aquatechnik®
united kingdom

Solutions for plumbing and plant-engineering

safety® plus+ for multilayer pipes

WRAS APPROVED PRODUCT

Lloyd's Register

kiwa

ISO 9001:2015

ISO 14001:2015


aquatechnik
tecnica di estrusione e stampaggio ad iniezione


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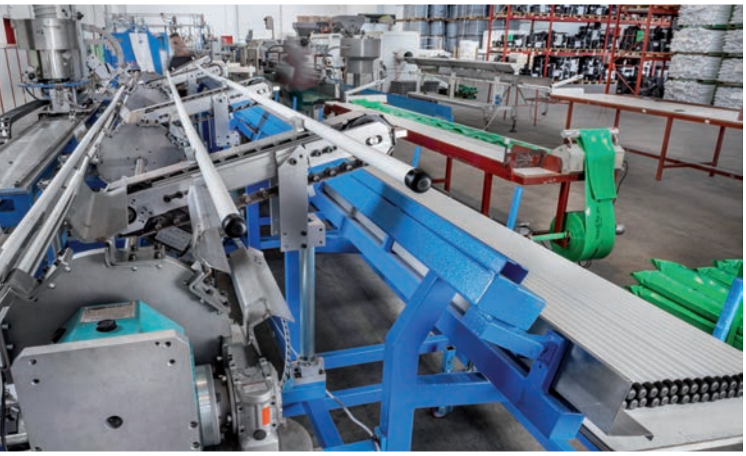

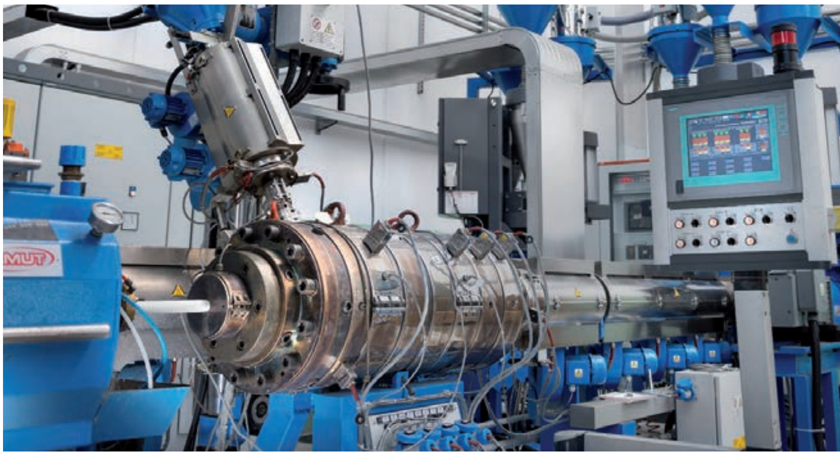

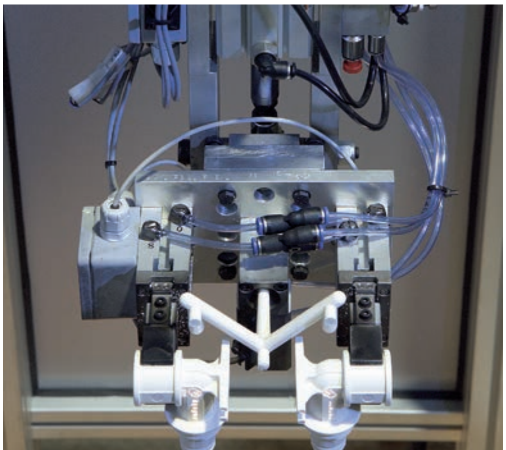

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Who we are

Aquatechnik produces and distributes sanitary, heating, air conditioning and compressed air pipe work systems for domestic, commercial and industrial installations. Our manufacturing facilities, located in Magnago (MI), comprise several departments serving a variety of processes: injection moulding, extrusion and pipe coating, PUR foam and assembly of special fittings (manifolds). The production facility is supported by a Technical Department responsible for developing the tools and equipment required to process the various systems.

The above, combined with our laboratories and research centre, along with our high level of automation, ensure the highest production standards. Our main warehouse which is located adjacent to the manufacturing facility, allows the fast and efficient distribution of products to our World Wide network of distributors.

Dedicated Aquatechnik Product Specialists and our specialist UK distributor Smith Brothers Stores, provide a complete sales and after-sales service.

The company is committed to innovation and product development, and has over time, developed a comprehensive and complete offering of pipe systems, components, special fittings and equipment that can meet the most varied requirements for pipe work installations.

Today, Aquatechnik can boast that thousands of our systems have been installed thanks to the approvals obtained from certification institutes worldwide, which rank us among the leading companies in Europe and the world.

Our history

Aquatechnik was founded in the early 1980s after current president and founder Lino Petenà's extensive experience in the hydro-thermal-sanitary sector, with the desire to develop and produce innovative new solutions for pipe work systems in plastic materials, as an alternative to conventional metallic pipes.

Our fusio-technik welded system was successful from its introduction and by 1984, the company had expanded its facilities to meet the increasing sales levels and demand. Our first headquarters was a warehouse of about 1000 m^2 located in Busto Arsizio.

At the beginning of the 1990s, the Company built a dedicated Training Centre in order to provide product and installation training for its customers.

At this time the main facility moved to Magnago (MI), where it remains to date, stretching over an area of 60,000 m^2.

The company, which was initially created with the sole purpose of sales and distribution, took its first steps in production and commenced sales activities abroad.

At the turn of the millennium, Aquatechnik established itself with a unique patented connection system between multilayer pipes and PPS fittings: the "safety" system. Initially produced in a brass & plastic version (safety-metal) and later with a fitting made entirely in plastic (PPS), it was received enthusiastically both at a National and International level.

The production capacity today is about 6,000 tonnes/year of PP-R for pipe production and the production potential is greater than 20,000,000 metres/year of multilayer pipe. The injection moulding department produces up to 80,000,000 parts/year.

The production site works in compliance with the ISO 9001 standards since the early 1990s and in full respect of the environment according to ISO 14001 Standards.

The company today employs in excess of 150 people.

Our principles

Aquatechnik was founded with a mission to distribute, build and develop innovative products that can simplify applications, ensure maximum safety in the installations and contribute to energy savings, respecting environmental sustainability.

Passion is what drives the soul of our company, leading us to pursue the goals we set and push us to reach increasingly higher levels.

Quality is the heart of our business philosophy, as it unites the concepts of style and design with product excellence, which have always been the distinguishing features of made in Italy products: the union of these elements is the key to opening foreign markets.

Listening to and taking care of our customers stimulates the creation of new ideas and forges our entrepreneurial culture, facilitating a collaborative atmosphere, reciprocally satisfying needs.

Aquatechnik means “water technology”, a concept that we have expanded and integrated into different systems, becoming, to date, one of the most influential players in the hydro-thermal-sanitary market.

Marco Petenà (CEO): “Our company is a family business and every person that works with us is an important part of this family.”

contents


safety

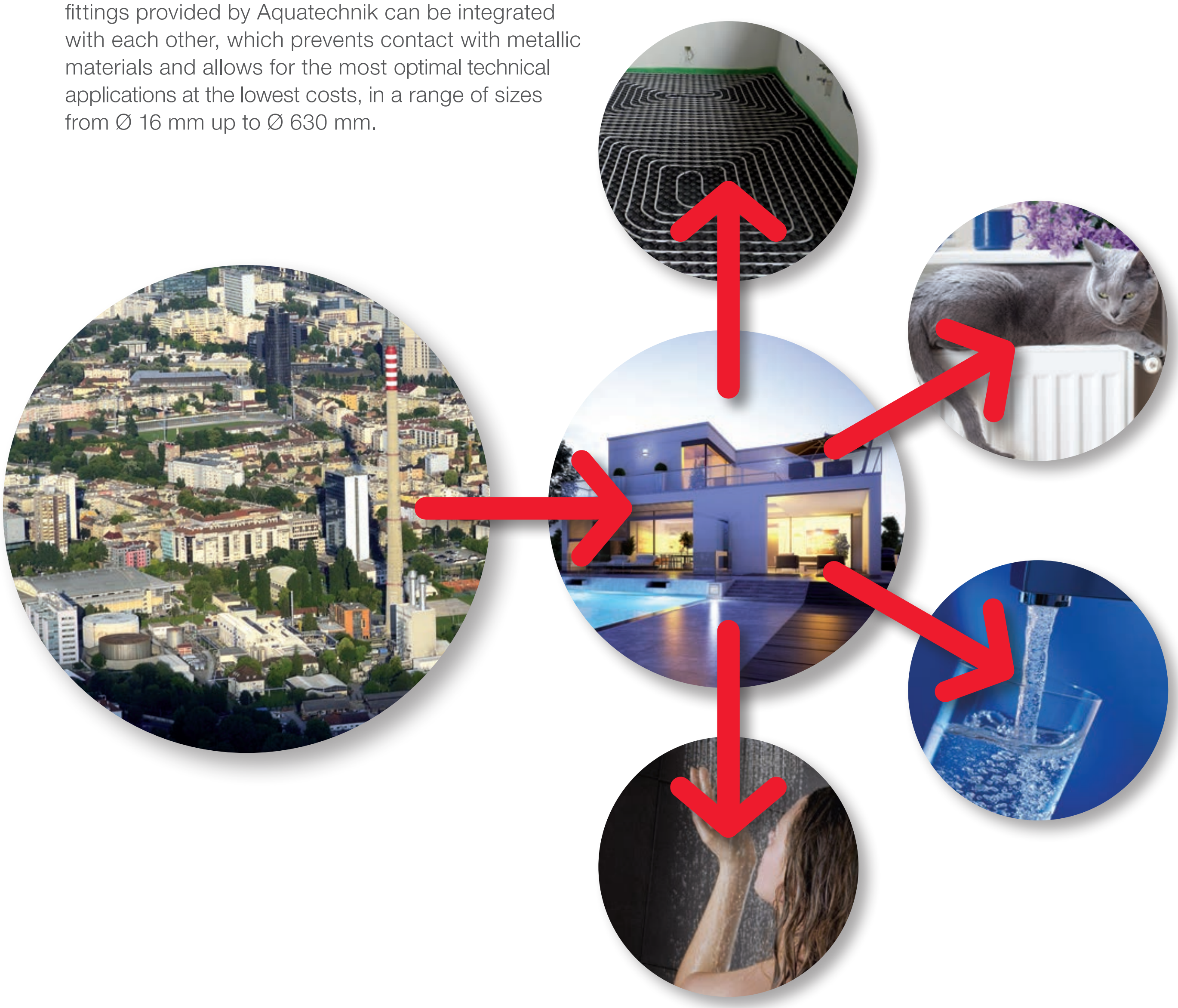
Introduction

Aquatechnik provides a complete range of multilayer pipes and fittings with a wide variety of solutions from Ø 16 to Ø 75 mm (90 mm).

The highest quality pipes and fittings, approved by the most widely recognised certification organisations in the world, can be chosen for each installation. Furthermore, each process is guaranteed by an Integrated Quality and Environmental Management System and is compliant with ISO 9001 and ISO 14001 standards.

Continual research for new solutions has further widened the potential fields of application.

With the creation of special parts, all pipe systems and fittings provided by Aquatechnik can be integrated with each other, which prevents contact with metallic materials and allows for the most optimal technical applications at the lowest costs, in a range of sizes from Ø 16 mm up to Ø 630 mm.



Basic materials

PE-X (crosslinked polyethylene)

PE-X is a polymer which, after cross-linking, is thermoset and displays excellent characteristics for the distribution of thermo-sanitary water in terms of chemical, thermal, creep, fracture toughness and to stress-cracking resistance.

PE-X is a polyethylene that is cross-linked during or at the end of the transformation process (extrusion in the case of pipes) by the initial addition of specific additives.

The cross-linking process that leads to the formation of lateral bonds between the different polymer chains can take place using a number of different technologies:

- **PE-Xa with peroxides**

  This is produced by the decomposition of peroxide during the extrusion process: the free radicals which are formed, generate bonds between the carbon atoms in the polymer chains.

- **PE-Xb with silanes**

  After extrusion of the pipe, the cross-linking agents are activated via exposure of the polymer to water vapour, which leads to the formation of silane bonds between the carbon atoms in the polymer chains.

- **PE-Xc by irradiation**

  After the transformation process (extrusion or moulding), electron bombardment takes place using γ or β radiation which creates bonds between the carbon atoms in the polymer chains. This procedure is not performed directly by the manufacturers of the products, but by specialised companies.

- **PE-Xd by means of azo compounds**

  This process does not currently have any industrial applications.

Pipes produced by Aquatechnik are made of PE-Xb.

Aluminium

Material known for its lightness, lifespan and physical resistance.

The combination of cross-linked polyethylene and aluminium enables the production of pipes (so-called “multilayer”) with exceptional mechanical properties, combining the advantages of the two materials in one single product.

The intermediate metallic layer of multilayer multi-calor pipe is made from a foil of a special aluminium alloy.

The foil is formed around the PE-Xb layer and the two ends, which run along the length of the pipe, are then TIG (Tungsten Inert Gas) butt welded.

The TIG welding process welds aluminium thicknesses ranging from 0.2 to 2.5 mm.

Large diameter pipes with high aluminium thicknesses can thus be welded using this particular particular method. The main characteristics of the aluminium alloy used in the manufacture of multilayer pipes are the following:

- long lifespan and excellent corrosion resistance;
- excellent working properties;
- high mechanical strength and temperature resistance;
- high yield point, which is the maximum applicable stress where a material maintains an elastic behaviour.

PE-HD (polyethylene high density)

Polyethylene is a semi-crystalline thermoplastic polymer consisting of long molecules (macromolecules), which may be linear or branched. The overall length of the macromolecules is a function of the molecular weight, which is defined as the sum of the atomic masses of all the atoms in the chains.

The molecular weight, its distribution and the degree of crystallinity determine the characteristics of the polymer.

Polyethylene is used in a range of densities: low (LDPE), medium (MDPE) and high (HDPE). As the density increases, the tensile strength, flexural strength, impact strength and melting temperatures also increase.

EVOH (ethylene/vinyl alcohol)

It is an ethylene/vinyl alcohol copolymer and is classified according to its molar fraction of ethylene: a low ethylene content confers greater barrier properties while a high ethylene content decreases its process temperature. Due to its excellent performance characteristics as an oxygen barrier, EVOH is commonly used in food packaging to ensure food and aroma preservation.

It is a highly transparent, oil and solvent resistant, printable and recyclable material. This thermoplastic polymer is commonly co-extruded between two layers of plastic or paper.

PE-RT (polyethylene of raised temperature resistance)

PE-RT is a thermoplastic material developed using a new catalyst in the polymerisation of polyethylene and special additives.

The result of this innovative process is a crystalline microstructure with a range of specific characteristics, such as ease and speed during the extrusion stage, flexibility and resistance to high temperatures without the need for cross-linking, which also makes it a low-cost product.

Multi-calor pipes

Product description

Multilayer PE-X/Al/PE-X pipes for sanitary, heating, air conditioning and compressed air systems.

For open laid exposed and concealed applications.

Multi-calor has the highest performance characteristics of the multilayer pipes provided by Aquatechnik. Their structure is made up of five layers of tightly bound materials which enhance the qualities of this metal-polymer duo.

The inner and outer layers are made from cross-linked polyethylene (PE-Xb), a polymer whose resistance to high temperatures and elevated hydrostatic pressures has been established by its use in engineering sector installations for more than thirty years. As far as organoleptic and non-toxicity factors are concerned, this material is universally recognised as one of the most suitable for the conveyance of drinking water.

The first stage of the production process is the extrusion of the inner layer of the pipe.

The system, fed by cross-linkable polyethylene granules, additives and catalysts, melts the mixture and conveys it through a matrix to form the inner layer. The molten material passes through a calibration system and cooling chamber in vacuum where it takes on the required size and shape.

In the next stage, a second extruder applies the first layer of adhesive to the surface of the pipe, which will allow a strong permanent bond between the plastic pipe and the aluminium foil, which will be applied later.

The aluminium foil, which is supplied in rolls, is accurately aligned by cutting the edges in such a way that the width exactly coincides with the circumference of the pipe on which it is to be wound.

Following alignment, the foil is gradually formed around the pipe using a multi-stage process that brings the two external edges into direct contact with each other whereupon TIG (Tungsten Inert Gas) butt welding takes place.

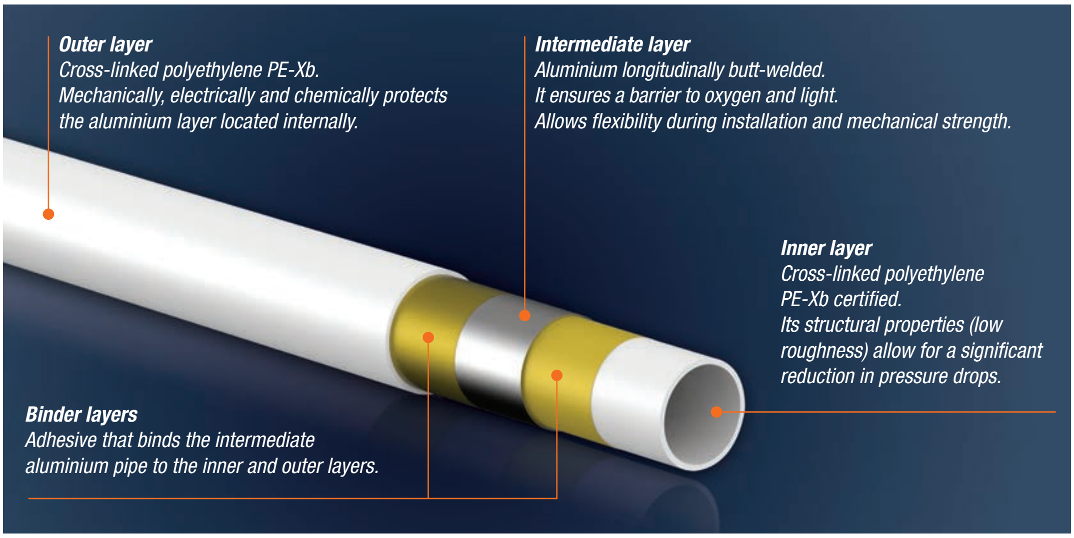
Unlike other processes, including overlapping or overlapping with subsequent welding, this particular technology for moulding aluminium pipes, besides guaranteeing uniformity of thickness over the entire circumference including the welding area, ensures **greater resistance** to pressure, **uniformity** in terms of mechanical properties, **greater adhesion** with the bonding layers and an oxygen barrier.

Immediately thereafter, the pipe is heated to activate the adhesive layer and generate the bond between the polyethylene and the aluminium.

A third extruder then covers the aluminium with an additional layer of adhesive. Finally, a fourth extruder covers the pipe with a layer of cross-linkable polyethylene with the thickness required to reach the final diameter of the finished pipe. At the end of the extrusion, a cross-linking process takes place using the silane method.

This process is performed by using heat and humidity together. This allows the water molecules to disperse inside the polyethylene, thus activating the silane components and making the polymer chains bind together via silane bonds, which creates a solid molecular structure with high mechanical strength.

Multi-calor pipe stratigraphy



In the last few decades, Aquatechnik has made a significant contribution in the improvement of multilayer technology using the design and manufacture of its “safety” fittings. This enhancement has included all stages of construction, from the application of new adhesives that are more resistant to mechanical stresses, to aluminium alloy foils with higher performance characteristics and that are easier to weld, and even includes the synchronisation of the entire manufacturing process to guarantee the highest standards of quality.

Check compatibility with our Product Specialists for conveying chemical products.

Advantages

The multi-calor range of pipes feature a host of outstanding properties due to their metal-plastic construction that are not possible with pipes made of a single material.

- **Durability and mechanical strength**

  The system has a durability that is guaranteed by product standards of at least a 50 year lifecycle at pressures of 10 bar and temperatures up to 95°C. For operating temperatures below 95°C, the pipes are able to withstand pressures greater than 10 bar and demonstrate a high degree of reliability over time. The mechanical properties of multi-calor pipes are such that the pressures required at room temperature to fail are (in relation to the diameter) over 100 bar. Durability is also enhanced by the high abrasion resistance of the material, which makes the pipes particularly resistant to frictional damage caused by high velocity and debris in the system.

■ **Corrosion resistance**

The polymeric nature of the materials ensures a total absence of corrosive phenomena which is typical of metals. An elevated resistance to commonly used chemicals allows their use in a variety of applications, including industrial settings.

■ **Low surface roughness and resistance to limescale**

Reduced roughness of the internal surface (0.007 mm) ensures reduction of pressure drops and eliminates the formation of surface deposits.

■ **Thermal expansion**

The low value of linear thermal expansion coefficient considerably reduces the axial elongation of pipes compared to other thermoplastic materials. The properties of multi-calor pipes are indeed comparable to those of normal metal pipes used in thermosanitary systems, but with a considerable reduction in the stress developed by the pipe in terms of expansion.

■ **Thermal conductivity**

The thermal conductivity of the pipe, between 0.42 ÷ 0.52 W/mK (in relation to the diameter), is approximately 900 times lower than that of copper, ensuring greater temperature stability of the conveyed fluid.

■ **Lightness, flexibility and form stability**

Multi-calor pipes are extremely light compared to metal pipes: weights are generally 1/4 compared to those of corresponding copper pipes and 1/5 compared to those of steel. In addition, the combination of cross-linked polyethylene and aluminium ensures excellent flexibility in the forming stage, which is maintained even after pipe bending. Multi-calor pipes are form stable allowing a reduction in the number of clamping collars compared to systems that require the installation of other plastic materials (PE-X, PE-RT, PP-R, PB, PVC-C, etc.).

■ **Sound absorption**

Cross-linked polyethylene is able to absorb vibrations to a high degree, giving it excellent soundproofing properties. In addition, the reduction of pressure drops guaranteed by the “safety” system allows operation at reduced speeds, (when compared to MLCP systems with Press Fittings) which favours noise reduction, and will have a direct impact in this sense.

■ **Impermeable to oxygen and light**

The butt-welded aluminium layer forms a barrier to oxygen and light and prevents algae formation and corrosion of the metal parts that constitute the plant.

■ **Toxicity**

The system is manufactured from completely non-toxic materials and is certified for the conveyance of drinking water.

■ **Eco-friendly**

Multi-calor pipes are manufactured using recyclable materials which can be recovered at the end of their lifecycle.

Data sheet and Marking

Pipe composition:

PE-X/Al/PE-X (cross-linked polyethylene + aluminium + cross-linked polyethylene)

Material:

1) inner: cross-linked polyethylene layer (PE-Xb)
2) intermediate: adhesive layer (grafted PE maleic anhydride)
3) central: aluminium layer (Al)
4) intermediate: adhesive layer (grafted PE maleic anhydride)
5) outer: cross-linked polyethylene layer (PE-Xb)

Colour:

white

Aluminium welding:

butt with TIG (Tungsten Inert Gas) technology with control camera

Inner layer chemical cross-linking:

PE-Xb with silanes, minimum cross-linking value 65%
Outer layer chemical cross-linking:
PE-Xb with silanes, minimum cross-linking value 65%

Aluminium alloy:

- annealing treatment
- minimum yield point 50 MPa
- elongation at break minimum 30%
- enlargement after welding over 20%

Adhesive:

minimum adhesion: 80 N/cm^2

Oxygen permeability:

< 0.1 mg/l

Maximum temperature:

- at continuous operation 70°C as per UNI EN 21003 standard
- peaks 95°C

Minimum temperature:

-45°C (below 0°C, glycol or antifreeze additives are required)

Maximum pressure

- at 70°C: 10 bar with peaks up to 95°C
- at 20°C: 25 bar (SF1 / 50 years)

Euroclass:

Fire Rating: C-s2, d0 according to EN 13501-1

Thermal conductivity:

0.420 ÷ 0.520 W/mK (depending on pipe Ø)

Coefficient of linear thermal expansion:

0.026 mm/mK

Internal roughness:

0.007 mm

Bending radius:

5 x diameter

Potability and organoleptic properties:

in compliance with European Union Directives 10/11; for national territory, see Decree No. 174 of 06 April, 2004

Marking:

wording printed along pipe length with dashed spacing each metre as follows:

m. <nnn> ft. <nnn> aquatechnik - multi-calor - dia x thk -

PE-X/AL/PE-X - Production date: HH:MM DD/MM/YY - Date service pipe: DD/MM/YY- (standard and product certification references) - PN 10 - 95°C - barcode - (internal notes of production) ---- MADE IN ITALY ----

Product specifications

The wide range of diameters and advantages provided by these pipes enables the use of multi-calor pipes in commercial, industrial and domestic applications, for sanitary, heating, cooling, irrigation and compressed air systems.

Multi-calor pipes in rods

Item	DN/OD*	int. Ø	Thickness	Aluminum thickness	DN	H_2O cont.	Weight**	Rod	Quantity per bundle
	mm	mm	mm	mm		l/m	Kg/m	m	m
74154	16	12	2	0.30	12	0.113	0.113	4	60
74156	20	16	2	0.40	15	0.201	0.156	4	40
74158	26	20	3	0.58	20	0.314	0.286	4	40
74160	32	26	3	0.75	25	0.531	0.390	4	32
74162	40	33	3.5	0.80	32	0.854	0.545	4	20
74164	50	42	4	1.00	40	1.383	0.833	4	20
74166	63	54	4.5	1.20	50	2.286	1.232	4	12
74168	75	65	5	1.35	65	3.312	1.603	4	8
74170	90	76	7	1.35	80	4.528	2.403	4	4

Multi-calor pipes in coils

Item	DN/OD*	int. Ø	Thickness	Aluminum thickness	DN	H_2O cont.	Weight**	Roll	Pallet
	mm	mm	mm	mm		l/m	Kg/m	m	m
74004	16	12	2	0.30	12	0.113	0.113	100	5200
74006	18	14	2	0.30	15	0.154	0.130	100	3200
74008	20	16	2	0.40	15	0.201	0.156	100	3000
74010	26	20	3	0.58	20	0.314	0.286	50	1200
74012	32	26	3	0.75	25	0.531	0.390	50	800

*The DN/OD value shown in the tables refers to metal pipes and indicates the corresponding plastic pipe.

**NB: the indicated weights are the physical weights of the item during the production phases, therefore they can change according to the dimensional variations of the product.

Multi-calor isoline pipes in coils, coated with thermal insulation

Coiled pipes in reels with diameters ranging from 16 to 32 mm are also supplied in a pre-insulated version.

The insulating material, which constitutes the coating of the pipe, is a closed-cell polyethylene foam with a water vapour diffusion resistance factor μ of approximately 5,000 and a thermal conductivity λ = 0.040 W/mK.

A low-density polyethylene film of different colours is then extruded on the insulating layer.

Multi-calor pipes in coils, with light blue thermal insulation

Range for heating systems, air conditioning and sanitary systems (energy containment and anti-condensation).

Item	DN/OD*	int. Ø	Thickness	Aluminum thickness	DN	ext. Ø insulated pipe	Insulation thickness	H_2O cont.	Weight**	Roll	Pallet
	mm	mm	mm	mm		mm	mm	l/m	Kg/m	m	m
74064	16	12	2	0.30	12	36	10	0.113	0.133	50	1200
74068	20	16	2	0.40	15	40	10	0.201	0.179	50	1000
74070	26	20	3	0.58	20	52	13	0.314	0.334	25	450
74072	32	26	3	0.75	25	58	13	0.531	0.445	25	300

Multi-calor isoline-plus pipes in coils, with thermal insulation

The insulating material, which constitutes the coating of the pipe, is a closed-cell polyethylene foam with a water vapour diffusion resistance factor μ of approximately 5,000 and a particularly low thermal conductivity λ = 0.035 W/mK.

Multi-calor pipes in coils, with red thermal insulation

Range for heating systems and high-temperature sanitary systems (energy containment) with increased insulation power.

Item	DN/OD*	int. Ø	Thickness	Aluminum thickness	DN	ext. Ø insulated pipe	Insulation thickness	H_2O cont.	Weight**	Roll	Pallet
	mm	mm	mm	mm		mm	mm	l/m	Kg/m	m	m
74064R	16	12	2	0.30	12	28	6	0.113	0.121	50	1700
74068R	20	16	2	0.40	15	32	6	0.201	0.166	50	1500

Multi-calor pipes in coils, with blue thermal insulation

Range for use in heating systems and high-temperature sanitary systems (energy containment) with increased insulation power.

Item	DN/OD*	int. Ø	Thickness	Aluminum thickness	DN	ext. Ø insulated pipe	Insulation thickness	H_2O cont.	Weight**	Roll	Pallet
	mm	mm	mm	mm		mm	mm	l/m	Kg/m	m	m
74064B	16	12	2	0.30	12	28	6	0.113	0.121	50	1700
74068B	20	16	2	0.40	15	32	6	0.201	0.166	50	1500

*The DN/OD value shown in the tables refers to metal pipes and indicates the corresponding plastic pipe.

**NB: the indicated weights are the physical weights of the item during the production phases, therefore they can change according to the dimensional variations of the product.

Multi-calor pipes coated with corrugated casing

Multi-calor pipes in coils, with blue corrugated casing

Range for sanitary distribution systems where a certain level of protection or pipe removal and replacement is required.

Item	DN/OD*	int. Ø	Thickness	Aluminum thickness	DN	ext. Ø insulated pipe	Insulation thickness	H_2O cont.	Weight**	Roll	Pallet
	mm	mm	mm	mm		mm	mm	l/m	Kg/m	m	m
74204	16	12	2	0.30	12	32.5	0.85	0.113	0.172	50	600
74206	20	16	2	0.40	15	37.5	1.05	0.201	0.235	50	600

Multi-calor pipes in coils, with red corrugated casing

Range for sanitary distribution systems where a certain level of protection or pipe removal and replacement is required.

Item	DN/OD*	int. Ø	Thickness	Aluminum thickness	DN	ext. Ø insulated pipe	Insulation thickness	H_2O cont.	Weight**	Roll	Pallet
	mm	mm	mm	mm		mm	mm	l/m	Kg/m	m	m
74224	16	12	2	0.30	12	32.5	0.85	0.113	0.172	50	600
74226	20	16	2	0.40	15	37.5	1.05	0.201	0.235	50	600

*The DN/OD value shown in the tables refers to metal pipes and indicates the corresponding plastic pipe.

**NB: the indicated weights are the physical weights of the item during the production phases, therefore they can change according to the dimensional variations of the product.

Application classes

In accordance with the international EN ISO 21003 standard, there are four application classes or fields of use which must be checked by laboratory testing in combination with the operating pressure (PD) that the manufacturer has established (4, 6, 8, 10 bar).

From this standard, it is clear that multi-calor pipes are certified for all four application classes for pressures up to 10 bar, as shown in the table.

Application class	Operating temperature	Duration	Max operating temperature	Duration	Malfunction temperature	Duration	Typical application
	°C	years	°C	years	°C	hours	
1ª	60	49	80	1	95	100	Sanitary hot water (60°C)
2ª	70	49	80	1	95	100	Sanitary hot water (70°C)
4ª	20 + 40 + 60	2.5 + 20 + 25	70	2.5	100	100	Floor heating and low temperature installations
5ª	20 + 60 + 80	14 + 25 + 10	90	1	100	100	High temperature heating installations

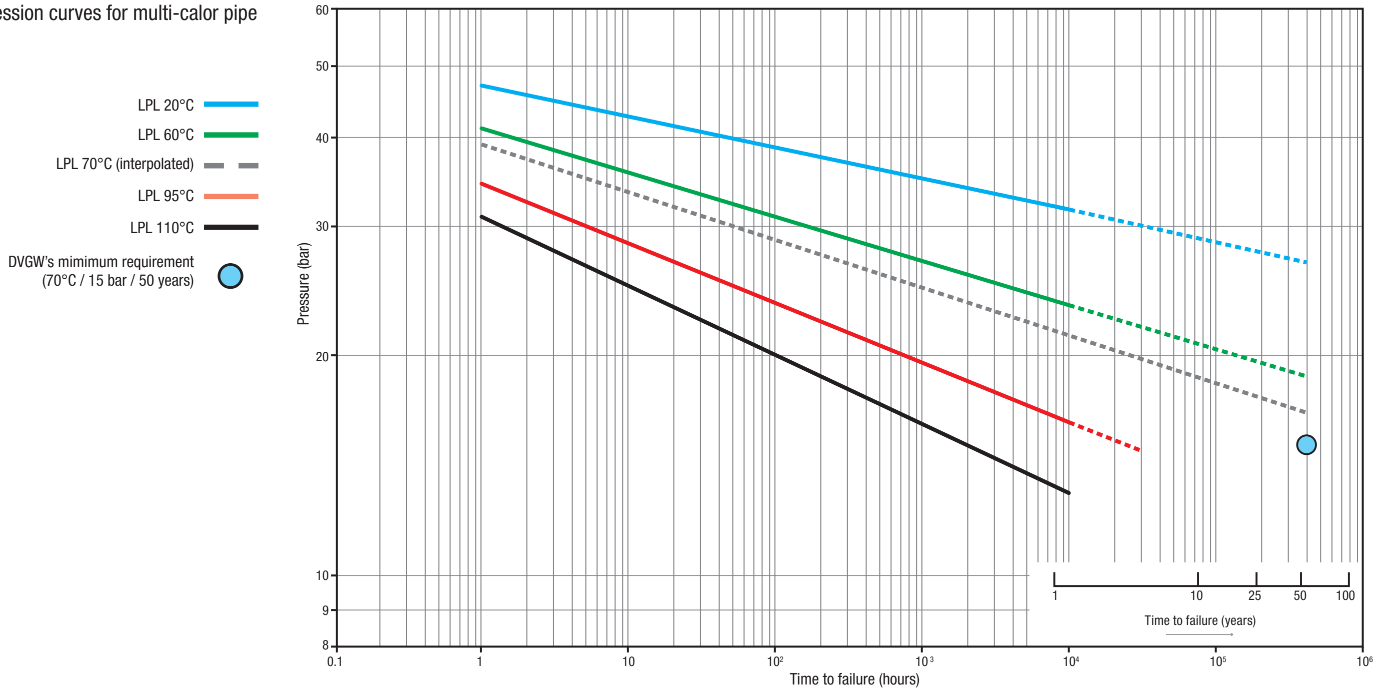
ISO 9080 Regression curves

The maximum stress that the material can withstand at 20°C, extrapolated to an established period of 50 years, is determined by internal pressure resistance tests performed on pipes for over 10,000 hours (greater than a year) according to the ISO 9080/DIN 16788 standard.

Testing is carried out at different temperatures in order to accelerate creep behaviour, subjecting the samples to different pressures and evaluating the time required to break the pipe. The values shown in the following graph are extrapolated from test report No. B477/14 performed by IMA Dresden, an organisation accredited by DVGW, DIN CERTCO, DIBt and ISO 17025.

These curves allow the determination of the operating conditions (pressures and temperatures) related to the expected lifetime of the product.

Regression curves for multi-calor pipe



Expected values of long-term resistance may vary according to the severity of particular applications or the presence of chemically aggressive liquids and/or surfactants: in these instances, contacting our Product Specialists is recommended.

Working conditions multi-calor pipes

* SF = Safety factor

Temperature	Years of operation	Pressure (bar)		
		SF 1*	SF 1.25*	SF 1.5*
10°C	10	29.8	23.8	19.8
	25	28.6	22.8	19.0
	50	27.8	22.2	18.5
	100	27.0	21.6	18.0
20°C	10	27.8	22.2	18.5
	25	26.8	21.4	17.8
	50	26.0	20.8	17.3
	100	25.2	20.1	16.8
30°C	10	26.0	20.8	17.3
	25	24.8	19.8	16.5
	50	24.0	19.2	16.0
	100	23.2	18.5	15.4
40°C	10	24.0	19.2	16.0
	25	22.8	18.2	15.2
	50	22.0	17.6	14.6
	100	21.2	16.9	14.1
50°C	10	22.0	17.6	14.6
	25	20.8	16.6	13.8
	50	20.0	16.0	13.3
	100	19.2	15.3	12.8
60°C	10	20.0	16.0	13.3
	25	18.8	15.0	12.5
	50	18.0	14.4	12.0
70°C	10	17.8	14.2	11.8
	25	16.8	13.4	11.2
	50	16.0	12.8	10.6
80°C	10	15.8	12.6	10.5
	25	14.8	11.8	9.8
95°C	5	13.6	10.8	9.0
	10	12.8	10.2	8.5

Fields of application

Multi-calor pipes can be used in commercial, industrial and domestic applications, for sanitary, heating, irrigation and compressed air systems.

The pipes are suitable for the conveyance of hot or cold drinking water.

Consult our Product Specialists in advance regarding the construction of systems to convey different liquids and/or substances.

Standards and Certifications

Product compliant with EN ISO 21003 and the main European, North American and Australian organoleptic standards for the conveyance of hot or cold drinking water, heating, air conditioning and compressed air systems.

Multi-calor pipes are also certified by the most widely recognised bodies in Europe and the world.

Certifications available on www.aquatechnik.co.uk – on the documentation page.

Pipe applications

🟢 Recommended for technical advantages
🟡 Possible use

	multi-calor
Drinking water at high temperature	🟢
Drinking water at low temperature	🟢
Heating	🟢
Conditioning/cooling	🟢
Chilled water	🟢
Swimming pools	🟢
Heating/ Cooling for sports facilities	🟢
Conveying chemicals*	🟢
Rainwater	🟡
Irrigation	🟡
Compressed air	🟢
Floor heating and cooling	🟢
Ship	🟢
District heating**	🟡
Civil geothermal plants	🟢
Industrial geothermal plants	🟢
Agriculture	🟡

* After a corporate technical evaluation ** max 90°C

Safety-plus fittings

In addition to the multilayer pipeline system outlined, Aquatechnik also provides a wide range of fittings made of polymeric materials that can be used to create connections with our pipeline system.

A key feature among the various fittings which the "safety" system uses is the particular geometry of the fittings, which has clear advantages in terms of fluid flow, ease of processing and levels of safety.

The unique feature of this system is that it maintains the same flow cross section at the pipe/fitting transition point, compared to traditional methods which show a significant reduction in flow.

This innovative principle allows considerable reduction of pressure drops in a simple, rapid and reliable way, which not only favours energy savings due to reduced pump energy usage, but also leads to a reduction in associated pipeline noise.

The joint system between pipe and fitting can thus be characterised by a number of fundamental factors:

- **expansion of the pipe (flaring):**
  made with specific patented tooling, it allows simple, rapid and safe coupling of the pipe and fitting;
- **the pipe/fitting joint system:**
  the pipe is positioned and secured at the fitting using a cap which eliminates any movement;
- **the anti-unscrewing system:**
  the cap is locked in position with a locking spanner produced by Aquatechnik, that ensures a secure joint. However, if required, this can be unlocked by using the locking spanner, allowing easy removal of the fitting.

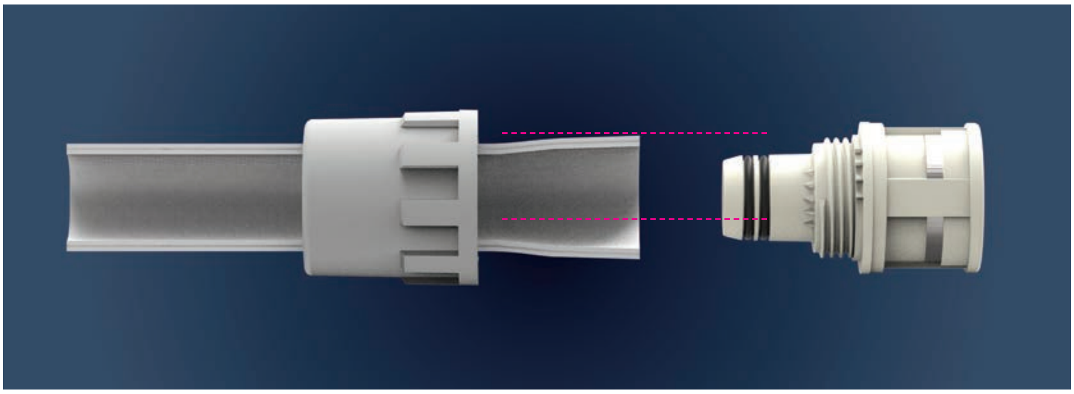
The safety-plus series of fittings was designed and patented by Aquatechnik to provide the highest levels of safety to multilayer pipe joints, improve their technical performance, and simplify installation methods. It is made from polyphenylene sulfide (PPS), an engineering plastic that is resistant to high temperatures and stresses.

In addition to these properties, PPS is distinguished by its durability, the complete elimination of corrosion risk and its excellent resistance to chemicals.

PPS also completes the “safety” systems suitability for the conveyance of drinking water. Its very low internal roughness combined with the innovative jointing system between pipe and fitting provides a significant reduction in pressure drops.

Male and female threads are made entirely out of synthetic material, a detail that guarantees the organoleptic features of the conveyed fluids, which never come into contact with any metal parts.

The O-rings are made from peroxide-crosslinked EPDM, a special rubber which has a long lifecycle and excellent compatibility with the conveyed liquids.



The research, analysis and design which began at the end of the 1990s, which was carried out on prototypes of various materials, led to a careful selection of the materials to be used in the final version of the system: PPS (polyphenylene sulfide) for the manufacture of fittings and PA-M (modified polyamide) for the construction of the caps.

Before being marketed in 2003, the products were subjected to extreme operating conditions for extended time, to the maximum limits of tolerable stress. The extremely positive results, recognised by prominent Italian and International certification institutes, led to the approval of “safety” for the National and International marketplaces.

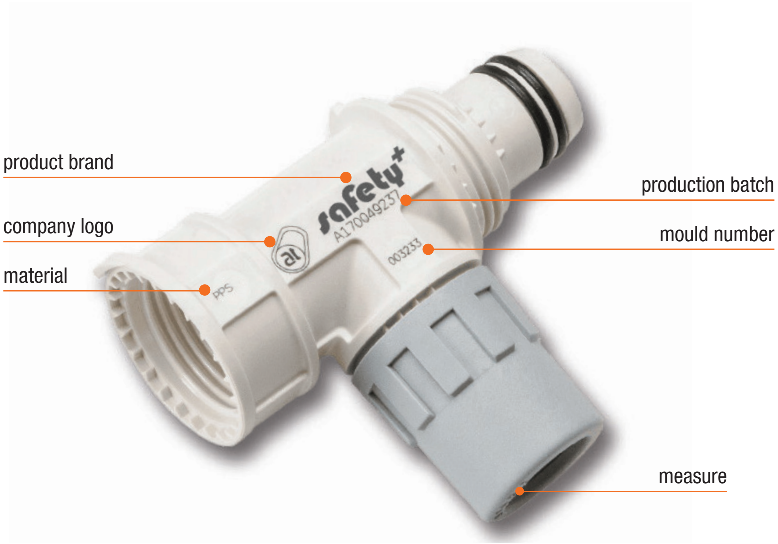
Basic material

Denomination	Working temperature	Expected life	Tensile strength	Flexural modulus	Impact resistance	Strain at break
	C°	years	N/mm²	N/mm²	KJ/m²	%
PPS (Polyphenylene sulfide)	from -100 to +207	50	126	8100	51	2.5

Advantages

The main advantages of the series are:

- **complete safety** in concealed and external pipe-fitting couplings;
- **high resistance to impact;**
- **elevated fluid flow rates and reduced pressure drops;**
- **rapid installation;**
- **option of dismantling all fittings;**
- **high resistance to chemicals;**
- **high fatigue resistance;**
- **good compatibility with hot and cold drinking water;**
- **guaranteed money-saving** thanks to the possible re-use of the fittings.



Data sheet and Marking

Name:
safety-plus system

Material:

- **fitting:** PPS (Polyphenylene sulfide)
- **caps:** PA-M (Modified polyamide)
- **O-ring:** EPDM (Ethylene Propylene Diene Monomer) peroxide Shore A70

Colour:

- **fitting:** ivory
- **caps:** grey
- **O-ring:** black

Operating temperature:
from -45°C* to 95°C (*below 0°C, glycol or antifreeze additives are required)

Maximum working pressure up to 95°C: 10 bar

Range: from Ø 16 to Ø 75 mm (90 mm)

Marking:
all pieces, barring exceptions, display sizes, production batch, mould numbers, company logo and system mark as shown in the figure.

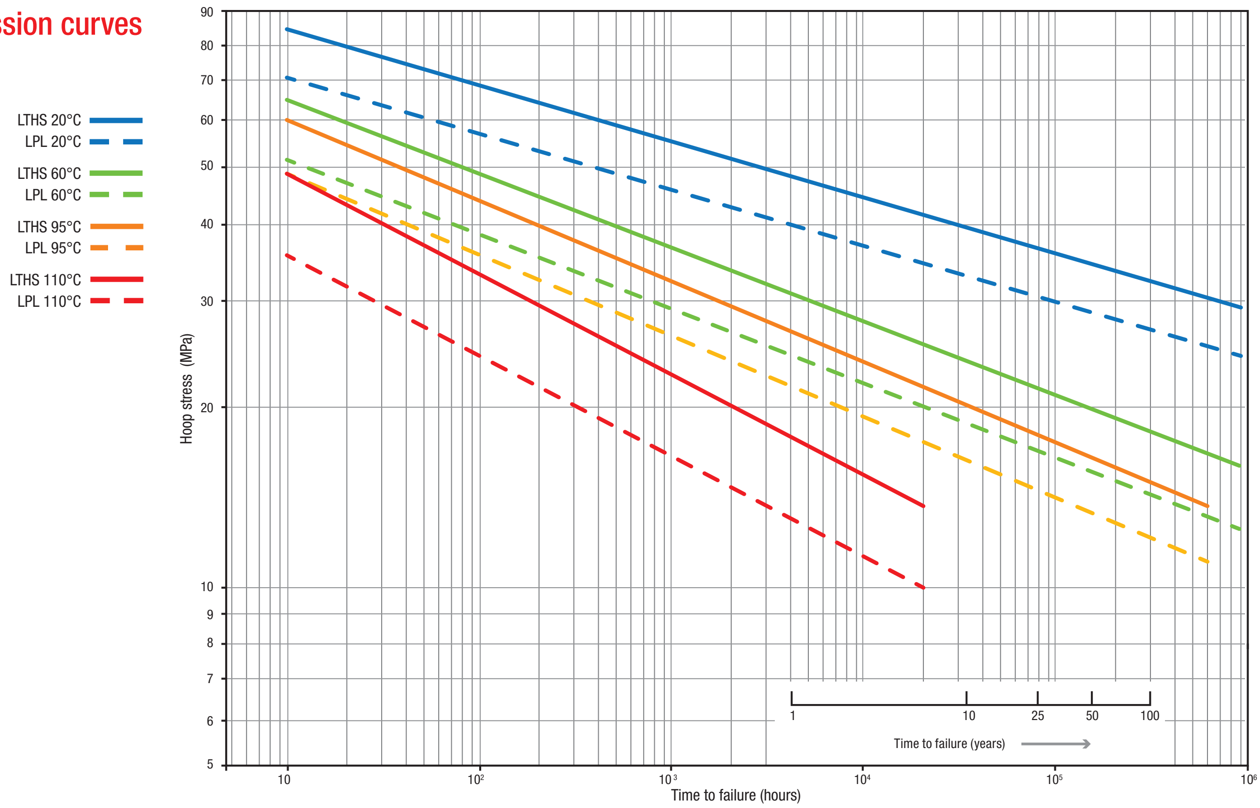
Product specifications

Aquatechnik has designed the safety-plus series in compliance with regulatory standards so that the fluids conveyed by the system are never in contact with metal components, except for a limited ½" male and female threaded range, created with a CW 617 N brass alloy insert.

The compliance with the organoleptic properties is therefore, guaranteed by the following factors:

- the fittings are made entirely from PPS (polyphenylene sulphide) with modified polyamide (PA-M) caps;
- all male and female threads are created from a synthetic material (PPS) and include the following figures:
  - male threaded joint,
  - female threaded joint,
  - 90° elbow with bracket female threaded,
  - 90° elbow female threaded,
  - 90° elbow male threaded,
  - tee female threaded,
  - eccentric tee female threaded,
  - 90° tee female threaded.
- O-rings are made from peroxide-crosslinked EPDM, a special rubber that allows a long lifetime and excellent compatibility with the conveyed fluid.

Regression curves

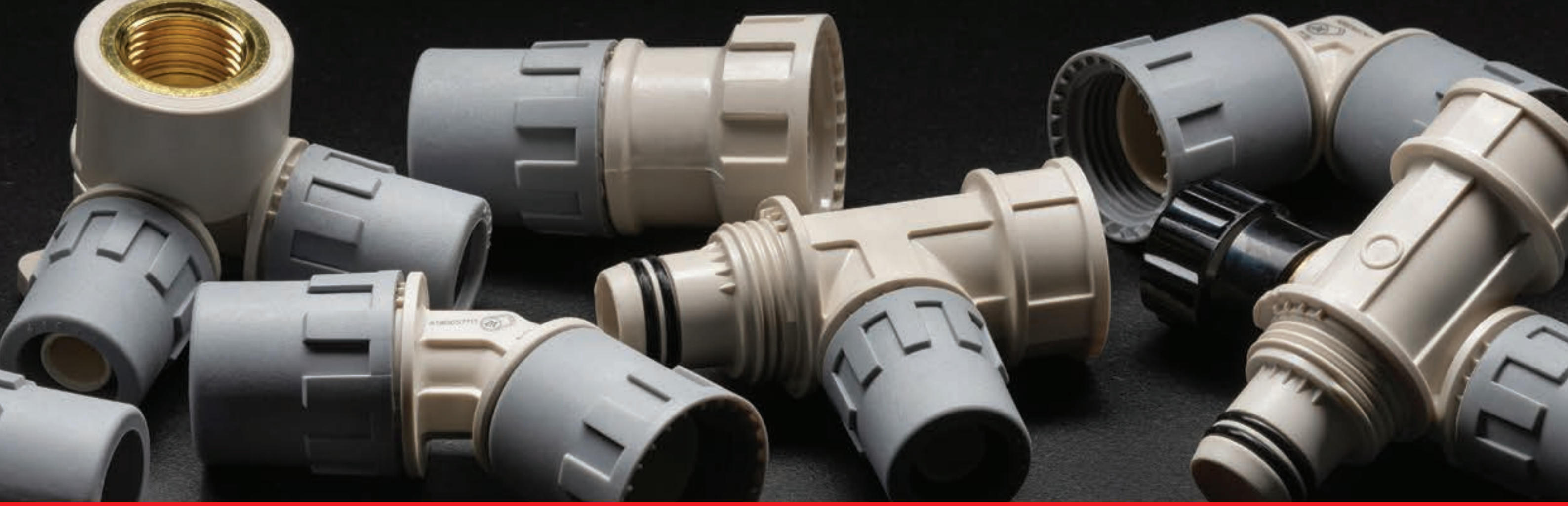


Fields of application

Safety-plus fittings are suitable for many applications, specifically for the sanitary, heating and air conditioning systems, industrial systems for the conveyance of various liquids with temperatures up to 95°C, and compressed air. Please contact our Product Specialists beforehand to confirm compatibility for systems to convey special liquids and/or other substances (www.aquatechnik.co.uk/contact-us).

Standards and Certifications

Compliant with EN ISO 21003 and in compliance with the Integrated Quality and Environment Management System UNI EN ISO 9001:2015 and UNI EN ISO 14001:2015. Approved by the most widely recognised International certification organisations.

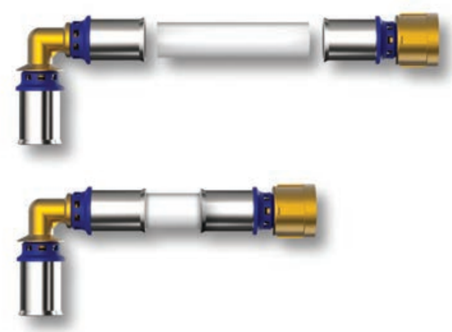


Special fittings

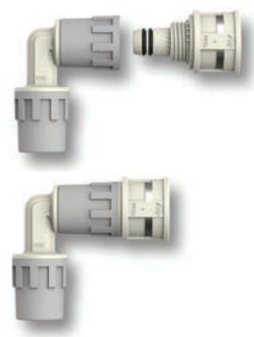
The "safety" series includes a wide range of fittings which have a female "safety" connection allowing for direct connections to other fittings.

This solution allows a drastic reduction in the overall dimensions and installation costs owing to a lower quantity of material used and a reduction in processing times, as well as offering the best and most versatile solution for all construction needs.

Pressing solution example	
Material	1 elbow 90° 1 piece of pipe 1 threaded joint female
Processing	2 processes
Space	149 mm approx



Solution with safety-plus joint female example	
Material	1 elbow 90° 1 threaded joint female
Processing	nothing
Space	87 mm approx



Reducers

A vast and complete series of reducers is an integral part in this type of fitting. Reducers for multilayer pipes, which are unique in their field, provide the clear advantage of transforming any fitting into a reduced fitting and lowering the number of additional ranges of fittings and associated stocking requirement.

Reducers in the "safety" range, for example, can compensate for a missing reduced tee by connecting a reducer to an equal tee.

If this involves the use of two fittings instead of one, it will be as advantageous in terms of cost since, assuming that this requirement occurs on site, the price of a reducer will certainly not be comparable to the costs (time and resources) required to locate the missing piece.

Manifolds

This type of fitting is made up of the wide range of modular manifolds in the “safety” series. The range includes manifolds with 20, 26, 32 and 40 mm diameters, with outlets of 14, 16, 20, 26 mm and eurocone.

The range of “safety” manifolds meets all installation needs with its five different alternatives:

- **modular without shut-off valves**
  for open laid exposed and concealed applications;
- **multirapid, with shut-off valve**
  for accessible installation;
- **cross, with two outlets**
  for free-laying and concealed applications;
- **coplanar**
  for free-laying and concealed applications;
- **branching, male/male and male/female**
  for free-laying and concealed applications.

All “safety” manifolds are modular and can be mounted rapidly and safely, meeting all construction needs. This is an enormous advantage for installers, who do not need to purchase specific manifolds with a predetermined number of outlets that depend on the installation scenario required.

Since the “safety” manifolds are modular, coupling the modules according to design requirements is a simple procedure.

As for reducers, a further unparalleled advantage in terms of cost is the option of managing frequent last minute system modifications that occur on site with extreme ease and speed.

A client may wish to include an additional connection on site: with “safety” manifolds, the addition of another module is all that is required instead of a new manifold, which saves time, the need for further resources and lowers costs.

Even if this is not the case, as for example when an additional user has been mistakenly included. All that is required is that the module be dismantled, which prevents plugging the unnecessary outlet, and using the module for any future installation.

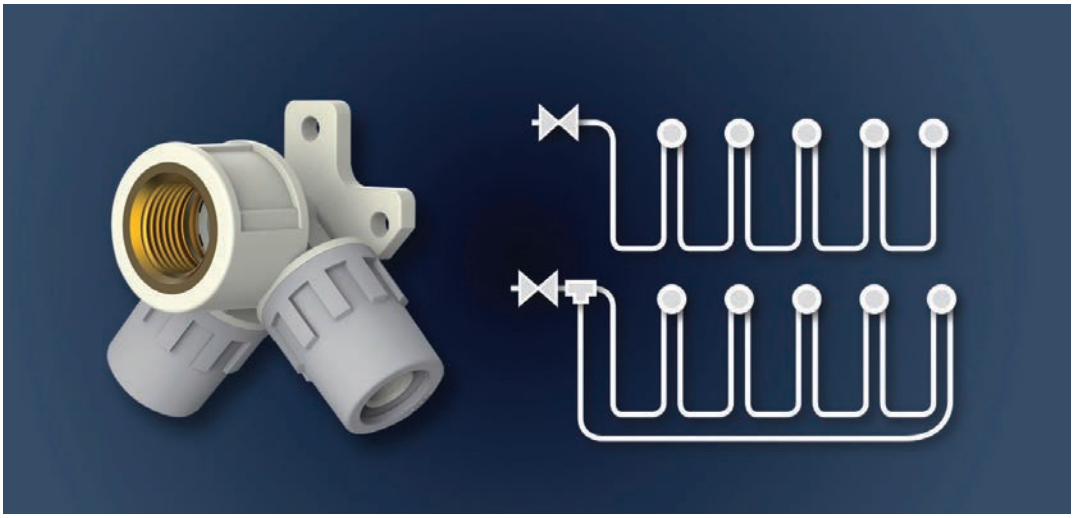
Threaded tee female angle 90°

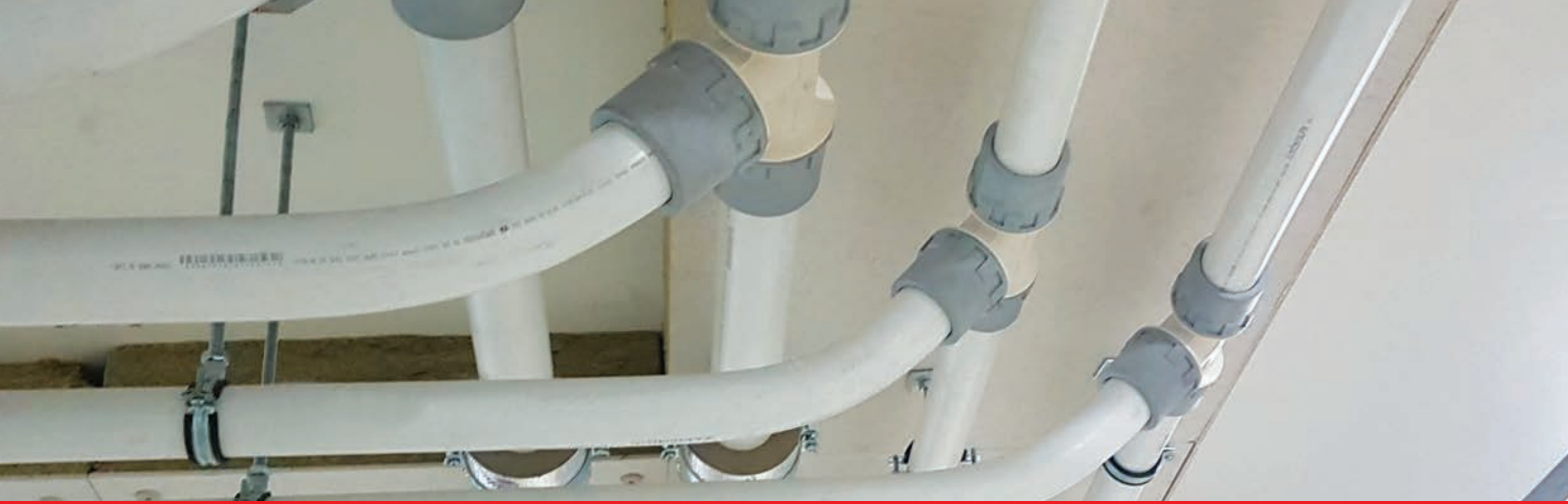
Aquatechnik has developed a new fitting for domestic water distribution in series and in ring circuit applications, available in ½" female thread (with brass alloy insert) for Ø 16 mm pipes.

The fitting guarantees high fluid flow to the final draw off circuit, minimising water stagnation at any point of the

system, with the following advantages:

- **allows to get more water outlet points**, reducing costs and needed material;
- **guarantees continuous water flow**, reducing the risks of stagnation, and ensuring high levels of hygiene.





Fittings applications

● Recommended for technical advantages
● Possible use

	safety-plus
Drinking water at high temperature	● (green)
Drinking water at low temperature	● (green)
Heating	● (green)
Conditioning/cooling	● (green)
Chilled water	● (green)
Swimming pools	● (green)
Heating/ Cooling for sports facilities	● (green)
Conveying chemicals*	● (green)
Rainwater	● (yellow)
Irrigation	● (green)
Compressed air	● (green)
Floor heating and cooling	● (green)
Ship	● (green)
District heating**	● (green)
Civil geothermal plants	● (green)
Industrial geothermal plants	● (green)
Agriculture	● (green)

* After a corporate technical evaluation ** max 90°C

Designing with multilayer pipes and “safety” system

How to choose the most suitable system

The choice of the most suitable system will be guided by the specific nature of the systems to be installed and will depend on whether drinking water lines or mechanical systems (air conditioning, compressed air or industrial in general) are required.

In the latter case, chemical compatibility with the fluid conveyed needs to be checked.

Operating temperatures and pressures of the system with reference to the classes of the pipeline system will also need to be considered.

Heat loss and insulation

Since they are manufactured from synthetic materials, all Aquatechnik multilayer pipe and safety-plus fittings have very low thermal conductivities compared to those of metal.

Thermal conductivity (λ)
W/mK
multi-calor pipe
0.420 ÷ 0.520*

* *depending on the pipe diameter*

On the basis of what has been noted, the risk of condensation is much lower when using plastic pipes compared to metal pipes.

For example, making a comparison between a copper pipe having a conductivity of λ = 390 W/mK, and a multi-calor with a conductivity between 0.420 and 0.520 W/mK (depending on the Ø of the pipe), it is clear that the latter significantly reduces the risk of condensation, owing to a thermal conductivity which is approximately 900 times lower than copper.

Nonetheless, according to the provisions of the laws in force (in Italy, Presidential Decree 412/93 which, among other things, does not specify the type of insulated pipe regarding insulation thicknesses), insulation of pipes is required in order to:

- prevent the formation of condensate;
- limit dispersion of temperature as far as possible, a factor that significantly increases energy savings.

In order to facilitate the needs of installers and heating technicians, Aquatechnik provides a wide range of pre-insulated multi-calor pipe.

Isoline-plus range

The isoline-plus range is available exclusively for multi-calor pipes. The insulating material, which constitutes the coating of the pipe, is a polyethylene foam with a water vapour diffusion resistance factor μ of approximately 5,000 and a particularly low thermal conductivity λ = 0.035 W/mK.

This means that the properties of this special polyethylene are such that with the same thickness as other insulators, isoline-plus has a significantly greater value of insulation. A low-density coloured polyethylene film is then extruded onto the insulating layer.

The coating, according to the reaction to fire characteristics, is in Class BL-s1, d0.

The following are available:

- **multi-calor pipes**
  - with red and blue insulation for heating and sanitary systems (energy containment).
    Range Ø 16 and Ø 20 mm.

The fields of application for the red and blue insulation are the same for both types of coating, following specific verification of thicknesses, to be evaluated by the designer for each specific case.

Isoline range

The isoline range is available for multi-calor pipe. The insulating material, which constitutes the coating of the pipe, is a polyethylene foam with a water vapour diffusion resistance factor μ of approximately 5,000 and a thermal conductivity λ = 0.040 W/mK.

A low-density coloured polyethylene sheath is then extruded onto the insulating layer.

The insulation, according to the reaction to fire characteristics, is in Class BL-s1, d0.

- **with light blue insulation**
  for heating, air conditioning and sanitary systems
  (energy containment and anti-condensation).
  Range from Ø 16 to Ø 32 mm (excluding Ø 18).

Insulation technical features

Features	Isoline range	Isoline-plus range
Material	Closed-cell polyethylene foam (covered with a film of LDPE, low-density polyethylene)	Closed-cell polyethylene foam (covered with a film of LDPE, low-density polyethylene)
Colour	multi-calor pipe	multi-calor pipe multi-calor pipe
Density	30 kg/m³	30 kg/m³
Thickness	6-13 mm	6 mm
Working temperature	from -45°C to +95°C	from -45°C to +95°C
Vapour resistance factor	5000 µ (according to UNI EN 13469)	5000 µ (according to UNI EN 13469)
Thermal conductivity	W/mK 0,040	W/mK 0,035
Fire resistance	Class B_L-s1, d0 (Class 0) (EN 13501-1:2009)	Class B_L-s1, d0 (Class 0) (EN 13501-1:2009)

Insulation of polymeric fittings

Despite having a very low thermal conductivity due to the plastic materials from which they are made, thermal insulation of the fittings used in the construction of the systems is also required. For this purpose, Aquatechnik provides a dedicated adhesive sheath (art. 71397) that uses a water-based glue.

The composition of the glue is a fundamental factor as synthetic materials, in particular PPS (polyphenylene sulfide), may be attacked by solvents that are usually contained in common adhesives.

For this reason, exclusive use of the insulating sheath supplied by Aquatechnik is recommended, or in other eventualities, prior consultation with our Product Specialists.

Compressed air

The technical characteristics of the "safety" system, together with ease of processing and installation, make this product suitable for the construction of compressed air plants for industrial use.

Advantages:

- the safety-plus system is made entirely from plastic which, unlike metal, is resistant to possible oxidation caused by condensation;
- the particular geometry of the fitting guarantees reduced concentrated pressure drops and consequent optimisation of air flows to the various users.

Correct pipe choice must be made considering flow rates, operating pressures and the types of installation envisaged. For operating conditions, refer to page 16.

The designer is responsible for the application of the appropriate Safety Factor (SF). In the case of open laid exposed installations, refer to the clamping distances on page 44. For characteristics and concentrations of the lubricating oil in use, consult the Product Specialists in advance. An adequate respect of any legislative (e.g. PED Directory) or regulatory requirements and the need to identify networks using specific colours (e.g. application of labels) should be carried out.

Systems with different fluids

Systems conveying chemical compounds is made possible by the technology of the safety-plus system: indeed, the use of fittings and pipes made of polymeric material is such that the conveyed fluid is never in contact with any metal parts. To check compatibility of the conveyed fluid with the materials from which the system is composed, contact our Product Specialists (www.aquatechnik.co.uk/contact-us), specifying:

- **the fluid to be conveyed;**
- **the temperature;**
- **the pressure;**
- **the number of operating hours per year.**

Sizing

Drinking water and other water distribution systems, in compliance with industry standards: UNI 9182 and EN 806 related to the sizing of pipes for sanitary systems.

In particular, the EN 806 standard contains information for adopting a simplified method that considers uses such as LU (load unit).

When sizing pipes, water requirements should be determined, considering maximum admissible speeds, containment of flow associated noise, water hammer and overall pressure drops.

The “safety” system, with the particular geometry of its fittings that includes a larger internal bore compared to other systems, results in reducted concentrated pressure drops, meaning that at the same pressure, especially for small diameters, there are advantages in terms of flow rates and a reduction in noise due to water flow.

Recommended flow speed – sanitary networks inside buildings

The above-mentioned standards give an indication regarding maximum admissible flow speeds, distinguishing between main distribution and branches to individual devices.

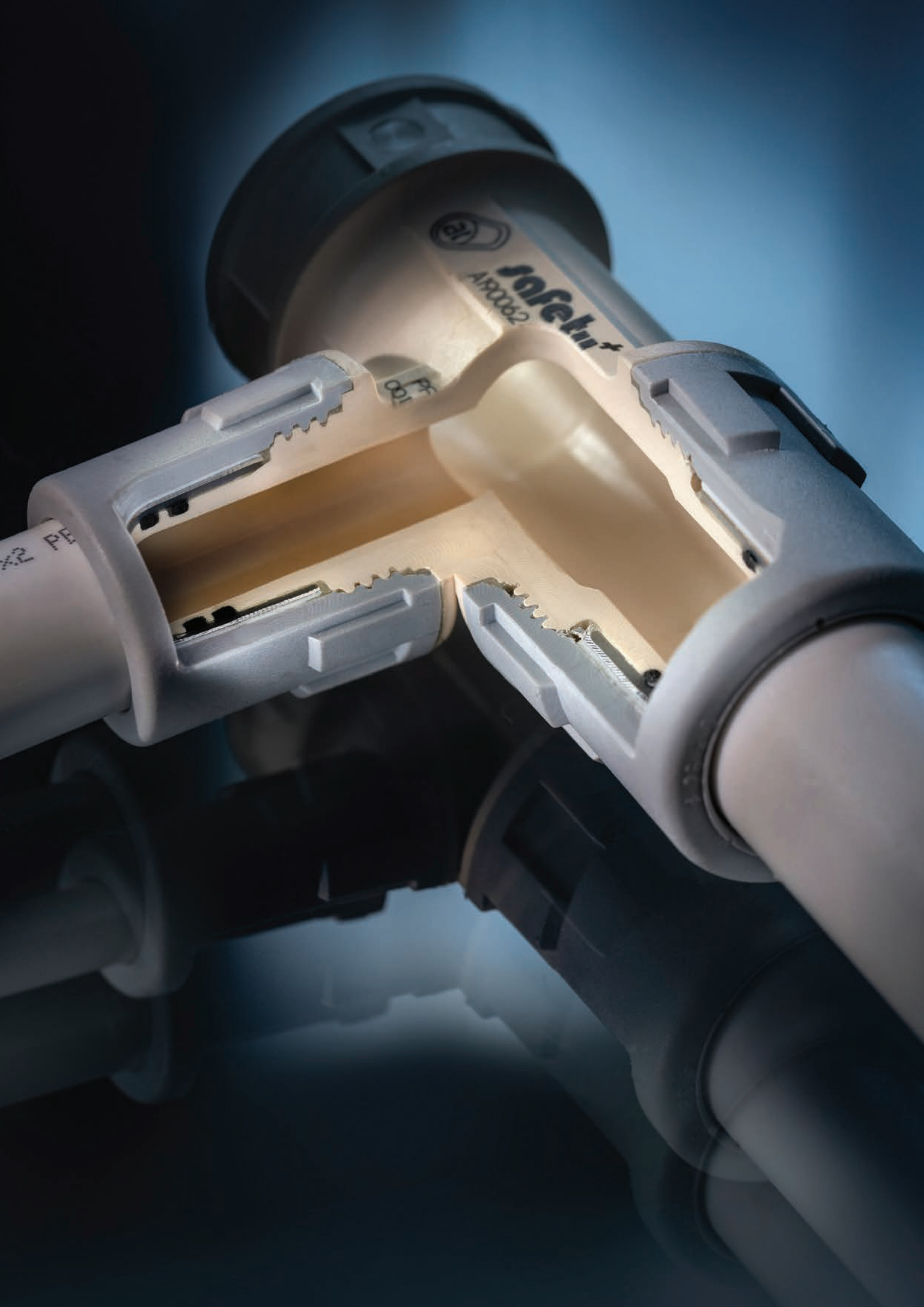
		Pipe section			
		Connection lines	Intake pipe: sections with full-bore minimum pressure drop valves (<2.5*)	Sections of pipe with valves with high pressure drop coefficient**	Sanitary hot water recirculation
Maximum flow speed considered for a flow duration	≤ 15 min not-continuous (sanitary)	2 m/s	5 m/s	2.5 m/s	1 m/s
	> 15 min continuous (heating)	2 m/s	2 m/s	2 m/s	1 m/s

for example * ball valves, inclined-seat valves ** flat-seat valves

Pipe continuous pressure drops

Pressure drops are caused by resistances that oppose fluid motion. These may be continuous or localised.

Continuous drops occur along linear sections of a pipeline, while localised drops are of an accidental nature and make the direction or the cross section of fluid flow vary (e.g. reducers, branches, Tee, elbows, influxes, valves, filters, etc.).



Calculation of continuous pressure drops

For each metre of pipe, continuous water pressure drops can be calculated using the formula:

$$r = \left(F_a \cdot \frac{1}{D} \cdot \rho \cdot \frac{v^2}{2}\right)/100$$

where:

r = unitary continuous pressure drop (mbar/m)

F_a = dimensionless friction factor

r = density of water (Kg/m^3)

v = average water speed (m/s)

D = internal pipe diameter (m)

Note the diameter of the pipe, the speed of the water and its density, the only parameter that is undetermined is the friction factor (F_a), which depends on the fluid flow rate and the pipe roughness.

All Aquatechnik pipes have smooth internal surfaces with a low roughness that pose low resistance to hot and cold fluid flow, are less prone to the formation of deposits which - over time - reduce the actual and user flow rates. These factors allow higher water speeds in distribution networks, without the negative consequences that can arise in metal pipes (turbulence, noise, flow rate reduction and erosion).

The following tables can be used to correctly size hot and cold water supply lines for each type of system and have been determined by using the formula for pipes with low roughness.

Continuous pipes pressure drop

Rugosity	0.007 mm	
Specific weight	998.00 kg/m³	977.90 kg/m³
Temperature	20°C	70°C
Viscosity	1,00E-06 m²/s	4,13E-07 m²/s

Q = flow (l/s) **De** = Ø ext.Ø (mm) **Di** = Ø int.Ø (mm)
R = continuous pressure drop (mbar/m) **V** = speed (m/s)

Q	De	16.0		18.0		20.0		26.0		32.0		40.0		50.0		63.0		75.0		90.0	
	Di	12.0		14.0		16.0		20.0		26.0		33.0		42.0		54.0		65.0		76.0	
0.01	R	0.18	0.14	0.09	0.07	0.05	0.04	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00						
	V	0.09		0.06		0.05		0.03		0.02		0.01		0.01							
0.02	R	0.62	0.48	0.30	0.23	0.16	0.12	0.05	0.04	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	V	0.18		0.13		0.10		0.06		0.04		0.02		0.01		0.01		0.01		0.00	
0.03	R	1.26	0.98	0.60	0.47	0.32	0.25	0.11	0.09	0.03	0.03	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	V	0.27		0.19		0.15		0.10		0.06		0.04		0.02		0.01		0.01		0.01	
0.04	R	2.08	1.63	1.00	0.78	0.53	0.42	0.18	0.14	0.05	0.04	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	V	0.35		0.26		0.20		0.13		0.08		0.05		0.03		0.02		0.01		0.01	
0.05	R	3.07	2.41	1.48	1.16	0.78	0.61	0.27	0.21	0.08	0.06	0.03	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
	V	0.44		0.32		0.25		0.16		0.09		0.06		0.04		0.02		0.02		0.01	
0.06	R	4.22	3.31	2.03	1.59	1.08	0.84	0.37	0.29	0.11	0.08	0.03	0.03	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
	V	0.53		0.39		0.30		0.19		0.11		0.07		0.04		0.03		0.02		0.01	
0.07	R	5.53	4.34	2.66	2.09	1.41	1.11	0.49	0.38	0.14	0.11	0.05	0.04	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
	V	0.62		0.45		0.35		0.22		0.13		0.08		0.05		0.03		0.02		0.02	
0.08	R	6.99	5.48	3.36	2.64	1.78	1.40	0.62	0.48	0.18	0.14	0.06	0.04	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00
	V	0.71		0.52		0.40		0.25		0.15		0.09		0.06		0.03		0.02		0.02	
0.09	R	8.58	6.73	4.13	3.24	2.19	1.72	0.76	0.60	0.22	0.17	0.07	0.06	0.02	0.02	0.01	0.01	0.00	0.00	0.00	0.00
	V	0.80		0.58		0.45		0.29		0.17		0.10		0.06		0.04		0.03		0.02	
0.10	R	10.32	8.10	4.96	3.89	2.63	2.07	0.91	0.72	0.26	0.21	0.08	0.07	0.03	0.02	0.01	0.01	0.00	0.00	0.00	0.00
	V	0.88		0.65		0.50		0.32		0.19		0.12		0.07		0.04		0.03		0.02	
0.12	R	14.20	11.14	6.83	5.36	3.62	2.84	1.25	0.98	0.36	0.28	0.12	0.09	0.04	0.03	0.01	0.01	0.00	0.00	0.00	0.00
	V	1.06		0.78		0.60		0.38		0.23		0.14		0.09		0.05		0.04		0.03	
0.14	R	18.60	14.59	8.94	7.02	4.74	3.72	1.64	1.29	0.47	0.37	0.15	0.12	0.05	0.04	0.01	0.01	0.01	0.00	0.00	0.00
	V	1.24		0.91		0.70		0.45		0.26		0.16		0.10		0.06		0.04		0.03	
0.16	R	23.50	18.43	11.30	8.86	5.99	4.70	2.08	1.63	0.60	0.47	0.19	0.15	0.06	0.05	0.02	0.01	0.01	0.01	0.00	0.00
	V	1.42		1.04		0.80		0.51		0.30		0.19		0.12		0.07		0.05		0.04	
0.18	R	28.87	22.65	13.88	10.89	7.36	5.78	2.55	2.00	0.73	0.58	0.24	0.19	0.08	0.06	0.02	0.02	0.01	0.01	0.00	0.00
	V	1.59		1.17		0.90		0.57		0.34		0.21		0.13		0.08		0.05		0.04	
0.20	R	34.72	27.24	16.70	13.10	8.85	6.95	3.07	2.41	0.88	0.69	0.28	0.22	0.09	0.07	0.03	0.02	0.01	0.01	0.01	0.00
	V	1.77		1.30		1.00		0.64		0.38		0.23		0.14		0.09		0.06		0.04	
0.30	R	70.59	55.38	33.94	26.63	18.00	14.12	6.24	4.89	1.79	1.41	0.58	0.45	0.18	0.14	0.06	0.04	0.02	0.02	0.01	0.01
	V	2.65		1.95		1.49		0.96		0.57		0.35		0.22		0.13		0.09		0.07	
0.40	R	116.79	91.63	56.16	44.06	29.78	23.36	10.32	8.10	2.97	2.33	0.96	0.75	0.30	0.24	0.09	0.07	0.04	0.03	0.02	0.01
	V	3.54		2.60		1.99		1.27		0.75		0.47		0.29		0.17		0.12		0.09	
0.50	R	172.58	135.40	82.98	65.10	44.01	34.53	15.25	11.96	4.39	3.44	1.41	1.11	0.45	0.35	0.14	0.11	0.06	0.04	0.03	0.02
	V	4.42		3.25		2.49		1.59		0.94		0.58		0.36		0.22		0.15		0.11	
0.60	R	237.44	186.28	114.17	89.57	60.55	47.50	20.98	16.46	6.03	4.73	1.94	1.53	0.62	0.49	0.19	0.15	0.08	0.06	0.04	0.03
	V	5.31		3.90		2.99		1.91		1.13		0.70		0.43		0.26		0.18		0.13	
0.70	R			149.53	117.31	79.30	62.21	27.47	21.56	7.90	6.20	2.55	2.00	0.81	0.64	0.25	0.19	0.10	0.08	0.05	0.04
	V			4.55		3.48		2.23		1.32		0.81		0.51		0.31		0.21		0.15	
0.80	R			188.89	148.19	100.17	78.59	34.71	27.23	9.98	7.83	3.22	2.52	1.02	0.80	0.31	0.24	0.13	0.10	0.06	0.05
	V			5.20		3.98		2.55		1.51		0.94		0.58		0.35		0.24		0.18	
0.90	R			232.12	182.11	123.10	96.58	42.65	33.46	12.27	9.62	3.95	3.10	1.26	0.99	0.38	0.30	0.16	0.12	0.08	0.06
	V			5.85		4.48		2.87		1.70		1.05		0.65		0.39		0.27		0.20	
1.00	R					148.02	116.13	51.29	40.24	14.75	11.57	4.75	3.73	1.51	1.19	0.46	0.36	0.19	0.15	0.09	0.07
	V					4.98		3.18		1.88		1.17		0.72		0.44		0.30		0.22	
1.20	R					203.66	159.78	70.56	55.36	20.29	15.92	6.54	5.13	2.08	1.63	0.63	0.49	0.26	0.20	0.12	0.10
	V					5.97		3.82		2.26		1.40		0.87		0.52		0.36		0.26	
1.40	R							92.41	72.50	26.58	20.85	8.56	6.72	2.72	2.14	0.83	0.65	0.34	0.27	0.16	0.13
	V							4.46		2.64		1.64		1.01		0.61		0.42		0.31	
1.60	R							116.74	91.59	33.57	26.34	10.82	8.49	3.44	2.70	1.04	0.82	0.43	0.34	0.21	0.16
	V							5.10		3.02		1.87		1.16		0.70		0.48		0.35	
1.80	R							143.46	112.55	41.26	32.37	13.29	10.43	4.23	3.32	1.28	1.01	0.53	0.42	0.25	0.20
	V							5.73		3.39		2.11		1.30		0.79		0.54		0.40	
2.00	R									49.61	38.92	15.99	12.54	5.08	3.99	1.54	1.21	0.64	0.50	0.30	0.24
	V									3.77		2.34		1.44		0.87		0.60		0.44	
2.20	R									58.62	45.99	18.89	14.82	6.01	4.71	1.82	1.43	0.75	0.59	0.36	0.28
	V									4.15		2.57		1.59		0.96		0.66		0.49	
2.40	R									68.26	53.55	22.00	17.26	7.00	5.49	2.12	1.66	0.88	0.69	0.42	0.33
	V									4.52		2.81		1.73		1.05		0.72		0.53	
2.60	R									78.52	61.60	25.30	19.85	8.05	6.31	2.44	1.91	1.01	0.79	0.48	0.38
	V									4.90		3.04		1.88		1.14		0.78		0.57	
2.80	R									89.39	70.13	28.81	22.60	9.16	7.19	2.78	2.18	1.15	0.90	0.55	0.43
	V									5.28		3.28		2.02		1.22		0.84		0.62	
3.00	R									100.87	79.13	32.50	25.50	10.34	8.11	3.13	2.46	1.30	1.02	0.62	0.48
	V									5.65		3.51		2.17		1.31		0.90		0.66	

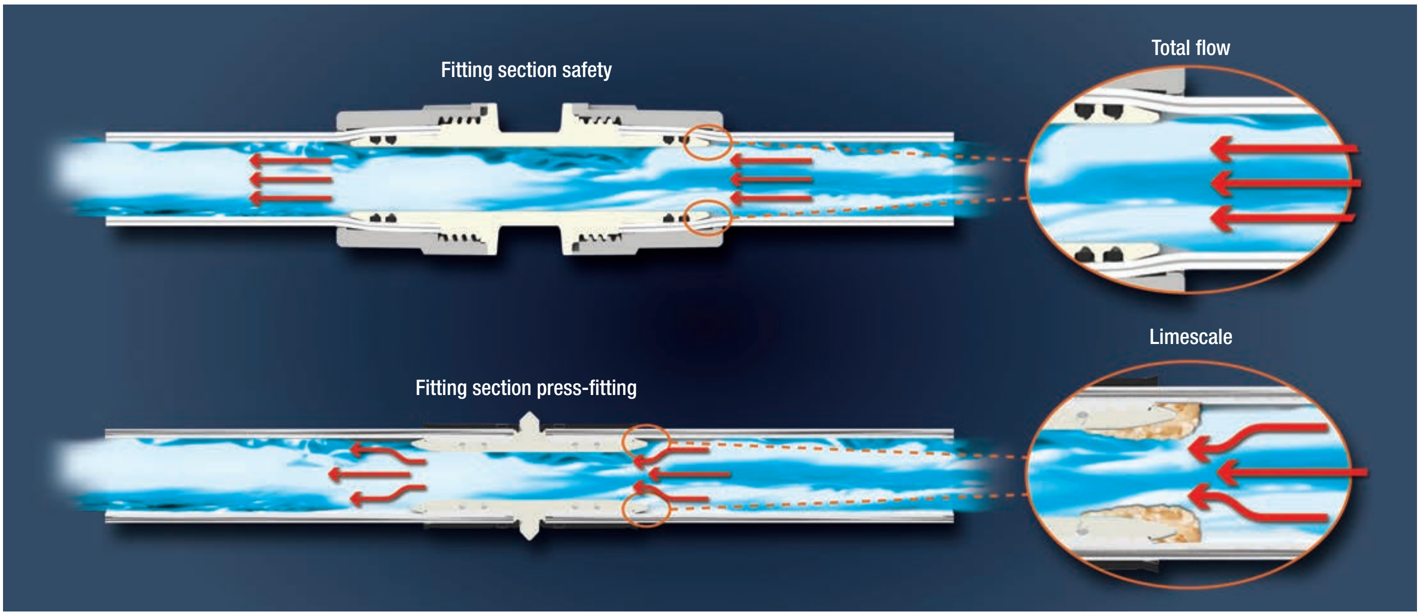
Q	De	16.0	18.0	20.0	26.0	32.0	40.0	50.0	63.0	75.0	90.0
	Di	12.0	14.0	16.0	20.0	26.0	33.0	42.0	54.0	65.0	76.0
3.20	R						36.39 28.55	11.57 9.08	3.51 2.75	1.45 1.14	0.69 0.54
	V						3.74	2.31	1.40	0.96	0.71
3.40	R						40.46 31.74	12.87 10.10	3.90 3.06	1.62 1.27	0.77 0.60
	V						3.98	2.46	1.49	1.03	0.75
3.60	R						44.72 35.08	14.22 11.16	4.31 3.38	1.79 1.40	0.85 0.67
	V						4.21	2.60	1.56	1.09	0.79
3.80	R						49.16 38.57	15.63 12.27	4.74 3.72	1.96 1.54	0.93 0.73
	V						4.45	2.74	1.66	1.15	0.84
4.00	R						53.77 42.19	17.10 13.42	5.18 4.07	2.15 1.69	1.02 0.80
	V						4.68	2.89	1.75	1.21	0.88
4.20	R						58.57 45.95	18.63 14.61	5.65 4.43	2.34 1.84	1.11 0.87
	V						4.91	3.03	1.83	1.27	0.93
4.40	R						63.53 49.85	20.21 15.85	6.12 4.81	2.54 1.99	1.21 0.95
	V						5.15	3.18	1.92	1.33	0.97
4.60	R						68.67 53.88	21.84 17.14	6.62 5.19	2.74 2.15	1.31 1.02
	V						5.38	3.32	2.01	1.39	1.01
4.80	R						73.98 58.04	23.53 18.46	7.13 5.60	2.96 2.32	1.41 1.10
	V						5.61	3.47	2.10	1.45	1.06
5.00	R						74.96 62.34	25.27 19.83	7.66 6.01	3.18 2.49	1.51 1.19
	V						5.85	3.61	2.18	1.51	1.10
5.20	R							27.07 21.24	8.20 6.44	3.40 2.67	1.62 1.27
	V							3.76	2.27	1.57	1.15
5.40	R							28.92 22.69	8.76 6.88	3.63 2.85	1.73 1.36
	V							3.90	2.36	1.63	1.19
5.60	R							30.82 24.18	9.34 7.33	3.87 3.04	1.84 1.45
	V							4.04	2.45	1.69	1.24
5.80	R							32.77 25.71	9.93 7.79	4.12 3.23	1.96 1.54
	V							4.19	2.53	1.75	1.28
6.00	R							34.77 27.28	10.54 8.27	4.37 3.43	2.08 1.63
	V							4.33	2.62	1.81	1.32
6.20	R							36.83 28.89	11.16 8.76	4.63 3.63	2.20 1.73
	V							4.48	2.71	1.87	1.37
6.40	R							38.93 30.54	11.80 9.26	4.89 3.84	2.33 1.83
	V							4.62	2.80	1.93	1.41
6.60	R							41.08 32.23	12.45 9.77	5.16 4.05	2.46 1.93
	V							4.77	2.88	1.99	1.46
6.80	R							43.29 33.96	13.12 10.29	5.44 4.27	2.59 2.03
	V							4.91	2.97	2.05	1.50
7.00	R							45.54 35.73	13.80 10.83	5.72 4.49	2.72 2.14
	V							5.06	3.06	2.11	1.54
7.50	R							51.38 40.31	15.57 12.22	6.46 5.06	3.07 2.41
	V							5.42	3.28	2.26	1.65
8.00	R							57.53 45.13	17.44 13.68	7.23 5.67	3.44 2.70
	V							5.78	3.49	2.41	1.76
8.50	R								19.39 15.21	8.04 6.30	3.82 3.00
	V								3.71	2.56	1.87
9.00	R								21.43 16.81	8.88 6.97	4.23 3.32
	V								3.93	2.71	1.98
9.50	R								23.55 18.48	9.76 7.66	4.65 3.64
	V								4.15	2.86	2.10
10.00	R								25.77 20.21	10.68 8.38	5.08 3.99
	V								4.37	3.02	2.21
12.00	R								35.45 27.81	14.69 11.53	6.99 5.49
	V								5.24	3.62	2.65
14.00	R									19.24 15.10	9.16 7.18
	V									4.22	3.09
16.00	R									24.31 19.07	11.57 9.08
	V									4.82	3.53
18.00	R									29.87 23.44	14.22 11.15
	V									5.43	3.97
20.00	R										17.09 13.41
	V										4.41
25.00	R										25.26 19.82
	V										5.51

Fitting localised pressure drops

In traditional fittings for multilayer pipes (press-fitting, push-fitting, quick-connect), the connection with the pipe has a reduce internal bore which considerably influence the flow rates of the fluid with increased pressure drops.

Similar obstacles may also lead to the formation of deposits that may affect the operating conditions of the system. In addition, the high pressure drops of traditional systems force the pump to operate at higher rotation speeds, resulting in higher energy consumption.

These phenomena are easily observed and appreciated by observing the internal section of the types of pipe-fitting connections.



Noise levels and energy saving

The "safety" system, in addition to ensuring an increase in flow rates of approximately 40% compared to other connection systems with multilayer pipes, guarantees an average energy saving of 60% and a significant reduction in recorded noise levels.

System	LAeq dBA (with Q = 25 l/min)	Pump power absorbtion (with Q = 25 l/min)
Push fitting	53.5	1405W
Press fitting 1	53.2	1400W
Press fitting 2	59.4	1180W
safety	**42.9**	**500W**

Data collected by third party S.A. Servizio Ambientale srl in Aquatechnik soundproof room.

Calculation of localised pressure drops

Localised pressure drops are of an accidental nature (for example reducers, branches, tees, elbows, influxes, valves, filters, etc.), which make the direction or the cross section of fluid flow vary. They can be calculated using one of the following methods:

- **direct method:**
  uses coefficients that depend on the geometry and size of the fittings;
- **nominal flow rate method:**
  the value of the nominal flow is used for each piece:
  i.e., the flow rate that corresponds to a predefined unit pressure drop (for example 1 bar);
- **method of equivalent lengths:**
  a segment of linear pipe corresponding to the individual pressure drop is replaced for each piece.

In general, the direct method is used for pipe and pump sizing, as it is accurate enough and easy to use.

According to this method, localised pressure drops can be calculated with the following formula:

$$z = (\xi \cdot \rho \cdot \frac{v^2}{2})/100$$

where:

z = localised pressure drop (mbar)

ξ = localised, dimensionless drop coefficient (also called K)

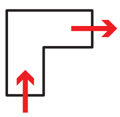
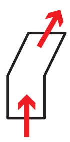
ρ = density of water (Kg/m^3)

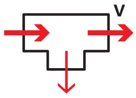
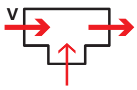
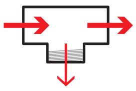
v = average fluid speed (m/s)

The values of the coefficients are shown in the following table “csi” (ξ) relating to the figures that are usually used in hydraulic distribution lines.

If you need to know the coefficient to use for a figure not in the table, you can refer to what is indicated in the standard or contact an Aquatechnik Product Specialist for more information.

Localised pressure drop coefficient table

	Description	Measure	Localised pressure drop coefficient (ξ) safety-plus
	Pipe coupling Threaded joint female Threaded joint male NB: for reduced pipe-couplings, add the value of the reducers	14x2	0.5
		16x2	0.5
		18x2	0.5
		20x2	0.4
		26x3	0.4
		32x3	0.3
		40x3.5	0.2
		50x4	0.2
		63x4.5	0.1
		75x5	0.1
		90x7	0.1
	Elbow 90° Threaded elbow 90° female Threaded elbow 90° male Elbow 90° male/female Elbow 90° female/female Threaded elbow 90° female/female Threaded elbow 90° male/female	14x2	2.2
		16x2	2.1
		18x2	2.0
		20x2	1.6
		26x3	1.6
		32x3	1.3
		40x3.5	1.2
		50x4	1.1
		63x4.5	0.9
		75x5	0.7
		90x7	0.7
	Elbow 45° Elbow 45°male/female	14x2	1.1
		16x2	1.0
		18x2	1.0
		20x2	0.8
		26x3	0.8
		32x3	0.7
		40x3.5	0.6
		50x4	0.6
		63x4.5	0.5
		75x5	0.4
		90x7	0.4

Description	Measure	Localised pressure drop coefficient (ξ) safety-plus
TD  Tee duct Threaded tee duct female NB: for reduced pipe-couplings, add the value of the reducers	14x2	0.7
	16x2	0.7
	18x2	0.6
	20x2	0.5
	26x3	0.5
	32x3	0.3
	40x3.5	0.3
	50x4	0.2
	63x4.5	0.2
	75x5	0.1
	90x7	0.1
TA  Tee with flow separation Threaded tee female with flow separation NB: for reduced pipe-couplings, add the value of the reducers	14x2	2.0
	16x2	2.2
	18x2	2.1
	20x2	1.8
	26x3	1.8
	32x3	1.5
	40x3.5	1.3
	50x4	1.2
	63x4.5	1.0
	75x5	0.9
	90x7	0.8
TG  Tee separation with divided flow Threaded separation tee female with divided flow NB: for reduced pipe-couplings, add the value of the reducers	14x2	2.1
	16x2	2.4
	18x2	2.2
	20x2	1.9
	26x3	1.8
	32x3	1.5
	40x3.5	1.3
	50x4	1.2
	63x4.5	1.0
	75x5	0.8
	90x7	0.8
 Reducer	1 size	0.4
	2 sizes	0.5
	3 sizes	0.6
	4 sizes	0.7

UNI/TS 11589 2015 **v** = Reference flow

Manifold units

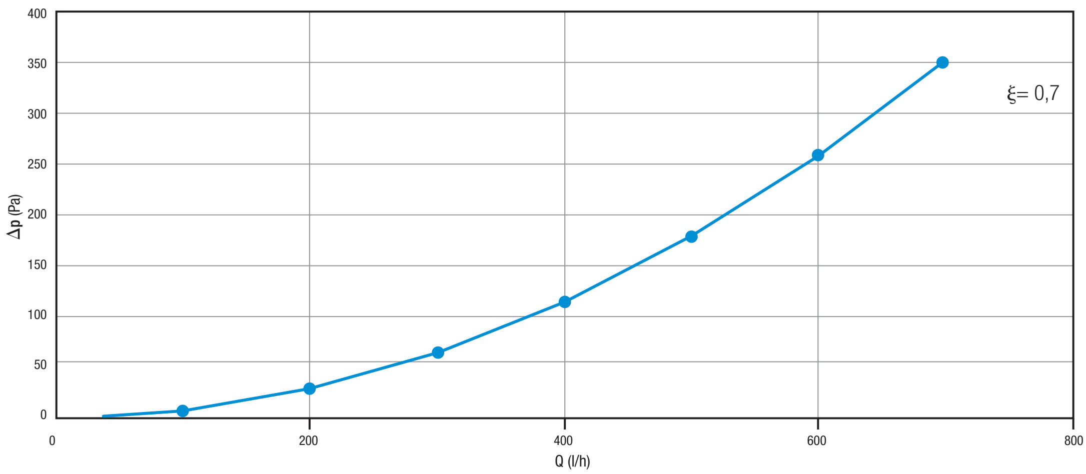
A particular aspect of the “safety” manifolds is that it is possible to create multiple arrangements. To determine pressure drops of some of the combinations, a number of tests have been carried out by the Department of Hydraulic Engineering at Politecnico di Milano.

Some examples are shown below.

Our Product Specialists can provide specific data regarding particular configurations on request.

Modular Manifold Art. 21302

The pressure drop curve extrapolated from the above-mentioned relationship, valid for manifolds from 1 to 10 elements, is shown below.



Calculation example

Problem:

Calculate the pressure drops that occur in a manifold

Ø 20-16 through which water flows at a speed of 0.5 m/s at temperatures of 40 and 10°C.

Solution:

The pressure drop required can be calculated directly using the formula for the direct method.

The coefficient ξ for a Ø 20 manifold with 16 mm outlet is 0.7. Therefore:

a) for water at temperature 40°C: ρ = 992 kg/m³

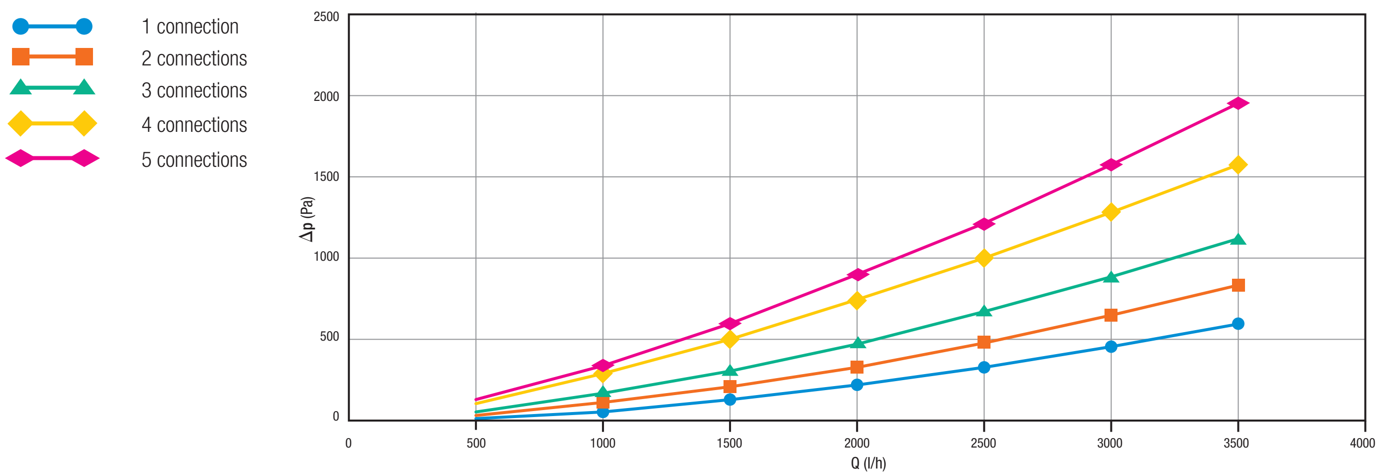
$$z = 0.7 \cdot 992 \cdot \frac{0.5^2}{(2 \cdot 9.81)} = \textbf{8.84 mm approx.}$$

b) for water at temperature 10°C: ρ = 999.6 kg/m³

$$z = 0.7 \cdot 999.6 \cdot \frac{0.5^2}{(2 \cdot 9.81)} = \textbf{8.91 mm approx.}$$

Modular Manifold Art. 22322

The pressure drop curve extrapolated from the above-mentioned relationship.



From what can be observed, the pressure drop is highly dependent on the Reynolds number, which identifies the type of motion of the fluid conveyed by the manifold and is affected by the number of connections themselves.

Installation techniques

Laying outside and inside buildings

Any pipe, whether manufactured in plastic or metal, has an elongation due the temperature of the conveyed fluid increases (linear thermal expansion).

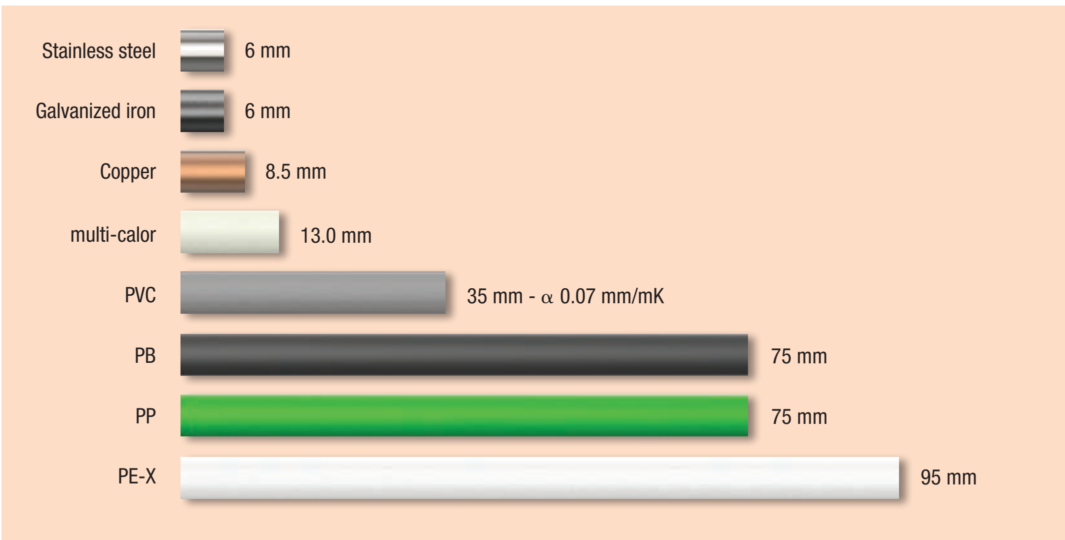
Linear expansion creates mechanical stresses which, if not adequately contained, may damage the system itself.

Polymeric pipes show greater linear thermal expansion compared with metallic ones, but develop lower mechanical stress.

Multilayer pipes (multi-calor), a metal-plastic combination, behave in a similar way to metal pipes: indeed, the intermediate adhesives impose the elongation of the aluminium to the plastic layers, making the linear expansion of these pipes very similar to those of metal pipes.

	Type of pipe					
	Galvanised steel	Copper	PE-HD	PP	PE-RT	multi-calor
Coefficient of linear thermal expansion α = mm/mK	0.012	0.017	0.220	0.150	0.180	**0.026**

Comparison table for elongation in mm:
Dt 50°C for 10 linear m of pipe



Installing outside buildings

The installation of pipes in relation to the sanitary sector, and specifically outside buildings (e.g. crossing land or gardens), must be carried out in compliance with sector standard and regulations, for example EN 806.

In the event of trench installations, the pipeline is defined as self-compensating. The trench must be deep enough to prevent the formation of ice and the pipe must be positioned on a bed of sand with which it is to be covered homogeneously.

Moreover, backfilling of the trench must avoid damaging the pipelines, which must be protected from being crushed with particular attention in vehicle access areas.

Installation must include access areas: particular precautions must be taken in the event of soils with risk of pipeline contamination.

In these cases, suitable protective casing should be used.

In the event of free-laying installations outside buildings, adequate thermal insulation must be included to prevent the formation of ice and to ensure protection from direct UV light.

Installation inside buildings

Installing pipes inside buildings can be either free or concealed.

In the event of **concealed installations**, the effects of linear thermal expansion are not evaluated as the pipelines are considered to be self-compensating.

In the event of **open laid exposed**, however, linear thermal expansion must be taken into consideration. When securing pipes made of synthetic materials, specific sliding collars to allow the pipe to slide and fixed point collars to lock the pipe must be used.

In creating a fixed point, rigid anchoring must strictly be guaranteed using threaded bars with appropriate diameters and limited lengths.

As far as vertical installated are concerned (**riser installations**), the effects of linear thermal expansion is not considered from an aesthetic point of view but adequate clamping is still required with regard to the structural aspect.

Fixed point clamping must generally be made closed to the main branches: fixed points must be positioned immediately after the fitting, following the flow direction.

For risers, clamping distances can be increased by 20% compared to values shown in the tables.

When installing exposed pipes with external anchoring (e.g. basements, boiler rooms and plant rooms), linear or extended, omega expansion compensators (expansion loops) or direction changes with bends must be created.

For installations with many direction or level changes or with short straight sections, the effects of expansion may be ignored, securing only using fixed points.

Enable specific requirements for seismic clamping.

Calculating linear thermal expansion

Linear thermal expansion is calculated using the following formula:

$$DL = \alpha \cdot L \cdot \Delta t$$

where:

DL = expansion (mm)

α = coefficient of linear thermal expansion (see table below)

L = length of pipeline (m)

Δt = change in temperature (°C)

	Pipe type
	multi-calor (PE-X/Al/PE-X)
Coefficient of linear thermal expansion α = mm/mK	0.026

For a handy reference, refer to the tables below.

These show linear expansion values for pipes with lengths between 0.5 and 10 linear metres, with Δt between 10 and 80°C for the Aquatechnik pipeline range.

Multi-calor pipe linear thermal expansion (mm)

Pipe Length	ΔT 10	ΔT 20	ΔT 30	ΔT 40	ΔT 50	ΔT 60	ΔT 70	ΔT 80
m	mm	mm	mm	mm	mm	mm	mm	mm
0.5	0.2	0.3	0.4	0.6	0.7	0.8	1.0	1.1
1.0	0.3	0.6	0.8	1.1	1.3	1.6	1.9	2.1
2.0	0.6	1.1	1.6	2.1	2.6	3.2	3.7	4.2
3.0	0.8	1.6	2.4	3.2	3.9	4.7	5.5	6.3
4.0	1.1	2.1	3.2	4.2	5.2	6.3	7.3	8.4
5.0	1.3	2.6	3.9	5.2	6.5	7.8	9.1	10.4
6.0	1.6	3.2	4.7	6.3	7.8	9.4	11.0	12.5
7.0	1.9	3.7	5.5	7.3	9.1	11.0	12.8	14.6
8.0	2.1	4.2	6.3	8.4	10.4	12.5	14.6	16.7
9.0	2.4	4.7	7.1	9.4	11.7	14.1	16.4	18.8
10.0	2.6	5.2	7.8	10.4	13.0	15.6	18.2	20.8

Fixed point installation

Securing at fixed points

The design has to consider the pipeline length, the pipe dimensions and the working conditions of the plant.

Carrying out fixed point clamping is possible but care must be taken in creating the fixed points before each branch or change of direction and near heat generator outlets.

Calculation of expansion compensators

Securing with expansion compensators

As mentioned above, in the case of long, straight pipeline sections installed using the open laid exposed method, expansion compensators (expansion loops) should be included that are generally U- or L- shaped, according to the available space requirements.

Lengths of the curved sides (bending arms) of the expansion compensators is calculated using the following formula:

$$LB = C \cdot \sqrt{(D \cdot DL)}$$

where:

LB = length of bending arm (mm)

C = material constant

(33 for multi-calor pipelines)

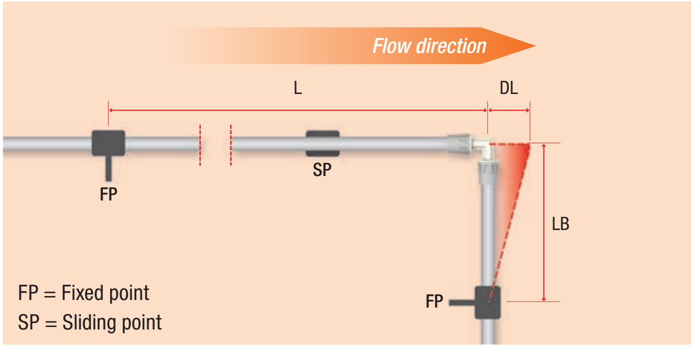
D = external pipe diameter (mm)

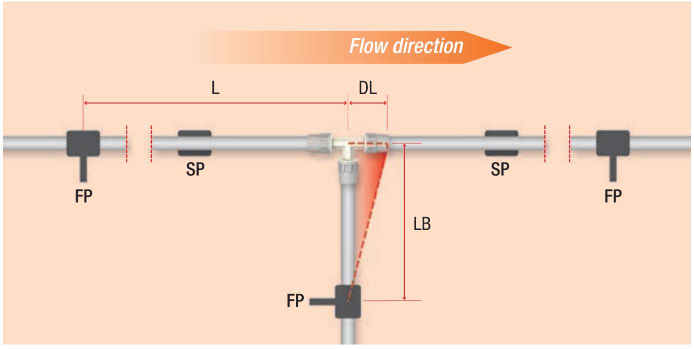
DL = linear thermal expansion (mm)

(obtained using the previous formula)

We will now see various types that can be used to compensate for the effects of linear thermal expansion.

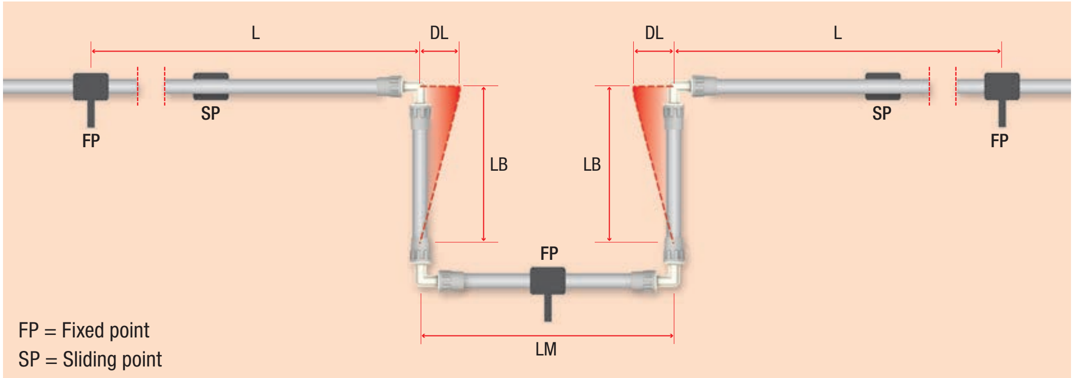
Curved or L- shaped expansion compensators (expansion loops)





This is the most commonly used type of compensator, as it is usually possible to exploit the pipe path change to create it.

Omega- or U-shaped expansion compensators



If it is not possible to compensate the expansion exploiting the pipe path change (via curved or L- shaped expansion compensators) when, for example, there are long straight sections, omega- or U- shaped expansion compensators need to be created.

Therefore, in addition to calculating the length of the bending arm (LB), the distance (LM) between the two arms that will form the “U” of the compensator needs to be calculated using the following formula:

$$LM > 2 \cdot DL$$

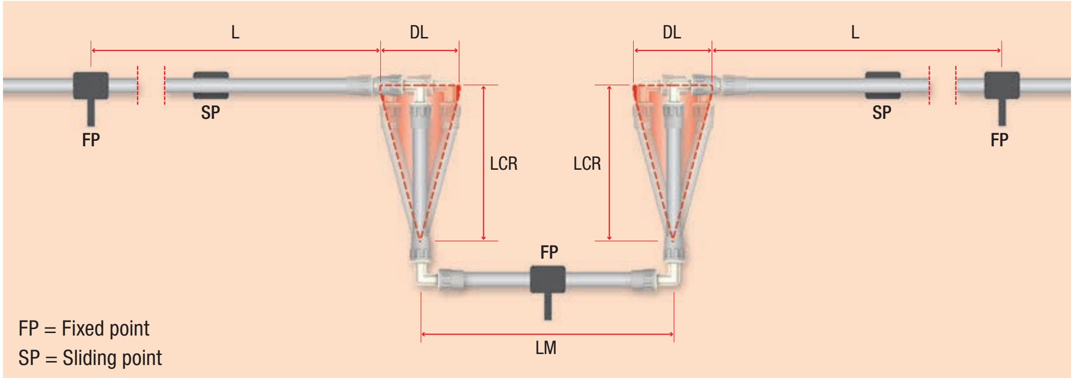
where:

LM = distance between bending arms (mm)

DL = linear thermal expansion (mm)

2 = fixed value

Omega- or U-shaped pre-tensioned expansion compensators



If limited space does not allow the previous sizes to be created, it is possible to reduce the extent of the bending arm via the pre-tensioned compensator technique.

During the expansion stage, the installer must pre-tension the omega, using the arm, thus absorbing half of the linear expansion.

The formula for the calculation is as follows:

$$LCR = C \cdot \sqrt{(D \cdot (DL/2))}$$

where:

LCR = reduced curved side length (mm)

C = material constant (see data in table)

D = external pipe diameter (mm)

DL = linear thermal expansion (mm)

2 = fixed value

Clamping

Proper pipe clamping is a vital procedure, not only from a structural and aesthetic point of view, but also in terms of limiting the effects of linear thermal expansion in plants.

Correct clamping construction also contributes to the effectiveness of the expansion compensators (which require suitable fixed points for them to operate).

Correct securing clamp positioning must be carried out based on the type of pipe being used and the temperature of the fluid to be conveyed.

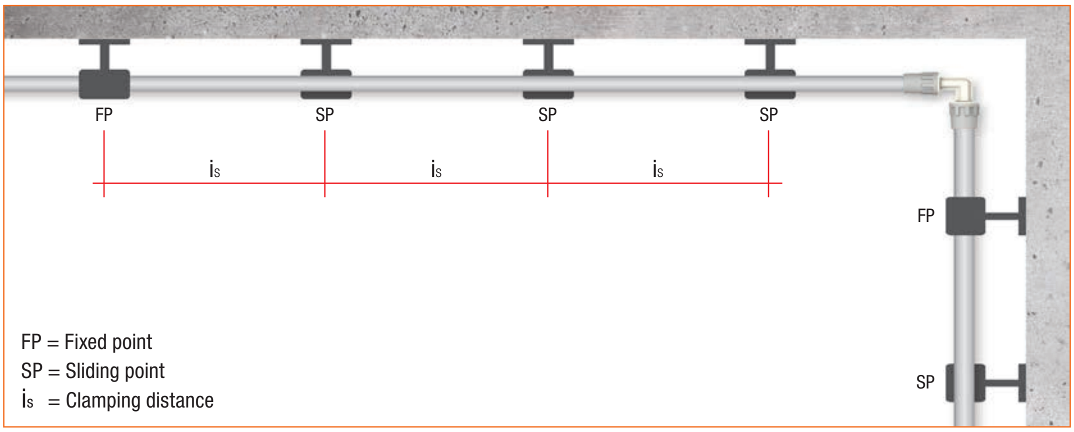
To limit and compensate for the effects caused by linear expansion, it is therefore necessary to provide clamps that completely restrict any possibility of pipe movement – called fixed points – and clamps that allow pipes to slide – called sliding points. In this case, the clamps must be created in such a way that valves and/or fittings do not impede sliding.

Fixed points prevent pipe movement and divide them into single sections of linear expansion. When fixed points are being created, all forces that act simultaneously on the pipe section (linear expansion forces, material weight, fluid weight and other additional loads) need to be taken into consideration.

It is advisable to carry out fixed point clamping at main branches, valves, plant items and threaded connections in general.

In this case, sliding points must be positioned in such a way as to take advantage of the changes in direction of the pipe so as to absorb the linear expansion.

Clamping diagram:
A fixed point FP + sliding point SP



Pipelines must be clamped using special brackets equipped with adequate protection to safeguard the pipeline itself.

The clamps that constitute the fixed and sliding points must be perfectly aligned so as to prevent the pipeline from jamming and to allow it to be guided during expansion.

When selecting and installing clamping systems, it must be remembered that excessive distance between the collar and the wall structure may cause bending or misalignment, which could affect the proper behaviour of the compensation system.

Because of the layer of aluminium foil with which it is constructed, multilayer pipes (metal-plastic composites) behave, from a mechanical point of view, in a similar way to metal pipes. The utmost care during clamping is, therefore, recommended so as to definitively reduce the stresses to which the individual components may be subjected.

Clamping values

As an aid to the proper clamping of pipes when open laid exposed, the table below indicates the positioning distances of the clamps according to the temperature of the conveyed fluid and pipe diameter.

Multi-calor pipe clamping (cm)

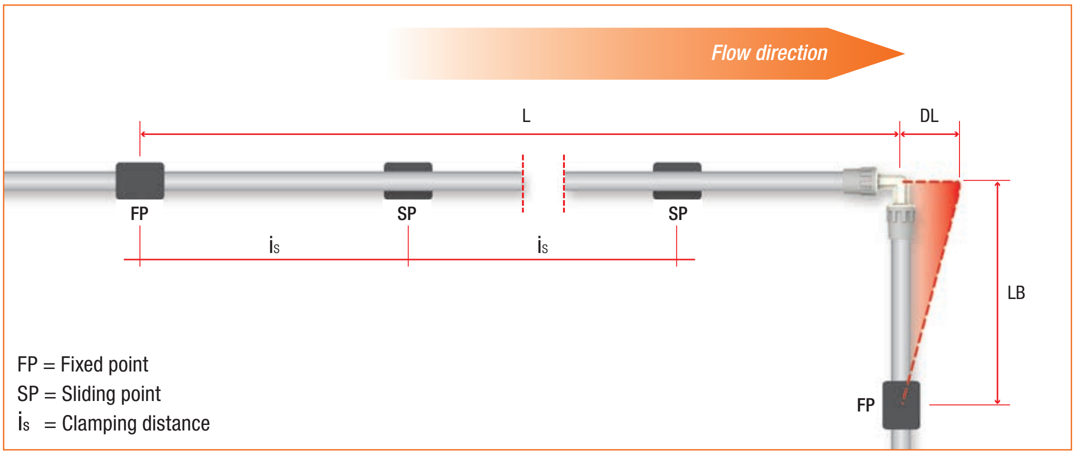
Δt	ø 14	ø 16	ø 18	ø 20	ø 26	ø 32	ø 40	ø 50	ø 63	ø 75	ø 90
0°C	120	130	140	155	170	190	230	255	300	300	300
10°C	100	115	130	140	150	155	185	235	290	290	290
20°C	100	110	120	120	130	155	185	235	290	290	290
30°C	100	110	115	120	130	150	175	225	280	280	280
40°C	90	110	110	110	120	145	175	210	280	280	280
50°C	85	100	110	110	120	145	170	210	270	270	270
60°C	75	90	100	100	110	140	160	190	250	250	250
70°C	65	80	90	90	100	130	150	180	230	230	230

Δt *is the difference between the temperature of the fluid and ambient temperature.*

Installation examples

Examples of clamping related to pipes conveying hot water:

1 **A linear distribution** of length L, requires a clamping system to be set up. The geometry of the line is such that the thermal expansion can be compensated for by exploiting the final change of direction.



Consider a line with the following characteristics:

ext. Ø	Length	Δt	C	α	E
63x4.5 mm (A = 826.6 mmq)	20 m	70°C	33	0.026 mm/mK	19000 N/mmq (calculation value for a specific Ø)

The stresses developed by the pipe on the fixed points can be derived considering the following cases:

a) Pipeline secured with fixed points at the ends

(an additional fixed point, therefore, before the fitting).

The axial stress that the pipe transmits to the fixed points is given by:

N = A • E • α • Δt = 826.6 • 19000 • 0.000026 • 70 = **28.6 kN**

b) Pipeline free to expand with bending arm

The expansion is given by:

DL = L • α • Δt = 20 • 0.026 • 70 = **36.4 mm**

Length of bending arm:

LB = 33 • √(63 • 36.4) = **1.580 mm**

The force that acts on the fixed points in the specific case is given by:

$$N \simeq \frac{(3 \cdot E \cdot J \cdot DL)}{(LB^3)} = 0.19 \text{ kN}$$

This nominal value must then be increased to take into account the structure-collar offset, any misalignments, and static and dynamic loads.

b) Pipeline free to expand with bending arm reduced (LBr)

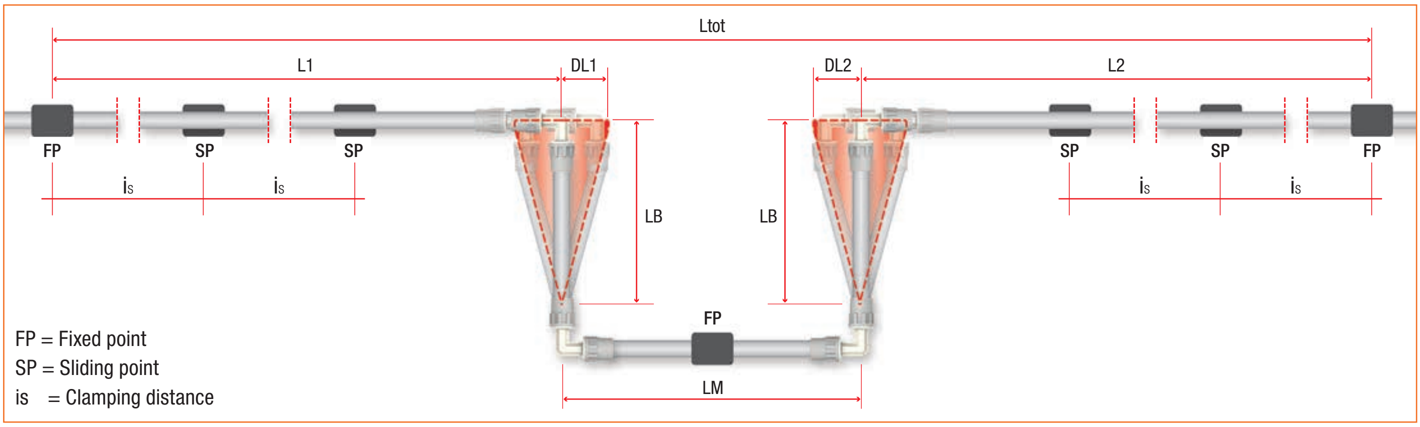
It is assumed that, due to assembly error, the bending arm LB has been halved compared to the correct value given by the formula, thus LBr = 790 mm.

By carrying out the calculations, it follows that the consequent nominal stress on the fixed points will be around 1.5 kN (net of the above increases).

Caution: this “reduced arm” hypothesis causes excessive stresses on the line components, so the installation carried out is incorrect.

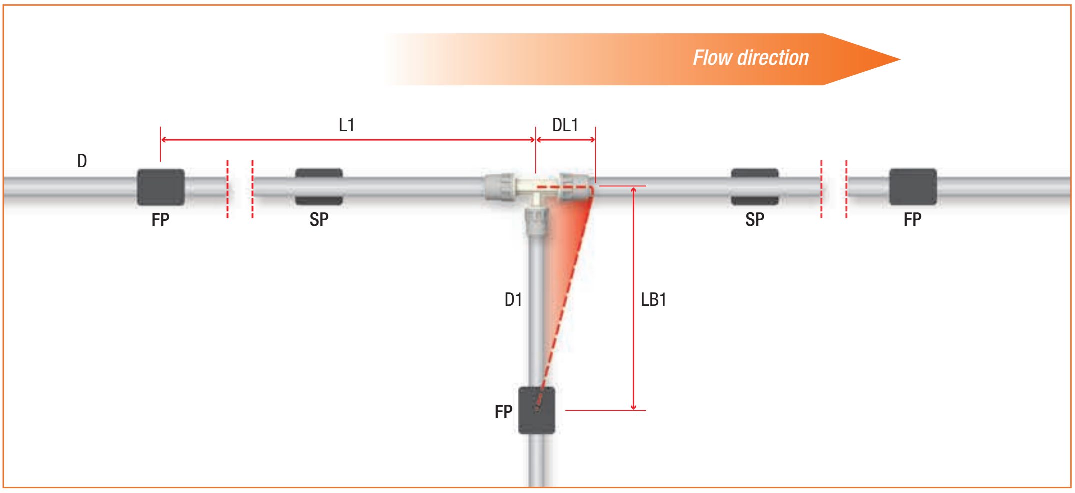
2 There is now a **linear distribution** of length L tot, whose thermal expansion cannot be compensated for by means of bending arms at the end sections since these are to be secured with fixed points.

In this scenario, an OMEGA or U of intermediate compensation is created which absorbs expansion of the line.



The maximum clamping distances between the centres (is) will always be given by the above table. We position the "omega" between the two extreme end points by dividing the line into two sections L1 and L2. We then calculate for both, using the formula **DL = α • L • Δt** the expansion for the single sections, to obtain DL1 and DL2. In this specific case, given that the pipe is the same for the two sections, we take the larger of the two and with this we calculate the length of the bending arm LB required to compensate for the thermal expansion of the entire line.

3 In the case of a **linear distribution with deviating branches**, we calculate for each of them the length of the bending arms so as to allow free compensation of the main line and the branched ones (TEE), according to the criteria mentioned above.

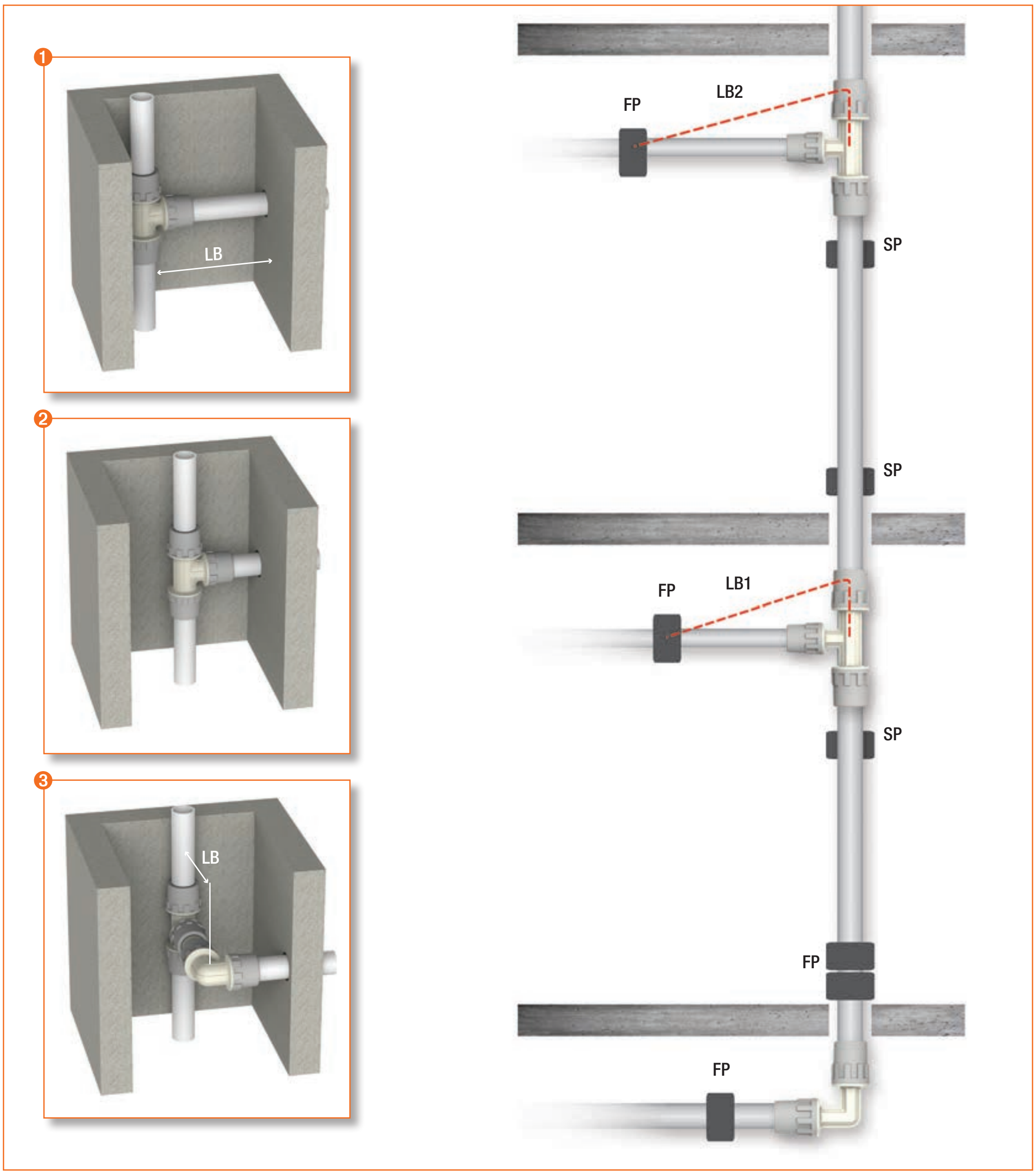


We first calculate the clamping distances between the centres (i_s) for each section using the table.

Then, as has already been seen in previous examples, we calculate the value of the thermal expansion of the main line at the branch section beginning from the fixed point to obtain DL1.

With the formula of the bending arm, we therefore calculate the length LB1 with respect to the branch with a diameter D1 such as to allow compensation for thermal expansion. In the event that there are breaks or bends to follow, the same procedure will be used.

4 For **vertical installations in multi-storey buildings** with pipelines being threaded through channels or conduits, the effects of thermal expansion on each branch on the various floors must also be considered when executing clamping procedures, adopting the appropriate compensation techniques (bending arms).



In the above example, there is a fixed point at the base of the riser with floor branches that are free to move due to thermal expansion of the riser itself.

The branches require the ability to absorb the movement in one of the following ways:

1) positioning the riser at the correct point in the duct such that the distance LB is adequate;

2) leaving space for the branch pipe to absorb expansion;

3) installing a compensation arm using an elbow.

For each diameter, clamping distances between the centres are obtained from the specific table, while for the illustrated formulas, thermal expansion and lengths of bending arm are obtained for each floor branch.

Clearly, the clamping at the base must be able to bear the weight of the relevant loaded riser and the thrust generated by the bending arms on each floor.

For further information, contact the Product Specialists.

Energy efficiency

In order to reduce heat losses of Aquatechnik pipeline systems, national standards and regulations in force on energy saving must be applied.

The polymeric components of “safety” systems, created using multilayer or homogeneous technology with the same insulation as metal, reduce heat losses and contribute to an increase in energy efficiency in installations.

In addition, the patented “safety” fitting system ensures a drastic reduction in pressure drops, favouring both energy savings, as circulation pumps can operate at reduced speeds, and a considerable reduction in associated noise.

Pipelines for domestic hot water or heating

The regulatory standards on energy savings provide useful information for calculating minimum insulation thicknesses, which depend on the material that constitutes the insulation, on the size of the pipeline, and on the type of system to be installed.

In Italy, these values are outlined by Law 10/91 and subsequent decrees (DPR 412/93).

Pipes for domestic cold or chilled water

Insulation in this type of system keeps the water at a constant temperature, and limits any possible return heat flows to prevent the formation of surface condensation. Concealed pipelines or those installed externally may be influenced by environmental changes in temperature or humidity. The type and thickness of the insulation used should therefore be checked to prevent the possible formation of condensation.

This will clearly depend on the individual installation conditions (air temperature, relative humidity and temperature of the fluid conveyed).

Thermal conductivities of pipelines are shown on the respective technical data sheets.

If Aquatechnik isoline or isoline-plus series pipes are used, thermal conductivities of the insulation and the related water vapour diffusion resistance factors are also displayed on the respective data sheets as well as in the table on page 28.

Integrating with other systems

Aquatechnik has developed a series of special fittings, called transition fittings, which allow the creation of connections between the “safety” system and other systems.

The main connection & transition options and their features is listed below.

Joint systems

Threaded joints

The first and most widely known joint system is the male and female thread according to ISO 228.

Aquatechnik's selection for this type of connection is among the most complete on the market and is divided into three different types:

- **safety-plus system:**

  threads available in sizes from ¾” to 3”, made entirely of synthetic material (barring exceptions) which together with the body of the fitting, which is also made of polymeric material, guarantees no contact between water and metal parts;

- **safety-plus system, with brass alloy insert:**

  threads available in ⅛” sizes made from a particular brass alloy with low zinc and lead content.

  They incorporate a special design that allows coupling to PPS units during the moulding stage, ensuring hydraulic seal effectiveness and reliability over time;

Aquatechnik to Copper Adapters

The compression adapter to get from 16mm AQ multi-calor tube to any 15mm compression connection is the **AQ73062**.

The other AQ to CU adaptors are the brass-spigot AQ7s from 16 x 15 mm to 26 x 22 mm.

Item	Transition option diameters	Code
AQ7016015	16 AQ x 15 mm Brass Spigot Male	39313
AQ7020015	20 AQ x 15 mm Brass Spigot Male	39324
AQ7020022	20 AQ x 22 mm Brass Spigot Male	39325
AQ7026022	26 AQ x 22 mm Brass Spigot Male	39326

Collar flange

A series of PP flanges with a metal core and a series of PPS collars allow connection to flanges of various types. Particularly suited to larger diameters, this type of joint is widely recognised for its ease of disassembly and the effectiveness of its seal.

Generally used for connection to accessories that may require servicing (valves, pumps, main plant items, etc.), the range is available from Ø 16 to Ø 63 mm.

The collar is made entirely from synthetic material, which guarantees no contact between water and metal parts, while the coupling flange is reinforced by a special ductile cast iron core which, owing to a particular design of the sheet metal, allows it to bear very high loads and, therefore, high pressures (PN 10/16).

The flanges are drilled according to EN 1092 and ISO 7005 standards and are protected by an external coating in PP (polypropylene homopolymer) which protects the metal from oxidation and, at the same time, guarantees low weight and high mechanical strength.

Special flanges with ANSI drilling are available for the American market.

Pipe unions

Joint system that allows parts to be dismantled with ease. Even for this series of joints, Aquatechnik provides many solutions:

- **straight and 90° elbow threaded fittings**, made with synthetic material fitting unit connected using a metal nut with ISO 228 standard thread, in special brass alloy, available in female version from ¾" to 1¼", for pipes from 16 to 32 mm;
- **straight fittings** made entirely from synthetic material. This type of union is specially designed for connection to "safety" fittings on one end and to multilayer pipes on the other, allowing for dismantling if required.

  Available for pipes from 16 to 32 mm.

Direct junction for multilayer pipes

Direct junctions are elements that make the Aquatechnik range stand out. These special fittings allow bran-ching from a larger pipe to connect it to a smaller pipe in confined spaces with limited equipment and extremely reduced timeframes. This procedure can be carried out even on pipelines that have already been installed.

Direct junctions are available in various sizes with ½" and ¾" M threaded couplings on the main Ø 63 and Ø 75 mm pipeline. Patented by Aquatechnik, it is priceless for its practicality.

Manifolds

Of all the components provided by Aquatechnik, the "safety" range boasts one of the most complete series of manifolds available on the market:

- **modular with no shut-offs**, for exposed and concealed installation;
- **cross**, with two outlets, for exposed and concealed installation;
- **coplanar**, for exposed and concealed installation;
- **branching, male/male and male/female**, for exposed and concealed installation;
- **multirapid, with shut-off**, for localised control & isolation. The latter series is also available in the valurapid version, manufactured in black modified polyamide (PA-M), exclusively designed for the construction of mechanical, heating and air conditioning distribution systems.

The vast range of fittings in the "safety" series guarantees coupling of their manifolds to any type of pipe on the market.

Shut-off systems

Ball valves made entirely of polymeric material

These cutting-edge valves have been designed not only for the conveyance of water but also for aggressive fluids that are incompatible with metals. The body, ball and the related mechanics are made entirely from PP, while the unions are in PPS, with no metal components in contact with the fluid.

The seal is adjustable due to a unique system that allows the valve to keep running with perfect efficiency, using only a simple procedure. The two unions and collars allow the valve to be replaced at any time. The seal of the unions is created using EPDM peroxide O-rings housed in the valve body. Available from Ø 16 to Ø 63 mm.

Ball valves with alloy body and union

For the creation of shut-off valves, the '"safety" range includes a series of ball valves with a brass body equipped with a double union, which is removable and full flow.

Fire resistance

Most of the components in the “safety” system (polymeric pipes and fittings) are not non-combustible: some of design and installation recommendations are outlined below.

They highlight the risks due to the flammable properties that most of the items in this range have.

Fire load

The pipes installed in areas subject to fire prevention must be located according to certain fire protection requirements to which reference should be made according to the specific instructions of the laws and sector standards in force in individual countries.

To calculate the compartmentalisation zones, the Specific Fire Load (qf) is given by the degree of the flammability value of all materials in the concerned area: electrical cables, pipelines, thermal insulation and various furnishings.

For the determination of the Combustion Heat (kWh/m) from each material present in the concerned zone, in the case of pipes or several pipeline sections, the polymeric material component, the linear mass as a function of diameter and thickness and, for each material, the Calorific Value (H) must be considered quantitatively.

Components made from metallic materials are to be considered incombustible.

Values for the different types of polymeric material that constitute the components (pipe and fitting) of the “safety” system are shown below.

These values are purely indicative and must be thoroughly checked during the design.

	pipe **multi-calor**
Calorific value H kWh/kg	ca.12.5*

** Value referring to the PE-X component in the pipe*

Furthermore, classifications for multi-calor pipes are shown below:

	pipe **multi-calor**
Classification according to EN 13501-1	C-s2, d0 (bare pipe) For the classifications about the insulations, see page 28

Fire protection

Through-penetration of all pipes and technical materials, cables, ducting, etc., (service supply lines) must include suitable protection to limit the spread of fire and the transmission of heat and smoke from one compartment to another.

The EN 1366 European standard part 3 defines the sealing parameters and systems for the barrier and passive protection of these penetrations.

Adopting specific, certified intumescent fire sealing systems, polymeric pipes easily fulfil these requirements.

The following devices can be found on the market:

- **intumescent flange collars:**

  They come in both vertical (between flooring) and horizontal (between wall) installations, and are suitable for through-penetrations carried out with structural boring for individual lines;

- **firestop pillows*:**

  Suitable for through-penetration installations carried out via structural gap openings to transition through multi-service lines, they are positioned by overlapping them, filling the empty spaces in the conduit passage.

  They can be subsequently removed to allow for the transition of further lines;

- **intumescent strips*:**

  Suitable for through-penetrations between flooring and walls, this type is flexible, and wraps around the pipeline.

Intumescent devices are made of fibreglass and a mixture of mineral fibres combined with expanding agents. When exposed to heat, these devices expand rapidly, filling the pipe, which collapses under the compression until the opening is completely sealed, thus preventing transmission of flames, smoke and gas from one zone to another.

*If these systems are to be adopted, fixed pipeline points should be installed before and after the wall/flooring system through-penetration.

Jointing and Equipment

The whole “safety” range is unique and cannot be compared to other mechanical compression fittings (screwing method), and even less so to press fitting systems.

The connection between pipe and fitting is not made by pressing or compression screwing, but through the perfect coupling between the shape of the flared pipe and the fitting profile.

The safety cap also prevents any possible movement of the joined parts, and guarantees, more than any other method, all the couplings, whether walled in or laid freely.

Aquatechnik provides a complete range of equipment for the implementing these couplings.

The machines used for this process, known as coupling machines, are designed and patented by the company and allow the end of the pipe to be flared safely.

There are two different types of coupling machines:

- **manual**;
- **powered** by battery or by cable connected to the electric power supply (220 V).

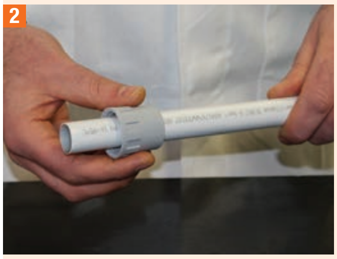
Jointing is simple, fast, safe and the is the same process for the entire diameter range from 16 to 90 mm and does not require deburring and calibration of the pipes before the flaring process.

For detailed instructions, operating and maintenance information, always refer to the instructions supplied with the machine.

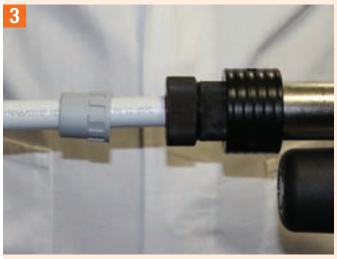
Coupling

1


Cut the pipe accurately.

2


Insert the cap into the pipe.

3


Insert the pipe on the head of the coupling machine.

4


Start the process until the pipe is flared (the pipe will be automatically released from the machine once this operation is over).

5


Slot the fitting into the flared pipe as far as it will go.

6


Screw the cap as far as the self-locking safety notches (use the special 50600 series wrench).

Precautions on processing

- Once the fitting is locked in place, it can be adjusted slightly.
- To remove the fitting and use it again, turn the cap with the the locking spanner, to release it.
- We always suggest replacing the cap, especially if it is damaged.

Warnings for appropriate use of the systems

- Handle the product with caution and protect installations at risk of accidents. Avoid any knocks or impacts during storage, transportation and handling on the work site.
- Cut the pipes accurately at right angles, making sure that there are no rough edges and inaccuracies.
- To cut the pipes, use specific tools (shears and pipe cutters)
- Do not use tools for calibrating the pipes before processing them.
- Locate the cap onto the pipe before flaring the pipe.
- Execute the flaring process in line with the pipe.
- Eliminate uneven and imperfect flared ends (e.g. splitting of aluminium).
- If the pipe layers come apart during the flaring process, cut off the faulty flared end and repeat the operation, or correct the flared end by using the special “MC 1420 punch” (51250 series).

  Inserting a coupling in a pipe with layers that have delaminated could damage the O-ring.
- All the “safety” fittings are pre-lubricated: however, we recommend Lubricating the O-rings with specific grease (art. 71391), if necessary.
- Secure the caps on the safety notches with the locking spanner until they are fully engaged before final testing and commissioning the system.
- For PPSU threaded gaskets, only use:
  - Hemp with the special Aquatechnik paste (art. 71370)
  - Aquatechnik sealant (art. 71380)
  - Teflon
  - Specific PPSU-compatible sealants
- If PPS and metal threads are joined, make sure the threads are lined up and do not use non-standard and/ or damaged threads.

  If female ½’’ PPS threads need to be repaired, the special “Threading” tool is available (art. 51240).
- Only connect caps or fittings from the system to the “safety” threads (manifolds, reducers, plugs, male/female fittings, etc.).
- Do not reuse worn or damaged caps and couplings.
- Correct the end alignment with moderation, without exerting excessive force on the tightened fittings.
- Observe the bending radius whether it is made manually or with a pipe bender.
- Work with care and keep the work area clean. The presence of foreign objects, especially on the sealing O-rings can compromise the hydraulic seal of the joint.
- Exposing the pipes and fittings to sunlight for limited periods is only an aesthetic problem (darkening of material). In the event of prolonged exposure, always protect the pipes and fittings by walling them in, installing them in channels or using special paint (art. 71400) or adhesive tape (art. 71397).
- PPS is compatible with most polyurethane foams on the market. Should it be necessary to use it, and in case of doubt about compatibility, please contact our Product Specialists.

- PPS is compatible with most adhesive tape on the market. To insulate the fittings against heat and condensation, we suggest using tape with water-based adhesive. In case of doubts about compatibility, please contact our Product Specialists.
- For pipes carrying hot liquids, insulate the pipes in accordance with the reference standards.
- Take care not to damage the pipes in any way (e.g. when removing the insulating tape or removing the packaging).
- Install brackets if required to prevent sagging, distortion, etc., as indicated in the section entitled Clamping (page 43).
- Test the systems as per the relevant standard before walling the pipes permanently and commissioning the system. Take care over maximum pressure of the other installed components.

  Always fill in the testing report.
- If performing an air test, only use Aquatechnik spray (art. 71393) to detect any leaks.

  If you need to use different sprays, contact the Product Specialists beforehand to check they are compatible.
- Do not heat the pipes and/or fittings with naked flames.
- Do not use faulty or damaged equipment and tools which are not properly maintained.

NB: the processing equipment and accessories may undergo manufacturing and/or functional changes at the discretion of the manufacturer; please refer to the instructions for use provided with the relevant equipment for this purpose.

It should be noted that the guarantee on the products is valid only for obvious faults or manufacturing defects; the installation operations and any other function concerning the systems are the responsibility of the installation companies and not attributable to Aquatechnik.

Washing the sanitary system

Once the systems have been built and the tightness test has been performed as indicated by the EN 806-4 European standard, flush the system; if using water-air mixtures, the compressor or compressed air tanks must be equipped with an oil separating filter.

Flush sections of piping of no more than 100 m in length. Start from the input point, working through the standpipes and proceeding floor by floor.

The flow rate must be at least 2 m/s, the water exchange at least 20 times the volume in the pipes.

For each floor, open the tap furthest from the standpipe and continue for all the other taps.

When the operation is complete, close the taps in reverse, drain the system if it is unused or if there is a risk of ice forming.

Complete the procedure registration report to hand in to the works supervisor and building owner.

Preventive measures against the spread of Legionella

Prevention during the design phase is an efficient way to combat the risk of Legionella proliferation.

For sanitary systems, be sure to:

- avoid pipes with dead legs or no circulation;
- prevent stagnation, by installing recirculation loops. For this purpose, we recommend using threaded tee female angle 90° (art. 20632), especially designed to ensure maximum hygiene (see page 40);
- plan for periodic, simple cleaning;
- choose the materials carefully (e.g. use multi-calor pipe with extremely low surface roughness, 0.007 mm with free-flowing fittings, which reduce the risk of deposits that may encourage bacterial proliferation);
- prevent the formation of biofilm, sediment and limescale.

Disinfection techniques

Disinfection processes must be designed and carried out with the goal of:

- safeguarding humans from the presence of bacteria in water, overexposure to oxidising agents and the risk of burns;
- maintaining the chemical-physical requirements required by European Directive 98/83/EC and subsequent updates on the quality of water intended for human consumption;
- protecting the environment from pollution by oxidants from waste water;
- ensuring the integrity and duration of the components making up the systems.

a) Chemical disinfection of drinking water

Continuously disinfecting drinking water chemically must be done with a maximum concentration of 0.2 mg/l of free chlorine.

The water temperature must not exceed 70°C.

If bacteria are present, the hyperchlorination process can be performed up to twice a year. To define times, temperatures and doses, consult the Product Specialists.

Once complete, flush the systems with cold drinking water. If necessary, neutralise the oxidiants in the waste water to avoid polluting the environment.

Super shock chlorine has extremely negative effects on metal pipes because it accelerates corrosion.

Multi-calor pipes, however, have a greater resistance to chemical compounds and can withstand this type of treatment for several years without any loss of performance.

There are also new types of treatment available against Legionella and chlorination consisting of the use of chlorine dioxide and monochloramine.

We do not have reliable data on these sanitisation products, therefore contact our Product Specialists for more information.

b) Thermal disinfection of the system

Stable temperatures of 70°C for at least 3 minutes in all parts of the system. To carry out if the presence of bacteria has been confirmed, protecting people from the risk of burns and scalds.

Thermal and hyperchlorination disinfection must never be carried out at the same time.

Disinfection processes must be carried out by properly qualified personnel; we recommend completing a log with the doses, temperatures and pressures detected during the processes.

Important

In systems created with Aquatechnik products that require washing or permanent sanitisation, it is always advisable to consult an Aquatechnik Product Specialist:

www.aquatechnik.co.uk/contact-us

Testing the system

Every sanitary, heating or other system installed must be tested by the installing company in compliance with the law before being permanently walled in.

The installer is legally responsible for the work done and must guarantee perfect operation in all of its parts.

Therefore, all the tests carried out must be recorded (you can request the relevant "Testing Report" form by contacting www.aquatechnik.co.uk/contact-us).

Based on its thirty years' experience, Aquatechnik suggests testing the system according to UNI EN 806-4 (procedure C), but applying a 15 bar pressure.

If it is impossible to apply 15 bar, the test can be performed at reduced pressures which in any case must always be higher than 1.1 times the Maximum Design Pressure in the case of pipelines inside buildings or 1.5 times the Maximum Project Pressure in the case of pipelines outside buildings (from UNI EN 805): in this case the time must be increased proportionally (for example, at 8 bar the times could be doubled, at 5 bar the times could be tripled).

This indication is aimed at ensuring a high degree of safety in the testing without compromising the operation of the system in any way.

In case of air testing, apply the provisions of the UNI EN 806-4 standard: "where permitted by the national regulations, use clean, oil-free low-pressure air or inert gases. Pay attention to the possible danger caused by gas or air in the system".

To search for any leaks, only use Aquatechnik spray (art. 71393) to detect any leaks. If you need to use different sprays, contact our Product Specialists to check they are compatible.

For any other details, consult the UNI EN 806-4 standard.

Testing is, therefore, recommended by carrying out the following procedures:

1 - PRE-TEST

duration 60 minutes (1 hour)

- Fill the system, making sure all the air pockets have been removed, then close the vents and drain valves.
- Connect the variable pressure pump to the most suitable terminal, and fill the system up to the maximum pressure of 15 bar.

  NB: if there are heating elements, shut-off valves, valves, in the system, reduce the pressure.

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Important notes

- After 30 minutes, record the measured pressure and make a visual inspection to detect any leaks in the system
- After a further 30 minutes, record the measured pressure. If the pressure drop is less than 0.6 bar, the system can be considered to be leak-free and the pre-test can be considered successful.

2 - DEFINITIVE TEST

minimum duration 120 minutes (2 hours)

- If the pre-test gave a positive result, maintain the same pressure for the next 120 minutes (2 hours).

  During this time, carry out an additional visual inspection to detect any leaks in the system.
- After 120 minutes (2 hours), if the pressure drop is less than 0.2 bar, the test can be considered successful.
- Fill in all the fields of the test report.

Regulations for creating systems

The purpose of the following regulation is to clarify the duties and responsibilities for heating, cooling and plumbing systems in general, created with materials manufactured by Aquatechnik.

1 The duties and responsibilities of Aquatechnik® group s.p.a. are limited to the materials manufactured and supplied by the company, covered by a standard warranty, for any manufacturing faults or defects.

2 The company is exonerated from any possible claims that may regard:

a) Any type and kind of malfunctioning systems.

b) Broken pipes and/or fittings caused by transport to the construction or work sites; failure to carry out hydraulic testing as indicated in the technical guide; transporting aggressive fluids; materials from other sources inserted into the system that can cause collateral damage or wear to the original piping.

c) Mistakes in the hydraulic, electrical or electronic connections committed by installation technicians.

The duties and responsibilities in implementing the systems are outlined in the diagram below.

System part	Person in charge
System estimate, calculation and sizing according to the standards in force.	Professional firm and/or freelancer qualified for thermotechnical design
Installation of the necessary materials, including: thermoplastic pipes and fittings, insulation in compliance with the standard to lay out supply and connection networks to terminal heating elements, water exchange tanks, adjustment equipment, boiler and central heating system, various testing, system start-up and all other work pertaining to the system.	Company specialised in thermo-hydraulic installations and technical service centres
Electrical connections to control equipment, to service thermostats, safety devices and all other work pertaining to the electrical or electronic parts.	Company specialised in electrical installations
Thermoplastic pipes and fittings for hydraulic circuits, accessories and components manufactured by the company.	Aquatechnik group spa

Integrated Quality/Environment Management System

Aquatechnik has chosen quality as the guideline to manage its production and commercial activity.

The production site, founded in the 1990s, immediately adhered to the ISO 9001 quality system, implementing the operating rules and methods to ensure highest quality products manufactured with monitored processes.

This went hand in hand with the expansion of the testing laboratories which, in addition to ensuring continual monitoring of the manufactured products, consist of a specialised research and development centre, essential resources in today's business philosophy.

The company has always taken a keen interest in protecting the planet and opted from the very beginning to use processes with a low environmental impact and recyclable materials. It, therefore, decided to implement the ISO 14001 standard and set up an integrated Quality/Environmental Management System whose effectiveness have been demonstrated by the new certification obtained in 2019. Using an integrated Quality/Environment Management System and respecting the ISO 9001 and 14001 standards has strengthened the desire to improve all the departments by improving not only from a technical point of view, but from a human one too.

To this end, Aquatechnik has focused on the concept of service, thus providing its customers and all users with an efficient, punctual partner who can guarantee all-round, comprehensive solutions.

The company's professional approach and care are demonstrated by a full cycle that starts from the design of the product, continuing through its development and checks on its technical qualities before reaching distribution and culminating in an efficient after-sales customer service, guaranteed by specialised technical personnel.

Thanks to efficient consulting during the quotation, design and installation stages, the customer can thus count on a guaranteed, on-hand service ready to respond to all queries, clear up any doubts and provide the necessary installation knowledge and techniques.

Aquatechnik products undergo stringent approval tests by major international institutes that continuously monitor production and control processes.

By achieving high quality standards, Aquatechnik has obtained the most important worldwide certifications.

Warranty for Contractual Liability and Product Liability

The warranty for contractual liability complies with the provisions under the Italian Civil Code from clauses 128 to 145. Aquatechnik guarantees that all its products are free from faults and/or non-conformities.

The warranty has a duration of 2 years from the delivery date to its customers and is invalidated two months after the defect is discovered. The warranty is increased to 25 years providing the installer has received installation competency training by an Aquatechnik product specialist. Contact www.aquatechnik.co.uk/contact to find out more.

Liability for damage due to a defective product is governed by the provisions contained in Part IV, Title II, clauses 114 to 127 of Italian Legislative Decree 206/2005 (Consumer Code) and by the EEC Directive 85/374/EEC dated 25/07/1985. Aquatechnik guarantees its system for ten years, except in Countries with different regulations, from the production date. However, any action aimed at damage compensation remains valid for three years after the day on which the party concerned was or would have had been aware of the damage, defect and identity of the responsible party.

The insurance covers any damage, with a maximum claim of €15,000,000.00, for any damage that may result from the use of pipes and fittings with uncharacteristic defects, resulting in the lack of safety that can be legitimately expected of them, taking into account all circumstances including:

(a) how the product was put on the market, its performance, its obvious features, the instructions and war-nings provided;

(b) the use for which the product can be reasonably intended and the conduct that, in relation to said use, can be reasonably foreseen;

(c) the period in which the product was put on the market; i.e., lacking the safety features usually offered by other models of the same series.

Product liability is not valid in the following cases:

a) for flared ends and couplings with incorrect "safety" fittings;

b) for work with equipment and assembly carried out with materials not supplied by the system manufacturer;

c) for pipe or fitting installations that do not comply with the technical instructions and warnings indicated in the original documents published by the manufacturer, for which system installers are required to be up-to-date;

d) for the use of material already deteriorated due to carelessness and/or negligence (i.e.: nicks, violent impacts, incisions, twisting of parts assembled, assembly of tapered and/or worn threading, crushing, exposure to sunlight, naked flames, etc.);

e) for abnormal system operation, excessive heating temperatures, internal pressures above the prescribed standards, aggressive agents in the fluids, building structure settlement, fluid freezing, perforations, formation of ice in the pipes, etc. and in all cases in which the defect that caused the damage did not exist when the manufacturer marketed the product;

f) for non-compliance of hydraulic testing indicated in the technical guidelines;

g) if the manufacturer did not produce the product to be sold or for any other type of free distribution, or if the manufacturer did not manufacture or distribute the product within its professional business activity;

h) if the defect is due to the fact that the product is compliant with a mandatory legal standard or a binding provision;

i) if the scientific and technical knowledge available at the time the manufacturer put the product on the market did not allow the product to be considered defective;

j) if the product defect does not depend on the quality of the components, but rather on how it was used in creating the final product.

Competent Court

All disputes shall be the responsibility of the court of Busto Arsizio - Varese - Italy.

Warranty activation

If a possible production flaw or defect is detected, the installer must communicate it in writing to the dealer from which the goods were purchased; **Aquatechnik Technical Assistance** will set up an on-site inspection to assess the validity of the defect by carrying out tests at its laboratory or through designated institutes.

Once the real cause of the defect has been confirmed and acknowledged as such, the installer that incurred the damage will be requested to provide an estimate of the costs to restore the system, followed by settlement of the incident.

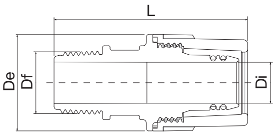
NB.

If the Technical Assistance confirm that the presumed defects cannot be attributed to Aquatechnik material, all the expenses incurred for carrying out the checks will be charged to the installer or the customer.

The manufacturer reserves the right to make changes or replacements, without prior notice, to its products and technical documentation.

Users are, therefore, invited to periodically obtain updates of the above.

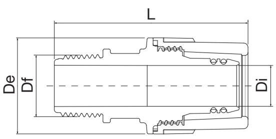
Safety-plus fittings



THREADED JOINT MALE with PPS thread

Item	M	T	L	Df	De	Di	Weight		
		mm	mm		mm	mm	g	pcs	pcs
20000	M½”- sm14	14-2	61.0	M½”	25.5	8.0	20.4	10	300
20001	M⅜” - sm16	16-2	61.4	M⅜”	27.5	8.0	23.3	10	300
20002	M½” - sm16	16-2	63.9	M½	27.5	9.5	25.0	10	300
20004	M½”- sm18	18-2	65.5	M½	30.0	11.5	25.5	10	250
20006	M½”- sm20	20-2	65.7	M½	32.6	14.0	30.8	10	250
20010	M¾”- sm20	20-2	68.2	M¾”	32.6	14.0	33.7	10	250
20012	M¾”- sm26	26-3	74.6	M¾”	41.2	18.0	52.3	5	100
20013	M1”- sm26	26-3	75.1	M1”	41.2	19.0	52.3	5	100
20016	M1”- sm32	32-3	81.3	M1”	50.0	25.0	82.2	5	80
20018	M1¼”- sm40	40-3.5	101.6	M1¼”	60.0	32.0	138.3	1	40
20028	M1½”- sm50	50-4	110.0	M1½”	73.2	40.0	217.3	1	40
20033	M2” - sm63	63-4.5	137.5	M2”	95.0	53.0	465.9	1	10
20039	M2½”- sm75	75-5	155.0	M2½”	115.0	65.2	762.2	1	10
320045*	M3”- sm90	90-7	161.0	M3”	139.0	72.5	4057.0		

* Bronze body, PA-M caps

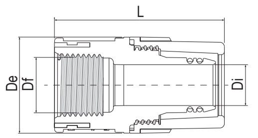


THREADED JOINT MALE with alloy thread

Item	M	T	L	Df	De	Di	Weight		
		mm	mm		mm	mm	g	pcs	pcs
20022	M½”- sm16	16-2	71.9	M½”	33.5	9.5	81.4	10	200
20026	M½”- sm20	20-2	73.5	M½”	32.6	14.0	85.8	10	200

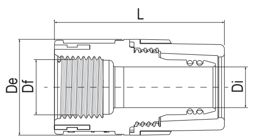
sf male “safety” thread
sm male “safety” thread
R fitting
T pipe
M dimension
LEGEND

aquatechnik



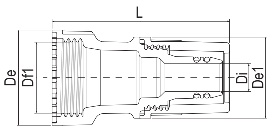
THREADED JOINT FEMALE with PPS thread

Item	M	T	L	Df	De	Di	Weight		
		mm	mm		mm	mm	g	pcs	pcs
20060	F½”- sm14	14-2	52.7	F½”	32.0	8.0	34.5	10	300
20062	F½” - sm16	16-2	55.9	F½”	32.0	9.5	37.5	10	300
20064	F½” - sm18	18-2	57.5	F½”	32.0	11.5	41.9	10	250
20066	F½”- sm20	20-2	57.7	F½”	32.6	14.0	43.7	10	250
20070	F¾”- sm20	20-2	55.2	F¾”	39.0	14.0	46.6	10	250
20072	F¾”- sm26	26-3	61.6	F¾”	41.2	17.8	64.0	5	100
20073	F1”- sm26	26-3	65.6	F1”	41.2	17.8	83.7	5	100
20076	F1”- sm32	32-3	68.3	F1”	50.0	25.0	107.5	5	80
20078	F1¼”- sm40	40-3.5	81.5	F1¼”	60.0	32.0	190.7	1	40
20088	F1½”- sm50	50-4	88.0	F1½”	73.2	40.0	265.1	1	40
20093	F2”- sm63	63-4.5	113.0	F2”	95.0	65.2	562.5	1	15



THREADED JOINT FEMALE with alloy thread

Item	M	T	L	Df	De	Di	Weight		
		mm	mm		mm	mm	g	pcs	pcs
20082	F½”- sm16	16-2	55,9	F½”	35,0	9,5	67,0	10	200
20086	F½” - sm20	20-2	57,5	F½”	35,0	14,0	72,7	10	200



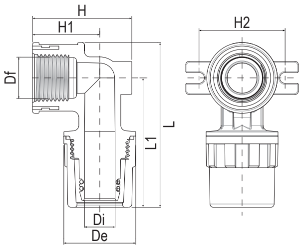
REDUCER

Item	M	T	R	L	De	De1	Di	Weight		
		mm	mm	mm	mm	mm	mm	g	pcs	pcs
20114	sf16 - sm14	14-2	16	54.2	27.5	25.5	8.0	18.1	10	300
20120	sf20 - sm14	14-2	20	57.0	32.3	25.5	8.0	19.4	10	250
20122	sf20 - sm16	16-2	20	60.2	32.3	27.5	9.5	23.3	10	250
20123	sf20 - sm18	18-2	20	61.8	32.3	30.0	11.5	23.6	10	250
20126	sf26 - sm16	16-2	26	64.9	41.2	27.5	9.5	30.6	5	200
20130	sf26 - sm20	20-2	26	66.7	41.2	32.6	14.0	35.2	5	200
20132	sf32 - sm16	16-2	32	68.9	50.0	27.5	9.5	42.7	5	80
20136	sf32 - sm20	20-2	32	70.7	50.0	32.6	14.0	46.6	5	80
20138	sf32 - sm26	26-3	32	76.0	50.0	41.5	17.8	61.6	5	80
20142	sf40 - sm16	16-2	40	74.0	60.0	27.5	9.5	51.9	1	40
20144	sf40 - sm20	20-2	40	75.8	60.0	32.6	14.0	54.7	1	40
20146	sf40 - sm26	26-3	40	81.0	60.0	41.5	17.8	67.2	1	40
20148	sf40 - sm32	32-3	40	84.9	60.0	50.0	25.0	93.0	1	40
20156	sf50 - sm32	32-3	50	93.8	73.0	50.0	25.0	122.3	1	40
20158	sf50 - sm40	40-3.5	50	100.5	73.0	60.0	32.0	148.5	1	40
20166	sf63 - sm32	32-3	63	103.8	95.0	50.0	25.0	220.9	1	30
20168	sf63 - sm40	40-3.5	63	110.5	95.0	60.0	32.0	252.0	1	30
20170	sf63 - sm50	50-4	63	120.5	95.0	73.2	40.0	301.0	1	24
20178	sf75 - sm32	32-3	75	119.8	115.0	50.0	25.0	435.8	1	20
20180	sf75 - sm40	40-3.5	75	126.5	115.0	60.0	32.0	457.9	1	20
20182	sf75 - sm50	50-4	75	136.5	115.0	73.2	40.0	476.3	1	16
20184	sf75 - sm63	63-4.5	75	153.0	115.0	95.0	53.0	670.0	1	12
320193*	sf90 - sm63	63-4.5	90	158.0	139.0	95.0	53.0	3570.4		
320194*	sf90 - sm75	75-5	90	163.5	139.0	115.5	65.5	4112.0		

* Bronze body, PA-M caps

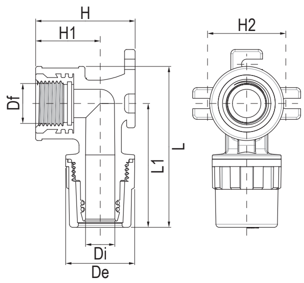
THREADED ELBOW 90° FEMALE with PPS thread and bracket

Item	M	T	L	L1	H	H1	H2	Df	De	Di	Weight		
		mm	mm	mm	mm	mm	mm	mm	mm	mm	g	pcs	pcs
20212	F½”- sm16	16-2	70.8	54.8	45.0	30.5	39.0	F½”	27.5	9.5	51.0	10	200
20216	F½”- sm20	20-2	74.5	58.5	47.0	30.5	39.0	F½”	32.6	14.0	57.2	10	150



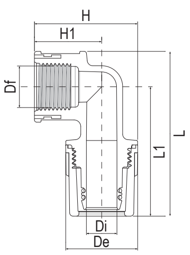
THREADED ELBOW 90° FEMALE with alloy thread and bracket

Item	M	T	L	L1	H	H1	H2	Df	De	Di	Weight		
		mm	mm	mm	mm	mm	mm		mm	mm	g	pcs	pcs
20202	F½”- sm16	16-2	72.3	54.8	45.0	30.5	37.0	F½”	27.5	9.5	79.7	10	150
20206	F½”- sm20	20-2	76.0	58.5	47.0	30.5	37.0	F½”	32.6	14.0	87.3	10	150



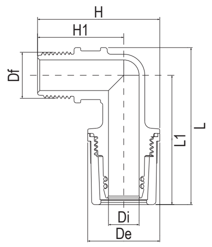
THREADED ELBOW 90° FEMALE with PPS thread

Item	M	T	L	L1	H	H1	Df	De	Di	Weight		
		mm	mm	mm	mm	mm		mm	mm	g	pcs	pcs
20222	F½”- sm16	16-2	70.8	54.8	44.3	30.5	F½”	27.5	9.5	45.9	10	250
20226	F½”- sm20	20-2	74.5	58.5	46.8	30.5	F½”	32.6	14.0	52.3	10	200
20230	F¾”- sm20	20-2	80.7	61.2	44.8	28.5	F¾”	32.6	14.0	57.4	10	150
20232	F¾”- sm26	26-3	87.1	67.6	52.6	32.0	F¾”	41.2	17.8	79.5	5	100
20238	F1”- sm32	32-3	100.5	76.3	63.0	38.0	F1”	50.0	24.8	132.3	5	60



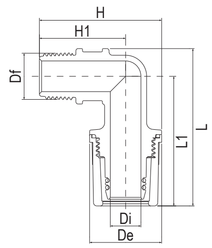
THREADED ELBOW 90° FEMALE with alloy thread

Item	M	T	L	L1	H	H1	Df	De	Di	Weight		
		mm	mm	mm	mm	mm		mm	mm	g	pcs	pcs
20262	F½”- sm16	16-2	72.3	54.8	44.3	30.5	F½”	27.5	9.5	71.2	10	250
20266	F½”- sm20	20-2	76.0	58.5	46.8	30.5	F½”	32.6	14.0	80.5	10	150



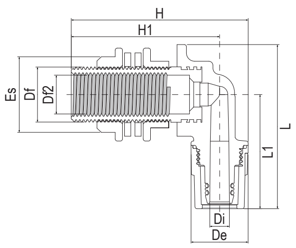
THREADED ELBOW 90° MALE with PPS thread

Item	M	T	L	L1	H	H1	Df	De	Di	Weight		
		mm	mm	mm	mm	mm		mm	mm	g	pcs	pcs
20282	M½”- sm16	16-2	67.3	54.8	52.8	39.0	M½”	27.5	9.5	30.0	10	250
20286	M½”- sm20	20-2	71.0	58.5	55.3	39.0	M½”	32.6	14.0	36.0	10	200
20288	M¾”- sm20	20-2	76.9	61.2	57.8	41.5	M¾”	32.6	14.0	44.6	10	150
20290	M¾”- sm26	26-3	83.3	67.6	65.6	45.0	M¾”	41.2	18.0	66.4	5	100
20296	M1”- sm32	32-3	75.8	76.3	76.0	51.0	M1”	50.0	25.0	103.9	5	60



THREADED ELBOW 90° MALE with alloy thread

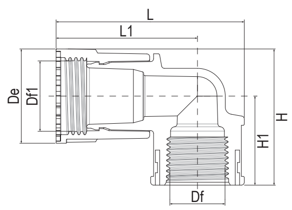
Item	M	T	L	L1	H	H1	Df	De	Di	Weight		
		mm	mm	mm	mm	mm		mm	mm	g	pcs	pcs
20322	M½”- sm16	16-2	71.3	54.8	60.3	46.5	M½”	27.5	9.5	88.5	10	200
20326	M½”- sm20	20-2	75.0	58.5	55.3	46.5	M½”	32.6	14.0	100.1	10	150



ELBOW 90° WITH EXTENDED THREAD MALE/FEMALE

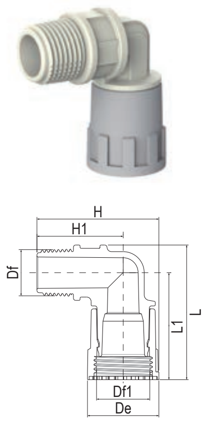
with brass thread, for prefabricated walls, thread length 51 mm

Item	M	T	L	L1	H	H1	Df	Df2	De	Di	Es	Weight		
		mm	mm	mm	mm	mm			mm	mm	mm	g	pcs	pcs
20330	M¾”-F½”- sm16	16-2	78.8	54.8	85.3	71.5	M¾”	F½”	27.5	9.5	36.0	150.4	5	100



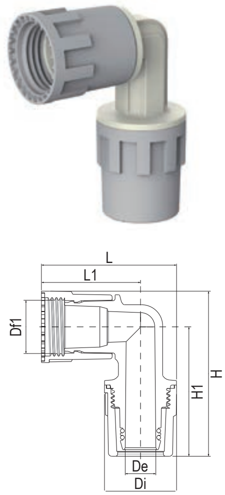
THREADED ELBOW 90° FEMALE/FEMALE with PPS thread and turning cap

Item	M	R	L	L1	H	H1	Df	De	Weight		
		mm	mm	mm	mm	mm		mm	g	pcs	pcs
20332	F½”- sf16	16	62.0	46.0	44.3	30.5	F½”	27.5	39.0	10	200
20336	F½”- sf20	20	64.3	48.3	46.7	30.5	F½”	32.5	45.6	10	150
20337	F¾”- sf26	26	76.5	57.0	52.8	32.0	F¾”	41.5	69.6	5	100
20338	F1”- sf32	32	88.5	64.3	63.0	38.0	F1”	50.0	110.8	5	80



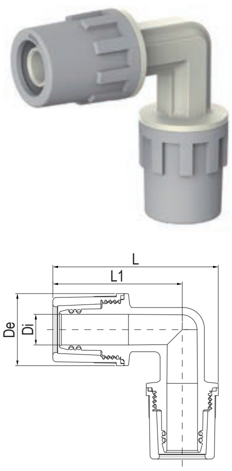
THREADED ELBOW 90° MALE/FEMALE with PPS thread and turning cap

Item	M	R	L	L1	H	H1	Df	De	Weight		
		mm	mm	mm	mm	mm		mm	g	pcs	pcs
20342	M½"- sf16	16	58.8	46.3	52.8	39.0	M½"	27.5	24.1	10	200
20344	M½"- sf20	20	60.8	48.3	55.2	39.0	M½"	32.6	29.4	10	150
20346	M¾"- sf26	26	68.7	53.0	65.8	45.0	M¾"	41.2	54.0	5	100
20348	M1"- sf32	32	78.6	59.1	76.0	51.0	M1"	50.0	80.7	5	80



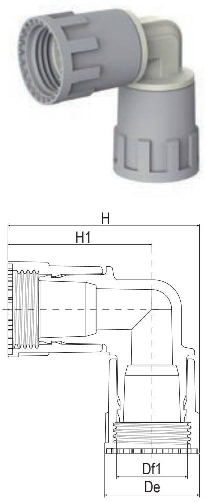
ELBOW 90° MALE/FEMALE with turning cap

Item	M	T	R	L	L1	H	H1	De	Di	Weight		
		mm	mm (Df1)	mm	mm	mm	mm	mm	mm	g	pcs	pcs
20352	sf16- sm16	16-2	16	54.0	40.3	68.6	54.8	27.5	9.5	32.1	10	200
20356	sf20- sm20	20-2	20	61.1	44.8	76.7	58.5	32.6	14.0	45.0	10	150
20358	sf26- sm26	26-3	26	73.6	53.0	84.4	63.6	41.2	18.0	83.2	5	80
20360	sf32- sm32	32-3	32	83.5	58.5	97.3	72.3	50.0	25.0	129.8	5	50
20362	sf40- sm40	40-3.5	40	100.6	70.6	118.5	88.5	60.0	32.0	214.3	1	20



ELBOW 90°

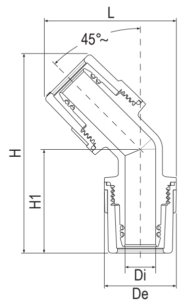
Item	M	T	L	L1	De	Di	Weight		
		mm	mm	mm	mm	mm	g	pcs	pcs
20382	sm16- sm16	16-2	68.6	54.8	27.5	9.5	37.0	10	250
20386	sm20- sm20	20-2	74.8	58.5	32.6	14.0	51.7	10	150
20388	sm26- sm26	26-3	84.2	63.6	41.2	18.0	94.2	5	60
20390	sm32- sm32	32-3	97.3	72.3	50.0	25.0	153.1	5	40
20392	sm40- sm40	40-3.5	118.4	88.5	60.0	32.0	244.3	1	30
20394	sm50- sm50	50-4	140.6	104.0	73.2	40.0	404.2	1	15
20396	sm63- sm63	63-4.5	179.0	131.5	95.0	53.0	867.4	1	8
20398	sm75- sm75	75-5	212.8	155.0	115.0	65.2	1452.1	1	4
20400	sm90- sm90	90-7	241.5	172.0	139.0	72.5	2599.0	1	



ELBOW 90° FEMALE/FEMALE with turning caps

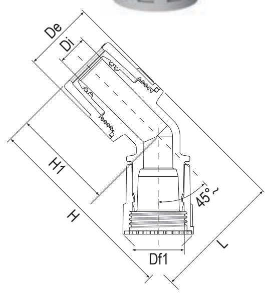
Item	M	R	H	H1	De	Weight		
		mm (Df1)	mm	mm	mm	g	pcs	pcs
20402	sf16- sf16	16	57.9	44.1	27.5	27.5	10	250
20406	sf20- sf20	20	65.0	48.8	32.5	38.6	10	200
20408	sf26- sf26	26	78.8	58.0	41.5	76.0	5	100
20410	sf32- sf32	32	89.5	64.5	50.0	116.3	5	60

LEGEND
M dimension
T pipe
R fitting
sm male "safety" thread
sf male "safety" thread



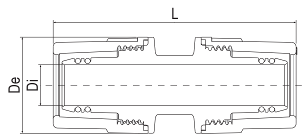
ELBOW 45°

Item	M	T	L	H	H1	De	Di	Weight		
		mm	mm	mm	mm	mm	mm	g	pcs	pcs
20416	sm20 - sm20	20-2	59.8	90.5	47.0	32.6	14.0	46.3	10	120
20418	sm26 - sm26	26-3	72.2	106.3	54.8	41.2	18.0	85.2	5	50
20420	sm32 - sm32	32-3	83.3	118.6	30.3	50.0	25.0	136.1	5	50
20422	sm40 - sm40	40-3.5	99.0	139.0	70.0	60.0	32.0	218.9	1	20
20424	sm50 - sm50	50-4	118.3	164.7	83.0	73.2	40.0	365.1	1	15
20426	sm63 - sm63	63-4.5	151.1	208.1	104.4	95.0	53.0	784.5	1	10
20428	sm75 - sm75	75-5	180.1	244.4	122.0	115.0	65.0	1327.3	1	6
20430	sm90 - sm90	90-7	210.0	279.0	138.0	139.0	72.5	2379.6	1	



ELBOW 45° MALE/FEMALE with turning cap

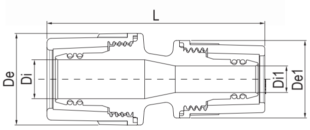
Item	M	T	R	L	H	H1	De	Di	Weight		
		mm	mm (Df1)	mm	mm	mm	mm	mm	g	pcs	pcs
20432	sm20- sf20	20-2	20	59.4	90.1	47.0	27.5	14.0	42.6	10	120
20433	sm26- sf26	26-3	26	72.8	106.9	54.8	32.6	18.0	79.9	5	50
20434	sm32- sf32	32-3	32	84.0	119.3	60.3	41.2	25.0	121.2	5	30
20435	sm40- sf40	40-3.5	40	101.1	141.2	70.1	50.0	32.0	195.0	1	20
20436	sm50- sf50	50-4	50	125.5	171.9	83.0	50.0	40.0	336.8	1	20



PIPE COUPLING

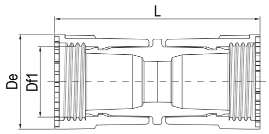
Item	M	T	L	De	Di	Weight		
		mm	mm	mm	mm	g	pcs	pcs
20440	sm14- sm14	14-2	70.0	25.5	8.0	25.9	10	250
20442	sm16- sm16	16-2	78.8	27.5	9.5	32.0	10	250
20444	sm18- sm18	18-2	81.0	30.0	11.5	35.8	10	200
20446	sm20- sm20	20-2	82.4	32.6	14.0	43.8	10	200
20448	sm26- sm26	26-3	92.2	41.2	18.0	80.2	5	80
20450	sm32- sm32	32-3	99.6	50.0	25.0	131.8	5	60
20452	sm40- sm40	40-3.5	117.0	60.0	32.0	203.2	1	40
20454	sm50- sm50	50-4	141.0	73.2	40.0	339.3	1	30
20456	sm63- sm63	63-4.5	179.0	95.0	53.0	731.1	1	12
20458	sm75- sm75	75-5	207.0	115.0	65.2	1231.6	1	8
320460*	sm90- sm90	90-7	246.0	139.0	72.5	7069.9	1	

* Bronze body, PA-M caps



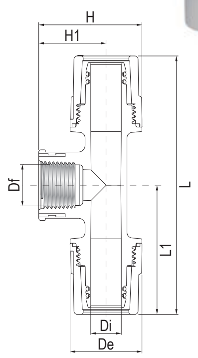
REDUCED PIPE COUPLING

Item	M	T	L	De	De1	Di	Di1	Weight		
		mm	mm	mm	mm	mm	mm	g	pcs	pcs
20472	sm20 - sm16	20-2 16-2	77.6	32.6	27.5	14.0	9.5	39.2	10	200
20480	sm26 - sm20	26-3 20-2	85.8	41.2	32.6	18.0	15.0	62.3	10	80



NIPPLES FEMALE/FEMALE with turning caps

Item	M	R	L	De	Weight		
		mm	mm	mm	g	pcs	pcs
20522	sf16 - sf16	16	65.2	27.5	23.5	10	250
20526	sf20 - sf20	20	69.7	32.3	31.8	10	200
20528	sf26 - sf26	26	80.0	41.5	59.4	5	150
20530	sf32 - sf32	32	85.0	50.0	87.5	5	60
20532	sf40 - sf40	40	97.3	60.0	134.7	1	40
20534	sf50 - sf50	50	126.4	73.2	247.3	1	30



THREADED TEE FEMALE with PPS thread

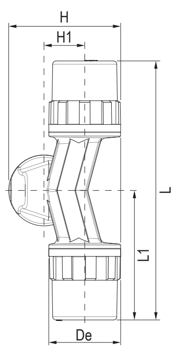
Item	M	T	L	L1	H	H1	Df	De	Di	Weight		
		mm	mm	mm	mm	mm		mm	mm	g	pcs	pcs
20542	sm16 - F½”- sm16	16-2	109.6	54.8	44.3	30.5	F½”	27.5	9.5	63.2	10	150
20546	sm20 - F½”- sm20	20-2	117.0	58.5	46.8	30.5	F½”	32.6	14.0	75.4	10	120
20550	sm26 - F¾”- sm26	26-3	135.2	67.6	52.6	32.0	F¾”	41.2	18.0	121.1	5	50
20556	sm32 - F1”- sm32	32-3	152.6	76.3	63.0	38.0	F1”	50.0	25.0	200.5	5	30

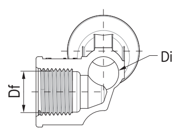
THREADED TEE FEMALE with alloy thread

Item	M	T	L	L1	H	H1	Df	De	Di	Weight		
		mm	mm	mm	mm	mm		mm	mm	g	pcs	pcs
20582	sm16 - F½”- sm16	16-2	109.6	54.8	44.3	30.5	F½”	27.5	9.5	91.1	10	150
20586	sm20 - F½”- sm20	20-2	117.0	58.5	46.8	30.5	F½”	32.6	14.0	103.1	10	120

THREADED TEE FEMALE with PPS thread and distance brackets

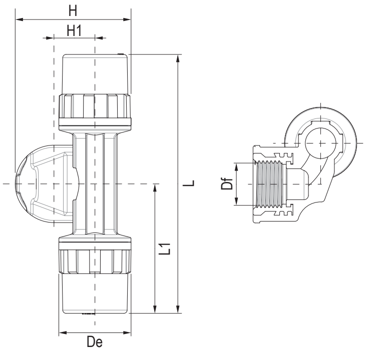
Item	M	T	L	L1	H	H1	Df	De	Di	Weight		
		mm	mm	mm	mm	mm		mm	mm	g	pcs	pcs
20592	sm16 - F½”- sm16	16-2	109.6	54.8	48.3	18.5	F½”	27.5	9.5	65.5	10	100
20596	sm20 - F½”- sm20	20-2	117.0	58.5	50.8	18.5	F½”	32.6	14.0	76.9	10	80





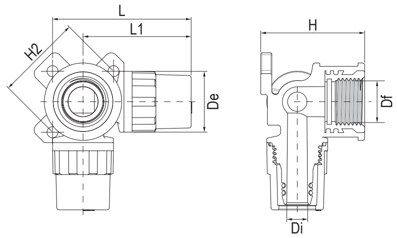
THREADED TEE FEMALE with alloy thread and distance brackets

Item	M	T	L	L1	H	H1	Df	De	Di	Weight	pcs	pcs
		mm	mm	mm	mm	mm		mm	mm	g	pcs	pcs
20606	sm20 - F½”- sm20	20-2	117.0	58.5	50.3	18.5	F½”	32.6	14.0	81.2	10	80



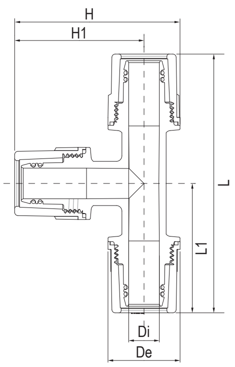
THREADED TEE FEMALE ANGLE 90° with alloy thread and bracket

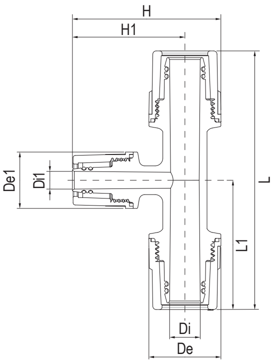
Item	M	T	L	L1	H	H2	Df	De	Di	Weight	pcs	pcs
		mm	mm	mm	mm	mm		mm	mm	g	pcs	pcs
20632	sm16 - F½”- sm16	16-2	82.7	48.9	47.0	39.0	F½”	27.5	9.5	97.7	10	100



TEE

Item	M	T	L	L1	H	H1	De	Di	Weight	pcs	pcs
		mm	mm	mm	mm	mm		mm	g	pcs	pcs
20662	sm16-sm16-sm16	16-2	109.6	54.8	68.5	54.8	27.5	9.5	54.3	10	100
20666	sm20-sm20-sm20	20-2	117.0	58.5	74.8	58.5	32.6	14.0	75.0	10	80
20668	sm26-sm26-sm26	26-3	127.2	63.6	84.2	63.6	41.2	18.0	136.2	5	40
20670	sm32-sm32-sm32	32-3	144.6	72.3	97.3	72.3	50.0	25.0	221.9	5	30
20672	sm40-sm40-sm40	40-3.5	177.0	88.5	118.4	88.5	60.0	32.0	351.3	1	20
20674	sm50-sm50-sm50	50-4	208.0	104.0	140.6	104.0	73.2	40.0	582.1	1	10
20676	sm63-sm63-sm63	63-4.5	263.0	131.5	179.0	131.5	95.0	53.0	1250.3	1	5
20678	sm75-sm75-sm75	75-5	310.0	155.0	212.8	155.0	115.0	65.2	2104.4	1	3
20680	sm90-sm90-sm90	90-7	344.0	172.0	241.5	172.0	139.0	72.5	3746.2	1	



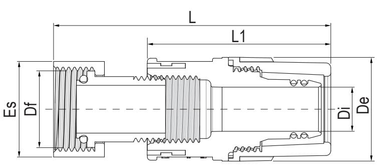


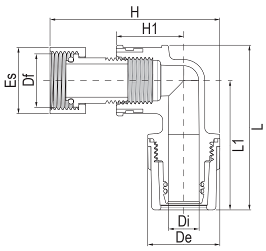
REDUCED TEE

Item	M	T	L	L1	H	H1	De	De1	Di	Di1	Weight		
		mm	mm	mm	mm	mm	mm	mm	mm	mm	g	pcs	pcs
20712	sm16-sm14-sm16	16-2 14-2	109.6	54.8	64.7	50.9	27.5	25.5	9.5	8.0	52.7	10	100
20717	sm20-sm16-sm16	20-2 16-2	113.3	58.5	71.1	54.8	32.6	27.5	14.0	9.5	65.6	10	80
20718	sm20-sm14-sm20	20-2 14-2	117.0	58.5	67.2	50.9	32.6	25.5	14.0	8.0	67.3	10	80
20720	sm20-sm16-sm20	20-2 16-2	117.0	58.5	71.1	54.8	32.6	27.5	14.0	9.5	68.4	10	80
20722	sm20-sm18-sm20	20-2 18-2	117.0	58.5	73.7	57.4	32.6	30.0	14.0	11.5	74.7	5	40
20724	sm26-sm14-sm26	26-3 14-2	135.2	67.6	71.5	50.9	41.2	25.5	18.0	8.0	113.1	5	40
20725	sm26-sm16-sm26	26-3 16-2	135.2	67.6	75.4	54.8	41.2	27.5	18.0	9.5	117.3	5	60
20726	sm26-sm18-sm26	26-3 18-2	135.2	67.6	78.0	57.4	41.2	30.0	18.0	11.5	118.2	5	40
20728	sm26-sm20-sm26	26-3 20-2	127.2	63.6	76.6	56.0	41.2	32.6	18.0	14.0	117.1	5	40
20730	sm32-sm14-sm32	32-3 14-2	152.6	76.3	75.9	50.9	50.0	25.5	25.0	8.0	172.7	5	30
20732	sm32-sm16-sm32	32-3 16-2	152.6	76.3	79.8	54.8	50.0	27.5	25.0	9.5	175.8	5	40
20734	sm32-sm18-sm32	32-3 18-2	152.6	76.3	82.4	57.4	50.0	30.0	25.0	11.5	213.4	5	40
20735	sm32-sm20-sm32	32-3 20-2	152.6	76.3	83.5	58.5	50.0	32.6	25.0	14.0	181.8	5	40
20736	sm32-sm26-sm32	32-3 26-3	144.6	72.3	88.6	63.6	50.0	41.2	25.0	18.0	191.9	5	30
20740	sm40-sm16-sm40	40-3.5 16-2	177.0	88.5	81.4	51.4	60.0	27.5	32.0	9.5	267.2	1	20
20742	sm40-sm20-sm40	40-3.5 20-2	177.0	88.5	83.0	53.0	60.0	32.6	32.0	14.0	272.1	1	20
20744	sm40-sm26-sm40	40-3.5 26-3	177.0	88.5	88.6	58.6	60.0	41.2	32.0	18.0	289.4	1	20
20746	sm40-sm32-sm40	40-3.5 32-3	177.0	88.5	106.3	76.3	60.0	50.0	32.0	25.0	310.7	1	20
20750	sm50-sm16-sm50	50-4 16-2	208.0	104.0	93.0	56.4	73.2	27.5	40.0	9.5	438.6	1	15
20754	sm50-sm20-sm50	50-4 20-2	208.0	104.0	94.8	58.2	73.2	32.6	40.0	14.0	443.6	1	15
20756	sm50-sm26-sm50	50-4 26-3	208.0	104.0	100.7	64.1	73.2	41.2	40.0	18.0	460.1	1	15
20758	sm50-sm32-sm50	50-4 32-3	208.0	104.0	104.4	67.8	73.2	50.0	40.0	25.0	464.9	1	15
20760	sm50-sm40-sm50	50-4 40-3.5	208.0	104.0	125.0	88.5	73.2	60.0	40.0	32.0	509.2	1	15
20762	sm63-sm16-sm63	63-4.5 16-2	263.0	131.5	110.9	63.4	95.0	27.5	53.0	9.5	887.2	1	8
20766	sm63-sm20-sm63	63-4.5 20-2	263.0	131.5	113.0	65.5	95.0	32.6	53.0	14.0	891.7	1	8
20768	sm63-sm26-sm63	63-4.5 26-3	263.0	131.5	118.9	71.4	95.0	41.2	53.0	18.0	906.7	1	8
20770	sm63-sm32-sm63	63-4.5 32-3	263.0	131.5	122.3	74.8	95.0	50.0	53.0	25.0	944.9	1	8
20772	sm63-sm40-sm63	63-4.5 40-3.5	263.0	131.5	130.0	82.5	95.0	60.0	53.0	32.0	964.4	1	6
20774	sm63-sm50-sm63	63-4.5 50-4	263.0	131.5	151.5	104.0	95.0	73.2	53.0	40.0	1042.3	1	6
20778	sm75-sm20-sm75	75-5 20-2	310.0	155.0	130.8	73.0	115.0	32.6	65.2	14.0	143.72	1	3
20788	sm75-sm63-sm75	75-5 50-4	310.0	155.0	189.3	131.5	115.0	95.0	65.2	53.0	1822.1	1	3
20794	sm90-sm32-sm90	90-7 32-3	344.0	172.0	157.8	88.3	139.0	50.0	72.5	25.0	2666.6	1	
20800	sm90-sm63-sm90	90-7 63-4.5	344.0	172.0	213.0	144.0	139.0	95.0	72.5	53.0	2986.4	1	
20802	sm90-sm75-sm90	90-7 75-5	344.0	172.0	244.5	155.0	139.0	115.0	72.5	65.0	3954.3	1	

PIPE UNION with PPS thread and alloy tang

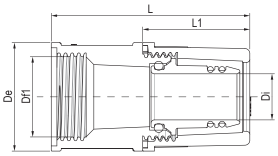
Item	M	T	L	L1	Df	De	Di	Es	Weight		
		mm	mm	mm		mm	mm	mm	g	pcs	pcs
20832	F¾”- sm16	16-2	85.4	55.9	F¾”	32.0	9.5	30.0	95.6	5	100
20836	F¾”- sm20	20-2	87.2	57.7	F¾”	32.5	14.0	30.0	99.5	5	100
20840	F1”- sm26	26-3	93.6	61.6	F1”	41.2	18.0	38.0	146.2	5	50
20844	F1¼”- sm32	32-3	105.8	71.3	F1¼”	50.0	25.0	46.0	255.9	5	40





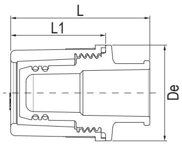
BENT PIPE UNION with PPS thread and alloy tang

Item	M	T	L	L1	H	H1	Df	De	Di	Es	Weight		
		mm	mm	mm	mm	mm		mm	mm		g	pcs	pcs
20862	F¾”- sm16	16-2	70.8	54.8	73.8	30.5	F¾”	27.5	9.5	30.0	101.7	5	100
20866	F¾”- sm20	20-2	74.5	58.5	76.8	30.5	F¾”	32.6	14.0	30.0	108.1	5	100
20870	F1”- sm26	26-3	87.1	67.6	85.6	32.0	F1”	41.2	18.0	38.0	171.1	5	50
20874	F1¼”- sm32	32-3	100.5	76.3	98.5	38.0	F1¼”	50.0	25.0	46.0	281.0	5	40



PIPE UNION in PPS, inspectable

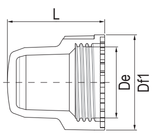
Item	M	T	R	L	L1	De	Di	Weight		
		mm	mm	mm	mm	mm	mm	g	pcs	pcs
20882	sf16 - sm16	16-2	16.0	54.5	30.4	27.5	9.5	21.0	5	100
20886	sf20 - sm20	20-2	20.0	59.7	32.2	32.6	14.0	30.8	5	100
20888	sf26 - sm26	26-3	26.0	67.2	37.4	41.2	18.0	53.1	5	100
20890	sf32 - sm32	32-3	32.0	71.3	41.3	50.0	25.0	81.5	5	80



CLOSING CAP MALE

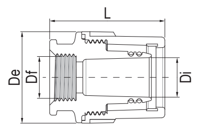
Item	M	T	L	L1	De	Weight		
		mm	mm	mm	mm	g	pcs	pcs
20902	sm16	16-2	43.4	30.4	27.6	16.6	10	300
20906	sm20	20-2	47.2	32.2	32.6	23.1	10	250
20908	sm26	26-3	52.1	37.6	41.2	47.4	5	200
20910	sm32	32-3	56.8	41.3	50.0	75.1	5	150
20912	sm40	40-3.5	75.0	48.0	60.0	132.7	1	70
20914	sm50	50-4	90.5	58.0	73.2	216.5	1	40
20916	sm63	63-4.5	110.0	74.5	95.0	453.1	1	24
20918	sm75	75-5	124.0	85.5	115.5	758.5	1	14
320920*	sm90	90-7	135.0	100.0	139.0	3826.2	1	

* Bronze body, PA-M caps



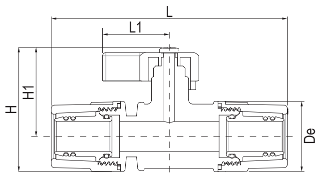
CLOSING CAP FEMALE

Item	M	R	L	De	Weight		
		mm (Df1)	mm	mm	g	pcs	pcs
20952	sf16	16	31.3	27.2	7.3	10	500
20956	sf20	20	33.0	32.3	10.5	10	500
20958	sf26	26	36.1	41.2	18.6	5	300
20960	sf32	32	39.0	50.0	29.7	5	200
20962	sf40	40	46.8	60.0	41.1	1	50
20964	sf50	50	54.0	73.0	74.5	1	50
20966	sf63	63	73.5	95.0	191.1	1	20
20968	sf75	75	86.5	115.0	409.6	1	12



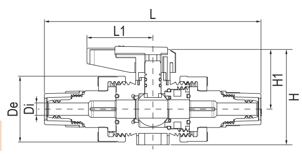
CLOSING CAP MALE only for vent and drain set

Item	M	T	L	Df	De	Di	Weight	pcs	pcs
		mm	mm		mm	mm	g	pcs	pcs
21064	F½"- sm26	26-3	52.1	F½"	41.2	18.0	57.4	5	200
21066	F½"- sm32	32-3	56.8	F½"	50.0	25.0	83.5	1	150



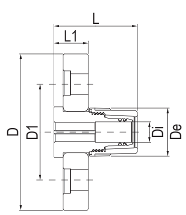
BALL VALVE with butterfly handle and alloy body

Item	M	T	L	L1	H	H1	De	Weight	pcs	pcs
		mm	mm	mm	mm	mm	mm	g	pcs	pcs
21282	sm16 - sm16	16-2	133.2	30.0	52.6	38.9	27.5	167.9	5	50
21286	sm20 - sm20	20-2	131.6	30.0	57.7	41.4	32.6	290.9	5	50
21288	sm26 - sm26	26-3	149.5	35.0	65.7	45.1	41.2	383.7	1	30
21290	sm32 - sm32	32-3	169.7	35.0	70.1	45.1	50.0	644.8	1	30



BALL VALVE IN PP with body and ring-nut of PP, collars of PPS, cap of PA-M

Item	M	T	L	L1	H	H1	De	Di	Weight	pcs	pcs
		mm	mm	mm	mm	mm	mm	mm	g	pcs	pcs
21002	sm16 - sm16	16-2	165.3	48.1	72.9	45.6	50.3	9.5	167.3	1	35
21006	sm20 - sm20	20-2	169.9	48.1	72.9	45.6	50.3	14.0	207.3	1	25
21008	sm26 - sm26	26-3	193.2	58.7	86.7	56.7	59.0	18.0	264.4	1	25
21010	sm32 - sm32	32-3	207.1	58.7	105.0	64.7	70.4	25.0	382.7	1	15
21012	sm40 - sm40	40-3.5	238.1	63.2	129.4	83.4	86.0	32.0	677.4	1	10
21014	sm50 - sm50	50-4	265.8	63.2	144.4	89.4	99.5	40.0	916.9	1	7
21016	sm63 - sm63	63-4.5	321.2	107.3	184.7	114.7	125.5	53.0	1727.7	1	3

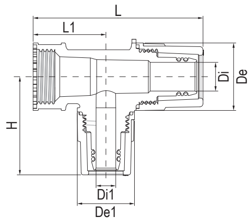


COLLARS WITH FLANGE

Item	M	DN	T	L	L1	D	D1	De	Di	*	Viti Screws	Weight	pcs	pcs
			mm	mm	mm	mm	mm	mm	mm	nr.		g	pcs	pcs
21632	sm16	10-16	16-2	54.6	23.2	106.0	65.0	27.5	9.5	4	M12	408.1	1	
21636	sm20	10-16	20-2	56.4	23.2	106.0	65.0	32.6	14.0	4	M12	412.2	1	
21638	sm26	10-16	26-3	63.8	23.7	118.0	75.0	41.2	18.0	4	M12	520.8	1	
21640	sm32	10-16	32-3	67.7	25.9	122.0	85.0	50.0	25.0	4	M12	602.0	1	
21642	sm40	10-16	40-3.5	77.0	27.0	142.0	100.0	60.0	32.0	4	M16	689.9	1	
21644	sm50	10-16	50-4	88.0	28.0	156.0	110.0	73.2	40.0	4	M16	920.3	1	
21646	sm63	10-16	63-4.5	109.6	32.6	171.0	125.0	95.0	53.0	4	M16	1363.7	1	

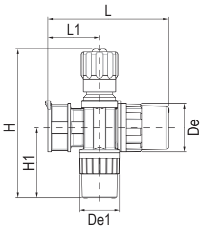
* Fori *Holes*

LEGEND
M dimension
T pipe
R fitting
sm male "safety" thread
sf male "safety" thread



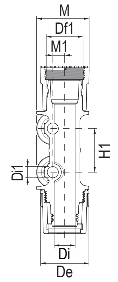
MODULAR MANIFOLD free-laying and walled-in

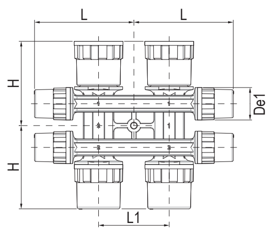
Item	M	T	R	L	L1	H	De	De1	Di	Di1	Weight		
		mm	mm (Df)	mm	mm	mm	mm	mm	mm	mm	g	pcs	pcs
21300	sf20-sm14-sm20	20-2 14-2	20	81.7	35.0	44.5	32.6	25.5	14.0	8.0	41.4	10	150
21302	sf20-sm16-sm20	20-2 16-2	20	81.7	35.0	47.4	32.6	27.5	14.0	9.5	43.9	10	150
21303	sf26-sm14-sm26	26-3 14-2	26	96.6	40.5	49.5	41.2	25.5	18.0	8.0	61.0	5	100
21304	sf26-sm16-sm26	26-3 16-2	26	96.6	40.5	52.4	41.2	27.5	18.0	9.5	63.4	5	80
21305	sf26-sm18-sm26	26-3 18-2	26	96.6	40.5	54.0	41.2	30.0	18.0	11.5	66.3	5	80
21307	sf26-sm20-sm26	26-3 20-2	26	96.6	40.5	54.2	41.2	32.6	18.0	14.0	67.4	5	80



MULTIRAPID MANIFOLD for sanitary water conveyance, with shut-off valve

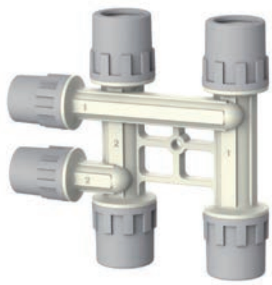
Item	M	T	R	L	L1	H	H1	De	De1	Weight		
		mm	mm (Df)	mm	mm	mm	mm	mm	mm	g	pcs	pcs
21312	sf20-sm16-sm20	20-2 16-2	20	81.7	35.0	100.8	47.4	32.6	27.5	105.1	10	100
21316	sf26-sm16-sm26	26-3 16-2	26	96.6	40.5	105.8	52.4	41.2	27.5	125.6	5	80
21322	sf32-sm16-sm32	32-3 16-2	32	103.8	43.0	113.7	55.4	50.0	27.5	166.4	5	40
21326	sf32-sm20-sm32	32-3 20-2	32	103.8	43.0	112.3	55.4	50.0	32.6	173.0	5	40

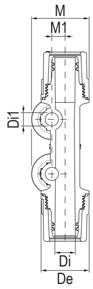


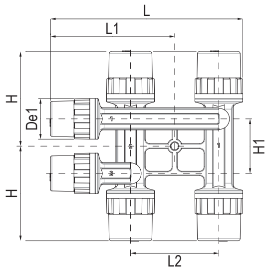


COMPLANAR MANIFOLD modular

Item	M	T	R	L	L1	H	H1	De	De1	Di	Di1	M	M1	Weight		
		mm	mm (Df)	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	g	pcs	pcs
21658	sm26-sm16-sf26	26-3 16-2	26	84.4	60.0	71.5	37.0	41.2	27.5	18.0	9.5	44.5	10.0	276.3	1	20



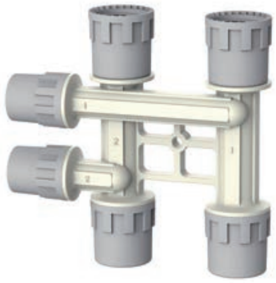


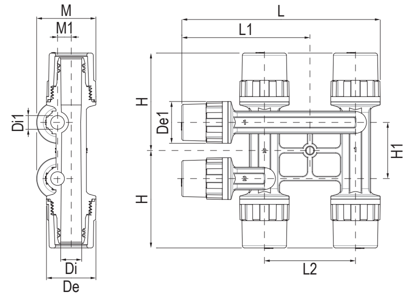


COMPLANAR MANIFOLD

Item	M	T	L	L1	L2	H	H1	De	De1	Di	Di1	M	M1	Weight		
		mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	g	pcs	pcs
21685	sm20-sm16-sm20	20-2 16-2	130.7	84.4	60.0	64.2	37.0	32.6	27.5	14.0	9.5	39.0	9.0	163.3	1	25
21689	sm26-sm16-sm26	26-3 16-2	135.0	84.4	60.0	70.6	37.0	41.2	27.5	18.0	9.5	44.4	9.0	247.6	1	25

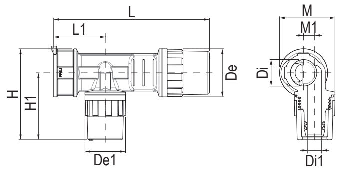
DERIVATION MANIFOLD MALE/FEMALE modular



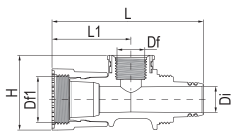


Item	M	T	R	L	L1	L2	H	H1	H2	De	De1	Di	Di1	M	M1	Wt.	pcs	pcs
		mm	mm (Df)	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	g	pcs	pcs
21745	sm20-sm16-sf20	20-2 16-2	20	130.7	84.4	60.0	129.5	64.2	37.0	32.6	27.5	14.0	9.5	39.0	9.0	156.0	1	25

SWAN NEK MANIFOLD modular



Item	M	T	R	L	L1	H	H1	De	De1	Di	Di1	M	M1	Weight	pcs	pcs
		mm	mm (Df)	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	g	pcs	pcs
21782	sf20-sm16-sm20	20-2 16-2	20	105.7	35.0	61.7	45.4	32.6	27.5	14.0	9.5	37.6	7.5	51.0	10	150



DERIVATION FITTING with PPS thread and turning cap

Item	M	T	R	L	L1	H	Df	Di	Weight	pcs	pcs
		mm	mm (Df1)	mm	mm	mm		mm	g	pcs	pcs
21806	sf26 -F½"-sm26	26-3	26	102.8	53.5	50.8	F½"	18.0	82.7	1	50
21810	sf32 -F½"-sm32	32-3	32	108.0	56.0	55.0	F½"	25.0	104.5	1	50

LEGEND
M dimension
T pipe
R fitting
sm male "safety" thread
sf male "safety" thread

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