

UNDERGROUND CABLE INSTALLATION EQUIPMENT & PROCEDURES

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Underground Cable Installation

Equipment & Procedures

When the decision is made to "Go Underground" on a new distribution system, there are many different areas to consider prior to construction. In the following paper, we would like to suggest some of these areas for your consideration in regards to equipment and procedures for underground cable installation.

The three most common methods of cable placement are Direct Buried, Cable in Conduit, and a Total Conduit System. Most Utilities are currently using one or more of these methods with various degrees of success.

The first system or method commonly undertaken is the Direct Buried method. As this system matures, a few questions come to the surface. How much care was taken in preparation of the trench? How was the cable placed in the trench? How does different cables react to different soils and ground conditions? How complicated is it to replace damaged or faulted cable? When a fault or damage caused by digging occurs, it is very time consuming to open the trench and make repairs. All these factors and many more affect the reliability and life of the conductor.

Due to these and other conditions, the Cable in Conduit method is considered in some areas. The cable is placed in a conduit during the manufacturing process, and this conduit protects the conductor as it lies in the trench, giving it longer life. However, most of the same questions occur when using the C.I.C. method as occurs when using the Direct Buried method.

The particular method we would like to discuss in this paper is the Total Conduit System.

1. System Preparation:

- A. A good system must be installed properly with attention given to preparation of the trenches, placement of the conduit, and care used when backfilling the trenches.
- B. Consideration should be given to selecting the size of inside diameter to ensure adequate fill ratios and schedules such as DB-120, SCH-40, or SCH-80 as required in specific areas.
- C. The pulling cable has a great impact on the selection of the schedule of the conduit. Initially, everyone assumed if synthetic rope is good enough for overhead, it must be good enough for underground as well. However, we learned synthetic rope

generates heat, causes friction, and burns through the PVC. The most common response was to increase the wall thickness of the conduit or even go to steel 90's in order to stop this problem. Since the rope was causing the problem, most pullers today use steel pulling ropes. Steel ropes dissipate the heat over the length of the cable and slides around the 90's, instead of burning through them.

- D. The maximum length between vaults depends on system designs, customer requirements, and pulling equipment available. The average pull normally runs between 500 and 1,000 ft., however, some systems require cable pulls over 2,000 ft.
- E. How many 90-degree sweeps can one pull have before damage is done to the conductor? The rule of thumb in the industry is a maximum of 270 degrees. However, some designs or requirements demand more, but keep in mind every 90-degree sweep adds pulling tension to the pull. The cable manufacture normally recommends a maximum pulling tension for a specific size and type of conductor.
- F. Remember a good conduit system is sized, installed, and tested (mandreled) properly prior to installing the conductor.

2. Pulling Equipment

- A. Drum type winches - A common practice is using the same drum puller for overhead and underground, or a bed winch, to pull in the URD conductor. A drum type puller or winch has no way to monitor actual line tension. Also, the maximum pulling capacity is obtained when the drum is empty. As the drum fills up with cable, the speed increases and the pulling tension decreases. At the end of the pull when the drum is full, the winch is at its minimum capacity; and that is when the pull is at its maximum tension.
- B. Bullwheel type pullers - A puller with bullwheels maintains the same speed and tension when the drum is empty as when the drum is full. The actual drum on this type puller is merely a storage drum with no effect on the speed or tension.
- C. Underground pullers - A puller designed specifically for underground normally has a dynamometer and footage counter to allow the operator to monitor and maintain desired pulling tensions and speeds for safe and efficient cable installation.

3. **Reel Trailers**

- A. Reel trailers are built in various designs and configurations and normally carry from one to four reels. Care should be taken in the selection of a safe and functional reel trailer with capacities equal to the size and weights of the conductor reels.
- B. A Manual Reel Trailer is most commonly used for underground construction. This trailer allows the puller to remove the conductor at it's own speed with a manual overspin brake to prevent overspinning.
- C. A Hydraulic Reel Trailer allows the operator to adjust the speed and tension of the conductor hydraulically as it flows from the reel stands. However, care should be taken to ensure enough slack is available to prevent the reel trailer from pulling against the puller, which causes unnecessary tension on the conductor.
- D. Regardless of the design, manual or hydraulic, the trailer should be equipped with a ball bearing on the reel shaft to prevent the additional pulling tension and friction required just to turn the reel.

4. Rigging, Blocks, and Accessories

- A. Properly installed rigging ensures safe and efficient cable installation with a minimum amount of damage to the conductor. If the rigging slips during a pull, causing the pull to stop, the conductor settles to the bottom of the conduit. When the pull resumes, the pulling tension required to move the conductor is much greater than the tension required before the pull stopped.
- B. The diameter of the blocks used should be selected to ensure proper bending radius and installation without damage to the conductor. The cable manufacture will provide its recommendations for specific cables and applications.
- C. Conduit Rollers are available to assist the conductor from the conduit to the puller or reel trailer. This roller is designed to fit the inside of the conduit and provide protection for the conductor as it slides past the end of the conduit.
- D. Lip Rollers are used to assist the conductor over the lip of the vault or manhole without unnecessary damage.
- E. Jamb Skids and Quadrant Blocks are normally used on larger conductor installations. The jamb skid is designed to rest on the floor of the vault and is secured to the manhole.

F. Feed Tubes assist the conductors from the reel trailers into the vault and conduit. The round tube helps form the conductors into a triangle shape to allow proper entry into the conduit. Without this tool, normally someone has to assist the conductors into the conduit.

5. Lubricant

A. It is very important to maintain a proper amount of lube on the conductor as it is pulled into the conduit. Inadequate lubricant can cause damage and unnecessary tension to the conductor during installation. How much lube is "proper" or "adequate"? Pulling conditions vary with conduit, conductor, length of pull, and layout designs. Attached is a general chart that can be used to determine the quantity of lubricant. However, the quantity needs to be adjusted according to the pulling conditions.

All of the above areas of consideration are very important steps to ensure safe, reliable, and long lasting cable installation.

1. A tested and proven Conduit System.
2. Select a Cable Puller to meet your specific needs.
3. The Reel Trailer should be designed to safely transport the conductor.
4. Make sure your rigging is safe and secure.
5. Use adequate amounts of lubricant.

Please feel free to contact me if you have any questions, or if I may be of any assistance. Thank you for your time and consideration.

LUBRICANT IN GALLONS (G)

PULL LENGTH IN FEET (L)	CONDUIT I.D. IN INCHES (D)		
	2"	3"	4"
100	.30	.45	.60
500	1.50	2.25	3.00
1,000	3.00	4.50	6.00

$G = L \times D \times .0015$