



NATIONAL FIRE PROTECTION ASSOCIATION

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M E M O R A N D U M

TO: Code-Making Panel 6

FROM: Sarah Caldwell, *Project Administrator*

DATE: January 30, 2019

SUBJECT: NEC® Second Draft FINAL Ballot Results (A2019)

According to the final ballot results, all ballot items received the necessary affirmative votes to pass ballot.

13 Members Eligible to Vote
0 Members Not Returned

The attached report shows the number of affirmative, negative, and abstaining votes as well as the explanation of the vote for each revision.

To pass ballot, each revision requires: (1) a simple majority of those eligible to vote and (2) an affirmative vote of $\frac{2}{3}$ of ballots returned. See Sections 3.3.4.3.(c) and 4.3.10.1 of the ***Regulations Governing the Development of NFPA Standards***.



Second Revision No. 7745-NFPA 70-2018 [Detail]

Change title to read:

Article 334 Nonmetallic-Sheath Cable: Tyypes NM, and NMC

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Wed Oct 24 16:04:12 EDT 2018

Committee Statement

Committee Statement: The title of Article 334 is being revised to reflect the First Revisions FR 8045, FR 8047 and FR 8048 where Type NMS cable was deleted from the Article.

Response Message: SR-7745-NFPA 70-2018

[Public Comment No. 899-NFPA 70-2018 \[Section No. 334.6\]](#)

Ballot Results

✔ This item has passed ballot

13 Eligible Voters

0 Not Returned

13 Affirmative All

0 Affirmative with Comments

0 Negative with Comments

0 Abstention

Affirmative All

Crisman, Todd

Cross, Joseph W.

Earl, Timothy

Hunter, Christel K.

Kent, Gerald W.

Mercier, Charles David

Nielsen, Dennis A.

Porcaro, Michael Thomas

Riedl, Kenneth

Scearce, Susan Newman

Stene, Susan L.

Straniero, George A.

Wheeler, Wesley L.



Second Revision No. 7572-NFPA 70-2018 [Definition: Free Air (as applied to conductors).]

Free Air (as applied to conductors).

Open or ventilated environment that allows for heat dissipation and 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 75 mm (3 in.) for every 3 m (10 ft) of conductor . (CMP-6)~~

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Mon Oct 22 14:42:19 EDT 2018

Committee Statement

Committee Statement: Requirements were removed per PC 1742 edits and now only define "free air."

Removing the definition of "free air" does not help define a condition for the user in conductor application or selection. (CMP6)

Response Message: SR-7572-NFPA 70-2018

[Public Comment No. 1315-NFPA 70-2018 \[Definition: Free Air \(as applied to conductors\). \]](#)

[Public Comment No. 735-NFPA 70-2018 \[Definition: Free Air \(as applied to conductors\). \]](#)

[Public Comment No. 1217-NFPA 70-2018 \[Definition: Free Air \(as applied to conductors\). \]](#)

[Public Comment No. 1742-NFPA 70-2018 \[Definition: Free Air \(as applied to conductors\). \]](#)

Ballot Results

✓ **This item has passed ballot**

13 Eligible Voters

0 Not Returned

13 Affirmative All

0 Affirmative with Comments

0 Negative with Comments

0 Abstention

Affirmative All

Crisman, Todd

Cross, Joseph W.

Earl, Timothy

Hunter, Christel K.

Kent, Gerald W.

Mercier, Charles David

Nielsen, Dennis A.

Porcaro, Michael Thomas

Riedl, Kenneth

Scearce, Susan Newman

Stene, Susan L.

Straniero, George A.

Wheeler, Wesley L.

**Second Revision No. 7573-NFPA 70-2018 [Definition: Messenger or Messenger Wire.]****Messenger or Messenger Wire.**

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

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Mon Oct 22 14:58:17 EDT 2018

Committee Statement

Committee Statement: The revision will insure that the definition does not cause confusion with the term "parallel conductors". (CMP-6)

Response Message: SR-7573-NFPA 70-2018

Public Comment No. 2002-NFPA 70-2018 [Definition: Messenger or Messenger Wire.]

Ballot Results

✔ **This item has passed ballot**

13 Eligible Voters

0 Not Returned

13 Affirmative All

0 Affirmative with Comments

0 Negative with Comments

0 Abstention

Affirmative All

Crisman, Todd

Cross, Joseph W.

Earl, Timothy

Hunter, Christel K.

Kent, Gerald W.

Mercier, Charles David

Nielsen, Dennis A.

Porcaro, Michael Thomas

Riedl, Kenneth

Scearce, Susan Newman

Stene, Susan L.

Straniero, George A.

Wheeler, Wesley L.



Second Revision No. 7730-NFPA 70-2018 [Section No. 310.4]

310.4 Conductor Constructions and Applications.

Insulated conductors shall comply with Table 310.4(A) and Table 310.4(B).

Informational Note: Thermoplastic insulation may stiffen at temperatures lower than -10°C ($+14^{\circ}\text{F}$). 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 Name	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 8–2	0.51 0.76		20 30		None
		200°C (392°F)	Dry locations — special applications ³	Fluorinated ethylene propylene	14–8	0.36		14		Glass braid
					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	18–16 ⁴ 16–10 9–4 3–500	0.58 0.91 1.27 1.40		23 36 50 55		Copper or alloy steel
		250°C (482°F)	For special applications ³							
Moisture-, heat-, and oil-resistant thermoplastic	MTW	60°C (140°F)	Machine tool wiring in wet locations	Flame-retardant, moisture-, heat-, and oil-resistant thermoplastic	22–12 10 8 6 4–2 1–4/0 213–500 501–1000	(A) (B)		(A) (B)	(A) (B)	(A) None
		90°C (194°F)	Machine tool wiring in dry locations.			0.76	0.38	30	15	(B) Nylon jacket or equivalent
						0.76	0.51	30	20	
						1.14	0.76	45	30	
		1.52	0.76			60	30			
			1.52			1.02	60	40		
			2.03			1.27	80	50		
			2.41			1.52	95	60		
			2.79			1.78	110	70		
		Paper				85°C (185°F)	For underground service conductors, or by special permission	Paper		
Perfluoro-alkoxy	PFA	90°C (194°F)	Dry and damp locations	Perfluoro-alkoxy	14–10 8–2 1–4/0	0.51 0.76 1.14		20 30 45		None
		200°C (392°F)	Dry locations — special applications ³							
Perfluoro-alkoxy	PFAH	250°C	Dry locations only. Only for leads within apparatus or within raceways connected to apparatus (nickel or nickel-coated copper only)	Perfluoro-alkoxy	14–10 8–2	0.51 0.76		20 30		None
		(482°F)								

Trade Name	Type Letter	Maximum Operating Temperature	Application Provisions	Insulation	Thickness of Insulation			Outer Covering ²		
					AWG or kcmil	mm	mils			
					1–4/0	1.14	45			
Thermoset	RHH	90°C	Dry and damp locations		14–10	1.14	45	Moisture-resistant, flame-retardant, nonmetallic covering ²		
		(194°F)			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	Dry and wet locations	Flame-retardant, moisture-resistant thermoset	14–10	1.14	45	Moisture-resistant, flame-retardant, nonmetallic covering		
		(167°F)			8–2	1.52	60			
		RHW-2			90°C	1–4/0	2.03		80	
					(194°F)	213–500	2.41		95	
						501–1000	2.79		110	
						1001–2000	3.18		125	
Silicone	SA		90°C	Dry and damp locations		Silicone rubber	14–10	1.14	45	Glass or other suitable braid material
		(194°F)	8–2		1.52		60			
			200°C		1–4/0		2.03	80		
					(392°F)		213–500	2.41	95	
							501–1000	2.79	110	
							1001–2000	3.18	125	
Thermoset	SIS	90°C		Switchboard and switchgear wiring only		Flame-retardant thermoset	14–10	0.76	30	None
		(194°F)	8–2		1.14		45			
			1–4/0		2.41 1.40		55			
Thermoplastic and fibrous outer braid	TBS	90°C	Switchboard and switchgear wiring only	Thermoplastic	14–10	0.76	30	Flame-retardant, nonmetallic covering		
		(194°F)			8	1.14	45			
					6–2	1.52	60			
					1–4/0	2.03	80			
Extended polytetrafluoroethylene	TFE	250°C	Dry locations only. Only for leads within apparatus or within raceways connected to apparatus, or as open wiring (nickel or nickel-coated copper only)	Extruded polytetrafluoroethylene	14–10	0.51	20	None		
		(482°F)			8–2	0.76	30			
					1–4/0	1.14	45			
Heat-resistant thermoplastic	THHN	90°C	Dry and damp locations	Flame-retardant, heat-resistant thermoplastic	14–12	0.38	15	Nylon jacket or equivalent		
		(194°F)			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	Wet location	Flame-retardant, moisture- and	14–10	0.76	30	None		
		(167°F)			8	1.14	45			
					6–2	1.52	60			

<u>Trade Name</u>	<u>Type Letter</u>	<u>Maximum Operating Temperature</u>	<u>Application Provisions</u>	<u>Insulation</u>	<u>Thickness of Insulation</u>			<u>Outer Covering²</u>
					<u>AWG or kcmil</u>	<u>mm</u>	<u>mils</u>	
		90°C (194°F)	Dry location	heat-resistant thermoplastic	1–4/0 213–500 501–1000 1001–2000	2.03 2.41 2.79 3.18	80 95 110 125	
Moisture- and heat-resistant thermoplastic	THW	75°C (167°F) 90°C (194°F)	Dry and wet locations Special applications within electric discharge lighting equipment. Limited to 1000 open-circuit volts or less. (Size 14-8 only as permitted in 410.68.)	Flame-retardant, moisture- and heat-resistant thermoplastic	14–10 8 6–2 1–4/0 213–500 501–1000 1001–2000	0.76 1.14 1.52 2.03 2.41 2.79 3.18	30 45 60 80 95 110 125	None
	THW-2	90°C (194°F)	Dry and wet locations					
Moisture- and heat-resistant thermoplastic	THWN	75°C (167°F)	Dry and wet locations	Flame-retardant, moisture- and heat-resistant thermoplastic	14–12 10 8–6 4–2	0.38 0.51 0.76 1.02	15 20 30 40	Nylon jacket or equivalent
	THWN-2	90°C (194°F)			1–4/0 250–500 501–1000	1.27 1.52 1.78	50 60 70	
Moisture-resistant thermoplastic	TW	60°C (140°F)	Dry and wet locations	Flame-retardant, moisture-resistant thermoplastic	14–10 8 6–2 1–4/0 213–500 501–1000 1001–2000	0.76 1.14 1.52 2.03 2.41 2.79 3.18	30 45 60 80 95 110 125	None
Underground feeder and branch-circuit cable — single conductor (for Type UF cable employing more than one conductor, see Article 340).	UF	60°C (140°F) 75°C (167°F) ⁵	See Article 340.	Moisture-resistant Moisture- and heat-resistant	14–10 8–2 1–4/0	1.52 2.03 2.41	60 ⁶ 80 ⁶ 95 ⁶	Integral with insulation
Underground service-	USE	75°C (167°F) ⁵	See Article 338.	Heat- and moisture-	14–10 8–2	1.14 1.52	45 60	Moisture-resistant

Trade Name	Type Letter	Maximum Operating Temperature	Application Provisions	Insulation	Thickness of Insulation			Outer Covering ²						
					AWG or kcmil	mm	mils							
entrance cable — single conductor (for Type USE cable employing more than one conductor, see Article 338).				resistant	1–4/0	2.03	80	nonmetallic covering (See 338.2.)						
					213–500	2.41	95 ⁷							
					501–1000	2.79	110							
					1001–2000	3.18	125							
Thermoset	XHH	90°C (194°F)	Dry and damp locations	Flame-retardant thermoset	14–10	0.76	30	None						
					8–2	1.14	45							
					1–4/0	1.40	55							
					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	Flame-retardant, moisture-resistant thermoset	14–10	0.76	30	None
75°C (167°F)	Wet locations	8–2	1.14	45										
			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-resistant thermoset	14–10		0.76	30	None	
									8–2		1.14	45		
1–4/0		1.40			55									
213–500		1.65			65									
501–1000		2.03			80									
1001–2000		2.41			95									
Moisture-resistant thermoset	XHWN	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							
					4–2	1.02	40							
	XHWN-2	90°C (194°F)			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	Dry locations	10	0.51	20										
		8–4	0.64	25										

<u>Trade Name</u>	<u>Type Letter</u>	<u>Maximum Operating Temperature</u>	<u>Application Provisions</u>	<u>Insulation</u>	<u>Thickness of Insulation</u>			<u>Outer Covering²</u>
					<u>AWG or kcmil</u>	<u>mm</u>	<u>mils</u>	
		(302°F)	— special applications ³		3–1 1/0–4/0	0.89 1.14	35 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					
		150°C (302°F)	Dry locations — special applications ³					
	ZW-2	90°C (194°F)	Dry and wet locations		8–2	1.14	45	

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

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

³Where Higher temperature rated constructions shall be permitted where design conditions require maximum conductor operating temperatures above 90°C (194°F).

⁴For Conductor sizes shall be permitted for signaling circuits permitting 300-volt insulation.

⁵For ampacity limitation, see 340.80. The ampacity of Type UF cable shall be limited in accordance with 340.80.

⁶Includes integral jacket. Type UF insulation thickness shall include the integral jacket.

⁷Insulation 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.

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

<u>Conductor Size (AWG or kcmil)</u>	<u>Column A¹</u>		<u>Column B²</u>	
	<u>mm</u>	<u>mils</u>	<u>mm</u>	<u>mils</u>
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
501–1000	3.56	140	3.05	120
1001–2000	3.56	140	3.56	140

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

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

Supplemental Information

File Name

Description

Approved

70-
Article_310_For_NFPA_use.docx

310.4 - Attached word doc for clarity of change. Staff use
only.

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Tue Oct 23 21:28:12 EDT 2018

Committee Statement

Committee Statement: The mm equivalent of 55 mils for SIS cable was corrected from 2.41 to 1.40. The notes at the bottom of the table were edited to mandatory language for compliance to the Style Manual. Note 4 was not deleted. It is rewritten in mandatory language.

Response Message: SR-7730-NFPA 70-2018

[Public Comment No. 1721-NFPA 70-2018 \[Section No. 310.4\]](#)

Ballot Results

✔ This item has passed ballot

13 Eligible Voters

0 Not Returned

13 Affirmative All

0 Affirmative with Comments

0 Negative with Comments

0 Abstention

Affirmative All

Crisman, Todd

Cross, Joseph W.

Earl, Timothy

Hunter, Christel K.

Kent, Gerald W.

Mercier, Charles David

Nielsen, Dennis A.

Porcaro, Michael Thomas

Riedl, Kenneth

Scearce, Susan Newman

Stene, Susan L.

Straniero, George A.

Wheeler, Wesley L.

**Second Revision No. 7612-NFPA 70-2018 [Section No. 310.6(C)]****(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 equipment 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.

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Mon Oct 22 17:57:45 EDT 2018

Committee Statement

Committee Statement: Equipment grounding conductors have specific color requirements in the NEC. Other grounding and bonding conductors may not have specific color requirements.

Response Message: SR-7612-NFPA 70-2018

[Public Comment No. 455-NFPA 70-2018 \[Section No. 310.6\(C\)\]](#)

[Public Comment No. 575-NFPA 70-2018 \[Section No. 310.6\(C\)\]](#)

Ballot Results

✔ **This item has passed ballot**

13 Eligible Voters

0 Not Returned

13 Affirmative All

0 Affirmative with Comments

0 Negative with Comments

0 Abstention

Affirmative All

Crisman, Todd

Cross, Joseph W.

Earl, Timothy

Hunter, Christel K.

Kent, Gerald W.

Mercier, Charles David

Nielsen, Dennis A.

Porcaro, Michael Thomas

Riedl, Kenneth

Scearce, Susan Newman

Stene, Susan L.

Straniero, George A.

Wheeler, Wesley L.

**Second Revision No. 7633-NFPA 70-2018 [Section No. 310.8(B)(1)]****(1) Surface Marking.**

The following conductors and cables shall be durably marked on the surface:

- (1) Single-conductor and multiconductor ~~rubber-~~ thermoset 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

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.).

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Mon Oct 22 18:23:52 EDT 2018

Committee Statement

Committee Statement: Rubber was changed to thermoset to harmonize with changes made elsewhere in the NEC. Two sentences were moved after the list for clarity.

Response Message: SR-7633-NFPA 70-2018

[Public Comment No. 1724-NFPA 70-2018 \[Section No. 310.8\(B\)\(1\)\]](#)

[Public Comment No. 1227-NFPA 70-2018 \[Section No. 310.8\(B\)\(1\)\]](#)

Ballot Results

✔ **This item has passed ballot**

13 Eligible Voters

0 Not Returned

13 Affirmative All

0 Affirmative with Comments

0 Negative with Comments

0 Abstention

Affirmative All

Crisman, Todd

Cross, Joseph W.

Earl, Timothy

Hunter, Christel K.

Kent, Gerald W.

Mercier, Charles David
Nielsen, Dennis A.
Porcaro, Michael Thomas
Riedl, Kenneth
Scearce, Susan Newman
Stene, Susan L.
Straniero, George A.
Wheeler, Wesley L.

**Second Revision No. 7636-NFPA 70-2018 [Section No. 310.8(B)(2)]****(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 shall not require a marker tape .

Exception No. 2: Type AC cable shall not require a marker tape .

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.

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Mon Oct 22 18:29:20 EDT 2018

Committee Statement

Committee Statement: Exception No. 1 and Exception No. 2 are rewritten as complete sentences and in permissive text in accordance with the NEC® Style Manual.

Response Message: SR-7636-NFPA 70-2018

[Public Comment No. 1229-NFPA 70-2018 \[Section No. 310.8\(B\)\(2\)\]](#)

Ballot Results

✔ **This item has passed ballot**

13 Eligible Voters

0 Not Returned

13 Affirmative All

0 Affirmative with Comments

0 Negative with Comments

0 Abstention

Affirmative All

Crisman, Todd

Cross, Joseph W.

Earl, Timothy

Hunter, Christel K.

Kent, Gerald W.

Mercier, Charles David

Nielsen, Dennis A.

Porcaro, Michael Thomas

Riedl, Kenneth

Scearce, Susan Newman

Stene, Susan L.

Straniero, George A.

Wheeler, Wesley L.



Second Revision No. 7638-NFPA 70-2018 [Section No. 310.12]

310.12 Single-Phase Dwelling Services and Feeders.

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(A) through (D).

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

(A) Services.

For a service rated 100 amperes 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.

(B) Feeders.

For a feeder rated 100 amperes 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.

(C) Feeder Ampacities.

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

(D) Grounded Conductors.

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 ampere 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>
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

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

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Mon Oct 22 18:42:13 EDT 2018

Committee Statement

Committee Statement: Updated format to comply with the NEC® Style Manual. Cited reference is corrected.

Response Message: SR-7638-NFPA 70-2018

[Public Comment No. 1727-NFPA 70-2018 \[Section No. 310.12 \[Excluding any Sub-Sections\]\]](#)

[Public Comment No. 1242-NFPA 70-2018 \[Section No. 310.12\]](#)

[Public Comment No. 677-NFPA 70-2018 \[Section No. 310.12 \[Excluding any Sub-Sections\]\]](#)

Ballot Results

✔ This item has passed ballot

13 Eligible Voters

0 Not Returned

13 Affirmative All

0 Affirmative with Comments

0 Negative with Comments

0 Abstention

Affirmative All

Crisman, Todd

Cross, Joseph W.

Earl, Timothy

Hunter, Christel K.

Kent, Gerald W.

Mercier, Charles David

Nielsen, Dennis A.

Porcaro, Michael Thomas

Riedl, Kenneth

Scearce, Susan Newman

Stene, Susan L.

Straniero, George A.

Wheeler, Wesley L.



Second Revision No. 7650-NFPA 70-2018 [Section No. 310.15]

310.15 Ampacity Tables.

(A) General.

Ampacities for conductors rated 0 volts to 2000 volts shall be as specified in the Ampacity Table 310.16 through 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. 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. Interpolation is based on the conductor area and not the conductor overall area.

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

Informational Note No. 4: 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)(a), and Table 400.5(A)(b).

(B) Ambient Temperature Correction Factors.

(1) General.

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 Equation 310.15(B).

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

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)

(2) Rooftop.

Raceways For raceways or cables exposed to direct sunlight on or above rooftops, ~~Where where~~ the distance above the roof to the bottom of the raceway or cable is less than 23 mm ($\frac{7}{8}$ 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*.

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

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
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 40°C (104°F)

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 (°C)	Temperature Rating of Conductor						Ambient Temperature (°F)
	60°C	75°C	90°C	150°C	200°C	250°C	
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

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.

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

(C) Adjustment Factors.

(1) More than Three Current-Carrying Conductors.

The ampacity of each conductor shall be reduced as shown in Table 310.15(C)(1) where 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.). Each current-carrying conductor of a paralleled set of conductors shall be counted as a current-carrying conductor.

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 (4): If cables meeting the requirements in 310.15(C)(1)(d)(1) through (C)(1)(d)(3) 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.

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

<u>Number of Conductors*</u>	<u>Percent of Values in Table 310.16 Through Table 310.19 as Adjusted for Ambient Temperature if Necessary</u>
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.

(2) Raceway Spacing.

Spacing between raceways shall be maintained.

(D) Bare or Covered Conductors.

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.

Neutral conductors shall be considered current carrying in accordance with any of the following:

- (1) 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).
- (2) 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).
- (3) 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.

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

Supplemental Information

<u>File Name</u>	<u>Description</u>	<u>Approved</u>
70-Article_310_For_NFPA_use.docx	310.15 - Attached word doc for clarity of change. Staff use only.	

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Mon Oct 22 20:49:29 EDT 2018

Committee Statement

Committee Statement: Clarification for conductor area is included in the informational note rather than the main text.

Information was relocated to correct location. The requirement for raceway spacing was incorrectly located as a note, so it was deleted and then added as list item (C)(2).

Exception and informational note were moved to the correct location.

Editorial change was made to make text into a complete sentence.

Removed the word "allowable" to correlate with the removal of allowable from the ampacity tables.

Response Message: SR-7650-NFPA 70-2018

[Public Comment No. 1731-NFPA 70-2018 \[Section No. 310.15\(C\)\]](#)

[Public Comment No. 390-NFPA 70-2018 \[Section No. 310.15\(C\)\(1\)\]](#)

[Public Comment No. 1729-NFPA 70-2018 \[Section No. 310.15\(B\)\]](#)

[Public Comment No. 389-NFPA 70-2018 \[Section No. 310.15\(B\)\]](#)

[Public Comment No. 464-NFPA 70-2018 \[Section No. 310.15\(B\)\]](#)

[Public Comment No. 579-NFPA 70-2018 \[Section No. 310.15 \[Excluding any Sub-Sections\]\]](#)

[Public Comment No. 1976-NFPA 70-2018 \[New Section after 310.15\(B\)\]](#)

[Public Comment No. 1422-NFPA 70-2018 \[Section No. 310.15\(C\)\(1\)\]](#)

Ballot Results

✔ This item has passed ballot

13 Eligible Voters

0 Not Returned

13 Affirmative All

0 Affirmative with Comments

0 Negative with Comments

0 Abstention

Affirmative All

Crisman, Todd

Cross, Joseph W.

Earl, Timothy

Hunter, Christel K.

Kent, Gerald W.

Mercier, Charles David

Nielsen, Dennis A.

Porcaro, Michael Thomas

Riedl, Kenneth

Scearce, Susan Newman

Stene, Susan L.

Straniero, George A.

Wheeler, Wesley L.



Second Revision No. 7651-NFPA 70-2018 [Sections 310.16, 310.17, 310.18, 310.19, 310.20, 310.21]

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

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

- (1) Conductors are rated 0 volts to through 2000 volts.
- (2) Conductors are rated 60°C (140°F), 75°C (167°F), or 90°C (194°F).
- (3) Wiring is installed in a 30°C (86°F) ambient temperature.
- (4) There are not more than three current-carrying conductors.

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

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

- (1) Conductors are rated 0 volts to through 2000 volts.
- (2) Conductors are rated 60°C (140°F), 75°C (167°F), or 90°C (194°F).
- (3) Wiring is installed in a 30°C (86°F) ambient temperature.

310.18 Allowable Ampacities of Insulated Conductors in Raceway or Cable.

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

- (1) Conductors are rated 0 volts to through 2000 volts.
- (2) Conductors are rated 150°C (302°F), 200°C (392°F), or 250°C (482°F).
- (3) Wiring is installed in a 40°C (86 104 °F) ambient temperature.
- (4) There are not more than three current-carrying conductors.

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

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

- (1) Conductors are rated 0 volts to through 2000 volts.
- (2) Conductors are rated up to 250°C (482°F).
- (3) Wiring is installed in a 40°C (86 104 °F) ambient temperature.

310.20 Ampacities of Conductors Supported on a Messenger.

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

- (1) Conductors are rated 0 volts to through 2000 volts.
- (2) Conductors are rated 75°C (167°F) or 90°C (194°F).
- (3) Wiring is installed in a 40°C (86 104 °F) ambient temperature.
- (4) There are not more than three single-insulated conductors.

310.21 Ampacities of Bare or Covered Conductors in Free Air.

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

- (1) Wind velocity is 610 mm/sec (2 ft/sec).
- (2) Conductors are 80°C (176°F) total conductor temperature.
- (3) Wiring is installed in a 40°C (86 104 °F) ambient temperature.

Table 310.16 (Ampacities of Insulated Conductors with Not More Than Three Current-Carrying Conductors in Raceway, Cable, or Earth (Directly Buried))

Size AWG or kcmil	Temperature Rating of Conductor [See Table 310.4(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, USE, ZW	Types TBS, SA, SIS, FEP, FEPB, MI, PFA, RHH, RHW-2, THHN, THHW, THW-2, THWN-2, USE-2, XHH, XHHW, XHHW-2, XHWN, XHWN-2, XHHN, Z, ZW-2	Types TW, UF	Types RHW, THHW, THW, THWN, XHHW, XHWN, USE	Types TBS, SA, SIS, THHN, THHW, THW-2, THWN-2, RHH, RHW-2, USE-2, XHH, XHHW, XHHW-2, XHWN, XHWN-2, ZW-2 XHHN	
	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:

1. Section 310.16 shall be referenced for conditions of use.

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

** 3. Section 310.15(C)(1) shall be referenced for more than three current-carrying conductors.

** Refer to Section 240.4(D) shall be referenced for conductor overcurrent protection limitations, except as modified elsewhere in the Code.

Table 310.17 Ampacities of Single-Insulated Conductors in Free Air

Size AWG or kcmil	Temperature Rating of Conductor [See Table 310.4(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, PFA, RHH, RHW-2, THHN, THHW, THW-2, THWN-2, USE-2, XHH, XHHW, XHHW-2, XHWN, XHWN-2, XHHN, Z, 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 XHHN	
	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
1500	980	1175	1325	795	950	1070	1500
1750	1070	1280	1445	875	1050	1185	1750

<u>Size AWG or kcmil</u>	<u>Temperature Rating of Conductor [See Table 310.4(A)]</u>						<u>Size AWG or kcmil</u>
	<u>60°C (140°F)</u>	<u>75°C (167°F)</u>	<u>90°C (194°F)</u>	<u>60°C (140°F)</u>	<u>75°C (167°F)</u>	<u>90°C (194°F)</u>	
	<u>Types TW, UF</u>	<u>Types RHW, THHW, THW, THWN, XHHW, XHWN, ZW</u>	<u>Types TBS, SA, SIS, FEP, FEPB, MI, PFA, RHH, RHW-2, THHN, THHW, THW-2, THWN-2, USE-2, XHH, XHHW, XHHW-2, XHWN, XHWN-2, XHHN, Z, ZW-2</u>	<u>Types TW, UF</u>	<u>Types RHW, THHW, THW, THWN, XHHW, XHWN</u>	<u>Types TBS, SA, SIS, THHN, THHW, THW-2, THWN-2, RHH, RHW-2, USE-2, XHH, XHHW, XHHW-2, XHWN, XHWN-2, ZW-2 XHHN</u>	
	<u>COPPER</u>			<u>ALUMINUM OR COPPER-CLAD ALUMINUM</u>			
2000	1155	1385	1560	960	1150	1295	2000

Notes:

1. Section 310.17 shall be referenced for conditions of use.

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

** Section 240.4(D) shall be referenced for conductor overcurrent protection limitations, except as modified elsewhere in the Code.

Table 310.18 Ampacities of Insulated Conductors with Not More Than Three Current-Carrying Conductors in Raceway or Cable

<u>Size AWG or kcmil</u>	<u>Temperature Rating of Conductor [See Table 310.4(A)]</u>				<u>Size AWG or kcmil</u>
	<u>150°C (302°F)</u>	<u>200°C (392°F)</u>	<u>250°C (482°F)</u>	<u>150°C (302°F)</u>	
	<u>Type Z</u>	<u>Types FEP, FEPB, PFA, SA</u>	<u>Types PFAH, TFE</u>	<u>Type Z</u>	
	<u>COPPER</u>		<u>NICKEL OR NICKEL- COATED COPPER</u>	<u>ALUMINUM OR COPPER-CLAD ALUMINUM</u>	
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:

1. Section 310.18 shall be referenced for conditions of use.

2. Section 310.15(C)(1) shall be referenced for more than three current-carrying conductors.

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

Table 310.19 Ampacities of Single-Insulated Conductors in Free Air

<u>Size AWG or kcmil</u>	<u>Temperature Rating of Conductor [See Table 310.4(A)]</u>				<u>Size AWG or kcmil</u>
	<u>150°C (302°F)</u>	<u>200°C (392°F)</u>	<u>250°C (482°F)</u>	<u>150°C (302°F)</u>	
	<u>Type Z</u>	<u>Types FEP, FEPB, PFA, SA</u>	<u>Types PFAH, TFE</u>	<u>Type Z</u>	
	<u>COPPER</u>		<u>NICKEL, OR NICKEL-COATED COPPER</u>	<u>ALUMINUM OR COPPER-CLAD ALUMINUM</u>	
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:

1. Section 310.19 shall be referenced for conditions of use.

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

Table 310.20 Ampacities of Conductors on a Messenger

<div>Size AWG or kcmil</div>	Temperature Rating of Conductor [See Table 310.4(A)]				<div>Size AWG or kcmil</div>
	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, THW-2, THWN-2, XHWN, XHWN-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
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

<div>Size AWG or kcmil</div>	Temperature Rating of Conductor [See Table 310.4(A)]				<div>Size AWG or kcmil</div>
	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, THW-2, THWN-2, XHWN, XHWN-2, USE-2, ZW-2	
	COPPER		ALUMINUM OR COPPER-CLAD ALUMINUM		
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:

1. Section 310.20 shall be referenced for conditions of use.

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

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

Table 310.21 Ampacities of Bare or Covered Conductors in Free Air

<u>Copper Conductors</u>				<u>AAC Aluminum Conductors</u>			
<u>Bare</u>		<u>Covered</u>		<u>Bare</u>		<u>Covered</u>	
<u>AWG or kcmil</u>	<u>Amperes</u>	<u>AWG or kcmil</u>	<u>Amperes</u>	<u>AWG or kcmil</u>	<u>Amperes</u>	<u>AWG or kcmil</u>	<u>Amperes</u>
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
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: Section 310.20 310.21 shall be referenced for conditions of use.**Supplemental Information**

<u>File Name</u>	<u>Description</u>	<u>Approved</u>
70-Article_310_For_NFPA_use.docx	310.16 through 310.21 - Attached word doc for clarity of change. Staff use only.	

Submitter Information Verification

Committee: NEC-P06

Submission Date: Tue Oct 23 10:46:21 EDT 2018

Committee Statement

Committee Statement: [for PC 1434]: Added PFA, XHHN and Z to 90C copper. Only XHHN was added to 90C aluminum based on UL Product Category [Wire] Thermoplastic-insulated Wire, ZLGR showing PFA, Z and ZW-2 only in copper. MTW was not added based on reference to NFPA 79. ZW-2 was removed from the aluminum column based on UL Category ZLGR showing it is made in copper only.

[for PCs 1733, 467, 632, 1734, 468, 636, 1736, 469, 1737 and 470]: Deleted "allowable" based on Ampacity Task Group Pls.

[for PCs 624, 626, 627, 628, 629 and 630]: Editorial correction for temperature conversion and clarifies that 2000 volts is included in voltage rating.

[for PC 1739]: Editorial changes made to make the notes into mandatory text, provide consistent numbering for the notes (except for the asterisk for the 240.4(D) references), and add words to clarify certain phrases.

[for PCs 631 and 633]: Corrected temperature conversion for 40°C from 86°F to 104°F.

Response Message: SR-7651-NFPA 70-2018

[Public Comment No. 1739-NFPA 70-2018 \[Section No. 310.21\]](#)

[Public Comment No. 633-NFPA 70-2018 \[Section No. 310.21\]](#)

[Public Comment No. 1434-NFPA 70-2018 \[New Section after 310.16\]](#)

[Public Comment No. 467-NFPA 70-2018 \[Section No. 310.16\]](#)

[Public Comment No. 1734-NFPA 70-2018 \[Section No. 310.17\]](#)

[Public Comment No. 629-NFPA 70-2018 \[Section No. 310.20\]](#)

[Public Comment No. 1737-NFPA 70-2018 \[Section No. 310.19\]](#)

[Public Comment No. 470-NFPA 70-2018 \[Section No. 310.19\]](#)

[Public Comment No. 626-NFPA 70-2018 \[Section No. 310.18\]](#)

[Public Comment No. 469-NFPA 70-2018 \[Section No. 310.18\]](#)

[Public Comment No. 636-NFPA 70-2018 \[Section No. 310.17\]](#)

[Public Comment No. 624-NFPA 70-2018 \[Section No. 310.18\]](#)

[Public Comment No. 1736-NFPA 70-2018 \[Section No. 310.18\]](#)

[Public Comment No. 468-NFPA 70-2018 \[Section No. 310.17\]](#)

[Public Comment No. 628-NFPA 70-2018 \[Section No. 310.19\]](#)

[Public Comment No. 631-NFPA 70-2018 \[Section No. 310.21\]](#)

[Public Comment No. 630-NFPA 70-2018 \[Section No. 310.20\]](#)

[Public Comment No. 1733-NFPA 70-2018 \[Section No. 310.16\]](#)

[Public Comment No. 627-NFPA 70-2018 \[Section No. 310.19\]](#)

[Public Comment No. 632-NFPA 70-2018 \[Section No. 310.16\]](#)

Ballot Results

✔ **This item has passed ballot**

13 Eligible Voters

0 Not Returned

13 Affirmative All

0 Affirmative with Comments

0 Negative with Comments

0 Abstention

Affirmative All

Crisman, Todd

Cross, Joseph W.

Earl, Timothy

Hunter, Christel K.

Kent, Gerald W.

Mercier, Charles David

Nielsen, Dennis A.

Porcaro, Michael Thomas

Riedl, Kenneth

Scearce, Susan Newman

Stene, Susan L.

Straniero, George A.

Wheeler, Wesley L.



Second Revision No. 7577-NFPA 70-2018 [Section No. 311.1]

311.1 Scope.

This article covers the use, installation, construction specifications, and ampacities for Type MV 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 .~~

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Mon Oct 22 15:40:10 EDT 2018

Committee Statement

Committee Statement: This is an editorial activity, the following edits are in accordance with the style manual as recommended by PC 830.

Response Message: SR-7577-NFPA 70-2018

[Public Comment No. 830-NFPA 70-2018 \[Global Input\]](#)

Ballot Results

✔ This item has passed ballot

13 Eligible Voters

0 Not Returned

13 Affirmative All

0 Affirmative with Comments

0 Negative with Comments

0 Abstention

Affirmative All

Crisman, Todd

Cross, Joseph W.

Earl, Timothy

Hunter, Christel K.

Kent, Gerald W.

Mercier, Charles David

Nielsen, Dennis A.

Porcaro, Michael Thomas

Riedl, Kenneth

Scearce, Susan Newman

Stene, Susan L.

Straniero, George A.

Wheeler, Wesley L.

**Second Revision No. 7574-NFPA 70-2018 [Section No. 311.10]****311.10** Constructions and Applications.

Type MV cables shall comply with the applicable provisions in 311.10(A) through (C).

(A) Conductor Application and Insulation.

Conductor application and insulation 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 volts 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 volts to 35,000 volts shall comply with Table 311.10(C) and 311.10(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~~ These cables are applicable to the great majority of cable installations that are on grounded systems, ~~they and~~ 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~~ Cable shall be permitted to be used in 100 percent insulation level applications where the installation requires 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~~ required 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~~ Cables shall be permitted to be used in 100 percent or 133 percent insulation level applications where the installation requires additional insulation ~~strength is desirable~~.

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

<u>Trade Name</u>	<u>Type Letter</u>	<u>Maximum Operating Temperature</u>	<u>Application Provision</u>	<u>Insulation</u>	<u>Outer Covering</u>
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.

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

<u>Conductor Size (AWG or kcmil)</u>	<u>Dry Locations, Single Conductor</u>						<u>Wet or Dry Locations</u>					
	<u>Without Jacket</u>		<u>With Jacket</u>				<u>Single Conductor</u>				<u>Multiconductor Insulation*</u>	
	<u>Insulation</u>		<u>Insulation</u>		<u>Jacket</u>		<u>Insulation</u>		<u>Jacket</u>		<u>Insulation*</u>	
	<u>mm</u>	<u>mils</u>	<u>mm</u>	<u>mils</u>	<u>mm</u>	<u>mils</u>	<u>mm</u>	<u>mils</u>	<u>mm</u>	<u>mils</u>	<u>mm</u>	<u>mils</u>
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.

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

<u>Conductor Size (AWG or kcmil)</u>	<u>2001-5000 Volts</u>		<u>5001-8000 Volts</u>				<u>8001-15,000 Volts</u>					
	<u>100 Percent Insulation Level</u>		<u>100 Percent Insulation Level</u>		<u>133 Percent Insulation Level</u>		<u>173 Percent Insulation Level</u>		<u>100 Percent Insulation Level</u>		<u>133 Percent Insulation Level</u>	
	<u>Insulation Level</u>		<u>Insulation Level</u>		<u>Insulation Level</u>		<u>Insulation Level</u>		<u>Insulation Level</u>		<u>Insulation Level</u>	
	<u>mm</u>	<u>mils</u>	<u>mm</u>	<u>mils</u>	<u>mm</u>	<u>mils</u>	<u>mm</u>	<u>mils</u>	<u>mm</u>	<u>mils</u>	<u>mm</u>	<u>mils</u>
8	2.29	90	—	—	—	—	—	—	—	—	—	—
6-4	2.29	90	2.92	115	3.56	140	4.45	175	—	—	—	—
2	2.29	90	2.92	115	3.56	140	4.45	175	4.45	175	5.59	220
1	2.29	90	2.92	115	3.56	140	4.45	175	4.45	175	5.59	220
1/0-2000	2.29	90	2.92	115	3.56	140	4.45	175	4.45	175	5.59	220

<u>Conductor Size (AWG or kcmil)</u>	<u>25,001–28,000 Volts</u>						<u>28,001–35,000 Volts</u>					
	<u>100 Percent Insulation Level</u>		<u>133 Percent Insulation Level</u>		<u>173 Percent Insulation Level</u>		<u>100 Percent Insulation Level</u>		<u>133 Percent Insulation Level</u>		<u>173 Percent Insulation Level</u>	
	<u>mm</u>	<u>mils</u>	<u>mm</u>	<u>mils</u>	<u>mm</u>	<u>mils</u>	<u>mm</u>	<u>mils</u>	<u>mm</u>	<u>mils</u>	<u>mm</u>	<u>mils</u>
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

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Mon Oct 22 15:23:10 EDT 2018

Committee Statement

Committee Statement: This is an editorial activity, the following edits are in accordance with the style manual as recommended by PC 830.

Response Message: SR-7574-NFPA 70-2018

Ballot Results

✔ This item has passed ballot

13 Eligible Voters

0 Not Returned

13 Affirmative All

0 Affirmative with Comments

0 Negative with Comments

0 Abstention

Affirmative All

Crisman, Todd

Cross, Joseph W.

Earl, Timothy

Hunter, Christel K.

Kent, Gerald W.

Mercier, Charles David

Nielsen, Dennis A.

Porcaro, Michael Thomas

Riedl, Kenneth

Scearce, Susan Newman

Stene, Susan L.

Straniero, George A.

Wheeler, Wesley L.

**Second Revision No. 7576-NFPA 70-2018 [Section No. 311.16(C)]****(C) Optional Markings.**

Cables shall be permitted to be marked to indicate special characteristics of the cable materials. ~~These markings include, but are not limited to, markings for , such as~~ limited smoke and sunlight resistant resistance .

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Mon Oct 22 15:36:56 EDT 2018

Committee Statement

Committee Statement: This is an editorial activity, the following edits are in accordance with the style manual as recommended by PC 830.

Response Message: SR-7576-NFPA 70-2018

Ballot Results

✔ **This item has passed ballot**

13 Eligible Voters

0 Not Returned

13 Affirmative All

0 Affirmative with Comments

0 Negative with Comments

0 Abstention

Affirmative All

Crisman, Todd

Cross, Joseph W.

Earl, Timothy

Hunter, Christel K.

Kent, Gerald W.

Mercier, Charles David

Nielsen, Dennis A.

Porcaro, Michael Thomas

Riedl, Kenneth

Scearce, Susan Newman

Stene, Susan L.

Straniero, George A.

Wheeler, Wesley L.

**Second Revision No. 7578-NFPA 70-2018 [Section No. 311.32]****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 ~~340.10(H)~~ 310.10(G).
- (8) Type MV cable used where exposed to direct sunlight shall be identified for the use.

Informational Note: The "uses permitted" in ~~341.32~~ is not an all-inclusive list.

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Mon Oct 22 15:44:41 EDT 2018

Committee Statement

Committee Statement: This is an editorial activity, the following edits are in accordance with the style manual as recommended by PC 830.

Response Message: SR-7578-NFPA 70-2018

Ballot Results

✔ **This item has passed ballot**

13 Eligible Voters

0 Not Returned

13 Affirmative All

0 Affirmative with Comments

0 Negative with Comments

0 Abstention

Affirmative All

Crisman, Todd

Cross, Joseph W.

Earl, Timothy
Hunter, Christel K.
Kent, Gerald W.
Mercier, Charles David
Nielsen, Dennis A.
Porcaro, Michael Thomas
Riedl, Kenneth
Scearce, Susan Newman
Stene, Susan L.
Straniero, George A.
Wheeler, Wesley L.

**Second Revision No. 7579-NFPA 70-2018 [Section No. 311.36]****311.36 Direct-Burial Conductors.**

Type MV conductors and cables used for direct burial applications shall be ~~of a type shielded~~, 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, a 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.

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Mon Oct 22 15:46:51 EDT 2018

Committee Statement

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Ballot Results

✔ This item has passed ballot

13 Eligible Voters

0 Not Returned

13 Affirmative All

0 Affirmative with Comments

0 Negative with Comments

0 Abstention

Affirmative All

Crisman, Todd

Cross, Joseph W.

Earl, Timothy

Hunter, Christel K.

Kent, Gerald W.

Mercier, Charles David

Nielsen, Dennis A.

Porcaro, Michael Thomas

Riedl, Kenneth

Scearce, Susan Newman

Stene, Susan L.

Straniero, George A.

Wheeler, Wesley L.

**Second Revision No. 7598-NFPA 70-2018 [Section No. 324.60]****324.60** Grounding and Bonding .

All metal shields, boxes, receptacle housings, and self-contained devices shall be electrically continuous to the equipment grounding conductor of the supplying branch circuit. All such electrical connections shall be made with connectors identified for this use. The electrical resistivity of such shield system shall not be more than that of one conductor of the Type FCC cable used in the installation.

Submitter Information Verification**Committee:** NEC-P06**Submittal Date:** Mon Oct 22 16:52:57 EDT 2018**Committee Statement**

Committee Statement: The existing wording "electrically continuous" is used within 324.60. The terms grounded and bonded are used extensively in the code and CMP6 is not aware of confusion with its application. The term "Grounding and Bonding" is better understood rather than "electrically continuous" as the title.

Response Message: SR-7598-NFPA 70-2018

[Public Comment No. 343-NFPA 70-2018 \[Section No. 324.60\]](#)

Ballot Results

✔ **This item has passed ballot**

13 Eligible Voters

0 Not Returned

13 Affirmative All

0 Affirmative with Comments

0 Negative with Comments

0 Abstention

Affirmative All

Crisman, Todd

Cross, Joseph W.

Earl, Timothy

Hunter, Christel K.

Kent, Gerald W.

Mercier, Charles David

Nielsen, Dennis A.

Porcaro, Michael Thomas

Riedl, Kenneth

Searce, Susan Newman

Stene, Susan L.

Straniero, George A.

Wheeler, Wesley L.

**Second Revision No. 7742-NFPA 70-2018 [Section No. 330.80(B)]****(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 310.20 for conductors rated 0 volts through 2000 volts
- (2) ~~Table 310.60(C)(67)~~ Table 311.60(C)(67) and ~~Table 310.60(C)(68)~~ Table 311.60(C)(68) for conductors rated over 2000 volts

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Wed Oct 24 15:42:32 EDT 2018

Committee Statement

Committee Statement: Editorial per PC#2211.

Response Message: SR-7742-NFPA 70-2018

Ballot Results

✔ This item has passed ballot

13 Eligible Voters

0 Not Returned

13 Affirmative All

0 Affirmative with Comments

0 Negative with Comments

0 Abstention

Affirmative All

Crisman, Todd

Cross, Joseph W.

Earl, Timothy

Hunter, Christel K.

Kent, Gerald W.

Mercier, Charles David

Nielsen, Dennis A.

Porcaro, Michael Thomas

Riedl, Kenneth

Scearce, Susan Newman

Stene, Susan L.

Straniero, George A.

Wheeler, Wesley L.

**Second Revision No. 7736-NFPA 70-2018 [Section No. 330.104]****330.104** Conductors.

For ungrounded, grounded, and equipment grounding conductors, the minimum conductor sizes shall be 14 AWG copper, nickel, or nickel-coated copper and 12 AWG aluminum or copper-clad aluminum.

~~Conductors shall be of copper, aluminum, copper-clad aluminum, nickel or nickel-coated copper, solid or stranded. The For control and signal conductors minimum conductor sizes shall be 18 AWG copper, nickel, or nickel-coated copper, or 14 AWG copper-clad aluminum, and 12 AWG aluminum or copper-clad aluminum .~~

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Wed Oct 24 12:37:11 EDT 2018

Committee Statement

Committee Statement: The minimum size copper-clad aluminum conductor size was reduced to 14 AWG for control and signal conductors based on data submitted to the panel.

The test data provided in support of the public input and comment addresses temperature considerations only. For other applications, a fact-finding investigation is needed that specifically develops a test program and develops test data that supports the proposed change in the NEC based on the specific code language being proposed. This would include overcurrent protection, compatibility with wiring devices and equipment and other correlation within the code where the 14 AWG CCA could be used.

Response Message: SR-7736-NFPA 70-2018

Public Comment No. 1407-NFPA 70-2018 [Section No. 330.104]

Ballot Results

✔ **This item has passed ballot**

13 Eligible Voters

0 Not Returned

9 Affirmative All

2 Affirmative with Comments

1 Negative with Comments

1 Abstention

Affirmative All

Cross, Joseph W.

Earl, Timothy

Hunter, Christel K.

Mercier, Charles David

Nielsen, Dennis A.

Porcaro, Michael Thomas

Scearce, Susan Newman

Stene, Susan L.

Straniero, George A.

Affirmative with Comment

Crisman, Todd

Note that the original proposal was to establish a distinction between aluminum and copper-clad aluminum. The driving force behind this intent was to designate a 10 amp ampacity for a 14 awg copper-clad aluminum conductor "cca" with a 60c rating. Testing was performed by NSF that compared the temperature rise of cca with copper of the same awg. Testing showed that the temperatures were close until the ampacity was double what was proposed. Intertek performed testing that showed that a cca conductor had less linear thermal expansion than that of ETP copper. Additional testing was done to prove the reliability of the cca conductor with various wire connectors. The submitter had stated in his substantiation that the two NRTL's that were approached did not have a standard, or a test procedure to determine ampacity. The consensus of the panel was that a full fact finding investigation should be done before allowing the 14 awg cca conductor to be used for power with a designated ampacity. Second Revision 7736 was action taken by the Panel recognizing that the 14 awg cca conductor could be used for control and signal conductors. Yes a 10 amp circuit breaker does exist, however; it is not included in the standard ampere ratings in Table 240.6(A). If the original public input was accepted to allow a 14 awg cca conductor to have an ampacity of 10 amps at 60c - it's likely the rules in 240.4(B) could be interpreted to allow the installer to use a 14 awg cca conductor and protect it with a 15 amp circuit breaker.

Kent, Gerald W.

The information provide supported the differences between Copper-clad Aluminum and Aluminum and panel action reflects this.

Negative with Comment

Wheeler, Wesley L.

The public comment substantiation provided information to support the proposal, however this information needs to be included in the original proposal so it may be reviewed and commented upon by all interested parties as part of the consensus revision process. Submitting the test and listing data in the comment stage does not allow for review and comments by industry.

Abstention

Riedl, Kenneth

I am a member of the organization that performed testing provided by the submitter as substantiation for this revision under Public Comment 1407. As such, I believe it best to abstain from voting on SR-7736.



Second Revision No. 7590-NFPA 70-2018 [Section No. 330.130]

330.130 Hazardous (Classified) Locations.

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

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Mon Oct 22 16:31:37 EDT 2018

Committee Statement

Committee Statement: Interlock armor was added to correlate changes to Article 501.

Response Message: SR-7590-NFPA 70-2018

Public Comment No. 1335-NFPA 70-2018 [Section No. 330.130]

Ballot Results

✔ **This item has passed ballot**

13 Eligible Voters

0 Not Returned

13 Affirmative All

0 Affirmative with Comments

0 Negative with Comments

0 Abstention

Affirmative All

Crisman, Todd

Cross, Joseph W.

Earl, Timothy

Hunter, Christel K.

Kent, Gerald W.

Mercier, Charles David

Nielsen, Dennis A.

Porcaro, Michael Thomas

Riedl, Kenneth

Scearce, Susan Newman

Stene, Susan L.

Straniero, George A.

Wheeler, Wesley L.

**Second Revision No. 7727-NFPA 70-2018 [Section No. 334.12(A)]****(A) Types NM and NMC.**

Types NM and NMC 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*
- (11) Where subject to physical damage

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Tue Oct 23 20:48:19 EDT 2018

Committee Statement

Committee Statement: "Where subject to physical damage" was added so this rule will be similar to 320.13, 330.12, 336.12, 338.12, 340.12, 340.12. NM cable is restricted from use where subject to physical damage as covered in 300.4. Including it in 334.12 improves usability.

Response Message: SR-7727-NFPA 70-2018

Public Comment No. 403-NFPA 70-2018 [Section No. 334.12(A)]

Ballot Results

✔ **This item has passed ballot**

13 Eligible Voters

0 Not Returned

13 Affirmative All

0 Affirmative with Comments

0 Negative with Comments

0 Abstention

Affirmative All

Crisman, Todd

Cross, Joseph W.

Earl, Timothy

Hunter, Christel K.

Kent, Gerald W.

Mercier, Charles David

Nielsen, Dennis A.

Porcaro, Michael Thomas

Riedl, Kenneth

Scearce, Susan Newman

Stene, Susan L.

Straniero, George A.

Wheeler, Wesley L.



Second Revision No. 7728-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. The cable length between the cable entry and the closest cable support shall not exceed 450 mm (18 in.). 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

Committee: NEC-P06

Submittal Date: Tue Oct 23 20:52:32 EDT 2018

Committee Statement

Committee Statement: The term measured along the cable sheath was removed and replaced with a sentence indicating that the cable length between the last cable support and the junction box enclosure would not exceed 18 in. total.

Response Message: SR-7728-NFPA 70-2018

[Public Comment No. 1264-NFPA 70-2018 \[Section No. 334.30 \[Excluding any Sub-Sections\]\]](#)

[Public Comment No. 596-NFPA 70-2018 \[Section No. 334.30 \[Excluding any Sub-Sections\]\]](#)

[Public Comment No. 915-NFPA 70-2018 \[Section No. 334.30\]](#)

Ballot Results

✔ This item has passed ballot

13 Eligible Voters

0 Not Returned

13 Affirmative All

0 Affirmative with Comments

0 Negative with Comments

0 Abstention

Affirmative All

Crisman, Todd

Cross, Joseph W.

Earl, Timothy

Hunter, Christel K.

Kent, Gerald W.

Mercier, Charles David

Nielsen, Dennis A.

Porcaro, Michael Thomas

Riedl, Kenneth

Scearce, Susan Newman

Stene, Susan L.

Straniero, George A.

Wheeler, Wesley L.



Second Revision No. 7689-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:
 - a. The cable is Type TC-ER.
 - b. The cable is installed in industrial establishments where the conditions of maintenance and supervision ensure that only qualified persons service the installation.
 - c. The cable is continuously supported and protected against physical damage using mechanical protection such as struts, angles, or channels.
 - d. The cable complies with the crush and impact requirements of Type MC cable and is identified with the marking "TC-ER."
 - e. The cable is secured at intervals not exceeding 1.8 m (6 ft).
 - f. 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 shall be provided within the cable or, at the time of installation, one or more insulated conductors must shall 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.

- (8) ~~Where installed in wet locations,~~ Type TC cable shall ~~also~~ be resistant to moisture and corrosive agents where installed in wet locations.
- (9) In one- and two-family dwelling units, Type TC-ER-JP 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-JP 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: 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.

- (10) Direct buried, where identified for such use.
- (11) In hazardous (classified) locations where specifically permitted by other articles in this Code.

Informational Note: See 310.14(A)(3) for temperature limitation of conductors.

Supplemental Information

File Name

Description

Approved

Section_336.10_-_Track_Changes.docx

See attached word doc for clarity of changes made to list items in section 336.10--for staff use

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Tue Oct 23 14:22:13 EDT 2018

Committee Statement

Committee Statement: The designation "TC-ER-JP" was added to the mandatory language and the informational note was deleted. Cable suitable for pulling through structural members in accordance with NEC 336.10(9) is surface marked with the suffix "-JP" after the type designation "TC-ER." Therefore, cable is required to be marked "TC-ER-JP" in order to eliminate any confusion between AHJ's and installers as well as fall in line with the marking requirements of applicable product standard.

The exception is no longer limited to utilization equipment.

Response Message: SR-7689-NFPA 70-2018

[Public Comment No. 1625-NFPA 70-2018 \[Section No. 336.10\]](#)

[Public Comment No. 180-NFPA 70-2018 \[Section No. 336.10\]](#)

Ballot Results

✔ **This item has passed ballot**

13 Eligible Voters

0 Not Returned

13 Affirmative All

0 Affirmative with Comments

0 Negative with Comments

0 Abstention

Affirmative All

Crisman, Todd

Cross, Joseph W.

Earl, Timothy

Hunter, Christel K.

Kent, Gerald W.

Mercier, Charles David

Nielsen, Dennis A.

Porcaro, Michael Thomas

Riedl, Kenneth

Scearce, Susan Newman

Stene, Susan L.

Straniero, George A.

Wheeler, Wesley L.



Second Revision No. 7739-NFPA 70-2018 [Section No. 336.104 [Excluding any Sub-Sections]]

~~The insulated~~ For ungrounded, grounded, and equipment grounding conductors of Type TC cables, the conductor sizes shall be in sizes 18- 14 AWG to through 1000 kcmil copper, nickel, or nickel-coated copper and sizes 12 AWG through 1000 kcmil aluminum or copper-clad aluminum. ~~Insulated conductors of sizes 14 AWG, and larger copper, nickel, or nickel-coated copper, and sizes 12 AWG through 1000 kcmil aluminum or copper-clad aluminum~~ Insulation types shall be one of the types listed in Table 310.4(A) or Table 310.4(B) that is suitable for branch circuit and feeder circuits or one that is identified for such use.

For control and signal conductors, the minimum conductor sizes shall be 18 AWG copper, nickel, or nickel-coated copper, 14 AWG copper-clad aluminum, and 12 AWG aluminum.

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Wed Oct 24 14:13:51 EDT 2018

Committee Statement

Committee Statement: The minimum size copper-clad aluminum conductor size was reduced to 14 AWG for control and signal conductors based on data submitted to the panel.

The test data provided in support of the public input and comment addresses temperature considerations only. For other applications, a fact-finding investigation is needed that specifically develops a test program and develops test data that supports the proposed change in the NEC based on the specific code language being proposed. This would include overcurrent protection, compatibility with wiring devices and equipment and other correlation within the code where the 14 AWG CCA could be used.

Response Message: SR-7739-NFPA 70-2018

[Public Comment No. 1411-NFPA 70-2018 \[Section No. 336.104 \[Excluding any Sub-Sections\]\]](#)

Ballot Results

✔ This item has passed ballot

13 Eligible Voters

0 Not Returned

10 Affirmative All

1 Affirmative with Comments

1 Negative with Comments

1 Abstention

Affirmative All

Crisman, Todd

Cross, Joseph W.

Earl, Timothy

Hunter, Christel K.

Mercier, Charles David

Nielsen, Dennis A.

Porcaro, Michael Thomas

Scearce, Susan Newman

Stene, Susan L.

Straniero, George A.

Affirmative with Comment

Kent, Gerald W.

The information provide supported the differences between Copper-clad Aluminum and Aluminum and panel action reflects this.

Negative with Comment

Wheeler, Wesley L.

The public comment substantiation provided information to support the proposal, however this information needs to be included in the original proposal so it may be reviewed and commented upon by all interested parties as part of the consensus revision process. Submitting the test and listing data in the comment stage does not allow for review and comments by industry.

Abstention

Riedl, Kenneth

I am a member of the organization that performed testing provided by the submitter as substantiation for this revision under Public Comment 1411. As such, I believe it best to abstain from voting on SR-7739.

**Second Revision No. 7674-NFPA 70-2018 [Section No. 336.130]****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~~ overall nonmetallic jacket shall be continuous and gas/vapor tight.
- (4) For construction greater than 25.4 mm (1 in.) in diameter, the following shall apply:
 - a. The equipment grounding conductor shall be bare.
 - b. A metallic shield shall be included over all conductors under the outer jacket.

Supplemental Information

<u>File Name</u>	<u>Description</u>	<u>Approved</u>
Section_336.130_-_Track_Changes.docx	Word document for editing use. Clarifies the revisions in the list--for staff use	

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Tue Oct 23 13:07:00 EDT 2018

Committee Statement

Committee Statement: The word "essentially" was not deleted since it would make the requirement less enforceable. The reality is that cable is not perfectly circular. Two words in the final list item were corrected for spelling. The spelling of the word "overall" was corrected.

Response Message: SR-7674-NFPA 70-2018

[Public Comment No. 916-NFPA 70-2018 \[Section No. 336.120\]](#)

[Public Comment No. 1912-NFPA 70-2018 \[Section No. 336.130\]](#)

Ballot Results

✔ **This item has passed ballot**

13 Eligible Voters

0 Not Returned

13 Affirmative All

0 Affirmative with Comments

0 Negative with Comments

0 Abstention

Affirmative All

Crisman, Todd

Cross, Joseph W.

Earl, Timothy

Hunter, Christel K.

Kent, Gerald W.

Mercier, Charles David

Nielsen, Dennis A.

Porcaro, Michael Thomas

Riedl, Kenneth

Scearce, Susan Newman

Stene, Susan L.

Straniero, George A.

Wheeler, Wesley L.



Second Revision No. 7729-NFPA 70-2018 [Article 337]

Article 337 Type P Cable

Part I. General

337.1 Scope.

This article covers the use, installation, and construction specifications for 600 up through 2000 volt 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. Cable

A factory assembly of ~~two~~ one or more insulated flexible tinned copper conductors, with associated ~~bare or covered equipment~~ grounding conductors, impervious sheath, conductor(s), with or without a braided metallic ~~armored or unarmored cable. See Part III armor and with an overall nonmetallic jacket .~~

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) locations and to transition between a hazardous (classified) location and a non-hazardous (classified) location as follows Type P cable shall be permitted to be used :~~

- ~~(1) In industrial locations under Under engineering supervision in industrial installations where the conditions of maintenance and supervision ensure that only qualified persons monitor and service the installation, system.~~
- ~~(2) In hazardous (classified) locations where specifically permitted by other articles in this Code .~~
- ~~(2) For services, feeders, and branch circuits~~
- ~~(2) For power, lighting, control, and signal circuits~~
- ~~(2) Indoors~~
- ~~(2) Outdoors where identified for such use~~
- ~~(2) Exposed or concealed~~
- ~~(2) For direct burial where identified for such use~~
- ~~(2) In cable tray where identified for such use~~
- ~~(2) In any raceway~~
- ~~(2) In wet locations~~
- ~~(2) Between a cable tray and the utilization equipment or device(s), provided all of the following apply:~~
 - ~~0. The cable is installed in industrial establishments where the conditions of maintenance and supervision ensure that only qualified persons service the installation.~~
 - ~~0. The cable is continuously supported and protected against physical damage using mechanical protection such as struts, angles, or channels.~~
 - ~~0. The cable is secured at intervals not exceeding 1.4 m (4.5 ft).~~
 - ~~0. Equipment grounding for the utilization equipment is provided by a bare equipment grounding conductor within the cable.~~

~~*Exception to (10): 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 where it will be exposed to physical damage. :

- ~~(1) where Where it will be exposed to physical damage~~
- ~~(2) Where not specifically permitted by other articles in the Code~~

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) The minimum bending radii during installations and handling in service shall be adequate to prevent damage to the cable .~~

~~(A) Unarmored Cable.~~

- ~~(0) Four times the overall diameter for cables 25 mm (1 in.) or less in diameter~~
- ~~(0) Five times the overall diameter for cables larger than 25 mm (1 in.) but not more than 50 mm (2 in.) in diameter~~
- ~~(0) Six times the overall diameter for cables larger than 50 mm (2 in.) in diameter~~

(A)– Armored Cable.

- (0) Ten times the external diameter of the metallic armor for cable not more than 19 mm (¾ in.) in external diameter
- (0) Twelve times the external diameter of the metallic armor for cable more than 19 mm (¾ 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:

- (0) Is fished between access points through concealed spaces in finished buildings or structures and supporting is impractical
- (0) 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
- (0) 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 310.15 310.14(A) or 310.14(B) for 14 AWG and larger conductors and . For 18 AWG and 16 AWG conductors the ampacities shall be determined in accordance with Table 402.5 for 18 AWG and 16 AWG conductors . When installed in cable tray, the ampacities shall be permitted to 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) be a thermoset type identified for use in Type P cable. All conductors shall be suitable for wet locations. The minimum wall thickness shall be 0.76 mm (30 mils) .

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) .

337.114 Shield.

Metallic shield(s) shall be permitted over a single conductor or groups of conductors.

337.115 Jacket.

Single conductor cables and multiconductor cables shall have an overall nonmetallic jacket that is impervious to moisture, corrosion resistant, and sunlight resistant.

337.116 Sheath Armor .

~~The sheath or outer covering shall comply with 337.116(A) or (B). An overall nonmetallic jacket impervious to moisture and corrosion-resistant armor shall be provided permitted over the armor jacket . The If provided, 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 or as an equipment grounding conductor. A nonmetallic jacket that conforms to 337.115 shall be provided over the armor .~~

(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~~ When an armor is provided, the cable shall be marked as ~~Type P-HL~~ accordingly .

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Tue Oct 23 20:57:46 EDT 2018

Committee Statement

Committee Statement: Article 337 was developed based on industry need for the limited use of Type P cable in land based drilling rigs.

[1969, 1445 and 1448] The language does not restrict the use of Type P to hazardous locations.

[2043] The definition was revised to permit single conductor Type P cables.

[1460] An EGC that complies with 250.122 is required. It is not limited to an insulated conductor.

[2049] The armor is not permitted as the EGC in 337.116.

[1457 and 2056] Unnecessary reference to 337.112(A) and (B) were deleted.

[1481 and 2058] The reference to Type P-HL was deleted.

[792, 794, and 795] CMP-6 has purview over wiring methods and Type P cable is a wiring method and shall stay in Chapter 3 where general wiring methods reside. The title of the article has been revised to "Type P Cable" per the request of the correlating committee. Article 337 has been edited to align with the style manual.

Response Message: SR-7729-NFPA 70-2018

Public Comment No. 1969-NFPA 70-2018 [Section No. 337.1]

[Public Comment No. 2056-NFPA 70-2018 \[Section No. 337.112\]](#)

[Public Comment No. 1460-NFPA 70-2018 \[Section No. 337.108\]](#)

[Public Comment No. 1445-NFPA 70-2018 \[Section No. 337.1\]](#)

[Public Comment No. 2049-NFPA 70-2018 \[Section No. 337.108\]](#)

[Public Comment No. 1448-NFPA 70-2018 \[Section No. 337.10\]](#)

[Public Comment No. 1481-NFPA 70-2018 \[Section No. 337.120\]](#)

[Public Comment No. 1457-NFPA 70-2018 \[Section No. 337.112\]](#)

[Public Comment No. 2043-NFPA 70-2018 \[Definition: Type P.\]](#)

[Public Comment No. 2058-NFPA 70-2018 \[Section No. 337.120\]](#)

[Public Comment No. 792-NFPA 70-2018 \[Global Input\]](#)

[Public Comment No. 794-NFPA 70-2018 \[Global Input\]](#)

[Public Comment No. 795-NFPA 70-2018 \[Global Input\]](#)

Ballot Results

✔ This item has passed ballot

13 Eligible Voters

0 Not Returned

12 Affirmative All

1 Affirmative with Comments

0 Negative with Comments

0 Abstention

Affirmative All

Crisman, Todd

Cross, Joseph W.

Earl, Timothy

Hunter, Christel K.

Mercier, Charles David

Nielsen, Dennis A.

Porcaro, Michael Thomas

Riedl, Kenneth

Scearce, Susan Newman

Stene, Susan L.

Straniero, George A.

Wheeler, Wesley L.

Affirmative with Comment

Kent, Gerald W.

Much effort was placed into ensuring Type P cable was available to land based drilling rig operations.



Second Revision No. 7682-NFPA 70-2018 [Definition: Service-Entrance Conductor Assembly.]

Service-Entrance Conductor Assembly Assembly .

Multiple single-insulated conductors twisted together without an overall covering, other than an optional binder intended only to keep the conductors together.

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Tue Oct 23 13:36:20 EDT 2018

Committee Statement

Committee Statement: Editorial.

Response Message: SR-7682-NFPA 70-2018

Ballot Results

✓ **This item has passed ballot**

13 Eligible Voters

0 Not Returned

13 Affirmative All

0 Affirmative with Comments

0 Negative with Comments

0 Abstention

Affirmative All

Crisman, Todd

Cross, Joseph W.

Earl, Timothy

Hunter, Christel K.

Kent, Gerald W.

Mercier, Charles David

Nielsen, Dennis A.

Porcaro, Michael Thomas

Riedl, Kenneth

Scearce, Susan Newman

Stene, Susan L.

Straniero, George A.

Wheeler, Wesley L.



Second Revision No. 7678-NFPA 70-2018 [Section No. 338.10(B)(4)]

(4) Installation Methods for Branch Circuits and Feeders.

Informational Note No. 1: See 310.15 310.14(A)(3) for temperature limitation of conductors.

Informational Note No. 2: For the installation of main power feeder conductors in dwelling units refer to 310.12.

(a) Interior Installations.

- (1) 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.
- (2) Where more than two Type SE cables containing two or more current-carrying conductors in each cable are installed in contact with thermal insulations, 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).
- (3) For Type SE cable with ungrounded conductor sizes 10 AWG and smaller, where installed in contact with 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 ampacity does not exceed that for a 60°C (140°F) rated conductor.

(b) Exterior Installations.

- (1) 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.
- (2) 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>
Section_338.10_B_4_-_Track_Changes.docx	See attached word doc for clarity of editorial changes to list items of section 338.10(B)(4)--for staff use	

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Tue Oct 23 13:30:33 EDT 2018

Committee Statement

Committee Statement: The only changes were correcting a reference in IN 1 and deleting an "s" at the end of insulation.

Response Message: SR-7678-NFPA 70-2018

Public Comment No. 1914-NFPA 70-2018 [Section No. 338.10(B)(4)]

Ballot Results

✔ This item has passed ballot

13 Eligible Voters

0 Not Returned

13 Affirmative All

0 Affirmative with Comments

0 Negative with Comments

0 Abstention

Affirmative All

Crisman, Todd

Cross, Joseph W.

Earl, Timothy

Hunter, Christel K.

Kent, Gerald W.

Mercier, Charles David

Nielsen, Dennis A.

Porcaro, Michael Thomas

Riedl, Kenneth

Scearce, Susan Newman

Stene, Susan L.

Straniero, George A.

Wheeler, Wesley L.

**Second Revision No. 7680-NFPA 70-2018 [Section No. 338.100]****338.100** Construction.**(A)** Assemblies.

Cabled assemblies of multiple single-conductor Type USE conductors shall be permitted 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) Uninsulated Conductor.

Type SE or USE cable with an overall covering containing two or more conductors shall be permitted to have one conductor uninsulated.

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Tue Oct 23 13:32:56 EDT 2018

Committee Statement

Committee Statement: Editorial.

Response Message: SR-7680-NFPA 70-2018

[Public Comment No. 1918-NFPA 70-2018 \[Section No. 338.100\(A\)\]](#)

[Public Comment No. 1922-NFPA 70-2018 \[Section No. 338.100\(B\)\]](#)

[Public Comment No. 917-NFPA 70-2018 \[Section No. 338.100\]](#)

Ballot Results

✔ **This item has passed ballot**

13 Eligible Voters

0 Not Returned

13 Affirmative All

0 Affirmative with Comments

0 Negative with Comments

0 Abstention

Affirmative All

Crisman, Todd

Cross, Joseph W.

Earl, Timothy

Hunter, Christel K.

Kent, Gerald W.

Mercier, Charles David

Nielsen, Dennis A.

Porcaro, Michael Thomas

Riedl, Kenneth

Scearce, Susan Newman

Stene, Susan L.

Straniero, George A.

Wheeler, Wesley L.

**Second Revision No. 7732-NFPA 70-2018 [Section No. 400.12]****400.12 Uses Not Permitted.**

Unless specifically permitted in 400.10, flexible cords, flexible cables, cord sets, and power supply cords shall not be used for the following:

- (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 cords, flexible cables, and power supply cords 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

Informational Note: For proper application see UL 817, *Cord Sets and Power-Supply Cords*, and UL 62, *Flexible Cords and Cables*.

Submitter Information Verification

Committee: NEC-P06

Submittal Date: Wed Oct 24 11:37:15 EDT 2018

Committee Statement

Committee Statement: Edited to include power supply cord in the exception.

Response Message: SR-7732-NFPA 70-2018

[Public Comment No. 391-NFPA 70-2018 \[Section No. 400.12\]](#)

Ballot Results

✔ This item has passed ballot

13 Eligible Voters

0 Not Returned

12 Affirmative All

1 Affirmative with Comments

0 Negative with Comments

0 Abstention

Affirmative All

Crisman, Todd

Cross, Joseph W.

Earl, Timothy

Hunter, Christel K.

Mercier, Charles David

Nielsen, Dennis A.

Porcaro, Michael Thomas

Riedl, Kenneth

Scearce, Susan Newman

Stene, Susan L.

Straniero, George A.

Wheeler, Wesley L.

Affirmative with Comment

Kent, Gerald W.

Clarification to confirm power supply cord are acceptable if enclosed in approved enclosure. This should clarify cord connected LED drivers (along with other items) can be used when enclosed in approved enclosures.



Second Revision No. 7743-NFPA 70-2018 [Section No. B.7]

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

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 (<u>AWG</u> or <u>kcmil</u>)	Temperature Rating of Conductor. [See Table 310.104(A) 310.4(A) .]						Size (<u>AWG</u> or <u>kcmil</u>)
	<u>60°C(140°F)</u>	<u>75°C(167°F)</u>	<u>90°C(194°F)</u>	<u>60°C(140°F)</u>	<u>75°C(167°F)</u>	<u>90°C(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>			
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
500	315	378	427	254	303	342	500
600	343	413	468	279	335	378	600
700	376	452	514	310	371	420	700
750	387	466	529	321	384	435	750
800	397	479	543	331	397	450	800
900	415	500	570	350	421	477	900
1000	448	542	617	382	460	521	1000

*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)*

Size (AWG or kcmil)	Temperature Rating of Conductor. [See Table 310.104(A) 310.4(A) .]								Size (AWG or kcmil)
	60°C (140°F)	75°C (167°F)	85°C (185°F)	90°C (194°F)	60°C (140°F)	75°C (167°F)	85°C (185°F)	90°C (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
3/0	165	213	238	249	129	166	185	194	3/0
4/0	190	245	274	287	149	192	214	224	4/0
250	212	274	305	320	166	214	239	250	250
300	237	306	341	357	186	240	268	280	300
350	261	337	377	394	205	265	296	309	350
400	281	363	406	425	222	287	317	334	400
500	321	416	465	487	255	330	368	385	500
600	354	459	513	538	284	368	410	429	600
700	387	502	562	589	306	405	462	473	700
750	404	523	586	615	328	424	473	495	750
800	415	539	604	633	339	439	490	513	800
900	438	570	639	670	362	469	514	548	900
1000	461	601	674	707	385	499	558	584	1000

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

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

Table B.310.15(B)(2)(5) Ampacities of Single Insulated Conductors, Rated 0 Through 2000 Volts, in Nonmagnetic Underground Electrical Ducts (One Conductor 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)

Size (kcmil)	<u>3 Electrical Ducts [Fig. B.310.15(B)(2)(2), Detail 2]</u>			<u>6 Electrical Ducts [Fig. B.310.15(B)(2)(2), Detail 3]</u>			<u>9 Electrical Ducts [Fig. B.310.15(B)(2)(2), Detail 4]</u>			<u>3 Electrical Ducts [Fig. B.310.15(B)(2)(2), Detail 2]</u>			<u>6 Electrical Ducts [Fig. B.310.15(B)(2)(2), Detail 3]</u>			<u>9 Electrical Ducts [Fig. B.310.15(B)(2)(2), Detail 4]</u>		
	<u>Types RHW, THHW, THW, THWN, XHHW, USE</u>			<u>Types RHW, THHW, THW, THWN, XHHW, USE</u>			<u>Types RHW, THHW, THW, THWN, XHHW, USE</u>			<u>Types RHW, THHW, THW, THWN, XHHW, USE</u>			<u>Types RHW, THHW, THW, THWN, XHHW, USE</u>			<u>Types RHW, THHW, THW, THWN, XHHW, USE</u>		
	<u>COPPER</u>									<u>ALUMINUM OR COPPER-CLAD ALUMINUM</u>								
	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
	50	100	100	50	100	100	50	100	100	50	100	100	50	100	100	50	100	100
250	410	344	327	386	295	275	369	270	252	320	269	256	302	230	214	288	214	214
350	503	418	396	472	355	330	446	322	299	393	327	310	369	277	258	350	258	258
500	624	511	484	583	431	400	545	387	360	489	401	379	457	337	313	430	308	308
750	794	640	603	736	534	494	674	469	434	626	505	475	581	421	389	538	379	379
1000	936	745	700	864	617	570	776	533	493	744	593	557	687	491	453	629	438	438
1250	1055	832	781	970	686	632	854	581	536	848	668	627	779	551	508	703	470	470
1500	1160	907	849	1063	744	685	918	619	571	941	736	689	863	604	556	767	511	511
1750	1250	970	907	1142	793	729	975	651	599	1026	796	745	937	651	598	823	551	551
2000	1332	1027	959	1213	836	768	1030	683	628	1103	850	794	1005	693	636	877	581	581
Ambient Temp.(°C)	Correction Factors																	
6–10	1.09			1.09			1.09			1.09			1.09			1.09		
11–15	1.04			1.04			1.04			1.04			1.04			1.04		
16–20	1.00			1.00			1.00			1.00			1.00			1.00		
21–25	0.95			0.95			0.95			0.95			0.95			0.95		
26–30	0.90			0.90			0.90			0.90			0.90			0.90		

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)

Size (AWG or kcmil)	<u>1 Electrical Duct [Fig. B.310.15(B) (2)(2), Detail 1]</u>			<u>3 Electrical Ducts [Fig. B.310.15(B) (2)(2), Detail 2]</u>			<u>6 Electrical Ducts [Fig. B.310.15(B) (2)(2), Detail 3]</u>			<u>1 Electrical Duct [Fig. B.310.15(B) (2)(2), Detail 1]</u>			<u>3 Electrical Ducts [Fig. B.310.15(B) (2)(2), Detail 2]</u>			<u>6 Elec Ducts B.310 (2)(2), 3</u>		
	<u>Types RHW, THHW, THW, THWN, XHHW, USE</u>			<u>Types RHW, THHW, THW, THWN, XHHW, USE</u>			<u>Types RHW, THHW, THW, THWN, XHHW, USE</u>			<u>Types RHW, THHW, THW, THWN, XHHW, USE</u>			<u>Types RHW, THHW, THW, THWN, XHHW, USE</u>			<u>Types THHW THW XHHW</u>		
	<u>COPPER</u>									<u>ALUMINUM OR COPPER-CLAD ALUM</u>								
	RHO	RHO	RHO	RHO	RHO	RHO	RHO	RHO	RHO	RHO	RHO	RHO	RHO	RHO	RHO	RH		
	60	90	120	60	90	120	60	90	120	60	90	120	60	90	120	60	90	
	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	
8	58	54	53	56	48	46	53	42	39	45	42	41	43	37	36	41	32	
6	77	71	69	74	63	60	70	54	51	60	55	54	57	49	47	54	42	

Size (AWG or kcmil)	1 Electrical Duct [Fig. B.310.15(B)(2)(2), Detail 1]	3 Electrical Ducts [Fig. B.310.15(B)(2)(2), Detail 2]	6 Electrical Ducts [Fig. B.310.15(B)(2)(2), Detail 3]	1 Electrical Duct [Fig. B.310.15(B)(2)(2), Detail 1]	3 Electrical Ducts [Fig. B.310.15(B)(2)(2), Detail 2]	6 Electrical Ducts [Fig. B.310.15(B)(2)(2), Detail 3]
	Types RHW, THHW, THW, THWN, XHHW, USE	Types RHW, THHW, THW, THWN, XHHW, USE	Types RHW, THHW, THW, THWN, XHHW, USE	Types RHW, THHW, THW, THWN, XHHW, USE	Types RHW, THHW, THW, THWN, XHHW, USE	Types RHW, THHW, THW, THWN, XHHW, USE
	COPPER			ALUMINUM OR COPPER-CLAD ALUMINUM		
4	101 93 91	96 81 77	91 69 65	78 72 71	75 63 60	71 54
2	132 121 118	126 105 100	119 89 83	103 94 92	98 82 78	92 70
1	154 140 136	146 121 114	137 102 95	120 109 106	114 94 89	107 79
1/0	177 160 156	168 137 130	157 116 107	138 125 122	131 107 101	122 90
2/0	203 183 178	192 156 147	179 131 121	158 143 139	150 122 115	140 101
3/0	233 210 204	221 178 158	205 148 137	182 164 159	172 139 131	160 116
4/0	268 240 232	253 202 190	234 168 155	209 187 182	198 158 149	183 133
250	297 265 256	280 222 209	258 184 169	233 207 201	219 174 163	202 144
350	363 321 310	340 267 250	312 219 202	285 252 244	267 209 196	245 171
500	444 389 375	414 320 299	377 261 240	352 308 297	328 254 237	299 201
750	552 478 459	511 388 362	462 314 288	446 386 372	413 314 293	374 251
1000	628 539 518	579 435 405	522 351 321	521 447 430	480 361 336	433 291
Ambient Temp. (°C)	Correction Factors					
6–10	1.09	1.09	1.09	1.09	1.09	1.09
11–15	1.04	1.04	1.04	1.04	1.04	1.04
16–20	1.00	1.00	1.00	1.00	1.00	1.00
21–25	0.95	0.95	0.95	0.95	0.95	0.95
26–30	0.90	0.90	0.90	0.90	0.90	0.90

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)

Size (AWG or kcmil)	1 Electrical Duct [Fig. B.310.15(B)(2)(2), Detail 1]	3 Electrical Ducts [Fig. B.310.15(B)(2)(2), Detail 2]	6 Electrical Ducts [Fig. B.310.15(B)(2)(2), Detail 3]	1 Electrical Duct [Fig. B.310.15(B)(2)(2), Detail 1]	3 Electrical Ducts [Fig. B.310.15(B)(2)(2), Detail 2]	6 Electrical Ducts [Fig. B.310.15(B)(2)(2), Detail 3]
	Types RHW, THHW, THW, THWN, XHHW, USE	Types RHW, THHW, THW, THWN, XHHW, USE	Types RHW, THHW, THW, THWN, XHHW, USE	Types RHW, THHW, THW, THWN, XHHW, USE	Types RHW, THHW, THW, THWN, XHHW, USE	Types RHW, THHW, THW, THWN, XHHW, USE
	COPPER			ALUMINUM OR COPPER-CLAD ALUMINUM		
	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
	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
6	84 77 75	80 67 63	75 56 53	66 60 58	63 52 49	59 44
4	111 100 98	105 86 81	98 73 67	86 78 76	79 67 63	77 57
3	129 116 113	122 99 94	113 83 77	101 91 89	83 77 73	84 65
2	147 132 128	139 112 106	129 93 86	115 103 100	108 87 82	101 73
1	171 153 148	161 128 121	149 106 98	133 119 115	126 100 94	116 83

Size (AWG or kcmil)	<u>1 Electrical Duct [Fig. B.310.15(B) (2)(2), Detail 1]</u>	<u>3 Electrical Ducts [Fig. B.310.15(B) (2)(2), Detail 2]</u>	<u>6 Electrical Ducts [Fig. B.310.15(B) (2)(2), Detail 3]</u>	<u>1 Electrical Duct [Fig. B.310.15(B) (2)(2), Detail 1]</u>	<u>3 Electrical Ducts [Fig. B.310.15(B) (2)(2), Detail 2]</u>	<u>6 Elec Ducts B.310 (2)(2), 3</u>
	<u>Types RHW, THHW, THW, THWN, XHHW, USE</u>	<u>Types RHW, THHW, THW, THWN, XHHW, USE</u>	<u>Types RHW, THHW, THW, THWN, XHHW, USE</u>	<u>Types RHW, THHW, THW, THWN, XHHW, USE</u>	<u>Types RHW, THHW, THW, THWN, XHHW, USE</u>	<u>Types THHW THW XHHW</u>
	COPPER			ALUMINUM OR COPPER-CLAD ALUMINUM		
1/0	197 175 169	185 146 137	170 121 111	153 136 132	144 114 107	133 94
2/0	226 200 193	212 166 156	194 136 126	176 156 151	165 130 121	151 100
3/0	260 228 220	243 189 177	222 154 142	203 178 172	189 147 138	173 120
4/0	301 263 253	280 215 201	255 175 161	235 205 198	219 168 157	199 130
250	334 290 279	310 236 220	281 192 176	261 227 218	242 185 172	220 150
300	373 321 308	344 260 242	310 210 192	293 252 242	272 204 190	245 160
350	409 351 337	377 283 264	340 228 209	321 276 265	296 222 207	266 170
400	442 376 361	394 302 280	368 243 223	349 297 284	321 238 220	288 190
500	503 427 409	460 341 316	412 273 249	397 338 323	364 270 250	326 210
600	552 468 447	511 371 343	457 296 270	446 373 356	408 296 274	365 230
700	602 509 486	553 402 371	492 319 291	488 408 389	443 321 297	394 250
750	632 529 505	574 417 385	509 330 301	508 425 405	461 334 309	409 260
800	654 544 520	597 428 395	527 338 308	530 439 418	481 344 318	427 270
900	692 575 549	628 450 415	554 355 323	563 466 444	510 365 337	450 280
1000	730 605 576	659 472 435	581 372 338	597 494 471	538 385 355	475 300
AmbientTemp.(°C)	Correction Factors					
6–10	1.09	1.09	1.09	1.09	1.09	1.09
11–15	1.04	1.04	1.04	1.04	1.04	1.04
16–20	1.00	1.00	1.00	1.00	1.00	1.00
21–25	0.95	0.95	0.95	0.95	0.95	0.95
26–30	0.90	0.90	0.90	0.90	0.90	0.90

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)	<u>1 Cable [Fig. B.310.15(B)(2)(2), Detail 5]</u>		<u>2 Cables [Fig. B.310.15(B)(2)(2), Detail 6]</u>		<u>1 Cable [Fig. B.310.15(B)(2)(2), Detail 5]</u>		<u>2 Cables [Fig. B.310.15(B)(2)(2), Detail 6]</u>		Size (AWG or kcmil)
	<u>60°C (140°F)</u>	<u>75°C (167°F)</u>	<u>60°C (140°F)</u>	<u>75°C (167°F)</u>	<u>60°C (140°F)</u>	<u>75°C (167°F)</u>	<u>60°C (140°F)</u>	<u>75°C (167°F)</u>	
	<u>TYPES</u>				<u>TYPES</u>				
	<u>UF</u>	<u>RHW, THHW, THW, THWN, XHHW, USE</u>	<u>UF</u>	<u>RHW, THHW, THW, THWN, XHHW, USE</u>	<u>UF</u>	<u>RHW, THHW, THW, THWN, XHHW, USE</u>	<u>UF</u>	<u>RHW, THHW, THW, THWN, XHHW, USE</u>	
	<u>COPPER</u>				<u>ALUMINUM OR COPPER-CLAD ALUMINUM</u>				
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

Size (AWG or kcmil)	1 Cable [Fig. B.310.15(B)(2)(2), Detail 5]		2 Cables [Fig. B.310.15(B)(2)(2), Detail 6]		1 Cable [Fig. B.310.15(B)(2)(2), Detail 5]		2 Cables [Fig. B.310.15(B)(2)(2), Detail 6]		Size (AWG or kcmil)
	60°C (140°F)	75°C (167°F)	60°C (140°F)	75°C (167°F)	60°C (140°F)	75°C (167°F)	60°C (140°F)	75°C (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				
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.(°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

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), Detail 7		See Fig. B.310.15(B) (2)(2), Detail 8		See Fig. B.310.15(B) (2)(2), Detail 7		See Fig. B.310.15(B) (2)(2), Detail 8	
	60°C(140°F)	75°C(167°F)	60°C(140°F)	75°C(167°F)	60°C(140°F)	75°C(167°F)	60°C(140°F)	75°C(167°F)
	TYPES				TYPES			
	UF	USE	UF	USE	UF	USE	UF	USE
	COPPER				ALUMINUM OR COPPER-CLAD ALU			
8	72	84	66	77	55	65	51	60
6	91	107	84	99	72	84	66	77
4	119	139	109	128	92	108	85	100
2	153	179	140	164	119	139	109	128
1	173	203	159	186	135	158	124	147
1/0	197	231	181	212	154	180	141	167
2/0	223	262	205	240	175	205	159	189

Size (AWG or kcmil)	See Fig. B.310.15(B) (2)(2), Detail 7		See Fig. B.310.15(B) (2)(2), Detail 8		See Fig. B.310.15(B) (2)(2), Detail 7		See Fig. B.310.15(B) (2)(2), Detail 7	
	60°C(140°F)	75°C(167°F)	60°C(140°F)	75°C(167°F)	60°C(140°F)	75°C(167°F)	60°C(140°F)	75°C(167°F)
	TYPES				TYPES			
	UF	USE	UF	USE	UF	USE	UF	USE
	COPPER				ALUMINUM OR COPPER-CLAD ALUMINUM			
3/0	254	298	232	272	199	233	181	215
4/0	289	339	263	308	226	265	206	241
250	—	370	—	336	—	289	—	255
350	—	445	—	403	—	349	—	315
500	—	536	—	483	—	424	—	385
750	—	654	—	587	—	525	—	475
1000	—	744	—	665	—	608	—	555
Ambient Temp.(°C)	Correction Factors							
6–10	1.12	1.09	1.12	1.09	1.12	1.09	1.12	1.09
11–15	1.06	1.04	1.06	1.04	1.06	1.04	1.06	1.04
16–20	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
21–25	0.94	0.95	0.94	0.95	0.94	0.95	0.94	0.95
26–30	0.87	0.90	0.87	0.90	0.87	0.90	0.87	0.90

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), Detail 9		See Fig. B.310.15(B) (2)(2), Detail 10		See Fig. B.310.15(B) (2)(2), Detail 9		See Fig. B.310.15(B) (2)(2), Detail 9	
	60°C(140°F)	75°C(167°F)	60°C(140°F)	75°C(167°F)	60°C(140°F)	75°C(167°F)	60°C(140°F)	75°C(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	71
6	107	126	101	118	84	98	78	91
4	139	163	130	152	108	127	101	117
2	178	209	165	194	139	163	129	150
1	201	236	187	219	157	184	146	171
1/0	230	270	212	249	179	210	165	196
2/0	261	306	241	283	204	239	188	221
3/0	297	348	274	321	232	272	213	250
4/0	336	394	309	362	262	307	241	283
250	—	429	—	394	—	335	—	300
350	—	516	—	474	—	403	—	363
500	—	626	—	572	—	490	—	441
750	—	767	—	700	—	605	—	551
1000	—	887	—	808	—	706	—	641
1250	—	979	—	891	—	787	—	716
1500	—	1063	—	965	—	862	—	786
1750	—	1133	—	1027	—	930	—	841
2000	—	1195	—	1082	—	990	—	896

Size (AWG or kcmil)	<u>See Fig. B.310.15(B) (2)(2), Detail 9</u>		<u>See Fig. B.310.15(B) (2)(2), Detail 10</u>		<u>See Fig. B.310.15(B) (2)(2), Detail 9</u>		<u>See Fig. B.310.15(B) (2)(2), Detail 10</u>	
	<u>60°C(140°F)</u>	<u>75°C(167°F)</u>	<u>60°C(140°F)</u>	<u>75°C(167°F)</u>	<u>60°C(140°F)</u>	<u>75°C(167°F)</u>	<u>60°C(140°F)</u>	<u>75°C(167°F)</u>
	<u>TYPES</u>				<u>TYPES</u>			
	<u>UF</u>	<u>USE</u>	<u>UF</u>	<u>USE</u>	<u>UF</u>	<u>USE</u>	<u>UF</u>	<u>USE</u>
	<u>COPPER</u>				<u>ALUMINUM OR COPPER-CLAD ALUMINUM</u>			
Ambient Temp.(°C)	Correction Factors							
6–10	1.12	1.09	1.12	1.09	1.12	1.09	1.12	1.09
11–15	1.06	1.04	1.06	1.04	1.06	1.04	1.06	1.04
16–20	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
21–25	0.94	0.95	0.94	0.95	0.94	0.95	0.94	0.95
26–30	0.87	0.90	0.87	0.90	0.87	0.90	0.87	0.90

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

Number of Conductors*	Percent of Values in Tables as Adjusted for Ambient Temperature if Necessary
4–6	80
7–9	70
10–24	70**
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) (D) and (5) (E) .

**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 310.16, Table 310.18, 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.

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

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.

$$A_2 = \sqrt{\frac{(0.5)(24)}{18}} \times 20(0.7) = 11.5 \text{ amperes}$$

[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 = $F \times I_1$.

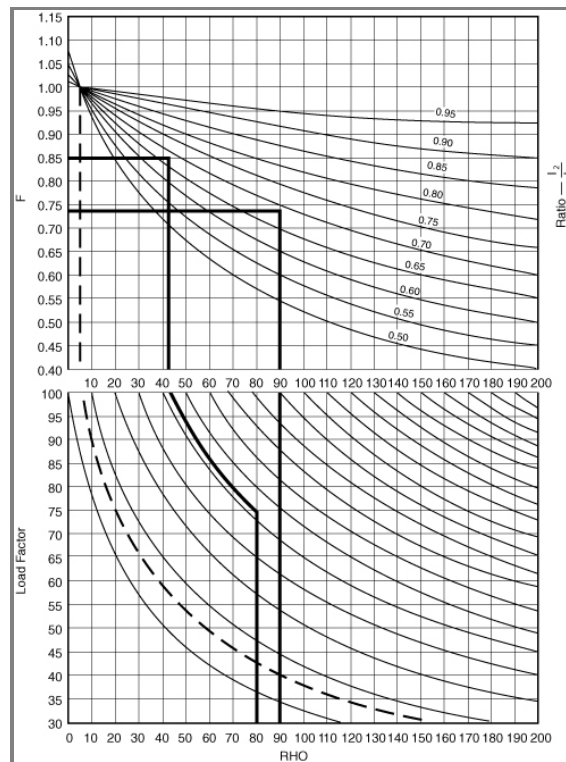


Figure B.310.15(B)(2)(2) Cable Installation Dimensions for Use with Table B.310.15(B)(2)(5) Through Table B.310.15(B)(2)(10).

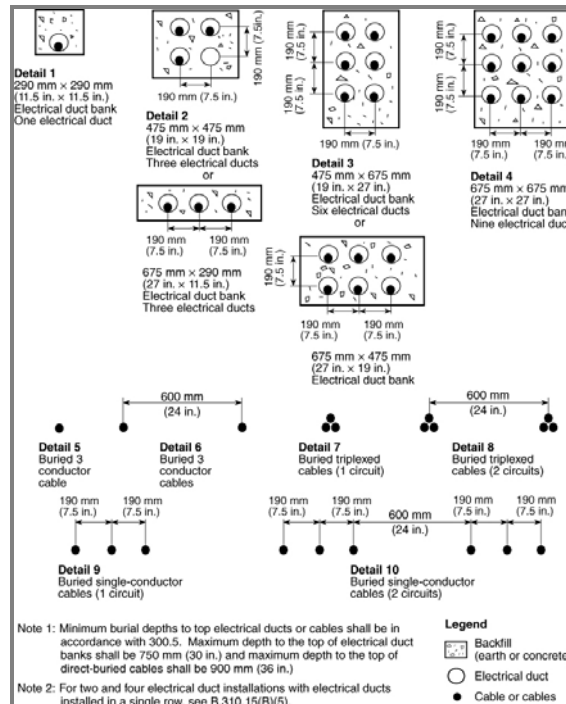


Figure Informational Note Figure B.310.15(B)(2)(3) Ampacities of Single Insulated Conductors Rated 0 Through 5000 Volts in Underground Electrical Ducts (Three Conductors per Electrical Duct), Nine Single-Conductor Cables per Phase Based on Ambient Earth Temperature of 20°C (68°F), Conductor Temperature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

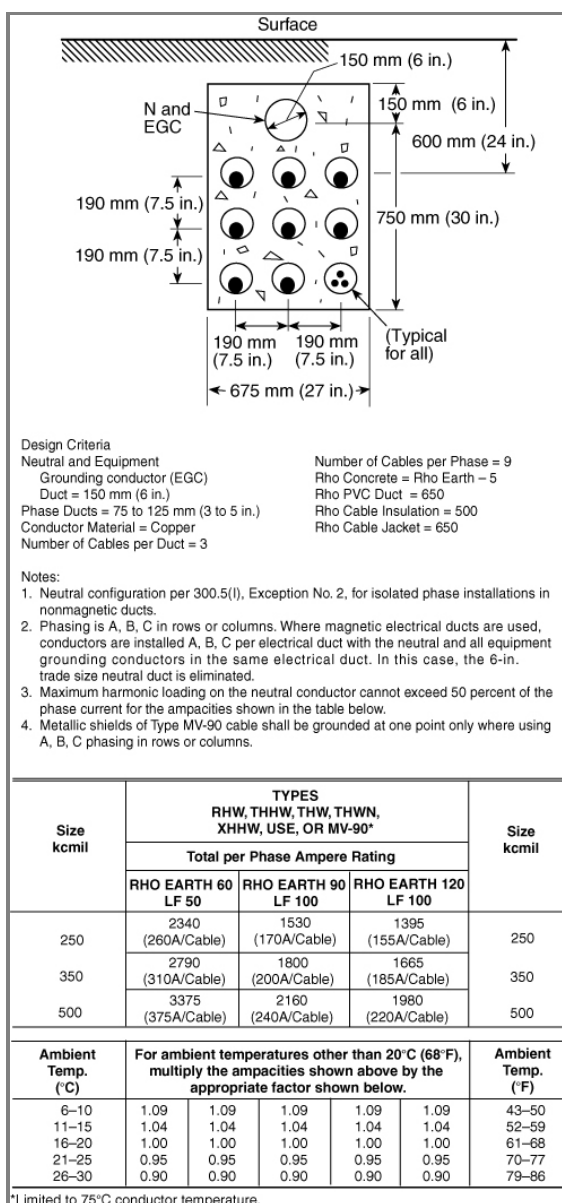


Figure Informational Note Figure B.310.15(B)(2)(4) Ampacities of Single Insulated Conductors Rated 0 Through 5000 Volts in Nonmagnetic Underground Electrical Ducts (One Conductor per Electrical Duct), Four Single-Conductor Cables per Phase Based on Ambient Earth Temperature of 20°C (68°F), Conductor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

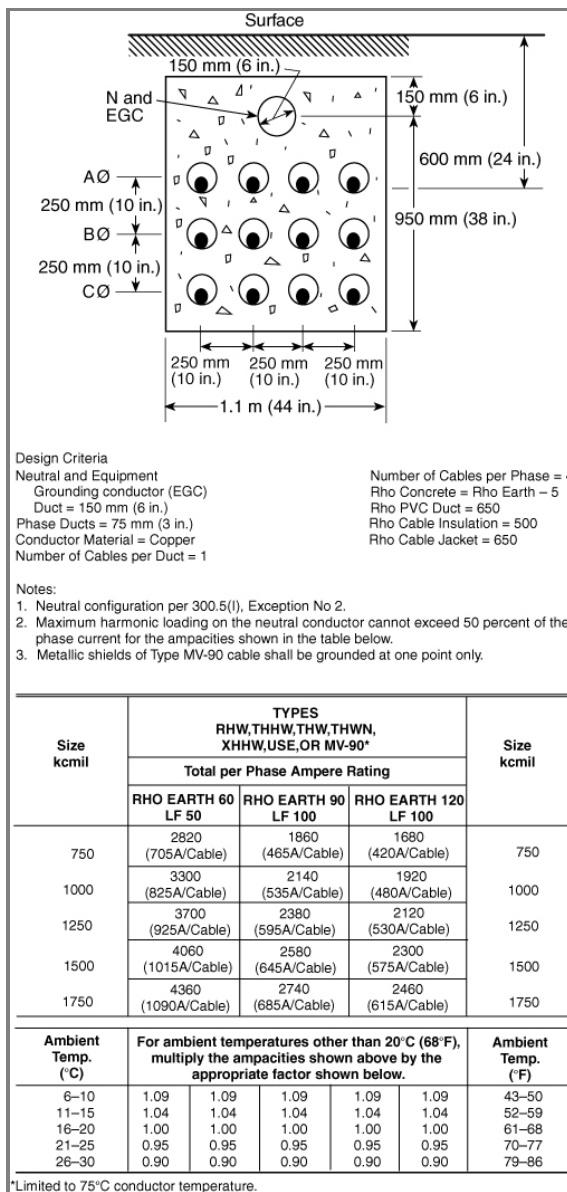
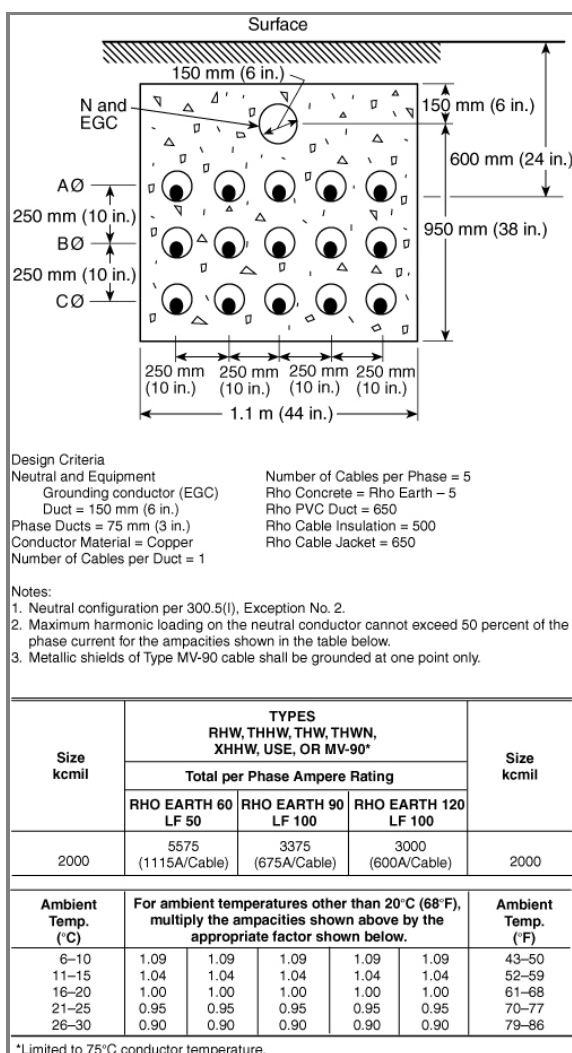


Figure Informational Note Figure B.310.15(B)(2)(5) Ampacities of Single Insulated Conductors Rated 0 Through 5000 Volts in Nonmagnetic Underground Electrical Ducts (One Conductor per Electrical Duct), Five Single-Conductor Cables per Phase Based on Ambient Earth Temperature of 20°C (68°F), Conductor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



Submitter Information Verification

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Committee Statement

Committee Statement: Editorial per PC#2211.

Response Message: SR-7743-NFPA 70-2018

Ballot Results

✓ This item has passed ballot

13 Eligible Voters

0 Not Returned

13 Affirmative All

0 Affirmative with Comments

0 Negative with Comments

0 Abstention

Affirmative All

Crisman, Todd

Cross, Joseph W.

Earl, Timothy

Hunter, Christel K.

Kent, Gerald W.

Mercier, Charles David

Nielsen, Dennis A.

Porcaro, Michael Thomas

Riedl, Kenneth

Scearce, Susan Newman

Stene, Susan L.

Straniero, George A.

Wheeler, Wesley L.