ofs
A Furukawa Company

Direct Buried Cable Installation

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1. General

1.1 This installation procedure is intended as a basic guideline for the installation of direct buried fiber optic cable. It is intended for personnel with prior experience in the planning, engineering, or placement of buried fiber optic cable. A working familiarity with buried cable requirements, practices, and work operations is necessary as this guide does not cover all aspects of buried cable placement.

1.2 This document does not cover cable installation in underground conduit systems. For information regarding cable placement in conduit systems, please refer to OFS IP-009, *Placing Fiber Optic Cable in Underground Plant*.

2. Precautions

2.1 OFS optical fiber cables are designed to meet the rigors of conventional aerial, direct buried, and underground duct environments. However, care must be taken during installation to observe the cable's minimum recommended bend diameter and maximum rated cable load (MRCL).

2.2 Cable minimum bend diameters[1] are typically expressed as a multiple of the cable outside diameter (OD) for both static and dynamic conditions. The static condition represents an installed cable subjected only to long-term residual load. The dynamic condition represents a cable that may be subjected to the MRCL. Minimum bend diameters are also specified for slack storage coils. Minimum recommended

[1] Some manufacturers specify minimum bend radius rather than minimum bend diameter. To convert minimum bend diameter to minimum bend radius, divide the minimum bend diameter by two. For example, the minimum recommended bend radii for OFS loose tube cables are 10 × OD and 15 × OD, respectively, for static and dynamic conditions.

bend diameters for commonly used OFS cables are summarized in Table 1. For specific dimensions, refer to the documentation shipped with your cable or contact OFS Customer Support at 1-888-FIBER-HELP (1-888-342-3743) for further information.

Table 1 – Minimum Bend Diameters for OFS Cable

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® and AccuTube+ RR	30 × OD	30 × OD	30 × 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® ≥ 240 fibers	30 × OD	40 × OD	40 × OD

2.3 Cable tensile load ratings are specified for both short-term and long-term (residual) conditions. The short-term condition applies to a cable during installation and in general, a MRCL of 600 pounds (2700 N) applies to most OFS cables. For long-term conditions, a maximum residual tension of 180 pounds (800 N) can be applied to the cable. Please be aware that higher or lower tensile load ratings may apply for self-supporting aerial and other special application cables. Please refer to your cable documentation or contact OFS Customer Support at 1-888-FIBER-HELP (1-888-342-3743) for further information.

2.4 To assure that the cable is not over tensioned during installation, breakaway pulling swivels and/or tension-limited pulling winches are recommended. Cable lubricants should also be used to minimize the cable installation force. Contact a lubricant manufacturer for guidance on the selection and use of cable lubricants for your application.

2.5 Personal protective gear must be worn when working near construction equipment and/or in open trenches. All open trenches must be shored as required by OSHA and/or local requirements. Work area protection, e.g., safety cones, flags, and barricades, must be used as required.

2.6 Full time inspection during the construction, placement, backfilling, and restoration of buried cable plant is recommended to ensure the use of proper installation methods, equipment, and materials.

3. Location

3.1 Buried cable plant will usually be located along roads or highways, on private rights-of-way, along or near property lines, or in the space between the curb and the sidewalk. To the extent possible, buried cable plant should be placed where future construction activities will not overlap the cable.

3.2 The buried cable route should be as direct as practical without causing excessive damage to the roots of trees, shrubs, or other vegetation along the route.

3.3 When possible, splice points should be located near road crossings or other obstacles where the cable will be fed through underground pipe or casings.

3.4 If the trench is used for both communications and power cables, or if the cable route crosses or parallels power cables, NESC and/or local separation requirements must be observed.

3.5 The buried cable route must be documented on construction drawings for use in the field. The construction drawings should show all underground utilities and obstacles. Any deviation between the planned cable route and "as built" cable route should be noted on the construction drawings and transferred to the permanent route drawings and maps.

3.6 A presurvey of subsurface conditions should be conducted prior to construction activities. The presurvey will identify subsurface conditions that may require the use of special tools or techniques, e.g., the use of rock saws or blasting.

3.7 Contact the local "one-call center" well ahead of construction activities and notify them of your construction schedule and location. The one-call center will notify other subsurface utilities so that their facilities can be located and marked in the vicinity of the cable route.

4. Depth of Plant

4.1 Minimum recommended cable burial depth is summarized in Table 2. In croplands, the cable should be buried a minimum of 12 inches below the maximum depth attained by agricultural equipment. Deeper burial depth requirements may apply along highway and railroad right-of-ways. Contact the local highway or railroad authorities for their minimum requirements.

4.2 At road and highway crossings, the burial depth should be sufficient to avoid cable damage due to road grading and maintenance activities

4.3 When crossing existing subsurface utilities, it is desirable to install the cable beneath them, if possible, to minimize future cable disruptions. A minimum of 1 foot of vertical separation should be maintained between the cable and subsurface utility.

Table 2 – Minimum Recommended Burial Depth

Type of Facility	Depth of Cover (in.)
Toll & Trunk Cable	30
Feeder & Distribution Cable	24
Drop Cables	12

5. Cable Trenching

5.1 The trenching method will depend on the local soil conditions, topography, terrain, and available equipment. Backhoes, trenchers, or a combination of both may be used for the trenching operation. For maximum speed and performance, never dig a trench deeper or wider than required; however, it is recommended that trenches be no less than 4 inches in width.

5.2 When streets, driveways, sidewalks and other surface obstacles are encountered, it may be preferable to install a duct or casing below the roadway rather than cut and restore the roadway. A 4-inch diameter (or larger) metal or rigid plastic duct is recommended for use under permanent surface structures. Small-diameter innerducts can be placed inside the larger duct or casing to house the fiber optic cable. All ducts, casings, and innerducts should be installed and capped prior to trenching and cable installation activities.

5.3 The trench bottom shall be free of rocks, stones, clumps of frozen material, and other debris that may damage the cable. The trench bottom should be raked free of all debris prior to cable placement. If the trench bottom contains rocks or debris that cannot be removed, a 2" layer of sand or rock-free spoil should be placed on the trench bottom prior to cable placing.

5.4 If the cable path crosses underground utilities or other obstacles, the adjacent utility must be exposed by hand digging to avoid damage and possible injury.

6. Cable Placing

6.1 Mount the cable reel on the reel carrier so that the cable pays off the top of the reel. Position the cable reel near the starting splice location and pull the required cable slack into the handhole or splice point. Coil the slack cable and store it in the handhole being sure to observe the minimum recommended bend and coil diameters.

6.2 During cable placement, the reel carrier should be driven along the trench line and the cable should be paid directly from the reel and carefully laid on the trench bottom. Exercise caution at the start of the installation so that cable is not pulled out of the splice handhole. Tend the cable reel by hand and do not allow the cable to rub over the edge of the reel flange.

6.3 Caution: Do not pull the cable through the trench. The abrasive nature of the trench bottom and walls may cause severe jacket abrasion leading to cable damage and ground-fault failures.

6.4 Always observe the MRCL and minimum cable bend diameter.

6.5 If bores have been installed at road crossings or other obstacles, figure-eight techniques may be required during cable installation. The cable should be handled manually and stored on the ground during the figure-eight process. Place the cable on tarps to prevent damage from gravel, rocks, or other abrasive surfaces. Tarps should also be used in muddy conditions to keep the cable clean. Be sure to allow enough area to accommodate the cable length to be stored and provide sufficient personnel to maintain the required minimum-bending diameter as well as avoid kinking or otherwise damaging the cable. Please refer to IP-009, *Placing Fiber Optic Cable in Underground Plant*, for further information regarding figure-eight techniques.

6.6 Caution: "Figure-eight eliminator" equipment, which is used to eliminate manual figure-eight procedures, **has been found to cause cable and fiber damage.** This equipment typically uses a mechanized cable delivery system to wrap the fiber optic cable onto a stationary drum. **This type of equipment is not recommended for use with OFS fiber optic cable. Cable damage resulting from the use of this equipment is not covered by OFS cable warranty.**

6.7 At the ending splice location, slack cable must be pulled into the handhole, coiled, and stored for future splicing activities. Be sure to observe the minimum recommended bend and coil diameters.

6.8 Splice closures may be housed in handholes or they may be direct buried. Excavate the splice hole about six inches below final grade of the splice closure. Fill the bottom of the excavation with gravel or crushed stone to a level several inches above final grade of the splice closure. Compact the fill by tamping the gravel to final grade. Position the handhole in the excavation and backfill as required. If the splice closure is direct buried, it should be placed on a supporting surface, e.g., concrete blocks or treated lumber. Cover the splice closure with six inches of select fill. A buried electronic marker or locating device should be placed over the splice location for future locating purposes.

7. Backfilling

7.1 Backfill the cable with six inches of select fill, e.g., sand, crushed stone dust, or sandy soil.

7.2 Locating wire and/or plastic warning tape should be installed about 12 inches above the cable during the backfilling process.

7.3 Tamp the trench line to prevent settlement. Best results may be obtained by tamping the backfill in two or more passes; however, do not compact the trench until at least 12 inches of backfill has been placed over the cable.

7.4 Restore the cable right-of-way as required.

7.5 If practical, the installed cable should be tested prior to asphalt and concrete restorations.

8. Cable Plowing

8.1 The following guidelines are applicable to both static and vibratory plows.

8.2 The selection of the cable plowing equipment depends primarily on the soil conditions and the required burial depth. Construction contractors familiar with the local soil conditions are often the best judge of the required equipment. Lacking local field experience, guidelines relating the required prime mover horsepower to burial depth are given in Table 3.

Table 3 – Recommended Horsepower vs. Burial Depth

Minimum Burial Depth (in.)	Net Flywheel Horsepower
24	60 – 80
30	80 - 100
36	100 - 150
42	150 - 225
48	225 - 325

8.3 Too much horsepower is better than too little. A prime mover of marginal capability will have difficulty maintaining the required burial depth and will place added demands on the plow operator, particularly while negotiating turns and irregular terrain. While plowing, the operator should be able to concentrate on the cable reel and cable.

8.4 The reel carrier must be adequately sized and should allow for easy installation of the cable reel. The spindle bar should be a good fit to the arbor hole. To maintain steady rotation, the diameter of the spindle bar should be 1/16 to 1/8 inch smaller than the reel arbor hole. **Spindle bar bearings are not recommended as they may cause over-spinning of the cable reel.** Locking collars should always be used to prevent the reel from sliding along the spindle bar.

8.5 The cable delivery system must safely guide the fiber optic cable from the reel into the feed chute without violating the cable's minimum bend diameter. A typical cable delivery system is shown in Figure 1. The cable tray is mounted on top of the tractor and is used to guide the cable over the cab. A sheave, quadrant block, or capstan is mounted above the feed chute to guide the cable into the center of the feed

chute. Quadrant blocks with closely spaced, multiple rollers may be used as long as the overall radius of the quadrant meets the minimum bend diameter of the cable. Hydraulic capstans are effective in reducing peak cable tension and are recommended for use. The capstan assist device pulls cable off the reel and delivers it directly into the feed chute at low tension. The cable must make one complete turn around the capstan, and the speed of the capstan must exceed the speed of the tractor for the capstan assist to be fully effective.

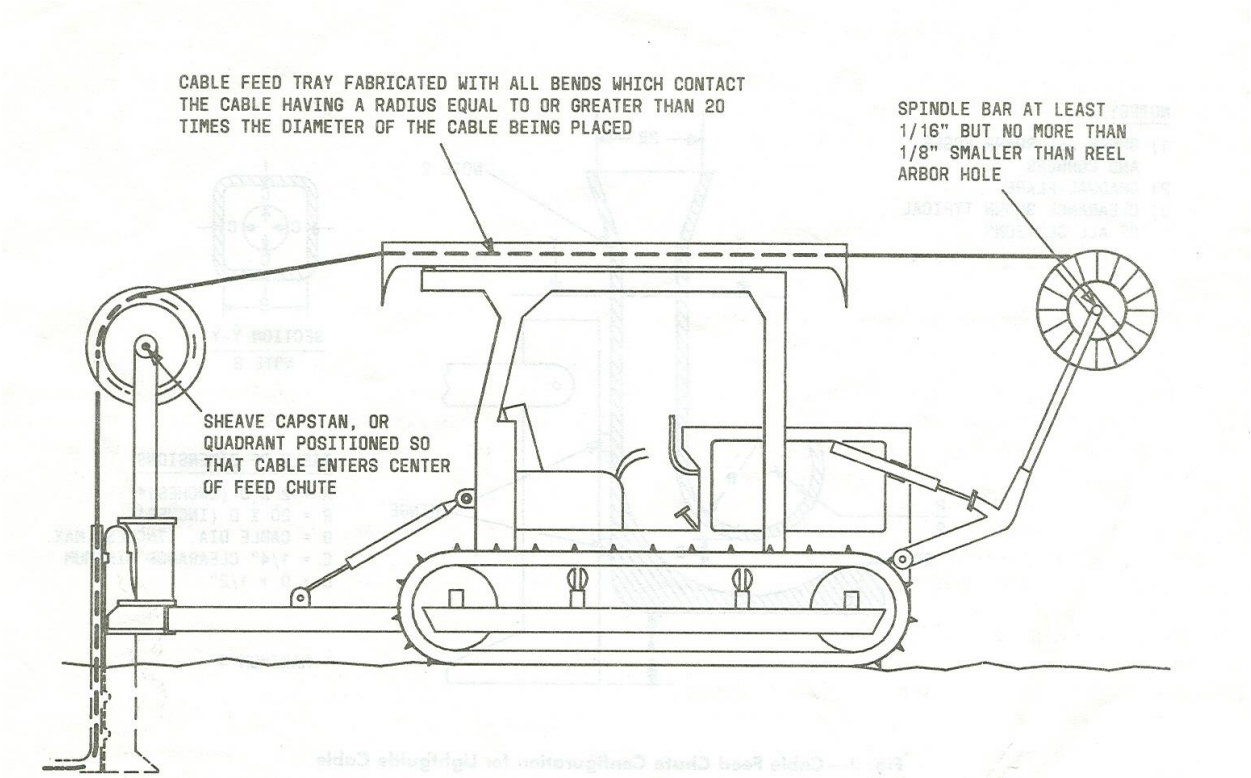

Fig. 1—Typical Cable Delivery System

8.6 The cable feed chute should have a removable gate to allow the cable to be removed or inserted into the chute at any intermediate point between splice locations. The cable path inside the feed chute must be free of burrs, sharp edges, and excessive surface roughness. Welds should be smooth, and gussets or stiffeners on the divider gate of multiple chute designs should not interfere with smooth passage of the cable. Clearances in multiple chute designs should be maintained under operating conditions. Internal guide rollers are not recommended. Proper maintenance and cleaning of the cable chute will help ensure that the cable feeds smoothly through the chute.

8.7 The cable feed chute requirements for fiber optic cables are shown in Figure 2. Note that the chute radius is expressed in terms of cable diameter and may be larger than that typically required for copper cable. This design is required to comply with the minimum bending radius of the fiber optic cable. Also, relatively large radii are called for at the point where the cable exits the feed chute. This configuration at the top and bottom of the exit serves to support and protect the cable if the plow share is abruptly raised or lowered during plowing.

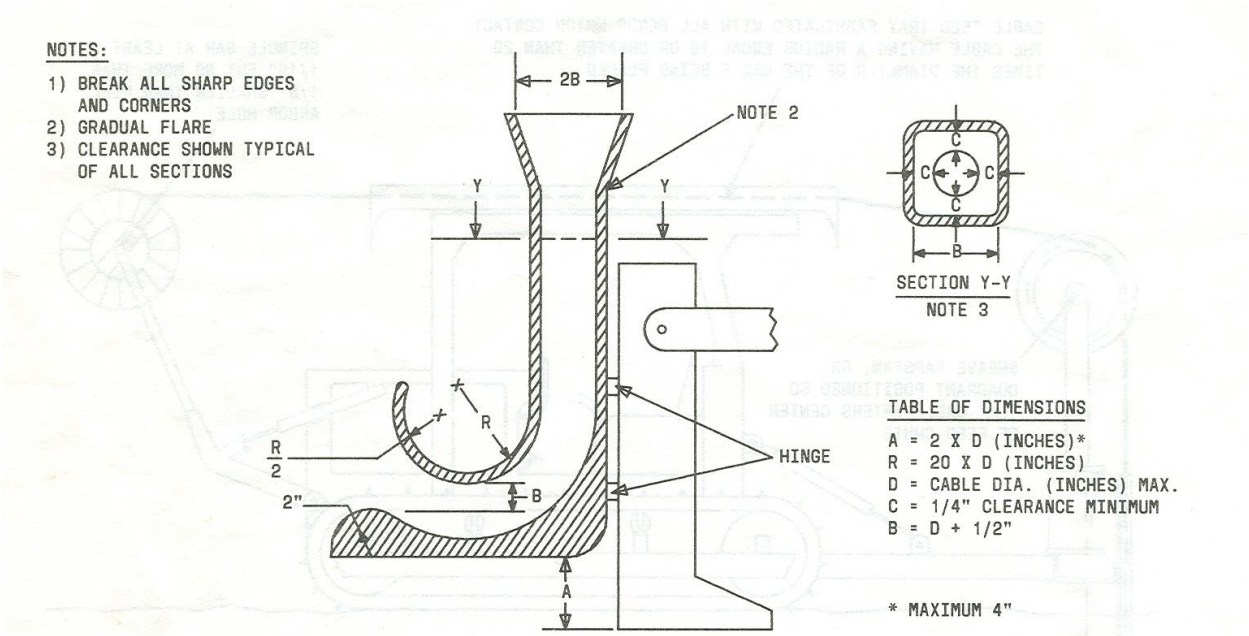

Fig. 2—Cable Feed Chute Configuration for Lightguide Cable

8.8 To ensure the cable route is clear from obstructions, a ripping pass should be made at full burial depth before plowing the cable. The ripping pass should be made in the same direction as the plowing operation. A ripper tooth, rather than the shank of the cable plow, should be used for the ripping pass.

8.9 Starting and finishing pits should be dug at the splice locations prior to the start of plowing. The starting (finishing) pits should be about 3-feet long and at the required burial depth.

8.10 Inspect the cable reel flanges to ensure the surfaces are smooth and free of nails or other imperfections that could damage the cable. Load the cable onto the reel carrier and feed the cable over the cable tray, around the cable sheave or capstan, and through the cable chute.

8.11 Lower the plow blade into the starting pit and pull the cable and required slack through the plow chute to the splice point. Coil the slack cable and store it in the handhole.

8.12 Secure the cable at the splice point to prevent cable movement at the start of the plowing operation. Start the plowing operation smoothly and slowly and gradually increase speed after all cable slack is removed from the cable delivery system.

8.13 Plow attitude and depth should be changed gradually and only while the tractor is moving. If it is necessary to raise the plow share to the surface when the tractor stopped, the cable should be excavated for a short distance behind the plow to prevent kinking the cable over the feed chute exit as the plow is raised.

8.14 Under no circumstances should the plow be backed up with cable in the chute.

8.15 Do not plow more than one cable through a single feed chute.

8.16 Abrupt changes in terrain along the cable path should be graded off ahead of the plow.

8.17 The plowing operation should be continuously observed for obstructions, proper feeding of cable, maintaining proper depth, etc.

8.18 Observe all cable handling precautions at road-crossings or other obstacles where the cable must be figure-eighted, pulled through conduit or beneath obstacles, and re-reeled. Refer to Section 6, *Cable Placing*, regarding cable handling recommendations and precautions.

8.19 Continue the plowing operation to the splice point. Once the cable plow has reached the finishing pit, the plow can be raised and the cable can be removed from the plow chute. Feed the cable into the splice point, coil the slack cable, and store it in the handhole. Be sure to observe the minimum coiling diameter of the cable as summarized in Table 1.

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