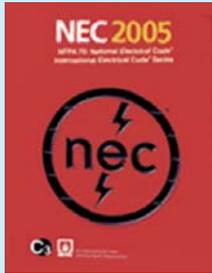
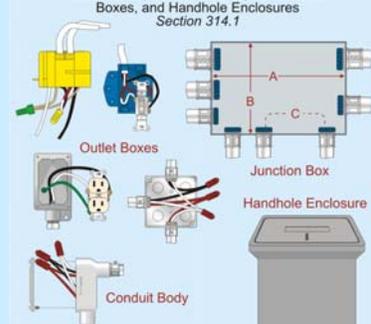


Wiring Methods Part Two

2005 NEC, NFPA 70



Outlet boxes, Conduit Bodies, Pull/Junction Boxes, and Handhole Enclosures
Section 314.1



Article 314 contains the installation requirements for outlet boxes, conduit bodies, pull and junction boxes, and handhole enclosures.

COPYRIGHT 2004 Mike Holt Enterprises, Inc.

2



Short Radius Conduit Bodies
Section 314.5

Sometimes Called:

- Jake Elbow
- Short Elbow
- Pulling Elbow
- Corner Elbow

Short-radius conduit bodies must not contain a splice or tap.

Splices can be made in standard conduit bodies [314.16(C)].

COPYRIGHT 2004 Mike Holt Enterprises, Inc.

4



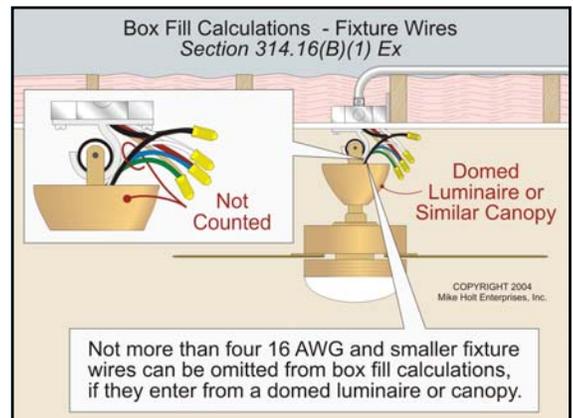
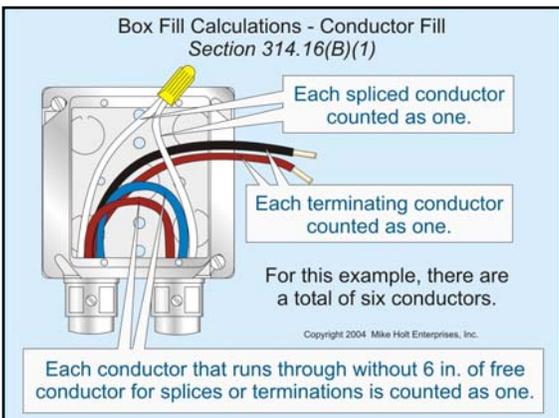
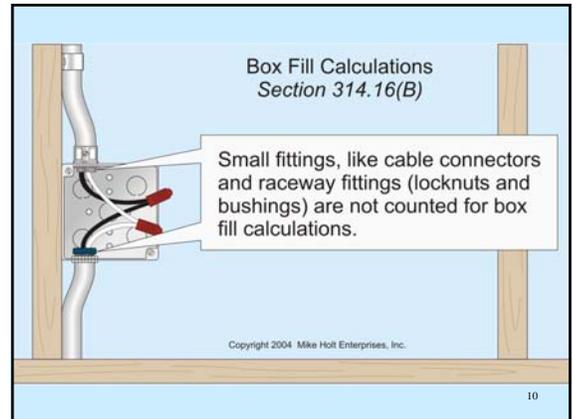
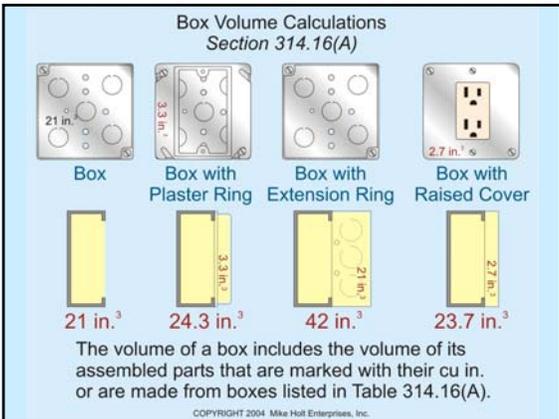
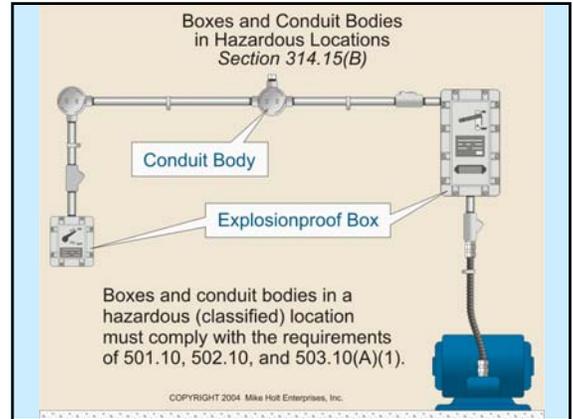
Boxes and Conduit Bodies in Damp or Wet Locations
Section 314.15(A)

VIOLATION Set-screw fitting



Enclosures and fittings installed in wet locations must be listed for use in wet locations.

COPYRIGHT 2004 Mike Holt Enterprises, Inc.



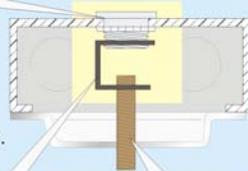
Box Fill Calculations - Supporting Fitting Fill
Section 314.16(B)(3)

Luminaire Stud
1 Conductor

Each luminaire stud or hickey counts as 1 conductor, based on largest conductor in the box.

Luminaire Hickey
1 Conductor

3/8 in. Mounting Stem (not counted)



COPYRIGHT 2004 Mike Holt Enterprises, Inc.

13

Box Fill Calculations - Device Yoke Fill
Section 314.16(B)(4)

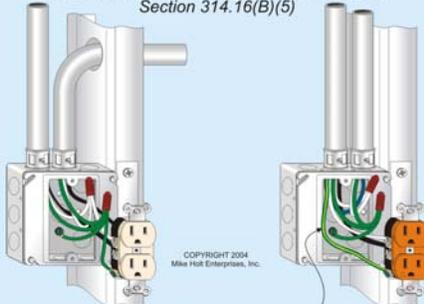


Each device yoke counts as two conductors, based on the largest conductor terminating on the device.

COPYRIGHT 2004 Mike Holt Enterprises, Inc.

14

Box Fill Calculations - Bonding Conductor Fill
Section 314.16(B)(5)



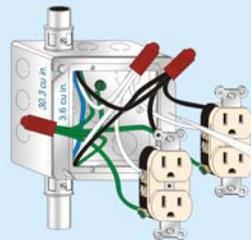
One or more equipment grounding (bonding) conductors count as one conductor.

An isolated grounding (bonding) conductor counts as an additional conductor.

COPYRIGHT 2004 Mike Holt Enterprises, Inc.

15

Box Fill Calculations
Example
Section 314.16(B)



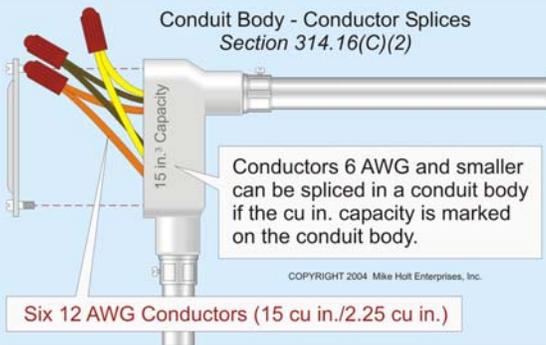
How many 14 AWG conductors can be added?

COPYRIGHT 2004 Mike Holt Enterprises, Inc.

- Step 1. Volume of box/ring: 30.3 + 3.6 cu in. = 33.9 cu in.
- Step 2. Volume of existing conductors/devices = 22.5 cu in.
- Step 3. Space remaining: 33.9 - 22.5 = 11.4 cu in.
- Step 4. Number of 14 AWG added: 11.4/2.0 cu in. = 5

16

Conduit Body - Conductor Splices
Section 314.16(C)(2)



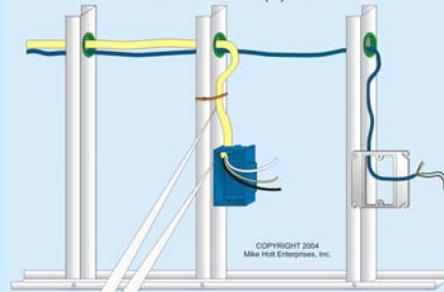
Conductors 6 AWG and smaller can be spliced in a conduit body if the cu in. capacity is marked on the conduit body.

COPYRIGHT 2004 Mike Holt Enterprises, Inc.

Six 12 AWG Conductors (15 cu in./2.25 cu in.)

17

Nonmetallic Single-Gang Box - NM Cable
Section 314.17(C) Ex



COPYRIGHT 2004 Mike Holt Enterprises, Inc.

NM cable terminating to a single-gang (2 1/4 in. x 4 in.) device box is not required to be secured to the box if the cable is securely fastened within 8 in. of the box.

18

Boxes Recessed in Walls or Ceilings
Section 314.20

Noncombustible Finished Surface

Maximum of 1/4 in. from the finished surface.

COPYRIGHT 2004 Mike Holt Enterprises, Inc.

Boxes, plaster rings, extension rings, or listed extenders must have the front edge set back no more than 1/4 in. from the noncombustible finish surface

Boxes Recessed in Walls or Ceilings
Section 314.20

Combustible Finished Surface

Flush with or project out from the surface.

COPYRIGHT 2004 Mike Holt Enterprises, Inc.

Boxes, plaster rings, extension rings, or listed extenders must have the front edge flush with, or project out from, the combustible finish surface

Repairing Gaps Around Outlet Boxes
Section 314.21

Violation Gap over 1/8th in.

Maximum 1/8th in. Gap

Gaps around boxes recessed in plaster, drywall, or plasterboard having flush-type covers, must be repaired so there will be no gap greater than 1/8 in. at the edge of the box.

COPYRIGHT 2004 Mike Holt Enterprises, Inc.

21

Surface Extensions
Section 314.22

Extension Ring

Surface Extension

Surface extensions from a flush box must be made from an extension ring that is installed over the flush box.

COPYRIGHT 2004 Mike Holt Enterprises, Inc.

22

Surface Extension from a Cover
Section 314.22 Ex

Extension from cover is permitted if:

- cover is designed not to fall off
- a flexible wiring method is used
- the grounding (bonding) connection must be independent from the cover

Surface Extension From a Cover

COPYRIGHT 2004 Mike Holt Enterprises, Inc.

Box Support - Finished Surface
Section 370.23(C)

Cut-in Box

Fished Cable

Bracket provides support for box.

Boxes can be secured to a finished surface by clamps, anchors, or fittings identified for the purpose.

COPYRIGHT 2004 Mike Holt Enterprises, Inc.

Box Support - Ceiling Framing Members
Section 314.23(D)(1)

Outlet boxes can be secured to suspended-ceiling members by bolts, screws, rivets, clips, or other means identified for the purpose.

COPYRIGHT 2004 Mike Holt Enterprises, Inc.

25

Box Support - Independent Support Wires
Section 314.23(D)(2)

Independent support wires can be used to secure electrical wiring [300.11(A)].

COPYRIGHT 2004 Mike Holt Enterprises, Inc.

Outlet boxes can be secured, with fittings identified for the purpose, to independent support wires that are taut and secured at both ends.

Box Support - Threaded Raceways
No Devices or Luminaires
Section 314.23(E)

Enclosure not over 100 cu in.

36 in.

36 in.

Two threaded IMC or RMC can support an outlet box without devices or luminaires, if each raceway is supported within 36 in., or within 18 in. if all conduits are on one side.

COPYRIGHT 2004 Mike Holt Enterprises, Inc.

Box Support - Threaded Raceways
With Devices and Luminaires
Section 314.23(F)

Two threaded IMC or RMC can support an outlet box with devices or luminaires if each raceway is supported within 18 in.

VIOLATION

Conduit must be threaded and directly connected to the box.

Max 18 in.

COPYRIGHT 2004 Mike Holt Enterprises, Inc.

Box Support - Pendant Cord
Section 314.23(H)(1)

Boxes can be supported from a cord that is connected to fittings so that tension is not transmitted to joints or terminals.

COPYRIGHT 2004 Mike Holt Enterprises, Inc.

29

Covers and Canopies
Section 314.25

Blank cover plates can cover an outlet box.

A faceplate or luminaire can cover an outlet box.

When an installation is complete, each outlet box must be provided with a cover, faceplate, fixture canopy, lampholder, or similar device.

COPYRIGHT 2004 Mike Holt Enterprises, Inc.

Device Outlet Box - Luminaire Support
Section 314.27(A) Ex

Device box or plaster ring.

Wall-Mount - OKAY Ceiling-Mount - VIOLATION

A wall-mounted luminaire (not more than 6 lbs) can be supported to a device box or plaster ring.

COPYRIGHT 2004 Mike Holt Enterprises, Inc.

Outlet Box - Luminaire Weight
Section 314.27(B)

Lighting outlet boxes can support luminaires that weigh up to 50 lbs.

COPYRIGHT 2004 Mike Holt Enterprises

Luminaires over 50 lbs must be supported independently.

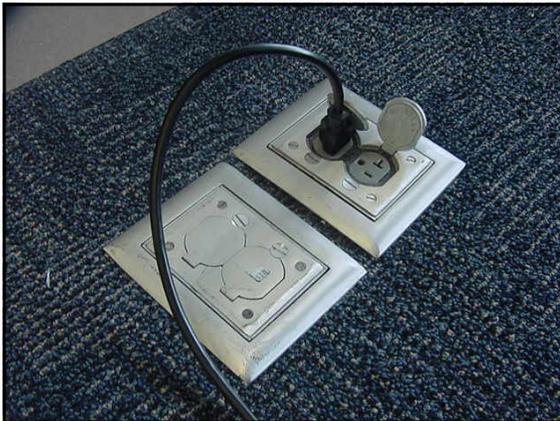
32



Floor Outlet Box
Section 314.27(C)

Floor outlet boxes must be listed for the purpose.

COPYRIGHT 2004 Mike Holt Enterprises, Inc.



Outlet Box - Ceiling Paddle Fan
Section 314.27(D)

70 lbs or less Over 70 lbs

Fan outlet boxes must be listed, marked as suitable for the purpose, and cannot support a fan that weighs more than 70 lbs.

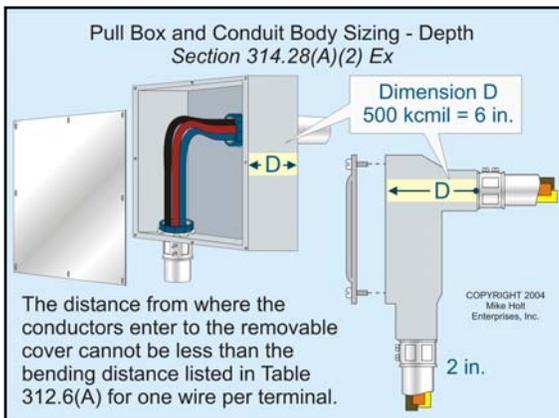
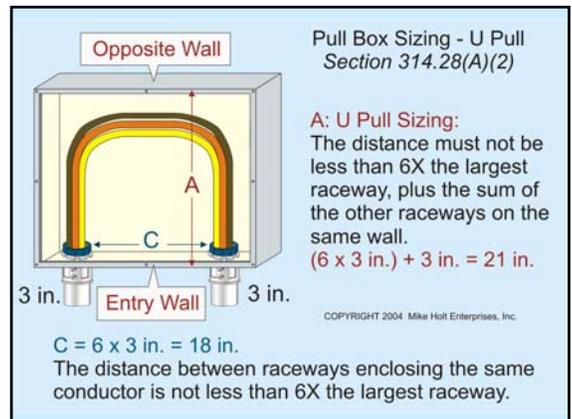
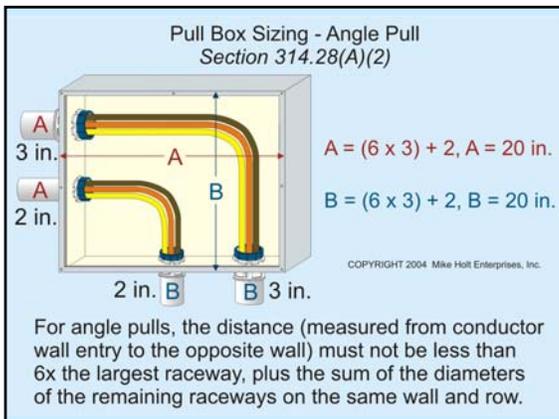
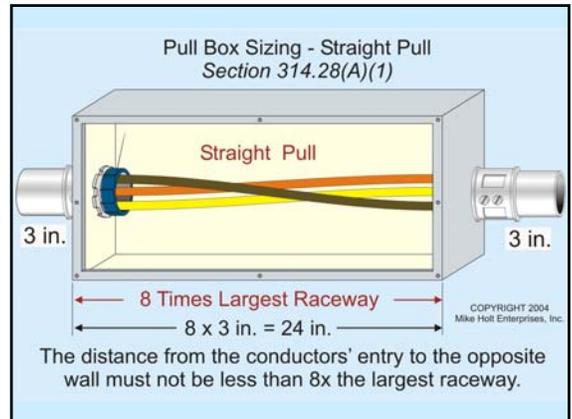
COPYRIGHT 2004 Mike Holt Enterprises, Inc.

Paddle fans over 70 lbs must be supported independently of the box.

314.28 Boxes and Conduit Bodies for Conductors 4 AWG and Larger

- Boxes and conduit bodies containing conductors 4 AWG and larger must be sized so the conductor insulation will not be damaged.

37





**Wiring in Boxes, Conduit Bodies, and Handholes
Must be Accessible
Section 314.29**

Accessible by
removing ceiling panels.

Accessible by
removing device.

Accessible by
removing floor panels

Boxes, conduit bodies, and handhole enclosures must be installed so that the wiring contained in them can be made accessible without removing any part of the building, or excavating sidewalks, paving, or earth.

COPYRIGHT 2004 Mike Holt Enterprises, Inc.

44



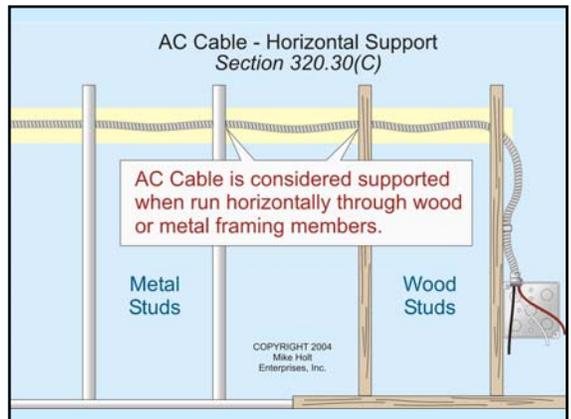
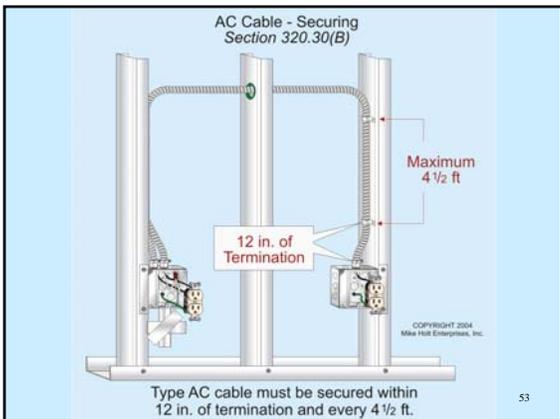
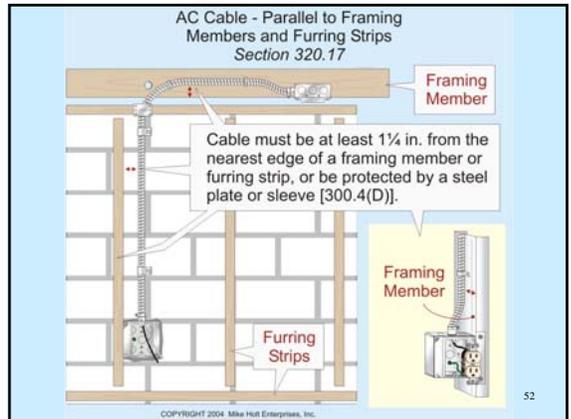
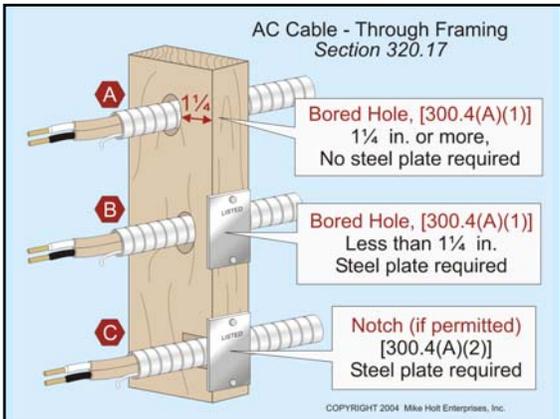
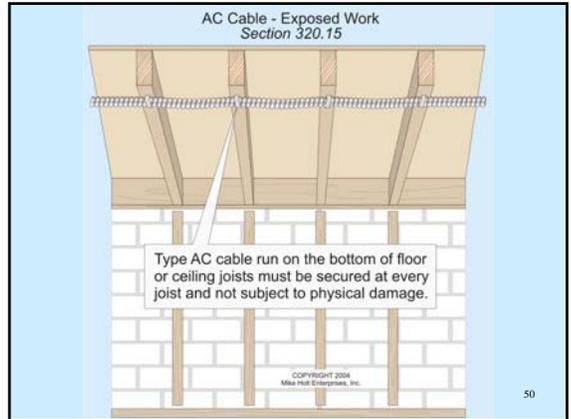
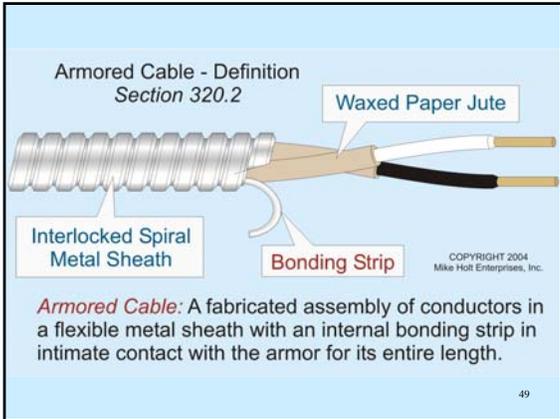
**Handhole Enclosures
Mechanical Raceway and Cable Connection
Section 314.30(B)**

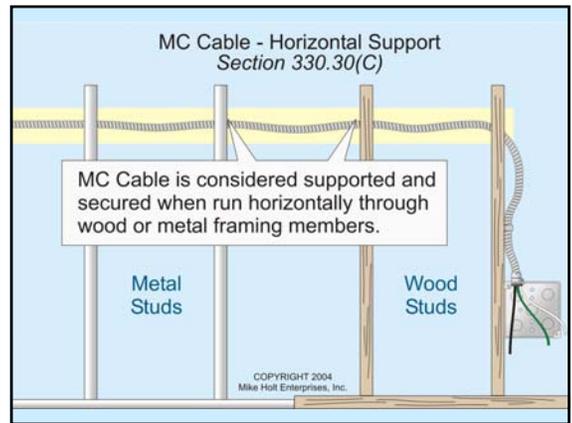
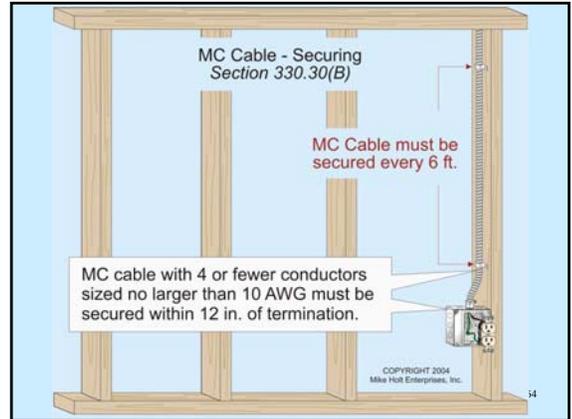
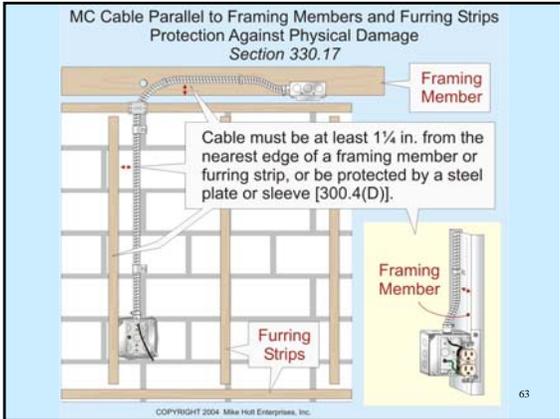
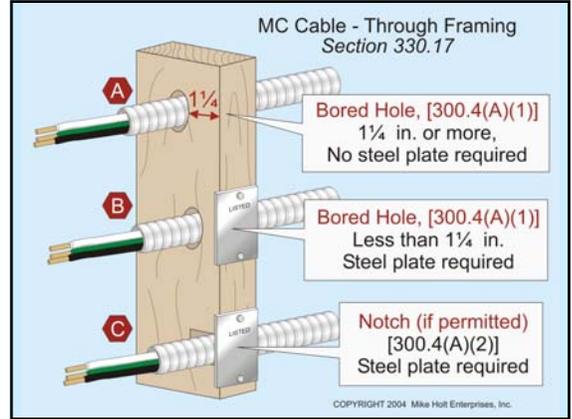
Underground raceways and cable entering a handhole enclosure aren't required to be mechanically connected to the handhole enclosure.

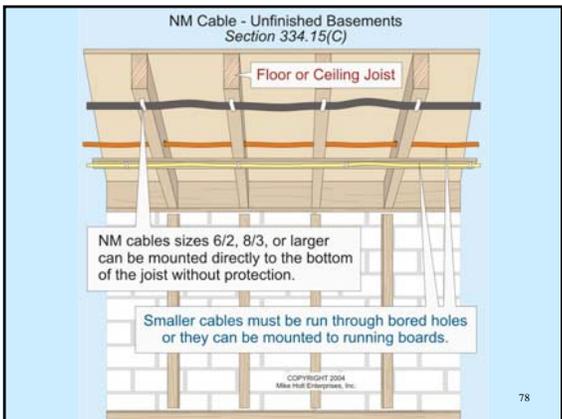
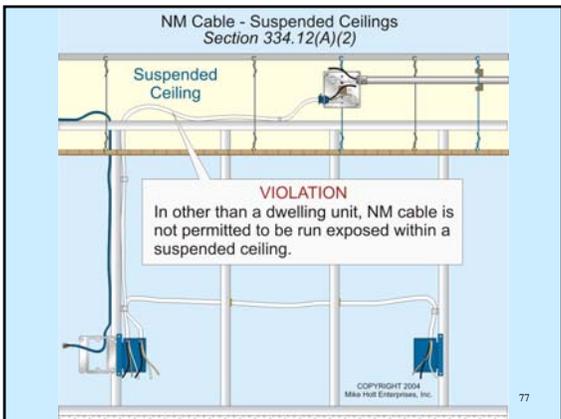
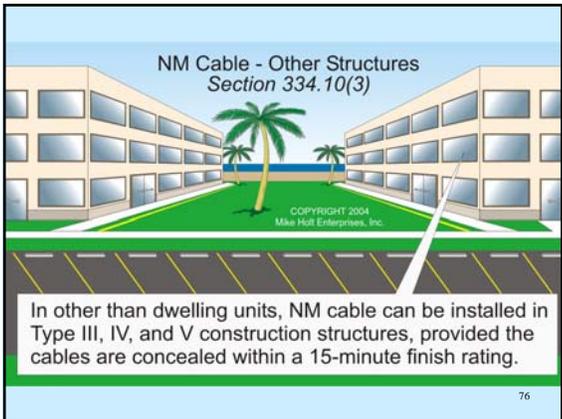
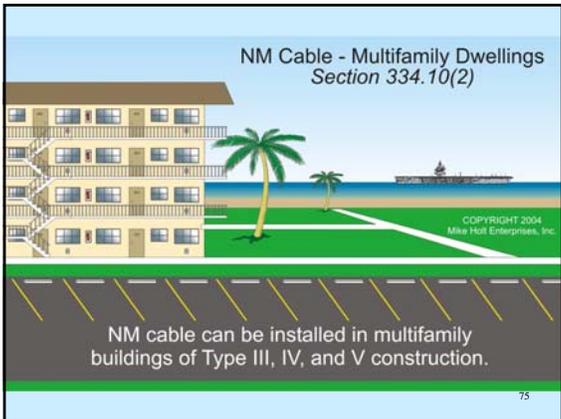
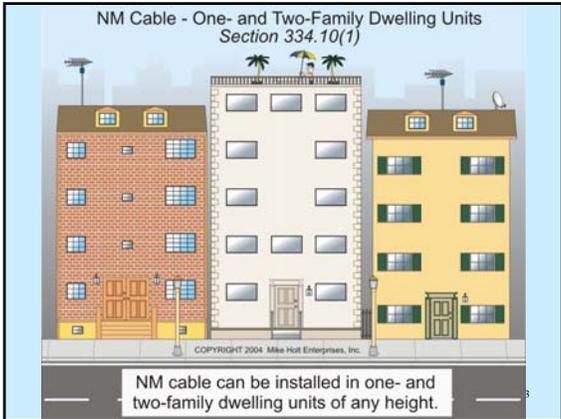
COPYRIGHT 2004 Mike Holt Enterprises, Inc.

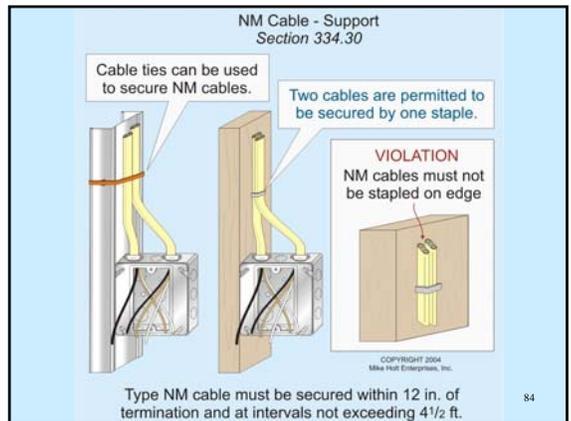
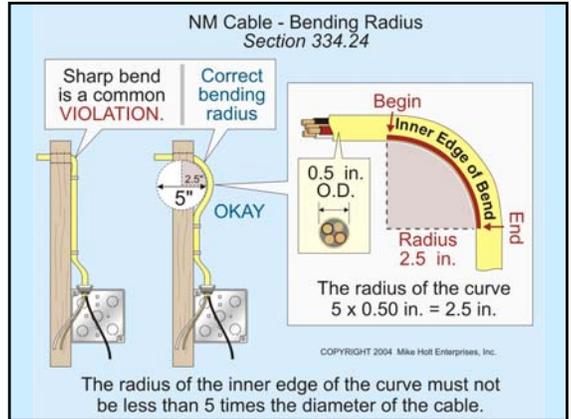
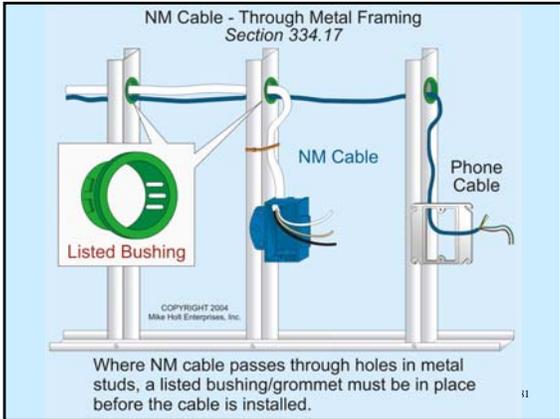
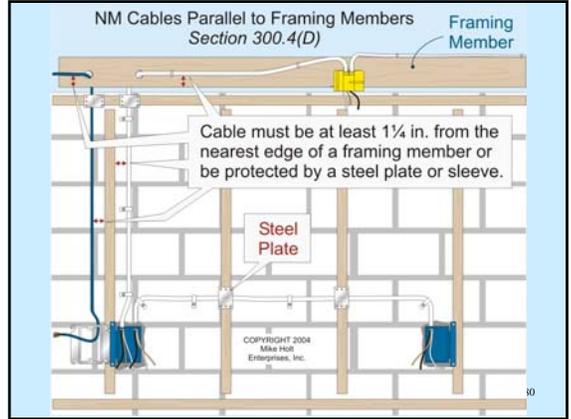
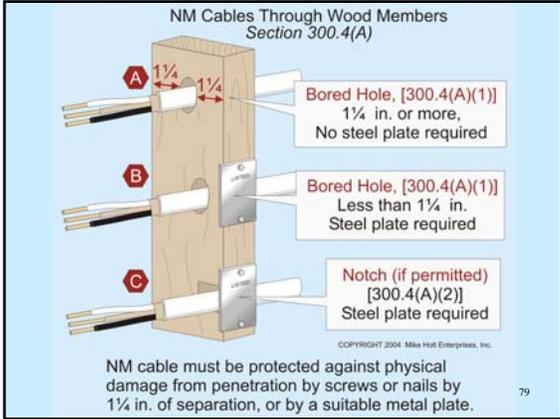
Splices or terminations must be listed as suitable for wet locations [314.30(C)].

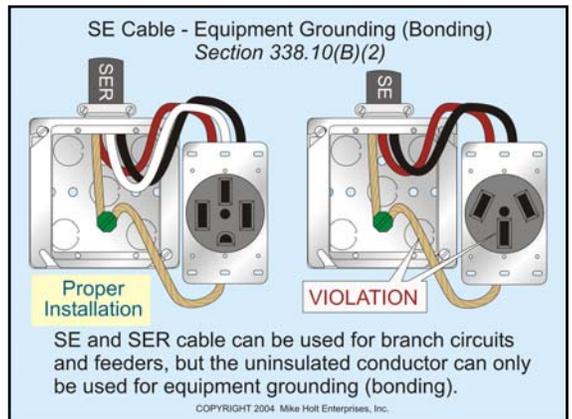
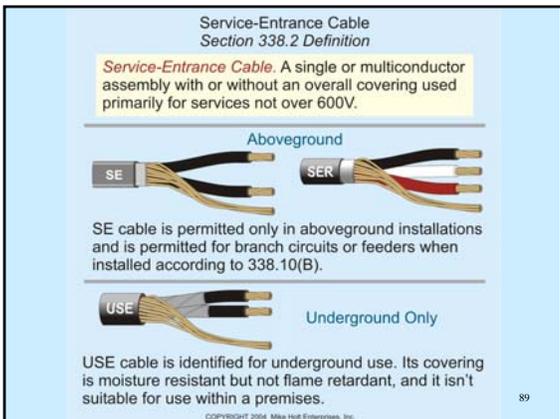
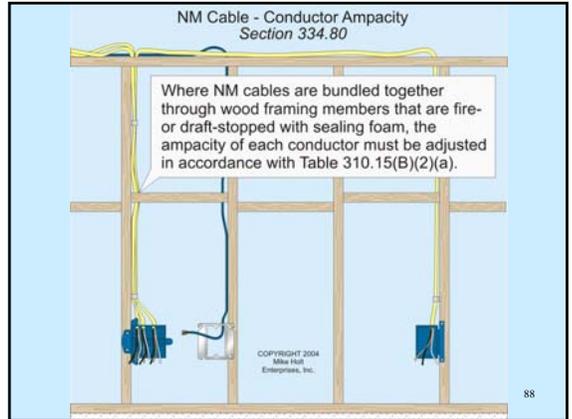
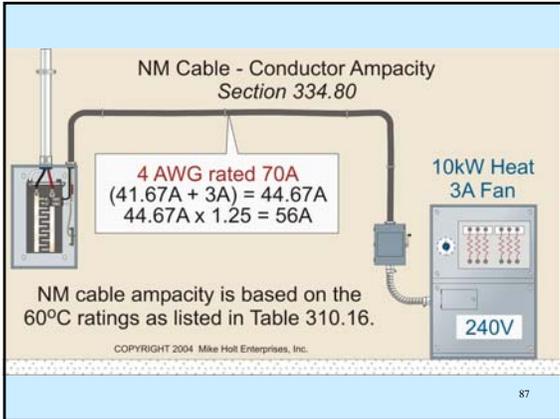
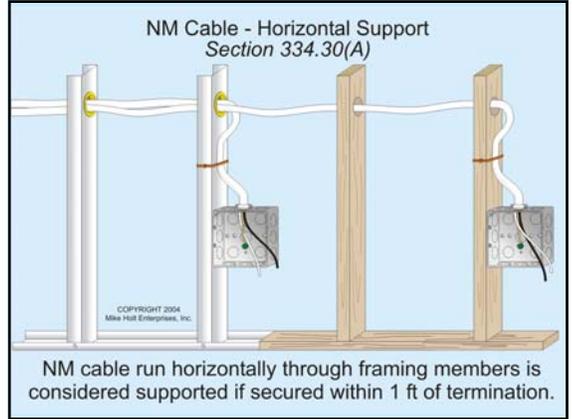
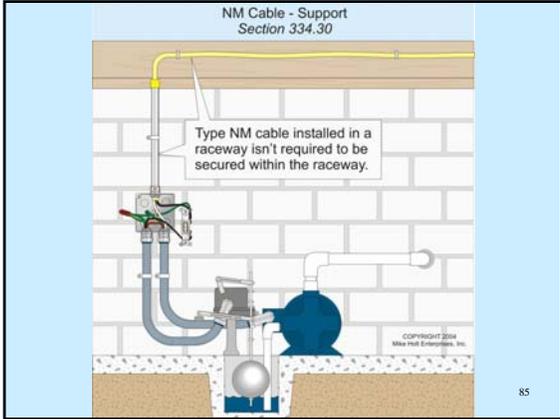


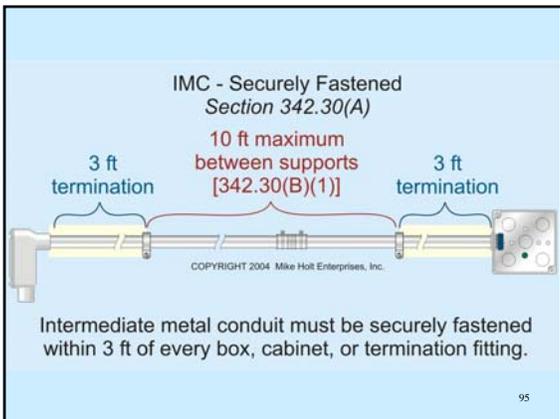
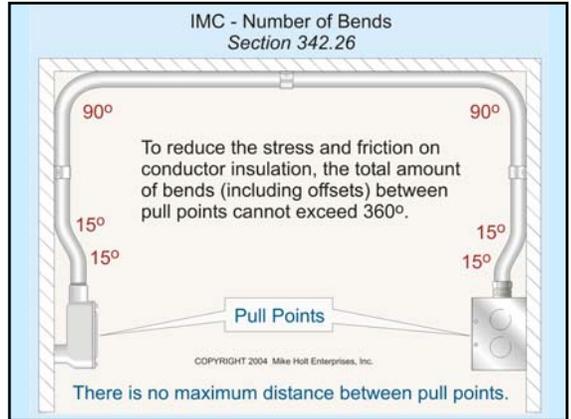
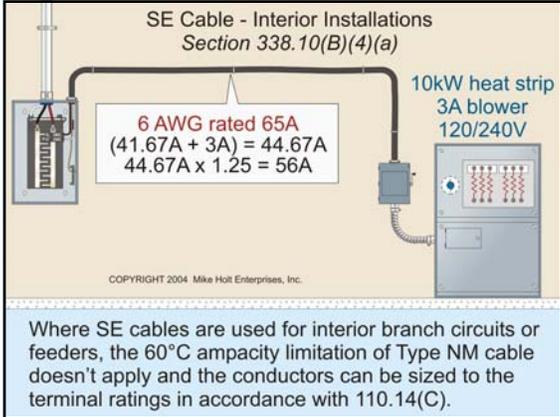












IMC - Securely Fastened to Structural Members Sections 342.30(A)

Coupling is okay. Secured

Maximum 5 ft Maximum 5 ft

Where structural members do not permit fastening within 3 ft of termination, it must be secured within 5 ft.

COPYRIGHT 2004 Mike Holt Enterprises, Inc.

97

IMC - Support of Straight Runs Section 342.30(B)(2)

1 in. IMC
Table 344.30(B)(2)
12 ft between supports

VIOLATION

3 ft 12 ft 12 ft 3 ft

Straight horizontal runs made with threaded couplings can be supported in accordance with the distances listed in Table 344.30(B)(2).

COPYRIGHT 2004 Mike Holt Enterprises, Inc.

IMC - Support of Vertical Risers Section 342.30(B)(3)

Exposed vertical risers can be supported at intervals not exceeding 20 ft if firmly supported and secured at the top and bottom of the riser.

Up to 20 ft

COPYRIGHT 2004 Mike Holt Enterprises, Inc.

IMC - Running Threads Section 342.42(B)

Standard Thread Running Thread

Okay between boxes or enclosures.

Threaded Coupling

VIOLATION

Running threads are not permitted for the connection of couplings, but they are permitted at other locations.

COPYRIGHT 2004 Mike Holt Enterprises, Inc.

IMC - Bushings Section 342.46

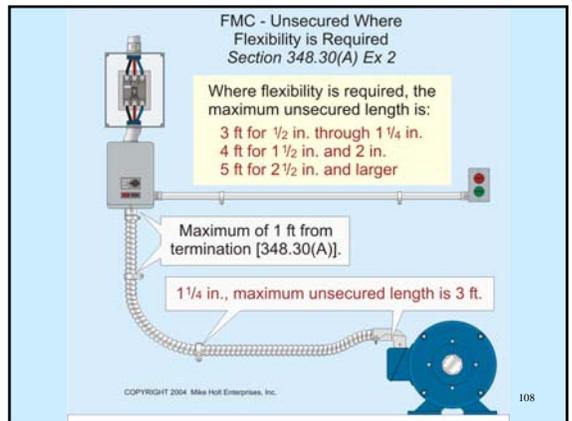
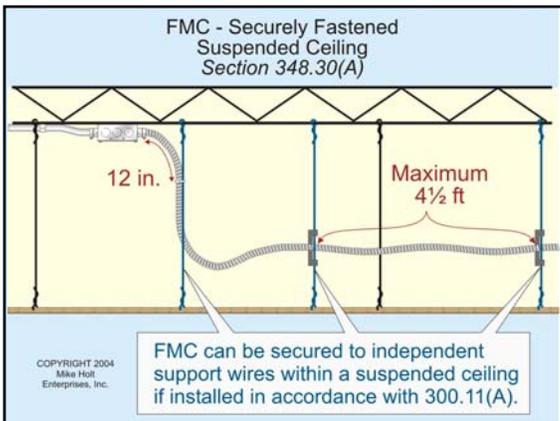
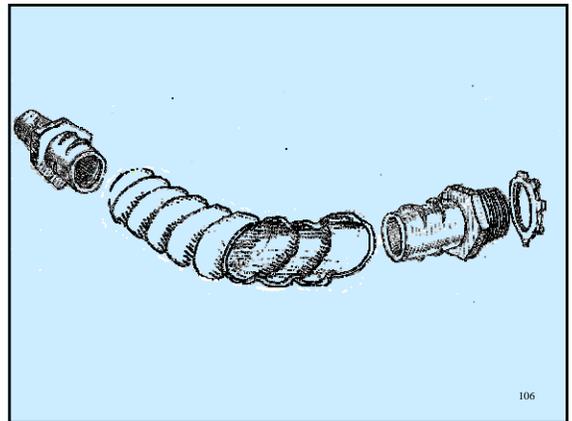
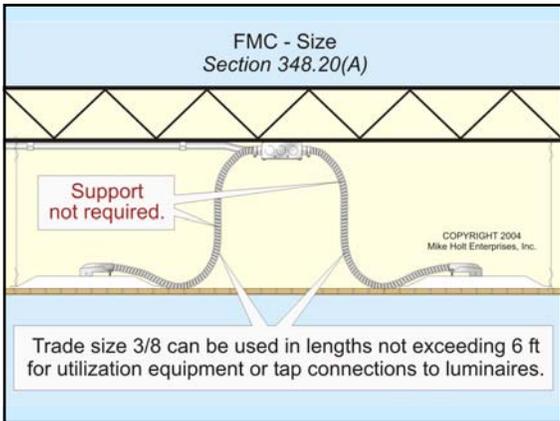
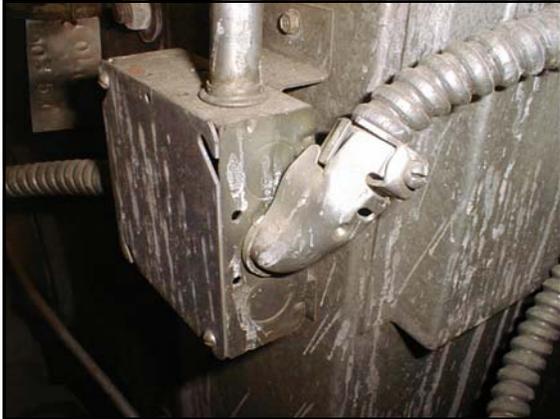
Threaded Termination	Fitting Termination		Hub or Boss Termination
Any Size Conductor	4 AWG and Larger	6 AWG and Smaller	Any Size Conductor
Bushing Required	Bushing Required	Bushing Not Required	Bushing Not Required

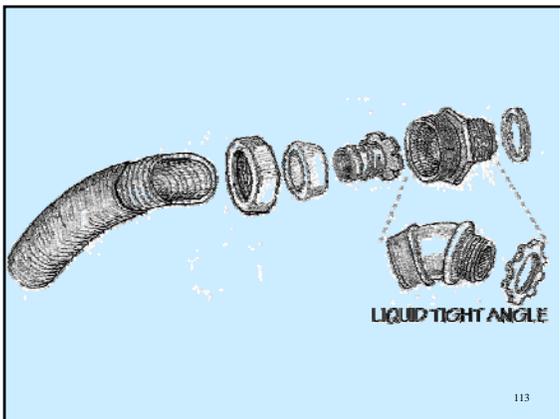
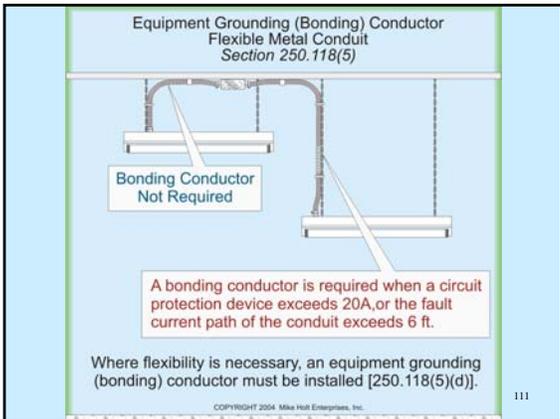
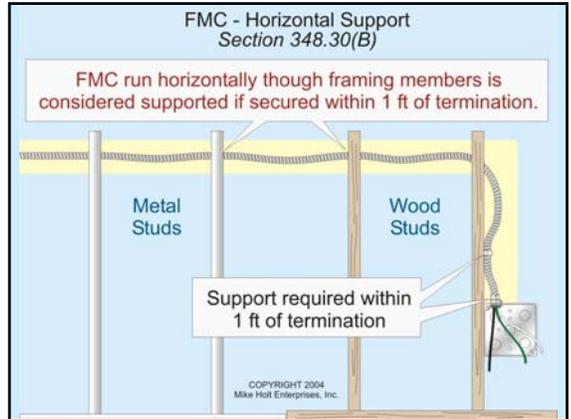
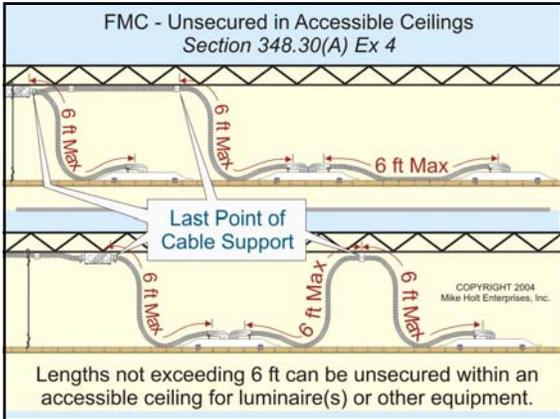
Conductors 4 AWG and larger must be protected by a fitting that provides a smooth, rounded, insulating surface, such as an insulating bushing [300.4(F)].

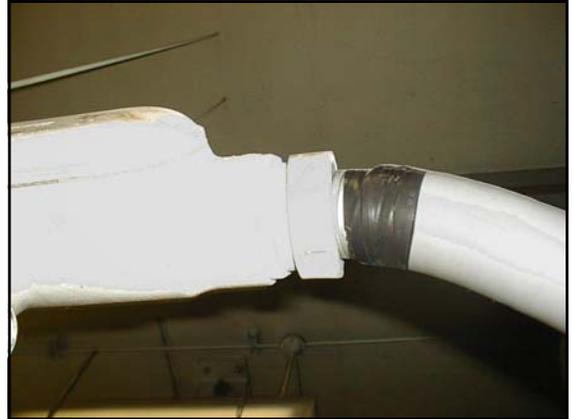
COPYRIGHT 2004 Mike Holt Enterprises, Inc.

101









LFMC - Number of Conductors
Section 350.22(A)

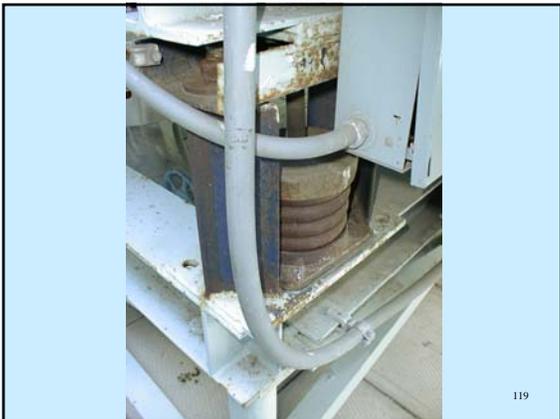
1 inch Listed Liquidtight

6 AWG THHN
6 AWG THHN
6 AWG THHN
6 AWG THHN

COPYRIGHT 2004
Mike Holt Enterprises, Inc.

A maximum of 7 - 6 THHN conductors can be installed in trade size 1 LFMC [Table C7].

When all conductors in a raceway are the same size and insulation, the number of conductors permitted can be found in Annex C.



LFMC - Grounding (Bonding)
Section 250.118(6)

Separate Grounding Conductor Not Required

<p>3/8 or 1/2 in.</p> <ul style="list-style-type: none"> • 6 ft or less • 15 or 20A protection device 	<p>3/4, 1, or 1 1/4 in.</p> <ul style="list-style-type: none"> • 6 ft or less • Up to a 60A protection device
---	---

See 350.60

COPYRIGHT 2004
Mike Holt Enterprises, Inc.

Where flexibility is necessary, an equipment grounding (bonding) conductor must be installed [250.118(6)e].

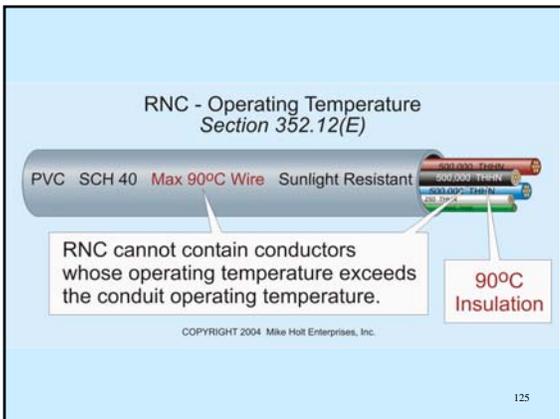
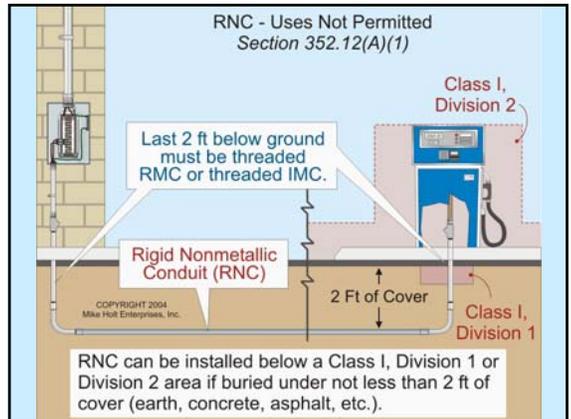
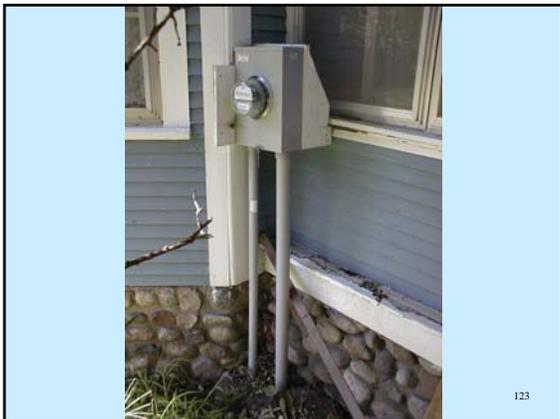
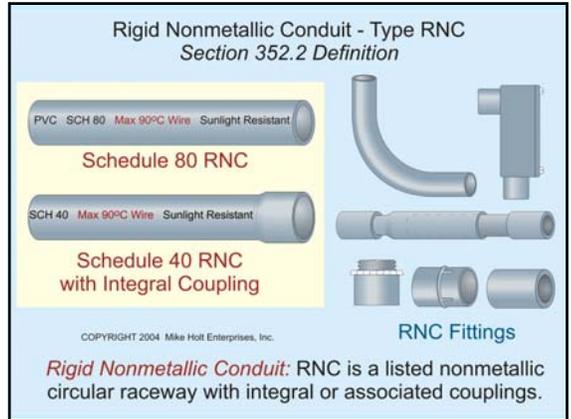
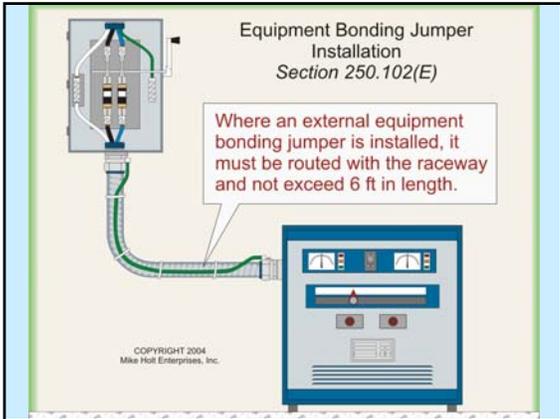




Table 352.30(B) Support of Rigid Nonmetallic Conduit (RNC)

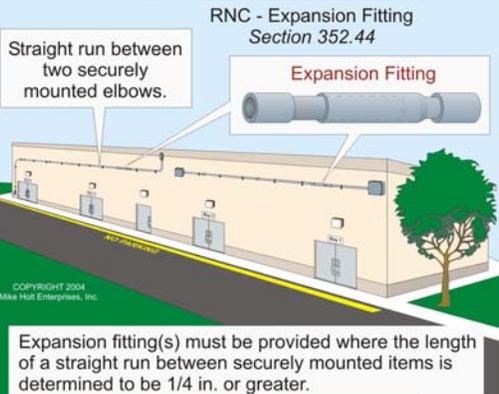
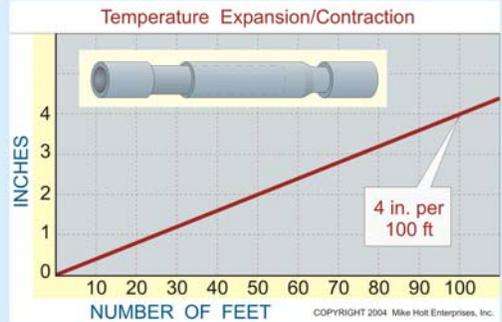
Conduit Size		Maximum Spacing Between Supports
Trade Size	ft	
½-1	3	
1¼-2	5	
2½-3	6	
3½-5	7	
6	8	

128

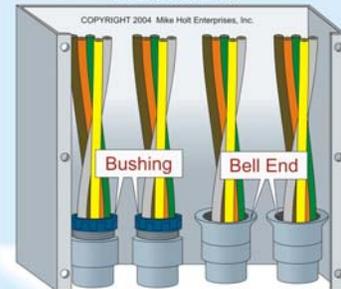
Table 10. Expansion Characteristics of PVC Rigid Nonmetallic Conduit

Temperature Change in Degrees F	Length Change in Inches per 100 ft. of PVC Conduit	Temperature Change in Degrees F	Length Change in Inches per 100 ft. of PVC Conduit
5	0.2	105	4.2
10	0.4	110	4.5
15	0.6	115	4.7
20	0.8	120	4.9
25	1.0	125	5.1
30	1.2	130	5.3
35	1.4	135	5.5
40	1.6	140	5.7
45	1.8	145	5.9
50	2.0	150	6.1
55	2.2	155	6.3
60	2.4	160	6.5
65	2.6	165	6.7
70	2.8	170	6.9
75	3.0	175	7.1
80	3.2	180	7.3
85	3.4	185	7.5
90	3.6	190	7.7
95	3.8	195	7.9
100	4.1	200	8.1

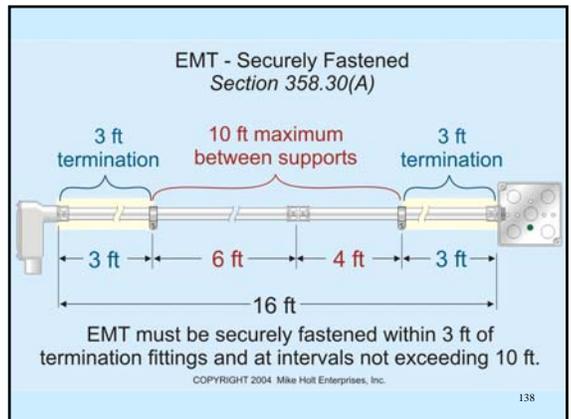
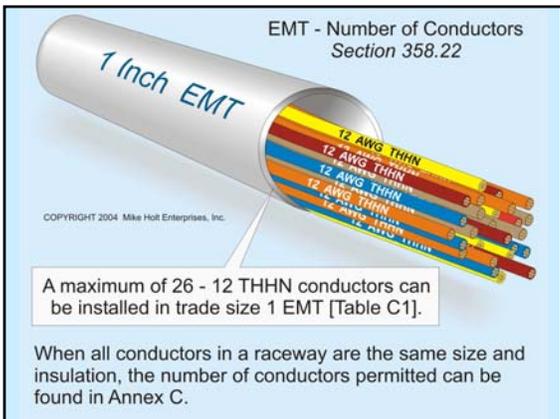
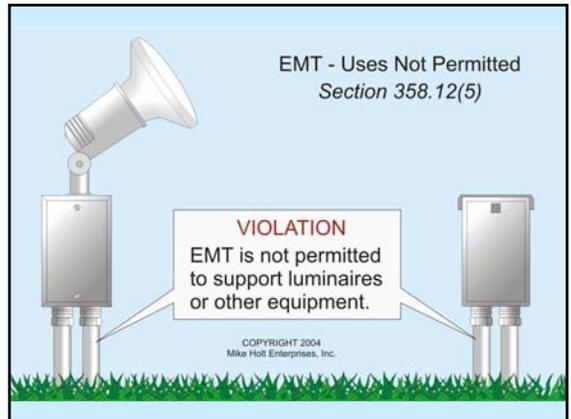
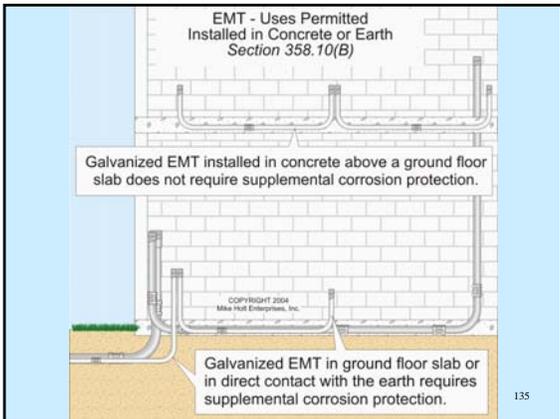
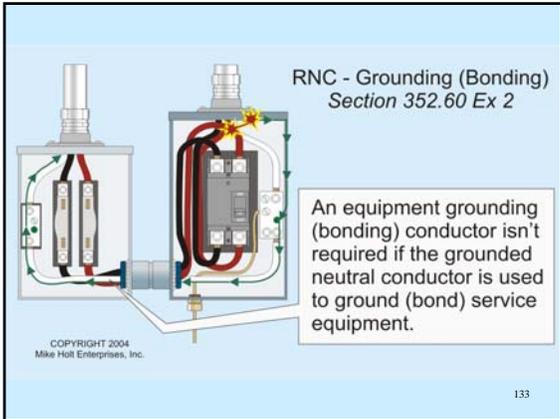
RNC - Expansion Fittings
Table 352.44(A)



RNC - Bushings
Section 352.46



Conductors 4 AWG and larger require a fitting that provides a smooth, rounded, insulating surface to protect the wire during and after installation, see 300.4(F).



EMT - Securely Fastened to Structural Members
Section 358.30(A) Ex 1

Where structural members do not permit fastening within 3 ft of the termination, EMT must be secured within 5 ft.

139

EMT - Bushings
Section 300.4(F)

Fitting Termination

4 AWG and Larger
Bushing Required

6 AWG and Smaller
Bushing Not Required

COPYRIGHT 2004 Mike Holt Enterprises, Inc.

140

ENT - Building not Over 3 Floors
Section 362.10(1)

In a building not over 3 floors, ENT can be run exposed, concealed, or above a suspended ceiling.

COPYRIGHT 2004 Mike Holt Enterprises, Inc.

ENT - Building Over 3 Floors
Section 362.10(2)

In buildings over 3 floors, ENT must be concealed behind floors, walls, and ceilings that have a 15-minute finish rating.

COPYRIGHT 2004 Mike Holt Enterprises, Inc.

ENT - Fire Sprinkled Building
Section 362.10(2) Ex

When a fire sprinkler system is installed on all floors, ENT can be installed exposed or concealed regardless of the finish rating.

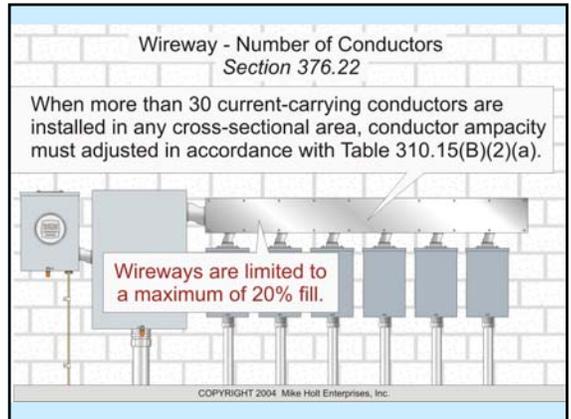
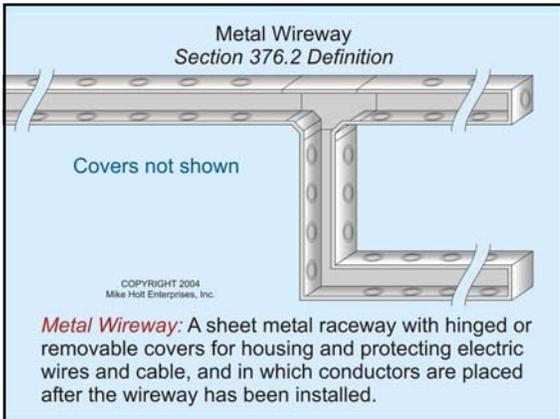
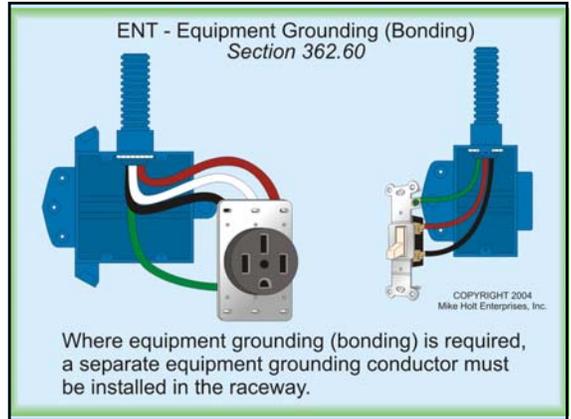
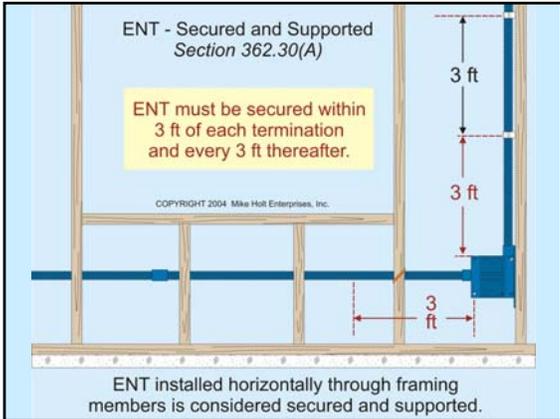
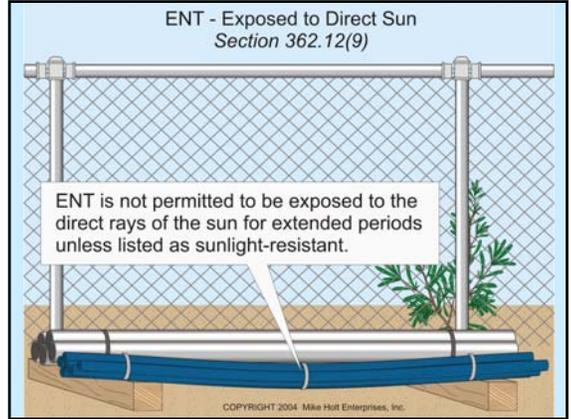
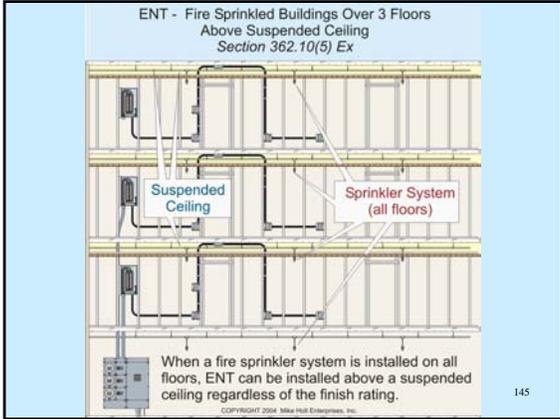
COPYRIGHT 2004 Mike Holt Enterprises, Inc.

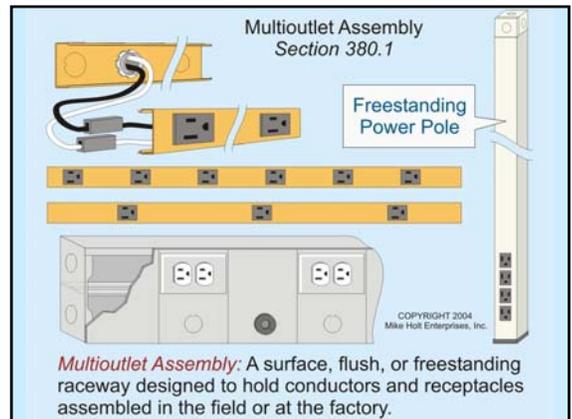
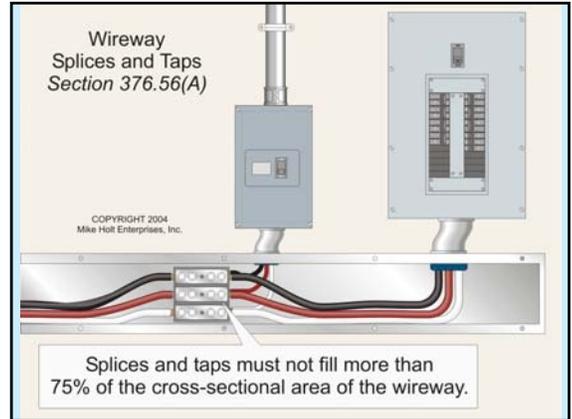
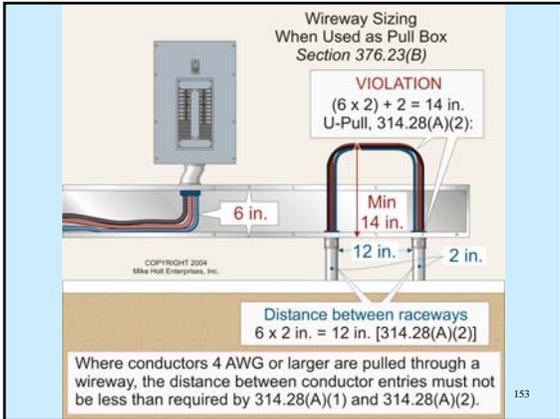
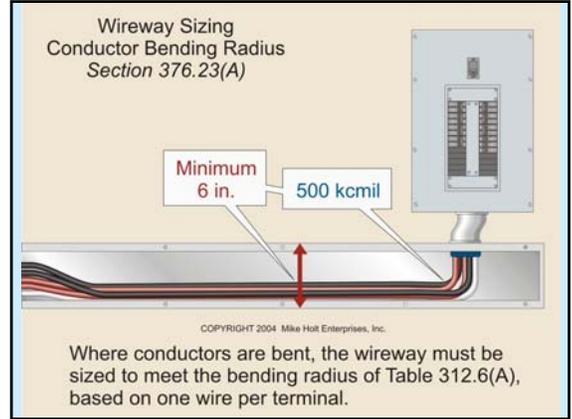
143

ENT - Suspended Ceiling Over 3 Floors
Section 362.10(5)

ENT is permitted above a suspended ceiling (not used for environmental air) if the suspended ceiling provides a 15-minute finish rating.

COPYRIGHT 2004 Mike Holt Enterprises, Inc.





Strut-Type Channel Raceway
Section 384.2 Definition

Strut-Type Channel Raceway

COPYRIGHT 2004
Mike Holt Enterprises, Inc.

Strut-Type Channel Raceway: A metallic raceway mounted to the surface or suspended, in which conductors or cables are laid in place after the raceway has been installed.

• **Table 384.22 Channel Size and Inside Diameter Area**

• Size • Channel	Area		40% Area*		25% Area**	
	in. ²	mm ²	in. ²	mm ²	in. ²	mm ²
• 1 5/8 x 13/16	0.887	572	0.355	229	0.222	143
• 1 5/8 x 1 3/8	1.151	743	0.460	297	0.288	186
• 1 5/8 x 1 3/8	1.677	1076	0.671	433	0.419	270
• 1 5/8 x 1 5/8	2.028	1308	0.811	523	0.507	327
• 1 5/8 x 2 7/16	3.169	2045	1.267	817	0.792	511
• 1 5/8 x 3 1/4	4.308	2780	1.723	1112	1.077	695
• 1 1/2 x 3/4	0.849	548	0.340	219	0.212	137
•						
• 1 1/2 x 1 1/2	1.828	1179	0.731	472	0.457	295
• 1 1/2 x 1 7/8	2.301	1485	0.920	594	0.575	371
• 1 1/2 x 3	3.854	2487	1.542	995	0.964	622

158

Surface Metal Raceways
Section 386.2 Definition

COPYRIGHT 2004
Mike Holt Enterprises, Inc.

Surface Raceway: A raceway intended to be mounted to the surface, in which conductors are placed after the raceway has been installed as a complete system.

159

Surface Raceway - Conductor Fill
Section 386.22

The ampacity adjustment factors of 310.15(B)(2)(a) do not apply where all of the following conditions are met:

- (1) Cross-sectional area exceeds 4 sq in.,
- (2) Number of current-carrying conductors does not exceed 30, and
- (3) Conductor fill does not exceed 20% of the cross-sectional area of the raceway.

COPYRIGHT 2004 Mike Holt Enterprises, Inc.

160

ARTICLE 388 Surface Nonmetallic Raceways

Permitted in dry locations
Unbroken lengths allowed to pass transversely through dry walls

Not allowed:

- Where concealed
- Where subject to physical damage
- Where the voltage is 300 volts or higher between conductors
- In hoistways
- In hazardous locations
- In high temperature conditions
- For conductors whose temperature rating exceed that of the wireway

161





Cable Tray - Uses Permitted
Section 392.3

Cable trays can be used as a support system for:

- Service Conductors
- Feeder
- Branch Circuits
- Communications Circuits
- Control Circuits
- Signaling Circuits

COPYRIGHT 2004 Mike Holt Enterprises, Inc.

Cable Tray - Support Raceways and Boxes
Section 392.6(J)

Raceways, cables, boxes, and conduit bodies can be supported to a cable tray where only qualified persons will service the installation.

COPYRIGHT 2004 Mike Holt Enterprises, Inc.

