



ECET 4520

*Industrial Distribution Systems,
Illumination, and the NEC*

Conduit Fill



Electric Distribution System Design

Conduit Fill is the percent of the area inside a conduit taken up by the conductor(s) or cable(s) that are contained by the conduit.

Maintaining an adequate amount of empty space within a conduit is important for both heat-dissipation and ease of installation.

If the conductors that are being pulled through the conduit take up too much of the available space, jamming may occur, especially in long conduit runs or those with a large number of bends.



Article 358 – Electrical Metallic Tubing

358.1 – Scope

This article covers the use, installation, and construction specifications for electrical metallic tubing (EMT) and associated fittings.

358.22 – Number of Conductors

The number of conductors shall not exceed that permitted by the percent fill specified in Table 1, Chapter 9.

Electrical Metallic Tubing (EMT)
An unthreaded thin-wall raceway of circular cross section designed for the physical protection and routing of conductors and cables and for use as an equipment grounding conductor when installed utilizing appropriate fittings.
EMT is generally made of steel (ferrous) with protective coatings or aluminum (nonferrous).



Article 358 – Electrical Metallic Tubing

358.20 – Size

(A) **Minimum** – EMT smaller than metric designator 16 (trade size 1/2) shall not be used.

(B) **Maximum** – The maximum size of EMT shall be metric designator 103 (trade size 4).

Article 358 also covers many other topics relating to EMT, including:

- Uses Permitted and Uses Not Permitted
- Bends (How Made and Number in One Run)
- Securing and Supporting
- Couplings and Connectors
- Grounding.



Conduit Fill

Chapter 9 – Table 1 – Percent of Cross Section of Conduit and Tubing for Conductors

Table 1 establishes the maximum fill permitted for circular conduit and tubing.

Table 1 Percent of Cross Section of Conduit and Tubing for Conductors

Number of Conductors	All Conductor Types
1	53
2	31
Over 2	40

Informational Note No. 1: Table 1 is based on common conditions of proper cabling and alignment of conductors where the length of the pull and the number of bends are within reasonable limits. It should be recognized that, for certain conditions, a larger size conduit or a lesser conduit fill should be considered.



Article 220 Pt. III – Feeder/Service Loads

Annex C provides the maximum number of conductors, all of the same size (total cross-sectional area including insulation) permitted in trade sizes of the applicable conduit or tubing.

Table C.1 Maximum Number of Conductors or Fixture Wires in Electrical Metallic Tubing (EMT) (Based on Table 1, Chapter 9) (partial)

Type	CONDUCTORS										
	Conductor Size (AWG kcmil)		Metric Designator (Trade Size)								
	16 (½)	21 (¾)	27 (1)	35 (1¼)	41 (1½)	53 (2)	63 (2½)	78 (3)	91 (3½)	103 (4)	
THHN, THWN, THWN-2	14	12	22	35	61	84	138	241	364	476	608
	12	9	16	26	45	61	101	176	266	347	443
	10	5	10	16	28	38	63	111	167	219	279
	8	3	6	9	16	22	36	64	96	126	161
	6	2	4	7	12	16	26	46	69	91	116
	4	1	2	4	7	10	16	28	43	56	71
	3	1	1	3	6	8	13	24	36	47	60
	2	1	1	3	5	7	11	20	30	40	51
	1	1	1	1	4	5	8	15	22	29	37
	1/0	1	1	1	3	4	7	12	19	25	32
	2/0	0	1	1	2	3	6	10	16	20	26
	3/0	0	1	1	1	3	5	8	13	17	22
4/0	0	1	1	1	2	4	7	11	14	18	
250	0	0	1	1	1	3	6	9	11	15	
300	0	0	1	1	1	3	5	7	10	13	
350	0	0	1	1	1	2	4	6	9	11	
400	0	0	0	1	1	1	4	6	8	10	
500	0	0	0	1	1	1	3	5	6	8	

Note that the maximum number of conductors includes neutral and grounding conductors.



Article 220 Pt. III – Feeder/Service Loads

For Example – Determine the minimum standard-sized conduit that is needed for a run containing 5 - #4 THHN conductors.

Table C.1 Maximum Number of Conductors or Fixture Wires in Electrical Metallic Tubing (EMT) (Based on Table 1, Chapter 9) (partial)

		CONDUCTORS									
Conductor		Metric Designator (Trade Size)									
Type	Size (AWG kcmil)	16 (½)	21 (¾)	27 (1)	35 (1¼)	41 (1½)	53 (2)	63 (2½)	78 (3)	91 (3½)	103 (4)
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	2	1	1	3	5	7	11	20	30	40	51
	1	1	1	1	4	5	8	15	22	29	37
	1/0	1	1	1	3	4	7	12	19	25	32
	2/0	0	1	1	2	3	6	10	16	20	26
	3/0	0	1	1	1	3	5	8	13	17	22
	4/0	0	1	1	1	2	4	7	11	14	18
	250	0	0	1	1	1	3	6	9	11	15
	300	0	0	1	1	1	3	5	7	10	13
	350	0	0	1	1	1	2	4	6	9	11
	400	0	0	0	1	1	1	4	6	8	10
	500	0	0	0	1	1	1	3	5	6	8

Article 220 Pt. III – Feeder/Service Loads

For Example – Determine the minimum standard-sized conduit that is needed for a run containing 5 - #4 THHN conductors.

Table C.1 Maximum Number of Conductors or Fixture Wires in Electrical Metallic Tubing (EMT) (Based on Table 1, Chapter 9) (partial)

		CONDUCTORS									
Conductor		Metric Designator (Trade Size)									
Type	Size (AWG kcmil)	16 (½)	21 (¾)	27 (1)	35 (1¼)	41 (1½)	53 (2)	63 (2½)	78 (3)	91 (3½)	103 (4)
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	1	1	1	1	4	5	8	15	22	29	37
	1/0	1	1	1	3	4	7	12	19	25	32
	2/0	0	1	1	2	3	6	10	16	20	26
	3/0	0	1	1	1	3	5	8	13	17	22
	4/0	0	1	1	1	2	4	7	11	14	18
	250	0	0	1	1	1	3	6	9	11	15
	300	0	0	1	1	1	3	5	7	10	13
	350	0	0	1	1	1	2	4	6	9	11
	400	0	0	0	1	1	1	4	6	8	10
	500	0	0	0	1	1	1	3	5	6	8

Must find a conduit that is capable of holding at least 5 - #4 THHN conductors.