Conduit Fill Requirements

Conduit Fill Requirements Table

Conduit			Area of Conduit								Minimum Radius of Bends			
	Internal Diameter		rea = .79D Total 100%		Maximum Occupancy Recommended									
					A		B		C		D		E	
					1 Cable 53% Fill		2 Cables 31% Fill		3 Cables or more 40% Fil		.ayers of Stee Within Sheath		Other Sheath	
Trade Size	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
1 ¼	35.1	1.38	973	1.51	516	0.80	302	0.47	389	0.60	350	14	210	8
1 ½	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
2 ½	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
3 ½	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	.2,98	20.15	6882	L0.68	4025	6.25	5194	8.06	1280	50	1280	50
6	154.1	6.07	.8,76(	29.11	9943	L5.43	5816	9.02	7504	11.6	1540	60	1540	60

When sizing a conduit, there are three factors that must be taken into account. The number of cables being placed in the conduit, the cross-sectional area of the cable or cables being placed in the conduit, and the number of conduit bends.

The first step in sizing a conduit is to determine the number of cables that will be run through the conduit. This will determine the maximum fill allowance. For a single cable it is 53%, for 2 cables it is 31% and for 3 or more cables it is 40% (see table below).

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

Second, determine the cross sectional area of cable or cables being placed in the conduit. This is done by using the following formula :

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

If there is more than one cable being placed in the conduit simply add up the results of calculation as follows:

$0.79D^2$ (Cable 1) + $0.79D^2$ (Cable 2) + $0.79D^2$ (Cable 3) + $0.79D^2$ (Cable 4) + …

Third, determine the number of bends to be placed in the conduit. For each 90^o conduit bend, subtract 15% from the overall fill requirement. (See examples below)

Note: It is recommended that no more that 2-90^o bends be placed in a single piece of conduit.

Example 1:

Suppose 2-RG-6 Quad Shield (QS) coaxial cables and 2-4pair Unshielded Twisted Pair (UTP) cables are to be placed 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 formula:

$$0.79D^2$$

where: D = 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 for cables as follows:

Coax 1 + Coax 2 + UPT 1 + UTP 2 = cross-sectional area
0.076 + 0.076 + 0.049 + 0.049 = 0.25 in^2

Because 3 or more cables being placed in the conduit the maximum fill is 40% based on the table above. Looking at the conduit fill table provided, 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. This value is less than 0.25 in^2 as calculated above in example 1 and therefore is too small. For a 1" conduit, the value is 0.35 in^2. This value is greater than 0.25 in^2 and therefore is the appropriate conduit for this application. (See highlighted section below)

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					1 Cable 53% Fill		2 Cable 31% Fill		3 Cables or more 40% Fil		.ayers of Stee Within Sheath		Other Sheath	
rade Size	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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1	26.6	1.05	559	0.87	296	0.46	173	0.27	224	0.35	270	11	160	6
1 ¼	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 2-RG-6 QS coax and 2-4pair UTP cables are placed in a conduit that includes **2-90°** bends.

Calculations: The cross-sectional area of the cables would not change. The cross-sectional area of all of the cables is still 0.25 in^2. However, since there are 2-90° bends, the acceptable fill must be reduced by 15% for each bend or a total of 30% to find the proper maximum fill. This is done using the following equations:

100%
-30% (2-90° bends)
70%
x 40% (proper fill for 3 or more cables)
28% (new fill requirement)

Now the new maximum fill is 28%. Since there is no column 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. Looking at the chart, 1" conduit has an area of 0.87 in^2 and 1 ¼" conduit has an area of 1.51 in^2. (See highlighted area below)

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

Area x 28%

1" = 0.87 x 28% = 0.24 in^2
1 ¼" = 1.51 x 28% = 0.42 in^2

The maximum occupancy for a 1" conduit is 0.24 in^2. Since this is less than the 0.25 in^2 required as calculated earlier, a 1" conduit is too small. The maximum occupancy for a 1 ¼" conduit is 0.42 in^2. Since this value is greater than the 0.25 in^2 required, a 1 ¼" conduit would be the appropriate conduit for this application.

Summary

This document should be used as a guideline for cable fill requirements. Please keep in mind that these requirements are minimum values and does not take into account additional cabling requirements that may be necessary in the future.