Technical manual
L02-207/2

valsir®
QUALITY FOR PLUMBING

PEXAL - MIXAL

Installation and use of multilayer pipes and fittings
Project design of water distribution and heating networks

- ✔ Great resistance to abrasion, deposits and corrosion
- ✔ One single product for water distribution and heating
- ✔ Elevated flow rate
- ✔ Oxygen barrier
- ✔ Fast and safe installation

www.valsir.it

DNV

DET NORSKE VERITAS

QUALITY MANAGEMENT SYSTEM CERTIFICATE

Certificato No. / Certificate No. ***CERT-00192-94-AQ-MIL-SINCERT***

Si attesta che / This certifies that

IL SISTEMA DI GESTIONE PER LA QUALITÀ DI / THE QUALITY MANAGEMENT SYSTEM OF

VALSIR S.p.A.

Località Merlaro, 2 - 25078 Vestone (BS) - Italy
Località Piani di Mura - 25070 Casto (BS) - Italy
Via Comunale, 125 - Frazione Carpeneda - 25079 Vobarno (BS) - Italy
Via della Ferriera, 1 - 25079 Vobarno (BS) - Italy

È CONFORME AI REQUISITI DELLA NORMA PER I SISTEMI DI GESTIONE PER LA QUALITÀ
CONFORMS TO THE QUALITY MANAGEMENT SYSTEMS STANDARD

UNI EN ISO 9001:2000 (ISO 9001:2000)

Questa certificazione è valida per il seguente campo applicativo:
This certificate is valid for the following products or services:
(Ulteriori chiarimenti riguardanti lo scopo e l'applicabilità dei requisiti della normativa si possono ottenere consultando l'organizzazione certificata)
(Further clarifications regarding the scope and the applicability of the requirements of the standard(s) may be obtained by consulting the certified organisation)

Progettazione e produzione di cassette di risciacquamento per incasso ed esterne. Produzione di tubi e raccordi per scarico in polipropilene copolimero, polipropilene omopolimero autoestinguente, polipropilene fonoassorbente, polietilene ad alta densità. Produzione di tubi per impianti sanitari e di riscaldamento in multistrato e in polietilene ad alta densità reticolato e con barriera di ossigeno (E.V.O.H). Progettazione e produzione di raccordi in polifenilsulfone (PPSU). Produzione e commercializzazione di sifoni ed accessori. Progettazione di impianti di riscaldamento a pavimento

Design and production of in-wall and exposed flush cisterns. Production of pipes and fittings for waste systems, made of copolymer polypropylene, self-extinguishing homopolymer polypropylene, acoustically insulated polypropylene, high density polyethylene. Production of multi-layer and high density crosslinked polyethylene pipes with oxygen barrier (E.V.O.H) for sanitary and heating systems. Design and production of polyphenyl sulfone (PPSU) fittings. Production and trade of traps and accessories. Underfloor heating design

Luogo e data *Place and date* **Agrate Brianza, (MI) 2007-05-22**	*Data Prima Emissione:* *First Issue Date:* **1994-02-07**	*per l'Organismo di Certificazione* *for the Accredited Unit* **Det Norske Veritas Italia S.r.l.**
Lead Auditor: EROS FUSARI **Settore EA: 14 – 29a – 17 - 34**	SINCERT SGQ Registrazione N. 003A SGA Registrazione N. 003D PRD Registrazione N. 003B Membro degli Accordi di Mutuo Riconoscimento EA e IAF Signatory of EA and IAF Mutual Recognition Agreements	**Vittore Marancon** **Management Representative**

La validità del presente certificato è subordinata a sorveglianza periodica (ogni 6, 9 o 12 mesi) e al riesame completo del sistema con periodicità triennale
The validity of this certificate is subject to periodical audits (every 6, 9 or 12 months) and the complete re-assessment of the system every three years
Le aziende in possesso di un certificato valido sono presenti nella banca dati sul sito www.dnv.it e sul sito Sincert (www.sincert.it) - All the companies with a valid certificate are online at the following address: www.dnv.it and www.sincert.it

1 THE PEXAL AND MIXAL MULTILAYER PIPE

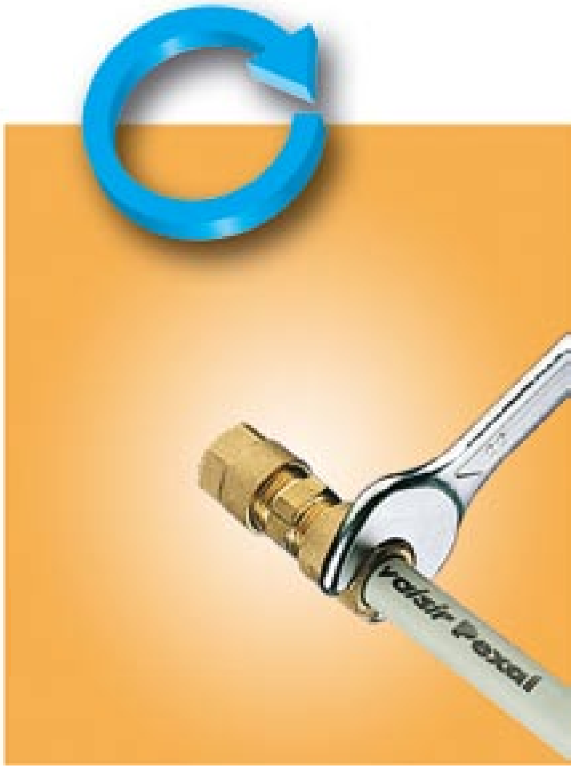
1.1 General information

It is an innovative system that was introduced on the market some time ago and is used for the creation of internal hot and cold water distribution networks, for heating circuits, air-conditioning and compressed air systems. The multi-layer pipe unites the characteristics of plastic and those of ductile metal. The plastic material used for the internal and external layers is crosslinked polyethylene PE-X (for the Mixal pipe it is HDPE), whereas the intermediate layer is in aluminium. In this way the fluid in transported inside the internal layer of PE-X (with the consequent advantages in terms of hygiene and corrosion resistance). The aluminium layer is formed around the PE-X layer and is welded with a continuous longitudinal weld. This characteristic makes the pipe extremely easy to shape: once bent, it maintains the given configuration. The use of coils avoids the necessity of using intermediate fittings. Furthermore, the pipe guarantees protection against oxidation in the internal layer of PE-X. The outer layer ensures a perfect insulation for the pipe against corrosion by external agents and stray currents (electrochemical corrosion). The intermediate metal pipe is connected to the external and internal layers in crosslinked polyethylene with two layers of special adhesive. On the whole, the multi-layer pipe possesses a low linear expansion coefficient (0.026 mm/m °C as opposed to 0.15 with PE-X); expansion caused by temperature fluctuations are reduced above all in external installations where expansions are usually greater. As far as the connections are concerned, Pexal and Mixal utilise two types of fittings in a special brass alloy and in a plastic material (for Pexal only):

CRIMP FITTINGS (PRESS-FITTING):
The seal is created by deforming the pipe around the insert of the fitting itself, by means of a crimping operation.

COMPRESSION FITTINGS:
The seal in guaranteed by screwing a nut onto a cut olive that provokes the progressive compression of the pipe thus generating the seal of the connection.
The seal is guaranteed by O-rings placed on the insert, a plastic seal insulates the metal of the fitting from the metal layer of the multi-layer pipe thus avoiding phenomena of electro-chemical corrosion. The use of this system in the installation of heating and plumbing systems is more efficient in terms of time as compared with traditional systems (galvanised steel, copper, PP-r): comparison tests on complete systems indicate a saving in time of 45%.

CRIMP FITTING (PRESS-FITTING)



COMPRESSION FITTINGS

1.2 Characteristics of crosslinked polyethylene (PE-X)

Unlike HDPE (that is not crosslinked) PE-X has an optimum capacity to transport hot water at temperatures higher than 40 °C: in this way the problem of pipe ageing caused by the transport of water at high temperatures, is reduced. Furthermore, PE-X possesses a greater tensile strength, significant mechanical resistance, a better chemical resistance, and elevated abrasion resistance.
The crosslinking process consists of creating bridges between the various polymer chains. This is carried out in order to guarantee the pipe a long life. The crosslinking of the two layers of the Pexal pipe is carried out by using the silanes method (PE-Xb).

CHARACTERISTIC	VALUE
Density	950 kg/m^3
Application field (Temp. Water)	0/+95°C
Softening temperature	135 °C
Tensile strength 23 °C	23 MPa
Tensile strength 100 °C	9 MPa
Thermal conductivity coefficient	0.37 kcal/m h °C

THE PE-X USED FOR THE MULTI-LAYER PIPE IS CERTIFIED ANSI/NSF STANDARD 61.

L'ANSI/NSF STANDARD 61 establishes the requirements of the products used in plumbing systems, in private households and in offices so that they can be used for the transport of drinking water. It is issued after the material has passed very strict chemical and toxicological tests. This certification is issued by NSF International, one of the most qualified organisations worldwide in the definition of standards and the granting of certifications in the field of environmental protection and public health. NSF is guaranteed by ANSI (American National Standard Institute) and is recognised by WHO (World Health Organisation).

1.3 Characteristic of aluminium

The intermediate metal layer of the multi-layer pipe is made up of sheets of aluminium alloy. The sheet is formed around the layer of PE-X. The two ends, which run along the length of the pipe, are butt-welded with a TIG welding process. This technology enables the production of a multilayer pipe with an aluminium thickness of 0.2 mm to 2.5 mm and therefore, large diameter pipes with thick layers of aluminium.

The most important characteristics of the aluminium alloy utilised in the production of the multilayer pipes are:

- Good welding.
- Elevated yield point, that represents the maximum stress that can be applied before the material tears.
- Clean surface and free of impurities to guarantee better values of adhesion between the layers.

2 PRODUCT APPROVALS

UNI 10954-1

IIP-UNI: Certificate of conformity of the Pexal multilayer pipe systems for the transport of hot and cold water in heating and domestic hot water systems.

TYPE APPROVAL

RINA: Approval, which guarantees the use of the Pexal multilayer system for water distribution, heating and air-conditioning systems on ships.

-LT606-
-LT813-

IIS: Qualification certificate of the aluminium welding procedure adopted in the production of the Pexal multilayer pipe, in accordance with specifications EN 288-8: 1997 Annex No.12.

Spec. 438
LN IP083

AS 4176 SPEC. 438 LN IP083: Certificate of conformity of the Pexal system to be utilised to distribute hot and cold drinking water under pressure.

AS/NZS 4020 (PEXAL): Certificate of conformity of the Pexal multi-layer pipe for transporting cold and hot drinking water (up to 85°C) in domestic water systems. TEST REPORT: MAT/ASN 018D.

AS/NZS 4020 (PPSU): Certificate of conformity of PPSU plastic fittings for transporting cold and hot drinking water (up to 85°C) in domestic water systems. TEST REPORT: MAT/ASN 019D.

MC-GOST: Certificate of conformity of the Pexal system to be used to transport hot and cold drinking water in domestic hot water and heating systems.

AT/2000-02-0873-02
AT/2000-02-1022-01

Polish certificate of approval for installation of the Pexal pipes for heating and distribution of hot and cold water for domestic use.

Polish certificate of approval for the Pexal system to distribute drinking water.

Önorm B5157 GEPRÜFT

Approval that guarantees the suitability of the Pexal multi-layer pipe for use in delivering hot water to heating systems.

W 1.404

OVGW: System certification referring to the PEXAL product to be used in plumbing systems in domestic hot water and heating systems. The certification places particular attention both on the quality aspect and the environmental aspect e.g.: Emissions during the production process and recycling of each single component during use.

UKr CEPRO A1.106.86340-03 A1.106.86341-03	Approval that guarantees the suitability of the Pexal multi-layer pipe for use in the transport of hot water in heating systems.
SKZ	Product approval that guarantees the suitability of the Pexal multilayer pipe in hot and cold water applications.
DVGW product	Product approval that guarantees the suitability of Pexal system in hot and cold water applications.
KOMO K 22518/01 K 22504/01	Product certification referring to the suitability of the Pexal multi-layer system to be used in heating systems.
kiwa	Product certification referring to the suitability of the Pexal multi-layer system to be used in domestic hot water systems.
BS 6920 (PEXAL):	Certificate of approval of Pexal multi-layer pipe for transporting cold and hot drinking water in water supply systems at temperatures of 85°C. TEST REPORT: MAT/LAB 636L.
BS 6920 (PPSU):	Certificate of approval of Pexal multi-layer pipe for transporting cold and hot drinking water in water supply systems at temperatures of 85°C. TEST REPORT: MAT/LAB 637L.
Lloyd's Register Certificate N° 03/00044(E1) TYPE APPROVAL	Approval that guarantees the use of the PEXAL multi-layer system on ships, for domestic hot water and heating systems.
ÉMI A - 794/2002	Approval that guarantees the use of the PEXAL multi-layer systems for the transport of hot and cold water in domestic hot water and heating systems.
CSTBat 110-856	Product approval referring to the suitability of the PEXAL system to be employed for the transport of hot and cold water in domestic hot water, heating and air-conditioning systems.
AENOR Producto Certificado	Product approval referring to the suitability of the PEXAL multi-layer pipe to be used in heating systems.
НИП РУП СН СТРОЙТЕХНОРМ	Certificate of conformity of Pexal multi-layer pipe and fittings in brass and PPSU for the transport of hot and cold water in water supply and heating systems.
	Certificate of conformity of brass and PPSU fittings for the transport of hot and cold drinking water in water supply systems.
	Product certification referring to the suitability of the Pexal multi-layer system to be used in domestic hot water systems.

3.1 Pexal water distribution system

PEXAL multi-layer pipe ø 14x2-16x2.25-18x2-20x2.5-26x3-32x3-40x3.5-50x4-63x4.5

The PEXAL water supply system consists of the combined use of a multi-layer pipe with fittings in a special brass alloy or in PPSU and allows both water supply and heating systems to be created with the same pipe and the same fittings.

1 INTERMEDIATE LAYER
Pipe in aluminium alloy butt-welded lengthwise

2 INTERNAL LAYER
Pipe in crosslinked polyethylene PE-Xb (crosslinked with silanes)

EXTERNAL LAYER 3
Pipe in crosslinked polyethylene PE-Xb (crosslinked with silanes) Colour RAL 9003 (white)

BINDING LAYERS 4
Two layers bind the intermediate metal pipe with the internal and external layers in crosslinked polyethylene

The pipes and fittings are insulated from each other thanks to a flat seal that is positioned between the end part of the pipe and the brass fitting. This seal excludes every possibility of contact between the two metals thus avoiding the phenomena of electrochemical corrosion.

COMPRESSION FITTINGS

ø 14-16-20-26-32

PRESS-FITTINGS

ø 40-50-63

PRESS-FITTINGS

ø 14-16-20-26-32

PEXAL EASY

ø 16-20-26-32-40-50

PEXAL multi-layer pipe ø 16-18-20

The PEXAL water supply system with ø 16-18-20 and wall thickness of 2 mm consists of the combined use of the multi-layer pipe with nickel-plated brass fittings and allows both water supply and heating systems to be created with the same pipe and the same fittings.

COMPRESSION FITTINGS

ø 16-18-20

PRESS-FITTINGS

ø 16-20

PEXAL EASY

ø 16-18-20

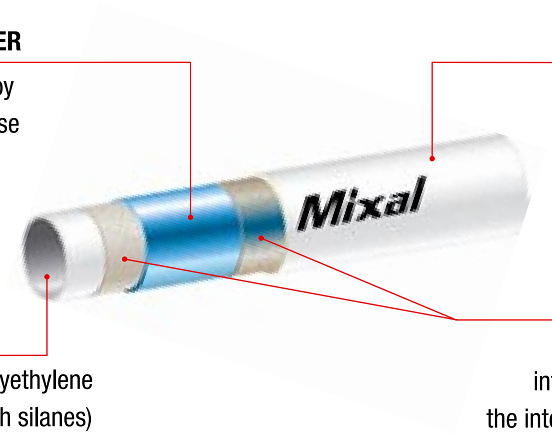
3.2 Mixal water distribution system

MIXAL multi-layer pipe ø 16-20. Aluminium thickness 0.2-0.25 mm

The MIXAL system ø 16-20 with aluminium thickness of 0.2 – 0.25 mm consists of the combined use of the multi-layer pipe and the compression nickel-plated brass fittings and crimp brass alloy fittings and allows both domestic hot water and heating systems to be installed by using the same pipe and the same fittings.

1 INTERMEDIATE LAYER
Pipe in aluminium alloy butt-welded lengthwise

3 EXTERNAL LAYER
High density polyethylene pipe RAL 9003 (white)



2 INTERNAL LAYER
Pipe in crosslinked polyethylene PE-Xb (crosslinked with silanes)

4 BINDING LAYERS
Two layers bind the intermediate metal pipe with the internal and external layers in crosslinked polyethylene

COMPRESSION FITTINGS

ø 16-20

PRESS-FITTINGS

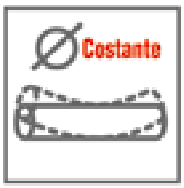
ø 16-20

3.3 Technical characteristics of the Pexal and Mixal pipe

The Valsir water distribution system was designed to facilitate installation and increase functionality: one type of pipe, installed with the fittings made of a special brass alloy, allows the installation of both heating and domestic hot water systems. With the multi-layer pipe, the typical advantages of metal pipes are added to those of plastic pipes and at the same time the positive aspects of one material compensate for the defects of the other. The negative aspects of metal such as: corrosion, toxicity, deposits, rigidity, weight, elevated pressure losses are neutralised by the pipe in PE-X that comes into contact with the fluid. The negative aspects of plastic, such as: low barrier to gas and UV rays, elevated heat expansion and instability, are overcome thanks to the aluminium pipe.

Resistance to abrasion, deposits and corrosion

The internal layer in PE-X is not subject to corrosion and deposits. The surface is not corroded and therefore there is no risk of rust particles or lime scale resulting from galvanic corrosion. PE-X is particularly resistant to abrasion. This property is very important, especially in bends, where the abrasive action of the impurities present in the water is amplified, above all when the flow rate of the water is particularly elevated.



Mechanical behaviour

The bending radius can vary from 2.5 to 5 times the diameter of the pipe and the section of the bend remains constant. The pipe, once bent, remains in the desired position just like a metal pipe. It is therefore possible, when systems need to be installed in series, to prepare pipe sections in advance with the fittings pre-fitted and to bring them to the building site already assembled. The malleable features of the pipe enable bends with a very narrow radius to be formed. If pipes of a lager diameter need to be bent, or a very tight bend is required, then pipe benders will be required. Use of an anti-crushing spring is recommended when bending manually, if the radius is narrow.

Elongation

The thermal expansion (0.026 mm/m°C) takes on values very close to the thermal expansion of metal pipes.

Elongation of different types of pipe

Type of pipe	Elongation in mm for a pipe length of 10 m. ΔT=50°C
PEXAL	13.00
Galvanised steel	6.0
Stainless steel	8.3
Copper	8.3
Plastic material (PE-X; HD-PE; PPRC)	60-90

Oxygen barrier

The aluminium pipe forms a perfect barrier to gas molecules thereby avoiding corrosion hazards due to oxygen penetration and damage as a result of exposure to UV rays.

Smoothness

The internal layer of the pipe has a smooth surface (roughness 0.007 mm) and is free from lime scale and rust deposits. The losses in pressure are therefore very low, and remain constant over time which represents a very important aspect.

Performance when exposed to fire

The pipe does not burn easily thanks to the intermediate metal layer.
The density of smoke produced is very low and the emissions produced are not toxic.

Lightweight

The specific weight of the components of the pipe are significantly low. A coil of 100 mt. of 16x2.25 weighs approx. 13 Kg.

Durability

If used at the pressures and temperatures indicated (pressure up to 10 bar, maximum operating temperature of 0-95°C, for the operative temperatures see the tests), the materials will possess a very elevated ageing resistance. Artificial laboratory ageing tests guarantee the pipe a working life of over 50 years. At working temperatures below 95°C, the pipe will withstand pressures of over 10 bar without undergoing damaged (up to 25 bar with temperatures of 20°C).

Degree of hygiene

The system is used in every type of installation without any drawbacks. Non-toxic materials are used for the pipes and fittings and can be used to distribute drinking water.

Thermal conductivity

The thermal conductivity of the pipe is 0.43 W/m.K., that is, very low. The heat loss is approximately 900 times lower as compared with copper.

Acoustic absorption

The acoustic insulation properties of the pipe are very good. The internal and external layer in PE-X attenuate the noises that normally would not be absorbed by metal pipes.

Pexal

TECHNICAL DETAILS OF THE PEXAL MULTILAYER PIPE												
External diameter	mm	14	16	16	18	20	20	26	32	40	50	63
Total thickness	mm	2	2.25	2	2	2.5	2	3	3	3.5	4	4.5
Coil length	m	100	100	100	100	100	100	50	50	-	-	-
Pipe length	m	5	5	5	5	5	5	5	5	5	5	5
Water volume content	l/m	0.077	0.103	0.113	0.154	0.176	0.201	0.314	0.531	0.960	1.385	2.289
Operating temperature	°C	0-80	0-80	0-80	0-80	0-80	0-80	0-80	0-80	0-80	0-80	0-80
Maximum operating temperature	°C	95	95	95	95	95	95	95	95	95	95	95
Maximum operating pressure temp 95°	bar	10	10	10	10	10	10	10	10	10	10	10
Coefficient of heat expansion	mm/mK	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026
Internal heat conductivity	W/m K	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43
Internal roughness	mm	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
Oxygen diffusion	mg/l	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Bending radius without pipe bender	mm	70	80	80	90	100	100	140	160	-	-	-
Bending radius with pipe bender	mm	35	50	50	65	80	80	100	120	150	190	240
Colour	RAL	white 9003	white 9003	white 9003	white 9003	white 9003	white 9003	white 9003	white 9003	white 9003	white 9003	white 9003

TECHNICAL DETAILS OF INSULATED PEXAL MULTILAYER PIPE									
External diameter of bare pipe	mm	14	16	16	18	20	20	26	32
Pipe thickness	mm	2	2.25	2	2	2.5	2	3	3
Insulation thickness	mm	6	6/10	6/10	6	6/10	6/10	6/10	6
External diameter of insulated pipe	mm	26	28	28	30	32	32	38	44
Coil length	m	50	50	50	50	50	50	50	50
Insulation density	Kg/m³	33	33	33	33	33	33	33	33
Tensile strength of insulation	N/mm²	>0.18	>0.18	>0.18	>0.18	>0.18	>0.18	>0.18	>0.18
Tear elongation of insulation	%	>80	>80	>80	>80	>80	>80	>80	>80
Vapour barrier of insulation	mg/Pa s.m	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15	<0.15
Heat conductivity of insulation	W/mk	0.0397	0.0397	0.0397	0.0397	0.0397	0.0397	0.0397	0.0397
Heat conductivity of insulated pipe	W/mk	0.066	0.064	0.06	0.068	0.068	0.066	0.070	0.072
Fire resistance	-	No	No	No	No	No	No	No	No
THE INSULATING LAYER IS MADE OF CLOSED CELL FLAME-RETARDANT HDPE									

Mixal

TECHNICAL DETAILS OF INSULATED MIXAL MULTILAYER PIPE			
External diameter	mm	16	20
Total thickness	mm	2	2
Thickness of aluminium layer	mm	0.2	0.25
Coil length	m	100/120/240/500	100/120/240
Pipe length	m	5	5
Water volume content	l/m	0.113	0.201
Operating temperature	°C	0-80	0-80
Maximum operating temperature	°C	95	95
Maximum operating pressure temp 95°	bar	10	10
Coefficient of heat expansion	mm/m K	0.026	0.026
Internal heat conductivity	W/m K	0.43	0.43
Internal roughness	mm	0.007	0.007
Oxygen diffusion	mg/l	0.000	0.000
Bending radius without pipe bender	mm	80	100
Bending radius with pipe bender	mm	50	80
Colour	RAL	white 9003	white 9003

TECHNICAL DETAILS OF INSULATED PEXAL MULTILAYER PIPE			
External diameter of bare pipe	mm	16	20
Pipe thickness	mm	2	2
Insulation thickness	mm	6	6
External diameter of insulated pipe	mm	28	30
Coil length	m	50	50
Insulation density	Kg/m^3	33	33
Tensile strength of insulation	N/mm^2	> 0.18	> 0.18
Tear elongation of insulation	%	> 80	> 80
Vapour barrier of insulation	mg/Pa s.m	< 0.15	< 0.15
Heat conductivity of insulation	W/m K	0.0397	0.0397
Heat conductivity of insulated pipe	W/m K	0.066	0.066
Fire resistance	-	NO	NO
Colour	RAL	white 9003	white 9003
THE INSULATING LAYER IS MADE OF CLOSED CELL FLAME-RETARDANT HDPE			

4.1 Brass fittings

A complete range of fittings, available in the compression and crimp version, satisfy all installation requirements and enables connection to all types of system. The material employed in the construction of all of the parts that come into contact with the liquid is a brass alloy that contains specific anti-corrosion and anti-dezincification inhibitors (that is, they keep the zinc attached-standards BS 2874-CW 602N), and is approved and certified by the principal European Institutes for corrosion and is therefore suitable to be used for drinking water.

Dezincification is a particular type of corrosion that causes a preferential dissolving of the zinc making the zone in question spongy, porous and friable. This porosity progresses with time until the component becomes irreparably damaged.

Some of the main causes that favour humid dezincification are:

- The chemical composition of the water, in particular, a high chloride content, a low bicarbonate concentration and water containing dissolved CO_2.
- The water temperature.
- An association with more noble materials present in the system that create an electrochemical effect (galvanic cell).
- Defects in the structure of the material itself.

The Pexal fittings passed the tests carried out by the Department of mechanical and managerial innovation of the University of Padua, for the identification of the residual tensions in accordance with the tests established by the standards BS 2874-1987.
The fittings, following the hot pressing, undergo a special thermal treatment, in order to increase the particular anti-corrosion characteristics of the material.

4.1.1 Compression fittings

The compression fittings unite the quality of an elevated reliability with a simple installation technique, in fact, they do not require any particular tools. The permanent connection of the pipe is achieved by compression, in fact, by screwing the nut onto the cut olive, the profiles of the two pieces determine the progressive tightening of the olive and the distribution of the compression over the whole contact surface. To guarantee the seal an insert was made with a particular slip-proof profile, with radial kurling to prevent rotation, with two O-rings directly in contact with the pipe and one o-ring for mounting the insert onto the body of the fitting.

The integrity of the assembly is guaranteed both by the base seal, that separates the aluminium from the fitting thus preventing galvanic corrosion, and by the quality of the fitting itself manufactured using special brass alloys. The use of normal spanners, the standardisation of the threads (GAS ISO) thus enabling connection to any other system type and the possibility of re-utilising the fitting in case of error, all contribute to making this a simple and economical system.

4.1.2 Crimp fittings

The crimp fittings were designed to further simplify the installation operations, by significantly reducing assembly times.

This technique also creates the permanent deformation of the pipe by compression, that is obtained directly with the action of a pressing machine equipped with suitable jaws; the machine operates by permanently deforming a ferrule of a suitable thickness to guarantee the pressure even in the presence of thermal variations. The seal is guaranteed by the particular slip-proof profile of the insert, and by the two o-rings directly in contact with the pipe.

The integrity of the connection is guaranteed by the seal that insulates the aluminium from the fitting, made of a particular aluminium alloy (CW602N). Great attention was paid to the simplicity of this system and is based on the use of a jaw crimping tool that is readily available on the market (with a particular crimping profile, designed by Valsir), on the standardisation of the threads (GAS ISO) that enable connection to any system, on the reduction and standardisation of the components that make up the fitting, that results in a simpler warehouse stock management.

UNIVERSITÀ DEGLI STUDI DI PADOVA
DIPARTIMENTO DI INNOVAZIONE MECCANICA E GESTIONALE
PADOVA

Padova, lì 09/12/1996

CERTIFICATO N. 453 RICHIESTA N. 118

Richiedente VALSIR S.P.A. Loc. MERLARO-VESTONE (Bs)

Campioni 6 raccordi in ottone del sistema idrico PEXAL.

Ricevuti direttamente.

Contrassegni ///

RISULTATI D'ANALISI:

Si certifica che i raccordi in ottone marcati PEXAL dal risultato delle analisi chimiche risultano costruiti in ottone CZ 132 e sono a norma BS 2874-1986.

COMPOSIZIONE CHIMICA:

Rame (Cu) 62,24%
Piombo (Pb) 2,16%
Stagno (Sn) 0,15%
Ferro (Fe) 0,10%
Arsenico (As) 0,10%
Zinco (Zn) .... resto

I raccordi PEXAL hanno superato le prove per l'identificazione delle tensioni residue secondo i test previsti dalle norme BS 2874-1986.
I campioni dopo l'immersione per 30 minuti nella soluzione di nitrato mercuroso non evidenziano lo sviluppo di cricche.

Determinazione della resistenza alla dezincificazione (secondo norme ISO 6509)

Risultati delle prove

SEZIONE LONGITUDINALE x100 SEZIONE TRASVERSALE x100

ESAME MICROSTRUTTURALE x200

Il Responsabile
prof. M.

Il Direttore
Prof.

4.2 Characteristics of the brass fittings

Compression fittings
for pipe ø 14x2-16x2.25-20x2.5-26x3-32x3

1. The material used for the manufacture of the fitting body is made up of an anti-dezincification brass allow CW602N.
2. The insert is created with a particular anti-slip profile and can be separated from the fitting body, to facilitate the installation operations.
3. Presence of two O-ring seals on the insert.
4. Presence on the base of the fitting of a Teflon seal that prevents contact between the aluminium in the pipe and the brass of the fitting to protect it from corrosion.

Crimp fittings
for pipe ø 14x2-16x2.25-20x2.5-26x3-32x3

1. The material used for the manufacture of the fitting body is made up of an anti-dezincification brass allow CW602N.
2. Stainless steel ferrule 1.4301 (aisi 304) fixed to the body of the fitting.
3. The ferrule has 4 inspection holes so that contact between the pipe and the fitting base is visible.
4. Presence of two O-ring seals on the insert.
5. Presence on the base of the fitting of a seal in PE that prevents contact between the aluminium in the pipe and the brass of the fitting to protect it against corrosion.
6. The insert has a special anti-loosening profile.

Crimp fittings
for pipe ø 40x3.5-50x4-63x4.5

1. The material used for the manufacture of the fitting body is made up of an anti-dezincification brass allow CW602N.
2. Sleeve in stainless steel 1.4301 (AISI 304), removable from the fitting body.
3. The insert is made with a particular anti-slip profile.
4. Presence of two O-ring seals on the insert.
5. Presence on the base of the fitting of a seal in PE that prevents contact between the aluminium in the pipe and the brass of the fitting to protect it against corrosion.

LGR Press fittings for Pexal pipe ø 16x2-20x2-26x3 and Mixal pipe ø 16x2-20x2

1. The material used for the manufacture of the fitting body is made up of CW617N.
2. Stainless steel ferrule 1.4301 (AISI 304) fixed to the body of the fitting.
3. The ferrule has 4 inspection holes so that contact between the pipe and the fitting base is visible.
4. The insert is made with a particular anti-slip profile.
5. Presence of two O-ring seals on the insert.
6. Presence on the base of the fitting of a Teflon seal that prevents contact between the aluminium in the pipe and the brass of the fitting to protect it against corrosion.
7. If the fitting has not been pressed, it will visibly leak during the water proof test of the system.

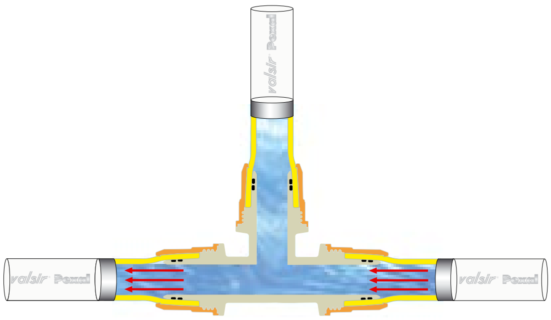
Compression fittings for Pexal pipe ø 16x2-18x2-20x2 and Mixal pipe ø 16x2-20x2

1. The material used for the manufacture is made up of CW617N (nickel thickness 15 μm).
2. The insert is a part of the fitting and therefore it is made up of 3 pieces instead of 4.
3. The insert is made with a particular anti-slip profile.
4. The olive cut sideways can be used in both directions.

4.3 PPSU fittings

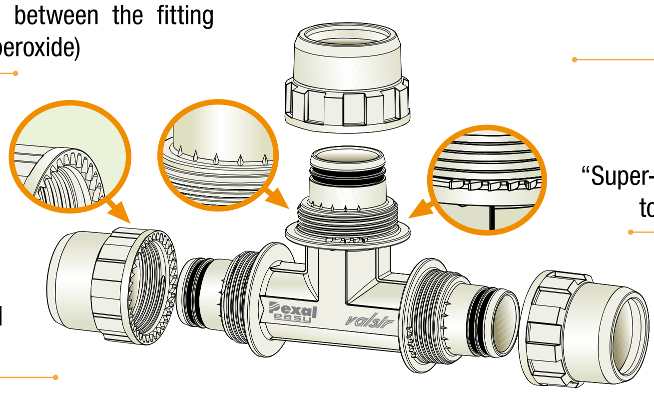
Fruit of the vast experience of Valsir in the technology of multilayer pipes and crimp-fittings, a technologically advanced and innovative product, both in its design and its use. Pexal Easy is an advanced system of fittings made of Polyphenyl Sulfone (PPSU), a “techno-polymer” of a new generation. Its numerous characteristics make the new Pexal Easy fittings equal both in performance and in quality to the brass fittings. The elevated mechanical characteristics (tensile strength, modulus of elasticity etc.) greatly exceed those of the normal polymers present on the market and they are similar in performance to the metal fittings: the new Pexal Easy fittings do not “fear“, therefore, any type of accidental or deliberate blow, either at low or high temperatures. For this reason, the body of the fitting, the nuts and the threads are all in PPSU. Pexal Easy possesses, furthermore, an elevated ageing resistance that is maintained even at high temperatures. Furthermore, the structure of the fittings is immune to chemical agents. It can therefore be laid in grooves or in surface mounting, satisfying all the installation requirements that a plumber can encounter. The connection between the pipe and the fitting is carried out easily, thus further reducing the laying times. An innovative system that locks the nut onto the fitting, guarantees a firm connection with the pipe, thus eliminating the possibility of error. Indeed, at the base of the thread, a special anti-loosening profile has been created which guarantees the definitive connection. Despite this feature, the fitting can be reused without having to replace the o-rings or the nut. The particular type of connection of Pexal Easy, thanks to the pipe socket, makes it impossible to remove the pipe from the fitting. Unlike other systems, with Pexal Easy there is no reduction in the bore when passing from the pipe to the insert; this means a significant reduction in pressure drops: in practice, whereas before a 20 mm pipe was necessary, with Pexal Easy it is possible to use a 16 mm pipe.

TOTAL PASSAGE
ensures an optimum flow since the internal diameter of the fitting in PPSU is the same as the internal diameter of the Pexal pipe.



Two “o-ring” seals between the fitting and pipe (in EPDM peroxide)

Resistance to loosening



“Super-safe” installation thanks to the tamper-proof fitting

Elevated mechanical resistance

4.4 Characteristics of the fittings

Fittings for Pexal pipe ø 14x2-16x2-16x2.25-18x2-20x2-20x2.5-26x3-32x3-40x3.5-50x4

1. The material used for the manufacture pf the Pexal Easy fittings is PPSU (Polyphenyl sulfone). The characteristics of the material are listed in Appendix B on page 81.

2. Reduction in pressure drops in the **fittings-total passage**. Unlike other systems, there is no reduction in the section due to the insert. In fact, the internal diameter of the insert of this new fitting is the same as the pipe. As compared with traditional system, passage is increased by 30%.

3. The fitting can be dismantled and used again after laying. The fitting can be dismantled by forcing the anti-slip screw, it can therefore be used once more without having to replace any of the fitting components.

4. Resistance to loosening. Even in the presence of elevated thermal movements, the cone-shaped socket of the pipe supplies an elevated resistance to loosening. This characteristic enables the system to support cycles of thermal expansion and contraction that are not easily reached by other systems. This particular type of connection makes loosening of the pipe impossible.

5. The installation is made safe by the **anti-loosening system**. An innovative blocking system of the nut on the fitting guarantees the definitive connection with the pipe.

6. Two peroxide EPDM o-rings between the pipe and the fitting. The seal of the fitting is guaranteed by two o-rings.

7. High resistance to corrosion, even extremely concentrated and hot acids. This characteristic makes the system extremely resistant to chlorinated water; often too many additives (chlorine dioxide) are added to render water safe for drinking purposes. Metal pipes have already demonstrated their limits over time when in contact with this agent. The combination of the multilayer pipe and the PPSU fittings therefore forms a totally resistant system to chemical agents.

8. Lightweight. PPSU has a specific weight of 1.3 g/cm^3 and is therefore 6 times lower than that of metal.

9. Less subject to lime scale formation than metal fittings. All metal fittings which are produced mechanically possess a rough surface which favours the deposit of lime scale. With particularly hard water, over time, this phenomenon can lead to the total blockage of the pipe. The Pexal Easy fittings in PPSU are molded and the surface is therefore smooth and so there is no formation of lime scale.

10. Better resistance than metal fittings to mortar. Cement and sand themselves, are not aggressive towards fittings, however, the additives in mortar can be damaging (e.g. lubricants, fluidisers etc.). Mortar with a high percentage of line (lime putty, hydraulic lime) is also aggressive. Such agents corrode the surface of metals, even though the corrosion is not deep. The Pexal Easy fittings is PPSU do not come under attack from the additives contained in mortar.

11. Very good mechanical resistance. The PPSU utilised in Pexal Easy fittings guarantees a mechanical resistance that is much higher than all of the other polymers available on the market, with a wide range of working temperatures.

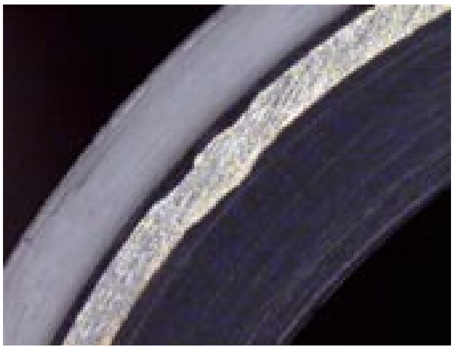
12. The pipe-fittings system is guaranteed at 10 bar and 95°C.

13. The system is suitable for domestic hot water and heating systems.

14. Reduction in purchase cost of tools. The connection between the pipe and Pexal Easy PPSU fittings necessitates the use of three simple tools: a pipe cutter, a socketer and an expander in LDPE mono-use. The investment required is therefore greatly reduced as compared to other multi-layer systems.

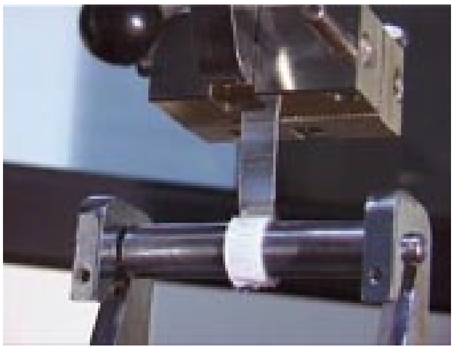
5 QUALITY CONTROL

In the Valsir factories, the entire production process of the multi-layer pipe undergoes continuous and strict quality controls. As well as the numerous tests requested by the protocols published by the most important international certification institutes, Valsir carries out important tests of a high qualitative value on its products. The following paragraphs illustrate some of the tests applied to the Pexal and Mixal pipes.



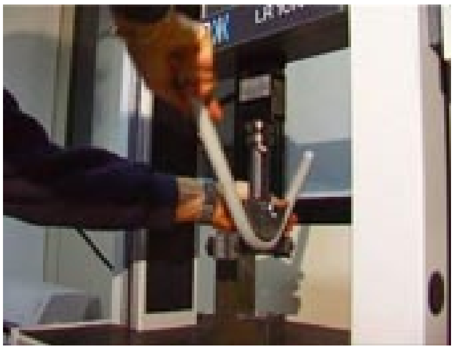
1. Dimensional aspect

The principal test performed on the multilayer pipe by the Valsir Quality Control Function is to measure the diameters and the thickness of the individual layers; this test is performed in the laboratory with the help of the most technologically advanced optical measurement equipment, complete with software capable of automatically carrying out the dimensional tests (the dimensions of the pipe are tested in the process using laser detectors). The sophisticated optical projector also enables the weld cross-section to be checked and therefore to verify that the weld has been correctly carried out.



2. Separation test

Of equal importance is the separation test; this is performed using a computerised dynamometer capable of assessing the force required to separate the aluminium layer from the internal pipe (glued together). As a result, the test provides a graph describing the value of the force (at every point on the pipe's circumference) to be applied to separate the layers; the adhesion between the PEX and the aluminium is fundamental for the seal of a multilayer pipe under pressure: the greater the adhesive strength, the greater the pressure the product can undergo.



3. Bending test

The 90° bending test is one of the mechanical tests performed on the Pexal pipe. This test is performed using a dynamometer that records the force required for bending. The test is passed if no squeezing or wrinkling of the external layer occurs on the test specimen.

4. Estimation of the degree of crosslinking

The finished Pexal and Mixal pipe (which has already completed the cross-linking process) is subjected to a test that measures the degree of cross-linking achieved by the polymeric materials. The testing procedures are defined by international standards and are strictly followed by the operators assigned to perform the test; the degree of cross-linking of the polymers is used to assess the aggregation of the material's molecules and it is therefore important for assessing the increase in the mechanical and chemical resistance of the polyethylene.

5. Pressure test

Throughout the daily production of the Pexal and Mixal pipes, sample pipes are selected (at pre-established intervals) and are subsequently tested at 95 °C at specific pressures for each product. The tests are designed to ensure the product is suitable for sale and to evaluate its hydraulic, mechanical and structural characteristics. The tests are performed in special tanks or ovens at electronically controlled temperatures. The pressures set at the inlet of each sample and the test conditions are controlled and recorded step by step by a computerised system and were established during the certification of the product.

6. Long duration tests

The long duration tests are carried out to confirm the reliability of the product over time. In fact, they are carried out for 1000 hours both at 95 °C in special tanks, and at 110 °C in special ovens.

7. Cone test

Samples of Pexal and Mixal pipe taken during the production phase at regular intervals undergo the cone test; this test is performed in compliance with international standards, and is carried out on-line by the production operators and in the laboratory by the Quality operators (in this case the test is performed using a computerised dynamometer); this test is designed to assess the seal of the weld and the sealing strength of the glue applied between the various layers, after having expanded the pipe by more than 13% of its nominal diameter.

8. Dimensional test during production

The diameters of the pipe are constantly monitored by laser instruments during the production of Pexal and Mixal, supported by a computerised system in the successive phases of the manufacturing process; in this way the production operators are able to observe the trend graphs of the individual diameters on the line monitors at every moment; appropriate alarms are activated when the values lie outside the pre-established range.

9. Tensile test

The fundamental raw material for the production of the Pexal and Mixal pipes is aluminium; in order to avoid defects in the supply of this material (even with top quality suppliers) Valsir carries out tests on each delivery by measuring the dimensions and mechanical characteristics; the mechanical properties are verified by carrying out tensile tests (established by international standards) on samples of material randomly selected from the batch that has been delivered; the tests are carried out with the use of sophisticated computerised dynamometrical instruments.

10. Analysis of melt flow index

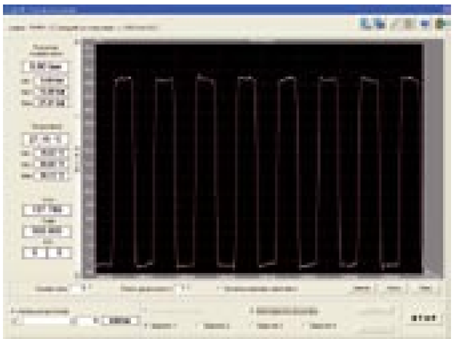
All of the polymerical raw materials utilised in the manufacture of the multilayer pipe are controlled on arrival in order to verify their principal characteristics; this allows Valsir to produce with the certainty of employing materials suitable for manufacturing; the instruments utilised for the controls are the most technologically advanced available: for example, the melt flow index measurement is taken with the use of the most up-to-date automatic appliances.

11. Heat resistance test

The controls carried out by the Valsir quality control laboratories on the polymerical materials employed in the production of the Pexal and Mixal pipes, do not end with the controls carried out on in-coming materials, but continue after the production phase; the shrinkage and sliding test are carried out on the finished product on the various layers of polyethylene; pieces of pipe undergo artificial ageing tests and thermal stress tests in thermostatic cells.

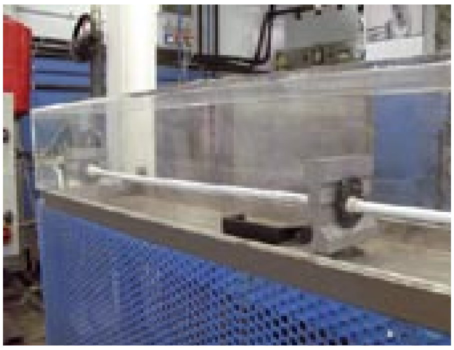
12. Suitability of internal diameter (marble test)

Along the production line each and every coil of Pexal and Mixal multi-layer pipe is tested by introducing a steel marble into the pipe itself with the use of compressed air. This operation ensures the absence of collapses in the wall or obstacles inside the pipe.



13. Pipe hammer

At each production start-up of the Pexal and Mixal multi-layer pipes and the plastic fittings in PPSU (Polyphenyl Sulfone) a pressure cycle test is performed at 23°C. This consists of creating sudden pressure changes (frequency = 30 cycles per minute) inside the test specimen ranging from the lowest value (0.5 bar) to the highest value (25 bar) for 10,000 times with the aim of verifying the mechanical stability of the product and consequently the complete absence of leaks.



14. Vibration test

At each production start-up of the multi-layer pipe a vibration test is performed: this consists of subjecting a 2 m long specimen, obtained by combining two 1 m long pipes each with an intermediate fitting, to a combination of static pressure (15 bar) and vertical mechanical stress of misalignment (about 10 mm) with the aim of verifying the pipe-fitting compatibility or more precisely the absence of withdrawing. Each pipe-fitting combination is subjected to a total of 330 cycles each lasting 80 seconds that are made up of 20 seconds of vibrations with a pause of 60 seconds.
The test is considered positive if there are no leaks or ruptures.

6.1 Pipe bending

The pipe can be bent in various ways; the method adopted depends on the diameter of the pipe. Valsir offers a large range of pipe bending tools. The table shows the available tools and the range of diameters for which they can be used.

Valsir pipe bending tools

ARTICLE	DESCRIPTION	DIAMETERS
115001	Portable hydraulic pipe bender in carrier case mod. OB 85S complete with matrix and counter-matrix	14x2-16x2.25-20x2.5 16x2-20x2-26x3-32x3
115005	Tool for by-pass bends	20x2-20x2.5-26x3
115050	Diameter 18 matrix and countermatrix for pipe bender OB 85 S – 18x2	18x2
115051	Portable friction pipe bender in plastic carrier case mod. AMICA 3 complete with matrix and counter-matrix	14x2-16x2.25-20x2.5 16x2-18x2-20x2-26x3
115052	Matrix and counter-matrix ø 32 for pipe bender AMICA 3	32x3
116014	Spring for bending pipes-internal	14x2
116016	Spring for bending pipes-internal	16x2-16x2.25
116020	Spring for bending pipes-internal	20x2-20x2.5
116114	Spring for bending pipes-external	14x2
116116	Spring for bending pipes-external	16x2.25-16x2
116120	Spring for bending pipes-external	20x2.5-20x2
115060	Manual, crank operated pipe bender complete with folding tripod stand	40x3.5-50x4

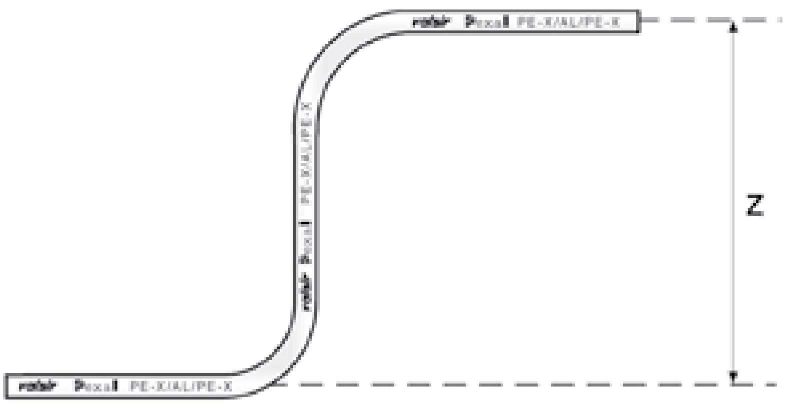
N.B. If you choose not to use the tools as indicated in the table, then make sure that the diameter and radius of curvature of the matrix and the counter-matrix correspond to the exact outside diameter of the pipe, thus avoiding crushing during the bending operation.

Pipe bending methods

Ø	BY HAND		WITH INTERNAL SPRING		WITH EXTERNAL SPRING		WITH PORTABLE PIPE BENDER		WITH WORKBENCH MOUNTED PIPE BENDER	
	Bending possibility	Min. bending radius (mm)	Bending possibility	Min. bending radius (mm)	Bending possibility	Min. bending radius (mm)	Bending possibility	Min. bending radius (mm)	Bending possibility	Min. bending radius (mm)
14x2	X	70	X	55	X	55	X	41	-	-
16x2.25	X	80	X	65	X	65	X	49	-	-
20x2.5	X	100	X	80	X	80	X	80	-	-
16x2	X	80	X	65	X	65	X	49	-	-
18x2	X	90	X	75	X	75	X	65	-	-
20x2	X	100	X	80	X	80	X	80	-	-
26x3	X	140	-	-	-	-	X	90	-	-
32x3	X	160	-	-	-	-	X	120	-	-
40x3.5	-	-	-	-	-	-	-	-	X	150
50x4	-	-	-	-	-	-	-	-	X	190
63x4.5	-	-	-	-	-	-	-	-	X	240

Minimum misalignment between two consecutive bends with various bending methods

Ø	MINIMUM MISALIGNMENT Z (mm)			
	BY HAND	EXT / INT. SPRING	PORTABLE PIPE BENDER	WORKBENCH PIPE BENDER
14x2	160	110	90	-
16x2.25-16x2	170	120	100	-
18x2	175	125	110	
20x2.5-20x2	180	130	160	-
26x3	-	-	-	-
32x3	-	-	-	-
40x3.5	-	-	-	480
50x4	-	-	-	600
63x4.5	-	-	-	760



6.2 Use of compression fittings for the Pexal pipe ø 14x2-16x2.25-20x2.5-26x3 32x3

1. Cutting the pipe.

We recommend the use of a long-bladed pipe cutter of the type shown in the figure to obtain a quick and precise cut. **We do not recommend the use of shears as these could ovalise the pipe.**

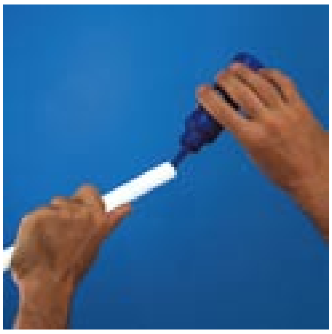
Valsir pipe cutter

CODE	Ø
105000	6 ÷ 50
458001	6 ÷ 64

2. Pipe calibration and deburring.

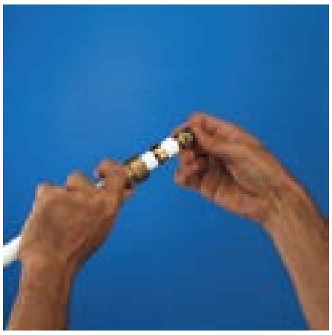
This is an **essential** operation to be performed before inserting the insert into the pipe. Insert the calibration tool inside the pipe, turning it carefully so that the cut ends have a rounded lead in. After calibrating the pipe, use the same instrument to deburr the ends, the end of the tool also acts as a deburrer; then remove the shavings that have formed inside the pipe as a result of this operation.

N.B. Before calibrating, make sure that the calibrating tool is free from dents, as they could cause irreparable damage to the pipe, thus putting the waterproof seal at risk. Special calibrators must be used to perform the calibration (code 105101-105105-105113-105117-105121-105125-105133-105999-105173-105175).



3. Lubrication.

Lubricate the inside of the pipe end and O-rings fitted on the insert with silicon oil (code 105210-avoid using other products such as grease, etc); this operation makes pipe insertion easier and ensures the duration of the O-ring over time.

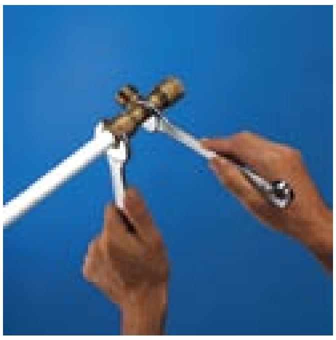


4. Mounting the fitting.

4.1 Slide the nut and the olive over the pipe making sure that the conical part of the olive is facing the nut.

4.2 Insert the insert with the double O-rings inside the pipe, exerting sufficient pressure to ensure contact of the pipe with the Teflon separator seal already pre-fitted on the insert.

4.3 Insert the insert and tighten the nut by hand as much as possible.



5. Blocking the pipe with the fitting.

Finally, tighten the nut by no more than two turns of the spanner interrupting the tightening operation when the pipe tends to turn with the nut.

N.B. The tightening operation must be carried out with two spanners: one for tightening and the other as a contrast.

6.3 Use of crimp fittings for Pexal pipes ø 14x2-16x2.25-20x2.5-26x3-32x3

1. Cutting the pipe.

We recommend the use of a long-bladed pipe cutter of the type shown in the figure to obtain a quick and precise cut. **We do not recommend the use of shears as these could ovalise the pipe.**

Valsir pipe cutter

CODE	Ø
105000	6 ÷ 50
458001	6 ÷ 64

2. Pipe calibration and deburring.

This is an **essential** operation to be performed before inserting the insert into the pipe. Insert the calibration tool inside the pipe, turning it carefully so that the cut ends have a rounded lead in. After calibrating the pipe, use the same instrument to deburr the ends, the end of the tool also acts as a deburrer; then remove the shavings that have formed inside the pipe as a result of this operation.

N.B. Before calibrating, make sure that the calibrating tool is free from dents, as they could cause irreparable damage to the pipe, thus putting the waterproof seal at risk. Special calibrators must be used to perform the calibration (code 105101-105105-105113-105117-105121-105125-105133-105173-105175).

3. Lubrication.

Lubricate the inside of the pipe end and O-rings fitted on the insert with silicon oil (code 105210-avoid using other products such as grease, etc); this operation makes pipe insertion easier and ensures the duration of the O-ring over time.

4. Mounting the fitting.

Insert the pipe fully into the fitting. Use the four inspection holes on the ferrule to ensure that the pipe is fully inserted.

5. Blocking the pipe with the fitting.

Position so that the pressing jaws are right up against the fitting body, then activate the start button on the pressing machine (as detailed in the chapter on operation of the pressing machine). Pressing machines normally available on the market can be used, but they must be equipped with specific grip jaws, the type to use is indicated in the Chapter 6.12 “Pressing machines for the Pexal and Mixal pipes”.

N.B. Do not use jaws other than those described in the Tools section of the Valsir General Catalogue/Price List (L02-290/2).

6.4 Use of crimp fittings for the Pexal pipe ø 40x3.5-50x4-63x4.5

1. Cutting the pipe.

We recommend the use of a long-bladed pipe cutter of the type shown in the figure to obtain a quick and precise cut. **We do not recommend the use of shears as these could ovalise the pipe.**

Valsir pipe cutter

CODE	Ø
105000	6 ÷ 50
458001	6 ÷ 64

2. Pipe calibration and deburring.

This is an **essential** operation to be performed before inserting the insert into the pipe. Insert the calibration tool inside the pipe, turning it carefully so that the cut ends have a rounded lead in. After calibrating the pipe, use the same instrument to deburr the ends, the end of the tool also acts as a deburrer; then remove the shavings that have formed inside the pipe as a result of this operation.

N.B. Before calibrating, make sure that the calibrating tool is free from dents, as they could cause irreparable damage to the pipe, thus putting the waterproof seal at risk. Special calibrators must be used to perform the calibration (code 105133-105175-105177).

3. Lubrication.

Lubricate the inside of the pipe end and O-rings fitted on the insert with silicon oil (code 105210-avoid using other products such as grease, etc); this operation makes pipe insertion easier and ensures the duration of the O-ring over time.

4. Mounting the fitting.

4.1 Slide the ferrule over the pipe.

4.2 Introduce the insert into the pipe until the pipe rests against the white Teflon seal.

4.3 Slide the ferrule along the pipe until it comes into contact with the white Teflon seal.

5. Blocking the pipe with the fitting.

Mount the chain jaw on the fitting and close it. Position it so that it is up against the fitting body. Attach it to the basic insert already mounted on the pressing tool, then close it by pressing the trigger on the pressing tool (as shown in the chapter concerning pressing tools). For the pressing procedure, any pressing tool can be used but it must be equipped with compatible jaws, as shown in Chapter 6.12 “Pressing tools for the Pexal and Mixal pipes”.

N.B. Do not use jaws other that those described in the Tools section of the Valsir General Catalogue/Price List (L02-290/2).

6.5 Use of compression fittings for the Pexal pipes ø 16x2-18x2-20x2 and the Mixal pipes ø 16x2-20x2

1. Cutting the pipe.

We recommend the use of a long-bladed pipe cutter of the type shown in the figure to obtain a quick and precise cut. **We do not recommend the use of shears as these could ovalise the pipe.**

Valsir pipe cutter

CODE	Ø
105000	6 ÷ 50

2. Pipe calibration and deburring.

This is an **essential** operation to be performed before inserting the insert into the pipe. Insert the calibration tool inside the pipe, turning it carefully so that the cut ends have a rounded lead in. After calibrating the pipe, use the same instrument to deburr the ends, the end of the tool also acts as a deburrer; then remove the shavings that have formed inside the pipe as a result of this operation.

N.B. Before calibrating, make sure that the calibrating tool is free from dents, as they could cause irreparable damage to the pipe, thus putting the waterproof seal at risk. Special calibrators must be used to perform the calibration (code105106-105107-105114-105171).

3. Lubrication.

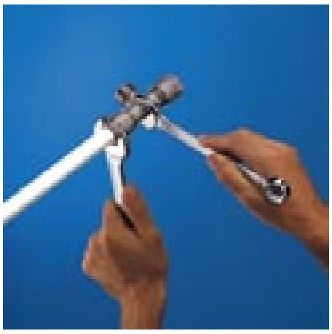
Lubricate the inside of the pipe end and O-rings fitted on the insert with silicon oil (code 105210-avoid using other products such as grease, etc); this operation makes pipe insertion easier and ensures the duration of the O-ring over time.

4. Mounting the fitting.

4.1 Slide the nut and olive over the pipe.

4.2 Insert the fitting into the pipe, exerting sufficient pressure to ensure contact of the pipe with the Teflon seal already pre-fitted on the insert.

4.3 Tighten the nut by hand as far as possible.



5. Blocking the pipe with the fitting.

Finally, tighten the nut by no more than two turns of the spanner, interrupting the turning operation when the pipe tends to turn with the nut.

N.B. The tightening operation must be carried out by using two spanners: one to tightening and the other as a contrast.

6.6 Use of crimp fittings for Pexal pipes ø 16x2-20x2 and Mixal pipes ø 16x2-20x2

1. Cutting the pipe.
We recommend the use of a long-bladed pipe cutter of the type shown in the figure to obtain a quick and precise cut. **We do not recommend the use of shears as these could ovalise the pipe.**

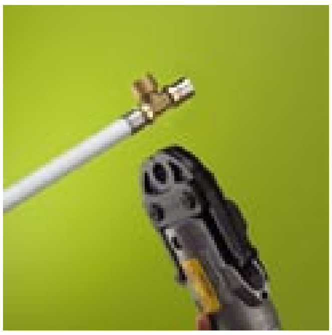
Valsir pipe cutter

CODE	Ø
105000	6 ÷ 50
458001	6 ÷ 64

2. Pipe calibration and deburring.
This is an **essential** operation to be performed before inserting the insert into the pipe. Insert the calibration tool inside the pipe, turning it carefully so that the cut ends have a rounded lead in. After calibrating the pipe, use the same instrument to deburr the ends, the end of the tool also acts as a deburrer; then remove the shavings that have formed inside the pipe as a result of this operation.
N.B. Before calibrating, make sure that the calibrating tool is free from dents, as they could cause irreparable damage to the pipe, thus putting the waterproof seal at risk. Special calibrators must be used to perform the calibration (code 105106-105114-105171).

3. Lubrication.
Lubricate the inside of the pipe end and O-rings fitted on the insert with silicon oil (code 105210-avoid using other products such as grease, etc); this operation makes pipe insertion easier and ensures the duration of the O-ring over time.

4. Mounting the fitting.
Insert the pipe fully into the fitting. Use the four inspection holes on the ferrule to ensure that the pipe is fully inserted.



5. Blocking the pipe with the fitting.
Position so that the pressing jaws are right up against the fitting body, then activate the start button on the pressing machine (as detailed in the chapter on operation of the pressing machine). Pressing machines normally available on the market can be used, but they must be equipped with specific grip jaws, the type to use is indicated in the Chapter 6.12 “Pressing machines for the Pexal and Mixal pipes”.
N.B. The jaws used in the systems 16x2 and 20x2 are the same as those used in the systems 16x2.25 and 20x2.5. Only use the jaws described in the Valsir catalogue “Common tools and components”.

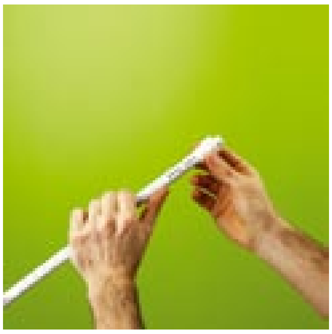
6.7 Use of Pexal Easy fittings for the Pexal pipe ø 14x2-16x2-16x2.25-18x2 20x2-20x2.5-26x3-32x3

1. Cutting the pipe.

We recommend the use of a long-bladed pipe cutter of the type shown in the figure to obtain a quick and precise cut. **We do not recommend the use of shears as these could ovalise the pipe.**

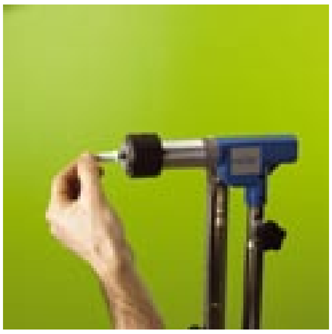
Valsir pipe cutter

CODE	Ø
105000	6 ÷ 50
458001	6 ÷ 64



2. Introduction of the nut in PPSU onto the pipe.

Place the PPSU nut over the pipe making sure that the threaded part is facing the end part of the socket.

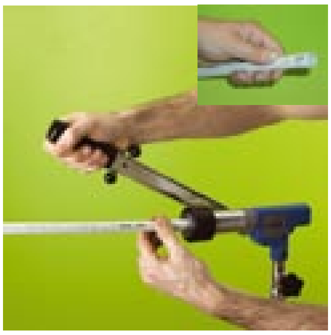


3. Insertion of the plastic expander in the extractor that is engaged in the socketer.

3.1 Release the expander from the socketer.

3.2 Insert the LDPE expander on the extractor.

3.3 Connect again the extractor to the socketer.

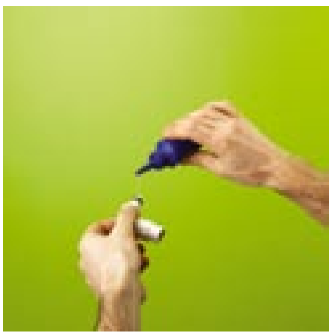


4. Socketing of pipe end.

4.1 Insert the pipe on the extractor until it comes in contact with the expander and the socketer.

4.2 Keeping the pipe with one hand, turn the socketer's handle anticlockwise with the other hand until the complete ejection of the pipe from the machine.

N.B. The LDPE expander can only be used once, and therefore must be disposed of after it has been used for socketing the pipe.



5. Lubrication of the fitting insert.

Lubricate the internal edge of the pipe and the O-rings fitted on the insert using silicon oil (code 105210-avoid other products such as grease, etc.); this operation favours assembly of the insert on the pipe and ensures the duration of the O-ring over time.

6. Insertion of the fitting into the pipe.
Fit the insert into the pipe so that the pipe comes into contact with the end of the insert.

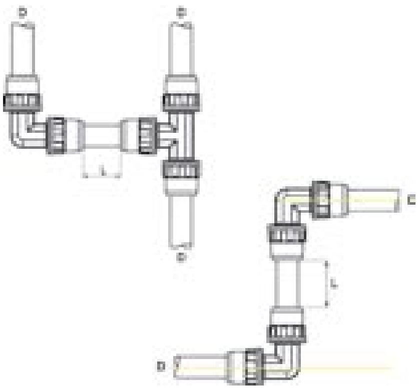
7. Tightening the nut.
By means of a special spanner (code 162301-162303-162305-162307-162309) tighten the fitting until the nut is blocked on the anti-slip profile of the fitting body.

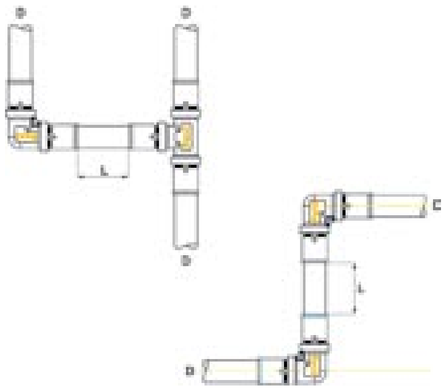
Colour of the expanders

CODE	DESCRIPTION	COLOUR
161901	14x2	Brown
161905	16x2	White
161903	16x2.25	Grey
161909	20x2	Red
161907	20x2.5	Grey
161913	26x3	Yellow
161917	32x3	Brown

Minimum pressing distance

ø (mm)	L (mm)
16	65
20	65
26	65
32	80
40	110
50	110





6.8 Use of Pexal Easy fittings for the Pexal pipe ø 40x3,5-50x4

1. Cutting the pipe.

We recommend the use of a long-bladed pipe cutter of the type shown in the figure to obtain a quick and precise cut.

We do not recommend the use of shears as these could ovalise the pipe.

Valsir pipe cutter

CODE	Ø
105000	6 ÷ 50
458001	6 ÷ 64

2. Introduction of PPSU nut onto the pipe.

Place the PPSU nut over the pipe making sure the threaded part is facing the end part of the socket.

3. Socketing of the pipe end.

3.1 Use the spray supplied with the mechanical dilating tool. This operation should be performed every 3-4 pipe socketing operations.

3.2 Place the pipe fully over the mechanical dilating tool.

3.3 Keep the pipe in line with the tool; if necessary, use the pipe stand code 162253.

3.4 Press the trigger and keep it pressed until the socketing operation has been fully completed.

4. Lubrication of the fitting insert.

Use silicone oil (code 105210- avoid other products such as grease, etc.) to lubricate the inside of the pipe or the o-rings on the insert; this will aid introduction of the insert into the pipe and guarantees the duration of the o-rings over time.

5. Insertion of fitting into the pipe.

Fit the insert into the socketed pipe; the pipe end must be in contact with the end part of the insert.

6. Completion of pipe-fitting connection.

Use the special key (code 162307- 162309) to tighten the fitting. The nut should be fully tightened onto the anti-loosening profile of the fitting body.

6.9 Socketers and tools for the Pexal Easy system

CODE 162201/162203

CODE 162219

CODE 162214

The Pexal pipe socketing and the use of PPSU Pexal Easy fittings is carried out by means of the equipment indicated in the table.

CODE	DESCRIPTION
162201	Hand socketing tool + extractors ø 16-20x2-20x2.5-26-32 + tool stand + plastic case
162203	Hand socketing tool + tool stand + plastic case
162219	Electric socketing tool + mechanical expanders ø 40-50
162301	Spanner for cap ø 14-18
162303	Spanner for cap ø 16-20
162305	Spanner for cap ø 26-32
162307	Spanner for cap ø 40
162309	Spanner for cap ø 50
162101	Extractor ø 14
162103	Extractor ø 16
162105	Extractor ø 18
162107	Extractor ø 20x2
162108	Extractor ø 20x2.5
162109	Extractor ø 26
162111	Extractor ø 32
162214	Battery run socketing tool BE32 + extractors ø 16/20x2/20x2.5/26 + 2 batteries + battery recharger + plastic case

The electrical tools are designed for use with electric energy of 220 V/50Hz.

6.10 Use of socketing tool code 162213 for Pexal pipe ø 14x2-16x2-16x2.25-18x2-20x2 20x2.5-26x3-32x3

1. Retract the black-coloured release ring nut positioned on the end of the socketer.

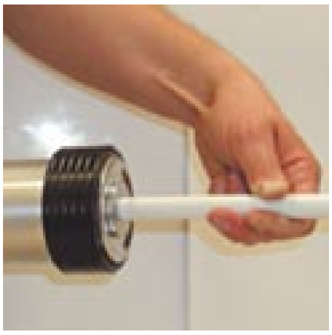
2. Remove the extractor from its housing.

Ensure the extractor is held firmly in one hand during the release operation.

3. Insert the disposable LDPE expander onto the extractor.

4. Replace the extractor and the expander inserting them in the relative housing in the socketer.

Press down firmly until the engagement catch clicks.



5. Insert the pipe on the extractor piece firmly until the pipe comes into contact with the expander and the body of the socketing machine.

Actuate the socketer until the pipe is ejected from the machine.

N.B. The LDPE expander can only be used once, and therefore must be disposed of after it has been used for socketing the pipe.

6.11 Use of socketing tool code 162219 for Pexal pipe ø 40x3.5-50x4

1. Screw on the suitable head according to the diameter that needs to be socketed.

2. Use the spray supplied with the tool on the mechanical expander. This should be done every 3-4 operations.

3. Press the trigger and keep it pressed until the socketing operation has been completed.

6.12 Pressing machines for the Pexal and Mixal pipe

The pressing operation of the crimp fittings is performed using special machines designed for thi purpose: the Valsir range consists of two pressing machines, the characteristics of which are indicated in the table.

CODE	BRAND	DESCRIPTION
133994	CBC	Pressing machine + carrier case + jaws ø 16-20-26
133904	CBC	Pressing machine + carrier case
133912	CBC	Battery-operated pressing machine + battery charge + plastic carrier case
133913	CBC	Battery-operated pressing machine + jaws ø 16-20-26 + battery charge + plastic carrier case
133951	CBC	Battery 14 V for code 133912-133913 old model
133955	CBC	Battery recharger 14V/18V for code 133951-133952
133953	CBC	Control gauge for pressing machine (suitable for all pressing machines with 3.2 kN force)

CODE	BRAND	DESCRIPTION
133909		Insert for base jaw ø 50
133911		Insert for base jaw ø 63
133914		Pressing jaw ø 14 for pressing tool code 133994-133904-133912-133913
133916		Pressing jaw ø 16
133920		Pressing jaw ø 20
133926		Pressing jaw ø 26
133935*		Pressing jaw ø 32 (stainless steel ferrule)
133940		Pressing jaw ø 40
133950		Pressing jaw ø 50
133905		Basic jaw for ø 40-50-63 (can be used if suitable inserts are attached)
133952		Battery 18V for pressing tool code 133912-133913 new model
133980	KLAUKE	Battery run pressing tool with jaws ø 16-20-26
133971	KLAUKE	Pressing jaw ø 16 for pressing tool code 133994-133904-133912-133913
133973	KLAUKE	Pressing jaw ø 20 for pressing tool code 133994-133904-133912-133913
133975	KLAUKE	Pressing jaw ø 26 for pressing tool code 133994-133904-133912-133913
133977*	KLAUKE	Pressing jaw ø 32 for pressing tool code 133994-133904-133912-133913
133978	KLAUKE	Pressing jaw ø 16 for pressing tool code 133994-133904-133912-133913
133957	KLAUKE	Manual pressing tool with inserts ø 16-20

**Yellow coloured pressing jaw for the new pipe fittings ø 32 with stainless steel ferrule.*

For ø 50 it is possible to use the jaw (code 133950) or the basic jaw (code 133905) with the insert for the basic jaw ø 50 (code 133909).

The jaw codes 133971, 133973, 133975, 133977, 133978 can be mounted only on Klauke pressing tool code 133980.

The jaw codes 133914, 133916, 133920, 133926, 133932, 133935, 133940, 133950 and the basic jaw code 133905 can be mounted on CBC pressing tool codes 133994, 133904, 133912, 133913.

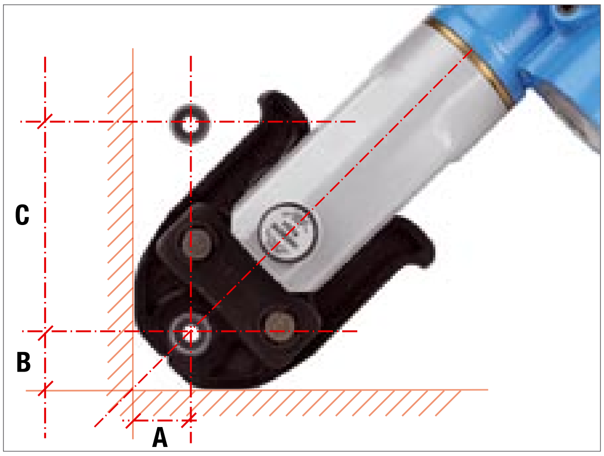
The various fitting diameters are compatible with the following pressing profiles:

DIAMETER D	PROFILE JAW
14x2	H
16x2	H, TH, U
16x2,25	H, TH, U
20x2	H, TH, U
20x2,5	H, TH, U
26x3	H, TH, C
32x3	VAL, H, TH, U
40x3,5	U, VAL
50x4	VAL
63x4,5	VAL
75x5	VAL

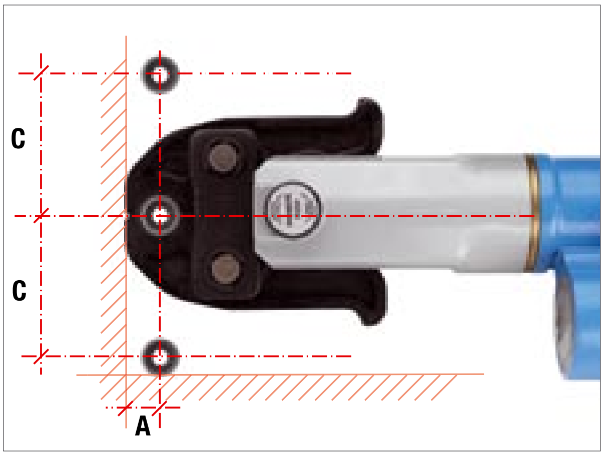
6.13 Pressing dimensions

It is important to consider the overall dimensions of the pressing machine jaws for pressing operations on the crimp fittings.

6.13.1 Dimensions of jaw for pressing tool codes 133904-133994-133912-133913

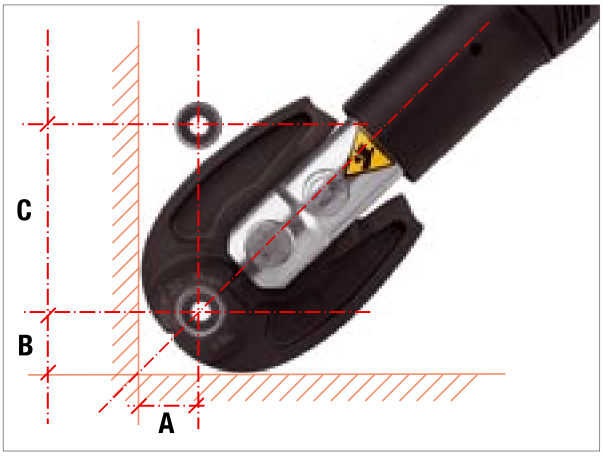


DIAMETER	A (mm)	B (mm)	C (mm)
14	35	35	82
16	35	35	85
20	36	36	87
26	42	42	91
32	46	46	98
40	48	48	105
50	52	52	110
40 with insert	68	68	88
50 with insert	75	75	100
63 with insert	84	84	115

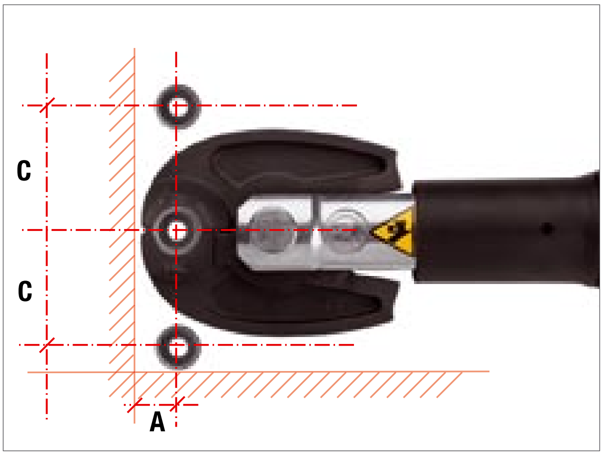


DIAMETER	A (mm)	C (mm)
14	24	54
16	24	56
20	25	59
26	29	69
32	37	81
40	41	88
50	45	100
40 with insert	68	88
50 with insert	75	100
63 with insert	84	115

6.13.2 Dimensions of jaw for Klauke pressing tool code 133980

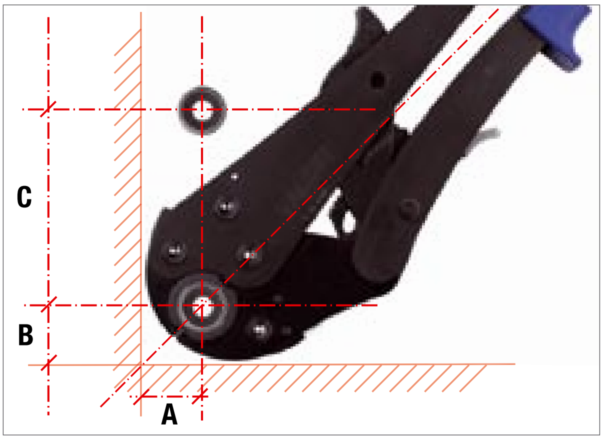


DIAMETER	A (mm)	B (mm)	C (mm)
16	25	25	64
20	26	26	69
26	30	30	73
32	35	35	78

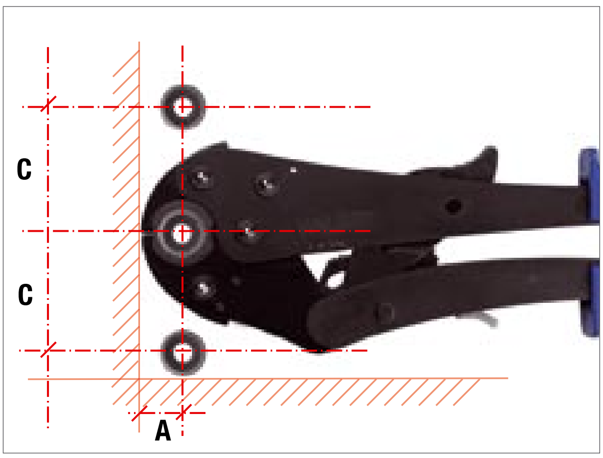


DIAMETER	A (mm)	C (mm)
16	14	46
20	16	46
26	24	52
32	30	55

6.13.3 Dimensions of jaw for manual pressing tool code 133957



DIAMETER	A (mm)	B (mm)	C (mm)
16	25	28	66
20	25	28	68



DIAMETER	A (mm)	C (mm)
16	21	48
20	21	50

6.14 Use of pressing tools 133904-133994-133912-133913 for Pexal pipe 14-16-20-26-32-40-50

1. Turn and press the lock pin to insert the pressing jaw into the pressing tool.

2. A spring will automatically push the lock pin open.

3. Insert the jaw into place.

3.1 Push the lock pin down to block the jaw.

4. Adjust the ends of the grip tool to the open position to insert the pipe.

4.1 Position the pressing machine so that the pressing jaw comes into contact with the body of the pipe fitting.

4.2 Let go of the jaw and then actuate the trigger on the pressing tool.

4.3 Press the lever on the tool and release it.

4.4 Actuate the trigger on the pressing tool.

4.5 Keep the trigger pressed until the pressing cycle has finished.

4.6 Push the rear end of the pressing jaws together to open the jaws and remove the pressed fitting.

6.15 Use of battery run Klauke pressing tool code 133980 for Pexal pipe ø 16-20-26-32

1. Turn and press the lock pin to insert the pressing jaw into the pressing tool.

2. A spring will automatically push the lock pin open.

3. Insert the jaw into place and push the lock pin down to block the jaw.

4. Push the rear end of the pressing jaw together to open the jaws and insert the fitting to be pressed.

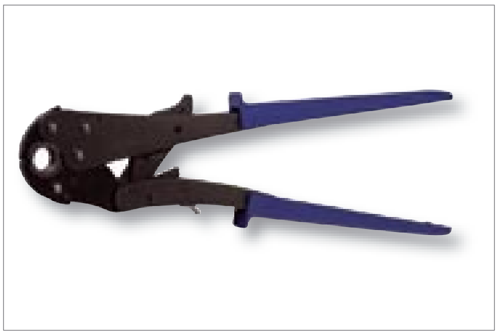
4.1 Position the pressing tool so that the pressing jaw is right up against the fitting body.

4.2 Release the rear end of the jaw and press the trigger on the pressing tool.

4.3 Keep the trigger pressed until the pressing cycle has finished.

4.4 Push the rear end of the pressing jaws together to open the jaws and remove the fitting.

6.16 Use of manual pressing tool code 133957 for Pexal pipe ø 16-20



1. To open the pressing tool it must first be completely closed. Once completely closed it will open automatically.

2. Position the two inserts (ø 16/20) depending on the diameter to be pressed.

2.1 Press the lever positioned over the head of the jaw and position the first insert. Release the lever when the insert is in position.

2.2 Repeat the operation with the other insert

3. Insert the fitting in the pressing position, placing the jaw against the wall of the fitting.

4. Press the fitting by closing the ends of the tool.

4.1 To facilitate the operation actuate the chrome lever near the closing levers. The pressing tool will not open until the pressing operation has been completed.

4.2 Extract the connection pressed by the tool.

6.17 Pressing operation with insert and jaw for ø 40-50-63

1. Insert the base jaw for the diameters (40-50-63) in the relative housing of the pressing machine (as described in the previous paragraph).
2. Position the jaw insert on the fitting and tighten on the pipe by turning the relative release/locking device **so that the press jaw comes into contact with the while seal** (FIG. 1).
3. Insert the base jaw in the relative slot pressing on the ends of the jaw itself. Release the jaw and check that the insert fits correctly inside the relative housing (FIG. 2-3).
4. Press the fitting by activating the pressing machine. Keep pressed until the pressing operation has been completed. Adjust the ends of the jaw to extend the grips and withdraw from the insert and then remove the insert from the pipe.

FIG. 1

FIG. 2

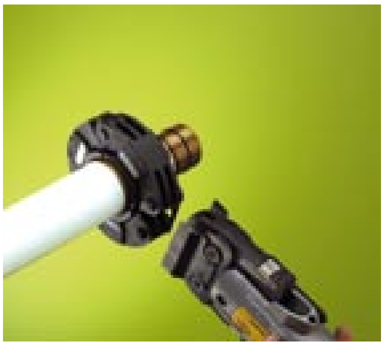
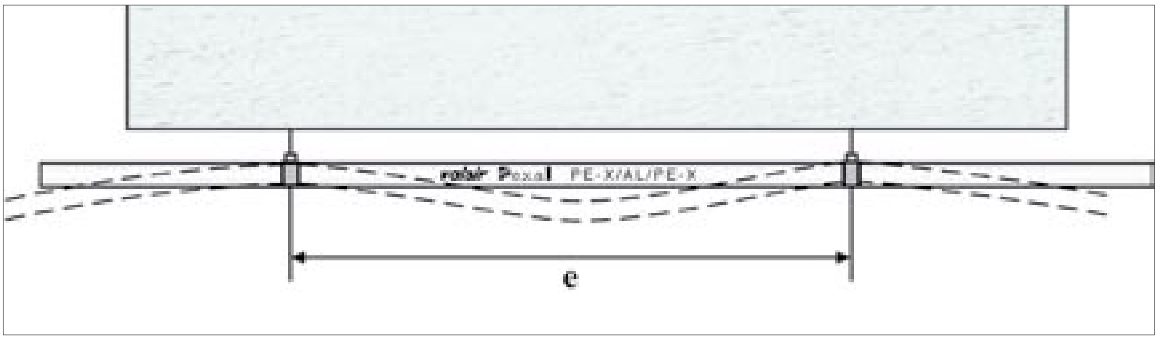


FIG.3

6.18 Fixing the pipe with clips

The Pexal pipe is fixed with the use of suitable clips, with diameters that range from ø 14 to ø 63; they are equipped with a plastic 8 mm anchor. Recommended spacings have been established between one clip and the next, as shown in the table, to prevent the pipe sagging between clips (due to expansion) as shown in the figure.



N.B. The clips should be left slightly open to prevent unnecessary strain on the pipework due to expansion and contraction.

Recommended support spacing

DIAMETER	e (mm)	SCREW	ANCHOR	VALSIR CODE
14	750	M8x100 mm	ø 10x50 mm	**108014**
16	1000	M8x100 mm	ø 10x50 mm	**108016**
18	1100	M8x100 mm	ø 10x50 mm	**108018**
20	1250	M8x100 mm	ø 10x50 mm	**108020**
26	1500	M8x100 mm	ø 10x50 mm	**108026**
32	2000	M8x100 mm	ø 10x50 mm	**108032**
40	2250	M8x100 mm	ø 10x50 mm	**108040**
50	2500	M8x100 mm	ø 10x50 mm	**108050**
63	2750	M8x100 mm	ø 10x50 mm	**108063**

6.19 Acoustic insulation of Pexal and Mixal systems

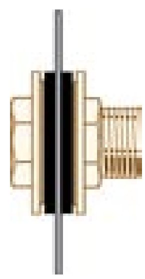
Despite the fact the Pexal pipe has excellent sound-absorbing properties, the connection of fittings to fixed structures can transmit vibrations to the construction, thus generating noise. For this reason, Valsir has designed fittings with plastic seals which do not transmit vibrations to the structures therefore overcoming the possibility of noise. The pipe clips are also fitted with a rubber seal which isolates the wall on which the clip is fixed from the pipe's vibrations. The use of insulators or sheaths on the pipe increases the sound-absorbing capacity of the system.

Sound-proofing apparatus for the pipe

CODE	DESCRIPTION	DIAMETER
823038	Straight, flanged fitting for plumbing structures complete with anti-vibration seal.	F3/8” x F3/8”
823042	Squared, flanged fitting for plumbing structures complete with anti-vibration seal.	F1/2” x F1/2”
825028	Straight fitting for plumbing structures complete with anti-vibration seals, washers and nut.	F3/8” x M3/8”
825022	Straight, flanged fitting for plumbing structures complete with anti-vibration seal.	F1/2” x M1/2”
825039	Squared, flanged fitting for plumbing structures complete with anti-vibration seal.	F3/8” x M3/8”
825045	Straight fitting for plumbing structures complete with anti-vibration seals, washers and nut.	F1/2” x M1/2”






6.20 Multilayer pipe for air-conditioning systems

For air-conditioning systems we recommend the insulated pipe with 10 mm thickness code 100461 (16x2), code 100463 (16x2.25), code 100465 (20x2), code 100467 (20x2.5), code 100469 (26x3).

Before a pipe can be used in air-conditioning systems (e.g. fan coil or fan convectors), it must satisfy the following technical requirements:

1. The pipe must not form condensation: this requirement is guaranteed in the case of the Pexal and Mixal pipe by the lining that is formed by high-density closed-cell polyethylene and by the manufacturing process that ensures the lining is joined perfectly to the pipe. In this way the formation of gaps is avoided that negatively effect the thermal conductivity and with the possible formation of stagnant condensation on the outside wall of the pipe.

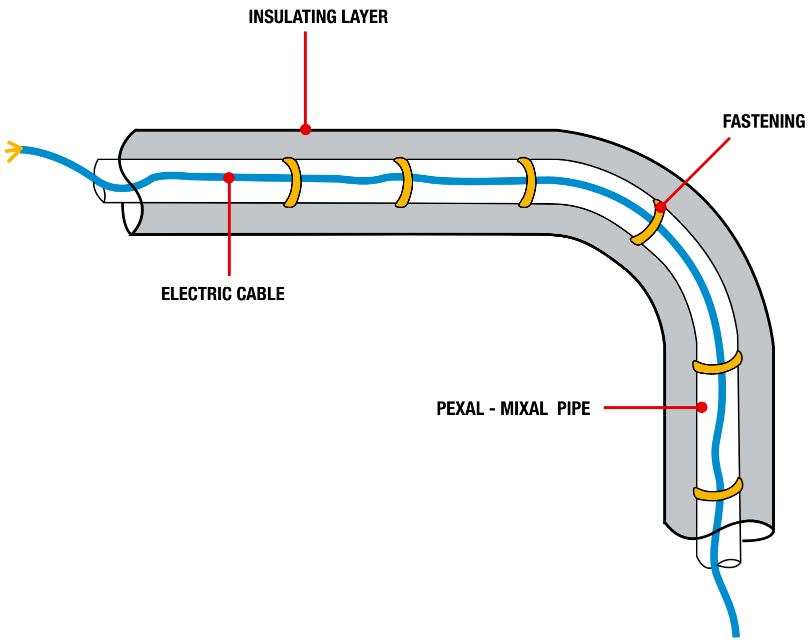
2. The maximum operating conditions must not exceed the conditions permitted by the pipe: operating range from 0°C to 95°C and a maximum pressure of 10 bar. In the case of air-conditioning, water at a temperature of approximately 7°C and a pressure of 1-1.5 bar is used, therefore the operating range of the system comes within the performance limits of the Pexal pipe.

3. The fluid used must be water and at any rate a fluid that is not aggressive for the system. The fluid used is generally water in the case of a fan coil unit or fan-convector application; a mixture of water and ethylene glycol is however accepted (which enables the fluid temperature to be decreased without solidifying).

We do not recommend using the system to transport cryogenic fluids adopted in refrigerator plants (cooling or freezing plants) for example the various types of freon (HFC, HCFC) or ammonia, both because they can be aggressive for the system and also because the insulating lining is not sufficiently thick for such applications.

6.21 Trace heating

This is a heating system that uses an electric cable fixed along the full length of the pipe carrying water. The electric current flowing in the cable generates heat, which is transferred to the pipe to heat the water. The Pexal and Mixal pipe can be used for this application since the aluminium layer guarantees uniform distribution of the heat over the entire surface of the pipe. The electric cable fixed to the pipe must not exceed a temperature of 80 °C. The pipe and electric cable, fixed to each other, must be protected with a minimum insulation layer of 10 mm.



6.22 Installation guidelines for the Pexal and Mixal pipe system

It is advisable to adopt a number of recommendations when installing a plumbing and heating system with the Pexal and Mixal pipe:

1. Pipes installed in wall masonry chases or under the floor must be laid in a straight and orderly layout, one line adjacent to the next. Crossovers must be anchored to each other. It is important to protect the pipes installed under the floor from being accidentally crushed: avoid positioning excessively heavy weights over the pipes, protect the points where passing of persons could cause the pipe to be crushed or where there is a danger of heavy objects falling.

2. When installing the pipes in masonry it is advisable to protect them using a corrugated pipe or insulating material (to protect and compensate the effects of expansion). Valsir proposes using the insulated pipe (see table).

3. We always recommend protecting the brass fittings with heavy paper or insulating tape, to avoid them being attacked by chemical agents contained in the wall plaster. Some types of cement mortar can be particularly corrosive and cause the brass fitting, or a part of it, to oxidise, thus causing leakages over time. In this case the brass fitting must be completely insulated with a suitable material that prevents contact between the cement or with other oxidising agents.

4. Do not use excessive quantities of hemp for threaded pipe fittings that could lead to breakages in the fitting. We recommend the use of Teflon tape or a suitable liquid sealing agent.

In the case of threaded fittings in PPSU the use of some liquid sealing agents could render the material fragile. Refer to the paragraph on compatibility on page 76 of this handbook or else the technical information of the liquid sealing agent given by the producer.

5. During installation the pipe must not be bent over a sharp edge. Neither in the floor chase or in the wall masonry chase, nor in recesses.

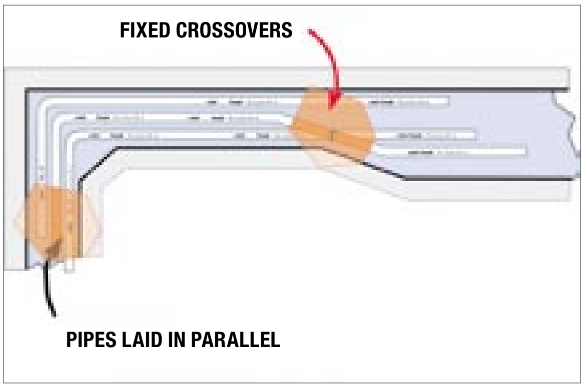
6. For surface mounting the pipe should be clipped as indicated in the chapter "Fixing of pipes with clips".

7. For the purposes of connecting flush cisterns, Valsir produces special male and female bends with a counter-nut, which can be fitted to all cistern types, including those not produced by Valsir.

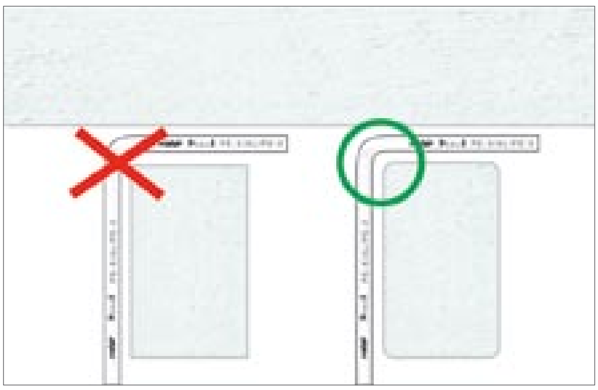
8. When connecting the pipe to sanitary appliances, it is advisable to use wall-mounting plates onto which special flanged fittings are fixed. These plates can be anchored to the wall using screws or cement.

9. If a plumbing or heating system is carried out with manifolds, it is possible to use the range of Valsir products which includes manifolds, brackets, in-wall cabinets for the manifolds.

Correct laying of pipes in chases



Pipe bends in chases or in the open



Insulated pipe in coils

	CODE	Ø	mt.	COLOUR	INSULATION THICKNESS
Pexal	**100201**	14x2	50	RAL 9003 (white)	6
	100205	16x2.25	50	RAL 9003 (white)	6
	100213	20x2.5	50	RAL 9003 (white)	6
	100217	26x3	50	RAL 9003 (white)	6
	100219	32x3	25	RAL 9003(white)	6
	100207	16x2	50	RAL 9003 (white)	6
	100209	18x2	50	RAL 9003 (white)	6
	100215	20x2	50	RAL 9003 (white)	6
	100461	16x2	50	(blue)	10
	100463	16x2.25	50	(blue)	10
	100465	20x2	50	(blue)	10
	100467	20x2.5	50	(blue)	10
	100469	26x3	50	(blue)	10
Mixal	**100237**	16x2	50	RAL 9003 (white)	6
	100239	20x2	50	RAL 9003 (white)	6

Fittings complete with nuts

CODE	Ø
820136	F 3/8” x M 3/8”
820137	F 1/2” x M 1/2”
820139	F 3/8” x F 3/8”
820140	F 1/2” x F 1/2”

Anchoring plates

CODE	L (mm)
106018	180*
106028	280*
106118	180**
106128	280**

*For Pexal Easy press fittings

**For compression fittings

6.23 Chemical resistance of Pexal and Mixal pipes

In compliance with the ISO/TR 10358:1993 Standard, the external layer (Pe-Xb or HDPE) of the pipe can come into contact with chemical compounds (in the concentrations and temperatures indicated).

Painting or washing the external layer of the pipe with detergents is permitted, provided the chemical composition of the paints or detergents used is compatible with the characteristics detailed in the table detailed in the Appendix "A" on page 76.

6.24 Protection of Pexal Easy fittings from UV rays

The Pexal Easy system has a reduced resistance to UV rays. Prolonged exposure to UV rays will discolour the fitting, turning it yellow; even though this has no significant effect on the mechanical characteristics or the performance of the fitting, in the case of surface mounting, it could represent a problem of an aesthetical nature. To protect the Pexal Easy pipes and fittings, Valsir S.p.A. suggests using a special paint (code 162475) and relative thinner (code 162479). These products have been studied and created by Valsir in collaboration with a leading company in the paint sector.

<table>
<tr><th colspan="2">TECHNICAL CHARACTERISTICS AND USE</th></tr>
<tr><th colspan="2">ANTI UV PAINT CODE 162475</th></tr>
<tr><td>COMPOSITION</td><td>Xylene, mix of isomers (contains epoxy resins).</td></tr>
<tr><td>DESCRIPTION</td><td>Primer and final coat.</td></tr>
<tr><td>APPLICATION FIELD</td><td>The product has been developed for painting pipes and fittings in plastic.</td></tr>
<tr><td>BINDER</td><td>Modified alkylic resin.</td></tr>
<tr><td>PRINCIPAL CHARACTERISTICS</td><td>- Good adhesion to PP-R, PPSU, PE-X.
- Significant resistance to atmospheric agents and UV rays.
- Can be painted over with any paint or enamel.</td></tr>
<tr><td>TECHNICAL CHARACTERISTICS</td><td>- Dry residue: 44%±3
- Density: 1200 g/l ± 30
- Colour: grey
- Brightness 3÷6 glass a 60°</td></tr>
<tr><td>PREPARATION OF THE MIX</td><td><table><tr><th>COMPONENT</th><th>MIXING RATIO %</th></tr><tr><td>Paint</td><td>100</td></tr><tr><td>Thinner</td><td>20÷30</td></tr></table>
N.B. The product does not require catalysis</td></tr>
<tr><td>APPLICATION</td><td>- The product is applied with a brush, roller or spray after the surface to be painted has been carefully cleaned with thinner code 162479.
- The dilution ratio of the paint should be equal to 20÷30 % with a suitable thinner code 162479.
- The diluted product must be applied at least twice. Wait at least 4 hours before applying a second coat of paint.
- The product dries slowly in order to guarantee maximum adhesion to the surface. It is recommended not to use the product until the film has dried completely (about 2 days).
- The paint will wear over time; regular maintenance is therefore necessary.</td></tr>
<tr><td>WARNINGS</td><td>- Inflammable product, harmful if inhaled, avoid contact with the skin, irritates skin.
- Store the can in a ventilated place, away from foodstuffs, animal feed or drinks.
- Keep away from naked flames or sparks, do not smoke in the vicinity, avoid accumulation of electrostatic loads.
- Use suitable protective clothing.</td></tr>
<tr><td>PACKAGE</td><td>1 Kg</td></tr>
</table>

TECHNICAL CHARACTERISTICS AND USE	
THINNER FOR ANTI UV PAINT CODE 162479	
COMPOSITION	Xylene, mix of isomers.
DESCRIPTION	Polyurethane synthetic thinner.
APPLICATION FIELD	Dilution of paints, destined for applications on critical plastic surfaces.
TECHNICAL CHARACTERISTICS	- Dry residue: 0% - Density: 895 g/l ± 15 - Colour: transparent
APPLICATION	- Used for the dilution of paint. - The thinner for anti UV paint is also recommended for cleaning the surface before applying the paint.
WARNINGS	- Inflammable product, harmful if inhaled, avoid contact with the skin, irritates skin and eyes. Repeated exposure can cause dry and cracked skin. - Store the can in a ventilated place, away from foodstuffs, animal feed or drinks. - Keep away from naked flames or sparks, do not smoke in the vicinity, avoid accumulation of electrostatic loads. - Use suitable protective clothing.
PACKAGE	1 Kg

6.25 System pressure testing

Following installation, the system must be flushed out.
The system must be pressure tested before final plastering in accordance with the applicable regulations in force in each country.

ITALIAN REGULATIONS:

- **UNI 5364 Standard** "Hot water heating systems" point 3.1.8 establishes that "the system inspection must include a seal test, by pressurising the complete system to a pressure value exceeding 1 Kg/cm^3 compared with the pressure rating corresponding to normal operating conditions, maintaining this condition for 6 consecutive hours".

- **UNI 9182 Standard** "Hot and old hot supply and distribution systems" establishes that the system inspection must include hydraulic seal tests.

- **Point 27.2.1 Cold hydraulic test**
  This test must be performed on the complete cold and hot water distribution system before the tap fittings are mounted and before the rooms, recesses, false ceilings etc.. are sealed, maintaining the pipes are a pressure of 1.5 times the maximum operating pressure with a minimum of 600 Kpa for no less than 4 consecutive hours. If the pressure gauge indicates the initial pressure value at the end of the test with a tolerance of 30 Kpa, the test is passed. Tests on system segments are allowed.

- **Point 27.2.2 Hot hydraulic test**
  The test refers exclusively to centralised hot water distribution systems. The test must be performed at the operating pressure, after putting the hot water production system into operation, for no less than two consecutive hours, at an initial temperature value that is at least 10°C higher that the maximum temperature value reached during normal operating conditions. The test is designed to assess the effects of thermal expansion on the pipes. The visual inspection of the effects on the accessible parts and the indirect determination on the inaccessible parts must verify the unrestricted movement of the pipes (in particular at masonry work junctions, without damaging the structures in question) and the absence of water leakages.

FOREIGN REGULATIONS:
Perform the system test in compliance with the provisions established by the regulations in force.

7.1 Pressure drop calculation

The calculation of continuous pressure drops (that is due to friction of the water on the pipe walls) can be performed using the 3 diagrams shown below, that supply the pressure drops based on the temperature of the water. By using the chart, it is possible to make an approximate calculation of the flow rate within the pipe.
A more accurate calculation of the size is possible by dividing the flow rate value by the internal cross-section of the pipe. In general, the flow rate of the water inside the pipe should not exceed 2 m/s for diameters 16-20-26 and 3/3.5 m/s for diameters 32-40-50-63 (incidents of flow noise could be produced) and in any event a pipe is correctly sized if the pressure losses do not exceed 10-15% of the supply pressure. In view of the above, the diagram mentioned can be used to calculate the correct pipe diameter for transporting a given flow rate.

EXAMPLE 1: Calculation of the continuous pressure losses in pipework.

Calculate the pressure drop of a Pexal pipe ø 20x2.5, 15 m long, flow rate of cold water 9 l/min (approximately 0.54 m^3/h).

For this purpose, the pressure drop chart with water temperature at 10 °C is used. The axis showing the flow rate values corresponding to 9 l/min is considered and made to intersect the downward sloping straight line applicable to the pipe ø 20x2.5. A value of 7.5 mbar/m can then be read on the vertical axis.
Therefore, the total pressure loss is:

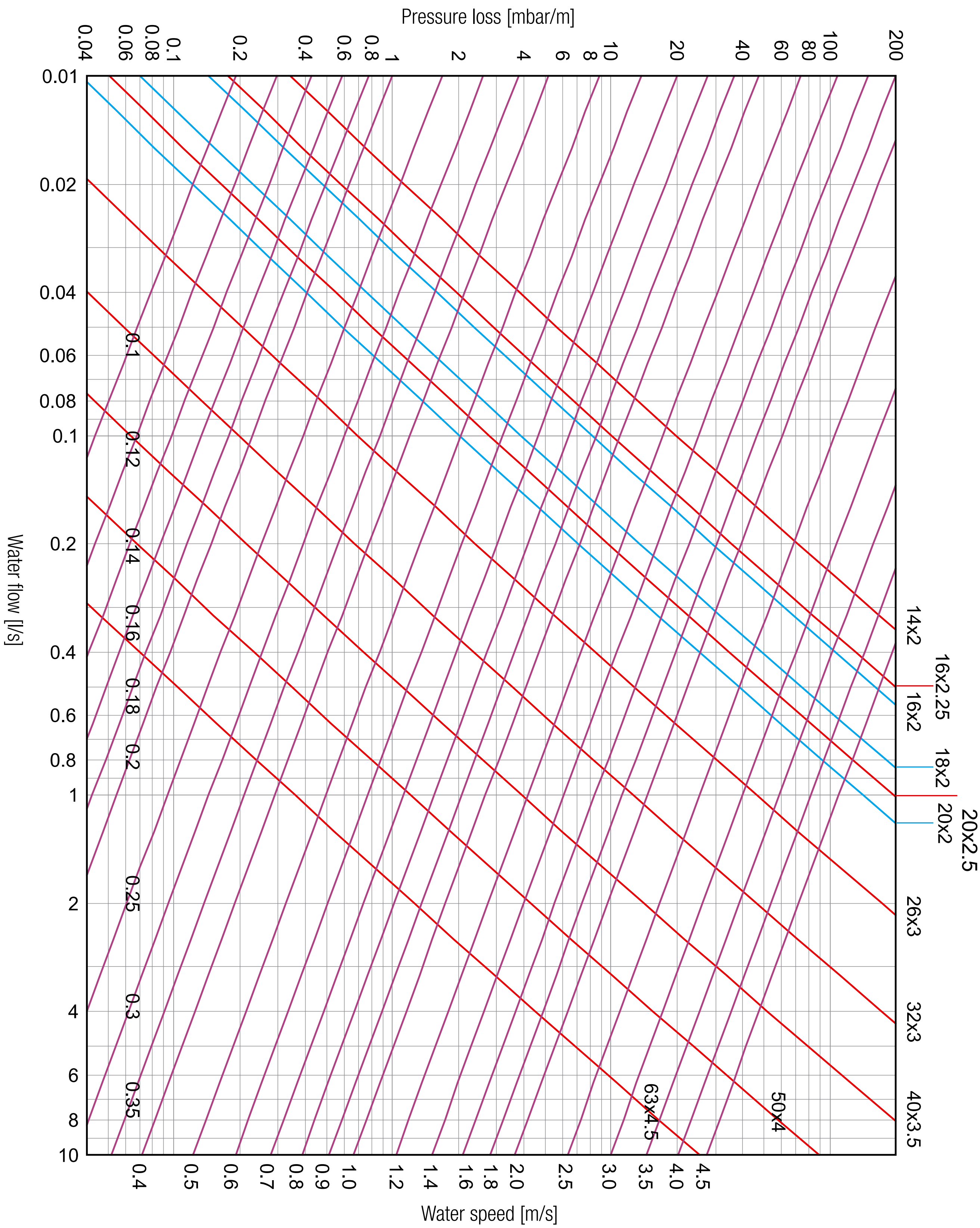
Δp = 7.5 mbar/m x 15 m =112.5 mbar

If the supply pressure of the Pe pipe is, for example, 4 bar, the exit pressure Pu will be:

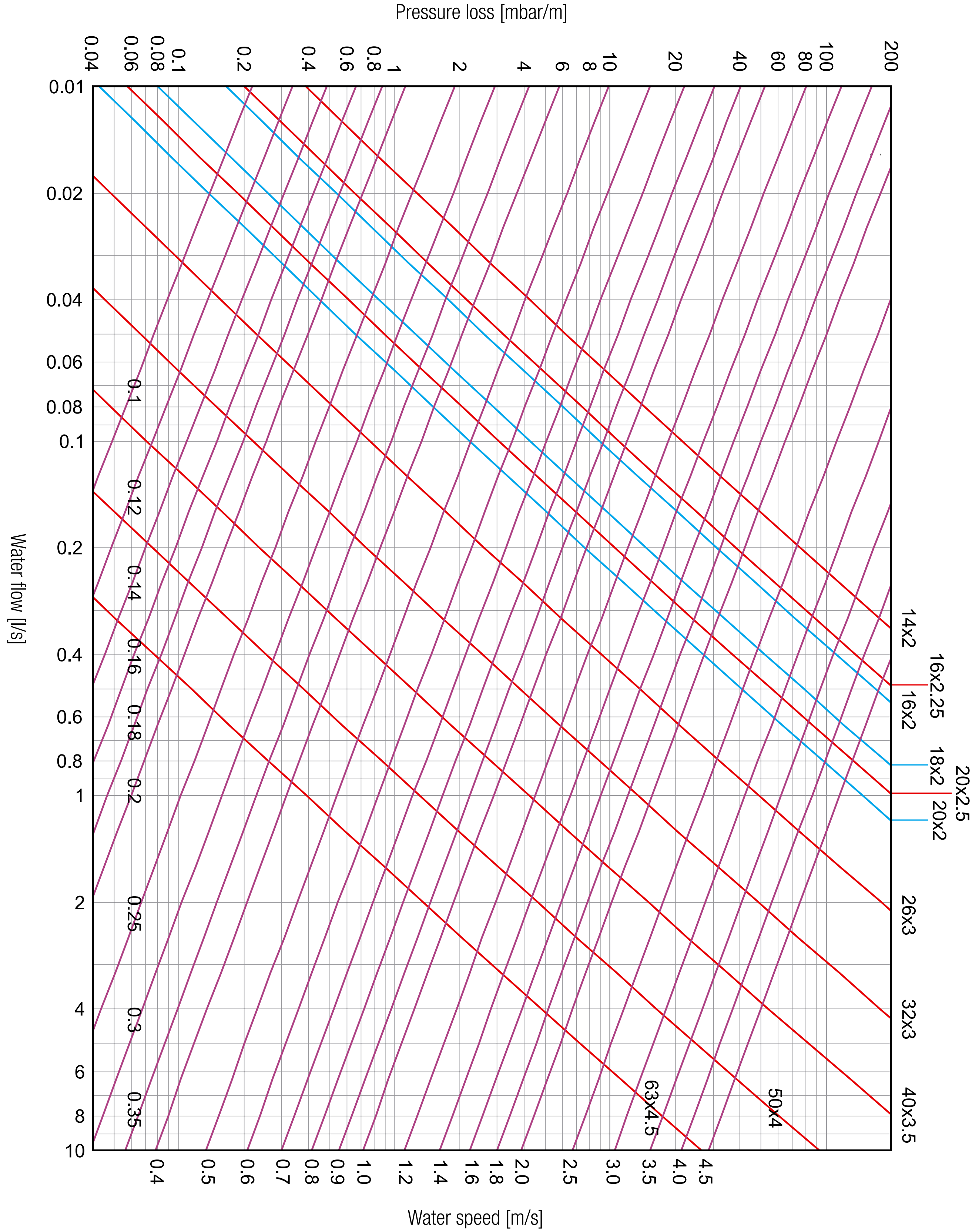
Pu = Pe-Δp = 4-0.1125 = 3.8875 bar

From the diagram the flow rate of the water is 0.8 m/s

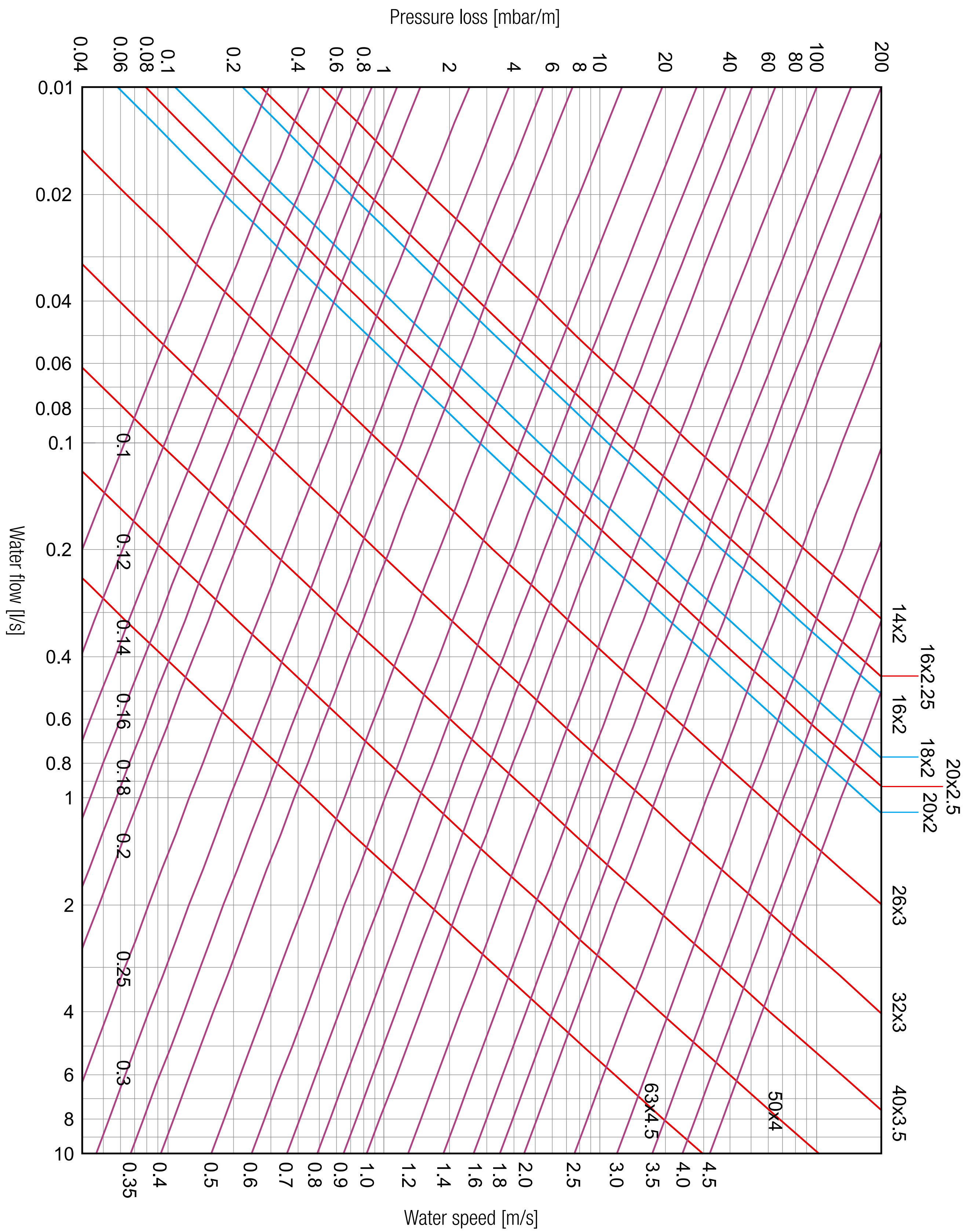
Temperature of water 80 °C



Temperature of water 50 °C

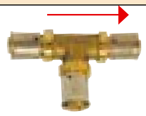
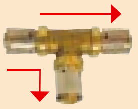
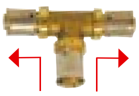
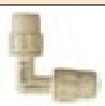
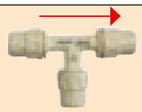
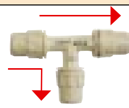
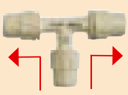


Temperature of water 10 °C



7.2 Localised pressure drops

Localised pressure drops (at a bend in the pipe or at any pipe fittings), can be calculated using the table shown below.

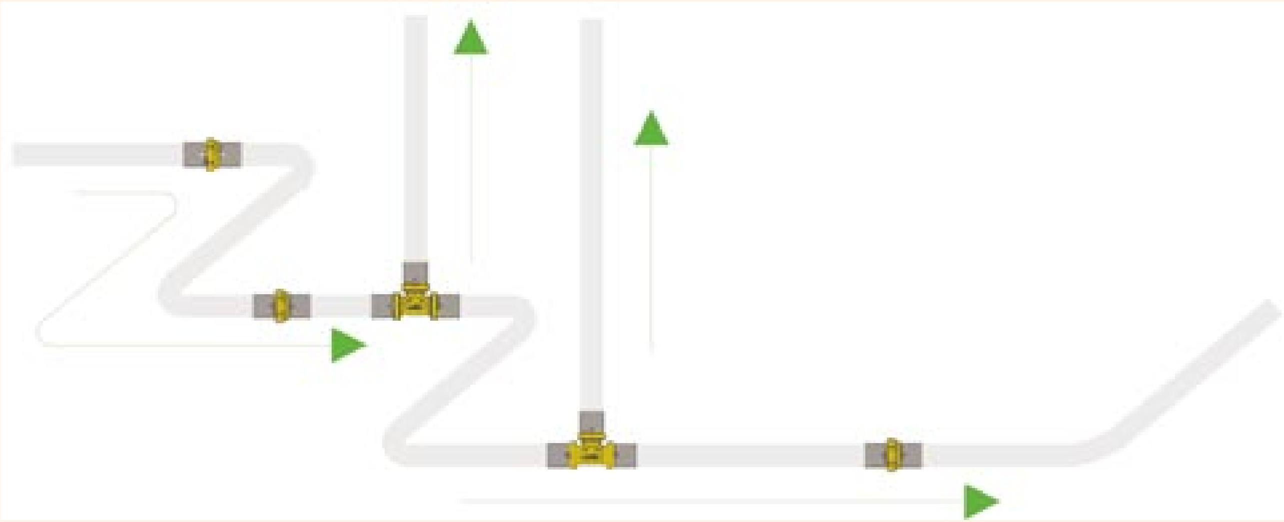
PIPE DIAMETER			14x2	16x2.25	16x2	18x2	20x2.5	20x2	26x3	32x3	40x3.5	50x4	63x4.5
	EQUIVALENT PIPE LENGTH IN METERS												
Mixal Pexal	Pipe bend		0.75	0.65	0.63	0.60	0.55	0.54	0.50	0.55	0.45	0.48	0.50
	90°Bend		1.8	1.05	1.4	1.3	0.84	1.1	1.05	0.95	1.15	1.15	1.2
	90° T-fitting		1.5	0.87	1.0	0.9	0.52	0.73	0.62	0.58	0.55	0.65	0.7
	90° T-fitting		1.75	1.08	1.53	1.50	1.01	1.44	1.4	1.3	1.2	1.2	1.1
	90° T-fitting		1.9	1.15	1.50	1.35	0.88	1.24	1.2	1.1	1.25	1.3	1.25
	Straight fitting		1.15	0.6	0.80	0.75	0.48	0.65	0.25	0.2	0.35	0.45	0.50
Pexal easy	90°Bend		1.0	0.7	0.65	0.6	0.4	0.3	0.25	0.20	0.3	0.3	-
	90° T-fitting		0.6	0.4	0.30	0.25	0.25	0.2	0.15	0.10	0.10	0.15	-
	90° T-fitting		0.65	0.5	0.45	0.4	0.4	0.35	0.35	0.30	0.30	0.30	-
	90° T-fitting		1.1	0.7	0.53	0.5	0.5	0.4	0.4	0.35	0.35	0.35	-
	Straight fitting		0.5	0.3	0.16	0.15	0.15	0.15	0.15	0.15	0.15	0.15	-

The pressure drops of the compression fittings are comparable to those of the crimp fittings.

The values are expressed in equivalent pipe meter length. To calculate the total pressure drops of the circuit, it is necessary to sum the continuous pressure drops for each pipe section and the localised pressure drops. To do so, it is sufficient to sum the equivalent meters of pipe due to the presence of pipe fittings or bends along the pipe with the actual length of a given pipe. This sum must then be multiplied by the unit pressure drop expressed in mbar/m derived from the diagram.

EXAMPLE 2: Calculate the total pressure drops of a horizontal pipework

Calculate the pressure drop for Pexal pipe ø 20x2.5 length 20 m as shown in the figure, containing 5 90° bends, 2 90° T fittings with a follow-up flow stream and 3 straight intermediate fittings. The flow rate transported is 0.3 l/s.



PIPE	BEND	T	STRAIGHT	TOTAL
20 m	0.55x5 m	0.75x2 m	0.70x3 m	26.35 m

A unit pressure drop of 26 mbar/m is obtained by using the diagram with a water temperature of 10°C, and considering the horizontal axis with 0.3 l/s corresponding to the straight line applicable to ø 20x2.5. The total pressure drop for the pipe is then:

Δp_{tot} = 26 mbar/m x 26.35 m = 685.1 mbar

The exit pressure is given by considering the inlet pressure and subtracting the total pressure drops of the pipe. If the pipe is positioned vertically, 1 bar must be subtracted or added for every 10 m of vertical length of the pipe (depending on whether the exit is higher or lower than the inlet) in order to calculate the exit pressure of the pipe.

7.3 Calculation of expansion

As already mentioned, the multilayer pipe has a thermal expansion which is very close to the thermal expansion value of a metal pipe, due to the presence of the aluminium layer and adhesive which force the PE-X layers to follow the expansion of metal pipes. The following table provides a comparison between the thermal expansion coefficients of the pipe and other materials.

The thermal expansion of the Pexal multilayer pipe can be calculated in two ways:
1. By using the following formula:

$\Delta l = \alpha \times L \times \Delta t$

where:
L = Pipe length expressed in m.
ΔL = Pipe expansion expressed in mm.
α = Expansion coefficient of the material expressed in mm/(°C m).
Δt = Difference between the operating temperature and the temperature at the time of installation expressed in °C.

EXAMPLE 3: Calculation of the expansion of a Pexal pipe by using the formula

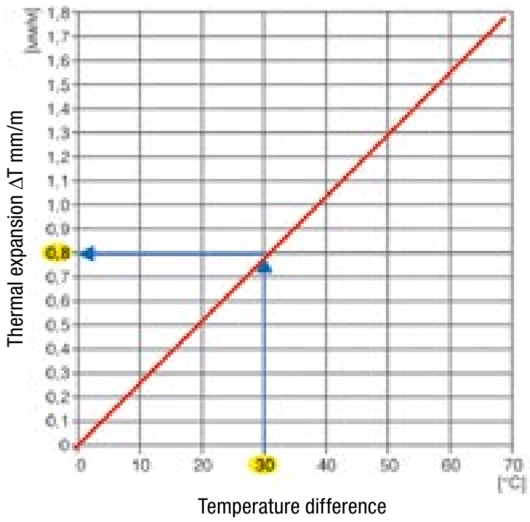
Calculate the expansion of 15 m of Pexal pipe ø 20 x 2.5 at an operating temperature of 50 °C, laid at a temperature of 20°C.

$\Delta L = 0.026 \times 15\ (50-20) = 11.7$ mm

2. Furthermore, it is possible to determine the pipe expansion by using the chart that follows. An expansion value (in mm) can be read on the vertical axis per pipe meter length by considering the horizontal axis which shows the temperature difference between the operating temperature, and the temperature value at the time of installation and by intersecting the straight line on the chart. This last value must be multiplied by the length of pipe (expressed in mm) to calculate the actual expansion value.

Thermal expansion coefficient for different materials

Type of Pipe	Thermal expansion coefficent A [mm/ (°c m)]
Pexal-Mixal	0.026
Galvanised steel	0.012
Stainless steel	0.017
Copper	0.017
Plastic material (PE-X HDPE PPRC)	0.12-0.20

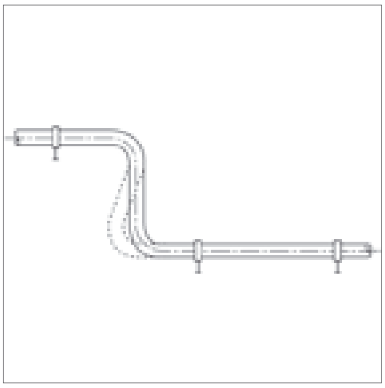


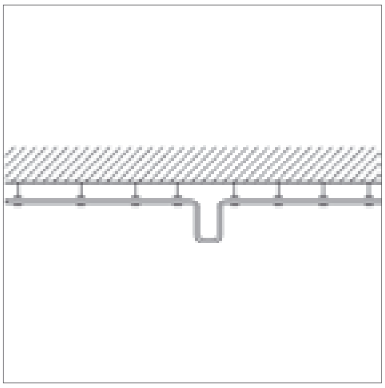
EXAMPLE 4: Calculation of the expansion of a Pexal pipe by using the diagram

Calculate the expansion of 15 m of Pexal pipe ø 20x2.5 with an operating temperature of 50 °C, laid at a temperature of 20°C.
The Δt value applied to the pipe is 50 – 20 = 30 °C.
An expansion value per meter length of pipe of approximately 0.8 mm/m can be read on the vertical axis by considering the value of 30°C in the graph and intersecting the straight line. Total expansion is given by:

$\Delta L = 15 \times 0.8 = 12$ mm

7.4 Compensation of the expansions and minimum pipe length





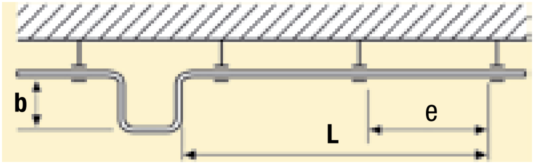
Despite the fact that the multilayer pipe has a limited expansion coefficient, heating and cooling undoubtedly causes the pipe to expand or contract. One compensation technique, in the case of pipes inside recesses, namely free to move, consists in leaving suitable omega-shaped loops in the straight sections. In the case of enclosed pipes or inside masonry, this problem can be overcome by insulating the pipe.

7.5 Calculation of the expansion loop length

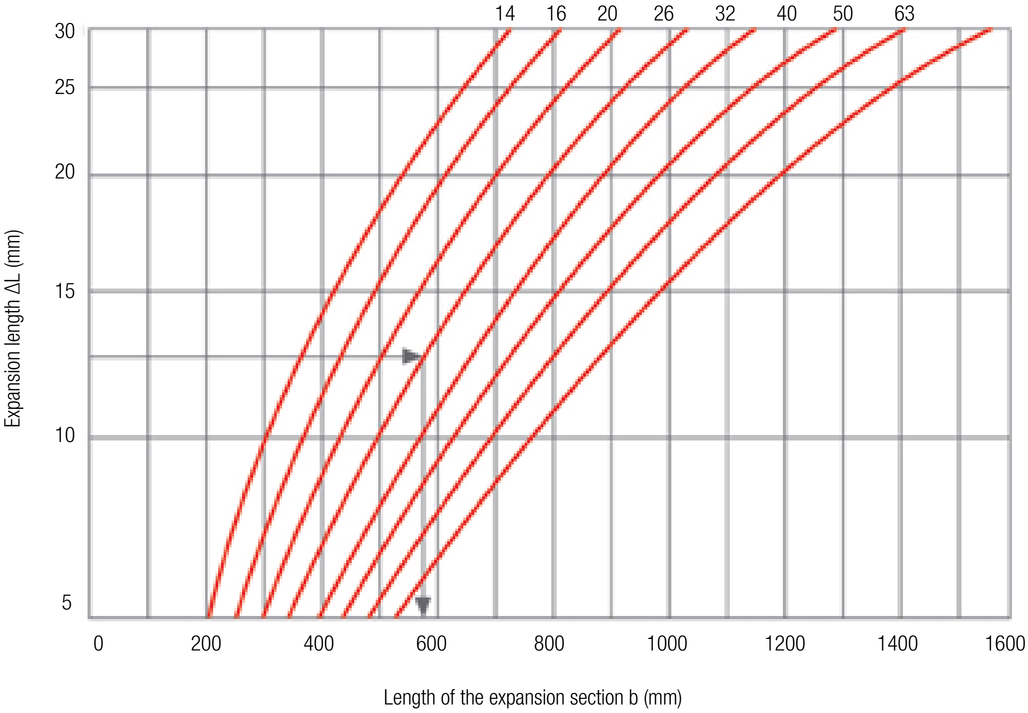
The length of the expansion loop can be obtained from the chart shown below, or can be calculated analytically by using the following formula:

$$\mathbf{b = K \times (ø \times \Delta L)^{1/2}}$$

Where:



b = Length of the loop
ø = external diameter of the multilayer pipe (in mm)
ΔL = expansion of the pipework (calculated as illustrated previously)
K = material constant (for the Pexal and Mixal pipe = 33)



EXAMPLE 5: Calculation of the expansion loop

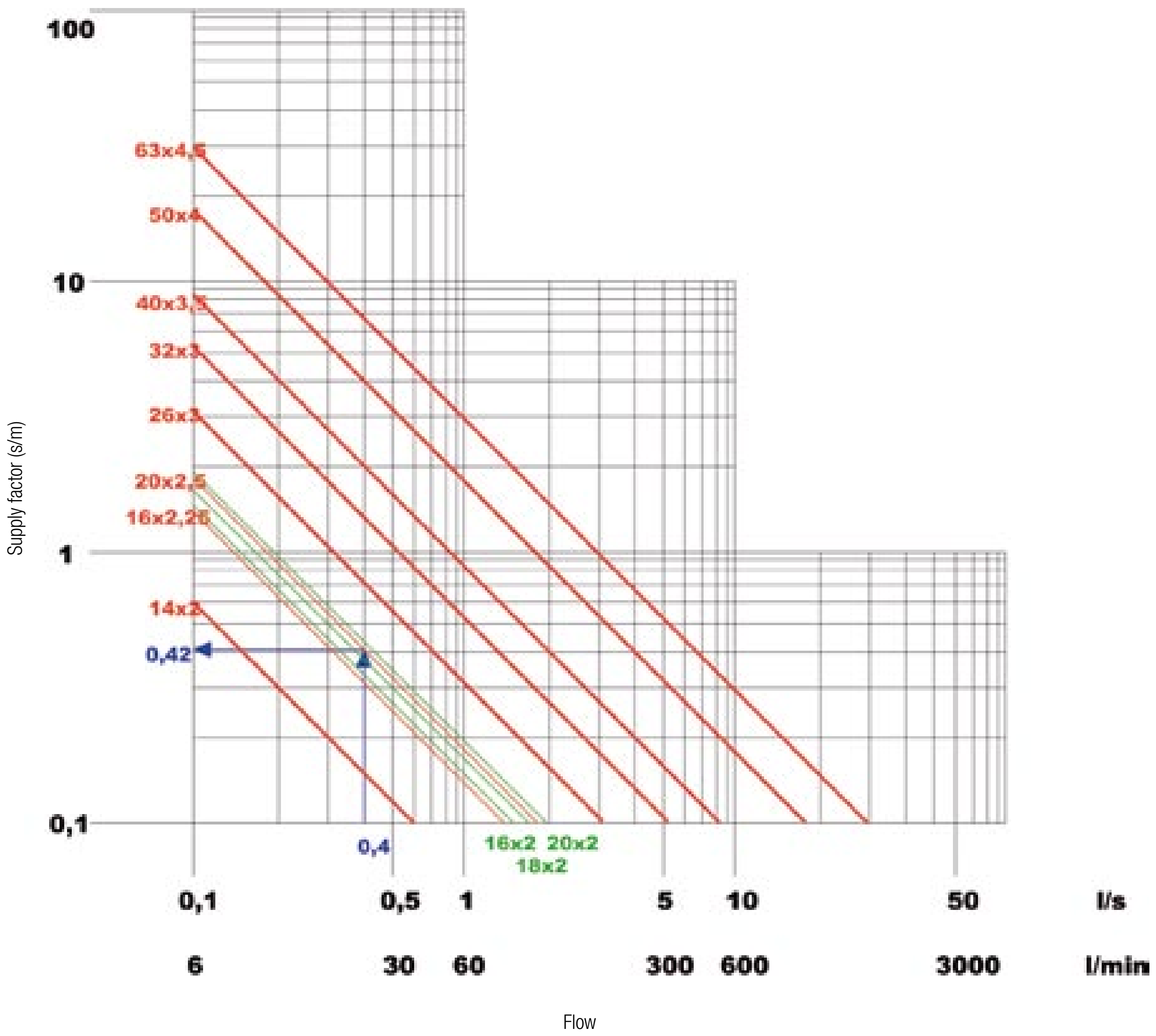
Calculate the length of the expansion loop for a Pexal multilayer pipe ø 26 length 8 m subjected to a temperature difference of $\Delta t = 60$ °C.

$\mathbf{\Delta L = \alpha \times L \times \Delta t = 0.026 \times 8 \times 60 = 12.5}$ **mm**

$\mathbf{b = 33 \times (26 \times 12.5)^{1/2} = 595}$ **mm**

7.6 Hot water supply time

In order to contain water consumption, the hot water supply time should be less than half a minute. Such time values depend on the flow rate used, on the pipe diameter and the distance between the hot water generator and the point of use. To calculate the supply time it is sufficient to use the following chart that provides the supply factor A ([s/m]), which, when multiplied by the length of the pipe, gives the time required to supply hot water.



EXAMPLE 6: Calculate the hot water supply time

Calculate the time required to supply a Pexal pipe ø 20x2.5 length 13 m and operating with a flow rate of 0.4 l/s.

Use the chart shown above, read 0.4 l/s on the horizontal axis corresponding to the inclined straight line applicable to the Ø 20 pipe; read the supply factor A on the vertical axis, corresponding to 0.42 s/m on the horizontal axis.
Multiply the value for A by the length of the pipe to obtain the supply time.

T erog.= A x L = 0.42 x 13 = 5.46 s

7.7 Comparison of pressure drops for different pipe materials

The materials used to manufacture pipes for the transport of fluids under pressure have different characteristics; once of these characteristics is the roughness of the pipe, that is, the presence of imperfections on the internal surface, caused by the nature of the material, which then generates a pressure drop and hence a reduction in the flow rate. It is therefore possible that two pipes made of different materials and with a different diameter may be capable of conveying the same flow rate.

Roughness of materials utilised to transport fluids under pressure

MATERIAL	ROUGHNESS (mm)
Pexal-Mixal	**0.007**
Copper	0.015
PP random	0.007
Galvanized steel	0.045
PE-X	0.007
Stainless steel	0.040

The following table shows a comparison of flows that can be supplied based on the pressure losses in the different types of pipe present on the market.

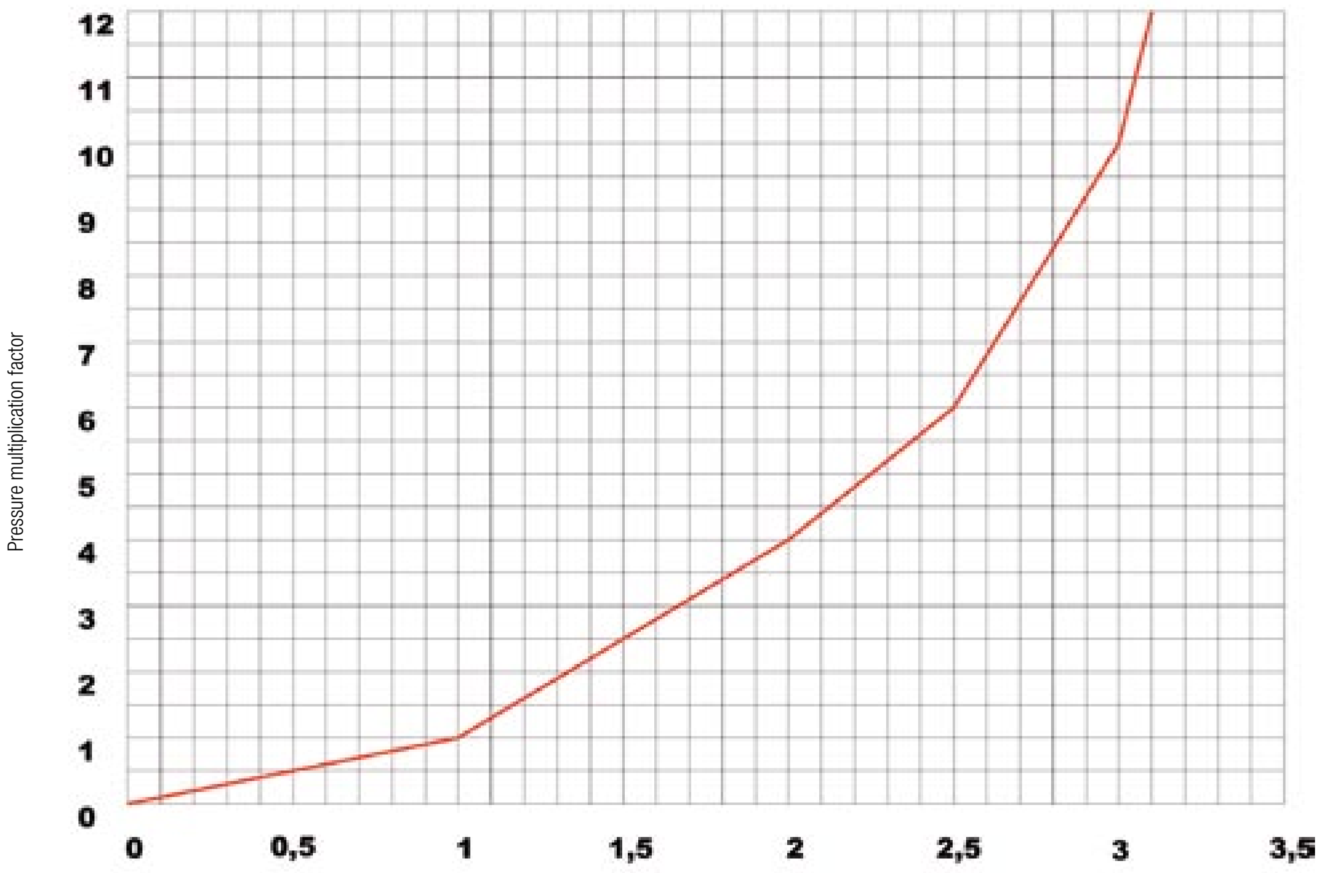
ACCEPTED FLOW RATE (l/s)	PEXAL MIXAL	PP RANDOM	PE-X (PN16)	COPPER	STAINLESS STEEL	GALVANIZED STEEL
0.10	-	-	12x2 (8)	12x1 (10)	12x1 (10)	-
0.12	14x2 (10)	-	14x2 (10)	-	-	-
	-		15x2.5 (10)	-	-	-
0.13	-	16x2.7 (10.6)	-	-	-	-
0.18	16x2.25 (11.5)	-	16x2.2 (11.6)	-	-	-
0.2	-	-	-	14x1 (12)	14x1 (12)	-
0.22	16X2 (12)	-	-	-	-	-
0.24	-	-	17x2.3 (12.4)	15x1 (13)	15x1 (13)	
0.26	-	20X3.4 (13.2)	-	16x1 (14)	16x1 (14)	-
0.33	18x2 (14)	-	-	-	-	-
0.35	-	-	20x2.8 (14.4)	-	-	-
0.38	20x2.5 (15)	-	-	18x1 (16)	18x1 (16)	1/2" (16.7)
0.42	20x2 (16)	-	22x3 (16)	-	-	-
0.45	-	25X4.2 (16.6)	-	-	-	-
0.58	-	-	-	22x1.5 (19)	22x1.5 (19)	3/4" (21.3)
0.65	26x3 (20)	32x5.4 (20)	28x4 (20)			
1.2	-	-	-	28x1.5 (25)	28x1.5 (25)	1" (27.4)
1.35	32x3 (26)	40x6.7 (26.6)	-	32x1.5 (29)	32x1.5 (29)	-
2	-	-	-	-	-	1"1/4 (36.1)
2.1	-	-	-	-	-	-
2.2	40x3.5 (33)	50x8.4 (33.2)	-	-	-	-
2.9	-	-	50x6.9 (36.2)	42x1.5 (39)	42x1.5 (39)	-
3.2	-	-	-	-	-	1"1/2 (42)
3.5	50x4 (42)	63x10.5 (42)	-	-	-	
5.5	-	-	-	-	-	2" (53.1)
6	63x4.5 (54)	-	75x10.4 (54.2)	-	-	-

N.B. The values between the brackets are the internal diameters expressed in mm.

7.8 Relationship between pressure and flow rate

Increasing the pressure inside the pipe causes the speed, and therefore the flow rate, to increase. The increase in the flow rate, however, is not proportional to the increase in pressure; the above occurs because the increase in the pressure drops also increase as the speed increases. The following chart shows a curve that represents the variation in the flow rate in relation to the increase in pressure.

Pressure – Flow rate trend



Flow rate multiplication factor

EXAMPLE 7

A Pexal pipe ø 20x2.5 conveys a flow rate of 0.25 m^3/h at 3.5 bar.
How much must the pressure inside the pipe increase to obtain a flow rate of 0.35 m^3/h?

Calculate the multiplication factor of the flow, equal to 0.35/0.25 = 1.4.
Use the chart corresponding to the multiplication factor for the flow rate value found and intersect this value with the curve, the pressure multiplication value is equal to 2.
Therefore, the pressure must be:

3.5 x 2 = 7 bar.

7.9 Sizing criteria for water distribution and heating networks

Nominal flow rates

It is necessary to consider the water flow rate required at each sanitary appliance to ensure the correct sizing of the water supply networks inside buildings. Reference is therefore made to nominal flow rates, namely the minimum flow rate that must be assured to tap fittings of each sanitary appliance.The calculation of flow rate Gt, is performed by summing the nominal flow rates of the sanitary appliances connected to the water distribution and heating network for hot and cold water(as detailed in the following example).

Nominal flow rates and minimum pressures

APPLIANCES	COLD WATER (l/s)	HOT WATER (l/s)	MINIMUM PRESSURE	
			(bar)	(m.w.c.)
Washbasin	0.1	0.1	0.5	5
Bidet	0.1	0.1	0.5	5
Pan with cistern	0.1	-	0.5	5
Pan with rapid flush	0.1	-	0.5	5
Pan with flow meter	1.5	-	1.5	15
Bathtub	1.5	0.2	1.5	15
Shower	0.2	0.15	0.5	5
Kitchen sink	0.15	0.2	0.5	5
Washing machine	0.2	-	0.5	5
Dishwasher	0.1	-	0.5	5
Controlled urinal	0.2	-	0.5	5
Continuous flow urinal	0.1	-	0.5	5

For the Pexal pipe, the acceptable total flow rates Gt (with cold water), considering a maximum water speed of 2 m/s for the diameters 16-20-26-32 and 3-3.5 m/s for the diameters 40-50-63.

TOTAL ACCEPTED FLOW RATES GT FOR THE PEXAL AND MIXAL PIPES											
Diameter	14x2	16x2.25	20x2.5	16x2	18x2	20x2	26x3	32x3	40x3.5	50x4	63x4.5
Di (mm)	10	11.5	15	12	14	16	20	26	33	42	54
Gt (l/s)	0.12	0.18	0.38	0.22	0.3	0.42	0.65	1.35	2.2	3.5	6

EXAMPLE 8: Calculation of the total flow rate Gt

Calculate the total flow rate Gt in a building where the following sanitary appliances are installed:
3 pans with cistern, 3 bidets, 3 washbasins, 3 showers, 3 sinks, 3 washing machines.
The calculation in performing by summing the nominal flow rates of the appliances installed.

APPLIANCES	NOMINAL FLOW RATE (l/s)		NUMBER OF APPLIANCES	MINIMUM PRESSURE	
	Cold	Hot		Cold	Hot
Pan with cistern	0.1	-	3	0.3	-
Bidet	0.1	0.1	3	0.3	0.3
Washbasin	0.1	0.1	3	0.3	0.3
Shower	0.15	0.15	3	0.45	0.45
Sin	0.20	0.20	3	0.6	0.6
Washing machine	0.10	-	3	0.3	-
Total flow rate Gt				**2.25**	**1.65**

The total flow rate required for the building considered is equal to 2.25 l/s for cold water and 1.65 l/s for hot water.

Project flow rates (Gpr)

The project flow rate Gpr, corresponds to the flow rate used as the basis to size the pipes of the distribution and heating systems. This value is obtained from the following graphs, starting from the total flow rate Gt (the sum of the nominal flow rates of the sanitary appliances installed). There is a reference chart for each type of building.

CHART 1

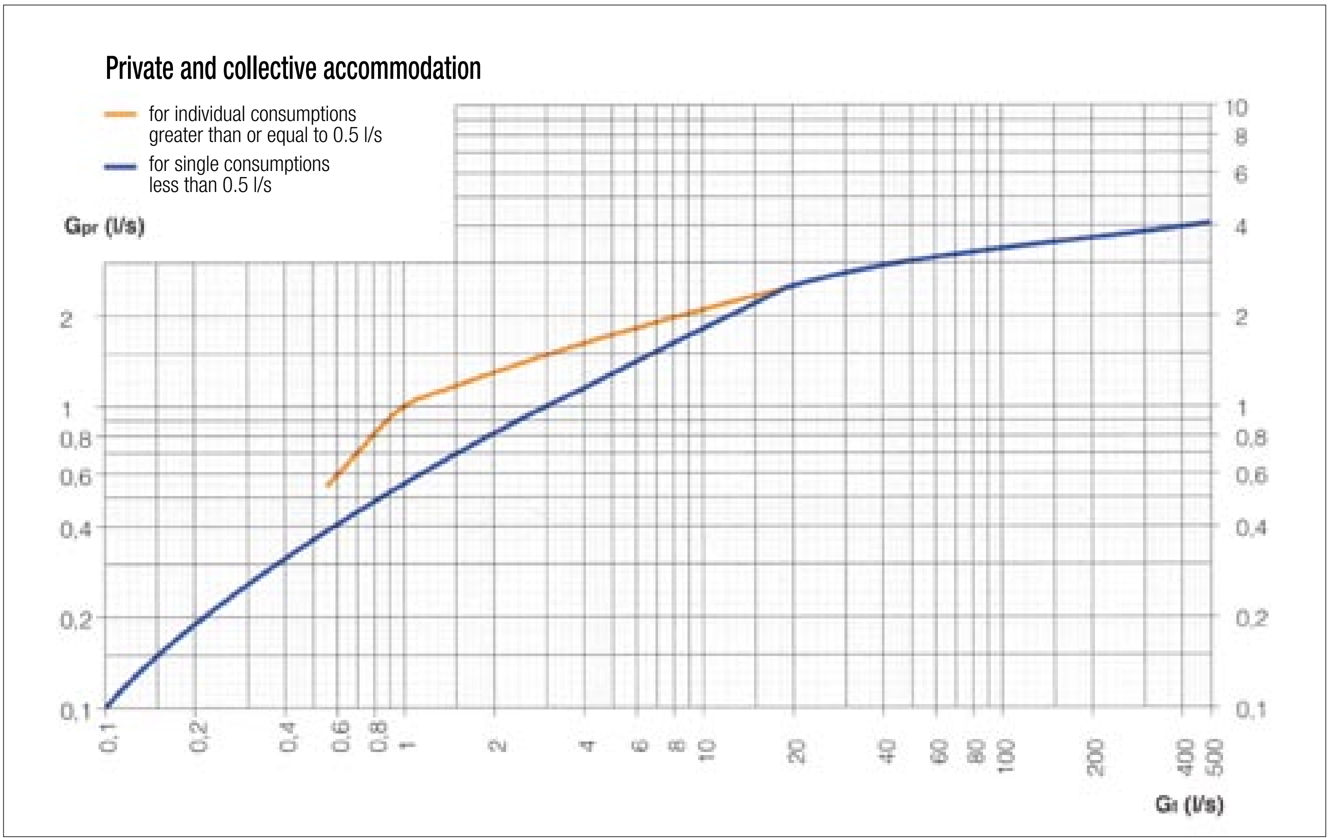


CHART 2

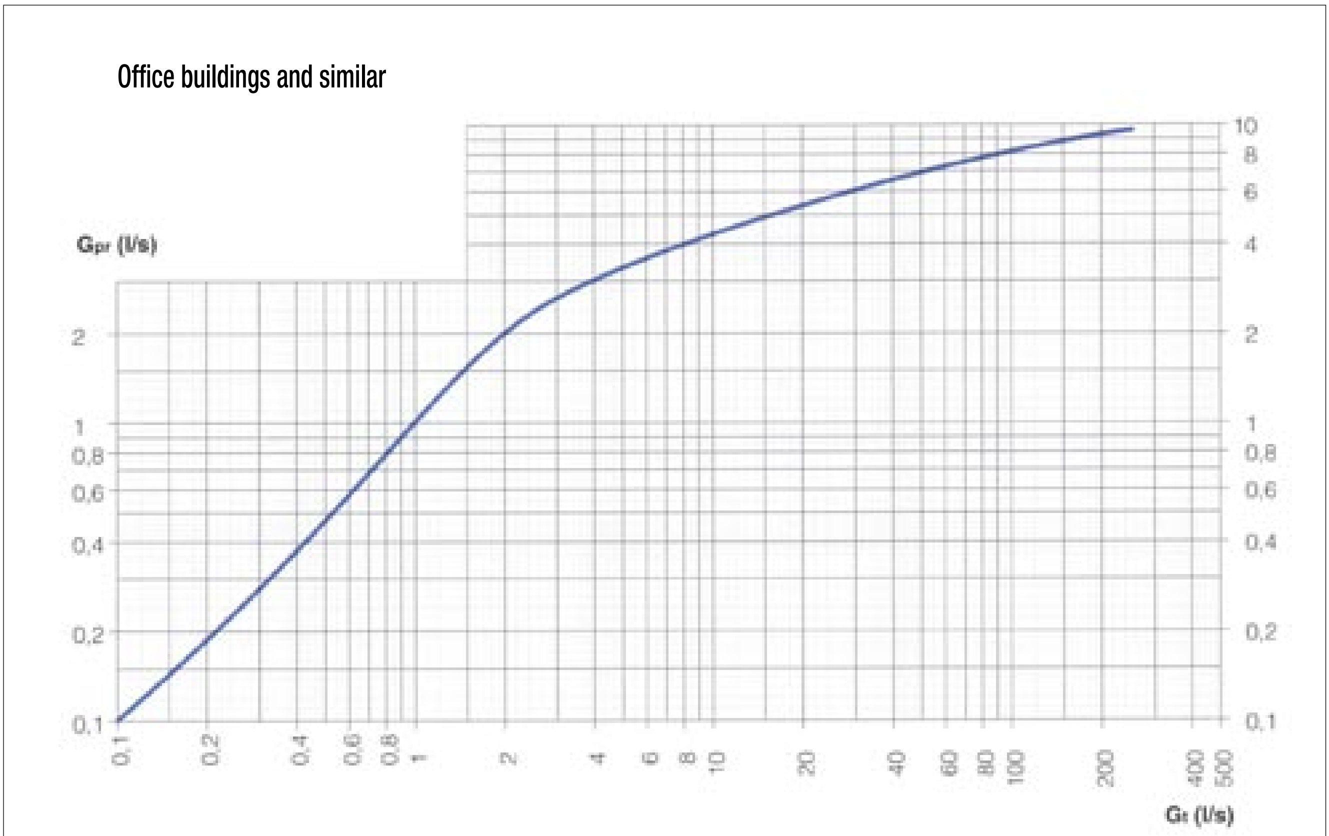


CHART 3

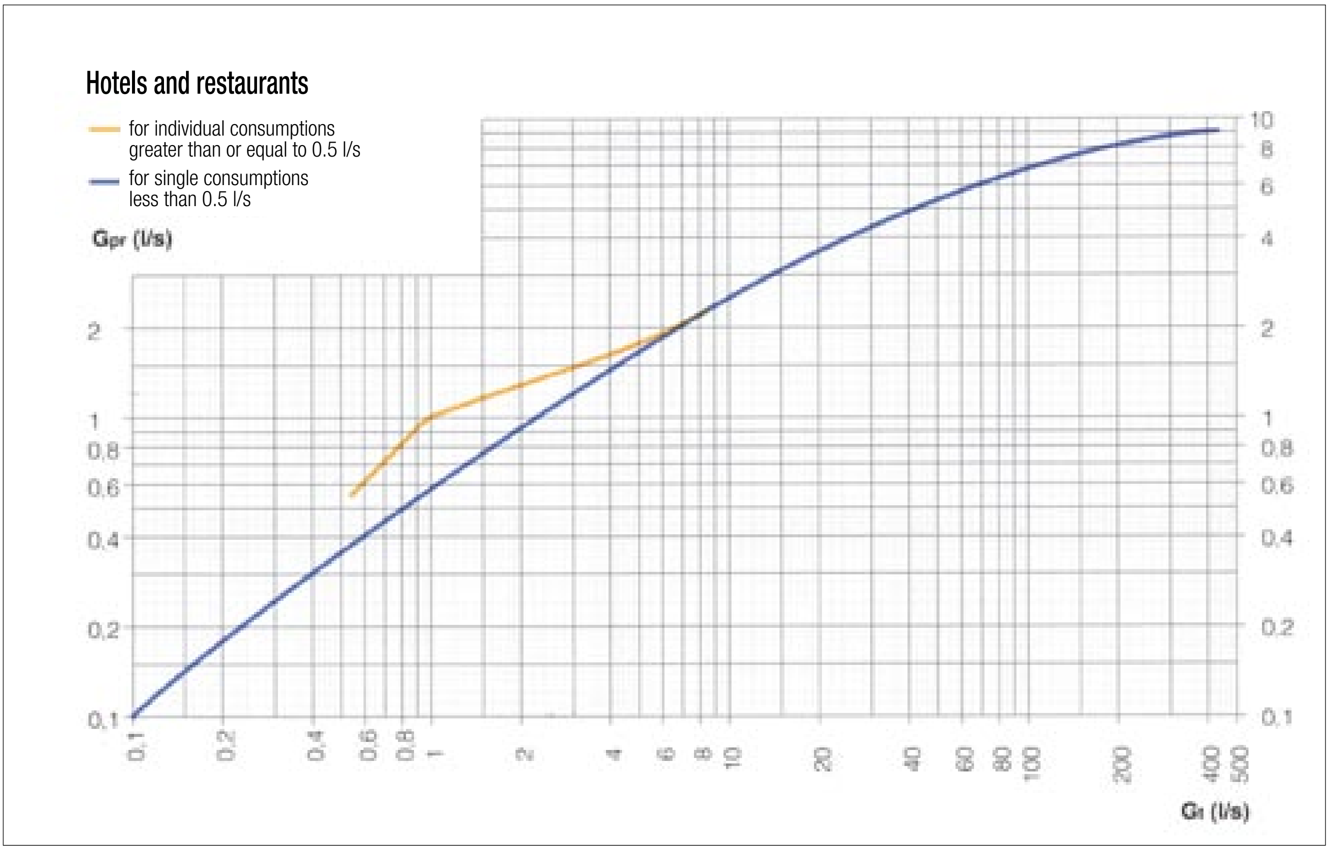


CHART 4

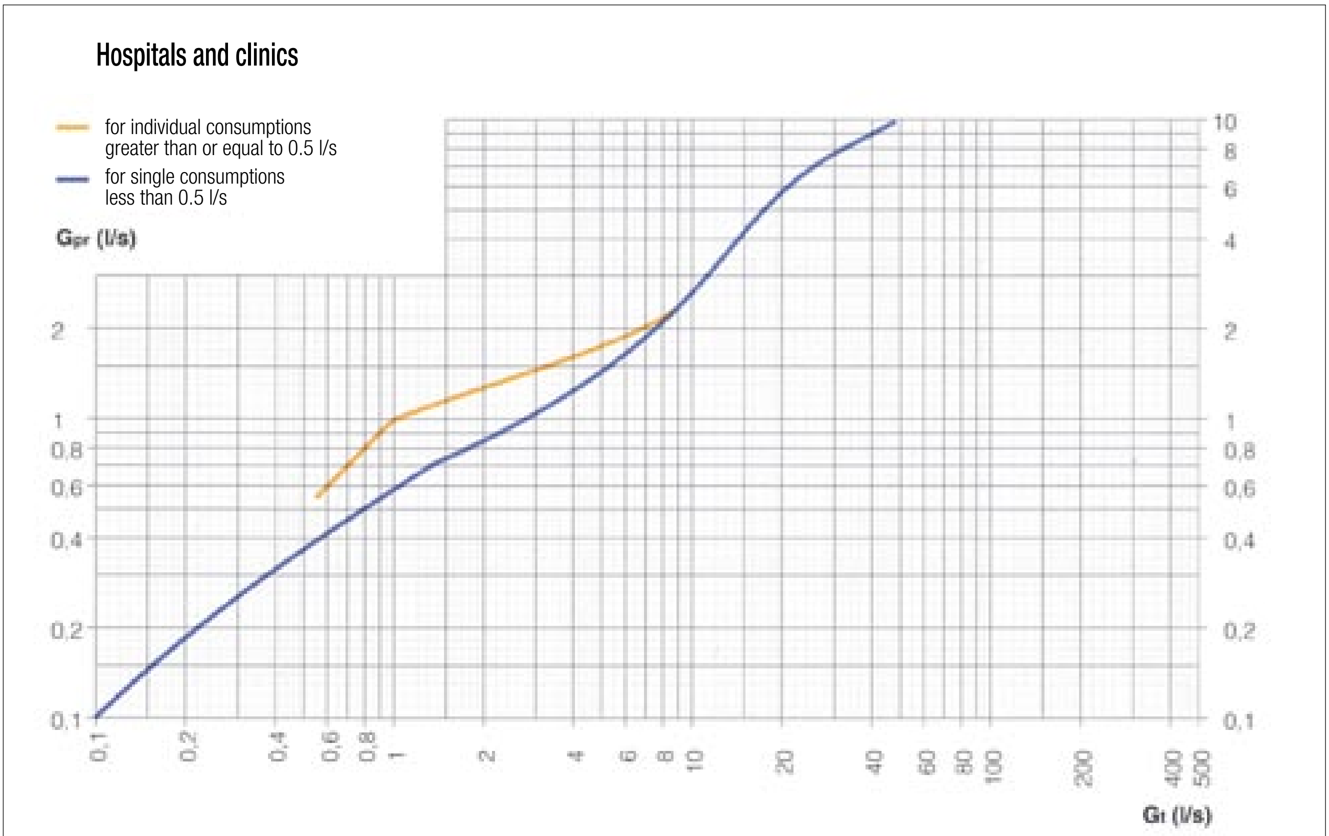
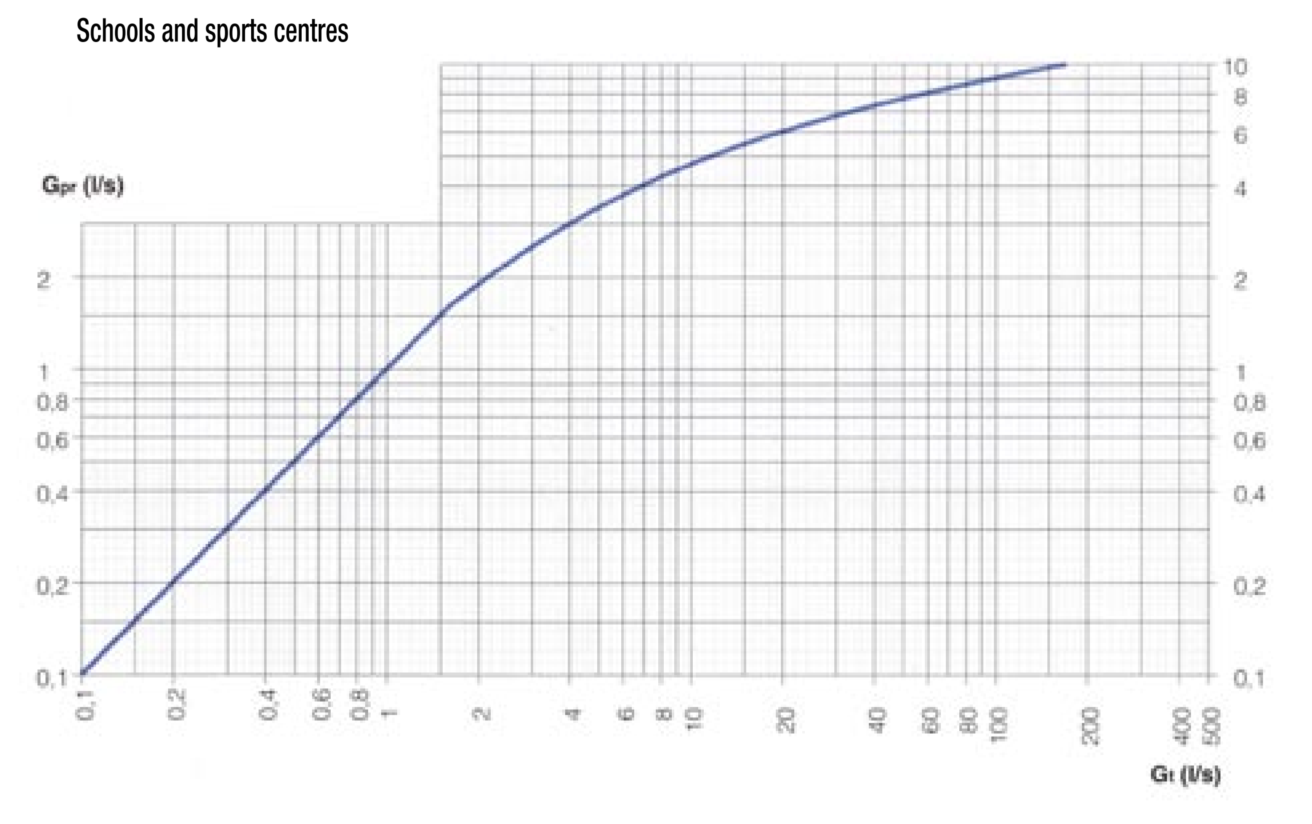


CHART 5



Required pressure

This represents the pressure necessary to overcome the level gradient between the beginning of the network and the most unfavourably positioned sanitary appliance and the pressure drops that are created in the pipes. It is advisable not to exceed values of 5 bar (50 m w.c.) in a water distribution and heating system to avoid generating noise in the pipes. Aqueducts generally supply pressures of about 3-4 bar (30-40 m w.c.). These pressures enable 3-4 storey buildings to be supplied. Higher buildings must adopt systems that increase the pressure in the pipes (however buildings with more than 6-7 storeys cannot be served, since the pressures on the lower floors would be too high).

Total linear load (H_{lin})

This represents the load that can be dedicated to overcome the linear pressure drops along the network. This value is calculated using the following formula:

$$H_{lin} = P_d - P_a - P_{min} - \Delta p_{comp} - \Delta p_{loc}$$

where:

P_d = Available pressure, represents the water pressure supplied to the mains meter (in m w.c.).

P_a = Level gradient between the network origin and the connection of the most unfavourably placed sanitary appliance, that is the appliance placed highest (in m w.c.).

P_{min} = Minimum pressure upstream of the most unfavourably placed sanitary appliance (in m w.c.). This value is obtained from the nominal flow rates table.

Δp_{comp} = Pressure drops (in m w.c.) due to system components (meter, heat exchanger, water softeners, etc.) are indicated in a table that follows.

Δp_{loc} = Pressure drops (in m w.c.) due to the interception valves, bends and special pieces (bends, t-fittings, reducers etc.).

As the value Δp_{loc} is generally 30-40 % of the total linear load, the following can be written:

$$H_{lin} = (P_d - P_a - P_{min} - \Delta p_{comp}) \times 0,7$$

EXAMPLE 9: Calculation of the project flow rates in a private household

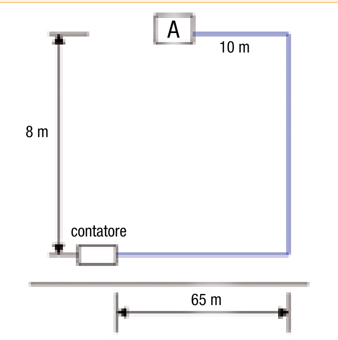
CHART 1 shown previously, is used by considering the axis where values for x correspond to the values of Gt found in example 7.

Intercepting the curve enables the values for the project flow rates to be read on the vertical axis, which in this case are: Gpr-cold=0.9 l/s e Gpr-hot=0.75 l/s

Pressure drops Δp_{comp} generated by the main components of the water distribution and heating system

APPLIANCE	PRESSURE DROP	
	(bar)	m w.c.
Water meter	0.8	8
Non-return valve	0.6	6
Thermostatic mixer	0.4	4
Electronic mixer	0.2	2
Heat exchanger	0.4	4
Water softener	0.8	8
Polyphosphate dosage unit	0.4	4

EXAMPLE 10: Calculation of the total linear load



Calculate the linear pressure drop of the system shown in the figure, by considering a pressure at the mains meter of 3.5 bar.
The unfavourably placed appliance is a washbasin in position A.

TOTAL LINEAR LOAD (H_{lin})
This represents the load that can be dedicated to overcoming the linear pressure drops along the network.
The value is calculated using the following formula:

The total linear load is calculated using the formula seen previously, where:

P_d = 3.5 bar = 35 m w.c.
P_a = 8 m
P_{min} = 5 m w.c. (washbasin)
Δp_{comp} = 8 m w.c. (meter)

$$H_{lin} = (P_d - P_a - P_{min} - \Delta p_{comp}) \times 0.7$$

$$H_{lin} = (35-8-5-8) \times 0.7 = 9.8 \text{ m w.c./m}$$

Unit linear load (J)

This value corresponds to the load that can be used to overcome the pressure drops in one meter length of pipe.
The value expressed in (mm w.c./m)

J = (Hlin x 1000) / L

Where:
L = length of the pipes that connect the beginning of the network with the least favourably placed sanitary appliance (in m).
J = the value of the unit linear load gives information on the pressure available at the origin of the network, more precisely:

J (mm w.c.):

- < 25 It is advisable to increase the available pressure (surge tank).
- 25<J<120 The pressure available at the beginning of the network is acceptable.
- J>120 It is advisable to reduce the pressure available at the beginning of the network (pressure reducer).

EXAMPLE 11: Calculation of the unit linear load

Using the data obtained in example 9 (H_{lin} 9.8 m w.c.) calculate the unit linear load.
By using the formula seen previously, the following is obtained:

J = (H_{lin} x 1000) / L

J = (9.8 x1 000) / (8+65+10) = 118 mm w.c./m

In this case it can be seen that since J<120 the system does not require either an increase or a decrease of the inlet pressure.

Calculation of the diameter

By using the unit linear load value and the value of project flow rate, it is possible to obtain the diameter of the Pexal pipe to be adopted for hot water (with the water temperature at 50°C) and cold water (T=10°C) by using the pressure drop charts. By intercepting the two values on the abscissa and on the ordinate a meeting point on one of the straight lines representing the diameters is obtained, the straight line where the meeting occurs corresponds to the diameter of the required pipe.
If the meeting point of the two values between the straight lines corresponds to two different diameters, the larger of the two values is selected.

EXAMPLE 12: Calculation of the pipe diameter

Using the data obtained from example 10 determine the diameter of the pipe (washbasin with J=118 mm w.c./m), assuming cold water is running in the pipe.

Considering the nominal flow of the washbasin is equal to 0.1 l/s, and is equal to the total value and since in the previous example the system contains a single sanitary appliance, DIAGRAM 1 indicates that the project flow rate is equal to 0.1 l/s. The water flowing in the pipe is cold, therefore the pressure drops chart for cold water (temperature 10°C) will be used.

Considering that 118 mm w.c./m = 11.8 mbar/m, this value intercepts the diagram with the project flow rate (0.1 l/s). The straight line close to the meeting point for the two values corresponds to the diameter 16x2.25.

Calculation of the recycle network

The recycle network of a plumbing network are designed to maintain hot water in circulation preventing the water from cooling down when it remains still inside the supply pipe. The temperature gradient between the hot water boiler and the most distant unit is considered equal to 2 °C (namely, the temperature gradient which is generally found in a system with a normal level of insulation), a unit value equal to 6 l/h for each meter length of pipe in the hot water distribution system is assumed for the recycle flow rate calculation. **An average pressure drop of 2.5 mbar/m is considered to calculate the pipe diameter.**

EXAMPLE 13: Calculation of the recycle network

Calculate the diameter of the recycle network in EXAMPLE 12.
The recycle flow rate inside the pipe under review is calculated by multiplying the unit recycle flow rate by the total length of the network:

$\mathbf{G_{RIC} = 6 \times L = 6 \times 83 = 498\ l/h}$

Refer to the pressure drop chart at 50°C adopting the flow rate value found and using the average pressure drop of 2.5 mbar/m, this gives the diameter of the recycle network equal to ø 20x2.5.

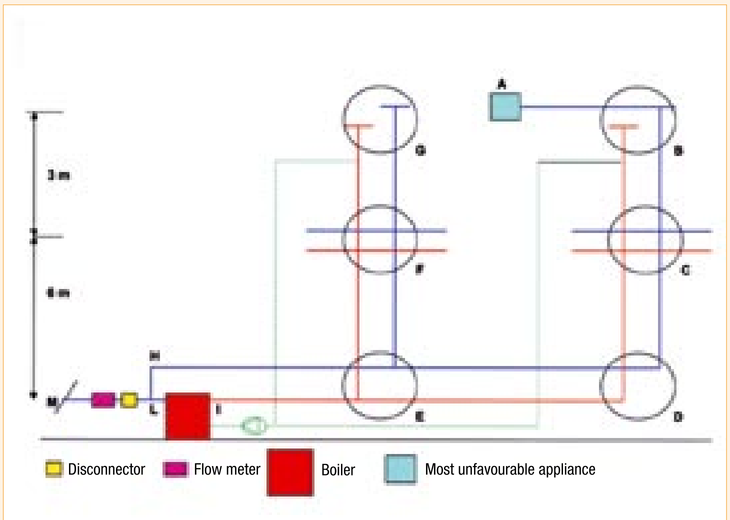
EXAMPLE 14: Calculation of a water distribution and heating network

For the sake of greater clarity we will now indicate a complete example referring to the sizing of a water distribution and heating network realised using the Pexal pipe in a building containing 4 apartments. Each apartment contains the following sanitary appliances:

- 1 washbasin
- 1 bidet
- 1 W.C. with cistern
- 1 shower
- 1 kitchen sink
- 1 washing machine

The lengths of the single sections of pipe are indicated in the following table:

SECTION	LENGTH (m)	SECTION	LENGTH (m)	SECTION	LENGTH (m)
AB	12	EF	6	HL	2
BC	3	FG	3	LM	4
CD	6	EH	12		
DE	10	EI	10		



1. Calculation of the total flow rates (Gt) and the project flow rate (Gpr):

APPLIANCES	NOMINAL FLOW RATE (l/s)		NUMBER OF APPLIANCES	TOTAL FLOW RATE OF APPLIANCES (l/s)	
	Cold water	Hot water		Cold water	Hot water
Pan with cistern	0.1	-	4	0.4	-
Bidet	0.1	0.1	4	0.4	0.4
Washbasin	0.1	0.1	4	0.4	0.4
Shower	0.15	0.15	4	0.6	0.6
Sink	0.20	0.20	4	0.8	0.8
Washing machine	0.10	-	4	0.4	-
Total flow rate Gt				**3**	**2.2**

The project flow rates are obtained from CHART 1 and apply to every single section:

SECTION	L (m)	COLD WATER		HOT WATER	
		Gt	Gpr	Gt	Gpr
AB	12	0.1	0.1	0.1	0.1
BC	3	0.75	0.48	0.75	0.48
CD	6	1.5	0.7	1.5	0.7
DE	10	1.5	0.7	1.5	0.7
EF	6	1.5	0.7	1.5	0.7
FG	3	0.75	0.48	0.75	0.48
EH	12	3	1	3	1
EI	10	-	-	-	-
HL	2	3	1	3	1
LM	4	5.2	1.7	5.2	1.7

2. Calculation of the total linear load

P_d = 35 m w.c.

P_a = 9 m

P_{min} = 5 m (minimum pressure required by the most unfavourable appliance that is a W.C. with cistern)

H_{comp} = 8 + 6 = 14 m w.c. (pressure drops due to the flow meter and the disconnector)

H_{lin} = (35-9-5-14)x0.7 = 4.9 m w.c./m

3. Calculation of the unit load

The length of the pipe from the origin to the most unfavourable appliance is:

L = ML + LH + HE + HD + DC + CB + BA = 4+2+12+10+6+3+12= 49 m

J = (H_{lin} x 1000) / L = (4.9 x1000)/49= 100 mm w.c./m

The available pressure need not be increased or decreased in that 25 < J < 120.

4. Calculation of the diameters of each single section

It is now possible to determine the pipe diameters shown in the table, using the value for J and the project flow rates, with the pressure drop charts for hot and cold water.

SECTION	L (m)	COLD WATER		HOT WATER	
		Gpr	ø Pexal	Gpr	ø Pexal
AB	12	0.1	20x2.25	-	-
BC	3	0.48	32x3	0.4	32x3
CD	6	0.7	32x3	0.57	32x3
DE	10	0.7	32x3	0.57	32x3
EF	6	0.7	32x3	0.57	32x3
FG	3	0.48	32x3	0.4	32x3
EH	12	1	40x3.5	-	
EI	10	-	-	0.85	40x3
HL	2	1	40x3.5	-	-
LM	4	1.7	50x4	-	-

5. Calculation of the recycle network diameters

The flow rates in the various sections of the hot water distribution network are as follows:

$G_{GE} = L_{GE} X 6 = 19 X 6 = 114$ l/h

$G_{GE} = L_{GE} X 6 = 9 X 6 = 54$ l/h

$G_{EI} = L_{EI} X 6 + G_{GE} + G_{GE} = 10 X 6 + 54 + 114 = 228$ l/h

By using the above flow rates and considering an average pressure drop of 2.5 mbar/m, the diameter of the recycle network is obtained from the pressure drop chart at 50 °C.

SECTION	L(m)	Ø PEXAL
BE	19	14x2
GE	9	14x2
EI	10	20x2.5

7.10 Sizing criteria for heating systems with distribution manifolds

Heating systems with distribution manifolds are the most commonly used systems by project designers and installation technicians, since they offer many more advantages compared with other solutions (for example, mono-pipe systems), both as regards the design, the control and the installation.

These advantages are as follows:

- The design work is more simple and fast as compared to other system types.
- Possibility of creating separate heating zones within a given system (for example, living areas and night areas).
- Elevated thermal output of heating units: in practice the fluid reaches all of the heating terminals at the same temperature. This enables smaller size heating units to be used thereby reducing costs.
- All the heating terminals heat up simultaneously, enabling the steady state conditions of the system to be achieved more uniformly and to maintain the room temperature.
- Each heating terminal is independent from the others, enabling a given terminal to be excluded without influencing the others.
- Pipe installation is easier in that systems with manifolds allow the use of smaller diameter pipes that reduce the overall dimensions during the installation operations and furthermore, smaller diameter pipes are easier to bend.

Calculation method

This practical calculation method for sizing systems with manifolds, assumes the pressure head values at the manifold ends and the temperature differential between the flow and return circuit, are predetermined.

1. Pressure head of predetermined zone (H):

is the pressure head supplied by the system at the manifold ends. The following values are assumed for zone pressure head:

- 800 – 1200 mm w.c. for radiator systems without thermostatic valves.
- 1000 – 1500 mm w.c. for radiator systems with thermostatic valves.
- 1200 – 2000 mm w.c. for systems with convectors and fan convectors.

If the system is made up of several manifolds, positioned on different floors, the predetermined pressure head is assumed to be upstream of the highest placed manifold, **one of the pressure heads indicated above (based on the type of system) is increased by 100 mm w.c. for each lower floor.**

EXAMPLE 15: Calculation of the pressure head in a predetermined zone

Calculate the pressure head of a predetermined zone at each manifold for a heating system with 2 manifolds located on 2 floors. The heating terminals are made up of radiators without thermostatic valves.

As explained previously, the pressure head value for the predetermined zone is assumed to be the value at the ends of the manifold on the second floor (the highest floor), corresponding to a pressure head value lying between 800 and 1200 mm w.c. (since the heating terminals are radiators).
We will adopt the value of 1000 mm w.c. The pressure head for the lower floor will be:

H(2° piano)= 1000 mm w.c.

H(1° piano)= H(2° piano) + 100 = 1100 mm w.c.

H(piano terra)= H(1° piano) + 100 = 1200 mm w.c.

2. Thermal head (ΔT):

Thermal head is understood to mean the difference between the supply temperature of the fluid and the return temperature at the project conditions. The value adopted for the thermal head is:

HEAT SOURCE TYPE	THERMAL HEAD ADOPTED (Δt)
Traditional boiler	10 °C
Condensation boiler	5 °C
Heat pump	5 °C
District heating	20 °C

3. Maximum project temperature (T_{max}):

This represents the maximum temperature that the heating liquid can reach at the heating terminals. In general this value is assumed as:

HEAT SOURCE TYPE	MAXIMUM PROJECT TEMPERATURE
Traditional boiler	75 °C
Condensation boiler	55 °C
Heat pump	55 °C
District heating	65 °C

4. Maximum fluid flow rate in the internal circuits (V_{max}):

The maximum flow rate of the fluid in the internal circuits must be less than 1 m/s to prevent pipe noise and damages to the valves.

MAX SPEED IN THE INTERNAL CIRCUITS (V_{max}): < 1m/s

DETERMINATION OF THE DIAMETERS OF THE INTERNAL CIRCUITS

Internal circuits are understood to mean the lines that convey the heating fluid from the manifolds to the heating terminals.

1. The heating capacity required from each circuit is calculated on the basis of the heating requirement of each room (calculated according to the method as detailed in LAW no. 10/91), the temperature differential and the flow rate for each circuit are obtained on the basis of these values using the following formula:

$$G = \frac{Q}{1{,}16 \times \Delta t}$$

where:

Q = thermal energy required to heat each room (thermal requirement of the room) expressed in W.

G = is the circuit flow rate expressed in l/h.

Δt = is the thermal head between the supply and the return heating fluid expressed in °C (assumed data based on the considerations made previously).

2. The average linear pressure drop is determined for each circuit based on the established pressure head at the ends of the manifold, by using the formula:

$$pm = \frac{H \times b}{La + Lr}$$

where:

pm = average linear pressure drop for the circuit expressed in mm w.c./m

H = predetermined pressure head at the ends of the manifold expressed in mm w.c. (see above).

b = corrective factor equal to 0.6 for circuits without thermostatic valves. 0.4 for circuits with thermostatic valves.

La / Lr = length of supply circuit / length of the return circuit. Expressed in m.

3. The pipe diameters of each circuit are determined by intersecting the flow rate value and the linear pressure drop value for each circuit in once of the 3 pressure drop charts. The choice of the chart used is based on the maximum project temperature (for example, if the maximum project temperature has been set at a temperature of 75 °C, then the pressure drop chart at 80 °C is to be considered).

N.B. Check that the fluid flow rate remains less than 1 m/s, otherwise the pipe diameter has to be increased.

Sizing the manifold

The total flow rate of the manifold is calculated by summing the flow rates of each single circuit; based on this value the diameter of the manifold to be used in obtained (based on the following table).

MANIDOLD DIAMETER	TOTAL FLOW RATE
3/4”	< 800 l/h
1”	800 – 1600 l/h
Split the manifold	> 1600 l/h

EXAMPLE 16: Sizing of a system with manifolds

Size the circuits of a heating system in a 2-storey house (as shown in the figure). Consider one manifold for each floor with a zone valve. The system is serviced by a traditional type boiler. The heat requirements of the rooms are shown in the table.

1ST FLOOR		2ND FLOOR	
N°	Q (W)	N°	Q (W)
1	1776	5	888
2	1570	6	2664
3	1480	7	1480
4	1776	8	1480

1ST FLOOR

As mentioned previously, the practical calculation requires a number of sizes to be defined:

- Pre-established pressure head at the ends of the manifold on the second floor: H= 1000 mm w.c.
- We consider a pressure head loss for each floor of 100 mm w.c. Therefore, there will be a pressure head of 1100 mm w.c. for the first floor.
- Temperature differential between flow and return: Δt = 10°C.
- Maximum project temperature: T_{max}= 75 °C.

The lengths of the flow (LA) pipes and the return (LR) pipes, which connect to each heating element are obtained from the drawing, as shown below.

N°	LA	LR	Ltot
1	4	4	8
2	12	12	24
3	8	8	16
4	3	3	6

The water flow rates for each internal circuit are determined as follows:

G = Q / (Δt x 1.16) = Q / (10 x 1.16) = Q/11.6

The average losses for each connecting section between the manifold and the radiator are calculated using the following formula:

pm = H x b / Ltot = 1000 x 0.4 / Ltot

N°	Q (W)	G (l/h)	PM (mm w.c./m)	G (l/s)	PM (mbar/m)
1	1776	153.10	50	0.04	5
2	1570	135.34	16.67	0.037	1.7
3	1480	127.59	25	0.035	2.5
4	1776	153.10	66.67	0.04	6.7

The pressure drop graph at 80°C is used with the rm and Q (l/s) values and the pipe diameters are determined. Namely:

N°	Ø PEXAL
1	14x2
2	16x2.25
3	16x2.25
4	14x2

The flow rates in the pipes are acceptable because all of the values are less than 1 m/s.
The diameter of the manifold to be used is obtained by adding all of the flow rates of the radiators relative to the 1st floor:

Gtot1= G1+G2+G3+G4= 153.1+135.34+127.59+153.1= 569.13 l/h

Since Gtot1<800 a 3/4” size manifold pipe will be used.

2ND FLOOR

The lengths of the flow (LA) pipes and the return (LR) pipes, which connect to each heating element are obtained from the drawing, as shown below.

N°	LA	LR	Ltot
5	3	3	6
6	8	8	16
7	8	8	16
8	8	8	16

The water flow rates for each internal circuit are determined as follows:

G = Q / (Δt x 1.16) = Q / (10 x 1.16) = Q/11.6

The average losses for each connecting section between the manifold and the radiator are calculated using the following formula:

pm = H x b / Ltot = 1000 x 0.4 / Ltot

N°	Q (W)	G (l/h)	PM (mm w.c./m)	G (l/s)	PM (mbar/m)
1	888	76.55	66.67	0.021	6
2	2088	180	25	0.05	2.5
3	1480	127.58	25	0.035	2.5
4	1480	127.58	25	0.035	2.5

The pressure drop graph at 80°C is used with the pm and Q (l/s) values and the pipe diameters are determined. Namely:

N°	Ø PEXAL
1	14 x 2
2	16 x 2.25
3	16 x 2.25
4	16 x 2.25

The flow rates in the pipes are acceptable because all of the values are less than 1 m/s.
The diameter of the manifold to be used is obtained by adding all of the flow rates of the radiators relative to the 1st floor:

Gtot1= G1+G2+G3+G4= 76.55 + 180 + 127.58 + 127.58 = 511.71 l/h.

Since Gtot1<800 a 3/4” size manifold pipe will be used.

TABLE OF COMPATABILITY WITH CHEMICAL COMPOUNDS (ISO/TR 10358:1993)

COMPOUND	Concent. (%)	T (°C)	HDPE	PE-X
Acetaldeide	40	20	S	X
		60	L	X
	Tg-l	20	S	X
		60	L	X
Acetic acid	Up to 10	20	S	S
		60	S	S
		80	X	S
	From 10 to 40	20	S	S
		60	X	S
	50	20	S	S
	From 40 to 60	20	S	S
	60	20	S	X
	80	20	S	X
Acetic acid, glacial	>96	20	S	S
		60	L	X
Acetic anhydride	Tg-l	20	S	X
		60	L	X
Acetone	Tg-l	20	L	S
		60	L	L
Adipic acid	Sat. Sol.	20	S	X
		60	S	X
Allyl alcohol	Tg-l	20	S	X
		50	X	Ns
		60	S	X
Aluminium chloride	Sat. Sol.	20	S	X
		60	S	X
Aluminium fluoride	Susp.	20	S	X
		60	S	X
Aluminium hydroxide	Susp.	20	S	X
		60	S	X
Aluminium nitrate	Sat. Sol.	20	S	X
		60	S	X
Aluminium oxychloride	Susp.	20	S	X
		60	S	X
Aluminium potassium sulphate	Sat. Sol.	20	S	X
		60	S	X
Aluminium sulphate	Sat. Sol.	20	S	X
		60	S	X
Ammonia aqueous	Sat. Sol.	20	S	X
		60	S	X
Ammonia dry gas	Tg-g	20	S	X
		60	S	X
Ammonia liquid	Tg-g	20	S	X
		60	S	X
Ammonium carbonate	Sat. Sol.	20	S	X
		60	S	X
Ammonium chloride	Sat. Sol.	20	S	X
		60	S	X
Ammonium fluoride	Up to 20	20	S	X
Ammonium hydrogen	Sat. Sol.	20	S	X
		60	S	X
Ammonium hydrogen carbonate	Sat. Sol.	20	S	X
		60	S	X
Ammonium metaphospate	Sat. Sol.	20	S	X
		60	S	X
Ammonium nitrate	Sat. Sol.	20	S	X
		60	S	X
Ammonium persulphate	Sat. Sol.	20	S	X
		60	S	X

COMPOUND	Concent. (%)	T (°C)	HDPE	PE-X
Mercurous nitrate	Sol.	20	S	X
		60	S	X
	Sat. Sol.	20	S	X
		60	S	X
Mercury	Tg-l	20	S	X
		60	S	X
Methyl alcohol	5	20	X	S
		60	X	S
	Tg-l	20	S	S
		60	S	S
Methyl ethyl ketone	Tg-l	20	X	S
		60	X	S
Mineral oils	Work sol.	20	S	S
		60	L	S
		80	X	L
Naphtha	Work sol.	20	X	S
		60	X	S
		80	X	S
Nickel chloride	Sat. Sol.	20	S	X
		60	S	X
Nickel nitrate	Sat. Sol.	20	S	X
		60	S	X
Nickel sulphate	Sat. Sol.	20	S	X
		60	S	X
Nicotinic acid	Susp.	20	S	X
Nitric acid	5	20	S	S
		60	S	L
	10	20	S	S
		60	S	L
	20	20	S	S
		60	S	L
	25	20	S	S
		60	S	L
	50	20	L	Ns
		60	Ns	Ns
	>50	20	Ns	Ns
		60	Ns	Ns
	Fuming	20	Ns	X
		60	Ns	X
Oil and fats	Tg-l	20	S	X
		60	L	S
Oleic acid	Tg-l	20	S	X
		60	S	X
Oleum	-	20	Ns	X
		60	Ns	X
Oxalic acid	Sat. Sol.	20	S	X
		60	S	X
Phenol	Sol.	20	S	X
		60	S	X
Phosphoric acid	Up to 50	20	S	X
		60	S	X
Phosphorus chloride	Tg-l	20	S	X
		60	L	X
Picric acid	Sat. Sol.	20	S	X
Potassium bicarbonate	Sat. Sol.	20	S	X
		60	S	X
Potassium bisulphate	Sat. Sol.	20	S	X
		60	S	X
Potassium borate	Sat. Sol.	20	S	X

COMPOUND	Concent. (%)	T (°C)	HDPE	PE-X
Ammonium sulphate	Sat. Sol.	20	S	X
		60	S	X
Ammonium sulphite	Sat. Sol.	20	S	X
		60	S	X
Ammonium thiocyanate	Sat. Sol.	20	S	X
		60	S	X
Amyl acetate	Tg-l	20	S	L
		60	L	L
		80	X	L
Amyl alchool	Tg-l	20	S	S
		60	L	S
Aniline	Tg-l	20	S	X
		60	L	X
Antimony (III) chloride	Sat. Sol.	20	S	X
		60	S	X
Aqua regia	HCl/HNO3 = 3/1	20	Ns	X
		60	Ns	X
Arsenic acid	Sat. Sol.	20	S	X
		60	S	X
Barium bromide	Sat. Sol.	20	S	X
		60	S	X
Barium carbonate	Susp.	20	S	X
		60	S	X
Barium chloride	Sat. Sol.	20	S	X
		60	S	X
Barium hydroxide	Sat. Sol.	20	S	X
		60	S	X
Barium sulphate	Susp.	20	S	X
		60	S	X
Barium sulphite	Sat. Sol.	20	S	X
		60	S	X
Benzaldehyde	Tg-l	20	S	X
		60	S	X
Benzene	Tg-l	20	L	S
		60	L	X
Benzoic acid	Sat. Sol.	20	S	X
		60	S	X
Bismuth carbonate	Sat. Sol.	20	S	X
		60	S	X
Borax	Sol.	20	S	X
		60	S	X
	Sat. Sol.	20	S	X
		60	S	X
Boric acid	Dil. Sol	20	S	X
		60	S	X
	Sat. Sol.	20	S	X
		60	S	X
Boron trifluoride	Sat. Sol.	20	S	X
Bromine gas	Tg-g	20	Ns	X
		60	Ns	X
Bromine liquid	Tg-l	20	Ns	X
		60	Ns	X
n-Butanol	Tg-l	20	S	X
		60	S	X
Butyric acid	Tg-l	20	S	X
		60	S	X
Calcium carbonate	Susp.	20	S	X
		60	S	X
Calcium chlorate	Sat. Sol.	20	S	X
		60	S	X
Calcium chloride	Sat. Sol.	20	S	S
		60	S	S
		80	X	S

COMPOUND	Concent. (%)	T (°C)	HDPE	PE-X
Potassium borate	Sat. Sol.	60	S	X
Potassium bromate	Sat. Sol.	20	S	X
		60	S	X
	Up to 10	20	S	X
		60	S	X
Potassium bromide	Sat. Sol.	20	S	X
		60	S	X
Potassium carbonate	Sat. Sol.	20	S	X
		60	S	X
Potassium chlorate	Sat. Sol.	20	S	X
		60	S	X
Potassium chloride	Sat. Sol.	20	S	X
		60	S	X
Potassium chromate	Sat. Sol.	20	S	X
		60	S	X
	40	20	S	X
		60	S	X
Potassium cyanide	Sol.	20	S	X
		60	S	X
	Sat. Sol.	20	S	X
		60	S	X
Potassium dichromate	Sat. Sol.	20	S	X
		60	S	X
	40	20	S	X
		60	S	X
Potassium ferricyanide	Sat. Sol.	20	S	X
		60	S	X
Potassium fluoride	Sat. Sol.	20	S	X
		60	S	X
Potassium ferrocianide	Sat. Sol.	20	S	X
		60	S	X
Potassium hydrogen sulphite	Sol.	20	S	X
		60	S	X
Potassium hydroxide	Sol.	20	S	X
		60	S	X
	10	20	S	S
		60	S	S
	20	20	X	S
		60	X	S
		80	X	S
	Up to 50	20	X	S
		60	X	S
		80	X	S
Potassium hypochloite	Sol.	20	S	X
		60	L	X
Potassium nitrate	Sat. Sol.	20	S	X
		60	S	X
Potassium orthophosphate	Sat. Sol.	20	S	X
		60	S	X
Potassium perchlorate	Sat. Sol.	20	S	X
		60	S	X
Potassium permanganate	20	20	S	X
		60	S	X
Potassium persulphate	Sat. Sol.	20	S	X
		60	S	X
Potassium sulphate	Sat. Sol.	20	S	X
		60	S	X
Potassium sulphide	Sat. Sol.	20	S	X
		60	S	X
Potassium sulphite	Sat. Sol.	20	S	X
		60	S	X
Potassium thiosulphate	Sat. Sol.	20	S	X
		60	S	X

COMPOUND	Concent. (%)	T (°C)	HDPE	PE-X
Calcium hydroxide	Sat. Sol.	20	S	X
		60	S	X
Calcium hipoclorite	Sol.	20	S	X
		60	X	X
Calcium nitrate	Sat. Sol.	20	S	S
		60	S	S
		80	X	S
Calcium sulphate	Susp.	20	S	X
		60	S	X
Calcium sulphide	Dil. Sol.	20	L	X
		60	L	X
Calcium hydrogen sulphide	Sol.	20	S	X
		60	S	X
Carbon disulphide	Tg-l	20	L	S
		60	Ns	X
Carbon tetra-chloride	Tg-l	20	L	L
		60	Ns	Ns
Chlorine water	Sat. Sol.	20	L	X
		60	Ns	X
Chloroacetic water	Sol.	20	S	X
		60	S	X
Chlorobenzene	Tg-l	20	X	S
		60	X	L
		80	X	L
		100	X	Ns
Chloroform	Tg-l	20	Ns	Ns
		60	Ns	Ns
Chloromethane gas	Tg-l	20	L	X
Chlorosulphonic acid	Tg-s	20	Ns	X
		60	Ns	X
Chrome alum	Sol.	20	Ns	X
		60	Ns	X
Chromic acid	20	20	S	X
		60	L	X
	50	20	S	X
		60	L	X
Citric acid	Sat. Sol.	20	S	X
		60	S	X
Copper chloride (III)	Sat. Sol.	20	S	X
		60	S	X
Copper cyanide (III)	Sat. Sol.	20	S	X
		60	S	X
Copper nitrate (III)	2	20	S	X
		60	S	X
	Sat. Sol.	20	S	X
		60	S	X
Copper sulphate (III)	Sat. Sol.	20	S	X
		60	S	X
Cresylic acid	Sat. Sol.	20	L	X
Cyclohexanol	Tg-s	20	S	X
Cyclohexanone	Tg-l	20	S	L
		60	L	L
		80	X	L
Decalin	Tg-l	20	S	X
		60	L	X
Developers (photographic)	Work. Sol.	20	S	X
		60	S	X
Dextrin	Sol.	20	S	X
		60	S	X
Dextrose	Sol.	20	S	X
		60	S	X
Ethylene glycol	Tg-l	20	S	S
		60	S	S
		80	X	S
		100	X	S
Ethyl ether	Tg-l	20	L	S
Ferric chloride	Sat. Sol.	20	S	X
		60	S	X
Ferric nitrate	Sat. Sol.	20	S	X
		60	S	X
Ferric sulphate	Sat. Sol.	20	S	X

COMPOUND	Concent. (%)	T (°C)	HDPE	PE-X
Propionic acid	50	20	S	X
		60	S	X
	Tg-l	20	S	X
		60	L	X
Piridine	Tg-l	20	S	X
		60	L	X
Salicylic acid	Sat. Sol.	20	S	X
		60	S	X
Silver acetate	Sat. Sol.	20	S	X
		60	S	X
Silver cyanide	Sat. Sol.	20	S	X
		60	S	X
Silver nitrate	Sat. Sol.	20	S	X
		60	S	X
Sodium acetate	Sat. Sol.	20	S	X
		60	S	X
Sodium antiminate	Sat. Sol.	20	S	X
		60	S	X
Sodium arsenite	Sat. Sol.	20	S	X
		60	S	X
Sodium benzoate	Sat. Sol.	20	S	X
		60	S	X
Sodium bicarbonate	Sat. Sol.	20	S	X
		60	S	X
Sodium bisulphate	Sat. Sol.	20	S	X
		60	S	X
Sodium bromide	Sat. Sol.	20	S	X
		60	S	X
Sodium carbonate	Sat. Sol.	20	S	X
		60	S	X
	25	20	S	X
		60	S	X
	Up to 50	20	S	X
		60	S	X
Sodium chlorate	Sat. Sol.	20	S	X
		60	S	X
Sodium chloride	Sat. Sol.	20	S	X
		60	S	X
	10	20	S	X
		60	S	X
Sodium chlorite	2	20	S	X
Sodium chromate	Dil. Sol.	20	S	X
		60	S	X
Sodium cyanide	Sat. Sol.	20	S	X
		60	S	X
Sodium dichromate	Sat. Sol.	20	S	X
		60	S	X
Sodium ferricyanide	Sat. Sol.	20	S	X
		60	S	X
Sodium ferrocyanide	Sat. Sol.	20	S	X
		60	S	X
Sodium fluoride	Sat. Sol.	20	S	X
		60	S	X
Sodium hydrogen sulphite	Sat. Sol.	20	S	X
		60	S	X
Sodium hydroxide	Sol.	20	S	X
		60	S	X
	Sat. Sol.	20	X	S
		60	X	S
	1	20	S	S
	From 1 to 35	20	S	S
	40	20	S	S
		60	S	S
	From 40 to 60	20	X	S
		60	X	S
Sodium hypochlorite	From 10 to 15	20	S	X
		60	S	X
	12.5	20	S	X
		60	S	X
Sodium nitrate	Sat. Sol.	20	S	X
		60	S	X

COMPOUND	Concent. (%)	T (°C)	HDPE	PE-X
Ferric sulphate	Sat. Sol.	60	S	X
Ferrous chloride	Sat. Sol.	20	S	X
		60	S	X
Ferrous sulphate	Sat. Sol.	20	S	X
		60	S	X
Dioctyl phtalate	Tg-l	20	S	X
		60	L	X
Dioxane	Tg-l	20	S	X
		60	S	X
Ethanol	40	20	S	X
		60	L	X
Ethyl acetate	Tg-l	20	S	X
		60	Ns	X
Fluosilicic acid	40	20	S	X
		60	S	X
Formaldehyde	from 30 to 40	20	S	X
		60	S	X
Formic acid	10	20	S	S
		60	S	S
	40	20	S	S
		60	S	S
	50	20	S	S
		60	S	S
Freon – F12	Work Sol.	20	X	S
Gasoline (fuel)	Work Sol.	20	S	X
		60	L	X
Glucose	Sol.	20	S	X
		60	S	X
Glycerine	Tg-l	20	S	X
		60	S	X
Glycolic acid	Sol.	20	S	X
		60	S	X
Heptane	Tg-l	20	S	S
		60	Ns	S
		80	X	L
Hydrobromic acid	Up to 20	20	S	X
		60	S	X
	Up to 48	20	S	X
		60	S	X
Hydrochloric acid	Up to 10	20	S	S
		60	S	S
		80	X	S
		100	X	S
	from 10 to 20	20	S	S
		60	S	S
		80	X	S
		100	X	S
	20	20	S	S
		60	S	S
		80	X	S
		100	X	S
	>25	20	S	S
		60	S	S
	30	20	S	S
		60	S	S
	>30	20	S	S
		60	S	S
	36	20	S	S
		60	S	S
	Conc.	20	S	S
		60	S	S
Hydrocyanic acid	10	20	S	X
		60	S	X
Hydrofluoric acid	Up to 10	20	S	X
		60	S	X
	60	20	S	X
		60	S	L
Hydrogen peroxide	Up to 10	20	S	X
		60	S	X
	30	20	S	X

COMPOUND	Concent. (%)	T (°C)	HDPE	PE-X
Sodium nitrite	Sat. Sol.	20	S	X
		60	S	X
Sodium phosphate, acid	Sat. Sol.	20	S	X
		60	S	X
Sodium phosphate, neutral	Sat. Sol.	20	S	X
		60	S	X
Sodium silicate	Sol.	20	S	X
		60	S	X
Sodium sulphate	Sat. Sol.	20	S	X
		60	S	X
	0.1	20	S	X
		60	S	X
Sodium sulphide	Sat. Sol.	20	S	X
		60	S	X
Sodium sulphide	Sat. Sol.	20	S	X
		60	S	X
	40	20	S	X
		60	S	X
Sulphur trioxide	Tg-l	20	Ns	X
		60	Ns	X
Sulphuric acid	Up to 10	20	S	S
		60	S	S
	15	20	S	S
		60	S	S
	From 10 to 30	20	S	S
		60	S	S
	From 10 to 50	20	S	S
		60	S	S
	50	20	S	S
		60	S	S
	From 50 to 75	20	S	S
		60	S	S
	From 50 to 90	20	X	S
		60	X	L
		80	X	Ns
	From 75 to 90	20	X	S
		60	X	L
		80	X	Ns
	95	20	X	S
		60	X	L
		80	X	Ns
	96	20	X	S
		60	X	L
		80	X	Ns
	98	20	S	S
		60	Ns	L
		80	X	Ns
	Fuming	20	Ns	X
		60	Ns	X
Sulphurous acid	Up to 30	20	S	X
		60	S	X
Tannic acid	Sol.	20	S	X
		60	S	X
Tartaric acid	Sol.	20	S	X
		60	S	X
	Sat. Sol.	20	S	S
		60	S	S
Tetrahydrofuran	Tg-l	20	X	L
		60	X	Ns
Thionyl chloride	Tg-l	20	Ns	X
		60	Ns	X
Tin (II) chloride	Sat. Sol.	20	S	X
		60	S	X
Tin (IV) chloride	Sol.	20	S	X
		60	S	X
Toluene	Tg-l	20	L	S
		60	Ns	L
Trichloroethilene	Tg-l	20	Ns	L
		60	Ns	Ns
Triethanolamine	Sol	20	S	X

COMPOUND	Concent. (%)	T (°C)	HDPE	PE-X
Hydrogen peroxide	30	60	S	X
	90	20	S	X
		60	Ns	X
Hydroquinone	Sat. Sol.	20	S	X
		60	S	X
Iodine (in potassium iodide)	Sat. Sol.	20	Ns	X
		60	Ns	S
Iodine in alcohol	Work Sol.	20	Ns	X
		60	Ns	X
Lactic acid	10	20	S	X
		60	S	X
	28	20	S	X
		60	S	X
	From 10 to 90	20	S	X
		60	S	X
	Tg-l	20	S	X
		60	S	X
Lead acetate	Dil. Sol.	20	S	X
		60	S	X
	Sat. Sol.	20	S	X
		60	S	X
Magnesium carbonate	Susp	20	S	X
		60	S	X
Magnesium chloride	Sat. Sol.	20	S	X
		60	S	X
Magnesium hydroxide	Sat. Sol.	20	S	X
		60	S	X
Magnesium nitrate	Sat. Sol.	20	S	X
		60	S	X
Magnesium sulphate	Sat. Sol.	20	S	X
		60	S	X
Maleic acid (T=160°)	Sat. Sol.	20	S	X
		60	S	X
Malic acid	Sol.	20	S	X
		60	S	X
	Sat. Sol.	20	S	X
		60	S	X
Mercuric chloride	Sat. Sol.	20	S	X
		60	S	X
Mercuric cyanide	Sat. Sol.	20	S	X
		60	S	X
Triethanolamine	Sol.	60	L	X
Urea	Sol.	20	S	X
		60	S	X
Xylenes	Tg-l	20	L	X
		60	Ns	X
Zinc carbonate	Susp.	20	S	X
		60	S	X
Zinc chloride	Sat. Sol.	20	S	X
		60	S	X
	58	20	S	X
		60	S	X
Zinc nitrate	Sat. Sol.	20	S	X
		60	S	X
Zinc oxide	Susp.	20	S	X
		60	S	X
Zinc sulphate	Sat. Sol.	20	S	X
		60	S	X

S	SATISFACTORY RESISTANCE
L	LIMITED RESISTANCE
Ns	NON-SATISFACTORY RESISTANCE
X	NO DATA AVAILABLE
Dil. Sol.	WATER SOLUTION DILUTED WITH A CONCENTRATION ≤ A 10%
Sol.	WATER SOLUTION WITH A CONCENTRATION >10 UNSATURATED
Sat. Sol.	SWATER SOLUTION SATURATED PREPARED AT 20 °C
Tg-s	SOLID TECHNICAL DEGREE
Tg-l	LIQUID TECHNICAL DEGREE
Tg-g	GASEOUS TECHNICAL DEGREE
Work Sol.	NORMAL SOLUTION FOR INDUSTRIAL USE
Susp.	SUSPENSION OF SOLIDS IN A SATURATED SOLUTION AT 20 °C
Conc.	PURE COMPOUND EMPLOYED

This table derives from the Standard ISO/TR 10358:1993.
For compounds not listed on this table, check compatibility in the abovementioned standard.

PPSU CHARACTERISTICS

TABLE OF PPSU PROPERTIES			
Specific weight		g/cm³	1.29
Linear expansion coefficient		mm/m °C	0.05
Impact strength		J/m	690
Ultimate elongation	23 °C	%	60-120
Modulus of elasticity	23 °C	MPa	2,400
	60 °C		1,950
	90 °C		2,000
Tensile strength	23 °C	MPa	75
	60 °C		65
	90 °C		60

INDICATIONS ON CHEMICAL RESISTANCE OF PPSU

COMPOUND	NOTE	SUITABILITY
1,1,1 trichloroethane	GOOD	S
Benzene	SUFFICIENT	S
Ethanol	EXCELLENT	S
n-Butanol	EXCELLENT	S
Toulene	SUFFICIENT	S
Iso-octane	EXCELLENT	S
Methyl-ethyl-ketone	STRONG ATTACK AND BREAKAGE	Ns
2-Etossyethanol	STRONG ATTACK AND BREAKAGE	Ns
Carbon Tetrachloride	EXCELLENT	S
Acetic acid (20%)	EXCELLENT	S
Hydrochloric acid (20%)	EXCELLENT	S
Sulphuric acid (20%)	EXCELLENT	S
Sodium hydroxide (20%)	EXCELLENT	S
Aldehydes	STRONG ATTACK AND BREAKAGE	Ns
Ketones	STRONG ATTACK AND BREAKAGE	Ns

S	**SATISFACTORY RESISTANCE**
L	**LIMITED RESISTANCE**
Ns	**NON-SATISFACTORY RESISTANCE**

CHEMICAL RESISTANCE OF PPSU IMMERGED FOR 7 DAYS AT ROOM TEMPERATURE (23°C)

COMPOUND	Concent. (%)	T (°C)	NOTE
1,1,1 trichloroethane	100	23	Unaltered
Acetone	100	23	Surface opacity
Benzene	100	23	Streak
Butanol	100	23	Unaltered
Butyl Acetate	100	23	Unaltered
Carbitol	100	23	Unaltered
Cycloexanol	100	23	Unaltered
Ethanol	100	23	Black spots
Ethyl Acetate	100	23	Whitened edges
Ethylene Glycol	100	23	Unaltered
Formaldehyde	40	23	Unaltered
Glycerol	100	23	Unaltered
Methanol	100	23	Streak
Toluene	100	23	White spots
Acetic acid	100	23	Slight attack
Acetic anhydride	100	23	Cracking
Citric acid	100	23	Unaltered
Formic acid	10	23	Unaltered
Hydrochloric acid	20	23	Unaltered
Hydrochloric acid	37	23	Whitening
Nitric acid	20	23	Unaltered
Nitric acid	71	23	Dulled
Oleic acid	100	23	Unaltered
Potassium hydroxide	10	23	Unaltered
Sodium hydroxide	10	23	Unaltered
Sulphuric acid	50	23	Unaltered
Sulphuric acid	97	23	Strong attack
Brakes liquid	100	23	Streak
Diesel oil	100	23	Unaltered
Hydraulic oil	100	23	Unaltered
Airplane fuel	100	23	Streak
Kerosene	100	23	Unaltered

C CHEMICAL RESISTANCE OF PPSU WITH MOST COMMON PRODUCTS FOR BUILDING

INSULATING MATERIAL

COMMON NAME	PRODUCER	GOOD	BAD
Brush-on / Blue insulation for threads	Hercules	☺	
Insulation for threads for durable seal	Federal Process Cor.		☹
Kolmat connection paste	Denso	☺	
Locher special paste	Locher & Co ag	☺	
Loctite 5061	Loctite	☺	
Loctite 518	Loctite		☹
Loctite 5331	Loctite	☺	
Loctite 5366 silicomet AS-310	Loctite	☺	
Loctite 542	Loctite		☹
Loctite 55	Loctite		☹
Loctite 577	Loctite		☹
Loctite dry seal	Loctite	☺	
Loctite red silicon	Loctite	☺	
Neo-Fermit	Nissen & Volk	☺	
Neo-Fermit universal 2000	Krause K	☺	
Blue paste for pipe connection	Oatey	☺	
White paste for pipe connection	Oatey	☺	
Pure white compound in teflon for pipes	RectorSeal Corp.	☺	
RectorSeal # 5	RectorSeal Corp.		☹
RectorSeal T Plus 2	RectorSeal Corp.	☺	
Right Stuff insulation	Permatex Inc.	☺	
Rite-Lok	Chemence		☹
“scotch-grip” rubber and insulating adhesive #1300	3M		☹
Gomma “scotch-grip” e adesivo isolante # 2141	3M		☹
Gomma “scotch-grip” e adesivo isolante # 847	3M		☹
Selet Unyten	Whitman		☹
Silicon # 4210	----------	☺	
Viscotex Locher 2000 paste	Viscotex	☺	
X-Pando compound for pipe connection	X-Pando Producrs Co.	☺	

GLUES AND FOAMS

COMMON NAME	PRODUCER	GOOD	BAD
Contact glue	----------		☹
GB480 (Vidoglue)	Pekay		☹
GB685 (Insulglue)	Pekay	☺	
PUR foam (difenilmetano4.4disocyanate)	Wickes		☹
Repa R 200	Wefa Plastic	☺	
Glue for waterproofing wood	Soudal	☺	

GREASES

COMMON NAME	PRODUCER	GOOD	BAD
Paste for hydraulic assembly	Dansoll Silec	☺	
Blue silicone spray	Dansoll Silec	☺	
Kluber Unisilikone L 250 L	Kluber	☺	
Kluber Unisilikone TK 572/300	Kluber	☺	
Kluber Unisilikone L 641	Kluber	☺	
Litiostearato –fenilmetile-polisiloxane	---------	☺	
Luga Spray (LEIF KOCH)	Dansoll	☺	
Rhodorsil 47 V 1000	Rhodia	☺	
Silicone Spray (MOTIP)	Motip	☺	
Silicone lubricant SDP ref. S-155	---------	☺	
Turmisilon GL 320-12	---------	☺	
Silicone	Wacker	☺	

FILLING FOR WALLS

COMMON NAME	PRODUCER	GOOD	BAD
FT Extra	---------	☺	
Polyfila for internal walls	Polyfilla	☺	
Instantaneous filling	Henkel	☺	
Mortar for repairs	Henkel		☹
Portland cement	CBR	☺	
Stucal plaster	Gyproc	☺	

** all of the products are tested at 95°C for 168 hours.*
** for further information consult the technical details of the product for compatibility with plastic materials.*
** if you are using a product not included in this list, then contact your local fitting distributor.*

D MEASUREMENT UNITS AND CONVERSIONS

TABLE OF MULTIPLES AND SUBMULTIPLES OF THE MEASUREMENT UNITS

PREFIX	SYMBOL	MULTIPLYING FACTOR	
Tera	T	10^{12}	1,000,000,000,000
Giga	G	10^{9}	1,000,000,000
Mega	M	10^{6}	1,000,000
Kilo	k	10^{3}	1,000
Etto	h	10^{2}	100
Deca	da	10	10
Deci	d	10^{-1}	0.1
Centi	c	10^{-2}	0.01
Milli	m	10^{-3}	0.001
Micro	µ	10^{-6}	0.000 001
Nano	n	10^{-9}	0.000 000 001
Pico	p	10^{-12}	0.000 000 000 001

CONVERSION TABLE OF THE MAIN MEASUREMENT UNITS

SIZE	SYST.	NAME	m.u.	CONVERSION
Length	SI	meter	m	1 m = 3.28 ft = 39.37 in
	IN	inch	1” in	1 in = 2.54 cm
	IN	hand	-	4 in = 10.16 cm
	IN	span	-	9 in = 22.86 cm
	IN	foot	1” ft	1 ft = 12 in = 30.48 cm
	IN	yard	yd	1 yd = 3 ft = 91.44 cm
	IN	marine mile	-	1 miglio marimo = 1852 m 1 nodo = 1853.181 m
	IN	US terrestrial mile	mi	1 mi = 1609.347 m
Mass	SI	Kilogram	kg	1 kg = 2.204 lb
	N	ton	T	1 t = 1000 kg = 1 Mg
	IN	pound	lb	1 lb = 0.454 kg
Strength and Weight	SI	newton	N	1 N = 0.102 kgf 1 kgf = 9.81 N
	ST	kilogram	kg	1 kg = 9.81 N 1 N = 0.102 kg
Pressure	SI	pascal	Pa	1 Pa = 1 N/m² 1 kPa = 0.01 bar = 1 N/cm²
	N	bar	bar	1bar = 100,000 Pa = 1.019 kg/cm² = 14.48 psi = 10.19 mH_2O
	IN	pounds on inch²	psi	1 psi = 6.906 kPa = 0.068 bar = 0.0703 kg/cm²
	ST	technical atmosphere	at	1 at = 1 kg/cm² = 736 mm di Hg = 10 mH_2O = 98.066 Pa
	ST	kilograms on cm²	kg/cm²	1 kg/cm² = 98.068 kPa = 0.980 bar = 0.967 atm
	ST	metric atmosphere	atm	1 atm = 101325 Pa = 760 mm di Hg = 1.033 at = 1 torr
Volume	SI	cubic metre	m³	1 m³ = 35.3146 ft³ = 61023.759 in³ = 264.20 galUs
	IN	cubic feet	ft³	1 ft³ = 0.02832 m³ = 1728.0006 in³
	IN	cubic inch	in³	1 in³ = 0.00001638 m³ = 0.0005787 ft³
	US	gallon US	galUS	1 galUS = 0.003785 m³
	IN	gallon UK	galUK	1 galUK = 0.004546 m³
Specific weight	SI	newton on dm³	N/dm³	1 N/dm³ = 0.102 kg/dm³
	ST	kilogram on dm³	kg/dm³	1 kg/dm³ = 9.807 N/dm³
Temperature	SI	Kelvin	K	1 K = °C + 273.15
	SI	centigrade degree	°C	1 °C = (°F-32) x 5/9 = K-273.15
	IN	fahrenheit degree	°F	1 °F = 9/5 x °C + 32
Moment or couple	SI	newton per meter	N·m	1 N·m = 0.102 kg·m = 0.7376 ft·lb
	ST	kilogram per meter	kg·m	1 kg·m = 9.807 N·m = 7.233 ft·lb
Work and Energy	SI	joule	J	1 J = 1 N·m 1 J = 0.102 kg·mJ 1 kg·m = 9.807
	ST	kilowatt per hour	kW·h	1 kW·h = 1.36 CV·h = 860 kcal = 1000 W x 1J = 3.6 x 106 J
	ST	horsepower per hour	CV·h	1 CV·h = 270.000 kg·m = 0.736 kW·h
Power	SI	watt	W	1 kW = 1.36 CV = 1.34 HP = 860 kcal/h
	ST	horsepower	CV	1 CV = 0.736 kW = 0.986 HP = 75 kg·m/s
	IN	horsepower	HP	1 HP = 1.014 CV = 0.746 kW
Angle	SI	radiant	rad	1 rad = 57°,29578 = 57°17’44”,81 = 63c
	ST	sexag.angle	1°	1° = 0.01745 rad = 1.11111c
	ST	centesimal angle	1c	1 c = 0.01571 rad = 0.90°

SI - INTERNATIONAL SYSTEM
ST - TECHNICAL SYSTEM
IN - ENGLISH SYSTEM
US - AMERICAN SYSTEM

E.1 Pexal water supply system

PEXAL water supply system for hot and cold water distribution and heating. Composed of a multi-layer pipe in PEXb-Al-PEXb with TIG butt-welding of the metal layer along the entire length of the pipe with certification of the welding process issued by IIS (Italian Institute of Welding) and crosslinking of the internal and external layers using the silane technology. Pipe suitable for transporting fluids, in compliance with ISO TR 10358, at a continuous maximum working temperature of 95°C and a maximum pressure of 10 bar. Both compression and press fittings are available, made with alloys CW602N and CW617N obtained by means of hot molding followed by a mechanical processing, equipped with elastomer o-rings. This system has achieved product approval issued by accredited institutes and in compliance with the regulations in force on potable water.

TECHNICAL DETAILS OF THE PEXAL MULTILAYER PIPE												
External diameter	mm	14	16	16	18	20	20	26	32	40	50	63
Total thickness	mm	2	2,25	2	2	2,5	2	3	3	3,5	4	4,5
Coil length	m	100	100	100	100	100	100	50	50	-	-	-
Pipe length	m	5	5	5	5	5	5	5	5	5	5	5
Water volume content	l/m	0,077	0,103	0,113	0,154	0,176	0,201	0,314	0,531	0,960	1,385	2,289
Operating temperature	°C	0-80	0-80	0-80	0-80	0-80	0-80	0-80	0-80	0-80	0-80	0-80
Maximum operating temperature	°C	95	95	95	95	95	95	95	95	95	95	95
Maximum operating pressure temp 95°	bar	10	10	10	10	10	10	10	10	10	10	10
Coefficient of heat expansion	mm/mK	0,026	0,026	0,026	0,026	0,026	0,026	0,026	0,026	0,026	0,026	0,026
Internal heat conductivity	W/m K	0,43	0,43	0,43	0,43	0,43	0,43	0,43	0,43	0,43	0,43	0,43
Internal roughness	mm	0,007	0,007	0,007	0,007	0,007	0,007	0,007	0,007	0,007	0,007	0,007
Oxygen diffusion	mg/l	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000
Bending radius without pipe bender	mm	70	80	80	90	100	100	140	160	-	-	-
Bending radius with pipe bender	mm	35	50	50	65	80	80	100	120	150	190	240
Colour	RAL	white 9003	white 9003	white 9003	white 9003	white 9003	white 9003	white 9003	white 9003	white 9003	white 9003	white 9003

TECHNICAL DETAILS OF INSULATED PEXAL MULTILAYER PIPE									
External diameter of bare pipe	mm	14	16	16	18	20	20	26	32
Pipe thickness	mm	2	2,25	2	2	2,5	2	3	3
Insulation thickness	mm	6	6/10	6/10	6	6/10	6/10	6/10	6
External diameter of insulated pipe	mm	26	28	28	30	32	32	38	44
Coil length	m	50	50	50	50	50	50	50	50
Insulation density	Kg/m³	33	33	33	33	33	33	33	33
Tensile strength of insulation	N/mm²	>0,18	>0,18	>0,18	>0,18	>0,18	>0,18	>0,18	>0,18
Tear elongation of insulation	%	>80	>80	>80	>80	>80	>80	>80	>80
Vapour barrier of insulation	mg/Pa s.m	<0,15	<0,15	<0,15	<0,15	<0,15	<0,15	<0,15	<0,15
Heat conductivity of insulation	W/mk	0,0397	0,0397	0,0397	0,0397	0,0397	0,0397	0,0397	0,0397
Heat conductivity of insulated pipe	W/mk	0,066	0,064	0,06	0,068	0,068	0,066	0,070	0,072
Fire resistance	-	No	No	No	No	No	No	No	No
THE INSULATING LAYER IS MADE OF CLOSED CELL FLAME-RETARDANT HDPE									

E.2 Mixal water supply system

MIXAL water supply system for hot and cold water distribution and heating. Composed of a multi-layer pipe in PEXb-Al-HDPE with TIG butt-welding of the metal layer along the entire length of the pipe with certification of the welding process issued by IIS (Italian Institute of Welding) and crosslinking of the internal layer using the silane technology. Pipe suitable for transporting fluids, in compliance with ISO TR 10358, at a continuous maximum working temperature of 95°C and a maximum pressure of 10 bar. Both compression and press fittings are available, made with alloys CW602N and CW617N obtained by means of hot molding followed by a mechanical processing, equipped with elastomer o-rings. This system has achieved product approval issued by accredited institutes and in compliance with the regulations in force on potable water.

TECHNICAL DETAILS OF INSULATED MIXAL MULTILAYER PIPE			
External diameter	mm	16	20
Total thickness	mm	2	2
Thickness of aluminium layer	mm	0,2	0,25
Coil length	m	100/120/240/500	100/120/240
Pipe length	m	5	5
Water volume content	l/m	0,113	0,201
Operating temperature	°C	0-80	0-80
Maximum operating temperature	°C	95	95
Maximum operating pressure temp 95°	bar	10	10
Coefficient of heat expansion	mm/m K	0,026	0,026
Internal heat conductivity	W/m K	0,43	0,43
Internal roughness	mm	0,007	0,007
Oxygen diffusion	mg/l	0,000	0,000
Bending radius without pipe bender	mm	80	100
Bending radius with pipe bender	mm	50	80
Colour	RAL	white 9003	white 9003

TECHNICAL DETAILS OF INSULATED MIXAL MULTILAYER PIPE			
External diameter of bare pipe	mm	16	20
Pipe thickness	mm	2	2
Insulation thickness	mm	6	6
External diameter of insulated pipe	mm	28	30
Coil length	m	50	50
Insulation density	Kg/m^3	33	33
Tensile strength of insulation	N/mm^2	> 0,18	> 0,18
Tear elongation of insulation	%	> 80	> 80
Vapour barrier of insulation	mg/Pa s.m	< 0,15	< 0,15
Heat conductivity of insulation	W/m K	0,0397	0,0397
Heat conductivity of insulated pipe	W/m K	0,066	0,066
Fire resistance	-	NO	NO
Colour	RAL	white 9003	white 9003
THE INSULATING LAYER IS MADE OF CLOSED CELL FLAME-RETARDANT HDPE			

E.3 Pexal Easy water supply system

PEXAL EASY water supply and heating system, composed of a multi-layer pipe in PEXb-Al-PEXb with TIG butt-welding of the metal layer along the entire length of the pipe with certification of the welding process issued by IIS (Italian Institute of Welding) and crosslinking of the internal and external layer using the silane technology. Fittings are in PPSU (Polyphenyl Sulfone) obtained by molding with elastomer o-rings and pipe-fitting connections otained by socketing. System suitable for transporting fluids, in compliance with ISO TR 10358, at a continuous maximum working temperature of 95°C and a maximum pressure of 10 bar.

Technical manual
L02-207/2

Uff.Pub. Valsir - L02-207/2 Giugno 2008

Among the first in the world to have obtained the certification **UNI EN ISO 9001:2000** with the certification institute **DNV**.

You can indicate in which areas you would like to see improvement, indicating us your degree of satisfaction and filling in an appropriate form. Visit our Web Site **www.valsir.it**, enter the "Service" section and click "Give your opinion on Valsir".

Valsir S.p.A.
Località Merlaro, 2
25078 Vestone (Brescia) Italia
Tel. +39 0365 877011 - Fax +39 0365 820261
valsir@valsir.it - commerciale.italia@valsir.it
assistenza@valsir.it - impianti@valsir.it
export@valsir.it