American Polywater's
Technical Talk
A Publication for Engineers Involved in Cable Installations

Lab Report

Abstract:

Friction coefficients were measured in a wound duct test for 12/10 mm microduct pulled over an existing cable. The microduct was pulled both unlubricated and lubricated with Polywater® FTTx. The friction coefficients determined were similar to those measured when microduct was pulled into a non-occupied (empty) HDPE duct.

A significant reduction in friction was measured using the Polywater® FTTx lubricant. The most effective way to reduce friction was wiping the microduct with the FTTx lubricant saturated on a towel. Based on the friction reduction observed, microduct could be pushed 2 to 3 times farther if lubricated with Polywater® FTTx.

Objective:

An inquiry was received on the appropriateness of pushing microduct into an occupied conduit using Polywater® FTTX. To answer this question, a friction study of HDPE microduct (12/10 mm) in an occupied innerduct was needed.

Background:

Blowing or jetting is the most common way to install longer runs of microduct in an exterior conduit. This blowing combines a pushing force with a localized force on the microduct from the high velocity air. Friction reduction is critical to optimize installed length, and Polywater® Prelube 2000 is the preferred product for blowing installation.

However, for shorter runs of microduct, pushing (or push/pull installation) can be sufficient. Such hand pushing requires no equipment and is both fast and simple. On occasion, the conduit is not new or empty, and the microduct must be pushed into a conduit on top of an existing cable.

Procedure:

The test method used was a modification of Bellcore test procedure TR-TSY-00356 Sections 4.1.3 and 4.1.4. This method uses the quick build-up of tension through multiple bends to quantify friction.

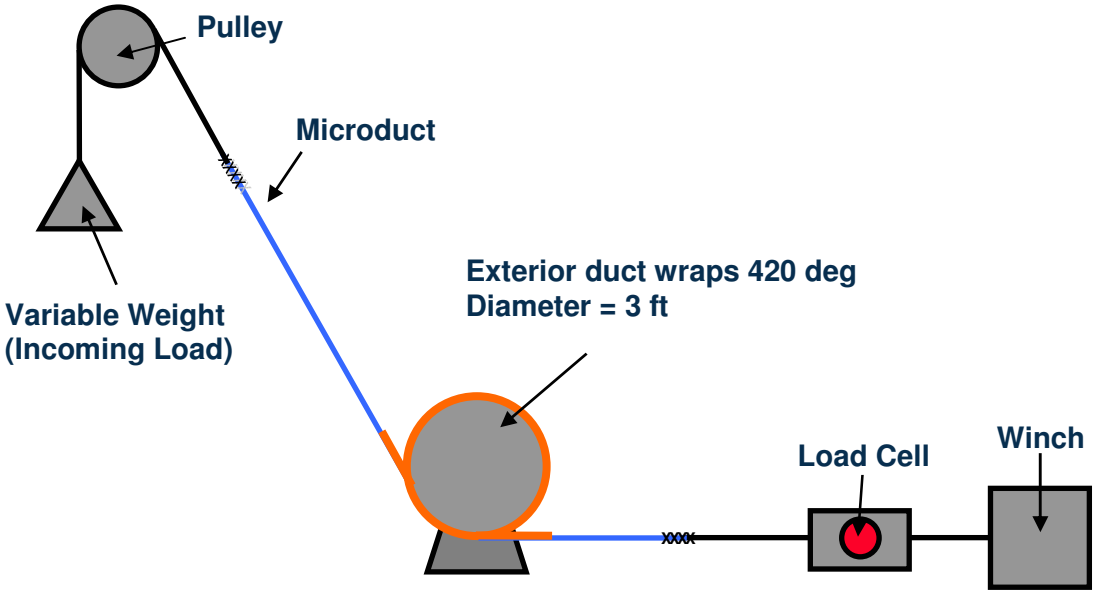

Figure 1 – Multiple Bend Friction Testing Apparatus

Figure 1 shows the test set-up. The 1.25-inch exterior innerduct (containing a 0.625-inch MDPE jacket cable) was wound 420° around a 3-foot mandrel. The microduct was pressurized and plugged to keep it from collapsing or kinking. The microduct was pulled through the innerduct on top of the interior cable. The pulling force was measured every half second using a load cell.

Incoming tension could be put on the microduct by a weight suspended from a pulley 15 feet above the pulling plane. Five different weights (two to twenty-five lbs incoming tension) were used. The microduct was pulled by the winch at a speed of 65 feet per minute. Pulling force data was captured directly by a PC and a spreadsheet averaged the pulling tension and calculated the friction coefficient. Note that the microduct was moving when these force readings were taken, and thus represent a “kinetic" friction coefficient.

Equation (1) was used to calculate the coefficient of friction:

Equation (1): $$\mu = \frac{\ell n\left(\frac{T_{out}}{T_{in}}\right)}{\theta}$$

Where: μ is the kinetic coefficient of friction (dimensionless)
T_{in} is the incoming tension (lbs)
T_{out} is the measured pulling tension (lbs)
θ is the total angle of duct around bend (7.33 radians)

In the first set of pulls (results below), the microduct was pulled against the fiber cable-in-conduit using no lubricant. Note that at 25 lbs. incoming tension without lubrication, tension forces destroyed the microduct during the test.

Figure 2 - Polywater® FTTx in Quart Spray Bottle

For the lubricated testing, Polywater® FTTx was chosen as most appropriate for this type of installation. Polywater® FTTx is a thin, highly concentrated liquid designed for ease of use and lubrication efficiency in "smaller" fiber installations.

In the second set of pulls, 5 squirts from a spray bottle of Polywater® FTTx lubricant (shown in Figure 2) was sprayed into the entry end of the conduit before beginning the pull.

In the third set of pulls, Polywater® FTTx lubricant was applied directly to the microduct with a saturated wipe (Figure 3).

Figure 3 – Polywater® FTTx is available in a wipe

Results:

Ribbed 12/10 mm microduct
1-1/4" HDPE w/OSP MDPE cable inserted
No Lubricant

Tension Incoming (lbs)	Avg Tension Outgoing (lbs)	Coeff. of Friction
2	15.1	0.28
4	31.6	0.28
8	55.3	0.26
14	106.9	0.28
25	Destroys microduct	NA

Ribbed 12/10 mm microduct
1-1/4" HDPE w/OSP MDPE cable inserted
FTTX Spray

Tension Incoming (lbs)	Avg Tension Outgoing (lbs)	Coeff. of Friction
2	6.2	0.16
4	9.0	0.11

8	17.9	0.11
14	32.7	0.12
25	54.6	0.11

Ribbed 12/10 mm microduct
1-1/4" HDPE w/OSP MDPE cable inserted
FTTX wipe

Tension Incoming (lbs)	Avg Tension Outgoing (lbs)	Coeff. of Friction
2	4.0	0.09
4	8.0	0.09
8	15.5	0.09
14	25.7	0.08
25	44.6	0.08

Discussion:

While the comparisons are not shown, these friction results are quite similar to the friction measured with microduct in a non-occupied (empty) exterior duct. The cable present in the conduit does not cause a significant difference in the test.

There is a significant reduction in friction coefficient with the Polywater® FTTx lubricant. A complete wipe of the microduct showed the lowest friction and is the most effective way to apply the lubricant. Polywater® FTTx is appropriate and recommended for microduct pushing or microduct push/pull.

Topic Related Links

Polywater FTTx Flyer
Other FTTx Product Literature
Polywater Blowing Lubricants

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