheathed cable and of lead-sheathed or multiconductor cable shall not be required to be flame retardant. For Type MC cable, see 330.104. For nonmetallic-sheathed cable, see Article 334, Part III. For Type UF cable, see Article 340, Part III.

Commented [CK2]: Table notes should be mandatory

Table 310.4(B) Thickness of Insulation for Nonshielded Types RHH and RHW Solid Dielectric Insulated Conductors Rated 2000 Volts

Conductor Size (AWG or kcmil)	Column A ¹		Column B ²	
	mm	mils	mm	mils
14–10	2.03	80	1.52	60
8	2.03	80	1.78	70
6–2	2.41	95	1.78	70
1–2/0	2.79	110	2.29	90
3/0–4/0	2.79	110	2.29	90
213–500	3.18	125	2.67	105

Conductor Size (AWG or kcmil)	Column A ¹		Column B ²	
	mm	mils	mm	mils
501–1000	3.56	140	3.05	120
1001–2000	3.56	140	3.56	140

¹Column A insulations are limited to natural, SBR, and butyl rubbers.

²Column B insulations are materials such as cross-linked polyethylene, ethylene propylene rubber, and composites thereof.

Commented [CK3]: Table notes should be mandatory

310.6 Conductor Identification. [moved from 310.110]

(A) Grounded Conductors.

Insulated or covered grounded conductors shall be identified in accordance with 200.6.

(B) Equipment Grounding Conductors.

Equipment grounding conductors shall be identified in accordance with 250.119.

(C) Ungrounded Conductors.

Conductors that are intended for use as ungrounded conductors, whether used as a single conductor or in multiconductor cables, shall be finished to be clearly distinguishable from grounded, ~~and~~ grounding, and bonding conductors. Distinguishing markings shall not conflict in any manner with the surface markings required by 310.8(B)(1). Branch-circuit ungrounded conductors shall be identified in accordance with 210.5(C). Feeders shall be identified in accordance with 215.12.

Exception: Conductor identification shall be permitted in accordance with 200.7.

310.8 Marking. [moved from 310.120]

(A) Required Information.

All conductors and cables shall be marked to indicate the following information, using the applicable method described in 310.8(B):

- (1) The maximum rated voltage.
- (2) The proper type letter or letters for the type of wire or cable as specified elsewhere in this Code.
- (3) The manufacturer's name, trademark, or other distinctive marking by which the organization responsible for the product can be readily identified.
- (4) The AWG size or circular mil area.

Informational Note: See Conductor Properties, Table 8 of Chapter 9, for conductor area expressed in SI units for conductor sizes specified in AWG or circular mil area.

- (5) Cable assemblies where the neutral conductor is smaller than the ungrounded conductors shall be so marked.

(B) Method of Marking.

(1) Surface Marking.

The following conductors and cables shall be durably marked on the surface. The AWG size or circular mil area shall be repeated at intervals not exceeding 610 mm (24 in.). All other markings shall be repeated at intervals not exceeding 1.0 m (40 in.).

- (1) Single-conductor and multiconductor rubber- and thermoplastic-insulated wire and cable

- (2) Nonmetallic-sheathed cable
- (3) Service-entrance cable
- (4) Underground feeder and branch-circuit cable
- (5) Tray cable
- (6) Irrigation cable
- (7) Power-limited tray cable
- (8) Instrumentation tray cable

(2) Marker Tape.

Metal-covered multiconductor cables shall employ a marker tape located within the cable and running for its complete length.

Exception No. 1: Type MI cable.

Exception No. 2: Type AC cable.

Exception No. 3: The information required in 310.8(A) shall be permitted to be durably marked on the outer nonmetallic covering of Type MC, Type ITC, or Type PLTC cables at intervals not exceeding 1.0 m (40 in.).

Exception No. 4: The information required in 310.8(A) shall be permitted to be durably marked on a nonmetallic covering under the metallic sheath of Type ITC or Type PLTC cable at intervals not exceeding 1.0 m (40 in.).

Informational Note: Included in the group of metal-covered cables are Type AC cable (Article 320), Type MC cable (Article 330), and lead-sheathed cable.

(3) Tag Marking.

The following conductors and cables shall be marked by means of a printed tag attached to the coil, reel, or carton:

- (1) Type MI cable
- (2) Switchboard wires
- (3) Metal-covered, single-conductor cables
- (4) Type AC cable

(4) Optional Marking of Wire Size.

The information required in 310.8(A)(4) shall be permitted to be marked on the surface of the individual insulated conductors for the following multiconductor cables:

- (1) Type MC cable
- (2) Tray cable
- (3) Irrigation cable
- (4) Power-limited tray cable
- (5) Power-limited fire alarm cable
- (6) Instrumentation tray cable

(C) Suffixes to Designate Number of Conductors.

A type letter or letters used alone shall indicate a single insulated conductor. The letter suffixes shall be indicated as follows:

- (1) D — For two insulated conductors laid parallel within an outer nonmetallic covering
- (2) M — For an assembly of two or more insulated conductors twisted spirally within an outer nonmetallic covering

(D) Optional Markings.

All conductors and cables contained in Chapter 3 shall be permitted to be surface marked to indicate special characteristics of the cable materials. These markings include, but are not limited to, markings for limited smoke, sunlight resistant, and so forth.

Part III. Installation. [is Part II in current edition]

310.10 Uses Permitted.

The conductors described in 310.4 shall be permitted for use in any of the wiring methods covered in Chapter 3 and as specified in their respective tables or as permitted elsewhere in this Code.

(A) Dry Locations.

Insulated conductors and cables used in dry locations shall be any of the types identified in this Code.

(B) Dry and Damp Locations.

Insulated conductors and cables used in dry and damp locations shall be Types FEP, FEPB, MTW, PFA, RHH, RHW, RHW-2, SA, THHN, THW, THW-2, THHW, THWN, THWN-2, TW, XHH, XHHW, XHHW-2, XHHN, XHWN, XHWN-2, Z, or ZW.

(C) Wet Locations.

Insulated conductors and cables used in wet locations shall comply with one of the following:

- (1) Be moisture-impervious metal-sheathed
- (2) Be types MTW, RHW, RHW-2, TW, THW, THW-2, THHW, THWN, THWN-2, XHHW, XHHW-2, XHWN, XHWN-2 or ZW
- (3) Be of a type listed for use in wet locations

(D) Locations Exposed to Direct Sunlight.

Insulated conductors or cables used where exposed to direct rays of the sun shall comply with (D)(1) or (D)(2):

- (1) Conductors and cables shall be listed, or listed and marked, as being sunlight resistant
- (2) Conductors and cables shall be covered with insulating material, such as tape or sleeving, that is listed, or listed and marked, as being sunlight resistant

(E) Direct-Burial Conductors.

Conductors used for direct-burial applications shall be of a type identified for such use.

(F) Corrosive Conditions.

Conductors exposed to oils, greases, vapors, gases, fumes, liquids, or other substances having a deleterious effect on the conductor or insulation shall be of a type suitable for the application.

(G) Conductors in Parallel.

(1) General.

Aluminum, copper-clad aluminum, or copper conductors, for each phase, polarity, neutral, or grounded circuit shall be permitted to be connected in parallel (electrically joined at both ends) only in sizes 1/0 AWG and larger where installed in accordance with 310.10(G)(2) through (G)(6).

Exception No. 1: Conductors in sizes smaller than 1/0 AWG shall be permitted to be run in parallel to supply control power to indicating instruments, contactors, relays, solenoids, and similar control devices, or for frequencies of 360 Hz and higher, provided all of the following apply:

(a) They are contained within the same raceway or cable.

(b) The ampacity of each individual conductor is sufficient to carry the entire load current shared by the parallel conductors.

(c) The overcurrent protection is such that the ampacity of each individual conductor will not be exceeded if one or more of the parallel conductors become inadvertently disconnected.

Exception No. 2: Under engineering supervision, 2 AWG and 1 AWG grounded neutral conductors shall be permitted to be installed in parallel for existing installations.

Informational Note to Exception No. 2: Exception No. 2 can be used to alleviate overheating of neutral conductors in existing installations due to high content of triplen harmonic currents.

(2) Conductor and Installation Characteristics.

The paralleled conductors in each phase, polarity, neutral, grounded circuit conductor, equipment grounding conductor, or equipment bonding jumper shall comply with all of the following:

- (1) Be the same length.
- (2) Consist of the same conductor material.
- (3) Be the same size in circular mil area.
- (4) Have the same insulation type.
- (5) Be terminated in the same manner.

(3) Separate Cables or Raceways.

Where run in separate cables or raceways, the cables or raceways with conductors shall have the same number of conductors and shall have the same electrical characteristics. Conductors of one phase, polarity, neutral, grounded circuit conductor, or equipment grounding conductor shall not be required to have the same physical characteristics as those of another phase, polarity, neutral, grounded circuit conductor, or equipment grounding conductor.

(4) Ampacity Adjustment.

Conductors installed in parallel shall comply with the provisions of 310.15 ~~(C)(1)(B)(3)(a)~~.

(5) Equipment Grounding Conductors.

Where parallel equipment grounding conductors are used, they shall be sized in accordance with 250.122. Sectioned equipment grounding conductors smaller than 1/0 AWG shall be permitted in multiconductor cables, if the combined circular mil area of the sectioned equipment grounding conductors in each cable complies with 250.122.

(6) Bonding Jumpers.

Where parallel equipment bonding jumpers or supply-side bonding jumpers are installed in raceways, they shall be sized and installed in accordance with 250.102.

310.12 Single-Phase Dwelling Services and Feeders. [moved from 310.15(B)(7)]

For one-family dwellings and the individual dwelling units of two-family and multifamily dwellings, service and feeder conductors supplied by a single-phase, 120/240-volt system shall be permitted to be sized in accordance with 310.12(1) through (4).

For one-family dwellings and the individual dwelling units of two-family and multifamily dwellings, single-phase feeder conductors consisting of 2 ungrounded conductors and the neutral conductor from a 208Y/120 volt system shall be permitted to be sized in accordance with 310.12(1) through (3).

(1) For a service rated 100 through 400 amperes, the service conductors supplying the entire load associated with a

one-family dwelling, or the service conductors supplying the entire load associated with an individual dwelling unit in a two-family or multifamily dwelling, shall be permitted to have an ampacity not less than 83 percent of the service rating. If no adjustment or correction factors are required, Table 310.12 shall be permitted to be applied.

(2) For a feeder rated 100 through 400 amperes, the feeder conductors supplying the entire load associated with a one-family dwelling, or the feeder conductors supplying the entire load associated with an individual dwelling unit

in a two-family or multifamily dwelling, shall be permitted to have an ampacity not less than 83 percent of the feeder rating. If no adjustment or correction factors are required, Table 310.12 shall be permitted to be applied.

(3) In no case shall a feeder for an individual dwelling unit be required to have an ampacity greater than that specified in 310.12(1) or (2).

(4) Grounded conductors shall be permitted to be sized smaller than the ungrounded conductors, if the requirements of 220.61 and 230.42 for service conductors or the requirements of 215.2 and 220.61 for feeder conductors are met.

Where correction or adjustment factors are required by 310.15(B) or (C), they shall be permitted to be applied to the ampacity associated with the temperature rating of the conductor.

Informational Note No. 1: The service or feeder ratings addressed by this section are based on the standard ~~ampereampacity~~ ratings for fuses and inverse time circuit breakers from 240.6(A).

Informational Note No. 2: See Example D7 in Annex D.

Table 310.12 Single-Phase Dwelling Services and Feeders.

<u>Service or Feeder Rating (Amperes)</u>	<u>Conductor (AWG or kcmil)</u>	
	<u>Copper</u>	<u>Aluminum or Copper-Clad Aluminum</u>
<u>100</u>	<u>4</u>	<u>2</u>
<u>110</u>	<u>3</u>	<u>1</u>
<u>125</u>	<u>2</u>	<u>1/0</u>
<u>150</u>	<u>1</u>	<u>2/0</u>
<u>175</u>	<u>1/0</u>	<u>3/0</u>
<u>200</u>	<u>2/0</u>	<u>4/0</u>
<u>225</u>	<u>3/0</u>	<u>250</u>
<u>250</u>	<u>4/0</u>	<u>300</u>
<u>300</u>	<u>250</u>	<u>350</u>
<u>350</u>	<u>350</u>	<u>500</u>
<u>400</u>	<u>400</u>	<u>600</u>

Note: If no adjustment or correction factors are required, this table shall be permitted to be applied.

310.14 Ampacities for Conductors Rated 0-2000 Volts. [moved from 310.15]

(A) General.

(1) Tables or Engineering Supervision.

Ampacities for conductors shall be permitted to be determined by tables as provided in 310.15 or under engineering supervision, as provided in 310.14(B).

Informational Note No. 1: Ampacities provided by this section do not take voltage drop into consideration. See 210.19(A), Informational Note No. 4, for branch circuits and 215.2(A), Informational Note No. 2, for feeders.

Informational Note No. 2: For the allowable ampacities of Type MTW wire, see Table 1243.5.1 in NFPA 79-2015, Electrical Standard for Industrial Machinery.

(2) Selection of Ampacity.

Where more than one ampacity applies for a given circuit length, the lowest value shall be used.

Exception: Where different ampacities apply to portions of a circuit, the higher ampacity shall be permitted to be used if the total portion(s) of the circuit with lower ampacity does not exceed the lesser of 3.0 m (10 ft) or 10 percent of the total circuit.

Informational Note: See 110.14(C) for conductor temperature limitations due to termination provisions.

(3) Temperature Limitation of Conductors.

No conductor shall be used in such a manner that its operating temperature exceeds that designated for the type of insulated conductor involved. In no case shall conductors be associated together in such a way, with respect to type of circuit, the wiring method employed, or the number of conductors, that the limiting temperature of any conductor is exceeded.

Informational Note No. 1: The temperature rating of a conductor [see Table 310.4(A)] is the maximum temperature, at any location along its length, that the conductor can withstand over a prolonged time period without serious degradation. The ~~allowable~~ ampacity tables, ~~the ampacity tables~~ of Article 310 and the ampacity tables of Informative Annex B, the ambient temperature correction factors in 310.15(B), and the notes to the tables provide guidance for coordinating conductor sizes, types, ~~allowable ampacities~~, ampacities, ambient temperatures, and number of associated conductors. The principal determinants of operating temperature are as follows:

(1) Ambient temperature — ambient temperature may vary along the conductor length as well as from time to time.

(2) Heat generated internally in the conductor as the result of load current flow, including fundamental and harmonic currents.

(3) The rate at which generated heat dissipates into the ambient medium. Thermal insulation that covers or surrounds conductors affects the rate of heat dissipation.

(4) Adjacent load-carrying conductors — adjacent conductors have the dual effect of raising the ambient temperature and impeding heat dissipation.

Informational Note No. 2: Refer to 110.14(C) for the temperature limitation of terminations.

(B) Engineering Supervision. [NEW]

Under engineering supervision, conductor ampacities shall be permitted to be calculated by means of the following general equation:

$$I = \sqrt{\frac{T_c - T_a}{R_x(1 + Y_c)R_a}} \times 10^3 \text{ amperes} \quad [310.14(B)]$$

where:

T_c = conductor temperature in degrees Celsius (°C)

T_a = ambient temperature in degrees Celsius (°C)

R_{dc} = dc resistance of 305 mm (1 ft) of conductor in microohms

at temperature, T_c

Y_c = component ac resistance resulting from skin effect and

proximity effect

R_{ca} = effective thermal resistance between conductor and surrounding ambient

310.15 Ampacity Tables. [moved from 310.15(B)]

Ampacities for conductors rated 0 volts to 2000 volts shall be as specified in the Allowable-Ampacity Tables 310.16 through Table 310.21, and Ampacity Table 310.20 and Table 310.21 as modified by 310.15(A) through (F) and 310.12. Under engineering supervision, ampacities of sizes not shown in ampacity tables for conductors meeting the general wiring requirements shall be permitted to be determined by interpolation of the adjacent conductors based on the conductor's area.

The temperature correction and adjustment factors shall be permitted to be applied to the ampacity for the temperature rating of the conductor, if the corrected and adjusted ampacity does not exceed the ampacity for the temperature rating of the termination in accordance with the provisions of 110.14(C).

Informational Note No. 1: Table 310.16 through Table 310.19 are application tables for use in determining conductor sizes on loads calculated in accordance with Article 220. Allowable Ampacities result from consideration of one or more of the following:

- (1) Temperature compatibility with connected equipment, especially the connection points.
- (2) Coordination with circuit and system overcurrent protection.
- (3) Compliance with the requirements of product listings or certifications. See 110.3(B).
- (4) Preservation of the safety benefits of established industry practices and standardized procedures.

Informational Note No. 2: For conductor area see Chapter 9, Table 8, Conductor Properties.

Informational Note No. 3: For the ampacities of flexible cords and cables, see 400.5. For the ampacities of fixture wires, see 402.5.

(A) General. [moved from 310.15(B)(1)]

For explanation of type letters used in tables and for recognized sizes of conductors for the various conductor insulations, see Table 310.4(A) and Table 310.4(B). For installation requirements, see 310.1 through 310.14 and the various articles of this Code. For flexible cords, see Table 400.4, Table 400.5(A)(1), and Table 400.5(A)(2).

(B) Ambient Temperature Correction Factors. [moved from 310.15(B)(2)]

Ampacities for ambient temperatures other than those shown in the ampacity tables shall be corrected in accordance with Table 310.15(B)(1) or Table 310.15(B)(2), or shall be permitted to be calculated using the following equation:

$$I' = I \sqrt{\frac{T_c - T_a'}{T_c - T_a}} \quad [310.15(B)]$$

where:

I' = ampacity corrected for ambient temperature

I = ampacity shown in the tables

T_c = temperature rating of conductor (°C)

T_a' = new ambient temperature (°C)

T_a = ambient temperature used in the table (°C)

Table 310.15(B)(1) Ambient Temperature Correction Factors Based on 30C (86F)

For ambient temperatures other than 30°C (86°F), multiply the allowable ampacities specified in the ampacity tables by the appropriate correction factor shown below.

Ambient Temperature (°C)	Temperature Rating of Conductor			Ambient Temperature (°F)
	60°C	75°C	90°C	
10 or less	1.29	1.20	1.15	50 or less

For ambient temperatures other than 30°C (86°F), multiply the allowable ampacities specified in the ampacity tables by the appropriate correction factor shown below.				
Ambient	Temperature Rating of Conductor			Ambient
Temperature	60°C	75°C	90°C	Temperature
(°C)				(°F)
11–15	1.22	1.15	1.12	51–59
16–20	1.15	1.11	1.08	60–68
21–25	1.08	1.05	1.04	69–77
26–30	1.00	1.00	1.00	78–86
31–35	0.91	0.94	0.96	87–95
36–40	0.82	0.88	0.91	96–104
41–45	0.71	0.82	0.87	105–113
46–50	0.58	0.75	0.82	114–122
51–55	0.41	0.67	0.76	123–131
56–60	—	0.58	0.71	132–140
61–65	—	0.47	0.65	141–149
66–70	—	0.33	0.58	150–158
71–75	—	—	0.50	159–167
76–80	—	—	0.41	168–176
81–85	—	—	0.29	177–185

Table 310.15(B)(2) Ambient Temperature Correction Factors Based on 40C (104F)

For ambient temperatures other than 40°C (104°F), multiply the allowable ampacities specified in the ampacity tables by the appropriate correction factor shown below.							
Ambient	Temperature Rating of Conductor						Ambient
Temperature	60°C	75°C	90°C	150°C	200°C	250°C	Temperature
(°C)							(°F)
10 or less	1.58	1.36	1.26	1.13	1.09	1.07	50 or less
11–15	1.50	1.31	1.22	1.11	1.08	1.06	51–59
16–20	1.41	1.25	1.18	1.09	1.06	1.05	60–68
21–25	1.32	1.2	1.14	1.07	1.05	1.04	69–77
26–30	1.22	1.13	1.10	1.04	1.03	1.02	78–86
31–35	1.12	1.07	1.05	1.02	1.02	1.01	87–95
36–40	1.00	1.00	1.00	1.00	1.00	1.00	96–104
41–45	0.87	0.93	0.95	0.98	0.98	0.99	105–113
46–50	0.71	0.85	0.89	0.95	0.97	0.98	114–122
51–55	0.50	0.76	0.84	0.93	0.95	0.96	123–131
56–60	—	0.65	0.77	0.90	0.94	0.95	132–140
61–65	—	0.53	0.71	0.88	0.92	0.94	141–149
66–70	—	0.38	0.63	0.85	0.90	0.93	150–158
71–75	—	—	0.55	0.83	0.88	0.91	159–167
76–80	—	—	0.45	0.80	0.87	0.90	168–176
81–90	—	—	—	0.74	0.83	0.87	177–194
91–100	—	—	—	0.67	0.79	0.85	195–212
101–110	—	—	—	0.60	0.75	0.82	213–230
111–120	—	—	—	0.52	0.71	0.79	231–248
121–130	—	—	—	0.43	0.66	0.76	249–266
131–140	—	—	—	0.30	0.61	0.72	267–284
141–160	—	—	—	—	0.50	0.65	285–320
161–180	—	—	—	—	0.35	0.58	321–356
181–200	—	—	—	—	—	0.49	357–392

For ambient temperatures other than 40°C (104°F), multiply the allowable ampacities specified in the ampacity tables by the appropriate correction factor shown below.

Ambient	Temperature Rating of Conductor						Ambient
Temperature	60°C	75°C	90°C	150°C	200°C	250°C	Temperature
(°C)							(°F)
201–225	—	—	—	—	—	0.35	393–437

(C) Adjustment Factors. [moved from 310.15(B)(3)]

(1) More than Three Current-Carrying Conductors.

~~Where the~~ The ampacity of each conductor shall be reduced as shown in Table 310.15(C)(1) where
~~the~~ the number of current-carrying conductors in a raceway or cable exceeds three, or where single
conductors or multiconductor cables not installed in raceways are installed without maintaining spacing
for a continuous length longer than 600 mm (24 in.) ~~and are not installed in raceways, the allowable~~
~~ampacity of each conductor shall be reduced as shown in Table 310.15(C)(1).~~ Each current-
carrying conductor of a paralleled set of conductors shall be counted as a current-carrying conductor.

Table 310.15(C)(1) Adjustment Factors for More Than Three Current-Carrying Conductors

Number of Conductors*	Percent of Values in Table 310.16 Through Table 310.19 as Adjusted for Ambient Temperature if Necessary
4–6	80
7–9	70
10–20	50
21–30	45
31–40	40
41 and above	35

*Number of conductors is the total number of conductors in the raceway or cable, including spare
conductors. The count shall be adjusted in accordance with 310.15(E) and (F). The count shall
not include conductors that are connected to electrical components that cannot be simultaneously
energized.

Notes:

(12) Raceway Spacing.

Spacing between raceways shall be maintained.

(23) Raceways and Cables Exposed to Sunlight on Rooftops.

Where ~~raceways or cables are~~ exposed to direct sunlight on or above rooftops, ~~raceways or cables shall be installed a minimum distance above the roof to the bottom of the raceway or cable of 23 mm (7/8 in.).~~ Where the distance above the roof to the bottom of the raceway or cable is less than 23 mm (7/8 in.), a temperature adder of 33°C (60°F) shall be added to the outdoor temperature to determine the applicable ambient temperature for application of the correction factors in Table 310.15(B)(1) or Table 310.15(B)(2).

Exception: Type XHHW-2 insulated conductors shall not be subject to this ampacity adjustment.

Informational Note: One source for the ambient temperatures in various locations is the ASHRAE Handbook — Fundamentals.

Where conductors of different systems, as provided in 300.3, are installed in a common raceway or cable, the adjustment factors shown in Table 310.15(C)(1) shall apply only to the number of power and lighting conductors (Articles 210, 215, 220, and 230).

Informational Note No. 1: See Annex B for adjustment factors for more than three current-carrying conductors in a raceway or cable with load diversity.

Informational Note No. 2: See 366.23 for adjustment factors for conductors and ampacity for bare copper and aluminum bars in auxiliary gutters and 376.22(B) for adjustment factors for conductors in metal wireways.

- (a) Where conductors are installed in cable trays, the provisions of 392.80 shall apply.
- (b) Adjustment factors shall not apply to conductors in raceways having a length not exceeding 600 mm (24 in.).
- (c) Adjustment factors shall not apply to underground conductors entering or leaving an outdoor trench if those conductors have physical protection in the form of rigid metal conduit, intermediate metal conduit, rigid polyvinyl chloride conduit (PVC), or reinforced thermosetting resin conduit (RTRC) having a length not exceeding 3.05 m (10 ft), and if the number of conductors does not exceed four.
- (d) Adjustment factors shall not apply to Type AC cable or to Type MC cable under the following conditions:
 - 1. The cables do not have an overall outer jacket.
 - 2. Each cable has not more than three current-carrying conductors.
 - 3. The conductors are 12 AWG copper.
 - 4. Not more than 20 current-carrying conductors are installed without maintaining spacing, are stacked, or are supported on “bridle rings.”

Exception to (d): If cables meeting the requirements in 310.15(C)(1)(d)1 through 34 with more than 20 current-carrying conductors are installed longer than 600 mm (24 in.) without maintaining spacing, are stacked, or are supported on bridle rings, a 60 percent adjustment factor shall be applied.

(D) Bare or Covered Conductors. [moved from 310.15(B)(4)]

Where bare or covered conductors are installed with insulated conductors, the temperature rating of the bare or covered conductor shall be equal to the lowest temperature rating of the insulated conductors for the purpose of determining ampacity.

(E) Neutral Conductor. [moved from 310.15(B)(5)]

(1a) A neutral conductor that carries only the unbalanced current from other conductors of the same circuit shall not be required to be counted when applying the provisions of 310.15(C)(1).

(2b) In a 3-wire circuit consisting of two phase conductors and the neutral conductor of a 4-wire, 3-phase, wye-connected system, a common conductor carries approximately the same current as the line-to-neutral load currents of the other conductors and shall be counted when applying the provisions of 310.15(C)(1).

(3e) On a 4-wire, 3-phase wye circuit where the major portion of the load consists of nonlinear loads, harmonic currents are present in the neutral conductor; the neutral conductor shall therefore be considered a current-carrying conductor.

(F) Grounding or Bonding Conductor. [moved from 310.15(B)(6)]

A grounding or bonding conductor shall not be counted when applying the provisions of 310.15(C)(1).

310.16 Allowable Ampacities of Insulated Conductors in Raceway, Cable, or Earth (Directly Buried). [NEW]

The maximum allowable ampacities shall be as specified in Table 310.16 where all of the following conditions apply:

1a) ~~C~~onductors are rated 0 volts to 2000 volts.

2b) ~~C~~onductors are rated 60°C (140°F), 75°C (167°F), or 90°C (194°F).

3e) ~~W~~iring is installed in a 30°C (86°F) ambient temperature. ~~and~~

4d) ~~T~~here are not more than three current-carrying conductors.

310.17 Allowable Ampacities of Single-Insulated Conductors in Free Air. [NEW]

The maximum allowable ampacities shall be as specified in Table 310.17 where all of the following conditions apply:

1a) ~~C~~onductors are rated 0 volts to 2000 volts.

2b) ~~C~~onductors are rated 60°C (140°F), 75°C (167°F), or 90°C (194°F). ~~and~~

3e) ~~W~~iring is installed in a 30°C (86°F) ambient temperature.

310.18 Allowable Ampacities of Insulated Conductors in Raceway or Cable. [NEW]

The maximum allowable ampacities shall be as specified in Table 310.18 where all of the following conditions apply:

1a) ~~C~~onductors are rated 0 volts to 2000 volts.

2b) ~~C~~onductors are rated 150°C (302°F), 200°C (392°F), or 250°C (482°F).

~~3e) W~~wiring is installed in a 40°C (86°F) ambient temperature, ~~and~~

~~4d) T~~here are not more than three current-carrying conductors.

310.19 Allowable Ampacities of Single-Insulated Conductors in Free Air. [NEW]

The maximum allowable ampacities shall be as specified in Table 310.19 where all of the following conditions apply:

~~1a) C~~onductors are rated 0 volts to 2000 volts.

~~2b) C~~onductors are rated up to 250°C (482°F), ~~and~~

~~3e) W~~wiring is installed in a 40°C (86°F) ambient temperature.

310.20 Ampacities of Conductors Supported on a Messenger. [NEW]

The maximum ampacities shall be as specified in Table 310.20 where all of the following conditions apply:

~~1a) e~~Conductors are rated 0 volts to 2000 volts.

~~2b) e~~Conductors are rated 75°C (167°F) or 90°C (194°F).

~~3e) w~~Wiring is installed in a 40°C (86°F) ambient temperature, ~~and~~

~~4d) t~~There are not more than three single-insulated conductors.

310.21 Ampacities of Bare or Covered Conductors in Free Air. [NEW]

The maximum ampacities shall be as specified in Table 310.21 where all of the following conditions apply:

~~1a) w~~Wind velocity is 610 mm/sec (2 ft/sec).

~~2b) e~~Conductors are 80°C (176°F) total conductor temperature, ~~and~~

~~3e) w~~Wiring is installed in a 40°C (86°F) ambient temperature.

~~Table 310.15(B)(16) (formerly Table 310.16) Allowable Ampacities of Insulated Conductors Rated Up to and Including 2000 Volts, 60°C Through 90°C (140°F Through 194°F), Not More Than Three Current-Carrying Conductors in Raceway, Cable, or Earth (Directly Buried), Based on Ambient Temperature of 30°C (86°F) *~~ [?]

Size AWG or kcmil	Temperature Rating of Conductor [See Table 310.104(A)]						Size AWG or kcmil
	60°C (140°F)	75°C (167°F)	90°C (194°F)	60°C (140°F)	75°C (167°F)	90°C (194°F)	
	Types TW, UF	Types RHW, THHW, THW, THWN, XHHW, XHHWN, USE, ZW	Types TBS, SA, SIS, FEP, FEPB, MI, RHH, RHW-2, THHN, THHW, THW-2, THWN-2, USE- 2, XHH, XHHW, XHHW-2, XHHWN, XHHWN-2, ZW-2	Types TW, UF	Types RHW, THHW, THW, THWN, XHHW, XHHWN, USE	Types TBS, SA, SIS, THHN, THHW, THW- 2, THWN-2, RHH, RHW-2, USE-2, XHH, XHHW, XHHW-2, XHHWN, XHHWN-2, ZW-2	
COPPER				ALUMINUM OR COPPER-CLAD ALUMINUM			
18*	—	—	14	—	—	—	—
16*	—	—	18	—	—	—	—
14*	15	20	25	—	—	—	—
12*	20	25	30	15	20	25	12**
10*	30	35	40	25	30	35	10**
8	40	50	55	35	40	45	8
6	55	65	75	40	50	55	6
4	70	85	95	55	65	75	4
3	85	100	115	65	75	85	3
2	95	115	130	75	90	100	2
1	110	130	145	85	100	115	1
1/0	125	150	170	100	120	135	1/0
2/0	145	175	195	115	135	150	2/0
3/0	165	200	225	130	155	175	3/0
4/0	195	230	260	150	180	205	4/0
250	215	255	290	170	205	230	250
300	240	285	320	195	230	260	300
350	260	310	350	210	250	280	350
400	280	335	380	225	270	305	400
500	320	380	430	260	310	350	500
600	350	420	475	285	340	385	600
700	385	460	520	315	375	425	700
750	400	475	535	320	385	435	750
800	410	490	555	330	395	445	800
900	435	520	585	355	425	480	900
1000	455	545	615	375	445	500	1000
1250	495	590	665	405	485	545	1250
1500	525	625	705	435	520	585	1500
1750	545	650	735	455	545	615	1750
2000	555	665	750	470	560	630	2000

Notes:

Refer to Section 310.16 shall be referenced for conditions of use.

*Refer to Section 310.15(B)(2) shall be referenced for the ampacity correction factors where the ambient temperature is other than 30°C (86°F).
Refer to ** Section 310.15(B)(3)(a)(C)(1) shall be referenced for more than three current-carrying conductors.
** Section Refer to 240.4(D) for conductor overcurrent protection limitations.

Commented [CK4]: Table notes should be mandatory.

Table 310.15(B)(17) (formerly Table 310.17) Allowable Ampacities of Single-Insulated Conductors Rated Up to and Including 2000 Volts in Free Air, Based on Ambient Temperature of 30°C (86°F)*

Size AWG or kcmil	Temperature Rating of Conductor [See Table 310.104(A)]						Size AWG or kcmil
	60°C (140°F)	75°C (167°F)	90°C (194°F)	60°C (140°F)	75°C (167°F)	90°C (194°F)	
	Types TW, UF	Types RHW, THHW, THW, THWN, XHHW, XHHWN, ZW	Types TBS, SA, SIS, FEP, FEPB, MI, RHH, RHW-2, THHN, THHW, THW-2, THWN-2, USE- 2, XHH, XHHW, XHHW- 2, XHHWN, XHHWN-2, ZW-2	Types TW, UF	Types RHW, THHW, THW, THWN, XHHW, XHHWN	Types TBS, SA, SIS, THHN, THHW, THW- 2, THWN-2, RHH, RHW-2, USE-2, XHH, XHHW, XHHW-2, XHHWN, XHHWN-2, ZW-2	
COPPER			ALUMINUM OR COPPER-CLAD ALUMINUM				
18	—	—	18	—	—	—	—
16	—	—	24	—	—	—	—
14*	25	30	35	—	—	—	—
12*	30	35	40	25	30	35	12**
10*	40	50	55	35	40	45	10**
8	60	70	80	45	55	60	8
6	80	95	105	60	75	85	6
4	105	125	140	80	100	115	4
3	120	145	165	95	115	130	3
2	140	170	190	110	135	150	2
1	165	195	220	130	155	175	1
1/0	195	230	260	150	180	205	1/0
2/0	225	265	300	175	210	235	2/0
3/0	260	310	350	200	240	270	3/0
4/0	300	360	405	235	280	315	4/0
250	340	405	455	265	315	355	250
300	375	445	500	290	350	395	300
350	420	505	570	330	395	445	350
400	455	545	615	355	425	480	400
500	515	620	700	405	485	545	500
600	575	690	780	455	545	615	600
700	630	755	850	500	595	670	700
750	655	785	885	515	620	700	750
800	680	815	920	535	645	725	800
900	730	870	980	580	700	790	900
1000	780	935	1055	625	750	845	1000
1250	890	1065	1200	710	855	965	1250

Size AWG or kcmil	Temperature Rating of Conductor [See Table 310.154(A)]						Size AWG or kcmil
	60°C (140°F)	75°C (167°F)	90°C (194°F)	60°C (140°F)	75°C (167°F)	90°C (194°F)	
	Types TW, UF	Types RHW, THHW, THW, THWN, XHHW, XHWN, ZW	Types TBS, SA, SIS, FEP, FEPB, MI, RHH, RHW-2, THHN, THHW, THW-2, THWN-2, USE- 2, XHH, XHHW, XHHW- 2, XHWN, XHWN-2, ZW-2	Types TW, UF	Types RHW, THHW, THW, THWN, XHHW, XHWN	Types TBS, SA, SIS, THHN, THHW, THW- 2, THWN-2, RHH, RHW-2, USE-2, XHH, XHHW, XHHW-2, XHWN, XHWN-2, ZW-2	
COPPER			ALUMINUM OR COPPER-CLAD ALUMINUM				
1500	980	1175	1325	795	950	1070	1500
1750	1070	1280	1445	875	1050	1185	1750
2000	1155	1385	1560	960	1150	1295	2000

Notes:

Refer to Section 310.17 shall be referenced for conditions of use.

*Refer to Section 310.15(B)(2) shall be referenced for the ampacity correction factors where the ambient temperature is other than 30°C (86°F).

*Refer to Section 240.4(D) shall be referenced for conductor overcurrent protection limitations.

Table 310.15(B)(1) (formerly Table 310.18) Allowable Ampacities of Insulated Conductors Rated Up to and Including 2000 Volts, 150°C Through 250°C (302°F Through 482°F). Not More Than Three Current-Carrying Conductors in Raceway or Cable, Based on Ambient Air Temperature of 40°C (104°F)*

Size AWG or kcmil	Temperature Rating of Conductor [See Table 310.154(A)]				Size AWG or kcmil
	150°C (302°F)	200°C (392°F)	250°C (482°F)	150°C (302°F)	
	Type Z	Types FEP, FEPB, PFA, SA	Types PFAH, TFE	Type Z	
COPPER		NICKEL OR NICKEL- COATED COPPER		ALUMINUM OR COPPER- CLAD ALUMINUM	
14	34	36	39	—	14
12	43	45	54	30	12
10	55	60	73	44	10
8	76	83	93	57	8
6	96	110	117	75	6
4	120	125	148	94	4
3	143	152	166	109	3
2	160	171	191	124	2
1	186	197	215	145	1
1/0	215	229	244	169	1/0
2/0	251	260	273	198	2/0
3/0	288	297	308	227	3/0
4/0	332	346	361	260	4/0

Notes:

Refer to Section 310.18 shall be referenced for conditions of use.

*Refer to Section 310.15(B)(2) shall be referenced for the ampacity correction factors where the ambient temperature is other than 40°C (104°F).

Refer to Section 310.15(C)(1)(B)(3)(a) shall be referenced for more than three current-carrying conductors.

Commented [CK5]: Table notes should be mandatory

Table 310.15(B)(19) (formerly Table 310.19) Allowable Ampacities of Single-Insulated Conductors, Rated Up to and Including 2000 Volts, 150°C Through 250°C (302°F Through 482°F), in Free Air, Based on Ambient Air Temperature of 40°C (104°F)*

Size AWG or kcmil	Temperature Rating of Conductor [See Table 310.104(A).]				Size AWG or kcmil
	150°C (302°F)	200°C (392°F)	250°C (482°F)	150°C (302°F)	
	Type Z	Types FEP, FEPB, PFA, SA	Types PFAH, TFE	Type Z	
	COPPER		NICKEL, OR NICKEL-COATED COPPER	ALUMINUM OR COPPER-CLAD ALUMINUM	
14	46	54	59	—	14
12	60	68	78	47	12
10	80	90	107	63	10
8	106	124	142	83	8
6	155	165	205	112	6
4	190	220	278	148	4
3	214	252	327	170	3
2	255	293	381	198	2
1	293	344	440	228	1
1/0	339	399	532	263	1/0
2/0	390	467	591	305	2/0
3/0	451	546	708	351	3/0
4/0	529	629	830	411	4/0

Notes:

Refer to Section 310.19 shall be referenced for conditions of use.

*Refer to Section 310.15(B)(2) shall be referenced for the ampacity correction factors where the ambient temperature is other than 40°C (104°F).

Table 310.15(B)(20) (formerly Table 310.20) Ampacities of Conductors of Not More Than Three Single-Insulated Conductors, Rated Up to and Including 2000 Volts, Supported on a Messenger, Based on Ambient Air Temperature of 40°C (104°F)*

Size AWG or kcmil	Temperature Rating of Conductor [See Table 310.104(A).]				Size AWG or kcmil
	75°C (167°F)	90°C (194°F)	75°C (167°F)	90°C (194°F)	
	Types RHW, THHW, THW, THWN, XHHW, <u>XHWN</u> , ZW	Types MJ, THHN, THHW, THW-2, THWN-2, RHH, RHW-2, USE-2, XHHW, XHHW-2, <u>XHWN</u> , <u>XHWN-2</u> , ZW-2	Types RHW, THW, THWN, THHW, XHHW, <u>XHWN</u>	Types THHN, THHW, RHH, XHHW, RHW-2, XHHW-2, <u>XHWN</u> , <u>XHWN-2</u> , THW-2, THWN-2, USE-2, ZW-2	
	COPPER		ALUMINUM OR COPPER-CLAD ALUMINUM		
8	57	66	44	51	8
6	76	89	59	69	6
4	101	117	78	91	4
3	118	138	92	107	3
2	135	158	106	123	2
1	158	185	123	144	1
1/0	183	214	143	167	1/0
2/0	212	247	165	193	2/0

Size AWG or kcmil	Temperature Rating of Conductor [See Table 310.104(A).]				Size AWG or kcmil
	75°C (167°F)	90°C (194°F)	75°C (167°F)	90°C (194°F)	
	Types RHW, THHW, THW, THWN, XHHW, XHWN, ZW	Types MI, THHN, THHW, THW-2, THWN-2, RHH, RHW-2, USE-2, XHHW, XHHW-2, XHWN, XHWN-2, ZW-2	Types RHW, THW, THWN, THHW, XHHW, XHWN	Types THHN, THHW, RHH, XHHW, RHW-2, XHHW-2, XHWN, XHWN-2, THW-2, THWN-2, USE-2, ZW-2	
	COPPER		ALUMINUM OR COPPER-CLAD ALUMINUM		
3/0	245	287	192	224	3/0
4/0	287	335	224	262	4/0
250	320	374	251	292	250
300	359	419	282	328	300
350	397	464	312	364	350
400	430	503	339	395	400
500	496	580	392	458	500
600	553	647	440	514	600
700	610	714	488	570	700
750	638	747	512	598	750
800	660	773	532	622	800
900	704	826	572	669	900
1000	748	879	612	716	1000

Notes:

Refer to Section 310.20 shall be referenced for conditions of use.

*Refer to Section 310.15(B)(2) shall be referenced for the ampacity correction factors where the ambient temperature is other than 40°C (104°F).

Refer to Section 310.15(C)(1)(B)(3)(a) shall be referenced for more than three current-carrying conductors.

Table 310.15(B)(21) (formerly Table 310.21) Ampacities of Bare or Covered Conductors in Free Air, Based on 40°C (104°F) Ambient, 80°C (176°F) Total Conductor Temperature, 610 mm/sec (2 ft/sec) Wind Velocity

Copper Conductors				AAC Aluminum Conductors			
Bare		Covered		Bare		Covered	
AWG or kcmil	Amperes	AWG or kcmil	Amperes	AWG or kcmil	Amperes	AWG or kcmil	Amperes
8	98	8	103	8	76	8	80
6	124	6	130	6	96	6	101
4	155	4	163	4	121	4	127
2	209	2	219	2	163	2	171
1/0	282	1/0	297	1/0	220	1/0	231
2/0	329	2/0	344	2/0	255	2/0	268
3/0	382	3/0	401	3/0	297	3/0	312
4/0	444	4/0	466	4/0	346	4/0	364
250	494	250	519	266.8	403	266.8	423
300	556	300	584	336.4	468	336.4	492
500	773	500	812	397.5	522	397.5	548
750	1000	750	1050	477.0	588	477.0	617

Copper Conductors				AAC Aluminum Conductors			
Bare		Covered		Bare		Covered	
AWG or kcmil	Amperes	AWG or kcmil	Amperes	AWG or kcmil	Amperes	AWG or kcmil	Amperes
1000	1193	1000	1253	556.5	650	556.5	682
—	—	—	—	636.0	709	636.0	744
—	—	—	—	795.0	819	795.0	860
—	—	—	—	954.0	920	—	—
—	—	—	—	1033.5	968	1033.5	1017
—	—	—	—	1272	1103	1272	1201
—	—	—	—	1590	1267	1590	1381
—	—	—	—	2000	1454	2000	1527

Note:

Refer to Section 310.21 shall be referenced for conditions of use.

Commented [CK6]: Table notes should be mandatory

[310.60 moving to Article 311]

**First Revision No. 7864-NFPA 70-2018 [New Definition after Definition:****Luminaire.]****100, Messenger or Messenger Wire**

A wire that is run integral with or parallel to a cable or conductor to provide mechanical support for the cable or conductor. (CMP-6)

Submitter Information Verification**Submitter Full Name:** NEC-CMP Panel 06**Organization:** [Not Specified]**Street Address:****City:****State:****Zip:****Submittal Date:** Wed Jan 10 16:45:01 EST 2018**Committee Statement and Meeting Notes**

Committee Statement: The term 'Messenger Supported Wiring' is defined in Article 396, however, the term 'messenger and messenger wire' are used as stand-alone terms. Therefore, a definition is needed in Article 100.

Response Message:

Public Input No. 340-NFPA 70-2017 [New Definition after Definition: Luminaire.]

Editorial Comment

[Click here](#)

**First Revision No. 7861-NFPA 70-2018 [New Part after I.]**

NEW DEF, 100, Free Air (as applied to conductors). Open or ventilated environment that allows for air flow around an installed conductor with no other conductors closer than one cable diameter, and no insulation or building materials in contact with the conductor insulation for more than 3 inches for every 10 feet of conductor.

Submitter Information Verification**Submitter Full Name:** NEC-CMP Panel 06**Organization:** [Not Specified]**Street Address:****City:****State:****Zip:****Submittal Date:** Wed Jan 10 16:29:40 EST 2018**Committee Statement and Meeting Notes**

Committee Statement: The term "free air" is used for many wiring methods in the code, but there is no definition to help determine if a wiring method should be considered to be installed in free air. This definition would make it clear that contact or close proximity with additional conductors or other materials that could impede the flow of heat away from the conductor would not allow the use of free air ampacity ratings. (CMP6)

Response Message:**Committee Notes:**

<u>Date</u>	<u>Submitted By</u>	
Jan 18, 2018	NEC-CMP Panel 06	Place new def alphabetically

Public Input No. 3621-NFPA 70-2017 [New Part after I.]

Editorial Comment

[Click here](#)

**First Revision No. 7883-NFPA 70-2018 [New Section after 330.116]****330.130**

Where used in Class I Division 1 or Zone 1 locations, the cable shall be listed and marked MC-HL, and shall have a gas/vapor tight continuous corrugated metallic sheath, an overall jacket of suitable polymeric material, and a separate equipment grounding conductor.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 06

Organization: [Not Specified]

Street Address:

City:

State:

Zip:

Submittal Date: Wed Jan 10 17:19:53 EST 2018

Make Editorial Changes
Based on Committee
Text

Committee Statement and Meeting Notes

Committee Statement: These are cable construction requirements that belong in Article 330. This code-making panel has purview over construction requirements for MC cable.

Response Message:

Public Input No. 3961-NFPA 70-2017 [Section No. 330.10(A)]

**First Revision No. 7647-NFPA 70-2018 [New Section after 336.120]****336.130 Hazardous (Classified) Location Cable.**

Cable listed and marked Type TC-ER-HL shall comply with the following:

- 1) The overall nonmetallic jacket shall be suitable for the environment.
- 2) The overall cable construction shall be essentially circular in cross-section.
- 3) The overall nonmetallic jacket shall be continuous and gas/vapor tight.
- 4) For construction greater than 25.4 mm (1 in.) in diameter:
 - (a) The equipment grounding conductor shall be bare.
 - (b) A metallic shield shall be included over all conductors under the outer jacket.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 06

Organization: [Not Specified]

Street Address:

City:

State:

Zip:

Submittal Date: Tue Jan 09 11:26:48 EST 2018

Make Editorial Changes
Based on Committee
Text

Committee Statement and Meeting Notes

Committee Statement: This language addresses construction requirements for tray cables installed in hazardous locations, including suitability for the environment and compatibility with connectors. The inclusion of the shield allows for testing of the cable to ensure jacket continuity and a ground fault path within the cable. See Chapter 5 for applications and limitations.

Response Message:

Public Input No. 4258-NFPA 70-2017 [Section No. 336.10]

**First Revision No. 7874-NFPA 70-2018 [Section No. 320.15]****320.15** Exposed Work.

Exposed runs of cable, except as provided in 300.11(A B), shall closely follow the surface of the building finish or of running boards. Exposed runs shall also be permitted to be installed on the underside of joists where supported at each joist and located so as not to be subject to physical damage.

Submitter Information Verification**Submitter Full Name:** NEC-CMP Panel 06**Organization:** [Not Specified]**Street Address:****City:****State:****Zip:****Submittal Date:** Wed Jan 10 17:03:49 EST 2018

Make Editorial Changes
Based on Committee
Text

Committee Statement and Meeting Notes**Committee Statement:** 300.11 was revised in the 2017 cycle. Therefore the reference was updated.**Response Message:**

Public Input No. 350-NFPA 70-2017 [Section No. 320.15]

**First Revision No. 7873-NFPA 70-2018 [Section No. 320.2]****320.2 Definition.**

The definition in this section shall apply within this article and throughout the code.

Armored Cable, Type AC.

A fabricated assembly of insulated conductors in a flexible interlocked metallic armor. See 320.100.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 06

Organization: [Not Specified]

Street Address:

City:

State:

Zip:

Submittal Date: Wed Jan 10 17:02:08 EST 2018

Make Editorial Changes
Based on Committee
Text

Committee Statement and Meeting Notes

Committee Statement: Language was added based on the recommendation of the Correlating Committee task group on definitions to improve usability.

Response Message:

Public Input No. 2182-NFPA 70-2017 [Section No. 320.2]

**First Revision No. 7876-NFPA 70-2018 [Section No. 320.23(A)]****(A) Cables Run Across the Top of Floor Joists.**

Where run across the top of floor joists, or within 2.1 m (7 ft) of the floor or floor joists across the face of rafters or studding, the cable shall be protected by guard strips that are at least as high as the cable. Where this space is not accessible by ~~permanent~~ permanently installed stairs or ladders, protection shall only be required within 1.8 m (6 ft) of the nearest edge of the scuttle hole or attic entrance.

Submitter Information Verification**Submitter Full Name:** NEC-CMP Panel 06**Organization:** [Not Specified]**Street Address:****City:****State:****Zip:****Submittal Date:** Wed Jan 10 17:05:14 EST 2018

Make Editorial Changes
Based on Committee
Text

Committee Statement and Meeting Notes

Committee Statement: 'Fixed in place' is not permanently mounted and stairs that are fixed in place could be removed. Revising the wording to indicate 'permanently installed' clarifies the text.

Response Message:

Public Input No. 179-NFPA 70-2017 [Section No. 320.23(A)]

**First Revision No. 7877-NFPA 70-2018 [Section No. 320.30(C)]****(C) Supporting.**

Unless otherwise permitted, Type AC cable shall be supported at intervals not exceeding 1.4 m (4½ ft).

Horizontal runs of Type AC cable installed in wooden or metal framing members or similar supporting means shall be considered supported and secured where such support does not exceed 1.4 m (4½ ft) intervals.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 06

Organization: [Not Specified]

Street Address:

City:

State:

Zip:

Submittal Date: Wed Jan 10 17:08:45 EST 2018

Make Editorial Changes
Based on Committee
Text

Committee Statement and Meeting Notes

Committee Statement: To maintain consistency with supporting of similar cable types (MC cables), the wording is revised to include securement of AC cables.

Response Message:

Public Input No. 449-NFPA 70-2017 [Section No. 320.30(C)]

Public Input No. 1534-NFPA 70-2017 [Section No. 320.30(C)]

**First Revision No. 7959-NFPA 70-2018 [Section No. 320.80(A)]****(A) Thermal Insulation.**

Armored cable installed in thermal insulation shall have conductors rated at 90°C (194°F). The ampacity of cable installed in these applications shall not exceed that of a 60°C (140°F) rated conductor. The 90°C (194°F) rating shall be permitted to be used for ampacity adjustment and correction calculations; however, the ampacity shall not exceed that of a 60°C (140°F) rated conductor.

Where more than two Type AC cables containing two or more current-carrying conductors in each cable are installed in contact with thermal installation, caulk or sealing foam without maintaining spacing between cables, the ampacity of each conductor shall be adjusted in accordance with Table 310.15(C)(1).

Submitter Information Verification**Submitter Full Name:** NEC-CMP Panel 06**Organization:** [Not Specified]**Street Address:****City:****State:****Zip:****Submittal Date:** Thu Jan 11 13:09:55 EST 2018

Make Editorial Changes
Based on Committee
Text

Committee Statement and Meeting Notes

Committee Statement: Information was submitted in support of public input 4287 demonstrating that multiple cables in contact with thermal insulation create the potential for heating beyond the capabilities of the cables. This language will require spacing between the cables or derating of the conductor ampacity.

Response Message:

**First Revision No. 7866-NFPA 70-2018 [Section No. 322.2]****322.2 Definition._**

The definition in this section shall apply within this article and throughout the code.

Flat Cable Assembly, Type FC.

An assembly of parallel conductors formed integrally with an insulating material web specifically designed for field installation in surface metal raceway.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 06

Organization: [Not Specified]

Street Address:

City:

State:

Zip:

Submittal Date: Wed Jan 10 16:52:02 EST 2018

Make Editorial Changes
Based on Committee
Text

Committee Statement and Meeting Notes

Committee Statement: Language was added based on the recommendation of the Correlating Committee task group on definitions to improve usability.

Response Message:

Public Input No. 2183-NFPA 70-2017 [Section No. 322.2]

**First Revision No. 7871-NFPA 70-2018 [Section No. 324.2]****324.2 Definitions.**

The definitions in this section shall apply only within this article.

Bottom Shield.

A protective layer that is installed between the floor and Type FCC flat conductor cable to protect the cable from physical damage and may or may not be incorporated as an integral part of the cable.

Cable Connector.

A connector designed to join Type FCC cables without using a junction box.

FCC System.

A complete wiring system for branch circuits that is designed for installation under carpet squares.

Informational Note: The FCC system includes Type FCC cable and associated shielding, connectors, terminators, adapters, boxes, and receptacles.

Insulating End.

An insulator designed to electrically insulate the end of a Type FCC cable.

Metal Shield Connections.

Means of connection designed to electrically and mechanically connect a metal shield to another metal shield, to a receptacle housing or self-contained device, or to a transition assembly.

Top Shield.

A grounded metal shield covering under-carpet components of the FCC system for the purposes of providing protection against physical damage.

Transition Assembly.

An assembly to facilitate connection of the FCC system to other wiring systems, incorporating (1) a means of electrical interconnection and (2) a suitable box or covering for providing electrical safety and protection against physical damage.

Type FCC Cable.

Three or more flat copper conductors placed edge-to-edge and separated and enclosed within an insulating assembly.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 06

Organization: [Not Specified]

Street Address:

City:

State:

Zip:

Submittal Date: Wed Jan 10 16:57:47 EST 2018

Make Editorial Changes
Based on Committee Text

Committee Statement and Meeting Notes

Committee Statement: Language was added based on the recommendation of the Correlating Committee task group on definitions to improve usability.

Response Message:

WORKING DRAFT OF CMP MEETING OUTPUT - NATIONAL ELECTRICAL CODE - NFPA 70
JANUARY 8 - 20, 2018 - SUBJECT TO REVISION - NOT FOR PUBLICATION

Public Input No. 1209-NFPA 70-2017 [Section No. 324.2]

FOR CODE-MAKING PANEL USE ONLY
SUBJECT TO REVISION - NOT FOR PUBLICATION

**First Revision No. 7872-NFPA 70-2018 [Section No. 324.42(A)]****(A) Receptacles.**

All receptacles, receptacle housings, and self-contained devices used with the FCC system shall be identified for this use and shall be connected to the Type FCC cable and metal shields. Connection from any equipment grounding conductor of the Type FCC cable shall be made to the shield system at each receptacle.

Submitter Information Verification**Submitter Full Name:** NEC-CMP Panel 06**Organization:** [Not Specified]**Street Address:****City:****State:****Zip:****Submittal Date:** Wed Jan 10 16:59:36 EST 2018

Make Editorial Changes
Based on Committee
Text

Committee Statement and Meeting Notes

Committee Statement: The revised text uses terms defined in the Code and is consistent with the context of the meaning of the

section where the revisions are made. The revisions are made to provide clarity, and consistency in terminology usage.

Response Message:

Public Input No. 2376-NFPA 70-2017 [Section No. 324.42(A)]

Public Input No. 3325-NFPA 70-2017 [Section No. 324.42(A)]

**First Revision No. 7868-NFPA 70-2018 [Section No. 326.2]****326.2 Definition._**

The definition in this section shall apply within this article and throughout the code.

Integrated Gas Spacer Cable, Type IGS.

A factory assembly of one or more conductors, each individually insulated and enclosed in a loose fit, nonmetallic flexible conduit as an integrated gas spacer cable rated 0 through 600 volts.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 06

Organization: [Not Specified]

Street Address:

City:

State:

Zip:

Submittal Date: Wed Jan 10 16:54:00 EST 2018

Make Editorial Changes
Based on Committee
Text

Committee Statement and Meeting Notes

Committee Statement: Language was added based on the recommendation of the Correlating Committee task group on definitions to improve usability.

Response Message:

Public Input No. 2184-NFPA 70-2017 [Section No. 326.2]

**First Revision No. 7885-NFPA 70-2018 [Section No. 330.15]****330.15 Exposed Work.**

Exposed runs of cable, except as provided in 300.11(A B), shall closely follow the surface of the building finish or of running boards. Exposed runs shall also be permitted to be installed on the underside of joists where supported at each joist and located so as not to be subject to physical damage.

Submitter Information Verification**Submitter Full Name:** NEC-CMP Panel 06**Organization:** [Not Specified]**Street Address:****City:****State:****Zip:****Submittal Date:** Wed Jan 10 17:29:29 EST 2018[Make Editorial Changes
Based on Committee
Text](#)**Committee Statement and Meeting Notes**

Committee Statement: 300.11 was revised in the 2017 cycle. Therefore the reference was updated to reflect the correct references.

**Response
Message:**

[Public Input No. 351-NFPA 70-2017 \[Section No. 330.15\]](#)

[Public Input No. 3246-NFPA 70-2017 \[Section No. 330.15\]](#)

**First Revision No. 7879-NFPA 70-2018 [Section No. 330.2]****330.2 Definition._**

The definition in this section shall apply within this article and throughout the code.

Metal Clad Cable, Type MC.

A factory assembly of one or more insulated circuit conductors with or without optical fiber members enclosed in an armor of interlocking metal tape, or a smooth or corrugated metallic sheath.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 06

Organization: [Not Specified]

Street Address:

City:

State:

Zip:

Submittal Date: Wed Jan 10 17:09:57 EST 2018

Make Editorial Changes
Based on Committee
Text

Committee Statement and Meeting Notes

Committee Statement: Language was added based on the recommendation of the Correlating Committee task group on definitions to improve usability.

Response Message:

Public Input No. 2186-NFPA 70-2017 [Section No. 330.2]

**First Revision No. 7961-NFPA 70-2018 [Section No. 330.80]****330.80 Ampacity.**

The ampacity of Type MC cable shall be determined in accordance with 310.15 or 310.60 for 14 AWG and larger conductors and in accordance with Table 402.5 for 18 AWG and 16 AWG conductors. The installation shall not exceed the temperature ratings of terminations and equipment.

(A) Type MC Cable Installed in Cable Tray.

The ampacities for Type MC cable installed in cable tray shall be determined in accordance with 392.80.

(B) Single Type MC Conductors Grouped Together.

Where single Type MC conductors are grouped together in a triangular or square configuration and installed on a messenger or exposed with a maintained free airspace of not less than 2.15 times one conductor diameter ($2.15 \times \text{O.D.}$) of the largest conductor contained within the configuration and adjacent conductor configurations or cables, the ampacity of the conductors shall not exceed the allowable ampacities in the following tables:

- (1) Table 310.15(B)(20) for conductors rated 0 through 2000 volts
- (2) Table 310.60(C)(67) and Table 310.60(C)(68) for conductors rated over 2000 volts

(C) Thermal Insulation.

Where more than two Type MC cables containing two or more current-carrying conductors in each cable are installed in contact with thermal insulation, caulk or sealing foam without maintaining spacing between cables, the ampacity of each conductor shall be adjusted in accordance with Table 310.15(C)(1).

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 06

Organization: [Not Specified]

Street Address:

City:

State:

Zip:

Submittal Date: Thu Jan 11 13:13:38 EST 2018

Make Editorial Changes
Based on Committee
Text

Committee Statement and Meeting Notes

Committee Statement: Information was submitted in support of public input 4287 demonstrating that multiple cables in contact with thermal insulation create the potential for heating beyond the capabilities of the cables. This language will require spacing between the cables or derating of the conductor ampacity.

Response Message:

**First Revision No. 7870-NFPA 70-2018 [Section No. 332.2]****332.2 Definition.**

The definition in this section shall apply within this article and throughout the code.

Mineral-Insulated, Metal-Sheathed Cable, Type MI.

A factory assembly of one or more conductors insulated with a highly compressed refractory mineral insulation and enclosed in a liquidtight and gastight continuous copper or alloy steel sheath.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 06

Organization: [Not Specified]

Street Address:

City:

State:

Zip:

Submittal Date: Wed Jan 10 16:56:19 EST 2018

Make Editorial Changes
Based on Committee
Text

Committee Statement and Meeting Notes

Committee Statement: Language was added based on the recommendation of the Correlating Committee task group on definitions to improve usability.

Response Message:

Public Input No. 2187-NFPA 70-2017 [Section No. 332.2]

**First Revision No. 8020-NFPA 70-2018 [Section No. 334.10]****334.10 Uses Permitted.**

Type NM ~~and~~ Type NMC ~~and~~ Type NMS cables shall be permitted to be used in the following, except as prohibited in 334.12:

- (1) One- and two-family dwellings and their attached or detached garages, and their storage buildings.
- (2) Multi-family dwellings permitted to be of Types III, IV, and V construction.
- (3) Other structures permitted to be of Types III, IV, and V construction. Cables shall be concealed within walls, floors, or ceilings that provide a thermal barrier of material that has at least a 15-minute finish rating as identified in listings of fire-rated assemblies.

Informational Note No. 1: Types of building construction and occupancy classifications are defined in NFPA 220-2015, *Standard on Types of Building Construction*, or the applicable building code, or both.

Informational Note No. 2: See Informative Annex E for determination of building types [NFPA 220, Table 3-1].

- (4) Cable trays in structures permitted to be Types III, IV, or V where the cables are identified for the use.

Informational Note: See 310.15(A)(3) for temperature limitation of conductors.

- (5) Types I and II construction where installed within raceways permitted to be installed in Types I and II construction.

(A) Type NM.

Type NM cable shall be permitted as follows:

- (1) For both exposed and concealed work in normally dry locations except as prohibited in 334.10(3)
- (2) To be installed or fished in air voids in masonry block or tile walls

(B) Type NMC.

Type NMC cable shall be permitted as follows:

- (1) For both exposed and concealed work in dry, moist, damp, or corrosive locations, except as prohibited by 334.10(3)
- (2) In outside and inside walls of masonry block or tile
- (3) In a shallow chase in masonry, concrete, or adobe protected against nails or screws by a steel plate at least 1.59 mm ($\frac{1}{16}$ in.) thick and covered with plaster, adobe, or similar finish

(C) Type NMS.

Type NMS cable shall be permitted as follows:

- (1) For both exposed and concealed work in normally dry locations except as prohibited by 334.10(3)
- (2) To be installed or fished in air voids in masonry block or tile walls

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 06

Organization: [Not Specified]

Street Address:

Make Editorial Changes
Based on Committee Text

City:**State:****Zip:****Submittal Date:** Thu Jan 11 17:35:51 EST 2018

Committee Statement and Meeting Notes

Committee Statement: Type NMS cable construction is not manufactured.**Response Message:****Committee Notes:**

<u>Date</u>	<u>Submitted By</u>
Jan 11, 2018	NEC-CMP Panel The informational notes are not new, remove underlining. 06

Public Input No. 4002-NFPA 70-2017 [Section No. 334.10(C)]FOR CODE-MAKING PANEL USE ONLY
SUBJECT TO REVISION - NOT FOR PUBLICATION

**First Revision No. 8051-NFPA 70-2018 [Section No. 334.104]****334.104** Conductors.

The 600-volt insulated power conductors shall be sizes 14 AWG through 2 AWG copper conductors or sizes 12 AWG through 2 AWG aluminum or copper-clad aluminum conductors. The communications conductors shall comply with Part V of Article 800 - Control and signaling conductors shall be no smaller than 18 AWG copper.

Submitter Information Verification**Submitter Full Name:** NEC-CMP Panel 06**Organization:** [Not Specified]**Street Address:****City:****State:****Zip:****Submittal Date:** Fri Jan 12 08:41:19 EST 2018

Make Editorial Changes
Based on Committee
Text

Committee Statement and Meeting Notes

Committee Statement: Communication language was deleted to reflect the deletion of Type NMS. Control and Signaling conductors were added to provide minimum conductor sizes for these applications.

Response Message:

Public Input No. 3953-NFPA 70-2017 [Section No. 334.104]

**First Revision No. 8053-NFPA 70-2018 [Section No. 334.116(C)]**

(C) ~~Type NMS.~~

~~The overall covering shall be flame retardant and moisture resistant. The sheath shall be applied so as to separate the power conductors from the communications conductors.~~

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 06

Organization: [Not Specified]

Street Address:

City:

State:

Zip:

Submittal Date: Fri Jan 12 08:43:52 EST 2018

Make Editorial Changes
Based on Committee
Text

Committee Statement and Meeting Notes

Committee Statement: Type NMS cable construction is not manufactured and should have been deleted along with Article 780 in the 2008 NEC.

Response Message:

Public Input No. 3959-NFPA 70-2017 [Section No. 334.116(C)]

**First Revision No. 8045-NFPA 70-2018 [Section No. 334.12]****334.12 Uses Not Permitted.****(A)** Types NM ~~and~~ NMC ~~and~~ NMS.Types NM ~~and~~ NMC ~~and~~ NMS cables shall not be permitted as follows:

- (1) In any dwelling or structure not specifically permitted in 334.10(1), (2), (3), and (5)
- (2) Exposed within a dropped or suspended ceiling cavity in other than one- and two-family and multifamily dwellings
- (3) As service-entrance cable
- (4) In commercial garages having hazardous (classified) locations as defined in 511.3
- (5) In theaters and similar locations, except where permitted in 518.4(B)
- (6) In motion picture studios
- (7) In storage battery rooms
- (8) In hoistways or on elevators or escalators
- (9) Embedded in poured cement, concrete, or aggregate
- (10) In hazardous (classified) locations, except where specifically permitted by other articles in this Code

(B) ~~Types~~ Type NM ~~and~~ NMS.~~Types~~ Type NM ~~and~~ NMS cables shall not be used under the following conditions or in the following locations:

- (1) Where exposed to corrosive fumes or vapors
- (2) Where embedded in masonry, concrete, adobe, fill, or plaster
- (3) In a shallow chase in masonry, concrete, or adobe and covered with plaster, adobe, or similar finish
- (4) In wet or damp locations

Submitter Information Verification**Submitter Full Name:** NEC-CMP Panel 06**Organization:** [Not Specified]**Street Address:****City:****State:****Zip:****Submittal Date:** Fri Jan 12 08:17:10 EST 2018Make Editorial Changes
Based on Committee Text**Committee Statement and Meeting Notes****Committee Statement:** Type NMS cable construction is not manufactured and should have been deleted along with Article 780 in the 2008 NEC.**Response Message:**Public Input No. 4012-NFPA 70-2017 [Section No. 334.12]



First Revision No. 8046-NFPA 70-2018 [Section No. 334.15 [Excluding any Sub-Sections]]

In exposed work, except as provided in 300.11(A B), cable shall be installed as specified in 334.15(A) through (C).

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 06

Organization: [Not Specified]

Street Address:

City:

State:

Zip:

Submittal Date: Fri Jan 12 08:18:39 EST 2018

Make Editorial Changes
Based on Committee
Text

Committee Statement and Meeting Notes

Committee Statement: Section 300.11 was renumbered in 2017 revision to the NEC. Section 334.15 is being revised to reflect the correct reference which is 300.11(B)

Response Message:

Public Input No. 352-NFPA 70-2017 [Section No. 334.15 [Excluding any Sub-Sections]]

**First Revision No. 8047-NFPA 70-2018 [Section No. 334.17]****334.17** Through or Parallel to Framing Members.

Types NM ~~, and~~ NMC ~~, or NMS~~ cable shall be protected in accordance with 300.4 where installed through or parallel to framing members. Grommets used as required in 300.4(B)(1) shall remain in place and be listed for the purpose of cable protection.

Submitter Information Verification**Submitter Full Name:** NEC-CMP Panel 06**Organization:** [Not Specified]**Street Address:****City:****State:****Zip:****Submittal Date:** Fri Jan 12 08:19:15 EST 2018

Make Editorial Changes
Based on Committee
Text

Committee Statement and Meeting Notes

Committee Statement: Type NMS cable construction is not manufactured and should have been deleted along with Article 780 in the 2008 NEC.

Response Message:

Public Input No. 4014-NFPA 70-2017 [Section No. 334.17]

**First Revision No. 8002-NFPA 70-2018 [Section No. 334.2]****334.2 Definitions.**

The definitions in this section shall apply within this article and throughout the code.

Nonmetallic-Sheathed Cable.

A factory assembly of two or more insulated conductors enclosed within an overall nonmetallic jacket.

Type NM.

Insulated conductors enclosed within an overall nonmetallic jacket.

Type NMC.

Insulated conductors enclosed within an overall, corrosion resistant, nonmetallic jacket.

Type NMS.

~~Insulated power or control conductors with signaling, data, and communications conductors within an overall nonmetallic jacket.~~

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 06

Organization: [Not Specified]

Street Address:

City:

State:

Zip:

Submittal Date: Thu Jan 11 16:42:34 EST 2018

Make Editorial Changes
Based on Committee
Text

Committee Statement and Meeting Notes

Committee Statement: This added language provides clarity for the application of the definitions in article 334.

Type NMS cable construction is not manufactured.

Response Message:

Public Input No. 3948-NFPA 70-2017 [Definition: Type NMS.]

Public Input No. 2188-NFPA 70-2017 [Section No. 334.2]

**First Revision No. 8048-NFPA 70-2018 [Section No. 334.24]****334.24** Bending Radius.

Bends in Types NM ,~~NMC, and NMS cable~~ and NMC cable shall be so made that the cable will not be damaged. The radius of the curve of the inner edge of any bend during or after installation shall not be less than five times the diameter of the cable.

Submitter Information Verification**Submitter Full Name:** NEC-CMP Panel 06**Organization:** [Not Specified]**Street Address:****City:****State:****Zip:****Submittal Date:** Fri Jan 12 08:20:10 EST 2018

Make Editorial Changes
Based on Committee
Text

Committee Statement and Meeting Notes

Committee Statement: Type NMS cable construction is not manufactured and should have been deleted along with Article 780 in the 2008 NEC.

Response Message:

Public Input No. 4016-NFPA 70-2017 [Section No. 334.24]



First Revision No. 8049-NFPA 70-2018 [Section No. 334.30 [Excluding any Sub-Sections]]

Nonmetallic-sheathed cable shall be supported and secured by staples; cable ties listed and identified for securement and support; or straps, hangers, or similar fittings designed and installed so as not to damage the cable, at intervals not exceeding 1.4 m (4½ ft) and within 300 mm (12 in.) of every cable measured no more than 450 mm (18 in.) along the cable sheath, entry into enclosures such as outlet boxes, junction boxes, cabinets, or fittings. Flat cables shall not be stapled on edge.

Sections of cable protected from physical damage by raceway shall not be required to be secured within the raceway.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 06

Organization: [Not Specified]

Street Address:

City:

State:

Zip:

Submittal Date: Fri Jan 12 08:23:25 EST 2018

Make Editorial Changes
Based on Committee
Text

Committee Statement and Meeting Notes

Committee Statement: The current requirements permits unlimited lengths of cable to be unsecured from the last point of attachment. The extra length will provide conductor length for repair.

Response Message:

Public Input No. 3492-NFPA 70-2017 [Section No. 334.30 [Excluding any Sub-Sections]]

Public Input No. 2165-NFPA 70-2017 [Section No. 334.30 [Excluding any Sub-Sections]]

**First Revision No. 8005-NFPA 70-2018 [Section No. 334.6]****334.6** Listing Requirements.

Type NM ~~, and~~ Type NMC ~~, and~~ Type NMS cables and associated fittings shall be listed.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 06

Organization: [Not Specified]

Street Address:

City:

State:

Zip:

Submittal Date: Thu Jan 11 16:53:53 EST 2018

Make Editorial Changes
Based on Committee
Text

Committee Statement and Meeting Notes

Committee Statement: Type NMS cable construction is not manufactured.

Response Message:

Public Input No. 4000-NFPA 70-2017 [Section No. 334.6]

**First Revision No. 8050-NFPA 70-2018 [Section No. 334.80]****334.80 Ampacity.**

The ampacity of Types NM ~~-, and~~ NMC ~~-, and~~ NMS cable shall be determined in accordance with 310.15. The ~~allowable~~ ampacity shall not exceed that of a 60°C (140°F) rated conductor. The 90°C (194°F) rating shall be permitted to be used for ampacity adjustment and correction calculations, provided the final calculated ampacity does not exceed that of a 60°C (140°F) rated conductor. The ampacity of Types NM ~~-, and~~ NMC ~~-, and~~ NMS cable installed in cable trays shall be determined in accordance with 392.80(A).

Where more than two NM cables containing two or more current-carrying conductors are installed, without maintaining spacing between the cables, through the same opening in wood framing that is to be sealed with thermal insulation, caulk, or sealing foam, the ~~allowable~~ ampacity of each conductor shall be adjusted in accordance with Table 310.15(B)(3)(a) and the provisions of 310.15(A)(2), Exception, shall not apply.

Where more than two NM cables containing two or more current-carrying conductors are installed in contact with thermal insulation without maintaining spacing between cables, the ~~allowable~~ the ampacity of each conductor shall be adjusted in accordance with Table 310.15(B)(3)(a).

Submitter Information Verification**Submitter Full Name:** NEC-CMP Panel 06**Organization:** [Not Specified]**Street Address:****City:****State:****Zip:****Submittal Date:** Fri Jan 12 08:37:23 EST 2018[Make Editorial Changes
Based on Committee
Text](#)**Committee Statement and Meeting Notes**

Committee Statement: Type NMS cable construction is not manufactured and should have been deleted along with Article 780 in the 2008 NEC.

Ampacity is the maximum current, in amperes, that a conductor can carry continuously under the conditions of use without exceeding its temperature rating. The term used in this section should be "ampacity" and not "allowable ampacity" as it is the intent for this section to determine the ampacity of the conductor based upon its condition of use.

**Response
Message:**[Public Input No. 4017-NFPA 70-2017 \[Section No. 334.80\]](#)[Public Input No. 933-NFPA 70-2017 \[Section No. 334.80\]](#)

**First Revision No. 8032-NFPA 70-2018 [Section No. 336.10]****336.10 Uses Permitted.**

Type TC cable shall be permitted to be used as follows:

- (1) For power, lighting, control, and signal circuits.
- (2) In cable trays, including those with mechanically discontinuous segments up to 300 mm (1 ft).
- (3) In raceways.
- (4) In outdoor locations supported by a messenger wire.
- (5) For Class 1 circuits as permitted in Parts II and III of Article 725.
- (6) For non-power-limited fire alarm circuits if conductors comply with the requirements of 760.49.
- (7) Between a cable tray and the utilization equipment or device(s), provided all of the following apply:
 - (8) The cable is Type TC-ER.
 - (9) The cable is installed in industrial establishments where the conditions of maintenance and supervision ensure that only qualified persons service the installation.
 - (10) The cable is continuously supported and protected against physical damage using mechanical protection such as struts, angles, or channels.
 - (11) The cable that complies with the crush and impact requirements of Type MC cable and is identified with the marking "TC-ER."
 - (12) The cable is secured at intervals not exceeding 1.8 m (6 ft).
 - (13) Equipment grounding for the utilization equipment is provided by an equipment grounding conductor within the cable. In cables containing conductors sized 6 AWG or smaller, the equipment grounding conductor must be provided within the cable or, at the time of installation, one or more insulated conductors must be permanently identified as an equipment grounding conductor in accordance with 250.119(B) .

Exception to (7): Where not subject to physical damage, Type TC-ER shall be permitted to transition between cable trays and between cable trays and utilization equipment or devices for a distance not to exceed 1.8 m (6 ft) without continuous support. The cable shall be mechanically supported where exiting the cable tray to ensure that the minimum bending radius is not exceeded.

- (14) Where installed in wet locations, Type TC cable shall also be resistant to moisture and corrosive agents.
- (15) In one- and two-family dwelling units, Type TC-ER cable containing both power and control conductors that is identified for pulling through structural members shall be permitted for branch circuits and feeders . Type TC-ER cable used as interior wiring shall be installed per the requirements of Part II of Article 334 and where installed as exterior wiring shall be installed per the requirements of Part II of Article 340 ..

Exception: Where used to connect a generator and associated equipment having terminals rated 75°C (140°F) or higher, the cable shall not be limited in ampacity by 334.80 or 340.80.

Informational Note No. 1: TC-ER cable that is suitable for pulling through structural members is marked "JP."

Informational Note No. 2: See 725.136 for limitations on Class 2 or 3 circuits contained within the same cable with conductors of electric light, power, or Class 1 circuits.

- (16) Direct buried, where identified for such use
- (17) In hazardous (classified) locations where specifically permitted by other articles in this Code.

Informational Note: See 310.15(A)(3) for temperature limitation of conductors.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 06**Organization:** [Not Specified]**Street Address:****City:****State:****Zip:****Submittal Date:** Fri Jan 12 00:03:45 EST 2018[Make Editorial Changes
Based on Committee Text](#)

Committee Statement and Meeting Notes

Committee Statement: The determination of an industrial establishment is up to the AHJ. The words "for branch circuits and feeders" were added to indicate that Type TC-ER-JP is not allowed for use as a service. The reference to Part II of Article 340 was added to direct the user to installation requirements for TC-ER-JP used as exterior wiring. List item 11 was added in response to PI 4258.

**Response
Message:**

Committee Notes:

<u>Date</u>	<u>Submitted By</u>
Jan 12, 2018	NEC-CMP Panel 06 Items underlined in (7) are not new remove underlining.

[Public Input No. 2846-NFPA 70-2017 \[Section No. 336.10\]](#)

[Public Input No. 4036-NFPA 70-2017 \[Section No. 336.10\]](#)

**First Revision No. 7635-NFPA 70-2018 [Section No. 336.2]****336.2 Definition.**

The definition in this section shall apply within this article and throughout this code.

Power and Control Tray Cable, Type TC.

A factory assembly of two or more insulated conductors, with or without associated bare or covered equipment grounding conductors, under a nonmetallic jacket.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 06

Organization: [Not Specified]

Street Address:

City:

State:

Zip:

Submittal Date: Tue Jan 09 10:41:57 EST 2018

Make Editorial Changes
Based on Committee
Text

Committee Statement and Meeting Notes

Committee Statement: Language was added based on the recommendation of the Correlating Committee task group on definitions to improve usability. The term equipment was added to clarify which grounding conductors are referenced.

Response Message:

Public Input No. 3333-NFPA 70-2017 [Definition: Power and Control Tray Cable, Type TC.]

Public Input No. 3328-NFPA 70-2017 [Section No. 336.2]

Public Input No. 2189-NFPA 70-2017 [Section No. 336.2]

**First Revision No. 7676-NFPA 70-2018 [Section No. 336.80]****336.80** Ampacity.

The ampacity of Type TC tray cable shall be determined in accordance with 392.80(A) for 14 AWG and larger conductors, in accordance with 402.5 for 18 AWG through 16 AWG conductors where installed in cable tray, and in accordance with 310.15 where installed in a raceway or as messenger-supported wiring, outside of cable tray, where permitted.

Submitter Information Verification**Submitter Full Name:** NEC-CMP Panel 06**Organization:** [Not Specified]**Street Address:****City:****State:****Zip:****Submittal Date:** Tue Jan 09 14:38:31 EST 2018

Make Editorial Changes
Based on Committee
Text

Committee Statement and Meeting Notes

Committee Statement: Anything outside of cable tray should be subject to the ampacity requirements in Article 310.

Response Message:

Public Input No. 4261-NFPA 70-2017 [Section No. 336.80]

**First Revision No. 7955-NFPA 70-2018 [Section No. 338.10(B)(4)]**

******Revise the following section per attached word doc******

(4) Installation Methods for Branch Circuits and Feeders.

(a) *Interior Installations.* In addition to the provisions of this article, Type SE service-entrance cable used for interior wiring shall comply with the installation requirements of Part II of Article 334, excluding 334.80.

For Type SE cable with ungrounded conductor sizes 10 AWG and smaller, where installed in thermal insulation, the ampacity shall be in accordance with 60°C (140°F) conductor temperature rating. The maximum conductor temperature rating shall be permitted to be used for ampacity adjustment and correction purposes, if the final derated ampacity does not exceed that for a 60°C (140°F) rated conductor.

Informational Note No. 1: See 310.15(A)(3) for temperature limitation of conductors.

Informational Note No. 2: For the installation of main power feeder conductors in dwelling units refer to 310.15(B)(7) .

(b) *Exterior Installations.* In addition to the provisions of this article, service-entrance cable used for feeders or branch circuits, where installed as exterior wiring, shall be installed in accordance with Part I of Article 225. The cable shall be supported in accordance with 334.30. Type USE cable installed as underground feeder and branch circuit cable shall comply with Part II of Article 340.

Exception: Single-conductor Type USE and multi-rated USE conductors shall not be subject to the ampacity limitations of Part II of Article 340.

Supplemental Information

<u>File Name</u>	<u>Description</u>	<u>Approved</u>
Revised_Section_338.10-B-4.docx	Revise section 338.10(B)(4) per attached word doc. For staff use	✓

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 06

Organization: [Not Specified]

Street Address:

City:

State:

Zip:

Submittal Date: Thu Jan 11 13:02:11 EST 2018

Make Editorial Changes
Based on Committee Text

Committee Statement and Meeting Notes

Committee Statement: Information was submitted demonstrating that multiple cables in contact with thermal insulation create the potential for heating beyond the capabilities of the cables. This language will require spacing between the cables or ampacity adjustment. "Derated" was deleted based on the work of the CC Task Group on ampacity.

Response

Message:

[Public Input No. 4287-NFPA 70-2017 \[Section No. 338.10\(B\)\(4\)\]](#)

[Public Input No. 925-NFPA 70-2017 \[Section No. 338.10\(B\)\(4\)\]](#)

FOR CODE-MAKING PANEL USE ONLY
SUBJECT TO REVISION - NOT FOR PUBLICATION

**First Revision No. 7950-NFPA 70-2018 [Section No. 338.100]****338.100 Construction.**

~~A) Cabled , assemblies of multiple single-conductor , Type USE constructions recognized for underground-use conductors shall be permitted to have a bare copper conductor cabled with the assembly. Type USE single, parallel, or cabled conductor assemblies recognized for underground use shall be permitted to have a bare copper concentric conductor applied. These constructions shall not require an outer overall covering.~~

~~Informational Note: See 230.41 , Exception, item (2), for directly buried, uninsulated service-entrance conductors.~~

~~for direct burial. All conductors shall be insulated.~~

~~Informational Note: The term "cabled" refers to a manufacturing process of twisting single conductors together and may also be referred to as "plexed."~~

~~B) Type SE or USE cable with an overall covering containing two or more conductors shall be permitted to have one conductor uninsulated.~~

Supplemental Information

<u>File Name</u>	<u>Description</u>	<u>Approved</u>
Panel_6_FR-7950_338.100_leg_changes.docx	For staff use	✓

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 06

Organization: [Not Specified]

Street Address:

City:

State:

Zip:

Submittal Date: Thu Jan 11 11:57:48 EST 2018

Make Editorial Changes
Based on Committee
Text

Committee Statement and Meeting Notes

Committee Statement: Due to concerns for corrosion the allowance for use of a bare conductor was removed.

Response Message:

Public Input No. 3748-NFPA 70-2017 [Section No. 338.100]

**First Revision No. 7953-NFPA 70-2018 [Section No. 338.2]****338.2 Definitions.**

The definition in this section shall apply within this article and throughout the Code.

Service-Entrance Conductor Assembly.

Multiple single-insulated conductors twisted together without an overall covering, other than an optional binder intended only to keep the conductors together.

Service-Entrance Cable.

A single conductor or multiconductor ~~assembly cable~~ provided with or without an overall covering, primarily used for services, and of the following types:

Type SE.

Service-entrance cable having a flame-retardant, moisture-resistant covering.

Type USE.

Service-entrance cable, identified for underground use, having a moisture-resistant covering, but not required to have a flame-retardant covering.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 06

Organization: [Not Specified]

Street Address:

City:

State:

Zip:

Submittal Date: Thu Jan 11 12:56:05 EST 2018

Make Editorial Changes
Based on Committee
Text

Committee Statement and Meeting Notes

Committee Statement: The language recommended by the CC Task Group on definitions was added and a new definition was added to clarify the difference between an assembly and a cable. The words "or without" were removed from the definition of service-entrance cable since that construction is now included in the service-entrance conductor assembly definition.

Response Message:

Public Input No. 3787-NFPA 70-2017 [New Definition after Definition: Service-Entrance Cable.]

Public Input No. 2190-NFPA 70-2017 [Section No. 338.2]

**First Revision No. 7777-NFPA 70-2018 [Section No. 340.10]****340.10 Uses Permitted.**

Type UF cable shall be permitted as follows:

- (1) For use underground, including direct burial in the earth. ~~For underground requirements, see 300.5.~~
- (2) As single-conductor cables. Where installed as single-conductor cables, all conductors of the feeder ~~grounded conductor~~ or branch circuit, including the grounded conductor and equipment grounding conductor, if any, shall be installed in accordance with 300.3.
- (3) For wiring in wet, dry, or corrosive locations ~~under the recognized wiring methods of this Code.~~
- (4) Installed as nonmetallic-sheathed cable. Where so installed, the installation and conductor requirements shall comply with Parts II and III of Article 334 and shall be of the multiconductor type.
- (5) ~~For solar photovoltaic systems in accordance with 690.31.~~
- (6)
- (7) As single-conductor cables as the nonheating leads for heating cables as provided in 424.43.
- (8) Supported by cable trays. Type UF cable supported by cable trays shall be of the multiconductor type.

Informational Note: See 310.15(A)(3) for temperature limitation of conductors.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 06

Organization: [Not Specified]

Street Address:

City:

State:

Zip:

Submittal Date: Wed Jan 10 09:28:39 EST 2018

Make Editorial Changes
Based on Committee Text

Committee Statement and Meeting Notes

Committee Statement: The reference to 300.5 in list item 1 was unnecessary and therefore deleted. The words "grounded conductors" were incorrect and were therefore deleted. The phrase in list item 3 was deleted since it was unnecessary. List item 5 was deleted, as solar PV wiring methods are covered in Article 690. Renumbered list accordingly.

Response Message:

Committee Notes:

Date Submitted By

Jan 10, 2018 NEC-CMP Panel 06 The informational note after list item (8) is not new.

[Public Input No. 3367-NFPA 70-2017 \[Section No. 340.10\]](#)

[Public Input No. 3082-NFPA 70-2017 \[Section No. 340.10\]](#)

[Public Input No. 1123-NFPA 70-2017 \[Section No. 340.10\]](#)

[Public Input No. 4263-NFPA 70-2017 \[Section No. 340.10\]](#)

WORKING DRAFT OF CMP MEETING OUTPUT - NATIONAL ELECTRICAL CODE - NFPA 70
JANUARY 8 - 20, 2018 - SUBJECT TO REVISION - NOT FOR PUBLICATION

[Public Input No. 3084-NFPA 70-2017 \[Section No. 340.10\]](#)

FOR CODE-MAKING PANEL USE ONLY
SUBJECT TO REVISION - NOT FOR PUBLICATION

**First Revision No. 7776-NFPA 70-2018 [Section No. 340.12]**

****See attached word document "PI 4303 Revised" for revision****

340.12 Uses Not Permitted.

Type UF cable shall not be used as follows:

- (1) As service-entrance cable
- (2) In commercial garages
- (3) In theaters and similar locations
- (4) In motion picture studios
- (5) In storage battery rooms
- (6) In hoistways or on elevators or escalators
- (7) In hazardous (classified) locations, except as specifically permitted by other articles in this Code
- (8) Embedded in poured cement, concrete, or aggregate, except where embedded in plaster as nonheating leads where permitted in 424.43
- (9) Where exposed to direct rays of the sun, unless identified as sunlight resistant
- (10) Where subject to physical damage
- (11) As overhead cable, except where installed as messenger-supported wiring in accordance with Part II of Article 396

Supplemental Information

<u>File Name</u>	<u>Description</u>	<u>Approved</u>
PI_4303_Revised.docx	Added informational note to list item (9). For staff use	✓

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 06

Organization: [Not Specified]

Street Address:

City:

State:

Zip:

Submittal Date: Wed Jan 10 09:22:41 EST 2018

Make Editorial Changes
Based on Committee Text

Committee Statement and Meeting Notes

Committee Statement: The informational note lets the code user know that a sunlight resistant cable may not have sunlight resistant inner conductors.

Response Message:

Public Input No. 4303-NFPA 70-2017 [Section No. 340.112]

**First Revision No. 7765-NFPA 70-2018 [Section No. 340.2]****340.2 Definition.**

The definition in this section shall apply within this article and throughout the code.

Underground Feeder and Branch-Circuit Cable, Type UF.

A factory assembly of one or more insulated conductors with an integral or an overall covering of nonmetallic material suitable for direct burial in the earth.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 06

Organization: [Not Specified]

Street Address:

City:

State:

Zip:

Submittal Date: Wed Jan 10 08:36:50 EST 2018

Make Editorial Changes
Based on Committee
Text

Committee Statement and Meeting Notes

Committee Statement: Language was added based on the recommendation of the Correlating Committee task group on definitions to improve usability.

Response Message:

Public Input No. 2191-NFPA 70-2017 [Section No. 340.2]

**First Revision No. 7697-NFPA 70-2018 [Section No. 382.100]****382.100 Construction.**

Concealable nonmetallic extensions shall be a multilayer flat conductor design consisting of a center ungrounded conductor enclosed by a sectioned grounded conductor, and an overall sectioned equipment grounding conductor.

Submitter Information Verification**Submitter Full Name:** NEC-CMP Panel 06**Organization:** [Not Specified]**Street Address:****City:****State:****Zip:****Submittal Date:** Tue Jan 09 16:12:29 EST 2018

Make Editorial Changes
Based on Committee
Text

Committee Statement and Meeting Notes

Committee Statement: The revision incorporates terms into this section to clarify what conductors this definition is intended to apply to.

Response Message:

Public Input No. 2391-NFPA 70-2017 [Section No. 382.100]

Public Input No. 3329-NFPA 70-2017 [Section No. 382.100]

**First Revision No. 7699-NFPA 70-2018 [Section No. 382.104]****382.104 Flat Conductors.**

Concealable nonmetallic extensions shall be constructed, using flat copper conductors equivalent to 14 AWG or 12 AWG conductor sizes, and constructed per 382.104(A), (B), and (C).

(A) Ungrounded Conductor (Center Layer).

The ungrounded conductor shall consist of one or more ungrounded flat conductor(s) enclosed in accordance with 382.104(B) and (C) and identified in accordance with 310.110(C).

(B) Grounded Conductor (Inner Sectioned Layers).

The grounded conductor shall consist of two sectioned inner flat conductors that enclose the center ungrounded conductor(s). The sectioned grounded conductor shall be enclosed by the sectioned equipment grounding conductor and identified in accordance with 200.6.

(C) – Equipment Grounding Conductor (Outer Sectioned Layers).

The equipment grounding conductor shall consist of two overall sectioned conductors that enclose the grounded conductor and ungrounded conductor(s) and shall comply with 250.4(A)(5). The equipment grounding conductor layers shall be identified by any one of the following methods:

- (1) As permitted in 250.119
- (2) A clear covering
- (3) One or more continuous green stripes or hash marks
- (4) The term “Equipment Ground” ~~printed~~ Grounding Conductor” ~~printed~~ at regular intervals throughout the cable

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 06

Organization: [Not Specified]

Street Address:

City:

State:

Zip:

Submittal Date: Tue Jan 09 16:15:44 EST 2018

Make Editorial Changes
Based on Committee
Text

Committee Statement and Meeting Notes

Committee Statement: The revision incorporates terms into this section to clarify what conductors this definition is intended to apply to.

**Response
Message:**

Public Input No. 3335-NFPA 70-2017 [Section No. 382.104(C)]

Public Input No. 2392-NFPA 70-2017 [Section No. 382.104]

**First Revision No. 7700-NFPA 70-2018 [Section No. 382.112]****382.112** Insulation.

The ungrounded and grounded flat conductor layers shall be individually insulated and comply with 310.15(A)(3). The equipment grounding conductor shall be covered or insulated.

Submitter Information Verification**Submitter Full Name:** NEC-CMP Panel 06**Organization:** [Not Specified]**Street Address:****City:****State:****Zip:****Submittal Date:** Tue Jan 09 16:17:16 EST 2018

Make Editorial Changes
Based on Committee
Text

Committee Statement and Meeting Notes

Committee Statement: The revision incorporates terms into this section to clarify what conductors this rule is intended to apply to.

Response Message:

Public Input No. 3336-NFPA 70-2017 [Section No. 382.112]

Public Input No. 2393-NFPA 70-2017 [Section No. 382.112]

**First Revision No. 7696-NFPA 70-2018 [Section No. 382.2]**

382.2 Definitions. The definitions in this section shall apply within this article and throughout the code.

Concealable Nonmetallic Extension.

A listed assembly of two, three, or four insulated circuit conductors within a nonmetallic jacket, an extruded thermoplastic covering, or a sealed nonmetallic covering. The classification includes surface extensions intended for mounting directly on the surface of walls or ceilings, and concealed with paint, texture, joint compound, plaster, wallpaper, tile, wall paneling, or other similar materials.

Nonmetallic Extension.

An assembly of two insulated conductors within a nonmetallic jacket or an extruded thermoplastic covering. The classification includes surface extensions intended for mounting directly on the surface of walls or ceilings.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 06

Organization: [Not Specified]

Street Address:

City:

State:

Zip:

Submittal Date: Tue Jan 09 16:10:42 EST 2018

Make Editorial Changes
Based on Committee
Text

Committee Statement and Meeting Notes

Committee Statement: Language was added based on the recommendation of the Correlating Committee task group on definitions to improve usability.

Response Message:

Public Input No. 2217-NFPA 70-2017 [Section No. 382.2]

**First Revision No. 7701-NFPA 70-2018 [Section No. 394.2]****394.2 Definition._**

The definition in this section shall apply within this article and throughout the code.

Concealed Knob-and-Tube Wiring.

A wiring method using knobs, tubes, and flexible nonmetallic tubing for the protection and support of single insulated conductors.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 06

Organization: [Not Specified]

Street Address:

City:

State:

Zip:

Submittal Date: Tue Jan 09 16:20:19 EST 2018

Make Editorial Changes
Based on Committee
Text

Committee Statement and Meeting Notes

Committee Statement: Language was added based on the recommendation of the Correlating Committee task group on definitions to improve usability.

Response Message:

Public Input No. 2225-NFPA 70-2017 [Section No. 394.2]

**First Revision No. 7702-NFPA 70-2018 [Section No. 396.2]****396.2 Definitions.****(A) Application Within this Article and throughout the Code.**

The following definition shall apply within this article and throughout the code.

Messenger-Supported Wiring. [text moved with no changes]

An exposed wiring support system using a messenger wire to support insulated conductors by any one of the following:

- (1) A messenger with rings and saddles for conductor support.
- (2) A messenger with a field-installed lashing material for conductor support.
- (3) Factory-assembled aerial cable.
- (4) Multiplex cables utilizing a bare conductor, factory assembled and twisted with one or more insulated conductors, such as duplex, triplex, or quadruplex type of construction.

(B) Application Within this Article.

The following definition shall apply only within this article.

Insulated Conductor.

For the purposes of this article, an insulated conductor includes the following:

- (1) Conductor types described in 310.104, and
- (2) Overhead service conductors encased in a polymeric material that has been evaluated for the applied nominal voltage.

Informational Note: Evidence of evaluation for the applied nominal voltage can be given by certification that the conductors have met the requirements of ICEA S-76-474-2011, *Standard for Neutral Supported Power Cable Assemblies with Weather-Resistant Extruded Insulation Rated 600 Volts*.

Messenger-Supported Wiring.

An exposed wiring support system using a messenger wire to support insulated conductors by any one of the following:

- (1) A messenger with rings and saddles for conductor support
- (2) A messenger with a field-installed lashing material for conductor support
- (3) Factory-assembled aerial cable
- (4) Multiplex cables utilizing a bare conductor, factory assembled and twisted with one or more insulated conductors, such as duplex, triplex, or quadruplex type of construction

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 06

Organization: [Not Specified]

Street Address:

City:

State:

Zip:

Submittal Date: Tue Jan 09 16:24:47 EST 2018

Make Editorial Changes
Based on Committee Text

Committee Statement and Meeting Notes

Committee Statement: Language was added based on the recommendation of the Correlating Committee task group on definitions to improve usability.

Response Message:

[Public Input No. 2238-NFPA 70-2017 \[Section No. 396.2\]](#)

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**First Revision No. 7704-NFPA 70-2018 [Section No. 398.2]****398.2 Definition.**

The definition in this section shall apply within this article and throughout the code.

Open Wiring on Insulators.

An exposed wiring method using cleats, knobs, tubes, and flexible tubing for the protection and support of single insulated conductors run in or on buildings.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 06

Organization: [Not Specified]

Street Address:

City:

State:

Zip:

Submittal Date: Tue Jan 09 16:31:51 EST 2018

Make Editorial Changes
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Text

Committee Statement and Meeting Notes

Committee Statement: Language was added based on the recommendation of the Correlating Committee task group on definitions to improve usability.

Response Message:

Public Input No. 2226-NFPA 70-2017 [Section No. 398.2]

**First Revision No. 7711-NFPA 70-2018 [Section No. 399.10]****399.10 Uses Permitted.**

Outdoor overhead conductors over 1000 volts, nominal, shall be permitted only for systems rated over 1000 volts, nominal, as follows:

- (1) Outdoors in free air
- (2) For service conductors, feeders, or branch circuits

Informational Note: For additional information on outdoor overhead conductors over 1000 volts, see IEEE C2-2012 , *National Electrical Safety Code*, and ANSI/IEEE 3001.2, *Recommended Practice for Evaluating the Electrical Service Requirements of Industrial and Commercial Power Systems*.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 06

Organization: [Not Specified]

Street Address:

City:

State:

Zip:

Submittal Date: Tue Jan 09 16:50:39 EST 2018

Make Editorial Changes
Based on Committee
Text

Committee Statement and Meeting Notes

Committee Statement: The date was removed from the informational note to acknowledge that the latest version should be applied.

Response Message:

Public Input No. 1045-NFPA 70-2017 [Global Input]

Public Input No. 828-NFPA 70-2017 [Section No. 399.10]

**First Revision No. 7710-NFPA 70-2018 [Section No. 399.2]****399.2 Definition._**

The definitions in this section shall apply only within this article.

Outdoor Overhead Conductors.

Single conductors, insulated, covered, or bare, installed outdoors on support structures in free air.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 06

Organization: [Not Specified]

Street Address:

City:

State:

Zip:

Submittal Date: Tue Jan 09 16:48:32 EST 2018

Make Editorial Changes
Based on Committee
Text

Committee Statement and Meeting Notes

Committee Statement: Language was added based on the recommendation of the Correlating Committee task group on definitions to improve usability.

Response Message:

Public Input No. 1212-NFPA 70-2017 [Section No. 399.2]

**First Revision No. 7712-NFPA 70-2018 [Section No. 399.30(B)]****(B) Structures.**

Structures of wood, metal, concrete, or combinations of those materials, shall be provided for support of overhead conductors over 1000 volts, nominal. Documentation of the engineered design by a licensed professional engineer engaged primarily in the design of such systems and the installation of each support structure shall be available upon request of the authority having jurisdiction and shall include consideration of the following:

- (1) Soil conditions
- (2) Foundations and structure settings
- (3) Weight of all supported conductors and equipment
- (4) Weather loading and other conditions such as, but not limited to, ice, wind, temperature, and lightning
- (5) Angle where change of direction occurs
- (6) Spans between adjacent structures
- (7) Effect of dead-end structures
- (8) Strength of ~~guys~~ guy wires and guy anchors
- (9) Structure size and material(s)
- (10) Hardware

Submitter Information Verification**Submitter Full Name:** NEC-CMP Panel 06**Organization:** [Not Specified]**Street Address:****City:****State:****Zip:****Submittal Date:** Tue Jan 09 16:57:41 EST 2018

Make Editorial Changes
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Text

Committee Statement and Meeting Notes

Committee Statement: In the 2014 edition of the NEC the term "guy" as defined in article 694 was removed because it could be construed as referring to other than guy wires. Replace "guys" with "guy wires."

Response Message:

Public Input No. 2620-NFPA 70-2017 [Section No. 399.30(B)]

**First Revision No. 7911-NFPA 70-2018 [Section No. 400.1]****400.1 Scope.**

This article covers general requirements, applications, and construction specifications for flexible cords and flexible cables.

~~Informational Note: UL 817, *Cord Sets and Power-Supply Cords*, allows the use of flexible cords manufactured in accordance with UL 62, *Flexible Cords and Cables*. See 400.10 and 400.12 for flexible cords that are part of a listed cord set or power-supply cord.~~

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 06

Organization: [Not Specified]

Street Address:

City:

State:

Zip:

Submittal Date: Thu Jan 11 09:48:26 EST 2018

Make Editorial Changes
Based on Committee
Text

Committee Statement and Meeting Notes

Committee Statement: tThe Informational note is appropriately located under 400.12 and was revised for clarity.

Response Message:

**First Revision No. 7907-NFPA 70-2018 [Section No. 400.12]****400.12 Uses Not Permitted.**

Unless specifically permitted in 400.10 , flexible cords, flexible cables,

flexible

cord sets, and power supply cords shall not be used for the following:

Informational Note: for proper application see UL817, Cord Sets and Power-Supply Cords and UL62, Flexible Cords and Cables.

- (1) As a substitute for the fixed wiring of a structure
- (2) Where run through holes in walls, structural ceilings, suspended ceilings, dropped ceilings, or floors
- (3) Where run through doorways, windows, or similar openings
- (4) Where attached to building surfaces

Exception to (4): Flexible cord and flexible cable shall be permitted to be attached to building surfaces in accordance with 368.56(B) and 590 . 4.

- (5) Where concealed by walls, floors, or ceilings or located above suspended or dropped ceilings

Exception to (5): Flexible cord and flexible cable shall be permitted if contained within an enclosure for use in Other Spaces Used for Environmental Air as permitted by 300.22(C)(3).

- (6) Where installed in raceways, except as otherwise permitted in this Code
- (7) Where subject to physical damage

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 06

Organization: [Not Specified]

Street Address:

City:

State:

Zip:

Submittal Date: Thu Jan 11 09:36:08 EST 2018

Make Editorial Changes
Based on Committee Text

Committee Statement and Meeting Notes

Committee Statement: The Informational note is appropriately located under 400.12 and was revised for clarity. Since article 400 is "flexible cords and flexible cables", 400.12 should include both in its description of uses not permitted. Article 590 should be included in the exception that Article 400 flexible cords and flexible cables may be supported by the building surface but in the submitter's substantiation it is claimed that extension cords can be used for branch circuits and feeders which is not permissible.

Response Message:

Committee Notes:

Date Submitted By

Jan 11, NEC-CMP Panel The exception that is showing underlined is not new. Remove underline.
2018 06

Public Input No. 1676-NFPA 70-2017 [Section No. 400.10]

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[Public Input No. 1601-NFPA 70-2017 \[Section No. 400.1\]](#)

[Public Input No. 430-NFPA 70-2017 \[Section No. 400.12\]](#)

[Public Input No. 3258-NFPA 70-2017 \[Section No. 400.12\]](#)

[Public Input No. 325-NFPA 70-2017 \[Section No. 400.12\]](#)

[Public Input No. 2167-NFPA 70-2017 \[Section No. 400.12\]](#)

[Public Input No. 2684-NFPA 70-2017 \[Section No. 400.12\]](#)

[Public Input No. 2100-NFPA 70-2017 \[Section No. 400.12\]](#)

[Public Input No. 1674-NFPA 70-2017 \[Section No. 400.1\]](#)

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**First Revision No. 7931-NFPA 70-2018 [Section No. 400.17]****400.17** Protection from Damage.

Flexible cords and flexible cables shall be protected by bushings or fittings where passing through holes in covers, outlet boxes, or similar enclosures.

In industrial establishments where the conditions of maintenance and supervision ensure that only qualified persons service the installation, flexible cords and flexible cables shall be permitted to be installed in aboveground raceways that are no longer than 15 m (50 ft) to protect the flexible cord or flexible cable from physical damage. Where more than three current-carrying conductors are installed within the raceway, the ~~allowable~~ ampacity shall be ~~reduced~~ adjusted in accordance with Table 400.5(A)(3).

Submitter Information Verification**Submitter Full Name:** NEC-CMP Panel 06**Organization:** [Not Specified]**Street Address:****City:****State:****Zip:****Submittal Date:** Thu Jan 11 10:40:07 EST 2018[Make Editorial Changes
Based on Committee
Text](#)**Committee Statement and Meeting Notes**

Committee Statement: The term "allowable" was removed since it was not necessary and the term "reduced" was replaced with the term "adjusted" to correlate with the table title.

Response Message:

Public Input No. 939-NFPA 70-2017 [Section No. 400.17]

**First Revision No. 7932-NFPA 70-2018 [Section No. 400.23]****400.23** Equipment Grounding Conductor Identification.

A conductor intended to be used as an equipment grounding conductor shall have a continuous identifying marker readily distinguishing it from the other conductor or conductors. Conductors having a continuous green color or a continuous green color with one or more yellow stripes shall not be used for other than equipment grounding conductors. Cords or cables consisting of integral insulation and a jacket without a nonintegral equipment grounding conductor shall be permitted to be green. The identifying marker shall consist of one of the methods in 400.23(A) or (B).

(A) Colored Braid.

A braid finished to show a continuous green color or a continuous green color with one or more yellow stripes.

(B) Colored Insulation or Covering.

For cords having no braids on the individual conductors, an insulation of a continuous green color or a continuous green color with one or more yellow stripes.

Submitter Information Verification**Submitter Full Name:** NEC-CMP Panel 06**Organization:** [Not Specified]**Street Address:****City:****State:****Zip:****Submittal Date:** Thu Jan 11 10:42:46 EST 2018

Make Editorial Changes
Based on Committee
Text

Committee Statement and Meeting Notes

Committee Statement: The word "equipment" was added in front of the term "grounding conductor" to correspond with the defined term in Article 100.

Response Message:

Public Input No. 2396-NFPA 70-2017 [Section No. 400.23]



First Revision No. 7917-NFPA 70-2018 [Section No. 400.4]

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****See attached Word Doc****

400.4 Types.

FOR CODE-MAKING PANEL USE ONLY
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Flexible cords and flexible cables shall conform to the description in Table 400.4. The use of flexible cords and flexible cables other than those in Table 400.4 shall require permission by the authority having jurisdiction.

Table 400.4 Flexible Cords and Flexible Cables

<u>Trade</u> <u>Name</u>	<u>Type</u> <u>Letter</u>	<u>Voltage</u>	<u>AWG</u> <u>or</u> <u>kcmil</u>	<u>Number</u> <u>of</u> <u>Conductors</u>	<u>Insulation</u>	<u>AWG</u> <u>or</u> <u>kcmil</u>	<u>mm</u>	<u>mils</u>
Lamp cord	C	300 600	18–16 15–10	2 or more	Thermoset or thermoplastic	18–16 15–10	0.76 1.14	30 45
Elevator cable	E 1,2,3,4	300 or 600	20–2	2 or more	Thermoset	20–16 15–12 12–10 8–2	0.51 0.76 1.14 1.52	20 30 45 60
Elevator cable	EO 1,2,4	300 or 600	20–2	2 or more	Thermoset	20–16 15–12 12–10 8–2	0.51 0.76 1.14 1.52	20 30 45 60

WORKING DRAFT OF CMP MEETING OUTPUT - NATIONAL ELECTRICAL CODE - NFPA 70
JANUARY 8 - 20, 2018 - SUBJECT TO REVISION - NOT FOR PUBLICATION

<u>Trade</u> <u>Name</u>	<u>Type</u> <u>Letter</u>	<u>Voltage</u>	<u>AWG</u> <u>or</u> <u>kcmil</u>	<u>Number</u> <u>of</u> <u>Conductors</u>	<u>Insulation</u>	<u>AWG</u> <u>or</u> <u>kcmil</u>	<u>mm</u>	<u>mils</u>
Elevator cable	ETP 2,4	300 or 600	300 or 600			-	-	-
		ETT 2,4				-	-	-
Electric vehicle cable	EV 5,6	600	18-500	2 or more plus grounding conductor(s), plus optional hybrid data, signal communications, and optical fiber cables	Thermoset with optional nylon	18-15	0.76 (0.51)	30 (20)
						14-10	1.14 (0.76)	45 (30)
						8-2	1.52 (1.14)	60 (45)
						1-4/0	2.03 (1.52)	80 (60)
						250-500	2.41 (1.90)	95 (75)
	EVJ 5,6	300	18-12			18-12	0.76 (0.51)	30 (20)
		EVE 5,6	600	2 or more plus grounding conductor(s), plus optional hybrid data, signal communications, and	Thermoplastic elastomer with optional nylon	18-15		0.76 (0.51)
						14-10		1.14 (0.76)
						8-2		1.52 (1.14)

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JANUARY 8 - 20, 2018 - SUBJECT TO REVISION - NOT FOR PUBLICATION

<u>Trade</u> <u>Name</u>	<u>Type</u> <u>Letter</u>	<u>Voltage</u>	<u>AWG</u> <u>or</u> <u>kcmil</u>	<u>Number</u> <u>of</u> <u>Conductors</u>	<u>Insulation</u>	<u>AWG</u> <u>or</u> <u>kcmil</u>	<u>mm</u>	<u>mils</u>
							1-4/0	2.03
								(1.52)
							250- 500	2.41
		EVJE 5,6	300	18-12	optical fiber cables			(1.90)
							18-12	0.76
								(0.51)
		EVT 5,6	600	18-500	2 or more plus grounding conductor(s), plus optional hybrid data, signal communications, and optical fiber cables	Thermoplastic with optional nylon	18-15	0.76
								(0.51)
							14-10	1.14
								(0.76)
							8-2	1.52
								(1.14)
		EVJT 5,6	300	18-12			1-4/0	2.03
								(1.52)
							250- 500	2.41
Portable power cable	G	2000	12-500	2-6 plus grounding conductor(s)	Thermoset	12-2 1-4/0 250-500	1.52	60
							2.03	80
							2.41	95
	G-GC ⁷	2000	12-500	3-6 plus grounding conductors and 1 ground check	Thermoset		12-2	1.52
							1-4/0	2.03
							250-500	2.41

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<u>Trade</u> <u>Name</u>	<u>Type</u> <u>Letter</u>	<u>Voltage</u>	<u>AWG</u> <u>or</u> <u>kcmil</u>	<u>Number</u> <u>of</u> <u>Conductors</u>	<u>Insulation</u>	<u>AWG</u> <u>or</u> <u>kcmil</u>	<u>mm</u>	<u>mils</u>
					conductor			
Heater	HPD	300	18–12	2, 3, or 4	Thermoset	18–16	0.38	15
cord						15–12	0.76	30
Parallel	HPN ⁸	300	18–12	2 or 3	Oil-resistant thermoset	18–16	1.14	45
heater						15	1.52	60
cord						14	2.41	95
						12		
Thermoset	HSJ	300	18–12	2, 3, or 4	Thermoset	18–16	0.76	30
jacketed						15–12	1.14	45
heater								
cords								
		HSJO	300	18–12			-	-
	HSJOW ⁹	300	18–12			-	-	-
	HSJOO	300	18–12			Oil-resistant thermoset	-	-
	HSJOOW ⁹	300	18–12			-	-	-
Non-integral parallel cords	NISP-1	300	20–18	2 or 3	Thermoset	20–18	0.38	15
	NISP-2	300	18–16			18–16	0.76	30
	NISPE-1 ⁸	300	20–18		Thermoplastic elastomer	20–18	0.38	15
	NISPE-2 ⁸	300	18–16			18–16	0.76	30
	NISPT-1 ⁸	300	20–18		Thermoplastic	20–18	0.38	15
	NISPT-2 ⁸	300	18–16			18–16	0.76	30
Twisted	PD	300	18–16	2 or more	Thermoset or thermoplastic	18–16	0.76	30

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<u>Trade</u> <u>Name</u>	<u>Type</u> <u>Letter</u>	<u>Voltage</u>	<u>AWG</u> <u>or</u> <u>kcmil</u>	<u>Number</u> <u>of</u> <u>Conductors</u>	<u>Insulation</u>	<u>AWG</u> <u>or</u> <u>kcmil</u>	<u>mm</u>	<u>mils</u>
portable cord		600	14-10			15-10	1.14	45
Portable power cable	PPE ⁷	2000	12-500	1-6 plus optional grounding conductor(s)	Thermoplastic elastomer	12-2 1-4/0 250-500	1.52 2.03 2.41	60 80 95
Hard service cord	S ⁷	600	18-2	2 or more	Thermoset	18-15 14-10 8-2	0.76 1.14 1.52	30 45 60
Flexible stage and lighting power cable	SC ^{7,10}	600	8-250	1 or more	Thermoset	8-2 1-4/0 250	1.52 2.03 2.41	60 80 95
		SCE ^{7,10}	600					Thermoplastic elastomer
	SCT ^{7,10}	600					Thermoplastic	-
Hard service cord	SE ⁷	600	18-2	2 or more	Thermoplastic elastomer	18-15 14-9 8-2	0.76 1.14 1.52	30 45 60
		SEW ^{7, 9}	600				-	-
		SEO ⁷	600				-	-

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<u>Trade</u> <u>Name</u>	<u>Type</u> <u>Letter</u>	<u>Voltage</u>	<u>AWG</u> <u>or</u> <u>kcmil</u>	<u>Number</u> <u>of</u> <u>Conductors</u>	<u>Insulation</u>	<u>AWG</u> <u>or</u> <u>kcmil</u>	<u>mm</u>	<u>mil</u>
		SEOW ^{7,9}	600					
	SEOO ⁷	600						
	SEOOW ^{7,9}	600					Oil-resistant thermoplastic elastomer	
Junior hard service cord	SJ	300	18-10	2-6	Thermoset	18-11 10	0.76 1.14	30 45
		SJE	300					Thermop elastome
	SJEW ⁹	300						
		SJEO	300					
	SJEOW ⁹	300						
	SJEOO	300					Oil-resistant thermoplastic elastomer	

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Trade Name	-	-	-	-	-	-		
	Type		AWG or	Number of		AWG or		
	Letter	Voltage	kcmil	Conductors	Insulation	kcmil	mm	mils
	SJEOOW ⁹	300	300			-	-	-
		SJO						
	SJOW ⁹	300				-	-	-
	SJOO	300				Oil-resistant thermoset	-	
	SJOOW ⁹	300			-	-	-	
	SJT	300				Thermoplastic	-	
	SJTW ⁹	300			-	-	-	
		SJTO			300			
		SJTOW ⁹			300		-	
		SJTOO			300	Oil-resistant thermoplastic	-	
	SJTOOW ⁹	300	-	-	-			
Hard service cord	SO ⁷	600	18–2	2 or more	Thermoset	18–15	0.76	30
		SOW ^{7,9}	600				-	-

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<u>Trade</u> <u>Name</u>	<u>Type</u> <u>Letter</u>	<u>Voltage</u>	<u>AWG</u> <u>or</u> <u>kcmil</u>	<u>Number</u> <u>of</u> <u>Conductors</u>	<u>Insulation</u>	<u>AWG</u> <u>or</u> <u>kcmil</u>	<u>mm</u>	<u>mils</u>
		SOO ⁷	600					Oil-resist thermose
		SOOW ^{7,9}	600					-
All thermoset parallel cord	SP-1	300	20-18	2 or 3	Thermoset	20-18	0.76	30
		SP-2	300	18-16				
		SP-3	300	18-10				
All elastomer (thermo- plastic) parallel cord	SPE-1 ⁸	300	20-18	2 or 3	Thermoplastic elastomer	20-18	0.76	30
		SPE-2 ⁸	300	18-16				
		SPE-3 ⁸	300	18-10				
All thermoplastic parallel cord	SPT-1	300	20-18	2 or 3	Thermoplastic	20-18	0.76	30
		SPT-1W ⁹	300		2			-

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<u>Trade</u> <u>Name</u>	<u>Type</u>	<u>AWG</u>	<u>Number</u>	<u>AWG</u>	<u>Insulation</u>	<u>AWG</u>	<u>mm</u>	<u>mils</u>	
	<u>Letter</u>	<u>or</u>	<u>of</u>	<u>or</u>					
	<u>Voltage</u>	<u>kcmil</u>	<u>Conductors</u>	<u>kcmil</u>					
		SPT-2	300	18–16	2 or 3			18–1	
		SPT-2W ⁹	300					2	
		SPT-3	300	18–10	2 or 3			18–1	
								15	
								14	
12									
							10		
Range, dryer cable	SRD	300	10–4	3 or 4	Thermoset	10–4	1.14	45	
		SRDE	300	10–4	3 or 4	Thermoplastic elastomer	-	-	
	SRDT	300	10–4	3 or 4	Thermoplastic	-	-	-	
Hard service cord	ST ⁷	600	18–2	2 or more	Thermoplastic	18–15	0.76	30	
						14–9	1.14	45	
		STW ^{7,9}	600				8–2	1.52	60
								-	-
		STO ⁷	600					-	-
	STOW ^{7, 9}	600					-	-	

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<u>Trade</u> <u>Name</u>	<u>Type</u> <u>Letter</u>	<u>Voltage</u> <u>Letter</u>	<u>AWG</u> <u>or</u> <u>kcmil</u>	<u>Number</u> <u>of</u> <u>Conductors</u>	<u>Insulation</u>	<u>AWG</u> <u>or</u> <u>kcmil</u>	<u>mm</u> <u>Oil-resistant</u> <u>thermoplastic</u>	<u>mils</u>
	STOO ⁷	600						-
	STOOW ⁷	600						-
Vacuum cleaner cord	SV	300	18-16	2 or 3	Thermoset	18-16	0.38	15
		SVE	300					Thermop elastome
	SVEO	300						-
		SVEOO	300					Oil-resist thermopl elastome
	SVO	300					Thermoset	-
	SVOO	300					Oil-resistant thermoset	-
	SVT	300					Thermoplastic	-
	SVTO	300					Thermoplastic	-
	SVTOO	300					Oil-resistant thermoplastic	-
Parallel tinsel cord	TPT ¹¹	300	27	2	Thermoplastic	27	0.76	30

WORKING DRAFT OF CMP MEETING OUTPUT - NATIONAL ELECTRICAL CODE - NFPA 70
JANUARY 8 - 20, 2018 - SUBJECT TO REVISION - NOT FOR PUBLICATION

<u>Trade</u> <u>Name</u>	<u>Type</u> <u>Letter</u>	<u>Voltage</u>	<u>AWG</u> <u>or</u> <u>kcmil</u>	<u>Number</u> <u>of</u> <u>Conductors</u>	<u>Insulation</u>	<u>AWG</u> <u>or</u> <u>kcmil</u>	<u>mm</u>	<u>mil</u>
Jacketed tinsel cord	TST ¹¹	300	27	2	Thermoplastic	27	0.38	15
Portable power cable	W ⁷	2000	12-500	1-6	Thermoset	12-2	1.52	60
			501-1000	1		1-4/0	2.03	80
						250-500	2.41	95
						501-1000	2.80	110

Notes:

All types listed in Table 400.4 shall have individual conductors twisted together, except for Types HPN, SP-1, SP-2, SP-3, SPE-1, SPE-2, SPE-3, SPT-1, SPT-2, SPT-3, SPT-1W, SPT-2W, TPT, NISP-1, NISP-2, NISPT-1, NISPT-2, NISPE-1, NISPE-2, and three-conductor parallel versions of SRD, SRDE, and SRDT.

The individual conductors of all cords, except those of heat-resistant cords, shall have a thermoset or thermoplastic insulation, except that the equipment grounding conductor, where used, shall be in accordance with 400.23(B).

¹Rubber-filled or varnished cambric tapes shall be permitted as a substitute for the inner braids.

²Elevator traveling cables for operating control and signal circuits shall contain nonmetallic fillers as necessary to maintain concentricity. Cables shall have steel supporting members as required for suspension by 620.41. In locations subject to excessive moisture or corrosive vapors or gases, supporting members of other materials shall be permitted. Where steel supporting members are used, they shall run straight through the center of the cable assembly and shall not be cabled with the copper strands of any conductor.

In addition to conductors used for control and signaling circuits, Types E, EO, ETP, and ETT elevator cables shall be permitted to incorporate in the construction one or more 20 AWG telephone conductor pairs, one or more coaxial cables, or one or more optical fibers. The 20 AWG conductor pairs shall be permitted to be covered with suitable shielding for telephone, audio, or higher frequency communications circuits; the coaxial cables shall consist of a center conductor, insulation, and a shield for use in video or other radio frequency communications circuits. The optical fiber shall be suitably covered with flame-retardant thermoplastic. The insulation of the conductors shall be rubber or thermoplastic of a thickness not less than specified for the other conductors of the particular type of cable. Metallic shields shall have their own protective covering. Where used, these components shall be permitted to be incorporated in any layer of the cable assembly but shall not run straight through the center.

³Insulations and outer coverings that meet the requirements as flame retardant, limited smoke, and are so listed, shall be permitted to be marked for limited smoke after the Code type designation.

⁴Elevator cables in sizes 20 AWG through 14 AWG are rated 300 volts, and sizes 10 AWG through 2 AWG are rated 600 volts. 12 AWG is rated 300 volts with a 0.76 mm (30 mil) insulation thickness and 600 volts with a 1.14 mm (45 mil) insulation thickness.

⁵Conductor size for Types EV, EVJ, EVE, EVJE, EVT, and EVJT cables apply to nonpower-limited circuits only.

Conductors of power-limited (data, signal, or communications) circuits may extend beyond the stated AWG size range. All conductors shall be insulated for the same cable voltage rating.

⁶Insulation thickness for Types EV, EVJ, EVEJE, EVT, and EVJT cables of nylon construction is indicated in parentheses.

⁷Types G, G-GC, S, SC, SCE, SCT, SE, SEO, SEOO, SEW, SEOW, SEOWW, SO, SOO, SOW, SOOW, ST, STO, STOO, STW, STOW, STOWW, PPE, and W shall be permitted for use on theater stages, in garages, and elsewhere where flexible cords are permitted by this *Code*.

⁸The third conductor in Type HPN shall be used as an equipment grounding conductor only. The insulation of the equipment grounding conductor for Types SPE-1, SPE-2, SPE-3, SPT-1, SPT-2, SPT-3, NISPT-1, NISPT-2, NISPE-1, and NISPE-2 shall be permitted to be thermoset polymer.

⁹Cords that comply with the requirements for outdoor cords and are so listed shall be permitted to be designated as weather and water resistant with the suffix "W" after the *Code* type designation. Cords with the "W" suffix are suitable for use in wet locations and are sunlight resistant.

¹⁰The required outer covering on some single-conductor cables may be integral with the insulation.

¹¹Types TPT and TST shall be permitted in lengths not exceeding 2.5 m (8 ft) where attached directly, or by means of a special type of plug, to a portable appliance rated at 50 watts or less and of such nature that extreme flexibility of the cord is essential.

Supplemental Information

<u>File Name</u>	<u>Description</u>	<u>Approved</u>
Revised_Table_400.4_sls.docx	clean version--for staff use	✓
Panel_6_FR-7917_Table_400.4_leg_changes.docx	For staff use	✓

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 06

Organization: [Not Specified]

Street Address:

City:

State:

Zip:

Submittal Date: Thu Jan 11 10:07:35 EST 2018

Make Editorial Changes
Based on Committee Text

Committee Statement and Meeting Notes

Committee Statement: Since a new outdoor cable type has been developed for the industry regarding heaters then the NEC should reflect this addition.

Per the work of the grounding task group, this language should include the word "equipment" grounding conductor as this best describes the function of this conductor.

The product standard is being updated to allow 1000 volt rated electric vehicle cable.

The submitter has identified a typo in the NEC.

Response Message:

[Public Input No. 1643-NFPA 70-2017 \[Section No. 400.4\]](#)

[Public Input No. 2059-NFPA 70-2017 \[Section No. 400.4\]](#)

[Public Input No. 2395-NFPA 70-2017 \[Section No. 400.4\]](#)

WORKING DRAFT OF CMP MEETING OUTPUT - NATIONAL ELECTRICAL CODE - NFPA 70
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[Public Input No. 1636-NFPA 70-2017 \[Section No. 400.4\]](#)

FOR CODE-MAKING PANEL USE ONLY
SUBJECT TO REVISION - NOT FOR PUBLICATION



First Revision No. 7901-NFPA 70-2018 [Section No. 400.5(A)]

FOR CODE-MAKING PANEL USE ONLY
SUBJECT TO REVISION - NOT FOR PUBLICATION

(A) Ampacity Tables.

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Table 400.5(A)(1) provides the ~~allowable~~ ampacities, and Table 400.5(A)(2) provides the ampacities for flexible cords and flexible cables with not more than three current-carrying conductors. These tables shall be used in conjunction with applicable end-use product standards to ensure selection of the proper size and type. Where cords and cables are used in ambient temperatures other than 30°C (86°F), the temperature correction factors from Table 310.15(B)(2)(a) that correspond to the temperature rating of the cord or cable shall be applied to the ampacity in Table 400.5(A)(1) and Table 400.5(A)(2). Cords and cables rated 105°C shall use correction factors in the 90°C column of Table 310.15(B)(2)(a) for temperature correction. Where the number of current-carrying conductors exceeds three, the ~~allowable~~ ampacity or the ampacity of each conductor shall be reduced from the three-conductor rating as shown in Table 400.5(A)(3).

Informational Note: See Informative Annex B, Table B~~2~~ 310.15(B)(2)(11), for adjustment factors for more than three current-carrying conductors in a raceway or cable with load diversity.

Table 400.5(A)(1) -~~Allowable~~ Ampacity for Flexible Cords and Flexible Cables

[Based on Ambient Temperature of 30°C (86°F). See 400.13 and Table 400.4.]

<u>Copper Conductor</u> <u>Size (AWG)</u>	<u>Thermoplastic Types TPT, TST</u>	<u>Thermoset Types C, E, EO, PD, S, SJ, SJO, SJOW, SJOO, SJOOW, SO, SOW, SOO, SOOW, SP-1, SP-2, SP-3, SRD, SV, SVO, SVOO, NISP-1, NISP-2</u>		Column A ^a	Column B ^b
		<u>Thermoplastic Types ETP, ETT, NISPE-1, NISPE-2, NISPT-1, NISPT-2, SE, SEW, SEO, SEOO, SEOW, SEOOW, SJE, SJEW, SJEQ, SJEQO, SJEOW, SJEQOW, SJT, SJTW, SJTO, SJTOW, SJTOO, SJTOOW, SPE-1, SPE-2, SPE-3, SPT-1, SPT-1W, SPT-2, SPT-2W, SPT-3, ST, STW, SRDE, SRDT, STO, STOW, STOO, STOOOW, SVE, SVEO, SVEOO, SVT, SVTO, SVTOO</u>	<u>Types HPD, HPN, HSJ, HSJO, HSJOW, HSJOO, HSJOOW</u>		
27 ^C	0.5	—	—	—	—
20	—	5d	e	—	—
18	—	7	10	10	—
17	—	9	12	13	—
16	—	10	13	15	—
15	—	12	16	17	—
14	—	15	18	20	—
13	—	17	21	—	—
12	—	20	25	30	—
11	—	23	27	—	—
10	—	25	30	35	—
9	—	29	34	—	—
8	—	35	40	—	—
7	—	40	47	—	—
6	—	45	55	—	—
5	—	52	62	—	—
4	—	60	70	—	—
3	—	70	82	—	—
2	—	80	95	—	—

^aThe ~~allowable~~ currents under Column A apply to three-conductor cords and other multiconductor cords connected to utilization equipment so that only three-conductors are current-carrying.

^bThe allowable currents under Column B apply to two-conductor cords and other multiconductor cords connected to utilization equipment so that only two conductors are current-carrying.

^cTinsel cord.

^dElevator cables only.

^e7 amperes for elevator cables only; 2 amperes for other types.

Table 400.5(A)(2) Ampacity of Cable Types SC, SCE, SCT, PPE, G, G-GC, and W

[Based on Ambient Temperature of 30°C (86°F). See Table 400.4.]

<u>Copper Conductor</u> <u>Size</u> <u>(AWG or kcmil)</u>	<u>Temperature Rating of Cable</u>								
	<u>60°C (140°F)</u>			<u>75°C (167°F)</u>			<u>90°C (194°F)</u>		
	<u>D¹</u>	<u>E²</u>	<u>F³</u>	<u>D¹</u>	<u>E²</u>	<u>F³</u>	<u>D¹</u>	<u>E²</u>	<u>F³</u>
12	—	31	26	—	37	31	—	42	35
10	—	44	37	—	52	43	—	59	49
8	60	55	48	70	65	57	80	74	65
6	80	72	63	95	88	77	105	99	87
4	105	96	84	125	115	101	140	130	114
3	120	113	99	145	135	118	165	152	133
2	140	128	112	170	152	133	190	174	152
1	165	150	131	195	178	156	220	202	177
1/0	195	173	151	230	207	181	260	234	205
2/0	225	199	174	265	238	208	300	271	237
3/0	260	230	201	310	275	241	350	313	274
4/0	300	265	232	360	317	277	405	361	316
250	340	296	259	405	354	310	455	402	352
300	375	330	289	445	395	346	505	449	393
350	420	363	318	505	435	381	570	495	433
400	455	392	343	545	469	410	615	535	468
500	515	448	392	620	537	470	700	613	536
600	575	—	—	690	—	—	780	—	—
700	630	—	—	755	—	—	855	—	—
750	655	—	—	785	—	—	885	—	—
800	680	—	—	815	—	—	920	—	—
900	730	—	—	870	—	—	985	—	—
1000	780	—	—	935	—	—	1055	—	—

¹The ampacities under subheading D shall be permitted for single-conductor Types SC, SCE, SCT, PPE, and W cable only where the individual conductors are not installed in raceways and are not in physical contact with each other except in lengths not to exceed 600 mm (24 in.) where passing through the wall of an enclosure.

²The ampacities under subheading E apply to two-conductor cables and other multiconductor cables connected to utilization equipment so that only two conductors are current-carrying.

³The ampacities under subheading F apply to three-conductor cables and other multiconductor cables connected to utilization equipment so that only three conductors are current-carrying.

Table 400.5(A)(3) Adjustment Factors for More Than Three Current-Carrying Conductors in a Flexible Cord or Flexible Cable

<u>Percent of Value in</u>	
<u>Number of Conductors</u>	<u>Table 400.5(A)(1) and</u>
	<u>Table 400.5(A)(2)</u>
4–6	80
7–9	70
10–20	50
21–30	45
31–40	40
41 and above	35

A neutral conductor that carries only the unbalanced current from other conductors of the same circuit shall not be required to meet the requirements of a current-carrying conductor.

In a 3-wire circuit consisting of two phase conductors and the neutral conductor of a 4-wire, 3-phase, wye-connected system, a common conductor carries approximately the same current as the line-to-neutral currents of the other conductors and shall be considered to be a current-carrying conductor.

On a 4-wire, 3-phase, wye circuit where more than 50 percent of the load consists of nonlinear loads, there are harmonic currents present in the neutral conductor and the neutral conductor shall be considered to be a current-carrying conductor.

An equipment grounding conductor shall not be considered a current-carrying conductor.

Where a single conductor is used for both equipment grounding and to carry unbalanced current from other conductors, as provided for in 250.140 for electric ranges and electric clothes dryers, it shall not be considered as a current-carrying conductor.

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 06

Organization: [Not Specified]

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State:

Zip:

Submittal Date: Thu Jan 11 08:55:51 EST 2018

Make Editorial Changes
Based on Committee Text

Committee Statement and Meeting Notes

Committee Statement: As per the work of the ampacity task group, the word "allowable" was removed as it is not necessary.

Response Message:

Public Input No. 938-NFPA 70-2017 [Section No. 400.5(A)]



First Revision No. 7982-NFPA 70-2018 [Section No. 402.3]

FOR CODE-MAKING PANEL USE ONLY
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******Revise Table 402. 3 per attached Word Doc******

402. 3 Types.

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Fixture wires shall be of a type listed in Table 402.3, and they shall comply with all requirements of that table. The fixture wires listed in Table 402.3 are all suitable for service at 600 volts, nominal, unless otherwise specified.

Informational Note: Thermoplastic insulation may stiffen at temperatures lower than -10°C (+14°F). Thermoplastic insulation may also be deformed at normal temperatures where subjected to pressure, such as at points of support.

Table 402.3 Fixture Wires

<u>Name</u>	<u>Type</u> <u>Letter</u>	<u>Insulation</u>	<u>AWG</u>	<u>mm</u>	<u>mils</u>	<u>Outer</u> <u>Covering</u>	<u>Thickness of Insulation</u>	
							<u>Maximum</u> <u>Operating</u> <u>Temperature</u>	<u>Application</u> <u>Provisions</u>
Heat-resistant rubber-covered fixture wire — flexible stranding	FFH-2	Heat-resistant rubber	18–16	0.76	30	Nonmetallic covering	75°C (167°F)	Fixture wiring
		Cross-linked synthetic polymer	18–16	0.76	30			
ECTFE — solid or 7-strand	HF	Ethylene chloro-trifluoroethylene	18–14	0.38	15	None	150°C (302°F)	Fixture wiring
ECTFE — flexible stranding	HFF	Ethylene chlorotrifluoroethylene	18–14	0.38	15	None	150°C (302°F)	Fixture wiring
Tape insulated fixture wire — solid or 7-strand	KF-1	Aromatic polyimide tape	18–10	0.14	5.5	None	200°C (392°F)	Fixture wiring — limited to 300 volts
	KF-2	Aromatic polyimide tape	18–10	0.21	8.4	None	200°C (392°F)	Fixture wiring
Tape insulated fixture wire — flexible stranding	KFF-1	Aromatic polyimide tape	18–10	0.14	5.5	None	200°C (392°F)	Fixture wiring — limited to 300 volts
	KFF-2	Aromatic polyimide tape	18–10	0.21	8.4	None	200°C (392°F)	Fixture wiring

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<u>Name</u>	<u>Type</u> <u>Letter</u>	<u>Insulation</u>	<u>AWG</u>	<u>mm</u>	<u>mils</u>	<u>Outer</u> <u>Covering</u>	<u>Thickness of Insulation</u>	
							<u>Maximum</u> <u>Operating</u> <u>Temperature</u>	<u>Application</u> <u>Provisions</u>
Perfluoro-alkoxy — solid or 7-strand (nickel or nickel-coated copper)	PAF	Perfluoro-alkoxy	18–14	0.51	20	None	250°C (482°F)	Fixture wiring (nickel or nickel-coated copper)
Perfluoro-alkoxy — flexible stranding	PAFF	Perfluoro-alkoxy	18–14	0.51	20	None	150°C (302°F)	Fixture wiring
Fluorinated ethylene propylene fixture wire — solid or 7-strand	PF	Fluorinated ethylene propylene	18–14	0.51	20	None	200°C (392°F)	Fixture wiring
Fluorinated ethylene propylene fixture wire — flexible stranding	PFF	Fluorinated ethylene propylene	18–14	0.51	20	None	150°C (302°F)	Fixture wiring
Fluorinated ethylene propylene fixture wire — solid or 7-strand	PGF	Fluorinated ethylene propylene	18–14	0.36	14	Glass braid	200°C (392°F)	Fixture wiring
Fluorinated ethylene propylene fixture wire — flexible stranding	PGFF	Fluorinated ethylene propylene	18–14	0.36	14	Glass braid	150°C (302°F)	Fixture wiring
Extruded polytetrafluoroethylene — solid or 7-strand (nickel or nickel-coated copper)	PTF	Extruded polytetrafluoroethylene	18–14	0.51	20	None	250°C (482°F)	Fixture wiring (nickel or nickel-coated copper)
Extruded polytetrafluoroethylene — flexible stranding 26-36 (AWG silver or	PTFF	Extruded polytetrafluoro-	18–14	0.51	20	None	150°C	Fixture wiring (silver or

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<u>Name</u>	<u>Type</u> <u>Letter</u>	<u>Insulation</u>	<u>AWG</u>	<u>mm</u>	<u>mils</u>	<u>Outer</u> <u>Covering</u>	<u>Thickness of Insulation</u>	
							<u>Maximum</u>	<u>Application</u>
							<u>Operating</u> <u>Temperature</u>	<u>Provisions</u>
nickel-coated copper)		roethylene					(302°F)	nickel-coated copper)
Heat-resistant rubber-covered fixture wire — solid or 7-strand	RFH-1	Heat-resistant rubber	18	0.38	15	Nonmetallic covering	75°C (167°F)	Fixture wiring — limited to 300 volts
	RFH-2	Heat-resistant cross-linked synthetic polymer	18–16	0.76	30	None or non-metallic covering	75°C (167°F)	Fixture wiring
Heat-resistant cross-linked synthetic polymer-insulated fixture wire — solid or 7-strand	RFHH-2*	Cross-linked synthetic	18–16	0.76	30	None or non-metallic	90°C	Fixture wiring
	RFHH-3*	polymer	18–16	1.14	45	covering	(194°F)	
Silicone insulated fixture wire — solid or 7-strand	SF-1	Silicone rubber	18	0.38	15	Nonmetallic covering	200°C (392°F)	Fixture wiring — limited to 300 volts
	SF-2	Silicone rubber	18–12 10	0.76 1.14	30 45	Nonmetallic covering	200°C (392°F)	Fixture wiring
Silicone insulated fixture wire — flexible stranding	SFF-1	Silicone rubber	18	0.38	15	Nonmetallic covering	150°C (302°F)	Fixture wiring — limited to 300 volts
	SFF-2	Silicone rubber	18–12 10	0.76 1.14	30 45	Nonmetallic covering	150°C (302°F)	Fixture wiring
Thermoplastic covered fixture wire — solid or 7-strand	TF*	Thermoplastic	18–16	0.76	30	None	60°C (140°F)	Fixture wiring

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Name	Type Letter	Insulation	AWG	mm	mils	Outer Covering	Thickness of Insulation	
							Maximum Operating Temperature	Application Provisions
Thermoplastic covered fixture wire — flexible stranding	TFF*	Thermoplastic	18–16	0.76	30	None	60°C (140°F)	Fixture wiring
Heat-resistant thermoplastic covered fixture wire — solid or 7-strand	TFN*	Thermoplastic	18–16	0.38	15	Nylon-jacketed or equivalent	90°C (194°F)	Fixture wiring
Heat-resistant thermoplastic covered fixture wire — flexible stranded	TFFN*	Thermoplastic	18–16	0.38	15	Nylon-jacketed or equivalent	90°C (194°F)	Fixture wiring
Cross-linked polyolefin insulated fixture wire — solid or 7-strand	XF*	Cross-linked polyolefin	18–14 12–10	0.76 1.14	30 45	None	150°C (302°F)	Fixture wiring — limited to 300 volts
Cross-linked polyolefin insulated fixture wire — flexible stranded	XFF*	Cross-linked polyolefin	18–14 12–10	0.76 1.14	30 45	None	150°C (302°F)	Fixture wiring — limited to 300 volts
Modified ETFE — solid or 7-strand	ZF	Modified ethylene tetrafluoro-ethylene	18–14	0.38	15	None	150°C (302°F)	Fixture wiring
Flexible stranding	ZFF	Modified ethylene tetrafluoro-ethylene	18–14	0.38	15	None	150°C (302°F)	Fixture wiring
High temp. modified ETFE— solid or 7-strand	ZHF	Modified ethylene	18–14	0.38	15	None	200°C	Fixture wiring

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<u>Name</u>	<u>Type</u> <u>Letter</u>	<u>Insulation</u>	<u>AWG</u>	<u>mm</u>	<u>mils</u>	<u>Outer</u> <u>Covering</u>	<u>Thickness of Insulation</u>		<u>Application</u> <u>Provisions</u>
							<u>Maximum</u>		
							<u>Operating</u>		
							<u>Temperature</u>		
		tetrafluoro- ethylene					(392°F)		

*Insulations and outer coverings that meet the requirements of flame retardant, limited smoke, and are so listed, shall be permitted to be marked for limited smoke after the *Code* type designation.

Supplemental Information

<u>File Name</u>	<u>Description</u>	<u>Approved</u>
Revised_Table_402.3.docx	Revised Table 402.3. For staff use	✓

Submitter Information Verification**Submitter Full Name:** NEC-CMP Panel 06**Organization:** [Not Specified]**Street Address:****City:****State:****Zip:****Submittal Date:** Thu Jan 11 15:06:56 EST 2018[Make Editorial Changes
Based on Committee Text](#)**Committee Statement and Meeting Notes**

Committee Statement: A new type of heat-resistant rubber-covered fixture wire — flexible stranding (FFHH-2) for 90 deg C was added to the table as it is new to the industry and will be recognized by the product standards. The other revisions to the table were editorial.

Response Message:

**First Revision No. 7978-NFPA 70-2018 [Section No. 402.5]****~~402.5~~ Allowable ~~5~~ Ampacities for Fixture Wires.**

The ~~allowable~~ ampacity of fixture wire shall be as specified in Table 402.5.

No conductor shall be used under such conditions that its operating temperature exceeds the temperature specified in Table 402.3 for the type of insulation involved.

Informational Note: See 310.15(A)(3) for temperature limitation of conductors.

Table ~~402.5~~ Allowable ~~5~~ Ampacity for Fixture Wires

<u>Size (AWG)</u>	<u>Allowable Ampacity</u>
18	6
16	8
14	17
12	23
10	28

Submitter Information Verification

Submitter Full Name: NEC-CMP Panel 06

Organization: [Not Specified]

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Submittal Date: Thu Jan 11 14:41:54 EST 2018

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Committee Statement and Meeting Notes

Committee Statement: Ampacity is the maximum current, in amperes, that a conductor can carry continuously under the conditions of use without exceeding its temperature rating. The term used in this section should be "ampacity" and not "allowable ampacity" as it is the intent for this section to determine the ampacity of the conductor based upon its condition of use.

Response Message:

Public Input No. 940-NFPA 70-2017 [Section No. 402.5]



First Revision No. 8331-NFPA 70-2018 [Detail]

Chapter 9, Table 5A

Table 5A Compact Copper and Aluminum Building Wire Nominal Dimensions** and Areas

Size (AWG or kcmil)	Bare Conductor		Types RHH**, RHW**, or USE				Types THW and THHW				Type 1	
	Diameter		Approximate Diameter		Approximate Area		Approximate Diameter		Approximate Area		Approximate Diameter	
	mm	in.	mm	in.	mm ²	in. ²	mm	in.	mm ²	in. ²	mm	in.
8	3.404	0.134	6.604	0.260	34.25	0.0531	6.477	0.255	32.90	0.0510	—	—
6	4.293	0.169	7.493	0.295	44.10	0.0683	7.366	0.290	42.58	0.0660	6.096	0.240
4	5.410	0.213	8.509	0.335	56.84	0.0881	8.509	0.335	56.84	0.0881	7.747	0.305
2	6.807	0.268	9.906	0.390	77.03	0.1194	9.906	0.390	77.03	0.1194	9.144	0.360
1	7.595	0.299	11.81	0.465	109.5	0.1698	11.81	0.465	109.5	0.1698	10.54	0.415
1/0	8.534	0.336	12.70	0.500	126.6	0.1963	12.70	0.500	126.6	0.1963	11.43	0.450
2/0	9.550	0.376	13.72	0.540	147.8	0.2290	13.84	0.545	150.5	0.2332	12.57	0.495
3/0	10.74	0.423	14.99	0.590	176.3	0.2733	14.99	0.590	176.3	0.2733	13.72	0.540
4/0	12.07	0.475	16.26	0.640	207.6	0.3217	16.38	0.645	210.8	0.3267	15.11	0.595
250	13.21	0.520	18.16	0.715	259.0	0.4015	18.42	0.725	266.3	0.4128	17.02	0.670
300	14.48	0.570	19.43	0.765	296.5	0.4596	19.69	0.775	304.3	0.4717	18.29	0.720
350	15.65	0.616	20.57	0.810	332.3	0.5153	20.83	0.820	340.7	0.5281	19.56	0.770
400	16.74	0.659	21.72	0.855	370.5	0.5741	21.97	0.865	379.1	0.5876	20.70	0.815
500	18.69	0.736	23.62	0.930	438.2	0.6793	23.88	0.940	447.7	0.6939	22.48	0.885
600	20.65	0.813	26.29	1.035	542.8	0.8413	26.67	1.050	558.6	0.8659	25.02	0.985
700	22.28	0.877	27.94	1.100	613.1	0.9503	28.19	1.110	624.3	0.9676	26.67	1.050
750	23.06	0.908	28.83	1.135	652.8	1.0118	29.21	1.150	670.1	1.0386	27.31	1.075
900	25.37	0.999	31.50	1.240	779.3	1.2076	31.09	1.224	759.1	1.1766	30.33	1.194
1000	26.92	1.060	32.64	1.285	836.6	1.2968	32.64	1.285	836.6	1.2968	31.88	1.255

** Types RHH and RHW without outer coverings.

** Dimensions are from industry sources.

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Submitter Full Name: NEC-CMP Panel 06

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Committee Statement and Meeting Notes

Committee Statement: Changed the Asterisks to reflect the reordered references below the table.

Response Message:

[Public Input No. 606-NFPA 70-2017 \[Section No. Table\]](#)

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**First Revision No. 8918-NFPA 70-2018 [Detail]**

****Relocate 310.15(B)(3)(C) and insert after the formula under "Ambient Temperature Correction Factors"****

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Committee Statement and Meeting Notes

Committee Statement: Relocate text from 310.15(B)(3)(c) to this section relating to temperature correction.

Response Message:

[Public Input No. 1525-NFPA 70-2017 \[Section No. 310.15\(B\)\(2\)\]](#)

[Public Input No. 1524-NFPA 70-2017 \[Section No. 310.15\(B\)\(3\)\]](#)