OCC-206-2

Installation – General Guidelines Excerpt from Optical Cable Corporation's INSTALLATION GUIDE

Tensile Load Strength

For fiber optic cable, the tensile strength of a cable represents the highest load or pulling force that can be placed upon any cable before any damage occurs to the fibers or their optical properties and characteristics. This is not the cable breaking strength, but a realistic allowable limit.

There are two tensile strength values used to define fiber optic cable: 1) installation (or short term) and 2) long term (or operating load). These values change depending on the cable construction and fiber count.

The installation tensile strength rating is the maximum value that a specific cable can withstand during an actual installation. Short term stresses during an installation can be caused by pulling the cable through ducts, around bends, back tension on the payoff reel, etc. *Installation tensile strengths in excess of 2,700 Newton's (600 pounds) are not recommended, regardless of the tensile load rating*.

The value for the long term tensile strength rating is the maximum value that a specific cable can withstand after the cable has been installed. After a cable has been installed, the cable will be subjected to a lesser tensile load as compared to the installation tensile load.

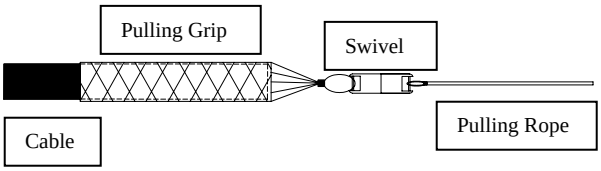
Maximum pulling tensions during installation are specified by the manufacturer and should not be exceeded at any time. The cable should be pulled by hand as much as possible. Pulling tensions should always be monitored when using mechanical pulling techniques. The cable should be pulled in a steady, continuous motion and never jerked. At no time should the cable be pushed. The cable should be installed using the minimum possible tension.

For permanent installed cable, the tensile load on the cable should be kept to a minimum well below the manufacturer's specification.

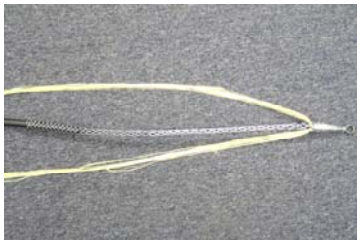
The installation and long term tensile values for Optical Cable Corporation's cables can be found on Optical Cable Corporation's web site (www.occfiber.com), catalog, or by phone at (800) 622-7711.

Pulling Attachments and Grips

During the installation of fiber optic cable, the use of a pulling grip that attaches to the cable and to a breakaway swivel that is rated at the proper pulling tension of the cable is highly recommended. For pulling multiple cables at one time, each cable should be fitted with a pulling grip. All cables should then be connected to one breakaway swivel that is rated for the cable that has the lowest installation tensile strength. For example, if three cables are being installed together with two of the three rated at 600 lbs and one cable rated at 300 lbs (maximum installation tensile load), then the single breakaway swivel should be rated for 300 lbs.



For Distribution and Round Messenger cables, the grip is installed by removing the outer jacket material and fibers at the end of the cable, exposing the aramid yarn. The aramid yarn is then folded back over the grip and taped down to insure that the grip is using the strength member to pull the cable. For Breakout and Sub-Grouping cables, the grip can be placed over the outer jacket. Please refer to Optical Cable Corporation's application notes AE001 (*Interlock Armor CST Cable Grip Installation Procedure),* AE003 (*Distribution Cable Pulling Grip Installation Procedure*), and AE004 (*Breakout and Subgrouping Cable Pulling Grip Installation Procedure*) for more details.



The pulling grip should be sized appropriately for the diameter of the cable. For interlocked and corrugated steel tape cables, the grip also needs to be able to fit the diameter of the outer armored jacket. Kellems pulling grips are recommended. Listed below are sample model numbers for the Kellems pulling grips with and without the swivel eyes and the corresponding cable diameters. Please refer to the Kellems web site for more details.

Kellems Model #	*Cable Diameters*
With Swivel	
033291007	.10 - .22 inches
033291008	.21 - .35 inches
033291009	.32 - .48 inches
033291010	.42 - .61 inches
033291011	.53 - .74 inches
033291012	.64 - .87 inches
Without Swivel	
033291193	.10 - .22 inches
033291194	.21 - .35 inches
033291195	.32 - .48 inches
033291196	.42 - .61 inches
033291197	.53 - .74 inches
033291198	.64 - .87 inches
033291199	.75 - 1.0 inches

Breakaway swivels are designed to prevent twisting of the fiber optic cable and pulling line as well as provide a safety mechanism if the pulling tension exceeds the rated load of the breakaway swivel. When selecting a breakaway swivel, the tensile strength of the swivel must not exceed installation tensile load rating of the cable. Consult the cable manufacturer for cable installation tensile load ratings.

Cable Twist

Fiber optic cables should never be subject to excessive twist. Excessive twist in the cable causes bending stress in the fibers, resulting in increased attenuation.

1. Storage & Transport – Cable Twist

If storing a cable by laying the cable on the ground, the cable should lay flat in a figure 8 configuration. Ensure that the figure 8 curves are larger than the cable's minimum bending radius. To prevent potential damage when storing long cable lengths, support the cable crossing points in the middle of the figure 8 pattern.

The figure 8 position places a half twist in on one side of the 8 and takes it out on the other.

When storing cables on a jobsite, the use of fencing or other barriers to protect cables and reels against damage by vehicles or other equipment moving about the storage area is highly recommended.

When transporting cable not on a reel, the cable should be placed in a figure 8 and the two halves of the figure 8 should be folded together. This allows the cable to be placed in a coil form that does not introduce twist in the cable yet allows for easy transportation. Placing a cable in a coil form without placing the cable in a figure 8 position first will cause twist in a cable.

2. Installation – Cable Twist

When paying the cable off from a reel, the cable should always be rolled off the reel by supporting the reel so it can turn instead of spinning the cable off over the end flange of a stationary reel. Spinning the cable off puts a twist in the cable for every turn on the reel.

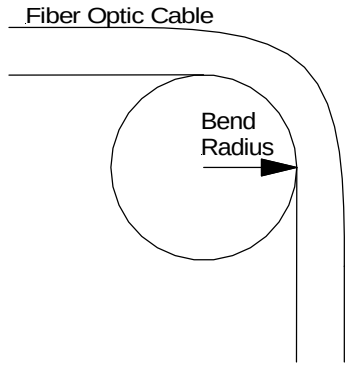
The proper way to handle excess slack in a cable at pulling locations or at other locations along the route is to lay the cable in a figure 8. For storage, the two figure 8 sections may be folded together. For further installation, the figure 8 may be "flipped" upside down, and the cable pulled from the figure 8.
The cable should *never* be removed from the drum by removing a flange and sliding the cable come off the drum.

Breakaway swivels should always be used during installation because pulling tension will cause twisting forces on the cable and pulling rope.

Minimum Bend Radius

The minimum bend radius is the value determined to be the smallest bend a cable can withstand without causing any excess attenuation in the fiber. Each fiber optic cable has a minimum bending radius specified by the manufacturer for installation and long term tensile load. The installation bend radius, the higher value, is the amount of bending radius the cable can withstand while under the load of installation. This is specified as a larger bend radius because the forces of the pulling tension are added to the forces of the bending of the cable. After the cable has been installed, the stress of being pulled is removed and the cable will typically be able to withstand a smaller bend radius.

Bending a cable tighter than its minimum bending radius, whether during installation or long term, can damage the cable and/or increase fiber attenuation above the manufacturer's specifications. Furthermore, individual fibers may be broken even if no physical damage to cable is evident.



The minimum values for the radius to which cables may be bent can be determined by the following formula:

$$MBR = OD \times M$$

Where:

MBR = Minimum radius of bend (in)
OD = Outside diameter of cable (in)
M = Diameter multiplier (For more information, please refer to the Optical Cable Corporation web site @ www.occfiber.com)

Crush and Impact

The effects of both crush and impact are important as they apply to real-life installation situations.

Crush can be defined as a fiber optic cable's ability to withstand, or recover from (or both), the effects of a compressive force.

Impact can be defined as a fiber optic cable's ability to with stand repeated impact loads.

The industry standard procedures for testing crush and impact resistance can be found in documents EIA-455-41A "Compressive Loading Resistance of Fiber optic Cables" (Crush) and EIA-455-25B "Repeated Impact Testing of Fiber Optic Cables and Cable Assemblies" (Impact).

Temperatures – Installation & Operation

Installation and operating temperatures for indoor and indoor/outdoor fiber optic cables are defined in standards ICEA S-83-596 "Standard for Optical Fiber Premises Distribution Cable" and ICEA S-104-696 "Standard for Indoor-Outdoor Optical Fiber Cable", respectively.

The temperatures listed in the ICEA documents are minimum acceptable temperature ranges for these cables types. Some cable types, based upon the manufacturer, may be able to be installed and operate at different temperatures. Please consult the cable manufacturer.

In cold weather installations, it is recommended that fiber optic cables be stored in a heated storage area at least twenty four hours prior to cable installation.

The installation temperatures are the actual temperature of cable, not the surrounding air. Large reels of cable can retain low or high temperatures for hours after prolonged exposure.