PIPES AND FITTINGS IN PP-R

COPRAX

PRANDELLI ®

PRANDELLI ®

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INDEX

1. GENERAL INFORMATION

COPRAX, produced by Prandelli since 1987, is a system made up of Random Copolymer Polypropylene (hereinafter referred to as PP-R) pipes and fittings. The system's characteristics make it suitable of heating and water installations which over time have become particularly reliable and available in several different forms. Its use is also permitted for the transport of industrial and food fluids depending on the characteristics of the fluid conveyed. The peculiarity of the COPRAX system is the technique for its assembly: assembly is made by fusion welding of the parts to be connected. After the welding, the pipe and fitting become a single part. This excludes problems which could result from potential losses. The assembly technique, the wide range of fitting measurements available, the versatility of the system and the excellent chemical and physical characteristics make COPRAX a product whose high quality is proven.

The COPRAX system is made from a Random Copolymer Polypropylene (PP-R) approved for the production of pipes according to the standards DIN 8078 (Polypropylene Pipes. General Quality Requirements - Tests) and UNI EN ISO 15874.

Before processing, the granule is submitted to specific tests in our laboratories to verify its suitability for use (ISO/R 1133 procedure 18. Melt index MFI 190/5).

PP-R is a thermoplastic resin which is transformed into the finished product by a rise in temperature, which plasticizes the material, allowing the pipe to be produced by means of extrusion, and the fittings by moulding.

These processes are carried out inside our factory, under the control of skilled, qualified staff. The dimensions of the pipes and fittings, with the relative processing tolerances, are established in accordance with the standard UNI EN ISO 15874 (Pipes in polypropylene, PP, dimensions) Pipes are produced in the following Series: S5, S3.2 and S2.5.

PROPERTY’		TEST METHOD	UNIT OF MEASUREMENT	TEST VALUE
Density		ISO 1183	Kg/m³	905
Fusion index	**MFR (230°C/2, 16 Kg)**	ISO 1133	g/10 min	0.25
Minimum modulus of elasticity		ISO 178	MPa	480
Flexure modulus (2 mm/min)		ISO 178	MPa	800
Tensile modulus (1 mm/min)		ISO 527	MPa	900
Strain elongation (50 mm/min)		ISO 527-2	%	13.5
Deformation Stress warpage (50 mm/min)		ISO 527-2	MPa	25
Impact strength (Charpy) c/notch (23°C)		ISO 179/1eA	kJ//m²	20
Impact strength (Charpy) c/notch (0°C)		ISO 179/1eA	kJ//m²	3.5
Impact strength (Charpy) c/notch (-23°C)		ISO 179/1eA	kJ//m²	2.0
Impact strength (Charpy) s/notch (23°C)		ISO 179/1eU	kJ//m²	no break
Impact strength (Charpy) s/notch (0°C)		ISO 179/1eU	kJ//m²	no break
Impact strength (Charpy) s/notch (-23°C)		ISO 179/1eU	kJ//m²	40
Coef. of linear thermal expansion (0°C/70°C)		DIN 53752	K^{-1}	1.5×10^{-4}
Thermal conductance		DIN 52612	W/mK	0.24
Specific heat (20°C)		adiabatic calorimeter	kJ/kg K	2.0
Surface resistivity		IEC 60093	Ohm	$> 10^{12}$

2. COPRAX SYSTEM PROPERTIES

RESISTANCE TO ELECTROCHEMICAL CORROSION

COPRAX is chemically inert and highly resistant to a wide range of acids and bases. This makes it suitable for contact with the materials normally used in the construction sector, such as lime or cement, with no need for specific protection.For transport of/or contact with special substances, please refer to check the chemical resistance of the polypropylene, consulting the table provided on page 31.

Volume resistivity (at 20° C) of COPRAX and the metals normally used in the heating and water supply sector		
COPRAX (determined according DIN 53482)	> $1 \cdot 10^{16}$	Ω cm
Steel	= $0.1 \div 0.25 \cdot 10^{-4}$	Ω cm
Pure iron	= $0.0978 \cdot 10^{-4}$	Ω cm
Pipe grade industrial copper	= $0.017241 \cdot 10^{-4}$	Ω cm

LOW THERMAL CONDUCTIVITY

The material's high level of thermal insulation ensures containment of heat loss on the part of the fluid conveyed. This means minimal drop in temperature between the hot water production and delivery points, with consequent energy saving.

Conductivity (at 60° C) of COPRAX and the metals normally used in the heating and water supply sector		
COPRAX (determined according DIN 52612)	$\lambda = 0.24$	W/mK
Steel	$\lambda = 45 \div 60$	W/mK
Iron	$\lambda = 45 \div 60$	W/mK
Copper	$\lambda = 300 \div 400$	W/mK

The low thermal conductivity value also causes a drastic reduction in the formation of condensation on the outside of the pipe, a frequent problem on metal pipes in some temperature and humidity conditions.

Finally, it takes longer for the water to freeze when the outdoor temperature is particularly low.

LOW NOISE

Due to the material's high sound insulation value, the noise level of the systems is considerably reduced both with particularly high water flow speeds and when water hammers are present.

HYGIENIC AND NON-TOXIC

PP-R, the raw material used for production of the COPRAX system, is completely non-toxic and complies with the current standards at international level.

RESISTANCE TO STRAY ELECTRIC CURRENTS

Due to its high electrical insulating properties, COPRAX is unaffected by stray currents, which may create dangerous punctures in metal pipes. This phenomenon occurs above all in installations in zones with a high concentration of industrial facilities, close to railway lines and in other zones with a high concentration of electrostatic currents.

LOW LOSS OF PRESSURE

Due to the particularly homogeneous, compact structure of the material, achieved by using a state of the art production technology, the inside surface of COPRAX pipes and fittings is non- porous and free from cracks or crazing. This means the surface is extremely smooth, and loss of pressure is very low (see graphs on page 38/39).

There is also no risk of pipe blockages caused by scale deposits.

EASY WORKABILITY

Due to the density of just 0.905 g/cm3, the pipes and fittings are very light. Combined with the wide range of fittings available, this enables installations to be made easily and safely, with considerable time saving compared to conventional products.

3. COPRAX FIBRA SYSTEM PROPERTIES

COPRAX FIBRA

is produced through coextrusion of two distinct material, and the result is the pipe wall is made from 3 different layers as follows:

1. Inner layer, in direct contact with water, made from PPR
2. Intermediate layer, made from PPR and Fiber Glass (GF)
3. Outer layer, made from PPR

The production process allows us to realize all the three layers in a unique production phase. The three layers are linked together through the common PPR raw material.

The main advantage related to the presence of fiber glass raw material is the impressive reduction of the linear expansion coefficient of the finished product. This advantage allows the plumber to reduce the number of clamps in case of external installation.
We recommend in any case to follow the installation guideline chapter in the technical guide.

The regular COPRAX fittings are suitable for connection with COPRAX FIBRA pipe, and the installation technique is the same used for the normal COPRAX pipe, because the welding point is only the outer layer of the COPRAX FIBRA pipe.

ADVANTAGES

- Linear expansion reduced up to 60%
- Higher stability
- Versatility in the external installation works

SOME OF THE FIELDS OF APPLICATION

- Hot and cold, potable water installation
- High rise installation
- Industrial installation
- Compressed air transportation
- Air conditioning systems

4. TECHNICAL INFORMATIONS

Checking the resistence of a product is achieved by taking the following into consideration:

1. **The MATERIAL** that it is made of.
2. **The DEMANDS** placed upon it.

1. COPRAX system is produced with PP-R. Its behaviour characteristics when faced with stress are summarised in the so-called „regression curves". These represent the material's identity card and provides the answer to environmental stress.
2. The stresses to which a thermohydraulic system is exposed are numerous. To keep it simple let us imagine that the fluid transported is water and the environment in which the system operates is not equipped with specific features. Otherwise these eventual particular features would impact negatively on product durability.

Having made this preliminary observation, we can state that the stresses that define the system's working conditions, for transporting hot and cold water, are:

- TEMPERATURE

- TIME

- PRESSURE

Starting from the regression curves of the material that makes up the base matter from which the COPRAX range tubes and fittings are designed, once the work temperature and the working time have been set, following table of maximum pressures for continued use can be compiled. The table shown has been calculated by considering a safety coefficient equal to C = 1.5 for all conditions. This is the predicted value for the design temperature.

4. TECHNICAL INFORMATIONS

CONTINUOUS WORK MAXIMUM PRESSURE

TEMPERATURE (°C)	WORKING TIME(YEARS)	MAXIMUM WORKING PRESSURE (BAR)		
		*SDR 11	*SDR 6	*SDR 7.4
20°C	1	15,0	30,1	23,5
	5	14,1	28,3	22,1
	10	13,8	27,5	21,5
	25	13,3	26,6	20,8
	50	12,9	25,9	20,2
30°C	1	12,8	25,6	20,0
	5	12,0	24,0	18,8
	10	11,7	23,3	18,2
	25	11,3	22,5	17,6
	50	10,9	21,9	17,1
40°C	1	10,9	21,7	17,0
	5	10,2	20,3	15,9
	10	9,9	19,7	15,4
	25	9,5	19,0	14,8
	50	9,2	18,4	14,4
50°C	1	9,2	18,4	14,4
	5	8,6	17,1	13,4
	10	8,3	16,6	13,0
	25	8,0	16,0	12,5
	50	7,8	15,5	12,1
60°C	1	7,8	15,5	12,1
	5	7,2	14,4	11,3
	10	7,0	14,0	10,9
	25	6,7	13,4	10,5
	50	6,5	13,0	10,1
65°C	1		14,2	11,1
	5		13,2	10,3
	10		12,8	10,0
	25		12,3	9,6
	50		11,9	9,3
70°C	1		13,0	10,2
	5		12,1	9,4
	10		11,7	9,1
	25		10,1	7,9
	50		8,6	6,7

TEMPERATURE (°C)	WORKING TIME (YEARS)	MAXIMUM WORKING PRESSURE (BAR)		
		*SDR 11	*SDR 6	*SDR 7.4
75°C	1		12,0	9,3
	5		11,1	8,6
	10		10,1	7,9
	25		8,1	6,3
	50		6,9	5,4
80°C	1		10,9	8,5
	5		9,7	7,6
	10		8,2	6,4
	25		6,5	5,1
	50		5,5	4,3
85°C	1		10,0	7,8
	5		7,8	6,1
	10		6,6	5,2
	25		5,3	4,1
	50		4,5	3,5
90°C	1		9,1	7,1
	5		6,4	5,0
	10		5,4	4,2
	25		4,3	3,4
	50		3,6	2,8

**Please see the definition of SDR later on.*

The table set out above is merely indicative, as the actual working conditions to which an installation is exposed can vary in pressure and temperature over time. This approach, which is close to reality, complies with the standard UNI EN ISO 15874, which refers to "Plastic piping installation systems for hot and cold water– Polypropylene (PP)" in its various parts.

4. TECHNICAL INFORMATIONS

The COPRAX system meets the requirements of the standard UNI EN ISO 15874: section I of this standard identifies four application Classes for the working conditions of the system; each class refers to a different scope of application. This is shown in table 1 below:

TABLE 1

<table>
<tr><th>Application class</th><th>Design temperature T_D °C</th><th>Time to T_D years</th><th>T_{max} °C</th><th>Time to T years</th><th>T_{awar} [2] °C</th><th>time at t_m h</th><th>Typical scope of application</th></tr>
<tr><td>1 [1]</td><td>60</td><td>49</td><td>80</td><td>1</td><td>95</td><td>100</td><td>Hot water supply (60°C)</td></tr>
<tr><td>2 [1]</td><td>70</td><td>49</td><td>80</td><td>1</td><td>95</td><td>100</td><td>Hot water supply (70°C)</td></tr>
<tr><td rowspan="2">4</td><td>20
followed by 40
followed by
60</td><td>2,5
20
25</td><td>70</td><td>2.5</td><td rowspan="2">100</td><td rowspan="2">100</td><td rowspan="2">Pavement heating and low temperature radiators</td></tr>
<tr><td colspan="2">followed by
(see following column)</td><td colspan="2">followed by
(see following column))</td></tr>
<tr><td rowspan="2">5</td><td>20
followed by 60
followed by
80</td><td>14
25
10</td><td>90</td><td>1</td><td rowspan="2">100</td><td rowspan="2">100</td><td rowspan="2">High temperature radiators</td></tr>
<tr><td colspan="2">followed by
(see following column)</td><td colspan="2">followed by
(see following column)</td></tr>
</table>

TIME: the working period estimated for each design class is 50 years.

TEMPERATURE: the system should be used at the design temperature TD, but the possibility is also considered that certain situations can occur in which the maximum temperature Tmax and/or a Tmal malfunction temperature is reached. The table above shows different time for the different temperature levels, always taking into account 50 years'periods. The design engineer should know the value of the design pressure PD, which is not included in the table above; such value is an essential factor for selecting the right pipe dimensions (series) based on the intended use. Generally speaking, all the systems which meet the requirements shown in the table must also meet the following requirements:

TEMPERATURE = 20°C

TIME = 50 YEARS

PRESSURE = 10 BAR

CHOOSING PIPE DIMENSIONS

According to the diameter and the thickness of the pipe the following parameters can be defined:

- SDR (Standard Dimension Ratio)

- SERIE S

SDR: is a dimensionless number which is obtained from the ratio between the nominal external diameter of the pipe (dn) and the nominal thickness of the wall (en).

SERIE S: is a parameter defined by the standard UNI EN ISO 15784-1, which determines the S series by calculating it (the Scalc parameter) based on the nominal external diameter (dn) and the nominal wall thickness (en), as follows:

Scalc = (dn - en)/2en

It should be pointed out that according to the above mentioned formula, the S series decreases as thickness increases. In other words, between two pipes of the same diameter, the one with a lower series will have a greater resistance section. Knowing the S series is essential in order to determine if a pipe meets the requirements for use under the working condititions of the installation for which it is intended.

The reference for pipe requirements is table 2 of the standard UNI EN ISO 15874-2.

TABLE 2

PD bar	Class 1 TD=60°	Class 2 TD=70°	Class 4 TD=60°	Class 5 TD=80°
	$S_{calc,max}$			
4.0	6.9	5.3	6.9	4.8
6.0	5.2	3.6	5.5	3.2
8.0	3.9	2.7	4.1	2.4
10.0	3.1	2.1	3.3	1.9

4. TECHNICAL INFORMATIONS

Once the application class and therefore the related design temperature TD has are known, and also knowing the design pressure PD, the maximum calculated series (Scalc, max) which meets the required conditions can be found in Table 2. The condition to be verified as true is:

Scalc < = Scalc, max

EXAMPLE: realization of an installation having the following characteristics:

- **Domestic hot water supply at TD = 70°C**
- **Design pressure = 8 bar**

In order to meet requirement A), we search for the class of application in table 1 and find out that it is Class 2.

In order to meet the requirement B), we search for the corresponding Series in Table Y, which shows that the Series which meets the requirements should be equal or lower than 2.7. In the COPRAX range this corresponds to Series 2.5.

In accordance with what above, the range of COPRAX can be classified as follows:

SERIES S2.5 = SDR 6 = Class 1/10bar

Class 2/8bar Class 4/10 bar Class 5/6bar

SERIES S3.2 = SDR 7.4 = Class 1/8bar

Class 2/6bar Class 4/10bar Class 5/6 bar

SERIES S5 = SDR 11= Class 1/6bar

Class 2/4 bar Class 4/6 bar

The COPRAX system comprises a wide range of fittings, which can be subdivided into two groups, depending on their intended use:

- **PP-R fittings for welding;**
- **PP-R fittings with metal inserts.**

In the first case, the joint between the pipe and the fitting (and in some cases between fitting and fitting) is made by melting the parts, while in the second case one of the fitting ends has a threaded metal insert sunk into the PP-R body. Parts of this kind are used for connecting the system connection to previously instelled equipment or any other threaded metal elements.

NOTE: all COPRAX fittings guarantee maximum working pressure of 20 BAR at 20°C.

COPRAX PIPE SDR 11 (PN 10 - S 5)

According to: DIN 8077-78 - UNI EN ISO 15874

Certificates/approvals: CERTIF, CSTB, WRAS

Main application field: cold and chilled water, rainwater.

DIMENSIONAL CHARACTERISTICS

Nominal diameter (Dn) mm	Minimum external diameter (Demin) mm	Internal diameter Di (mm)	Minimum thickness Emin (mm)	Weight g/m	Volume l/m
20	20	16.2	1.9	108	0.206
25	25	20.4	2.3	162	0.327
32	32	26.2	2.9	253	0.539
40	40	32.6	3.7	463	0.834
50	50	40.8	4.6	618	1.307
63	63	51.4	5.8	999	2.074
75	75	61.4	6.8	1381	2.959
90	90	73.6	8.2	2061	4.252
110	110	90.0	10.0	2946	6.359
125	125	102.2	11.4	3930	8.205

CLASS OF USE

PD bar	Class 1	Class 2	Class 4	Class 5
	$S_{calc,max}$			
4.0	6.9	5.3	6.9	
6.0	5.0		5.5	
8.0				
10.0				

COPRAX PIPE SDR 7,4 (PN 16 - S 3,2)

According to: DIN 8077-78 - UNI EN ISO 15874

Certificates/approvals: IIP, CERTIF, WRAS

Main application field: cold water, hot water, heating.

DIMENSIONAL CHARACTERISTICS

Nominal diameter (Dn) mm	Minimum external diameter (Demin) mm	Internal diameter Di (mm)	Minimum thickness Emin (mm)	Weight g/m	Volume l/m
32	32	23.2	4.4	380	0.423
40	40	29.0	5.5	560	0.661
50	50	36.2	6.9	840	1.029
63	63	45.8	8.6	1323	1.647
75	75	54.4	10.3	1884	2.323
90	90	65.4	12.3	2702	3.358
110	110	79.8	15.1	4051	4.999
125	125	90.8	17.1	5267	6.472

CLASS OF USE

PD bar	Class 1 (TD=60°C) hot water	Class 2 (TD=70°C) hot water	Class 4 (TD=MIX) floor heating	Class 5 (TD=MIX) radiators
	$S_{calc,max}$			
4.0	6.9	5.3	6.9	4.7
6.0	5.0	3.5	5.5	3.2
8.0	3.8		4.1	
10.0			3.3	

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COPRAX PIPE SDR 6 (PN 20 - S 2,5)

According to: DIN 8077-78 - UNI EN ISO 15874

Certificates/approvals: IIP, SKZ, CERTIF, CSTB, DVGW, RINA, WRAS

Main application field: cold water, hot water, heating.

DIMENSIONAL CHARACTERISTICS

Nominal diameter (Dn) mm	Minimum external diameter (Demin) mm	Internal diameter Di (mm)	Minimum thickness Emin (mm)	Weight g/m	Volume l/m
20	20	13.2	3.4	176	0.137
25	25	16.6	4.2	270	0.216
32	32	21.2	5.4	444	0.353
40	40	26.6	6.7	686	0.555
50	50	33.4	8.3	1037	0.865
63	63	42.0	10.5	1689	1.385
75	75	50.0	12.5	2250	1.963
90	90	60.0	15.0	3350	2.826
110	110	73.4	18.3	4900	4.298

CLASS OF USE

PD bar	Class 1 (TD=60°C) hot water	Class 2 (TD=70°C) hot water	Class 4 (TD=MIX) floor heating	Class 5 (TD=MIX) radiators
	$S_{calc,max}$			
4.0	6.9	5.3	6.9	4.7
6.0	5.0	3.5	5.5	3.2
8.0	3.8	2.6	4.1	
10.0	3.0		3.3	

COPRAX FIBRA PIPE SDR 7,4 (PN 16 - S 3,2)

Main application field: cold water, hot water, heating, air conditioning.

DIMENSIONAL CHARACTERISTICS

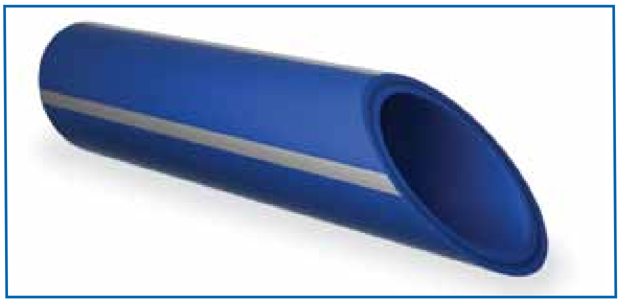
Nominal diameter (Dn) mm	Minimum external diameter (Demin) mm	Internal diameter Di (mm)	Minimum thickness Emin (mm)	Weight g/m	Volume l/m
20	20	14.4	2.8	146.2	0.163
25	25	18.0	3.5	228.3	0.254
32	32	23.2	4.4	368.6	0.423
40	40	29.0	5.5	575.2	0.660
50	50	36.2	6.9	901.4	1.029
63	63	45.8	8.6	1417.8	1.647
75	75	54.4	10.3	2020.4	2.323
90	90	65.4	12.3	2897.6	3.358
110	110	79.8	15.1	4343.6	4.999
125	125	90.8	17.1	5204.5	6.472

CLASS OF USE

PD bar	Class 1 (TD=60°C) hot water	Class 2 (TD=70°C) hot water	Class 4 (TD=MIX) floor heating	Class 5 (TD=MIX) radiators
	$S_{calc,max}$			
4.0	6.9	5.3	6.9	4.7
6.0	5.0	3.5	5.5	3.2
8.0	3.8		4.1	
10.0			3.3	

COPRAX FIBRA PIPE SDR 11 (PN 10 - S 5)

Main application field: cold and chilled water, rainwater, air conditioning.



DIMENSIONAL CHARACTERISTICS

Nominal diameter (Dn) mm	Minimum external diameter (Demin) mm	Internal diameter Di (mm)	Minimum thickness Emin (mm)	Weight g/m	Volume l/m
40	40	32.6	3.7	407.2	0.834
50	50	40.8	4.6	633.3	1.307
63	63	51.4	5.8	1005.4	2.074
75	75	61.4	6.8	1405.6	2.959
90	90	73.6	8.2	2033.4	4.252
110	110	90.0	10	3031.2	6.359
125	125	102.2	11.4	3925.6	8.203

CLASS OF USE

PD bar	Class 1 (TD=60°C) hot water	Class 2 (TD=70°C) hot water	Class 4 (TD=MIX) floor heating	Class 5 (TD=MIX) radiators
	$S_{calc,max}$			
4.0	6.9	5.3	6.9	
6.0	5.0		5.5	
8.0				
10.0				

5. GUARANTEE

The following guarantee is provided for the COPRAX system when used for heating and water supply installations, in a manner compatible with the technical characteristics of the product and in accordance with the related installation instructions:

1. Through insurance cover with a leading insurance company, Prandelli, manufacturer of the COPRAX system, will compensate injury or damage caused by breakage of pipes and fittings due to obvious manufacturing defects up to a **maximum of € 2.000.000,00, for a period of 10 YEARS after the date marked on the pipe.**

2. The conditions regulating this guarantee are as follows:

- the pipe and fittings must be installed in accordance with the installation instructions provided by us, further to checking for possible faults or tampering with which have occurred after production due to accidental causes.
- The working conditions (pressure and temperature) must be within the technical limits stated by the latest COPRAX Guide.
- The product must carry the COPRAX identification mark

3. The guarantee DOES NOT APPLY in the following cases:

- failure to comply with our installation instructions and recommendations.
- Connection of the pipe and fittings to heat sources with temperature and pressure limits not compatible, even accidentally, with the characteristics of the pipe and fittings.
- Use of obviously unsuitable material (pipes and fittings which are worn out, old, scratched, etc.)
- Use of one or more components not manufactured by us in the construction of the system.
- Poor welds produced using unsuitable equipment.

4. Instructions for requesting after sales service under guarantee.

In case of damage to the COPRAX system due solely to obvious manufacturing defects, users must send us a registered letter, sending a copy to their local agent. This letter must contain:

- date and place of installation;
- specifications and identification mark of the pipe and fittings
- information about the working conditions (pressure and temperature);
- sample of the pipe or fitting on which the damage has occurred;
- name and address of the installer who constructed the system.

We will send a technician to check the causes of the damage within a reasonable period of time after receipt of the aforesaid registered letter.

If the damage is covered by the terms and conditions of the GUARANTEE, we will put the matter in the hands of our insurance company, and they will pay out compensation after checking the cause and amount of the damage.

If the damage is not covered by the GUARANTEE, we will charge the expenses we have incurred to the customer.

Prandelli S.p.A.

6. INSTRUCTIONS FOR USE

The following specific equipment is required for the construction of installations using COPRAX system components:

2 positions fusion welding machine

pipe cutter

welder for electric couplings

prisma bench welder

WELDING BY A FUSION WELDING MACHINE (COPRAX)

The heating and welding procedures must be done in such a way that the push exerted on the components is gradual and linear. Twisting forces and rotations are to be avoided. Correcting the position between the pipe and the pipe joint is only possible during the first few moments after welding and, in case, movements should be minimal.

The weld must cool gradually, without sudden temperature changes which could create considerable internal strains.

Operating instructions:

Preparing the fusion welding machine

- fit on the fusion welding machine the dies corresponding to the diameters to be welded.
- plug it in to the power supply at 220 V
- wait for the green light on the machine to switch off.

NOTE: when welding machine has reached working temperature, the green indicator light goes off on the fusion welding machine.

Preparing the parts to be welded

- cut the using the appropriate pipecutter
- clean the joint area using a clean cloth

Welding

- check that the fusion welding machine is ready to operate.
- whilst respecting the working guidelines set out in the table on p.24 simultaneously insert the pipe and fitting in the dies (which must be of the correct size), always respecting the working instructions reported in the table.
- after heating, extract the heated parts from the dies to join them to each other.

6. INSTRUCTIONS FOR USE

WELDING TIME WITH A FUSION WELDING MACHINE

Diameter D mm	Heating time s	Working time s	Cooling time min
20	5	4	2
25	7	4	3
32	8	6	4
40	12	6	4
50	18	6	4
63	25	8	6
75	30	8	8
90	40	8	8
110	50	10	8
125	60	10	8

N.B: The heating time is calculated starting from the moment the pipe and the fitting are brought into contact on the dies.

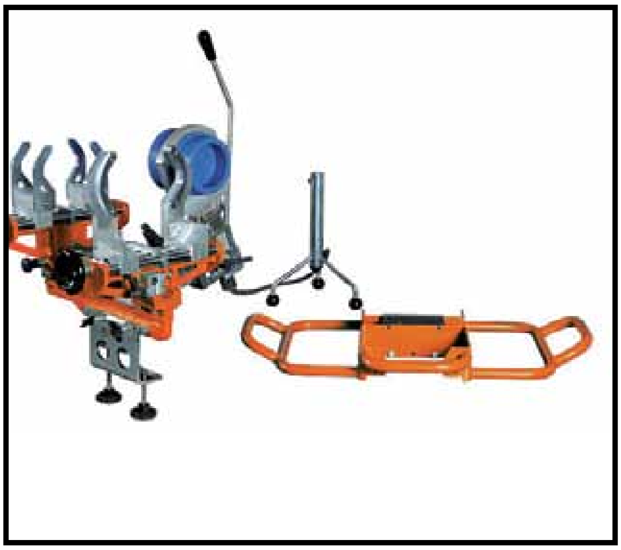
WARNINGS ON FUSION WELDING During the stage where the pipe is inserted into the fitting it is advisable to avoid going over the rabbet step located inside the fitting in order not to make the passage section become too narrow.

It is essential that the pipe is aligned with the fitting so that the surfaces of the parts to be welded match to each other perfectly. Incorrect alignment can actually compromise a successful jointing.


WELDING OK


WELDING NOT OK

WELDING BY PRISMA BENCH WELDER



PRISMA 125LIGHT (d. 63-125 mm)

Voltage 230 Volt - 50/60 Hz - Single phase

Power max. absorption: 1400 W

Operating temperature:

260°C (± 10°C)

Dimensions: 405x175x50 mm

Weight: kg 27

PRISMA 125 (d. 25-125 mm)

Power supply 230 Volt - 50 Hertz - Single phase

Absorbed power: 1400 W

Working temperature about 260°C - internal electrical adjustment

Dimensions: cm 80x146x135

Weight: kg 152

FOR ALL TECHNICAL SPECIFICATIONS OF THIS MACHINE, PLEASE REFER TO THE GUIDE CONTAINED IN THE PACKAGE.

WELDING USING AN ELECTRIC COUPLING WELDING MACHINE

Electric coupling welding is particularly recommended to carry out repairs or welding on parts already installed.

Operating instructions:

Preparing the parts to be welded

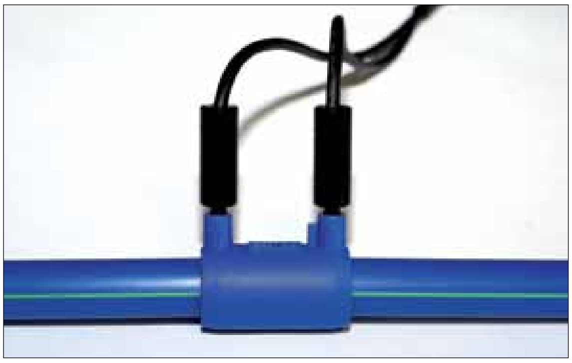
- Cut the pipe using the appropriate pipecutter.
- Clean the junction area using a clean cloth.
- Mark out the welding zone ensuring it is equal to half the length of the coupling.

- Scrape the welding area along the whole pipe circumference to eliminate any negative effects due to oxidation and traces of dirt/grease on the surface.

- Insert the pipes into the coupling ensuring that the tops are perfectly aligned.

Prepare the coupling welding machine

- Prepare the COPRAX welding machine for use by ensuring that it is connected to a power supply of 220 V 50 Hz, and that the power supply cable is laying completely flat.
- Connect the terminals to the welding coupling. Make sure that the weight of the cables is not on the junction point.



- Start welding according to the instructions of the welding machine.
- Make sure that during welding and subsequent colling down (minimum 10 minutes) the pipes are not subected to any stress.
- Wait at least 1 hour before pressurising the installation.

WELDING TIME USING THE ELECTRICAL COUPLING WELDING MACHINE

Diameter D mm	Voltage V	Welding time s	Cooling tome. min (external stress)	Cooling time min (installation pressure)
20	10.90	48	20	120
25	12.60	55	20	120
32	19.40	55	20	120
40	24.00	92	20	120
50	24.00	116	20	120
63	24.00	127	20	120
75	24.00	145	20	120
90	24.00	175	20	120
110	24.00	260	20	120
125	40.00	160	20	120

PRECAUTIONS FOR WELDING USING THE ELECTRIC COUPLING WELDER

- The elements must be clean and free from moisture to obtain good welding: please pay attention to this requirement.
- For the same reasons, after scraping take care not to touch the welding zone. Any traces of dirt/grease due to accidental causes must be removed using a specific detergent for polypropylene/polyethylene (e.g. Henkel Tangit KS). Use of oil-based solvents is forbidden, since they leave a film on the surface of the pipes which prevents welding.
- For optimum welding, the pipes must be inserted in the coupling by the same length, and must be perfectly aligned with it.
- Check that the working diameter set on the machine is the same as the real diameter of the elements to be joined.
- If several welding cycles have to be performed on the same coupling, wait for the weld to cool completely between one cycle and the next

6. INSTRUCTIONS FOR USE

WELDING USING SADDLE FITTINGS (K47)

The K47 saddle fitting can prove to be extremely useful for the installer as it enables union joints to be obtained in a practical and reliable way on segments of previously installed pipes and enables the joints to have a larger diameter compared to the requirements of the new users to be activated. In order to perform the necessary welding operations, using fusion welding machine matrices having the correct geometry is essential to achieve perfect fusion of the surfaces to be welded to each other. Here is a summary of the operating stages for the correct use of the K47 saddle fitting.

Preparing the pipe

Any dirt on the pipe segment to be used for realizing the union joint must be effectively cleaned off; the parts to be welded together need to be polished; scraping is essential to remove the external layer of the pipe which will definitely have undergone an oxidation process over the course of time and would prevent the achievement of an optimum welding process.

Drilling the pipe

Pipe drilling must be drilled using an ordinary drill the dimension of which must always be 1mm less than the size of the union joint to be obtained.

The pipe wall must be drilled taking care not to damage the opposite wall. In order to ensure perfect welding, the hole must be radial with respect to the circumference of the pipe.

Fusion procedure

When mount the dies onto the normal fusion welding machine, the following factors must be taken into account: the concave element operates on the external surface of the pipe, where the intended union joint and standard hole opening should be made; while the convex element operates on the fitting used to create the union joint. After having ensured that the fusion welding machine has reached working temperature (signalled by the green indicator light going off), light pressure must be exerted simoultaneously so that the dies surface fits together perfectly with the surface of the pipe and fitting.The times required for this operation are displayed in the table below. The heating time indicated must be calculated from the moment the surfaces make contact.

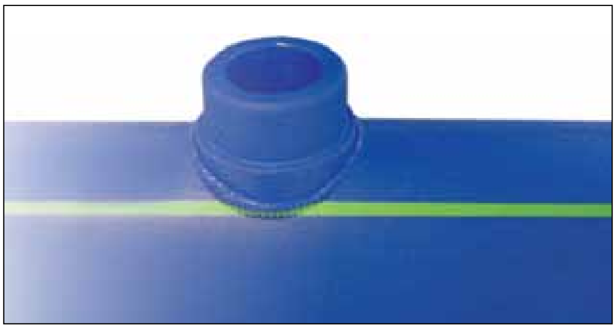
Once this time has elapsed, seams of melted material will be visible.

Welding

Once the heating period is completed, the elements that to be connected must be extracted from the dies; exerting a steady pressure, the pipe-fitting components must be fitted together within the time indicated on the table shown below, and must be kept pressed together for at least a further 30 seconds.

Cooling

Once welding is completed, avoid any pressure on the unit joints, be it mechanical or thermal, for the length of cooling time advised. Cooling must occur at room temperature.



OPERATING PARAMETERS

Union joint diameter mm	Heating time sec	Working time sec	Cooling time min	Drill tip mm
20	5	4	2	19
25	7	4	3	24
32	8	6	4	31

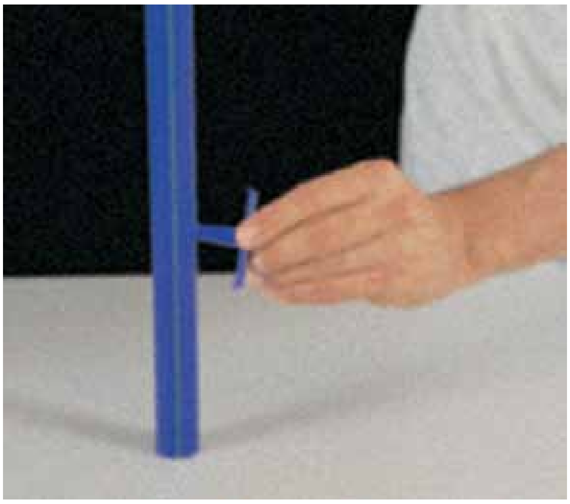
6. INSTRUCTIONS FOR USE

USE OF THE HOLE-REPAIRING DIE

In the event that the pipe is accidentally drilled (with a drill, etc.) on only one wall, repairs can be made using the hole-repairing die, keeping in mind that the feasibility of repairs depends on the diameter of the die.

The repair operation must be carried out via the following stages:

- drying and cleaning of the segment for repair
- fusion of the surfaces containing the weld, inserting the tapped part of the hole-repairing die into the hole to be repaired. During this operation, in order to avoid the fusion of the opposite wall of the pipe as well as a result of an excessive introduction of the die, remember that the die has a metal sleeve that can be adjusted according to the thickness of the pipe. The adjustment takes place via the movement of the sleeve on the die and is achieved by loosening the tightening screw of the sleeve.
- fusion of the repair section (provided with the die) using the female part of the hole-repairing die.
- insertion of the repair section into the hole (having respected the heating times – 5 sec)



7. CHEMICAL RESISTANCE

PP-R has high resistance to a large number of aggressive substances, and is therefore particularly suitable for special applications.

The table below provides the resistance of PP-R to various chemicals. The table refers to the raw material only, not subjected to external mechanical stresses and atmospheric pressure.

Transport of combustible fluids must be carried out in compliance with all legal regulations in force on the matter.

Particular attention and care is required in the event of installations intended for water which has a chlorine content over the limits permitted by law and/or water which contains elements inducing oxidation in general.

TABLE OF PP-R RESISTANCE TO CHEMICALS

EXAMINED SUBSTANCES	CONCENTRATION %	TEMPERATURE (°C) 20	60
Acetic, anhydride	100	+	
Vinegar	-	+	+
Acetic, acid	100	+	+
Acetone	100	+	O
Acid (see acid name)	-		
Battery, acid	-	+	+
Chloric water	sol. sat.	O	–
Distilled water	100	+	+
Drinking water	-		
Brackish water	-	+	+
Lake water	-		
Boric water	sol. sat.(4.9)	+	+
Hydrogen peroxide	10		
Hydrogen peroxide	3	+	+
Alum	sol. sat.		
Aluminium, salt	t	+	+
Ammonia, gas	100	+	+
Ammonia, liquid	conc.	+	+
Ammonium, acetate	t		
Ammonium, carbonate	t	+	+
Hydrocloric, ammonium	t	+	+
Ammonium, phosphate	t		

SYMBOLS

+	= higly resistant
⊕	= resistant
O	= fairly resistant
⊖	= scarcely resistant
–	= non resistant
sol. sat.	= satured solution
t	= all %

7. CHEMICAL RESISTANCE

EXAMINED SUBSTANCES	CONCENTRATION %	TEMPERATURE (°C) 20	60
Ammonium, nitrate	t	+	+
Ammonium, sulphate	t	+	+
Starch	t	+	+
Amber, acid	sol. sat.	+	+
Aniline	100	+	⊕
Antifreeze	–	+	+
Silver, salt	sol. sat.	+	+
Aspirin ®	–	+	
Asphalt	–	+	O
Barium, chloride	t	+	+
Benzaldheyde	100	+	
Benzaldheyde, liquid	sol. sat. (0.3)	+	
Benzol	100	ϴ	–
Benzoid, acid	100	+	+
Ethyl, benzol	100	O	–
Beer	–	+	
Borax	sol. sat.	+	+
Boric, acid	100	+	+
Bromine, liquid	100	–	
Bromine, dry steam	alta conc.	–	–
Bromine, dry steam	bassa conc.	O	–
Butane, liquid	100	+	
Butane gas	100	+	+
Butyl, gas	100	⊕	
Butanol	100	+	
Butter	100	+	+
Butyl, alcohol	–	+	+
Cacao	–	+	+
Calcium, chloride	sol. sat.	+	+
Calcium, nitrate	sol. sat.	+	+
Quinine	–	+	
Bleach	12.5% cloro	O	O
Coffee	–	+	+
Limestone	–	+	+
Sulphure, carbon	–	O	
Chlorine, liquid	100	–	
Chlorine, dry gas	100	–	–
Chlorine, wet gas	100	O	–
Chloroform	10	ϴ	–
Chlorosulfonic, acid	100	–	–
Benzoyl chloride	100	ϴ	–

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EXAMINED SUBSTANCES	CONCENTRATION %	TEMPERATURE (°C) 20	60
Ethyl, chloride	100	–	
Hydrocloric, acid	alta conc.	+	+
Hydrocloric, acid	bassa conc.	+	+
Chromium,salt	sol. sat.	+	+
Chromium plating bath	–	+	+
Chromic, acid	–	+	O
Chromium trioxide	sol. sat.	+	–
Cresol	100	+	O
Cyclohexan	100	+	
Cyclohexanol	100	+	+
Wax	–	+	O
Coca Cola ®	–	+	
Naphtalene, decahydro	100	⊖	–
Toothpaste	–	+	+
Diethyl ether	100	O	
Dimenthyl formamide	100	+	
Diossano	100	+	O
Dixan liquid	–	+	+
Hexane	100	+	O
Heptane	100	⊕	O
Ethyl, acetate	100	O	O
Etihyl, alcohol	100	+	
Ethyl, hexanol	100	+	
Oil ether	100	+	O
Flour	–	+	
Phenol	sol. sat.	+	+
Iron, salt	sol. sat.	+	+
Formaldehyde	40	+	+
Phosphurus, acid	sol. sat.	+	O
Formic, acid	–	+	
Phosphurus, oxichloride	100	O	–
Photographic acid	–	+	+
Gelatine	–	+	+
Gin	40	+	
Glycerine	100	+	+
Glycerine, liquid	bassa conc.	+	+
Glycolic, acid	100	+	+
Diesel oil	–	+	O
Glucose	–	+	+
Iso propylic alcohol	100	+	+
Iso octane	100	+	O

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7. CHEMICAL RESISTANCE

EXAMINED SUBSTANCES	CONCENTRATION %	TEMPERATURE (°C) 20	60
Iodine, tincture	–	$+_S$	
Lanolin	–	+	O
Milk	–	+	+
Lactic, acid	–	+	+
Liquors	t	+	
Lemonades	–	+	
Magnesium, salt	sol. sat.	+	+
Margarine	–	+	+
Jam	–	+	+
Mayonnaise	–	+	
Menthol	–	+	
Methanol	100	+	+
Methyl chloride	100	O	
Methyl-ethy-ketone	100	+	O
Mercury	100	+	+
Muriatic, acid	10	+	+
Naphta	100	+	
Naphtalene	100	+	
Nitric, acid	10	⊕	–
Nitrobenzene	100	⊕	O
Nickel, salt	sol. sat.	+	+
Oleic, acid	100	+	
Oleum	t	–	–
Peanut oil	–	+	⊕
Animal oil	–	+	⊕
Camphor oil	–	+	+
Combustible oil	–	+	O
Coconut oil	–	+	⊕
Almond oil	–	+	+
Cod oil	–	+	
Motor oil	–	+	O
Peppermint oil	–	+	+
Mais oil	–	+	O
Linseed oil	–	+	+
Cloves oil	–	+	
Rosin oil	–	+	⊕
Olive oil	–	+	+
Oxalic oil	–	+	+
Silicone oil	–	+	⊕
Oil of turpenthine	–	O	–
Paraffin oil	–	+	O

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EXAMINED SUBSTANCES	CONCENTRATION %	TEMPERATURE (°C) 20	60
Octane	–	+	O
Ozone	<0.5 ppm.	⊕	Θ
Cream	–	+	
Paraffin	100	+	+
Petroleum	100		
Pepper	–	+	O
Perfume	–	+	+
Propane, liquid	100	+	
Propane gas	100	+	
Pyridine	100	+	+
Potassium carbonate	sol. sat.	+	O
Potassium chlorate	sol. sat. (7.3)	+	+
Potassium chlorite	sol. sat.	+	+
Potassium chromate	sol. sat. (12)	+	+
Potassium iodide	sol. sat.		
Potassium nitrate	sol. sat.	+	+
Potassium permangan.	sol. sat. (6.4)		
Potassium persulfate	sol. sat. (0.5)	+	+
Potassium sulfate	sol. sat.	+	+
Copper, salt	sol. sat.	+	⊕
Copper, nitrate	30%	+	
Salt dry	–	+	+
Soap liquid	10		
Mustard	–	+	+
Soda water	–		
Soda caustic	100	+	+
Sodium bicarbonate	sol. sat.		
Sodium carbonate	sol. sat.	+	+
Sodium chlorate	25	+	+
Sodium hypochlorite	5		
Sodium chloride	sol. sat.	+	+
Sodium chlorite	5	+	
Sodium nitrate	sol. sat.	+	+
Sodium perborate	sol. sat. (1.4)	+	+
Sodium sulphate	sol. sat.		
Sodium phosphate	sol. sat.	+	+
Sodium sulphite	sol. sat.	+	+
Sodium thiosulphate	sol. sat.	+	
Tin II chloride	sol. sat.	+	+
Apple juice	–		
Orange, juice	–	+	+

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7. CHEMICAL RESISTANCE

SYMBOLS	
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sol. sat.	= satured solution
t	= all %

EXAMINED SUBSTANCES	CONCENTRATION %	TEMPERATURE (°C) 20	60
Lemon juice	–	+	+
Fruit juice	–	+	+
Tea	–	+	+
Turpentine	100		
Carbon, tetracheoride	100	–	
Tetra-chlorine-ethylen	100	Θ	–
Tetraidrophurano	100	O	–
Naphtalene, trachloride	100	O	–
Thiophene	100	O	–
Trichlorethylene	100	O	–
Tricresylphosphate	–	O	Θ
Urea	sol. sat.	+	
Vanilla	–	+	+
Vaseline	–	+	+
Xylene	100	+	O

8. PRESSURE LOSS

Calculation of pressure loss is a fundamental step in the design of heating and water supply systems. This parameter is closely linked to the delivery rate of the system, i.e. the amount of water which reaches the individual users within a unit of time.

Pressure loss may be continuous or localised. The sum of these two components provides the total pressure loss of the system.

Continuous loss of pressure is generated by the continuous resistance which a fluid encounters as it flows along a pipe. Such resistance consist of the internal friction of the fluid itself, due to viscosity, and resistance generated by contact with the inside surface of the pipe.

Continuous loss of pressure is measured in pressure units (pascal, bar, metres or millimetres of water column); in general, the measurement refers to a unit length of pipe.

In the specific case of COPRAX system pipes, the continuous loss of pressure is determined by means of the graphs given on the facing page (measured with water at 20°C).

FLOW RESISTANCE DIAGRAM

To use the diagram, at least two data are needed: the size of the pipe and the flow rate or speed.

Pipe PN 20: ø 32 x 5,4

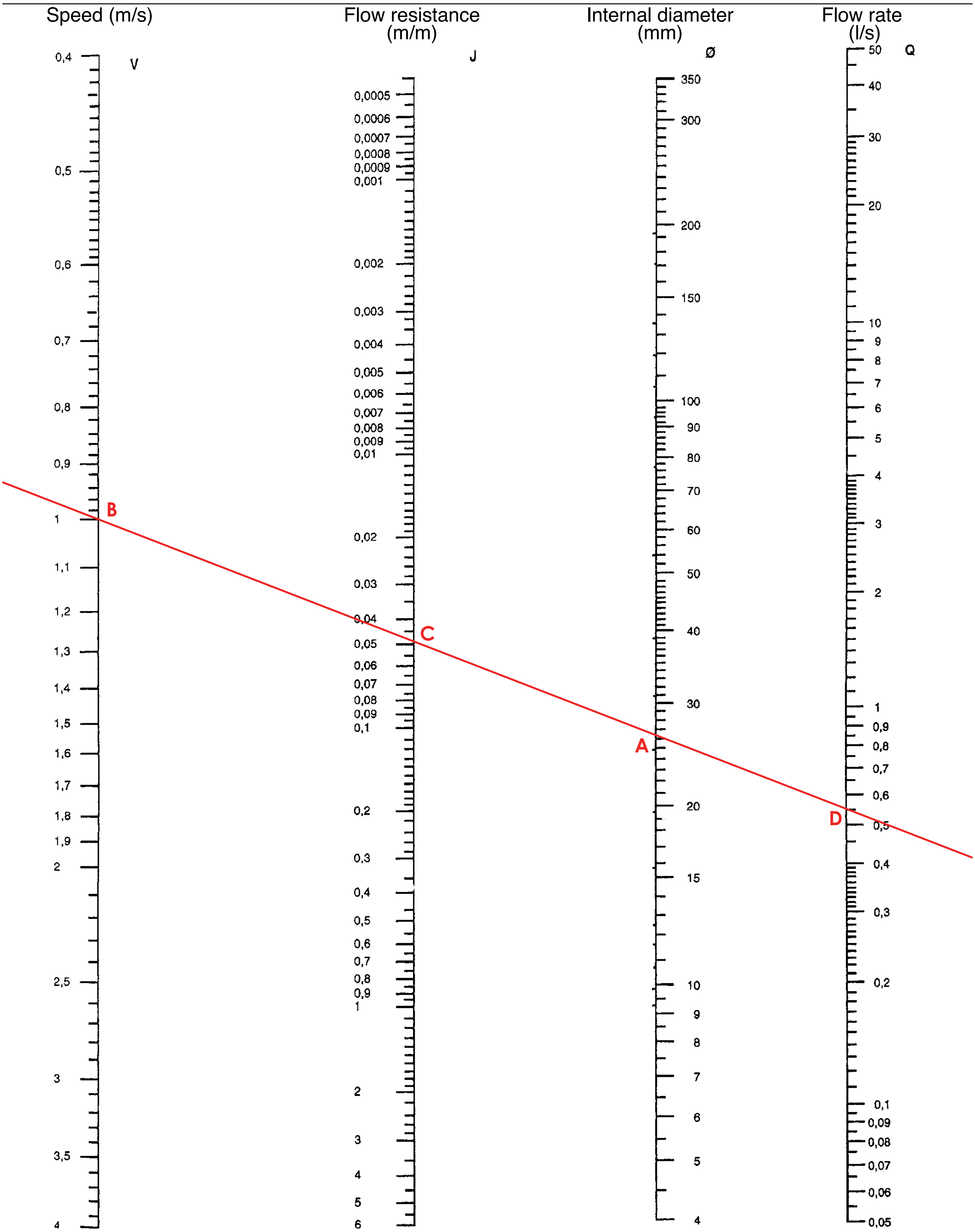
ø int. = mm 21.2 (point A)

speed 1 m/s (point B)

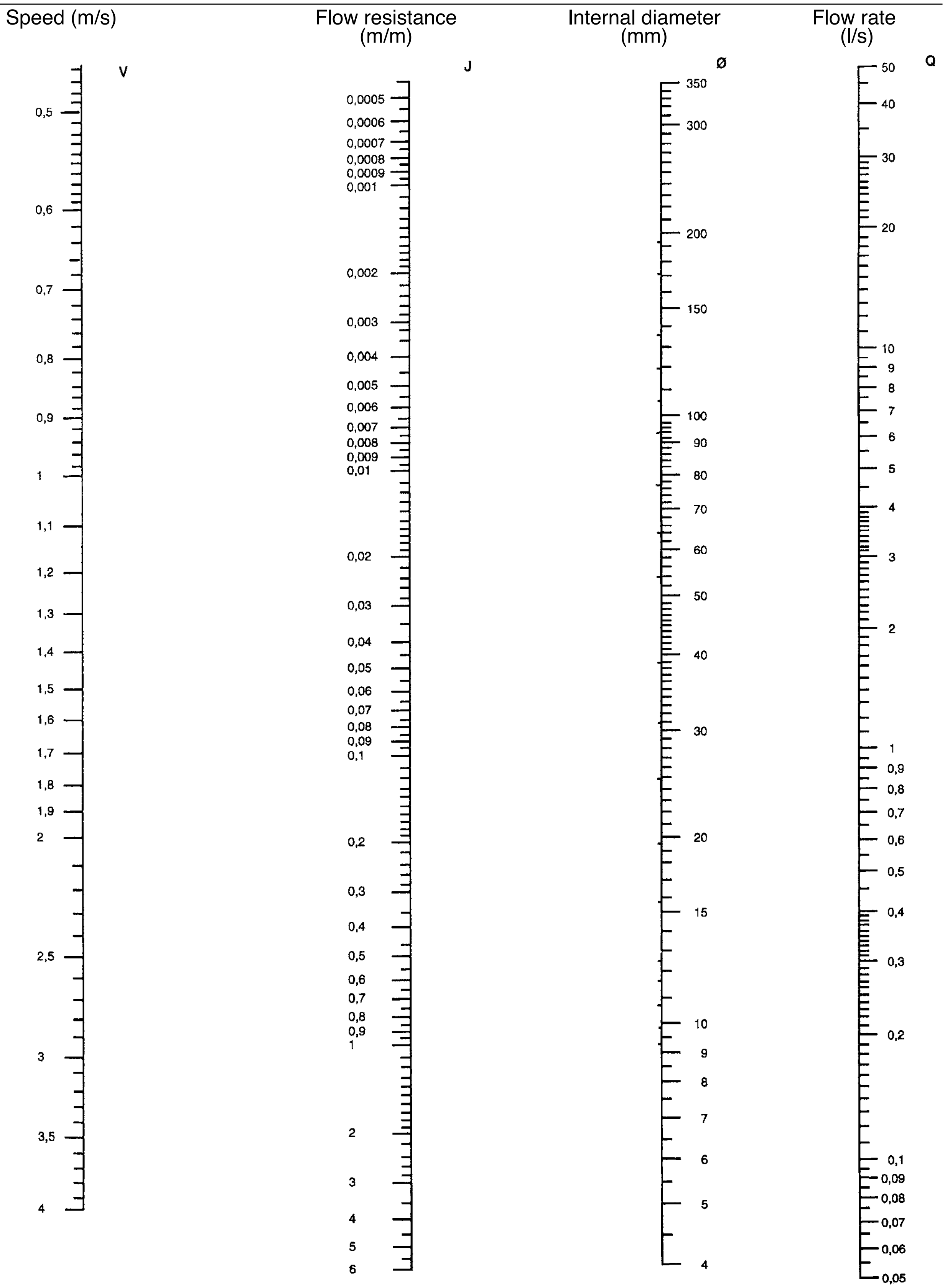
By joining points A and B with a straight line, points C and D are found which indicate a flow resistance J = 0.065 m/mand flow rate Q = 0.036 l/s.

8. PRESSURE LOSS

WATER AT 20°C



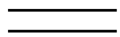
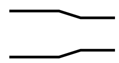
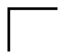
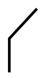
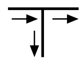
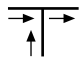
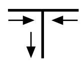
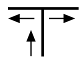
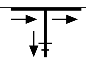
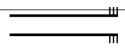
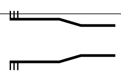
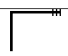
WATER AT 60°C


Speed (m/s)
V
0,5
0,6
0,7
0,8
0,9
1
1,1
1,2
1,3
1,4
1,5
1,6
1,7
1,8
1,9
2
2,5
3
3,5
4
Flow resistance (m/m)
J
0,0005
0,0006
0,0007
0,0008
0,0009
0,001
0,002
0,003
0,004
0,005
0,006
0,007
0,008
0,009
0,01
0,02
0,03
0,04
0,05
0,06
0,07
0,08
0,09
0,1
0,2
0,3
0,4
0,5
0,6
0,7
0,8
0,9
1
2
3
4
5
6
Internal diameter (mm)
Ø
350
300
200
150
100
90
80
70
60
50
40
30
20
15
10
9
8
7
6
5
4
Flow rate (l/s)
Q
50
40
30
20
10
9
8
7
6
5
4
3
2
1
0,9
0,8
0,7
0,6
0,5
0,4
0,3
0,2
0,1
0,09
0,08
0,07
0,06
0,05

8. PRESSURE LOSS

Localised loss of pressure are generated by the obstacles and irregularities which a fluid encounters as it flows along the pipeline (bends, valves, reductions, etc.).

Localised loss of pressure can be expressed in various ways; in this our discussion, we consider the ways which refer to the measurement of the so-called „localised resistance coefficient" associated to the COPRAX range of pipe fittings.

LOCALISED RESISTANCE COEFFICIENTS "r" FOR COPRAX PIPE FITTINGS			
FIGURE	DESCRIPTION	GRAPHIC SYMBOL	RESISTANCE COEFFICIENT
K10	coupling		0.25
K40	reduction till 2 dimensions		0.55
	reduction ≥ 3 dimensions		0.85
K20	elbow 90°		2.0
K70	elbow 45°		0.6
K30-K35	union tee		1.8
	reduced union tee		3.6
K30-K35	union tee		1.3
	reduced union tee		2.6
K30-K35	union tee		4.2
	reduced union tee		9.0
K30-K35	union tee		2.2
	reduced union tee		5.0
K33-K31	threaded tee		0.8
K11	male threaded joint		0.4
K12	male threaded elbow		0.85
K21	reduced male threaded elbow		2.2

Once the coefficients „r" are known, the system's localised loss of pressure are calculated using the following formula:

$$z = \Sigma\, r \cdot v^2 \cdot \gamma \,/\, 2g \cong 5 \cdot \Sigma\, r \cdot v^2 \quad \text{(mbar)}$$

where:

γ = 999.7 kg/m3 specific weight of water

g = 9.81 m/s2 gravity acceleration

v = speed of water in m/s

Σ= summation

LOSS OF PRESSURE Z IN RELATION TO R=1 W/WATER AT 10°C FOR VARIOUS SPEEDS V

FLOWING SPEED v (m/s)	LOSS OF PRESSURE z FOR r=1 (mbar)	FLOWING SPEED v (m/s)	LOSS OF PRESSURE z FOR r=1 (mbar)
0.1	0.1	2.6	33.8
0.2	0.2	2.7	36.5
0.3	0.5	2.8	39.2
0.4	0.8	2.9	42.1
0.5	1.3	3.0	45
0.6	1.8	3.1	48
0.7	2.5	3.2	51
0.8	3.2	3.3	55
0.9	4.1	3.4	58
1.0	5.0	3.5	61
1.1	6.1	3.6	65
1.2	7.2	3.7	68
1.3	8.5	3.8	72
1.4	9.8	3.9	76
1.5	11.3	4.0	80
1.6	12.8	4.1	84
1.7	14.5	4.2	88
1.8	16.2	4.3	92
1.9	18.1	4.4	97
2.0	20.0	4.5	101
2.1	22.1	4.6	106
2.2	24.2	4.7	110
2.3	26.5	4.8	115
2.4	28.8	4.9	120
2.5	31.3	5.0	125

8. PRESSURE LOSS

TOTAL LOSS OF PRESSURE

As already mentioned, the total system pressure loss is obtained by adding together the continuous and localised loss of pressure:

$$\Delta P = l \cdot R + z \cdot 10$$

where:

ΔP	= total loss of pressure	(mm c.a.)
l	= pipeline length	(m)
R	= continuous loss of pressure	(mm c.a./m)
z	= localised loss of pressure	(mbar)

EXPANSION AND STIRRUPS

Each material which undergoes a variation in temperature over time reacts by modifying its size to varying degrees.
This phenomenon is called thermal expansion; the body will increase in volume when the temperature rises, or contract when it decreases.

Thermal expansion may be linear, superficial or cubic, depending on whether it mainly affects one, two or all three of the body's dimensions.

In the case of pipelines, the expansion is mainly linear, since their length far exceeds their other dimensions.

The parameter which provides guidance on a pipe's tendency to expand or contract in case of a temperature variation is its linear expansion coefficient.

Therefore, when designing and constructing installations it is essential to know the value of this coefficient, in order to correctly calculate the extent of expansion/contraction and adopt the necessary measures to ensure that this will not damage the piping.

9. THERMAL INSULATION

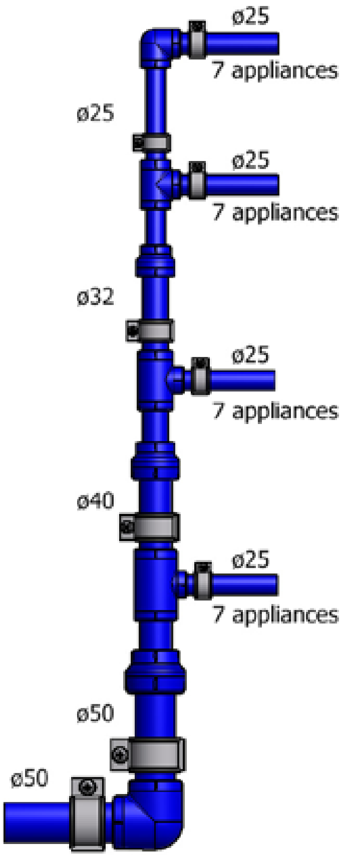
The Law 10/91 on the reduction of energy consumption and the current Italian Presidential Decree 412/93 requires that the pipes used for the production of thermal circuits are suitably coated with insulating material. Obviously in the case of thermal installations and/or the domestic hot water systems, insulation is required to avoid spillage, whilst those for air conditioning systems it is required not only for avoiding an increase in the temperature of the conveyed fluid, but also for preventing the formation of condensation on the pipe surface due to air humidity. At an equal thickness to the insulation coating, the greater the insulating power of the insulation coating is and the smaller thermal exchange surface is, the higher the subsequent energy saving will be. The Italian Presidential Decree 412/93 determines the minimum values of the insulation coating thickness based on the thermal conductivity of the insulating material and the diameter of the pipe to be insulated; it also specifies that the thickness recorded in the table below must be applied as follows: CASE A as they are in the table, for pipe segments placed in non-heated areas (i.e. garages, cellars etc.) CASE B multiplied by a 0.5 reduction coefficient for pipe segments mounted in places located inside the peripheral walls of a building CASE C multiplied by a 0.3 reduction coefficient for pipe segments placed in structures which are neither facing the exterior nor next to non-heated buildings.

INSULATION MATERIAL THICKNESS (mm)

Thermal conductivity of the insulation W / m°K	Outer diameter of the piping mm					
	<20	da 20 a 39	da 40 a 59	da 60 a 79	da 80 a 99	> 100
0,030	13	19	26	33	37	40
0,032	14	21	29	36	40	44
0,034	15	23	31	39	44	48
0,036	17	25	34	43	47	52
0,038	18	28	37	46	51	56
0,040	20	30	40	50	55	60
0,042	22	32	43	54	59	64
0,044	24	35	46	58	63	69
0,046	26	38	50	62	68	74
0,048	28	41	54	66	72	79
0,050	30	44	58	71	77	84

EXAMPLE OF DIMENSIONS OF A COLD WATER SUPPLY NETWORK

CONNECTED APPLIANCES AND RELATIVE DELIVERY RATES (UNI 9182-87)	
1 Washbasin	0.1 l/s
1 WC with cistern	0.1 l/s
1 Bidet	0.1 l/s
1 Bath	0.1 l/s
1 Sink	0.2 l/s
1 Dishwasher	0.2 l/s
1 Washing machine	0.2 l/s
7 Appliances	**1.0 l/s**



N. APPLIANCES	TOTAL DELIVERY RATE l/s	SIMULT. FACTOR %	SIMULT DELIVERY RATE l/s	COPRAX DIAMETER mm	COPRAX DELIVERY RATE l/s	LOSS OF PRESSURE mm ca/m	WATER SPEED m/s
7	1.0.	55.0	0.55	25	0.6	525	2.8
14	2.0	38.0	0.76	32	0.8	270	2.3
21	3.0	33.0	0.99	40	1.0	135	1.8
28	4.0	28.0	1.12	50	1.2	64	1.4

Note: the simultaneous delivery rates take into account the probability that the taps can be opened simultaneously.

EXPANSION IN COPRAX AND COPRAX FIBRA PIPES

Naturally, COPRAX and COPRAX Fibra system pipes are not immune to thermal expansion, and so this factor must be carefully evaluated during design and installation.

First, it is important to distinguish between the two alternative installation modes:

- installation under concrete

- external installation (visible)

In the first case, the effect of expansion is negligible, since the material is able to absorb expansion and no special measures are required.

On the other hand, when pipes are installed outside the walls and therefore exposed to considerable variations in temperature, it is essential to allow for the thermal expansion by proceeding as described hereafter.

CALCULATING EXPANSION

The variation in length ΔL of a COPRAX pipe further to a temperature variation can be calculated using the following formula:

$$\mathbf{\Delta L = \alpha \cdot L \cdot \Delta T}$$ where:

ΔL = variation in pipe length (mm)

α = linear expansion coefficient of the material, which for COPRAX is 0.15 mm/m°C, while for COPRAX Fibra it is 0.035 mm/m°C

L = length of the pipe section free to expand (m)

ΔT = difference in temperature between the time of installation and the operating temperature (°C).

EXAMPLE 1: EXPANSION

L	= 6 m;
Tm	= 20°C (installation temperature);
Tmax	= 75°C (maximum operating temperature);

from which we obtain

$\Delta L = \alpha \cdot L \cdot \Delta T = 0.15 \cdot 6 \cdot 55 = 49.5$ mm (Coprax)

$\Delta L = \alpha \cdot L \cdot \Delta T = 0.035 \cdot 6 \cdot 55 = 11.55$ mm (Coprax Fibra)

In this case, the pipe expands, increasing its initial length.

EXAMPLE 2: CONTRACTION

L	= 6 m;
Tm	= 20°C (installation temperature);
Tmin	= 5°C (minimum operating temperature, e.g.air-conditioning);

from which we obtain

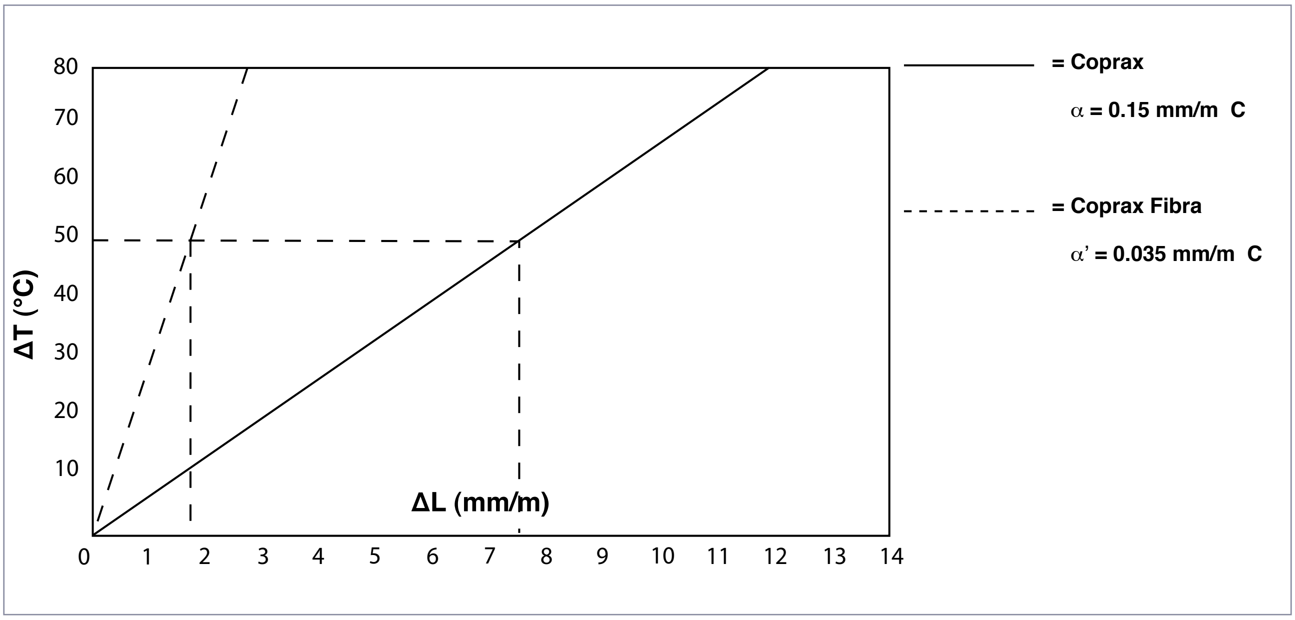
$\Delta L = \alpha \cdot L \cdot \Delta T = 0.15 \cdot 6 \cdot (25) = 22.5$ mm (Coprax)

$\Delta L = \alpha \cdot L \cdot \Delta T = 0.035 \cdot 6 \cdot (25) = 5.2$ mm (Coprax Fibra)

In this case, the pipe contracts, reducing its initial length.

CALCULATING OF ΔL IN RELATION TO ΔT, PER METRE OF PIPE

The parameter ΔL can also be calculated using the graph shown below.



EXAMPLE RELATING TO THE GRAPH

ΔT	= 50°C	with	Tm	= 20°C on installation
			Tmax	= 70°C max oper. temp.
ΔL	= a)	7.5 mm	for Coprax pipe	
	b)	1.7 mm	for Coprax Fibra pipe	
these values are multiplied by the total length of the pipe to obtain the total expansion value				

INSTALLATION TECHNIQUE WHEN THERMAL EXPANSION IS PRESENT

Once the variation in length of the piping has been calculated, the necessary measures must be taken to ensure that its effects do not cause problems for the piping itself. The following procedures may be used:

- provision of fixed and sliding points;
- compensation with expansion arms.

FIXED AND SLIDING POINTS

These are fixtures which secure the piping to the masonry structure of the building, totally or partially preventing the movements generated by thermal expansion.

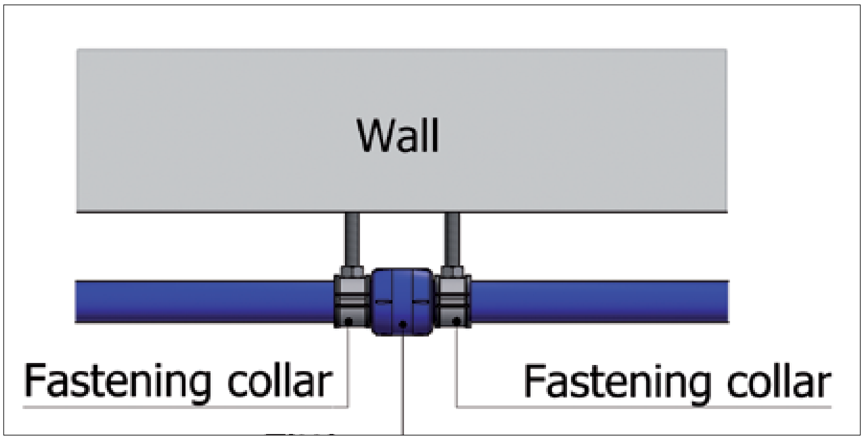
Fixed points prevent pipes from moving, and so must provide a rigid connection between the installation and the masonry.

They are constructed using rigid collars, consisting of a gripping element, generally made of metal, lined with rubber on the pipe side, and a component for fixing to the wall on the other side. Naturally, the part in rubber (or in another similar material) is intended to prevent dangerous cutting of the surface of the pipe.

Fixed points must normally be positioned where the system changes direction (branches, elbows, etc.) to ensure that the expansion forces are not discharged in these points. In all cases, a fixed supporting point should always be provided next to any joint in the pipe created using a coupling or any other welded fitting.

Obviously, the fixed points limit the length of the sections of pipe free to expand, and thus reduce the relative ΔL value.

EXAMPLE OF A FIXED POINT

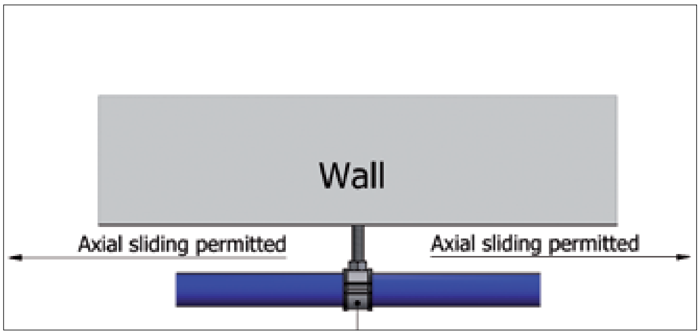


10. TECHNICAL INSTALLATION

Sliding points allow the pipe to move axially in both directions. They therefore have to be positioned well away from joints made using pipe fittings, on a free part of the pipe's surface. The collar which forms the sliding support point must be absolutely free from contact with parts which might damage the outside surface of the pipe.

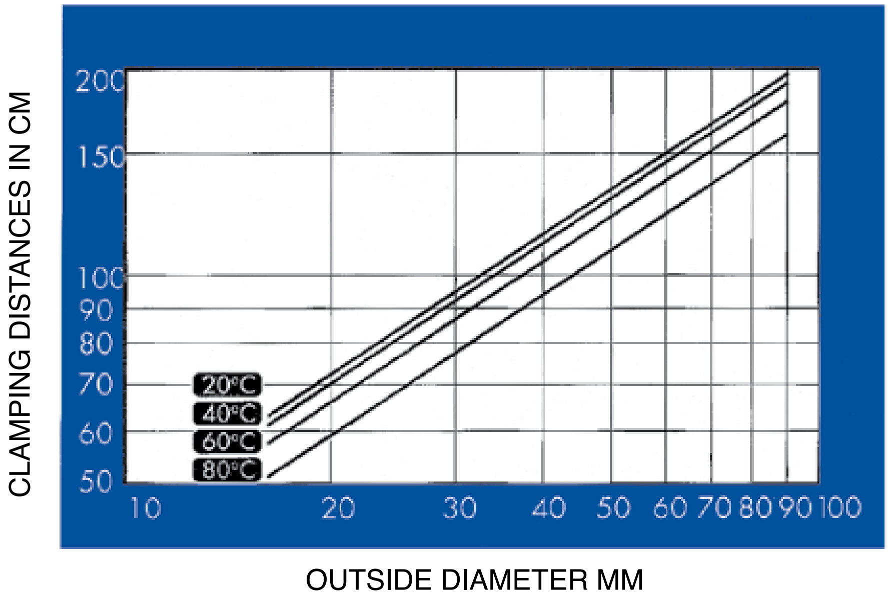
Sliding points also provide support and ensure (provided enough of them are installed) that the pipe remains straight in spite of thermal stresses. See „stirrup distances".

EXAMPLE OF SLIDING POINT



THE STIRRUP DISTANCES

To allow correct installation of COPRAX system pipes on the outside of walls, the following is the graph used to calculate the stirrup distances between points. These distances remain the same regardless of whether the pipes are horizontal or vertical.



COMPENSATING USING EXPANSION ARMS

With this technique, the pipe run is designed to allow any expansion to be absorbed. To ensure this, expansion arms, where the pipe is able to expand in case of thermal stresses, are installed at the points where direction changes (elbows, tees, etc.).

The specifications of these expansion arms are calculated using the following formula:

$LS = F \cdot \sqrt{(d \cdot \Delta L)}$ where:

LS = expansion arm length (mm)

F = constant of the material (for PP = 15)

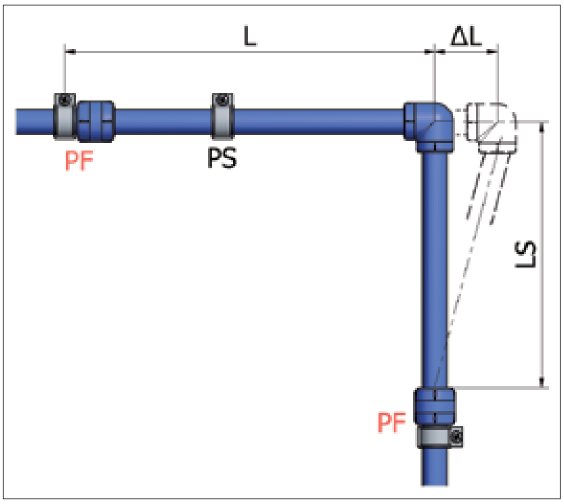
d = pipe outside diameter (mm)

ΔL = pipe length variation (mm)

To calculate the expansion arm length for a section of Coprax pipe where:		
d	=	40 mm (outside diameter);
L	=	6 m;
ΔT	=	55°C
Previous calculations have given a ΔL = 49.5 mm		
Therefore:		
$LS = F \cdot \sqrt{d \cdot \Delta L} = 15 \cdot \sqrt{(40 \cdot 49.5)} = 667$ mm		

Note: when COPRAX Fibra pipe is used in the same conditions and with the same F value, the expansion arm will be shorter than for COPRAX. This is because of the lower thermal expansion coefficient, which means that the increase in pipe length is reduced

EXAMPLE OF EXPANSION ARM



CALCULATING EXPANSION ARM LENGTH USING GRAPHS (COPRAX)

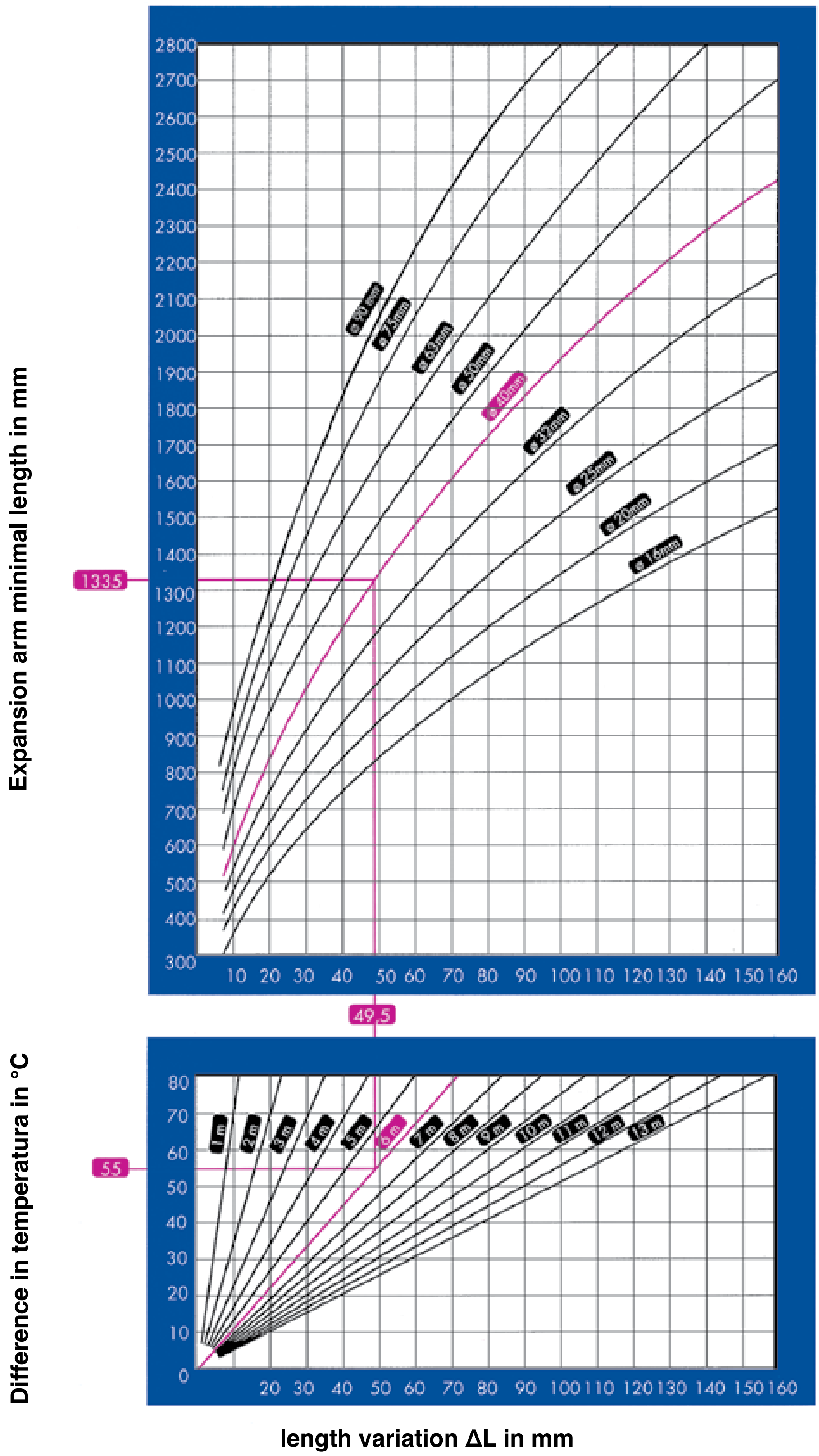
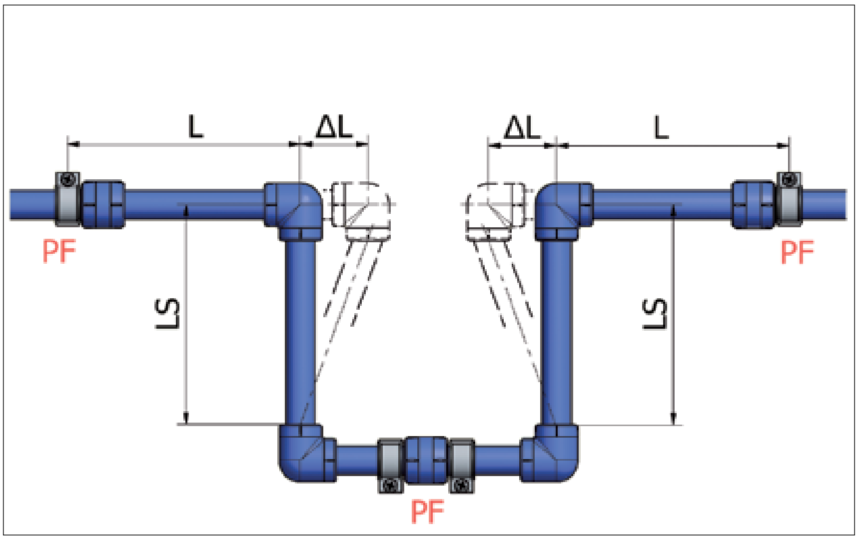
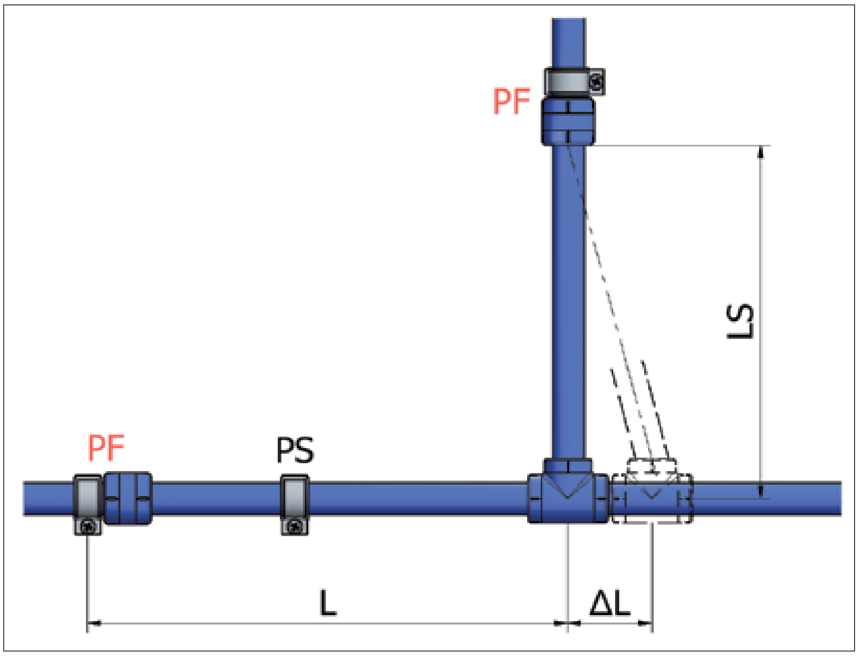
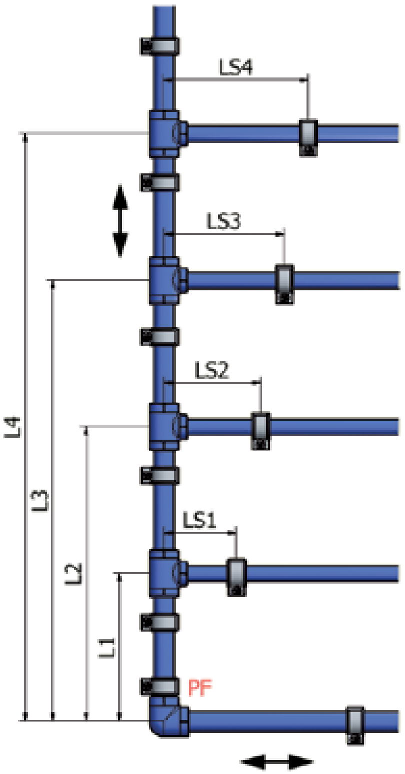


DIAGRAM EXAMPLES

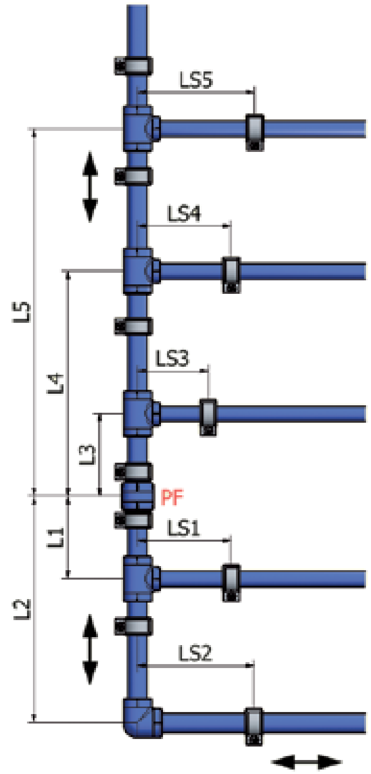
The following are some examples of correct installation of the COPRAX system on the outside of walls, with the various techniques adopted to allow for thermal expansion of the material.



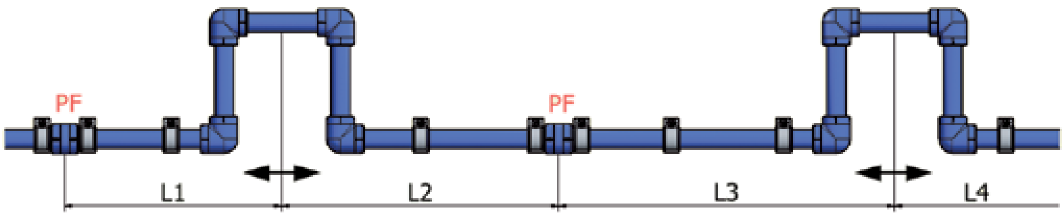




Fixed point at base of vertical pipe section



Fixed point in the middle of the vertical section



Length absorption with compensation loop in a straight section of pipe

11. PRECAUTIONS

Use of a system of plastic pipes and fittings offers a series of advantages from various points of view, as fully described in „COPRAX system properties", Chapter 2 (page 6).

However, in order to enjoy all the benefits of these properties, the user must be well aware of every aspect relating to the product. To assist the COPRAX system user, we have prepared a number of important recommendations, set out below.

WORKING CONDITIONS

The use of COPRAX and COPRAX Fibra in the stated working conditions creates absolutely no problems for the material.

However, exceeding the limit conditions for use may impair the product's resistance.

All precautions must therefore be taken to ensure that this does not occur; this not only protects the system itself, but frequently also its user.

ULTRAVIOLET RAYS

COPRAX must never be installed or stored where it is subject to direct ultraviolet rays (sunlight or neon lights). Ultraviolet ray causes ageing in the material, leading to loss of its initial chemical-physical characteristics.

HANDLING PIPES

During handling, storage and use on site, bundles of pipes or individual lengths must be protected against excessive external stresses, such as shaking, knocks, hammer blows, etc. This becomes even more important when ambient temperature falls, since at low temperatures the material is more rigid and has a less elastic response to outside stresses.

11. PRECAUTIONS

FORMATION OF ICE

When water passes from the liquid to the solid state (ice), its volume increases to an extent which may generate stresses inside the installation which the material is unable to withstand. The appropriate measures should be taken to ensure that this does not occur, draining the system completely after testing if there is the risk of freezing.

CONTACT WITH SHARP EDGED BODIES

Any contact with sharp edged bodies (such as brick shards) causes cuts on the outside of the pipe which might lead to breakages later. Care should be taken to ensure that this does not occur during storage and installation, and any scratched or scored pipes must not be used

BENDING

To bend COPRAX system pipes, proceed as follows:

- for very wide radius curves, the pipe may be bent cold
- for radius close to, but not below, 8 times the diameter of the pipe concerned, the pipe should be heated with hot air.
- flames must not be used.

Rmin ≥ 8 D

FITTINGS WITH METAL INSERT

When using COPRAX system fittings with threaded female metal insert, do not apply excessive tightening torques when connecting to male fittings. Also, take care not to place too much hemp between the parts to be assembled. Teflon is to be preferred in all cases. In addition, check that the male part is long enough for a proper connection; generally, at least one turn of thread should be left free.

If installation requirements mean that a COPRAX system fitting must be connected to an iron pipe or union, the connection should be made using COPRAX fittings with male thread.

CUTTING PIPES

Use tools capable of making a burr-free cut, perpendicular to the pipe’s axis.

WELDING

The parts for welding must always be kept thoroughly clean and the welding machine’s thermostat must indicate that it has reached the operating temperature. No twisting or rotation forces must be applied to the connected parts, either during or after welding. See page 23, “**WELDING BY A FUSION WELDING MACHINE**”.

12. TESTING

Testing an installation (according the ENV12108:2001 standard) is essential for its successful operation, as it allows making sure that the installation does not have any leakage points for any reasons.

The operations to complete are as follows:

- Visual inspection of the pipes and joints: this allows checking if the pipes and fittings have been installed correctly and if there are parts which have been accidentally damaged by sharp objects.

- Hydraulic test for checking water-tightness: it must be carried out when the installation can still be accessed directly, by filling it with water at room temperature.

1. When the installation has been filled with water closed, make it reach testing pressure and keep it under such pressure for 30 minutes (if pressure decreases due to the piping settling in, restore testing pressure at intervals of 10 minutes).

2. Read the pressure value after 30 minutes using devices with 0.1 bar accuracy. Read the value of the pressure after another 30 minutes: if the variation is less than 0.6 bar, the installation has no leaks. Continue the test for another 2 hours.

3. Read the pressure value after 2 hours, if pressure has decreased by more than 0.2, bar the system leaks; otherwise the result of testing is positive.

For single segments of the installation the operations referred to in point 3 can be omitted.

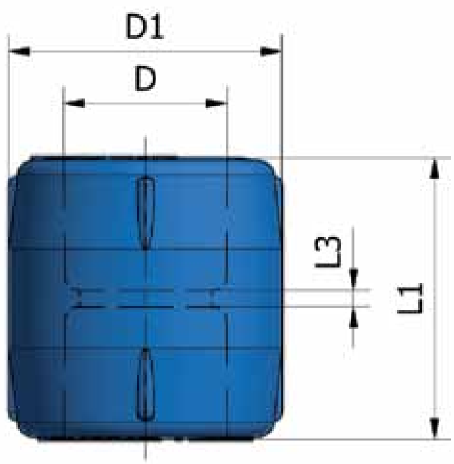
TESTING PRESSURE = MAXIMUM WORKING PRESSURE x 1.5

An appropriate use of the COPRAX System along with careful testing will avoid any problem even in the segments of the installations used for transporting hot water.

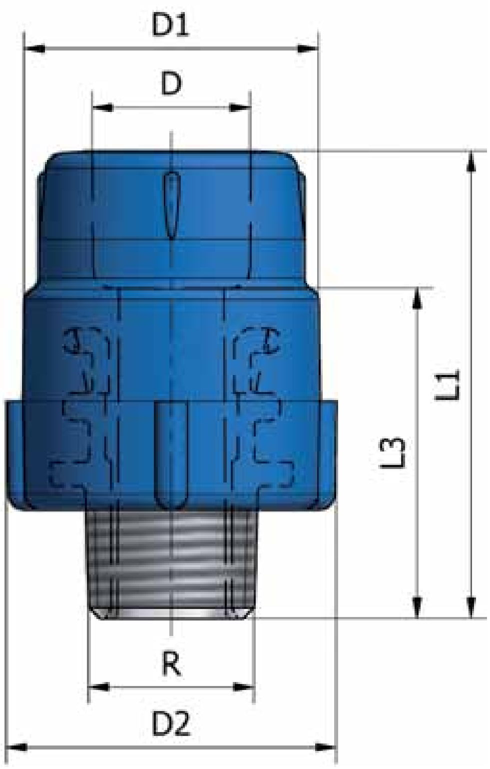
N.B. Once the testing is complete, the testing pressure is discharged from the installation; sometimes the installation should be completely discharged of pression, especially if testing has taken place in a zone subjected to reaching temperatures around or below 0°C.

This warning aims at avoiding possible unexpected breakages which may occur due to the formation of ice on the installations which are supposedly already tested and therefore are believed to be free from any inconvenience.

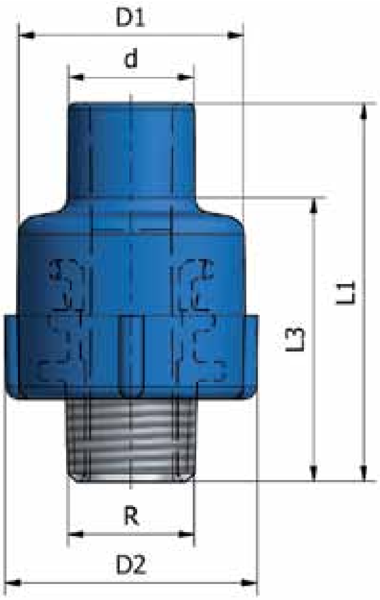
13. FITTINGS DIMENSIONS

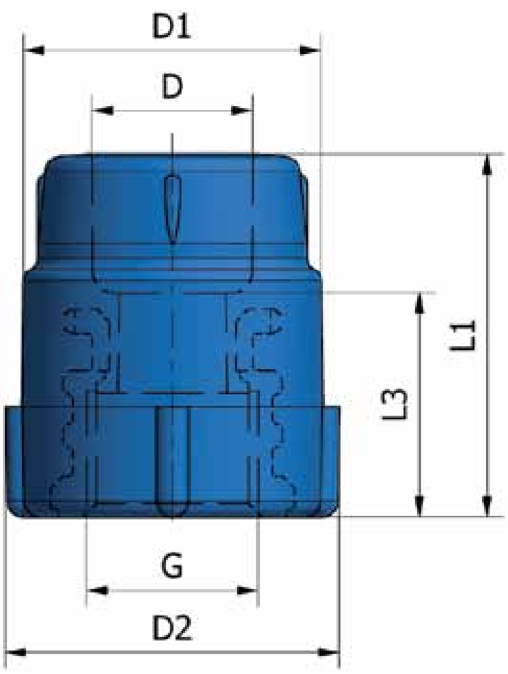


K10	Code	D	L1	L3	D1
	10710020	20	33.5	4.5	32.5
	10710025	25	37.5	5.5	40.5
	10710032	32	43	7	43.5
	10710040	40	50	9	59
	10710050	50	57	10	73.5
	10710063	63	64	9	84
	10710075	75	66	4	100
	10710090	90	79	8	120
	10710095	110	89.5	5	145.5
	10710096	125	91	10	163

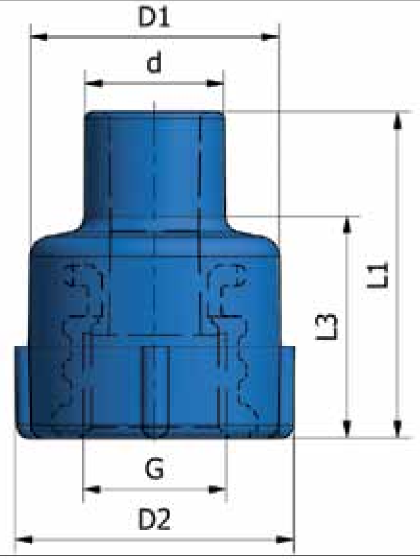


K11	Code	D/R	L1	L3	D1	D2
	10711220	20X1/2”	57	42.5	36	40
	10711320	20X3/4”	62	47.5	44	49
	10711120	20X3/8”	56	41.5	36	40
	10711225	25X1/2”	61	45	36	40
	10711325	25X3/4”	62	46	44	49
	10711425	25x1”	70.5	52	54	59
	10711232	32X1/2”	64	46	48	53
	10711332	32X3/4”	66	48	47.5	49
	10711432	32X1”	70.5	52	54	59
	10711540	40x1”1/4	92.5	72	59	69
	10711650	50X1”1/2	96.5	73	/	76
	10711763	63x2”	115	87.5	84	90.5
	10711875	75X2”1/2	123	92	100	106
	10711990	90x3”	121.5	86	120	127
	10711095	110x4”	149	112	170	180
	10711096	125x5”	170	125	168	220

K12	Code	d/R	L1	L3	D1	D2
	10712220	20X1/2”	60.5	46	36	40
	10712320	20X3/4”	63.5	49	44	49
	10712225	25X1/2”	62	46	36	40
	10712325	25X3/4”	65	49	44	49
	10712425	25x1”	74	58	55	60
	10712232	32X1/2”	66.5	48.5	36	40
	10712332	32X3/4”	68.5	50.5	44	49
	10712432	32X1”	76	58	55	60
	10712540	40x1”1/4	96.5	76	/	69
	10712650	50X1”1/2	100.5	77	/	76
	10712763	63x2”	115	87.5	/	90.5
	10712875	75X2”1/2	123	92	/	106

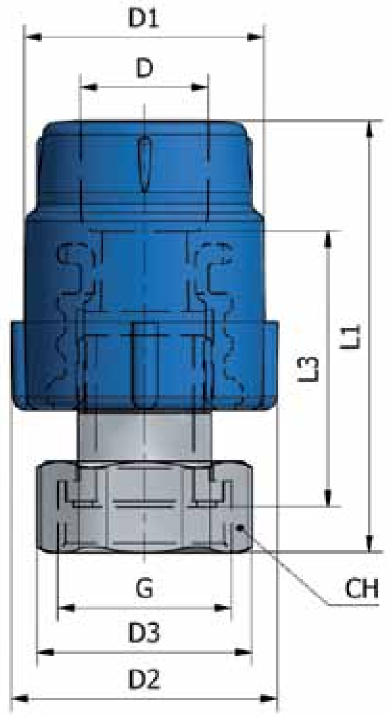
K13	Code	d/G	L1	L3	D1	D2
	10713220	20X1/2”	46.5	32	36	40
	10713320	20X3/4”	50.5	36	44	49
	10713225	25X1/2”	47.5	31.5	36	40
	10713325	25X3/4”	50.5	34.5	44	49
	10713425	25x1”	51.5	35.5	54	59
	10713232	32X1/2”	50.5	32.5	48	53
	10713332	32X3/4”	51.5	33.5	47.5	49
	10713432	32X1”	51.5	33.5	54	59
	10713540	40x1”1/4	73	52.5	59	69
	10713650	50X1”1/2	77	53.5	/	75.5
	10713763	63x2”	91	63.5	84	90.5
	10713875	75X2”1/2	97	66	100	106
	10713990	90x3”	102	68	133	142
	10713095	110x4”	108	72	170	180
	10713096	125x5”	112	72	168	220

K14

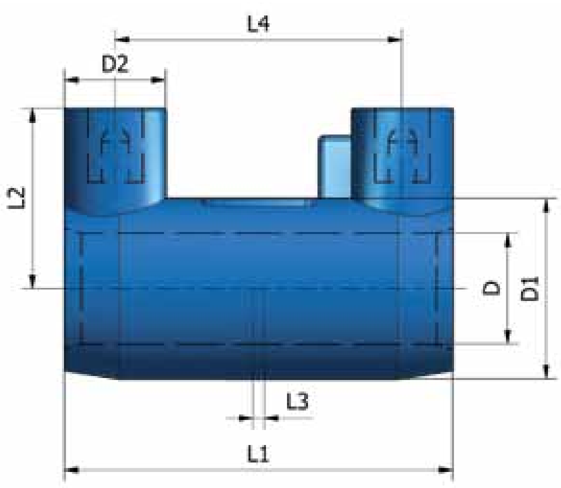


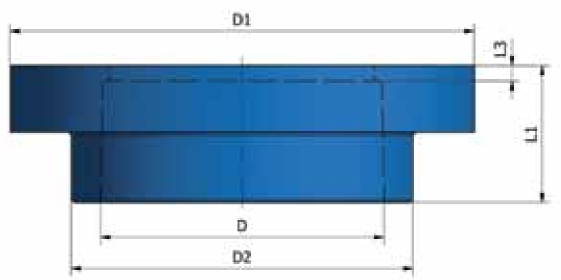
Code	d/G	L1	L3	D1	D2
10714220	20X1/2”	47	32.5	36	40
10714320	20X3/4”	49	34.5	44	49
10714225	25X1/2”	48.5	32.5	36	40
10714325	25X3/4”	50.5	34.5	44	49
10714232	32X1/2”	53	35	36	40
10714332	32X3/4”	54	36	44	49
10714432	32X1”	59	41	55	60
10714540	40x1”1/4	77	56.5	/	69
10714650	50X1”1/2	81	53.5	/	76
10714763	63x2”	91.5	64	/	90.5
10714875	75X2”1/2	97	66	/	106

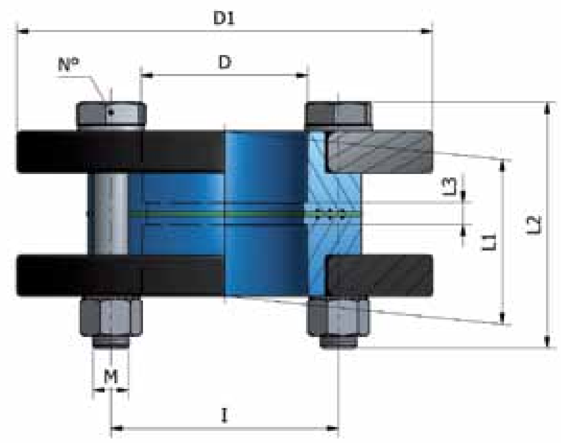
K15

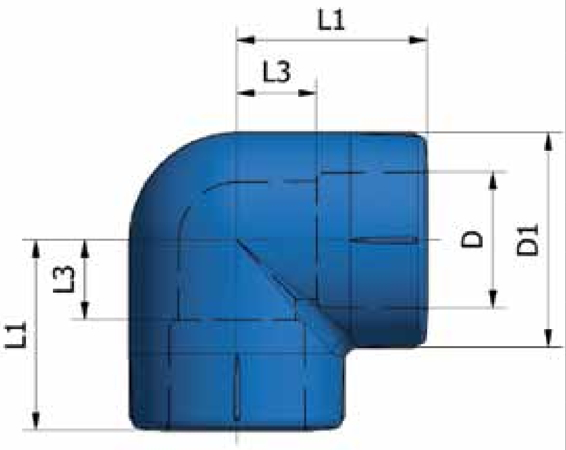


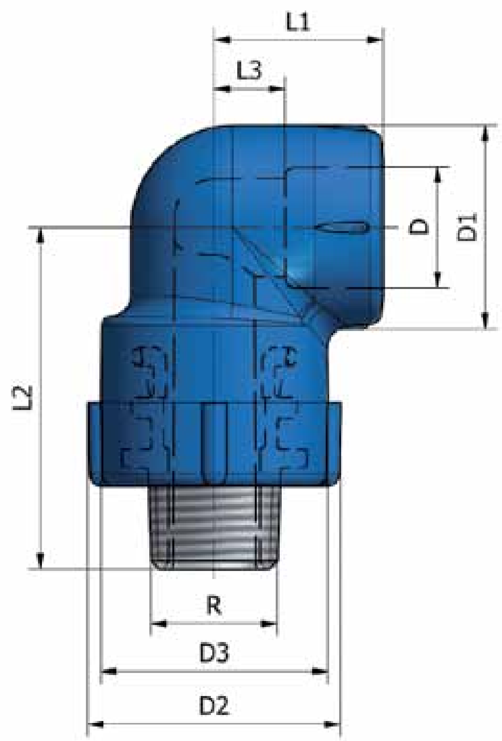
Code	D/G	L1	L3	D1	D2	D3	CH
10715220	20X1/2”	67.5	46.5	36	40	28	25
10715320	20X3/4”	67.5	46.5	36	40	33	30
10715325	25X3/4”	68.5	46	36	40	33	30
10715425	25x1”	75.5	51.5	44	49	40.5	37
10715532	32X1”1/4	85	47	54	59	51.5	47
10715640	40x1”1/2	105	75	59	69	55.5	52
10715750	50X2”	118	81	/	75.5	74.5	64
10715863	63x2”1/2	143	102	84	90.5	85	80

K17	Code	D	L1	L2	L3	L4	D1	D2
	10717020	20	70	34	3	51	33.5	18
	10717025	25	71	36	4	52	38.5	16.5
	10717032	32	80	41	3	62	46.5	16.5
	10717040	40	90	44	0	66	56	16.5
	10717050	50	100	50	0	75	68	17.5
	10717063	63	107	59	0	80	86	17.5
	10717075	75	121	65	0	92.5	103	17.5
	10717090	90	130	75	0	102	122	17.5
	10717095	110	142	85	0	108	146	17.5
	10717096	125	153	92	0	137	164	16

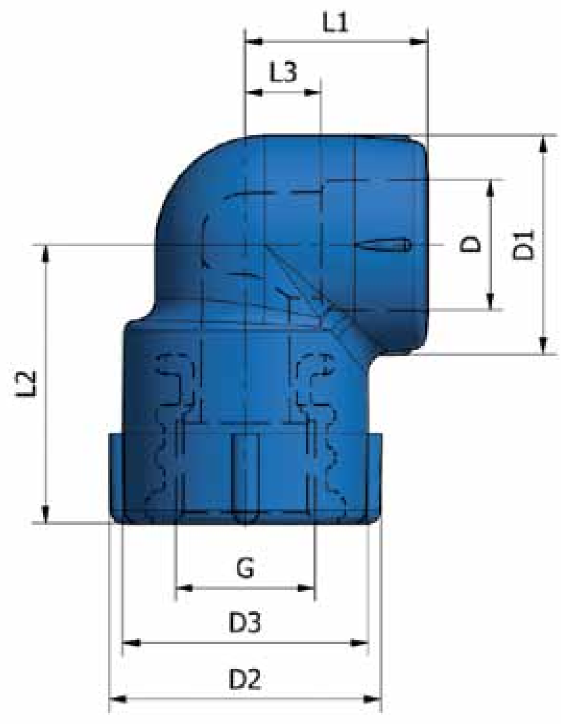
K18	Code	D	L1	L3	D1	D2
	10718075	75	36	5	120	88.5
	10718090	90	40	5	137.5	104.5
	10718095	110	51	10	154	126
	10718096	125	55	10	157	144

K19	Code	D	L1	L2	L3	D1
	10719075	75	74	110	12	186
	10719090	90	82	110	12	200
	10719095	110	105	130	23	218
	10719096	125	113	130	23	218

K20	Code	D	L1	L3	D1
	10720020	20	27	12.5	30.5
	10720025	25	31.5	15.5	37.5
	10720032	32	38.5	20.5	47.5
	10720040	40	46	25.5	59
	10720050	50	54	30.5	74
	10720063	63	63.5	36	84
	10720075	75	71	40	100
	10720090	90	81.5	46	120
	10720095	110	96	56	146
	10720096	125	109	64	170

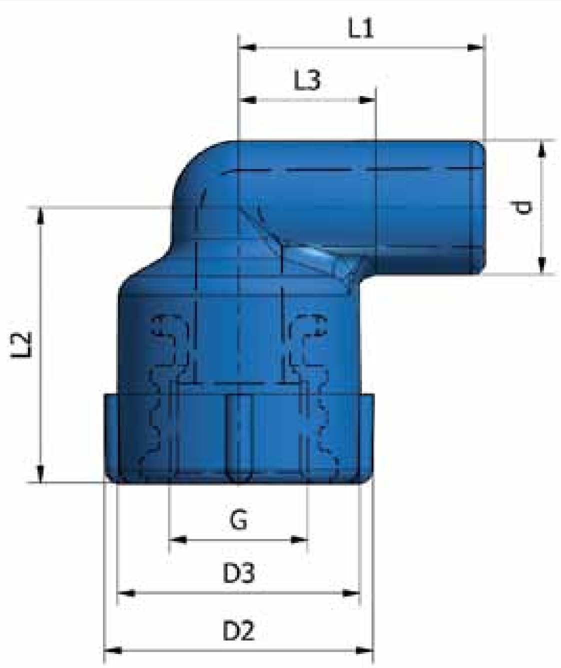
K21	Code	D/R	L1	L2	L3	D1	D2	D3
	10721120	20x3/8”	27	52	12.5	32.5	40	36
	10721220	20x1/2”	27	55	12.5	32.5	40	36
	10721325	25x3/4”	32.5	59.5	16.5	41	49	44
	10721432	32x1”	39.5	68	21.5	52.5	60	55

K23



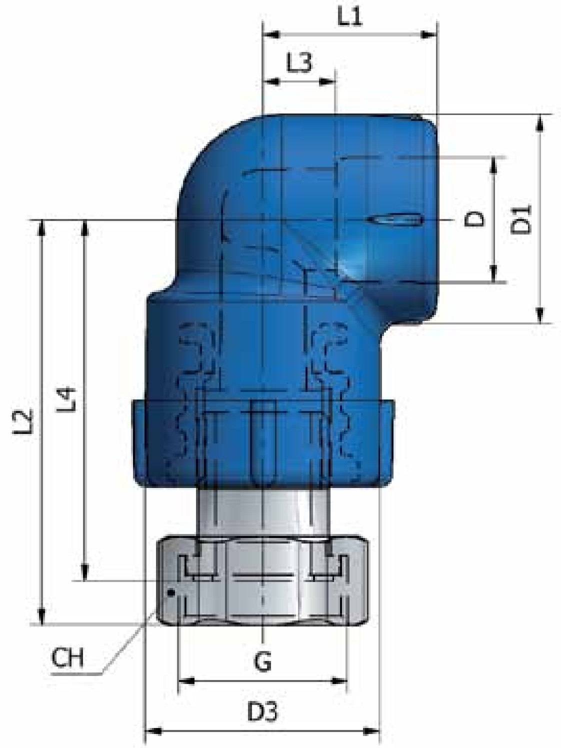
Code	D/G	L1	L2	L3	D1	D2	D3
10723120	20x3/8”	27	41	12.5	32.5	40	36
10723220	20x1/2”	27	41	12.5	32.5	40	36
10723225	25x1/2”	27	41	11	36.5	40	36
10723325	25x3/4”	32.5	45	16.5	41	49	44
10723332	32x3/4”	39.5	51	21.5	52.5	60	55
10723432	32x1”	39.5	51	21.5	52.5	60	55

K24



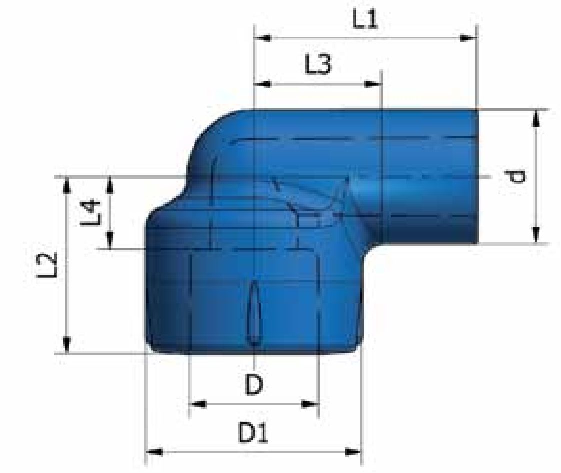
Code	D/G	L1	L2	L3	D2	D3
10724220	20X1/2”	37	41	22.5	36	40

K25



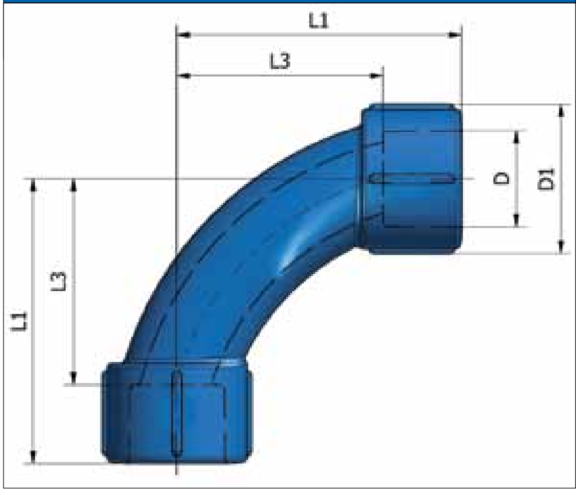
Code	D/G	L1	L2	L3	L4	D1	D3	CH
10725320	20x3/4”	27	62	12.5	55.5	32.5	36	30
10725425	25x1”	32.5	66	16.5	59.5	41	44	37
10725532	32x1”1/4	39.5	79	21.5	69.5	52.5	55	47

K26



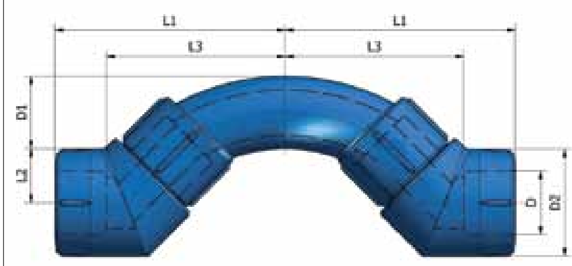
Code	D/d	L1	L2	L3	L4	D1
10726020	20x20	33.5	26.5	19	12	32.5
10726025	25x25	39.5	31.5	23.5	15.5	37.5

K28



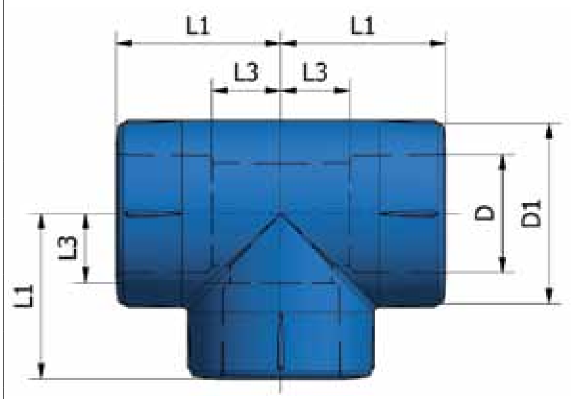
Code	D	L1	L3	D1
10728020	20	57	42.5	30

K29



Code	D	L1	L2	L3	D1	D2
10729020	20	70.5	17	56	22	33

K30



Code	D	L1	L3	D1
10730020	20	27	12.5	30.5
10730025	25	31.5	15.5	37.5
10730032	32	38	20	43.5
10730040	40	47.5	27	54
10730050	50	54.5	31	67
10730063	63	63.5	36	84
10730075	75	73	40	100
10730090	90	81.5	46	120
10730095	110	96	56	146
10730096	125	122	82	170

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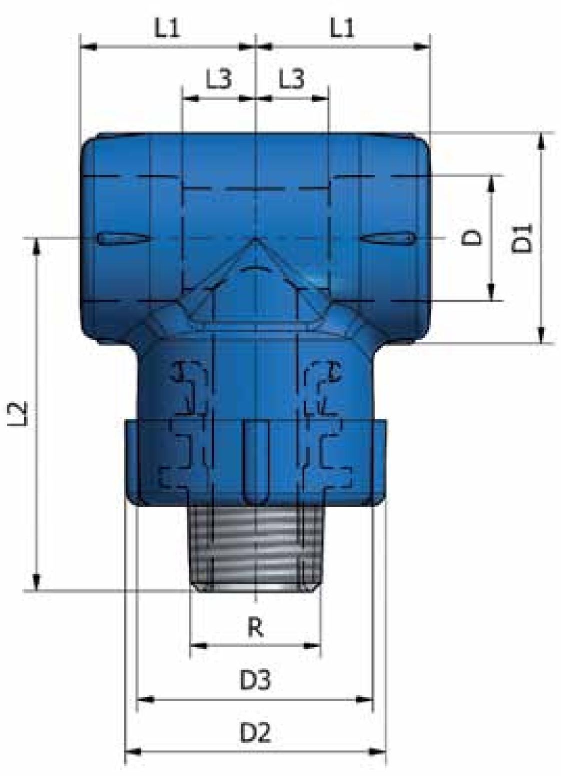
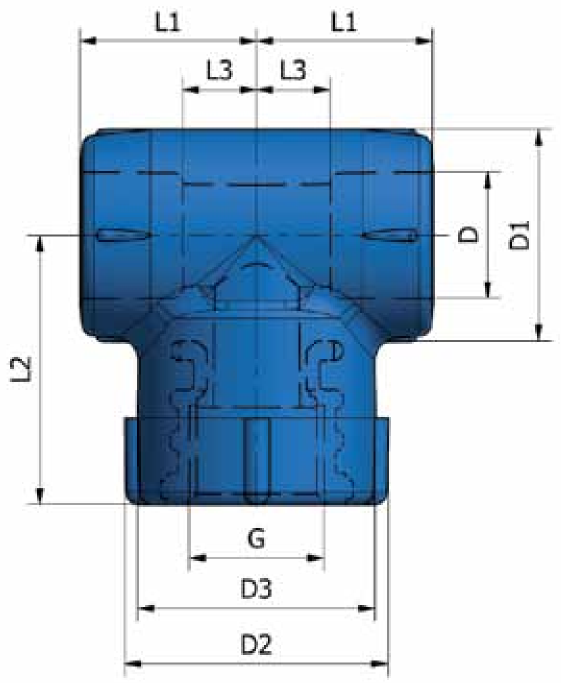
K31

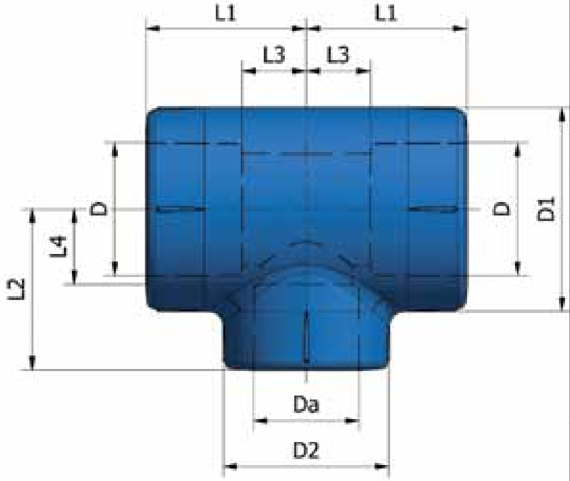


Code	D/R	L1	L2	L3	D1	D2	D3
10731120	20x3/8”	27	52	12.5	32.5	40	36
10731220	20x1/2”	27	55	12.5	32.5	40	36
10731325	25x3/4”	32.5	59.5	16.5	41	49	44
10731432	32x1”	39.5	68	21.5	52.5	60	55

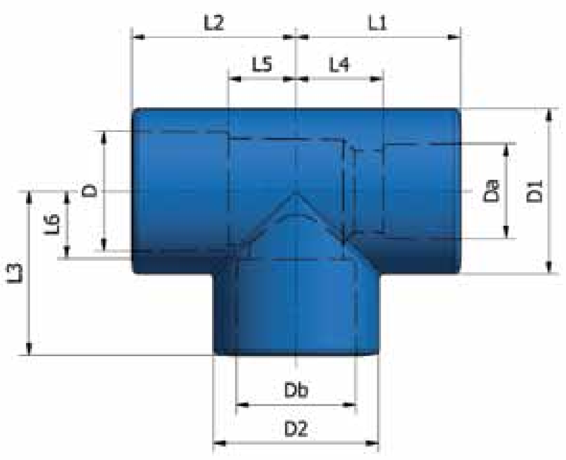
K33



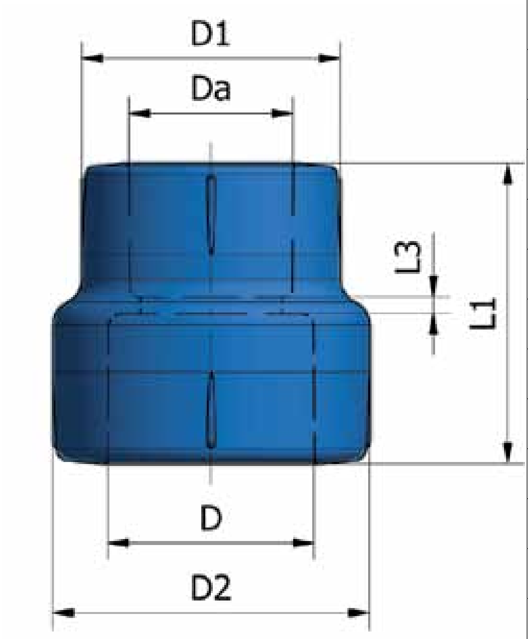
Code	D/G	L1	L2	L3	D1	D2	D3
10733120	20x3/8”	27	41	12.5	32.5	40	36
10733220	20x1/2”	27	41	12.5	32.5	40	36
10733225	25x1/2”	27	41	11	36.5	40	36
10733325	25x3/4”	32.5	45	16.5	41	49	44
10733232	32x1/2”	34.5	47	16.5	47.5	40	36
10733332	32x3/4”	39.5	51	21.5	52.5	60	55
10733432	32x1”	39.5	51	21.5	52.5	60	55

K35	Code	D/Da	L1	L2	L3	L4	D1	D2
	10735225	25x20	29.5	29.5	13.5	15	37.5	30.5
	10735232	32x20	38	33	20	18	43.5	29
	10735332	32x25	38	35	20	19	43.5	34
	10735240	40x20	47.5	39.5	27	25	54	28
	10735340	40x25	47.5	41.5	27	25.5	54	33.5
	10735440	40x32	47.5	45	27	27	54	43
	10735250	50x20	54.5	45	31	30.5	67	28
	10735350	50x25	54.5	47	31	31	67	33.5
	10735450	50x32	54.5	51	31	33	67	43
	10735550	50x40	54.5	52	31	31.5	67	54
	10735363	63x25	63.5	55	36	39	84	33.5
	10735463	63x32	63.5	57	36	39	84	43
	10735563	63x40	63.5	58	36	37.5	84	54
	10735663	63x50	63.5	60	36	36.5	84	67
	10735475	75x32	71	63	40	45	100	43
	10735575	75x40	71	64	40	43.5	100	54
	10735675	75x50	71	66	40	42.5	100	67
	10735775	75x63	71	68	40	40.5	100	85
	10735790	90x63	83	83	47.5	55.5	120	85
	10735890	90x75	83	83	47.5	52	120	100
	10735895	110x75	99	99	59	68	148	100
	10735995	110x90	99	99	59	63.5	148	120
	10735896	125x75	122	104	82	73	165	100
	10735996	125x90	122	104	82	71	165	120
	10735096	125x110	122	108	82	44	165	148

K36	Code	D/Da/Db	L1	L2	L3	L4	L5	L6	D1	D2
	10736320	25x20x20	33.5	33.5	33.5	19	17.5	19	33.5	33.5
	10736225	25x25x20	33.5	33.5	33.5	19	17.5	17.5	33.5	33.5

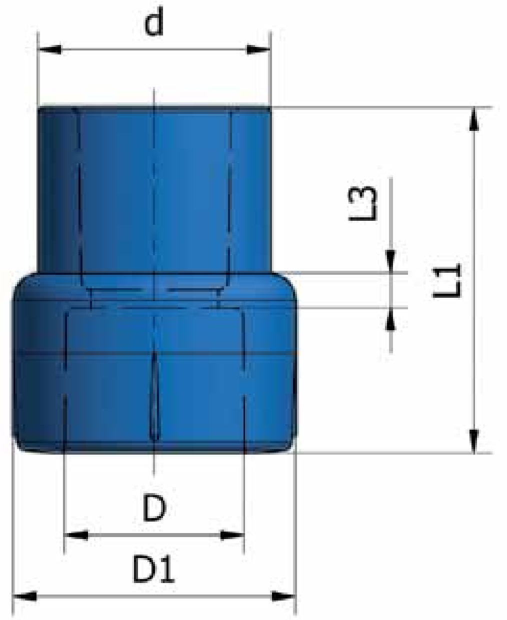


K40	Code	D/Da	L1	L3	D1	D2
	10740225	25x20	35.5	5	30.5	37.5
	10740232	32x20	37.5	5	31	47.5
	10740332	32x25	40	6	37.5	47.5
	10740240	40x20	43	8	30.5	59
	10740340	40x25	45	8.5	37.5	59
	10740440	40x32	47	8.5	47.5	59
	10740250	50x20	46	8	30.5	74
	10740350	50x25	48	8.5	37.5	74
	10740450	50x32	50	8.5	47.5	74
	10740550	50x40	54	10	59	74
	10740363	63x25	54	10.5	33.5	84
	10740463	63x32	59	13.5	43	84
	10740563	63x40	60	12	54	84
	10740663	63x50	62	11	67	84
	10740475	75x32	60	11	43	100
	10740575	75x40	61	9.5	54	100
	10740675	75x50	63	8.5	67	100
	10740775	75x63	65	6.5	84	100



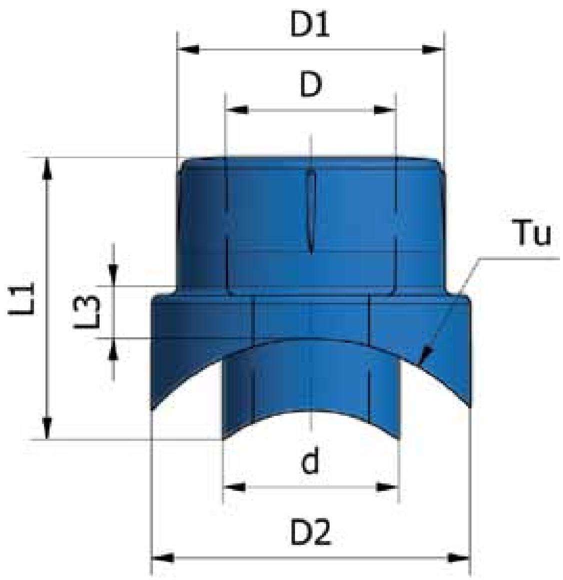
13. FITTINGS DIMENSION

K41



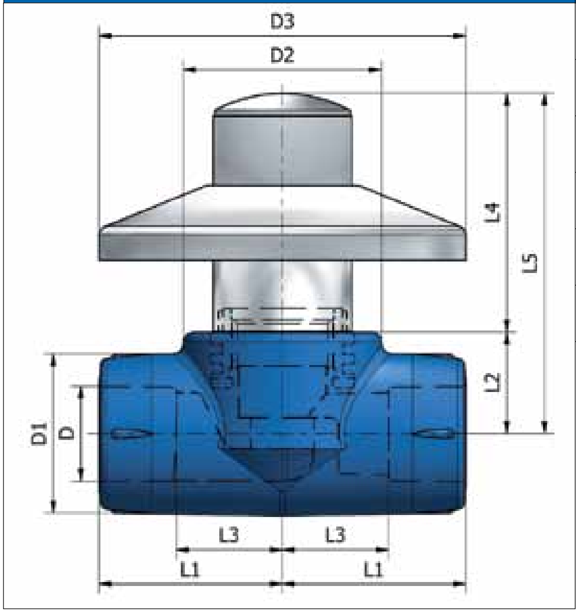
Code	d/D	L1	L3	D1
10741320	25x20	37.5	7	30.5
10741420	32x20	35.5	3	32
10741425	32x25	39.5	5.5	38.5
10741963	90x63	86.5	23.5	84
10741975	90x75	94.5	28	100
10741063	110x63	85	24	110
10741075	110x75	89	27	110
10741090	110x90	92	17	119

K47



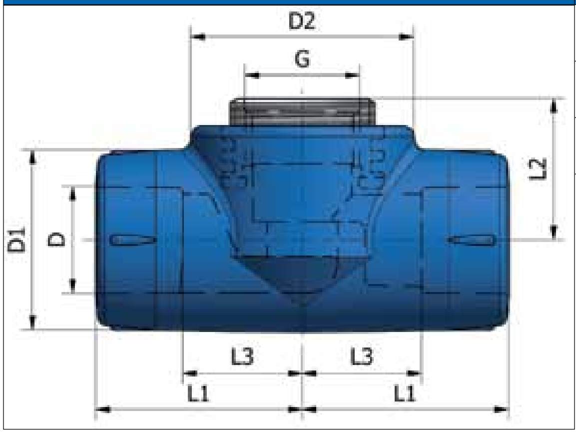
Code	D/Tu	d	L1	L3	D1	D2
10747620	20/50	20	32.5	6	30.5	36.5
10747720	20/63	20	33.5	6	30.5	36.5
10747820	20/75	20	35	6	30.5	36.5
10747920	20/90	20	37	6	30.5	36.5
10747625	25/50	25	37.5	7.5	37.5	43.5
10747725	25/63	25	38	7.5	37.5	43.5
10747825	25/75	25	39.5	7.5	37.5	43.5
10747925	25/90	25	41	7.5	37.5	43.5
10747732	32/63	32	49.5	13.5	47.5	54
10747832	32/75	32	49.8	13.5	47.5	54
10747932	32/90	32	51	13.5	47.5	54
10747132	32/110	32	53.5	13.5	47.5	54
10747940	40/90	40	54	11	59	66
10747140	40/110	40	55.5	11	59	66

K50



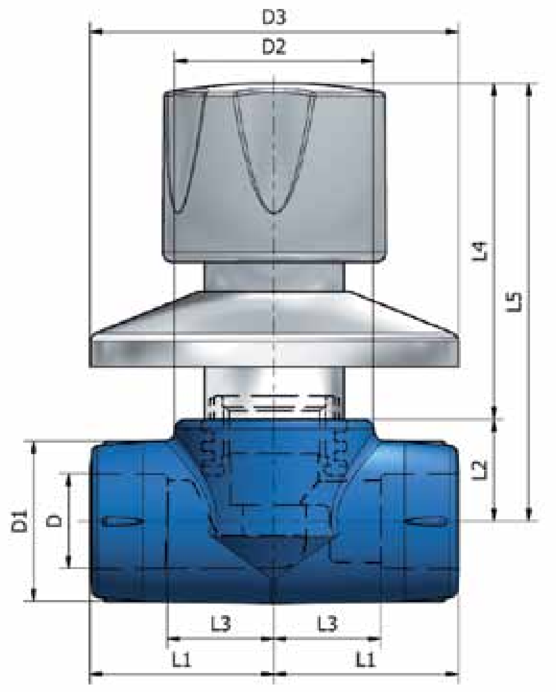
Code	D	L1	L2	L3	L4	L5	D1	D2	D3
10750020	20	37.5	20.5	21	50	70.5	33.5	41	76
10750120	20 L	37.5	20.5	21	80	100.5	33.5	41	76
10750025	25	46	33	30	50	81	36.5	47	76
10750125	25 L	46	33	30	80	111	36.5	47	76
10750032	32	46	33	28	50	81	49	49	76
10750132	32 L	46	33	28	80	111	49	49	76

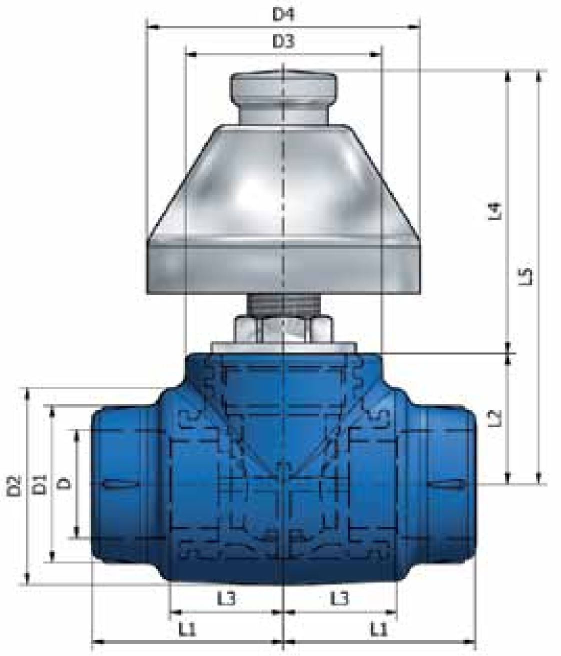
K50 CORPO



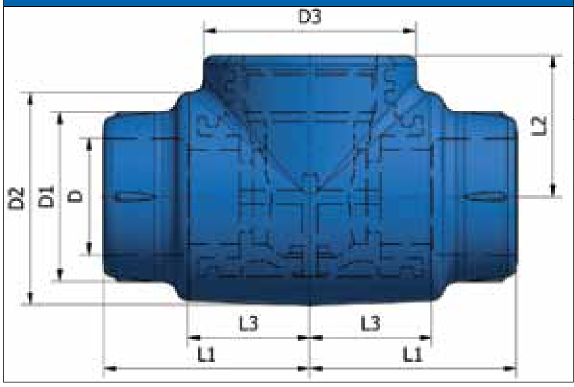
Code	D/G	L1	L2	L3	D1	D2
10750920	20X1/2”	37.5	25.5	21	33.5	41
10750925	25X3/4”	46	33	30	36.5	47
10750932	32X3/4”	46	33	28	49	49

13. FITTINGS DIMENSION

K50/M	Code	D	L1	L2	L3	L4	L5	D1	D2	D3
	10750320	20 L	37.5	20.5	21	70	90.5	33.5	41	76
	10750325	25 L	46	33	30	70	101	36.5	47	76
	10750332	32 L	46	33	28	70	101	49	49	76

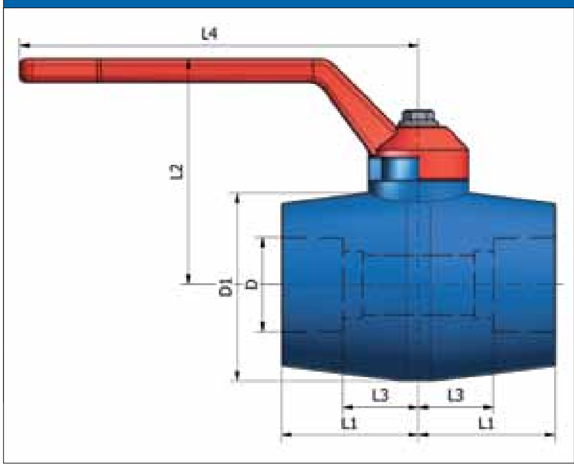
K51	Code	D	L1	L2	L3	L4	L5	D1	D2	D3	D4
	10751020	20	43.5	29.5	29	65	94.5	35.5	45	45	62.5
	10751025	25	43.5	29.5	27.5	65	94.5	35.5	45	45	62.5

K51 CORPO



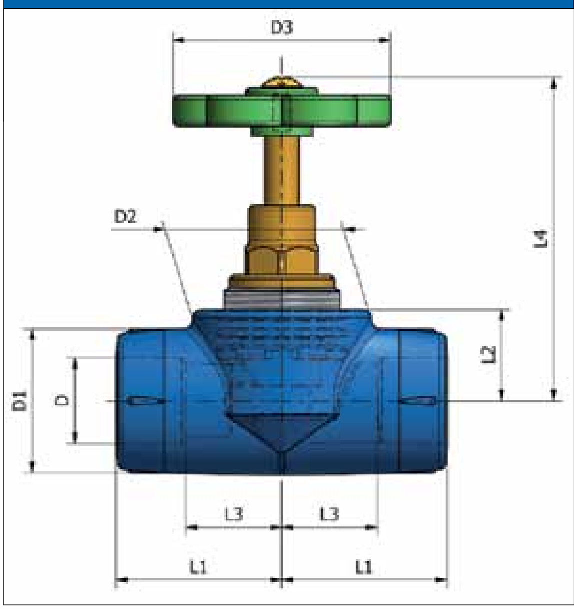
Code	D	L1	L2	L3	D1	D2	D3
10751820	20	43.5	29.5	29	35.5	45	45
10751825	25	43.5	29.5	27.5	35.5	45	45

K53

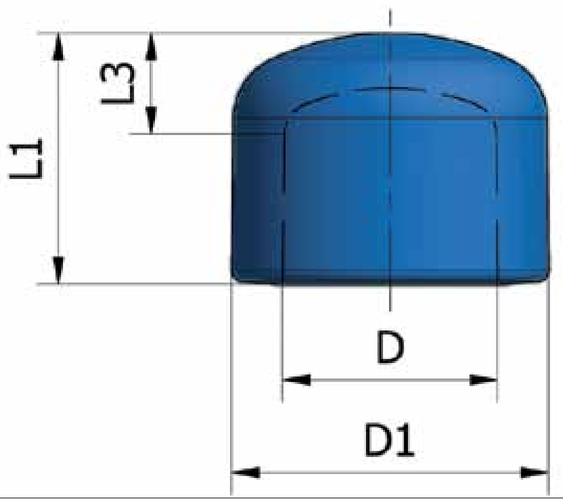


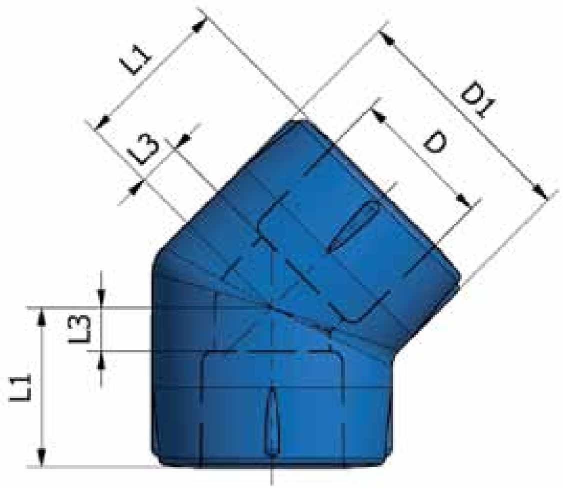
Code	D	L1	L2	L3	L4	D1
10753020	20	33.5	60	19	102	45.5
10753025	25	35.5	60	19.5	102	50
10753032	32	40	63	22	102	57
10753040	40	47	78	26.5	120	72.5
10753050	50	55	83	30.5	120	84.5
10753063	63	65	103	36.5	146	102
10753075	75	75	110	43,5	150	124

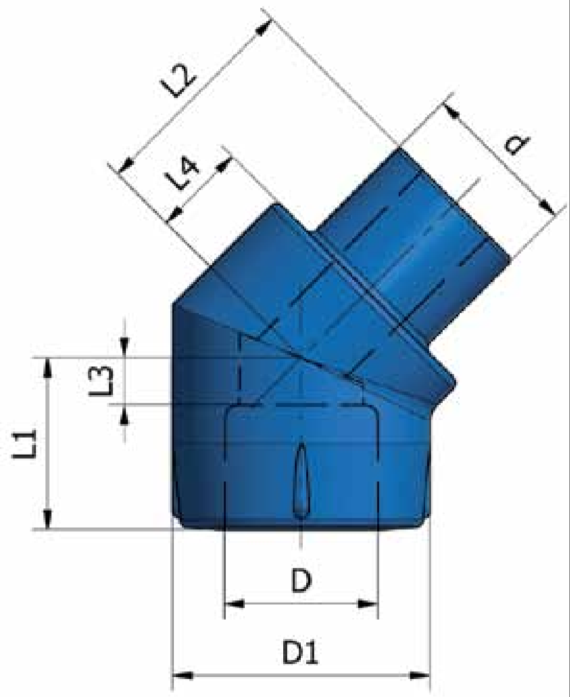
K54



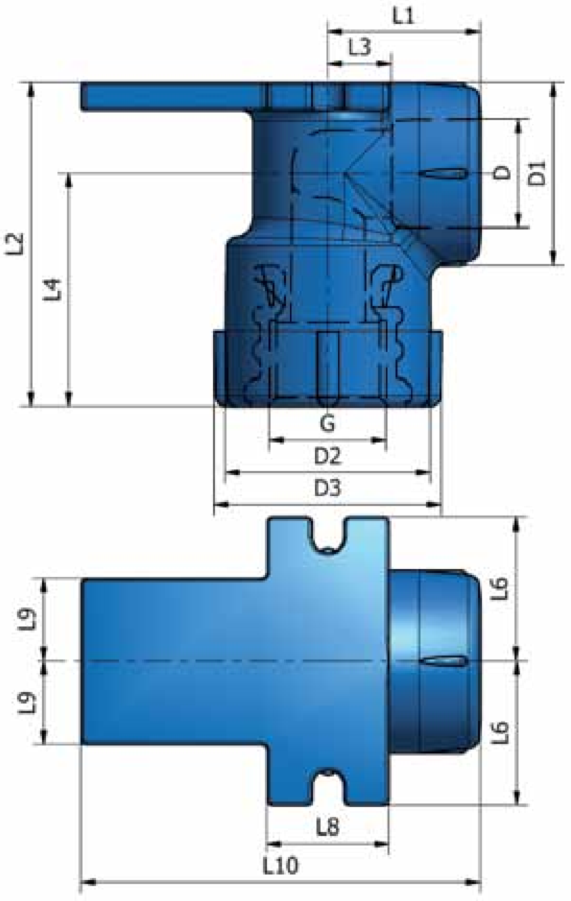
Code	D	L1	L2	L3	L4	D1	D2	D3
10754020	20	37.5	20.5	21	66-73	33.5	41	50
10754025	25	46	33	30	70-76	36.5	47	50

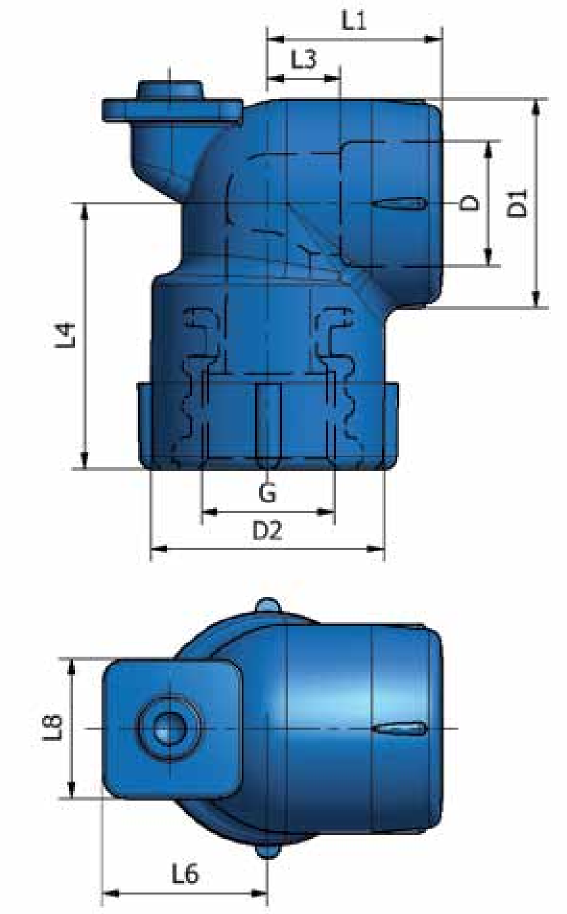
K60	Code	D	L1	L3	D1
	10760020	20	22.5	8	28.5
	10760025	25	28.5	12.5	35.5
	10760032	32	36.5	18.5	46
	10760040	40	35	14.5	59
	10760050	50	40	16.5	74
	10760063	63	45.5	18	84
	10760075	75	49	18	100
	10760090	90	57	21.5	120
	10760095	110	79	39	148
	10760096	125	87	45	165

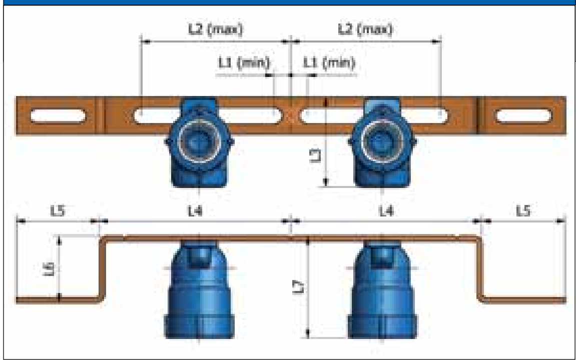
K70	Code	D	L1	L3	D1
	10770020	20	21.5	7	32.5
	10770025	25	25	9	37.5
	10770032	32	28.5	10.5	47.5
	10770040	40	36	15.5	54
	10770050	50	40	16.5	67
	10770063	63	45	17.5	84
	10770075	75	49	18	100
	10770090	90	57.5	22	120
	10770095	110	69	29	148
	10770096	125	77	32	165

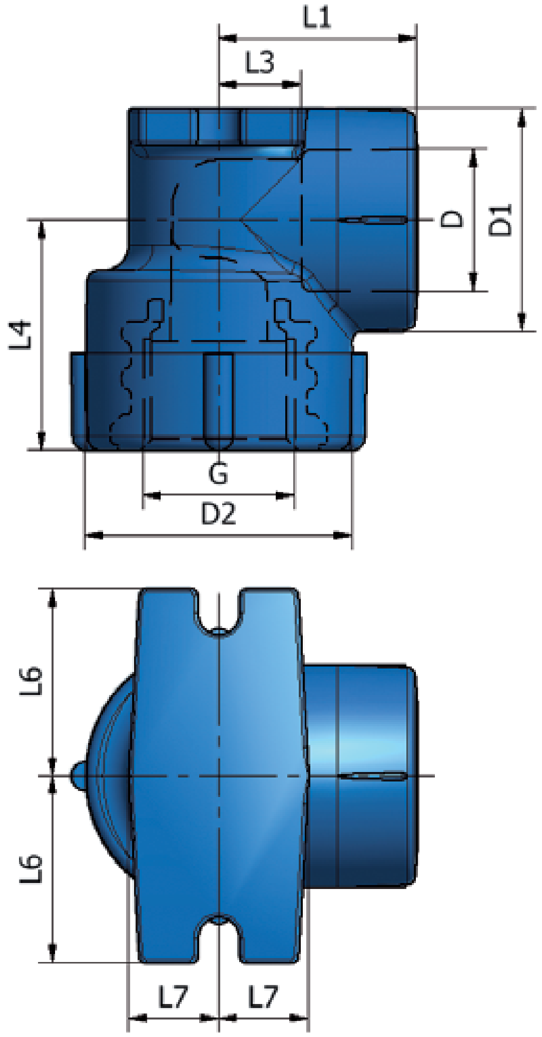
K71	Code	D/d	L1	L2	L3	L4	D1
	10771020	20x20	21.5	27.5	7	13	32.5

K83	Code	D/G	L1	L2	L3	L4	L6	L8	L9	L10	D1	D2	D3
	10783120	20x3/8”	27	46.5	12.5	31.5	25.5	23.5	15	71.5	30.5	36	40
	10783220	20x1/2”	27	57.5	12.5	41	25.5	23.5	15	71.5	30.5	36	40

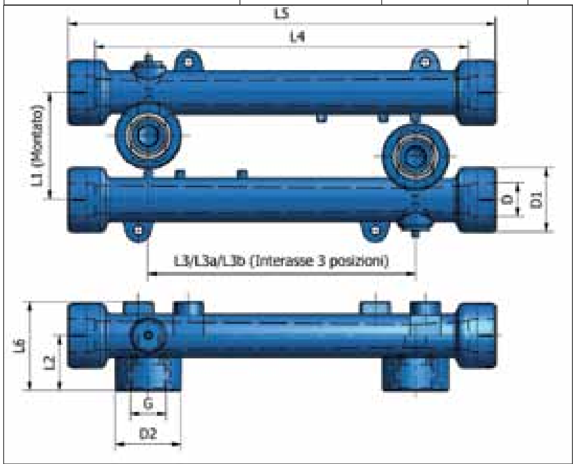


K84	Code	D/G	L1	L3	L4	L6	L8	D1	D2
	10784220	20x1/2”	27	12.5	41	26	21.5	32.5	36

K85	Code	D/G	L1	L2	L3	L4	L5	L6	L7
	10785020	20x1/2”	10	90	53	115	50	40	60,5

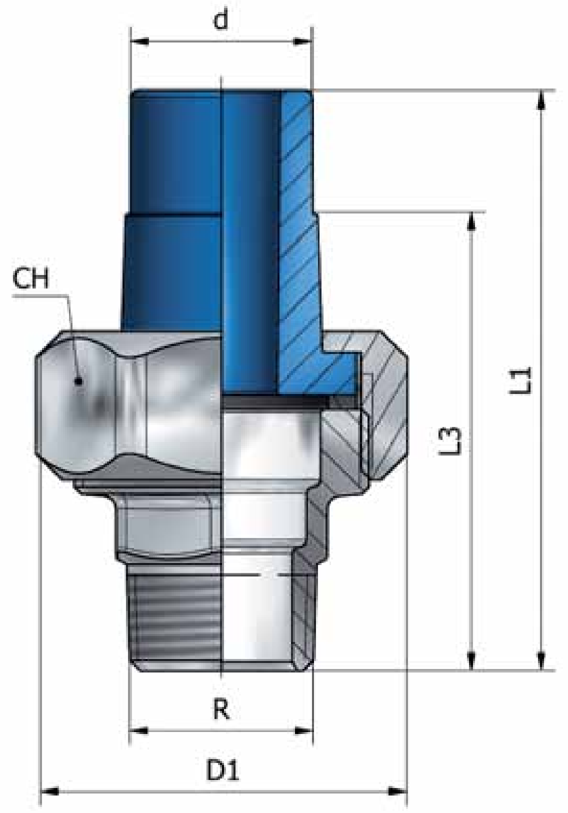
K86	Code	D/G	L1	L3	L4	L6	L7	D1	D2
	10786220	20x1/2”	27	12.5	31.5	25.5	12	30.5	36

K87	Code	D/G	L1	L2	L3	L3a	L3b	L4	L5	L6	D1	D2
	10787220	20x1/2”	52	32	155	135	100	219	248	51.5	37.5	38.5

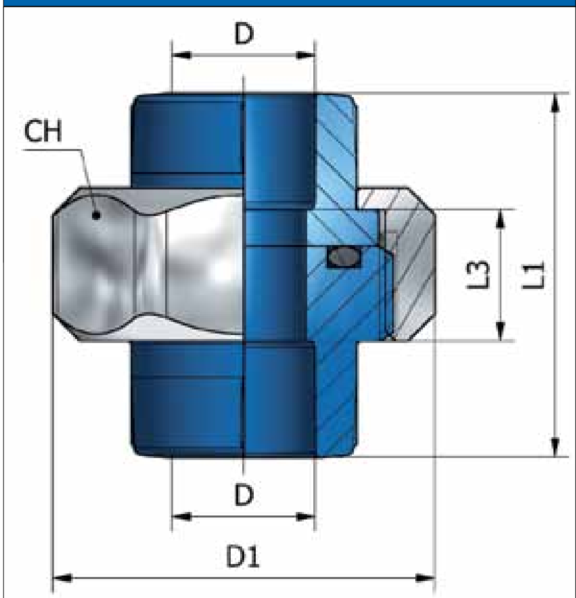


K90	Code	D	L1	L2
	10790020	20	200	30
	10790025	25	200	35
	10790032	32	200	42

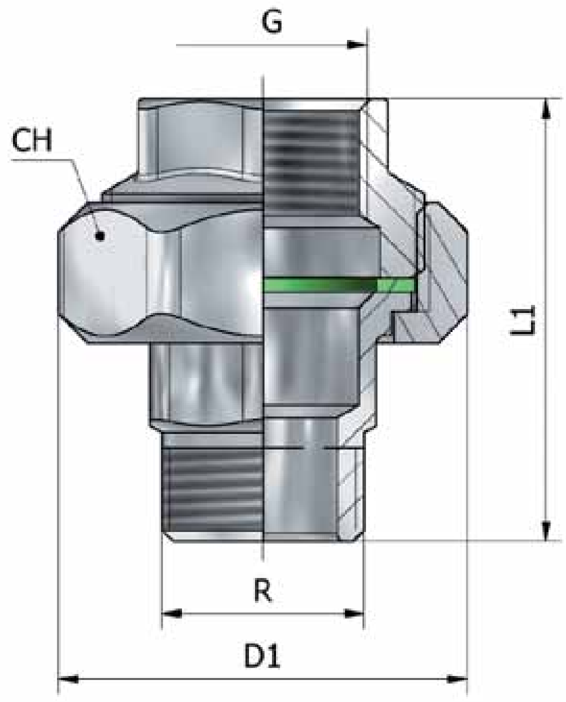
13. FITTINGS DIMENSION

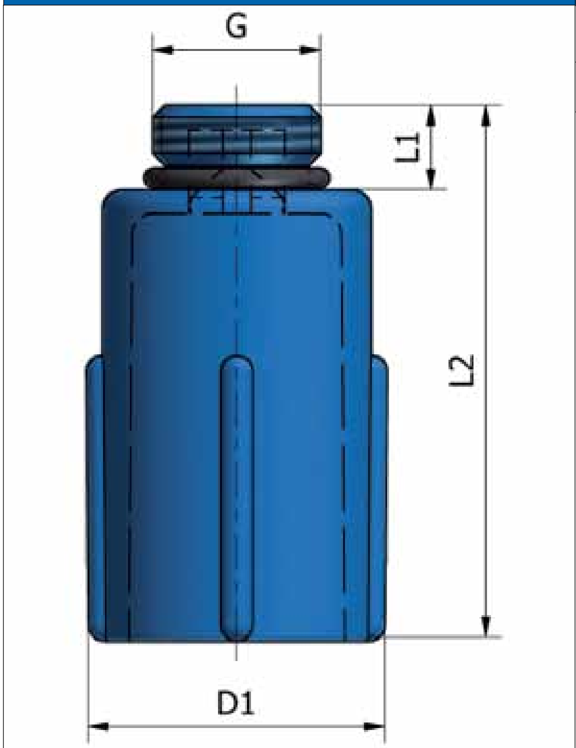


K91 Code	d/R	L1	L3	D1	CH
10791325	25x3/4”	81	65	53	47
10791432	32x1”	89	71	56	52
10791540	40x1”1/4	107	86.5	64	60
10791650	50x1”1/2	118	94.5	76	72
10791763	63x2”	132	104.5	94	88



K92 Code	D	L1	L3	D1	CH
10792020	20	49	20	53	47
10792025	25	54.5	22.5	56	52
10792032	32	62.5	26.5	64	60
10792040	40	71	30	76	72
10792050	50	77.5	30.5	94	88

K96	Code	D	L1	L3	D1
	10796220	1/2"x1/2"	52	41	37
	10796325	3/4"x3/4"	57	53	47
	10796432	1"x1"	60	56	52

BALL KNOB	Code	G	L1	L2	D1
	10799987	1/2"	10.5	66	37
	10799988	3/4"	13	72	42

NOTES

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