BS EN 50411-2-9:2010

BSI Standards Publication

Fibre organisers and closures to be used in optical fibre communications systems — Product specifications

Part 2-9: Non-sealed closures for air blown fibre microduct cable, for category S & A

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National foreword

This British Standard is the UK implementation of EN 50411-2-9:2010.

The UK participation in its preparation was entrusted by Technical Committee GEL/86, Fibre optics, to Subcommittee GEL/86/2, Fibre optic interconnecting devices and passive components.

A list of organizations represented on this committee can be obtained on request to its secretary.

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LWL-Spleißkassetten und -Muffen für die Anwendung in LWL-Kommunikationssystemen - Produktnormen - Teil 2-9: Nichtabgedichtete LWL-Muffen für ABF-Mikrorohrkabel für die Kategorien S und A

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

This European Standard was prepared by the Technical Committee CENELEC TC 86BXA, Fibre optic interconnect, passive and connectorised components.

The text of the draft was submitted to the formal vote and was approved by CENELEC as EN 50411-2-9 on 2009-10-01.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2010-10-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2012-10-01

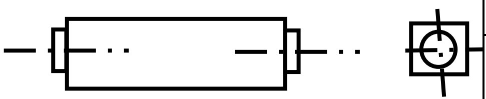
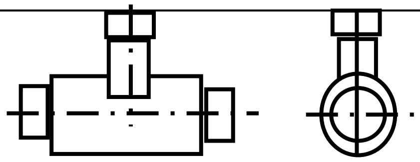
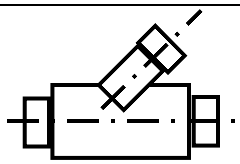
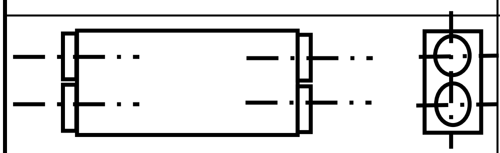
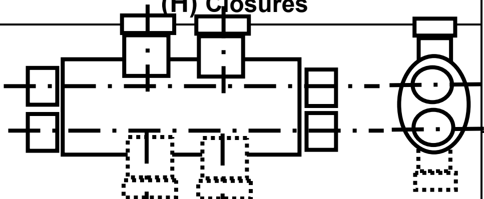
Fibre organisers and closures to be used in optical fibre communications systems - Product specifications

Part 2-9: Non-sealed closures for air blown fibre microduct cable, for category S & A

Description		Performance	
Construction:	Multiple ported closure	Applications:	
Cable management:	Microduct , protected microduct, ducts and/or sub-ducts.	Blown optical fibre cable networks:	EN 61753-1 Category S
Cable seals:	Heat activated and or cold applied	for underground: for aerial:	EN 61753-1 Category A IP40

Related documents:

EN 50411-2	Fibre organisers and closures to be used in optical fibre communication systems – Product specifications – Part 2: General and guidance for optical fibre cable joint closures, protected microduct closures, and microduct connectors
EN 50411-2-8	Part 2-8: Microduct connectors, for air blown optical fibres, Type 1
EN 60793-2-50	Optical fibres – Part 2-50: Product specifications – Sectional specification for class B single-mode fibres (IEC 60793-2-50)
EN 60794-5	Optical fibre cables – Part 5: Sectional specification – Microduct cabling for installation by blowing (IEC 60794-5)
EN 61300 series	Fibre optic interconnecting devices and passive components – Basic test and measurement procedures (IEC 61300 series)
EN 61753-1	Fibre optic interconnecting devices and passive components performance standard – Part 1: General and guidance for performance standards (IEC 61753-1)
ETSI EN 300 019 series	Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment

Construction:	Duct and cable port entries and dimensions (all direct burial, jointing pit or aerial mounted)				
	Closure	Min. number of ports	Maximum sizes of protected microduct cables or ducts (mm)		Maximum physical dimensions (mm) Length L Width W Depth D
			Inline retrofit ports	Range of drop ports	
 **(I) Closures**	(I)	2	50	N/A	410 × 120 × 120
 **(T) Closures**	(T)	3	50	50	390 × 240 × 100
 **(Y) Closures**	(Y)	3	50	50	380 × 210 × 100
 **(H) Closures**	(H)	4	60	60	830 × 340 × 160
 **(U) Closures**	(U)	12	50	50	600 × 470 × 310

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1 Scope

1.1 Product definition

This specification contains the initial, start of life dimensional, mechanical and environmental performance requirements which a fully installed blown fibre protected, non-sealed closure for duct and microduct cable, must meet in order for it to be categorised as an EN standard product.

These products are suitable for installation of and use with microduct fibre units, microduct optical fibre cables, microduct and protected microduct as defined within EN 60794-5.

When the non-sealed closures are installed in subterranean environments it is mandatory to use sealed ABF connectors meeting EN 50411-2-8 in order to guarantee the expected network performance and reliability.

1.2 Operating environment

The tests selected combined with the severities and duration are representative of an outside plant for subterranean and/or aerial environment defined by:

-	ETSI EN 300 019 series:	Class 8.1:	underground locations (without earthquake requirement);
-	EN 61753-1:	Category S:	subterranean environment;
		Category A:	aerial environment.

1.3 Test severity

The test severities are based on IP40 (see EN 60529). The test criteria for all mechanical and environmental tests cover visual appearance, and protected microduct retention of the closure.

It is generally accepted practice that liquids will enter the closure through its body or connected ducts.

1.4 Reliability

Whilst the anticipated service life expectancy of the product in this environment is a minimum of 20 years, compliance with this specification does not guarantee the reliability of the product. This should be predicted using a recognised reliability assessment programme.

1.5 Quality assurance

Compliance with this specification does not guarantee the manufacturing consistency of the product. This should be maintained using a recognised quality assurance programme.

1.6 Allowed fibre and cable types

This closure standard covers all IEC/EN standard optical fibre microducts, and protected microducts with their various fibre capacities, types and designs. This includes optical fibre cable standard EN 60794-5.

This product specification has only considered protected microduct cables containing microducts of same outside diameters. There are other hybrid protected microduct cables with microducts of differing OD's; it may be possible to use these hybrids, however the user must verify suitability in each case.

1.7 Allowed microduct connector types

This closure standard covers all EN standard microduct connectors, including: straight, reducer/enlarger stem, reducer/enlarger, close down, liquid block, liquid block with barb end, and end stop connectors. This includes EN 50411-2-8.

1.8 Microduct storage constraints

Microduct excess storage is not required in all air blown fibre closures. Some closure types do not have sufficient internal space to provide storage. The need for microduct storage is provided inside the closure when opened, typically to ensure that there is enough microduct to fulfil the following functions:

- remove the coiled microduct attached to the ‘closedown’ connectors, to a remote location, close to blowing equipment, in the process uncoiling the microducts to aid blowing;
- provide additional microduct if repeated cut backs for connectors are planned or likely to be fitted throughout the closure life.

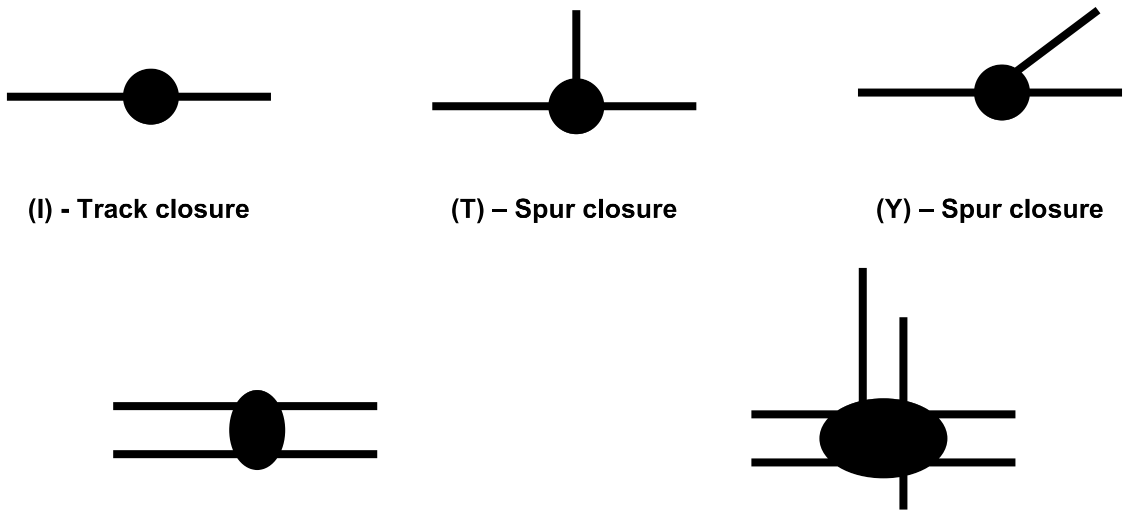
The minimum microduct storage bend radius is based on the outside diameter and material selection, typically based on 12 times the outside diameter (below 8 mm) and 20 times above. During fibre blowing the bend radius is typically 20 times the microduct diameter.

1.9 Essential differences between sealed and non-sealed ABF closures

The non-sealed ABF closures covered in this product specification typically differ from sealed ABF closures in EN 50411-2-5, in the following ways:

- mandatory to use ABF connectors in non-sealed closures meeting EN 50411-2-8 in order to protect the fibre within the microducts;
- typically rotational, compression, thermoformed or injection moulded;
- generally accepted that liquids will enter the closure through its body or connected ducts.

1.10 Closures configurations defined diagrammatically – By shape and application



(I) - Track closure **(T) – Spur closure** **(Y) – Spur closure**

(H) – Inline spur/Distribution closure **(U) – Universal distribution closure**

Figure 1 – Closures configurations

The above diagrams show one protected microduct per port, however, the use of port adaptors, sometimes known as manifolds, can increase this number at any output port.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 50411-2-5	Fibre organisers and closures to be used in optical fibre communication systems – Product specifications – Part 2-5: Sealed closures for air blown fibre microduct, type 1, for category S & A
EN 50411-2-8	Fibre organisers and closures to be used in optical fibre communication systems – Product specifications – Part 2-8: Microduct connectors, for air blown optical fibres, Type 1
EN 60068-2-10	Environmental testing – Part 2-10: Tests – Test J and guidance: Mould growth (IEC 60068-2-10)
EN 60529	Degrees of protection provided by enclosures (IP Code) (IEC 60529)
EN 60794-5	Optical fibre cables – Part 5: Sectional specification – Microduct cabling for installation by blowing (IEC 60794-5)
EN 61300 series	Fibre optic interconnecting devices and passive components – Basic test and measurement procedures (IEC 61300 series)
EN 61300-2-1	Fibre optic interconnecting devices and passive components – Basic test and measurement procedures – Part 2-1: Tests – Vibration (sinusoidal) (IEC 61300-2-1)
EN 61300-2-4	Part 2-4: Tests – Fibre/cable retention (IEC 61300-2-4)
EN 61300-2-5	Part 2-5: Tests – Torsion/twist (IEC 61300-2-5)
EN 61300-2-10	Part 2-10: Tests – Crush resistance (IEC 61300-2-10)
EN 61300-2-12:2005	Part 2-12: Tests – Impact (IEC 61300-2-12:2005)
EN 61300-2-22	Part 2-22: Tests – Change of temperature (IEC 61300-2-22)
EN 61300-2-26	Part 2-26: Tests – Salt mist (IEC 61300-2-26)
EN 61300-2-33	Part 2-33: Tests – Assembly and disassembly of fibre optic closures (IEC 61300-2-33)
EN 61300-2-34	Part 2-34: Tests – Resistance to solvents and contaminating fluids (IEC 61300-2-34)
EN 61300-2-37	Part 2-37: Tests – Cable bending for fibre optic closures (IEC 61300-2-37)
EN 61300-3-1	Part 3-1: Examinations and measurements – Visual examination (IEC 61300-3-1)
EN 61753-1	Fibre optic interconnecting devices and passive components performance standard – Part 1: General and guidance for performance standards (IEC 61753-1)
ETSI EN 300 019 series	Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment
ISO 1998-1	Petroleum industry – Terminology – Part 1: Raw materials and products
EN 590	Automotive fuels – Diesel – Requirements and test methods

3 Terms, definitions and abbreviations

3.1 Definitions

For the purposes of this document, the following terms and definitions apply.

3.1.1
duct
semi-rigid underground pipe, typically manufactured from a polymeric material, and typically greater than 65 mm outside diameter

3.1.2
sub-duct
underground semi-flexible pipes, which may fit inside a duct, typically manufactured from a polymeric material, and typically less than 50 mm outside diameter

3.1.3
microduct
small, flexible, lightweight tubes with an outer diameter typically less than or equal to 16 mm

3.1.4
protected microduct
one or more microducts surrounded by a protective sheath and/or protected by a duct/sub-duct

3.1.5
microduct optical fibre cable
optical fibre cables suitable for installation by blowing into a microduct

3.1.6
microduct fibre units
fibre unit that is suitable for installation by blowing into a microduct. It differs from microduct optical fibre cables in that it provides less protection to the fibres that it contains

3.1.7
air blown fibre non-sealed intercept microduct closure
ABF non-sealed intercept microduct closures provide a physical housing for microduct management; connection, fixing, anchoring, liquid and/or gas blocking, storage and routing up to the input and output protected microduct of the air blown fibre cable closure system

3.1.8
blowing point closure
closure used as a position for blowing fibre at multiple points in series (cascade blowing). Typically the closure contains ‘close down’ microduct connectors, for fibre unit or cable access to the blowing head equipment

3.1.9
straight microduct connector
microduct connectors are used to connect two microducts together. This connector has a means of microduct attachment and sealing on both sides and is typically unsupported inside the closure

3.1.10
straight bulkhead microduct connector
microduct connectors are used to connect two microducts together. This connector has a means of microduct attachment and sealing on both sides and is typically supported on a bulkhead attached by a suitable fixing system (i.e. nut or clip)

3.1.11
different ID reducers/enlarger stem microduct connector
stem connector which connects two microducts with the same OD but different ID, with a smooth internal transition to prevent fibre hang ups. Typically they have microduct attachment and sealing at one end of the connector, and a stem on the other end to facilitate attachment to a straight connector

3.1.12
different ID reducers/enlarger microduct connector
connectors which connect two microducts with the same OD but different ID, including a smooth internal transition to prevent fibre hang ups. Typically they are used to connect a heavy walled to a thinner wall MD

3.1.13
different OD reducers/enlarger stem microduct connector
stem which connects two microducts with the same ID but different OD. Typically they have microduct attachment and sealing at one end of the connector, and a stem on the other end to facilitate attachment to a straight connector

3.1.14
different OD reducers/enlarger microduct connector
connector which connects two microducts with the same ID but different OD

3.1.15
different ID and OD reducers/enlarger stem microduct connector
stem which connects two microducts with a different OD and different ID, including a smooth internal transition to prevent fibre hang ups. Typically they have microduct attachment and sealing at one end of the connector, and a stem on the other end to facilitate attachment to a straight connector

3.1.16
different ID and OD reducers/enlarger microduct connector
connector which connects two microducts with different OD's and different ID's, including a smooth internal transition to prevent fibre hang ups

3.1.17
close down microduct connector
microduct connectors that are used for fibre access for blowing head equipment for cascade blowing, allowing a microduct to be opened and resealed after blowing, without detriment to the fibre in situ

3.1.18
liquid block microduct connector
microduct connectors that are used at a transition point to stop liquids from flowing between the connected microducts to avoid liquid and contaminant ingress and liquid damage to other equipment

3.1.19
liquid block with a barb end
similar to a liquid block connector, at the barb end. The barb end is designed to interface with the non-microduct (transport tubing), which protects the fibre at a "fibre management system" closure

3.1.20
end stop microduct connector
microduct connectors that are used for sealing open ended microduct, avoiding air leakage, water or foreign material ingress

3.1.21
connector insertion force
force required to insert the microduct into the connector without damage

3.1.22
fibre management system
system to control fibre routing from the incoming to the outgoing fibres, containing one or more splice cassettes and additional functional elements

3.1.23
microduct management system
system to control microduct routing inside a closure or housing, from the incoming to the outgoing microduct, all jointed together with microduct connectors of various functional types

3.1.24
burst pressure
point at which the closure fails to contain pressure

3.1.25
cut backs
process to remove a short length of microduct in order to prepare the ends, prior to fitting a new connector, ensuring better sealing and attachment faces

3.1.26
retrofit
closure that allows fitting or access after the duct or protected microduct has been installed

3.1.27
entry ports
input or output for protected microduct

3.2 Abbreviations

For the purposes of this document, the following abbreviations apply.

PS Product Specification

MD Microduct

PM Protected Microduct

ABF Air Blown Fibre

ID Inside Diameter (microducts)

OD Outside Diameter (microducts)

AC Across Corners

MMS Microduct Management System

FMS Fibre Management Systems

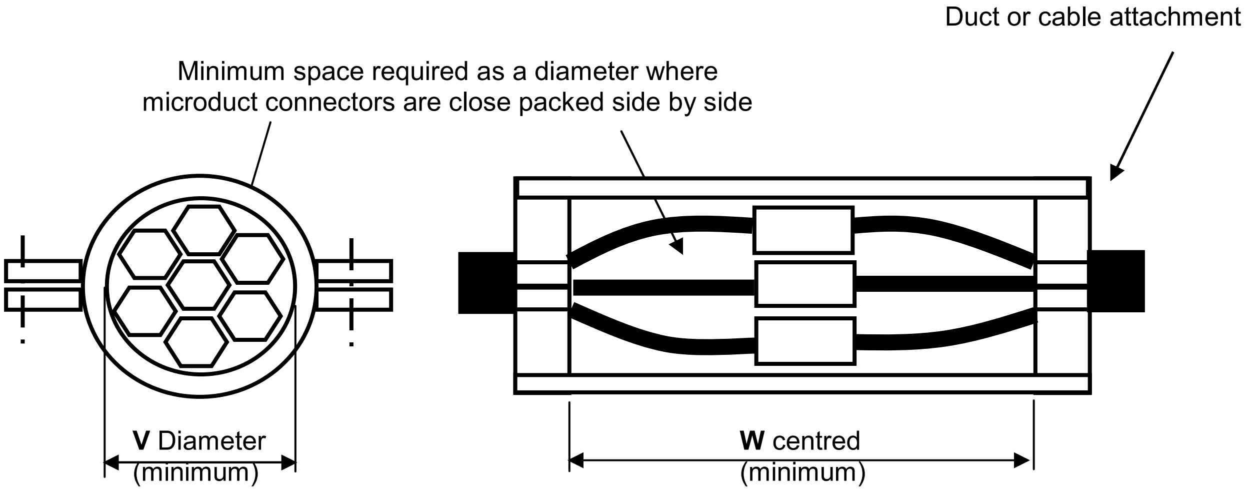
4 Description

4.1 Microduct closure

An ABF microduct closure comprises a closure housing that is attached to the ends of

- an underground installed duct or sub duct, or
- an air blown fibre protected microduct.

Microduct closures comprise access housing for the interconnection and storage of microducts or protected microducts. Figure 2 shows the minimum space profile required to house microduct connectors.



a) Inside cover diameter **b) Inside the cover body ends or end plates**

Figure 2 – Schematic – Minimum microduct and connector space profile (see Annex B)

Although the diagrams show connectors side by side it is general practice to stagger the position of the connectors.

4.2 Closure housing functions

Non-sealed microduct closures for protected microducts provide a mechanical structure or bridge that replaces the microduct cable sheath or duct wall, in the following applications:

- joining two microduct cables together;
- distribution point;
- a branch off for secondary microduct installation to a customer;
- an intercept to an existing pre-installed protected microduct;
- an access point for blowing fibre onward using conventional blowing equipment.

4.3 Burst pressure

In the case of non-sealed closures an overpressure safety system is not generally required. However, the non-sealed closure housing should be able to exhaust air fast enough through its interface parts to ensure that a pressure of equal to or less than 0,4 bar is achieved when the correct installation pressure is applied through the microducts.

4.4 Closure housing configurations

4.4.1 (I) Inline closure housing configurations

(I) Inline closures have two entry ports or end plates, one at each end. Figure 3 shows a typical option for the ‘I’ closure type.

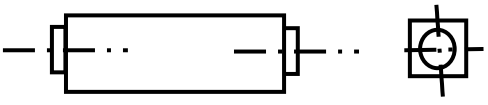


Figure 3 – (I) – Single port ended

4.4.2 (T) closure housing configurations

(T) closures have three entry ports, one at each end and one at an acute angle, typically at 90°. Figure 4 shows a typical option for the 'T' closure type.

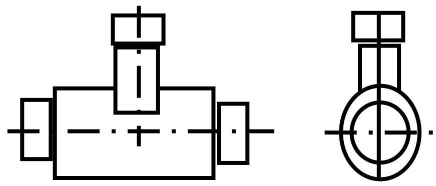
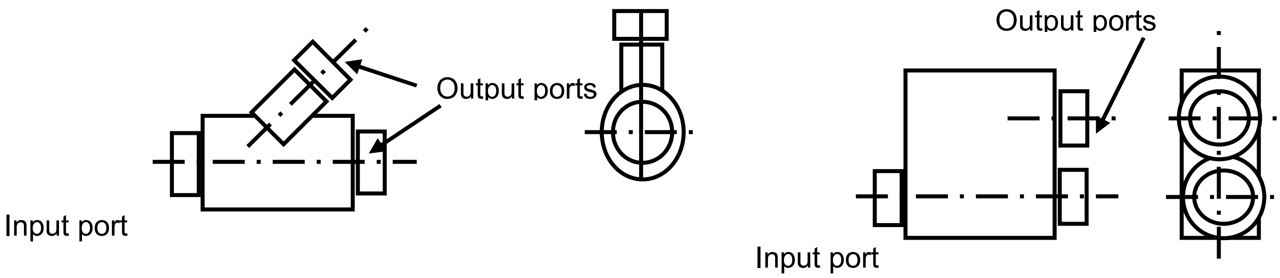


Figure 4 – (T) – Single entry port ends with a single port at 90°

4.4.3 (Y) closure housing configurations

(Y) closures have three entry ports, one at each end and the third port may be at an angle, typically less than 45°. Figures 5a and 5b show typical options for the 'Y' closure type.



a) **b)**

Figure 5 – (Y)

4.4.4 (H) closure housing configurations

(H) closures have multiple entry ports, more than one at each end, all inline. Each opposite end typically has two ports; one primary and the other a drop port. Figure 6 shows a typical option for the 'H' closure type.

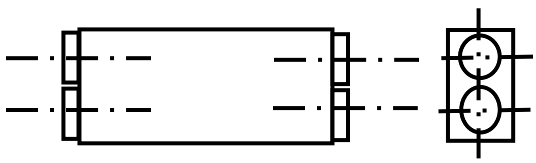


Figure 6 – (H) – Inline double entry ports at each ends

4.4.5 (U) universal closure housing configuration

(U) closures have entry ports in multiple positions and angles. They have typically five or more ports. Figure 7 shows an option for the 'U' closure body types.

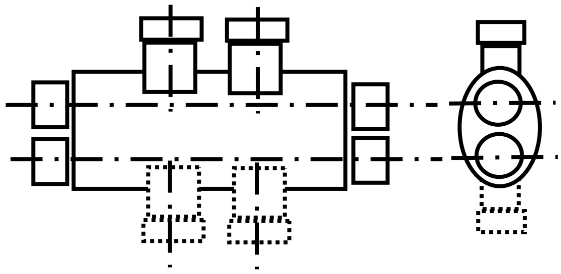


Figure 7 – (U) – Multiple end/side entry ported closure

4.5 Entry retention device or seal

Entry retention device or seal systems can be either

- (H) dedicated heat activated heat source for example, electrical, infrared, hot air or flame:
  - thermo-shrinkable materials;
  - hot melt adhesives;
  - polyethylene injection welding,
- (C) dedicated cold applied:
  - mastic, tapes, pastes, potting compounds, gels and cold adhesives;
  - o-rings, grommets, rubber shapes, are cold processes;
  - mechanical clamps or grab rings, or
- (U) combined heat activated and cold applied.

All retention devices or seals should be installed according to manufacturers guide lines.

4.6 Common base configurations

The design of the closure housing shall allow the jointing of two or more microducts, or protected microducts in the following configuration or applications:

- **track joint**: configuration used to connect two sub-ducts or protected microducts, with a minimum of 2 entry ports;
- **spur joint**: configuration used on local feeder cable with minimum of 3 cable entry ports;
- **distribution joint**: configuration used on customer feeds with a minimum of 8 drops.

NOTE Entry ports can accommodate more than one protected microduct.

All closures should be able to be retro-fitted (mid-span access), with the exception of manifold ported closers, typical (I) closures.

It is desirable that the closure can be re-opened when necessary without interruption or disturbance of the traffic of the live circuits within the microducts.

4.7 Microduct management system

The microduct management system consists of stored or routed microducts to EN 60794-5 and microduct connectors to EN 50411-2-8. The system provides a means for routing, storing (if appropriate) and protecting microduct connectors in a predetermined order.

A closure used at a blowing location requires storage of fibre microducts of a length suitable for remote deployment to a blowing head.

4.8 Materials

All materials that are likely to come in contact with personnel shall meet appropriate health and safety regulations. Materials must conform to RoHS requirements.

The closure and cable retention device materials shall be compatible with each other and with the materials of the cables.

All components of the closure shall be resistant to solvents and degreasing agents typically used to clean the protected microducts and cables.

The effects of fungus shall be determined by measuring a suitable property both before and after exposure and tested to EN 60068-2-10 (micro-organisms), using the 28-day test.

The effects of UV light shall not affect product performance for aerial closures. The use of UV stabilised materials for the outer housing is required.

Metallic parts shall be resistant to the corrosive influences they may encounter during the lifetime of the product.

4.9 Colour and marking

Marking/identification of the variant number (min. EN 50411–2-9–X_1) should be on the product or packaging label along with the following:

a) identification of manufacturer;

b) manufacturing date code: year / month.

4.10 Microduct connectors applications and capacity

The different types of microduct connectors can be found in EN 50411-2-8, ABF Microduct connectors for non-sealed closures, this covers all applications and include the follow connector types:

- straight connector;

  NOTE In order to reduce the number of variables, all connector volumes for any given closure size is based on the microduct outside diameter with a standard size straight connector. The straight connector has been selected as it is the most widely used type.

- straight bulkhead connector;
- ID reduce/enlarger stem connector;
- ID reduce/enlarger connector;
- OD reduce/enlarger stem connector;
- OD reduce/enlarger connector;
- ID and OD reduce/enlarger stem connector;
- ID and OD reduce/enlarger connector;
- close down connector;
- liquid block connector;
- liquid block with a barb end connector;
- end stop connector.

5 Variants

Table 1 – Variants for sealed closures for ABF protected microduct, for category S & A

EN 50411–2-9 – X_1 – X_2 – X_3 – X_4 – XXX_5 – XX_6 – XX_7 – XX_8

Variant No. X_1	Environmental performance
S	Subterranean environment (underground)
A	Aerial environment (above ground level)
B	Both subterranean and aerial

Variant No. X_2	Operating environment
T	Track closure (2 entry ports min.)
S	Spur closure (3 entry ports min.)
D	Distribution closure (8 customer drops min.)

Variant No. X_3	Protected microduct sealing technology
R	Cold applied
H	Heat activated (heat source required)
U	Universal, both methods in a single cable entry base

Variant No. X_4	Closure type, shape and port configuration
I	Inline single port at each end (2 cable entries min.)
T	Inline single primary port at each end and a drop port at a 90° angle
Y	Inline – single primary port at each end and a spur port at less than 60° angle
H	Inline – multiple port ends, with at least 2 ports each end; one primary and the other a drop port
U	Universal closure meeting the requirements of I, T, Y, and H

Variant No. XXX_5	Microduct storage and fibre blow through
BNS	Fibre blow through with no storage
BFS	Blow from (not through) but has storage

Variant No. XX_6	Microduct outside diameter (straight connector only)
	Outside diameter
03	3 mm
04	4 mm
05	5 mm
06	6 mm
07	7 mm
08	8 mm
10	10 mm
12	12 mm
14	14 mm

Depending on the primary protected microduct cable selection in Variant **XX_6** and **XX_7** (number of microducts 1, 2, 4, 7, 8, 9, 12, 19, and 24) refer to one of the following Tables 2, 3, 4, 5 and 6 to find **X_8**.

Tables 2, 3, 4, 5 and 6 are based on buried protected microduct cables.

Table 2 – (I) Closure inline port maximum capacity – Protected microduct cable selection

XX_6 → Microduct O/D	03	04	05	06	07	08	10	12	14
	Number of microducts in the protected microduct cable XX_7 (number in box)								
XX_8 Closure									
NA	19	7	7	4	2	1			
NB	24	24	24	24	24	19	7	7	4

Table 3 – (T) Closure inline port maximum capacity – Protected microduct cable selection

XX_6 → Microduct O/D	03	04	05	06	07	08	10	12	14
	Number of microducts in the protected microduct cable XX_7 (number in box)								
XX_8 Closure									
TA	24	24	24	24	24	19	7	7	4

Table 4 – (Y) Closure inline port maximum capacity – Protected microduct cable selection

XX_6 → Microduct O/D	03	04	05	06	07	08	10	12	14
	Number of microducts in the protected microduct cable XX_7 (number in box)								
XX_8 Closure									
YA	19	7	7	4	2	1			
YB	24	24	24	7	7	7	7	4	4
YC	24	24	24	24	24	19	7	7	4

Table 5 – (H) Closure inline port maximum capacity – Protected microduct cable selection

XX_6 → Microduct O/D	03	04	05	06	07	08	10	12	14
	Number of microducts in the protected microduct cable XX_7 (number in box)								
XX_8 Closure									
HA	19	7	4	4	2	1			
HB	24	19	12	12	7	4	4		
HC	24	24	24	12	7	7	7	4	4
HD	24	24	24	24	24	19	7	7	4
HE	24	24	24	24	24	24	7	7	4

Table 6 – (U) Closure inline port maximum capacity – Protected microduct cable selection

XX_6 → Microduct O/D	03	04	05	06	07	08	10	12	14
	Number of microducts in the protected microduct cable XX_7 (number in box)								
XX_8 Closure									
UA	24	24	19	12	7				
UB	24	24	24	7	7	7	7	4	4
UC	24	24	24	24	24	19	7	7	4
UD	24	24	24	24	24	19	7	7	4

6 Dimensions

6.1 Dimensions of (I) inline closures

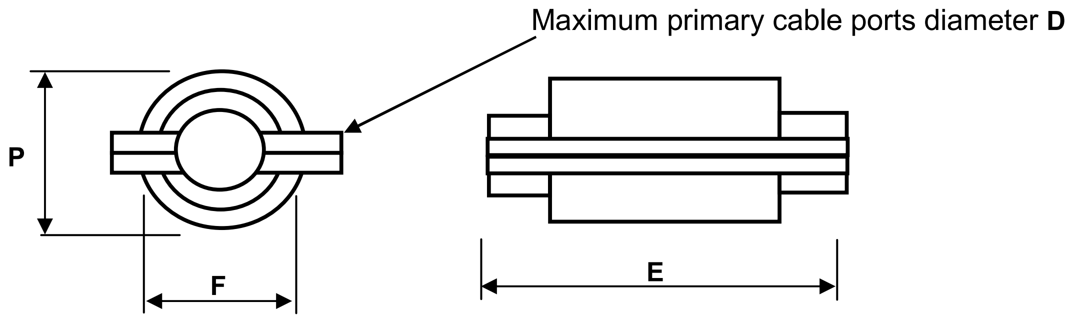


Figure 8 – Diagram showing (I) inline – Closures dimensions

Table 7 – Dimensions of (I) closures

(I) Closure size	Overall length mm	Maximum overall width mm	Maximum overall height mm	Maximum input port diameter mm
	E	**F**	**P**	**D**
NA	325	118	118	25
NB	406	118	100	50

6.2 Dimensions of (T) inline closures

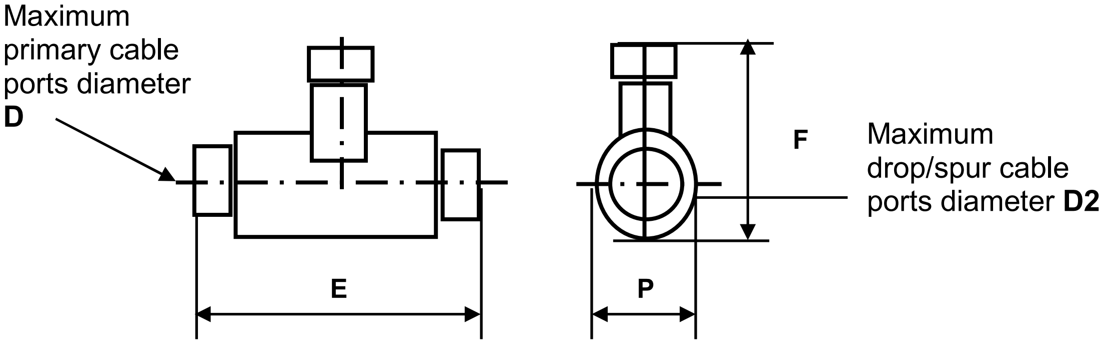


Figure 9 – (T) Diagram showing – Closures dimensions

Table 8 – Dimensions of (T) closures

(T) Closure size	**Overall length** mm	**Maximum overall width** mm	**Maximum overall height** mm	**Maximum input port diameter** mm	**Maximum output (drop/spur) diameter** mm
	E	**F**	**P**	**D**	**D2**
TA	386	235	100	50	50

6.3 Dimensions of (Y) inline closures

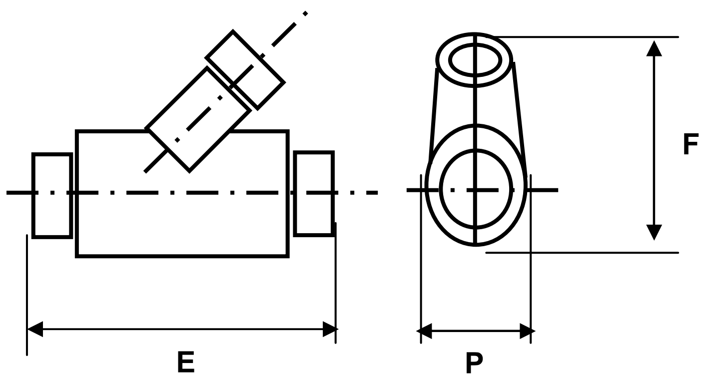


Figure 10 – (Y) Diagram showing – Closures dimensions

Table 9 – Dimensions of (Y) closures

(Y) Closure size	Overall length mm	Maximum overall width mm	Maximum overall height mm	Maximum input port diameter mm	Maximum output (drop/spur) diameter mm
	E	**F**	**P**	**D**	**D2**
YA	300	160	70	26	26
YB	380	180	90	40	40
YC	260	210	100	50	50

6.4 Dimensions of (H) inline closures

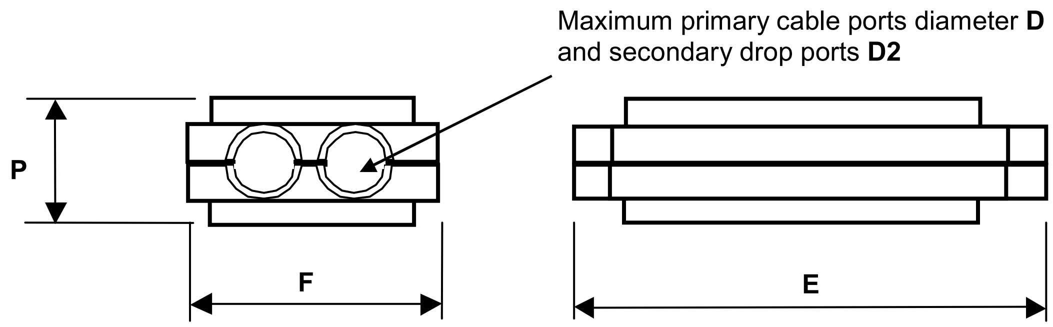


Figure 11 – (H) Diagram showing – Closures dimensions

Table 10 – Dimensions of (H) closures

(H) Closure size	Overall length mm	Maximum overall width mm	Maximum overall height mm	Maximum input port diameter mm	Maximum output (drop/spur) diameter mm
	E	**F**	**P**	**D**	**D2**
HA	330	150	52	22	22
HB	828	340	152	35	28
HC	648	160	150	40	40
HD	350	200	100	50	50
HE	440	250	90	60	60

6.5 Dimensions of (U) inline closures

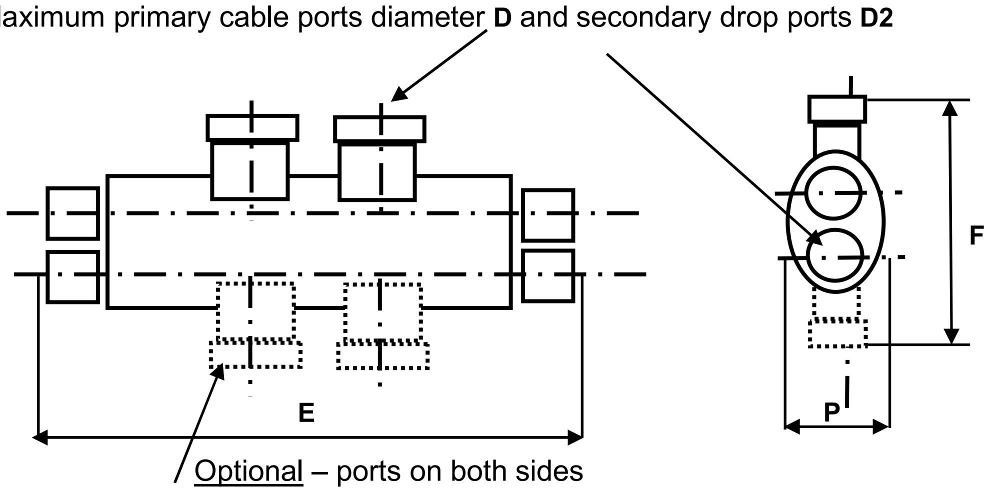


Figure 12 – (U) Diagram showing – Closures dimensions

Table 11 – Dimensions of (U) closures

(U) Closure size	**Overall length** mm	**Maximum overall width** mm	**Maximum overall height** mm	**Maximum input port diameter** mm	**Maximum output (drop/spur) diameter** mm
	E	**F**	**P**	**D**	**D2**
UA	590	290	108	35	30
UB	316	220	70	40	40
UC	561	210	183	50	22
UD	424	464	301	50	50

7 Tests

7.1 Sample size

Separate test samples for mechanical performance tests may be used. For the purposes of this standard, a mechanical performance test sample is defined as a closure installed with several cable ends.

The minimum recommended sample sizes are given in Annex A.

7.2 Test sequence

There is no defined sequence in which tests 3 – 13 must be run.

For the track joint closure (see Figure 13), spur joint closure (see Figure 14), and distribution joint closure (see Figure 15), the length of the test loop is chosen such that typically a protected microduct loop total length of 25 m to 50 m is used for this purpose. Part of the test involves blowing the fibre bundle or unit cable around the entire test circuit, from the input to output position.

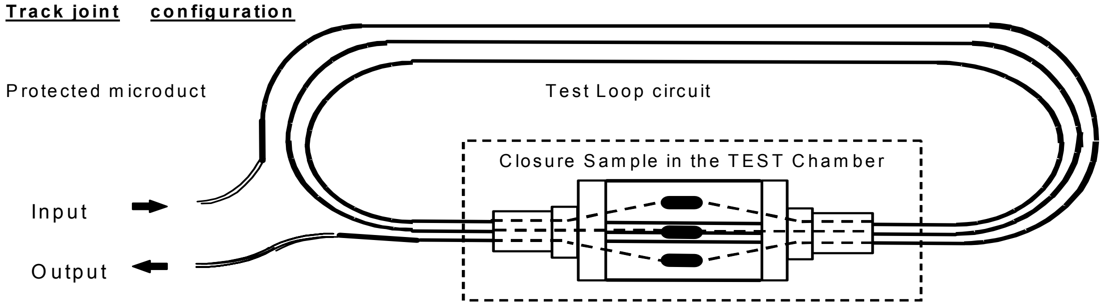


Figure 13 – Track joint configuration sample

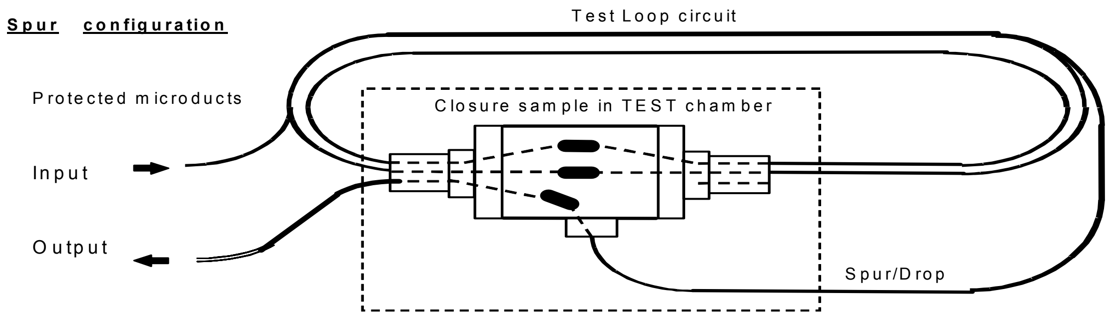


Figure 14 – Spur joint configuration sample

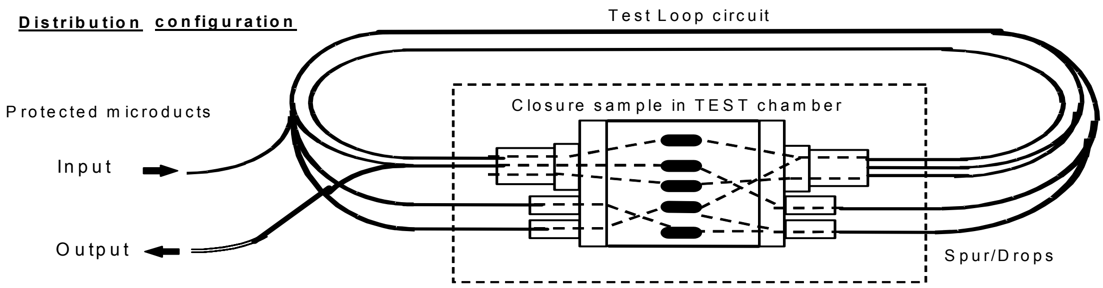


Figure 15 – Distribution joint configuration sample

7.3 Pass/fail criteria

A product will have met the requirements of this specification provided no failures occur in any test.

In the event of a failure occurring, the test shall be re run using a sample size double that of the original.

8 Test report

A fully documented test report and supporting data shall be prepared and must be available for inspection as evidence that the tests described in Clause 9 have been carried out in accordance with this specification.

Conduct the blowing test using at least one of the following cables or fibre, selected according to the application of the closure.

Options:

1. microduct optical fibre unit up to 1,2 mm diameter (3/2,1 mm and 4/2,5 mm MD, min. ID);
2. microduct optical fibre unit up to 2,0 mm diameter (5/3,5 mm to 8/6,0 mm MD, min. ID);
3. microduct optical fibre cable – filling 80 % of the bore diameter (4 mm to 14 mm MD).

The length of the fibre unit or microduct cable should be restricted to less than 200 mm.

The use of a blowing bead or cable end cap is permitted.

Test pressure up to 10 bar.

9 Performance requirements

9.1 Dimensional and marking requirements

Dimensions and marking of the product shall be in accordance with the requirements of Clause 6, and shall be measured using the appropriate EN test method.

9.2 Appearance performance criteria

Table 12 – Appearance performance criteria

No.	Test	Category	Requirement	Details	
1	Visual appearance	S & A	No defects which would affect functionality of the closure	Method:	EN 61300-3-1
				Examination:	Product shall be checked with naked eye. Any through cracks or holes. Permanent excessive distortion that affects normal function.
2	IP40	S & A	Maximum specified gap on any split line or cable entry	Method: Intrusion of objects: Protection against water ingress:	EN 60529, IP40 1 mm gap max. None

9.3 Mechanical performance requirements

Table 13 – Mechanical performance requirements

No.	Test	Category	Requirement	Details	
3	Vibration (sinusoidal)	S	Visual appearance (test 1) IP40 (test 2)	Method:	EN 61300-2-1
				Frequency:	10 Hz
				Amplitude:	3 mm
				Duration:	10 days
				Test temperature:	23 °C ± 3 °C
				Pre-conditioning procedure:	Sample should be conditioned to room temperature for at least 2 h.
		A	Visual appearance (test 1) IP40 (test 2)	Method:	EN 61300-2-1
				Frequency range:	5 Hz – 500 Hz at 1 octave/min
				Amplitude / acceleration force:	3 mm or 1 g_n max.
				Cross-over frequency:	9 Hz
				Number of sweeps:	10 sweeps (5 Hz – 500 Hz – 5 Hz)
				Number of axes:	3 mutually perpendicular
				Test temperature:	23 °C ± 3 °C
				Pre-conditioning procedure:	Sample should be conditioned to room temperature for at least 2 h.
4	Cable retention	S	Visual appearance (test 1) IP40 (test 2)	Method:	EN 61300-2-4
				Test temperatures:	-15 °C ± 2 °C and +45 °C ± 2 °C
				Load:	$\varnothing_{Cable}$ (mm)/45*1 000 N or 1 000 N max.
				Duration:	1 h per cable
				Pre-conditioning procedure:	Sample should be conditioned to specified temperature for at least 4 h.
		A	Visual appearance (test 1) IP40 (test 2)	Method:	EN 61300-2-4
				Test temperatures:	-15 °C ± 2 °C and +45 °C ± 2 °C
				Load:	$\varnothing_{Cable}$ (mm)/45*1 000 N or 1 000 N max.
				Duration:	1 h per cable
				Pre-conditioning procedure:	Sample should be conditioned to specified temperature for at least 4 h.
5	Cable bending	S and A	Visual appearance (test 1) IP40 (test 2)	Method:	EN 61300-2-37
				Test temperatures:	-15 °C ± 2 °C and +45 °C ± 2 °C
				Force:	30° or max. 500 N
				Force application:	400 mm from end of port
				Number of cycles:	5 cycles per cable
				Pre-conditioning procedure:	Sample should be conditioned to specified temperature for at least 4 h.

Table 13 – Mechanical performance requirements *(continued)*

No.	Test	Category	Requirement	Details	
6	Torsion and Twist	S	Visual appearance (test 1) IP40 (test 2)	Method:	EN 61300-2-5
				Test temperatures:	-15 °C ± 2 °C and +45 °C ± 2 °C
				Maximum twist angle and maximum torque:	90° or max. 50 Nm
				Force application:	400 mm from end of seal
				Number of cycles:	5 cycles per cable
				Pre-conditioning procedure:	Sample should be conditioned to specified temperature for at least 4 h.
		A	Visual appearance (test 1) IP40 (test 2)	Method:	EN 61300-2-5
				Test temperatures:	-15 °C ± 2 °C and +45 °C ± 2 °C
				Maximum twist angle and maximum torque:	90° or max. 50 Nm
				Force application:	400 mm from end of seal
				Number of cycles:	5 cycles per cable
				Pre-conditioning procedure:	Sample should be conditioned to specified temperature for at least 4 h.
7	Impact	S	Visual appearance (test 1) IP40 (test 2)	Method:	EN 61300-2-12:2005, Method B
				Test temperatures:	-15 °C ± 2 °C and +45 °C ± 2 °C
				Impact tool:	Steel ball of 1 kg
				Drop height:	2 m
				Impact locations:	0°, 90°, 180° and 270°
				Number of impacts:	1 per location
				Pre-conditioning procedure:	Sample should be conditioned to specified temperature for at least 4 h.
		A	Visual appearance (test 1) IP40 (test 2)	Method:	EN 61300-2-12:2005, Method B
				Test temperatures:	-15 °C ± 2 °C and +45 °C ± 2 °C
				Impact tool:	Steel ball of 1 kg
				Drop height:	1 m
				Impact locations:	0°, 90°, 180° and 270°
				Number of impacts:	1 per location
				Pre-conditioning procedure:	Sample should be conditioned to specified temperature for at least 4 h.

Table 13 – Mechanical performance requirements *(continued)*

8	Crush resistance	S	Visual appearance (test 1) IP40 (test 2)	Method: Test temperatures: Load: Application area: Locations: Duration: Pre-conditioning procedure:	EN 61300-2-10 -15 °C ± 2 °C and +45 °C ± 2 °C 1 000 N 25 cm^2 Centre of closure at 0° and 90° around longitudinal axis of closure 10 min Sample should be conditioned to specified temperature for at least 4 h.
9	Re-entries	S & A	Applicable for H and U closures only Visual appearance (test 3) IP40 (test 2)	Method: Test temperature: Conditioning between each re-entry: Number of re-entries:	EN 61300-2-33 +23 °C ± 3 °C Ageing of min. 1 temperature cycle as specified in test 14 5

9.4 Environmental performance requirements

Table 14 – Environmental performance requirements

No.	Test	Category	Requirement	Details	
10	Change of temperature	S	Visual appearance (test 1) IP40 (test 2)	Method: Extreme temperatures: Dwell time: Rate of change: Number of cycles:	EN 61300-2-22 -30 °C ± 2 °C and +60 °C ± 2 °C 4 h 1 °C/min 20
		A	Visual appearance (test 1) IP40 (test 2)	Method: Extreme temperatures: Dwell time: Rate of change: Number of cycles:	EN 61300-2-22 -40 °C ± 2 °C and +65 °C ± 2 °C 4 h 1 °C/min 20
11	Salt mist	A	Visual appearance (test 1) IP40 (test 2)	Method: Test temperatures: Salt solution: Duration:	EN 61300-2-26 +35 °C ± 2 °C 5 % NaCl (pH 6,5-7,2) 5 days
12	Resistance to solvents and contaminating fluids	S	Visual appearance (test 1) IP40 (test 2)	Method: Test temperatures: Submersion in:	EN 61300-2-34 +23 °C ± 3 °C HCl at pH 2 NaOH at pH 12 Kerosene (lamp oil) ISO 1998/I 1,005 NaCl (pH 6,5-7,2) Saturated in water Petroleum jelly Diesel fuel for cars EN 590

				Drying time at 70 °C: Duration:	None 5 days
13	Resistance to stress cracking solvents	S	Visual appearance (test 3) IP40 (test 2)	Method: Test temperatures: Submersion in: Drying time at 70 °C: Duration:	EN 61300-2-34 +50 °C ± 2 °C 10 % detergent solution of Nonyl Phenol Ethoxylate (Igepal) None 5 days

Annex A
(informative)

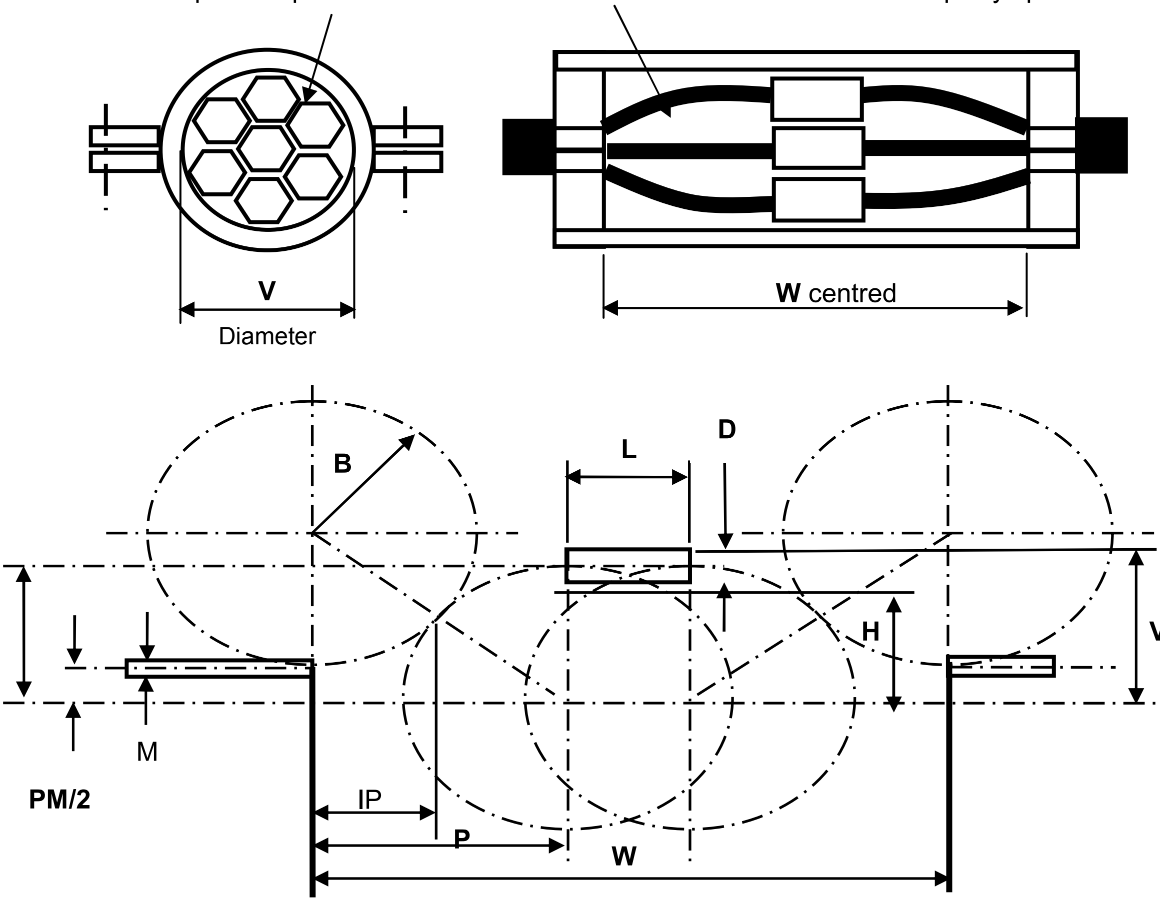
Sample size and product sourcing requirements

Table A.1 – Minimum sample size requirements

No.	Test	Sample size Sealing performance
NA	Dimensional	3
1	Visual appearance	Criterion
2	IP40 test	Criterion
3	Vibration (sinusoidal)	3
4	Cable retention	3
5	Cable bending	3
6	Torsion/Twist	3
7	Impact	3
8	Crush resistance	3
9	Re-entries	3
10	Change of temperature	3
11	Salt mist (aerial only)	3
12	Resistance to solvents and fluids	3
13	Resistance to stress cracking solvents	3

Annex B
(informative)

Closure minimum internal diameters, containing microduct connectors



Key

W =	Space required inside the ABF closure – Minimum	P =	Microduct path minimum length to the connector
D =	Connector outside envelope/diameter	B =	Bend radii – Minimum
L =	Connector length	IP =	Intersection point between minimum bend radii
M =	Microduct diameter	PM =	Protected microduct outside
V or Y =	Connector bundle diameter (whichever is the larger)	H =	Bend height – Centres lines of the offset microducts

Dimensions D, L, M and L found in Tables 2 to 7

Dimensions B found in 9.1 (storage 12 x M)

Dimensions V found in Tables B.2 to B.8 (suppliers information)

Formula to calculate W Dimension:

$$W = 2P + L$$

$$P = IP \times 2$$

$$IP = \sqrt{B^2 - [B - (H/2)]^2}$$

$$H = \frac{(V - D) - (PM - M)}{2}$$

Figure B.1 – Schematic – Minimum microduct and connector space profile

Table B.1 – Typical ABF closure space required, containing 2 blown fibre microduct connectors

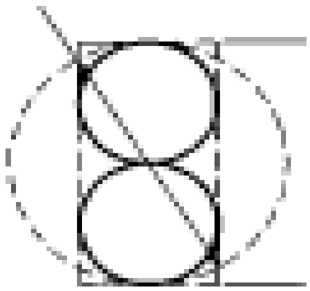
<table>
<tr><td rowspan="12">V diameter
</td><td rowspan="2">Microduct outside diameter M
mm</td><td>Theoretical space required, all connectors side by side
mm
(with 2 microduct connector bundle)</td></tr>
<tr><td>Diameter V
mm</td></tr>
<tr><td>3</td><td>18</td></tr>
<tr><td>4</td><td>28</td></tr>
<tr><td>5</td><td>31</td></tr>
<tr><td>7</td><td>35</td></tr>
<tr><td>8</td><td>40</td></tr>
<tr><td>10</td><td>48</td></tr>
<tr><td>12</td><td>50</td></tr>
<tr><td>14</td><td>55</td></tr>
<tr><td>15</td><td>66</td></tr>
<tr><td>16</td><td>64</td></tr>
</table>

Table B.2 – Typical ABF closure space required, containing 4 blown fibre microduct connectors

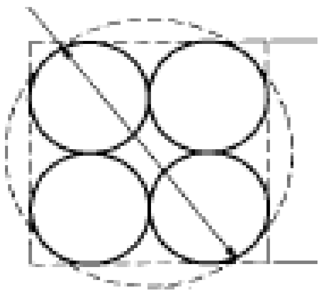
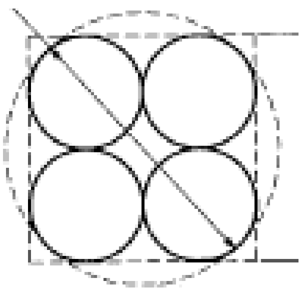
<table>
<tr><td rowspan="13">V diameter

V diameter
</td><td rowspan="2">Microduct outside diameter M
mm</td><td>Theoretical space required, all connectors side by side
mm
(with 4 microduct connector bundle)</td></tr>
<tr><td>Diameter V
mm</td></tr>
<tr><td>3</td><td>22</td></tr>
<tr><td>4</td><td>34</td></tr>
<tr><td>5</td><td rowspan="2">36</td></tr>
<tr><td>6</td></tr>
<tr><td>7</td><td>42</td></tr>
<tr><td>8</td><td>48</td></tr>
<tr><td>10</td><td>58</td></tr>
<tr><td>12</td><td>60</td></tr>
<tr><td>14</td><td>70</td></tr>
<tr><td>15</td><td>80</td></tr>
<tr><td>16</td><td>77</td></tr>
</table>

Table B.3 – Typical ABF closure space required, containing 7 blown fibre microduct connectors

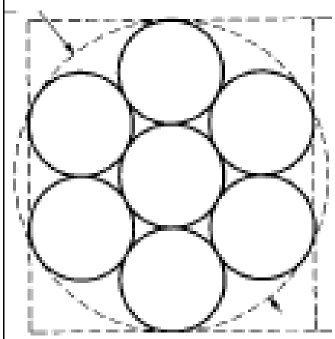
	Microduct outside diameter M mm	Theoretical space required, all connectors side by side mm (with 7 microduct connector bundle) Diameter V mm
V diameter 	3	7
	4	42
	5	45
	6	
	7	52
	8	60
	10	72
	12	75
	14	88
	15	99
	16	96

Table B.6 – Typical ABF closure space required, containing 12 blown fibre microduct connectors

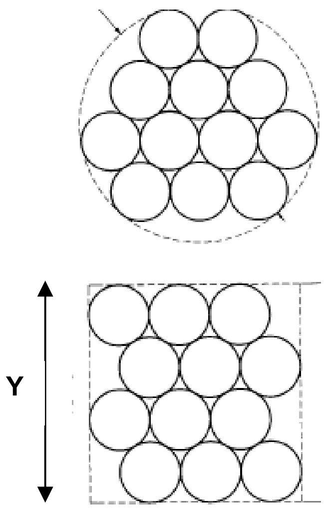
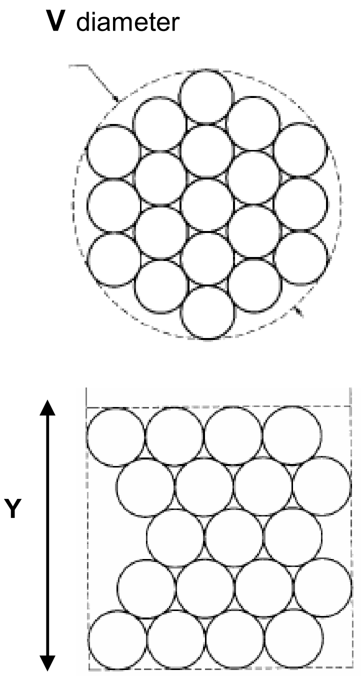
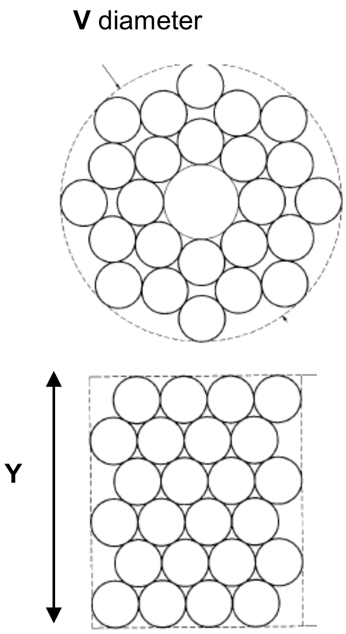
	Microduct outside diameter M mm	Theoretical space required, all connectors side by side mm (with 8 microduct connector bundle)	
		Circular shape V	Square shape Y
V diameter 	3	37	37
	4	57	50
	5	61	54
	6		
	7	71	63
	8	81	72
	10	97	86
	12	101	90
	14	117	104
	15	134	119
	16	129	115

Table B.7 – Typical ABF closure space required, containing 19 blown fibre microduct connectors



Microduct outside diameter M mm	Theoretical space required, all connectors side by side mm (with 19 microduct connector bundle)	
	Circular shape V	**Square shape Y**
3	45	41
4	70	63
5	75	66
6		
7	96	84
8	100	90
10	120	108
12	125	113
15	165	149
16	160	144

Table B.8 – Typical ABF closure space required, containing 24 blown fibre microduct connectors



Microduct outside diameter M mm	Theoretical space required, all connectors side by side mm (with 24 microduct connector bundle)	
	Circular shape V	**Square shape Y**
3	54	48
4	85	75
5	91	50
6		
7	106	79
8	121	107
10	145	128
12	151	133
14	175	155
15	199	176
16	194	171

Annex C
(informative)

Typical buried subterranean blown fibre microduct cable outside diameters

Table C.1 – Number of microducts per protected microduct – Direct bury

Microduct outside diameter mm	Number of microducts per protected microduct (direct bury) Protected microduct – Maximum – Nominal outside diameter mm						
	1	2	4	7	12	19	24
3	10,2	13,2	14,4	16,2	19,4	21,8	25,2
4	11,2	15,2	16,9	19,2	23,5	27,3	31,8
5	10,5	16,6	22,3	23,5	29,5	33,8	39,1
6	6,2						
7	7,2	14,2	25,3	30,5	38,0		53,9
8	15,2	23,2	27,1	31,8			
10	18,5	27,2	31,9	37,8			
12	19,1	31,1	37,5	44,6			
14	22,9		40,0				

Table C.2 – Number of microducts per protected microduct – Direct bury reinforced

Microduct outside diameter mm	Number of microducts per protected microduct (direct bury reinforced) Protected microduct – Maximum – Nominal outside diameter mm						
	1	2	4	7	12	19	24
3	11,2		16,0	18,0	21,2	23,6	27,0
4	12,4		18,1	20,4	25,2	29,0	33,5
5	14		21,1	24,0	29,9		39,5
7	14,2	16,6	27,9	33,2	40,8	46,0	55,7
8	15,2		28,3	33,5	42,1	49,5	57,9
10			33,6	39,5			
12			38,5	45,5			
14	24,2						

NOTE 1 Outside diameter information in Table E.1 is used to calculate dimension W in Annex D (closure capacity).

NOTE 2 For duct-installed protected microduct applications, the protected microduct is within these sizes in Table C.1.

Annex D
(informative)

Microduct definitions and sketches

D.1 Straight microduct connectors

Microduct connectors are used to connect two microducts together. This connector has a means of microduct attachment and sealing on both sides and is typically unsupported (floating inside the closure).

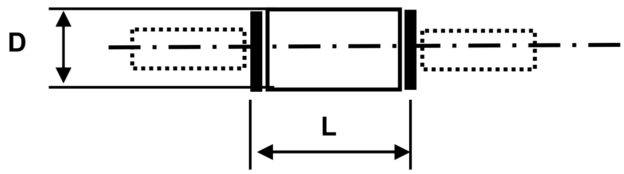


Figure D.1 – Straight microduct connectors

D.2 Straight bulkhead microduct connectors

Microduct connectors are used to connect two microducts together. This connector has a means of microduct attachment and sealing on both sides and is typically supported on a bulkhead attached by a suitable fixing system (i.e. nut or clip).

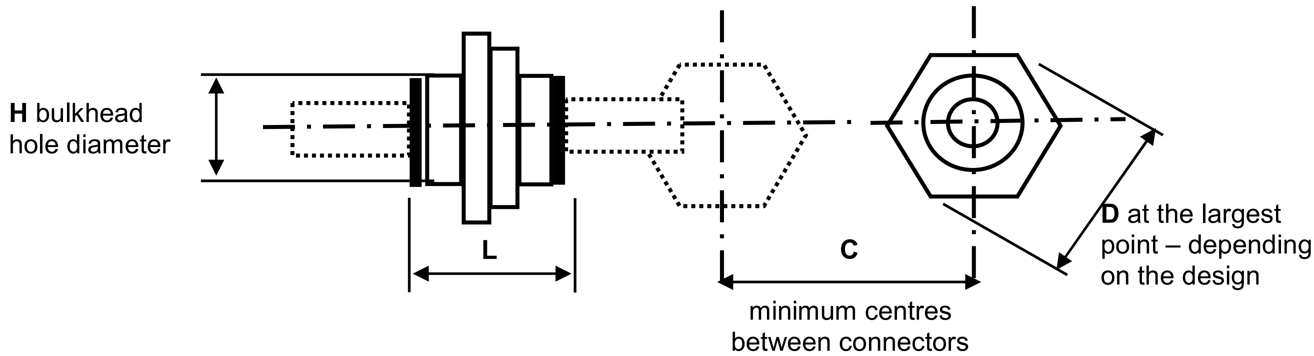


Figure D.2 – Straight bulkhead microduct connectors

D.3 ID/OD/ID and OD reducer/enlarger stem microduct connectors

A stem connector which connects two microducts with the same OD but different ID, including a smooth internal transition to prevent fibre 'hang ups', typically they have microduct attachment and sealing at one end of the connector, and a 'stem' on the other end to facilitate attachment to a 'straight connector'.

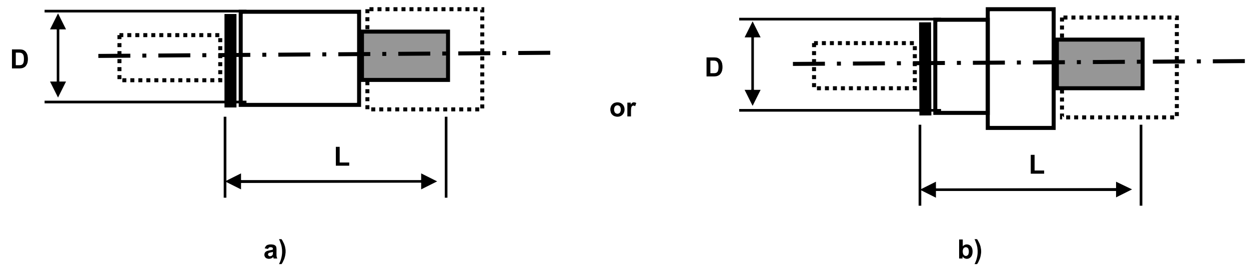


Figure D.3 – ID/OD/ID and OD reducer/enlarger stem microduct connectors

D.4 ID/OD/ID and OD reducer/enlarger microduct connectors

A connector which connects two microducts with the same OD but different ID, including a smooth internal transition to prevent fibre ‘hang ups’ typically they are to connect a heavy walled to a thinner wall MD.

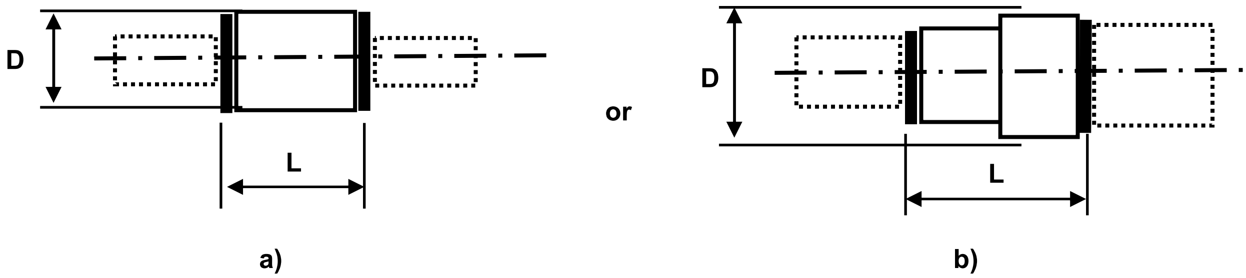


Figure D.4 – ID/OD/ID and OD reducer/enlarger microduct connectors

D.5 Close down microduct connectors

Microduct connectors that are used for fibre access for blowing head equipment for cascade blowing, allowing a microduct to be opened and resealed after blowing, without detriment to the fibre in situ.

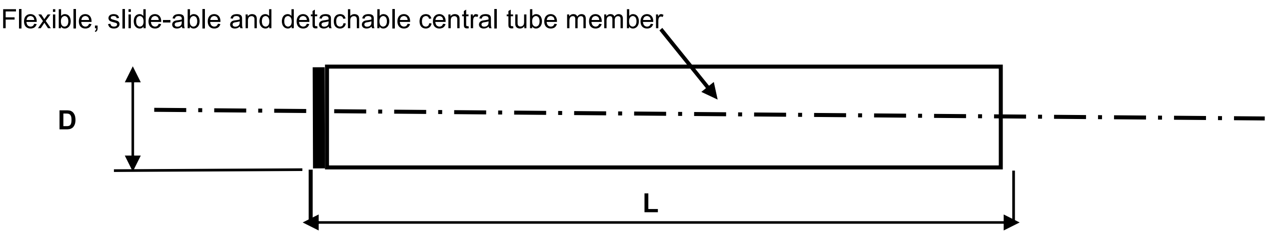


Figure D.5 – Close down microduct connectors

D.6 Liquid block microduct connectors

Microduct connectors that are used at a transition point to stop liquids from flowing between the connected microducts to avoid; liquid and contaminant ingress and, liquid damage to other equipment.

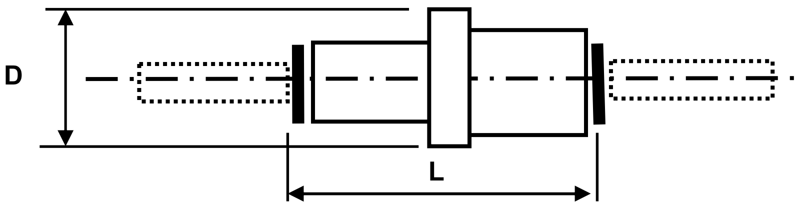


Figure D.6 – Liquid block microduct connectors

D.7 Liquid block with a barb end

Similar to a liquid block connector, however it may not necessarily meet the requirements of this specification, at the barb end. The barb end is designed to interface with the non-microduct (transport tubing), which protects the fibre at a “fibre management system” closure.

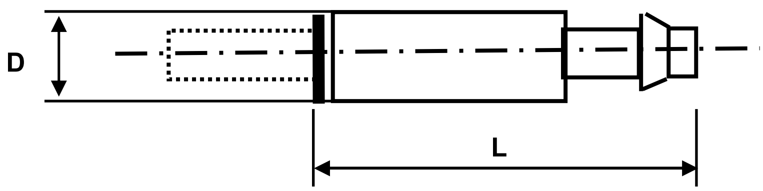


Figure D.7 – Liquid block with a barb end

D.8 End stop microduct connectors

Microduct connectors that are used for sealing open ended microduct, avoiding air leakage, water or foreign material ingress and safety reasons.

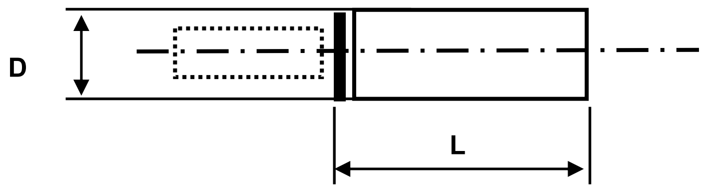


Figure D.8 – End stop microduct connectors

Annex E
(informative)

Microduct minimum bend radius

E.1 Object

This annex sets out to provide a practical recommendation for the minimum bend radius for various nominal microduct diameters.

E.2 Factors that can affect the minimum bend radius

Microducts with fitted connectors can be installed into closures at various bend radii. The following factors can affect the minimum recommended bend radius, reducing microduct kinking, and resistance to blowing:

a) microduct internal diameter size (resistance to fibre and air flow);

b) microduct internal surface coefficient of friction (bore material selection);

c) microduct material rigidity, (wall thickness and low temperature);

d) blowing equipment (pressure and airflow settings);

e) microduct supplied condition (ovality, eccentricity and sizing tolerance control);

f) interface between the connector internal geometry, and the fitted microducts;

g) fibre unit coating material and unit number of fibres (4 or 12 fibres).

E.3 Industry guidelines on the minimum 'Protected microduct' bend radius

Experience of installation company's air blowing optical fibre through microducts has resulted in these companies setting practical guidelines for the minimum microduct radius during the blowing process. Many companies use their own differing standards. The following table provides a compilation of these company standards, to arrive at an industry standard.

Table E.1 – Microduct connector definitions and sketches

Microduct nominal outside diameter mm	**Cable type**	**Protected microducts bend radius – Minimum** (based on the number of microducts in the protected microduct) mm						
		1	2	4	7	12	19	24
3	Outdoor only	150	150	200	230	270	330	375
5		190	190	300	380	430	550	650
8		230	230	400	540	700	900	1 000
10		100	300	300	400			
12								

NOTE 1 Outdoor protected microduct cable tends to be the larger direct buried cable with a thicker sheath sometimes re-enforced, and the indoor protected microduct cable is the ducted cable. With a thinner sheathed.

NOTE 2 Table E.1 assumes a typical blowing pressure of 10 bar.

NOTE 3 A 12 fibre unit has a minimum bend radius of 80 mm.

Annex F
(informative)

Typical (U) closure configurations
(but not limited to these examples)

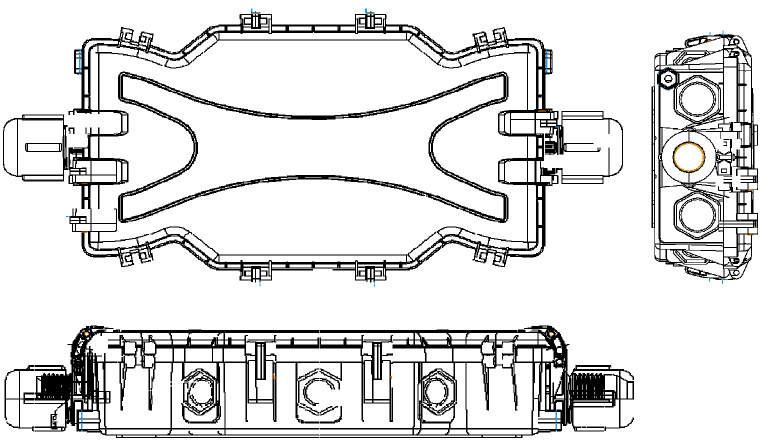


Figure F.1 – Universal UA – Inline closure

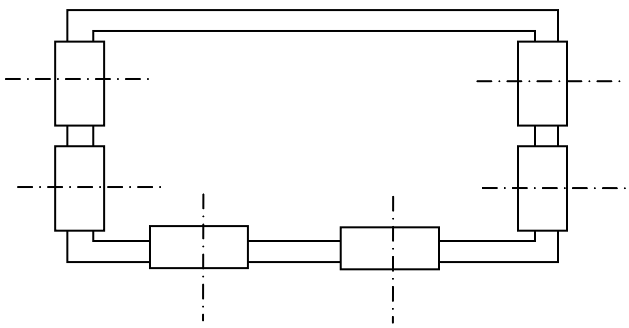


Figure F.2 – Universal UB – Inline closure

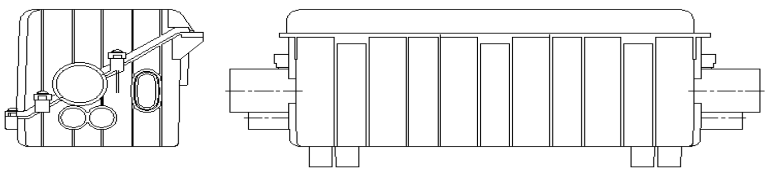


Figure F.3 – Universal UC – Inline closure

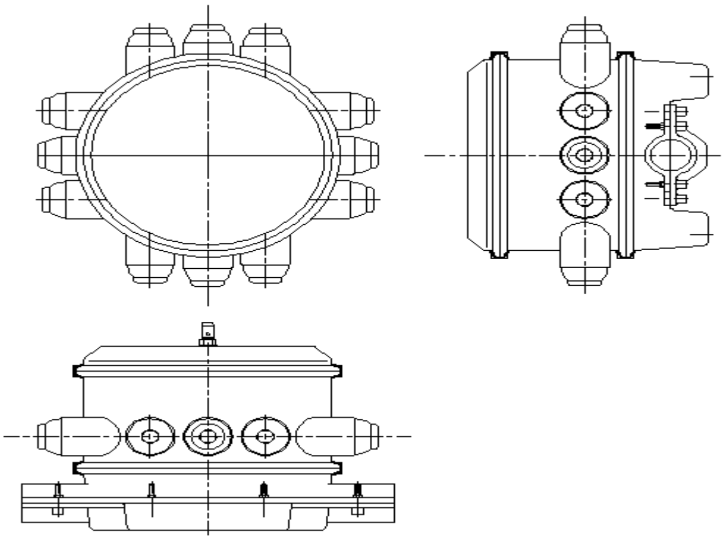


Figure F.4 – Universal UD – Inline closure

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