

**The most often heard contractor phrase:  
No one else makes me do that, so why do I have to ... Derating**

- Violation** : Multiple NM cables installed together, resulting in more than 3 current-carrying conductors without maintaining spacing (two 2-conductor NM cables contain 4 current-carrying conductors)
- Code Section** : 2008 NEC 310.15(B)(2)(a) and Table 310.15(B)(2)(a)
- Comments** : Contractor shall install NM cable as required to avoid derating or apply derating per code to the conductors and circuits for the various conditions, conductors need to be sized accordingly
- Violation** : More than two NM cables installed through opening in wood framing, without maintaining spacing, which is sealed, is to be sealed, and/or are installed in thermal insulation
- Code Section** : 2008 NEC 334.80; also note that 334.80 refers to Table 310.15(B)(2)(a)
- Comments** : Contractor shall install NM cable as required to avoid derating or apply derating per the code to the various conductors and circuits having those conditions, conductors need to be sized accordingly

This newsletter addresses two issues:

- Violation 1:** Multiple NM cables installed together, resulting in more than 3 current-carrying conductors without maintaining spacing (two 2-conductor NM cables contain 4 current-carrying conductors)
- Violation 2:** More than two NM cables installed through opening in wood framing, without maintaining spacing, which is sealed, is to be sealed, and/or are installed in thermal insulation

Before addressing derating for the above reasons, the insulation rating of NM cable needs to be discussed.

Years ago, non-metallic sheathed cable (NM cable) had conductor insulation rated for 60°C. After years of installing 60°C rated NM cable in attics, it was noted that derating was required for the ambient temperature of attics/other locations. NM cable with 60°C rated insulation installed in a 135°F attic ... is not allowed ... the maximum allowed ambient temperature for 60°C rated NM cable, copper, is 131°F ... which also requires derating to 41% of ampacity ... 14 AWG 60°C rated NM cable derates to 8.2 amps at 41% and 12 AWG 60°C rated NM cable derates to 10.25 amps at 41% – see the Correction Factors, Table 310.16 below.

	Temperature Rating of Conductor [See Table 310.13(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)	
	COPPER			ALUMINUM OR COPPER-CLAD ALUMINUM			
<b>CORRECTION FACTORS</b>							
<b>Ambient Temp. (°C)</b>	For ambient temperatures other than 30°C (86°F), multiply the allowable ampacities shown above by the appropriate factor shown below.						<b>Ambient Temp. (°F)</b>
21–25	1.08	1.05	1.04	1.08	1.05	1.04	70–77
26–30	1.00	1.00	1.00	1.00	1.00	1.00	78–86
31–35	0.91	0.94	0.96	0.91	0.94	0.96	87–95
36–40	0.82	0.88	0.91	0.82	0.88	0.91	96–104
41–45	0.71	0.82	0.87	0.71	0.82	0.87	105–113
46–50	0.58	0.75	0.82	0.58	0.75	0.82	114–122
51–55	0.41	0.67	0.76	0.41	0.67	0.76	123–131
56–60	—	0.58	0.71	—	0.58	0.71	132–140
61–70	—	0.33	0.58	—	0.33	0.58	141–158
71–80	—	—	0.41	—	—	0.41	159–176

In the mid-1980's, nonmetallic-sheathed cable was updated with conductor insulation rated for 90°C and became NM-B. With 90°C rated insulation, NM cable is derated to 71% when any part of the NM cable circuit is installed in an attic with potentially 135°F temperatures. 14 AWG NM cable, copper, derates from 25 amps (used for derating purposes) to 17.75 amps [25 x .71 = 17.75], which is still sufficient ampacity (8 for use in 15 amp overcurrent protected circuits; 12 AWG NM cable, copper, derates from 30 amps (used for derating purposes) to 21.3 amps [30 x .71 = 21.3], which is still sufficient ampacity for use in 20 amp overcurrent protected circuits.

**Note: Any additional derating which is required further reduces the already derated ampacity of the NM cable.**

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This newsletter addresses that **ADDITIONAL derating**, derating in addition to ambient temperature derating.

Derating such as for multiple cables without maintaining spacing and/or more than two cables installed through openings in wood framing which is, or is to be, sealed/caulked/insulated/foamed; or in contact with thermal insulation.

**Violation 1:** Multiple NM cables installed together, resulting in more than 3 current-carrying conductors without maintaining spacing (two 2-conductor NM cables contain 4 current-carrying conductors)

**Example 1:**

There are five 2-conductor NM cables in a raceway for longer than 24 inches (raceway is approximately 5 feet long). The number of current-carrying conductors in the raceway is 10.

**Table 310.15(B)(2)(a) Adjustment Factors for More Than Three Current-Carrying Conductors in a Raceway or Cable**

<b>Number of Current-Carrying Conductors</b>	<b>Percent of Values in Tables 310.16 through 310.19 as Adjusted for Ambient Temperature if Necessary</b>
4-6	80
7-9	70
<b>10-20</b>	<b>50</b>
21-30	45
31-40	40
41 and above	35

From Table 310.15(B)(2)(a), the derating factor is 50, which means the ampacity is to be derated to 50%.

14 AWG NM cable, copper: Starting at an ambient derating for a 135°F attic with a derated ampacity for ambient of 17.75 amps

17.75 amps x 50% = **8.875 amps derated ampacity for 14-2 NM** after derating for ambient temperature and **for 10 current-carrying conductors**

**14 AWG NM cable, copper, with a derated ampacity of 8.875 amps is not suitable for use on a 15 amp circuit**

12 AWG NM cable, copper: Starting at an ambient derating for a 135°F attic with a derated ampacity for ambient of 21.3 amps

21.3 amps x 50% = **10.65 amps derated ampacity for 12-2 NM** after derating for ambient temperature and **for 10 current-carrying conductors**

**12 AWG NM cable, copper, with a derated ampacity of 10.65 amps is not suitable for use on a 20 amp circuit**

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**Example 2:**

There are three 2-conductor non-metallic sheathed cables installed together for more than 24 inches (this distance is approximately 4 feet) without maintaining spacing. The number of current-carrying conductors is 6.

**Table 310.15(B)(2)(a) Adjustment Factors for More Than Three Current-Carrying Conductors in a Raceway or Cable**

<b>Number of Current-Carrying Conductors</b>	<b>Percent of Values in Tables 310.16 through 310.19 as Adjusted for Ambient Temperature if Necessary</b>
4-6	80
7-9	70
10-20	50
21-30	45
31-40	40
41 and above	35

From Table 310.15(B)(2)(a), the derating factor is 80, which means the ampacity is to be derated to 80%.

14 AWG NM cable, copper: Starting at an ambient derating for a 135°F attic with a derated ampacity for ambient of 17.75 amps

17.75 amps x 80% = **14.2 amps derated ampacity for 14-2 NM** after derating for ambient temperature and **for 6 current-carrying conductors**

**14 AWG NM cable, copper, with a derated ampacity of 14.2 amps is not suitable for use on a 15 amp circuit\***

\*A derated ampacity of 14.2 amps is sufficient per the code for a single outlet circuit as the next higher standard ampacity rating is 15 amps, however, the allowance to apply the next higher ampacity rating is not applicable to a multi-outlet circuit, and almost all, if not all, dwelling unit 15 amp circuits are multi-outlet circuits.

12 AWG NM cable, copper: Starting at an ambient derating for a 135°F attic with a derated ampacity for ambient of 21.3 amps

21.3 amps x 80% = **17.04 amps derated ampacity for 12-2 NM** after derating for ambient temperature and **for 6 current-carrying conductors**

**12 AWG NM cable, copper, with a derated ampacity of 17.04 amps is not suitable for use on a 20 amp circuit\***

\*A derated ampacity of 17.04 amps is sufficient per the code for a single outlet circuit as the next higher standard ampacity rating is 20 amps, however, this likely only applies to a very limited number of circuits in dwelling units as most 20 amp circuits are multi-outlet circuits.

**Example 3:**

There are two 2-conductor non-metallic sheathed cables installed together for more than 24 inches (this distance is approximately 4 feet) without maintaining spacing installed within a groove in the ICF form's insulation without maintaining spacing between cables. The number of current-carrying conductors is 4.

(Refer to Example 2 above – the derating for 4–6 conductors is the same factor – 80; resulting with the same derating to 80% ampacity.)

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From the 2008 National Electrical Code

- Chapter 3 Wiring Methods and Materials

- 310.15 Ampacities for Conductors Rated 0–2000 Volts.

- (B) Tables. Ampacities for conductors rated 0 to 2000 volts shall be as specified in the Allowable Ampacity Table 310.16 through Table 310.19, and Ampacity Table 310.20 and Table 310.21 as modified by (B)(1) through (B)(6).

- (2) Adjustment Factors.

- ◆ (a) More Than Three Current-Carrying Conductors in a Raceway or Cable. Where the number of current-carrying conductors in a raceway or cable exceeds three, or where single conductors or multiconductor cables are installed without maintaining spacing for a continuous length longer than 600 mm (24 in.) and are not installed in raceways, the allowable ampacity of each conductor shall be reduced as shown in Table 310.15(B)(2)(a). Each current-carrying conductor of a paralleled set of conductors shall be counted as a current-carrying conductor.

FPN No. 1: See Annex B, Table B.310.11, for adjustment factors for more than three current-carrying conductors in a raceway or cable with load diversity.

FPN No. 2: See 366.23(A) for adjustment factors for conductors in sheet metal auxiliary gutters and 376.22(B) for adjustment factors for conductors in metal wireways.

- ◇ Exception No. 1: Where conductors of different systems, as provided in 300.3, are installed in a common raceway or cable, the derating factors shown in Table 310.15(B)(2)(a) shall apply only to the number of power and lighting conductors (Articles 210, 215, 220, and 230).

- ◇ Exception No. 2: For conductors installed in cable trays, the provisions of 392.11 shall apply.

- ◇ Exception No. 3: Derating factors shall not apply to conductors in nipples having a length not exceeding 600 mm (24 in.).

- ◇ Exception No. 4: Derating 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, or rigid nonmetallic conduit having a length not exceeding 3.05 m (10 ft) and if the number of conductors does not exceed four.

- ◇ Exception No. 5: Adjustment factors shall not apply to Type AC cable or to Type MC cable without an overall outer jacket under the following conditions:

- (1) Each cable has not more than three current-carrying conductors.

- (2) The conductors are 12 AWG copper.

- (3) Not more than 20 current-carrying conductors are bundled, stacked, or supported on “bridle rings.”

A 60 percent adjustment factor shall be applied where the current-carrying conductors in these cables that are stacked or bundled longer than 600 mm (24 in.) without maintaining spacing exceeds 20.

**Table 310.15(B)(2)(a) Adjustment Factors for More Than Three Current-Carrying Conductors in a Raceway or Cable**

Number of Current-Carrying Conductors	Percent of Values in Tables 310.16 through 310.19 as Adjusted for Ambient Temperature if Necessary
4-6	80
7-9	70
10-20	50
21-30	45
31-40	40
41 and above	35

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- (b) More Than One Conduit, Tube, or Raceway. Spacing between conduits, tubing, or raceways shall be maintained.
- (c) Conduits Exposed to Sunlight on Rooftops. Where conductors or cables are installed in conduits exposed to direct sunlight on or above rooftops, the adjustments shown in Table 310.15(B)(2)(c) shall be added to the outdoor temperature to determine the applicable ambient temperature for application of the correction factors in Table 310.16 and Table 310.18.

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

**Table 310.16 Allowable Ampacities of Insulated Conductors Rated 0 Through 2000 Volts, 60°C Through 90°C (140°F Through 194°F), Not More Than Three Current-Carrying Conductors in Raceway, Cable, or Earth (Directly Buried), Based on Ambient Temperature of 30°C (86°F)**

Size AWG or kcmil	Temperature Rating of Conductor [See Table 310.13(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, USE, ZW	Types TBS, SA, SIS, FEP, FEPB, MI, RHH, RHW-2, THHN, THHW, THW-2, THWN-2, USE-2, XHH, XHHW, XHHW-2, ZW-2	Types TW, UF	Types RHW, THHW, THW, THWN, XHHW, USE	Types TBS, SA, SIS, THHN, THHW, THW-2, THWN-2, RHH, RHW-2, USE-2, XHH, XHHW, XHHW-2, ZW-2	
	COPPER			ALUMINUM OR COPPER-CLAD ALUMINUM			
18	—	—	14	—	—	—	—
16	—	—	18	—	—	—	—
14*	20	20	25	—	—	—	—
12*	25	25	30	20	20	25	12*
10*	30	35	40	25	30	35	10*
8	40	50	55	30	40	45	8
6	55	65	75	40	50	60	6
4	70	85	95	55	65	75	4
3	85	100	110	65	75	85	3
2	95	115	130	75	90	100	2
1	110	130	150	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	190	230	255	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	355	420	475	285	340	385	600
700	385	460	520	310	375	420	700
750	400	475	535	320	385	435	750
800	410	490	555	330	395	450	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	520	625	705	435	520	585	1500
1750	545	650	735	455	545	615	1750
2000	560	665	750	470	560	630	2000

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CORRECTION FACTORS							
Ambient Temp. (°C)	For ambient temperatures other than 30°C (86°F), multiply the allowable ampacities shown above by the appropriate factor shown below.						Ambient Temp. (°F)
21-25	1.08	1.05	1.04	1.08	1.05	1.04	70-77
26-30	1.00	1.00	1.00	1.00	1.00	1.00	78-86
31-35	0.91	0.94	0.96	0.91	0.94	0.96	87-95
36-40	0.82	0.88	0.91	0.82	0.88	0.91	96-104
41-45	0.71	0.82	0.87	0.71	0.82	0.87	105-113
46-50	0.58	0.75	0.82	0.58	0.75	0.82	114-122
51-55	0.41	0.67	0.76	0.41	0.67	0.76	123-131
56-60	—	0.58	0.71	—	0.58	0.71	132-140
61-70	—	0.33	0.58	—	0.33	0.58	141-158
71-80	—	—	0.41	—	—	0.41	159-176

\* See 240.4(D).

**Violation 2:** More than two NM cables installed through opening in wood framing, without maintaining spacing, which is sealed, is to be sealed, and/or are installed in thermal insulation [IAEI NEWS](#) / ([backup link](#))

**Example 4:**

There are more than two NM cables containing two or more current carrying conductors installed, without maintaining spacing, through the same opening in a wood framing which is sealed, or is to be sealed, with insulation, caulk, or sealing foam.

Two NM cables which contain two or more current-carrying conductors are permitted to go through the same opening in wood framing, this typically happens at the fireblocking at top and bottom plates, without having to apply derating (other than for ambient, which is covered by the 90°C insulation rating in NM).

However, when more than two NM cables go through an opening in wood framing which is sealed, or is to be sealed, with insulation, caulk, or foam (typically where NM cables go through the fireblocking at top and bottom plates), the NM cables are required to be derated in accordance with Table 310.15(B)(2)(a), after first derating for ambient temperature of attics (or any other ambient temperature which the circuit may go through and which may be higher than the attic) is applied as described at the beginning of this newsletter.

When three 2-conductor NM copper cables going through the same opening in wood framing, the number of current-carrying conductors is 6.

**Table 310.15(B)(2)(a) Adjustment Factors for More Than Three Current-Carrying Conductors in a Raceway or Cable**

<b>Number of Current-Carrying Conductors</b>	<b>Percent of Values in Tables 310.16 through 310.19 as Adjusted for Ambient Temperature if Necessary</b>
4-6	80
7-9	70
10-20	50
21-30	45
31-40	40
41 and above	35

From Table 310.15(B)(2)(a), the derating factor is 80, which means the ampacity is to be derated to 80%:

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14 AWG NM cable, copper: Starting at an ambient derating for a 135°F attic with a derated ampacity for ambient of 17.75 amps.

**17.75 amps x 80% = 14.2 amps derated ampacity for 14-2 NM after derating for ambient temperature and for 6 current-carrying conductors**

**14 AWG NM cable, copper, with a derated ampacity of 14.2 amps is not suitable for use on a 15 amp circuit\***

\*A derated ampacity of 14.2 amps is sufficient per the code for a single outlet circuit as the next higher standard ampacity rating is 15 amps, however, the allowance to apply the next higher ampacity rating is not applicable to a multi-outlet circuit, and almost all, if not all, dwelling unit 15 amp circuits are multi-outlet circuits.

12 AWG NM cable, copper: Starting at an ambient derating for a 135°F attic with a derated ampacity for ambient of 21.3 amps

**21.3 amps x 80% = 17.04 amps derated ampacity for 12-2 NM after derating for ambient temperature and for 6 current-carrying conductors**

**12 AWG NM cable, copper, with a derated ampacity of 17.04 amps is not suitable for use on a 20 amp circuit\***

\*A derated ampacity of 17.04 amps is sufficient per the code for a single outlet circuit as the next higher standard ampacity rating is 20 amps, however, this likely only applies to a very limited number of circuits in dwelling units as most 20 amp circuits are multi-outlet circuits.

#### Example 5:

There are two 2-conductor non-metallic sheathed cables installed together for more than 24 inches (this distance is approximately 4 feet) without maintaining spacing installed within a groove in the ICF form's insulation without maintaining spacing between cables. The number of current-carrying conductors is 4.

This example has two applicable code sections, depending on the length of conductors in the thermal insulation:

- a) When the length of the conductors in the thermal insulation is 24" or less.  
NEC 334.80 Ampacity applies, see Example 4 above.
- b) When the length of the conductors in the thermal insulation is more than 24".  
NEC Table 310.15(B)(2)(a) Adjustment Factors for More Than Three Current-Carrying Conductors in a Raceway or Cable applies, see Example 3 above.

From the 2008 National Electrical Code

- *Chapter 3 Wiring Methods and Materials*

- *334.80 Ampacity.*

*The ampacity of Types NM, NMC, and NMS cable shall be determined in accordance with 310.15. The ampacity shall be in accordance with the 60°C (140°F) conductor temperature rating. The 90°C (194°F) rating shall be permitted to be used for ampacity derating purposes, provided the final derated ampacity does not exceed that for a 60°C (140°F) rated conductor. The ampacity of Types NM, NMC, and NMS cable installed in cable tray shall be determined in accordance with 392.11.*

*Where more than two NM cables containing two or more current-carrying conductors are installed, without maintaining spacing between the cables, through the same opening in wood framing that is to be fire- or draft-stopped using thermal insulation, caulk, or sealing foam, the allowable ampacity of each conductor shall be adjusted in accordance with Table 310.15(B)(2)(a) and the provisions of 310.15(A)(2), Exception, shall not apply.*

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Where more than two NM cables containing two or more current-carrying conductors are installed in contact with thermal insulation without maintaining spacing between cables, the allowable ampacity of each conductor shall be adjusted in accordance with Table 310.15(B)(2)(a).

**Table 310.15(B)(2)(a) Adjustment Factors for More Than Three Current-Carrying Conductors in a Raceway or Cable**

Number of Current-Carrying Conductors	Percent of Values in Tables 310.16 through 310.19 as Adjusted for Ambient Temperature if Necessary
4-6	80
7-9	70
10-20	50
21-30	45
31-40	40
41 and above	35

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All contributors will be acknowledged and given credit for their contributions ... please help others by sharing the items, issues, and tips you have found in the field or during plan reviews.

I look forward to all contributions.

Respectfully submitted,



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