EDITION 10
VOLUME 2

TRAINING AND MINIMUM BEND RADIUS

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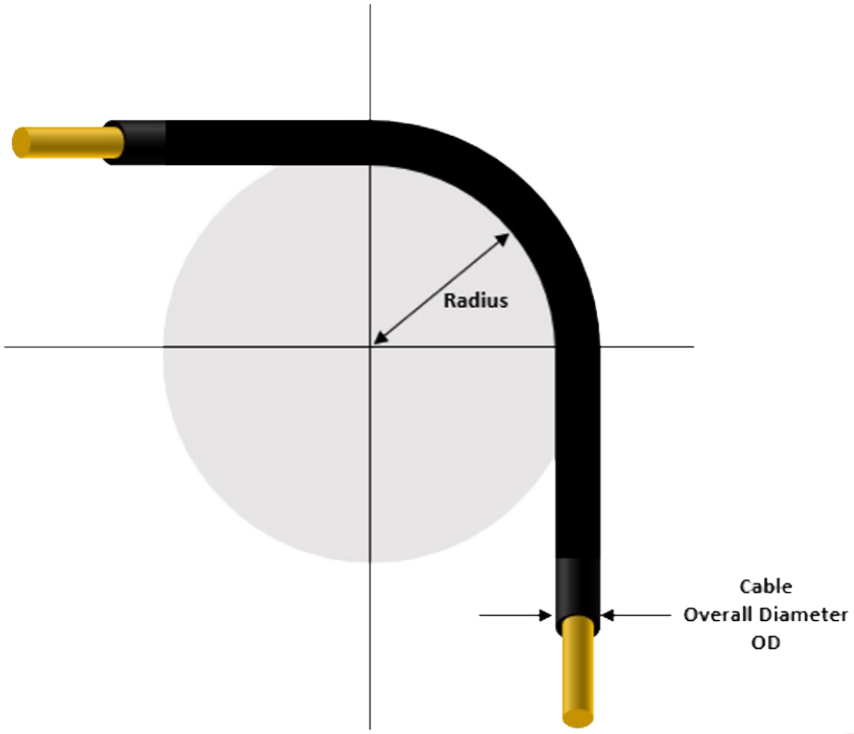
The training radius is the final positioning of cable ends after the cable has been placed in the raceway. The minimum bend radius is the smallest acceptable radius the cable is allowed to be bent around. These limits should not be used for cables subjected to pulling tensions during installation.



Larger bend radii shall be considered for conduit bends, sheaves, or other curved surfaces around which the cable may be pulled under tension while being installed, due to sidewall bearing pressure limits of the cable.

An unshielded cable can tolerate a sharper bend than a shielded cable. When bent too sharply, helical metal tapes can separate, buckle, and cut into the insulation. This problem is compounded by jackets concealing such damage. Corona problems related to metal shield damage may be initially masked by the semiconductive shielding bedding tapes or extruded polymers.

Example 1: A 600 kcmil CU THHN/THWN-2 conductor has an outer diameter (OD) of 1.024 inches. From Table 1, the multiplying factor is "5D", therefore minimum bending radius for this conductor is:
5 x OD = 5 x 1.024 inches = 5.120 inches

Example 2: Southwire SPEC 45252, TC-ER Cable 3C 500 kcmil, has an overall diameter (OD) of 2.262 inches. From Table 1, the multiplying factor is "6D", therefore minimum bending radius for this conductor is:
6 x OD = 6 x 2.262 inches = 13.57 inches

Example 3: Southwire SPEC 81102, Primary UD 15 kV cable for Utility 4/0 AWG, has an overall diameter (OD) of 1.193 inches. From Table 3, the formula is "F x OD" and, from Table 5, "F" for single concentric neutral is 8, therefore minimum bending radius for this conductor is:
8 x OD = 8 x 1.193 inches = 9.54 inches

For Drum Diameters of shipping reels please review NEMA WC 26 Binational Wire and Cable Packaging Standard.

For additional information, please contact cabletechsupport@southwire.com.

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MINIMUM BENDING RADIUS ACCORDING TO THE NATIONAL ELECTRIC CODE® (NEC 2020)

TABLE 1 - REQUIREMENTS FOR 1000 VOLTS, NOMINAL OR LESS, NEC®

1000 VOLT CABLE	
RECOMMENDED MINIMUM BENDING RADIUS	
CABLE CONSTRUCTION	MULTIPLE OF CABLE O.D.
Type TC, TC-ER, TC-ER-HL (Tray Cable) (NEC 336.24)	
Single conductor (THHN, THWN-2, XHHW-2, RHH/RHW-2, etc.) or Multiconductor Assembly (ICEA S-95-658)	
a) Diameter 1.0 inch or less	4D
b) Diameter between 1.0 inch to 2.0 inches	5D
c) Diameter larger than 2.0 inches	6D
d) Metallic Shielding	12D
Type MC, MC-HL (Metal Clad) Cables (NEC 330.24)	
a) Interlocked or Corrugated Sheath	7D
b) Smooth Sheath	
Max diameter 0.750 inches	10D
Max diameter 1.500 inches	12D
Diameter larger than 1.500 inches	15D
c) Shielded Conductors	12D* or 7D*

Where D = Overall Cable Diameter
*12 times individual shielded conductor diameter or 7 times overall cable diameter, whichever is greater.

TABLE 2 – REQUIREMENTS FOR OVER 1000 VOLTS, NOMINAL, NEC®

OVER 1000 VOLT CABLE	
RECOMMENDED MINIMUM BENDING RADIUS	
SINGLE AND MULTIPLE CONDUCTORS (NEC 300.34)	MULTIPLE OF CABLE O.D.
Unshielded and Unarmored	8D
Shielded and Lead Covered	12D
Multiconductor or Multiplexed Cable	12D* or 7D*
d) Metallic Shielding	12D

Where D = Overall Cable Diameter
*12 times individual shielded conductor diameter or 7 times overall cable diameter, whichever is greater.

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MINIMUM BENDING RADIUS ACCORDING TO THE AEIC AND ICEA STANDARDS

TABLE 3 – REQUIREMENTS FOR UTILITY CABLES, AEIC AND ICEA STANDARDS FOR UNARMORED POWER CABLES

CABLE CONSTRUCTION	FORMULA
Single Cables	Rmin = F x OD
Assembly of Three Single Cables	Rmin = F x (2.155 x OD)
Assembly of Four Single Cables	Rmin = F x (2.414 x OD)

Assembly - paralleled or multiplexed single cables
Where Rmin = minimum allowable bending radius
F = multiplication factor for the cable design
OD = overall single cable diameter

TABLE 4 - FACTOR "F" FOR CABLES 600V TO 2 KV, AEIC AND ICEA

THICKNESS OF CABLE INSULATION (MILS)	FORMULA		"F" FOR CABLE ASSEMBLIES OF SINGLE CABLE		
	OD < 1 INCH	OD > 1 INCH	OD < 1 INCH	1 INCH < OD < 2 INCHES	OD>2 INCHES
155 or less	4	5	4	5	6
170 to 310	5	6	5	6	7

TABLE 5 – FACTOR "F" FOR CABLES 5 KV TO 35 KV, AEIC AND ICEA

TYPE OF SHIELD	"F" FOR SINGLE CABLE	"F" FOR ASSEMBLIES OF SINGLE CABLE
Concentric Neutral	8	5
Tape and LC Shield	12	7
Wire Shield	8	5
Combination Tape & Wire	12	7
Lead Sheath	12	7

TABLE 6 – MINIMUM BENDING RADIUS FOR CABLES ICEA S-75-381, PORTABLE AND POWER FEEDER CABLES FOR USE IN MINES AND SIMILAR APPLICATIONS

CABLE TYPE	FACTOR MULTIPLIED BY CABLE OD
Portable Cable < 5,000 Volts	6
Portable Cable > 5,000 Volts	8
Mine Power Feeder	12

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