Cable and Microcable Installation by Air Blowing

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The air-blowing method is used to install cables into ducts over long distances, as well as to install microcables into microducts regardless of route length. The required equipment includes a cable blowing machine, an air compressor, and the appropriate hoses and fittings for connecting the compressor to the blowing machine. The following section describes the cable blowing procedure. The installation of microcables follows essentially the same process but uses equipment specifically designed for smaller cable and duct dimensions.

A cable blowing machine inserts and pushes the cable into the duct, while the air compressor generates the high air pressure and airflow required to suspend the cable and propel it efficiently through the duct. The compressor is connected to the cable blowing machine using suitable hoses and fittings, allowing compressed air to flow through the polyethylene (PE) duct.

It is essential that all installed ducts are airtight. This means that the ducts must be free from damage and that every coupling has been installed correctly. In addition, the ducts must be clean and free of dirt, foreign particles, and moisture. Various inspection and cleaning methods are used before installation, including specialized duct brushes, dry compressed-air cleaning, and other suitable techniques.

The maximum blowing distance depends on several factors, including the blowing equipment—particularly the air compressor—the cable stiffness and weight, the duct fill ratio (DFR), the condition of the route, and atmospheric conditions.

Cable stiffness depends on its construction, including whether the cable is metallic or non-metallic, the jacket material, and the number of buffer tubes. Installing very lightweight, small-diameter, and highly flexible cables by air blowing can be challenging. In such cases, cable pistons may be attached to the cable end to increase the pulling force generated by the compressed air. Stiffer cables generally achieve longer blowing distances on straight routes, while more flexible cables are better suited for routes containing numerous bends and elevation changes.

A key parameter in cable blowing is the relationship between the cable outside diameter and the duct inside diameter, commonly referred to as the Duct Fill Ratio (DFR). It is calculated as:

$$DFR\ (\%) = (d / D) \times 100$$

where:
d = cable outside diameter (mm), and

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D = duct inside diameter (mm).

Optimum blowing performance is generally achieved when the DFR is between 50% and 70%. The maximum recommended value is 80%. If the DFR is below 50%, the cable may buckle inside the duct, although this can often be prevented by properly adjusting the cable pushing force.

Atmospheric pressure decreases with altitude, reducing the effective blowing distance. For example, Denver, Colorado, has approximately 19% lower air density than sea level, which reduces the performance of air-blowing systems.

Temperature also influences the amount of moisture in the air. The recommended temperature range for cable blowing is approximately –10°C to 49°C. Under extremely dry conditions, static electricity may build up on the cable, increasing its tendency to adhere to the inner wall of the duct.

Before installation begins, the cable diameter should be measured with a vernier caliper to set the correct spacing between the drive wheels of the blowing machine. This ensures that the cable fits securely into the V-groove formed by the drive wheels. The installer should also verify that the cable does not slip between the wheels by manually pushing and pulling it several times. The cable should enter the blowing machine in a straight line and remain clean to minimize friction and maximize blowing distance. During installation, the cable should never be allowed to come into contact with the ground.

The air compressor delivers a large volume of compressed air into the duct, enabling the cable to move forward. The pulling and pushing forces are distributed evenly along the entire cable length, significantly reducing the tensile load at any single point. The effect of the compressed air is so efficient that, in most installations, there is no need to attach a cable piston to the leading end of the cable.

Before blowing begins, the cable should be manually inserted into the duct for several tens of meters (typically 50–100 m). The blowing process is then started by turning on the air compressor while keeping the drive wheels disengaged. Once the cable has straightened inside the duct, the drive wheels or tractor belts are engaged. Depending on the machine design, they may be powered by an electric motor, a hydraulic drive, or compressed air. The airflow causes the cable to float inside the duct, reducing friction and minimizing contact with the duct wall.

During installation, the air pressure must be continuously monitored to prevent cable damage. It is equally important to set the maximum cable pushing force, which depends on the cable stiffness, the available clearance between the cable and the duct, and the characteristics of the blowing equipment.

Suitable cable blowing lubricants may also be applied inside the duct to further reduce friction and increase the achievable blowing distance.

Typical characteristics of cable blowing systems include:

- cable diameter: 6–20 mm,
- duct inside diameter: 20–60 mm,
- maximum continuous blowing distance: approximately 3–4 km,
- typical installation speed: 80–120 m/min, and
- maximum operating air pressure: approximately 14 bar.

During cable installation, one or two technicians remain at the cable reel to feed the cable and ensure that it unreels smoothly, while another technician monitors the blowing machine to ensure that the drive wheels or tractor belts do not damage the cable jacket. To prevent cable damage if the cable suddenly stops during installation, modern blowing machines automatically stop the drive mechanism whenever excessive pushing force is detected.

Figure 1. Microcable blowing

Excessive friction may occur during cable installation for several reasons, including:

- bends in the duct,
- obstructions inside the duct (soil, roots, sand, etc.),
- insufficient use of blowing lubricant, and

- severe twisting of the duct caused by improper installation.

In each of these situations, the installation should be stopped and the cable withdrawn until the cause of the problem has been identified and eliminated. Any excess cable should be stored safely in a figure-eight configuration to prevent twisting and kinking.

To maintain reliable operation and consistent performance, cable blowing equipment should be cleaned periodically (for example, at least once during each week of continuous operation).

Before installing cables by the air-blowing method, as well as before manual or mechanical cable pulling, and prior to fusion splicing, the required preparatory work in the handholes or manholes should be completed. These activities include:

- securing the work area and installing the appropriate traffic control signs to ensure personnel and public safety,
- opening the handhole or manhole and placing the cover at a safe distance,
- checking for hazardous gases using an approved gas detector,
- providing adequate lighting,
- providing proper ventilation by opening not only the work chamber but also the two adjacent chambers for up to 30 minutes, particularly in urban areas where natural gas pipelines may be present,
- cleaning the chamber and pumping out water when necessary, and
- verifying duct continuity and cleaning the ducts using a fiberglass duct rod together with suitable ropes, brushes, or cleaning swabs.

During cable installation, cable slack should be left in predetermined handholes or manholes (Figure 2). These slack loops are provided to allow future splice closures to be installed (typically 15–20 m of cable), to provide reserve cable for emergency repairs (typically 40–50 m), or to facilitate the future routing of cables into cabinets or buildings.

Figure 2. Handholes/manholes with splice slack (left) and emergency cable reserve (right) (Source: FOA)

Ducts and microducts may also be routed directly into cabinets or buildings, where optical splitters are typically installed to distribute optical signals throughout the network or to provide subscriber connections, as illustrated in Figure 3.

Figure 3. Installation of microducts and microcables into a street cabinet

All cables installed in handholes, manholes, and cabinets should be clearly identified using durable plastic identification tags. Proper cable labeling becomes particularly important in locations where a large number of cables are present, simplifying future maintenance, troubleshooting, and network upgrades.

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