

BLOWING PROCEDURE FOR CABLES AND FIBER UNITS

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1. INTRODUCTION

This document tries to give an overview of different air-assisted installation techniques for optical cables and fiber units through micro-ducts. These techniques must be used to make the fiber deployment of UGG in Germany, and all the recommendations given in this document must be considered during the deployment.

1.1 REVISIONS

EDITION	DATE	REVISED SECTIONS	CHANGES	OBSERVATIONS
1 st	OCTOBER 2020			
2 nd	APRIL 2021	All	The entire document has been revised and some sections have been moved References to Telefonica or FiberCo have been changed to UGG	
		2.2.1 Fill Ratio	Added a table of the smallest and optimal microduct sizes for each cable	
		2.2.5 Duct Lubrication	Added the general steps for a correct lubrication as well as images of the products	
		4.3 Blowing Report	New section	
		4.4 Blowing optical fiber cables	Lubrication of the route method has been revised Added general steps for optical cable blowing	
		5. List of annexes	Descriptions of microducts, fiber units and optical cables have been moved to annexes	

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EDITION	DATE	REVISED SECTIONS	CHANGES	OBSERVATIONS
3 th	DECEMBER 2023	All the document	New codification	<p>The document is codified with the document code: TEF-NORM-00002.</p> <p>The logo of UGG is updated in the page header.</p>

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2. AIR-ASSISTED INSTALLATION TECHNIQUES

2.1 INTRODUCTION

The laying of optical cables in micro-ducts systems using air-assisted installation techniques require different requirements than traditional pulling. The condition of the pipeline must be perfect (clean, and without any leaks in all the connections in the path) to make possible this kind of installation successfully. However, these installations techniques enable the installation of longer cable lengths and reduces labour and material expenses.

Jetting and blowing are two common air-assisted cable installation techniques. Both methods require pushing the cable with a tractor mechanism while blowing compressed air into a preinstalled duct around the cable being installed. Both rely on air flow to help “float” the cable inside the duct, minimizing sidewall pressures to reduce friction between the cable and the duct.

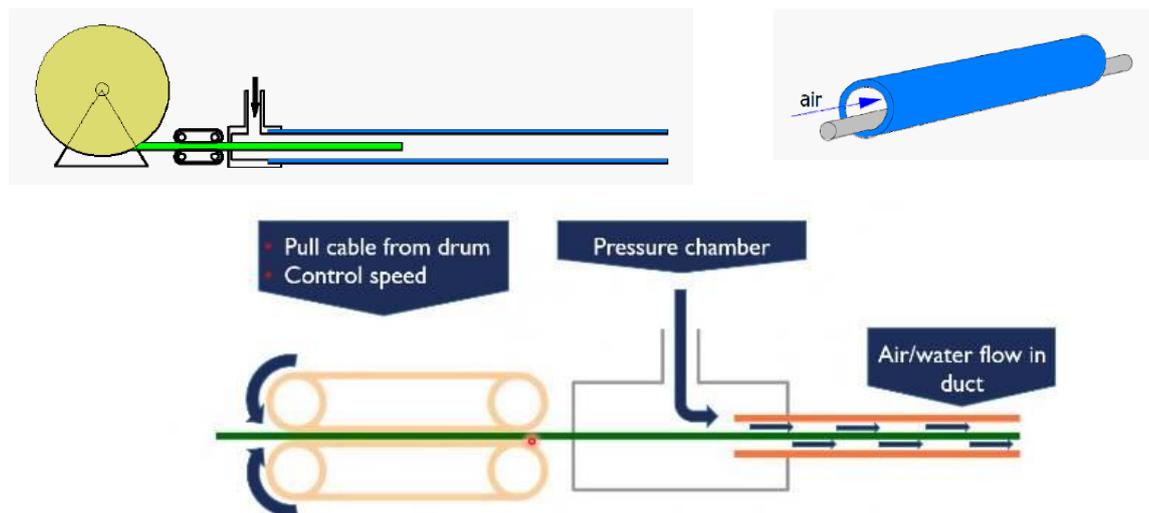


Figure 1. Schemes of blowing procedure

Jetting and blowing differ, though, in how pulling force is applied to the cable. Jetting uses a reaction head (or parachute) attached to the cable. A differential pressure across the reaction head creates a pulling force on the cable. Blowing does not use a reaction head. Instead, the pulling force on the cable is due to fluid drag of air rushing along the cable. This pulling force is distributed along the cable length.

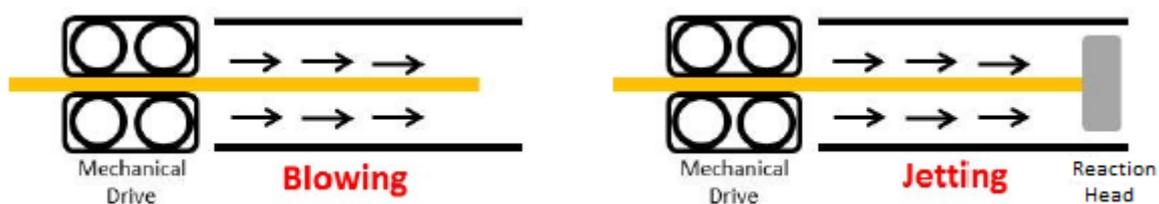


Figure 2. Difference between blowing and jetting

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With these kinds of procedures it is possible to install optical cables in a long distance, in a single blowing operation and in a fast way. Longer lengths can be achieved by cascading devices (i.e., providing mid-assist) throughout the cable run.

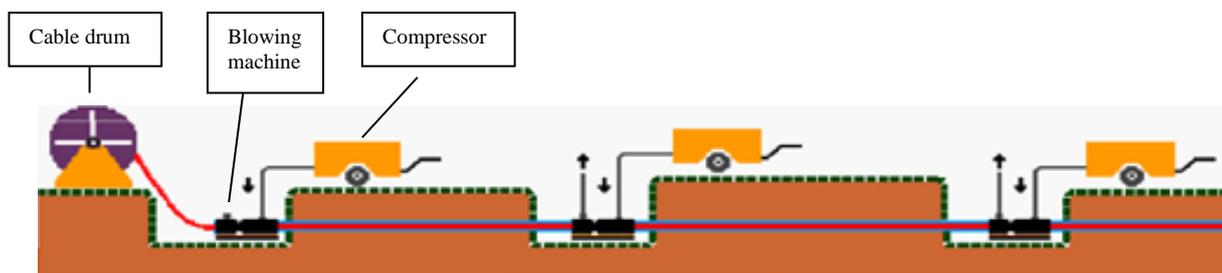


Figure 3. Example of cable blowing by cascading

2.2 GENERAL CONSIDERATIONS

In typical (non air-assisted) cable pulling operations, the friction between the cable and the duct wall, especially from the contact at bends and/or elevation changes, results in the pulling tension increasing exponentially as the cable length pulled into the duct increases. Air-assisted installations minimize these contact forces.

Regardless of whether a cable is pulled or jetted, cables which tend to conform to a set curve (e.g. wound on a reel), will generate more side force, and more drag. This is observed in reduced jetting distances for rigid cables and for cold cables relative to warm ones. Further, both effects worsen as cable diameters increase.

When preparing for an air-assisted installation, the following parameters should be considered:

- Cable and duct size (i.e., fill ratio)
- Cable type
- Ambient temperature/humidity
- Maximum hydraulic pressure of the tractor mechanism
- Cable bend radius
- Duct type and condition
- Duct lubrication

2.2.1 FILL RATIO

When pulling cables, the fill ratio is calculated using areas, or relation between diameters (d/D). For optimum performance when blowing or jetting cables, is possible to use simple diameters to calculate the fill ratio, with a recommended range between 50% to 80%.

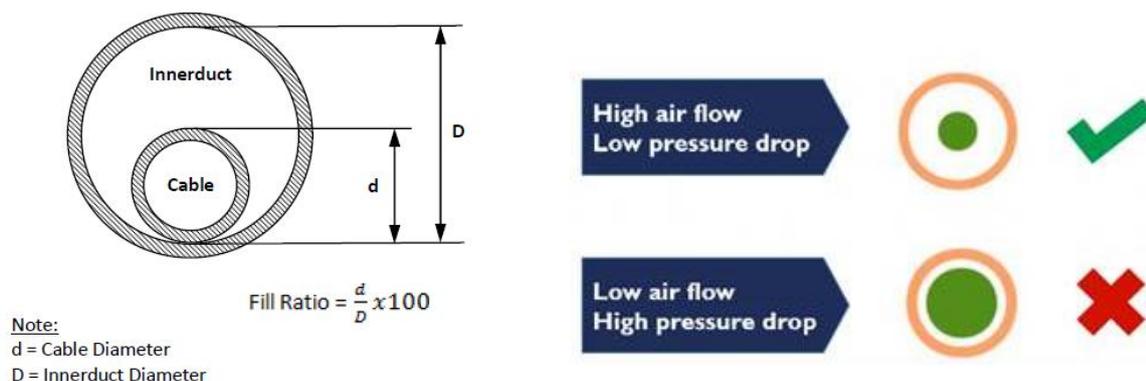


Figure 4. Fill ratio

In general, higher cable-to-duct fill ratios achieve longer installation distances for air-assisted installations. This is due to the cable's ability to be pushed through the duct without forming a helically shaped wave within the duct. However, performance on high fill ratios can be hindered by the inability of the cable to bend through turns along the cable route.

That's why it's important to use the correct duct size for each optical cable, to achieve the longest blowing distance and also optimize and reduce future blowing problems.

									
Fiber Count	12 F	24 F	36 F	48 F	72 F	96 F	144 F	192 F	288 F
Cable OD	6,5 mm	8,2 mm	8,2 mm	9,5 mm					
Smallest Duct ID (fill ratio)	10 mm (65%)	10 mm (82%)	10 mm (82%)	12 mm (79%)					
Optimal Duct ID (fill ratio)	10 mm (65%)	12 mm (68%)	12 mm (68%)	12 mm (79%)					

Table 1. Smallest and optimal microduct sizes for each cable in UGG portfolio

NOTE: OD: Outer Diameter and ID: Inner Diameter

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2.2.2 *PUSHING FORCE ON TRACTOR MECHANISM*

When installing cables in lower fill ratio applications, regard to the maximum pushing force applied in the tractor mechanism should be observed to safeguard against damaging the cable. If the maximum pushing force is used, smaller diameter cables are more prone to buckle at the duct entry point if obstructions are encountered. The maximum pushing force is typically determined by on-site testing, but general guidance is available from manufacturers of specific equipment.

2.2.3 *BEND RADIUS*

The minimum cable-bending radius should be considered during any optical cable installation.

This bend radius is based on the cable construction and is calculated to provide the smallest bend the cable can be subjected to before cable or fiber damage may result. The radius of conduit bends, cable guides, sheaves and capstans should be equal to or greater than the cable minimum bending radius.

Historically, minimum bend radius of optical fiber cables has been > 15 times the outer diameter of the cables during installation. However, it is recommended that the minimum bend radius specifications for the cable in question be confirmed prior to installation.

2.2.4 *DUCT TYPE AND CONDITION*

Duct type is an important consideration when using an air-assisted installation method.

Variation in achievable distances will be seen based on the type of duct selected. For example, corrugated innerduct will tend to reduce the performance relative to smooth wall or ribbed type ducts due to the disruption of airflow within the duct.

Duct integrity and cleanliness are also very important. The innerduct should be clear of mud, water, and other obstructions that will reduce the effectiveness of the air assisted technique. Innerduct tension is important since an over tensioned installation may result in necking of the innerduct.

Partial collapse of the innerduct will also have the same effect. Nail holes and poorly installed couplings will reduce effectiveness and installation distance, since air leakage will occur, thereby reducing the “floating” ability of the conveying airflow.

2.2.5 *DUCT LUBRICATION*

Duct lubrication is another parameter to consider. Manufacturers of air-assisted installation equipment offer lubricants designed especially for these types of installations. Formulations vary considerably depending on specific installation technique. Installation contractors should contact the equipment manufacturer for the recommended duct lubricant and the cable manufacturer to determine the compatibility of the lubricant and the cable sheath. Given the proper lubricant, the coefficient of friction between the cable outer sheath and the duct wall can be minimized for a variety of cable sheathing materials. Minimizing the friction will allow for longer installation lengths.

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The duct and equipment manufacturers should always be consulted for specific installation guidance, including lubrication.

In general, the steps to properly lubricate the duct are:

1. Insert a leading sponge the proper depth in the duct (check the lubricant instructions).
2. Apply the appropriate amount of lubricant in the duct (check the lubricant instructions).
3. Insert a trailing sponge in the duct.
4. Apply full airflow and verify both sponges arrive and observe the time.

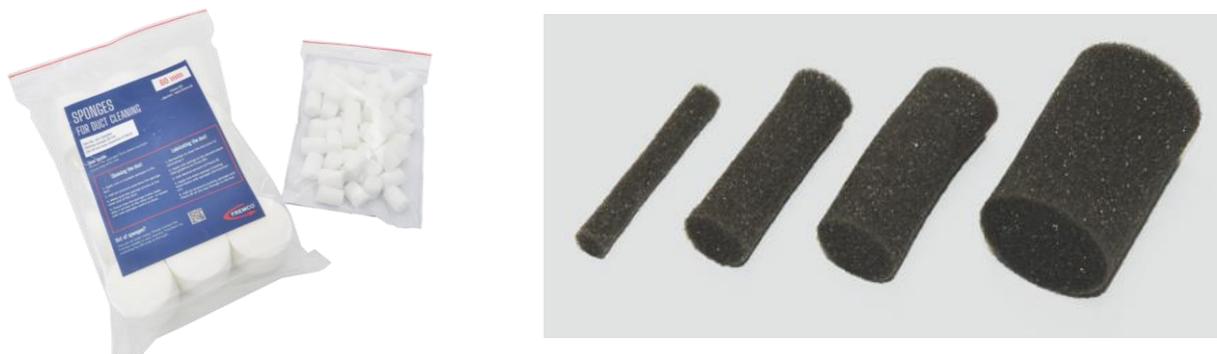


Figure 5. Sponges for duct cleaning



Figure 6. Lubrication for cable blowing

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3. BLOWING METHODS SCHEMES

This section outlines the methods used for blowing optical fiber cables and will include ‘Point to Point Blowing’, ‘Onward Blowing’, ‘Centre Blowing’ and ‘Tandem Blowing’.

3.1 POINT TO POINT BLOWING

This is the simplest of the blowing procedures and it is used when distances are within blowing distance of the optical cable and micro-duct combination.

In this method the blowing head and the cable drum is disposed in one end of the pipeline. The cable is fed into the micro-duct in one side (origin point) and is expected to emerge in the other side (destination point).

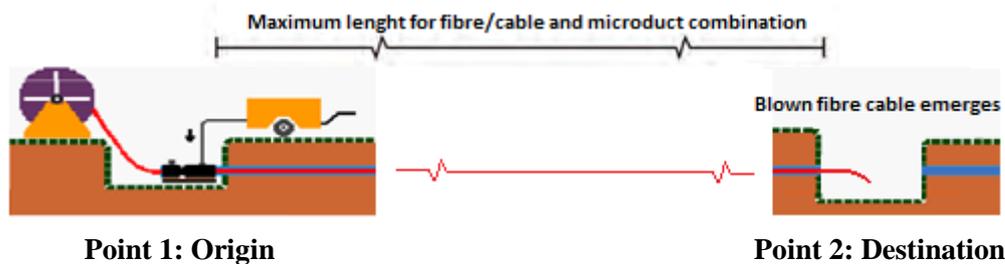


Figure 7. Basic scheme for point to point blowing

3.2 ONWARD BLOWING

This technique allows the extension of the installation distance. The extended distance is dictated by the amount of fiber/cable which is available. The onward blow can be carried out numerous times to extend the route without any splices.

The setup of the equipment initially is the same that for a point to point blow. At the far end where the fiber would normally be terminated it is flected on the ground in a figure of 8. This flected cable is required for the second blowing operation, when the blowing machine moves to the second point. The same step is repeated with the next intermediate point, until the destination point is reached.

The following pictures shows an example of onward blowing with 1 intermediate point:

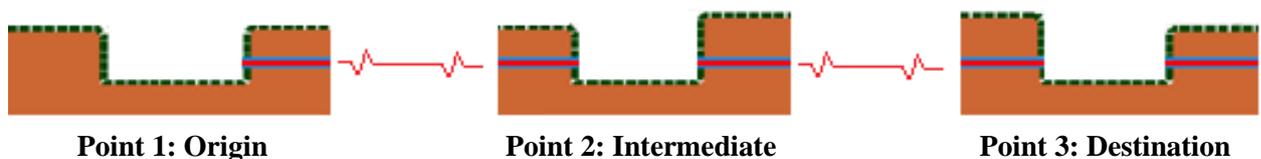


Figure 8. Basic scheme for on-going blowing

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First blowing operation:

This operation blows the cable from the origin point, to the second point (intermediate point). The blowing machine is fed from the drum cable. The cable that goes out in the point 2, must be coiled or flected on the ground making 8 shapes, to avoid tangles.

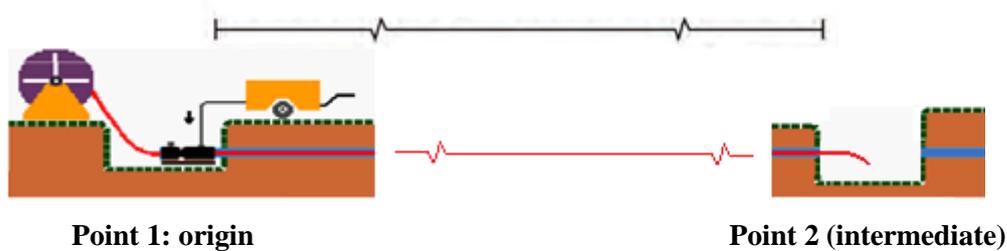


Figure 9. First blowing operation scheme



Figure 10. Example of cable flected on the ground in 8 shape (it has to be made in the intermediate point)

Second blowing operation:

This operation blows the cable from the second point (intermediate point), to the destination point. In this case, the cable is fed to the blowing machine from the floor instead from a drum.

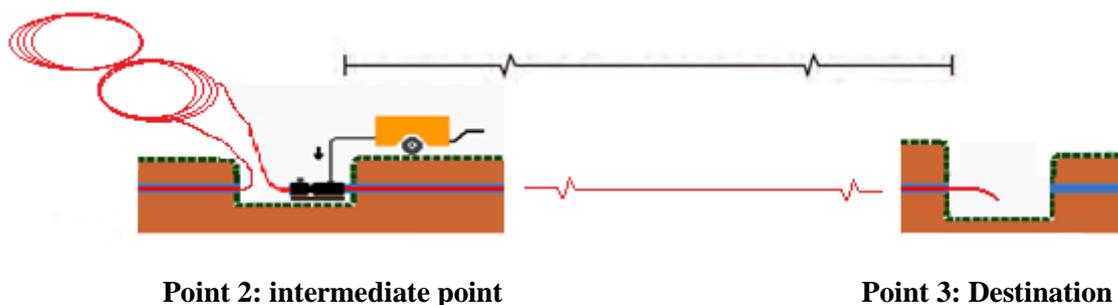


Figure 11. Second blowing operation scheme

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3.3 CENTRE BLOWING

This technique also allows to increase the installation distance of a cable without splices. This method starts blowing the cable from the centre. It also requires less blowing time than the onward blow as it is not necessary to blow the second half of the route through to intermediate chambers.

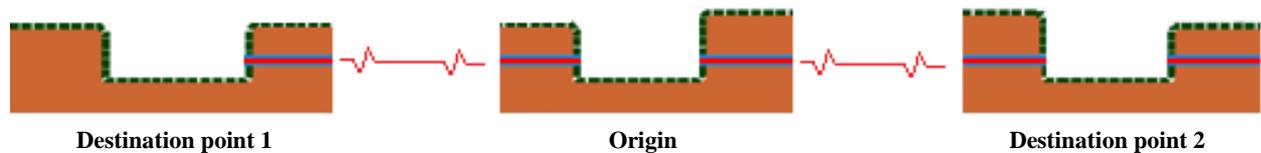


Figure 12. Basic scheme for centre blowing

When blowing fiber unit, after the first half of the route has been installed the fiber pans need inverted. When it comes to installing the second half of the route with mini cable it is necessary to fleet off the required amount from the cable drum.

In this case, is possible to fleet out the cable and store the mini-cable inverted into a collection basket element, instead to put manually in figure eight into the ground.



Figure 13. Example of a collection basket element

With this collection basket element is possible to store the mimicable into the basket using the blowing machine, so the time of deployment is faster than manually. From the basket, is possible to feed directly the cable to the blowing machine for the second blowing operation in the other direction.

When carrying out a centre blow with fiber unit or cables, all the fiber or cable must be blown through leaving no excess at the centre point.

Fiber cable length should be optimised prior to blowing i.e. start with no more than 50m of excess of the total length to be installed. If there was 500m excess, all of this has to be blown through the second micro-duct and recoiled, to eliminate surplus at the centre blow position.

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3.4 TANDEM OR CASCADE BLOWING

Tandem blowing is running two or more blowing machines at different locations at the same time in order to install a longer length of optical cable. This eliminates an onward blowing operation or a centre blowing operation.

This operation requires care in handling the active fiber cable loop at the centre, so it feeds into the second blowing machine without getting tight or tangled on the ground.

Tandem blowing can effectively cut the blowing time in half or more, depending the number of machines used.

The technicians that control each blowing machine must be in constant communications in order to synchronise the blowing speed of each machine that have to be the same.

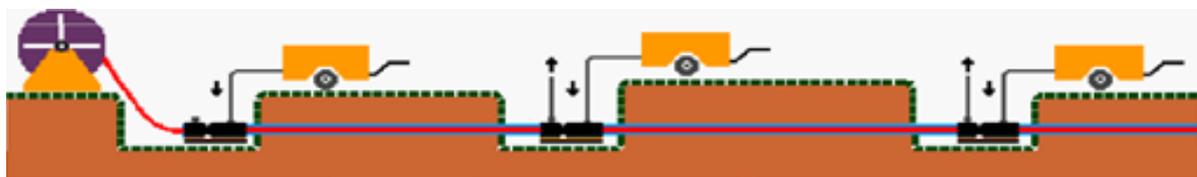


Figure 14. Scheme of tandem blowing

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4. OPTICAL CABLE AND FIBER UNIT BLOWING INSTALLATION

It is possible to blow mini cables for distances up to 2000 m at installation speeds up to 150 m/min (in only one operation). Distances beyond (2000 m) are also possible in fully optimised conditions. A realistic target distance for most scenarios is between 1000 m and 1500 m. Distances and speeds are dependent on several factors including the ambient temperature, micro-duct conditions (route and number of bends), fill ratio and blowing equipment utilised during the install.

For fiber units, 1200 m is a possible distance to blow at installation speeds up to 150 m/min also.

4.1 TECHNICAL TEAM NEEDED FOR BLOWING OPERATIONS

For each blowing operation it is needed to have a team of technicians to control the blowing process.

It is necessary to have technical personal at both ends of the laying path, and at the intermediate points in cases of tandem blowing.

The personal of the destination point must be in permanent contact with the technician that is controlling the blowing machine, in order to communicate the moment in which the cable arrives to the destination. The personal in the destination point, must assure that the cable doesn't hit any obstacle that could damage the cable.

In the case of onward blowing, the personal in the intermediate point must manage the labour of fleet the optical cable in eight shape.

In the case of the tandem blowing, all the technicians that control the blowing process must be in permanent contact between them in order to set the same parameters to the blowing machine (all the machines must had the same installation speed, for example).

4.2 EQUIPMENT NEEDED

4.2.1 COMPRESOR

The compressor is the equipment that supply the compressed air to the blowing head. The compressor must be able to delivery air up to 15 bars to blow optical cables and between 7 and 10 bars for fiber units.

A standard air compressor could be used to supply air for blowing micro cables.

The air to be supplied to the blowing head must be in a good condition, clean, dry and refrigerated, avoiding introducing warm air into the micro-ducts. If it is needed additional components should be added in order to guarantee the air quality for the blowing system. An air cooler at the discharge of the compressor is recommended in order to maintain lower air temperatures within the micro-duct during installation. The lower air temperatures help to ensure the lowest friction between the micro-duct and the cable sheath. Additionally, the air should be as dry as possible for optimal jetting.

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Example of compressor for cable blowing



Example of compressors for fiber unit blowing



Figure 15. Air compressors

4.2.2 AFTER COOLER

The after cooler is a mechanical heat exchanger that goes between the compressor outlet and the blowing head, it is designed to remove the compressed air heat and to condition the air before the cable blowing.

High temperatures sometimes are inevitable when working with compressed air. The after cooler is designed to cool the compressed air and to remove the water droplets prior to entering the blowing head. This type of equipment must be used in warm weather conditions to cool the air before the cable blowing.

The after cooler can be an external element of the compressor or it may be integrated in certain models of compressors.



Example of an after cooler for a compressor for cable blowing



Example of an after cooler integrated in a compressor for cable blowing

Figure 16. After coolers

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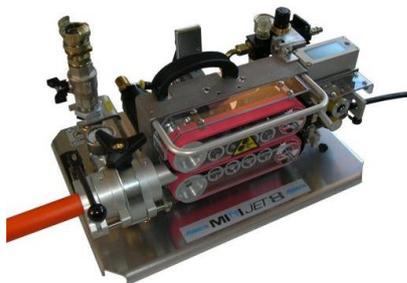
4.2.3 BLOWING HEAD

The blowing head is the equipment that push the cable/fiber unit into the micro-duct while injecting the air into the micro-duct.

This equipment must be set up to the type of cable that is going to be blown and the type of micro-duct (considering the diameters of each, the maximum pressure to apply, etc). It has all the valves and mechanism to control the pressure and the air flow that is going into the micro-duct.

This equipment includes the drive wheels that control the speed at which the cable is inserted into the micro-duct and control the maximum force that must apply avoiding damage to the optical cable in case of a sudden unexpected blockage.

The blowing head measure the distance of the cable installed.



Example of blowing head



Example of a display of a blowing head.



Examples of different blowing head machines to blow for fiber units

Figure 17. Different blowing heads

The mechanical push force for the micro cable installation can be driven by either a pneumatic or electric motor. For added protection of components, the motor should have an automatic shut-off or clutch feature that limits the push force that is applied to the cable. This can also be done by pre calibrating the machine by completing a crash test before the installation starts. This ensures that cable and duct damage can be prevented if the cable stops abruptly within the micro-duct during the installation process.

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Auxiliary elements of the blowing head

Other elements that could be needed to install in the blowing head:

- **Main air supply hose.** To supply the air to the blowing head that will be introduced into the microducts.
- **Pneumatic motor hose.** To supply the pneumatic motor of the blowing head (drive wheels). **Note:** only needed if the motor is pneumatic.
- **Duct insert, and O-ring.** Element to fix and seal the microduct to the blowing head.
- **Cable insert and cable seal.** Element to install inside the blowing head to guide, seal and feed the minicable into the microduct.



Main air supply hose



Pneumatic motor
hose.



Duct Insert



Cable insert and cable seal

Figure 18. Example of different auxiliary elements for the blowing head (depends on the blowing head)

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4.3 BLOWING REPORT

A full blowing report shall be obtained after the blowing installation, this report ensures that the blowing quality is 100% documented.

The blowing report is obtained by using an intelligent monitor or control box that supervises and records the performance of the blowing head, thanks to its integrated computer and embedded software, generating a full report on the installation results.



Figure 19. Blowing heads with their control boxes

The resultant blowing report must describe the devices used during the blowing process, the duct and cable specs as well as the weather conditions and the GPS location.

The blowing report must show the main values of the blowing process:

- Length (m)
- Pushing Force (N)
- Duct Pressure (bar)
- Speed (m/min)
- Time (hh:mm:ss)

These values must be represented in an operation chart and in a table.

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Project-#				Date: / /	
Trace Section					
Company name				Operator:	
Remarks					
Duct specs		Cable specs		Devices	
Manufacturer:		Manufacturer:		Jetting machine:	
Duct type:		Designation:		+ Slipping clutch [] + Lubricator []	
Duct assy:		Cable Ø: mm	Fiber amount:	Lubricant:	
Color/marks:		Reel Nb.:		Compressor:	
Inner design: Grooved		Metering: Start: m	End: m	+ Oil separator [] + aftercooler []	
Duct temperature: °C		Cable temperature: °C		Cable Tap type: []	
Summary:		Max pushforce: N (Measured by the crashtest)			
Trace distance: m	Weather: °C, % humidity.			Jetting temperature: °C	
Jetting duration: : :	Operating mode: Recording only			GPS Location:	

Figure 20. Blowing report information

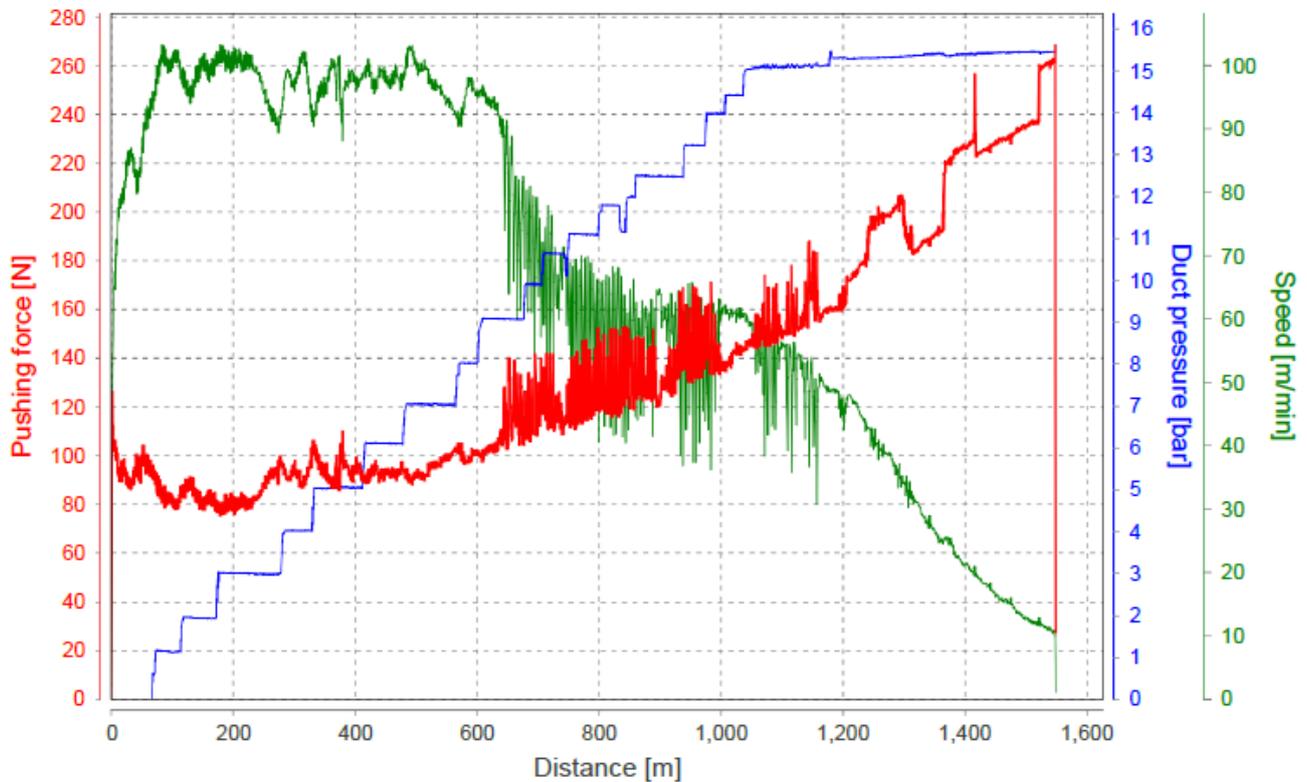


Figure 21. Example of a blowing report operation chart

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4.4 BLOWING OPTICAL FIBER CABLES

4.4.1 STEPS BEFORE THE CABLE BLOWING

Before starting the installation, it is important to perform some steps to check that everything is ready and to avoid future problems during the cable blowing.

It is important to put the cable drum, the blowing head and the micro-duct as good as possible in a straight line.

The cable drum shall be suspended from the ground on jacks, trailer or crane so that it can rotate freely. The cable must unwind from the top of the drum and it must be aligned with the laying section.

Before start blowing anything, must be checked that the other end of the micro-duct (the receiving end) is not sealed with an end cap. If this is the case, remove the end cap temporarily.

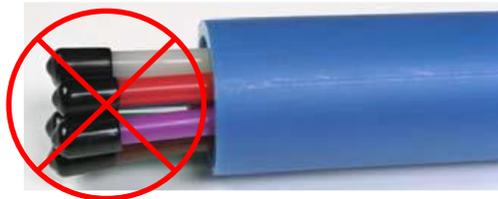


Figure 22. The other end of the micro-duct must be open

To verify that there isn't anything blocking the route, it is necessary to blow a sponge and check that it arrives to the receiving end without problems.

Another step to do before the cable blowing is to verify that there isn't pressure loss, the receiving end must be block and then 10 bars of pressure must be applied to the duct while checking if the pressure is stable.

It is important to ensure that all the equipment has been set-up according to the manufacturer of the blowing head and the compressor: oil lubricating, pressures, etc.

The blowing head also must be equipped with the correct nipples and seals for the optical fiber cable and the micro-duct that is going to be used.



Figure 23. Example of different O-rings, seals and holders for different cables and micro-ducts

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It is necessary to check if the blowing head is properly set for the type of optical fiber cable that will be blown in. If this isn't the case, then a calibre could be used to adjust the pressure wheel to the correct level given by the manufacturer.

Once all the parameters and settings are checked, it is possible to feed the optical fiber cable through the blowing head, fit the seals around the optical fiber cable and the micro-duct and close the blowing head.

Before start blowing it is needed to reset the power meter of the machine. Also, it is important to take note of the metre length stamped on the optical fiber cable.

NOTE: An after-cooler must be used during warm weather.

Lubrication of the route (only for optical cable blowing)

Before starting the cable installation, it is recommended to apply additional lubrication to the micro-ducts of the route, as described in the section 2.2.5.

IMPORTANT: No lubricate the 7/4 microducts of the distribution network in which are going to be installed fiber units because the effect produced is the opposite of the desired.

Before pouring the lubricant into the duct, a leading sponge must be inserted the proper depth in the duct (check lubricant instructions).

The type of lubricant and the quantity to be applied must be consulted to the manufacturer of the micro-ducts and the cables.

A quantity of 25mm/km could be poured into the micro-duct as a reference.

After pour the lubricant, a piece of sponge must be introduced to the micro-duct (a typical size could be 40 mm x 20 mm).

Allow the 2 sponges and the lubricant to be blown through the route. When the sponges have emerged from the end of the route and the technician that control the blow head consider that the set-up is correct, the cable installation could start.

In the following images, the sponge introduction into the duct and the basic set-up for this could be seen:



Detail of a sponge into the duct



O-ring over the duct



Duct positioned into the blowing head.

Figure 24. Detail of the use of a sponge to spread the lubrication through the duct

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Optical cable end preparation (for blowing)

Before insert the cable into the blowing head, the cable must be prepared according to the instructions of the blowing machine, the cable and the duct manufacturers.

The end of the cable must be prepared, to improve the blowing performance and avoid stacking in the ducts joints or curves of the pipeline.

A metal blowing bead could be used because to improve the blowing performance. To use this kind of metal bead, it is necessaire to retire about 15 mm the sheath of the cable and put a metallic bead over the cable core. In the following pictures could be seen the preparation:

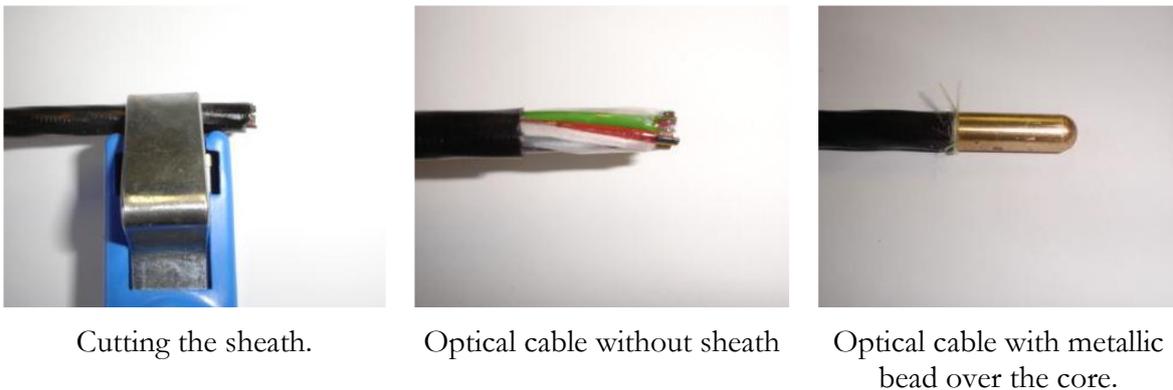


Figure 25. Cable end preparation for blowing (with metallic bead)

Sometimes the diameter of the metal bead, increase the diameter of the cable too much making this method counterproductive.

Other option is to cover the end of the cable with standard PVC tape instead use the metallic bead.

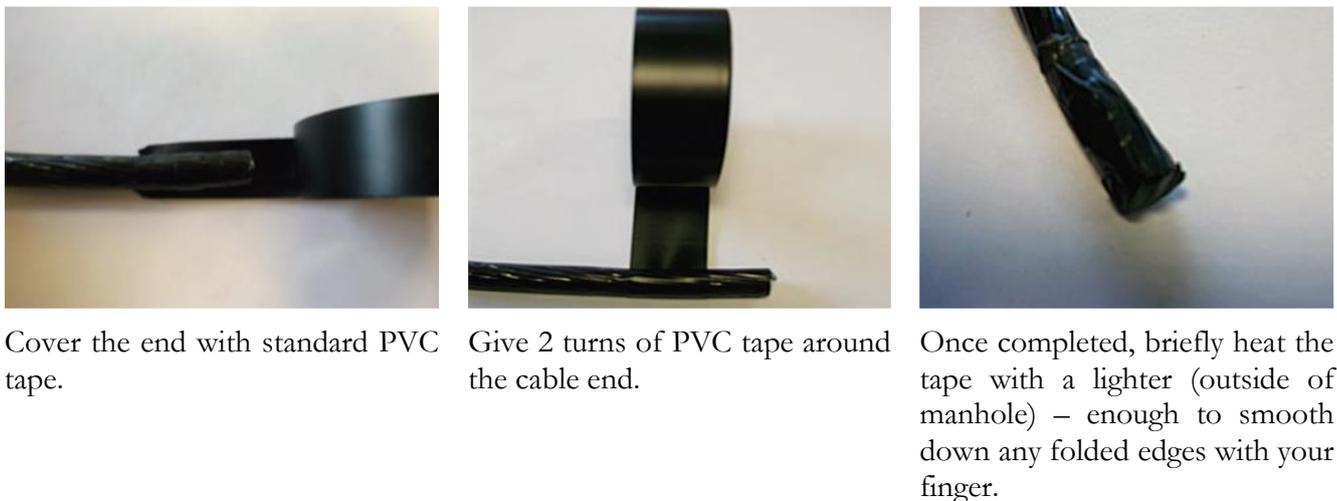


Figure 26. Alternative for cable end preparation for blowing (with PVC tape)

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4.4.2 OPTICAL CABLE BLOWING PROCEDURE

After all the previous steps described in the 4.1.1 section are done, the cable blowing can start performing the following steps:

1. Push the optical fiber cable manually over a length of at least 1m into the micro-duct.
2. Start feeding the cable into the duct using the control valve without applying air.



Figure 27. Detail of the preparation of the, duct, cable and blowing head to start blowing

3. Check for friction (Check with your hand that you can hold/stop the cable up to 500 meters maximum), when it appears, apply $\frac{1}{4}$ airflow.
4. Check for friction, if it appears, apply $\frac{1}{2}$ airflow.
5. Check for friction, if it appears, apply $\frac{3}{4}$ airflow.
6. Check for friction, if it appears, apply full airflow.

NOTE: It is important to apply air pressure only when it is required, air applied to an empty duct causes backpressure because the pressure is rising towards the middle of the duct length and could result in a problem.

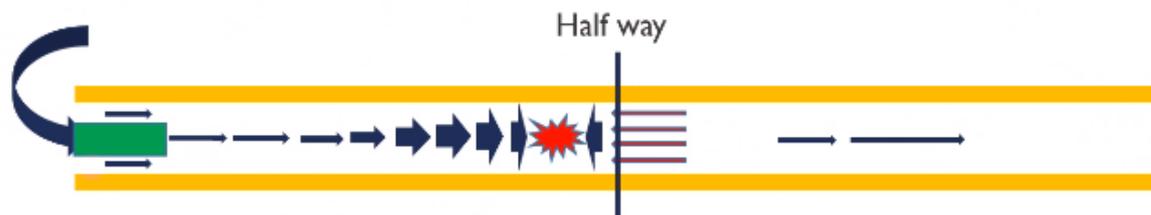


Figure 28. 10 BAR of air pressure applied to an empty duct could result in backpressure

When a cable is entering the duct, the same volume of air must be pressed into the duct and this causes the speed to rise and the pressure to go down. This could result in a problem when some air flows forward and the backpressure airflow flows backwards.

Air applied to a duct at the right time and in a right amount will not cause issue with backpressure because the pressure and speed are the same where it is needed along the cable distance.

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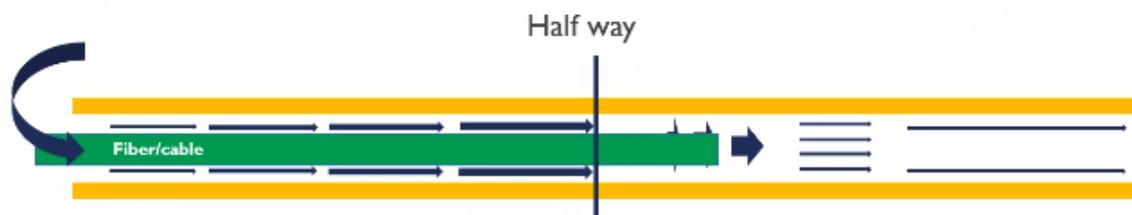


Figure 29. 4 BAR of air pressure applied at the right time

7. Check for friction, if it appears, reduce the speed of the cable.
8. Check for friction, if it appears, stop the speed of the cable and try to reverse 0,5 – 1 m then run forward again.
9. Check for friction, if it appears, stop the speed of the cable and air. Release air pressure and wait approximately 10 minutes. Then re-apply full airflow, wait 15 seconds and start the speed of the cable slowly.
10. Apply lubricant and try step 8 again and again.

If it is not possible to blow in the required total distance and the blowing process is stopped, make a note of the meter reading on the blowing head and the meter reading on the optical fiber cable. Compare both and determine the possible cascade location.

NOTE: The scheme of the cascade blowing is like the scheme described in the section 3.4, but in this case, the scenario was not expected or planned.

When the optical fiber cables have been blown in, remember to provide for an adequate spare length.

Mark the blown length of optical fiber cable by comparing the meter reading of the blowing head and the meter reading on the optical fiber cable.

In case of blowing another optical fiber cable on this location, simply switch the blowing head to another micro-duct.

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4.4.3 *CASCADE BLOWING OF OPTICAL FIBER CABLE*

If during the blowing of the OF Cable the speed drops below 10 m/min and still a considerable cable length must be blown, it is more efficient to make a cascade location for the blowing head.

If, however the remaining cable length is short, go on with blowing. At blowing speed below 5 m/min is not advisable.

Follow the next instructions:

- Note the distance of the blown cable on the blowing head as well as the meter stamp on the cable.
- Check where the cable ends in the circuit with the as build drawings from the protective duct circuit.
- Dig the bundle of micro-ducts free. Remove with a pipe-cutter and sheath-cutter about 1 meter of bundle sheath.
- Check if indeed the Cable has been passed beyond the point.
- Open the micro-duct with a micro-duct-cutter without damaging the optical cable.
- Take the additional optical fiber cable length out of the micro-duct.
- Place already over the optical cable a micro-duct connector to be able to close the micro-duct after the cascade blowing.
- Place the sealing rings and close the blowing head.
- Place the blowing head in a straight line with the micro-duct.
- Start, in constant communication with the installer of the first blowing machine, the blowing process.
- The blowing heads needs to be running at the same time and with the same speed.
- After the optical cable reaches the end, open the blowing head and remove the seals.
- Remove the blowing head and close the micro-duct with the earlier place micro-duct connector.
- The additional length of the cable (the length of the width of the blowing head) must be pushed carefully into the micro-duct. Take care not to kink the optical fiber cable.

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4.5 BLOWING OPTICAL FIBER UNITS

4.5.1 FIBER UNIT HANDLING

The fiber unit could be delivered in reels or in pans, the one in the pan is kept in place by the internal lid, which prevents excessive movement of the fiber unit.

When the pans are being stored or carried it should be kept horizontal to prevent the coils from sliding over each other. This could lead to problems when the fiber unit is being dispensed. It is preferable to store the reels and the pans indoors and away from sunlight until the fiber unit is ready to be used. This is especially important for the cardboard pans.

The external lid of the pan is designed to keep out dust and moisture but should not be considered as a waterproof seal.

4.5.2 STEPS BEFORE THE OPTICAL FIBER UNIT BLOWING

Fiber unit end preparation (for blowing)

Before insert the fiber unit into the blowing head, it is needed to prepare the end according to the instructions of the fiber unit manufacturer.

It is needed to use a bead for the fiber unit blowing, like the one mentioned for the cables, but in this case, there is no alternative.

The bead to be used, must be designed especially for the fiber unit diameter that is going to be used.



Figure 30. Examples of a blowing beads for fiber units from different manufacturers

NOTE: It is important to consult the fiber unit manufacturer to use the correct blowing bead.

Before to put the bead in the fiber unit it is important to ensure that the end of the fiber unit is free from any ragged edges. If this is not the case, it is needed to trim the end of the fiber unit again.

The next step is to push the blowing bead onto the end of the fiber unit, turning the bead and crimp it to the fiber unit (carefully).

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Putting the bead onto the fiber unit



Example of bead positioned on the fiber unit

Figure 31. Fiber Unit end preparation example

To ensure that the bead has a good grip, test lightly giving a small tug, and if the bead moves, repeat the crimping process with the crimping tool adjusted.

It is important not to deform the bead too much when crimping it as it will difficult the blowing process.



Example of a bead well installed



Example of a bead deformed

Figure 32. Examples of a bead well installed and bad installed

Blowing configuration

If the fiber unit is delivered in a pan, before start the blowing, it is very important to prepare the feeding of the fiber unit to the blowing head, installing an arm to elevate the fiber unit, and help to dispense it without any difficulties from the pan in which is served.

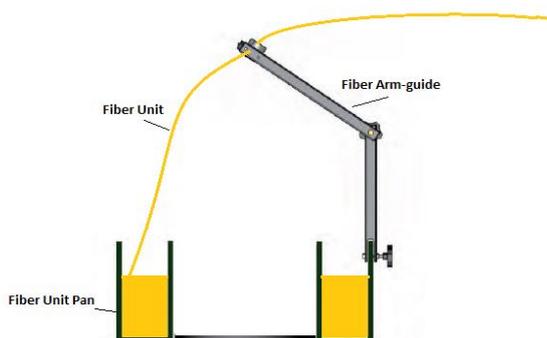


Figure 33. Fiber Arm Guide to extract the fiber unit from the pan for blowing

Also, it is important to follow the same instructions that the given for the optical fiber installation related to checking the ducts state and the setup of the blowing machine.

The blowing machine and the compressor it is smaller than the one needed to blow optical cables.

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Once all the parameters and settings are checked, is possible to feed the fiber unit through the blowing head, fit the seals around the fiber unit and the micro-duct and close the blowing head.

Before start blowing it is needed to reset the power meter of the machine. Also, it is important to take note of the metre length stamped on the optical fiber unit.

4.5.3 OPTICAL FIBER UNIT BLOWING PROCEDURE

Follow the recommendations described in the section 4.4 (only those that are applicable to fiber units).

Check that all the elements are correctly set up, according to the manufacturer recommendations.

Set the configuration of the blowing head, according to the microtube and the fiber unit that is going to be blown.

Prepare the end of the fiber unit (put a blowing bead).

Push the optical fiber unit manually over a length of at least 1m into the micro-duct.



Figure 34. Example of a fiber unit blowing

When the optical fiber units have been blown in, remember to provide for an adequate spare length.

Mark the blown length of optical fiber unit by comparing the meter reading of the blowing head and the meter reading on the optical fiber unit.

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ANNEX 1. MICRODUCTS DESCRIPTION

The micro-ducts that will be laid into the trenches for the deployment will be prepared for blowing installation techniques allowing adequate blowing pressures for the diameters of each type of micro-duct.

All the micro-ducts have a ribbed inner layer inside to minimize the friction between the cable and the duct.



Figure 35. Detail of the ribbed inner layer of the micro-ducts

Depending on the section of the network, the following types could be used:

- 16/12 micro duct with an outer diameter of 16 mm, and an inner diameter of 12 mm (valid for direct buried installations). This duct will be used mainly in the “local backbone” section of the network, to connect different PoPs.
- 14/10 micro-duct with an outer diameter of 14 mm and an inner diameter of 10 mm (valid for direct buried installations). This duct will be used mainly in the feeder section of the network, to connect the POPs with the DPs (Distribution Points).
- 12/10 micro-duct with an outer diameter of 12 mm and an inner diameter of 10 mm (valid for direct installations (subducting)).
- 7/4 micro-duct with an outer diameter of 7 mm and an inner diameter of 4 mm (valid for direct buried installations). This duct will be used mainly in the distribution network section to connect the Distribution Points (street cabinets) with the customer premises.



Figure 36. Example of micro-ducts with different colours

The micro-ducts will be deployed in bundles of different ducts counts. The micro-ducts 16/12, 14/10 could be used in bundles of 2, 4 or 7 units.

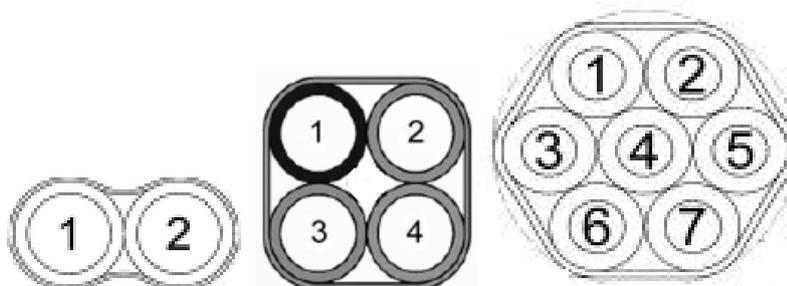


Figure 37. Bundles configurations for 16/12 and 14/10 micro-ducts

The micro-ducts 7/4 could be used in bundles of 7, 12 or 24 units.

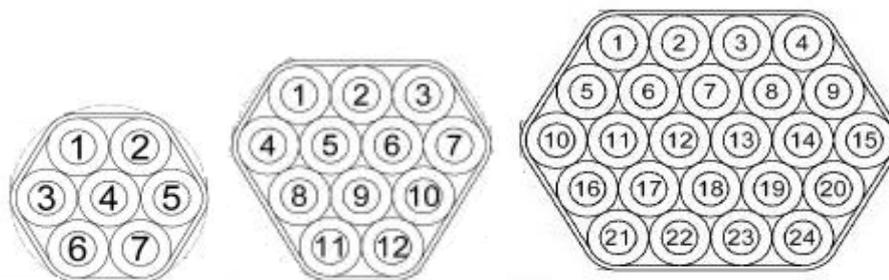


Figure 38. Bundles configurations for 7/4 micro-ducts

The micro-tubes inside the bundle will follow the colour coding VDE 0888.

Number	1	2	3	4	5	6	7	8	9	10	11	12
Color	Red	Green	Blue	Yellow	White	Grey	Brown	Violet	Turquoise	Black	Orange	Pink

Figure 39. Colour coding VDE 0888

For bundles from 13 to 24, the colour coding will be the previous one, complemented by 4 striped marks that must be distinguishable from the tube colour.

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ANNEX 2. FIBER UNITS DESCRIPTION

The optical fiber units defined are suitable for blowing installation techniques in microducts, and allow a blowing of at least 800 m in one operation.

These fiber units are fully dielectric, that is composed by a resin around the optical fibers and a yellow low friction sheath optimised for blowing.

The optical fiber used in the fiber units must comply with the ITU-T Recommendation G.657.A2.

FIBER UNITS STRUCTURE

The fiber units that could be used in the deployment has from 2 to 12 optical fibers. Depending on the number of optical fibers should follow these structures:

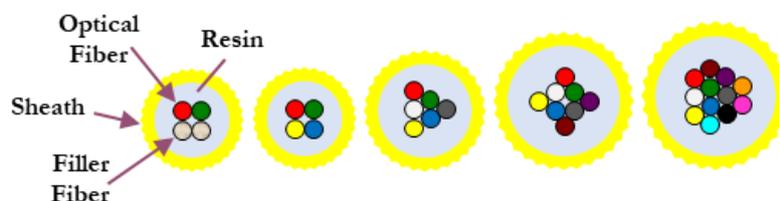


Figure 40. Fiber Units structure (transversal section)

OPTICAL FIBER	Type	G.657.A2				
	No. Fibers	2	4	6	8	12
OUTER SHEATH	Material	Thermoplastic low friction				
	Color	Yellow				
FILLER FIBER	No.	2	0			
	Color	Uncoloured				
CABLE	Diameter Max. (mm)	1,15 ± 0,05	1,35 ± 0,05	1,50 ± 0,05	1,65 ± 0,05	
	Weight Max. (Kg/Km)	1	1,6	1,8	2,2	
BLOWING DISTANCE		At least 800 m				

Table 2. Main characteristics of the Fiber Units

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ANNEX 3. OPTICAL CABLES DESCRIPTION

The optical cables that will be used in the deployment will be suitable for blown installation in micro-ducts.

These cables are fully dielectric, and its optical core is constituted by loose tubes around a central element. The central element is a glass fiber reinforced plastic rod (FRP) and the loose tubes are helically arranged with SZ step around the FRP.



Figure 41. Example of the structure of a mini cable for blowing

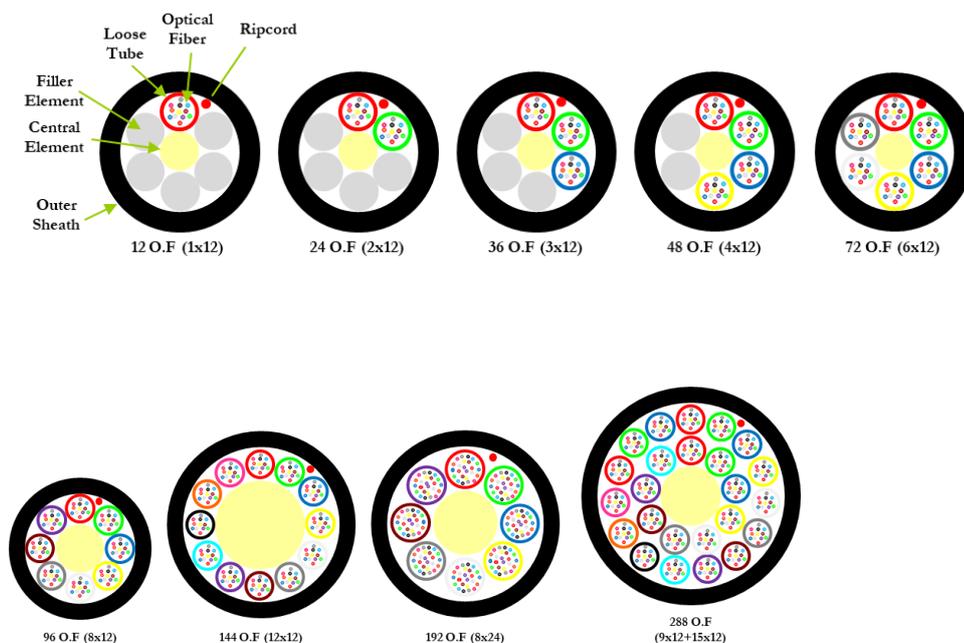
Each loose tube inside the cable (see next figure) includes 12 or 24 optical fibers. The optical fiber must comply with the recommendations ITU G.652.D.

The material used for the outer sheath is a high-density linear polyethylene (HDPE), coloured black, stable against UV radiation and weatherproof.

The cable includes 1 red ripcord under the outer sheath for easy cable opening. The cables have a fully watertight construction with a dry core.

CABLE STRUCTURE

The cables that will be used are defined from 12 to 288 optical fibers. Depending on the number of optical fibers, the cables must comply with the following structures:



42. Cable structure (transversal sections)

Figure

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This table, resume the main characteristics:

OPTICAL FIBER	Type	G.652.D									
		No. Fibers	12	24	36	48	72	96	144	192	288
	No. Fiber/tube	12							24	12	
LOOSE TUBE	No.	1	2	3	4	6	8	12	8	9+15	
	Wiring	SZ									
	Material	Thermoplastic									
CENTRAL ELEMENT	Material	Glass fiber reinforced plastic									
FILLER ELEMENT	No.	5	4	3	2	0	0	0	0	0	
	Material	Thermoplastic									
	Color	Uncolored (natural)									
RIPCORD	No.	1									
	Color	Red									
OUTER SHEATH	Material	High density linear polyethylene (HDPE) Stable against UV and weatherproof									
	Color	Black									
CABLE	Diameter (mm)	≤ 6,5						≤ 8,2		≤ 9,5	
	Weight (Kg/Km)	35 ± 5					40 ± 5		55 ± 5		75 ± 5
BLOWING DISTANCE		At least 1500 m									

Table 3. Main characteristics of the optical cables

FIBER COLORS

Inside each loose tube the optical fibers will follow this color coding:

No.	1	2	3	4	5	6	7	8	9	10	11	12
Colour	Red	Green	Blue	Yellow	White	Grey	Brown	Violet	Turquoise	Black	Orange	Pink

No.	13	14	15	16	17	18	19	20	21	22	23	24
Colour	Red	Green	Blue	Yellow	White	Grey	Brown	Violet	Turquoise	Natural	Orange	Pink

Figure 43. Fiber color coding (DIN- VDE 0888)

When the loose tubes have more than 12 optical fibers, the next fibers shall include a ring identification mark on their acrylate every 5 cm.

LOOSE TUBE COLORS

The loose tubes will follow this color coding:

No.	1	2	3	4	5	6	7	8	9	10	11	12
Colour	Red	Green	Blue	Yellow	White	Grey	Brown	Violet	Turquoise	Black	Orange	Pink

Figure 44. Loose tubes color coding (DIN - VDE 0888)

For 288 optical fibers cable, the cable is constructed in two layers of loose tube according to the following color coding:

- Inside layer

No.	1	2	3	4	5	6	7	8	9
Colour	Red	Green	Blue	Yellow	White	Grey	Brown	Violet	Turquoise

- Outside layer

No.	1	2	3	4	5	6	7	8	9	10	11	12
	13	14	15									
Colour	Red	Green	Blue	Yellow	White	Grey	Brown	Violet	Turquoise	Black	Orange	Pink

Figure 45. Loose tubes color coding (DIN - VDE 0888) (for cable with 288 of)

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ANNEX 4. BLOWING REPORT

Unsere Grüne Glasfaser GmbH & Co. KG Adalperostr. 82-86 85737 Ismaning		<h1>Blowing Report</h1>			
Project:				Date:	
Trace Section:					
Company name:				Operator:	
Remarks:					
Duct specs		Cable specs		Devices	
Manufacturer:		Manufacturer:		Jetting machine:	
Duct type:		Designation:		+ Slipping clutch [] + Lubricator []	
Duct assy:		Cable Ø: mm; Fiber amount:		Lubricant:	
Color/marks:		Reel Nb.:		Compressor:	
Inner design: Grooved		Metering: Start: m End: m		+ Oil separator [] + aftercooler []	
Duct temperature: °C		Cable temperature: °C		Cable Tap type: []	
Summary:		Max pushforce: N (Measured by the crashtest)			
Trace distance: m		Weather: °C, % humidity		Jetting temperature: °C	
Jetting duration: : :		Operating mode:		GPS Location:	

Note: the BLOWING CHART must be included