Installation Instructions

Direct Buried Installation of Microduct Assemblies

Contents

1 Introduction

This document is a description of the methods used for Direct Burial (DB) of microduct assemblies (multiducts) and for Thick Walled Duct (TWD). These methods describe how to install ducts directly in the ground. It also include descriptions of how to create and manage underground trenches, and how to place and manage ducts in them.

1.2 Scope

This document covers the methods for installation of microduct assemblies for direct burial into the ground.

1.2 Target Group

This document is primarily targeted at installation technicians. Hexatronic recommends that personnel have an adequate professional background and have attended product training arranged by Hexatronic.

1.3 Prerequisites

In this document, it is assumed that the reader is familiar with concepts, terminology, and abbreviations, concerning the Fiber Optic deployment.

2 General Conditions

The following conditions must apply to the installation procedure:

- Always follow local regulations and network owners regulations.
- Always check existing cabling and conduits before starting to excavate.
- If possible always lay the cable at constant depth.

3 Excavating Trench

This section describes the excavating and reinstating ground after excavation procedures.

Do!
Always check existing cabling and conduits before starting to excavate.

When performing a DB duct excavation, it is of highest importance to make sure that the trench is cleared from stones and sharp objects. Then the ducts are to be deployed on top of a fine bedding.

Note: Regarding how the ducts are installed into trench, see separate document guidelines.

- Installation of Microduct Assemblies in Existing Conduits, Reference [3]

After the ducts have been deployed, they are to be covered with sand or fine soil on top, and between the ducts, if there are more than one duct.

Finally, a warning tape shall be laid on the top of the cover layer. A warning tape of Al or plastics and a text is placed 10-20 cm above the duct. This is to minimize breaks from digging. If a plastic warning tape is used, it is possible to track the channel if the tape has a metallic wire. Ensure that the metallic wire is connected together if sections of warning tape is spliced.

Note: If a metallic wire is not present in the warning tape, it is a good idea to include a trace wire in the bottom of the trench together with the ducts.

A simplified view of an excavated trench is shown in Figure 1.

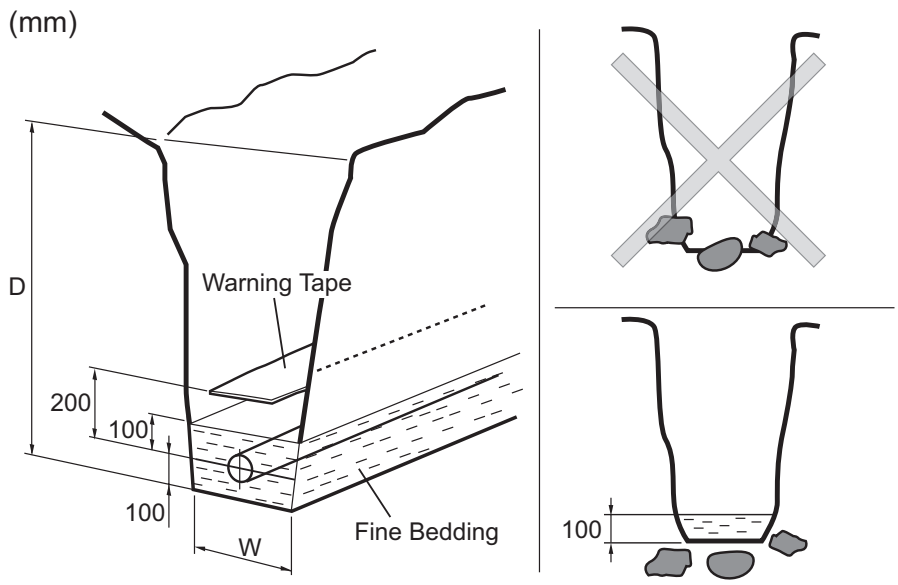


Figure 1 – Excavated Trench

Note: Different network owners will have different demand on depth of deployment (D). Normally, the depth is between 40-70 centimeters.

Always check with the network owner or local regulators to verify the correct depth. For reference, some examples of typical D values are shown below:

- Ducts in green areas and pavements shall be on at least 0.35 m depth
- For ducts in driving areas the depth shall be at least 0.55 m
- In areas with ground frost, the trench should be 0.7 m deep or more
- Ducts installed in cultivated areas must be placed so deep that further cultivation does not jeopardize the optical installation, for example, at least 0.8 m

3.1 Reinstating Ground After Excavation

When reinstating the ground, make sure to restore the ground to have similar looks and properties as before the excavation.

4 Plowing

This section describes the preplowing, plowing, and reinstating ground after plowing procedures.

Do!
Always check existing cabling and conduits before starting to plow.

4.1 Preplowing

Since the deployment using a plow has to be done in one go without stopping the machine, no obstacles must be in the route. Therefore, a preplowing has to take place. The preplowing is to be done minimum 100 mm deeper than the actual installation depth, as shown in Figure 2.

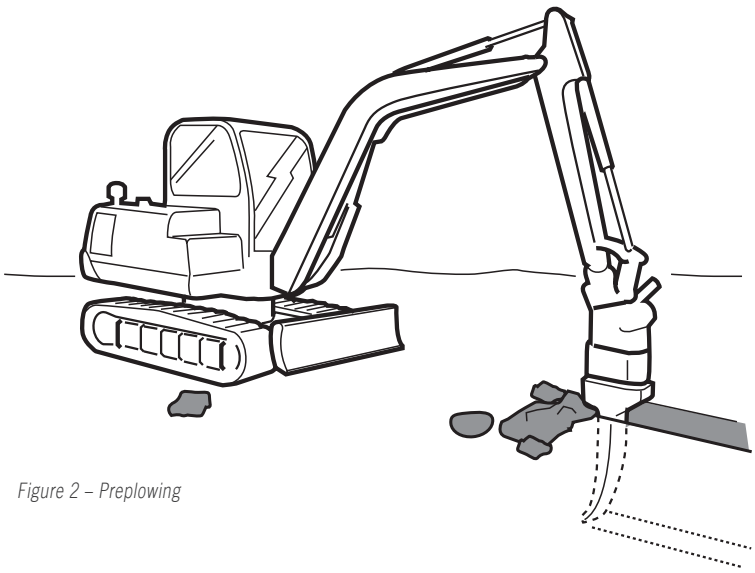


Figure 2 – Preplowing

4.2 Plowing DB-Ducts

After preplowing, the plowing of DB-ducts can take place. This is done in one go using a static or a vibrating plow, see Figure 3. Vibrating ploughs cut the ground easier and refill more efficient than a static plough. Therefore it is recommended to use vibrating ploughs.

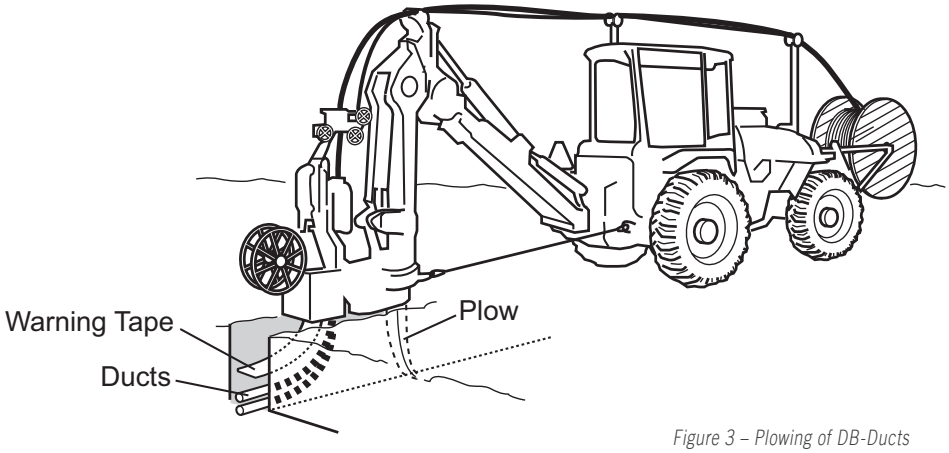


Figure 3 – Plowing of DB-Ducts

Several ducts can be deployed at the same time, and a warning tape, and preferably a trace wire is placed on the top.

During installations with plowing the special attention should be made for:

- Preplowing is performed properly
- Avoid obstacles
- Required volume of ducts is transported
- Feeding of cables and duct is done with no bursts
- The plow is kept at same depth
- Allowed bend radius is kept
- No tension is built into the cable or duct

When a duct has to be jointed, refer to Section 8.2 on page 13.

4.3 Reinstating Ground After Plowing

When reinstating the ground, make sure to restore the ground to have similar looks and properties as before the plowing. This can, for example, be done by driving with the machine where the plowing took place. First on one side of the track, then on the other side, and lastly on the top, as shown in Figure 4. Also, make sure to remove all visible rocks.

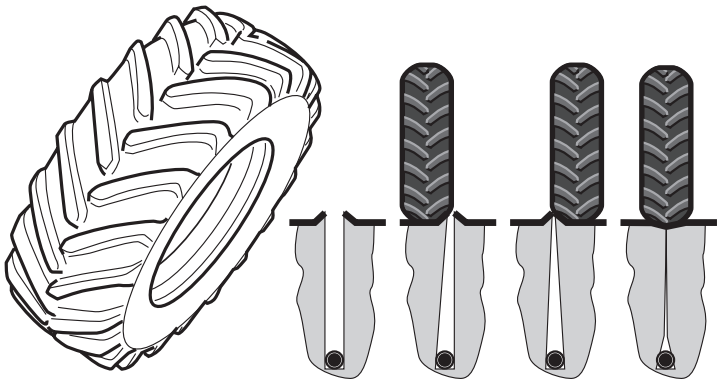


Figure 4 – Reinstating the Ground

5 Mini-trenching

This section describes the mini-trenching and reinstating ground after mini-trenching procedures.

Do!
Always check existing cabling and conduits before starting to mini-trench.

The mini-trenching technique comes in different ways, and uses various machines. The advantages of this technique over conventional cable laying technologies lie essentially in its speed of execution, lower cost, significantly lower environmental impact, and limited disruption to road traffic, and, as a consequence of the previous items, easiness in obtaining permits for the taking over of the public area, see Figure 5.

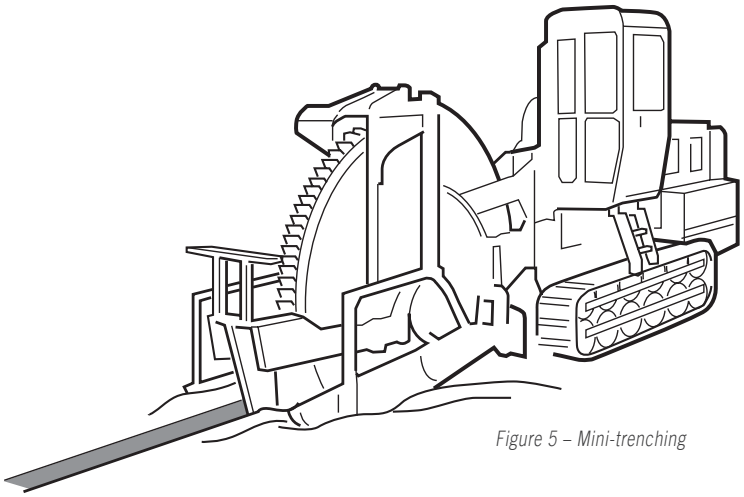


Figure 5 – Mini-trenching

The method gives a very narrow and shallow trench with a minimum of waste soil, see Figure 6. The trench must be cleansed from stones and sharp objects.

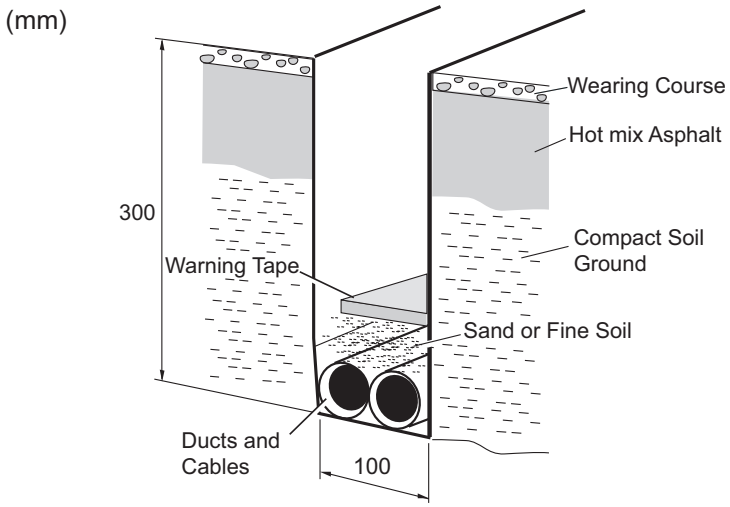


Figure 6 – Typical Trench Dimensions in Mini-trenching.

5.1 Reinstating Ground After Mini-trenching

Make sure to restore the ground to have similar looks and properties as before the mini-trenching. The trench must be reinstated with the correct backfill material. Concrete or foam concrete are materials frequently used as backfill, with Bitumen on top. For further details, see the following document:

- ITU-T L.48, Reference [5]

6 Micro-trenching

This section describes the micro-trenching and reinstating ground after micro-trenching procedures.

Do!
Always check existing cabling and conduits before starting to micro-trench.

Micro-trenching is a way to create a slot cut suitable for a few single micro-ducts. The cut is only a few centimeters deep, see Figure 7.

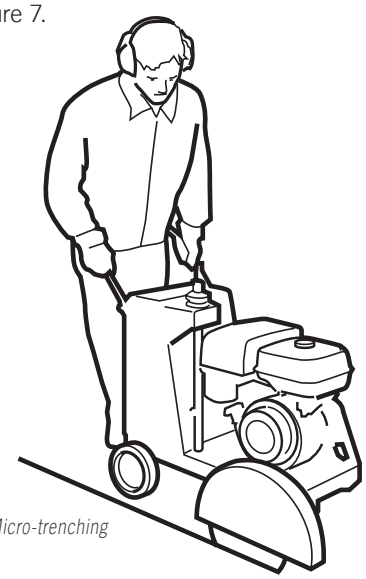


Figure 7 – Micro-trenching

6.1 Reinstating Ground After Micro-trenching

Make sure to restore the ground to have similar looks and properties as before the micro-trenching. Reinstatement is done with a rubber strip on the top of a duct and then Bitumen on the top, see Figure 8. For further details, see the following document:

- ITU-T L.49, Reference [6]

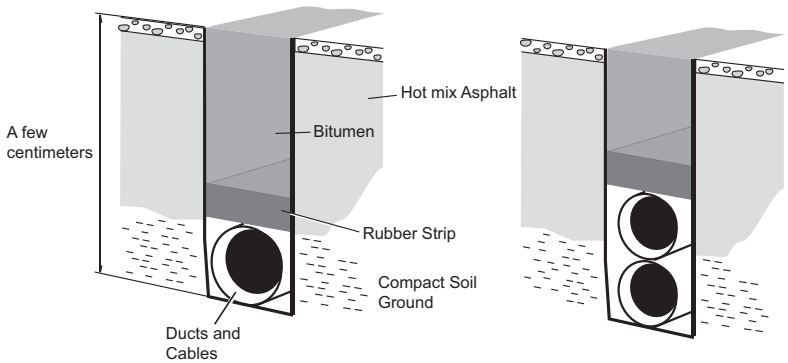


Figure 8 – Reinstatement Ground After Micro-trenching

7 Horizontal Directional Drilling

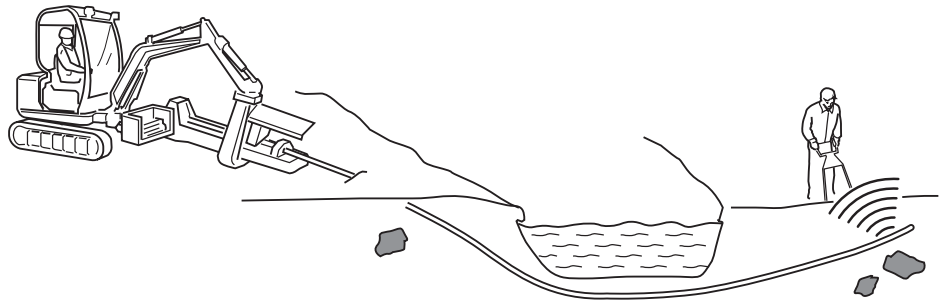
This section describes the horizontal directional drilling and gives an example of an efficient horizontal directional drilling procedure.

Do!
Always check existing cabling and conduits before starting to drill.

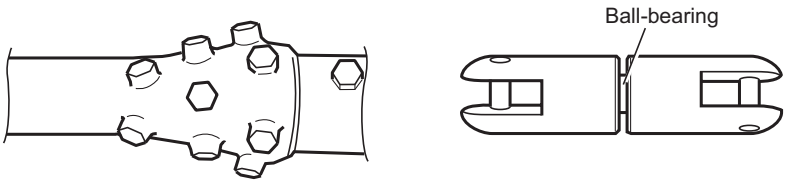
Horizontal directional drilling is a very useful method for deploying ducts. It is commonly used when deploying ducts under roads or water.

The method is described in the following steps:

1. Perform a survey with ground radar. This is to discover possible obstacles in the ground, for example, existing cables, water pipes, and sewers.
2. Perform the drilling in a team of two persons; one using the drilling machine, and the other one using the locating device to track the drill head. The drilling begins with a small diameter pilot hole at the entry side of a project site. Bentonite is commonly used to stabilize the hole.



3. Replace the drill head.
   Once the drill comes through, replace the drill head with a mandatory swivel and an optional reamer. The swivel makes sure that the duct does not rotate on the way back, and the reamer is used to widen the diameter of the drill hole.

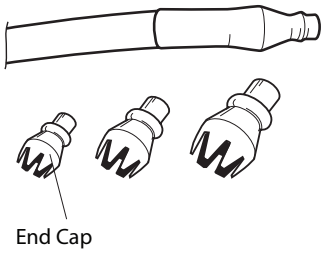


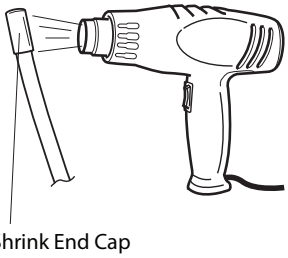
Reamer Swivel

4. Prepare the duct, as follows:

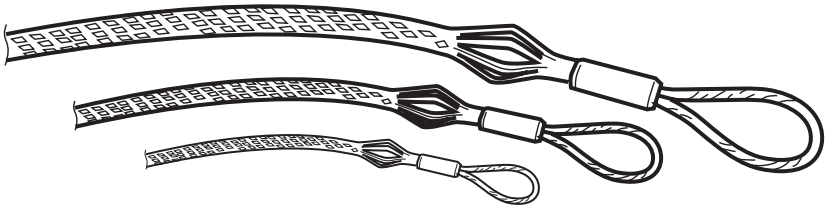
- Before pulling the duct back through the drilled hole, seal the end of the duct. This could be done by using a cold type duct seal, or a heat method by using a shrink end cap.

Note: Use an appropriate end cap, and secure it with tape to make sure it does not come off while pulling the duct.

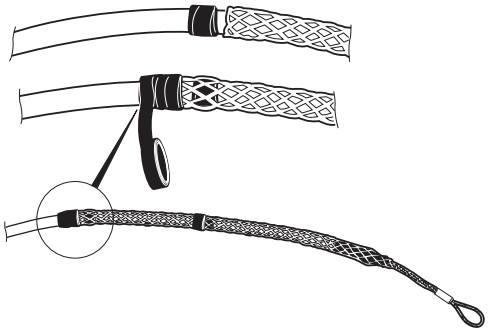




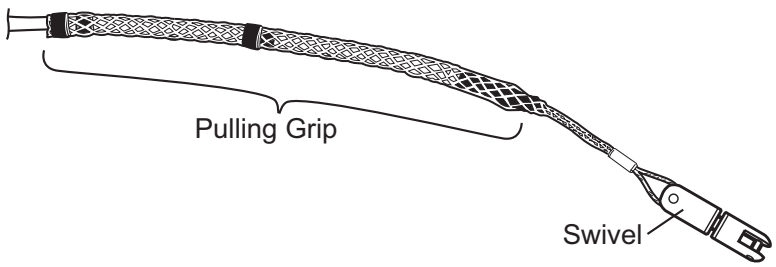
- Select the correct size of the pulling grip.



- Put on the pulling grip all the way, slide it back a few centimeters, and build up the diameter of the duct with some layers of tape. This is to make the grip hold better.
- Slide the pulling grip forwards again, all the way onto the duct, and tape on top. Stretch the tape while taping. Also, tape on the middle of the grip.



5. Attach the swivel to the pulling grip.



6. Tie the pulling rope to the swivel on the pulling grip with a strong knot.
7. After the duct has been pulled through, cut away the front part of the duct, see Figure 9. The length of the cutoff must be twice the length of the pulling grip. This is due to the extra stress on that part of the duct.

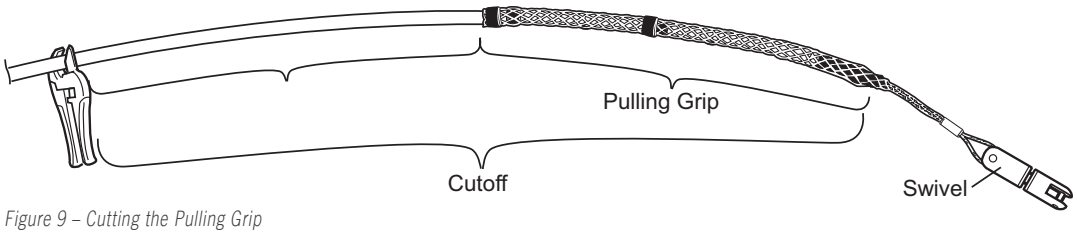


Figure 9 – Cutting the Pulling Grip

7.1 Example of an Efficient Horizontal Directional Drilling

In order to make the installation fast and efficient, it is common to drill a hole in one direction, pull the duct through, then turn the machine around and drill a hole in the opposite direction and pull the another duct through, see Figure 10. This way the equipment is moved as little as possible, saving time, and, if applicable, reducing the cost for renting the drilling machine. For further details, see the following documents:

- ITU-T L.38, Reference [7]
- ITU-T L.39, Reference [8]

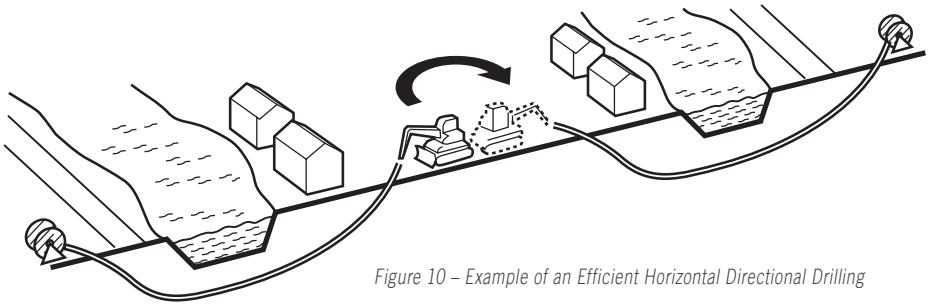


Figure 10 – Example of an Efficient Horizontal Directional Drilling

A disadvantage of this method is that the ducts are pulled in opposite directions, resulting in micro-ducts being crossed over each other in the multi-duct joint, see Section 8 on page 12.

Note: Precautions must be taken to prevent cracking of the duct, especially after jointing. Duct overlength increases the cracking risk. Forinformation about duct overlength technique, see Section 8.2 on page 13.

8 Jointing Ducts

The following section contains the general guidelines for jointing ducts. There are two systems, the traditional DI and DB and the second TWD, thick walled duct. It also describes how to handle the duct overlength when created, and specifies the minimum duct bending radiuses allowed.

8.1 Jointing Ducts Guidelines

All ducts are marked with product ID, product number, meter markings, and arrows. If the arrows always point in the same direction, not to each other, and not against each other, the jointing ducts will not be crossed inside the closure. They will then follow the number and color code symmetrically, see Figure 11.

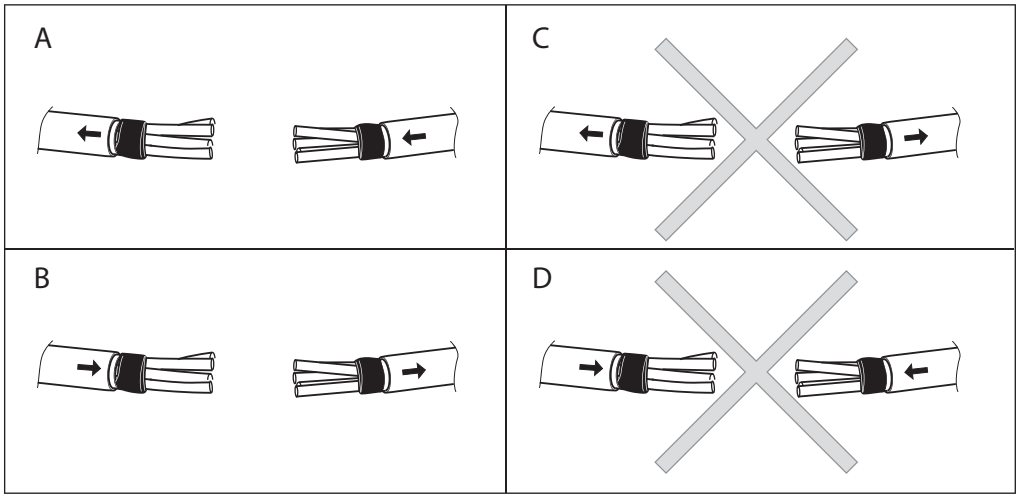


Figure 11 – Arrow Directions of Jointing Microduct Assemblies

To avoid squeezing or kinking the micro-ducts during the jointing process, it isvery important to stack the duct connectors inside the duct joint closure, see Figure 12. The procedure how to joint ducts for direct burial (DB) is described in the installation manuals for the corresponding jointing kits.

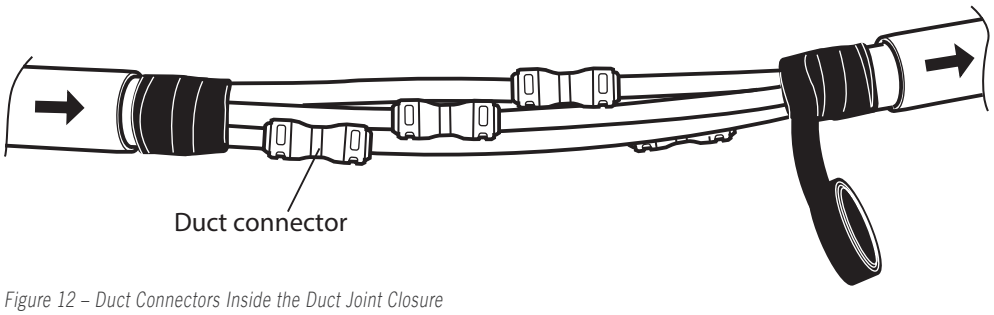


Figure 12 – Duct Connectors Inside the Duct Joint Closure

This is even more important if the micro-ducts have to cross each other inside the closure. Every duct crossing will add friction due to additional duct bending. To reduce the friction added make the opening as wide as possible allowing the ducts to go more straight, see Figure 13.

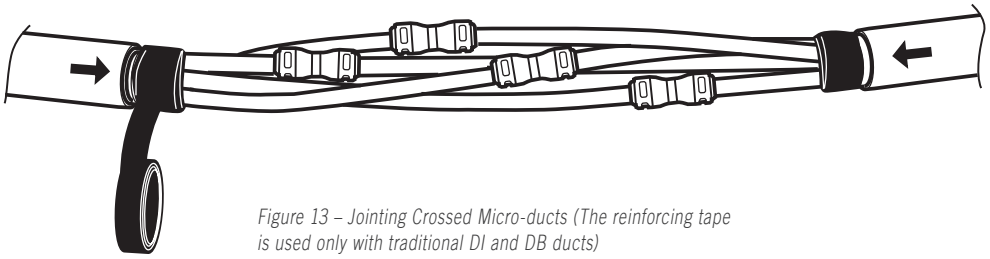


Figure 13 – Jointing Crossed Micro-ducts (The reinforcing tape is used only with traditional DI and DB ducts)

The issue with duct branching with crossed micro-ducts is common when horizontal directional drilling is used as deployment method. For more information, see an example of horizontal directional drilling in Section 7.1 on page 11. When this method is used, the arrows will point in opposite directions at the jointing position and the ducts will be crossing each other in the closure. Therefore, extra precautions are necessary in these situations.

8.2 Duct Overlength

Duct overlength is a very important consideration especially when using micro-trenching techniques or trenchless techniques, like horizontal directional drilling.

However, the best alternative is to avoid a duct overlength. In order to avoid making the duct over-length, try to keep the duct from going as a wave along the route as it will reduce the blowing length possible to reach.

Wherever the ducts have to be jointed, dig down to the same level as the duct main level and do the jointing there. This is also made by making the trench both deeper and wider where the duct is jointed. Then the work with the duct can be done in its final level, and after backfilling, the duct will be both straight and in level, see Figure 14.

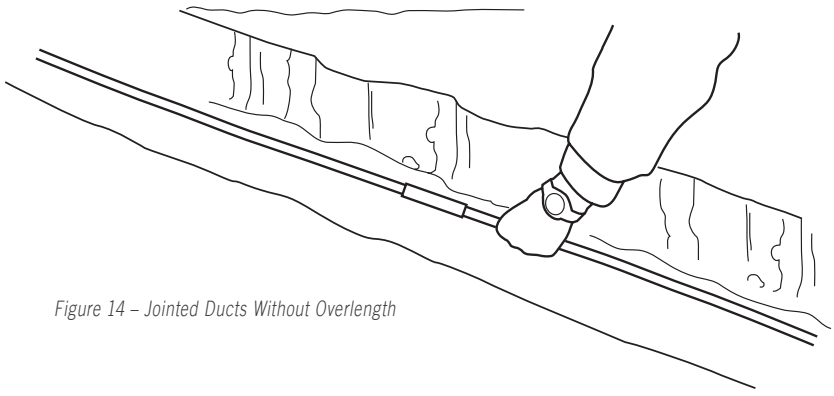


Figure 14 – Jointed Ducts Without Overlength

When using micro-trenching, the trench is very narrow and shallow, and when a duct joint is made, the most natural procedure is to lift the duct up and perform the jointing above the ground. This will create the duct overlength, which will make it impossible to put the duct back into the micro-trench. If pressing the joint from above, see Figure 15, the duct will try to adapt and it will push itself into the duct joint closure making a knee or a kink on the micro-ducts inside the closure. This is very dangerous since it will be impossible to blow a cable through the duct afterwards, and also because the damage is invisible from the outside.

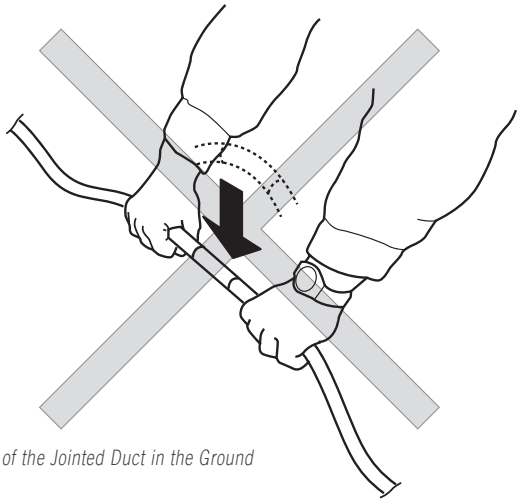


Figure 15 – Incorrect Laying of the Jointed Duct in the Ground

The solution when having a duct overlength, is to widen the trench enough to make the bend very smooth, see Figure 16.

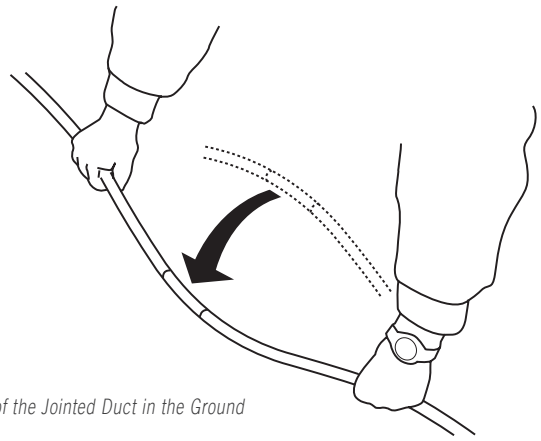


Figure 16 – Correct Laying of the Jointed Duct in the Ground

If the duct needs to be taken from the route sideways to perform the jointing, make sure to add an extra protection at the duct jointing place. This is because the duct is deviating from its original route at this position. To protect the deviating duct, use a piece of 110 millimeters conduit split in half and cut in contour, and fix it in a place with cable ties, see Figure 17.

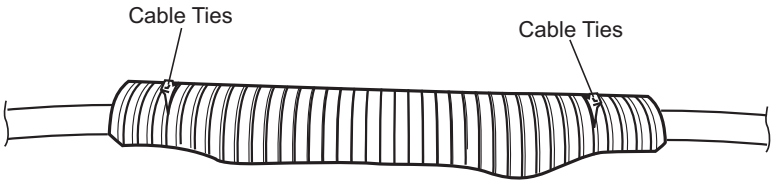


Figure 17 – Using the 110mm conduit

8.3 Jointing Ducts in Manholes

Whenever a Micronet duct ends in a manhole, extra length is needed in order to work with the duct, see Figure 18. This need applies whether a duct is to be ended, branched off, or straight jointed, in the manhole.

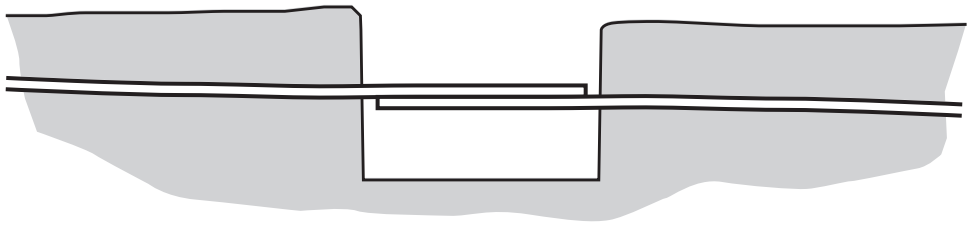


Figure 18 – Correct Ducts Ending in Manhole

Caution!
Make sure a duct overlap from side to side in the manhole is saved.

If the ducts to be jointed are cut in the same way the standard ducts are cut, (at the inner wall of the manhole), the ducts cannot be used, see Figure 19. To be able to use ducts that have been cut to short, they have to be lengthened by digging up on both sides of the manhole, and performing two additional duct joints.

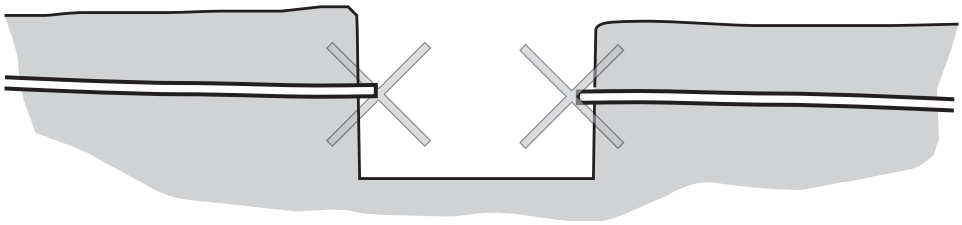


Figure 19 – Incorrect Ducts Ending in Manhole

8.4 Duct Bending Radiuses

The minimum bending radius specified in the product data sheet defines the radius to which the duct may safely be bent during installation, and for the long term. However, that is not the only limiting factor for reaching long distances during cable blowing. The stiffness of the cable is another important factor.

In order to reach long blowing lengths, it is recommended to use a minimum bending radius according to Table 1. As a rule of thumb, the bending radius is approximately 30 times the outer diameter of the multi duct, and approximately 25 times the outer diameter of the single duct.

Table 1 – Minimum Ducts Bending Radiuses

Duct type	10/8 mm	12/9.6 mm
1-way	400 mm	450 mm
4-way	900 mm	1100 mm
7-way	1200 mm	1300 mm

8.5 Thick Walled Duct

The handling of thick walled ducts do not differ from the use of DI or DB except for the use of joint closures. The new reinforced micro tube connector will alone protect the microcable/fiber from water ingress and therefore a traditionalsealed closure is not needed.

- To give sufficient protection it is essential to use the correct back filling materials given by this instruction e.g. chapter 3 when reinstating the trench or simply covering the duct(s).
- The minimum bending radius shall in no conditions be exceeded and action to prevent this shall be taken. This applies in all situations where a duct is deviating from its straight path e.g. a branch off. Information of the bending radius can be found in respectively material specification.
- For opening and removing the outer sheet of a multiduct assembly all suitable tools can be used. The opening length is free of choice. By making a mark around the circumference of the multiduct assembly sheet and then gently bend it repeatedly the sheet will break an be easy to remove. For a midspan two markings are made.

Suitable tools can be found in Hexatronic tool kit LTT 179003

9 Reference List

Hexatronic Documents

[1] Personal Health and Safety Information
PERSONAL HEALTH AND SAFETY INFORMATION, 124 46-2885

[2] System Safety Information
SYSTEM SAFETY INFORMATION, 124 46-2886

[3] Installation of Microduct Assemblies in Existing Conduits
INSTALLATION INSTRUCTION, 1531-MPB 302 90+

[4] Micronet Direct Buried Duct Assembly
MICRODUCT ASSEMBLIES FOR MICRO CABLES, 28701-MPB30270

[5] Mini-trench Installation Technique
ITU-T , L.48

[6] Micro-trench Installation Technique
ITU-T , L.49

[7] Use of Trenchless Techniques for the Construction of Underground Infrastructures for Telecommunication Cable Installation
ITU-T , L.38

[8] Investigation of the Soil Before Using Trenchless Techniques
ITU-T , L.39