SUPERIOR ESSEX

Premise Cable Conduit Fill Guidelines

Table 1: Premises Cable Conduit Fill Guidelines

Conduit					Area of Conduit							Minimum Radius of Bends			
Trade Size	Internal Diameter		Cross-sectional Area		Maximum Occupancy Recommended										
					A		B		C		D		E	
					1 Cable 53% Fill		2 Cables 31% Fill		3 Cables or more, 40% Fill		Layers of Steel Within Sheath		Other Sheath	
	mm	in	mm^2	in^2	mm^2	in^2	mm^2	in^2	mm^2	in^2	mm	in	mm	in
½	15.8	0.62	197	0.30	104	0.16	61	0.09	79	0.12	160	6	100	4
¾	20.9	0.82	345	0.53	183	0.28	107	0.16	138	0.21	210	8	130	5
1	26.6	1.05	559	0.87	296	0.46	173	0.27	224	0.35	270	11	160	6
1¼	35.1	1.38	973	1.51	516	0.80	302	0.47	389	0.60	350	14	210	8
1½	40.9	1.61	1322	2.05	701	1.09	410	0.64	529	0.82	410	16	250	10
2	52.5	2.07	2177	3.39	1154	1.80	675	1.05	871	1.36	530	21	320	12
2½	62.7	2.47	3106	4.82	1646	2.56	963	1.49	1242	1.93	630	25	630	25
3	77.9	3.07	4794	7.45	2541	3.95	1486	2.31	1918	2.98	780	31	780	31
3½	90.1	3.55	6413	9.96	3399	5.28	1988	3.09	2565	3.98	900	36	900	36
4	102.3	4.03	8268	12.83	4382	6.80	2563	3.98	3307	5.13	1020	40	1020	40
5	128.2	5.05	12,984	20.15	6882	10.68	4025	6.25	5194	8.06	1280	50	1280	50
6	154.1	6.07	18,760	29.11	9943	15.43	5816	9.02	7504	11.64	1540	60	1540	60

The first step in sizing a conduit is to determine the number of cables to be placed in the conduit. This will determine the maximum fill allowance (see Table 2 below).

Table 2: Maximum Fill Ratio

Number of Cables in Conduit	Maximum Fill (%)
1	53%
2	31%
3 or more	40%

$$A = \frac{\pi D^2}{4} \quad \text{or} \quad 0.79D^2$$

$$A_T = 0.79D_1^2 \text{ (Cable 1)} + 0.79D_2^2 \text{ (Cable 2)} + 0.79D_3^2 \text{ (Cable 3)} + 0.79D_4^2 \text{ (Cable 4)} + \ldots$$

Finally, determine the number of bends to be placed in the conduit. For each 90^o conduit bend, subtract 15% from the total cross-sectional area (see examples below).

Note: It is recommended that no more than two 90^o bends be placed in a single section of conduit.

Example 1:

Suppose two RG-6 Quad Shield (QS) coaxial cables and two 4-pair Unshielded Twisted Pair (UTP) cables are to be placed in a conduit with no bends. The outside diameter (OD) of each RG-6 QS coax is 0.310" and the OD of each UTP is 0.25".

Calculations: To find the cross-sectional area of any cable use the following equation:

$$A = 0.79D^2 \quad \text{where: } D = \text{OD of the cable}$$

So for this example the calculation would be as follows:

Coax: $0.79D^2 = 0.79 \times 0.31^2 = 0.076 \text{ in}^2$
UTP: $0.79D^2 = 0.79 \times 0.25^2 = 0.049 \text{ in}^2$

Simply add the results for all cables as follows:

$\text{Coax}_1 + \text{Coax}_2 + \text{UTP}_1 + \text{UTP}_2$ = total cross-sectional area
$0.076 + 0.076 + 0.049 + 0.049 = 0.25 \text{ in}^2$

Because 3 or more cables are being placed in the conduit, the maximum fill is 40% based on the Table 2 above. Thus, in Table 1, go to the column marked "C – 3 Cables or more, 40% fill". This column states the maximum allowed occupancy for each trade size. For ¾" trade size, the maximum occupancy is 0.21 in^2, which is less than the 0.25 in^2 required, and is therefore unsuitable for the application. For a 1" conduit, the maximum occupancy is 0.35 in^2, which of course is greater than 0.25 in^2, and therefore appropriate for this application (see highlighted table section, next page).

Conduit			Area of Conduit								Minimum Radius of Bends			
Trade Size	Internal Diameter		Area = .79D^2 Total 100%		Maximum Occupancy Recommended									
					A		B		C		D		E	
					1 Cable 53% Fill		2 Cables 31% Fill		3 Cables or more, 40% Fill		Layers of Steel Within Sheath		Other Sheath	
	mm	in	mm^2	in^2	mm^2	in^2	mm^2	in^2	mm^2	in^2	mm	in	mm	in
¾	20.9	0.82	345	0.53	183	0.28	107	0.16	138	0.21	210	8	130	5
1	26.6	1.05	559	0.87	296	0.46	173	0.27	224	0.35	270	11	160	6
1¼	35.1	1.38	973	1.51	516	0.80	302	0.47	389	0.60	350	14	210	8

Example 2:

Now suppose that the same two RG-6 QS coax and two 4-pair UTP cables are placed in a conduit that includes two 90° bends.

Calculations: The total cross-sectional area of the cables is still 0.25 in^2. However, because there are two 90° bends, the acceptable fill must be reduced by 15% for each bend (a total of 30%) to find the proper maximum fill. This is done via the following calculations:

100%
-30% (two 90° bends)
70%
x 40% (proper fill for 3 or more cables)
28% (new fill requirement)

Now the new maximum fill is 28%. Because there is no column in Table 1 for 28%, calculate the available space in the conduit manually. Finding the proper trade size, in an example such as this, is a matter of trial and error. From the Table 1, 1" conduit has an area of 0.87 in^2 and 1¼" conduit has an area of 1.51 in^2 (see highlighted table section, next page).

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					1 Cable 53% Fill		2 Cables 31% Fill		3 Cables or more, 40% Fill		Layers of Steel Within Sheath		Other Sheath	
	mm	in	mm^2	in^2	mm^2	in^2	mm^2	in^2	mm^2	in^2	mm	in	mm	in
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1¼	35.1	1.38	973	1.51	516	0.80	302	0.47	389	0.60	350	14	210	8

To calculate the maximum occupancy for these conduits, use the following equation:

Area x 28%

1” = 0.87 x 28% = 0.24 in^2
1¼” = 1.51 x 28% = 0.42 in^2

The maximum occupancy for a 1” conduit is 0.24 in^2, which is less than the 0.25 in^2 required, and is therefore unsuitable for the application. The maximum occupancy for a 1¼” conduit is 0.42 in^2, which of course is greater than 0.25 in^2, and therefore appropriate for this application.

Summary

This document should be used as a guideline for cable fill requirements. Please keep in mind that these requirements are min/max values and do not take into account additional factors that may affect conduit fill or future cabling requirements. One of the more important of these factors is maximum cable pulling tension, which may limit conduit fill more so than these guidelines and should be carefully examined.