# Fibre Optic Cable Blowing

Some interesting installation methods are being used to put fiber optic cable in duct.
Sometimes called "cable blowing", these methods use a high-volume air flow (7 bar back pressure) to "push" the cable.
Most blowing machines also have mechanical "pushing", where the cable is pushed by traction rollers as it enters the duct. First, let us review the two basic types of blowing installation.

## Piston Type

In this type of blowing unit, an air-tight piston is attached to the front of the cable. The air pushes this piston, and the piston "pulls" the cable. The pulling force is essentially the air pressure times the piston area. At 8 bar, the force can be 700N for 32mm high density polyethylene innerduct.
Field users should be aware that a pulling force exists in piston blowing, and cable tension maximums should be respected.

## Laminar Flow Type

The second type of blowing unit does not use a piston - and allows full air flow through the duct. Calculations indicate that air speeds of 100 m/h are possible. This rushing air pushes on the cable jacket, providing a general force "all over" the jacket.

## Mechanical "Pushing"

Pushing has always been an effective way to make short runs of cable in conduct. However, you can only push a cable to the point that it buckles, which can be less than 50N for a flexible, indoor cable, and up to 300N for an armored, outdoor type cable.
Even in straight ducts, pushing of typical outdoor cables is limited to maximum 100m.
This means the air forces, piston or laminar, are key to making blowing units function for the 1000 - 2000m runs typical for outdoor cable application.

## Air Tight Duct

Cable blowing machines don't work unless the duct is air-tight. Reinforced duct splices are usually required. Most cable blowing to date has been done in continuous polyethylene innerduct, which minimizes opportunities for air loss. It's a mistake to try to blow cable into a duct that has not been prepared for the pressures and forces involved.

## Key Application Parameters

Fiber Optic cable-blowing research indicates three major factors control how far a cable can be blown. These are:

- Duct **fill** (cable to duct size ratio)
- Cable **flexibility** or stiffness
- Coefficient of **friction** (lubrication)

Belden completed a series of experiments in 1996 on high speed air blowing with both piston- and laminar flow unit. Coefficient of friction was studied. The results are useful to those blowing or planning on blowing cable.

## Experimental Method

Cable was threaded through a 2000m multi-bend duct run. The force on the cable was from the airflow and pushing. This force was measured with a load cell. The airflow to the blowing unit could be increased to the compressor maximum capacity of 9 bar.

## Unlubricated versus Lubricated

With paraffin oil coated on the duct wall as a lubricant the friction forces will be reduced. The effect of lubrication is most significant with stiff jacket materials (nylon, high density polyethylene). As a result the maximum blowing distance can be doubled.
Use only cable/duct lubricants recommended by its blowing equipment manufacturer for optical fiber cable. Do not use soap or equivalent substances that may induce stress cracking of the jacket material.

## Lubricating Duct vs Cable

Preferably the lubricant is applied to the interior of the duct (by blowing through a coating missile before blowing the cable). This gives better results compared to coating on both the duct and cable. This indicates the cable jacket should not be "slippery" for optimal laminar-flow blowing. Remember, the air "pushes" on the jacket - through friction. A low friction jacket will not be as easy for air to push. Normally 0.25 liter lubricant is used to coat 2000m duct.

## Jacket materials

In order to gain minimum friction forces during cable blowing it is important to know the effect of different cable jacket materials. Relatively stiff materials like polyamid (nylon) and high density polyethylene (HDPE) give better results compared to low density polyethylene (LDPE) and flame retarded compounds (LSZH).

## Cable / Duct size ratio

To prevent buckling of the cable is it recommended not to use relatively small diameter cables in large ducts. As a guideline we recommend cable with an outer diameter approximately 50% of the duct inner diameter.

## Duct internal design

The maximum blowing distance can be influenced by the internal design of the duct (smooth, ribbed, corrugated, etc.). In general, the blowing distance in a S/Z ribbed duct will be 100% more compared to a longitudinally ribbed duct.

## Bends in Duct run

Sharp bends will reduce the maximum blowing distance. We advise a minimum duct radius of 1m. A large distance between the individual bends has also a positive effect. With a piston flow unit it is better to have the bends in the first part of the duct run, with a laminar flow unit at the end.
The piston type of blowing leads to double blowing distances in comparison with laminar flow.

## Recommendations

- Follow the recommendations of both the blowing equipment and cable supplier.
- A crash test should be performed to determine the **maximum push force**. Excessive pushing will cause the cable to cork screw in the duct or fold over which will damage the fiber.
- Cable with **smaller diameters** and **lower weight** will require a lower maximum push force and achieve larger blowing distances.
- The maximum cable push force will also decrease as the duct inside diameter increases.
- Do not exceed a 55 bar force for Loose Tube cables with a diameter < 15mm and 35 bar for cables < 12mm. Cable guides must be used for cables ≤ 25mm in diameter.
- Prepare the duct for blowing. This includes assuring the duct inside diameter has sufficient cable clearance for proper blowing. The duct entrance/exit must meet the cable bend radius specification.
- Use the **proper cable seals**/guides based on the cable diameter.
- Cable **end cap** or sealing is recommended to keep the air pressure out of the cable.
- Do not over tighten the top of the blowing unit. Use springs to control the maximum compression force.
- Consider the route to determine the maximum blowing distance. Follow the blowing equipment suppliers blowing distance recommendations; **1000 to 2000m is a typical blowing length**. A set up with multiple blowing machines may be required.
- Maintain proper air flow to “blow” the cable verses “pushing” the cable.
- Using an air compressor with a **minimum flow** of 420 $m^3$/h (32mm duct) to 640 $m^3$/h (40mm duct) is recommended. The minimum air pressure in the duct should be 7 bar with 8,5 bar recommended. Using a piston flow unit will reduce the flow to 240 $m^3$/h.
- Air compressor cooler should be used as recommended by the blower equipment manufacturer. Typically this is when the ambient air temperature exceeds 27˚C.
- Do not attempt to overdrive the blowing machine. **Higher speeds** will not provide much of a time savings or increase the maximum blowing distance.
- The cable should be clean as it enters the blowing equipment to allow for proper gripping of the cable. Contamination of the cable will increase the friction and result in reduced blowing distance

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