

CABLE LUBRICANT APPLICATION GUIDE FOR COMMUNICATION CABLES

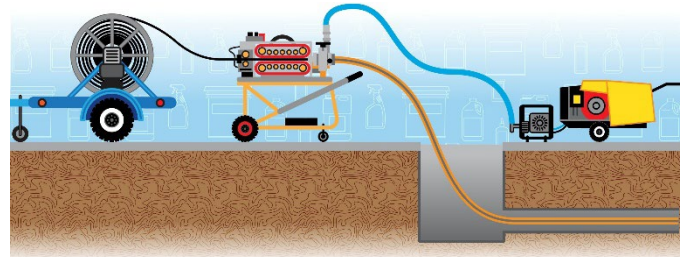
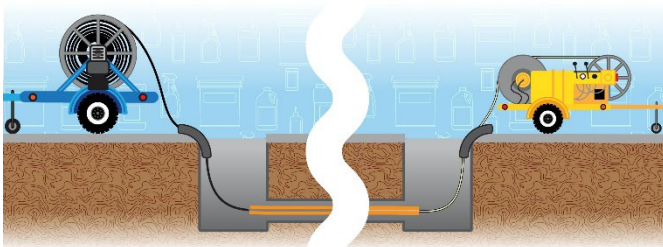
This practice describes the procedure for effective and safe use of Polywater® cable lubricants used to place communication cable into duct. There are two basic methods to install communication cables: pulling and blowing. For both methods, use of cable lubricant is key to success.

All types of communication cable can be pushed or pulled into underground conduit or ducts. In the pulling method, a pulling rope is installed inside the conduit and is attached to the cable for the pull.

Cable blowing uses a mechanical force combined with high speed compressed air to float the cable inside the duct. In high-speed blowing, a tractor mechanism pushes the cable into the duct and the high-speed air floats the cable through the conduit. This method became very popular in the last decades.

In piston or push/pull blowing, an air-tight piston is attached to the head of the cable. The air pushes this piston, and the piston “pulls” the cable, combined with a tractor mechanism that pushes the cable, through the conduit. This is mainly used for larger duct sizes.

Cable installation method is based on site conditions, available machinery and resources, and company practice. In all cases, lubrication increases the distance, safety, and speed of the cable installation. Below is a basic comparison of the two methods.



PULLING METHOD	BLOWING METHOD
Lubricant recommended	Lubricant recommended
Pulling rope or tape pre-installed	No pulling rope or tape required
Manual pushing or pulling for short distances. Machine pulling requires hydraulic power.	Large compressor and hydraulic power required.
Duct route should have minimal bends and undulations.	Duct integrity and cleanliness are important. Conduit system should be airtight.
Higher sidewall forces can damage cable.	Minimal forces on the cable are uniform throughout the installation length.
Suitable for distances from 500 to 1,000 feet (200 to 300 meters). Longer distances achievable with mid-assist.	Suitable for long distances, 5,000 to 7,000 ft (>2 km)

PLANNING AND LUBRICANT USE

- 1) Lubricant use is a critical component of cable installation in conduit. Cable lubricants will reduce the coefficient of friction resulting in longer installation distances. Use of lubricant will reduce the risk of cable damage during the installation.
- 2) Planning the installation is an important part of the process. Polywater's Pull-Planner™ software supports planning activities by estimating ending tension and sidewall or crushing force. Consider the following prior to cable installation:
 - Conduct a route survey and inspect for manhole, coiling, and splicing locations. Ensure that there are no sharp bends that exceed the minimum bend radius of the cable during pulling operations.
 - Plan duct inspection and cleaning activities sufficiently in advance of cable installation activities to determine the condition and suitability of the ducts for use.
 - Plan to have sufficient cable lubricants and cable installation accessories. Make sure equipment is in good condition. Use of a breakaway swivel or other tension monitoring device is strongly recommended for cable pulling.

SAFETY

Develop and review a comprehensive safety and regulatory checklist to ensure that no components are omitted, from protections, to traffic, to manhole ventilation. General guidance and adherence to safety procedures should be understood throughout this document. Safety considerations include personal protective equipment, equipment handling precautions, manhole/underground vault safety, and traffic safety.

Polywater lubricants are slippery when spilled on non-absorbent surfaces. Such spills should be covered with an absorbent material as soon as they occur. Polywater lubricants are non-irritating and non-sensitizing. Contact with human skin is not harmful.

Polywater lubricants are water based. Precautions should be taken when working around energized cables because these lubricants are electrically conductive.

LUBRICANT COMPATIBILITY

Cable lubricants should not cause polyethylene stress cracking and should be compatible with cable jacket materials. Liquid detergents should not be used. Cable lubricants should not support combustion, emit toxic gases, or harden after the cable installation is complete.

Polywater lubricants have been tested for compatibility and are approved by cable manufacturers.

DUCT FILL RATIO

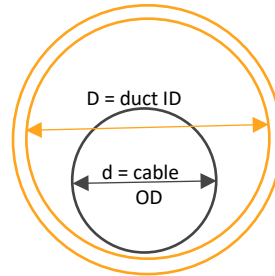
Use of lubricant to lower coefficient of friction is a critical component of successful cable installation. Proper duct fill ratio is another key parameter for further installation distances.

Diameter or area ratio are used to determine optimal cable and innerduct or duct size based on the cable outside diameter (OD) and the duct inside diameter (ID). Either ratio can be used, but consistently using one or the other is important to avoid confusion.

This ratio is calculated as follows:

$$\text{Diameter Ratio } 50\% \text{ to } 80\% = \frac{d}{D} \times 100$$

$$\text{Area Ratio } 25\% \text{ to } 65\% = \frac{d^2}{D^2} \times 100$$



INSTALLATION METHOD	DIAMETER RATIO	AREA RATIO
Cable Pulling	< 80%	< 65%
Cable Blowing	50 – 80%	25 – 65%

The higher duct fill ratio improves blowing distances by limiting cable buckling, the formation of helically shaped waves within the conduit.

GENERAL CABLE INSTALLATION GUIDANCE – CABLE PULLING

- Keep conduits clean and clear for successful cable and innerduct installation. Conduits blocked with ice, debris, or with collapsed or displaced sections, are often impossible through which to pull with or without cable pulling lubricant. When cable is laid out in a large figure-eight configuration, keep the cable as clean as possible. If the ground contains loose sand or dirt, lay a polyethylene sheet or other protective layer between the cable and ground.
- Make sure there is enough lubricant to complete the installation. Once the pull has started, it should not stop. It is hard to get the cable moving once it stops. Continue to apply lubricant throughout the pull.
- Cable should be protected and guided from the cable reel into the raceway by a suitable means. Do not exceed the minimum bend radius of the cable. Use of specialized, large radius Fiber Quad Blocks may be required. Attach a break-away swivel between the pulling eye and pulling rope to prevent the cable from twisting.
- Carefully choose racking space in intermediate manholes so that it provides maximum protection to the cable and maintains minimum bending radius.
- At the end of the pull, use a rag to remove the excess lubricant from the cable. Hold your hand tightly around the cable with the rag to remove almost all the lubricant. Any remaining residue of lubricant on the cable will evaporate quickly.

LUBRICATION PROCEDURE – CABLE PULLING

- 1) Conduits should be thoroughly cleaned prior to installing the cable. Any abrasive or sharp edges, which might damage the cable, should be removed.
- 2) Place approximately two-thirds of the recommended quantity of lubricant into the conduit. Lubricant can be poured or pumped directly into the conduit.
- 3) Use a lubricant spreader, swab, or attach a sponge/rag to the pulling eye to push and spread the lubricant throughout the conduit system during the pull. The spreader should be tight-fitting inside the conduit to distribute the lubricant evenly throughout the conduit.
- 4) Directly lubricate the cable or wire during the entire portion of the pull with the remaining one-third quantity. The entire top and bottom of the cable can be coated as it enters the conduit. Alternatively, lubricant can be poured or pumped onto the cable as it enters the conduit.

RECOMMENDED LUBRICANT – STANDARD PULLING (POLYWATER F)

The recommended amount of lubricant is dependent on the size and length of the conduit system. The following equation predicts a satisfactory quantity of Polywater lubricant for an average cable pull.

$$Q = k \times L \times D$$

- Q = quantity needed in gallons (liters)
- L = length of the pull in feet (meters)
- D = ID of the conduit in inches (mm)
- k = 0.0015 (0.0008 if metric units)

Quantity appropriate for complex pulls should be increased from the above recommendations by up to 50%. Consider the following factors:

- Conduit type and conditions – increase quantity for old, dirty, or rough conduits.
- Conduit fill – increase quantity for high percent conduit fill.
- Number of bends – increase quantity for pulls with several bends.
- Pulling environment – increase quantity for high temperatures.

**Do not add water to increase lubricant quantities. This can affect the lubricant's coefficient of friction, cable tension, and sidewall pressures during the cable installation.*

Table A provides quantities calculated from the equation for several pull lengths and conduit sizes.

Table A Recommended Quantity in Gallons (Liters)

LENGTH	CONDUIT ID inches/mm			
	1.25/32	2/50	3/75	4/100
100/30	0.19 (0.8)	0.3 (1.2)	0.45 (1.8)	0.6 (2.4)
500/150	0.94 (3.8)	1.5 (6.0)	2.25 (9.0)	3.0 (12.0)
1000/300	1.9 (7.7)	3.0 (12.0)	4.5 (18.0)	6.0 (24.0)
1500/460	2.8 (11.8)	4.5 (18.4)	6.8 (27.6)	9.0 (36.8)

LUBRICATION PROCEDURE – HIGH PERFORMANCE DATA CABLES

Polywater FTTx is recommended for high-performance data cables. It has a minimal effect on the data-carrying capacity of high-performance, Ethernet cables. As a “thin-film” lubricant, FTTx has a limited effect on cable signal attenuation.

- 1) Conduits should be thoroughly cleaned prior to installing the cable. Any abrasive or sharp edges, which might damage the cable, should be removed.
- 2) Lubricant may be sprayed directly into the conduit. It can also be sprayed onto a towel and wiped onto the cable jacket. The convenient FTTx-D20 wipe package contains pre-saturated wipes. The towel material is designed to release lubricant without mess.
- 3) Continue to lubricate the cable or wire during the entire portion of the pull. The entire top and bottom of the cable can be coated as it enters the conduit.

RECOMMENDED LUBRICANT QUANTITY (POLYWATER FTTX, THIN-FILM FORMULA)

The recommended amount of lubricant is dependent on the size and length of the conduit system into which the copper cables, wires or innerduct are being pulled. Lubricant quantity is modified for the specialty use of Polywater FTTx, thin-film formula.

Polywater FTTx is concentrated, and much less lubricant is required in the installation. Lubricant quantity recommendation follows the modified formula below.

$$Q = k \times L \times D$$

- Q = quantity needed in gallons (liters)
- L = length of the pull in feet (meters)
- D = ID of the conduit in inches (mm)
- k = 0.0003 (0.0002 if metric units)

Quantity can be increased from the above recommendations by up to 50% for complex pulls.

GENERAL GUIDANCE FOR CABLE INSTALLATION USING HIGH-SPEED AIR

Lubricant

Proper lubricant use will increase efficiency by up to 50%. Lubricant should be water based and easily miscible with any moisture in the air or conduit system. It should exhibit good flow and coat duct surfaces in a thin, uniform manner. Only use lubricants designed for cable blowing; standard cable pulling lubricants are not recommended. Polywater Prelube 2000 and 5000 are tested and recommended for this application. Prelube 2000 is intended for the installation of cable or microtubes into ducts with inner diameters (ID) 16 mm or larger. Prelube 5000 is recommended for use in microducts with ID less than 15 mm.

Conduit, Microduct

When cables are blown into duct or microduct, it is important that the system is airtight along the entire length. Joints must be fusion spliced or connected with a specialty connector to retain the airflow. Polywater offers BonDuit® Conduit Adhesive for an airtight, watertight connection using standard PVC connectors.

Smooth or ribbed conduit is preferred. Corrugated conduit may cause turbulent air flow, limiting installation lengths.

Air Compressors

Use the recommended size (scfm, sm^2/m) air compressor for the blowing machine and size and length of duct. Do not exceed the operating pressures recommended by the equipment or duct manufacturers.

Warm or humid weather:

Use of an aftercooler on the compressor is recommended, especially in warm or humid weather. This reduces the heat generated by compressed air and removes water droplets formed by condensation. Hot air can soften cable jacket and conduit materials creating a higher coefficient of friction. It may also dry the lubricant too quickly. Using a winter grade blowing lubricant will slow the drying.

Water from condensation will increase friction and in small conduits can pool and cause a water lock. It is important to dry and clear the duct with clean, foam discs prior to the installation. Oils should never be used to install blown cable as the combination of condensed water and oil will clog the duct.

Crash Test (Maximum Pushing Force)

Care should be taken to make sure the blowing machine does not damage the cable during installation. If the cable is forced to stop in the duct by an obstruction but the machine is still pushing, the cable may buckle, or jacket abrasion may occur. To prevent this, a crash test should be performed. Full information on this testing is available from your equipment manufacturer.

LUBRICATION PROCEDURE – HIGH-SPEED AIR INSTALLATION

Blown cable installation requires different lubricant techniques than traditional cable pulling. Lubricating the duct before the cable is blown will increase the distance, safety, and speed of installation.

- 1) Clean conduits thoroughly by blowing a mandrel or foam disc through the conduit prior to lubricating the conduit. This will remove water, dirt, sand, mud, or gravel and make sure the conduit is not blocked by ice or displaced sections and is not collapsed. Continue to blow foam discs through the conduit until they come out dry and clean. Sponges that are torn or damaged may indicate sharp edges or other obstructions within the duct system.
- 2) Squeeze appropriate lubricant quantity into duct. Insert 2 to 3 foam sponge spreaders to distribute lubricant throughout the duct. Sponges should be tight-fitting. A mesh bag can be attached to the end of the conduit to catch foam spreaders at the far end.
- 3) Follow equipment manufacturer recommendations to install cable. Run a pre-installation (crash) test to determine drive wheel/belt settings. Once cable is moving, do not stop.

RECOMMENDED LUBRICANT QUANTITY – POLYWATER PRELUBE 2000

Prelube 2000 Lubricant is effective at very thin coating levels.

DUCT SIZE (SDR 11)	POLYWATER PRELUBE 2000 QUANTITY	
	PER 1000 FT	PER 1000 M
(0.75 inch) 25/20 mm	3.5 fl. oz.	300 ml
(1 inch) 32/26 mm	4 fl. oz.	400 ml
(1.25 inch) 40/32 mm	5 fl. oz.	500 ml
(1.5 inch) 50/40 mm	6 fl. oz.	600 ml
(2 inch) 63/51 mm	8 fl. oz.	800 ml

Prelube 2000 lubricates efficiently at coating levels of 0.5 mg/cm². Prelube 2000 works best with a foam sponge spreader to help coat the entire length of the conduit. Foam sponge should have a snug fit inside the duct with some compression.

LUBRICATION PROCEDURE – MICROCABLE, MICRODUCT

Blown cable installation for microcable and duct requires slightly different lubricant techniques than standard cable blowing. In both cases, lubricating the duct before the cable is blown will increase the distance, safety, and speed of installation. For microduct, it is particularly important to have good air flow and avoid hydro locks.

- 1) Clean conduits thoroughly by blowing a mandrel or foam disc through the conduit prior to lubricating the conduit. This will remove water, dirt, sand, mud, or gravel and ensure the conduit is not blocked by ice or displaced sections and is not collapsed. Continue to blow foam discs through the conduit until they exit dry and clean. Sponges that are torn or damaged may indicate sharp edges or other obstructions within the duct system.
- 2) Add a few drops of lubricant into the microduct and then insert first sponge. Push the sponge into the duct the recommended length and squeeze appropriate lubricant quantity into the microduct. Insert the second foam sponge spreader and blow through the duct at low pressure to distribute lubricant throughout the duct.

Sponges should be tight-fitting. A mesh bag can be attached to the end of the conduit to catch foam spreaders at the far end.

- 3) Follow equipment manufacturer recommendations to install cable. Run a crash test to determine drive wheel/belt settings. Once cable is moving, do not stop.

RECOMMENDED LUBRICANT QUANTITY – POLYWATER PRELUBE 5000

Prelube 5000 Lubricant is effective at very thin coating levels. Usage quantity recommendation is lower than quantity recommendation for larger ducts lubricated with Prelube 2000. Polywater 5000 microcable lubricant is effective at coating levels of 0.05 mg/cm².

MICRODUCT SIZE (ID)	POLYWATER PRELUBE 5000 QUANTITY (DUCT FILL LENGTH)	
	PER 1000 FT	PER 1000 M
5 mm	3 ml (5 inches)	8 ml (40 cm)
6 mm	3 ml (4 inches)	9 ml (33 cm)
8 mm	4 ml (3 inches)	13 ml (25 cm)
10 mm	5 ml (2.5 inches)	16 ml (20 cm)
12 mm	6 ml (2 inches)	19 ml (17 cm)
15 mm	8 ml (1.7 inches)	24 ml (13 cm)

Prelube 5000 works best with a foam sponge spreader to help coat the entire length of the conduit. The foam sponge should have a tight fit inside the duct with some compression.

COLD WEATHER CONSIDERATIONS

Temperatures below freezing challenge all aspects of installing cable in conduits. Labor, equipment, conduit, cable, and cable lubricants are all affected by below freezing temperatures. Cable stiffness increases in cold temperatures, and this may increase pulling tension. A high-quality winter grade lubricant is a critical component for cold weather cable installation.

Polywater winter grade lubricants contain an anti-freeze solution to lower the freeze point. As the lubricant temperature drops below freezing, the lubricant will become thicker as slush begins to form. Polywater winter grade lubricants continue to perform at low temperatures, lubricating cable and lowering coefficient of friction. It is important to keep the lubricant as warm as possible before use. Larger packages take longer to thicken and freeze. Polywater's winter grade lubricants can be used down to -20°F (-30°C). Polywater lubricants do not phase out or separate after freeze/thaw cycling.

GENERAL NOTE

The primary purpose of this guide is to describe best practice for lubricant use during the installation of communication cabling. Review information from cable and equipment manufacturers for further details.

CABLE PULLING LUBRICANTS

Polywater has a broad selection of lubricants for use in a wide range of applications. Some high-performance lubricant options for communication cables are described below.

Polywater F Lubricant

Polywater F Lubricant is a high-performance, pourable, liquid, cable-pulling lubricant recommended for pulling underground fiber optic cable. Polywater F is also suitable for pulling coaxial and copper pair cable. Polywater F is a stringy liquid that is applied by pouring or pumping the lubricant into the duct system. It is compatible with a broad range of cable jackets, including polyethylene and prelubricated innerducts. For more information, please see product webpage: <https://www.polywater.com/en/product/polywater-f-lubricant/>

Polywater FTTx Spray Lubricant

Polywater FTTx is highly concentrated and works with only a thin coating. It can be sprayed or wiped for easy application or poured into innerduct for long pulls. Polywater FTTx continues to lubricate after it has dried, leaving a slippery film that retains lubricity for months after use. It is recommended for quick and easy lubrication with no mess. The lubricant is suitable for all types of communication cable installations. For more information, please see product webpage: <https://www.polywater.com/en/product/polywater-fttx-lubricant/>

Prelube 2000

Prelube 2000 is a high-performance, lubricant designed specifically to coat ducts prior to cable blowing installation. Prelube 2000 is recommended for duct ID 16 mm and higher. It is highly concentrated and works with a very thin coating. Once dried, it continues to perform. It is suitable for all types of communication cables and ducts. The residue is a thin, slippery film that retains lubricity for months after use. For more information, please see product webpage: <https://www.polywater.com/en/product/polywater-prelube-2000-lubricant/>

Prelube 5000

Polywater Prelube 5000 is specifically formulated for the installation of small diameter, fiber optic microcables. It is recommended for cables blown into microduct ID less than 15 mm. It spreads and coats microduct, remaining effective after drying. Prelube 5000 is compatible with all types of communication cables and ducts. For more information, please see product webpage: <https://www.polywater.com/en/product/polywater-prelube-5000-lubricant/>

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CONTACT US

+1-651-430-2270 Main | Europe, Middle East, North Africa +31 10 233 0578 | email: support@polywater.com

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