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POLYETHYLENE
PE DUCTING SYSTEMS
Technical Manual

almona TELECOMMUNICATION DUCTING

DVGW SKZ SASO NSF WRAS APPROVED PRODUCT

Only products bearing the NSF, SASO, WRAS, DVGW and SKZ Mark are certified by those organizations.

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"WE DESIGN, DEVELOP, MANUFACTURE AND PROVIDE INNOVATIVE PIPE SOLUTIONS THAT BEST MEET THE NEEDS OF OUR CUSTOMERS"

ABOUT US

Almona is a leading Saudi Arabian plastic pipe manufacturing company and since our establishment in 2008 we have constantly evolved to meet the requirements of our most demanding customers. Our aim is to provide sophisticated and diverse pipe solutions for hot and cold water applications, telecommunication networks, sewage and drainage systems together with water and gas infrastructure.

We are a certified to ISO 9001:2015 Quality Management Systems organization and all our products comply with the appropriate Saudi (SASO), German (DIN) and International (ISO) Standards. Our pipe systems for drinking water applications are NSF-61, WRAS and DVGW certified and all almona products are tested extensively in our state-of-the-art laboratory, to ensure that the quality and performance are continuously maintained.

Almona's success is the result of the company's persistent commitment to continuous innovation and investment in technology, in the relentless pursuit of providing quality products and services. Today, we are pleased to offer a wide range of plastic products, divided into four categories:

BUILDINGS

SEWAGE AND DRAINAGE

INFRASTRUCTURE

TELECOMMUNICATION DUCTING

CONTENTS

This manual is intended for designers, engineers, contractors and installers of ducting systems. It is divided into two parts: Part A - Corrugated Optical Ducts (COD) and Part B - Silicone Core Micro-Ducts. Each part is sub-divided into five sections as follows:

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Technical Manual
Part A

CORRUGATED OPTICAL DUCTS (COD)

Section I

1. General Information

1.1 Introduction

Almona offers a wide product range of innovative products and solutions for telecommunication networks, specially designed to utilize efficiently the available space in your existing duct systems. Furthermore, to fulfil the growing demand for telecommunication network expansion almona designed, developed and manufactures a special product range of Corrugated Optical Ducts (COD) to be used in high speed fiber optic internet networks, cable television, CCTV networks, medium and low voltage power cables, together with other types of communication and undersea duct networks.

With such a large variety of configurations and sizes of COD available in the almona product portofolio, there is virtually no fiber optic project that could not benefit from the use of our ducting technology in both reducing initial construction costs and future proofing the network. Almona COD systems are proven to provide maximum space utilization at minimum installation cost, when compared to traditional methods and designs.

Almona telecommunication ducting systems, are manufactured in our ISO 9001:2015 accredited production facilities, using only the highest quality raw materials available from leading international suppliers following highly controlled manufacturing processes and technologies. Our products are approved to the most stringent internal, national and international standards, for delivering high quality, comprehensive service and products that can be used with confidence in your ducting networks.

1.2 Advantages of almona COD Systems

The main advantages of almona corrugated optical ducts systems are summarized below:

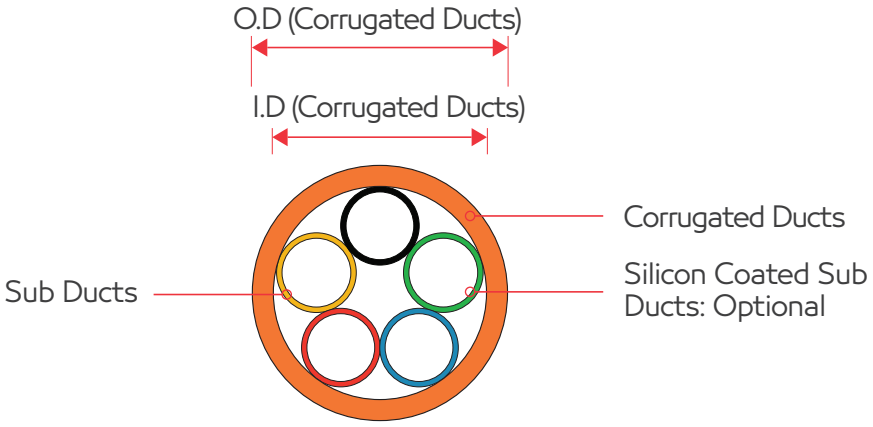
- COD systems can be coiled and therefore can reduce considerable the installation cost, by avoiding numerous connections in between two manholes in a one-time installation.
- High flexibility due to the spiral structure of the product - COD can easily be formed in to bends without much force being applied thus making it easy to by-pass or pass over obstacles along the ducting route.
- Easy insertion of cables up to a maximum coil length owing a perfect alignment of inner ducts and there being no friction due to frequent connections between ducts. In addition, this enables designers to extend the distance between manholes

- Lighter compared to the conventional ducts which offer benefits while transporting and handling the COD systems at the construction site.
- Cost efficient throughout all consecutive work stages and operational life.
- The ready build-in subducts perfectly eliminate any loose space inside of the corrugated duct, allowing COD to offer a considerable advantage in terms of compressive loads.

  CODs don't conduct electricity and are therefore ideal to be used for power cable ducts.
- Resistant to ground movement and earthquakes due to high system flexibility and strength.
- Resistant against chemical attack and corrosion from salty sea or ground water.

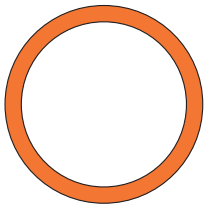
1.3 Characteristics of almona COD Systems

Almona COD are manufactured as an integrated single body with a corrugated outer pipe which contains multiple sub-ducts. On request, the sub-ducts can be supplied with smooth coated surface to reduce friction on cable installs. Both, corrugated pipes and sub-ducts are manufactured from High Density Polyethylene (HDPE) material.

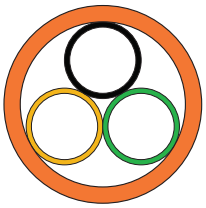


All contact surfaces between main corrugated duct and built-in sub-ducts are fused together during extrusion process to prevent movement or twisting of subducts inside the main COD duct. COD ducts are used to provide a single and continuous duct laying operation from one point to another between manholes of chambers and/or cable pits, without any break or connection. They can be laid directly into trench at standard depths even without sand bedding. Concrete encasement is normally not required.

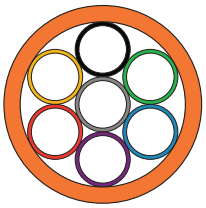
Almona COD systems comes in the following sizes and configurations: single, 3-way, 5-way and 7-way



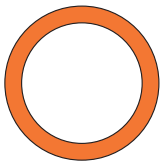
COD empty
OD 110 ± 2mm



COD with 3 subducts
OD 110 ± 2mm

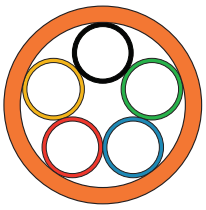


COD with 7 subducts
OD 110 ± 2mm



COD empty
OD 77 ± 2mm

COD with 3 subducts
OD 77 ± 2mm



COD with 5 subducts
OD 110 ± 2mm

For more information on the almona COD systems sizes and configurations, please refer to Section III: Product Range.

"WITH SUCH A LARGE VARIETY OF CONFIGURATIONS AND SIZES OF COD AVAILABLE IN THE ALMONA PRODUCT PORTOFOLIO, THERE IS VIRTUALLY NO FIBER OPTIC PROJECT THAT COULD NOT BENEFIT FROM THE USE OF OUR DUCTING TECHNOLOGY IN BOTH REDUCING INITIAL CONSTRUCTION COSTS AND FUTURE PROOFING THE NETWORK"

Section II

2. Technical Specifications

2.1 Raw Material Specifications for almona Corrugated Optical Ducts

Almona products are manufactured using only the highest quality raw materials available from leading international suppliers. The raw material physical properties are checked and approved by independent international and national laboratories. In addition, almona conducts in house testing at our state-of-the-art laboratory to ensure high quality standards of our products.

The physical properties of raw materials for manufacturing almona COD are provided in the following table:

Characteristics	Value	Unit	Test Method
Density	≥0.950	kg/m³	ISO 1183
Melt Flow Rate (MFR), 190/5,0 kg)	≥0.23	g/10 min	ISO 1133
Tensile Stress at Yield (50 mm/min)	25	MPa	ISO 527- 2
Tensile Modulus (1mm/min)	> 110	MPa	ISO 527- 2
Elongation at break	> 400	%	ISO 527- 2
Carbon Black Content	2.25 ± 0.25	%	ISO 6964
Coefficient of Friction	< 0.1	%	ISO 8295
MRS classification	10	MPa	ISO/TR 9080
Charpy notched impact strength (23°C)	26	kJ/m²	ISO 179

Almona COD systems fulfill local and international requirements are provided in the following table:

Characteristics	Value	Unit	Test Method
Resistance to slow crack growth - SCR (8.0 Bar, 80°C)	> 1000	Hours	ISO 13479
Bending Radius	30 x outer diameter	mm	DIN 8074
Pressurization	5min @ 16 Bar	Bar	EN 50411-6-1
Crush (800N, 60 Sec)	≤ 15 %	%	IEC 60794-1
Kink test	No Residual deformation ≥ 15% for inner & outer diameter	%	IEC 60794-1
Impact resistance	No cracks after a 9.1 kg load is dropped from a height of 1m at a temperature of 0°C	-	ASTM D 2444

2.2 Colour Range

Almona offers wide range of colours for COD, to suit customer requirements. The following table shows the possible RAL colour codes for the corrugated outer pipe and individual ducts. Additional color codes are available on request.

RAL 2004 RAL 3024 RAL 5012 RAL 6038 RAL 1021 RAL 9007 RAL 8016 RAL 9010 RAL 4001

2.3 UV Resistance

Almona COD systems are UV stabilised and can be stored outdoors in direct sunlight for one year. When exposure periods are longer than one-year, additional protection such as an opaque covering shall be provided, as these products are not designed for permanent outdoor exposure.

2.4 Temperature Resistance

Almona COD systems can be stored, installed, and operated at temperatures ranging between -20°C and +40°C. Temperatures above this may be tolerated for short periods.

2.5 Marking

Almona systems are marked with contrasting lettering at one metre intervals showing date of manufacture, dimensions, sequential meter marking and are able to incorporate any other information required by the customer.

2.6 Quality Assurance

Almona systems provide the highest levels of quality and our target is to exceed the requirements of national and international standards. This is achieved through highly controlled manufacturing processes and the implementation of a state-of-the-art quality control system which covers raw material, system manufacture, packing, storage, supply chain and post-sales support.

Our COD systems are produced using the latest generation of machinery operated by trained skilled professionals that are supported by a continuous research and development programme. Deviations on product quality are avoided through stringent quality control checks undertaken by our inhouse quality control laboratory.

2.7 Applicable Standards

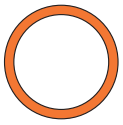
Almona COD systems comply with the following international standards:

ASTM F 405	Specification for Corrugated Polyethylene (PE) Pipe and Fittings
ASTM D 2412	Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
ASTM D 1505	Test Method for Density of Plastics by the Density-Gradient Technique
ASTM D 882	Test Method for Tensile Properties of Thin Plastic Sheeting
ASTM D 1693	Test Method for Environmental Stress-Cracking of Ethylene Plastics
ASTM D 1603	Test Method for Carbon Black Content in Olefin Plastics
ASTM D 2122	Test Method for Determining Dimensions of Thermoplastic Pipe and Fitting
ASTM D 2444	Test Method for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings
ISO 13479:2009	Polyolefin pipes for the conveyance of fluids - Determination of resistance to crack propagation -Test method for slow crack growth on notched pipes
DIN 8074	Polyethylene (PE) - Pipes PE 80, PE 100 - Dimensions
IEC 60794-1	Optical fibre cables – Basic optical cable test procedures – Mechanical test methods
ISO 1183-1:2019	Test Method for Determining the Density of non-cellular plastics
ISO 1133-2:2011	Test Method for Determining the Melt Mass-Flow Rate (MFR) and Melt Volume-Flow Rate (MVR) of thermoplastics
ISO 527-2	Test Method for Determining the Tensile Properties

Section III

3.1 Product Range

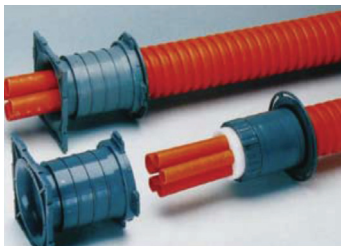
Almona corrugated optical ducts systems are available in different sizes and configurations as shown in the following table:

Type	Design configuration	Outer Diameter OD (mm)	Inner Diameter ID (mm)	Wall Thickness (mm)
COD empty 	COD main duct	77 ± 2	58 ± 2	2.5 ± 0.5
COD empty 	COD main duct	110 ± 2	90 ± 2	2.5 ± 0.5
COD with 7 subducts 	COD main duct	110 ± 2	90 ± 2	2.5 ± 0.5
	sub-ducts	29 ± 1	25 ± 1	2.0 ± 0.2
COD with 5 subducts 	COD main duct	110 ± 2	90 ± 2	2.5 ± 0.5
	sub-ducts	33 ± 1	28 ± 1	2.5 ± 0.5
COD with 3 subducts 	COD main duct	77 ± 2	58 ± 2	2.5 ± 0.5
	sub-ducts	27.2 ± 1	22.2 ± 1	2.5 ± 0.5
COD with 3 subducts 	COD main duct	110 ± 2	90 ± 2	2.5 ± 0.5
	sub-ducts	42 ± 1	36 ± 1	± 0.5

3.2 Accessories

Almona offers a broad variety of accessories for corrugated optical ducts such as connectors, cutters and end-caps.

Line connectors



Manhole connectors

COD Cutter

COD connecting jig

COD end caps

Almona also offers different sizes of subducts connectors with the following dimensions:

Sub-duct couplings	Dimensions			
	OD (mm)	ID (mm)	Wall thickness (mm)	Length (mm)
Sub-duct coupling for 29 mm OD sub-ducts, type 1	39	31	4±0.5	170
Sub-Duct coupling for 33 mm OD sub-ducts, type 2	43	35	4±0.5	170
Sub-Duct coupling for 42 mm OD sub-ducts, type 3	52	44	4±0.5	170
Sub-Duct coupling for 27.2 mm OD sub-ducts, type 4	37.2	29.2	4±0.5	170

Section IV

4. Installation of almona COD Systems

Almona optical ducting systems are suitable for all methods of duct and cable installation, including trenching, direct plow and installation into existing main pathways (conduit pulling, slip lining and pipe bursting). Also, the flexible nature of PE conduit facilitates directional bore installations to breach obstacles like rivers or highways. Cable can consistently be pulled or blown into PE duct over great distances and at fast rates due to its low coefficient of friction.

Almona COD systems shall be installed by experienced specialists under qualified supervision. For the installation of COD systems, it is extremely important to only use highly trained personnel for handling the systems correctly.

4.1 Unwinding from the drum

The COD system shall be uncoiled from the drum in a controlled manner to ensure installation in a straight line. The drum containing the COD system shall not be rolled on the ground and a drum trailer or installation trolley shall always be used. While uncoiling, the COD system shall be pulled in a straight line and from beneath the drum. The COD system shall be under traction during the unwinding process to prevent it unwinding in a spiral shape. Once uncoiled, the COD system can be fixed in the trench with piles of sand to ensure an optimum installation arrangement.

When exposed to high temperatures, the COD system shall not be stretched extensively during unwinding and installation. The COD shall be left in the trench for some time before backfilling to prevent tensioning in the COD system, particularly in the summer months, so that the COD system can contract to its original dimensions.

4.2 Trench Preparation and COD alignment in the trench

The number of CODs laid in the trench shall determine its width, which shall also take in to account the installation costs and safety associated with the laying operation. Generally, 0.2 m(W) x 0.5m(H) dimension is recommended up to laying of 2 lines of COD regardless of numbers of inner ducts. When two or more COD systems are to be laid in parallel, the respective COD shall be arranged with the specified distance. To this end, a simple gauge shall be prepared to straighten the laid COD every 3 or 4 meters. The straightened COD shall be held in place with sand or the equivalent material and then the gauge shall be removed.

Unless otherwise specified, mechanical leveling of the trench bed by excavator can be adequate. The lowermost COD shall not be laid directly on rocks and sharp pebbles. It is recommended that the excavated area shall be leveled and then covered with sand or soft soil before laying COD. The COD shall be laid carefully in order to prevent the entry of soil, sand and water.

4.3 Line connector installation

The steps described below and shown on the diagram shall be followed during line connector installation.

Step 1: Set the two ends of the ducts to be joined and mark each end of the corrugated duct 13 cm from duct end. Then, peel off the COD outer cover by rotating the cutter to the right.

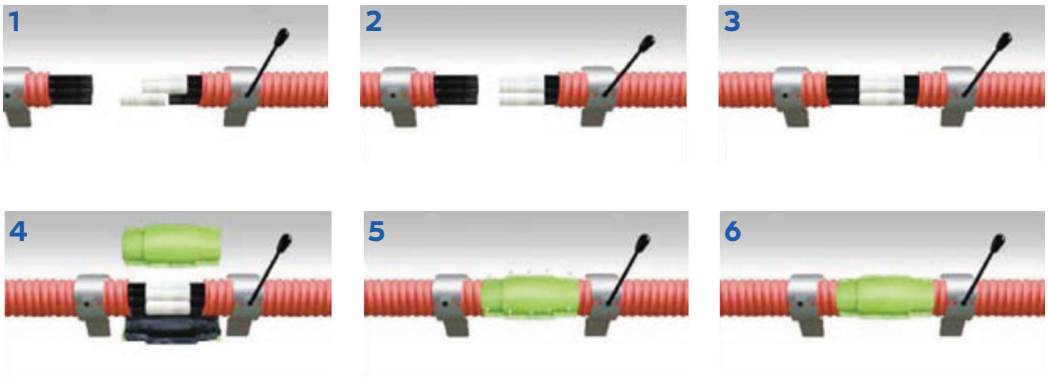
Step 2: Fix both ends of the COD systems to be connected in the connecting jig. Insert sub-duct coupling in one side of each sub-duct.

Step 3: Using the connection jig, insert the socket inside both ducts.

Step 4: After finishing the socket coupling, cover the outer fixing cover.

Step 5: Tighten the bolts and nuts.

Step 6: Complete the installation.



4.4 Line connector installation

The following steps shall be followed during manhole connector installation.

Step 1: Set the one end of the COD system to be connected to the manhole and mark 50 cm from duct end.

Step 2: Peel off the COD outer cover by rotating the cutter to the right.

Step 3: Insert the body of manhole connector on the COD system and ensure the connector body is in the right position.

Step 4: Tighten the bolts and nuts and complete the installation.

Section V

5. Handling and storage of almona COD Systems

5.1 Handling

The drums containing COD shall be transported on suitable vehicles and loaded and unloaded correctly. The COD systems shall be sealed with end caps to prevent entry of any contamination. Point loading and contact with sharp objects must be avoided during transport.

The drums shall always be transported on the supplied drum support frame. Thanks to the special drum support frame with a protective guard, forklift forks can be inserted under the duct bundles on both sides without damaging the ducts.

5.2 Storage

The COD systems shall be stored so that they cannot become contaminated or damaged. The ends of COD systems must always be securely sealed during storage to prevent entry of any contamination (transport caps or heat-shrinkable caps for temporary protection and sand-tight enclosure or end caps for a longer-term, pressure-tight seal).

The drums shall be stored on the supplied drum support frame on level ground or on suitable supports to prevent the ducts coming into contact with the ground. Any damage and deformation of the ducts shall be avoided since this may reduce the blow-in widths. The drums come delivered with an information sign which displays the guidelines for transport, storage and drum handling in a clearly arranged way.

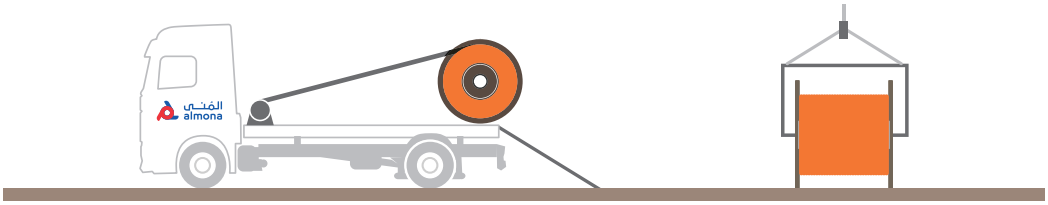
Almona COD systems are UV-stabilised and can be stored outdoors during installation. When exposure periods are longer than one-year, additional protection such as covering with an opaque sheet shall be provided, as these products are not designed for permanent outdoor exposure.

Transportation, storage and installation shall be conducted at temperature ranging between -10°C and +50°C.

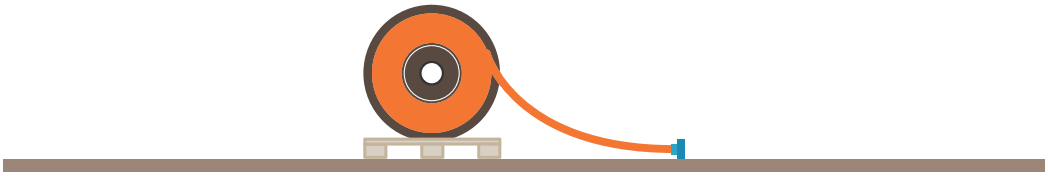
At temperatures above 50°C, even low mechanical loads could result in deformations. The material must not be exposed to any impact loads at temperatures of less than -15°C.

At temperatures below zero, it is more difficult to handle ducts and greater bending radii must be used. It is recommended to store the ducts in heated rooms prior to installation.

The temperature-related length variation in ducts shall be considered when producing infill lengths. A HDPE duct grows or shrinks 0.2 mm per meter of length if the duct wall temperature rises or falls 1°C). For example, a 100m long duct can experience a change in length of 20 cm for every 10oC change in temperature.

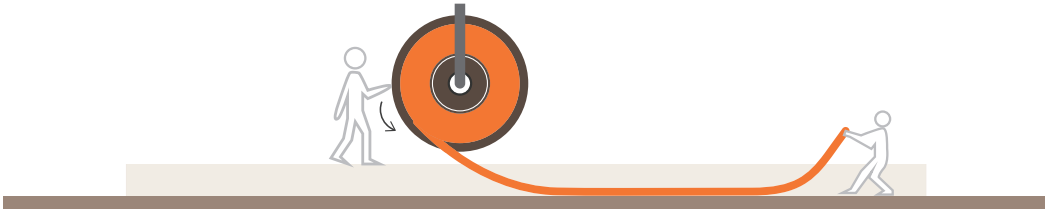


- The drums should be transported on suitable vehicles and loaded and unloaded correctly.
- Drums must be transported and stored with their battens intact.
- Point loading and contact with sharp objects must be avoided during transport and storage.



- Cable ends must always be sealed by using end caps. Using tape for sealing cable ends is considered unsuitable.
- Place the cable drum in line with the intended direction of deployment, in order to prevent the cable from rubbing against the reel flange.

- The drums should be transported on suitable vehicles and loaded and unloaded correctly.



- The drums should not be rolled on the ground to uncoil a duct bundle.
- A drum trailer or installation trolley shall always be used.
- When uncoiling the microduct bundle, ensure that the bundle is pulled in a straight line and from beneath the drum. It is not permitted to pull the bundle from the side via the flange.
- The bundle must be under traction during the unwinding process and the drum braked from the first metre to prevent it unwinding in a spiral shape.

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Technical Manual
Part B

SILICON CORE MICRO-DUCTS (COD)

Section I

1. General Information

1.1 Introduction

Almona offers a wide product range of innovative products and solutions for telecommunication networks, specially designed to utilize efficiently the available space in your existing duct systems. Furthermore, to fulfil the growing demand for telecommunication network expansion almona designed, developed and manufactures a special product range of silicon core micro-ducts to be used in high speed fiber optic internet networks, cable television, CCTV networks, medium and low voltage power cables, together with other types of communication and undersea duct networks.

With such a large variety of configurations and sizes silicon core micro-ducts available in the almona product portofolio, there is virtually no fiber optic project that could not benefit from the use of our ducting technology in both reducing initial construction costs and future proofing the network. Almona silicon core micro-duct bundles are proven to provide maximum space utilization at minimum installation cost, when compared to traditional methods and designs.

Almona telecommunication ducting systems, are manufactured in our ISO 9001:2015 accredited production facilities, using only the highest quality raw materials available from leading international suppliers following highly controlled manufacturing processes and technologies. Our products are approved to the most stringent internal, national and international standards, for delivering high quality, comprehensive service and products that can be used with confidence in your ducting networks.

1.2 Advantages of almona silicone core micro-ducts Systems

The main advantages of almona silicone core micro-ducts systems are summarized below:

- Risk elimination of having installed obsolete fibers that no longer meet the network's growing requirements without disrupting critical operations of the network.
- Using silicone core micro-ducts allows fast and easy installation of any fiber optic cable. The systems allow for immediate network upgrades while protecting the network in operation against potentially rapid obsolescence.
- Silicon core micro-ducts can be stored, installed, and operated at temperatures ranging from -20°C to +40°C. Temperatures above this may be tolerated for short periods.

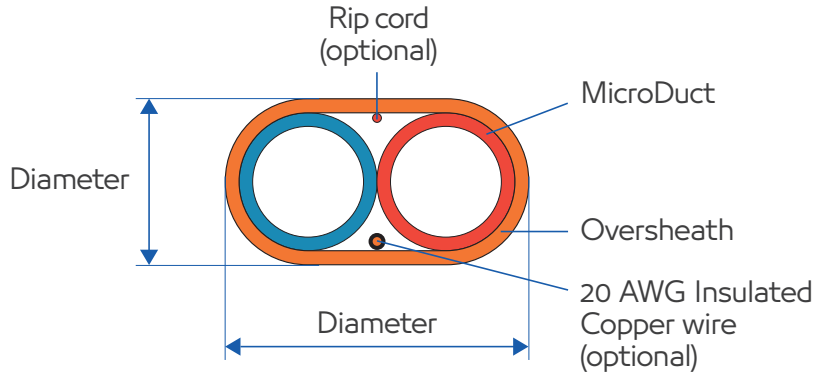
- The silicone core micro-ducts can have multiple configurations including single or bundled arrangements, multiple colours for easy identification and can be specially designed based on the specific project requirements.
- Due to the low bending radius and high flexibility, the almona silicon core micro-ducts according to DIN 16874 are particularly suitable for installation in congested urban areas.
- Resistant against chemical attack and corrosion from salty sea and ground water.

1.3 Characteristics of almona silicone core micro-ducts Systems

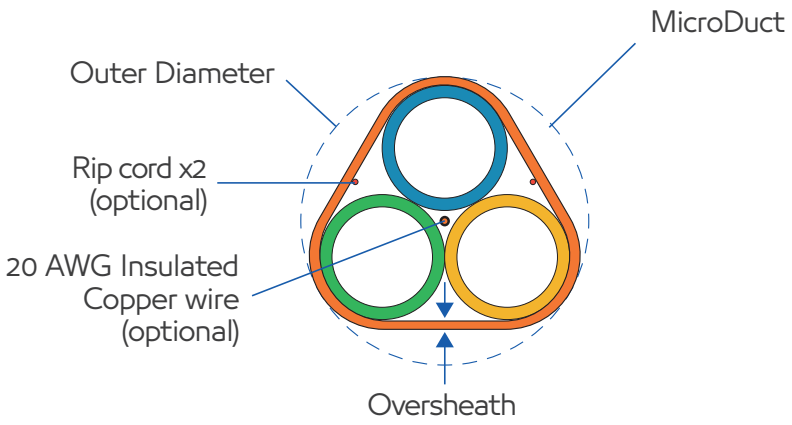
Almona silicon core micro-ducts system comprises of an outer sheath and multiple micro ducts. The structural part of a micro ducts is made from High Density Polyethylene (HDPE), whilst the inner surface of the micro ducts is made from permanent silicon material having a very low coefficient of friction. The inner silicone surface is formed into fine ribs to reduce the contact surface between the cable and duct. All almona micro-ducts configurations can be supplied with an insulated copper-locate wire. The copper-locate wire may be tested in the field using a common Ohmmeter by connecting the leads to each end of the locate wire. The ohm meter should read zero to 10 ohms, depending on the tightness of the connections and length of the almona system on the reel.

Almona silicon core micro-ducts bundled with a polyethylene over sheath comes in the following configurations: 2-way, 3-way, 4-way, 7-way, 10-way, 14-way and 24-way.

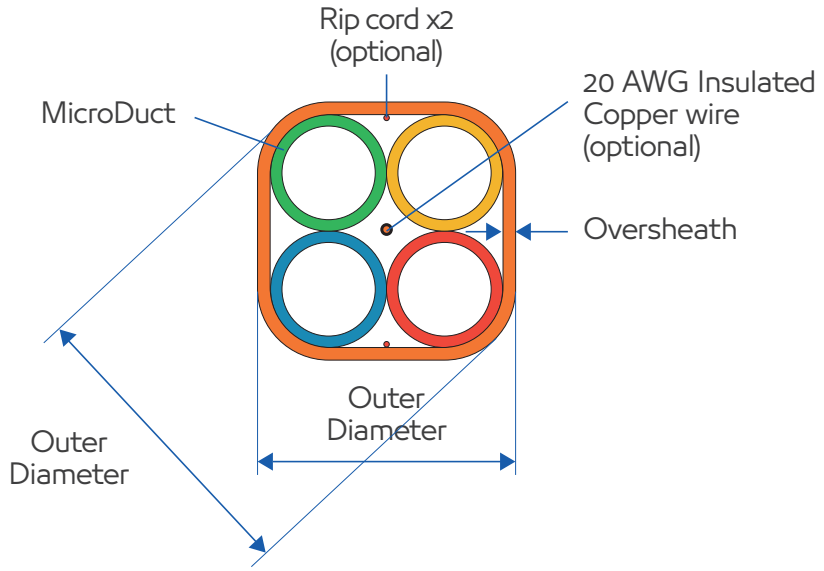
2-Way Micro-Ducts Bundle



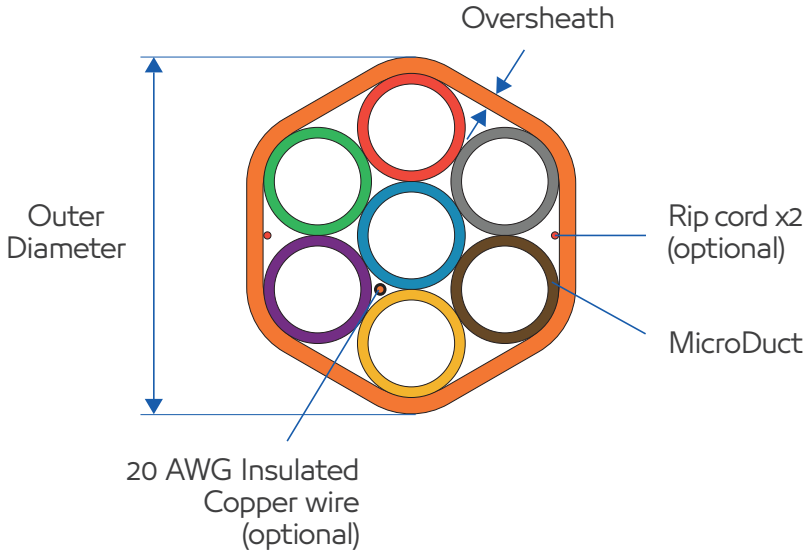
3-Way Micro-Ducts Bundle



4-Way Micro-Ducts Bundle



7-Way Micro-Ducts Bundle



The silicon core-micro ducts can be installed into existing larger sub ducts and can be used to increase the carrying capacity of the duct network. Micro ducts are intended for protection of optical micro cables and are not designed for permanent inner pressure.

1.3 Characteristics of almona silicone core conduit micro-ducts Systems

The almona silicon core conduit micro-ducts system is made from Low Density Polyethylene (LDPE). The inner surface of the conduit is made from permanent silicon material with a very low coefficient of friction that is formed into fine ribs to reduce the contact surface between the cable and duct.

Section II

2. Technical Specifications

2.1 Raw Material Specifications of almona silicone core micro-ducts and conduit silicone core micro-ducts

Almona products are manufactured using only the highest quality raw materials available from leading international suppliers. The raw material physical properties are checked and approved by independent international and national laboratories. In addition, almona conducts in house testing at our state-of-the-art laboratory to ensure high quality standards of our products.

The physical properties of raw materials for manufacturing almona silicone core micro-ducts are provided in the following table:

Characteristics	Value	Unit	Test Method
Density	≥0.950	kg/m³	ISO 1183
Melt Flow Rate (MFR), 190/5,0 kg)	≥0.23	g/10 min	ISO 1133
Tensile Stress at Yield (50 mm/min)	25	MPa	ISO 527- 2
Tensile Modulus (1mm/min)	> 110	MPa	ISO 527- 2
Elongation at break	> 400	%	ISO 527- 2
Carbon Black Content	2.25 ± 0.25	%	ISO 6964
Coefficient of Friction	< 0.1	%	ISO 8295
MRS classification	10	MPa	ISO/TR 9080
Charpy notched impact strength (23°C)	26	kJ/m²	ISO 179

The physical properties of raw materials for manufacturing almona silicone core conduit micro-ducts systems are provided in the following table:

Characteristics	Value	Unit	Test Method
Density	≥0.923	kg/m³	ISO 1183
Melt Flow Rate (MFR), 190/5,0 kg)	≥0.25	g/10 min	ISO 1133
Tensile Strength at break (MD)	300	MPa	ISO 527- 2
Tensile Elongation at break (MD)	> 110	%	ISO 527- 2
Tensile Strength at yield (MD)	12	MPa	ISO 527- 2
Coefficient of Friction	> 80	%	ISO 8295

Almona silicone core micro-ducts systems fulfill international requirements which are provided in the following table:

Characteristics	Value	Unit	Test Method
Resistance to slow crack growth - SCR (8.0 Bar, 80°C)	> 1000	Hours	ISO 13479
Bending Radius	30 x outer diameter	mm	DIN 8074
Pressurization	5min @ 16 Bar	Bar	EN 50411-6-1
Crush (800N, 60 Sec)	≤ 15 %	%	IEC 60794-1
Kink test	No Residual deformation ≥ 15% for inner & outer diameter	%	IEC 60794-1
Impact resistance	No cracks after a 9.1 kg load is dropped from a height of 1m at a temperature of 0°C	-	ASTM D 2444

2.2 Colour Range

Almona offers wide range of colours for COD, to suit customer requirements. The following table shows the possible RAL colour codes for the corrugated outer pipe and individual ducts. Additional color codes are available on request.

RAL 2004 RAL 3024 RAL 5012 RAL 6038 RAL 1021 RAL 9007 RAL 8016 RAL 9010 RAL 4001

2.3 UV Resistance

Almona silicone core micro-ducts and conduit silicone core micro-ducts are UV stabilised and can be stored outdoors in direct sunlight for one year. When exposure periods are longer than one-year, additional protection such as an opaque covering shall be provided, as these products are not designed for permanent outdoor exposure.

2.4 Temperature Resistance

Almona silicone core micro-ducts and conduit silicone core micro-ducts can be stored, installed, and operated at temperatures ranging between -20°C and +40°C. Temperatures above this may be tolerated for short periods only.

2.5 Blow-ability

One of the most important attributes of almona silicone core micro-ducts is the ability of the system to accept blown micro-cables or blown fibre units. The formulation and surface finish of the low friction inner layers of the micro-duct are of vital importance when blowing.

Factors which permit greater blow distances:

- More air pressure (12bar instead of 10bar)
- Straighter route
- Downwards direction (down a building or hill rather than up)
- Larger micro-ducts
- Smaller fibre product (lower weight)

2.6 Marking

Almona silicone core micro-ducts and conduit silicone core micro-ducts systems are marked with contrasting lettering at one metre intervals showing date of manufacture, dimensions, sequential meter marking and are able to incorporate any other information required by the customer.

2.7 Quality Assurance

Almona silicone core micro-ducts and conduit silicone core micro-ducts systems provide the highest levels of quality and our target is to exceed the requirements of national and international standards. This is achieved through highly controlled manufacturing processes and the implementation of a state-of-the-art quality control system which covers raw material, system manufacture, packing, storage, supply chain and post-sales support.

Our silicone core micro-ducts and conduit silicone core micro-ducts are produced using the latest generation of machinery operated by trained skilled professionals that are supported by a continuous research and development programme. Deviations on product quality are avoided through stringent quality control checks undertaken by our inhouse quality control laboratory.

2.7 Applicable Standards

Almona silicone core micro-ducts systems comply with the following international standards:

ASTM D 2412	Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
ASTM D 1505	Test Method for Density of Plastics by the Density-Gradient Technique
ASTM D 882	Test Method for Tensile Properties of Thin Plastic Sheeting
ASTM D 1693	Test Method for Environmental Stress-Cracking of Ethylene Plastics
ASTM D 2122	Test Method for Determining Dimensions of Thermoplastic Pipe and Fitting
ASTM D 2122	Test Method for Carbon Black Content in Olefin Plastics
ASTM D 2122	Test Method for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings
ISO 13479:2009	Polyolefin pipes for the conveyance of fluids - Determination of resistance to crack propagation -Test method for slow crack growth on notched pipes
DIN 8074	Polyethylene (PE) - Pipes PE 80, PE 100 - Dimensions
IEC 60794-1	Optical fibre cables – Basic optical cable test procedures – Mechanical test methods
ISO 1183-1:2019	Test Method for Determining the Density of non-cellular plastics
ISO 1133-2:2011	Test Method for Determining the Melt Mass-Flow Rate (MFR) and Melt Volume-Flow Rate (MVR) of thermoplastics
ISO 527-2	Test Method for Determining the Tensile Properties

Section III

3. Product Range

Almona manufactures different sizes and configurations of silicone core micro-ducts and conduit silicone core micro-ducts for a variety of applications, such as: Direct Install (DI) and Direct Buried (DB).

Direct Buried (DB): In applications where the micro-ducts will be directly buried or bundled into bundle configurations, we recommend using a thicker walled micro-duct to maintain the optimum fill ratios and have faster, easier installations.

Direct Install (DI): In applications where the micro-duct or bundle configuration will be placed inside an existing conduit and space is a more sensitive issue, we recommend using a thinner walled product where protection is provided by the existing conduit.

3.1 Single silicone core micro-ducts and conduit silicone core micro-ducts

Almona offers a wide product range of silicone core micro-ducts for both DB and DI, as shown in the following table:

application DB/DI	microduct size OD/ID (mm)	wall thickness (mm)	OD (mm)	Tolerance (mm)	minimum bending radius 20°C (mm)	max blowing pressure (bar)	burst pressure (bar)
DI	4/3	0.5	4	±0.05	80	10	> 30
DI	5/3.5	0.75	5	±0.05	100	10	> 30
DB	7/4	1.5	7	±0.15	140	16	> 50
DI	7/5.5	0.75	7	±0.15	140	10	> 30
DB	8/3.5	2.25	8	±0.15	200	16	> 50
DB	10/6	2	10	±0.15	240	16	> 50
DI	10/8	1	10	±0.15	200	10	> 30
DB	12/8	2	12	±0.15	280	16	> 50
DI	12/10	1	12	±0.15	240	10	> 30
DB	14/10	2	14	±0.15	280	16	> 50
DI	14/11.5	1.25	14	±0.15	280	10	> 30
DB	16/10	3	16	±0.15	320	16	> 50
DI	16/12	2	16	±0.15	320	10	> 30
DB	18/12	3	18	±0.30	360	16	> 50
DI	18/14	2	18	±0.30	360	10	> 30

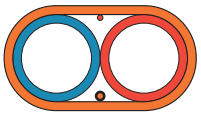
Almona silicone core conduit micro-ducts product range is provided in the following table:

Part No.	ID (mm)	Coil length (m)
21 901	16	40
21 902	23	40

Additional sizes up to 63 mm outer diameter (OD) are available on request.

3.2 Silicon Core 2-Way Micro-Duct Bundle

Almona offers a wide product range of silicone core 2-Way micro-ducts for both DB and DI, as shown in the following table:

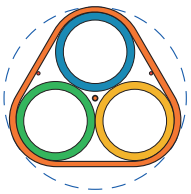


application DB/DI	microduct size OD/ID (mm)	protective sheath thickness (mm)	OD (mm)	minimum bending radius 20°C (mm)	Insulated Cooper Wire (mm)*
DI	4/3	1	10/6	200	0.6
DI	5/3.5	1	12/7	240	0.6
DI	7/5.5	1	16/9	320	0.6
DI	10/8	1	22/12	440	0.6
DI	12/10	1	26/14	520	0.6
DI	14/11.5	1	30/16	600	0.6
DB	14/10	1.2	30/16	600	0.6
DB	16/12	1.2	32/18	640	0.6
DB	18/14	1.2	38/20	760	0.6

*insulated copper wire can be added upon request

3.3 Silicon Core 3-Way Micro-Duct Bundle

Almona offers a wide product range of silicone core 3-Way micro-ducts for both DB and DI, as shown in the following table:

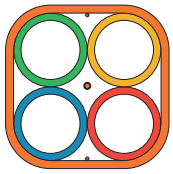


application DB/DI	microduct size OD/ID (mm)	protective sheath thickness (mm)	OD (mm)	minimum bending radius 20°C (mm)	Insulated Cooper Wire (mm)*
DI	4/3	1	10/10	200	0.6
DI	5/3.5	1	12/12	240	0.6
DI	7/5.5	1	16/16	320	0.6
DI	10/8	1	22/22	440	0.6
DI	12/10	1	26/26	520	0.6
DI	14/11.5	1	30/30	600	0.6
DB	14/10	1.2	30/30	600	0.6
DB	16/12	1.2	32/32	640	0.6
DB	18/14	1.2	38/38	760	0.6

*insulated copper wire can be added upon request

3.4 Silicon Core 4-Way Micro-Duct Bundle

Almona offers a wide product range of silicone core 4-Way micro-ducts for both DB and DI, as shown in the following table:

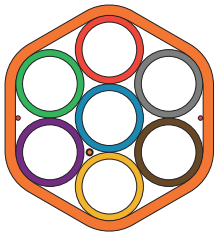


application DB/DI	microduct size OD/ID (mm)	protective sheath thickness (mm)	OD (mm)	minimum bending radius 20°C (mm)	Insulated Cooper Wire (mm)*
DI	4/3	1	10/10	200	0.6
DI	5/3.5	1	12/12	240	0.6
DI	7/5.5	1	16/16	320	0.6
DI	10/8	1	22/22	440	0.6
DI	12/10	1	26/26	520	0.6
DI	14/11.5	1	30/30	600	0.6
DB	14/10	1.2	30/30	600	0.6
DB	16/12	1.2	32/32	640	0.6
DB	18/14	1.2	38/38	760	0.6

*insulated copper wire can be added upon request

3.5 Silicon Core 7-Way Micro-Duct Bundle

Almona offers a wide product range of silicone core 7-Way micro-ducts for both DB and DI, as shown in the following table:



application DB/DI	microduct size OD/ID (mm)	protective sheath thickness (mm)	OD (mm)	minimum bending radius 20°C (mm)	Insulated Cooper Wire (mm)*
DI	4/3	1	14/14	420	0.6
DI	5/3.5	1	17/17	510	0.6
DI	7/5.5	1	23/23	690	0.6
DI	10/8	1	32/32	960	0.6
DI	12/10	1	38/38	1,140	0.6
DI	14/11.5	1	44/44	1,320	0.6
DB	14/10	1.2	44.4/44.4	1,320	0.6
DB	16/12	1.2	50.4/50.4	1,500	0.6

*insulated copper wire can be added upon request

3.6 Accessories for almona silicone core micro-ducts

Almona offers a new generation innovative accessories for silicon core and conduit micro-ducts such as connectors, reducers, locking clips, stripping tools, peeling equipment and bundle cutters.

3.6.1 Connectors

Metal free connectors avoid corrosion problems in DB and DI applications. High quality materials and a transparent body assure easy and quick installation. DB connectors shall be protected with rubber protection caps for proper DB functionality. DI connectors are designed to fit with thin-walled silicone core micro-ducts and are for any applications that are not directly buried, including inside buildings and manholes or branching boxes.

Reducing connectors allow interconnection between two silicone core micro-ducts with different outer diameter. Typically, this is the case at the transition point from DB to DI micro-duct at the point where it enters a building.

The end caps are metal free and have a transparent body. The pre-installed safety clips provide for quick and easy installation whilst keeping the micro-ducts clean and dry. All open silicone core micro-duct ends should be closed to keep the network free of contamination. Special rubber covers are recommended for direct burial (DB) applications to secure easy and smooth push-fit functionality of the connectors.

Main features and characteristics of almona DB and DI connectors, reducers and end caps are summarized below:

- No metal parts
- Inner diameter leveled with micro-ducts
- Push-fit system
- Safety clips pre-installed
- Body material: polyamide
- Working Pressure: max. 20 bars
- Lifespan: 25 years
- Standards: EN 50411-2-8

Connector for direct buried (DB) and direct install (DI) applications

Reducer Connector

End caps

Locking Clips

Compression Connector

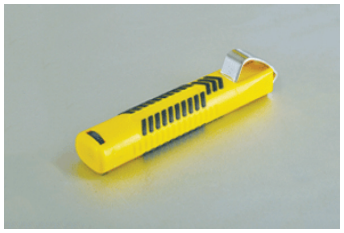
Compression connectors offer solutions for connecting HDPE ducts. The connector is designed to withstand working pressures of up to 16 bar. These compression connectors are manufactured in diameters ranging between 16 mm and 160 mm.

Main features and characteristics of almona compression connectors are summarized below:

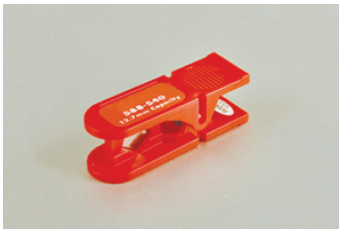
- No metal parts
- Manufactured from polypropylene material
- High quality
- Maximum operation pressure is 16 Bars

3.6.2 Stripping Tools

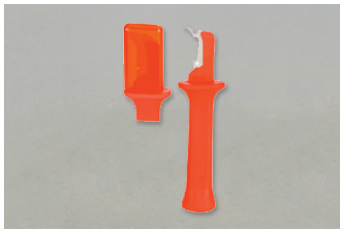
Almona provides a new generation innovative stripping tools, peeling equipment and bundle cutters for easy installation of silicone core micro-ducts systems



Cable stripping knife



Micro-duct cutter



Stripping knife

Peeling equipment

Bundle cutter

Section IV

4. Typical Installation

Almona manufactures different sizes and configurations of silicone core micro-ducts which can be Direct Install (DI) and Direct Buried (DB).

Before DI or BD installation the silicone core micro-ducts and micro-ducts bundles must be uncoiled from the drum carefully to ensure that the micro ducts systems are installed in a straight line. The drum containing the silicone core micro-duct systems shall not be rolled on the ground and a drum trailer or installation trolley shall always be used. While uncoiling, the silicone core micro-duct systems shall be pulled in a straight line and from beneath the drum. The silicone core micro-duct systems shall be under traction during the unwinding process to prevent it unwinding in a spiral shape. Once uncoiled, the silicone core micro-duct systems can be fixed in the trench with piles of sand to ensure an optimum installation arrangement.

When exposed to high temperatures, the silicone core micro-duct systems shall not be stretched extensively during unwinding and installation. The silicone core micro-duct systems shall be left in the trench for some time before backfilling to prevent tensioning in the silicone core micro-duct systems, particularly in the summer months, so that the silicone core micro-duct systems can contract to its original dimensions.

Almona silicone core micro-ducts systems shall be installed by experienced specialists under qualified supervision. For the installation of silicone core and conduit micro-duct systems, it is extremely important to only use highly trained personnel for handling the systems correctly.

4.1 Direct Buried (DB) silicone core micro-ducts installation

In applications where the silicone core micro-ducts and bundles will be directly buried, it is recommended to use a thicker walled micro-ducts to maintain the optimum fill ratios and have faster, easier installations.

Silicone core micro-ducts and micro-ducts bundles can be installed directly into the ground with thick-walled dimensions (wall thickness over 1.5 mm). During the installation process the silicone core micro-ducts and bundles shall not be installed over sharp edges or kink them during installation. The silicone core micro-duct ends shall be always sealed during installation to ensure that no foreign objects or water enters inside the micro-ducts. End caps shall be used for installation and not the yellow transport caps, to ensure a long-lasting, air-tight seal.

Silicone core micro-ducts shall be installed on a level, compacted, stone-free sand bed of at least 10 cm at an appropriate depth, whilst taking account of the structural requirements. If the subsoil is rocky or stony, the sand bed thickness shall be a minimum of 15 cm (sand grain size of 0.063-2.0 mm as per EN ISO 14688-1:2002). Light-weight compacting equipment shall be used for compaction.

4.2 Direct Install (DI) silicone core micro-ducts installation

In applications where the silicone core micro-ducts or bundle configuration will be placed inside an existing conduit and space is a more sensitive issue, we recommend using a thinner walled product where protection is provided by the existing conduit.

4.2.1 Blowing silicone core micro-ducts into HDPE protective cable ducts.

Silicone core micro-ducts can be blown into HDPE protective cable ducts with interior grooving using conventional blowing-in devices and a compressor. Compressed air needs to be applied to increase rigidity immediately before micro-ducts are blown into protective cable ducts. This prevents the micro-ducts lying on top of each other and twisting when being blown into the protective cable ducts, which will reduce the blow-in length. Furthermore, the supporting air reduces duct ovality. For this purpose, the micro-ducts are subjected to an air pressure of about 10 bar on the inside of the duct while the ducts are still on the drum. The ducts remain on the cable drum in this condition for one hour. The ends of the micro-ducts shall be sealed with almona end caps to ensure that pressure can be applied.

A number of silicone core micro-ducts can be blown into a protective cable duct at the same time. To do so, the drums for the individual duct shall be placed on a suitable drum support frame. The optimum occupancy value for the protective duct shall be 40% to ensure high blow-in widths are achieved. Only individual silicone core micro-ducts may be blown into protective ducts and not duct bundles. Silicone core micro-ducts bundles can be fed into protective ducts.

4.2.2 Feeding of silicone core micro-ducts and bundles into protective ducts

Feeding in thick-walled silicone core micro-ducts and bundles is especially suitable for existing duct lines without interior grooving. Micro-ducts and bundles can both be pulled in using a cable grip or individual pulling eyes. During the process the ends of the ducts shall be always sealed, and it is important to apply sufficient tractive forces when pulling in ducts.

4.3 Bending radii

As a general rule, the greater the bending radii, the greater the blow-in values

- Recommended minimum bend radius for microducts bundles is higher than 2.5 m.
- Recommended minimum bed radius of microducts is 20 x external diameter.
- No plug connectors may be used in bends since the optical fibre cable may snag on the interior edge when it is blow in.

4.4 Distances

The horizontal distance between silicone core micro-ducts bundles installed in parallel shall be at least 3 cm to ensure sufficient backfill. Micro-ducts bundles can be installed in parallel with different sheathing colours to ensure they are clearly assigned.

4.5 Connecting silicone core micro-ducts bundles

When connecting two silicone core micro-ducts bundles, the individual internal ducts are stripped at the connection point and connected with plug-in connectors. The micro-ducts shall be coupled offset to avoid the fittings being positioned on top of one another.

To avoid incorrect assignment during the blow-in process, only micro-ducts which have the same colour stripes and duct numbers may be bundled together. The almona installation clamp can be used to protect the open connection point against mechanical loads or dirt and to provide strain relief and stability.

4.6 Cutting silicone core micro-ducts bundles

The following basic principles apply to trimming:

- Do not use of any chip-producing tools such as saws to cutting ducts as chips produced on the inner edge of ducts and crushed ducts could impair the blow-in process.
- Duct cutter blades must be sharp, so that the micro-ducts are not crushed.
- Trim perpendicular to the longitudinal axis of ducts.
- If the tool is used correctly, the micro-ducts will not need to be deburred or pressed back into shape.
- When cutting bundles with larger micro-ducts (16/20 mm) to size, the ducts can become oval-shaped at the cutting point. These need to be pressed round again prior to installation.

4.7 Building connection

The number of silicone core micro-ducts in the bundle shall correspond to the planned number of properties/buildings (at least one duct for each building to be supplied). Unless otherwise is specified, the following steps are recommended to be followed when connecting the micro-ducts to building entrance points.

Step 1: Use a suitable sheath opener. Press the sliding block blade forward into the sheathing and pull sheath opener along the groove between two micro-ducts whilst applying slight pressure. Ensure that the individual ducts on the inside do not get damaged. Open approx. 60 -120 cm depending on the bundle size.

Step 2: Separate building connection micro-ducts. The individual silicone core micro-ducts are easily accessible in the opened bundle. Cut though the micro-ducts to be branched off using a suitable duct cutter.

Step 3: Mount the plug connectors onto a single duct branching off the bundle and connect to the prepared building connection single duct. The second end of the unassigned silicone core micro-ducts, which remains in the bundle, must be sealed with an end cap.

Step 4: Ensure that the plug connector is not placed in a bend when installing a branch. A branch support can be used to provide reliable duct guidance in the branch. The plug connector must be positioned before or after the branch support. It is recommended to fix the micro-ducts which branches from the bundle and the fitting into the straight section with cable binders/ tape to ensure it is securely positioned. The branch support must to be fitted at a sufficient distance from the bundle to prevent pressure marks on the duct bundle. In the case of a double connection with optical fibre, a second branch is established with the other end of the severed tube and both duct ends are branched off towards the building with plug connectors.

Step 5: Seal the building connection silicone core micro-ducts at the property or feed them into the building, so they are pressure tight. If a building temporary connection is to be made, the building connection duct can be left at the property boundary or on the property and stored in a bundled coil having an adequate reserve of around 10 m length. The duct must be sealed with an end cap. Inside the building, the micro-duct must be sealed with an end cap or an individual sealing element.

Section V

5. Handling and storage of silicon core micro-ducts

5.1 Handling

The drums containing silicone core micro-ducts shall be transported on suitable vehicles and loaded and unloaded correctly. The silicone core micro-ducts bundles are sealed with heat-shrinkable caps and the individual ducts with transport caps to prevent entry of any contamination. Point loading and contact with sharp objects must be avoided during transport.

The drums shall always be transported on the supplied drum support frame. Thanks to the special drum support frame with a protective guard, forklift forks can be inserted under the duct bundles on both sides without damaging the ducts.

5.2 Storage

The silicone core micro-ducts shall be stored so that they cannot become contaminated or damaged. The ends of the individual micro-ducts in bundles must always be securely sealed during storage to prevent entry of any contamination (transport caps or heat-shrinkable caps for temporary protection and sand-tight enclosure or end caps for a longer-term, pressure-tight seal).

The drums shall be stored on the supplied drum support frame on level ground or on suitable supports to prevent the ducts coming into contact with the ground. Any damage and deformation of the ducts shall be avoided since this may reduce the blow-in widths. The drums come delivered with an information sign which displays the guidelines for transport, storage and drum handling in a clearly arranged way.

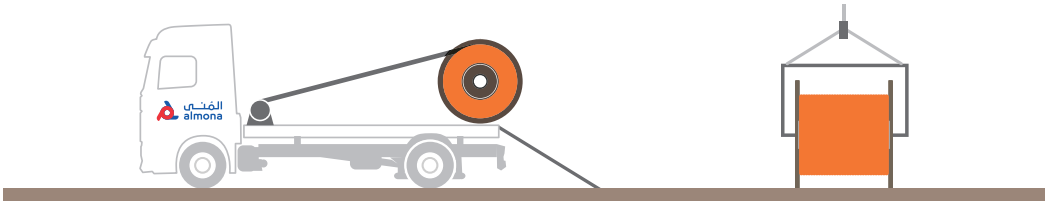
Almona silicone core micro-ducts are UV-stabilised and can be stored outdoors during installation. When exposure periods are longer than one-year, additional protection such as covering with an opaque sheet shall be provided, as these products are not designed for permanent outdoor exposure.

Transportation, storage and installation shall be conducted at temperature ranging between -10°C and +50°C.

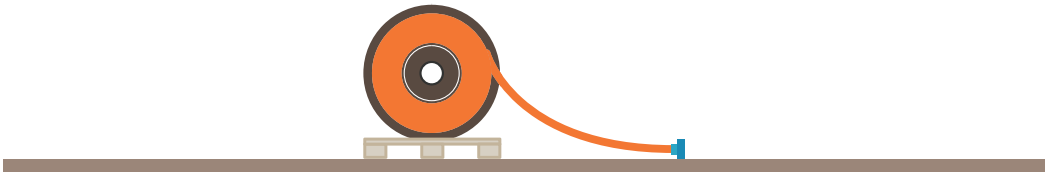
At temperatures above 50°C, even low mechanical loads could result in deformations. The material must not be exposed to any impact loads at temperatures of less than -15°C.

At temperatures below zero, it is more difficult to handle ducts and greater bending radii must be used. It is recommended to store the ducts in heated rooms until immediately prior to installation.

The temperature-related length variation in ducts shall be considered when producing infill lengths. A HDPE duct grows or shrinks 0.2 mm per metre of length if the duct wall temperature rises or falls 1 °C). For example, a 100m long duct can experience a change in length of 20 cm for every 10oC change in temperature.

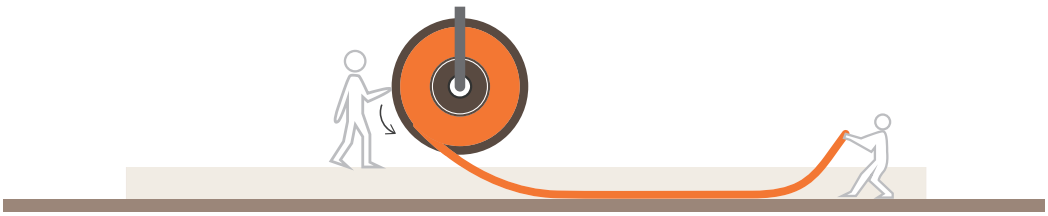


- The drums should be transported on suitable vehicles and loaded and unloaded correctly.
- Drums must be transported and stored with their battens intact.
- Point loading and contact with sharp objects must be avoided during transport and storage.



- Cable ends must always be sealed by using end caps. Using tape for sealing cable ends is considered unsuitable.
- Place the cable drum in line with the intended direction of deployment, in order to prevent the cable from rubbing against the reel flange.

- The drums should be transported on suitable vehicles and loaded and unloaded correctly.



- The drums should not be rolled on the ground to uncoil a duct bundle.
- A drum trailer or installation trolley shall always be used.
- When uncoiling the microduct bundle, ensure that the bundle is pulled in a straight line and from beneath the drum. It is not permitted to pull the bundle from the side via the flange.
- The bundle must be under traction during the unwinding process and the drum braked from the first metre to prevent it unwinding in a spiral shape.

Saudi made
صنع بالسعودية

High quality
جودة عالية

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