Technical manual

MultiSkin

Multilayer system

COMAP

MultiSkin system

Multilayer products combine economy and technical performance.
Ideal for tap water and heating applications.

MultiSkin
Multilayer system

CHAPTER 1
DESCRIPTION OF THE MULYILAYER SYSTEM

1. DESCRIPTION OF THE MULTILAYER SYSTEM

1.1. APPLICATIONS

1.1.1. Applications of multilayer water systems

The COMAP multilayer system is suitable for domestic water and heating water installations. It may be used in new construction or renovation projects.

Application	Operating temperature	Operating pressure
Drinking water	5°C to 95°C	Maximum of 10 bar
Heating water [1]	95° maximum	Maximum of 10 bar
Chilled water [1]	- 10° C minimum	Maximum of 10 bar
Rainwater	Outside temperature	Maximum of 10 bar
Dry compressed air [2]	Outside temperature	Maximum of 10 bar

The maximum content of chloride ions soluble in water may not exceed 100 mg / L.

[1] Up to 50% glycol can be used in addition to 50% water.

[2] For oil-free compressed air systems (with an oil filter in front of the installation), less than 25 mg / m3 of oil.

For any other application, please contact COMAP.

1.1.2. Multilayer gas system applications

The COMAP multilayer system is appropriate for gas installations. The multilayer gas system must be installed in accordance with local regulations.

Application	Operating temperature	Operating pressure
Gas [3]	60°C maximum	MOP 0.5 bar
Lubricated compressed air	- 10°C to 95°C	Maximum of 10 bar

[3] The COMAP gas multilayer system meets the European standard ISO / FDIS 17484-1 / 2006 for gas supply inside buildings with a maximum operating pressure of 5 bar (500 KPa), Part 1: specifications for systems. Installation must be carried out according to standard EN1775 or UNI / TS 11343.

1.1.3. Système multicouche COMAP

MultiSkin fittings

	14	16	18	20	26	32	40	50	63	75
 Metal crimp fittings for water	●	●	●	●	●	●	●	●	●	●
 Synthetic crimp fittings for water	-	●	-	●	●	●	●	●	●	-
 Push-fit fittings for water	●	●	-	●	●	-	-	-	-	-
 Metal compression fittings for water	●	●	●	●	●	●	-	-	-	-
 Metal crimp fittings for gas	-	●	-	●	●	●	-	-	-	-

MultiSkin 4 pipes

	14	16	18	20	26	32	40	50	63	75
 Coils	●	●	●	●	●	●	-	-	-	-
 Bar lengths	●	●	●	●	●	●	●	●	●	●
 Corrugated	●	●	●	●	●	●	-	-	-	-
 Insulated	●	●	●	●	●	●	-	-	-	-

MultiSkin 2 pipes

	14	16	18	20	26	32	40	50	63	75
 Coils	●	●	●	●	●	●	-	-	-	-
 Bar lengths	-	●	-	●	●	●	●	●	●	-
 Corrugated	-	●	-	●	●	-	-	-	-	-
 Insulated	-	●	-	●	●	●	-	-	-	-

MultiSkin Gas pipes

	14	16	18	20	26	32	40	50	63	75
 Coils	-	●	-	●	●	●	-	-	-	-
 Bar lengths	-	●	-	●	●	●	-	-	-	-
 Corrugated	-	●	-	●	●	●	-	-	-	-

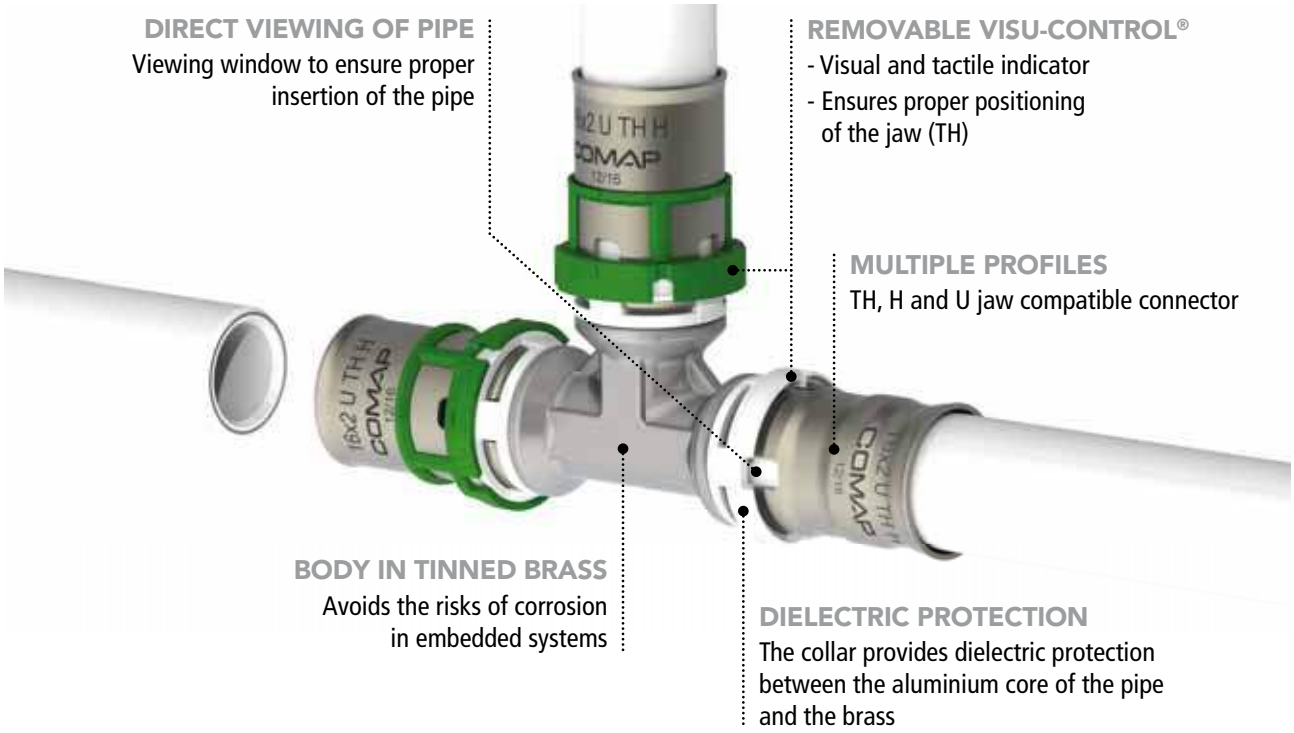
1.2. FITTINGS FOR MULTI-LAYER PIPES

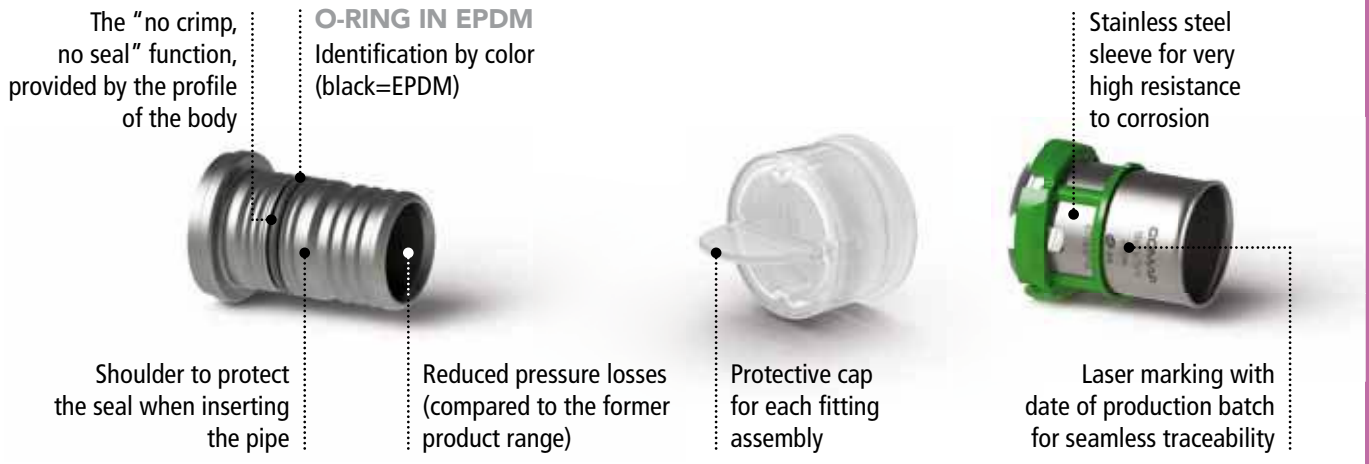
COMAP fittings can be installed quickly and reliably. A complete range of connectors with more than 500 references, using three different connection technologies: crimping, push and compression.

1.2.1. Range of crimp fittings

1.2.1.1. Metal crimp fittings for water

Tin plated brass fittings for rugged toughness and aesthetic quality.





Composition of metal crimp fitting	
Body	Brass CW617N-DW [1] according to EN12165 (Pb ≤ 2.2%), tinned (≥ 99.9% tin, by means of electroplating) [2]
O-ring	EPDM (ethylene-propylene-diene monomer rubber)
Sleeve	Stainless steel 1.4301 (AISI 304) according to EN ISO 10088
Visu-control® (fixed and removable rings)	PP (polypropylene)
Protective cap	14 to 32 mm PE-HD (polyethylene) and 40 to 75 mm PP (polypropylene)
Packaging bag	PE (Polyethylene)

1 Fittings adaptor to crimp profil M and profil V (7871W and 7872W) are made in gun metal CC499K (CuSn5Zn5Pb2-C)
2 Pipe ends to crimp, dedicated to heating applications are nickel plated (7090SW, 7090MW, 7090EW, 7090LW, 7130LW)

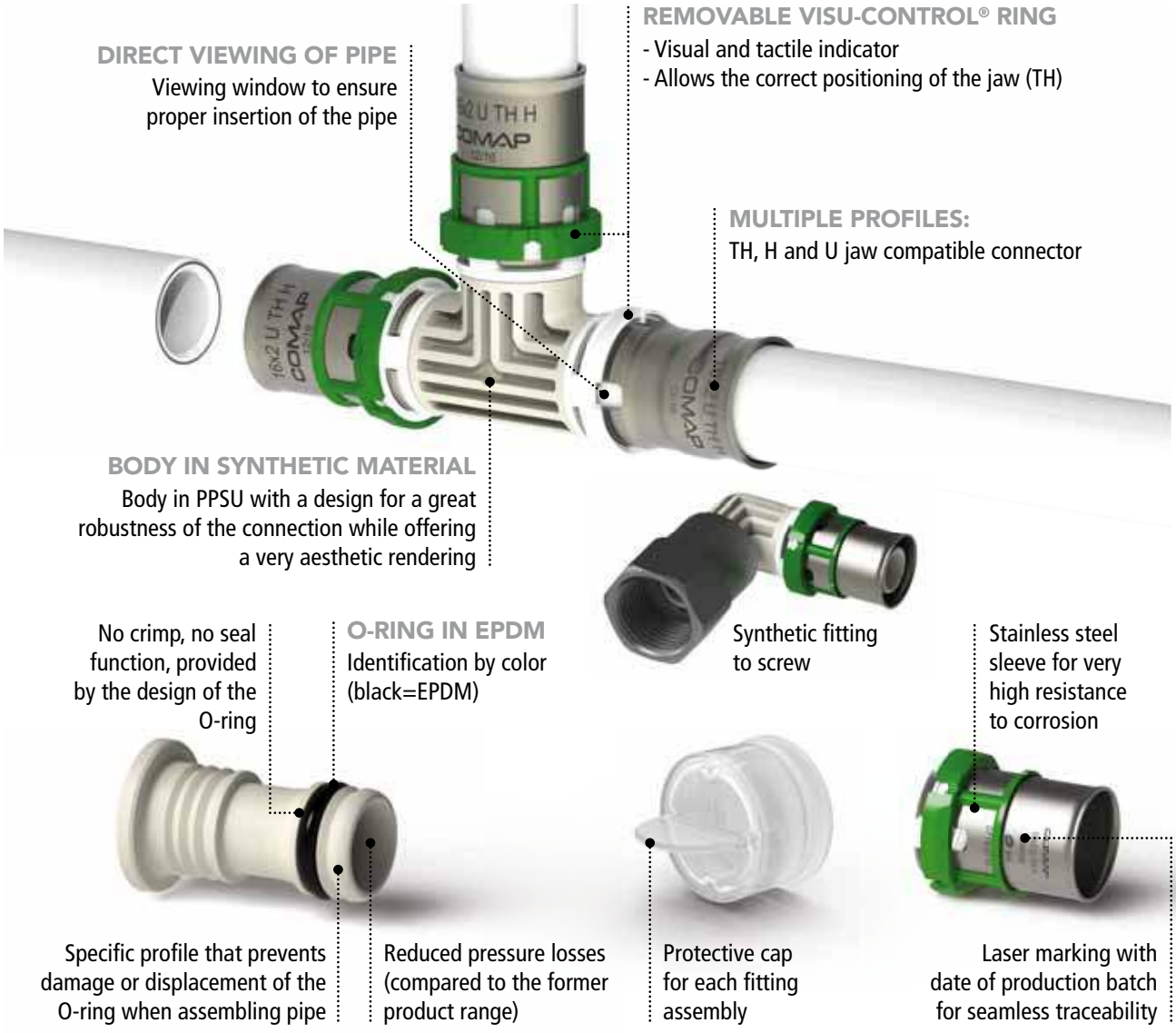
1.2.1.2. Synthetic crimp fittings for water

With its range of crimp fittings in synthetic material, COMAP offers plastic fittings for all your plumbing, heating, floor heating and other applications.

This type of fitting is made of polyphenylsulfone (PPSU). It is a highly technical polymer that provides extreme resistance to high temperatures and pressures. As an example, the fitting can resist a load of 18 kg per square cm at up to more than 200 ° C without warping.

Characteristics		Advantages
High quality resin	→	High quality, yet lightweight
Corrosion resistance	→	Easier maintenance
White	→	Attractive and discreet

Note: For more information on the chemical compatibility of fittings, please refer to chapter 3.3 (Resistance of fittings)



Composition of the fitting	Synthetic to crimp	Synthetic to crimp / to screw
Body	PPSU (polyphenylsulfone)	PPSU (polyphenylsulfone)
Screw-on part	-	DZR Brass CW625N or CW626N according to EN12165 (Pb ≤ 1.7%), tinned (≥ 99.9% tin, by means of electroplating)
O-ring	EPDM (ethylene-propylene-diene monomer rubber)	EPDM (ethylene-propylene-diene monomer rubber)
Sleeve	Stainless steel 1.4301 (AISI 304) according to EN ISO 10088	Stainless steel 1.4301 (AISI 304) according to EN ISO 10088
Visu-control® (fixed and removable rings)	PP (polypropylene)	PP (polypropylene)
Protective cap	16 to 32 mm PE-HD (polyethylene) and 40 to 63 mm PP (polypropylene)	16 to 32 mm PE-HD (polyethylene) and 40 to 63 mm PP (polypropylene)
Packaging bag	PE (polyethylene)	PE (polyethylene)

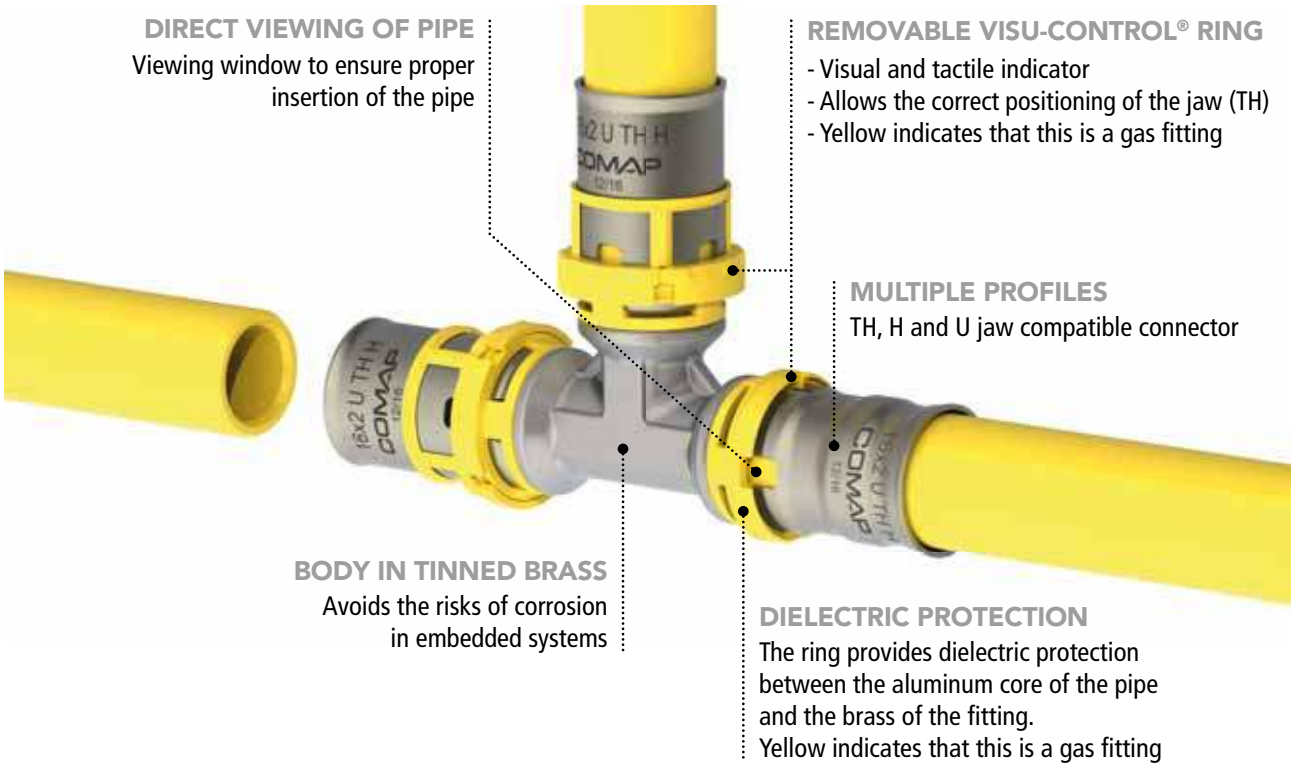
1.2.1.3. Metal crimp fittings for gas*

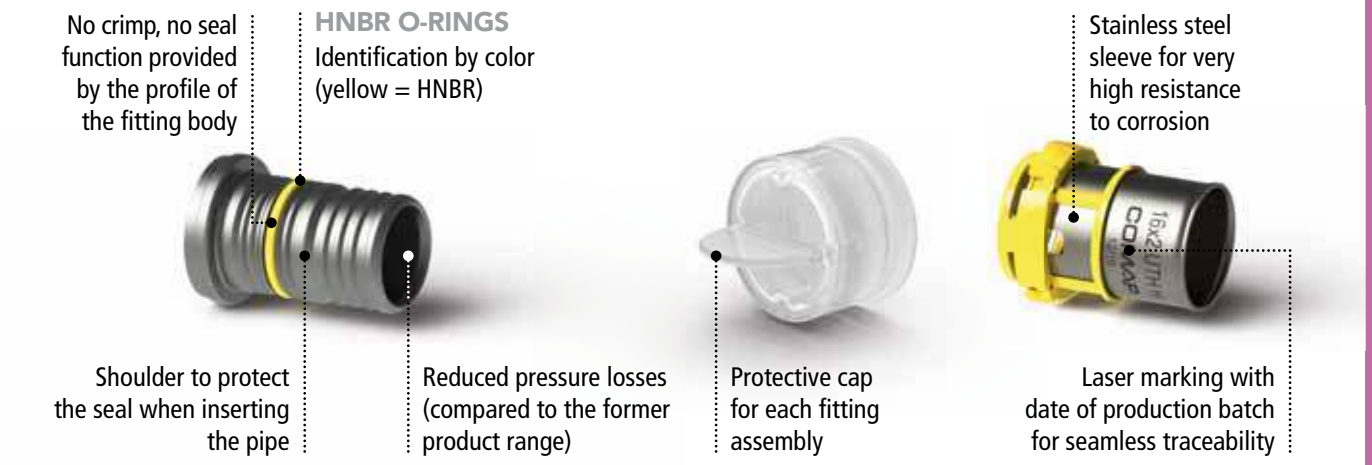
Multilayer pipes are increasingly used in Europe for gas applications.

This type of use is now approved by European certifications such as Gastec QA 198 in the Netherlands and UNITS 11343 in Italy. It is also based on European standard ISO / FDIS 17484-1: 2006.

COMAP has chosen to adapt its multilayer system to gas installations. Through the use of Visu-Control® and COMAP identification, installation is very reliable.

*Per local regulations.





Composition of metal crimp fitting for gas	
Body	Brass CW617N-DW according to EN12165 (Pb ≤ 2.2%), tinned (≥ 99.9% tin, by means of electroplating)
O-ring	HNBR (hydrogenated nitrile rubbers)
Sleeve	Stainless steel 1.4301 (AISI 304) according to EN ISO 10088
Visu-control® (bagues fixe et détachable)	PP (polypropylene)
Protective cap	PE-HD (polyethylene)
Packaging bag	PE (polyethylene)

1.2.1.4. Surface coating

Surface coating significantly improves the mechanical and visual characteristics of COMAP fittings. The fittings are plated with a 4-to-8-micron (µ)-thick layer composed of more than 99.9% tin (according to DVGW W534 and ISO 2093). This improves the fittings appearance and reduces the risk of oxidation.

These fittings have successfully passed tests for detection of applied or residual stresses which can cause failure of the material in service or storage through stress corrosion cracking:

- salt spray (fog) test following ISO 6957: 1988.
- mercury Nitrate test following EN ISO 196: 1995.

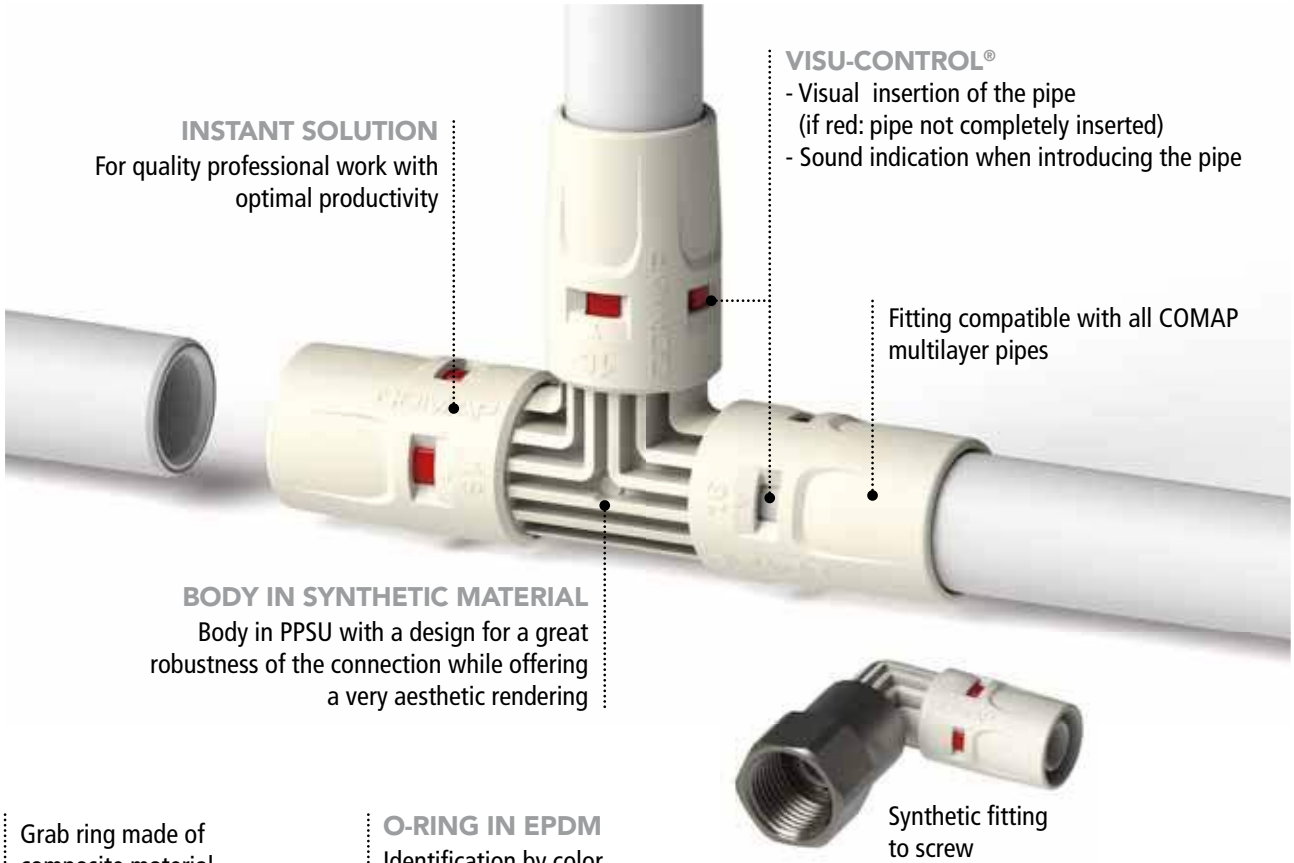
1.2.2. Push-fit fittings for water

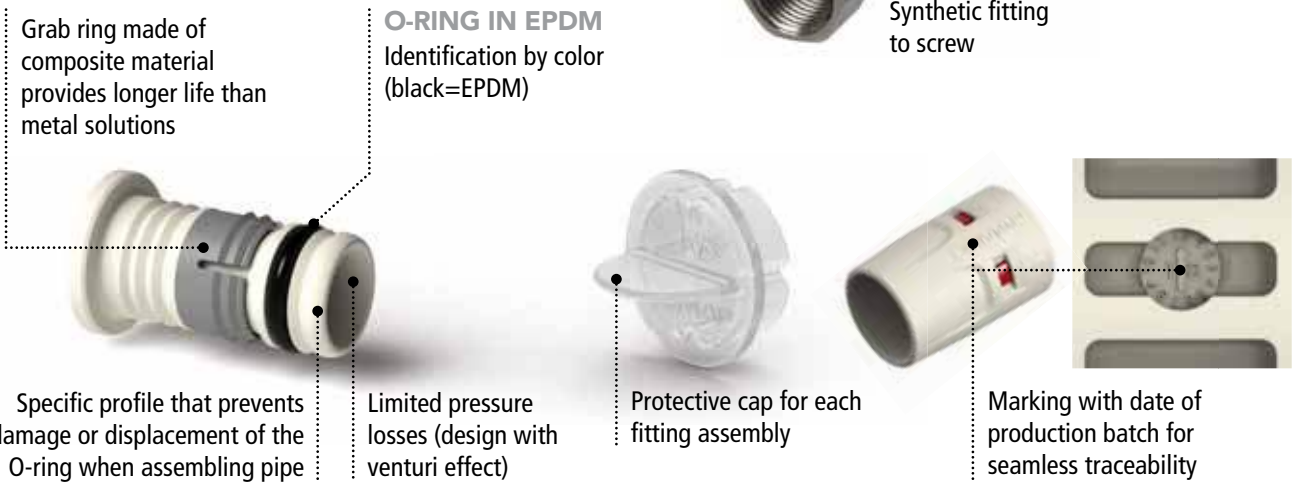
Push-fit fittings are designed exclusively for professionals and guarantee a reliable, discreet connection while offering unprecedented productivity to date.

Push-fit fittings are made of synthetic material: polyphenylsulfone (PPSU). It is a highly technical polymer that provides extreme resistance to high temperatures and pressures.

As an example, the fitting can resist a load of 18 kg per square cm at up to more than 200 ° C without warping.

Note: for more information on the chemical compatibility of fittings, please refer to chapter 3.3 (Fittings resistance)

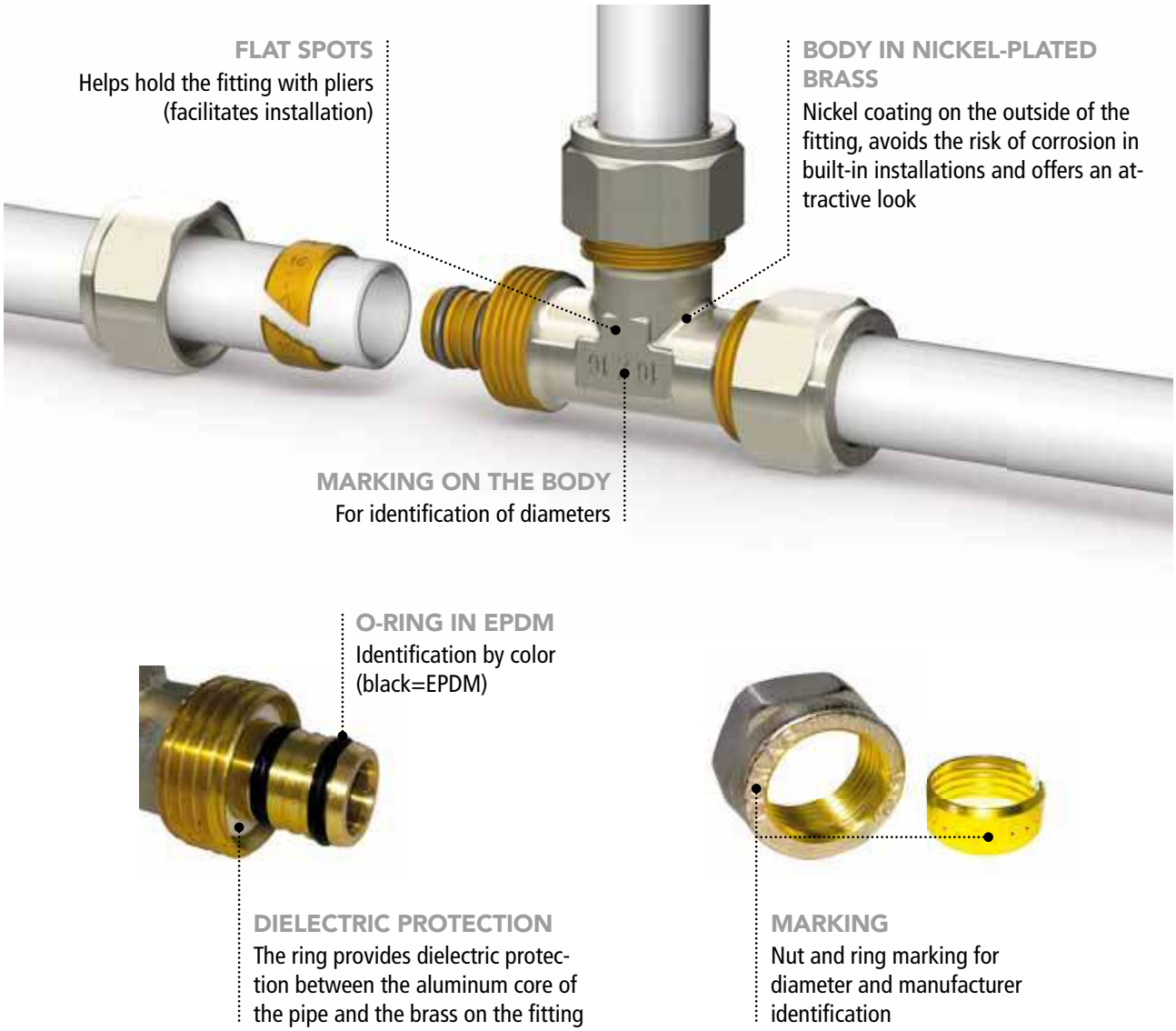




Composition of the push fitting	Push	Push / to Screw
Body	PPSU (polyphenylsulfone)	PPSU (polyphenylsulfone)
Screw-on part	-	DZR Brass CW625N or CW626N according to EN12165 (Pb ≤ 1.7%), tinned (≥ 99.9% tin, by means of electroplating)
O-ring	EPDM (ethylene-propylene-diene monomer rubber)	EPDM (ethylene-propylene-diene monomer rubber)
Hood	Polyamide	Polyamide
Visu-control®	ABS (Acrylonitrile butadiene styrene)	ABS (Acrylonitrile butadiene styrene)
Grab ring	PPS (Polysulfide of phenylene)	PPS (Polysulfide of phenylene)
Protective cap	PP (polypropylene)	PP (polypropylene)
Packaging bag	PE (polyethylene)	PE (polyethylene)

1.2.3. Compression fittings for water

Compression fittings are nickel-plated brass for rugged durability and aesthetic quality.



Composition of metal compression fitting	
Body, nut and ring	Brass CW617N-DW according to EN12165 (Pb ≤ 2.2%), nickel-plated on the outside (not in contact with water)
O-ring	EPDM (ethylene-propylene-diene monomer rubber)
Plastic washer	PE (Polyethylene)
Packaging bag	PE (Polyethylene)

1.2.4. Threading and tapping

The multilayer system also includes components with threading and tapped threads to connect with other threaded parts in a system, such as fittings, valves, etc.

The threaded fittings of the MultiSkin range use tapered male threads according to EN ISO 10226 (formerly ISO 7) and in some cases parallel (cylindrical) threads according to EN ISO 228: 2003.

On each thread of our water application fittings, connection products must be applied to ensure water-tightness (PTFE tape for tapered threads and flat seals for parallel threads).

The threaded fittings of the MultiSkin range for **water applications** have parallel threads according to EN ISO 228: 2003.

The threaded fittings of the MultiSkin range for **gas applications** have parallel threads in accordance with EN ISO 10226 (thread sealant).

Identification of threading / tapping types

Tapping:

Rp: designation of parallel internal thread according to EN ISO 10226 (ex: Rp1/2")

G: designation of an external parallel thread according to EN ISO 228 (ex: G1/2")

Threading:

R: designation of a taper external thread according to EN ISO 10226 (ex: R1/2")

G: designation of a taper internal thread according to EN ISO 228 (ex: G1/2")

Recommended tightening torque	20 Nm < 3/8" 30 Nm between 1/2" and 1" 40 Nm > 1"

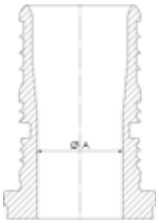
1.2.5. Inside diameter of fittings

The optimized inside diameter of COMAP fittings have been designed to minimize pressure losses

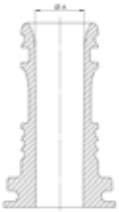
Note: The inside diameter at the center of the fitting is never less than the inside diameter at the ends of the fittings.

Fitting diameters

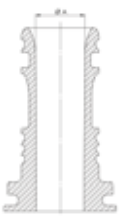
		14x2	16x2	18x2	20x2	26x3	32x3	40x3.5	50x4	63x4.5	75x6
Metal crimp fittings	Inner diameter A (mm)	5.6	8	9.4	11.2	13.8	19.5	25.5	33	43	51.5
	Inner radius R (mm)	2.8	4	4.7	5.6	6.9	9.75	12.75	16.5	21.5	25.75



Synthetic crimp fittings	Inner diameter A (mm)		7.5		11.3	14	19.5	25.7	33.4	43.6	
	Inner radius R (mm)		3.75		5.65	7	9.75	12.85	16.7	21.8	



Synthetic push-fit fittings	Inner diameter A (mm)	5.6	7.5		11.3	14					
	Inner radius R (mm)	2.8	3.75		5.65	7					



1.2.6. Crimping profile

The crimp fittings are designed to be crimped with different profiles. Below is a list of profiles compatible with metal and synthetic crimp fittings offered by COMAP.

Outside diameter (mm)	14	16	18	20	26	32	40	50	63	75
Crimping profile	TH	TH	TH	TH	TH	TH -THL	TH	TH	TH	TH
	U	U	U	U	-	U	U	U	U	U
	H	H	H	H	H	H	H	-	-	-

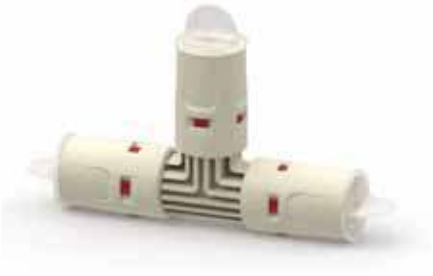
Example of crimping profiles:

TH profile

TH profile

U profile

1.2.7. Marking and traceability

Range	Product marking	Packet marking
Metal crimp fittings for water 	Sleeve (laser engraved): - "COMAP" logo - Ø and Profile of crimp - DVGW - NF - KK - Date of production batch Cap: - Diameter - Crimping profile - "COMAP" logo - Material used	Label (printed): - Product code - Diameter and/or threading/tapping - Product illustration - Number of fittings in the packet - EAN code - Certifications - "COMAP" logo - QR code - Lot number - Application classes and pressures
Metal crimp fittings for gas 	Sleeve (laser engraved): - "COMAP" logo - Ø and Profile of crimp - Date of production batch - Gastec Cap: - Diameter - Crimping profile - "COMAP" logo - Material used	Label (printed): - Product code - Diameter and/or threading/tapping - Product illustration - Number of fittings in the packet - EAN code - Certifications - "COMAP" logo - QR code - Lot number
Synthetic crimp fittings for water 	Sleeve (laser engraved): - "COMAP" logo - Ø and Profile of crimp - DVGW - NF - KK - Date of production batch Body: - Date of production batch Cap: - Diameter - Crimping profile - "COMAP" logo - Material used	Label (printed): - Product code - Diameter and/or threading/tapping - Product illustration - Number of fittings in the packet - EAN code - Certifications - "COMAP" logo - QR code - Lot number - Application classes and pressures
Synthetic press-fit connetion 	Hood: - "COMAP" logo - Diameter - Date of production batch (inkjet) Body: - Date of production batch Cap: - Diameter - "COMAP" logo - Material used	Label (printed): - Product code - Diameter and/or threading/tapping - Product illustration - Number of fittings in the packet - EAN code - Certifications - "COMAP" logo - QR code - Lot number - Application classes and pressures
Metal compression fittings for water 	Ring (olive): - Diameter Body: - Diameter and/or threading/tapping Nut: - Diameter - "COMAP" logo	Label (sticker): - Product illustration - "COMAP" logo - Product code - Figure number - Diameter and/or threading/tapping - Number of fittings in the packet - EAN code

Protection cap marking

Materials used for our protection cap injection are marked on every product. It simplifies recycling operations.

5 PP = Polypropylene 2 HDPE = High Density Polyethylene

1.2.8. Visu-control technology®

1.2.8.1. Crimp fittings and Visu-control®

With a plastic ring (made of polyethylene terephthalate) attached to each side of the fitting, the patented Visu-Control technology® includes a visual and tactile crimping indicator. The Visu-Control® ring ensures correct positioning of the TH profile press tool.

During crimping, the pressure of the TH, H or U jaws deforms the plastic ring. Once this ring is crimped, just detach the visu-control® from the fitting: proof that the assembly has been crimped.

Each application has a dedicated Visu-Control® color to avoid any errors.

Connection not crimped

Crimped connection

Visu-control® green for water systems, Visu-control® yellow for gas systems.

Visu-control®	Applications
Visu-control® Green 	- Drinking water systems - Sanitary hot and cold water systems - Heating systems - Cooling systems - Glycol water - Recovery of rainwater - Dry compressed air systems
Visu-control® Yellow 	- GPL (Butane -Propane) - Natural gas - Low pressure steam - Fuel and other hydrocarbons - Lubricated compressed airw

1.2.8.2. Press fit connections and Visu-control®

Each assembly for press fittings has a Visu-control component®: a red ABS ring.

Upon inserting the pipe into the fitting, the ring disappears, giving way to the white colour of the pipe.

This visual indicator confirms that the connection of the pipe and fitting has been properly completed.

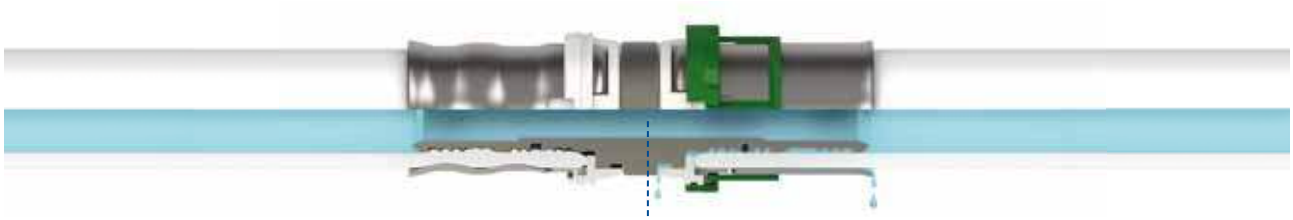
Connection not executed

Properly executed connection

1.2.9. The "no crimp, no seal" technology

The "no crimp, no seal" technology was designed to indicate where crimping has been omitted. As long as the fitting is not crimped, it lets in water or air. This makes it easy to detect the absence of crimping during the pressure test.

The concept is based on creating a grooved leak path between the fitting and the O-ring. Accordingly, water will flow along these grooves until the fitting is crimped. When crimping the joint, the material obstructs the leak path. This guarantees water and air tightness.

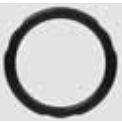


Crimped = waterproof

Not crimped = not waterproof

1.2.10. O-rings

The type of O-ring to be used depends on the application and the system. The water fittings of our multilayer system are for water and heating applications. They are provided with EPDM O-rings. The gas fittings of our multilayer system are for gas and compressed air applications. These fittings are provided with HNBR O-rings.

MultiSkin fittings		Diameters	The "no crimp, no seal" function	Type of O-ring		Number of O-rings
	Metal crimp fittings for water	14, 16, 18, 20, 26	Provided by the fitting body	EPDM standard O-ring (black)		1
		32, 75	Provided by the fitting body	EPDM standard O-ring (black)		2
		40, 50, 63	Provided by the O-ring	EPDM patented O-ring (black)		2
	Synthetic crimp fittings for water	16, 20, 26, 32,	Provided by the O-ring	EPDM patented O-ring (black)		1
		40, 50, 63	Provided by the O-ring	EPDM patented O-ring (black)		2
	Push-fit connections for water	14, 16, 20, 26	Non disponible	EPDM standard O-ring (black)		1
	Metal compression fitting	14, 16, 18, 20, 26, 32	Non disponible	EPDM standard O-ring (black)		2
	Metal crimp fittings for gas	16, 20, 26	Provided by the fitting body	Standard Yellow HNBR O-ring		1
		32	Provided by the fitting body	Standard Yellow HNBR O-ring		2

1.2.11. COMAP system compatibility

All COMAP multilayer products, old or new generation, are compatible. It is possible to associate on the same network old Skin (SkinPress, SkinPress PPSU, Sarfit) with the new MultiSkin range. It is also possible to use old COMAP multilayer pipes (MultiSkin, BetaSkin) with new fittings and vice versa.

Reminder: COMAP MultiSkin fittings must only be used with COMAP multilayer pipes.

OLD GENERATION*			NEW GENERATION		
SkinPress	SkinPress PPSU	Sarfit	MultiSkin metallic	MultiSkin synthetic	Sarfit
					
-	MultiSkin 4 pipe	BetaSkin pipe	MultiSkin Push	MultiSkin 4 pipe	MultiSkin 2 pipe
					

* Old generation : crimping TH only

1.2.12. COMAP calibration tools

Before inserting a multilayer pipe into a COMAP fitting, it is imperative to calibrate the pipe. This calibration operation must only be done with a COMAP calibration tool from the list below:

Triple calibrator	XL calibrator	Single calibrating end
		
Diameters 16, 20, 26 mm	**Diameters 40, 50, 63, 75 mm**	**To be used with a handle or with a screwdriver (14 to 75 mm)**
Commercial figure S120	*Commercial figure S130*	*Commercial figure 112*

1.2.13. Crimping tools

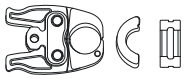
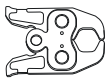
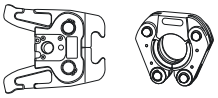
Crimping tools consist of a pressing machine and the corresponding jaws, inserts, adapters and chains. Pressing machines can be either battery- or mains-powered.

For each pipe diameter, the correct components should be used to achieve a perfectly tight connection (see table below).

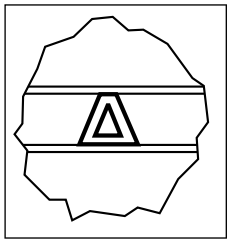
1.2.13.1. The COMAP range

COMAP offers a range of pressing tools designed to ensure reliability and simplicity for professionals.Novopress ACO 103, ACO 203 and ECO 301 and Klauke MAP2L and UAPL3L tools may be used for crimping of all diameters of copper, PEX, multilayer, carbon steel and stainless steel pipe.

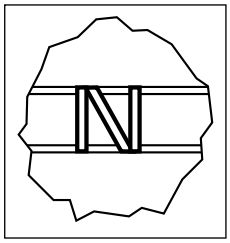
The system of inserts and jaw allows tools to be used with all pipe types, to include Multilayer, PEX, copper and steels simply by changing the inserts, instead of the heavy and bulky jaws.

	PEX	Multilayer
		
	CO	**TH - H - U**
Mother jaw + inserts 	Ø12-16-20-25 ACO103 / ACO203 / ACO203XL	Ø14-16-18-20-26 ACO103 / ACO203 / ACO203XL
	-	Ø14-16-18-20-26-32 MAP2L / UAP3L
Monobloc jaw 	-	-
	-	MAP2L Ø14-16-18-20-26-32 UAP3L Ø14-16-18-20-26-32-40-50-63 -75
Adapter + chains or base + inserts 	-	Ø40-50-63 -75 ACO203 / ACO203XL
	-	Ø40-50-63 -75 UAP3L

Inserts supplied by COMAP leave a print (on the fittings during the crimping operation) in the shape of an "A" (the A of COMAP). Jaws provided by COMAP leave an "N" shaped imprint. These marks certify that the fitting has been crimped with the original COMAP tooling.



A mark



N mark

1.2.13.2. Comparison of crimping tools

COMAP fittings have been designed and certified with Novopress tools. However, internal tests have been conducted with other crimping tools available on the market. The fittings have been developed and certified for the TH, H and U crimping profiles. COMAP recommends the use of the TH profile which ensures the correct positioning of the jaw during crimping and offers the best aesthetic result once the sleeve is crimped.

The table below shows the results of these tests as well as the various tools with which the crimping of COMAP press fittings has proved compliant.

		14			16			18			20			26		
		TH	U	H	TH	U	H	TH	U	H	TH	U	H	TH	U	H
NOVOPRESS	ACO102 / ACO103 / AFP101 / SP1932	TH	U	-	TH	U	H	TH	U	-	TH	U	-	TH	-	-
	ACO 202/203	TH	U	-	TH	U	H	TH	U	-	TH	U	H	TH	-	H
	ACO 202XL/203XL	TH	U	-	TH	U	H	TH	U	-	TH	U	H	TH	-	H
	ECO 301	TH	U	-	TH	U	H	TH	U	-	TH	U	H	TH	-	H
REMS	Mini REMS	*	U	*	*	*	*	*	*	H	TH	U	H	*	-	H
	POWERPRESS	*	U	*	*	*	*	*	*	H	TH	U	H	*	-	H
	AKKUPRESS	*	U	*	*	*	*	*	*	H	TH	U	H	*	-	H
KLAUKE	Mini KLAUKE (MAP1, MAP2, MAP2L)	*	-	-	*	*	*	*	*	*	TH	U	H	TH	-	H
	UAP2L	*	U	*	*	*	*	*	*	*	TH	U	H	TH	-	H
	UP2EL	*	U	*	*	*	*	*	*	*	TH	U	H	TH	-	H
	UP3EL	*	U	*	*	*	*	*	*	*	TH	U	H	TH	-	H
VIRAX	VIPER M20+/M21+	*	-	-	*	*	*	*	*	*	TH	U	-	TH	-	-
	VIPER P22+	*	U	-	*	*	*	*	*	*	TH	U	H	TH	-	-
	VIPER P25+	*	U	-	*	*	*	*	*	*	TH	U	H	TH	-	-
	VIPER P30+	*	U	-	*	*	*	*	*	*	TH	U	H	TH	-	-
ROTHENBERGER	ROMAX compact	X	U	*	*	*	*	*	*	-	X	U	H	TH	-	H
	ROMAX Pressliner ECO/AC ECO	*	U	H	*	*	*	*	*	-	TH	U	H	TH	-	H
	ROMAX 3000/3000AC	*	U	H	*	*	*	*	*	-	TH	U	H	TH	-	H
	ROMAX 4000	*	U	H	*	*	*	*	*	-	TH	U	H	TH	-	H

For any other tool, please contact COMAP.

* Validation tests in progress, for more information please contact COMAP
X : Not compatible.
- : Doesn't exist.

32			40			50			63			75		
TH	U	H	TH	U	H	TH	U	H	TH	U	H	TH	U	H
TH - THL	U	-	-	-	-	-	-	-	-	-	-	-	-	-
TH - THL	U	H	TH	U	-	TH	U	-	TH	U	-	-	U	-
TH - THL	U	H	TH	U	-	TH	U	-	TH	U	-	-	U	-
TH - THL	U	H	TH	U	-	TH	U	-	TH	U	-	-	U	-
TH - THL	U	H	*	*	H	-	-	-	-	-	-	-	-	-
TH - THL	U	H	*	*	H	*	*	-	*	*	-	TH	*	-
TH - THL	U	H	*	*	H	*	*	-	*	*	-	TH	*	-
TH	U	H	-	-	-	-	-	-	-	-	-	-	-	-
TH	U	-	*	*	*	*	*	-	*	*	-	*	*	-
TH	U	-	*	*	*	*	*	-	*	*	-	*	*	-
TH	U	-	*	*	*	*	*	-	*	*	-	*	*	-
TH	U	-	-	-	-	-	-	-	-	-	-	-	-	-
TH	U	-	*	*	*	*	*	-	*	*	-	-	*	-
TH	U	-	*	*	*	*	*	-	*	*	-	-	*	-
TH	U	-	*	*	*	*	*	-	*	*	-	-	*	-
TH	U	H	*	*	*	-	-	-	-	-	-	-	-	-
TH	U	H	*	*	*	*	*	-	*	*	-	-	*	-
TH	U	H	*	*	*	*	*	-	*	*	-	-	*	-
TH	U	H	*	*	*	*	*	-	*	*	-	-	*	-

1.3. MULTILAYER PIPES

1.3.1. General

1.3.1.1. Definition of multilayer pipes

We call pipes made of synthetic material composed of an aluminium core "multilayer" pipe.

The COMAP multilayer pipe may consist of 2 layers of PERT or 2 layers of PEX depending on the product.

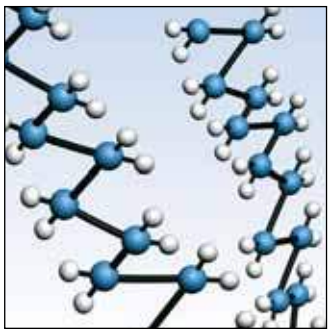
1.3.1.2. The layer of cross-linked PE or PERT

Cross-linked polyethylene PER (or PEX) is a synthetic material, of polyethylene type that has undergone a cross-linking treatment, which corresponds to a three-dimensional structure via the formation of strong chemical bonds between the different molecules constituting the material.

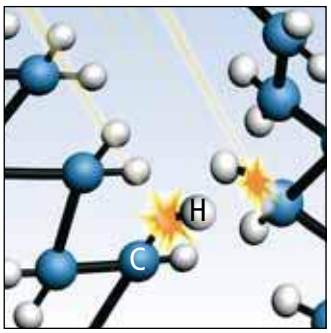
COMAP PEX multilayer pipes are manufactured using the electron beam cross-linking method.

Exposing the multilayer pipe to intense electron beams causes cross connections between the different molecule chains of the plastic. The electrons cause the hydrogen atoms to split from the different polyethylene chains. The carbon atoms are then allowed to join and form a strong cross-linked structure.

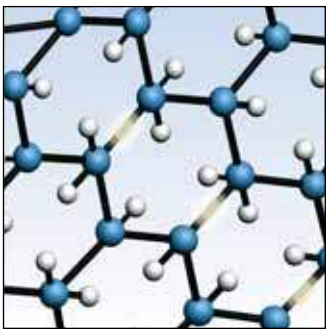
Certain properties, in particular the resistance to high temperatures and pressure, are thus improved, while maintaining a satisfactory level of flexibility, which allows the use of PER (or PEX) in hot and cold water sanitary or heating systems. PER (or PEX) also has better chemical properties, especially improved corrosion resistance, which makes it possible to embed these pipes in a screed.



Structure of high density polyethylene



Cold cross-lining via electron beam processing
Unstable or weak linking: H-C
strong and stable link: C=C



PE-Xc structure

There are several methods of cross-linking polyethylene that depend on an industrial choice by manufacturers.

Pex A = cross-linking obtained by chemical reaction of a peroxide.

Pex B = cross-linking obtained by chemical reaction of a silane.

Pex C = cross-linking obtained through the physical reaction of electron beams.

Pipes produced through each of the three cross-linking methods have very similar properties and characteristics. The differences are as much related to the cross-linking method as to the industrial facilities and their processes.

All these PER (or PEX) products are subject to the same standards, norms and certifications.

PERT is a type of polyethylene (PE) that is not cross-linked but withstands temperatures higher than a standard PE. The acronym RT stands for "raised temperatures", PE-RT: Polyethylene resin resistant to high temperatures.

PERT type I is particularly suitable for low temperature heating applications, such as underfloor heating. The COMAP multilayer pipes are composed of PERT type II, for more demanding applications like sanitary or high temperature heating uses.

1.3.1.3. Application class of multilayer pipes

Application class table

COMAP multilayer pipes comply with EN ISO 21003-1 and meet the requirements of classes 2, 4, and 5. The table below shows the application classes under the conditions of use specified in ISO 10508 for a service life of 50 years.

Application class	T_D		T_{max}		T_{mal}		Typical scope of application
		Duration[a]		Duration [D]		Duration	
	°C	years	°C	years	°C	hours	
1[a]	60	49	80	1	95	100	Hot water supply (60° C)
2[a]	70	49	80	1	95	100	Hot water supply (70°C)
4[b]	20 + cumulative effect 40 + cumulative effect 60	2.5 20 25	70	2,5	100	100	Underfloor heating and low temperature radiators
5[b]	20 + cumulative effect 60 + cumulative effect 80	14 25 10	90	1	100	100	High temperature radiators

Attention: this international standard does not apply to Td, Tmax and Tmal values higher than the values stated in the table.

[a] A country has the choice between classes 1 and 2 in accordance with its national regulations.

[b] Where more than one nominal temperature is given for a class, durations must be cumulated. "+ cumulative effect" in the table implies a temperature profile of the given temperature over a set period. (For example, the nominal temperature profile for 50 years for class 5 is 20° C for 14 years, followed by 60 ° C for 25 years, 80° C for 10 years, 90° C for 1 year and 100° C for 100 hours).

1.3.1.4. Benefits of COMAP multilayer pipe

COMAP multilayer pipe consists of an aluminium pipe butt welded lengthwise, with an inner and outer layer of polyethylene (PEX or PERT depending on the pipe). The different layers are connected by a layer of high quality glue. The result is a COMAP multilayer pipe that combines all the advantages of plastic and metal pipes.

Inner and outer walls of the pipe are made of PEX or PERT II (depending on the pipe). These two formulas significantly improve the qualities of polyethylene and increase the resistance of the pipe to pressure and temperature differences.

The pipe meets the most stringent requirements for drinking water systems and resists even very aggressive materials. The aluminium pipe guarantees a complete barrier against oxygen and stability of the pipe against deformation. The thickness of the pipe remains consistent throughout due to a lengthwise weld in the pipe. As a result, the outer layer, applied via the adhesion layer on the aluminium core, will also maintain like thickness everywhere. This also provides advantages for crimping because the crimping forces are evenly distributed. Depending on the diameter of a pipe, the thickness of the aluminium layer is calculated to ensure that the pipe always has the best resistance to pressure.

Applications

Low and high temperature heating, chilled water, drinking water, rainwater, and other applications (please consult COMAP).

Benefits of multilayer pipe

- Resistant to pressure and temperature: withstands a service temperature up to 95° C with maximum allowable pressure of 10 bar.
- Minimal linear expansion: thanks to the presence of the aluminium layer, the expansion coefficient of the pipe is comparable to that of copper and 8 times lower than that of a pipe made of ordinary synthetic material. The coefficient of expansion is 0.025 mm / mK.
- Low pressure drops: the smooth surfaces of the inner and outer layers prevent impurities from becoming embedded. This smooth surface has the effect of reducing the pressure drops
- Shape retention memory: after being bent, the pipe retains the desired shape. It does not have a thermal memory like the other pipes made of synthetic material. This simplifies and accelerates installation of pipes.
- Wear resistance: The outer and inner layers consist of PEX or PERT and are therefore not affected by wear, even at high temperatures or at high flow rates.
- Oxygen-proof: The integrated aluminium layer prevents the penetration of oxygen into the pipe.
- Lightweight and easy to use: quick and easy installation that saves time and money. Pipe is extremely supple and light. A 200m roll of 16 x 2 multilayer pipe weighs scarcely 25 kg.
- No noise nuisance: Unlike metal pipes, this pipe does not produce bothersome reverberations due to flow noise provided pipe diameter has been chosen correctly. Contact noise may be avoided by proper pipe installation.
- Corrosion resistance: PEX and PERT are naturally unaffected by corrosion.

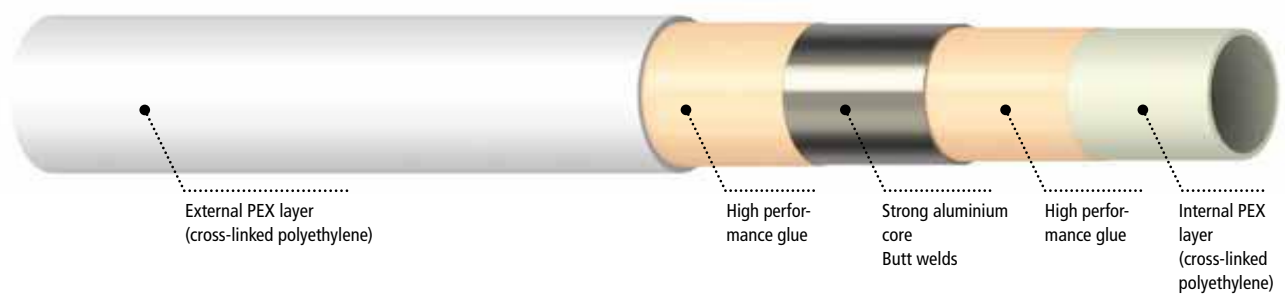
1.3.2. COMAP MultiSkin 4 pipe

MultiSkin 4 pipe features a complete range of multilayer pipes, with diameters ranging from 14 to 75 mm, made of PEX, with a thick aluminium core, for better pipe retention (ideal for surface installation).

Pipe is manufactured in accordance with EN ISO 21003 and is available in bar lengths, rolls, pre-insulated and in corrugated conduit.

MultiSkin 4 multilayer pipes combine all the advantages of plastic pipes and metal pipes. They are flexible, robust and provide excellent resistance to pressure and heat. The pipe consists of a thick aluminium layer (0.4mm for 16 x 2 diameter pipes) butt welded, with a cross-linked polyethylene (PEX) layer inside and an outer layer of PEX. All layers are connected by high performance glue.

1.3.2.1. COMAP MultiSkin 4 bare pipe



Characteristics										
Diameter of the pipe (mm) (Du)	**14**	**16**	**18**	**20**	**26**	**32**	**40**	**50**	**63**	**75**
Inside diameter (mm)	10	12	14	16	20	26	33	42	54	63
Wall thickness (in mm)	2	2	2	2	3	3	3.5	4	4.5	6
Aluminum thickness (mm)	0.4	0.4	0.4	0.4	0.5	0.7	0.7	0.9	1.2	1.2
Maximum operating temperature (°C)	95	95	95	95	95	95	95	95	95	95
Maximum operating pressure (bar)	10	10	10	10	10	10	10	10	10	10
Thermal conductivity coefficient (W/m/K)	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43
Linear expansion coefficient (mm/m/K)	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
Surface roughness of inner pipe (µ)	7	7	7	7	7	7	7	7	7	7
Oxygen diffusion (mg/l)	0	0	0	0	0	0	0	0	0	0
Smallest bending radius with external spiral spring (mm)	≥ 5xDu 70	≥ 5xDu 80	≥ 5xDu 90	≥ 5xDu 100	≥ 5xDu 130	-	-	-	-	-
Smallest bending radius with internal spiral spring (mm)	≥ 3xDu 42	≥ 3xDu 48	≥ 3xDu 54	≥ 3xDu 60	≥ 3xDu 78	-	-	-	-	-
Weight (g/m)	108	125	132	147	285	390	528	766	1 155	1 507
Water volume (l/m)	0.079	0.113	0.154	0.201	0.314	0.531	0.855	1.385	2.29	3.117

1.3.2.2. Characteristics of COMAP Multiskin 4 pipe in conduit

For installation in walls or ceilings, MultiSkin 4 pipes must be encased in conduit. In order to protect pipes from any damage during construction work, it is also recommended to use pipes protected in conduit.

Corrugated conduit is available in red, blue, or black, and is made of polyethylene.

Pipe diameter (in mm)	14	16	18	20	26	32
Inside diameter of conduit (mm)	20	20	24	24	28	36
Outside diameter of conduit (mm)	25	25	28	28	34	42

1.3.2.3. Characteristics of COMAP MultiSkin 4 Duo pipe in corrugated conduit

The COMAP MultiSkin 4 "duo" pipe consists of two MultiSkin 4 pipes and two polyethylene conduits, interconnected by means of perforated intermediate fasteners. The pipes come in a single roll. Intermediate fasteners hold the conduits together and guarantee a perfect finish to the installation.

The perforated fasteners also make it possible to separate the conduits when the installation work requires it.

One of the conduits is provided with a red border to be able to easily distinguish the contents of each one.

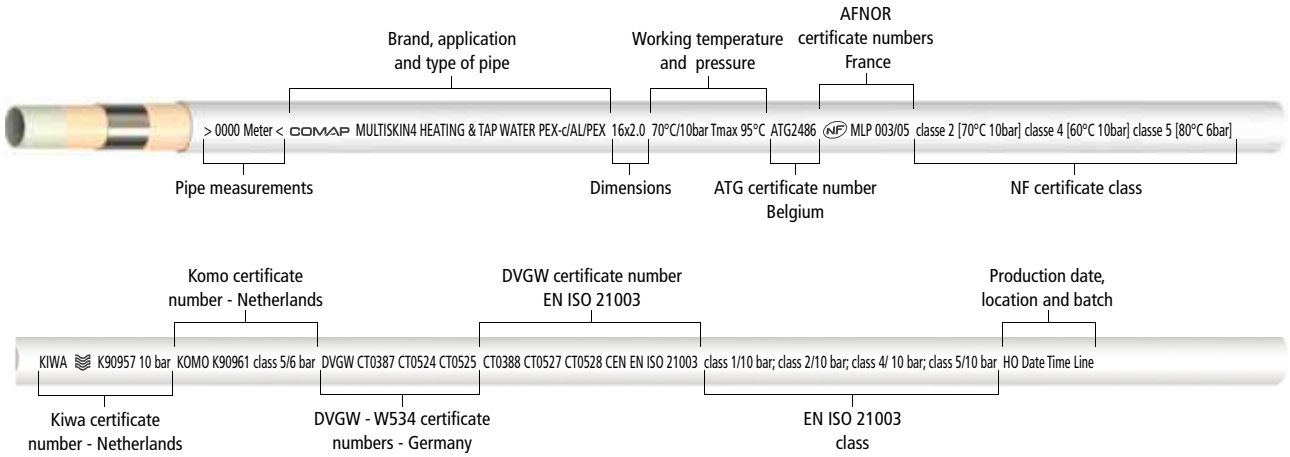
1.3.2.4. Characteristics of COMAP MultiSkin 4 pre-insulated pipe

MultiSkin 4 pipes are to be used with round thermal insulation made of extruded PE foam, provided by the manufacturer, which protects the pipe against condensation, heat loss, expansion and noise transmission.

Furthermore, pipes should be insulated where they cross each other, which causes raised temperatures (floor heating effect). PE-foam has an extruded PE-film colored red or blue. Heat insulation is CFC-free and is available in sizes of 6, 10 and 13 mm:

Characteristics	
Insulation value (ISO 8497)	0.040 W/mK at 40 °C
	0.036 W/mK at 10 °C
Class of fire resistance (EN 13501)	Class E
Temperature resistance	-40 °C too 100 °C
Operating temperature (EN 14707)	5 °C to 100 °C
Acoustical insulation	Up to 23 dB(A)

1.3.2.5. Marking



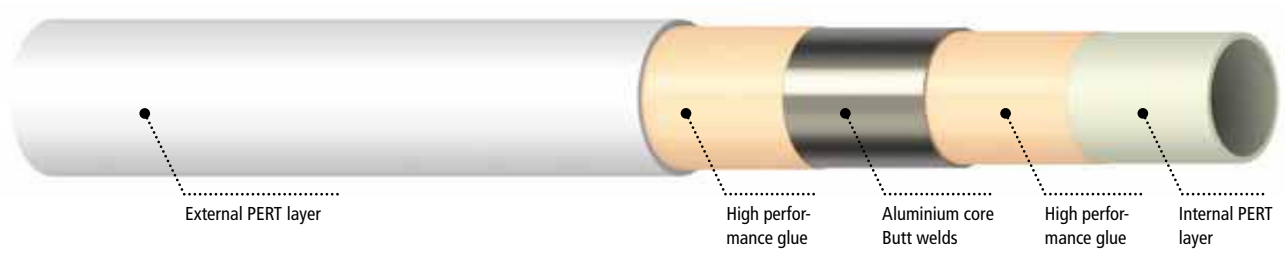
1.3.3. COMAP MultiSkin 2 pipe

Le pipe MultiSkin 2 is a full range of multilayer pipes, from diameters 14 to 63 mm, in PE-RT with a light aluminium core, for better pipe flexibility.

Produced according to the EN ISO 21003 standard, the pipes are available in lengths, rolls, pre-insulated and protected in a corrugated conduit.

MultiSkin 2 multilayer pipes combine all the advantages of plastic pipes and metal pipes. They are flexible and robust, with high pressure and temperature resistance. Pipes consist of a 0.2 mm layer of butt-welded aluminium, with an inner layer of PE-RT and an outer layer of PE-RT polyethylene. The layers are assembled with a high-performance adhesive agent.

1.3.3.1. COMAP MultiSkin 2 bare pipe



Characteristics									
Diameter of the pipe (mm) (Du)	**14**	**16**	**18**	**20**	**26**	**32**	**40**	**50**	**63**
Inside diameter (mm)	10	12	14	16	20	26	33	42	54
Wall thickness (in mm)	2	2	2	2	3	3	3.5	4	4.5
Aluminum thickness (mm)	0.18	0.20	0.25	0.25	0.35	0.50	0.50	0.60	0.80
Maximum operating temperature (°C)	95	95	95	95	95	95	95	95	95
Maximum operating pressure (bar)	10	10	10	10	10	10	10	10	10
Thermal conductivity coefficient (W/m/K)	0.44	0.44	0.46	0.46	0.45	0.48	0.47	0.47	0.49
Linear expansion coefficient (mm/m/K)	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023
Surface roughness of inner pipe (µ)	7	7	7	7	7	7	7	7	7
Oxygen diffusion (mg/l)	0	0	0	0	0	0	0	0	0
Smallest bending radius with external spiral spring (mm)	≥ 5xDu 70	≥ 5xDu 80	≥ 5xDu 90	≥ 5xDu 100	≥ 10xDu 260	-	-	-	-
Smallest bending radius with internal spiral spring (mm)	≥ 2xDu 28	≥ 2xDu 32	≥ 2xDu 36	≥ 2xDu 40	≥ 5xDu 130	≥ 5xDu 160	-	-	-
Weight (g/m)	90	105	125	140	260	350	510	715	1060
Water volume (l/m)	0.079	0.113	0.154	0.201	0.314	0.531	0.855	1.385	2.290

1.3.3.2. Characteristics of COMAP Multiskin 2 pipe in conduit

For installation in walls or ceilings, MultiSkin 2 pipes must be encased in conduit. In order to protect pipes from any damage during construction work, it is also recommended to use pipes protected in conduit.

Corrugated conduit is available in red and blue and is made of polyethylene.

Pipe diameter (in mm)	16	20
Inside diameter of conduit (mm)	20	27
Outside diameter of conduit (mm)	26	34

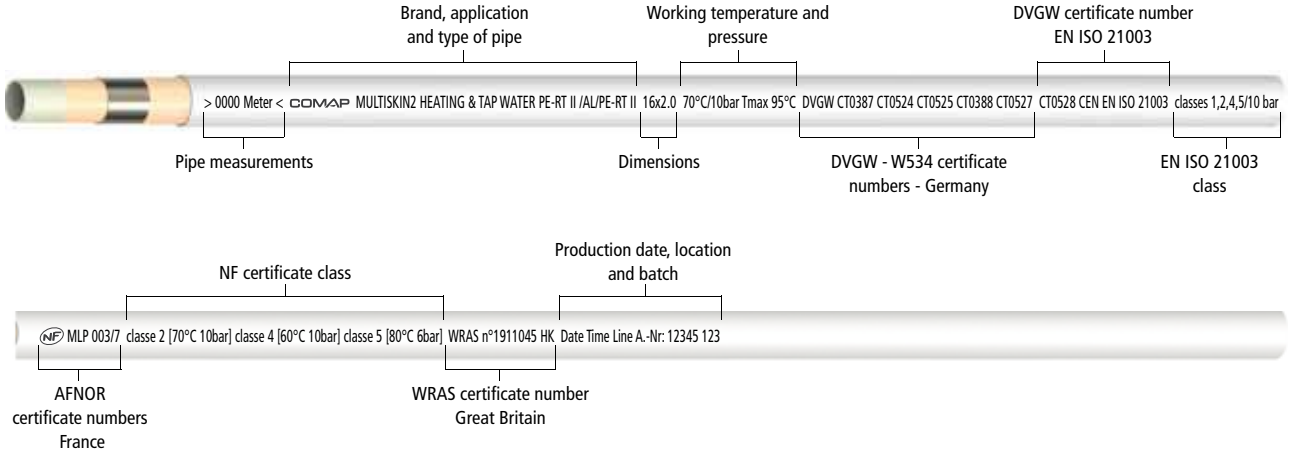
1.3.3.3. Characteristics of COMAP MultiSkin 2 pre-insulated pipe

MultiSkin 2 pipes are to be used with round thermal insulation made of extruded PE foam, provided by the manufacturer, which protects the pipe against condensation, heat loss, expansion and noise transmission.

Furthermore, pipes should be insulated where they cross each other, which causes raised temperatures (floor heating effect). PE-foam has an extruded PE-film colored red or blue. Heat insulation is CFC-free and is available in sizes of 6, 10 and 13 mm.

Characteristics	
Insulation value (ISO 8497)	0.040 W/mK at 40 °C
	0.036 W/mK at 10 °C
Class of fire resistance (EN 13501)	Class E
Temperature resistance	-40 °C to 100 °C
Operating temperature (EN 14707)	5 °C to 100 °C
Acoustical insulation	Up to 23 dB(A)

1.3.3.4. Marking



1.3.4. COMAP MultiSkin gas pipe

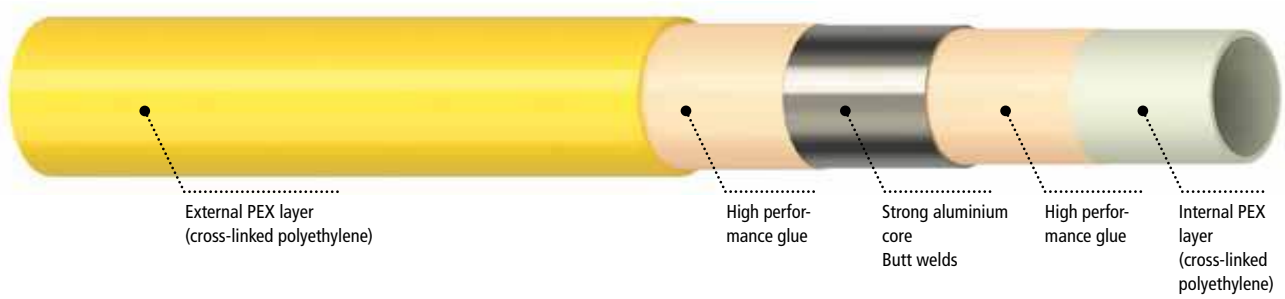
The COMAP system for gas is only allowed in countries where testing has taken place and certification obtained, such as in the Netherlands and Italy.

The system has Gastec and Uni gas approval and is intended for the construction of gas installations within the home and for the transportation of gas according to NPR-3378-10/NEN 1078 part 10.

The system consists of multilayer pipe (PEX/AL/PEX), press-fittings for gas, and protective conduits. The pipes and sleeves are colored yellow, with imprints indicating the brand and showing Gestec Kiwa gas approval.

To protect the pipe during construction work, it is recommended to use pipes with polyethylene conduit.

1.3.4.1. COMAP MultiSkin bare gas pipe



Diameter of the pipe (mm) (Du)	16	20	26	32
Inside diameter (mm)	12	16	20	26
Wall thickness (in mm)	2	2	3	3
Aluminum thickness (mm)	0.4	0.5	0.6	0.8
Thermal conductivity coefficient (W/m/K)	0.43	0.43	0.43	0.43
Linear expansion coefficient (mm/m/K)	0.025	0.025	0.025	0.025
Surface roughness of inner pipe (µ)	7	7	7	7
Oxygen diffusion (mg/l)	0	0	0	0
Smallest bending radius with external spiral spring (mm)	≥ 5xDu 80	≥ 5xDu 100	≥ 5xDu 130	-
Smallest bending radius with internal spiral spring (mm)	≥ 3,5xDu 56	≥ 3,5xDu 70	≥ 3,5xDu 91	≥ 3,5xDu 112
Water volume (l/m)	0.113	0.201	0.314	0.531

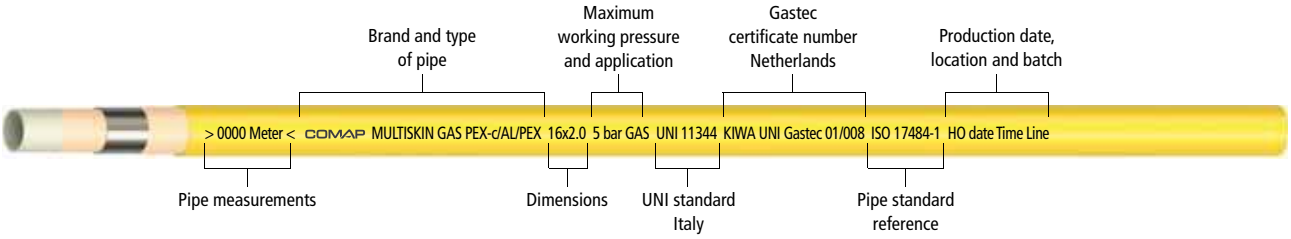
1.3.4.2. Characteristics of COMAP MultiSkin Gas pipe

For installation in walls or ceilings, COMAP MultiSkin Gas pipes must be encased in conduit. In order to protect pipes from any damage during construction work, it is also recommended to use pipes protected in conduit.

The pipes and sleeves are colored yellow and are made of polyethylene.

Pipe diameter (in mm)	16	20	26	32
Inside diameter of conduit (mm)	20	23	28	36
Outside diameter of conduit (mm)	25	28	34	42

1.3.4.3. Marking



NOTES

MultiSkin
Multilayer system

CHAPTER 2
IMPLEMENTATION

2. IMPLEMENTATION

2.1. PLANNING

2.1.1. General

Chapters 2.1.1. to 2.1.5. come from the CSTB notebook 2808-V2.

2.1.1.1. Restrictions

Prohibited installations

In particular, it is forbidden to install pipes:

- In smoke and smoke extraction ducts,
- In ventilation ducts,
- In garbage chutes.

Walls that make up these three types of ducts are also prohibited for piping.

In addition, it is recalled that regulations or standards prohibit or allow the installation of water piping to other parts of a building, subject to compliance with certain requirements. These may also prohibit the presence of pipes carrying different fluids in like conduits, or establish specific conditions.

Some examples include: electrical transformer substations, ducts and elevator machinery, gas and electricity ducts, etc.

Prohibited installation methods

It is forbidden to install pipes:

- In mortar of sealed tiles or in screeds containing hydraulic binders - note: in existing buildings or when the rooms have reduced surface areas, such as damp rooms, formwork containing pipes and the mortar or screed can be done in one operation.
- In the midst of a facade wall insulation. However, a supply line for a watering or well tap is allowed. In this case a shut-off valve and purge apparatus is required.
- In the midst of a floating screed
- In the midst of thermal insulation of an unattached floating slab.

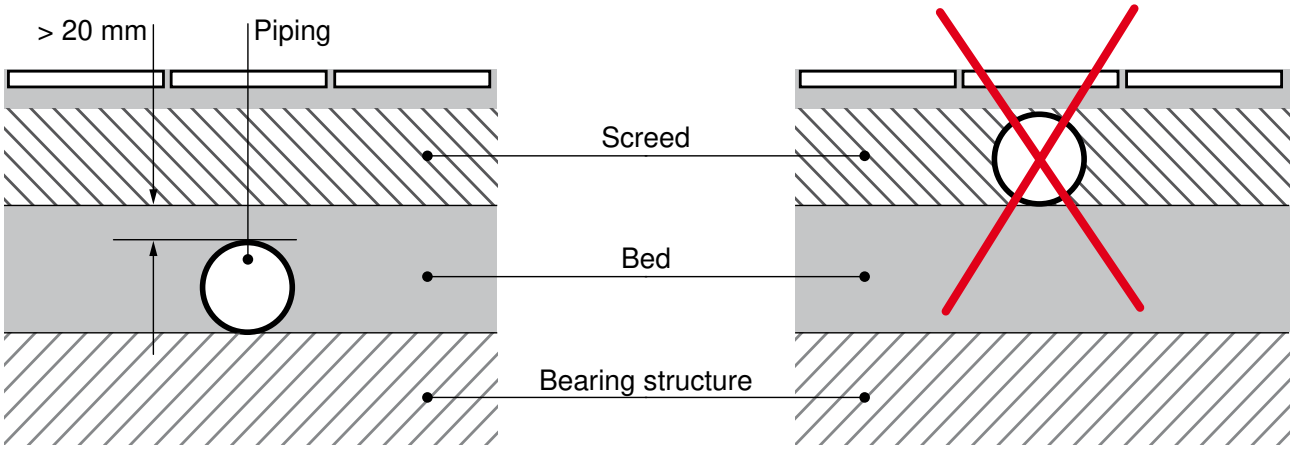


Figure 1: conduits must be placed in the bed, not in the screed

2.1.1.2. Pipes

Where pipes are delivered in rolls, they must be unrolled evenly in the opposite direction they were rolled up in order to avoid any twists.

Any "crooked" (distorted) pipe should be discarded.

In cold weather, any heating of pipes shall be carried out with a heat source at a maximum temperature of 80°C. Heating up pipes with open flame is prohibited.

The bending of pipes and curve radii are dealt with in chapter 2.1.7. Bending the pipe.

2.1.1.3. Conduits

Pipe conduits must be continuous, waterproof and installed with a radius of curvature greater than or equal to that allowed by the pipe that is placed inside of it.

COMAP does not recommend putting several pipes in the same conduit.

Pipes must be encased, embedded or placed with conduits where heating system temperatures exceed 60°C.

Heating pipes

Pipes must be installed:

- in conduits
- directly in a medium where operating temperatures of fluids are below 60°C.

Hot and cold water piping

Pipes must be installed:

- in conduits
- directly in a medium where operating temperatures of fluids are below 60°C.

Air conditioning lines

Pipes must be installed:

- in conduits
- directly in a given medium

Be sure to take the impact of condensation into account.

2.1.2. Running piping through walls and floors

General

Except in the case of a fixed point, wall penetrations through the pipes must be made using conduit or compressible closed-cell expanded polyethylene strips as defined by NF P 61-203 or by DTU 65.14.

Conduits shall be flush with the bare ceiling and extend past the bare floor with its floor covering by at least 30 mm.

Filling of pockets in walls after installation of pipes or conduit must not alter the position or damage walls or floors.

Special requirements for screeds or floating slabs

Pipe shall be contained in conduit or a compressible band as defined by NF P 61-203 or DTU 65.14 at all points where passing through walls or floors. An example is provided in Figure 2 below:

1 / The purpose of these provisions ensure separation of the floating screed or slab from its underlayment.

2 /Conduits and pipes must be installed before pouring the floating screed.

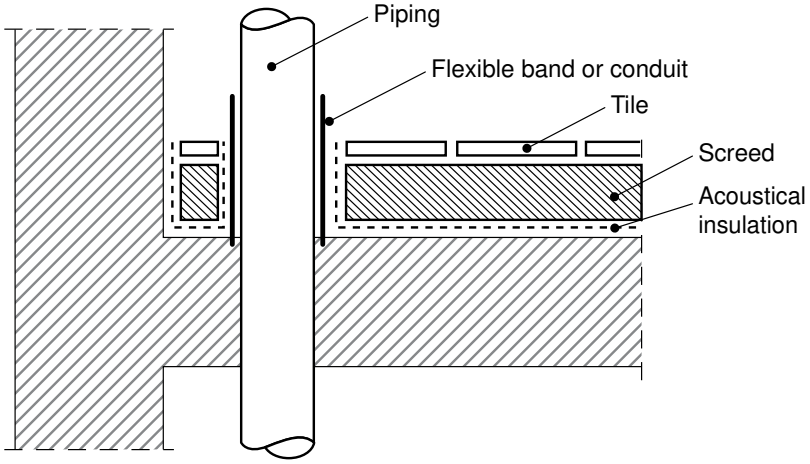


Figure 2: pipe enclosed in conduit or surrounded by a compressible band where passing through slabs

2.1.3. Pipes placed inside of a partition

Partitions made of pre-cast plaster blocks or terracotta bricks

Tuck-ins are permitted provided the conditions summarized in Table 1 are met. If partitions are unable to withstand the temperature of fluids carried in pipes, conduits should be used.

Recommendation	Partitions			
	In pre-cast plaster blocks with minimum thickness of the blocks (mm)		In terracotta bricks with minimum thickness of the bricks (mm)	
	70	100	50	70
Maximum outside diameter of conduit (mm)	21	21	24	24
Minimum thickness of mortar cover	15	15	15	15
Diagonal layout	Not allowed	Not allowed	Not allowed	Not allowed
Minimum horizontal layout (m)	0.40	0.40	0.40	0.40
Minimum vertical layout (m)	1.20	1.50	1.20	1.50
Maximum spacing of two pipes between two bonds (in mm)	700			
Maximum spacing of two pipes along a like bond (in mm)	150 in two channels or 50 mm in one channel			
Minimum thickness at the channel bottom (mm)	15	15		
Multiple channels on a like panel	On the same side of the partition	On the same side of the partition	On the same side of the partition	On the same side of the partition

Table 1: Tuck-ins allowed as follows

Composite panel partition: cladding panels installed on a frame or on a core or partition with framing panels.

Pass-through of the pipes between facing gypsum boards is authorized without conduit.

Access to mechanical assembly connections, compensators, valves and accessories for these non-accessible pipes must be provided in the form of inspection hatches or removable access panels.

If partitions are unable to withstand the temperature of fluids carried in pipes, conduits should be used. Similarly, the contact areas of pipes with metal framing elements must be protected to avoid friction areas.

2.1.4. On-ground installation

Pipes must be laid out on a bearing bed enclosed in conduit. The bed bottom shall be prepared and laid out using fine and homogeneous matter, either earth or sand, that is groomed so that the entire length of pipes rest on the ground. The backfilling of trenches must be carried out using fine and homogeneous matter, either earth or sand, that up to 0.20 m above the piping.

Beyond this, backfilling shall be comprised of successive and groomed layers of gravel.

2.1.5. In-ground installation

Heating, air conditioning and domestic hot water pipes must be installed in accordance with the requirements of NF DTU 65.9. Drains placed inside a gutter must be accessible.

Cold water pipes must be placed on the laying bed with or without conduit. The bed bottom shall be prepared and laid out using fine and homogeneous matter, either stone-free earth or sand, that is groomed so that the entire length of pipes rest on the ground.

The backfilling of trenches must be carried out using fine and homogeneous matter, either earth or sand, that up to 0.20 m above the piping. Beyond this, backfilling shall be comprised of successive and groomed layers of gravel. For pipes laid at very shallow depth, it is permissible to backfill with concrete, asphalt, etc.

Paths of piping may be marked out in trenches by mesh strip placed about 0.20 m above the upper part of the piping.

Where specific types of backfill are used, the marking can be done differently.

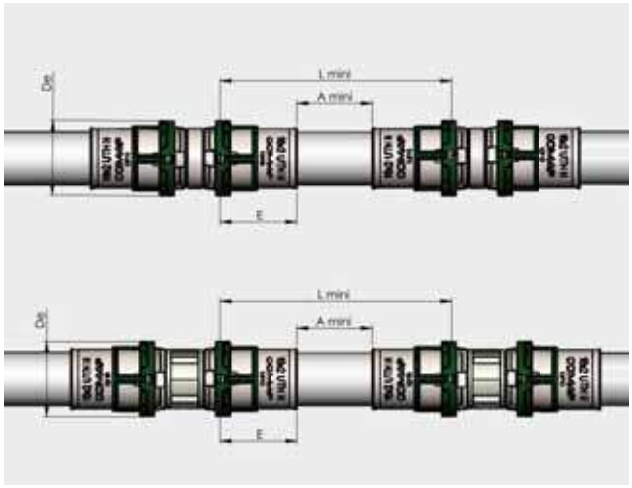
2.1.6. Minimum distance between fittings

To ensure a reliable installation, it is necessary to respect a minimum distance between two connections. This avoids interference from one crimp to another.

2.1.6.1. Crimp fittings

Recommended distances of installation

Diameter (mm)	A min (mm)	L min (mm)	E (mm)	De (mm)
14	32	80	24	21
16	32	80	24	23
18	32	80	24	25
20	32	80	24	27
26	30	80	25	34
32	22	80	29	40
40	10	88	39	48
50	10	90	40	58
63	10	134	62	71
75	10	136	63	86



Minimum space between piping and a wall to accommodate a crimping tool

The tables below give the minimum working space required for the fitting to be properly crimped with the appropriate tool (distances have been determined using the Novopress tool). These distances relate to general installation configurations as shown schematically in Figures 1 and 2.

Pipe diameter (in mm)	X (mm)	Y (mm)
14	40	72
16	40	72
18	40	74
20	40	74
26	40	77
32	40	80
40*	75	110
50*	85	120
63*	90	130
75*	100	140

* Fittings crimped using chains

Pipe diameter (in mm)	X (mm)	Y1	Y2
14	44	61	78
16	44	61	78
18	44	61	80
20	44	61	80
26	44	61	83
32	44	61	86
40*	75	75	110
50*	85	85	120
63*	90	90	130
75*	100	100	140

* Fittings crimped using chains

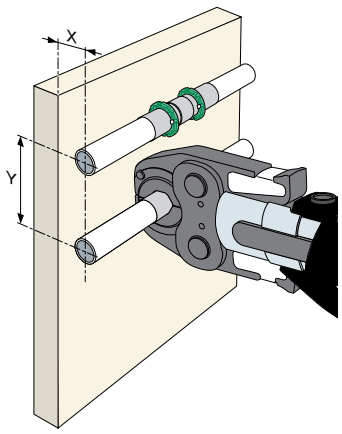


Figure 1: Installation against a wall

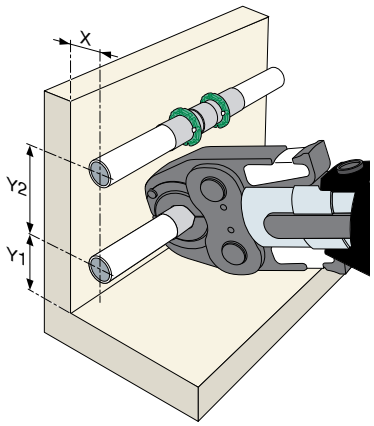
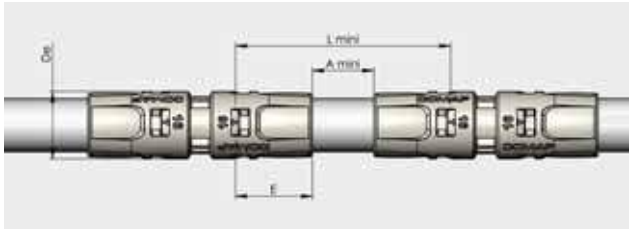


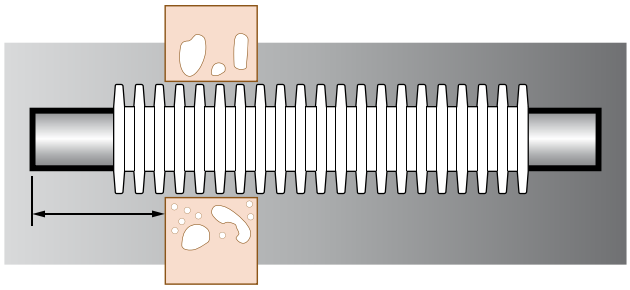
Figure 2: Installation at the base of a wall

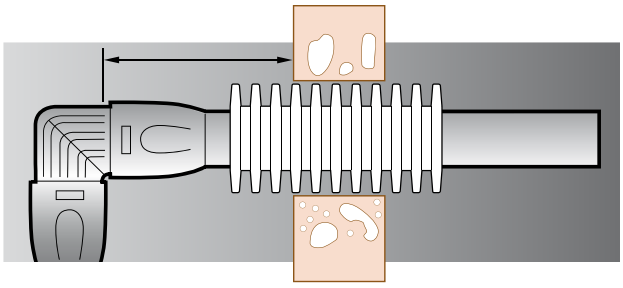
Recommended distances of installation

Diameter (mm)	A min (mm)	L min (mm)	E (mm)	De (mm)
14	10	59	25	18
16	10	59	25	21
20	10	61	26	24
26	10	64	27	30



Minimum space between pipes and a wall



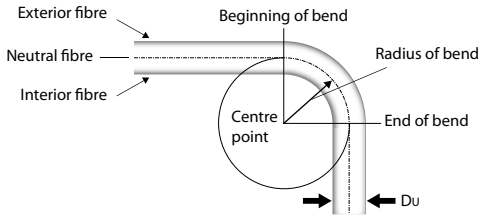


When passing through a slab or wall, it is important to ensure a minimum distance between the wall and the end of the pipe. The following table gives minimum lengths of pipes in these cases:

Fitting size (mm)	Spacing between piping and a wall (mm)
14	35
16	35
20	36
26	37

2.1.7. Pipe bending

One of the big advantages of multilayer pipes is that they can be bent. The pipes can be bent manually, by means of an internal or external bending spring, or by using other types of bending tools. For pipes with a diameter of 26 mm or less, the following bending radii must be observed:



Pipe type	Pipe diameter (mm) (Du)	14	16	18	20	26	32
MultiSkin4	Minimum bending radius **without tools** (mm)	≥ 5xDu 70	≥ 5xDu 80	≥ 5xDu 90	≥ 5xDu 100	≥ 5xDu 130	-
	Minimum bending radius **with tool** (mm)	≥ 3xDu 42	≥ 3xDu 48	≥ 3xDu 54	≥ 3xDu 60	≥ 3xDu 78	-
MultiSkin2	Minimum bending radius **without tools** (mm)	≥ 5xDu 70	≥ 5xDu 80	≥ 5xDu 90	≥ 5xDu 100	≥ 10xDu 260	-
	Minimum bending radius **with tool** (mm)	≥ 2xDu 28	≥ 2xDu 32	≥ 2xDu 36	≥ 2xDu 40	≥ 5xDu 130	≥ 5xDu 160
PEX/AL Gaz	Minimum bending radius **without tools** (mm)	-	≥ 5xDu 80	-	≥ 5xDu 100	≥ 5xDu 130	-
	Minimum bending radius **with tool** (mm)	-	≥ 3,5xDu 56	-	≥ 3,5xDu 70	≥ 3,5xDu 91	≥ 3,5xDu 112

For pipes with a diameter higher than 26 mm, it is advised to use elbow fittings.

Reminder: COMAP offers different bending tools.

2.1.8. Expansion compensation

It is mandatory to calculate the expansion for any pipe of at least 10 metres between 2 fixed points. When there are no such points(sliding fastener) the pipe must have at least one expansion arm. The pipe must be insulated if recessed (see chapter 2.1.8.3. insulated pipe) and bare if exposed.

To calculate the length of the expansion/shrinkage arm, the length of the pipe and temperature difference (water temperature and ambient temperature at the time of installation) must be entered into the formula - see chapter 3.1. Thermal expansion.

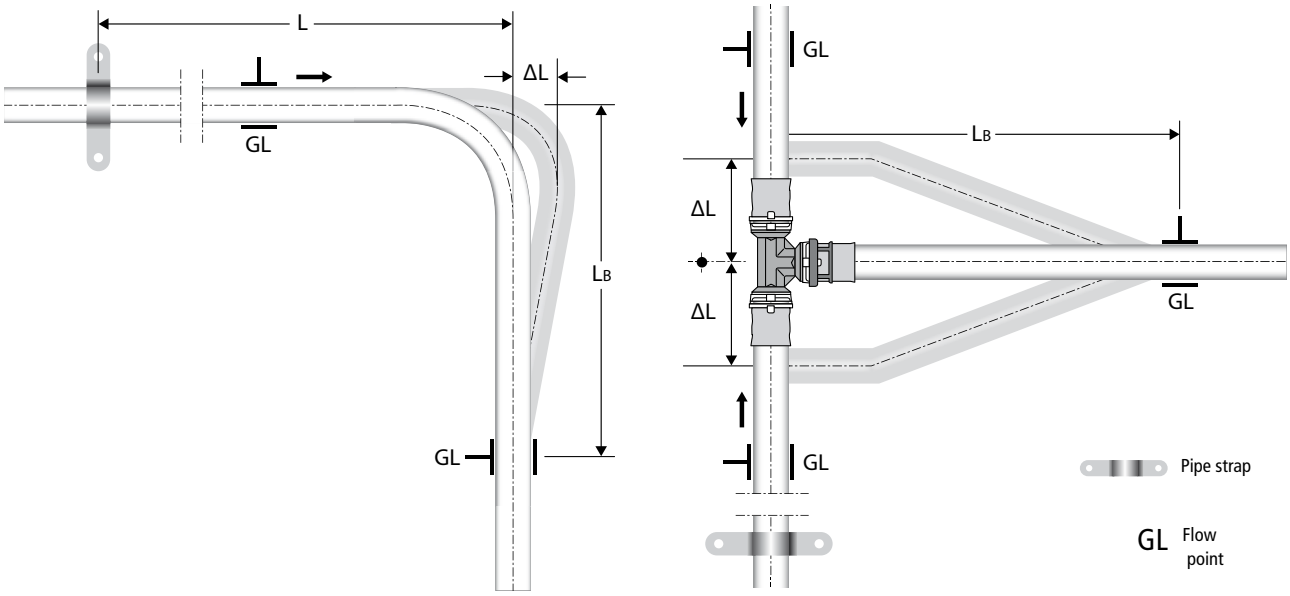
2.1.8.1. Z and L-shaped expansion compensation

Any pipe will expand/shrink with temperature differences. This phenomenon must be compensated for during installation. This can be done with the help of Z- or L-shaped expansion hoses.

This avoids any tension in the network that could deform and damage the various connections. The formula with which the expansion compensation (in mm) is calculated is as follows:

$$L_B = k1 \times \sqrt{(D_U \times \Delta L)}$$

L_B	Length to compensate for expansion	mm
k1	Constant in multi-layer pipes	33
ΔL	Linear expansion	mm
D_U	Outside pipe diameter	mm
α	Multi-layer thermal expansion coefficient	0.025 mm/m/°C



Example:

Calculating the allowance in a distribution system comprising 24 m of 20 mm multilayer pipe that experiences temperature variation of 50°C.

We seek to calculate the length of arm L_B needed to accommodate expansion (ΔL).

ΔL= α x L x Δϴ = 0.025 (multilayer pipe coefficient) x 24 m x 50°C = 30 mm

The linear expansion in the system is 30 mm (according to Chapter 3.1 Thermal expansion).

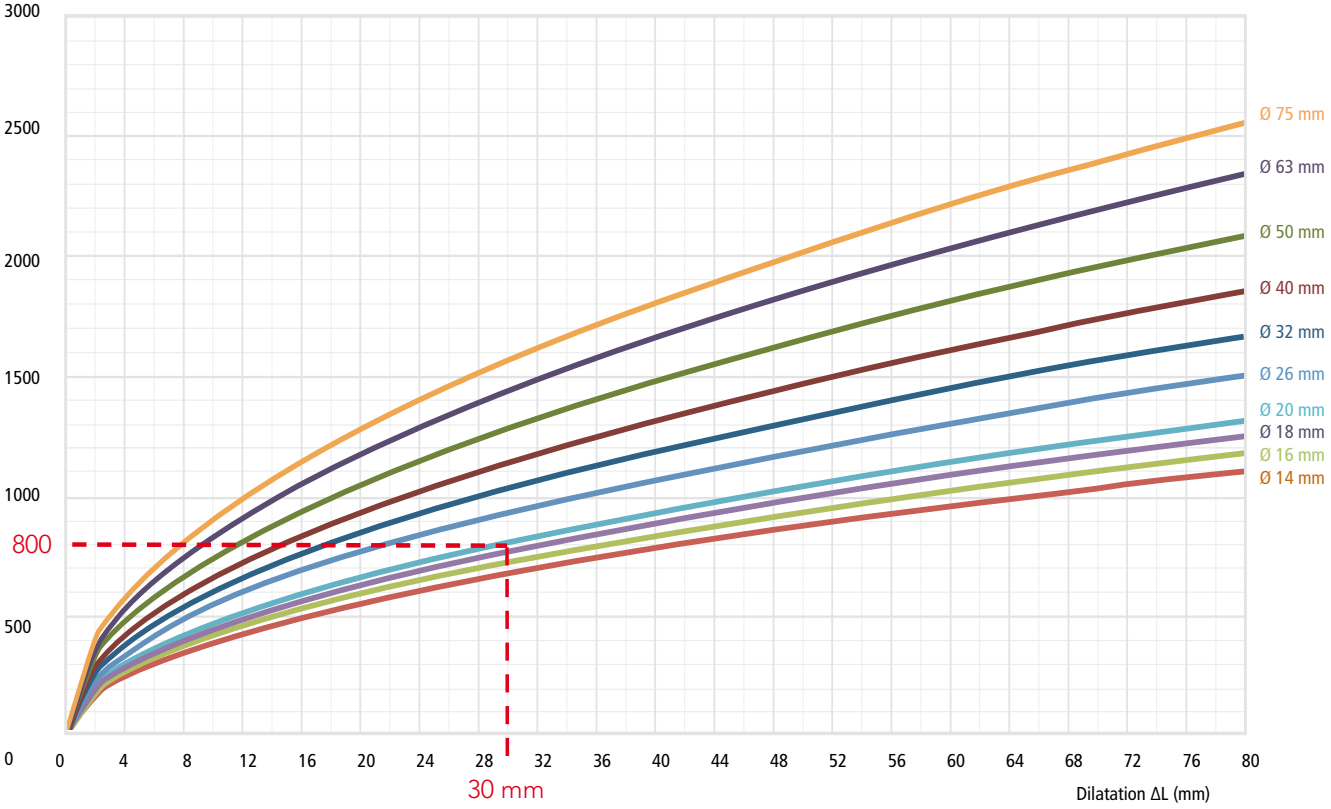
Using Chart 1 or Table 1, we obtain linear compensation of about 800 mm (see red markings).

By calculation, we obtain: $L_B = k1 \times \sqrt{(D_U \times \Delta L)}$

$L_B = 33 \times \sqrt{(20 \times 30)}$

L_B = 808 mm

Expansion compensation length LB (mm)



Graph 1: Length of compensator arms LB (mm)

Expansion compensation length LB (mm)	Pipe diameter Du (mm)									
Linear expansion ΔL (mm)	14	16	18	20	26	32	40	50	63	75
5	276	295	313	330	376	417	467	522	586	639
10	390	417	443	467	532	590	660	738	828	904
15	478	511	542	572	652	723	808	904	1014	1107
20	552	590	626	660	753	835	933	1044	1171	1278
25	617	660	700	738	841	933	1044	1167	1310	1429
30	676	723	767	808	922	1022	1143	1278	1435	1565
35	730	781	828	873	995	1104	1235	1380	1550	1691
40	781	835	885	933	1064	1181	1320	1476	1657	1807
45	828	885	939	990	1129	1252	1400	1565	1757	1917
50	873	933	990	1044	1190	1320	1476	1650	1852	2021
55	916	979	1038	1094	1248	1384	1548	1731	1943	2119
60	956	1022	1084	1143	1303	1446	1617	1807	2029	2214
65	995	1064	1129	1190	1357	1505	1683	1881	2112	2304
70	1033	1104	1171	1235	1408	1562	1746	1952	2191	2391
75	1069	1143	1212	1278	1457	1617	1807	2021	2268	2475

Table 1: Length of compensation arm LB (mm)

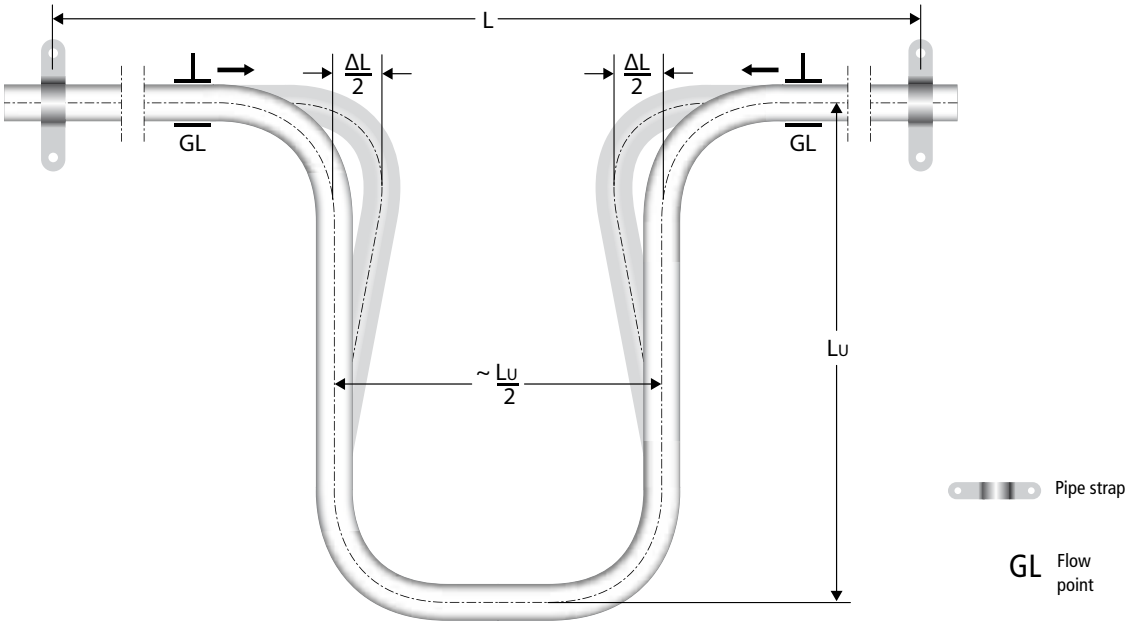
2.1.8.2. U-shaped expansion compensation

Note: To calculate thermal expansion, see chapter 3.1 on thermal expansion.

In case of significant expansion, U-shaped compensating loops may be fitted at installation. This avoids overly powerful tension in the system that could distort and damage connections. The formula used to calculate expansion compensation (in mm) is as follows:

$$L_U = k2 \times \sqrt{(D_U \times \Delta L)}$$

L_U	Length to compensate for expansion	mm
k2	Constant in multi-layer pipes	18.33
ΔL	Linear expansion	mm
D_U	Outside pipe diameter	mm
α	Multi-layer thermal expansion coefficient	0.025 mm/m/°C



Example:

Calculating the allowance in a distribution system comprising 24 m of 20 mm multilayer pipe that experiences temperature variation of 50°C.

We need to calculate the length of compensator (L_U) needed to accomodate expansion (ΔL).

$\Delta L = \alpha \times L \times \Delta\theta = 0.025$ (multilayer pipe coefficient) x 24 m x 50°C = 30 mm

The linear expansion in the system is 30 mm (according to Chapter 3.1 Thermal expansion).

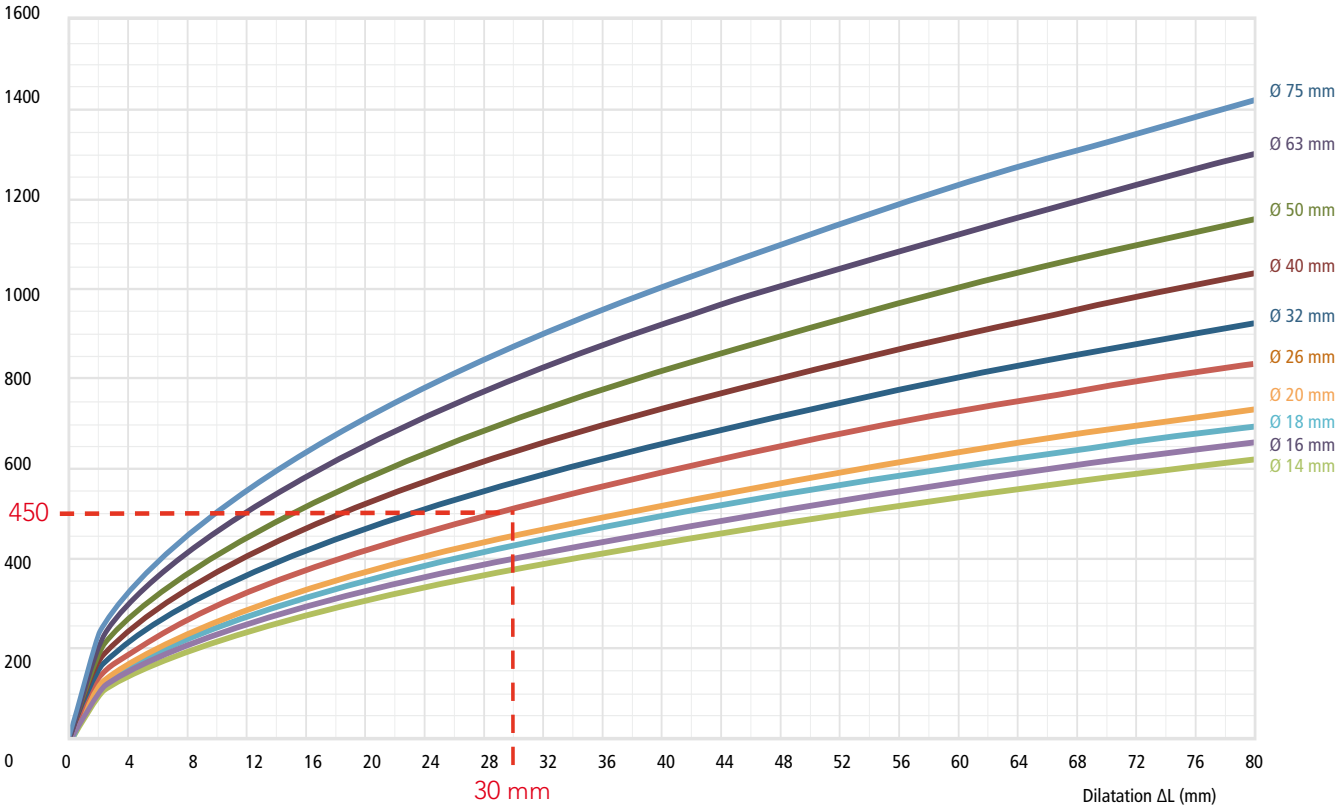
Using Graph 2 or Table 2, we arrive at a compensation length of approximately 450 mm (see red marks).

By calculation, we obtain: $L_U = k2 \times \sqrt{(D_U \times \Delta L)}$

$L_U = 18.33 \times \sqrt{(20 \times 30)}$

$L_U = 449$ mm

Expansion compensation length Lu (mm)

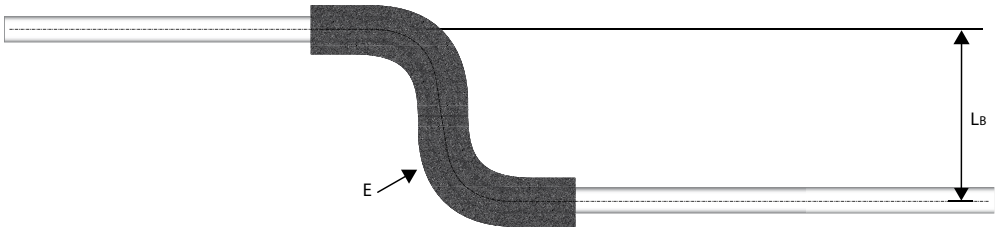


Graph 2: Length of compensator arms LU (mm)

Expansion compensation length Lu (mm)	Pipe diameter Du (mm)									
Linear expansion ΔL (mm)	**14**	**16**	**18**	**20**	**26**	**32**	**40**	**50**	**63**	**75**
5	153	164	174	183	209	232	259	290	325	355
10	217	232	246	259	296	328	367	410	460	502
15	266	284	301	317	362	402	449	502	563	615
20	307	328	348	367	418	464	518	580	651	710
25	343	367	389	410	467	518	580	648	727	794
30	376	402	426	449	512	568	635	710	797	869
35	406	434	460	485	553	613	686	767	861	939
40	434	464	492	518	591	656	733	820	920	1004
45	460	492	522	550	627	696	778	869	976	1065
50	485	518	550	580	661	733	820	917	1029	1122
55	509	544	577	608	693	769	860	961	1079	1177
60	531	568	602	635	724	803	898	1004	1127	1230
65	553	591	627	661	754	836	935	1045	1173	1280
70	574	613	651	686	782	868	970	1084	1217	1328
75	594	635	673	710	809	898	1004	1122	1260	1375

Table 2: Expansion compensation length Lu (mm)

2.1.8.3. Insulated pipe



Example:

Calculating the allowance in a distribution system comprising 5 m of 20 mm multilayer pipe that experiences temperature variation of 50°C.

We need to calculate the length of compensator (LB) needed to accomodate expansion (ΔL).

ΔL= α x L x ΔΘ = 0.025 (multilayer pipe coefficient) x 5 m x 50°C = 6.25 mm.

The linear expansion in the system is 6.25 mm (according to Chapter 3.1 Thermal expansion).

Insulation thickness : E = 1.5 x ΔL = 1.5 x 6.25 = 9.375 mm

By calculation, we obtain: $L_B = k1 \times \sqrt{(D_U \times \Delta L)}$

$L_B = 33 \times \sqrt{(20 \times 6{,}25)}$

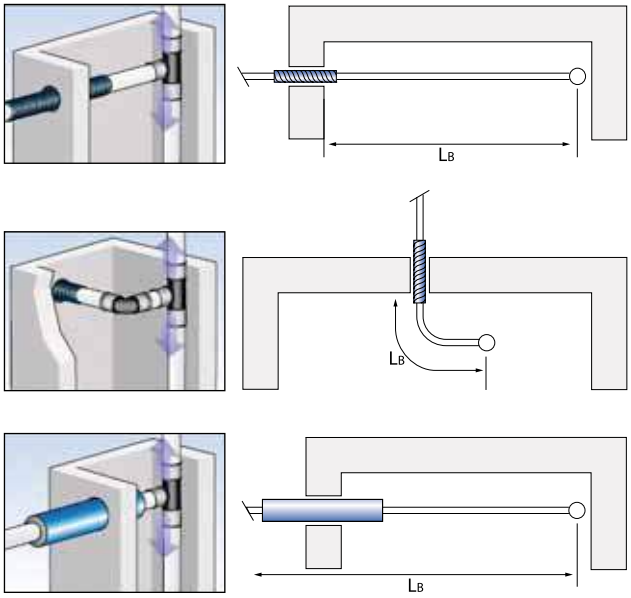
L_B = 376 mm

2.1.8.4. Other recommendations

When pipes from one storey run to a riser pipe within a shaft, these pipes must be able to move freely. Here, too, the change in length can be accommodated with an expansion bend. The expansion bend will absorb the upward and downward movements.

If the conduit is large enough and there is space to fit the calculated expansion bend, the pipe is simply put in conduit at the point where it passes through the wall.

If the conduit is too small to fit the calculated expansion bend, the hole in the wall will have to be made larger to give the pipe sufficient room for movement. At the point where the pipe passes through the wall, it must be insulated using polyethylene.



2.1.9. Attaching pipes

Correct compensation for expansion also depends on the use of pipe-installation methods such as saddles and clips.

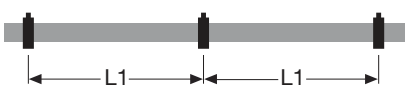
Attachment points must be on straight pipe segments. Attachments cannot be located on fittings. Never use sliding fixtures as attachments near to a pipe connection. It is recommended that pipe saddles be installed such that they are not used as fixed supports.

When straight segments of pipe exist without expansion compensation, only use one sliding fixture to prevent any deformation. Position this fixture as close to the middle of the straight pipe segment as possible: in this way, any expansion will be distributed in both directions and the length required to compensate expansion will be halved.

Space required between two stays:

The use of sliding fixtures with rubber lining is recommended to attenuate any noise and vibrations and improve the distribution of stresses.

Pipe diameter (in mm)	14	16	18	20	26	32	40	50	63	75
L1 (m) maximum	1	1	1	1	1.5	2	2	2.5	2.5	2.5



2.1.10. Embedding

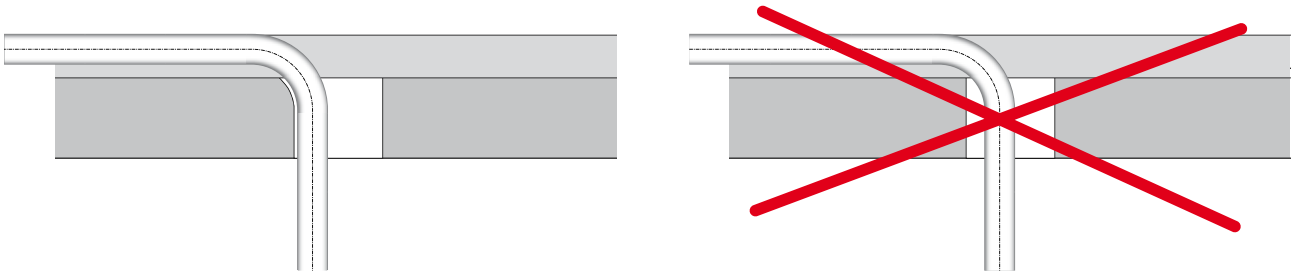
To accommodate the expansion of the pipe within the structure, you must provide insulated expansion bends at least every 10 m. When this has been done, bare COMAP pipe can be placed in sand or cement or placed in the wall.

We recommend always using conduit, or if possible, insulation.

The conduit has a protective function, while the insulation not only protects and thermally insulates the pipe, it also prevents the formation of condensation. To determine the insulation thickness you can apply the following rule: 1.5 x ΔL (change in length) - see example chapter 2.1.8.3.

The metal or synthetic parts of flush mounted fittings must be protected against corrosion. This can be by means of easily accessible, waterproof built-in boxes, tape-sealed conduit, or a tape-sealed conduit made of a synthetic cellular material. The materials used for this must not affect neither the pipe nor the fitting.

As with pipes that pass through walls, pipes that pass through ceilings must be inserted in conduit at minimum. In addition, to prevent kinking they should never be bent using a sharp corner. It is advised to ease all edges.



2.1.11. Insulation

Under certain circumstances, systems require insulation. To this end we offer pre-insulated pipe: to you this means having high quality insulation with no air gap as could occur if thermal insulation is carried out on site.

Depending on the type of installation, insulating systems may be done to protect against condensation, heat loss, expansion, or noise transmission.

If thermal insulation is required, it is essential to protect all metal and synthetic fittings beforehand. Both the adhesive and the insulation used could corrode fittings. Prior protection of metal and synthetic fittings can be done using an adhesive tape.

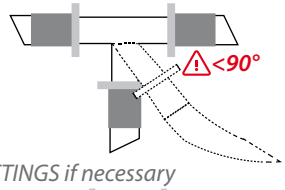
2.1.12. Recommendation for gas installation (NPR 3378-10 NL)

- Piping routes must be selected to minimise the likelihood of damage by, for example, drilling or nailing.
- When bending, observe the minimum bending radius, as specified by the manufacturer. Avoid bending pipes.
- In walls, channel depth must be such that the distance of the pipe to the external face of the wall is at least 10 mm.
- In floors, the distance from the pipe to the external face of the floor must be at least 20 mm.
- During construction work, the gas pipe must be closed off, so no dirt or dust can enter the pipe. If dirt has entered the pipe, the pipe must be cleaned with an inert gas or with air.
- Pipes and connections showing signs of surface damage must not be used.
- A conduit must be used when a pipe passes through a (cavity) wall. In addition, the shortest route must be chosen.

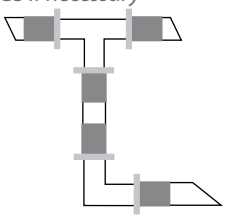
2.1.13. Recommendation for installing synthetic fittings

Instructions:
Fitting flexibility

…don't over twist ONE FITTING

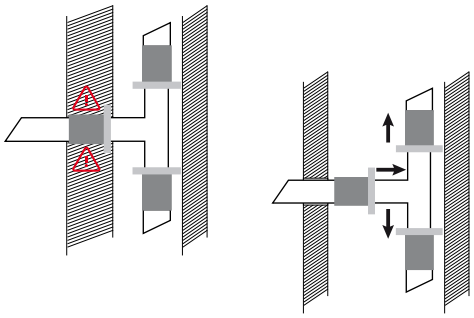


…use TWO FITTINGS if necessary



Instructions:
Building-in[1]

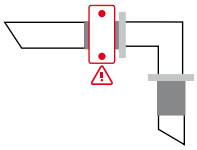
…a built-in fitting MUST NOT be fixed in the wall



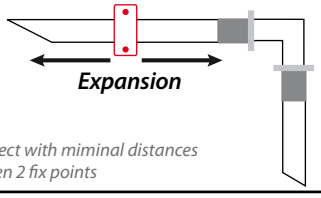
…but FREE TO MOVE

Instructions:
Fix point

…don't put a fix point ON THE FITTING



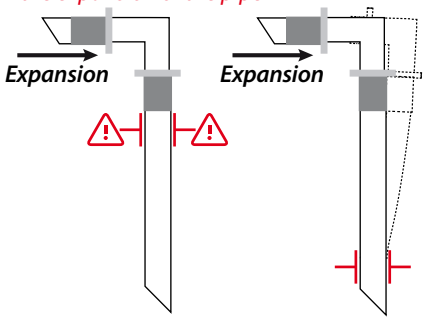
…but ON THE PIPE at mid-length to push the thermal expansion in the both directions*



** in respect with miminal distances between 2 fix points*

Instructions:
Sliding point

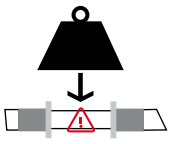
*…the position of a sliding point **MUST NOT STOP** the expansion of the pipe*



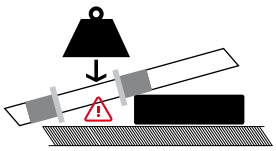
…place it at mid-length of the pipe for a better distribution of the loads and let its FREE TO MOVE

Instructions:
Physical sensitivity

Synthetic fittings are resistant in the framework of correct use. Here are the limits:



Do not drop heavy weight on the installation



Do not put a pressure on the fitting when it is not flat on the ground or a wall

Min = -10°C

Max = 95°C

Max = 10 Bars

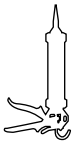
Instructions:
Chemical sensitivity[2]

In very rare cases (for example under presence of polyurethan), the products above can influence the resistance of the PPSU

Paints

Wall fillers

Detergent



Gaskets

Glue / Foams

Disinfectent

(1) Always protect recessed fittings, see Chapter "2.1.10. Recessing"

(2) For more information regarding the compatibility of synthetic fittings to chemical products, see Chapter "3.3.2. Resistance to chemical products"

2.1.14. Special case: overlapping pipes and cross tee connections

It is very common to observe the following assemblies (2 tees used for a subsidiary line):

This is not allowed with synthetic fittings.

To facilitate the installation and to limit the risks of damage, COMAP offers crossed tees.

The crossed tee is ideal to make a bypass or tie-in without having to cross pipes over one another.

With 50 mm centres, this fitting makes it possible to install supply lines to radiators with integrated valves cleanly and simply.

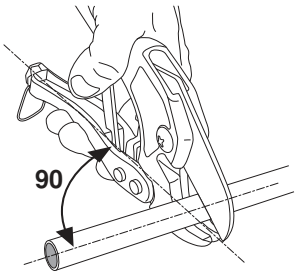
2.2. INSTALLATION

2.2.1. Crimp fittings

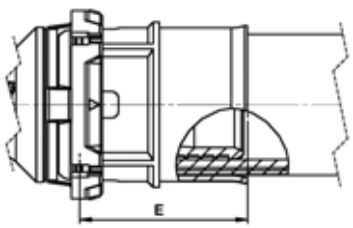
2.2.1.1. Cut the pipe to length

With a pipe cutter, cut the pipe by positioning the tool at a 90° angle. This ensures a square cut without burs.

Don't forget to add the length of the pipe that is situated inside the fitting in your calculation (Dimension «E»).

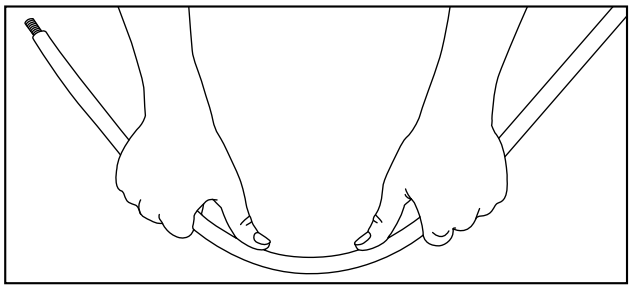


Pipe diameter (mm)	14	16	18	20	26	32	40	50	63	75
Insertion depth E (mm)	23.8	23.8	23.8	23.8	24.8	28.8	38.8	39.8	61.5	62.5



2.2.1.2. Bending pipes

It may be necessary to bend a pipe for installation purposes. COMAP markets several different bending tools. To find out about the minimum bending radii for various pipes and diameters see chapter 2.1.7. pipe bending.

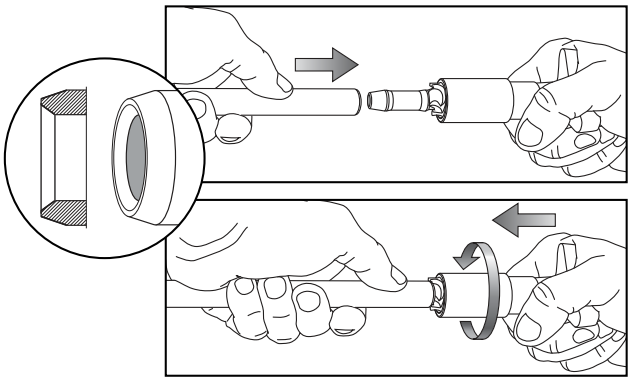


2.2.1.3. Calibrate and deburr the pipe

You must use the COMAP calibration tool to properly restore its cylindrical shape to the pipe and remove burrs.

Visually check that the edges of the pipe are clean and bevelled so as not to damage the O-ring located inside the fitting.

See chapter 1.2.12. COMAP calibration tools



2.2.1.4. Assembly of a crimp fitting and pipe

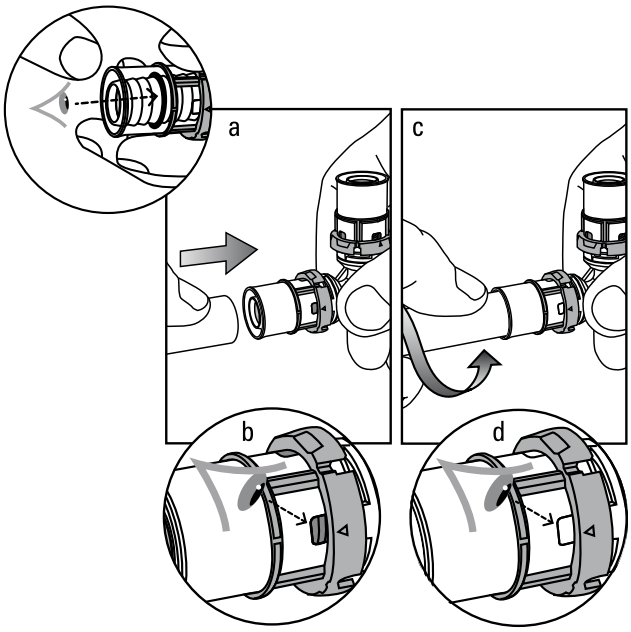
Before inserting the pipe into the fitting, make sure that the O-ring (s) are properly seated.

Insert the pipe into the press fitting up to the marked insertion depth while rotating slightly and pushing in an axial direction at the same time (drawings a and c). The marking for the insertion depth must still be visible.

In case of fittings without a stop, fittings should be inserted at least as far as the marked insertion depth. The pipe must not be inserted into the crimp fitting in a rough or careless manner, because this may result in damage to the O-ring.

Ensure that the pipe is properly inserted by checking the viewing window (drawing b). Once a pipe has been properly inserted, the window becomes white (drawing d).

Note: COMAP crimp fittings can be installed at temperatures from -20° C to 50° C.



2.2.1.5. Crimping

Before crimping, check that there are no impurities in the jaws and crimp chains. If so, these must be removed. The press machine must also be in good working order and operating and maintenance instructions of the supplier must be complied with.

Use of the correct jaws and crimping chains corresponding to the fittings is mandatory. For more information, refer to chapter "1.2.11. Crimping tools".

If you are using **TH profile jaws**, position the jaws on the Visu-Control® ring(a).

For reliable crimping, the notch of the crimping tool must surround the Visu-Control® ring of the COMAP crimp fitting.

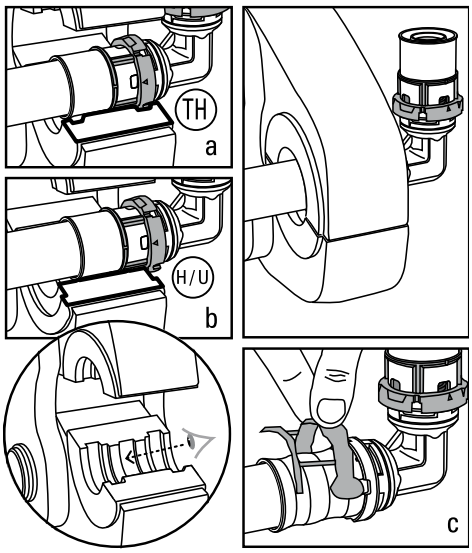
With **profiles H or U**, position the jaw against the Visu-Control® ring (b).

Once the pressing process is begun, it must not be interrupted.

Installers can check crimping both visually and by touch thanks to Visu-Control® technology® (plastic rings at the end of fittings).

Once crimping is complete, remove the Visu-Control® (c).

Note: the removable green ring of the Visu-Control® part has no other function than that of viewing the crimping. This means that it is possible to perform crimping without this removable ring, just as it is also possible to leave this ring in place once the fitting is crimped.

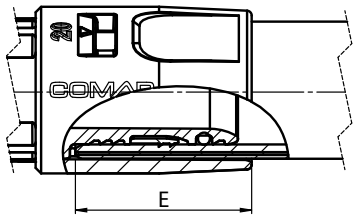


2.2.2. Push fittings

2.2.2.1. Cut the pipe to length

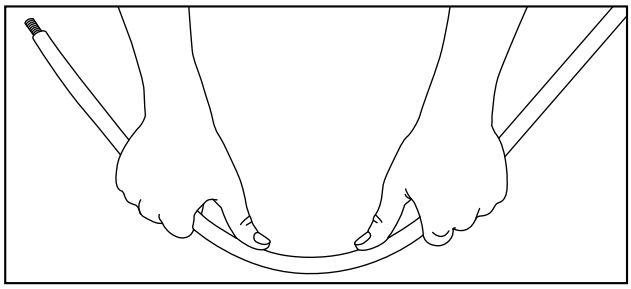
With a pipe cutter, cut the pipe by positioning the tool at a 90° angle. This ensures a square cut without burs.
Don't forget to add the length of the pipe that is situated inside the fitting in your calculation (Dimension «E»).

Pipe diameter (in mm)	14	16	20	26
Insertion depth E (mm)	24.7	24.7	25.7	27.2



2.2.1.2. Bending pipes

It may be necessary to bend a pipe for installation purposes. COMAP markets several different bending tools. To find out about the minimum bending radii for various pipes and diameters see chapter 2.1.7 pipe bending.

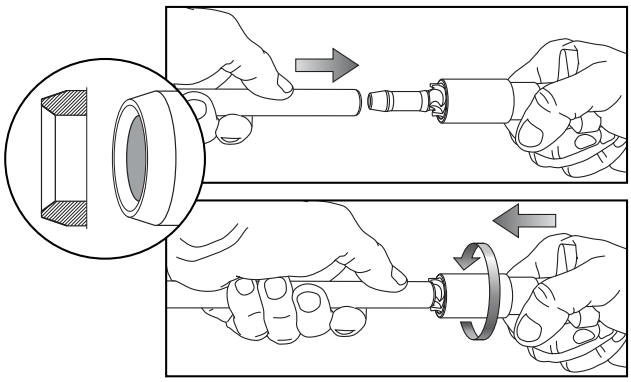


2.2.1.3. Calibrate and deburr the pipe

It's mandatory to use the new COMAP calibration tool, to properly restore a pipe's cylindrical shape and to remove burrs.

Visually check that the edges of the pipe are clean and bevelled so as not to damage the O-ring located inside the fitting.

See chapter 1.2.12. COMAP calibration tools



2.2.1.4. Assembly of the press fitting and pipe

Before inserting the pipe into the fitting, make sure that the O-ring (s) are properly seated.

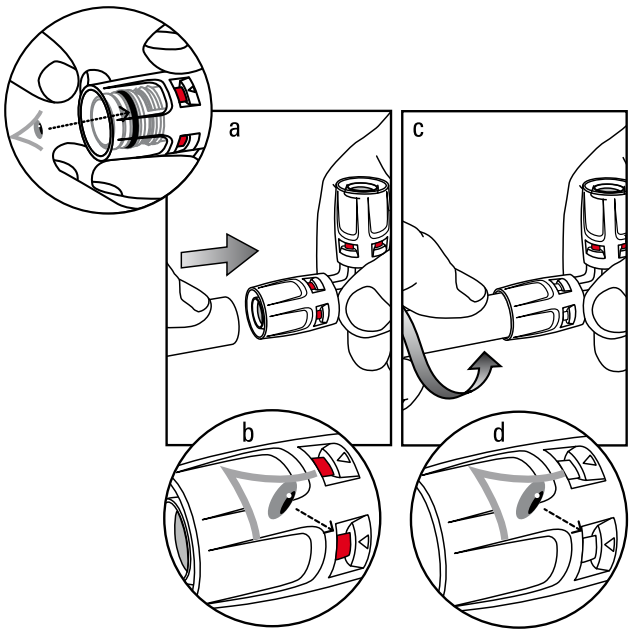
Insert the pipe into the fitting up to the marked insertion depth while rotating slightly and pushing in an axial direction at the same time (drawings a and c). The marking for the insertion depth must still be visible.

The pipe should be inserted up to the stop. The pipe must not be insured into the press fitting in a rough and careless manner that could result in damage to the O-ring.

Ensure that the pipe is properly inserted by checking the viewing window (Visu-Control®) (drawing b). Once a pipe is correctly inserted, the window colour changes from red, indicating a pipe that has not been inserted, to white (drawing d).

When the Visu-Control® colour is white, the fitting has been properly crimped.

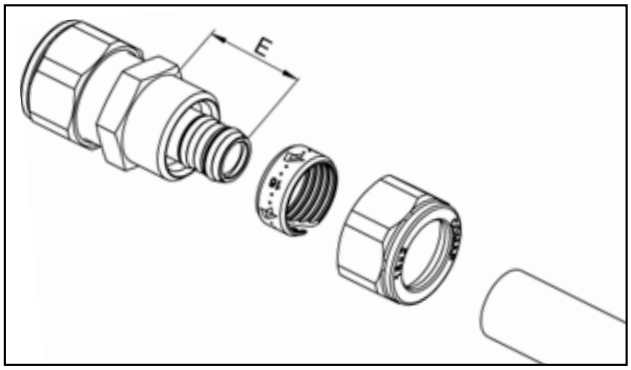
Note: COMAP instant fittings can be installed at temperatures from -20° C to 50° C.



2.2.3. Compression fittings

2.2.3.1. Cut the pipe to length

With a pipe cutter, cut the pipe by positioning the tool at a 90° angle. This ensures a square cut without burs.

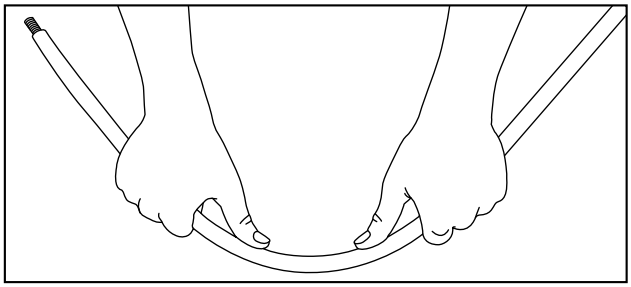


Don't forget to add the length of the pipe that is situated inside the fitting in your calculation (Dimension «E»).

Pipe diameter (mm)	14	16	18	20	26	32
Insertion depth E (mm)	17	17	17	17	21	22

2.2.3.2. Bending pipes

It may be necessary to bend a pipe for installation. COMAP markets several different bending tools. To find out about the minimum bending radii for various pipes and diameters see chapter 2.1.7 pipe bending.

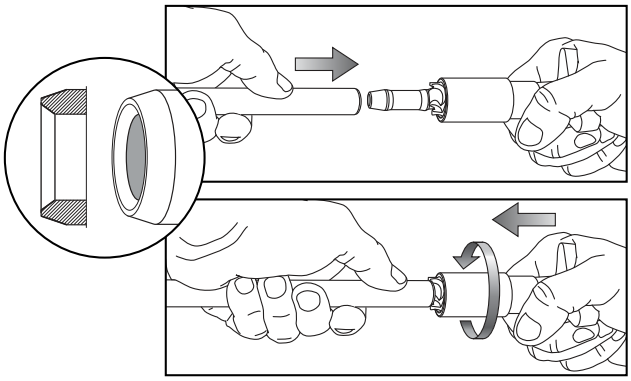


2.2.3.3. Calibrate and deburr the pipe

You must use a COMAP calibration tool to properly restore a pipe's cylindrical shape and to remove burrs.

Visually check that the edges of the pipe are clean and bevelled so as not to damage the O-ring located inside the fitting.

See chapter 1.2.12. COMAP calibration tools

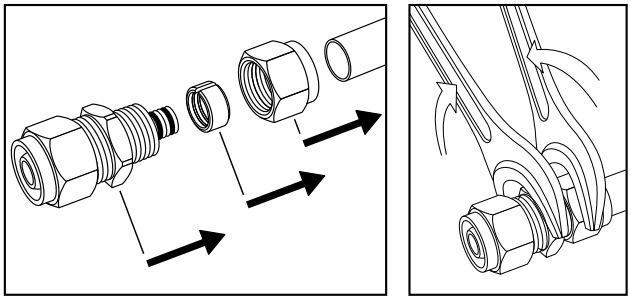


2.2.3.4. Assembly of a compression fitting and pipe

Prior to inserting the pipe into the fitting, make sure that the O-ring is present.

Assemble the fitting: slide the nut, then the ring (olive) onto the pipe. Insert the body of the fitting inside the pipe up to the stop to ensure proper watertightness.

Note: COMAP compression fittings may be installed at temperatures ranging from -20 °C to 50°C.



2.2.3.5. Tightening

Using the proper wrenches, firmly tighten the nuts without twisting the pipe.

Recommended tightening torque	20 Nm < Ø 14 mm 30 Nm between Ø 16 mm and Ø 26 mm 40 Nm > Ø 26 mm

NOTES

MultiSkin
Multilayer system

CHAPITRE 3
ADVANCED TECHNICAL FIGURES

3. ADVANCED TECHNICAL FIGURES

3.1. THERMAL EXPANSION

Note: To calculate thermal expansion, refer to page 36 (2.1.8. Compensating for thermal expansion).

All metals expand when heated and contract when cooled. Length variation due to temperature fluctuation must therefore be taken into account. Temperature variation and the length of the pipe are the two variables that will determine linear expansion.

The equation to calculate linear expansion is as follows:

$$\Delta L = \alpha \times L \times \Delta\theta$$

ΔL	Linear expansion	mm
α	Expansion coefficient for MultiSkin pipes	0.025 mm/m/°K
L	Pipe length	m
Δθ	Temperature difference between installation temperature and max. operating temperature	°K

Tables and graphs 3 show the expansion of multilayer pipes according to the length of the pipe and the temperature difference.

Example:

A 24 m system of 20 mm diameter multilayer pipes is subjected to a temperature difference of 50°C

When using the equation for calculating expansion, the result is:

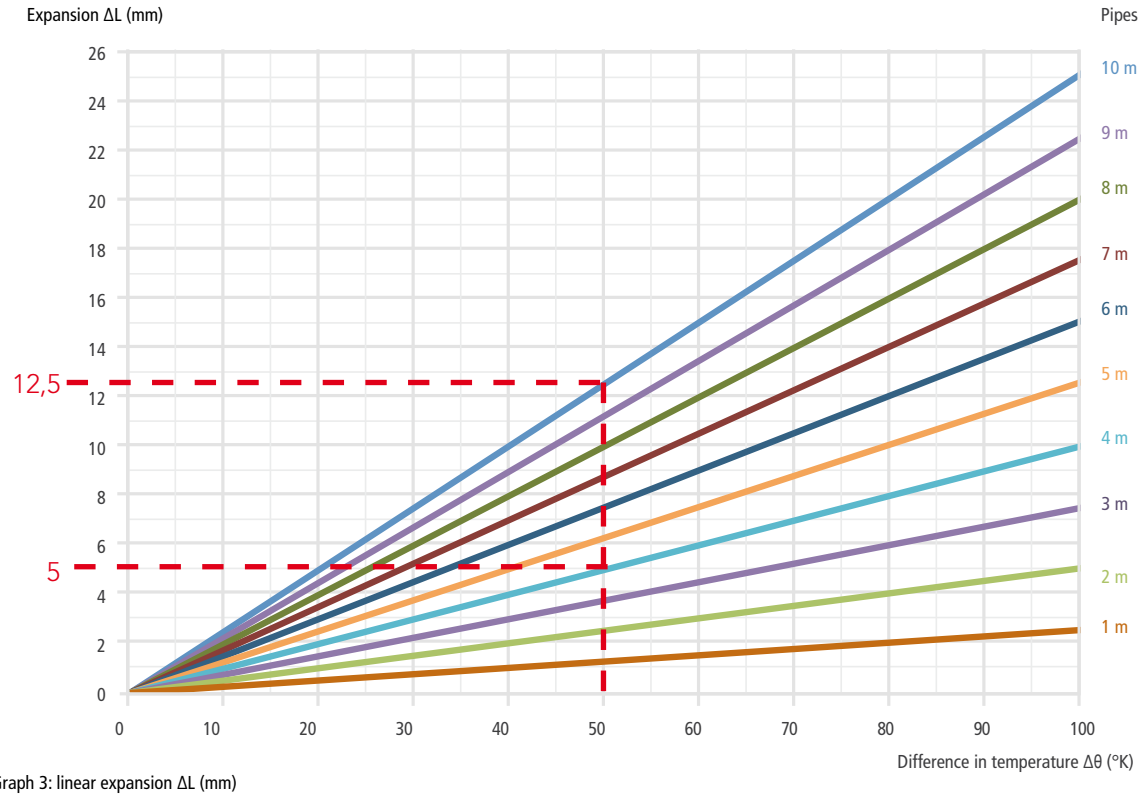
$\Delta L = \alpha \times L \times \Delta\theta$

$\Delta L = 0.025 \times 24 \times 50 = 30$ mm

The same result can be obtained using graph 3 or table 3 (see the boxes next page). For pipes longer than 10 m, add the linear expansion values together:

12.5 mm (10 m) + 12.5 mm (10 m) + 5 mm (4 m) = 30 mm (24 m)

3.1.1. Linear expansion of COMAP multilayer pipe



Graph 3: linear expansion ΔL (mm)

Expansion ΔL (mm)	Temperature difference Δθ (°K)									
Pipe length L(m)	10	20	30	40	50	60	70	80	90	100
1	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50
2	0.50	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00
3	0.75	1.50	2.25	3.00	3.75	4.50	5.25	6.00	6.75	7.50
4	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00
5	1.25	2.50	3.75	5.00	6.25	7.50	8.75	10.00	11.25	12.50
6	1.50	3.00	4.50	6.00	7.50	9,00	10.50	12.00	13.50	15.00
7	1.75	3.50	5.25	7.00	8.75	10,50	12.25	14.00	15.75	17.50
8	2.00	4.00	6.00	8.00	10.00	12,00	14.00	16.00	18.00	20.00
9	2.25	4.50	6.75	9.00	11.25	13,50	15.75	18.00	20.25	22.50
10	2.50	5.00	7.50	10.00	12.50	15.00	17.50	20.00	22.50	25.00

Table 3: linear expansion ΔL (mm).

3.2. PRESSURE LOSS

Any fluid flowing through a piping system faces resistance to flow, which leads to loss of pressure in the system. Continuous and local pressure drops must be considered separately. Continuous pressure drops are mainly caused by the resistance to flow in straight pipe sections, which is itself mainly caused by friction between the fluid and the pipe wall. Local pressure drops are caused by resistance to flow due to turbulence, for instance, where the inner diameter of a pipe changes at pipe branches, elbows, etc.

3.2.1. Linear pressure drop

With graph 5 and table 6, it is possible to determine the unit pressure drop R (mbar/m) and the flow velocity V (m/s) for a given water flow (Kg/h or l/min).

The values shown in graphs 5 and 6 and in tables 5 and 6 are calculated for water temperature of 20° and 70°C. To determine the value of the pressure drop for a different water temperature, use graph 4 or table 4 to apply a correction factor.

Example:

Calculate the linear pressure drop of a network with a length of 24 m consisting of multilayer pipes with a 16 x 2 mm in diameter. Water flow is 12 l/min (719 l/h) and mean temperature is 40°C.

According to graph 5 or table 5, the pressure drop is equal to 3,398 Pa/m (for a water temperature of 20°C).

One must then correct for a water temperature of 40°C, use the following formula using the temperature correction table or graph, by means of the following formula:

R(40°C) = R(20°C) x Kc (40°C)

R	Pressure loss	mbar/m
Kc	Correction factor*	-

*See table and graph 4

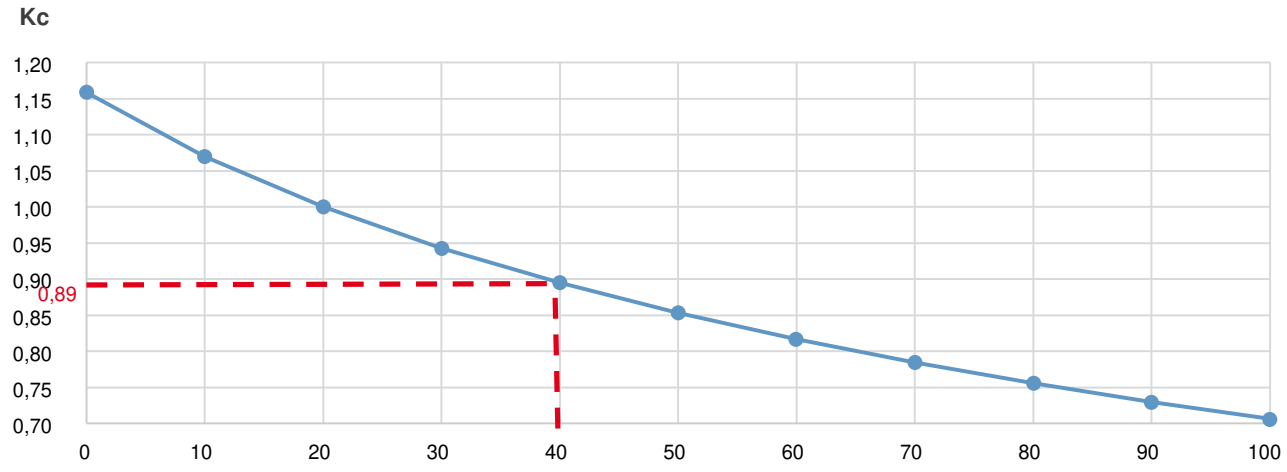
R(40°C) = 3 398 x 0.89

R(40°C) = 3 024.22 Pa/m

For a temperature of 40°C, pressure will drop by 3,024.22 Pa/m in this system, i.e. 72,581.28 Pa over 24 meters.

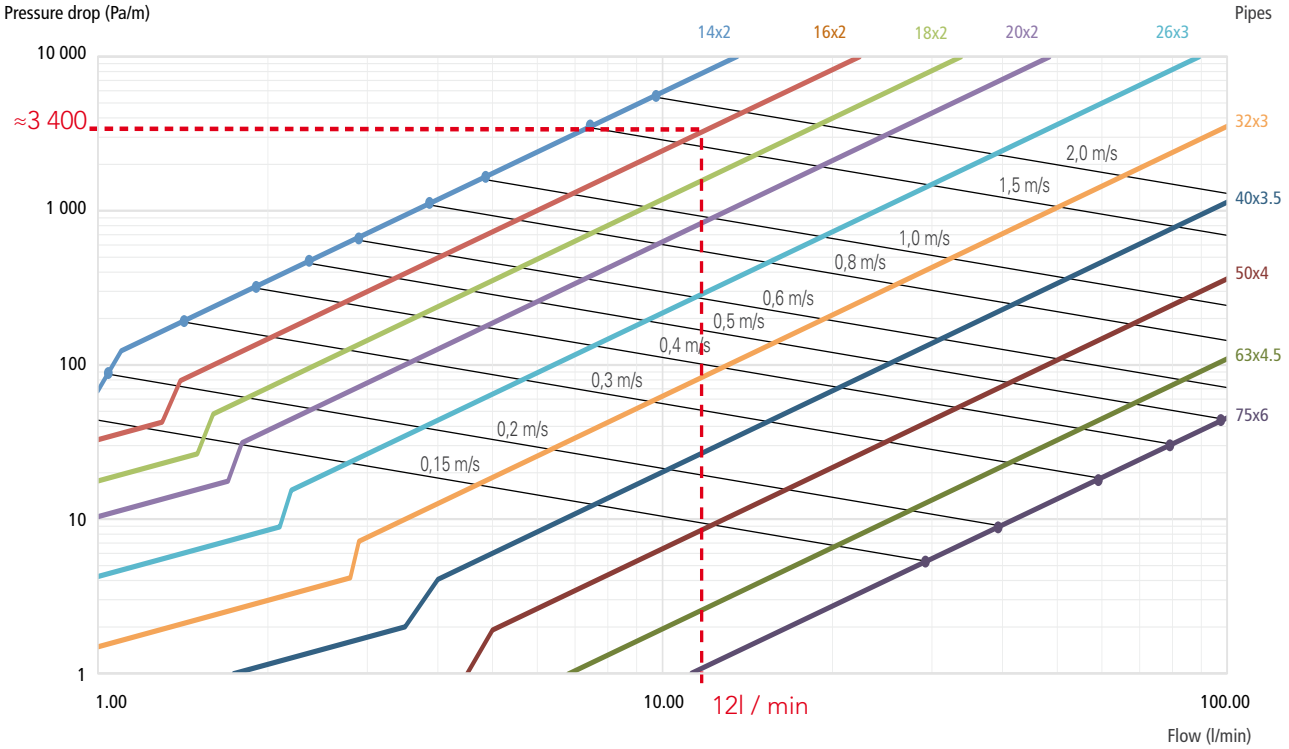
T°C	0	10	20	30	40	50	60	70	80	90
Kc	1.16	1.07	1.00	0.94	0.89	0.85	0.82	0.78	0.76	0.76

Table 4: Correction factor



Graph 4: Correction factor

3.2.1.1. Sanitary application (20°C)



Graph 5: Load loss diagram for sanitary applications

Sanitary application (20°C)

Flow	Mass flow	14x2		16x2		18x2		20x2		26x3		32x3		40x3.5		50x4		63x4.5		75x6	
l/min	Kg/h	m/sec	Pa/m	m/sec	Pa/m	m/sec	Pa/m	m/sec	Pa/m	m/sec	Pa/m	m/se c	Pa/m	m/sec	Pa/m	m/sec	Pa/m	m/sec	Pa/m	m/s	Pa/m
0.5	30	0.11	34	0.07	16	0.05	9	0.04	5	0.03	2	0.02	1	0.01	0	0.01	0	0.00	0	0,00	0
0.6	36	0.13	41	0.09	20	0.06	11	0.05	6	0.03	3	0.02	1	0.01	0	0.01	0	0.00	0	0,00	0
0.7	42	0.15	48	0.10	23	0.08	12	0.06	7	0.04	3	0.02	1	0.01	0	0.01	0	0.01	0	0,00	0
0.8	48	0.17	54	0.12	26	0.09	14	0.07	8	0.04	3	0.03	1	0.02	0	0.01	0	0.01	0	0,00	0
0.9	54	0.19	61	0.13	29	0.10	16	0.07	9	0.05	4	0.03	1	0.02	1	0.01	0	0.01	0	0,00	0
1	60	0.21	68	0.15	33	0.11	18	0.08	10	0.05	4	0.03	1	0.02	1	0.01	0	0.01	0	0,01	0
1.1	66	0.23	123	0.16	36	0.12	19	0.09	11	0.06	5	0.03	2	0.02	1	0.01	0	0.01	0	0,01	0
1.2	72	0.25	144	0.18	39	0.13	21	0.10	12	0.06	5	0.04	2	0.02	1	0.01	0	0.01	0	0,01	0
1.3	78	0.28	165	0.19	43	0.14	23	0.11	13	0.07	6	0.04	2	0.03	1	0.02	0	0.01	0	0,01	0
1.4	84	0.30	188	0.21	79	0.15	25	0.12	15	0.07	6	0.04	2	0.03	1	0.02	0	0.01	0	0,01	0
1.5	90	0.32	212	0.22	89	0.16	27	0.12	16	0.08	6	0.05	2	0.03	1	0.02	0	0.01	0	0,01	0
1.6	96	0.34	238	0.24	100	0.17	48	0.13	17	0.08	7	0.05	2	0.03	1	0.02	0	0.01	0	0,01	0
1.7	102	0.36	264	0.25	111	0.18	53	0.14	18	0.09	7	0.05	3	0.03	1	0.02	0	0.01	0	0,01	0
1.8	108	0.38	292	0.26	123	0.19	59	0.15	31	0.10	8	0.06	3	0.04	1	0.02	0	0.01	0	0,01	0
1.9	114	0.40	321	0.28	135	0.21	65	0.16	34	0.10	8	0.06	3	0.04	1	0.02	0	0.01	0	0,01	0
2	120	0.42	351	0.29	148	0.22	71	0.17	38	0.11	8	0.06	3	0.04	1	0.02	0	0.01	0	0,01	0
2.1	126	0.44	383	0.31	161	0.23	77	0.17	41	0.11	9	0.07	3	0.04	1	0.03	0	0.02	0	0,01	0
2.2	132	0.47	415	0.32	175	0.24	84	0.18	45	0.12	15	0.07	3	0.04	1	0.03	0	0.02	0	0,01	0
2.3	138	0.49	449	0.34	189	0.25	91	0.19	48	0.12	17	0.07	3	0.04	1	0.03	1	0.02	0	0,01	0
2.4	144	0.51	483	0.35	203	0.26	98	0.20	52	0.13	18	0.08	4	0.05	1	0.03	1	0.02	0	0,01	0
2.5	150	0.53	519	0.37	218	0.27	105	0.21	56	0.13	19	0.08	4	0.05	1	0.03	1	0.02	0	0,01	0
2.6	156	0.55	556	0.38	234	0.28	112	0.22	60	0.14	21	0.08	4	0.05	1	0.03	1	0.02	0	0,01	0
2.7	162	0.57	594	0.40	250	0.29	120	0.22	64	0.14	22	0.08	4	0.05	2	0.03	1	0.02	0	0,01	0
2.8	168	0.59	633	0.41	266	0.30	128	0.23	68	0.15	24	0.09	4	0.05	2	0.03	1	0.02	0	0,01	0
2.9	174	0.61	673	0.43	283	0.31	136	0.24	72	0.15	25	0.09	7	0.06	2	0.03	1	0.02	0	0.02	0
3	180	0.64	714	0.44	300	0.32	144	0.25	77	0.16	27	0.09	8	0.06	2	0.04	1	0.02	0	0,02	0
3.5	210	0.74	935	0.51	393	0.38	189	0.29	100	0.19	35	0.11	10	0.07	2	0.04	1	0.03	0	0,02	0
4	240	0.85	1 181	0.59	497	0.43	239	0.33	127	0.21	44	0.13	13	0.08	4	0.05	1	0.03	0	0,02	0
4.5	270	0.95	1 452	0.66	611	0.49	294	0.37	156	0.24	54	0.14	16	0.09	5	0.05	1	0.03	0	0,02	0

Flow	Mass flow	14x2		16x2		18x2		20x2		26x3		32x3		40x3.5		50x4		63x4.5		75x6	
l/min	Kg/h	m/sec	Pa/m	m/sec	Pa/m	m/sec	Pa/m	m/sec	Pa/m	m/sec	Pa/m	m/se c	Pa/m	m/sec	Pa/m	m/sec	Pa/m	m/sec	Pa/m	m/sec	Pa/m
5	299	1.06	1 746	0.74	734	0.54	353	0.41	187	0.26	65	0.16	19	0.10	6	0.06	2	0.04	0	0,03	0
5.5	329	1.17	2 062	0.81	868	0.59	417	0.46	221	0.29	77	0.17	22	0.11	7	0.07	2	0.04	0	0,03	0
6	359	1.27	2 402	0.88	1 010	0.65	486	0.50	258	0.32	89	0.19	26	0.12	8	0.07	3	0.04	1	0,03	0
6.5	389	1.38	2 763	0.96	1 162	0.70	559	0.54	296	0.34	103	0.20	30	0.13	10	0.08	3	0.05	1	0,03	0
7	419	1.48	3 145	1.03	1 323	0.76	636	0.58	337	0.37	117	0.22	34	0.14	11	0.08	3	0.05	1	0,04	0
7.5	449	1.59	3 549	1.10	1 493	0.81	718	0.62	381	0.40	132	0.24	38	0.15	12	0.09	4	0.05	1	0,04	1
8	479	1.69	3 973	1.18	1 671	0.86	804	0.66	426	0.42	148	0.25	42	0.16	14	0.10	4	0.06	1	0,04	1
8.5	509	1.80	4 418	1.25	1 858	0.92	894	0.70	474	0.45	164	0.27	47	0.17	15	0.10	5	0.06	1	0,05	1
9	539	1.91	4 883	1.32	2 054	0.97	988	0.74	524	0.48	181	0.28	52	0.18	17	0.11	5	0.07	2	0,05	1
9.5	569	2.01	5 367	1.40	2 258	1.03	1 086	0.79	576	0.50	199	0.30	57	0.18	18	0.11	6	0.07	2	0,05	1
10	599	2.12	5 872	1.47	2 470	1.08	1 188	0.83	630	0.53	218	0.31	63	0.19	20	0.12	6	0.07	2	0,05	1
10.5	629	2.22	6 395	1.54	2 690	1.13	1 293	0.87	686	0.56	238	0.33	68	0.20	22	0.13	7	0.08	2	0,06	1
11	659	2.33	6 937	1.62	2 918	1.19	1 403	0.91	744	0.58	258	0.34	74	0.21	24	0.13	8	0.08	2	0,06	1
11.5	689	2.44	7 498	1.69	3 154	1.24	1 517	0.95	804	0.61	279	0.36	80	0.22	26	0.14	8	0.08	2	0,06	1
12	719	2.54	8 078	1.77	3 398	1.30	1 634	0.99	866	0.64	300	0.38	86	0.23	28	0.14	9	0.09	3	0,06	1
12.5	749	2.65	8 676	1.84	3 649	1.35	1 755	1.03	931	0.66	322	0.39	93	0.24	30	0.15	10	0.09	3	0,07	1
13	779	2.75	9 293	1.91	3 909	1.40	1 880	1.08	997	0.69	345	0.41	99	0.25	32	0.16	10	0.09	3	0,07	1
13.5	809	2.86	9 927	1.99	4 176	1.46	2 008	1.12	1 065	0.71	369	0.42	106	0.26	34	0.16	11	0.10	3	0,07	2
14	838	2.97	10 580	2.06	4 450	1.51	2 140	1.16	1 135	0.74	393	0.44	113	0.27	36	0.17	12	0.10	4	0,07	2
14.5	868	3.07	11 250	2.13	4 732	1.57	2 275	1.20	1 207	0.77	418	0.45	120	0.28	39	0.17	12	0.11	4	0,08	2
15	898	3.18	11 937	2.21	5 021	1.62	2 414	1.24	1 280	0.79	444	0.47	128	0.29	41	0.18	13	0.11	4	0,08	2
16	958	3.39	13 365	2.35	5 621	1.73	2 703	1.32	1 433	0.85	497	0.50	143	0.31	46	0.19	15	0.12	4	0,09	2
17	1 018	3.60	14 861	2.50	6 251	1.84	3 006	1.41	1 594	0.90	552	0.53	159	0.33	51	0.20	16	0.12	5	0,09	2
18	1 078	3.81	16 424	2.65	6 908	1.95	3 322	1.49	1 762	0.95	610	0.56	176	0.35	57	0.22	18	0.13	5	0,10	3
19	1 138	4.02	18 054	2.79	7 594	2.05	3 651	1.57	1 936	1.01	671	0.60	193	0.37	62	0.23	20	0.14	6	0,10	3
20	1 198	4.24	19 749	2.94	8 307	2.16	3 994	1.65	2 118	1.06	734	0.63	211	0.39	68	0.24	22	0.15	7	0,11	3
21	1 258	4.45	21 510	3.09	9 047	2.27	4 350	1.74	2 307	1.11	799	0.66	230	0.41	74	0.25	24	0.15	7	0,11	3
22	1 318	4.66	23 334	3.24	9 815	2.38	4 719	1.82	2 503	1.17	867	0.69	249	0.43	80	0.26	26	0.16	8	0,12	4
23	1 378	4.87	25 222	3.38	10 609	2.49	5 101	1.90	2 705	1.22	937	0.72	270	0.45	87	0.28	28	0.17	8	0,12	4
24	1 437	5.08	27 172	3.53	11 429	2.59	5 496	1.99	2 914	1.27	1 010	0.75	290	0.47	94	0.29	30	0.17	9	0,13	4
25	1 497	5.30	29 184	3.68	12 275	2.70	5 903	2.07	3 130	1.32	1 085	0.78	312	0.49	101	0.30	32	0.18	10	0,13	5
26	1 557	5.51	31 258	3.82	13 148	2.81	6 322	2.15	3 353	1.38	1 162	0.81	334	0.51	108	0.31	34	0.19	10	0,14	5
27	1 617	5.72	33 392	3.97	14 045	2.92	6 754	2.23	3 582	1.43	1 241	0.85	357	0.53	115	0.32	37	0.20	11	0,14	5
28	1 677	5.93	35 586	4.12	14 968	3.03	7 197	2.32	3 817	1.48	1 322	0.88	380	0.54	123	0.34	39	0.20	12	0,15	6
29	1 737	6.14	37 840	4.27	15 916	3.13	7 653	2.40	4 059	1.54	1 406	0.91	404	0.56	130	0.35	41	0.21	13	0,15	6
30	1 797	6.35	40 153	4.41	16 889	3.24	8 121	2.48	4 307	1.59	1 492	0.94	429	0.58	138	0.36	44	0.22	13	0,16	6
32	1 917	6.78	44 954	4.71	18 908	3.46	9 092	2.65	4 822	1.69	1 671	1.00	480	0.62	155	0.38	49	0.23	15	0,17	7
34	2 036	7.20	49 985	5.00	21 025	3.67	10 110	2.81	5 361	1.80	1 858	1.07	534	0.66	172	0.41	55	0.25	17	0,18	8
36	2 156	7.63	55 243	5.30	23 236	3.89	11 173	2.98	5 925	1.91	2 053	1.13	590	0.70	190	0.43	61	0.26	18	0,19	9
38	2 276	8.05	60 726	5.59	25 542	4.11	12 282	3.14	6 513	2.01	2 257	1.19	649	0.74	209	0.46	67	0.28	20	0,20	10
40	2 396	8.47	66 429	5.88	27 941	4.32	13 435	3.31	7 125	2.12	2 469	1.25	710	0.78	229	0.48	73	0.29	22	0,21	11
42	2 515	8.90	72 350	6.18	30 432	4.54	14 633	3.48	7 760	2.22	2 689	1.32	773	0.82	249	0.50	79	0.31	24	0,22	12
44	2 635	9.32	78 486	6.47	33 013	4.76	15 874	3.64	8 418	2.33	2 917	1.38	839	0.86	270	0.53	86	0.32	26	0,23	13
46	2 755	9.74	84 835	6.77	35 683	4.97	17 158	3.81	9 099	2.44	3 153	1.44	907	0.89	292	0.55	93	0.33	28	0,25	14
48	2 875	10.17	91 395	7.06	38 443	5.19	18 485	3.97	9 803	2.54	3 396	1.50	977	0.93	315	0.58	100	0.35	30	0,26	15
50	2 995	10.59	98 163	7.36	41 289	5.40	19 854	4.14	10 529	2.65	3 648	1.57	1 049	0.97	338	0.60	108	0.36	33	0,27	16
52	3 114	11.01	105 137	7.65	44 223	5.62	21 264	4.30	11 277	2.75	3 907	1.63	1 124	1.01	362	0.62	115	0.38	35	0,28	17
54	3 234	11.44	112 316	7.94	47 242	5.84	22 716	4.47	12 047	2.86	4 174	1.69	1 200	1.05	387	0.65	123	0.39	37	0,29	18
56	3 354	11.86	119 696	8.24	50 347	6.05	24 209	4.63	12 838	2.97	4 448	1.75	1 279	1.09	412	0.67	131	0.41	40	0,30	19
58	3 474	12.29	127 277	8.53	53 535	6.27	25 742	4.80	13 652	3.07	4 730	1.82	1 360	1.13	438	0.70	139	0.42	42	0,31	20
60	3 594	12.71	135 057	8.83	56 807	6.48	27 315	4.96	14 486	3.18	5 019	1.88	1 443	1.17	465	0.72	148	0.44	45	0,32	22
62	3 713	13.13	143 033	9.12	60 163	6.70	28 929	5.13	15 341	3.28	5 316	1.94	1 529	1.21	493	0.74	157	0.45	47	0,33	23
64	3 833	3.56	151 205	9.41	63 600	6.92	30 581	5.30	16 218	3.39	5 619	2.01	1 616	1.24	521	0.77	166	0.46	50	0,34	24
66	3 953	13.98	159 571	9.71	67 119	7.13	32 273	5.46	17 115	3.50	5 930	2.07	1 705	1.28	550	0.79	175	0.48	53	0,35	25
68	4 073	14.40	168 129	10.00	70 718	7.35	34 004	5.63	18 033	3.60	6 248	2.13	1 797	1.32	579	0.82	184	0.49	56	0,36	27
70	4 192	14.83	176 878	10.30	74 398	7.57	35 774	5.79	18 972	3.71	6 573	2.19	1 890	1.36	609	0.84	194	0.51	59	0,37	28
75	4 492	15.89	199 576	11.03	83 946	8.11	40 365	6.21	21 406	3.97	7 417	2.35	2 133	1.46	687	0.90	219	0.54	66	0,40	32
80	4 791	16.95	223 439	11.77	93 983	8.65	45 191	6.62	23 966	4.24	8 304	2.51	2 388	1.56	770	0.96	245	0.58	74	0,43	36
85	5 091	18.01	248 447	12.50	104 502	9.19	50 249	7.03	26 648	4.50	9 233	2.66	2 655	1.65	856	1.02	272	0.62	82	0,45	40
90	5 390	19.06	274 584	13.24	115 495	9.73	55 535	7.45	29 451	4.77	10 204	2.82	2 935	1.75	946	1.08	301	0.65	91	0,48	44
95	5 690	20.12	301 834	13.97	126 957	10.27	61 046	7.86	32 374	5.03	11 217	2.98	3 226	1.85	1 040	1.14	331	0.69	100	0,51	48
100	5 989	21.18	330 180	14.71	138 880	10.81	66 780	8.27	35 415	5.30	12 270	3.13	3 529	1.95	1 137	1.20	362	0.73	110	0,53	53

Table 5: Pressure drop diagram for sanitary applications

3.2.1.2. Heating application (70°)

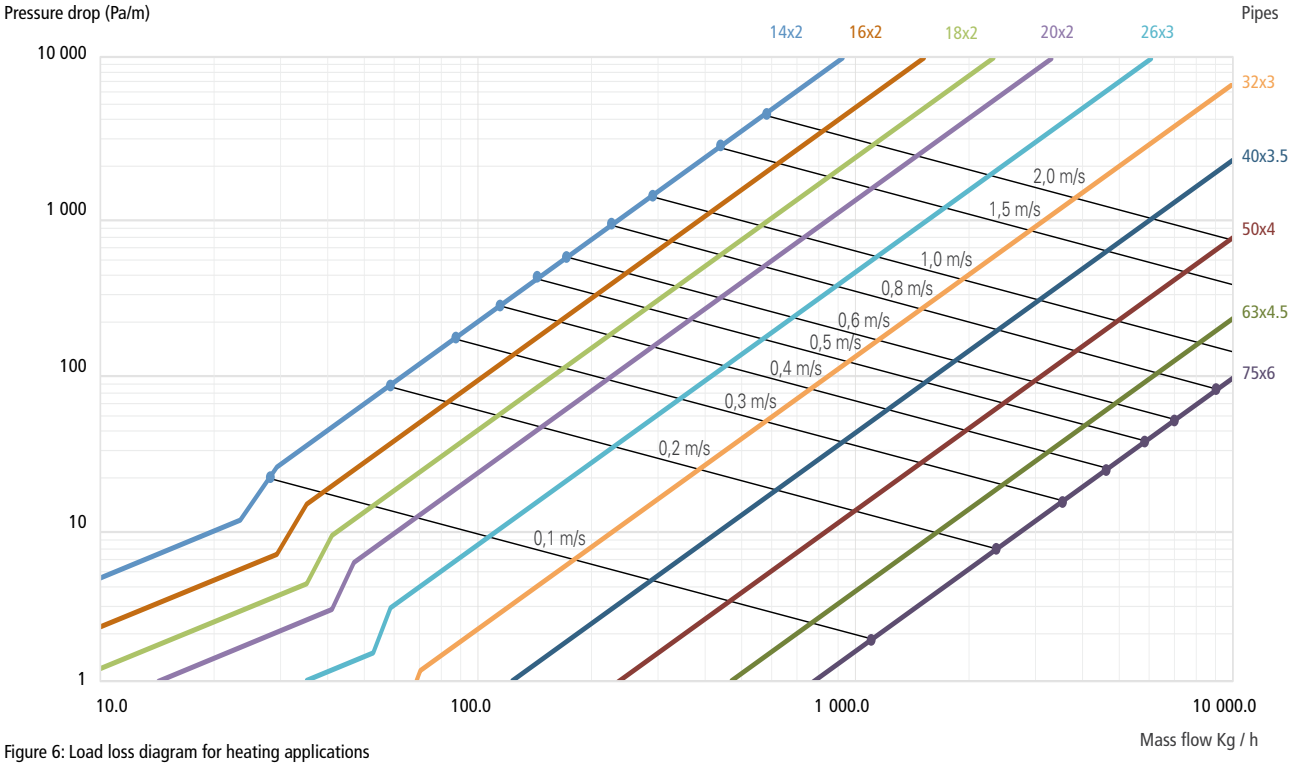


Figure 6: Load loss diagram for heating applications

Heating application (70°)

Flow	Mass flow	14x2		16x2		18x2		20x2		26x3		32x3		40x3.5		50x4		63x4.5		75x6	
l/min	Kg/h	m/sec	Pa/m	m/sec	Pa/m	m/sec	Pa/m	m/sec	Pa/m	m/sec	Pa/m	m/se c	Pa/m	m/sec	Pa/m	m/sec	Pa/m	m/sec	Pa/m	m/s	Pa/m
0.1	5.9	0.02	3	0.01	1	0.01	1	0.01	0	0.01	0	0.00	0	0.00	0	0.00	0	0.00	0	0,00	0
0.2	11.7	0.04	5	0.03	3	0.02	1	0.02	1	0.01	0	0.01	0	0.00	0	0.00	0	0.00	0	0,00	0
0.3	17.6	0.06	8	0.04	4	0.03	2	0.02	1	0.02	1	0.01	0	0.01	0	0.00	0	0.00	0	0,00	0
0.4	23.5	0.08	11	0.06	5	0.04	3	0.03	2	0.02	1	0.01	0	0.01	0	0.00	0	0.00	0	0,00	0
0.5	29.3	0.10	23	0.07	6	0.05	3	0.04	2	0.03	1	0.02	0	0.01	0	0.01	0	0.00	0	0,00	0
0.6	35.2	0.12	32	0.09	14	0.06	4	0.05	2	0.03	1	0.02	0	0.01	0	0.01	0	0.00	0	0,00	0
0.7	41.1	0.15	42	0.10	18	0.07	9	0.06	3	0.04	1	0.02	0	0.01	0	0.01	0	0.00	0	0,00	0
0.8	46.9	0.17	53	0.12	22	0.08	11	0.06	6	0.04	1	0.02	0	0.02	0	0.01	0	0.01	0	0,00	0
0.9	52.8	0.19	66	0.13	28	0.10	13	0.07	7	0.05	2	0.03	1	0.02	0	0.01	0	0.01	0	0,00	0
1.0	58.7	0.21	79	0.14	33	0.11	16	0.08	8	0.05	3	0.03	1	0.02	0	0.01	0	0.01	0	0,01	0
1.1	64.5	0.23	93	0.16	39	0.12	19	0.09	10	0.06	3	0.03	1	0.02	0	0.01	0	0.01	0	0,01	0
1.2	70.4	0.25	109	0.17	46	0.13	22	0.10	12	0.06	4	0.04	1	0.02	0	0.01	0	0.01	0	0,01	0
1.3	76.3	0.27	125	0.19	53	0.14	25	0.11	13	0.07	5	0.04	1	0.02	0	0.02	0	0.01	0	0,01	0
1.4	82.1	0.29	142	0.20	60	0.15	29	0.11	15	0.07	5	0.04	2	0.03	0	0.02	0	0.01	0	0,01	0
1.5	88.0	0.31	161	0.22	68	0.16	32	0.12	17	0.08	6	0.05	2	0.03	0	0.02	0	0.01	0	0,01	0
1.6	93.9	0.33	180	0.23	76	0.17	36	0.13	19	0.08	7	0.05	2	0.03	1	0.02	0	0.01	0	0,01	0
1.7	99.7	0.35	200	0.24	84	0.18	40	0.14	21	0.09	7	0.05	2	0.03	1	0.02	0	0.01	0	0,01	0
1.8	105.6	0.37	221	0.26	93	0.19	45	0.15	24	0.09	8	0.06	2	0.03	1	0.02	0	0.01	0	0,01	0
1.9	111.5	0.39	243	0.27	102	0.20	49	0.15	26	0.10	9	0.06	3	0.04	1	0.02	0	0.01	0	0,01	0
2.0	117.3	0.41	266	0.29	112	0.21	54	0.16	29	0.10	10	0.06	3	0.04	1	0.02	0	0.01	0	0,01	0
2.1	123.2	0.44	289	0.30	122	0.22	59	0.17	31	0.11	11	0.06	3	0.04	1	0.02	0	0.01	0	0,01	0
2.2	129.1	0.46	314	0.32	132	0.23	64	0.18	34	0.11	12	0.07	3	0.04	1	0.03	0	0.02	0	0,01	0
2.3	134.9	0.48	339	0.33	143	0.24	69	0.19	36	0.12	13	0.07	4	0.04	1	0.03	0	0.02	0	0,01	0
2.4	140.8	0.50	366	0.35	154	0.25	74	0.19	39	0.12	14	0.07	4	0.05	1	0.03	0	0.02	0	0,01	0
2.5	146.7	0.52	393	0.36	165	0.26	79	0.20	42	0.13	15	0.08	4	0.05	1	0.03	0	0.02	0	0,01	0
2.6	152.5	0.54	421	0.37	177	0.28	85	0.21	45	0.13	16	0.08	4	0.05	1	0.03	0	0.02	0	0,01	0
2.7	158.4	0.56	449	0.39	189	0.29	91	0.22	48	0.14	17	0.08	5	0.05	2	0.03	0	0.02	0	0,01	0
2.8	164.3	0.58	479	0.40	201	0.30	97	0.23	51	0.15	18	0.09	5	0.05	2	0.03	1	0.02	0	0,01	0
2.9	170.1	0.60	509	0.42	214	0.31	103	0.24	55	0.15	19	0.09	5	0.06	2	0.03	1	0.02	0	0,02	0
3.0	176.0	0.62	540	0.43	227	0.32	109	0.24	58	0.16	20	0.09	6	0.06	2	0.04	1	0.02	0	0,02	0
3.5	205.3	0.73	708	0.50	298	0.37	143	0.28	76	0.18	26	0.11	8	0.07	2	0.04	1	0.02	0	0,02	0
4.0	234.7	0.83	894	0.58	376	0.42	181	0.32	96	0.21	33	0.12	10	0.08	3	0.05	1	0.03	0	0,02	0

Flow	Mass flow	14x2		16x2		18x2		20x2		26x3		32x3		40x3.5		50x4		63x4.5		75x6	
l/min	Kg/h	m/sec	Pa/m	m/sec	Pa/m	m/sec	Pa/m	m/sec	Pa/m	m/sec	Pa/m	m/se c	Pa/m	m/sec	Pa/m	m/sec	Pa/m	m/sec	Pa/m	m/sec	Pa/m
4.5	264.0	0.93	1 099	0.65	462	0.48	222	0.36	118	0.23	41	0.14	12	0.09	4	0.05	1	0.03	0	0,02	0
5.0	293.3	1.04	1 321	0.72	556	0.53	267	0.41	142	0.26	49	0.15	14	0.10	5	0.06	1	0.04	0	0,03	0
5.5	322.7	1.14	1 561	0.79	656	0.58	316	0.45	167	0.29	58	0.17	17	0.10	5	0.06	2	0.04	1	0,03	0
6.0	352.0	1.24	1 817	0.86	764	0.64	368	0.49	195	0.31	68	0.18	19	0.11	6	0.07	2	0.04	1	0,03	0
6.5	381.3	1.35	2 091	0.94	879	0.69	423	0.53	224	0.34	78	0.20	22	0.12	7	0.08	2	0.05	1	0,03	0
7.0	410.7	1.45	2 380	1.01	1 001	0.74	481	0.57	255	0.36	88	0.21	25	0.13	8	0.08	3	0.05	1	0,04	0
7.5	440.0	1.56	2 686	1.08	1 130	0.79	543	0.61	288	0.39	100	0.23	29	0.14	9	0.09	3	0.05	1	0,04	0
8.0	469.3	1.66	3 007	1.15	1 265	0.85	608	0.65	322	0.41	112	0.25	32	0.15	10	0.09	3	0.06	1	0,04	0
8.5	498.7	1.76	3 343	1.22	1 406	0.90	676	0.69	359	0.44	124	0.26	36	0.16	12	0.10	4	0.06	1	0,04	1
9.0	528.0	1.87	3 695	1.30	1 554	0.95	747	0.73	396	0.47	137	0.28	39	0.17	13	0.11	4	0.06	1	0,05	1
9.5	557.3	1.97	4 062	1.37	1 708	1.01	821	0.77	436	0.49	151	0.29	43	0.18	14	0.11	4	0.07	1	0,05	1
10.0	586.7	2.07	4 443	1.44	1 869	1.06	899	0.81	477	0.52	165	0.31	47	0.19	15	0.12	5	0.07	1	0,05	1
10.5	616.0	2.18	4 839	1.51	2 035	1.11	979	0.85	519	0.54	180	0.32	52	0.20	17	0.12	5	0.07	2	0,05	1
11.0	645.3	2.28	5 250	1.59	2 208	1.16	1 062	0.89	563	0.57	195	0.34	56	0.21	18	0.13	6	0.08	2	0,06	1
11.5	674.7	2.39	5 674	1.66	2 387	1.22	1 148	0.93	609	0.60	211	0.35	61	0.22	20	0.14	6	0.08	2	0,06	1
12.0	704.0	2.49	6 113	1.73	2 571	1.27	1 236	0.97	656	0.62	227	0.37	65	0.23	21	0.14	7	0.09	2	0,06	1
12.5	733.3	2.59	6 566	1.80	2 762	1.32	1 328	1.01	704	0.65	244	0.38	70	0.24	23	0.15	7	0.09	2	0,07	1
13.0	762.7	2.70	7 032	1.87	2 958	1.38	1 422	1.05	754	0.67	261	0.40	75	0.25	24	0.15	8	0.09	2	0,07	1
13.5	792.0	2.80	7 512	1.95	3 160	1.43	1 519	1.09	806	0.70	279	0.41	80	0.26	26	0.16	8	0.10	2	0,07	1
14.0	821.3	2.90	8 006	2.02	3 367	1.48	1 619	1.13	859	0.73	298	0.43	86	0.27	28	0.16	9	0.10	3	0,07	1
14.5	850.7	3.01	8 513	2.09	3 581	1.54	1 722	1.18	913	0.75	316	0.45	91	0.28	29	0.17	9	0.10	3	0,08	1
15.0	880.0	3.11	9 033	2.16	3 800	1.59	1 827	1.22	969	0.78	336	0.46	97	0.29	31	0.18	10	0.11	3	0,08	1
16.0	938.7	3.32	10 113	2.31	4 254	1.69	2 045	1.30	1 085	0.83	376	0.49	108	0.30	35	0.19	11	0.11	3	0,08	2
17.0	997.3	3.53	11 245	2.45	4 730	1.80	2 274	1.38	1 206	0.88	418	0.52	120	0.32	39	0.20	12	0.12	4	0,09	2
18.0	1 056.0	3.73	12 428	2.59	5 228	1.91	2 514	1.46	1 333	0.93	462	0.55	133	0.34	43	0.21	14	0.13	4	0,09	2
19.0	1 114.7	3.94	13 662	2.74	5 746	2.01	2 763	1.54	1 465	0.99	508	0.58	146	0.36	47	0.22	15	0.14	5	0,10	2
20.0	1 173.3	4.15	14 945	2.88	6 286	2.12	3 023	1.62	1 603	1.04	555	0.61	160	0.38	51	0.24	16	0.14	5	0,10	2
25.0	1 466.7	5.19	22 084	3.60	9 289	2.65	4 467	2.03	2 369	1.30	821	0.77	236	0.48	76	0.29	24	0.18	7	0,13	4
30.0	1 760.0	6.22	30 384	4.32	12 780	3.18	6 145	2.43	3 259	1.56	1 129	0.92	325	0.57	105	0.35	33	0.21	10	0,16	5
35.0	2 053.3	7.26	39 793	5.04	16 738	3.71	8 048	2.84	4 268	1.82	1 479	1.07	425	0.67	137	0.41	44	0.25	13	0,18	6
40.0	2 346.7	8.30	50 268	5.76	21 144	4.23	10 167	3.24	5 392	2.07	1 868	1.23	537	0.76	173	0.47	55	0.28	17	0,21	8
45.0	2 640.0	9.34	61 774	6.48	25 983	4.76	12 494	3.65	6 626	2.33	2 296	1.38	660	0.86	213	0.53	68	0.32	21	0,24	10
50.0	2 933.3	10.37	74 282	7.20	31 244	5.29	15 024	4.05	7 967	2.59	2 761	1.53	794	0.95	256	0.59	81	0.36	25	0,26	12
55.0	3 226.7	11.41	87 764	7.93	36 915	5.82	17 750	4.46	9 413	2.85	3 262	1.69	938	1.05	302	0.65	96	0.39	29	0,29	14
60.0	3 520.0	12.45	102 199	8.65	42 987	6.35	20 670	4.86	10 962	3.11	3 798	1.84	1 092	1.14	352	0.71	112	0.43	34	0,31	16
65.0	3 813.3	13.49	117 566	9.37	49 451	6.88	23 778	5.27	12 610	3.37	4 369	2.00	1 256	1.24	405	0.76	129	0.46	39	0,34	19
70.0	4 106.7	14.52	133 846	10.09	56 298	7.41	27 071	5.67	14 356	3.63	4 974	2.15	1 430	1.33	461	0.82	147	0.50	44	0,37	21
75.0	4 400.0	15.56	151 022	10.81	63 523	7.94	30 544	6.08	16 198	3.89	5 612	2.30	1 614	1.43	520	0.88	165	0.53	50	0,39	24
80.0	4 693.3	16.60	169 079	11.53	71 118	8.47	34 197	6.48	18 135	4.15	6 283	2.46	1 807	1.52	582	0.94	185	0.57	56	0,42	27
85.0	4 986.7	17.64	188 004	12.25	79 078	9.00	38 024	6.89	20 165	4.41	6 987	2.61	2 009	1.62	647	1.00	206	0.60	62	0,44	30
90.0	5 280.0	18.67	207 782	12.97	87 397	9.53	42 024	7.29	22 286	4.67	7 722	2.76	2 221	1.71	716	1.06	228	0.64	69	0,47	33
95.0	5 573.3	19.71	228 402	13.69	96 070	10.06	46 195	7.70	24 498	4.93	8 488	2.92	2 441	1.81	787	1.12	250	0.68	76	0,50	36
100.0	5 866.7	20.75	249 852	14.41	105 093	10.59	50 533	8.11	26 799	5.19	9 285	3.07	2 670	1.91	860	1.18	274	0.71	83	0,52	40
105.0	6 160.0	21.79	272 123	15.13	114 460	11.12	55 037	8.51	29 187	5.45	10 113	3.22	2 908	2.00	937	1.24	298	0.75	90	0,55	43
110.0	6 453.3	22.82	295 203	15.85	124 168	11.64	59 705	8.92	31 663	5.71	10 971	3.38	3 155	2.10	1 017	1.29	323	0.78	98	0,58	47
115.0	6 746.7	23.86	319 084	16.57	134 213	12.17	64 535	9.32	34 224	5.97	11 858	3.53	3 410	2.19	1 099	1.35	350	0.82	106	0,60	51
120.0	7 040.0	24.90	343 756	17.29	144 590	12.70	69 525	9.73	36 871	6.22	12 775	3.68	3 674	2.29	1 184	1.41	377	0.85	114	0,63	55
125.0	7 333.4	25.94	369 212	18.01	155 298	13.23	74 674	10.13	39 601	6.48	13 721	3.84	3 946	2.38	1 272	1.47	404	0.89	123	0,65	59
130.0	7 626.7	26.97	395 443	18.73	166 331	13.76	79 979	10.54	42 414	6.74	14 696	3.99	4 226	2.48	1 362	1.53	433	0.93	131	0,68	63
135.0	7 920.0	28.01	422 442	19.45	177 687	14.29	85 440	10.94	45 310	7.00	15 699	4.14	4 515	2.57	1 455	1.59	463	0.96	140	0,71	67
140.0	8 213.4	29.05	450 202	20.17	189 364	14.82	91 054	11.35	48 288	7.26	16 731	4.30	4 812	2.67	1 550	1.65	493	1.00	149	0,73	72
145.0	8 506.7	30.09	478 715	20.89	201 357	15.35	96 821	11.75	51 346	7.52	17 790	4.45	5 116	2.76	1 649	1.71	524	1.03	159	0,76	76
150.0	8 800.0	31.12	507 976	21.61	213 664	15.88	102 739	12.16	54 485	7.78	18 878	4.60	5 429	2.86	1 749	1.76	556	1.07	169	0,78	81
155.0	9 093.4	32.16	537 977	22.33	226 283	16.41	108 807	12.56	57 702	8.04	19 993	4.76	5 750	2.95	1 853	1.82	589	1.10	179	0,81	86
160.0	9 386.7	33.20	568 713	23.05	239 212	16.94	115 023	12.97	60 999	8.30	21 135	4.91	6 078	3.05	1 959	1.88	623	1.14	189	0,84	91
165.0	9 680.0	34.24	600 178	23.78	252 446	17.47	121 387	13.37	64 374	8.56	22 304	5.06	6 414	3.14	2 067	1.94	657	1.17	199	0,86	96
170.0	9 973.4	35.27	632 367	24.50	265 986	18.00	127 897	13.78	67 826	8.82	23 500	5.22	6 758	3.24	2 178	2.00	693	1.21	210	0,89	101
175.0	10 266.7	36.31	665 273	25.22	279 827	18.53	134 552	14.18	71 356	9.08	24 723	5.37	7 110	3.33	2 291	2.06	729	1.25	221	0,91	106
180.0	10 560.0	37.35	698 892	25.94	293 967	19.06	141 352	14.59	74 962	9.34	25 973	5.52	7 469	3.43	2 407	2.12	766	1.28	232	0,94	112
185.0	10 853.4	38.39	733 219	26.66	308 406	19.58	148 295	14.99	78 644	9.60	27 248	5.68	7 836	3.52	2 525	2.18	803	1.32	243	0,97	117
190.0	11 146.7	39.42	768 249	27.38	323 140	20.11	155 380	15.40	82 401	9.86	28 550	5.83	8 211	3.62	2 646	2.23	842	1.35	255	0,99	123
195.0	11 440.0	40.46	803 977	28.10	338 168	20.64	162 606	15.81	86 233	10.12	29 878	5.99	8 593	3.72	2 769	2.29	881	1.39	267	1,02	128
200.0	11 733.4	41.50	840 400	28.82	353 488	21.17	169 972	16.21	90 140	10.37	31 232	6.14	8 982	3.81	2 894	2.35	921	1.42	279	1,05	134

Table 6: Load loss diagram for heating applications

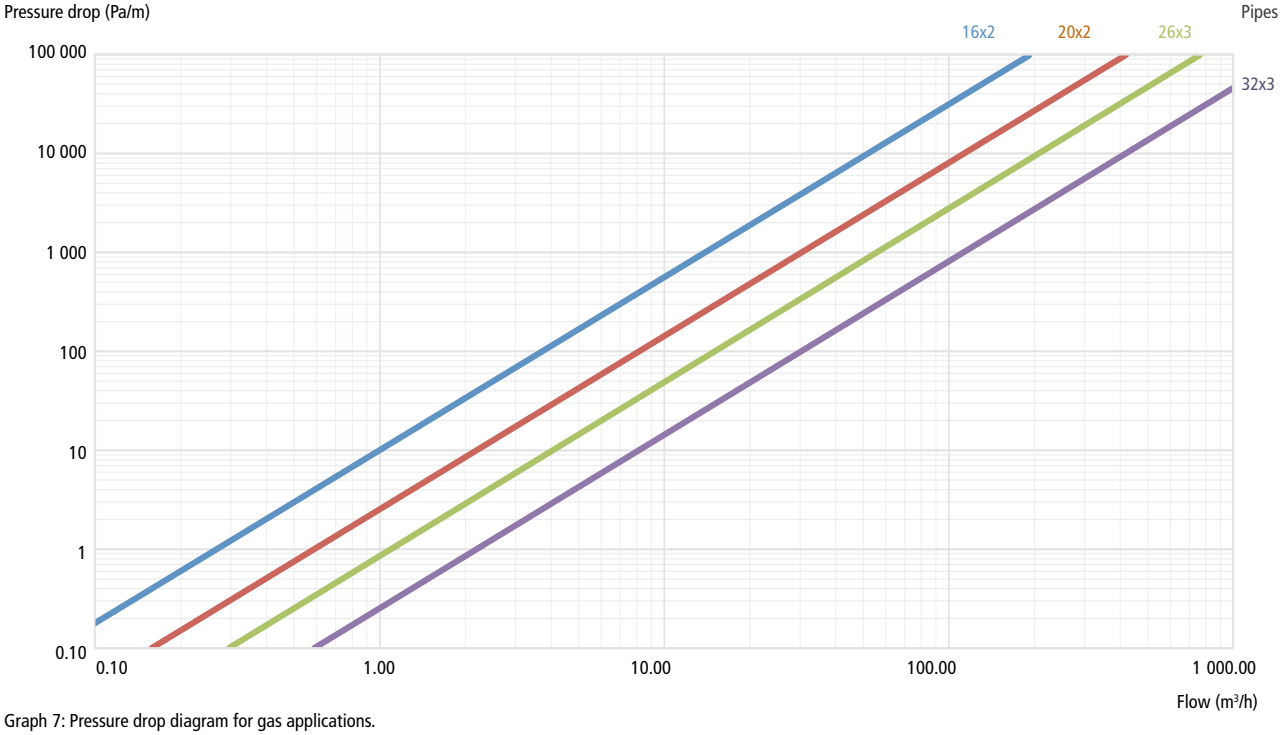
3.2.1.3. Natural gas application (12°C)

Like water, the gas will lose energy because of friction against the pipe wall. An accurate calculation can be made for pipes by means of a pressure drop diagram for gas. According to Dutch regulation NEN 1078, the pipe system must be designed so that no drop in pressure exceeds the difference between operating pressure and minimum required use pressure, depending on the manufacturer of the devices.

Atmospheric pressure 1013.

Gas temperature of 12°C.

Heat value of natural gas 35.17 MJ / m³ (maximum value for the Netherlands).



Graph 7: Pressure drop diagram for gas applications.

Natural gas application (12°C)

Power	Flow	Diameter 16x2		Diameter 20x2		Diameter 26x3		Diameter 32x3	
(kW)	m³/h	Speed (m/s)	r (Pa/m)	Speed (m/s)	r (Pa/m)	Speed (m/s)	r (Pa/m)	Speed (m/s)	r (Pa/m)
1	0.10	0.25	0.19	0.14	0.05	0.09	0.02	0.05	0.00
2	0.20	0.50	0.63	0.28	0.16	0.18	0.06	0.11	0.02
3	0.31	0.75	1.28	0.42	0.33	0.27	0.11	0.16	0.03
4	0.41	1.01	2.12	0.57	0.54	0.36	0.19	0.21	0.05
5	0.51	1.26	3.13	0.71	0.80	0.45	0.28	0.27	0.08
6	0.61	1.51	4.31	0.85	1.10	0.54	0.38	0.32	0.11
7	0.72	1.76	5.64	0.99	1.44	0.63	0.50	0.37	0.14
8	0.82	2.01	7.13	1.13	1.82	0.72	0.63	0.43	0.18
9	0.92	2.26	8.76	1.27	2.23	0.81	0.77	0.48	0.22
10	1.02	2.51	10.53	1.41	2.69	0.91	0.93	0.54	0.27
11	1.13	2.77	12.44	1.56	3.17	1.00	1.10	0.59	0.32
12	1.23	3.02	14.49	1.70	3.69	1.09	1.28	0.64	0.37
13	1.33	3.27	16.67	1.84	4.25	1.18	1.47	0.70	0.42
14	1.43	3.52	18.98	1.98	4.84	1.27	1.68	0.75	0.48
15	1.54	3.77	21.41	2.12	5.46	1.36	1.89	0.80	0.54
16	1.64	4.02	23.97	2.26	6.11	1.45	2.12	0.86	0.61
17	1.74	4.27	26.66	2.40	6.80	1.54	2.36	0.91	0.68
18	1.84	4.53	29.46	2.55	7.51	1.63	2.60	0.96	0.75
19	1.94	4.78	32.38	2.69	8.26	1.72	2.86	1.02	0.82
20	2.05	5.03	35.42	2.83	9.03	1.81	3.13	1.07	0.90
21	2.15	5.28	38.58	2.97	9.84	1.90	3.41	1.12	0.98
22	2.25	5.53	41.85	3.11	10.67	1.99	3.70	1.18	1.06
23	2.35	5.78	45.24	3.25	11.54	2.08	4.00	1.23	1.15
24	2.46	6.03	48.74	3.39	12.43	2.17	4.31	1.29	1.24
25	2.56	6.29	52.35	3.54	13.35	2.26	4.62	1.34	1.33
26	2.66	6.54	56.07	3.68	14.30	2.35	4.95	1.39	1.42

Power	Flow	Diameter 16x2		Diameter 20x2		Diameter 26x3		Diameter 32x3	
(kW)	m³/h	Speed (m/s)	r (Pa/m)	Speed (m/s)	r (Pa/m)	Speed (m/s)	r (Pa/m)	Speed (m/s)	r (Pa/m)
27	2.76	6.79	59.89	3.82	15.27	2.44	5.29	1.45	1.52
28	2.87	7.04	63.83	3.96	16.28	2.53	5.64	1.50	1.62
29	2.97	7.29	67.87	4.10	17.31	2.62	6.00	1.55	1.72
30	3.07	7.54	72.02	4.24	18.37	2.72	6.36	1.61	1.83
31	3.17	7.79	76.27	4.38	19.45	2.81	6.74	1.66	1.94
32	3.28	8.04	80.63	4.53	20.56	2.90	7.12	1.71	2.05
33	3.38	8.30	85.09	4.67	21.70	2.99	7.52	1.77	2.16
34	3.48	8.55	89.66	4.81	22.86	3.08	7.92	1.82	2.28
35	3.58	8.80	94.32	4.95	24.05	3.17	8.33	1.87	2.40
36	3.68	9.05	99.09	5.09	25.27	3.26	8.75	1.93	2.52
37	3.79	9.30	103.96	5.23	26.51	3.35	9.18	1.98	2.64
38	3.89	9.55	108.92	5.37	27.78	3.44	9.62	2.04	2.77
39	3.99	9.80	113.99	5.52	29.07	3.53	10.07	2.09	2.90
40	4.09	10.06	119.15	5.66	30.38	3.62	10.53	2.14	3.03
41	4.20	10.31	124.41	5.80	31.73	3.71	10.99	2.20	3.16
42	4.30	10.56	129.77	5.94	33.09	3.80	11.47	2.25	3.30
43	4.40	10.81	135.23	6.08	34.48	3.89	11.95	2.30	3.44
44	4.50	11.06	140.78	6.22	35.90	3.98	12.44	2.36	3.58
45	4.61	11.31	146.43	6.36	37.34	4.07	12.94	2.41	3.72
46	4.71	11.56	152.17	6.51	38.80	4.16	13.44	2.46	3.87
47	4.81	11.82	158.00	6.65	40.29	4.25	13.96	2.52	4.01
48	4.91	12.07	163.93	6.79	41.80	4.34	14.48	2.57	4.17
49	5.02	12.32	169.96	6.93	43.34	4.43	15.02	2.62	4.32
50	5.12	12.57	176.07	7.07	44.90	4.53	15.56	2.68	4.47
51	5.22	12.82	182.28	7.21	46.48	4.62	16.10	2.73	4.63
52	5.32	13.07	188.58	7.35	48.09	4.71	16.66	2.78	4.79
53	5.43	13.32	194.97	7.50	49.72	4.80	17.23	2.84	4.95
54	5.53	13.58	201.46	7.64	51.37	4.89	17.80	2.89	5.12
55	5.63	13.83	208.03	7.78	53.05	4.98	18.38	2.95	5.29
56	5.73	14.08	214.70	7.92	54.75	5.07	18.97	3.00	5.46
57	5.83	14.33	221.45	8.06	56.47	5.16	19.57	3.05	5.63
58	5.94	14.58	228.29	8.20	58.21	5.25	20.17	3.11	5.80
59	6.04	14.83	235.23	8.34	59.98	5.34	20.78	3.16	5.98
60	6.14	15.08	242.25	8.48	61.77	5.43	21.40	3.21	6.16
61	6.24	15.34	249.36	8.63	63.59	5.52	22.03	3.27	6.34
62	6.35	15.59	256.55	8.77	65.42	5.61	22.67	3.32	6.52
63	6.45	15.84	263.84	8.91	67.28	5.70	23.31	3.37	6.70
64	6.55	16.09	271.21	9.05	69.16	5.79	23.96	3.43	6.89
65	6.65	16.34	278.67	9.19	71.06	5.88	24.62	3.48	7.08
66	6.76	16.59	286.22	9.33	72.99	5.97	25.29	3.53	7.27
67	6.86	16.84	293.85	9.47	74.93	6.06	25.96	3.59	7.47
68	6.96	17.10	301.57	9.62	76.90	6.15	26.64	3.64	7.66
69	7.06	17.35	309.37	9.76	78.89	6.24	27.33	3.70	7.86
70	7.17	17.60	317.26	9.90	80.90	6.34	28.03	3.75	8.06
71	7.27	17.85	325.23	10.04	82.93	6.43	28.74	3.80	8.26
72	7.37	18.10	333.29	10.18	84.99	6.52	29.45	3.86	8.47
73	7.47	18.35	341.44	10.32	87.07	6.61	30.17	3.91	8.68
74	7.57	18.60	349.66	10.46	89.16	6.70	30.89	3.96	8.88
75	7.68	18.86	357.97	10.61	91.28	6.79	31.63	4.02	9.10
76	7.78	19.11	366.37	10.75	93.42	6.88	32.37	4.07	9.31
77	7.88	19.36	374.85	10.89	95.59	6.97	33.12	4.12	9.52
78	7.98	19.61	383.41	11.03	97.77	7.06	33.87	4.18	9.74
79	8.09	19.86	392.05	11.17	99.97	7.15	34.64	4.23	9.96
80	8.19	20.11	400.78	11.31	102.20	7.24	35.41	4.28	10.18
81	8.29	20.36	409.58	11.45	104.44	7.33	36.19	4.34	10.41
82	8.39	20.62	418.47	11.60	106.71	7.42	36.97	4.39	10.63
83	8.50	20.87	427.45	11.74	109.00	7.51	37.77	4.44	10.86
84	8.60	21.12	436.50	11.88	111.31	7.60	38.57	4.50	11.09
85	8.70	21.37	445.63	12.02	113.64	7.69	39.37	4.55	11.32
86	8.80	21.62	454.85	12.16	115.99	7.78	40.19	4.61	11.56
87	8.91	21.87	464.14	12.30	118.36	7.87	41.01	4.66	11.79
88	9.01	22.12	473.52	12.44	120.75	7.96	41.84	4.71	12.03
89	9.11	22.38	482.98	12.59	123.16	8.06	42.67	4.77	12.27
90	9.21	22.63	492.51	12.73	125.59	8.15	43.51	4.82	12.51
91	9.31	22.88	502.13	12.87	128.04	8.24	44.36	4.87	12.76
92	9.42	23.13	511.83	13.01	130.52	8.33	45.22	4.93	13.00
93	9.52	23.38	521.60	13.15	133.01	8.42	46.08	4.98	13.25
94	9.62	23.63	531.46	13.29	135.52	8.51	46.96	5.03	13.50
95	9.72	23.88	541.39	13.43	138.05	8.60	47.83	5.09	13.76
96	9.83	24.13	551.40	13.58	140.61	8.69	48.72	5.14	14.01
97	9.93	24.39	561.49	13.72	143.18	8.78	49.61	5.19	14.27
98	10.03	24.64	571.66	13.86	145.77	8.87	50.51	5.25	14.53
99	10.13	24.89	581.91	14.00	148.39	8.96	51.41	5.30	14.79
100	10.24	25.14	592.23	14.14	151.02	9.05	52.33	5.36	15.05

Table 7: Pressure drop diagram for gas applications.

3.2.2. Specific pressure losses

Specific pressure losses involve resistance to liquid flow caused by elbows and changes in direction and section of pipes.

3.2.2.1. Reminder: calculation of drops in pressure

Example for a crimped brass elbow with a 16 x 2 diameter multilayer pipe and flow equal to 900 l/h, according to the table Kv = 2.03 m^3/h and Zeta = 1.59.

Kv value: the quantity of water that flows through the fitting creating a drop in pressure of 1 bar.

$$\Delta P = 1000(Q/Kv)^2$$

ΔP	Pressure loss	mbar
Kv	Kv value (see table)	m^3/hour
Q	Débit	m^3/hour

The calculation shows: $\Delta P = 1{,}000\ (0.9/2.03)^2 = 196.56$ mbar

With a 16x2 elbow joint, if the flow rate is 900 l/h or 0.9 m^3/h (see 3.2.2.3. (see table of equivalents on page 63) and the Kv value is 2.03, pressure drop is 196.56 mbar per meter, or 0.19 bar per meter.

Zeta value: The Zeta value defines the hydraulic resistance of a fitting, according to its shape.

$$\zeta = \frac{200\Delta P}{\rho\, v^2} \quad \text{ou} \quad \Delta P = \zeta\, \frac{1}{200}\, \rho\, v^2$$

ζ	Zeta value	-
ΔP	Load loss mbar	mbar
V	Velocity (calculation method below)	m/sec
ρ	Density (around 1,000)	kg/m^3

The calculation shows: $\Delta P = 1.59 \times 1/2 \times 1{,}000 \times 4.97^2 = 196{,}4$ mbar

With a 16 x 2 brass elbow, if the flow rate is 900 l/h or 0.9 m^3/h and the Zeta value is 1.59 pressure drop is 19,600 pascal (or 0.19 bar) per meter.

Calcul de la vélocité :

$$V = \frac{Q/3600}{\pi\, R^2}$$

Q	Flow	m^3/h
V	Velocity	m/sec
R	Inner radius of the fitting	m

The calculation is: $V = \dfrac{\frac{0.9\ m^3/h}{3600}}{\pi \times 0.004^2} = 4.97$ m/s

With a 16 x 2 mm diameter bras elbow (i.e. an inner diameter of 0,004 mm according to the "fittings diameters table" chapter 1.2.5.), and flow is 900 l/h, then flow velocity is 4.97m/s.

3.2.2.2. Table of specific pressure losses

3.2.2.2.1. Kv values of metal crimp fittings

Values according EN 1267, 2m/s in the fitting, water at 20°C, Kv(m^3/h)

Figures			Table of Kv values measured following NF EN 1267									
			Ø 14	Ø 16	Ø 18	Ø 20	Ø 26	Ø 32	Ø 40	Ø 50	Ø 63	Ø 75
7090W			0.97	2.03	2.93	4.32	6.35	12.67	22.89	38.61	67.01	96.56
7041W							9.55	21.29	37.16	63.44	114.55	166.54
7270W			1.69	4.39	5.75	9.93	11.6	27.99	51.13	86.29	165.91	242.54
7130W*	 A B C	A > B	0.97	2.03	2.93	4.22	6.2	12.25	22.89	38.61	67.01	96.56
		B > C	0.97	1.95	2.93	4.22	6.2	12.25	22.89	38.61	67.01	96.56
		A > C	1.39	3.82	7.22	8.73	10.4	26.48	46.82	81.08	152.08	246.47
			Ø 16 - 1/2"	Ø 20 - 1/2"	Ø 20 - 3/4"	Ø 26 - 3/4"						
7471GW			2.39	4.82	4.29	6.5						
			Ø 16-14	Ø 18-16	Ø 20-14	Ø 20-16	Ø 20-18	Ø 26-16	Ø 26-18	Ø 26-20	Ø 32-16	Ø 32-20
7240W			1.53	3.63	1.64	3.41	4.46	3.46	4.94	7.85	3.31	7.19
			Ø 32-26	Ø 40-20	Ø 40-26	Ø 40-32	Ø 50-32	Ø 50-40	Ø 63-40	Ø 63-50	Ø 75-50	Ø 75-63
			10.40	6.42	9.64	21.97	17.60	33.98	29.95	56.80	55.76	111.12
			Ø 16-16-16*	Ø 20-16-16*	Ø 20-16-20*	Ø 20-20-20*						
7495W*	 A B C		1.95	2.01	2.33	2.36						
			1.41	1.69	1.45	2.82						
			Ø 16-20-16*	Ø 18-16-18*	Ø 20-16-16*	Ø 20-16-20*	Ø 20-20-16*	Ø 26-16-26*	Ø 26-20-26*	Ø 32-16-32*	Ø 32-20-32*	Ø 32-26-32*
7130RW*	 A B C	A > B	2.13	2.42	2.71	2.71	4.69	2.82	5.02	2.81	5.52	8.00
		B > C	3.01	2.18	2.46	3.08	3.02	3.10	5.87	2.82	6.53	9.87
		A > C	3.72	5.12	3.63	8.09	3.61	11.20	11.20	26.31	26.31	26.31
			Ø 40-20-40*	Ø 40-26-40*	Ø 40-32-40*	Ø 50-26-50*	Ø 50-32-50*	Ø 50-40-50*	Ø 63-26-63*	Ø 63-32-63*	Ø 63-40-63*	Ø 63-50-63*
		A > B	5.42	8.08	17.1	7.98	16.73	26.38	7.82	15.93	27.21	43.33
		B > C	3.9	6.17	14.87	5.86	14.09	24.23	5.65	12.36	22.81	41.08
		A > C	46.88	46.88	46.88	81.08	81.08	81.08	152.08	152.08	152.08	152.08
			Ø 75-50-75*	Ø 75-63-75*								
		A > B	45.4	74.47								
		B > C	39.36	71.34								
		A > C	223.19	223.19								
			Ø 16 - 3/4E	Ø 18 - 3/4E	Ø 20 - 3/4E							
7359GEW			3.31	5.73	8.10							
			Ø 14 - 1/2	Ø 16 - 3/8	Ø 16 - 1/2	Ø 20 - 1/2	Ø 20 - 3/4	Ø 26 - 3/4	Ø 26 - 1"	Ø 32 - 1"		
7243GW			1.21	4.09	3.47	10.20	6.58	11.00	9.46	24.60		
			Ø 14 - 1/2	Ø 16 - 1/2	Ø 18 - 1/2	Ø 20 - 1/2	Ø 20 - 3/4	Ø 26 - 3/4	Ø 26 - 1"	Ø 32 - 1"		
7270GW			1.23	3.43	5.29	10.40	6.67	11.40	9.53	26.40		
			Ø 14 - 1/2	Ø 16 - 1/2	Ø 18 - 1/2	Ø 20 - 1/2	Ø 20 - 3/4	Ø 26 - 3/4	Ø 26 - 1"	Ø 32 - 1"		
7092GW			1.04	2.59	3.21	4.93	4.27	6.59	7.97	13.00		
			Ø 14 - 1/2	Ø 16 - 1/2	Ø 18 - 1/2	Ø 20 - 1/2	Ø 20 - 3/4	Ø 26 - 3/4	Ø 26 - 1"	Ø 32 - 1"		
7090GW			0.97	1.91	3.37	4.96	4.92	6.45	7.80	13.30		

*Reading order: A-B-C

3.2.2.2.2. Zeta values of metal crimp fittings

Values according EN 1267, 2m/s in the fitting, water at 20°C

Figures			Table of Zeta values measured following NF EN 1267									
			Ø 14	Ø 16	Ø 18	Ø 20	Ø 26	Ø 32	Ø 40	Ø 50	Ø 63	Ø 75
7090W			1.92	1.59	1.59	1.35	1.44	1.44	1.29	1.27	1.22	1.21
7041W							0.64	0.51	0.49	0.47	0.42	0.41
7270W			0.63	0.34	0.41	0.26	0.43	0.30	0.26	0.25	0.20	0.19
7130W*	 A B C	A > B	1.92	1.59	1.59	1.41	1.51	1.54	1.29	1.27	1.22	1.21
		B > C	1.92	1.72	1.59	1.41	1.51	1.54	1.29	1.27	1.22	1.21
		A > C	0.94	0.45	0.26	0.33	0.54	0.33	0.31	0.29	0.24	0.19
			Ø 16 - 1/2"	Ø 20 - 1/2"	Ø 20 - 3/4"	Ø 26 - 3/4"						
7471GW			1.15	1.08	1.37	1.37						
			Ø 16-14	Ø 18-16	Ø 20-14	Ø 20-16	Ø 20-18	Ø 26-16	Ø 26-18	Ø 26-20	Ø 32-16	Ø 32-20
7240W			0.77	0.50	0.67	0.56	0.69	0.55	0.56	0.41	0.60	0.49
			Ø 32-26	Ø 40-20	Ø 40-26	Ø 40-32	Ø 50-32	Ø 50-40	Ø 63-40	Ø 63-50	Ø 75-50	Ø 75-63
			0.54	0.61	0.62	0.48	0.75	0.59	0.75	0.59	0.61	0.44
			Ø 16-16-16*	Ø 20-16-16*	Ø 20-16-20*	Ø 20-20-20*						
7495W*	 A B C	A > B	1.72	1.62	1.21	4.52						
		A > B	3.29	2.29	3.11	3.16						
			Ø 16-20-16*	Ø 18-16-18*	Ø 20-16-16*	Ø 20-16-20*	Ø 20-20-16*	Ø 26-16-26*	Ø 26-20-26*	Ø 32-16-32*	Ø 32-20-32*	Ø 32-26-32*
7130RW*	 A B C	A > B	1.44	1.12	0.89	0.89	1.14	0.82	1.00	0.83	0.83	0.91
		B > C	0.72	1.38	1.08	0.69	0.72	0.68	0.73	0.82	0.59	0.60
		A > C	0.47	0.52	0.50	0.38	0.50	0.46	0.46	0.33	0.33	0.33
			Ø 40-20-40*	Ø 40-26-40*	Ø 40-32-40*	Ø 50-26-50*	Ø 50-32-50*	Ø 50-40-50*	Ø 63-26-63*	Ø 63-32-63*	Ø 63-40-63*	Ø 63-50-63*
		A > B	0.86	0.89	0.79	0.91	0.83	0.97	0.95	0.91	0.91	1.01
		B > C	1.65	1.52	1.05	1.69	1.16	1.15	1.82	1.51	1.30	1.12
		A > C	0.31	0.31	0.31	0.29	0.29	0.29	0.24	0.24	0.24	0.24
			Ø 75-50-75*	Ø 75-63-75*								
		A > B	0.92	0.99								
		B > C	1.22	1.07								
		A > C	0.23	0.23								
			Ø 16 - 3/4E	Ø 18 - 3/4E	Ø 20 - 3/4E							
7359GEW			0.60	0.42	0.38							
			Ø 14 - 1/2	Ø 16 - 3/8	Ø 16 - 1/2	Ø 20 - 1/2	Ø 20 - 3/4	Ø 26 - 3/4	Ø 26 - 1"	Ø 32 - 1"		
7243GW			1.24	0.39	0.54	0.24	0.58	0.48	0.65	0.38		
			Ø 14 - 1/2	Ø 16 - 1/2	Ø 18 - 1/2	Ø 20 - 1/2	Ø 20 - 3/4	Ø 26 - 3/4	Ø 26 - 1"	Ø 32 - 1"		
7270GW			1.20	0.56	0.49	0.23	0.57	0.45	0.64	0.33		
			Ø 14 - 1/2	Ø 16 - 1/2	Ø 18 - 1/2	Ø 20 - 1/2	Ø 20 - 3/4	Ø 26 - 3/4	Ø 26 - 1"	Ø 32 - 1"		
7092GW			1.67	0.98	1.32	1.04	1.38	1.34	0.91	1.37		
			Ø 14 - 1/2	Ø 16 - 1/2	Ø 18 - 1/2	Ø 20 - 1/2	Ø 20 - 3/4	Ø 26 - 3/4	Ø 26 - 1"	Ø 32 - 1"		
7090GW			1.92	1.80	1.20	1.02	1.04	1.39	0.95	1.31		

*Reading order: A-B-C

3.2.2.2.3. Kv values of synthetic crimp and push fittings

Values according EN 1267, 2m/s in the fitting, water at 20°C, Kv(m^3/h)

Figures				Table of Kv values measured following NF EN 1267										
				Ø 16	Ø 20	Ø 26	Ø 32	Ø 40	Ø 50	Ø 63				
9090W				1.71	4.11	6.40	12.91	22.32	39.50	66.72				
9041W						9.91	20.98	34.94	66.64	113.18				
9270W				2.80	8.20	12.83	27.75	46.80	93.78	158.43				
9130W*			A > B	1.67	4.11	6.40	12.91	22.32	39.30	66.72				
			B > C	1.68	4.11	6.40	12.91	22.32	39.30	66.72				
			A > C	2.71	7.65	12.00	26.02	46.80	88.01	149.50				
				Ø 20-16	Ø 26-16	Ø 26-20	Ø 32-16	Ø 32-20	Ø 32-26	Ø 40-26	Ø 40-32	Ø 50-32	Ø 63-40	
9240W				3.2	3.18	7.6	3.06	7.37	11.62	10.66	22.15	20.45	34.98	
				Ø 16-20-16*	Ø 20-16-16*	Ø 20-16-20*	Ø 20-20-16*	Ø 20-26-16*	Ø 20-26-20*	Ø 26-16-16*	Ø 26-16-26*	Ø 26-20-26*	Ø 26-26-20*	
9130RW*			A > B	1.66	1.60	1.60	4.11	5.70	5.70	2.20	2.26	4.91	6.40	
			B > C	1.60	1.95	1.66	2.58	2.26	4.89	1.93	2.31	5.72	5.29	
			A > C	2.75	3.05	7.74	3.04	2.42	7.52	3.01	12.28	12.17	7.35	
				Ø 32-16-32*	Ø 32-20-32*	Ø 32-26-26*	Ø 32-26-32*	Ø 40-26-40*	Ø 40-32-40*	Ø 50-26-50*	Ø 63-26-63*	Ø 63-40-63*		
			A > B	2.28	5.35	8.05	8.05	8.06	15.2	7.94	7.81	26.87		
			B > C	2.19	6.24	7.76	10.00	5.92	13.59	6.46	5.64	29.07		
			A > C	27.24	27.02	11.13	27.44	45.18	44.8	90.87	152.68	154.88		

*Reading order: A-B-C

3.2.2.2.4. Zeta values of synthetic crimp and push fittings

Values according EN 1267, 2 m/s in the fitting, water at 20°C

Figures				Table of Zeta values measured following NF EN 1267										
				Ø 16	Ø 20	Ø 26	Ø 32	Ø 40	Ø 50	Ø 63				
9090W				1.73	1.54	1.50	1.39	1.31	1.22	1.23				
9041W						0.63	0.53	0.54	0.43	0.43				
9270W				0.65	0.39	0.37	0.30	0.30	0.22	0.22				
9130W*			A > B	1.81	1.54	1.50	1.39	1.31	1.23	1.23				
			B > C	1.79	1.54	1.50	1.39	1.31	1.23	1.23				
			A > C	0.69	0.45	0.43	0.34	0.30	0.24	0.24				
				Ø 20-16	Ø 26-16	Ø 26-20	Ø 32-16	Ø 32-20	Ø 32-26	Ø 40-26	Ø 40-32	Ø 50-32	Ø 63-40	
9240W				0.49	0.50	0.45	0.54	0.48	0.45	0.54	0.47	0.55	0.54	
				Ø 16-20-16*	Ø 20-16-16*	Ø 20-16-20*	Ø 20-20-16*	Ø 20-26-16*	Ø 20-26-20*	Ø 26-16-16*	Ø 26-16-26*	Ø 26-20-26*	Ø 26-26-20*	
9130RW*			A > B	1.84	1.98	1.98	1.54	0.80	0.80	1.05	0.99	2.55	1.50	
			B > C	1.98	1.33	1.84	0.76	0.99	1.09	1.36	0.95	0.80	0.93	
			A > C	0.67	0.54	0.44	0.55	0.86	0.46	0.56	0.41	0.41	0.48	
				Ø 32-16-32*	Ø 32-20-32*	Ø 32-26-26*	Ø 32-26-32*	Ø 40-26-40*	Ø 40-32-40*	Ø 50-26-50*	Ø 63-26-63*	Ø 63-40-63*		
			A > B	0.97	0.91	0.95	0.95	0.95	1.00	0.97	1.01	0.91		
			B > C	1.05	0.67	1.02	0.61	1.75	1.25	1.47	1.93	0.78		
			A > C	0.31	0.32	0.50	0.31	0.32	0.33	0.23	0.23	0.23		

* Sens de lecture : A-B-C

3.2.3. Pressure drop equivalents

This method gives the length of a straight pipe segment of the same diameter that would have the same pressure drop as a given fitting. To use this calculation method, all equivalent length values for each fitting must be added to the actual length of the system. In this way, we get the total pressure drop of all the fittings in the network.

This method is not as accurate as the direct method, but the calculation is quicker.

Equivalent pressure drops between a fitting and the length of a pipe.

Example:

The pressure losses due to a brass crimp elbow with a diameter of 16 mm is equivalent to the pressure drop of a 3,20 meters length of 16 x 2 mm multilayer pipe.

Metal MultiSkin				Table of equivalent lengths m (Multilayer)									
Figures				**Ø 14**	**Ø 16**	**Ø 18**	**Ø 20**	**Ø 26**	**Ø 32**	**Ø 40**	**Ø 50**	**Ø 63**	**Ø 75**
Equal tee			A > B	5.38	3.20	3.45	3.36	5.02	5.09	5.10	6.36	7.90	8.54
			B > C	5.38	3.47	3.45	3.36	5.02	5.09	5.10	6.36	7.90	8.54
			A > C	2.62	0.90	0.57	0.78	1.78	1.09	1.22	1.44	1.53	1.31
Coupling				1.77	0.68	0.90	0.61	1.43	0.98	1.02	1.27	1.29	1.35
Wall plate					2.31		2.57	4.56					
90° elbow				5.38	3.20	3.45	3.20	4.78	4.76	5.10	6.36	7.90	8.54
45° elbow								2.11	1.69	1.94	2.36	2.70	2.87

Pressure drop multilayer pipe / fluid velocity 1m / s (in the pipe).

Synthetic MultiSkin				Table of equivalent lengths m (Multilayer)						
Figures				**Ø 16**	**Ø 20**	**Ø 26**	**Ø 32**	**Ø 40**	**Ø 50**	**Ø 63**
Equal tee			A > B	4.73	3.54	4.71	4.59	5.36	6.14	7.97
			B > C	4.68	3.54	4.71	4.59	5.36	6.14	7.97
			A > C	1.80	1.02	1.34	1.13	1.22	1.22	1.59
Coupling				1.68	0.89	1.17	0.99	1.22	1.08	1.41
90° elbow				4.51	3.54	4.71	4.59	5.36	6.08	7.97
45° elbow						1.96	1.74	2.19	2.13	2.77

Pressure drop multilayer pipe / fluid velocity 1m / s (in the pipe).

3.2.4. Table of specific pressure losses - MultiSkin Gas

Measurements according to DVGW protocol - 2 m/s in the cannula - Natural gas at 15°C

Figures				Article	Dimensions	Kv (m^3/h)	Zeta
Equal tee			A > B	7130G16	16x2	79.06	7.91
				7130G20	20x2	158.8	6.19
				7130G26	26x3	235.69	6.86
				7130G32	32x3	497.25	4.4
			B > C	7130G16	16x2	79.06	7.91
				7130G20	20x2	158.8	6.19
				7130G26	26x3	235.69	6.86
				7130G32	32x3	497.25	4.4
			A > C	7130G16	16x2	128.54	2.99
				7130G20	20x2	273.57	2.09
				7130G26	26x3	387.34	2.54
				7130G32	32x3	898.53	1.35
Reduced tee			A > B	7130RG201616	20x2 - 16x2 - 16x2	100.96	4.85
				7130RG201620	20x2 - 16x2 - 20x2	100.96	4.85
				7130RG202016	20x2 - 20x2 - 16x2	174.02	5.16
				7130RG261620	26x3 - 16x2 - 20x2	102.47	4.71
				7130RG261626	26x3 - 16x2 - 26x3	105.09	4.47
				7130RG262020	26x3 - 20x2 - 20x2	185.35	4.55
				7130RG262026	26x3 - 20x2 - 26x3	186.88	4.47
				7130RG262616	26x3 - 26x3 - 16x2	310.4	3.96
				7130RG322032	32x3 - 20x2 - 32x3	206.17	3.67
				7130RG322632	32x3 - 26x3 - 32x3	301.99	4.18
			B > C	7130RG201616	20x2 - 16x2 - 16x2	91.01	5.97
				7130RG201620	20x2 - 16x2 - 20x2	112.88	3.88
				7130RG202016	20x2 - 20x2 - 16x2	113.87	3.81
				7130RG261620	26x3 - 16x2 - 20x2	75.58	8.65
				7130RG261626	26x3 - 16x2 - 26x3	75.51	8.67
				7130RG262020	26x3 - 20x2 - 20x2	151.67	6.79
				7130RG262026	26x3 - 20x2 - 26x3	213.44	3.43
				7130RG262616	26x3 - 26x3 - 16x2	117.37	3.59
				7130RG322032	32x3 - 20x2 - 32x3	240.93	2.69
				7130RG322632	32x3 - 26x3 - 32x3	365.97	2.85
			A > C	7130RG201616	20x2 - 16x2 - 16x2	135.67	2.68
				7130RG201620	20x2 - 16x2 - 20x2	268.35	2.17
				7130RG202016	20x2 - 20x2 - 16x2	135.48	2.69
				7130RG261620	26x3 - 16x2 - 20x2	268.35	2.17
				7130RG261626	26x3 - 16x2 - 26x3	387.34	2.54
				7130RG262020	26x3 - 20x2 - 20x2	268.35	2.17
				7130RG262026	26x3 - 20x2 - 26x3	280.34	4.85
				7130RG262616	26x3 - 26x3 - 16x2	128.7	2.98
				7130RG322032	32x3 - 20x2 - 32x3	898.53	1.35
				7130RG322632	32x3 - 26x3 - 32x3	898.53	1.35

Figures				Article	Dimensions	Kv (m^3/h)	Zeta
Coupling				7270G16	16x2	92.11	5.82
				7270G20	20x2	373.77	1.12
				7270G26	26x3	442.74	1.95
				7270G32	32x3	1021.66	1.04
Reduced coupling				7240G2016	20x2 - 16x2	137.59	2.61
				7240G2616	26x3 - 16x3	128.7	2.98
				7240G2620	26x3 - 20x2	288.94	1.87
				7240G3220	32x3 - 20x2	267.43	2.18
				7240G3226	32x3 - 26x3	387.91	2.53
Threaded Male coupling				7243GG1612	16x2 - 1/2	128.54	2.99
				7243GG2012	20x2 - 1/2	360.77	1.2
				7243GG2034	20x2 - 3/4	268.35	2.17
				7243GG2634	26x3 - 3/4	681.99	0.82
				7243GG261	26x3 - 1"	382.33	2.61
				7243GG321	32x3 - 1"	983.74	1.13
Threaded Female coupling				7270GG1612	16x2 - 1/2	102.55	4.7
				7270GG2012	20x2 - 1/2	386.89	1.04
				7270GG2034	20x2 - 3/4	255.9	2.39
				7270GG2634	26x3 - 3/4	426.7	2.09
				7270GG261	26x3 - 1"	376.46	2.69
				7270GG321	32x3 - 1"	983.74	1.13
Swivel nut coupling				7359GG1612	16x2 - 1/2	156.37	2.02
				7359GG1634	16x2 - 3/4	130.34	2.91
				7359GG161	16x2 - 1"	123.99	3.21
				7359GG2034	20x2 - 3/4	351.09	1.27
				7359GG201	20x2 - 1"	255.9	2.39
				7359GG2634	26x3 - 3/4	442.74	1.95
				7359GG261	26x3 - 1"	387.91	2.53
90° elbow				7090G16	16x2	79.06	7.91
				7090G20	20x2	158.8	6.19
				7090G26	26x3	235.69	6.86
				7090G32	32x3	497.25	4.4

3.3. RESISTANCE OF MULTILAYER PIPE FITTINGS

3.3.1. Mechanical resistance

The following table shows the various tested mechanical resistances for COMAP multilayer pipe fittings, as well as the reference standards utilised to calculate these values.

Note: MultiSkin metal fittings are manufactured from brass (CW617N-DW compliant with the requirements of the 4MS Common List, 12th Revision, October 14, 2019).
MultiSkin synthetic fittings are manufactured from Polyphenyl Sulfone (PPSU).

	Metal fittings	Standard
Density (g/cm³)	8.43	EN12165
Tensile strength (MPa)	430	EN12165 (test EN ISO 6892)
Elongation at rupture (%)	10 à 35	EN12165 (test EN ISO 6506)
Modulus of elasticity (MPa)	96 000	EN12165 (test EN ISO 6506)
Melting point (C°)	885 à 900	EN12165
Thermal conductivity at 23°C (W/m*K)	113	EN12165

	Synthetic fittings	Standard
Density (g/cm³)	1.30	ASTM D792
Tensile strength (MPa)	69.6	ASTM D368
Elongation at rupture (%)	60	ASTM D368
Modulus of elasticity (MPa)	2340	ASTM D368
Flexural strength (MPa)	91	ASTM D790
Flexural modulus (MPa)	2410	ASTM D790
Glass transition temperature in C°	220	ASTM E1536
Thermal conductivity at 23°C (W/m*K)	0.35	ASTM C177
Izod impact strength test (J/m) at 23°C	690	ASTM D256
Class of fire resistance	V-0	UL 94

3.3.2. Chemical resistance of synthetic fittings

The following table details the various agents to which Polyphenyl Sulfone (PPSU), a polymer used in the manufacture of our synthetic fittings, is sensitive or not.

It is important to check the composition of paints, adhesives, detergents, disinfectants, insulating materials, coatings, etc. that these agents may contain prior to applying them to COMAP synthetic fittings.

Note: COMAP declines any responsibility in case of a damages resulting from the chemical action of an agent incompatible with our synthetic fittings.

Organic agents	Concentration	Compatibility with synthetic fittings
Ethyl acetate	100%	No
Butyl acetate	100%	Yes
Acetone	100%	No
Acetic acid	≤ 20%	Yes
Hydrochloric acid	≤ 20%	Yes
Citric acid	100%	Yes
Formic acid	≤ 10%	Yes
Nitric acid	≤ 20%	Yes
Oleic acid	100%	Yes
Sulphuric acid	≤ 50%	Yes
Acetic anhydride	100%	No
Benzene	100%	No
Butanol	100%	Yes
Carbitol	100%	Yes
Cyclohexane	100%	Yes
Ethanol	100%	No
Ethoxyethanol	100%	No
Formaldehyde	40%	Yes
Glycerol	100%	Yes
Ethylene glycol	100%	Yes
Sodium hydroxide	≤ 10%	Yes
Potassium hydroxide	≤ 10%	Yes
Isooctane	100%	Yes
Methanol	100%	No
Methyl ethyl ketone	100%	No
N-Butane	100%	Yes
Carbon tetrachloride	100%	Yes
Toluene	100%	No
Trichloroethane	100%	Yes

3.3.2.2. Expanding foam

Expanding or expandive foams are widely used in the construction industry for insulation purposes.
Many products use dimethyl ether: this agent is not compatible with synthetic fittings produced by COMAP.

It is imperative to inform the COMAP technical service wherever expanding foam is used.

COMAP does offer an expanding foam compatible with COMAP synthetic fittings that has been tested and approved by the supplier of our polymer.

Fast curing polyeurathane foam. This product meets B2 fire class standards. To insulate, waterproof and seal joints, fittings, cracks, holes and openings, including partition walls, window or door frames, attic floors, chimneys, dormers and around ductwork, pipes, cables and electrical wires. Adheres to a large number of building materials such as wood, concrete, stone, masonry, plaster, metals, glass and various plastics such as polyester, polystyrene, PVC.

Not suitable for polyethylene sheet, silicone sealant or P.T.F.E. **COMAP product code: GR6150501**

Safety cut sheet: *https://www.griffon.eu/en/product.784*

3.3.3. Tables of equivalence

Flow units							
m^3/h	l/h	l/mn	l/s	UK Gallons/h	UK Gallons/mn	US Gallons/h	US Gallons/mn
1	1 000	16.7	0.278	220	3.67	264	4.40
0.001	1	0.0167	0.000278	0.220	0.00367	0.264	0.00440
0.06	60	1	0.0167	13.2	0.220	15.9	0.264
3.6	3 600	60	1	792	13.2	951	15.9
0.00455	4.55	0.0758	0.00126	1	0.0167	1.2	0.02
0.273	273	4.55	0.0758	60	1	72.1	1.2
0.00379	3.79	0.0631	0.00105	0.833	0.0139	1	0.0167
0.227	227	3.79	0.0631	50	0.833	60	1

Pressure units							
bar	mbar	Pa	kPa	mCE/mWK	mmCE/mmWK	PSI	atm
1.00	1 000	100 000	100.00	10.20	10 200	14.50	0.99
0.00	1.00	100.00	0.10	0.01	10.20	0.01	0.00
0.00	0.01	1.00	0.00	0.00	0.10	0.00	0.00
0.01	10.00	1 000	1.00	0.10	102.00	0.15	0.01
0.10	98.10	9 810	9.81	1.00	1 000	1.42	0.10
0.00	0.10	9.81	0.01	1 000	1.00	0.00	0.00
0.07	68.90	6 890	6.89	0.70	703.00	1.00	0.07
1.01	1 010	101 000	101.00	10.30	10 300	14.70	1.00

3.3.4. List of compatible products

The company that produces the polymer used by COMAP to manufacture its synthetic fittings maintains a list of products that have been tested.

COMAP can provide this list upon request.

3.3.5. Ultraviolet (UV) resistance

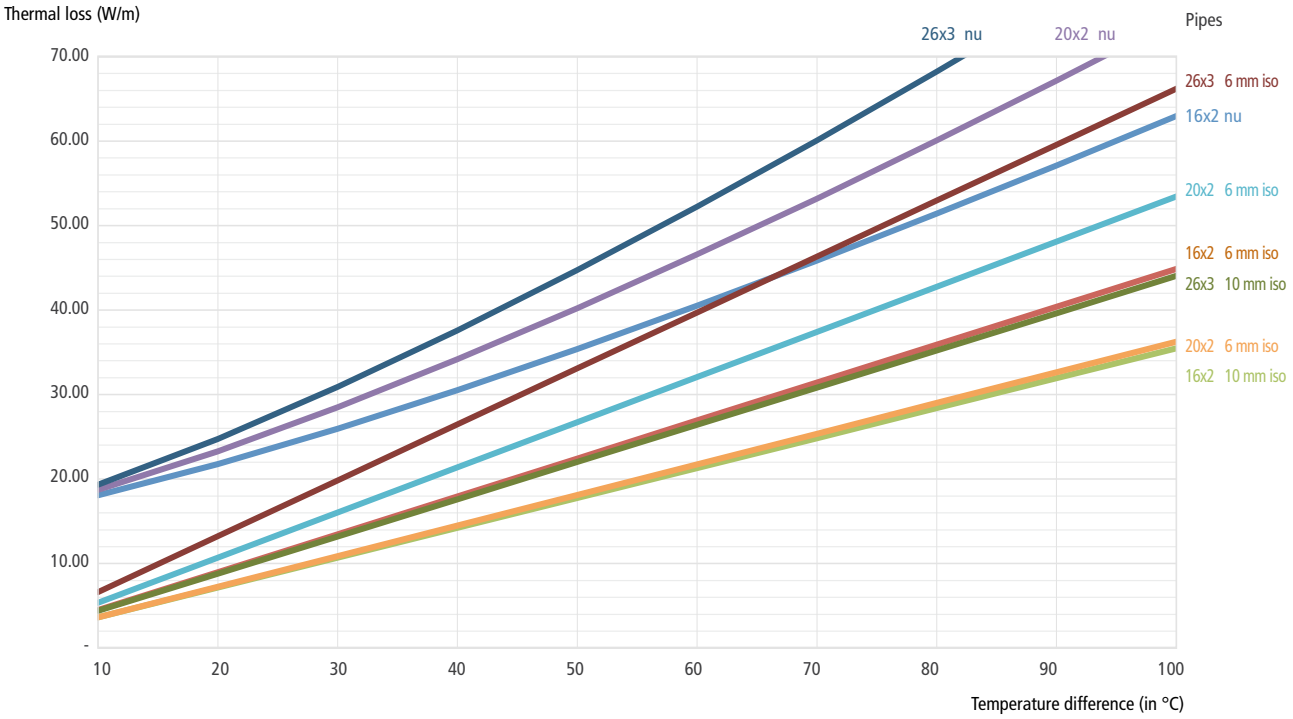
COMAP synthetic fittings are UV resistant. It is not recommended to externally expose synthetic fittings. It is recommended to protect permanently installed UV fittings by using an adhesive tape that is compatible with PPSU materials.

3.4. THERMAL LOSSES FOR INSULATED SHEATHED MULTILAYER PIPES

The table and graph below indicates thermal losses in watts per meter of pre-insulated multilayer pipes based on temperature differences between water inside pipes and the outside air.

Calculations are based on:

- Insulated multilayer pipe
- Polyethylene insulation with thermal conductivity of 0.040 W/mK.



Graph 8: Thermal losses for multilayer pipe depending on different diameters

		Pipe (mm) + insulation thickness (mm)								
Temperature differential (°C): water in the pipe / air outside the pipe	Heat loss (W/m)	16x2 nu	16x2 + 6 mm iso	16x2 + 10 mm iso	20x2 nu	20x2 + 6 mm iso	20x2 + 10 mm iso	26x3 nu	26x3 + 6 mm iso	26x3 + 10 mm iso
	10	18.09	4.49	3.62	18.73	5.34	3.62	19.33	6.62	4.40
	20	21.77	8.98	7.25	23.31	10.69	7.25	24.74	13.24	8.81
	30	25.97	13.47	10.87	28.52	16.04	10.88	30.91	19.86	13.21
	40	30.55	17.96	14.50	34.19	21.38	14.50	37.61	26.48	17.62
	50	35.42	22.45	18.12	40.23	26.73	18.13	44.75	33.10	22.02
	60	40.54	26.94	21.75	46.59	32.07	21.75	52.27	39.72	26.42
	70	45.88	31.43	25.37	53.21	37.42	25.38	60.10	46.34	30.83
	80	51.41	35.92	29.00	60.08	42.76	29.00	68.22	52.96	35.23
	90	57.12	40.41	32.62	67.16	48.11	32.63	76.59	59.58	39.64
	100	62.99	44.90	36.25	74.45	53.45	36.25	85.20	66.20	44.04

Table 8: Heat loss in multilayer pipes

3.5. CERTIFICATIONS

The ranges of fittings produced by COMAP are certified by many European organizations.

3.5.1. Fluid: water

	Certifications	EN ISO 21003	ATG	NF	DVGW	KIWA	KOMO	PZH	TSU	WRAS	VUPS
	Application	Drinking water Heating	Drinking water Heating	Drinking water Heating	Drinking water	Drinking water	Heating	Drinking water	Drinking water Heating	Drinking water Heating	Drinking water Heating
	Drinking water certified	Yes	Yes	Yes (ACS)	Yes (W534)	Yes	No	Yes	Yes	Yes	Yes
	Country	Europe	Belgique	France	Germany	Netherlands	Netherlands	Poland	Slovakia	Great Britain	Czech Republic
											
Ranges	Metal press fittings	●	●*	●	●	●	●	●	●*	●	●
Ranges	Synthetic press fittings	●	●*	●	●	●	●	●	●*	●	●
Ranges	Synthetic push fittings	●	●*	●	●	●	●	●	●*	●	●
Ranges	MultiSkin 2 pipe	●		●	●			●	●*	●	●
Ranges	MultiSkin 4 pipe	●	●*	●	●	●	●	●	●*		●

* Certification under progress

3.5.2. Fluid: gas

	Certification	ISO/FDIS 17484-1/2006	UNI	Gastec QA	ITC
	Application	Gas	Gas	Gas	Gas
	Country	Europe	Italy	Netherlands	Czech Republic
					
Ranges	Metal press fittings	●	●*	●	●
Ranges	MultiSkin gas pipe	●	●*	●	●

* Certification under progress

3.6. PRESSURE TESTS

Once installed, pipes are checked for leaks. Pressure tests may be carried out with water, air or inert gases for drinking water and heating installations. The fluid used and the results of a pressure test must be documented in what is known as a pressure test report.

Important: COMAP requires that a pressure test of piping systems be carried out at all times. Prior to sealing, insulation, paint or installation, a pipe must be pressure tested for leaks. The pressure test must always be carried out in compliance with local regulations.

The results of the tests will be recorded in writing and kept with the product cut sheets on the equipment.

Per CSTP dossier 2808-V2

3.6.1. Heating and cooling piping

The pipes must be leak tested. This type of test is always done using mains water. The test pressure is 1.5 times the maximum operating pressure and at least 6 bars.

3.6.2. Hot and cold domestic water

The pipes must be leak tested. The pressure test is conducted at 10 bar or 1.5 times the operating pressure where calculation values are greater than 10 bar. All hot and cold water supply lines are subject to this testing.

3.6.3. Leak tests

The lines in the system undergoing testing are filled with cold water and purged. The shut-off valves in lines are kept open. The test can be performed at one time on the entire network, or at several times, on isolated sections.

Operating procedure for multilayer pipe networks

Drain all water for piping.

Fill the water lines, making sure all air is purged, then stop all vents and taps.

Apply test pressure using a pump as specified in 3.6.1. or 3.6.2. for a period of 10 minutes.

Test pressure must remain constant during these 10 minutes ($\Delta p = 0$). If there is a drop in pressure, the system must be maintained at the test pressure until obvious leaks in the system are identified.

Figure 8 illustrates the above procedure.

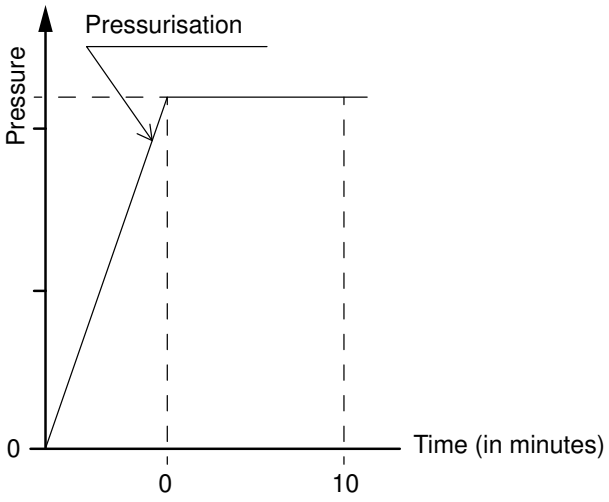


Figure 3: Operating mode for multilayer pipe networks

COMAP PRESSURE TEST PROTOCOL FOR SANITARY AND HEATING FACILITIES

(According to CPT 2808V2) - Test fluid: water. For multilayer or PER system (Ø ≤ 63 mm)

Project _____

Site _____

Client _____ Installer (Trade)_____

Name of the person conducting the test _____

Start of test _____ Date _____time_____

Section of piping tested _____

Were the lines filled with filtered water and fully purged? ☐ Yes ☐ No

Ambient temperature _____°C

Water temperature _____°C Maximum operating pressure_____bar

Pipe material _____

Pipe Diameter ☐ Ø12 ☐ Ø14 ☐ Ø16 ☐ Ø18 ☐ Ø20 ☐ Ø25
☐ Ø26 ☐ Ø32 ☐ Ø40 ☐ Ø50 ☐ Ø63

Total pipe length_____m

Type of crimping tool _____Jaw type_____

Were the crimp or threaded connections visually inspected? ☐ Yes ☐ No

Were the crimp fittings crimped or the threaded fittings tight? ☐ Oui ☐ No

LEAK TEST

After filling the pipes, wait for 30 minutes to allow the temperature to reach equilibrium.

Test pressure between 1 and 5 bar.

Perform a visual or pressure gauge check of the system.

Was leakage detected during the pressure test? ☐ Yes ☐ No

PRESSURE TEST (main)

Pressure testing is performed at a pressure about 1.5 times greater than maximum operating pressure. (Minimum 6 bar for heating/cooling application and maximum 10 bar for sanitary application).

Pressure at beginning of test _____bar_____time

Température de l'eau_____°C

Test pressure must remain constant for ten minutes.

Pressure at beginning of test _____bar_____time

Was a leak detected during pressure tests? ☐ Yes ☐ No

Was the maximum pressure loss threshold of 0.2 bar exceeded during pressure tests? ☐ Yes ☐ No

In case of freezing, appropriate measures must be taken (use anti-freeze products or heat the building).

Was an anti-freeze product added to the water? ☐ Yes ☐ No

If so, flush the pipes at least three times with pure water.

Were the pipes flushed at least three times? ☐ Yes ☐ No

Place_____ Date _____

Signature of principal Signature of installer

COMAP PRESSURE TEST PROCEDURE FOR SANITARY INSTALLATIONS

(according to DIN 19380) - Test medium: water or compressed air

Project_____

Site_____

Client _____ Installer (Trade)_____

Name of the person conducting the test _____

Start of test _____ Date _____time_____

Section of piping tested _____

Les conduites ont été remplies d'eau filtrées et totalement purgées ? ☐ Yes ☐ No

Ambient temperature_____°C

Water temperature_____°C Maximum operating pressure_____bar

Pipe material _____

Pipe Diameter ☐ Ø12 ☐ Ø14 ☐ Ø16 ☐ Ø18 ☐ Ø20 ☐ Ø25
☐ Ø26 ☐ Ø32 ☐ Ø40 ☐ Ø50 ☐ Ø63

Total pipe length_____m

Type of crimping tool_____Jaw type_____

Were the crimp or threaded connections visually inspected? ☐ Yes ☐ No

Were the crimp fittings crimped or the threaded fittings tight? ☐ Oui ☐ No

TEST FLUID

☐ Water ☐ Compressed air (dry) ☐ Carbon dioxide (CO_2) ☐ Nitrogen

COMAP PRESSURE TEST PROCEDURE FOR SANITARY INSTALLATIONS (follow)

LEAK TEST

After filling the system, wait for 30 minutes in order for the temperature to balance out.

Test pressure between 1 and 5 bar:

Perform a visual or pressure gauge check of the system.

Was leakage detected during the pressure test?

☐ Yes ☐ No

PRESSURE TEST (preliminary)

Pressure testing is performed at a pressure about 1.5 times greater than maximum operating pressure.

Pressure at beginning of test _____bar_____time

During the first preliminary test lasting 30 minutes, restore the test pressure every 10 minutes.

Test pressure (30 minutes after start of the test)

_____bar_____time

Stop the test after 30 minutes for 10 minutes, and then test again for 30 minutes. This represents a total of 60 minutes under pressure for the preliminary test.

Test pressure (60 minutes after start of the test)

_____bar_____time

Pressure loss per 5 minutes _____bar (max. 0.1 bar per 5 minutes and max. 0.6 bar in total)

Was leakage detected during the pressure test?

☐ Yes ☐ No

Was the maximum pressure loss threshold of 0.2 bar exceeded during pressure tests? ☐ Yes ☐ No

PRESSURE TEST (main)

Carry out immediately after the preparatory test (for 2 hours)

Test pressure (at the start of the main test) _____ bar _____ time

Test pressure (after 2 hours) _____ bar _____ time

Pressure loss must not exceed 0.2 bar.

Was leakage detected during the pressure test?

☐ Yes ☐ No

In case of freezing, appropriate measures must be taken (use anti-freeze products or heat the building).

Was an anti-freeze product added to the water?

☐ Yes ☐ No

If so, flush the pipes at least three times with pure water.

Were the pipes flushed at least three times?

☐ Yes ☐ No

LEAK TEST

Minimum duration of the test period for leaks: 30 minutes, with a pipe capacity of up to 100 liters. The test period must be increased by a further 10 minutes for each additional 100 liters.

Test pressure must range between a minimum of 110 mbar and a maximum of 200 mbar.

Total system capacity_____liters

Test duration _____ time

Wait until temperature and state of inertia of plastic materials are balanced before continuing the test procedure.

Perform a visual or pressure gauge check of the system.

Was leakage detected during the pressure test?

☐ Yes ☐ No

PRESSURE TEST (main)

Wait until temperature and state of inertia of plastic materials are balanced before continuing the test procedure.

Test pressure over 10 minutes:

☐ DN ≤ 50 (Ø 63x4.5mm): max. 3 bar

☐ DN > 50 (Ø 63x4.5mm): max. 1 bar

Pressure at beginning of test _____ bar _____ time

Pressure at end of test _____ bar _____ time

Was leakage detected during the pressure test?

☐ Yes ☐ No

Place_____

Date _____

Signature of client

Signature of installer

COMAP PRESSURE TEST PROTOCOL FOR HEATING SYSTEMS

(according to DIN 19380) - Test medium: water

Project_____

Site_____

Client _____ Installer (Trade)_____

Name of the person conducting the test _____

Start of test _____ Date _____time_____

Section of line tested_____

Were the lines filled with filtered water and fully purged? ☐ Yes ☐ No

Ambient temperature _____°C

Water temperature_____°C Maximum operating pressure_____bar

Pipe material _____

Pipe diameter ☐ Ø12 ☐ Ø14 ☐ Ø16 ☐ Ø18 ☐ Ø20 ☐ Ø25
☐ Ø26 ☐ Ø32 ☐ Ø40 ☐ Ø50 ☐ Ø63

Total pipe length_____m

Type of crimping tool _____Jaw type _____

Were the crimp or threaded connections visually inspected? ☐ Yes ☐ No

Were the crimp fittings crimped or the threaded fittings tight? ☐ Yes ☐ No

LEAK TEST

After filling the pipes, wait for 30 minutes to allow the temperature to reach equilibrium.

Test pressure between 1 and 5 bar:

Perform a visual or pressure gauge check of the system.

Was leakage detected during the pressure test? ☐ Yes ☐ No

PRESSURE TEST (main)

Apply pressure 1.3 times greater than maximum operating pressure at the lowest point of the heating system.

Pressure at beginning of test_____bar_____time

Water temperature _____°C

Test pressure must remain constant for 10 minutes.

Pressure at end of test _____bar_____time

Was a leak detected during pressure tests? ☐ Yes ☐ No

Was the maximum pressure loss threshold of 0.2 bar exceeded during pressure tests? ☐ Yes ☐ No

In case of freezing, appropriate measures must be taken (use anti-freeze products or heat the building).

Was an anti-freeze product added to the water? ☐ Yes ☐ No

If so, flush the pipes at least three times with pure water.

Were the pipes flushed at least three times? ☐ Oui ☐ Non

Place_____ Date _____

Signature of principal Signature iof nstaller

3.6.4. Flushing the system

All pipes must be flushed thoroughly before initial use to ensure that foreign matter and substances are removed from inside the pipe and that hygiene problems and corrosion damage are prevented to the extent possible.

The drinking water pipe must be flushed as soon as possible after installation and after pressure tests. Cold and hot water pipes will be flushed separately, intermittently and under pressure with an air-water mixture (DIN 1988, part 2).

Water of near-drinking water quality must be used to flush pipes to avoid any possible contamination of the pipes.

3.6.5. Legionnaire's disease prevention

Legionella bacteria develop in all soft water, particularly in tap water, but it does not present any danger except in certain highly specific circumstances. These depend mainly on the design and maintenance of the system, not on the type of pipe used in the system. The temperature of the water plays an essential part. The bacteria are harmless below 25°C. Temperatures of 60°C create risk. In addition, running water is harmful to these bacteria.

The danger occurs with water spray having a temperature of between 25°C and 50°C. When circumstances are conducive to the bacteria's growth (old pipes, build-up of corrosion), outside the zones where the bacteria is dormant or cannot survive, proliferation becomes a concern.

The smooth interior wall of the cross-linked inner pipe of COMAP products is corrosion-resistant. The following additional measures should be taken:

- Set the temperature of the boiler so that the supply pipe stays at a temperature of least 60°C. Set the return to 50°C and have the mixing take place as near as possible to the sanitary draw-off point (e.g. shower).
- Regularly flush all pipes abundantly with hot water, especially after a long absence.
- Empty unused sections of pipe.
- Avoid stagnant water.

3.7. 10-YEAR WARRANTY ON COMAP SYSTEMS

RULES GOVERNING TERMS AND CONDITIONS

For its piping systems (copper, PEX, multilayer and carbon/stainless steel) and associated fittings, COMAP offers a manufacturer's guarantee of 10 years for all incidents in which it is responsible.

This warranty applies with the following conditions:

1. All products necessary to the installation (manifolds, pipes, polystyrene tiles, fittings, pressing tools, connection accessories and additional components in the product line) that is covered by this guarantee are from COMAP product lines, for applications as specified in the Technical Notices published by the CSTB, AFNOR standards or, if these do not exist, in COMAP sales literature.

2. Installation is carried out following standard trade practices (EN, NF, DTU or CPT), or following the procedures described in COMAP technical manuals and sales literature. Failure due to external causes such as puncture, freezing, crushing by mechanical means, etc. is not covered.

   In addition, installation must have been performed by a professional. SIRET Business registration number and invoice must be provided.

3. The guarantee is effective beginning on the date that the installation of the concerned products is complete, as indicated on the attached certificate of guarantee, for a period of 10 years.

4. The certificate must be fully completed and returned to COMAP at the above-mentioned address, no more than two months following the date declared in § 3. The request is recorded and archived by COMAP, and a copy countersigned by COMAP is returned to you, as proof. You must provide this copy to submit a claim under this guarantee.

5 In some cases approved by COMAP sales literature, a use not yet established in the texts that govern current trade practices the warranty is applicable, provided installers follow the procedures established by COMAP.

Specifically, embedding press fittings is authorised by COMAP only for bypass or tapping (no extensions or "joins" within a slab or partition wall). In these cases, users should surround bypass or tapping fittings with padding or adhesive tape, in order to protect it from direct contact with surrounding materials.

This directly concerns tees, MultiSkin and PEX crimped pipes for heating, as well as straight sleeves for repairing underfloor heating pipes. Fittings that have threaded or tapped pieces must not be recessed.

6 In the specific case of press-fittings, the 10-year guarantee applies only when COMAP fittings are utilised with pipes and machines marketed by COMAP.

You will be asked to produce documentation that demonstrate that pressing tools have been properly maintained as specified in technical manuals.

* In the specific case of copper press fittings, the guarantee is applicable exclusively to copper pipes that conform to standard EN 1057, or to specifications stated in COMAP documentation.

7 In case of questions, only the Sanitary and Heating Systems Department technical assistance team of COMAP France, or personnel trained by this department, are able to provide information on operating procedures.

8 All incidents must be reported within 5 days of recognition of an incident. This declaration may be made only by registered letter with acknowledgement of receipt, or by fax, addressed to COMAP France - 16 avenue Paul Santy - BP8211 - F 69355 Lyon Cedex 08

As soon as the incident has been discovered, protective measures must be implemented to minimize consequences.

9 Failure to comply with any provisions in the preceding paragraphs will mean that COMAP is automatically absolved from all obligation under this guarantee.

10 The warranty does not cover indirect consequences of any incidents, such as operating losses, damages and interest, loss of asset use, loss of building or other property value, or other consequences not mentioned here.

11 The warranty covers the replacement of the components judged to be defective that have caused the incident, as well as reasonable expenses for restoring damaged premises to their initial state previous to the incident, as estimated by experts.

12 Where appropriate, COMAP reserves the right to contract with a company of its choice to perform the repairs to the system that is the subject of the claim.

13 Regarding claims for damages, COMAP has taken out professional liability insurance and can produce certification for such upon demand.

14 Any agreement concerning terms not stipulated in these conditions, will be considered invalid unless it is recorded in writing.

15 This warranty is linked to the project described on the certificate. It is therefore transferable if a building is sold. This warranty applies for the specified site, up till a specified date, and is valid even if COMAP ceases trading before that date.

16 For all other matters not mentioned in the preceding paragraphs, refer to the general conditions of sale appearing on the COMAP price list that is current on the date that the incident is reported.

17 Under the conditions detailed above, COMAP's responsibility will be limited to €770,000.00 per incident and per year.

18 Each claim under the current warranty may be made only through insurance companies, using their established procedures.

Specifically, for all incidents, the installer must make the report first to its own insurance company, and alert COMAP as specified above.

Repairs may be performed only following inspection and authorization by the expert designated by COMAP's insurance company; otherwise, compensation for repairs may not be made, and may incur the cancellation of this warranty.

TEN-YEAR WARRANTY ON COMAP SYSTEMS

WARRANTY CERTIFICATE No...... *(completed by COMAP)*

COMAP 10/2013 Ind. H

WORKSITE IDENTIFICATION

New ☐ **Renovation** ☐

TYPE:
☐ Individual residential unit -
☐ Industrial premises (Workshop, hangar, etc.)
☐ Healthcare establishment
☐ Collective housing
☐ Other premises (office - gymnasium, etc.)
Specify

PRODUCTS CONCERNED:
☐ Sanitary network
☐ Rising columns
☐ Secondary supply
☐ Heating system
☐ Rising columns
☐ Under-floor heating
☐ Under-floor heating / cooling

PIPE TYPE: ☐ PEX ☐ Copper ☐ Multilayer

OUTILLAGE : ☐ AFP101 *(SP1932)* ☐ ACO103 ☐ ACO203 ☐ ECO301 ☐ MAP2L ☐ UAP3L
☐ Other machine authorised by COMAP, please state which.....

Street number:..... Street:.....

.....

Post code:..... City:.....

IDENTIFICATION OF CONTRACTING AUTHORITY

NAME:.....
Street number:..... Street:.....
Post code:..... City:.....

IDENTIFICATION OF CONTRACTOR RESPONSIBLE FOR INSTALLATION

NAME:..... SIRET No. *(Required):*.....
Street number:..... Street:.....
Post code:..... City:.....

IDENTIFICATION OF OTHER PARTICIPANTS

General contractor: .....
Architect: .....
Design office (implementation plans, etc.): .....
Cement screed contractor:.....
Wholesaler:.....

Stamp of installer (on both documents)

Installation date: : ...../...../.....
Warranty expires on: : ...../...../.....
Done in:..... on : ...../...../.....
Installer's signature

Return this application within **2 months of the date** of installation indicated above to:
COMAP France - Département Systèmes Sanitaire et Chauffage
16 avenue Paul Santy - BP 8211 - F 69355 Lyon Cedex 08

VALIDATIONS COMAP France
For the Sanitary and Heating department

Done in Lyon on:...../...../.....

COMAP

OUR 3 AREAS OF EXPERTISE

CONTROL

COMAP's control solutions provide the right flow in the right place in a heating, air-conditioning or hot water system.

CONNECTION

COMAP offers a wide range of solutions for connecting to cold for thermal networks and plumbing.

WATER QUALITY

COMAP solutions are based on soft technologies and are more environment friendly, resulting in healthy and high quality water in residential buildings.

To learn more and discover the full range of the **MultiSkin** products, get in touch with your COMAP representative.

COMAP

A leading designer-manufacturer of thermal and sanitary solutions, to improve the comfort and environmental performance of buildings.

COMAP is a European industrial group, expert in the fields of plumbing and HVAC engineering. The group's offer is based on control-regulation, connection and water quality technologies as well as a wide range of sanitary taps. Its products are designed and manufactured in the group's design offices and factories in France, Italy, Spain and China.

COMAP's value-added solutions integrate harmoniously into living spaces, enabling intelligent management of water and energy and contributing to the comfort and well-being of occupants.

With headquarters in France, COMAP operates internationally, with a sales network in more than 20 countries. The group has 1,000 employees and is the "Hydronic Flow Control" entity of the Aalberts group.

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COMAP FRANCE
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www.aalberts.nl

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