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Installation Instructions

Dura-Line MicroTechnology

Buried MicroDuct systems
for FTTX expansion

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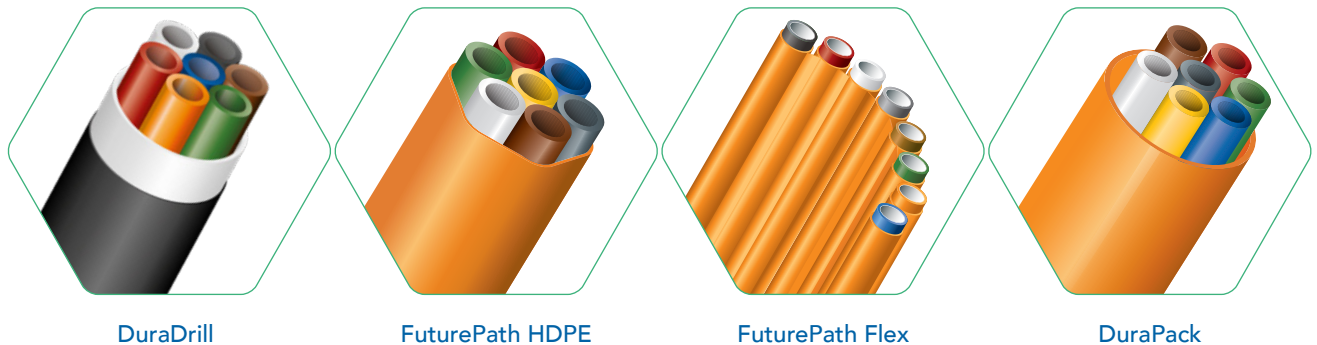
1. General

The processing and laying of MicroDucts, in a wide variety of designs, must be carried out by suitable specialists under expert supervision. When constructing the lines, the currently applicable technical rules and the additional regulations of the utility companies must be observed.

2. Scope of application

These instructions apply to the laying of MicroDucts as individual pipes and to the direct burial (DB) of multiple pipe assemblies such as the DuraDrill, FuturePath HDPE, DuraPack and FuturePath Flex.

Picture 1: Pipe bundles DB



3. Transport and storage

The pipes must be loaded and unloaded carefully and gently. During transport, the pipes or pipe drums must be secured in such a way that defects such as permanent deformation or damage to the outer jacket can be ruled out.

The MicroDucts and MicroDuct bundles must be checked for transport damage upon delivery and before installation. Damaged parts must be discarded.

If stored outdoors for a longer period of time, the pipes must be protected from direct sunlight (e.g. with an appropriate protective film). The UV resistance of the Dura-Line MicroDucts can correspond to 2 years in accordance with DIN EN ISO 4892-2.

In addition, the pipeline parts must be protected from contact with damaging media such as motor fuels, solvents or similar (see information in DIN 8075, Supplement 1).

4. Pipe trench and trench bottom

The pipe trench and the execution of the trench bottom must be carried out in such a way that they correspond to the planning specifications.

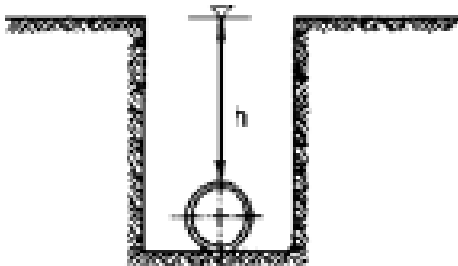
The pipes must lie in a straight line along their entire length. Ripples and undercurves lead to significant reductions in blowing lengths. With regard to the pipe trench design, the specifications of DIN 4124 apply. Sand with a grain size according to Table 1 must be used in the area of the trench bottom and the pipe bed.

Larger stones lead to localized deformations and ripples in the inner pipe wall. Permissible grain sizes depend on the pipe construction and the outside diameter of the pipes.

Table 1: Bedding material in the area of the pipe zone

Product	DuraDrill OD > 20 mm DuraPack	DuraDrill OD < 20 mm FuturePath HDPE FuturePath Flex DuraMicro DB ≤ 10 mm
Permissible grain sizes	0-20mm	0-6mm

Picture 2: Pipe trench, minimum cover: $h = 0.50$ m. For alternative laying methods such as plowing, trenching or milling, DIN 18220 applies with regard to the minimum coverage that can be undercut here.



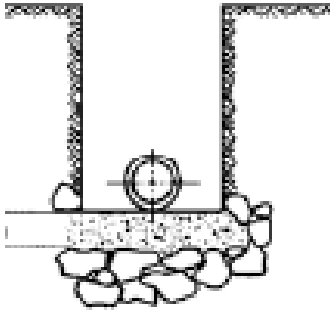
The trench bottom must be compacted with light equipment before pipe laying.

In rocky or stony ground, the trench bottom must be dug at least 10 cm deeper and the excavation must be replaced by a stone-free layer (see Table 1).

After laying, the cable zone is in a tensioned state with min. Fill 10 cm above the top of the pipe assembly.

Mechanical compaction devices may only be used after an overlap of min. 30 cm can be used.

Picture 3: Pipe trench with stony ground



If the trench bottom is unstable and contains a lot of water and there is a risk of the backfill material to be placed being washed out due to changing groundwater levels, appropriate measures must be taken to ensure stabilization.

Support and embedding of pipes and fittings must be carried out up to 10 cm above the pipe crown using materials as described in Table 1 and up to 30 cm pipe coverage in accordance with EN 1610.

If the soil layers change and the associated changes in the load-bearing capacity of the trench bottom, a sufficiently large embankment must be made at the transition points.

If leak tests are planned, the pipe connection points should be kept clear if possible.

5. Installation of the MicroDucts and production of the MicroDuct connections

5.1 Notes on laying in winter temperatures

FuturePath and single MicroDucts can be processed and operated at the following temperatures listed. When laying, care must be taken to avoid major temperature fluctuations.

Table 2: Laying temperatures

Laying:	-20°C to +50°C
Optimal laying temperature:	5°C to +20°C
Blowing in (air temperature max. 30°):	5°C to +30°C
Operational:	-40°C to +60°C

Installation instructions:

The effect of temperature-related expansion is discussed in 5.2. described.

When laying and unwinding pipes, it should be noted that the flexibility of the pipes depends on the ambient temperature. It is recommended to preheat pipe drums at temperatures in the freezing range. This can be done by temporarily storing it in a heated room for a period of several hours before unwinding. Backfilling and covering pipes with frozen ground is not permitted.

Instructions for blowing:

The temperature in the pipe depends on the surrounding soil. In a frozen environment, water and dirt in the pipe are frozen, even if the ambient temperature is higher.

The frost resistance of the lubricant used must be taken into account.

The properties of the cable to be used must be taken into account.

Laid pipes and pipe bundles, even when filled with water, withstand temperatures down to -20°C. However, care should always be taken to ensure that neither dirt nor water is present in the pipe nor can it penetrate the pipe system during installation.

Pipe closures available:

Picture 4: Types of pipe stoppers



Opto End Stop
(>20 mm)



Micro End Cap
(4-50 mm)



MicroDuct End Stop
(4-20 mm)

Water in the air can freeze during blowing. The humidity can be significantly reduced with suitable devices. The use of such devices in conjunction with an air aftercooler is recommended.

Minor ice formation can be avoided by using vinyl alcohol. However, no products containing PE-damaging isopropanol may be used. It is always recommended to clean the end of the pipes with a sponge before blowing in the cables to remove dirt and water.

5.2 Linear expansion

The pipes should be laid in the longest possible lengths, with each pipe length being measured according to the direction. The temperature-related changes in length that apply to polyethylene must be taken into account.

This is particularly true when laying in open protective pipes and ducts. PE-HD has an expansion coefficient of 0.2 mm, which means that when the pipe wall temperature increases or decreases by 1°C, a pipe lengthens or shortens by 0.2 mm per meter of length.

Table 3: Calculation of the linear expansion using a calculation example

Calculation example:	
Installation or ambient temperature	= 40°C
Soil temperature	= 10°C
Temperature difference	= 30°C
Initial data:	
Pipe length	= 100 m, expansion coefficient = 0.2 mm
Calculating the change in length:	
100m x 30°C x 0.2mm	= 600 mm expansion

Especially in midsummer, in order to avoid tensions within the pipe system, the pipe string must lie in the trench for some time before backfilling so that a temperature equilibrium can be established between the pipe and the soil.

MicroDucts are produced in straight lengths and then wound onto drums. Bends create tension, which is largely reduced after unwinding.

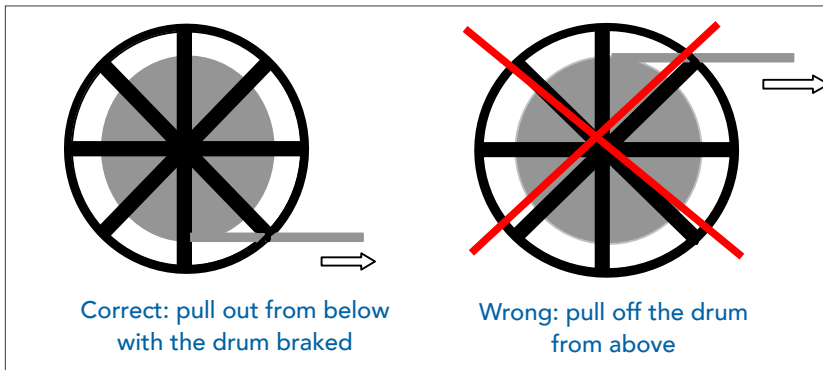
It is recommended to cover the pipes with sand after placing them in the trench and allow them to rest for some time before backfilling. During the rest period, a thermal equilibrium is established between the pipe and the floor. This reduces tension caused by expansion or contraction.

To avoid scoring or kinking, unwind pipe drums (as shown in Figure 3 below). The pipes must be unwound straight and must not be bent.

Peeling off in a spiral (corkscrew effect) is not permitted.

When unwinding the pipes from the drum, please note that the pipe ends can spring away when the fastening is loosened (risk of accident!).

Picture 5: Correct drumming and laying



Drum brakes are available from various manufacturers.



Correct: straight pipe laying
If possible, the pipes should be laid under tension.



Wrong: vertical or horizontal ripple
The waviness of the trench bottom was not compensated for here and is therefore transferred to the pipe structure. A reduction in the blowing length is to be expected!

5.3 Preparation for the MicroDucts connections

The MicroDucts must be cut using a suitable pipe cutter.

Picture 6: Pipe cutter



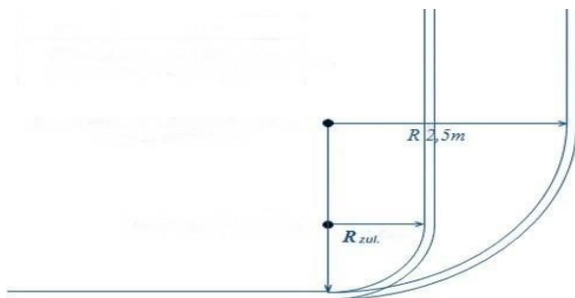
The pipes must be cut at right angles. Burrs and unevenness of the separating surfaces must be removed using a suitable tool such as a deburrer or knurled knife. Cuts and notches should be avoided. To protect the MicroDucts that are not yet connected from contamination and the ingress of water, they must be sealed with end plugs.

5.4 Changes of direction in the pipe route

The pipes and pipe bundles are generally bent "cold". The use of hot air at low temperatures is not permitted.

For temperatures close to frost, the permissible bending radius listed are multiplied by 1.5.

Picture 7: Permissible bending radius



Permissible bending radii are listed in Table 4 and apply to an ambient temperature of 20°C.

Changes in direction have a negative influence on the blowing lengths that can be achieved. For larger blow-in lengths, it is therefore recommended to avoid bending radii smaller than 2.5 m.

No connections may be placed in the area of arches. The ovality caused by the bending must not hinder the calibration of the pipes, which must be carried out before blowing in the cables (see Chapter 7).

Table 4: Bending radii at 20°C

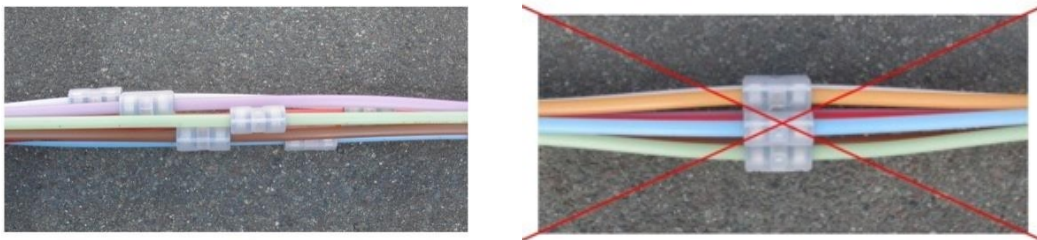
Pipe and pipe unions	Permissible bending radii
DuraPack	25 x OD
DuraDrill	35 x OD
FuturePath HDPE	35 x OD
MicroDucts DB	10 x OD

5.5 FuturePath connections

MicroDucts are connected directly with tensile, underground double sockets. Connectors with a plastic cover provide additional protection. The pipe jacket of the pipe bundles to be connected must be removed sufficiently so that the double sockets can be placed cascaded (offset) to one another. This avoids unnecessary changes in direction and point and heavy loads.

For DuraPack connections directly in the ground the additional protection for MicroDucts DI is needed. We recommend to use PDC closures.

Picture 8: Connection of the MicroDucts



5.6 Connections to structures

Connections to structures (shafts, etc.) must be carried out using suitable wall entry sealing.

6. Backfilling and compacting

6.1 Generally

Compaction contributes directly to the stability of the buried pipe and must therefore be carried out carefully. In the pipe zone, the soil must be placed in layers and compacted by hand.

From 30 cm above the top of the pipe, the trench can be excavated using mechanical compaction equipment, taking the effective depth into account.

Cable protection pipes are laid in dry ground. Any existing ground or layer water must be lowered to such an extent that laying and soil compaction in accordance with EN 1610 is possible.

For example, if the subsequent installation of molded parts is planned in the area of house connections to be created, the additional space required must be taken into account.

6.2 Single-layer pipe laying

Stone-free, compactable soil must be placed over the top of the pipe and in the side area in layers of up to 0.3 m and compacted by hand (with light equipment). The pipes must not be moved laterally.

Picture 9a: Laying of micro pipe associations the pipe

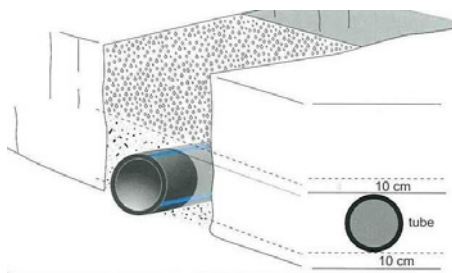
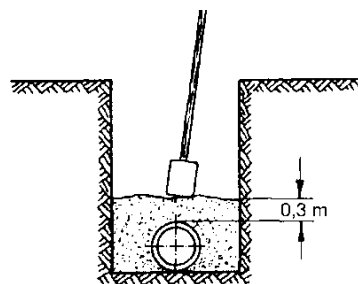


Figure 9b. Compact by hand up to 0.3 m above



6.3 Two- and multi-layer pipe laying

When laying multiple layers in a pipe trench, each pipe layer must be embedded, filled and compacted separately before the next layer is laid out.

The further backfilling must then be placed in layers up to approximately 0.3 m above the pipe crown with stone-free soil and sufficiently compacted.

The distance between the individual layers must be at least 50 mm.

6.4 Distances to underground facilities

If MicroDucts are laid parallel to other existing pipes or are laid when other pipe systems are laid, a minimum distance must be maintained for the establishment of house connections and to avoid interference.

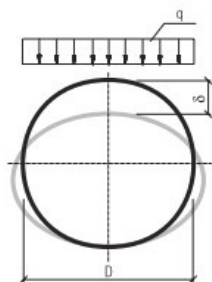
When laying in an open trench, it is recommended that a minimum distance of 20 cm to parallel supply and disposal systems and 10 cm of crossings be maintained.

This must be taken into account in the vicinity of pipe systems that emit heat (e.g. district heating or high-voltage lines). Long-term exposure to temperatures above 20°C should be avoided.

7. Tests

HDPE plastic pipes are flexible. If stresses are applied, for example through bending, earth or point loads, they deform.

Picture 10: Pipe deformation (q =load, D = pipe outside diameter, δ = pipe deformation)



Bending radius that are too small, ovalities and dents caused by larger stones can have a dramatic negative impact on the blowing length.

Due to this fact, we recommend testing with an appropriate caliber before each blowing.

This can ensure that:

- ▶ the maximum permissible deformation of the pipes is not exceeded
- ▶ the pipe system is free of contamination from sand, water or other foreign bodies

The trench must be covered for calibration. However, the beginning and end of the pipe must remain open. After a positive result, it is recommended to close the pipe ends with end caps. If the pipes and pipeline parts were exposed to extraordinary loads during transport or installation, the sealing reliability can be proven by a pressure test with air. Pressure testing instructions can be requested from Dura-Line.

8. Alternative laying techniques

If the floors are suitable, alternative laying techniques can also be used, such as:

- ▶ Trench milling
- ▶ Plowing
- ▶ Horizontal directional drilling (HDD)

If you have any questions about the different installation methods, Dura-Line technical sales will be happy to help you.

9. Standards and guidelines

- ▶ DIN 4124 Construction pits and trenches - embankments, working area widths, shoring
- ▶ EN 1610 Laying and testing of sewage pipes and sewers KRV
- ▶ Installation instructions A 535
- ▶ Cable protection pipes made of PE-HD (high-density polyethylene) laid underground
- ▶ Pipe systems for cable protection