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Sizing Handholes for Fiber Optic Cable

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1. General

This practice describes the basic guidelines for the proper sizing of handholes for use with fiber optic cable. The document is intended for personnel with prior experience in planning, engineering, or installation of fiber optic cable. Familiarity with fiber optic cable requirements, practices, and work operations is necessary as this guide does not cover all aspects of underground construction work.

Handholes are used for two different applications: (1) to provide access to the underground duct or innerduct during cable installation, and (2) to provide storage space for slack cable and splice closures. In general, larger handholes are required at splice locations to provide sufficient space for slack cable coils and splice closures. The splice handhole must also be large enough to accommodate the cable's minimum bend radius during installation as well as the installation tools and equipment that may be used during cable installation. In some cases, smaller handholes can be used at intermediate locations, but at a minimum, the intermediate handholes must be large enough to accommodate slack cable coils. If the intermediate handhole will be used for future splicing activities or as an intermediate assist location during cable installation, the intermediate handhole should be sized the same as the splice handholes. In addition, consideration should be given to installing larger sized handholes if additional cables and/or splice cases may be installed at a future date.

Innerducts should enter the handhole near the corners so that the full width of the handhole can be used to coil the cable. Prior to cable installation, the innerducts should be trimmed as necessary to accommodate cable placing. After cable installation, the innerduct should be trimmed so that only about six inches of innerduct protrudes into the handhole.

Handholes are available in a variety of shapes, sizes, materials, and for different vehicle loading conditions. In addition to selecting properly sized handholes, it is the responsibility of the outside plant engineer to consider local, state, and federal requirements that may influence the appropriate handhole choice.

2. Minimum Cable Bend Diameters

The minimum bend diameters¹ for OFS cables are defined for both dynamic and static conditions. The dynamic condition applies during installation. Caution must be used when pulling the cable

¹ Some cable manufacturers specify minimum bend radius rather than minimum bend diameter. Minimum bend diameter can be converted to minimum bend radius by dividing the minimum bend diameter by two. For example, the minimum bend radii for OFS DryBlock™ loose tube cables are 10 × OD and 15 × OD, respectively, for static and dynamic conditions.

out of the handhole to avoid bending the cable below its minimum required bend diameter. The static condition applies to the cable following installation. An example of the static condition is a cable that is racked through a manhole or on an equipment frame. Minimum coil diameters are also specified for long-term storage of slack cable. Minimum bend diameters are generally expressed as a multiple of the cable outside diameter (OD) and are summarized in Table 1. For information regarding specific dimensions, please visit www.ofsoptics.com to view cable data sheets or contact OFS Customer Service at 1-888-FIBERHELP (1-888-342-3743).

Table 1 – Minimum Bend Diameters for OFS Cables			
Cable Type	Minimum Bend Diameter		Minimum Storage Coil Diameter
	Static	Dynamic	
Loose Tube (DryBlock®, Fortex™ DT)	20 × OD	30 × OD	20 × OD (but no less than 12")
Ribbon in Loose Tube (AccuTube® ≤ 864 fibers)	30 × OD	30 × OD	30 × OD
Ribbon in Loose Tube (AccuTube+ 1728 fibers)	30 × OD	30 × OD	40 × OD
Central Tube (LightPack® LXE)	20 × OD	40 × OD	18 inches
Central Tube (AccuRibbon® ≤ 216 fibers)	20 × OD	40 × OD	18 inches
Central Tube (AccuRibbon® > 216 fibers, DuctSaver, DuctSaver+)	30 × OD	40 × OD	40 × OD

3. Cable Storage

Splice Handholes: Slack cable must be stored at splice locations to allow for splicing. Typically, a cable length of 50 to 100 feet is required for splicing purposes; however, the actual cable length may vary depending on the accessibility of the handhole. To eliminate twist, the slack cable should be rolled into a storage coil as described in OFS IP-009, *Placing Fiber Optic Cable in Underground Plant*. Cable storage coils must meet the minimum bend diameter requirements given in Table 1.

Intermediate Handholes: Many end users require that slack cable be stored in intermediate handholes along the cable route. These slack storage coils are used for future branch splices or route rearrangements. It is important that the coiling method accommodates the proper coil diameter given in Table 1 and does not introduce kinking or excessive twist into the cable. The appropriate coiling method will depend on the size, length, and bending-stiffness of the cable being installed. The following coiling methods are recommended for use in intermediate handhole applications and are covered in detail in OFS IP-009, *Placing Fiber Optic Cable in Underground Plant*.

- Fold-Over Method
- Tear Drop Method
- Garden Hose Method

4. Sizing Handholes

All handholes must be large enough to accommodate the minimum bend diameters as required for cable placing and coiling operations. If the intermediate handholes are used only for cable storage (no intermediate assist or future splicing activities), the minimum handhole dimensions are determined by the minimum storage-coil diameter of the cable (Table 1). For splice handholes, the minimum handhole dimensions depend on the minimum storage coil diameters and the dimensions of the splice closure. In both cases, consideration must also be given to other cables, closures, or apparatus that may be installed in the handhole. The following sections provide examples for sizing splice handholes for both loose tube and central tube applications.

Loose Tube and AccuTube (≤ 864 fibers) Cable: The minimum handhole length depends on the length of the splice closure relative to the minimum coil diameter. For short splice closures, i.e., if the closure length is less than one-half of the minimum coil diameter, the handhole length is equal to the minimum coil diameter, D_{coil} .

$$\text{Minimum Handhole Length, } L = D_{coil} \quad (\text{Equation 1})$$

For longer splice closures, i.e., if the closure length, $L_{closure}$, exceeds one-half of the coil diameter (see Figure 1), the minimum handhole length is determined from Equation 2.

$$\text{Minimum Handhole Length, } L = L_{closure} + (0.5 \times D_{coil}) \quad (\text{Equation 2})$$

In both cases, the handhole width must allow room for the width or diameter of the splice closure, $D_{closure}$, as shown in Figure 1.

$$\text{Minimum Handhole Width, } W = D_{coil} + (0.5 \times D_{closure}) \quad (\text{Equation 3})$$

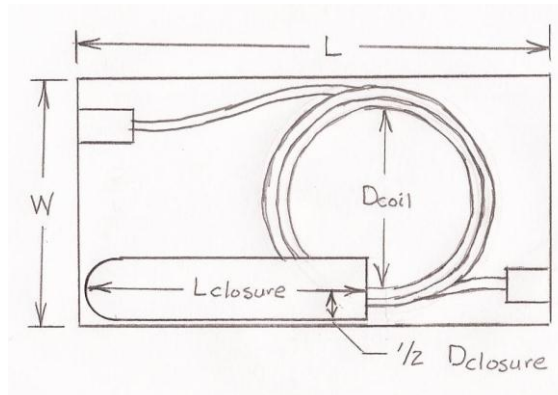


Figure 1 – Loose tube cable storage with closure.

Central Tube and AccuTube+ (1728 fibers) Cable: Compared to loose tube cables, central tube and AccuTube+ cables require larger storage coils. This is necessary to avoid attenuation in the edge fibers that may occur due to bending and twisting of the ribbon stack during the coiling operation. To minimize the required handhole dimensions, we can take advantage of the cable's static bend diameter as shown in Figure 2.

Caution: The static bend diameter is only used for the last turn of cable as it enters the splice closure. The remainder of the cable must meet the minimum recommended diameter of the storage coil.

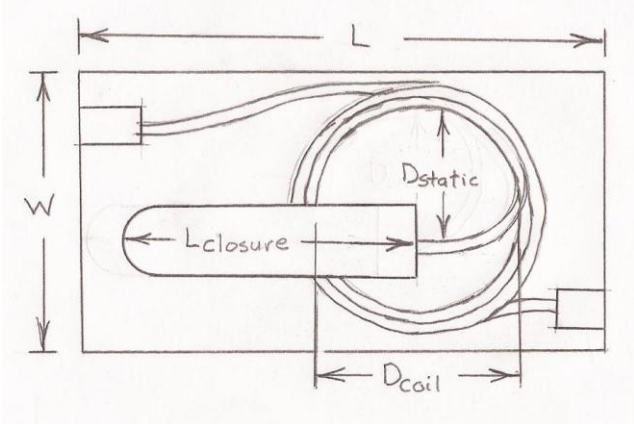


Figure 2 – Central tube cable storage with closure.

For central tube and AccuTube+ cables, the minimum storage coil diameter, the static bend diameter, and the closure length must all be considered. The minimum handhole length is taken as the **maximum** value determined in Equation 4 where D_{static} is the cable’s static bend diameter.

Minimum Handhole Length, $L = \text{MAX} \{D_{coil}, L_{closure} + (0.5 \times D_{static})\}$ (Equation 4)

For the handhole width, the minimum storage coil diameter, the static bend diameter, and the closure width or diameter must be considered. The minimum handhole width is determined by the **maximum** value defined by Equation 5.

Minimum Handhole Width, $W = \text{MAX} \{D_{coil}, D_{static} + (0.5 \times D_{closure})\}$ (Equation 5)

In some applications it may be desirable to store the cable coil on a diagonal rather than store it flat on the bottom of the handhole. Using the diagonal space in the handhole may allow the use of smaller, less expensive handholes. For example, the minimum storage coil diameter of a 144-fiber central tube cable is 18 inches which presumably disqualifies the use of a 17” x 30” x 15” (W x L x H) handhole. However, the diagonal length across top and bottom corners of the handhole is 22.7” which is sufficient to fit the storage coil. Assuming the handhole is long enough to accommodate the splice closure, the 17” x 30” x 15” handhole would be acceptable in this example.

Table 3 is a summary of the **minimum suggested** splice handhole dimensions for several different OFS cables. The suggested splice handhole dimensions should be used as a starting point and in some cases larger handholes may be required. Note that assumptions have been made regarding the closure dimensions and no allowances have been provided for additional cables or closures that may be stored in the handhole. **It is the responsibility of the OSP planner or engineer to confirm that these minimum suggested handhole dimensions are suitable for your application.**

Table 3 – Minimum Suggested Splice Handhole Dimensions						
Fiber Count	Cable OD, in.	Static Bend Diameter, in.	Minimum Coil Diameter, in.	Closure Length, in.	Closure Width, in	Minimum Suggested Handhole Dimensions (W x L)
Fortex DT Cable (Loose Tube), Light Armor						
12 - 96	0.54	10.8	12.0	19	8	17 x 30
108 - 144	0.68	13.6	13.6	19.5	9	17 x 30†
156 - 192	0.67	13.4	13.4	23	11.5	17 x 30†
204 - 288	0.76	15.2	15.2	30	11.5	24 x 36†
AccuTube Cable (Ribbon in Loose Tube), Light Armor						
≤ 288	0.91	27.3	27.3	19.5	9	30 x 36†
300 - 432	0.91	27.3	27.3	23	11.5	36 x 36†
444 - 864	1.05	31.5	31.5	23	11.5	36 x 48†
AccuTube+ Cable (Ribbon in Loose Tube), Single Jacket						
1728	1.2	36	48	32.6	10.8	36 x 60†
AccuRibbon Cable (Central Tube), Metallic						
≤ 216	0.71	14.2	18.0	19.5	9	17 x 30†
240 - 288	0.84	25.2	33.6	19.5	9	36 x 36†
312 - 432	0.84	25.2	33.6	23	11.5	36 x 48
456 - 576	0.90	27.0	36.0	23	11.5	36 x 48
864	1.00	30.0	40.0	23	11.5	48 x 48

† Assumes cable will be stored on diagonal in handhole.

For additional information please contact your sales representative. You can also visit our website at www.ofsoptics.com or call 1-888-FIBERHELP (1-888-342-3743) from inside the USA or 1-770-798-5555 from outside the USA.

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