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System description

1. General

COOLFLEX is the registered trade name for a flexible pipe system from Brugg Pipe Systems. This pipe system is especially suitable for use in local and district cooling networks, in industrial and with restrictions also for combined heat pump systems (cooling and heating).

The COOLFLEX district cooling pipe has a carrier pipe produced from high-density polyethylene (PE100) as per standard EN 12162. The polyethylene pressure pipes are the standard for drinking water and waste water systems, and also for the gas supply sector. The pipes are joined by means of standard screwed connectors, mechanical pipe couplings, with normal commercial electro fusion fittings or by means of butt fusion welding technology.

The heat insulation consists of CFC-free polyurethane foam with excellent insulating properties. COOLFLEX district cooling pipe can be adapted to all pipe routing conditions without problems. It is possible to pass over or under existing supply pipes, and obstacles are easily bypassed. With the flexible COOLFLEX district cooling pipe, you can choose the shortest pipe route without considering the classical method of pipe construction.

The flexible COOLFLEX district cooling pipe is delivered to the site in continuous coils or on a drum. Generous delivery lengths enable pipes to be laid largely without underground connections. Pipe trench can be considerably narrower and this allows considerable savings on underground work.

Taking account of the very short time required for installation, COOLFLEX district cooling pipe is not only a technically perfect solution but also the key to saving time and expense when setting up district cooling networks, because less coordination is required on site and the pipes are laid simply and quickly.

2. Range of applications

Max. continuous operating temperature T_{Bmax} : -20 to $+40$ °C*
Max. permitted operating pressure p: max. 16 bar

*warm water application with limited lifetime and operating pressure (as per DIN 8074)

System description

1. Medium pipe

Material: Polyethylene class PE100 with high density, to DIN EN ISO 12162
 Life expectancy: 50 years at 20 °C (16 bar) or 40 °C (11.6 bar) as per DIN 8074 (SF 1.25)
 Properties: suitable as district cooling, cold water and waste water pipe

PE carrier pipe	Reference temperature	Value	Test standard
Density	–	952 - 960 kg/m ³	DIN 53479
Thermal conductivity	40 °C	0.40 W/mK	DIN 52612
Tensile strengts	20 °C	32 N/mm ²	DIN 53455
Modulus of elasticity	20 °C	1000 N/mm ²	DIN 53457
Linear expansion coefficient	20 °C	1.8 · 10 ⁻⁴ 1/K	DIN 52328
Crystallite melting range	–	130 - 135 °C	–

2. Thermal insulation

Material: CFC-free, 100 % CO₂-blown polyurethane foam (PUR)

PUR insulation	Reference temperature	Flexible pipes DN 20 - DN 125	Test standard
Density	–	> 60 kg/m ³	ISO 845
Thermal conductivity	30	≤ 0.0234 W/mK	EN 253 and ISO 8497
Percentage of closed cells	–	≥ 90 %	–
Water absorption after 24 hours	–	≤ 10 %	EN 253

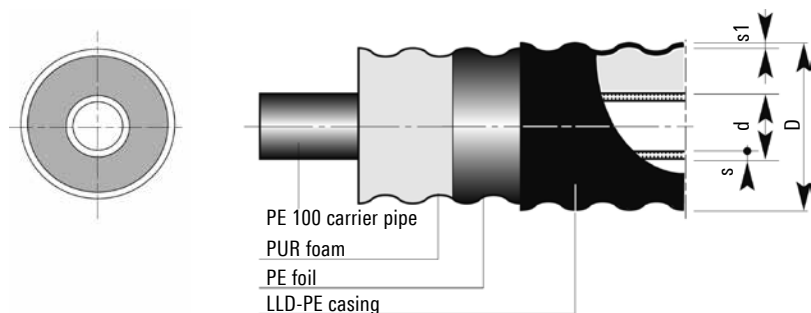
3. Protective casing

Material: linear polyethylene, low density (LLD-PE), seamlessly extruded
 Purpose: mechanical protection and moisture resistance

LLD-PE protective casing	Reference temperature	Flexible pipes	Test standard
Density	–	918 - 922 kg/m ³	ISO 1183
Thermal conductivity	–	0.33 W/mK	DIN 52612
Crystallite melting range	–	122 °C	ISO 11357-3

COOLFLEX range

Dimensions DN 20 - DN 125 / SDR 11 (coils)



Dimensions DN 20 - DN 125 / SDR 11

Type	DN	Inches	PE inner pipe d x s mm	Outer casing D x s1 mm	Minimum Bending radius m	Volume Inner pipe l/m	Weight kg/m	Maximum delivery lengths*	
		"						Jumbo coil m	Maxi coil m
25/ 76	20	¾	25 x 2.3	78 x 2.0	0.7	0.327	0.90	520	780
32/ 76	25	1	32 x 2.9	78 x 2.0	0.7	0.539	1.00	520	780
40/ 91	32	1¼	40 x 3.7	93 x 2.2	0.8	0.835	1.39	370	570
50/ 91	40	1½	50 x 4.6	93 x 2.2	0.8	1.307	1.54	370	570
63/126	50	2	63 x 5.8	128 x 2.7	1.0	2.091	2.60	192	291
75/126	65	2½	75 x 6.8	128 x 2.7	1.0	2.961	2.75	192	291
90/162	80	3	90 x 8.2	163 x 3.2	1.2	4.254	4.56	92	149
110/162	100	4	110 x 10.0	163 x 3.2	1.2	6.362	5.69	92	149
125/182	125	5	125 x 11.4	183 x 3.3	1.4	8.200	6.37	52	86

* Partial lengths can be delivered

- All dimensions are available in straight lengths on request.
- We will produce different dimensions or special items on request (> 500 m).
- Larger or smaller delivery lengths can be supplied on drums if requested.
- Coil dimensions: **Jumbo coil** outer diameter 2800 mm x 800 mm (width)
Maxi coil outer diameter 2800 mm x 1200 mm (width)

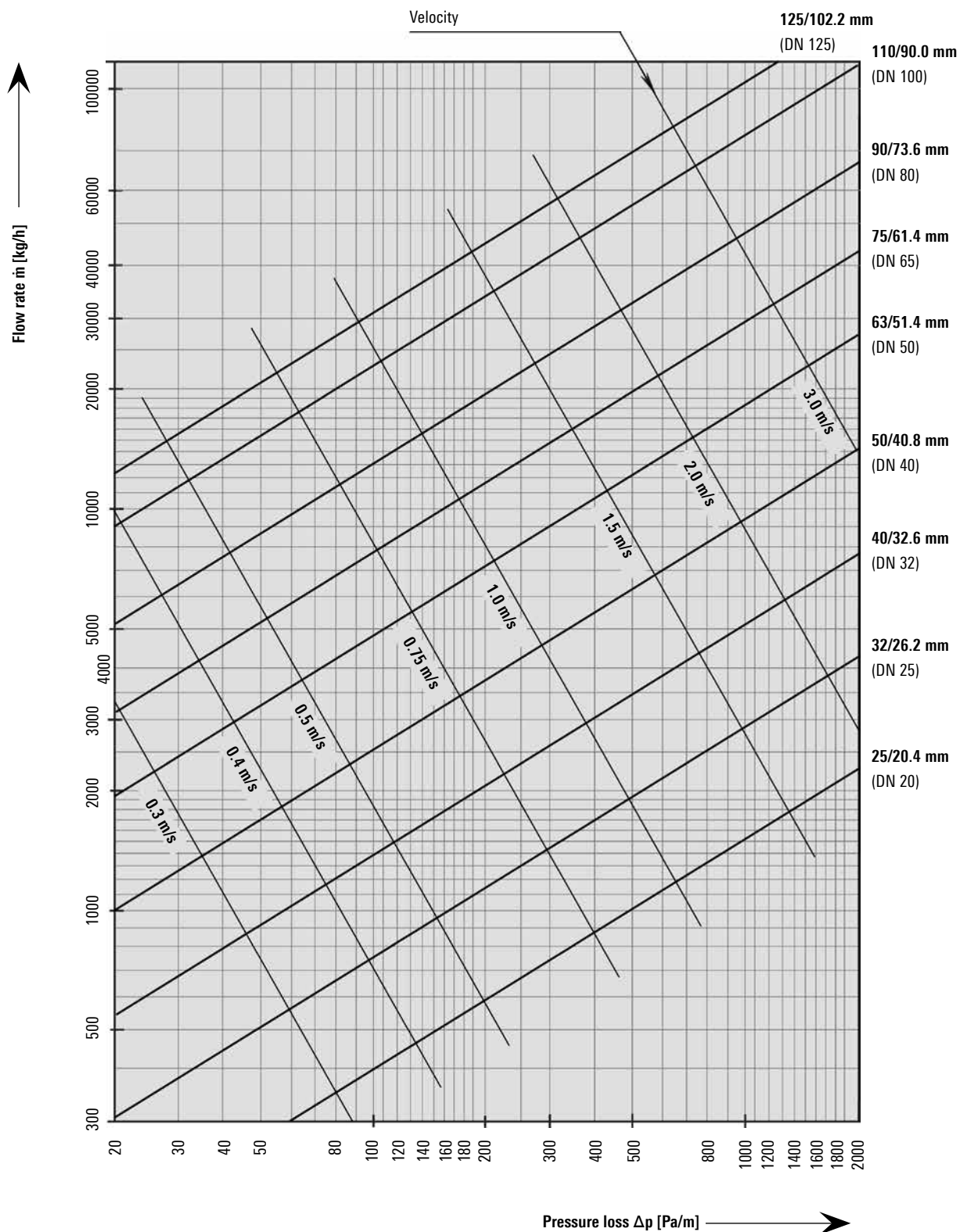
Pressure loss chart for water

DN 20 - DN 125 / SDR 11

Water temperature 10 °C

Roughness $\varepsilon = 0.01$ mm (PE100)

(1 mmWS = 9.81 Pa)



Pressure loss chart for ethylene glycol concentration

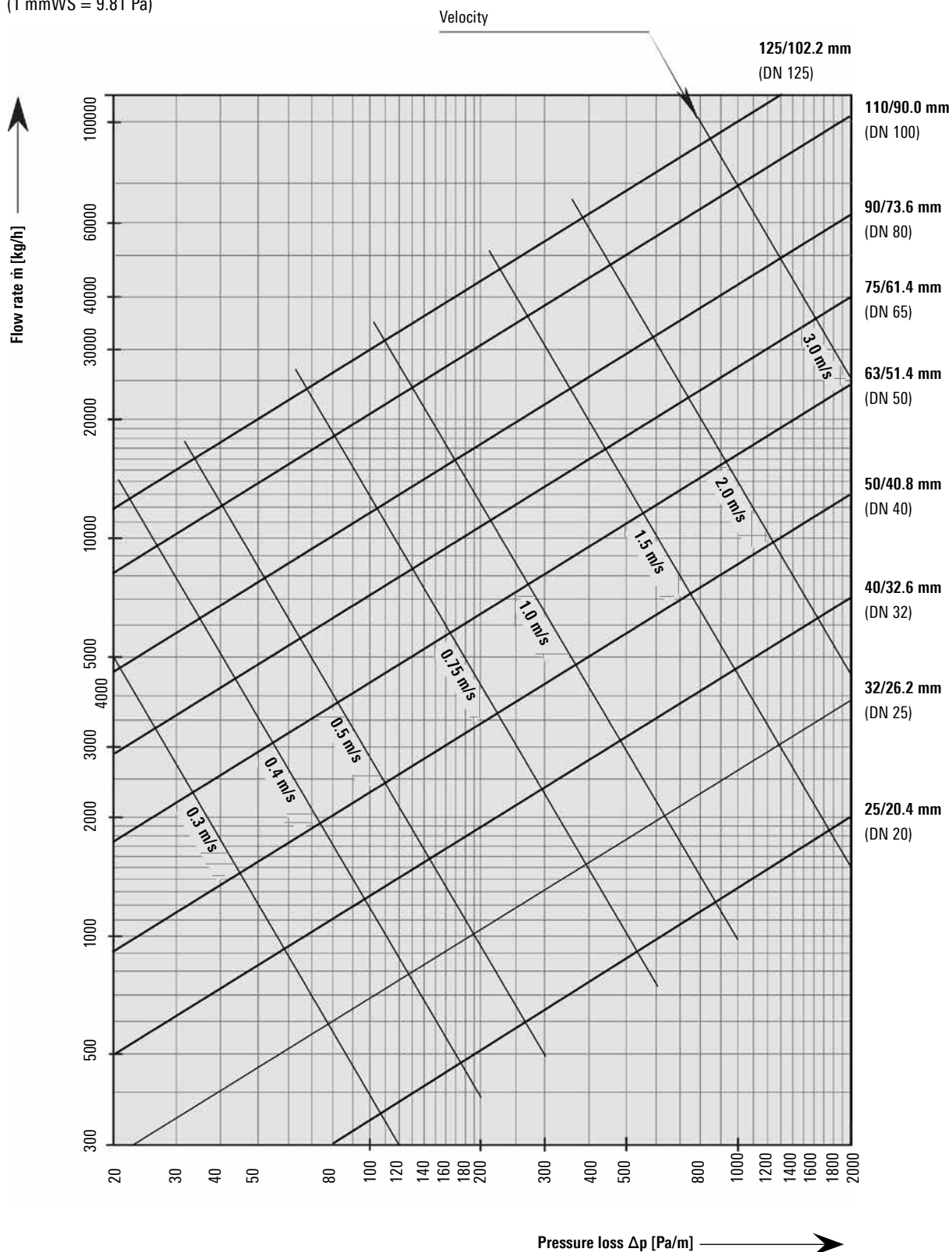
DN 20 - DN 125 / SDR 11

Medium temperature 10 °C

Ethylene glycol 30 % concentration

Roughness $\varepsilon = 0.01$ mm (PE100)

(1 mmWS = 9.81 Pa)

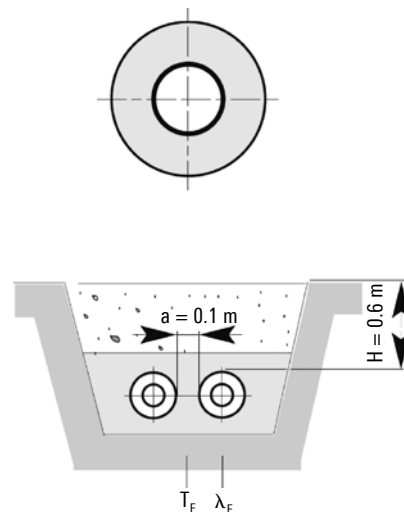


Energy losses

Applications laid in the ground

Dimensions DN 20 - DN 40

Heat losses q [W/m]		Average operating temperature T_B [°C]				
COOLFLEX	U-value [W/mK]	6°	8°	10°	12°	14°
25/ 76 - SDR 11	0.1254	-0.5	-0.3	0.0	0.3	0.5
32/ 76 - SDR 11	0.1588	-0.6	-0.3	0.0	0.3	0.6
40/ 91 - SDR 11	0.1657	-0.7	-0.3	0.0	0.3	0.7
50/ 91 - SDR 11	0.2243	-0.9	-0.4	0.0	0.4	0.9
63/126 - SDR 11	0.1941	-0.8	-0.4	0.0	0.4	0.8
75/126 - SDR 11	0.2523	-1.0	-0.5	0.0	0.5	1.0
90/162 - SDR 11	0.2269	-0.9	-0.5	0.0	0.5	0.9
110/162 - SDR 11	0.3287	-1.3	-0.7	0.0	0.7	1.3
125/182 - SDR 11	0.2275	-0.9	-0.5	0.0	0.5	0.9



Installation type CLX: 2-pipe, laid in the ground
 Pipe distance: $a = 0.10 \text{ m}$
 Cover above pipe: $H = 0.60 \text{ m}$
 Ground temperature: $T_E = 10.00 \text{ °C}$
 Soil conductivity: $\lambda_E = 1.2 \text{ W/mK}$
 Conductivity of PUR foam: $\lambda_{PU} = 0.0234 \text{ W/mK}$
 Conductivity of PE pipe: $\lambda_{PE} = 0.40 \text{ W/mK}$
 Conductivity of PE casing: $\lambda_{PE} = 0.33 \text{ W/mK}$

Heat loss during operation:

$$q = U (T_B - T_E) \text{ [W/m]}$$

U = Heat transfer coefficient [W/mK]

T_B = Average operating temperature [°C]

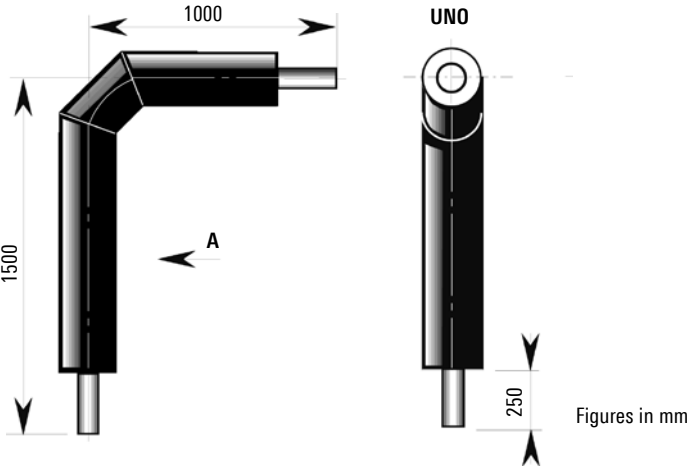
T_E = Average ground temperature [°C]

VL = Flow

RL = Return

On request, we shall be glad to calculate the heat losses for surface mounted pipe systems.

Bend, 90°

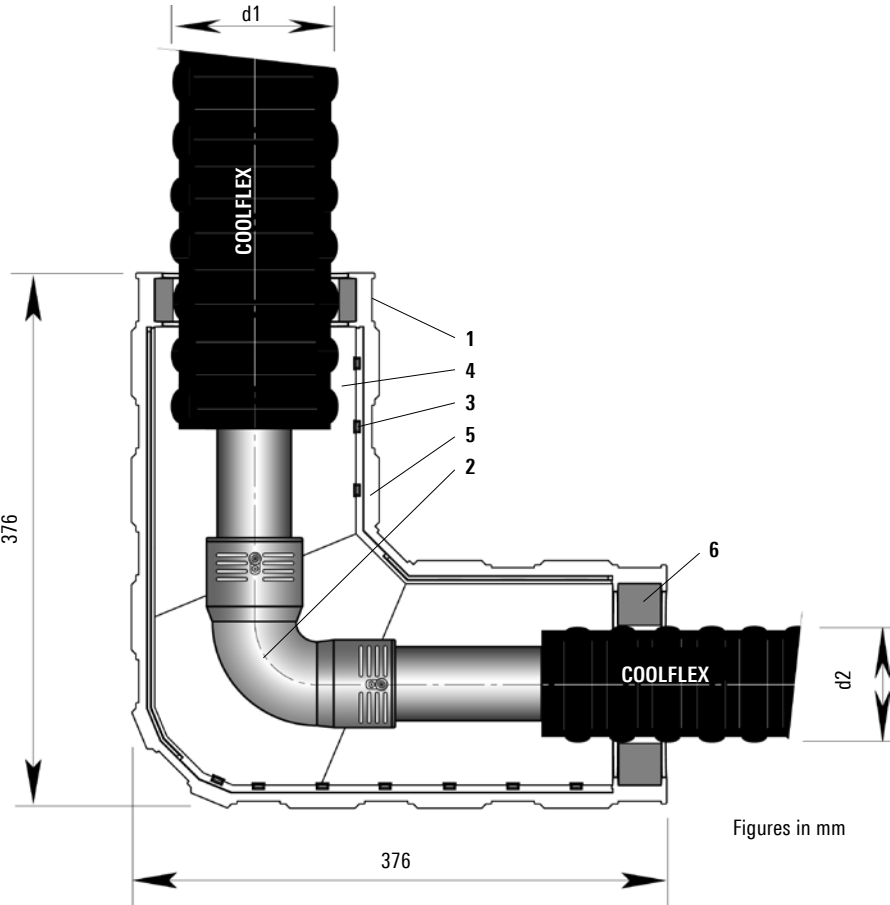


Dimensions DN 20 - DN 100 / SDR 11

Type	DN	Inches	PE inner pipe d x s mm	Outer pipe D x s1 mm	Volume Inner pipe l/m
25/ 76	20	3/4	25 x 2.3	75 x 4.5	0.327
32/ 76	25	1	32 x 2.9	75 x 4.5	0.539
40/ 91	32	1 ¼	40 x 3.7	90 x 3.5	0.835
50/ 91	40	1 ½	50 x 4.6	90 x 3.5	1.307
63/126	50	2	63 x 5.8	125 x 4.8	2.091
75/126	65	2 ½	75 x 6.8	125 x 4.8	2.961
90/162	80	3	90 x 8.2	160 x 4.9	4.254
110/162	100	4	110 x 10.0	160 x 4.9	6.362

COOLFLEX L-shell

Dimensions DN 20 - DN 65 (Ø 76 - 126 mm)



Figures in mm

COOLFLEX L-shell

Outer casing Ø d1	Ø d2		
	76	91	126
76	x		
91		x	
126			x

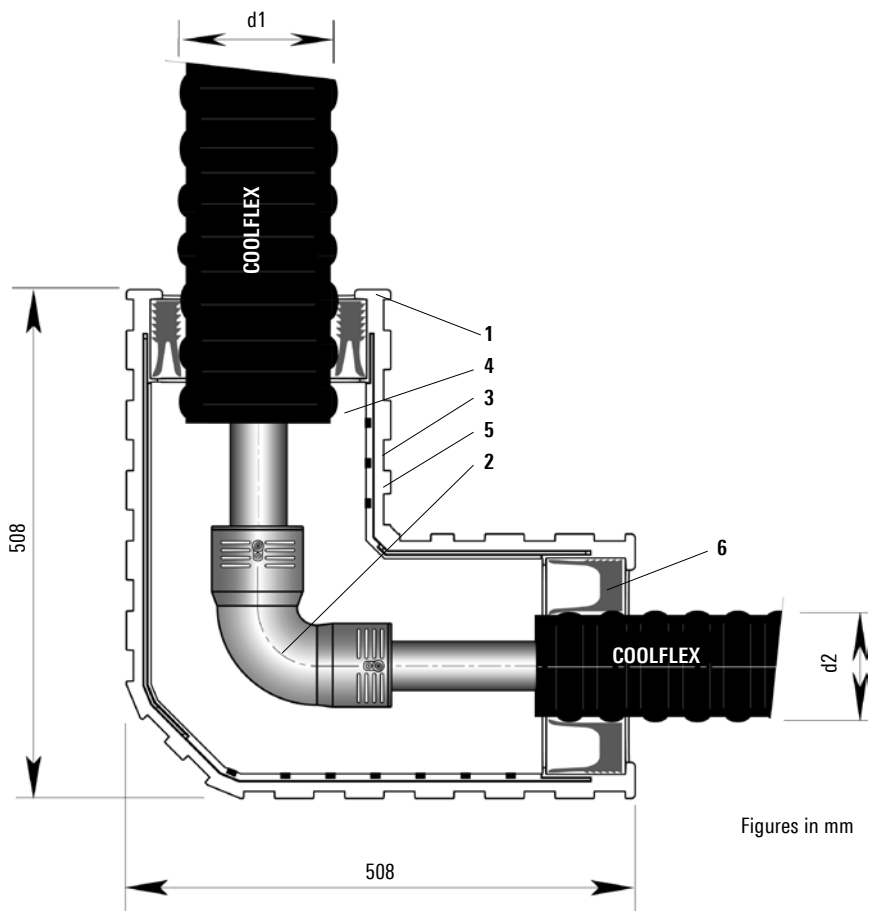
PE jointing methods; see CLX 2.350 - 2.360

Structure of the half-shell

- 1 ABS half-shells
- 2 PE fusion welded joints; see CLX 2.359
- 3 Sealing clamps (14 pcs.)
- 4 Insulation material; see CLX 2.345
- 5 Glued surface
- 6 Reducer ring or sealing ring

COOLFLEX Big L-shell

Dimensions DN 80 - DN 125 (Ø 162 - 182 mm)



Figures in mm

COOLFLEX Big L-shell

Outer casing Ø d1	Ø d2				
	76	91	126	162	182
76					
91					
126					
162				x	
182					x

COOLFLEX Big-shells are freely reducible from Ø 182 mm to Ø 76 mm
PE jointing methods; see CLX 2.350 - 2.360

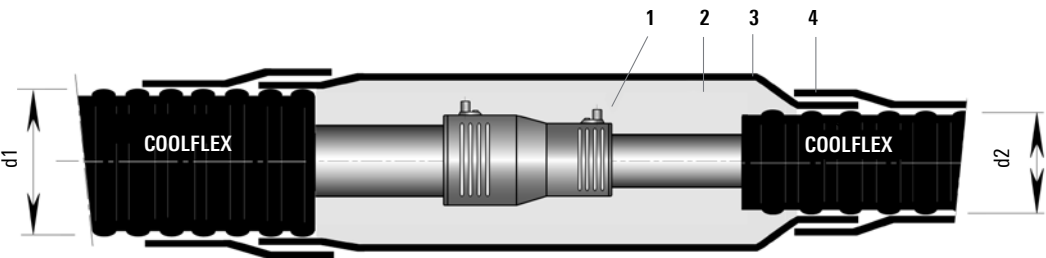
Structure of the half-shell

- 1 ABS half-shells
- 2 PE fusion welded joints; see CLX 2.359
- 3 Sealing clamps (24 pcs.)
- 4 Insulation material; see CLX 2.345
- 5 Glued surface
- 6 Reducer ring or sealing ring

Joint using PE-HD shrink sleeve

Dimensions Ø 76 - 182 mm

COOLFLEX joints and reduction joints



- 1 PE fusion welded joints; see CLX 2.359
- 2 Insulation material, PUR or PE; see CLX 2.345
- 3 Shrink sleeve pipe
- 4 Shrink hose

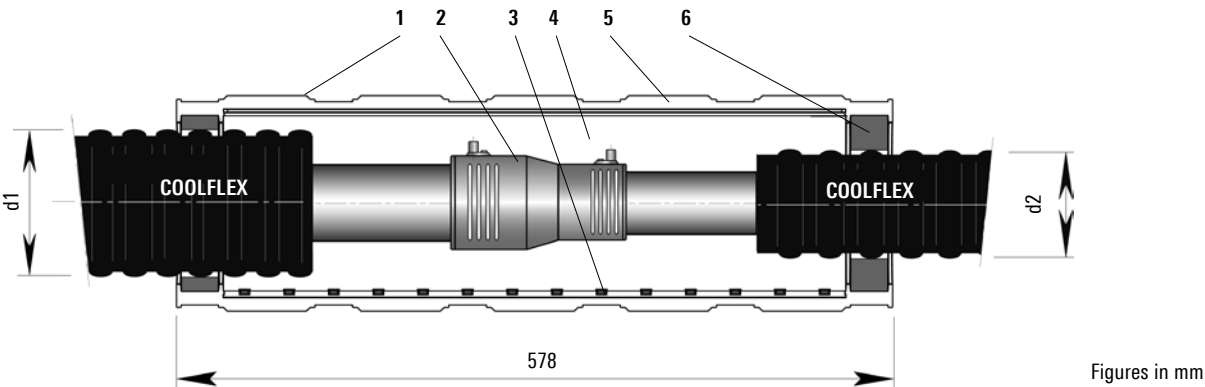
COOLFLEX – COOLFLEX

	Ø d2	76	91	126	162	182
Ø d1	76	x				
	91	x	x			
	126	x	x	x		
	162			x	x	
	182			x	x	x

PE jointing methods; see CLX 2.350 - 2.360

COOLFLEX I-shell

Dimensions DN 20 - DN 65 (Ø 76 - 126 mm)



COOLFLEX I-shell

Outer casing Ø d1	Ø d2		
	76	91	126
76	x		
91	x	x	
126	x	x	x

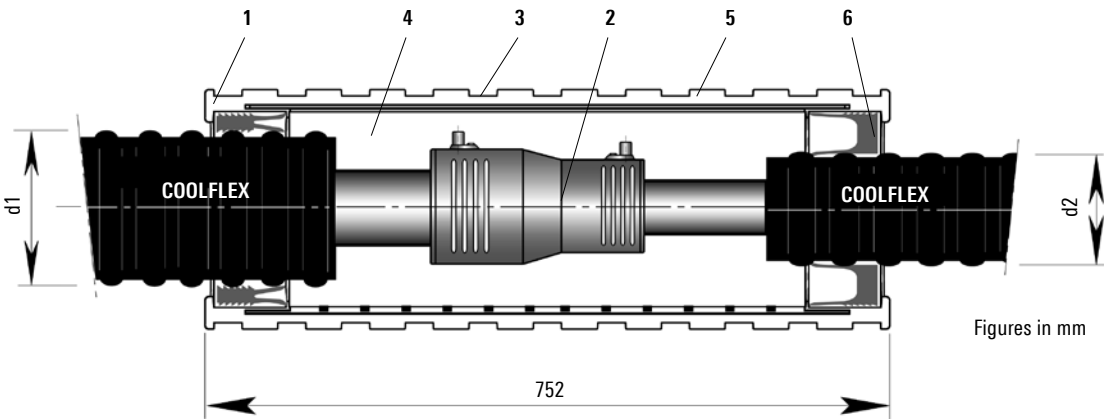
PE jointing methods; see CLX 2.350 - 2.360

Structure of the half-shell

- 1 ABS half-shells
- 2 PE fusion welded joints; see CLX 2.359
- 3 Sealing clamps (12 pcs.)
- 4 Insulation material; see CLX 2.345
- 5 Glued surface
- 6 Reducer ring or sealing ring

COOLFLEX Big I-shell

Dimensions DN 80 - DN 125 (Ø 162 - 182 mm)



COOLFLEX Big I-shell

Outer casing Ø d1	Ø d2				
	76	91	126	162	182
76					
91					
126					
162			x	x	
182				x	x

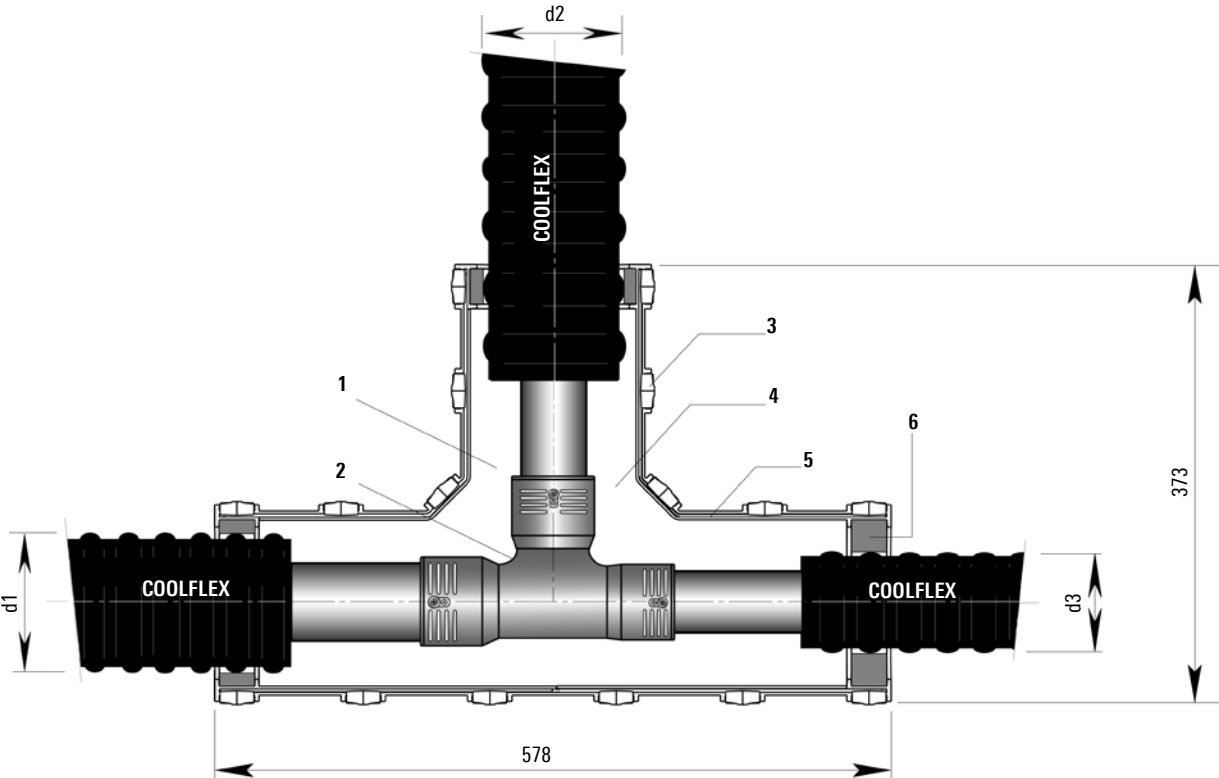
COOLFLEX Big-shells are freely reducible from Ø 182 mm to Ø 76 mm
PE jointing methods; see CLX 2.350 - 2.360

Structure of the half-shell

- 1 ABS half-shells
- 2 PE fusion welded joints; see CLX 2.359
- 3 Sealing clamps (22 pcs.)
- 4 Insulation material; see CLX 2.345
- 5 Glued surface
- 6 Reducer ring or sealing ring

COOLFLEX T-shell

Dimensions DN 20 - DN 65 (Ø 76 - 126 mm)



Figures in mm

COOLFLEX T-shell

Outer pipe Ø d1 - Ø d3	Branch, Ø d2		
	76	91	126
76 - 76	x	x	x
91 - 91	x	x	x
91 - 76	x	x	x
126 - 126	x	x	x
126 - 91	x	x	x
126 - 76	x	x	x

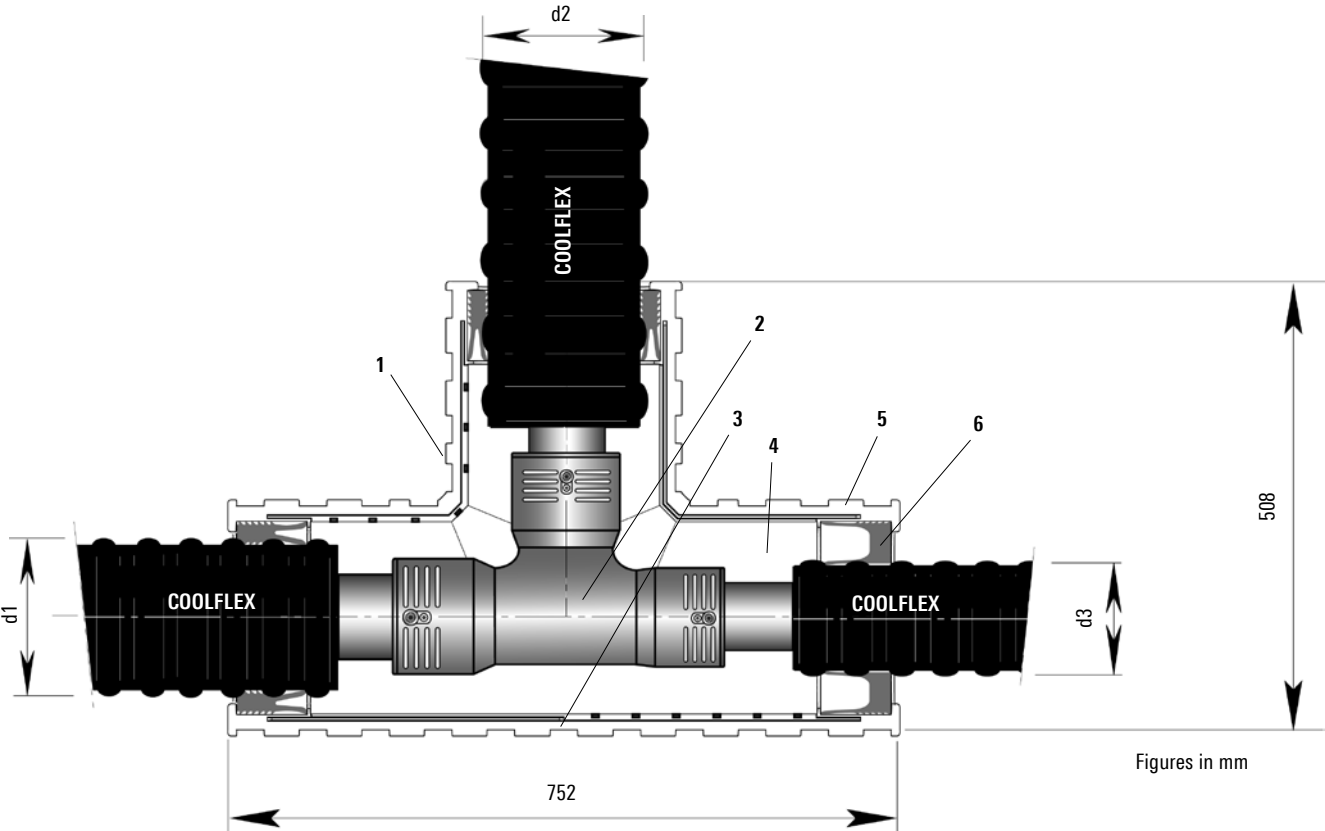
PE jointing methods; see CLX 2.350 - 2.360

Structure of the half-shell

- 1 ABS half-shells
- 2 PE T-piece; see CLX 2.359
- 3 Sealing clamps (16 pcs.)
- 4 Insulation material; see CLX 2.345
- 5 Glued surface
- 6 Reducer ring or sealing ring

COOLFLEX Big T-shell

Dimensions DN 80 - DN 125 (Ø 162 - 182 mm)



COOLFLEX Big T-shell

Outer pipe Ø d1 - Ø d3	Branch, Ø d2				
	76	91	126	162	182
162 - 162	x	x	x	x	x
162 - 126	x	x	x	x	x
162 - 91	x	x	x	x	x
162 - 76	x	x	x	x	x
182 - 182	x	x	x	x	x
182 - 162	x	x	x	x	x
182 - 126	x	x	x	x	x
182 - 91	x	x	x	x	x
182 - 76	x	x	x	x	x

PE jointing methods; see CLX 2.350 - 2.360

Structure of the half-shell

- 1 ABS half-shells
- 2 PE T-piece; see CLX 2.359
- 3 Sealing clamps (27 pcs.)
- 4 Insulation material; see CLX 2.345
- 5 Glued surface
- 6 Reducer ring or sealing ring

Insulation material

PUR foam containers (DN 20 - DN 125)

Insulation material for shrink joints and shell systems

PUR foam containers (DN 25 - DN 125)

CFC-free, cyclopentane-blown PUR foam in plastic bottles

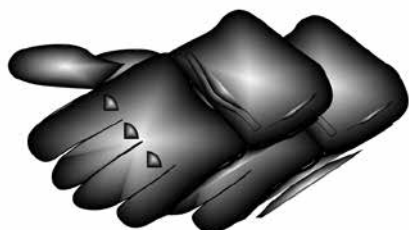
The required quantity of polyurethane foam is delivered in suitable container sizes for the various joints and T-pieces. The components are supplied separately in two bottles, and are only mixed together when needed. Please note the safety regulations in the installation instructions supplied with the product.



Safety regulations

Protective goggles and gloves must be worn during the foaming process.

Synthetic gloves



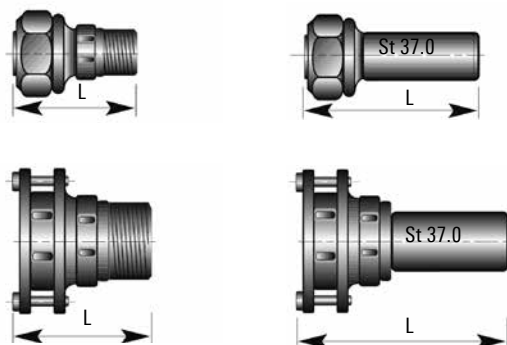
Protective goggles



PE jointing methods

Screwed connectors (outer thread, weld end, coupling)

Connection with outer thread/weld end

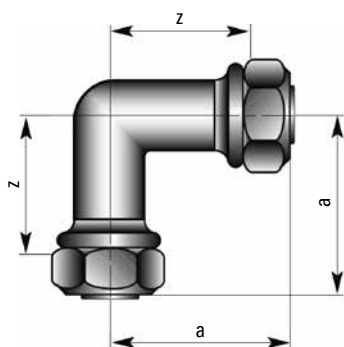


Cold water, 16 bar

Material: brass

PE pipe mm	Screwed connector mm	L mm	Weld end mm	L mm
25 x 2.3	25 x 2.3-3/4"	53	26.9 x 2.65	180
32 x 2.9	32 x 2.9-1"	63	33.7 x 2.3	180
40 x 3.7	40 x 3.7-1 1/4"	67	42.4 x 2.6	185
50 x 4.6	50 x 4.6-1 1/2"	71	48.3 x 2.6	190
63 x 5.8	63 x 5.7-2"	80	60.3 x 2.9	195
75 x 6.8	75 x 6.8-2 1/2"	92	76.1 x 3.2	200
90 x 8.2	90 x 8.2-3"	92	88.9 x 3.2	240
110 x 10.0	110 x 10.0-4"	102	114.3 x 3.6	280

90° angle coupling

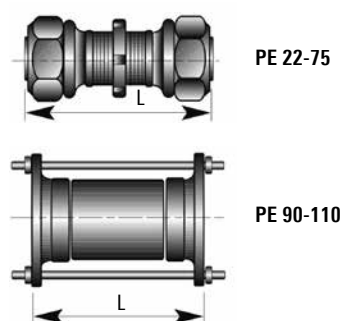


Cold water, 16 bar

Material: brass

PE pipe mm	PE pipe mm	a mm	z mm
25 x 2.3	25 x 2.3	54	32
32 x 2.9	32 x 2.9	64	37
40 x 3.7	40 x 3.7	74	42
50 x 4.6	50 x 4.6	87	48
63 x 5.8	63 x 5.8	106	60
75 x 6.8	75 x 6.8	117	67

Coupling, equal

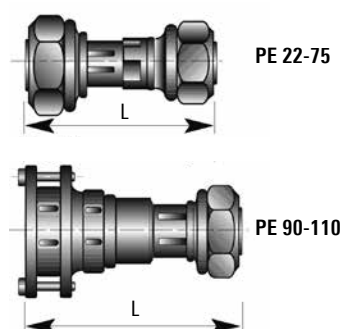


Cold water, 16 bar

Material: brass

PE pipe mm	Coupling mm	L mm
25 x 2.3	25 x 2.3	60
32 x 2.9	32 x 2.9	67
40 x 3.7	40 x 3.7	71
50 x 4.6	50 x 4.6	75
63 x 5.8	63 x 5.7	81
75 x 6.8	75 x 6.8	89
90 x 8.2	90 x 8.2	130
110 x 10.0	110 x 10.0	130

Coupling, reduced



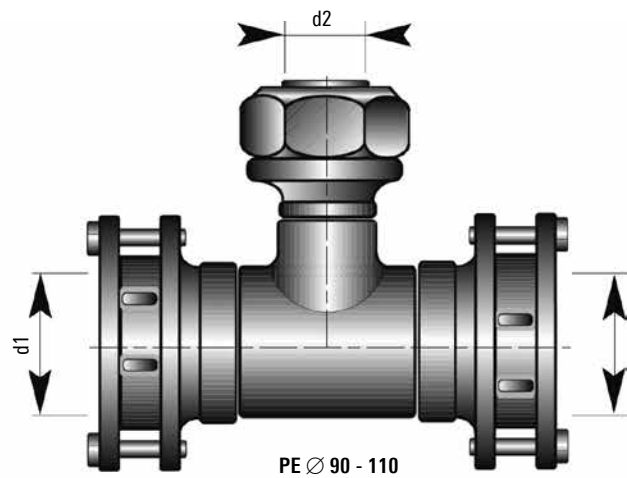
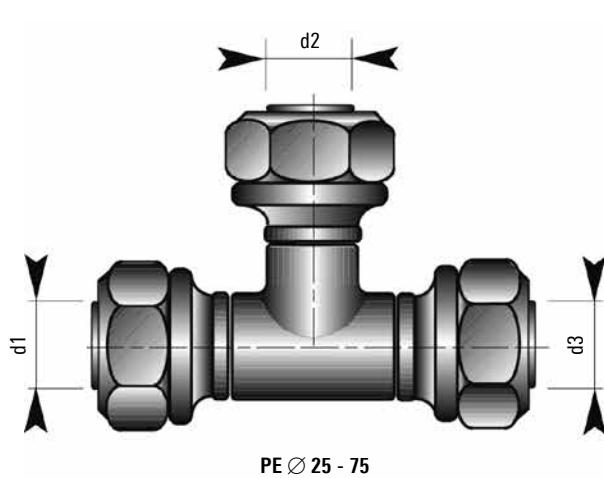
Cold water, 16 bar

Material: brass

PE pipe mm	Coupling mm
32 x 2.9 / 25 x 2.3	32-1" / 25-3/4"
40 x 3.7 / 32 x 2.9	40-1 1/4" / 32-1"
50 x 4.6 / 40 x 3.7	50-1 1/2" / 40-1 1/4"
63 x 5.8 / 50 x 4.6	63-2" / 50-1 1/2"
75 x 6.8 / 63 x 5.8	75-2 1/2" / 63-2"
90 x 8.2 / 75 x 6.8	90-3" / 75-2 1/2"
110 x 10.0 / 90 x 8.2	110-4" / 90-3"

PE jointing methods

screwed connectors, T-pieces



Material: brass

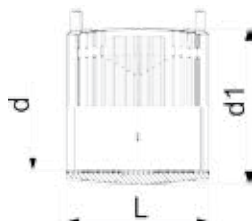
Ø d1 Ø d3 mm	Branch, Ø d2							
	mm							
	25 x 2.3	32 x 2.9	40 x 3.7	50 x 4.6	63 x 5.8	75 x 6.8	90 x 8.2	110 x 10.0
22 x 3.0 - 22 x 3.0								
25 x 2.3 - 25 x 2.3	x							
28 x 4.0 - 28 x 4.0		x						
32 x 2.9 - 32 x 2.9	x	x						
32 x 2.9 - 28 x 4.0		x						
32 x 2.9 - 25 x 2.3	x							
40 x 3.7 - 40 x 3.7	x	x	x					
40 x 3.7 - 32 x 2.9	x	x						
50 x 4.6 - 50 x 4.6	x	x	x	x				
50 x 4.6 - 40 x 3.7	x	x	x					
63 x 5.8 - 63 x 5.8	x	x	x	x	x			
63 x 5.8 - 50 x 4.6	x	x	x	x				
75 x 6.8 - 75 x 6.8	x	x	x	x	x	x		
75 x 6.8 - 63 x 5.8	x	x	x	x	x			
90 x 8.2 - 90 x 8.2	x	x	x	x	x	x	x	
90 x 8.2 - 75 x 6.8	x	x	x	x	x	x		
110 x 10.0 - 110 x 10.0	x	x	x	x	x	x	x	x
110 x 10.0 - 90 x 8.2	x	x	x	x	x	x	x	

Any other T-pieces that may be required can be supplied on request

PE jointing methods

Fusion welded

Sleeves

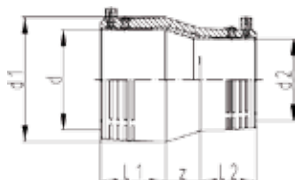


Cold water, 16 bar

Material: PE 100 / SDR 11

PE pipe mm	Sleeve mm	d1 mm	L mm
25 x 2.3	25	36	68
32 x 2.9	32	44	72
40 x 3.7	40	54	80
50 x 4.6	50	66	88
63 x 5.8	63	81	96
75 x 6.8	75	96	110
90 x 8.2	90	113	125
110 x 10.0	110	138	145
125 x 11.4	125	154	158

Reduction sleeves

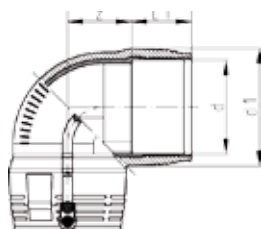


Cold water, 16 bar

Material: PE 100 / SDR 11

PE pipe mm	Sleeve mm	d1 mm	L mm	L1 mm	L2 mm	z mm
32 x 2.9 / 25 x 2.3	32 / 25	44	79	33	36	10
40 x 3.7 / 32 x 2.9	40 / 32	54	88	33	39	13
50 x 4.6 / 40 x 3.7	50 / 40	66	96	39	43	14
63 x 5.8 / 50 x 4.6	63 / 50	81	106	43	48	15
75 x 6.8 / 63 x 5.8	on request					
90 x 8.2 / 75 x 6.8	on request					
110 x 8.2 / 90 x 8.2	110 / 90	138	173	73	63	38
125 x 11.4 / 110 x 10.0	on request					

Angle piece, 90° equal

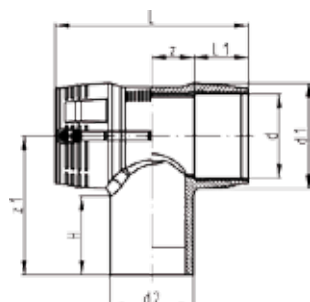


Cold water, 16 bar

Material: PE 100 / SDR 11

PE pipe mm	Sleeve mm	d1 mm	L mm	L1 mm	z mm
25 x 2.3	25	35	54	34	20
32 x 2.9	32	44	53	36	17
40 x 3.7	40	54	62	39	23
50 x 4.6	50	66	71	43	28
63 x 5.8	63	81	81	48	32
75 x 6.8	75	97	94	54	40
90 x 8.2	90	115	122	62	60
110 x 10.0	110	140	147	72	76
125 x 11.4	125	151	142	74	68

T-pieces



Cold water, 16 bar

Material: PE 100 / SDR 11

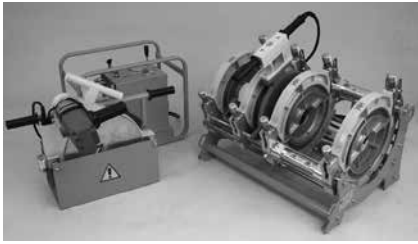
PE pipe mm	T-piece mm	d1 mm	L mm	L1 mm	z mm	z1 mm	H mm
25 x 2.3	25	35	90	34	11	92	70
32 x 2.9	32	44	102	36	15	100	74
40 x 3.7	40	54	120	39	21	114	82
50 x 4.6	50	66	135	43	24	126	90
63 x 5.8	63	81	152	48	28	150	102
75 x 6.8	75	97	178	54	35	143	87
90 x 8.2	90	115	205	62	41	161	94
110 x 10.0	110	140	255	72	56	184	104
125 x 11.4	125	161	276	78	60	207	113

(Source: Georg Fischer AG)

PE jointing methods

Alternative connections

Butt-fusion



(Source: PF-Schweisstechnologie GmbH)

Mechanical pipe couplings



To join:

plastic to plastic, or
plastic to metal pipes
Ø 40 - 250 mm

(Source: Straub Werke AG)

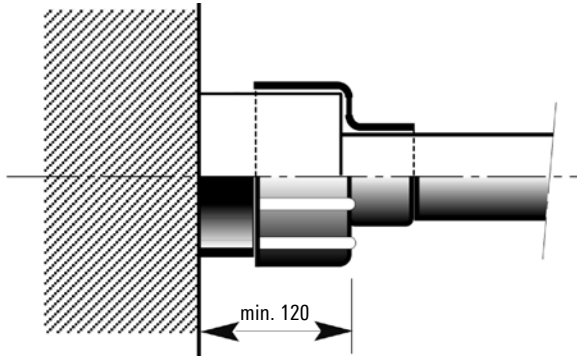
All jointing methods listed on this sheet are available on request.

End closure

Shrink-type closure, end caps (LD-PE)

Shrink-on closure

COOLFLEX shrink-on closures protect the PUR insulation on the front of the COOLFLEX pipes against splashing water in buildings and shafts. **Important:** in contact with water (flooding), the shrink-on closure is not necessarily watertight! The shrink-on closure also stops gas escaping from the PUR insulation.



Important fitting note

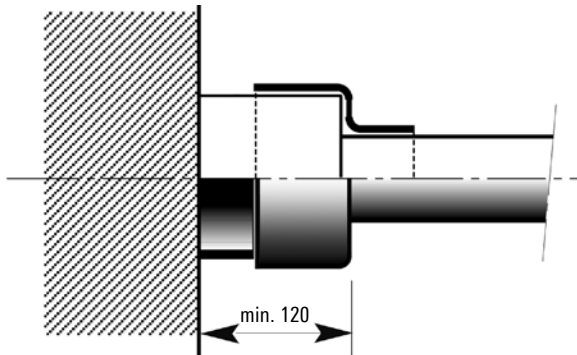
COOLFLEX shrink-on closures must be pushed onto the end of the COOLFLEX pipes before welding the inner pipes and must be protected against the action of heat during welding.

Material:

Heat-shrunk, cross-linked polyolefin.
Coated with sealing adhesive

End caps (PE-LD)

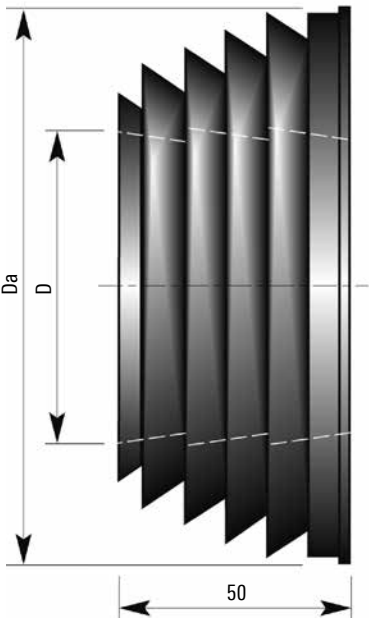
End caps are fitted as end closures for dry areas/rooms (up to Ø 182 mm).



Wall sealing ring

for wall openings

Wall sealing ring

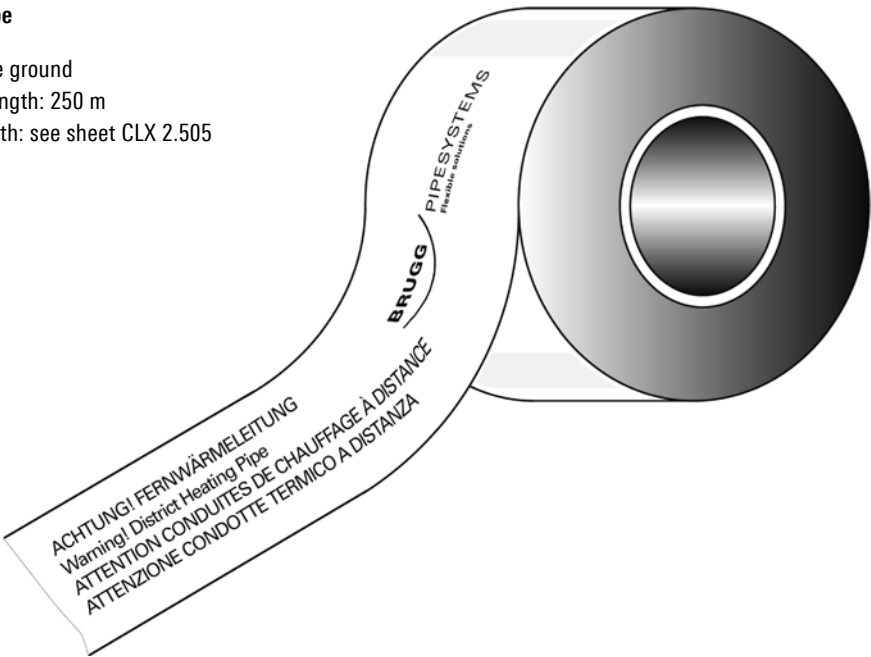


COOLFLEX

Type CLX	Da
25/ 76	118
32/ 76	118
40/ 91	133
50/ 91	133
63/126	168
75/126	168
90/162	203
110/162	203
125/182	223

Pipe warning tape

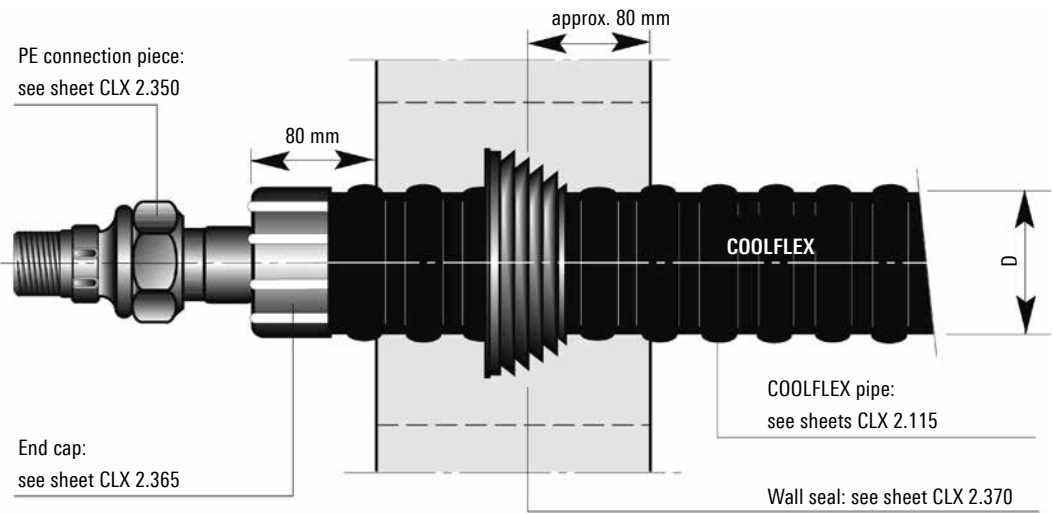
- To be laid in the ground
- Standard roll length: 250 m
- Installation depth: see sheet CLX 2.505



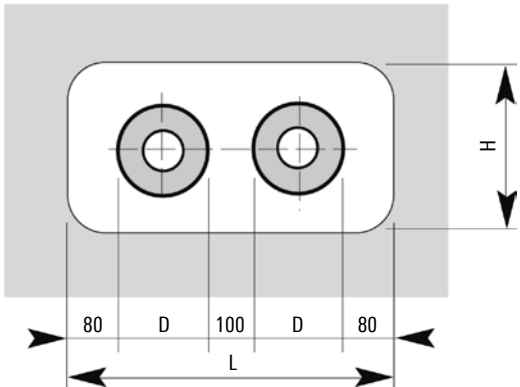
Building entry

Wall opening

Wall leadthrough



Wall opening



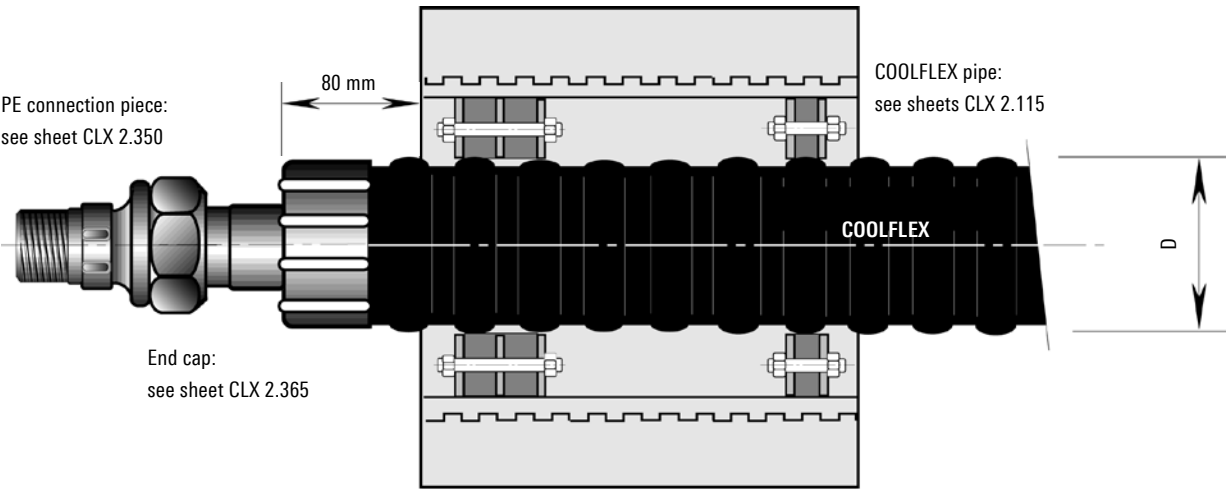
Figures in mm

Outer casing Ø D	L min	H min
mm	mm	mm
78	450	250
93	540	250
113	580	300
128	640	300
143	640	350
163	680	350
183	720	350

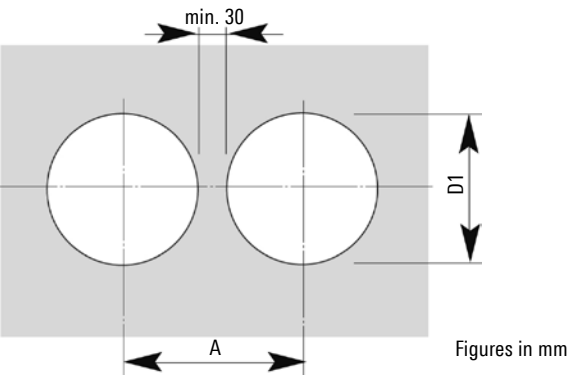
Building entry

Core bores/cement pipe liners

Wall leadthrough



Core bores



Outer casing Ø D	D1	A
mm	mm	mm
76	150	180
91	150	180
126	200	230
162	250	280
182	250	280

Core bores

Perfect bores are required for installation. As hairline cracks may be present in the concrete or result from drilling, it is advisable to seal the entire length of the borehole wall with suitable sealant (such as AQUAGARD).

Tightness can only be guaranteed if this recommendation is followed.

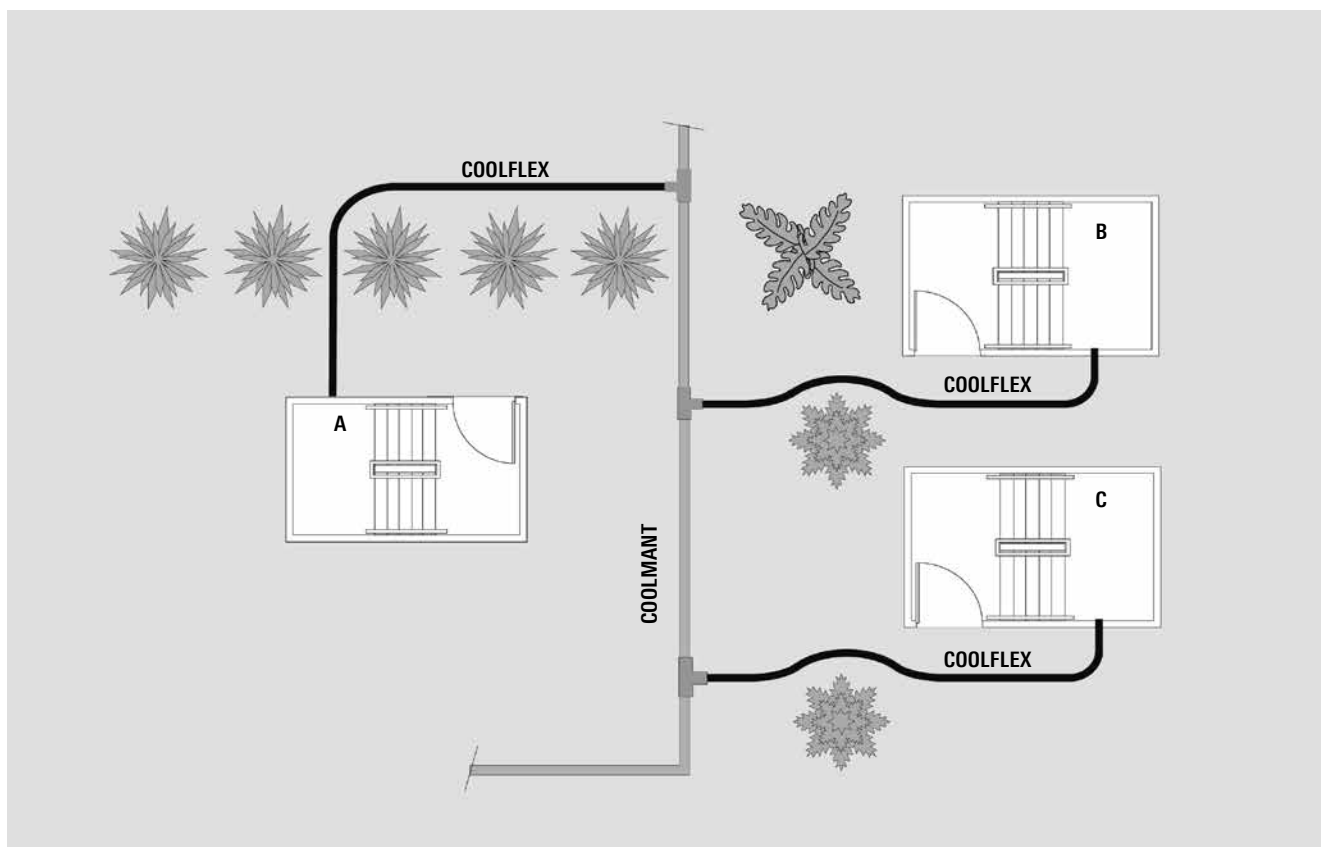
Key

- 1 COOLFLEX
- 2 Sealing set, single-seal, width 1 x 40 mm, Shore hardness D35
- 3 Sealing set, double-seal*, width 2 x 40 mm, Shore hardness D35
- 4 Liner pipe: made of fiber cement or coated core bore

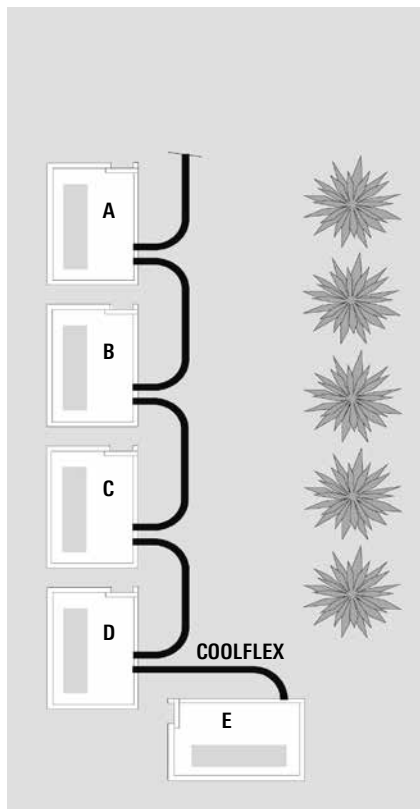
* Suitable for pressure from water up to 0.5 bar

Pipe routing

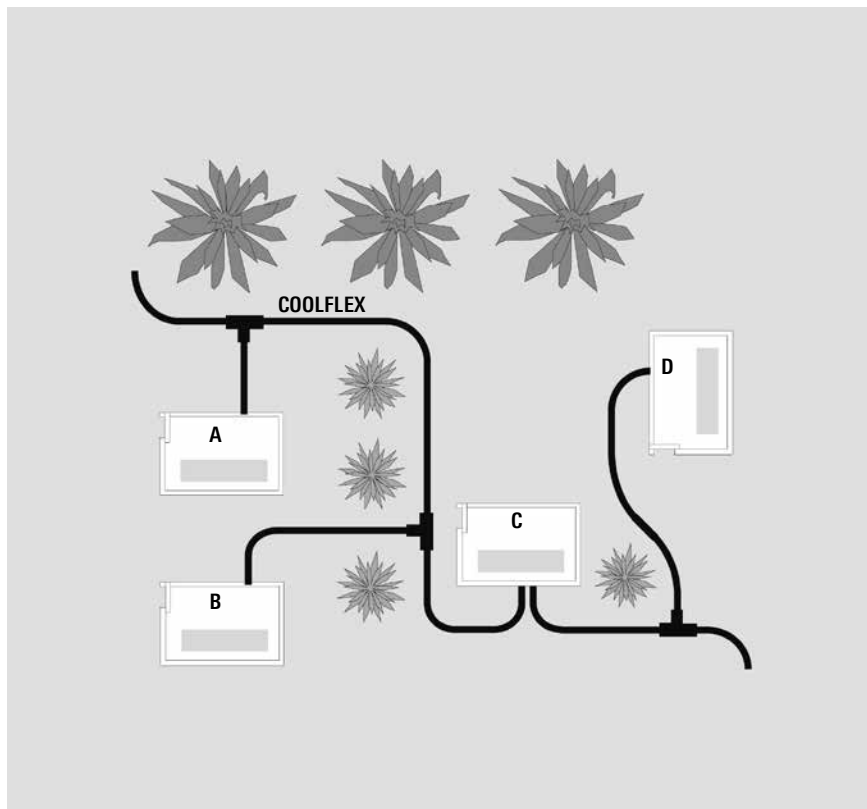
COOLFLEX – COOLMANT connection



Loop-in method



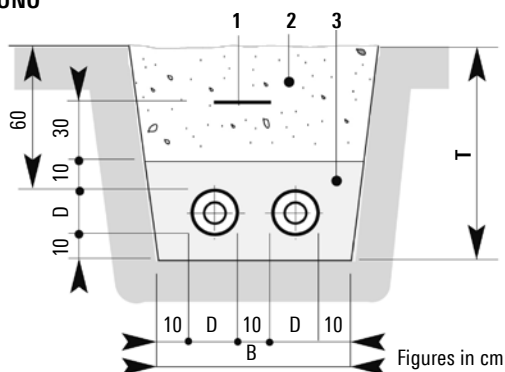
COOLFLEX – COOLFLEX connection



Trench dimensions

Trench profile, 2 COOLFLEX pipes (DN 20 - DN 125)

UNO



- 1 Pipe warning tape; see sheet CLX 2.370
- 2 Excavated material
- 3 Sand, washed, max. grain size 8 mm

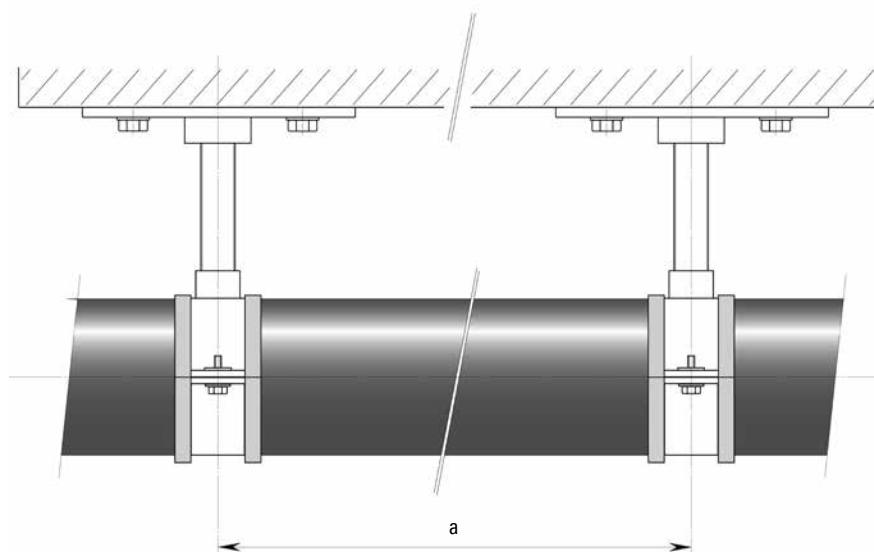
Casing pipe Ø D mm	Width B cm	Depth T cm	Minimum Bending radius m
76	45	80	0.7
91	50	80	0.8
111	55	85	0.9
126	55	85	1.0
162	65	90	1.2
182	70	95	1.4

Installation depth:
max. installation depth: 2.6 m
Our approval is required for installation at greater depths.

SLW 30 $\triangleq$ 300 kN total load as per DIN 1072; if subject to higher traffic loads (e.g. SLW 60), a load-distributing superstructure as per RSt075 is required.

With no traffic load, the minimum trench depth **T** can be reduced by 20 cm.

Surface installation



Special measures are required for surface installation of COOLFLEX district cooling pipes:

- Provide supports for changes of direction
- Secure with clamps and pressure distribution plates at specified intervals, in the 90° bend
- Clamps
- Fix ends with fixed points
- Assistance with design engineering and planning from BRUGG

Type	Weight including water kg/m	Minimum Bending radius m	distance between clamps a m
25/ 76	1.2	0.7	0.6
32/ 76	1.5	0.7	0.8
40/ 91	2.2	0.8	1.0
50/ 91	2.8	0.8	1.2
63/126	4.7	1.0	1.4
75/126	5.7	1.0	1.7
90/162	8.8	1.2	1.8
110/162	12.1	1.2	2.1
125/182	14.6	1.4	2.2