interplast

TECHNICAL MANUAL FOR AQUA-PLUS PIPES & FITTINGS

Aquaplus

WRAS

ΕΛΟΤ

AENOR

DVGW

Interplast's line of business is the production of high quality plastic pipes and fittings used in plumbing, heating and sewage systems covering a wide range of applications in the building, technical project and industrial fields.

In a unit of 40.000 sq. m which is located in the industrial area of Komotini the coordination of all productive actions of the company takes place on a daily basis.

The accounting office and sales office of North Greece are located in the unit of Thessaloniki.

The production of the brass fittings takes place in the unit located in Menidi, Attica.

Interplast is market leader in Greece in sales of plastic pipe for plumbing and heating systems with an extensive client network both in Greece and abroad.

Its highly experienced staff, and motivated members with their high towards to creation and innovation, have been a determining factor in the company's recent dynamic and rapid expansion: an expansion that was neither fortuitous, nor transitory.

Constantly orientated towards quality and technology, Inteplast has steadily secured a place among the leading European manufacturers of plastic pipe for plumbing, heating and sewage systems.

The main goal of the company is market knowledge, to follow trends and carry out systematic research for the development of new and improved products that meet the needs of its customers.

Every day, Interplast's staff dedicates themselves to the in-depth satisfaction of their client's needs, both pre and post sales, laying the foundations for excellent relations based on trust.

The vertical organization of the manufacturing process and the most stringent checks guarantee that top quality is achieved. The plant located in the industrial area of Komotini produces PP-R pipes and fittings for use in plumbing, heating and cooling systems and in industry, whereas its subsidiary company ELVIOM S.A. produces the brass inserts of the mixed components (male and female couplings, tees etc).

All Aqua-plus pipes and fittings are produced in accordance with international standards and are certified by the most stringent European institutes.

PP-R was first introduced as a material for piping systems by the Hulls company approximately 50 years ago.

The advantages of its properties made it one of the most rapidly accepted materials in the world market with applications in central piping to connect radiators, in hot and cold water piping systems, and in floor heating. The DIN standards covering PP-R were instituted in 1989 and the other national and international standards followed.

PP-R's special composition makes it suitable not only for the production of pipes (extrusion) but also for injected fittings and the material's properties make it a mono-material system offering a high number of advantages.

The reputation of these piping systems is founded on the particular properties of Propylene Random Type -3. The quality of the material guarantees the long lifespan of the system, estimated at over 50 years, with excellent resistance to chemical corrosion. Another significant advantage is its low heat permeability in comparison with conventional systems, a characteristic which has a marked effect on operational savings of hot water. A further plus is that polypropylene pipes and connections do not degrade the quality of drinking water.

The system is supplied complete and includes pipes, fittings, reducing bushes and electric couplings.

Connection is achieved by use of a thermal fusion welding machine and is performed by hand for diameters less than 50 mm, whereas the appropriate apparatus for large dimensions serves for greater sizes. Thermal fusion welding is a quick and easy 3-step process comprising cutting the pipe and fittings to approximately 270°C, and connecting them by applying pressure for a few seconds. Electrofusion welded fittings can also be employed and these are used on a similar scale.

PROPERTIES OF AQUA-PLUS RAW MATERIAL

3.1| PHYSICAL AND MECHANICAL PROPERTIES OF PP-R

MAIN CHARACTERISTICS	ISO METHOD	UNIT	VALUE	ASTM METHOD	UNIT	VALUE
Physical properties						
Melt flow index	R 1133	g/10 min	0.4-0.6	D 1238 L	g/10 min	0.4-0.6
Melt flow index	R 1133	g/10 min	<0.3	D 1238 L	g/10 min	<0.3
Melt flow index	R 1133	g/10 min	0.8-1.3	D 1238 L	g/10 min	0.8-1.3
Hardness	R 2039/2	R scale	93			
Coefficient of linear Expansion				D 696	mm/(m.°C)	0,07
Thermal Conductivity	R3146	W/(m.k)	0.17			
Specific Gravity	R1183		0.89	D792		0.89
Mechanical properties						
Flexural strength	R 178	MP a	835	D 790	MPa	950
Tensile strength at yield	R 527	MPa	28	D 638	MPa	28
Elongation at break	R 527	%	> 430	D 638	%	> 430
Izod impact strength (notched)						
at 23°C	R 180/1A	KJ/m^2	NB	D 256	J/m^2	NB
at 0°C	R 180/1A	KJ/m^2	9.1	D 256	J/m^2	160
at -20°C	R 180/1A	KJ/m^2	4.9	D 256	J/m^2	50
Izod impact strength (unnotched)						
at 23°C	R 180/1A	KJ/m^2	NB	D 256	J/m^2	NB
at 0°C	R 180/1A	KJ/m^2	NB	D 256	J/m^2	NB
Thermal properties						
Vicat softening temperature	R 306	°C		D 1525	°C	
HDT (0.45 Mpa)	R 75	°C	135	D 648	°C	135
Resistance to accelerated ageing in oven at 135°C	R 4577	hours	80	D 3012	hours	80
			> 9,000			> 9,000

The ASTM and ISO methods are constantly updated and follow the exact agreed procedures.
All test specimens are injection moulded.

Service life

The pipes have been designed for a lifespan for more than 50 years, for temperatures up to 95°C and operating pressure 6-26 bar. Temperature peaks of 110°C at 4 bar operating pressure do not affect the Aqua plus system.

Exceptional resistance to hydraulic shock

High pressures created by hydraulic shock do not affect the Aqua – plus system which is resistant to pressures greater than 100 bar at ambient temperature.

Shorter installation time

Aqua plus can be 30% time quicker to install than conventional system.

Low thermal conductivity

The thermal conductivity of PP-R is very low making it possible to reduce heat loss in the hot water networks. This means minimal fall in the temperature between the hot water supply and the delivery points resulting from in energy saving and lower insulation costs.

Thermal conductivity of Aqua-plus and of the other metals used in the heating and plumbing fields:

Aqua-plus	λ = 0,17	W/mk
Steel	λ =45-60	W/mk
Iron	λ =45-60	W/mk
Copper	λ =300-400	W/mk

The low thermal conductivity value means that condensate on the outside of the pipe which is a common problem in metal pipes under certain temperature and humidity conditions, is drastically reduced.

In addition, when the outside temperature is exceptionally low, the water does not freeze so quickly.

Chemical resistance

The material is resistant to more chemicals even at high temperatures which is why it is used in industrial networks.

Mechanical strength

The Aqua –plus system displays exceptional performance under mechanical stresses. Its high mechanical strength combined with its elasticity even at low temperatures makes the system suitable for all climatic conditions.

Corrosion resistant

The Aqua –plus system is exceptionally resistant to corrosion, even in areas with very hard water, remaining unaltered over the course of time. Unlike metal pipes, it does not present any signs of electrochemical corrosion. Consequently, it can be used with materials employed in the construction field such as lime or cement, without requiring any special protection. Moreover, the high water velocity does not cause corrosion. An added plus is that there is not one single point in the Aqua-plus system where metal is introduced since even the brass male inserts are lined with PP-R.

Low frictional coefficient

The structure of the material and its smooth surface texture ensure low friction losses resulting in low resistance and low pressure drop in the piping. This renders the system more economical, as pipes of smaller dimension and lower wattage pumps can be used for the same quantity of water. At the same time, Interplast distributes PN25 fittings with a local resistance coefficient considerably lower than that of the usual PN20 fittings, resulting in improved flow of the system.

Fire protection

Aqua-plus pipes and fittings meet all flammability specifications and the burning of the polypropylene does not give off any harmful substances such as dioxin or hydrochloric acid.

Noise free

The material used significantly reduces the noise generated and limits its transition through the pipes. This makes it possible to transfer great quantities of liquids with pipes of smaller dimension increasing the speed of flow of the network and consequently also the heat loads.

Clean and non-toxic

The Aqua plus system is free of toxic substances. Sanitary and toxicological analyses have been carried out to ensure approval of drinking water. The pipes are regularly tested by official institutes(General Chemical State Laboratory, Greece, DVGW Germany, WRAS NSF Great Britain) for taste and odor of water, development of microorganisms, extraction of substances and metals dangerous for public health (cadmium, arsenic etc).

Certified

The pipes are regularly tested for mechanical strength by official institutes (EVETAM Greece, SKZ Germany, AENOR Spain) and for suitability for drinking water ((General Chemical State Laboratory of Greece, DVGW Germany, WRAS NSF Great Britain).

Guaranteed

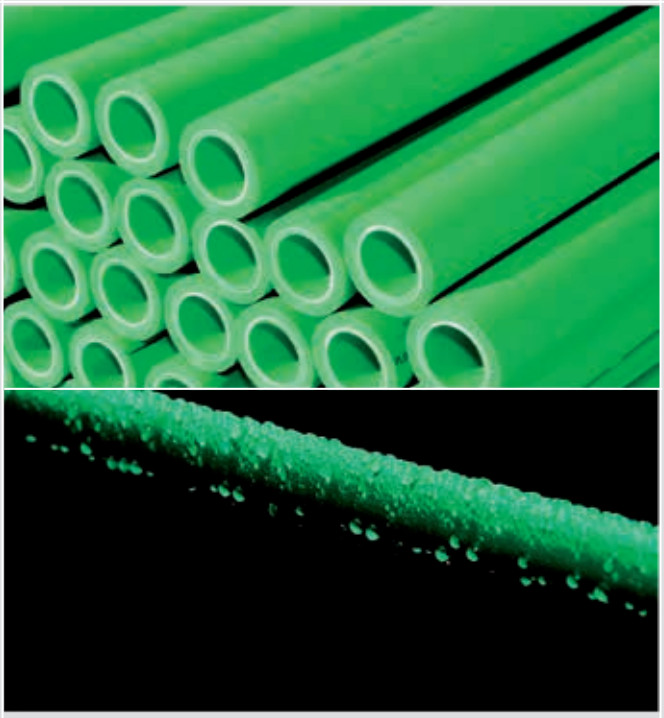
Interplast's Aqua plus system carries a 10 years guarantee covered by the Allianz insurance company against damages owing to faulty pipe and fitting production to a sum of € 500,000 per incident and up to a maximum of €3,000,000 within a year.

PIPES SDR 6 –PPR20

Interplast manufactures PP Random type 3 pipes and fittings with dimension from 20 mm to 160 mm with applications in plumbing-heating-cooling installations, in industry (transfer of liquids and compressed air) and in networks that run the risk of electrochemical corrosion.

Aqua plus pipes are manufactured in green colour in aligned segments 4 meters each. They can be manufactured in black stabilized color for UV protection. It is also available in rolls 100m each in 20mm dimension.

The pipes bear a printing per meter, indicating the trade name, outer diameter, wall thickness, operating pressure at ambient temperature, manufacturing specifications, (EN, DIN, UNE),certifying institutes (EVETAM, SKZ, AENOR, DVGW, WRAS) and a code number stating the time and date of production.



5.1 | PRODUCED INTERSECTIONS OF AQUA PLUS PN20 SDR 6 & AQUA PLUS ALUMINIUM

OUTER DIAMETER (mm)	WALL THICKNESS (mm)	INNER DIAMETER (mm)	WATER CAPACITY l/m	PIPE WEIGHT kgr/m	PACKAGING m
20	3,4	13,2	0,137	0,172	100
25	4,2	16,6	0,216	0,267	80
32	5,4	21,2	0,353	0,435	60
40	6,7	26,6	0,556	0,671	40
50	8,4	33,2	0,866	1,050	16
63	10,5	42	1,385	1,650	12
75	12,5	50	1,963	2,340	8
90	15	60	2,827	3,400	4
110	18,4	73,2	4,208	5,040	4
125	17,1	90,8	6,472	5,530	4
160	21,9	116,2	10,599	9,040	4

The structure of the material and the smooth surface texture ensure low friction losses resulting in low resistance and low pressure drop in the piping. In addition the material used significantly reduces the noise generated and limits its transmission through the pipes. This makes it possible to transfer greater quantities of liquids with plastic pipes of smaller dimension.

Average velocity of the pipes on the market:

MATERIAL	VELOCITY (mm)	MATERIAL	VELOCITY (mm)
Steel	0.046	copper	0.013+0.015
Cast-iron	0.26	concrete	0.3+ +3.0
Galvanized iron	0.15	ceramic	-0.07
Insured iron	0.12	plastic	0.006

The result from the things above is the use of smaller dimension of plastic pipes for the same quantity of water.
The correspondence among the Aqua plus pipes, copper pipes and metal pipes is shown in table 5.2

5.2 | COMPARATIVE PIPE INTERSECTIONS

Aqua-plus	Copper pipes	Metal pipes
20 x 3,4 mm	18 x 1,0 mm	1/2"
25 x 4,2 mm	22 x 1,0 mm	3/4"
32 x 5,4 mm	28 x 1,5 mm	1"
40 x 6,7 mm	35 x 1,5 mm	1 1/4"
50 x 8,4 mm	42 x 1,5 mm	1 1/2"
63 x 10,5 mm	54 x 2,0 mm	2"
75 x 12,5 mm	64 x 2,0 mm	2 1/2"
90 x 15 mm	76,1 x 2,0 mm	3"
110 x 18,4 mm	88,9 x 2,0 mm	4"
125 x 17,1 mm	108 x 2,5 mm	5"
160 x 21,9 mm	-	6"

AQUA-PLUS FIBERGLASS

Interplast manufactures polypropylene three-layer pipes PP-R MRS 11.2 MPa (new generation) with fiberglass and wall thicknesses that corresponds to SDR 7,4 and SDR 11.

The propylene used for the multi-layered pipes Aqua-Plus-Fiberglass (with mechanical support in the middle layer) is characterized as propylene random with high mechanical endurance and long lifespan, in contrast to the single PP-R in the category MRS 8.0 MPa (PP-R 80). Press endurance of pipes PP-R 112 with SDR 7,4 at 20°C is 20% greater in relation to the pipes PPR 80.

The new pipes Aqua Fiberglass are designed, manufactured and checked for their quality according to the standards that are valid for the simple propylene pipes (EN ISO 15874 & DIN 8077/78) and in accordance with the special guidelines HR 3.28 of the German Institute SKZ for the specific type of types.

The advantages of this new type are:
-Reduction of the thermal linear expansion by 50% in relation to the simple propylene pipes.

-Increase of the mechanical endurance of the pipe in the inner hydrolic pressures per 20% (for the SDR 7,4).

-Increase in the chemical endurance of the pipe against to corrosion

-High stiffness of the pipes

-Greater quantity of conveyed water

-Increase in the life of service

The thermal welding of the new pipes with the propylene fittings are carried out in the same easy way as in the simple pipes.

5.1.2 | PRODUCED DIMENSIONS OF AQUA-PLUS FIBERGLASS SDR 7.4 PIPES

Outer diameter (mm)	Wall thickness (mm)	Inner diameter (mm)	Water capacity l/m	Pipe weight kgr/m	Packaging m
20	2.8	14.4	0.163	0.158	100
25	3.5	18.0	0.254	0.246	80
32	4.4	23.2	0.423	0.394	60
40	5.5	29.0	0.660	0.613	40
50	6.9	36.2	1.029	0.955	16
63	8.6	45.8	1.647	1.500	12
75	10.3	54.4	2.323	2.135	8
90	12.3	65.4	3.358	3.058	4
110	15.1	79.8	4.999	4.576	4
125	17.1	90.8	6.472	5.891	4
160	21.9	116.2	10.599	9.538	4

Technical characteristics of the pipes

- Thickness 0,998g/cm²
- Tensile ≥ 40N/mm² (ISO R 527)
- Elasticity measurement ≥ 800N/mm² (ISO178)
- Impact strength ≥15mj/ mm² (ISOR 179)
- Hardness 40N/mm² (ISO 2039)
- Thermal conductivity (20 C):0,24 W/m C
- Velocity coefficient (roughness): 0,007mm

5.1.3 | PRODUCED DIMENSIONS OF AQUA-PLUS CLIMA SDR II PIPES

Outer diameter (mm)	SDR	Wall thickness (mm)	Inner diameter (mm)	Water capacity l/m	Pipe weight kgr/m	Packaging m
20	11	1.9	16.2	0.206	0.107	100
25	11	2.3	20.4	0.327	0.164	80
32	11	2.9	26.2	0.539	0.261	60
40	11	3.7	32.6	0.834	0.412	40
50	11	4.6	40.8	1.307	0.638	16
63	11	5.8	51.4	2.074	1.010	12
75	11	6.8	61.4	2.959	1.410	8
90	11	8.2	73.6	4.252	2.030	4
110	11	10.0	90.0	6.359	3.010	4
125	11	11.4	102.2	8.199	3.910	4
160	11	14.6	130.8	13.430	6.380	4

It is possible to manufacture pipes and fittings to 500 mm and pre-insulated pipes on demand.

AQUA-PLUS ALUMINIUM

Interplast, apart from the simple propylene Random Type 3 and the pipes with fiberglass thread manufactures three layered polypropylene – aluminum – polypropylene pipes.
The new pipes are designed, produced and checked for their quality according to the standards which are valid for the simple propylene pipes.

The Aqua Plus AL are classified at the same category with the simple Aqua plus pipes: Class2/10 bar (safety factor Sf=1,5) it means that they are designed for the transfer of drinking water with the possibility of continuous operation for 50 years with network pressure 10 bar and water temperature 70°C while there is the possibility for continuous operation under pressure of 20 bar at 20°C for the same period of time.

The conditions above are common for all pipe dimensions Aqua Plus AL, due to the stable relation which connects the outer dimension with the wall thickness.
(SDR=D/e=20/3,4=25/4,2=….=6)

The advantages of this new type of pipes are:
- Reduction in thermal linear expansion by 60% in comparison to the simple polypropylene pipes

- Increase in mechanical resistance of the pipe
in outer knocks

- Increase in mechanical endurance of the pipe in inner hydraulic pressures by 15%

- Increase in the impermeability in oxygen

The thermal welding of the new pipes with the fittings are carried out in the same way as the simple pipes after the cleaning of the ends with a scraper.

Interplast manufactures a wide range of certified fittings from polypropylene (Random type 3) in accordance with DIN 16962 and EN ISO 15874-3.Aqua-plus fittings are available in dimensions from 20 to 160mm.

The fittings have been designed according to the specification of pressure series PN 25 whereas conventional polypropylene systems are manufactured in accordance with pressure series PN20.

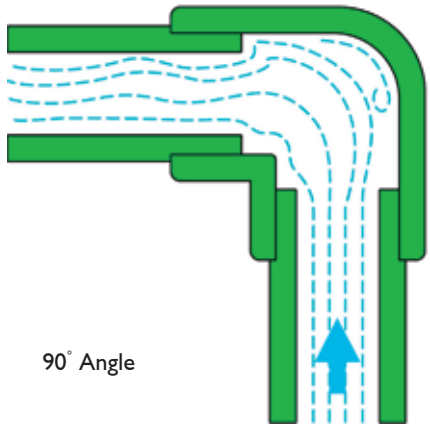
The PN 20 and PN25 symbols correspond to two fundamental parameters: pressure strength and resulting service life. From the point of view of pressure tests, PN25 means that for the 1hour duration of the test the tested elements are exposed to a pressure of 80 atmospheres at a temperature of 20°C. For the PN 20 series the same test is performed at a pressure of 64 atmospheres, we would also like to mention that the resistances created in the fittings are much greater in relation to those of the pipes.

Basically speaking, use of fittings of the PN25 category increases the service life of the system. In the case of polypropylene this service life depends on two fundamental factors: operating pressure and the temperature of the conveyed medium. As temperature and pressure increase the polypropylene undergoes an accelerated aging process. Thus, the use of PN 25 category systems offer many advantages since their estimated service life is 100 years whereas that of the PN 20 category connections is just 50 years.

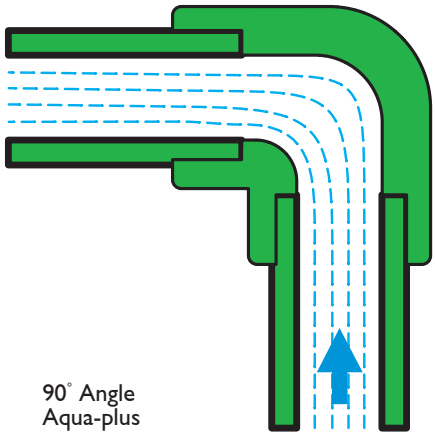
Another fundamental reason why the company chose to design and produce PN 25 fittings is that the considerable thickness of the walls of the fittings (PN 25) allows us to improve the design of the internal geometry of the fittings, thus considerably reducing the value of hydraulic losses and improving flow through the system. For example, the coefficient of local reistance (ζ) of the 90° elbow for the usual PN 20 fittings is 1.2 whereas for the PN 25 fittings it is 0.9 i.e. 25% less.

Finally, we would like to point out that for the manufacture of the fittings the company uses raw material with a low melt flow index identical to that of its pipes so that the mechanical strength of the pipe does not differ from that of the fittings.

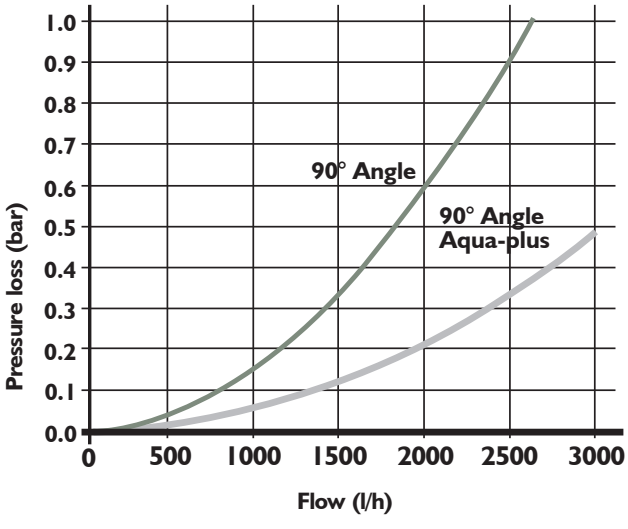
The Aqua-Pus fittings are one of the few fitting series certified worldwide.



90° Angle

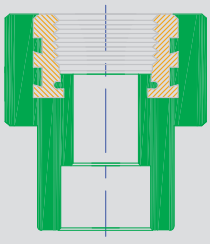


90° Angle
Aqua-plus



FITTINGS WITH METAL AND PLASTIC

Interplast is one of the few companies in Europe with vertically organized production and the only one in Greece manufacturing all parts of the system. Through its subsidiary company, ELVIOM S.A. it manufactures the brass inserts of the mixed components of propylene which have the following characteristics:

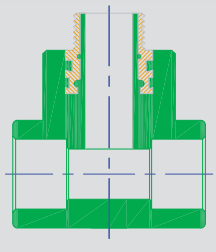


- Circumferential grooves for retention of fitting where one side of the groove has a negative gradient from the outside-in, so as to retain the PP-R material and prevent the metal part straying from the plastic when tensile forces develop.

- Cross-shape grooves in the base of the brass insert so as to eliminate the possibility of turning and consequent detachment of the metal from the plastic part.

- Use of raw material for brass with hardness less than 105 Brinell rather than the usual 125-130 The material (Brass) after processed increase the hardness 10-158 Brinell. Therefore the final product passes from annealing remaining at temperature of 350°C for one hour, so as to return to its original hardness of 105 Brinell. In this way we totally eliminate the possibility of cracks which appear particularly on the female threaded fittings.

- The brass parts are heavy duty (harder contact surface which keeps the brass element connected to the plastic one) in accordance with the specifications and requirements of the thermal fusion welding system.



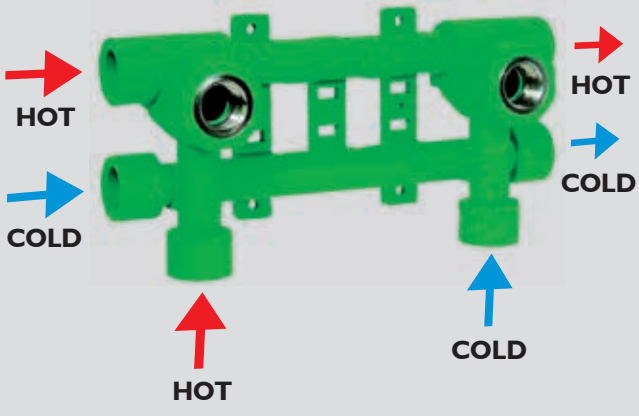
- PP-R is used to line the male brass inserts. In this way no metal is introduced into the system thus avoiding the deposit of solid residues and consequent reduction in flow. Moreover, electrochemical corrosion of the system is also avoided.

ALIGNING WATER INTAKE TEMPLATE

This is a water intake with fixed connection distances from the bath tap allowing connection of the hot or cold water pipes of either from the floor or from the wall. Its innovativeness lies in the fact that many options are available for connecting the hot and cold water pipes. Moreover the water intake makes it possible to continue the the hot or cold water line directly without the need for inserting other fittings. Available with four thermal fusion welded male end caps.

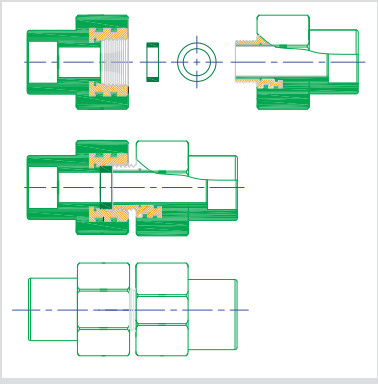
Characteristics

- Fixed connection distances from bath tap (153mm)
- Simplified method of mounting ensures battery remains "leveled"
- Possibility of connecting the hot-cold water lines from the floor or the wall
- Possibility of multiple connection (e.g. Boiler, Solar Heater) directly to the supply without the need for additional fittings
- Possibility of continuing the hot and cold water lines from the floor (vertical) to the wall (parallel)
- Possibility of connecting a recirculation device without the need for additional fittings
- Exceptionally easy wall mounting



PLASTIC-ELASTIC SEALING RING

(No Patented: 201203281)



This is a new innovation of Interplast whose specifications are described below:

- No other type of sealants is required for the connection of the metal fittings in plumbing, heating and air conditioning installations

- The connection and disconnection of the fittings is possible to happen using the same ring without any change.

- The inner plastic sealing ring serves as a spacer during the extreme tightening between the male and the female spiral. In this way, crackings are avoided and safe sealing between the fitting is achieved.

- The raw material used is polymer with special additives (elastomers) and the finished product (inner plastic ring) can be deformed and seems to be the same in geometry of the connection fittings. As a result, there is no need for extra sealants.

- Especially for the PPR, the plastic elastic ring creates a bridge with the inner coating of the male parts of the metal fittings. As a result, the metal has no contact with water.

Attention: Special geometry in the female parts of the fittings is required for the sealing. Interplast guarantees ONLY for its own production fittings PPR and the brass fittings of ELVIOM due to special design of the fittings with female threading. Interplast is not responsible for any other fittings.

In case that the inner plastic ring will not be used, Interplast recommends the use of hemp for the connection of the metal parts of the fittings in hot water. In cold water is possible to use Teflon.

SEPARATE HYDRAULIC CIRUITS

(No Patented: 20120100649)

Hydraulic Separator
The aim of the hydraulic separator is the creation of the hydraulic equalization and maintenance of the supplies of different sources and fields.

Operation
The hydraulic separator looks like a hydraulic container of infinite mass and thermal capacity which is not affected in a hydraulic and thermal way from the outgoing and incoming currents and masses of the fluid.

Benefits-Advantages
The hydraulic separator achieves considerable savings and right use of thermal and electric energy. It also achieves optimum utilization function without extra cost.

Applications
- In all heating, cooling, conditioning systems
- Use of autonomy
- Parallelism of the sources of energy
- Reduction in consumption and equipment cost

Operation-Analysis
During the flows in the consumptions and in the sources of energy are being changed according to the demand of a hydraulic splitter, the following conditions exist:

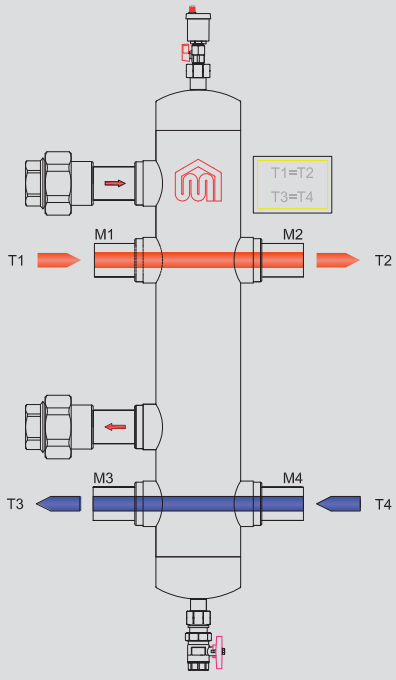
- The energy supply is equal to the supply to the consumptions

- The energy supply is greater than the supply to the consumptions

- The energy supply is less than the supply to the consumptions

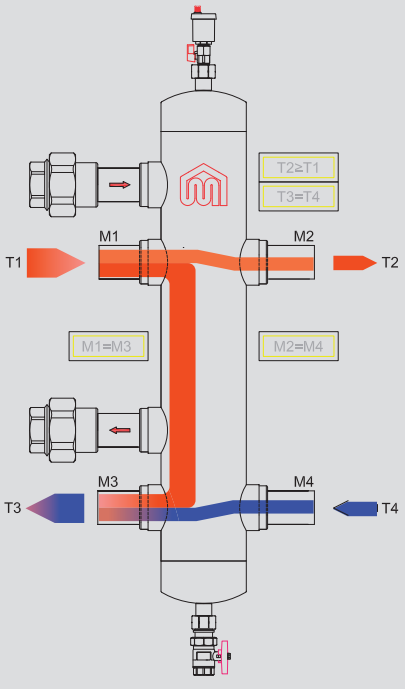
These conditions are based on thermodynamics rules.

Case I:
The supplies of water source of energy-installation are equal MI=M2 &M3=M4



A negligible mix of temperature takes place in the hydrolic splitter due to hydrolic balance of the supplies.

Case 2:
The water supply of installation is less than the supply of the source of energy MI-M3>M2-M4
While the supply in the primary network is greater, the temperature in the secondary network after the mix is equal and equal according to the conditions T2≥TI



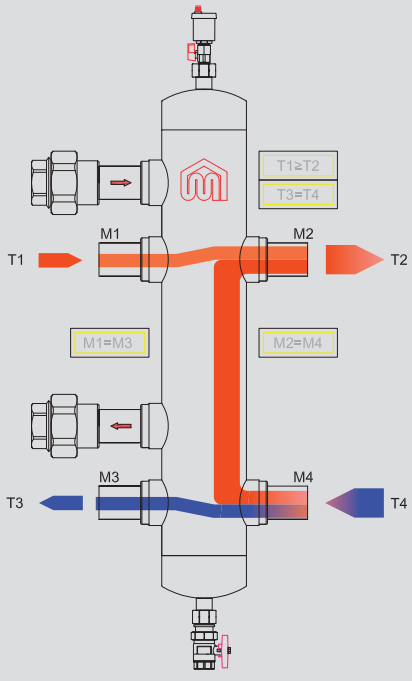
The mixing temperature in position (T2), to the installation network, can be calculated using:

$$T2 = \left[\frac{(M4-M1)T4+(M1)T1}{M4}\right]$$

Where:
M4 = Return supply water from the installation m³/h
MI= Outgoing supply water from the source of energy m³/h
T4= Return water temperature °C
TI= Outgoing water temperature °C

In the splitter water mixing takes place

Case 3:
The installation water supply is greater than source of energy supply. MI-M3<M2-M4



The mixing temperature in positions (T2) & (T3) can be calculated using:

$$T2 = \left[\frac{(M4-M1)T4+(M1)T1}{M4}\right]$$

$$T3 = \left[\frac{(M1-M2)T1+(M4)T4}{M1}\right]$$

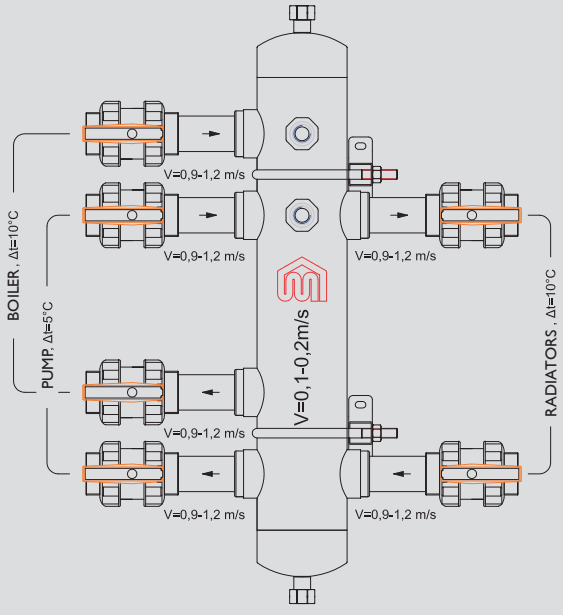
Where:
M4= Return supply water from the installation m³/h
MI= Outgoing supply water from the source of energy m³/h
T4= Return water temperature °C
TI= Outgoing water temperature °C

In the splitter a water mixing takes place

Dimensioning-Choice

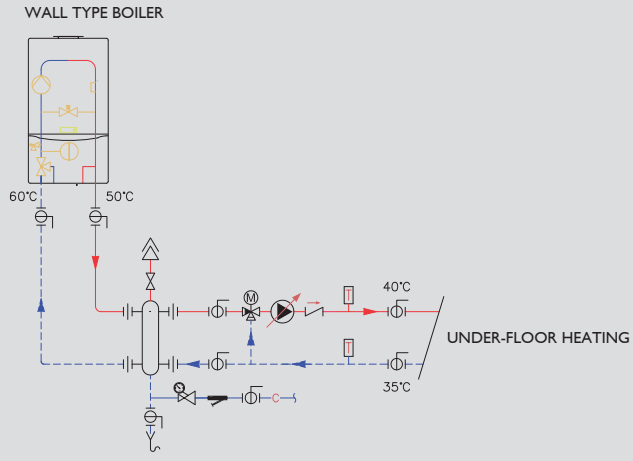
The suitable dimension of the sizes of the central pipe and of the smaller piping should satisfy the specific condition velocity-fluid supply. The splitter can operate as a degasifier and simultaneously as filter for draining particles at the bottom. Extreme and out of limits speed can make its additional operations invalid.

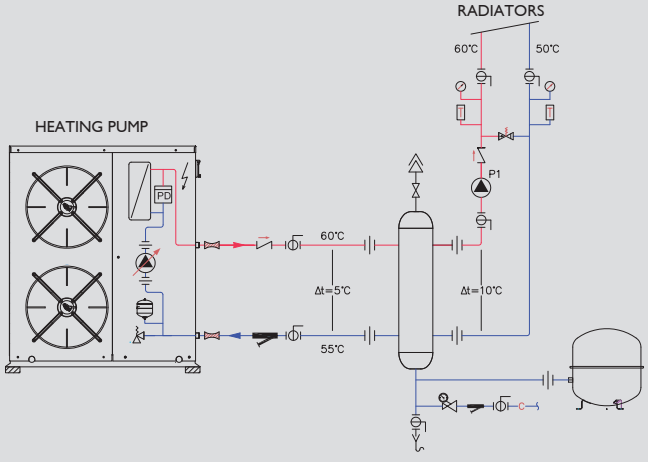
The maximum water speed is:
central pipe (max 0,2m/s), branches (max 1,2 m/s).

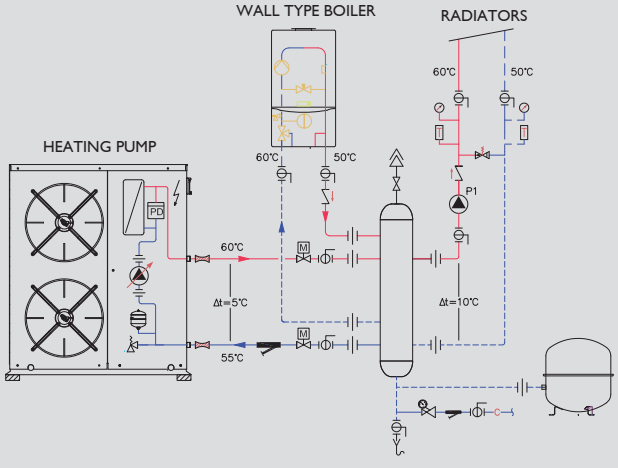


TYPE OF HYDRAULIC SPLITTER	1 (4/2) - 2 (2/2-1) - 3 (2/2-2)			
	160/75	125/50	110/40	90/32
DIMENSION OF MAIN DUCT	Ø160	Ø125	Ø110	Ø90
DIMENSION OF COLLECTION BRANCH	Ø75	Ø50	Ø40	Ø32
SUPPLY M3/H ΔT 10°C	3.44	2.58	1.72	0.86
SUPPLY M3/H ΔT 5°C	6.88	5.16	3.44	1.72
POWER KW FOR ΔT 10°C	80 KW	40 KW	30 KW	20 KW
POWER KW FOR ΔT 5°C	40 KW	30 KW	20 KW	10 KW
CAPACITY PER LITRE (LT) FOR FIBERGLASS PIPES SDR 7.4	12.93lt	6.47lt	4.04lt	2.20lt

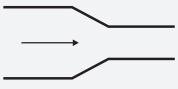
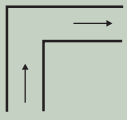
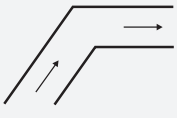
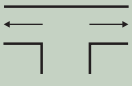
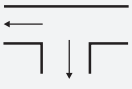
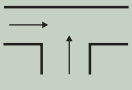
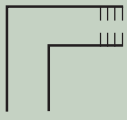
Examples of applications with hydraulic splitters

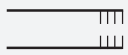
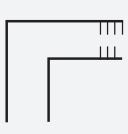
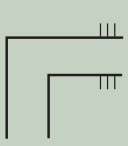
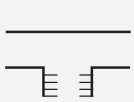
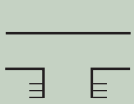
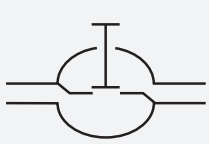






6.1 COEFFICIENTS OF SPOT RESISTANCE ζ FOR AQUA-PLUS SYSTEM FITTINGS

Type		Symbol	Remarks	ζ
	Socket		All diameters	0,25
	Reducing bush		Reduction by 1 size Reduction by 2 sizes Reduction by 3 sizes	0,3 0,5 0,55
	Elbow 90°		All diameters	0,9
	Elbow 45°		All diameters	0,4
	Tees (all diameters)		Straight flow	0,5
			Bifurcation	1,2
			Side inflow	0,8
			Convergent stream	3,0
			Divergent stream	1,8
		from the sum of ζs, and the contraction		
	Female angle with support		All diameters	1,4

Type		Symbol	Remarks	ζ
	Coupling female		20 mm ∏ 25 mm	0,4
			32 mm ∏ 75 mm	0,4
	Coupling male		20 mm ∏ 25 mm	0,5
			32 mm ∏ 75 mm	0,5
	Female elbow		All diameters	1,4
	Male elbow		All diameters	1,6
	Tee female threaded		All diameters	1,5
	Tee male threaded		All diameters	1,8
	Stop cock		20 25 32	13 11 10

07 LIFE SERVICE

The water distribution system from PP-R (type 3) has been used safely and reliably for the last 40 years. It been designed to have le service for over 50 years for temperatures up to 95°C. and operation pressure from 6 to 26 bar. Temperature edges at 110°C in operation pressure 4 bar that do not affect the Aqua plus system.

The Aqua plus system has great endurance in aging, high temperatures and pressure. The life service diagram proves the quality in case it is used under the standards of the manufacturer.

Generally the Aqua plus system is durable and absolutely reliable for plumbing and heating installations

The life service of the pipe depends on the factors such as: pressure, temperature and external stress
These parameters are connected with the following;

$$p = \frac{2 * S\,min * \sigma}{d\text{-}S\,min}$$

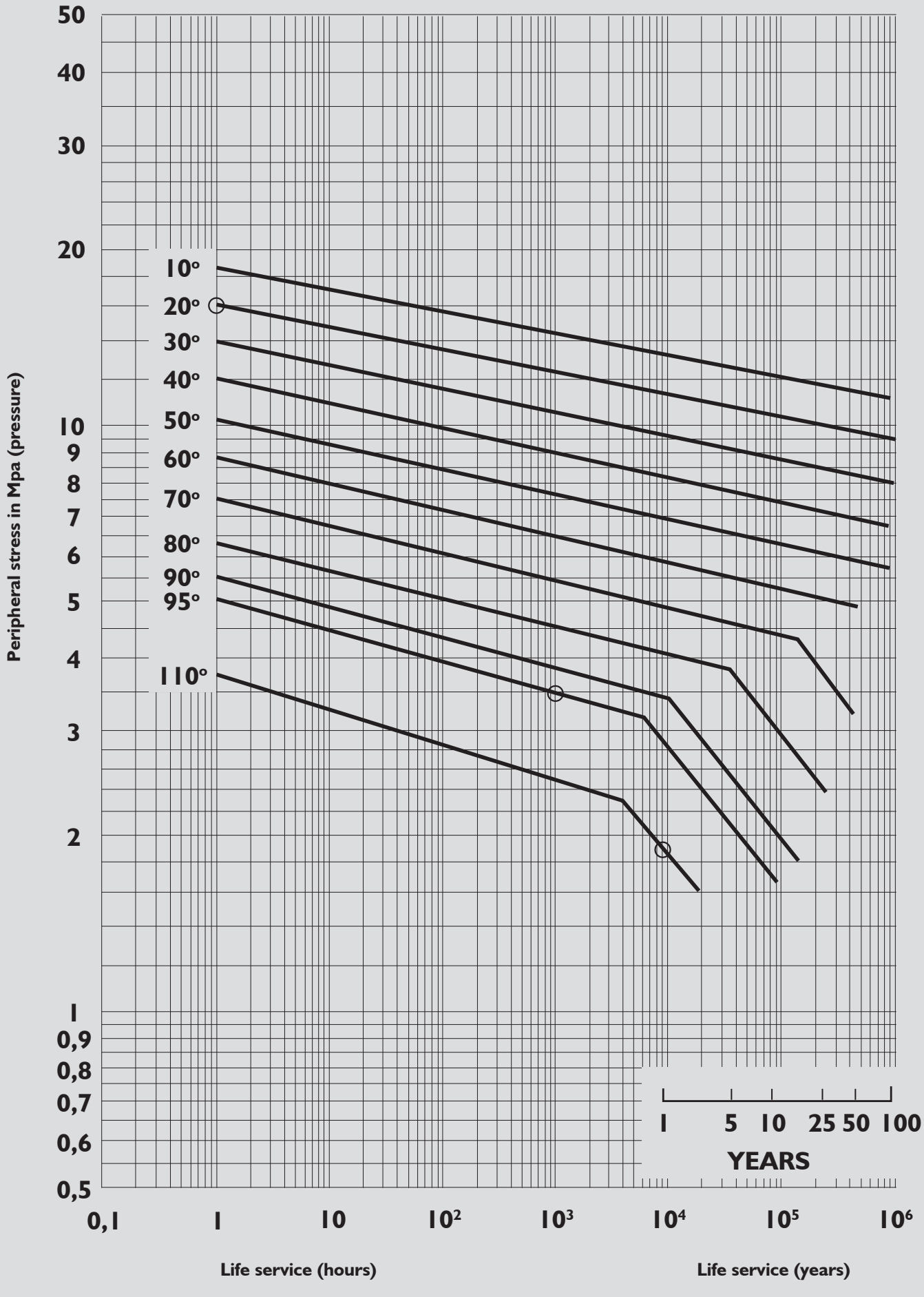
Where
P: maximum internal pressure
d: outer diameter
S min: wall thickness (minimum)
σ: stress N/mm²

According to the table, in case of plumbing installation life service of at least 50 years is possible at temperatures of 10-70°C the similar result is possible in case of heating installations at high temperatures and operation pressures.

For the SDR II pipe, the operation at temperatures over 60°C can happen only if the system has operated for a specific number of days. Such tables can be provided by our company

7.1 | TABLE OF SERVICE LIFE WITH SAFETY FACTOR 1.5

Degrees celsious	Service life in years	Operating pressure PP-R 80 SDR6-S 2,5 (bar)	Operating pressure PP-R 112 SDR7,4-S 3,2 (bar)	Operating pressure PP-R 112 SDRII-S 5 (bar)
10	1	35,2	36,2	22,8
	5	33,1	35,1	22,1
	10	32,3	34,7	21,9
	25	31,2	34,1	21,5
	50	30,4	33,6	21,2
	100	29,6	33,2	20,9
20	1	29,9	31,5	19,9
	5	28,3	30,5	19,3
	10	27,5	30,1	19,0
	25	26,7	29,6	18,6
	50	25,9	29,2	18,4
	100	25,1	28,8	18,1
30	1	25,6	27,3	17,2
	5	24,0	26,4	16,6
	10	23,2	26,0	16,4
	25	22,4	25,5	16,1
	50	21,9	25,1	15,8
40	1	21,6	23,5	14,8
	5	20,3	22,6	14,3
	10	19,7	22,3	14,1
	25	18,9	21,8	13,8
	50	18,4	21,5	13,6
50	1	18,3	20,1	12,6
	5	17,1	19,3	12,2
	10	16,5	19,0	12,0
	25	16,0	18,6	11,7
	50	15,5	18,3	11,5
60	1	15,5	17,0	10,7
	5	14,4	16,3	10,3
	10	13,9	16,0	10,1
	25	13,3	15,7	9,9
	50	12,9	15,4	9,7
70	1	13,1	14,3	
	5	12,0	13,7	
	10	11,6	13,5	
	25	9,9	13,1	
	50	8,5	12,9	
80	1	10,9	11,9	
	5	9,6	11,4	
	10	8,0	11,2	
	25	6,4	10,9	

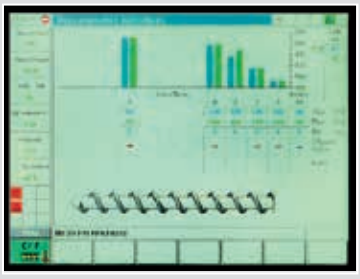

Peripheral stress in Mpa (pressure)
50
40
30
20
10
9
8
7
6
5
4
3
2
1
0,9
0,8
0,7
0,6
0,5
10°
20°
30°
40°
50°
60°
70°
80°
90°
95°
110°
1
5
10
25
50
100
YEARS
0,1
1
10
10²
10³
10⁴
10⁵
10⁶
Life service (hours)
Life service (years)

QUALITY ASSURANCE DURING PRODUCTION

Our foremost concern and basic commitment is total quality assurance and a significant part of our efforts is directed towards this. The mechanical equipment used for the manufacture of Aqua- plus pipes and fittings assures the highest degree of quality. Apart from the standard mechanical equipment for pipe manufacture, Interplast production line is equipped with the following apparatuses ensuring that the consumer receives a final product of the highest quality.

Raw material dehumidifier

In this way, the intake of the Extruder is stabilized for raw materials that easily absorbed humidity. Thus we eliminate alteration in dimension, which is a fairly common phenomenon in a number of pipes.



Automatic correction of screw turns.

Thus, we achieve steady weight per meter in the manufactured pipe, which means steady dimensions. This constitutes the first part of the dimensional stability of the pipe.

Automatic correction of pipe wall thickness.

A system where we define the desired limits of wall thickness which are automatically then regulated by means of the extruder of the production line. This constitutes the second part of the dimensional stability of the pipe.

Checking of stability outer diameter and ovality of the pipe by LASER.

This is the third and final part of electronic testing. The absolute values of LASER SCANNER ensure proper fit of the pipe to the fitting during the thermal welding process.

All these above which are the prerequisites for Interplast's pipe production for cold and warm water installations, the following guarantee the high quality of the Aqua Plus pipes and fittings.

Perfect mechanical equipment specially designed for PP-R pipes and fittings so as to avoid failure in homogenization.

Check of the fit of the brass inner part of the Aqua plus fittings in fitting with spiral (extra parts, nipels) . In this way we certify the application of our productions.

Dimensional check of the pipes by the operator of the line. The outer diameter is checked with a bead meter and the wall thickness and the oval of the pipe is checked with a caliper. The pieces measured are kept for the final check production manager and the technical manager who give the order of distribution after the completion of the laboratory checks. All the evidence of the measurements are registered in the ISO which is updated on a daily basis.

Check of trapping of the pipes and the fittings using the device for the thermal auto welding

The stringent specifications followed by Interplast in pipe production are certified in its laboratories with tests specified by European norms EN ISO 15874-1/2/3German DIN 8077/78 and 1692. The industry distributes pipes that have been quality tested in the following ways:

Check of the raw material flow index and the final products.

It is a standard test which takes place each time the raw material are received and a product is produced. The raw material flow index is very important for the definition of temperature profile of the extruder and consequently, it is essential for the homogenization of the material and its slight divergence from the index flow of the correspondent product proves the right processing of the material.

Visual inspection of pipe surface, measurement of outer diameter and measurement of wall thickness by use of calibrated instruments.

These are the tests that certify the continuous measurements that take place during the production.

Endurance and reliability test on the pipe and fitting time using cyclic thermal tester.

The products are tested as a system under extreme operational conditions for 5000thousand hours. The temperature of the water changes every 15 minutes between 20°C and 95°C (repeated thermal shocks) while the hydraulic pressure is at 6 bar

Checking % of linear tempering after heating of the pipes. (heat reversion test).

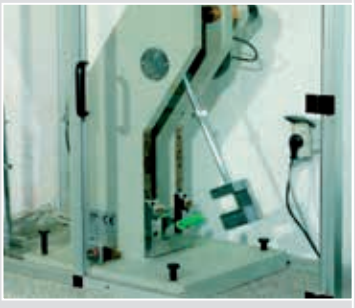
Specimens from each production lot are kept in the laboratory stove for 2 hours at 135°C. The results should not exceed 2% in accordance with DIN and EN ISO. Aqua plus pipes present values the order of 0.4%, The Aqua plus Aluminum and Aqua plus fiberglass values of 0.2%. This means that the coefficients of thermal linear expansion are greatly low during their operation in heating installations.

Microscopic homogenization material test.

This is one of the most important tests because it indicates the right processing of the raw material. All the pipes and fittings show the best possible homogenization resulting long service life.

Mechanical endurance test of the pipes and fittings in internal hydrostatic pressure, in test time of 1 hour at 20°C and 95°C and of 8760 hours at 110°C as it is specified by the European norms, the German and Spanish standards. The one-hour tests take place on each lot of the final product every two weeks. The tests of the 1000 and 8760 hours once annually for each cross section and type of pipes

Impact test in accordance with the standards of DIN 8078, DIN 53453, EN ISO 15874-2 and ISO 9854-1/2 which are described the way of testing. PP-R tests should correspond without breakage at the temperature of 0°C and impacts of 15J. The high quality of the Aqua plus pipes allows endurance at -5°C in impacts of 25J which exceeds the standards requirement by 66%.



DIN 8077
Polypropylene pipes, dimensions

DIN 8078
Polypropylene pipes, general quality requirements -testing.

DIN 8076
Metal compression fittings, test methods

DIN 2999
Polypropylene fittings with metal insert

DIN 16962
Polypropylene pipes and fittings,
Sheet 5: general quality requirements -testing.
Sheet 6: elbows for socket welding, dimensions
Sheet 7: tees for socket welding, dimensions
Sheet 8: caps and nipples for socket welding, dimensions
Sheet 9: reducing bush for socket welding, dimensions
Sheet 10: tapping saddles, flange necks and valves for socket welding, dimensions

DIN 2000
Guidelines for drinking water requirements. Design, development and operation of installations

DIN 1988
Drinking water pipes. Part 1 technical specifications for drinking water installations

DIN 4109, Sheet 5
Sound installation in water pipes

DIN 4109
Noise reduction in buildings (internal network)

DIN 16744
Thermoplastic mass: Polypropylene (PP)

DIN 53735
Testing of plastic material.
Melting index testing of thermoplastics

DIN 16960
Welding of thermoplastic materials, principles

DVS 2207, Part II
Welding of thermoplastic materials, Polypropylene pipes and fittings

DVS 2208, Part I
Machines and equipment for welding of thermoplastic materials

EN-ISO 15874-1
Systems of plastic pressure pipes from polypropylene for cold and hot water applications

EN-ISO 15874-2
Systems of plastic pressure pipes from polypropylene for cold and hot water applications. Pipes

EN-ISO 15874-3
Systems of plastic pressure pipes from polypropylene for cold and hot water applications. Fittings.

Aqua plus pipes meet and exceed the requirements set by the European norms, the internationally accepted German DIN, Spanish UNE, and British BS standards. Thus Aqua plus has not had a single failure in the regular 6-monthly checks that are performed by the officials institutes on random specimens from the production line and from the warehouse. Crowning of the above is that Aqua plus is certified as an end product by the following bodies:

ISO 9001 by TUV Germany for compliance with all international certifications regarding Aqua plus

EVETAM for pipes PN20 and fittings PN25 as an integrated system and for Aqua plus pipes with fiber glass.

SKZ Germany and **AENOR Spain** for the mechanical strength of the pipes. This comprises checking of pipe dimensions, microscopic homogenization check, pressure test in combination with different temperatures, linear expansion test and impact test.

SKZ Germany for the mechanical endurances of the pipes PN20 and fittings PN25 **as an integrated system**.

DVGW Germany and **WRAS-NSF Great Britain** for the suitability of Aqua plus pipes for drinking water. This comprises tests at 20°C and 80°C for taste, odor, development of microorganisms, extraction of substances and metals dangerous for the public health (cadmium, arsenic etc).

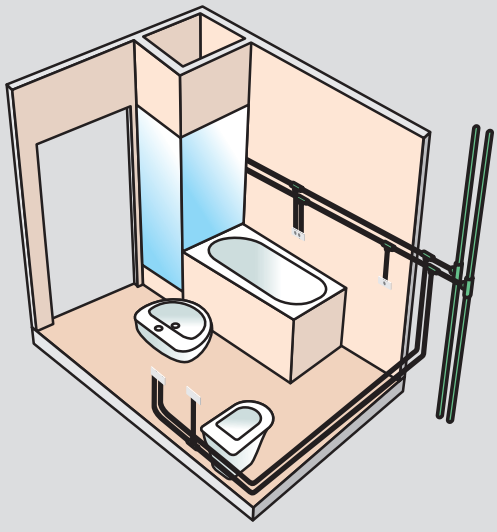
GOST Russia, ZIK Croatia and **ISS Serbia** for the mechanical endurances and the hygiene parameters. It has to do with the testing of the dimensions of the pipe, microscopic homogenization check, tests on pressure, linear expansion check and impact check.

In addition to the above, the pipes are tested in the laboratories of **ELOT** at 110°C under pressure in tests of long duration and by the **General Chemical State** laboratory, Greece for the suitability for drinking water.

12 APPLICATIONS

The PP-R (type 3) water distribution system has been used safely and reliably all over the world for the past 40 years. It has been designed for a lifespan of more than 50 years for temperatures up to 95°C and 6-26 bar operating pressure. Temperature peaks of 110°C at 4 bar operating pressure do not affect the Aqua plus system.

These properties of the material, combined with its cleanliness and non-toxicity, its excellent resistance to corrosion and low frictional coefficient have established the system made from PP-R as one of the basic choices of the technical world for plumbing and heating systems.

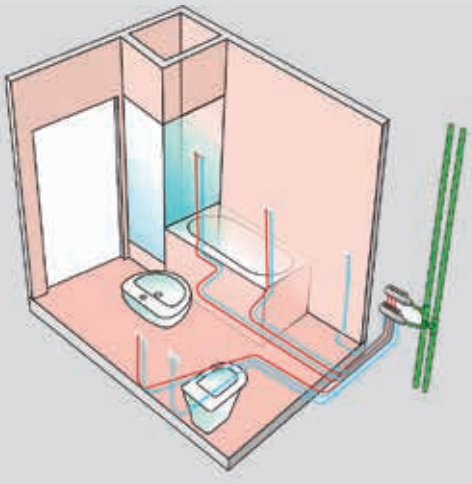


12.1 WATER SUPPLY SYSTEMS

For these systems the following devices are available:

T device where different discharge points can supply water from the same piping branch. The advantage of this method of installation which shares the same philosophy as the traditional method of installation for metal pipes is the smaller number of pipes in the building.

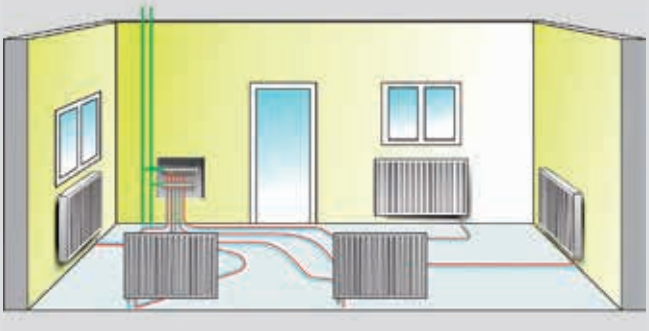
Combination of polypropylene with cross-linked polyethylene. The polypropylene is used for the central supply up to the manifold after which the water is distributed separately to different discharge points through cross-linked polyethylene pipes. The great advantage of this method of installation is the isolation of the circuits in the event of damage to the taps.



The Aqua-plus system can be used in combination with the saddles manufactured by Interplast for the water meters.

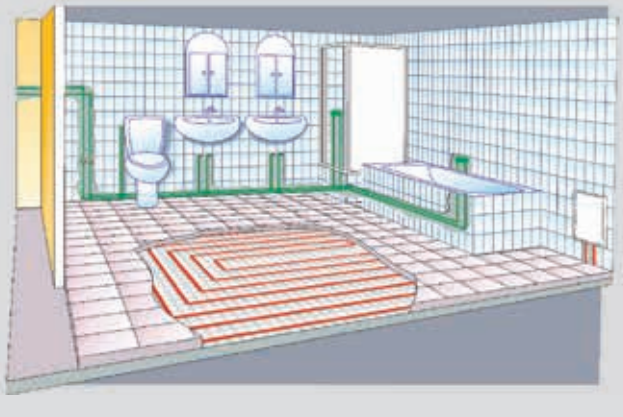
12.2 HEATING AND UNDER FLOOR HEATING SYSTEMS

The Aqua-plus system is used as the main supply from the oil boiler or heat pump to the manifold in systems with radiators and underfloor heating systems. Its low rectilinear expansion guarantees that the polypropylene pipes and fittings can be used safely and reliably as a central riser in heating systems.



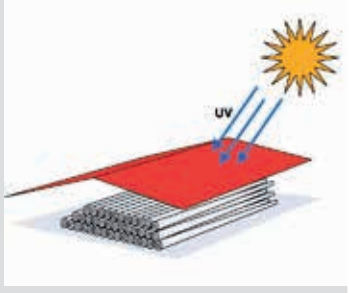
12.3 SPECIAL APPLICATIONS

The Aqua-plus system is used in industrial compressed air and cooling systems and in networks conveying aggressive liquids. Further applications include swimming pools and heat pumps.



Ultraviolet radiation is damaging to propylene. Thus long term exposure to sunlight can degrade the operating properties of the system. This is particularly true when the when the elements are stored in outdoor areas, in yards or installed unprotected on outdoor wall surfaces. In both cases pipes and fittings must be taken to indoor storage areas or be covered with a suitable insulant. When the pipes are installed next to balcony doors, windows and skylights the effect of the UV rays during the service life of the Aqua plus system can be considered negligible.

The Aqua plus pipes and fittings should not be exposed to sun ray for a long time. In case of outdoor installation, insulation or black plastic paint of two layers should be used which should be renewed every 5 years.



For cutting we use special shears so that the cut is perpendicular to the longitudinal axis of the pipes. Cutting with a knife, parer or hacksaw is not permitted. In the case of Aqua plus aluminum, the cleaning of the edges of the pipes should be very careful using scrapers so that filings of aluminum remain

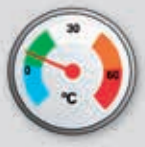
The plastic pipes must not be heated in a flame. If local heating of the pipe is required this must be achieved using hot air at a temperature of 130°C following which pipe must be left, undisturbed to return to ambient temperature.

The use of too much hemp is to be avoided as is excessive tightening of the threaded connections of the plastic brass fittings. The threads are precision made so as to ensure water tightness by simply screwing.

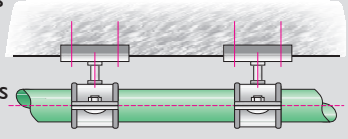
When we connect a metal pipe to an Aqua plus pipe we recommend use of a female/female coupling on top of which we connect an Aqua plus male threaded fitting.

In the case of frost and in systems that remain in disuse for a long time during winter (holiday homes at high altitude) although the Aqua plus system does not present exceptional elasticity we recommend draining the network.

When the temperature falls below 80 C special attention should be paid to cracks that might be subjected during transport.

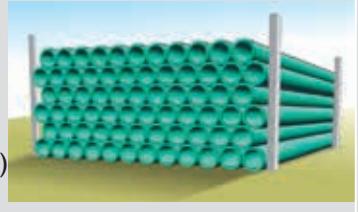


The correct distances must be observed between supports in accordance with the indications in this handbook.

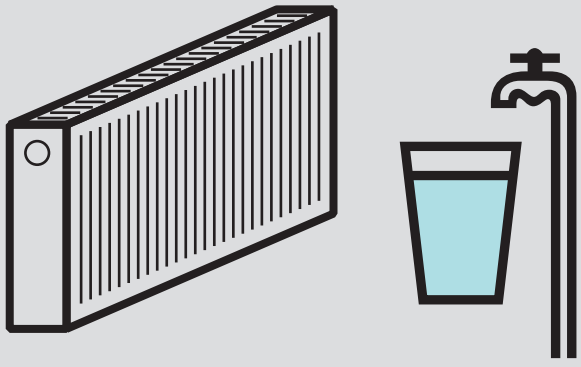


In underfloor or in-wall systems plaster or cement pipe coverings must be at least 3cm thick thus preventing any thermal elongation of the pipes.

Aqua plus pipes must be carried and stored in a horizontal position and rested on level surfaces only. Bending of the pipes is to be avoided in all cases. Throughout autumn and winter pipes must be stored in columns approximately 1.2 metres in height in areas protected from the cold (polypropylene becomes brittle at low temperatures)



The Interplast propylene random PP-R pipes and fittings under the tradename “Aqua plus system”, are suitable for building plumbing installations of potable water and for heating installations. The service life exceeds 50 years and continuous operation specifications are at a temperature of 20°C at pressure of 20 bar and at a temperature of 70°C at a pressure of 10 bar. The classification of the pipes is PN20 and of the fittings is PN25.

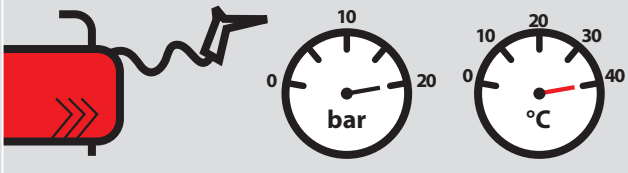


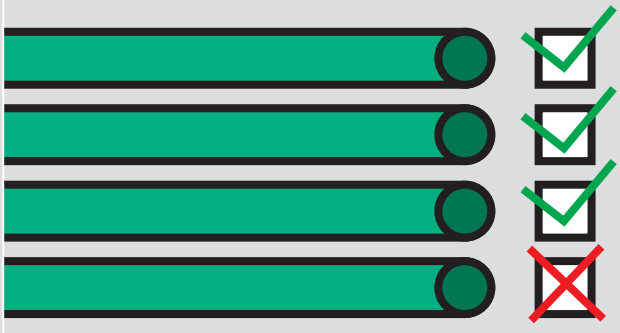
In conditioning applications, the system has chemical resistance to glucose aqueous solutions or to pure glucose (ethylene glycol or propylene glycol) and the operational pressure should not exceed 5bar as the temperature of the antifreeze is between -15°C .and +5°C.

The response of the system to the flame belongs to category B2 (normal ignition) according to the German standard DIN 4102-1 while toxic by-products are not produced while their burning.

A 10 year guarantee covers the pipes by the Allianz Insurance Company. The pipes and the fittings are required to belong to Aqua Plus System for reasons related to the homogenization of the materials which are thermally welded , the pressure testing of the system should be completed and the installation instructions should be completely followed according to the technical manual of Aqua plus so as to be covered by the guarantee.

The Aqua plus system can be used for compressed air applications. The pressure should not exceed 20bar and the temperature should be up to 40°C.





The Aqua plus system can be used for oil transport applications using appropriate groundings so as to avoid phenomena of static electricity. It can also be used for the transportation of ethyl alcohol (spirit). The transport of the liquids above should taken place at ambient temperature. The system should not be used for transportation of petrol, benzene, chloro and xylene and other aggressive liquids.

During the thermal fusion welding process the following rules must be observed:

Only clean and dry surfaces of pipes and fittings can be welded.

Pipes and fittings must be heated simultaneously and only once. A second heating is not permitted.

The heating and the welding process must not be interrupted.

During welding axial rotation of welded elements is not permitted. Adjustments of the axes of the elements is permitted +/- 3°C.

At ambient temperatures below 5°C heating time increase by 50%. Welding in ambient temperatures of below 0°C is not permitted.

Too short residence time of the pipe or fitting in the mould results in cold welding and danger of detachment. Too long residence time results in excessive melting of the material which can lead in decrease in dimension.

During the weld check, the external seam around the pipe must not be broken. In the case of a double seam, the two seams must be adjoining.

When installation is complete the circuits are tested in three successive phases:

A) First phase: each circuit is tested for 30 minutes at a test temperature of 1.5 times greater than the maximum operating pressure for the water supply systems while for the heating systems a pressure 2 bar greater than the maximum operating pressure is applied. After checking for leaks or a fall on the pressure gauge of more than 0.6 bar we move on to the second phase.

B) Second phase: We test the circuit as a whole using the same pressures and monitor leaks for a minimum of two hours

C) Third phase: We leave the circuit full of water under pressure until such time as the remaining work on the building has been completed, being sure to check the network for leaks. We ask subsequent workers (and of course the owner of the building) to inform us if they notice any leaks, or if they cause may damage to the pipes.

When the building is finished, and before it is inhabited we should «rinse» the networks such running potable water at velocities of 0.5m/s for a minimum of 15 minutes so as to deliver the circuits ready for use, free from dirt and any foreign matter. Detailed guidelines for the "care" of the heating-plumbing circuits prior to their operation can be found in standard DIN 1988 Part II.

14 THERMAL FUSION WELDING

14.1 TOOLS

The pipes and fitting of Aqua plus system are connected together by thermal fusion welding. This process includes the mixing of the melted material of the external surface of the pipe and the inner surface of the fitting after heating to a temperature of 260°C – 280°C. Suitably welded connections do not present any gaps between the two elements along the whole length of the connection when they are cut perpendicularly to the longitudinal axis of the pipe.
The following tools are used for welding the pipes and fittings:

- Pipe cutting tools available in two types:
1. cutting tools for pipes with outer diameter 20 to 40 mm
2. cutting tools for pipes with outer diameter 50 to 63 mm

Pipes with diameter 75 to 125 mm are cut with:
1. Revolving pipe cutting tools
2. Mechanical circular saws (sometimes manual). After cutting by circular saw protuberances should be removed from the inner end of the cut pipe.

- Welding machines available in two types:
1. Welding machine for pipes with outer diameter 20 to 40 m
2. Welding machine for pipes with outer diameter 50 to 125 mm fitted with a hand crank to facilitate precise assembly of the section of the system

14.2 ASSEMBLY GUIDELINES

Before switching on the welding machine, place the mould corresponding to the diameter of the elements to weld on the heating plate using the set of tools that comes with the welding machine. Check that the moulds make perfect contact with the heating surface.

Since the moulds are heated by the plate it is important to press them firmly against it to ensure that the entire surface of both mould and plate are in perfect contact.
The welding machine should be in perfect operational condition and keep constant temperature of 260°C. Otherwise, bond failure will happen (cold welding).

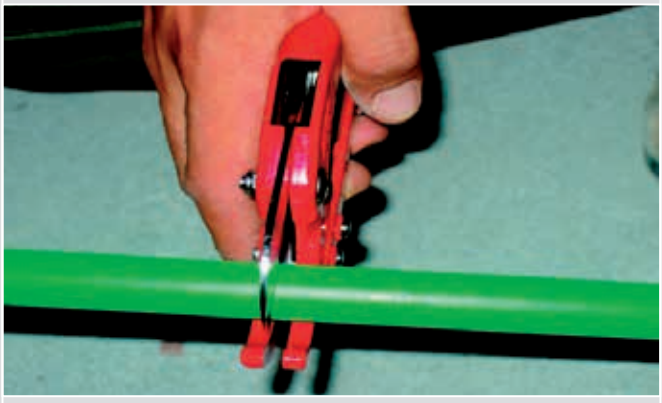
The moulds are manufactured from aluminum with a Teflon coating to prevent the melted plastic from sticking. For this reason they must be wiped periodically with a soft cloth (abrasives are not permitted) and cleaned with alcohol. Never use pliers or other unsuitable tools which can damage the coating of the welding tools.
The welding moulds should be in perfect condition without any scratch or bump. Teflon coating ensures right weldings because the existence of melted plastic is avoided in the inner and external part of the moulds after welding. This could result in the drop of temperature and in the creation of packing in the next welding process which put the welding at risk. (cold welding).

Two pairs of moulds can be placed on the heating plate permitting simultaneous welding of two different diameters. After switching on the machine two lights are on which show the operational condition(green) and the connection with the current supply (red which is constantly on). When the heating light is off (green), the plate has reached the appropriate temperature and the heating procedure is completed. This light remains off until the temperature of the plate drops at the degree that the restart of the heating cycle requires. The first welding can take place 2-3 minutes after switching off the heating light.
After the use, plug off the welding machine and let it cool. Water should not
be used for cooling the machine because the heating resistors are possible to be destroyed.
For perfect welding, the destroyed or dirty welding moulds must be restored so as to have perfect results.

14.3 WELDING

A) Pipe Cutting

Pipes must be cut to the appropriate length, perpendicularly to their axis. Ensure that the inside is free from scraps.



B) Cleaning

Before welding clean the inside of the fittings and outside of the pipe (The presence of dust can cause improper welding)

C) Marking the pipe

Mark a line on the pipe corresponding to penetration depth inside the mould. The mark should remain visible until heating and connecting the tube to the fitting. The depth depends on the outer diameter of the pipe and the relevant value should be chosen from the table below.

Pipe Dimension	Wall Thickness	Penentration Depth
(mm)	(mm)	(mm)
20	3,4	14
25	4,2	16
32	5,4	18
40	6,7	20
50	8,4	23
63	10,5	26
75	12,5	28
90	15,0	31
110	18,4	33
125	17,1	40

D) Heating

Heat pipe and heating pressing simultaneously inside the welding mould. Heating time begins when pipe and fitting are placed on the mould. When they have been heated for the required period of time, slowly remove the elements in a horizontal position.

At ambient temperatures below 5°C heating time is increased by 50%. Welding in ambient temperatures of below 0°C is not permitted.

Pipes and fittings must be heated simultaneously and only once. A second heating is not permitted. The heating and the welding process must not be interrupted.

The required times are given in the table below:

Pipe Dimension	Wall Thickness	Penentration Depth
(mm)	(mm)	(sec)
20	3,4	5
25	4,2	7
32	5,4	8
40	6,7	12
50	8,4	18
63	10,5	24
75	12,5	30
90	15,0	40
110	18,4	50
125		60

Too short residence time or fitting in the mould results in cold welding and danger of detachment. Too long residence time results in excessive melting of the material which can lead to a decrease in dimension.

E) Welding

Join pipe and fitting checking the marking. The elements can be aligned with the embossed line on the fitting and the broken line on the pipe.

During the welding process axial motion of the welded elements is not permitted. Adjustment of the axes of the elements is permitted up to +/- 3°C

During the weld check the outer seam on the pipe must not be broken. In the case of the double seam the two seams must be adjoining

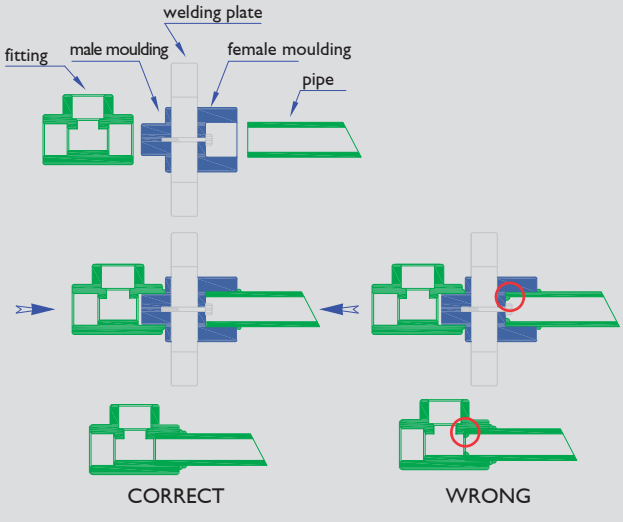
Pipe dimensions	Wall thickness	Cooling time
(mm)	(mm)	(sec)
20	3,4	4
25	4,2	4
32	5,4	6
40	6,7	6
50	8,4	6
63	10,5	8
75	12,5	10
90	15,0	10
110	18,4	10
125	17,1	15

F) Cooling

The welded elements must be left to cool undisturbed for the time specified in the following table:

Pipe dimensions	Wall thickness	Cooling time
(mm)	(mm)	(min)
20	3,4	2
25	4,2	2
32	5,4	4
40	6,7	4
50	8,4	4
63	10,5	6
75	12,5	8
90	15,0	8
110	18,4	8
125	17,1	10

PPR WELDING



In the inner part of the pipe a round stenosis is created due to: continuous pressure on the pipe when the moulding is terminated and due to the violation of the time limits of the heating.

THERMAL WELDING PROCESS OF PIPES Ø160, Ø200 & Ø250 (SDR 7.4 & SDR II)

Thermal welding process of pipes Ø160, Ø200 & Ø250 (SDR 7.4 & SDR II) is the following (DVS 2207, part II):

1. The ambient temperature should be over 5°C
2. The thermal welding machine should be in great operational condition
3. Cut the pipe at the desired length
4. Align the pipes and put them on the support bases
5. Work the ends of the pipes so as their forefronts to be parallel
6. Clean with spirit and make the surface smooth
7. Check the dimensional compatibility of the forefronts of the pipes (maximum tolerance= 0,1 x wall thickness)
8. Check the gap between the forefronts of the pipes that should be welded (maximum tolerance 0,5 mm)
9. Check the temperature of the thermal welding machines (210°C)
10. Clean the heating elements
11. After putting the heating elements, the pipes are pushed to the heating plate with the pressure required.
12. When the proper height of the ring is found (table 1) the pressure should be reduced. The end of this process is the beginning of the heating time the heating time should be followed for a sage thermal welding. (table2,3)
13. After the heating time remove the heating plate and join the forefront of the pipes
14. Keep the pipes joined under pressure for the appropriate time to complete the thermal welding. The pipes should be kept under pressure during the cooling time too.
15. Disconnect the clamps. The process of thermal welding is completed.

Table 1 Height of welded material (Ring)

DIMENSION	SDR 7,4	SDR II
Ø 160	1,5 mm	1,0 mm
Ø 200	2,0 mm	1,0 mm
Ø 250	2,0 mm	1,5 mm

Table 2 SDR 7,4 Pipes

Dimension	Settings		Heating		Welding			Cooling
mm	Pressure	Ring Height	Heating Time	Pressure During Heating	Transition Maximum Time	Pressure Time	Welding Pressure	Cooling Time
Ø 160	15,3 bar	1,5mm	361 sec	1,5 bar	10 sec	19 sec	15,3 bar	34 min
Ø 200	23,9 bar	2,0 mm	412 sec	2,4 bar	11 sec	23 sec	23,9 bar	42 min
Ø 250	37,3 bar	2,0mm	466 sec	3,7 bar	13 sec	30 sec	37,3 bar	52 min

Table3 SDR II Pipes

Dimension	Settings		Heating		Welding			Cooling
mm	Pressure	Ring Height	Heating Time	Pressure During Heating	Transition Maximum Time	Pressure Time	Welding Pressure	Cooling Time
Ø 160	10,7 bar	1,0 mm	277 sec	1,1 bar	8 sec	13 sec	10,7 bar	24 min
Ø 200	16,6 bar	1,0 mm	320 sec	1,7 bar	9 sec	16 sec	16,6 bar	29 min
Ø 250	26,0 bar	1,5 mm	368 sec	2,6 bar	10 sec	20 sec	26,6 bar	35 min

14.4 ELECTROFUSION

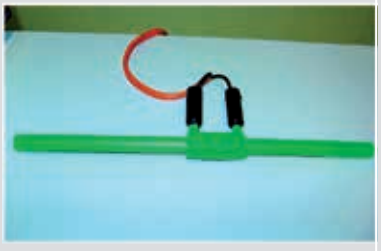
Pipe can be welded with electro fusion couplings and the aid of the electrofusion welding machine. this method of jointing is useful in the case of repairs when it is difficult to use the thermal fusion welding machine since limited space is available. During the electro fusion welding follow the guide-line below:

1. Clean the area for joining with a clean cloth. Scrape this same area with a blade around the pipe and remove any scraps. Check that the pipe is oval (permissible deviation < 1.5%).

2. Before welding remove any grease from the surface of the pipe with the solvent and a "fluff"-free cloth.

3. Insert the pipe ends into the electric coupling pushing them fully 'home". Check that the two ends of the pipe are aligned.

4. Stabilize the cables of the welding machine so that they do not come into contact with the clips. connect the clips to the terminals on the fitting and check that the corrections are correct.



5. Commence the welding process by pressing the start button the central green light will come on many times depending on dimension. Afterwards the yellow light will come on.

6. Never reduce cooling time by using water or cold air. After welding observe the minimum cooling time below.

∅	20	25	32	40	50	63	75	90	110	125	160
minutes	10	10	10	15	15	20	25	30	32	33	34

7. Approximately 2 hours hardening time is required after the fitting has cooled before any pressure tests can be performed.

8. Welding machines may be equipped with stylus readers. In this case, the data of time and temperature are automatically transferred to the machine.

14.5 REPAIR

Damage to the pipes can be repaired by welding and electro fusion as described in the relevant section. If fittings are accidentally punctured the hole can be repaired as follows:

- Determine hole size. 7mm and 11mm repair tacks are available to repair 6 and 10 mm holes respectively. Adjust the hole to these dimensions.

- Commence welding by heating the two parts for 5 seconds

- Join the two parts and hold the repaired section until it cools.

- Wait until cooling time is over before cutting off the excess.

14.6 SUPPLY SADDLES

Saddles are available for pipes with outer diameters 40 and 160 mm and outlets 20 and 75 mm. and with outlets with male and female spirals of ½", ´Y" and 1". To weld the saddle to the pipe, proceed as follows:

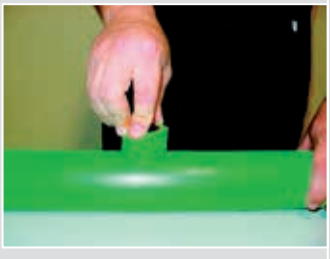
- Fit special convex moulds in the welding machine. Check that the welding machine has reached the required temperature of between 260°C and 280°C.

- Check the surface to be welded which must be cleaned and dry.

- Make a hole in the pipe wall at the point destined for the outlet using the special drill. Mount the fitting on the convex side of the mould. Insert the concave side in the hole made in the pipe so that it makes perfect contact with the outer wall of the pipe. Heating time for the elements is 30 minutes.

- When the heating phase is over remove the welding unit and place the supply saddle on the pipe. Stabilize it by applying gentle pressure without twisting for another 20 seconds.

- The system is ready for use 20 minutes after the last welding.



15.1.WATER SUPPLY

15.1.1 Water distribution networks calculation

For drinking water and service water network calculation follow the steps below:

- Divide the network into segments.

- Calculate the flow rate (qn) for each section to give the total requirements of the building (Σ qn)

- Calculate the required supply of the building (q) taking into account the simultaneous operation of the discharge points.

- Choose a pipe of suitable diameter for each segment

- Calculate the linear pressure drop of the network

- Calculate the local pressure drop at the fittings.

15.1.2 Calculation of flow rate

Calculation of flow rate for each section in which the network is separated is defined by the number of the outlet points.

For each point the required supply (qn) is specific and defined and is given in table 15.1. When we sum all these supplies (Σ qn), we calculate the supply based on the table 15.2 Based on table 4 at the end of this manual we can calculate the network supply which refers to the supply for every kind of building.

15.1 | TABLE FOR THE CHOICE OF PIPE DIAMETERS AND WATER FLOW

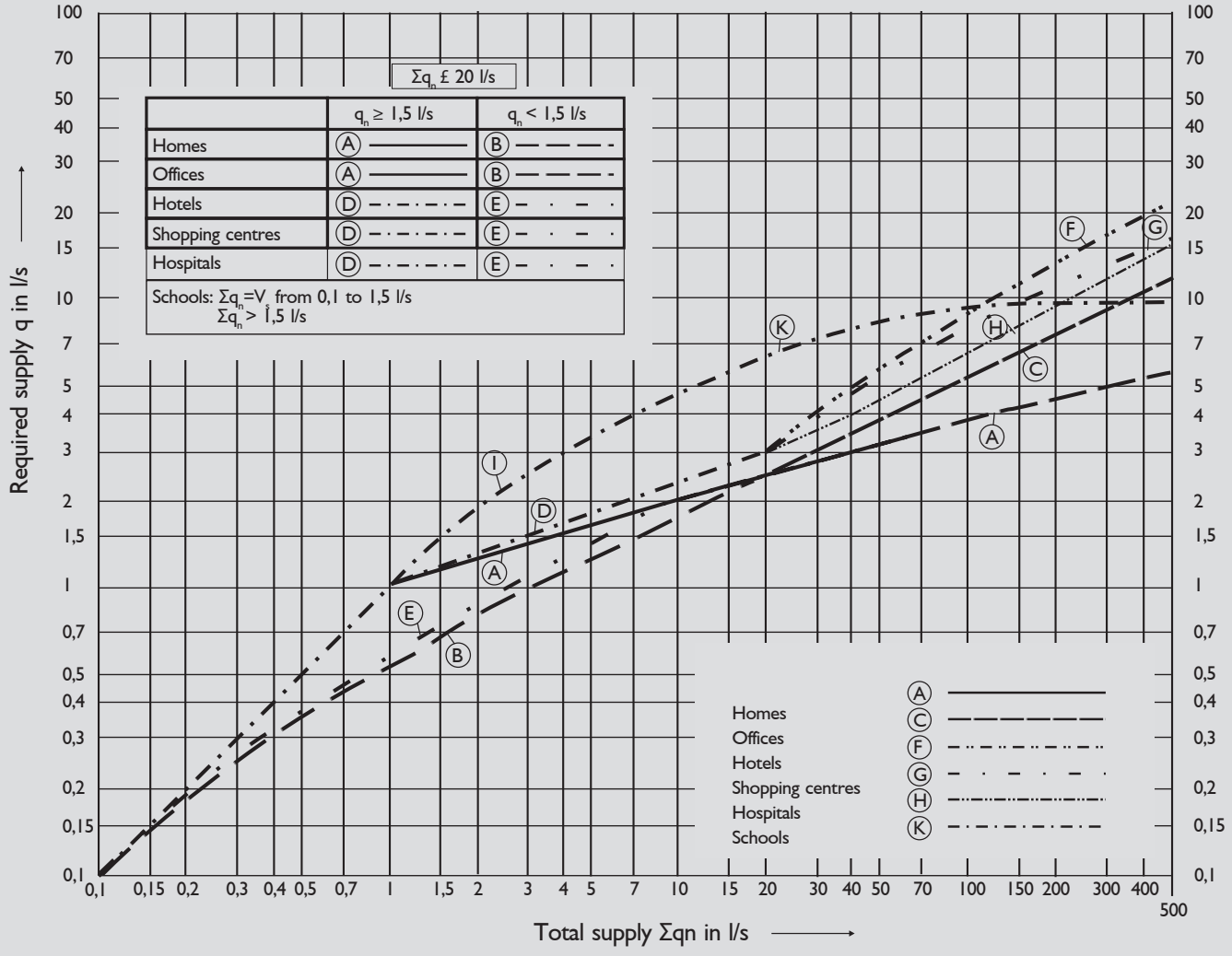
Water Connection Point	Flow (l/sec)	Pressure (bar)	Pipe Diameter (mm)
Wash - Basin			
Tap DN 15	0,07	0,50	20
Mixer Tap DN 15	0,07	1,00	20
Bidet			
Tap DN 15	0,07	0,50	20
Mixer Tap DN 15	0,07	1,00	20
Bath tub			
Mixer tap DN 15	0,15	1,00	20
DN 20	0,40	1,00	25
DN 25	1,00	1,00	32
Shower			
Spinkler DN 15	0,15	1,00	20
Small side Spinkler DN 15	0,06	1,00	20
Spinkler DN 20	0,18	1,00	20
Spinkler DN 25	0,31	1,00	20
Flush and flusing tank			
Flush DN 20	1,00	1,20	32
Flush tank DN 15	0,13	0,50	20
Electric and gas Boilers			
6kW	0,07	1,00	20
12kW	0,10	1,00	20
18kW	0,15	1,00	20
21kW	0,17	1,00	20
24kW	0,20	1,00	20
33kW	0,30	1,00	20
Sinks			
Mixer DN 15	0,07	1,00	20
DN 20	0,02	1,00	20
Dishwashers	0,15	1,00	20
Washing machines	0,25	1,00	20
Urinals			
Flush DN 15	0,30	1,20	20
Flusing Tank DN 15	0,13	0,50	20

15.2 | TABLE OF FORMULA FOR DETERMINATION OF REQUIRED SUPPLY IN CENTRAL WATER DISTRIBUTION NETWORKS

Type of building	Formula	Remarks
Residential buildings	$q= 0,682\ (\Sigma q_n)^{0,45} - 0,14$	for $0,07 \le \Sigma q_n \le 20$ l/s and for fittings with $q_n < 0,5$ l/s
	$q= 1,7\ (\Sigma q_n)^{0,21} - 0,7$	for $\Sigma q_n > 20$ l/s and for fittings with $q_n \ge 0,5$ l/s
Office and administration buildings	$q= 0,682\ (\Sigma q_n)^{0,45} - 0,14$	for $\Sigma q_n \le 20$ l/s
	$q= 0,4\ (\Sigma q_n)^{0,54} + 0,48$	for $\Sigma q_n > 20$ l/s
Hotels and department stores	$q= 0,4\ (\Sigma q_n)^{0,366}$	For draw-off points with $q_n > 0,5$ l/s and within the range $1 < \Sigma q_n \le 20$ l/s
	$q= 0,698\ (\Sigma q_n)^{0,5} - 0,12$	For draw-off points with $q_n < 0,5$ l/s and within the range of $0,1 < \Sigma q_n$ £ 20 l/s
	$q= 1,08\ (\Sigma q_n)^{0,5} - 1,82$	for $\Sigma q_n > 20$ l/s (for hotels)
	$q= 0,698\ (\Sigma q_n)^{0,5} - 0,12$	για $\Sigma q_n > 20$ l/s (for department stores)
Hospitals	$q= 0,698\ (\Sigma q_n)^{0,5} - 0,12$	for $\Sigma q_n \le 20$ l/s
	$q= 0,25\ (\Sigma q_n)^{0,65} + 1,25$	for $\Sigma q_n > 20$ l/s
Schools	$q= 4,4\ (\Sigma q_n)^{0,27} - 3,41$	for $1,5 < \Sigma q_n < 20$ l/s γfor $\Sigma q_n \le 1,5$ l/s $q=\Sigma q_n$
	$q= -22,5\ (\Sigma q_n)^{-0,5} + 11,5$	for $\Sigma q_n > 20$ l/s

q_n = flow rate at discharge points, l/sec
Σq_n = sum of the flows of all discharge points, l/sec
q = required supply, l/sec

* For central networks of buildings other than those mentioned above the formula for calculating required supply must be chosen on the basis of the use of the particular network in question.



15.1.3 FLOW VELOCITY

In a piping network operating under pressure maximum flow velocities according to network use are generally considered to be as follows:

WATER DISTRIBUTION NETWORK
- At connection points from the riser to the discharge points.....2.0m/sec
- In risers.....2.0 m/sec
- In distribution pipes.....1.5m/sec
- At water connection points.....1,5m/sec

15.1.4 PIPING CALCULATION

On the basis of the supply already calculated but taking into account also the maximum flow velocities refer to table 5 in the appendix at the end of the book to choose the appropriate dimensions of pipes to use in each network segment and see also the pressure drop per meter of pipe run.

15.1.5 LINEAR PRESSURE DROP

Linear pressure loss for each network segment is calculated using the Darcy - Weisbach formula:

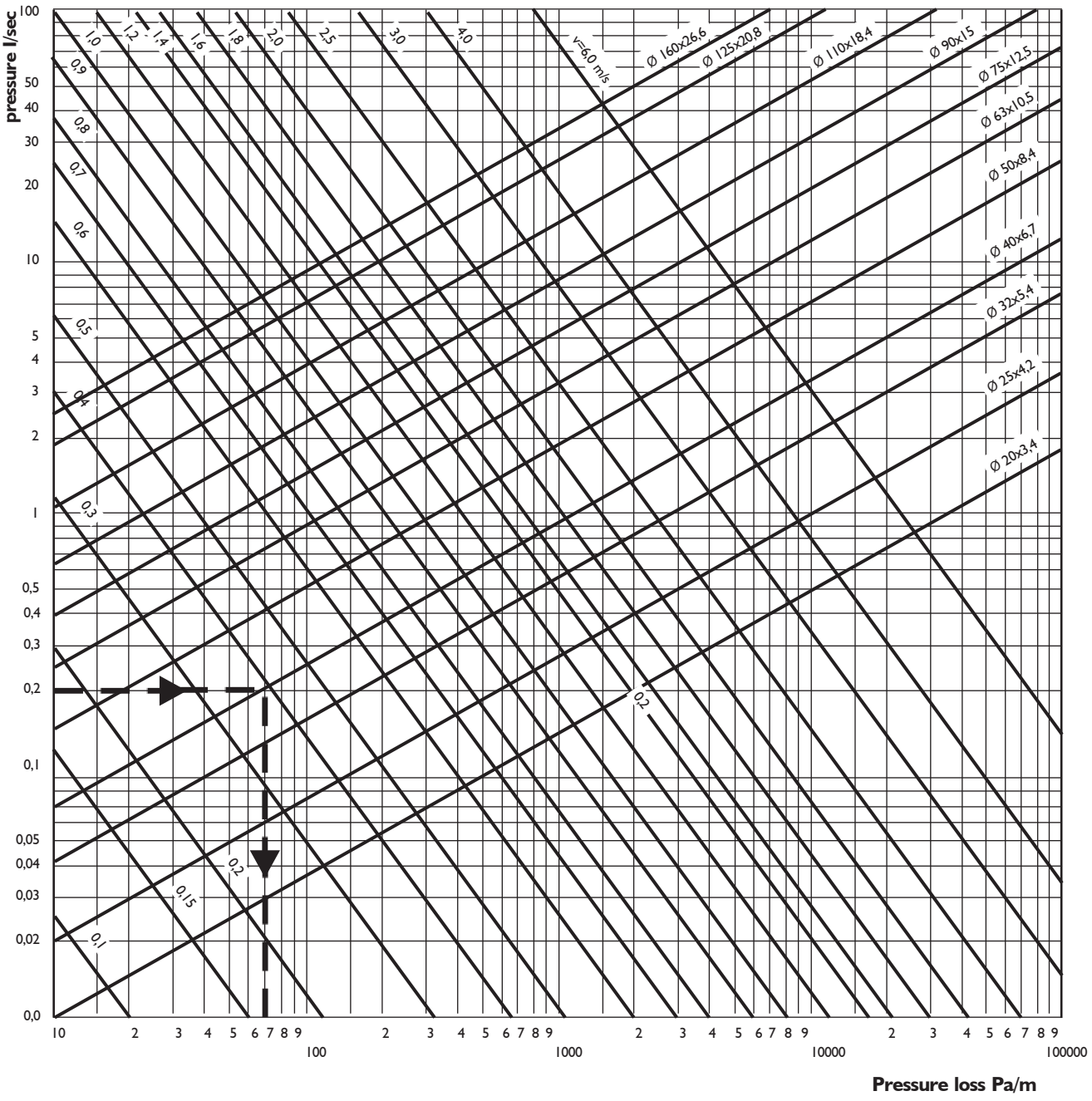
$$\Delta h_l = R*L = \lambda*L/D_w\, v^2/2g$$

where:
Δhl : linear pressure drop (m H_2O)
R = unitary press drop (hPa/m)
L = length of network segment (m)
λ = coefficient of linear resistance
Dw = pipe inner diameter
v = average flow velocity in network segment (m/sec)
g = gravitational acceleration (m/sec²)

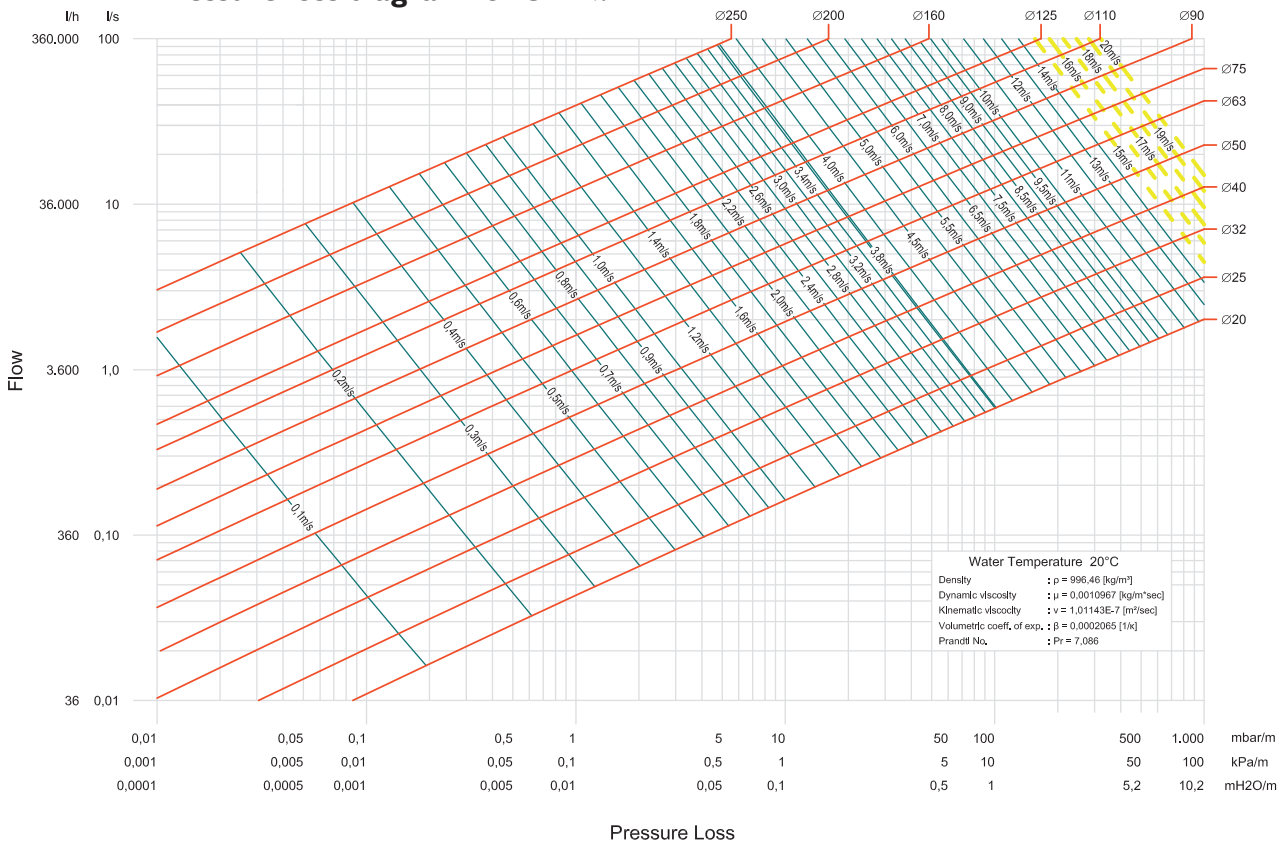
The coefficient λ is calculated using formula Colebrook White considering that the roughness coefficient k of the PP-R pipes is 0,007mm.

To simplify the the process of calculation of the linear pressure drop the values of pressure drop R are given on the diagram for several values of supplies of the pipe dimension and the typical temperatures.

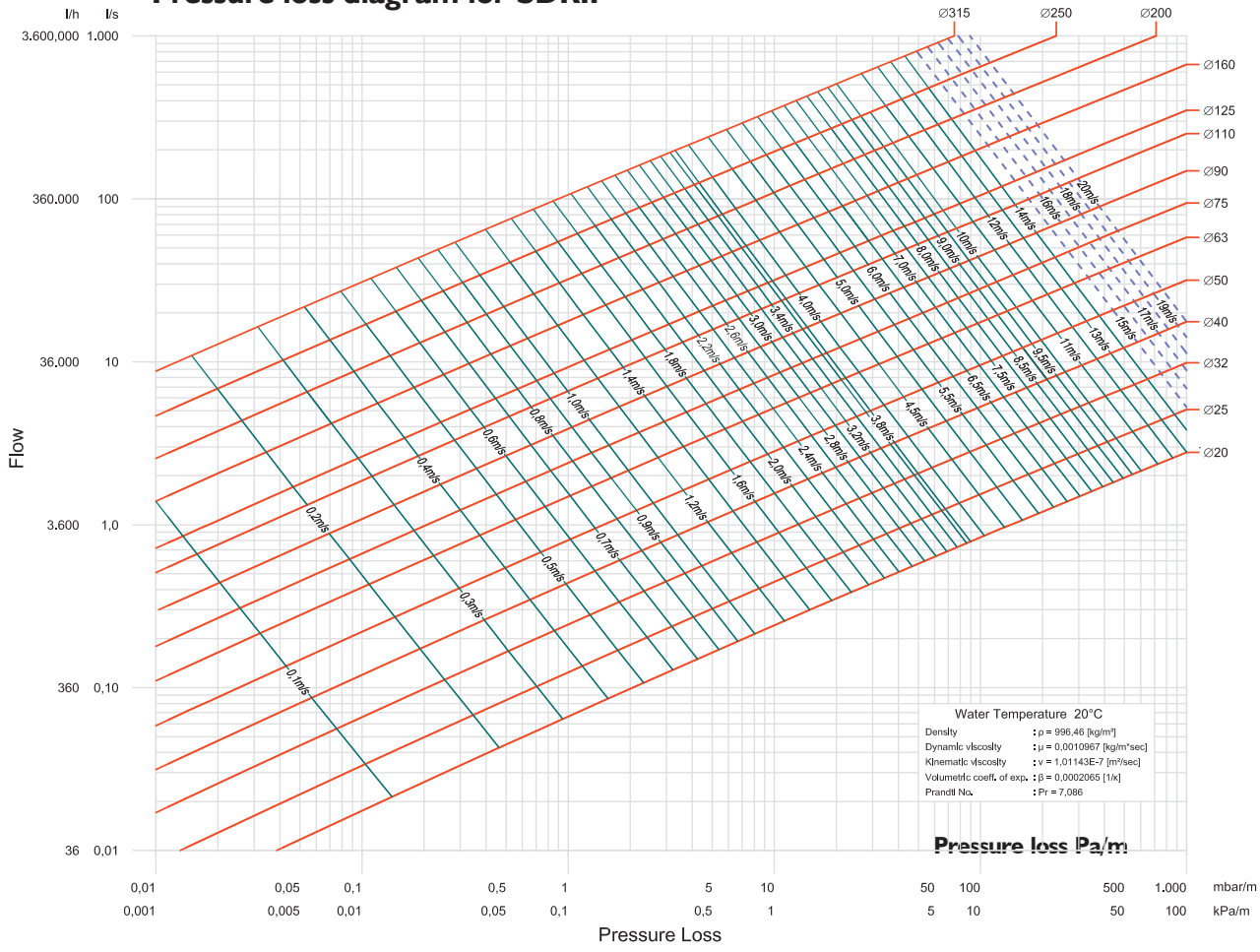
Pressure loss diagram for SDR6



Pressure loss diagram for SDR7.4



Pressure loss diagram for SDRII



15.1.6 Local pressure drop at the fittings

The local pressure drop at the fittings in the network is calculated using the following formula (Weisbach):

$$\Delta h_m = \zeta * v^2/2*g \quad (2)$$

Where
Δh_m = local pressure drop
ζ= local resistance co efficient
v= average flow velocity in the network segment (m/sec)
g = gravitational acceleration (m/sec^2)

15.1.7 Sum of pressure losses

The sum of the local pressure drops in the network plus the linear pressure drop gives the total pressure drop of the network.

$$\Delta h = \Delta h_l + \Sigma \Delta h_m$$

EXAMPLE OF NETWORK CIRCULATION

Supposing we want to consider the cold service water network of different homes we divide the network into segments (one per level) and calculate with the help of the table 15.1 the flow rate of each segment according to its discharge points thus:

GROUND FLOOR	Sink	q_n = 0,07 l/sec
	Dishwasher	q_n = 0,15 l/sec
	WC Wash basin	q_n = 0,07 l/sec
	WC Cistern	q_n = 0,13 l/sec
UPPER LEVEL	Bathroom wash basin	q_n = 0,07 l/sec
	Washing machine	q_n = 0,25 l/sec
	Bathtub	q_n = 0,15 l/sec
	Bathroom cistern	q_n = 0,13 l/sec

The total requirements of the building resulting from the sum of the above will be:

$$\Sigma q_n = 1,02 \text{ l/sec}$$

Considering the simultaneous operation of the above equipment, and with help of table 4 in the appendices, it results that the total demand from the network is equal to

$$q = 0,55 \text{ l/sec.}$$

To cover these requirements (in the central risers) for cold service water (20°C) it results that 0.6 l/sec can be supplied by PP-R pipe Φ25 x 4.2 with velocity v= 2.8m/sec and R= 0.525m H_2O. (Alternatively, PP-R Φ 32 x 5,4 pipe with velocity v=1.7m/sec and R= 0.16m H_2O could be used)

The linear pressure drop is then calculated which according to the formula (I) will be:

$$\Delta h_l = R*L = 4*0,525 = 2,1 \text{ m } H_2O$$

To calculate local pressure drop at each discharge point use the following formula in conjunction with table 6.1 on pages 8 and 9 which gives the values of the local resistance coefficient ζ for the network fittings.

$$\Delta h_m = \zeta * v^2/2*g = 1,2 * (2,8^2/2*9,81) = 0,479 \text{ m } H_2O$$

The above local pressure multiplied by the number of discharge points gives the total local pressure drop.
Finally, calculate the local pressure drop for the network by summing the linear pressure drop and the total of the local pressure drops:

$$\Delta h = \Delta h_l + \Sigma \Delta h_m = 2,1 + 8*0,479 = 5,932 \text{ m } H_2O = 0,58 \text{ bar}$$

15.2 HEATING

15.2.1 1Central heating network calculations

After calculating the thermal requirements for each area and determining the temperature of the supply and return water, consult the table 15.3 (pages 39-49) below to choose to choose a pipe of suitable diameter for each segment.

When designing the system it should be noted that due to the flow resistance velocities in the central heating networks will vary between 0.2 and 1.0 m/sec.

In some circumstances greater values for velocity provided that the network is protected against generation of noise or vibrations.

15.3| TABLE FOR HEAT TRANSFER CAPACITIES FOR SDR 6 & AQUA-PLUS ALUMINIUM

Pipe diameter **20 mm**
Wall thickness **3,4 mm**

m/s	l/s	kg/h	kcal/h* 20K	kcal/h* 15K
0,50	0,07	246	4.927	3.695
0,60	0,08	296	5.912	4.434
0,70	0,10	345	6.897	5.173
0,80	0,11	384	7.882	5.912
0,90	0,12	443	8.868	6.651
1,00	0,14	493	9.853	7.,390
1,10	0,15	542	10.938	8.129
1,20	0,16	591	11.824	8.868
1,30	0,18	640	12.809	9.,607
1,40	0,19	690	13.794	10.346
1,50	0,21	739	14.780	11.085
1,60	0,22	788	15.765	11.824

Pipe diameter **25 mm**
Wall thickness **4,2 mm**

m/s	l/s	kg/h	kcal/h* 20K	kcal/h* 15K
0,50	0,11	390	7.792	5.843
0,60	0,13	467	9.350	7.012
0,70	0,15	545	10.908	8.181
0,80	0,17	623	12.466	9.350
0,90	0,19	701	14.024	10.518
1,00	0,22	779	15.583	11.687
1,10	0,24	857	17.141	12.856
1,20	0,26	935	18.699	14.024
1,30	0,28	1013	20.257	16.193
1,40	0,30	1081	21.816	16.382
1,50	0,32	1169	23.374	17.530
1,60	0,35	1247	24.932	18.699

Pipe diameter	32 mm			
Wall thickness	5,4 mm			
m/s	l/s	kg/h	kcal/h* 20K	kcal/h* 15K
0,50	0,18	635	12.708	9.531
0,60	0,21	762	15.249	11.437
0,70	0,25	890	17.781	13.343
0,80	0,28	1.017	20.332	15.249
0,90	0,32	1.144	22.874	17.155
1,00	0,35	1.271	25.415	19.061
1,10	0,39	1.398	27.957	20.968
1,20	0,42	1.526	30.498	22.874
1,30	0,46	1.662	33.040	24.780
1,40	0,49	1.779	35.581	26.686
1,50	0,53	1.905	38.123	28.592
1,60	0,56	2.033	40.664	30.498

Pipe diameter	40 mm			
Wall thickness	6,7 mm			
m/s	l/s	kg/h	kcal/h* 20K	kcal/h* 15K
0,50	0,28	1.000	20.006	15.004
0,60	0,33	1.200	24.007	18.005
0,70	0,39	1.400	28.008	21.005
0,80	0,44	1.600	32.009	24.007
0,90	0,5	1.801	38.010	27.008
1,00	0,58	2.001	40.012	30.009
1,10	0,61	2.201	44.013	33.010
1,20	0,67	2.401	48.014	36.010
1,30	0,72	2.601	52.015	39.011
1,40	0,78	2.801	56.016	42.012
1,50	0,83	3.001	60.017	45.013
1,60	0,89	3.201	64.019	48.014

Pipe diameter 50 mm Wall thickness 8,3 mm				
m/s	l/s	kg/h	kcal/h* 20K	kcal/h* 15K
0,50	0,44	1.577	31.542	23.658
0,60	0,53	1.893	37.850	28.386
0,70	0,61	2.208	44.158	33.119
0,80	0,7	2.623	50.467	37.850
0,90	0,79	2.839	56.775	42.581
1,00	0,88	3.154	63.083	47.313
1,10	0,96	3.470	68.382	52.044
1,20	1,05	3.785	75.700	56.775
1,30	1,14	4.100	82.008	61.506
1,40	1,23	4.416	88.317	66.238
1,50	1,31	4.731	94.625	70.969
1,60	1,4	5.047	100.933	75.700

Pipe diameter 63 mm Wall thickness 10,5 mm				
m/s	l/s	kg/h	kcal/h* 20K	kcal/h* 15K
0,50	0,69	2.494	49.876	37.407
0,60	0,83	2.993	58.851	44.868
0,70	0,97	3.491	69.826	52.370
0,80	1,11	3.990	79.801	58.851
0,90	1,25	4.489	89.777	67.332
1,00	1,39	4.988	98.762	74.814
1,10	1,62	5.486	109.727	82.295
1,20	1,66	5.985	119.702	89.777
1,30	1,8	6.484	129.677	97.256
1,40	1,94	6.983	139.653	104.739
1,50	2,08	7.481	149.628	112.221
1,60	2,22	7.980	159.603	119.702

Pipe diameter	75 mm	Wall thickness	12,5 mm	
m/s	l/s	kg/h	kcal/h* 20K	kcal/h* 15K
0,50	0,98	3.534	70.686	53.014
0,60	1,18	4.241	84.823	63.617
0,70	1,37	4.948	98.950	74.220
0,80	1,57	5.855	113.097	84.823
0,90	1,77	6.362	127.235	95.428
1,00	1,96	7.069	141.372	108.029
1,10	2,16	7.775	155.509	116.632
1,20	2,36	8.482	169.646	127.235
1,30	2,55	9.189	183.783	137.837
1,40	2,75	9.896	197.920	148.440
1,50	2,95	10.603	212.058	159.043
1,60	3,14	11.310	226.195	169.646

Pipe diameter	90 mm	Wall thickness	15 mm	
m/s	l/s	kg/h	kcal/h* 20K	kcal/h* 15K
0,50	1,41	5.089	101.788	76.341
0,60	1,7	6.107	122.145	91.609
0,70	1,98	7.125	142.503	108.877
0,80	2,26	8.143	162.860	122.145
0,90	2,54	9.161	183.218	137.413
1,00	2,83	10.179	203.575	152.661
1,10	3,11	11.187	223.933	167.950
1,20	3,39	12.215	244.290	183.218
1,30	3,68	13.232	264.648	198.488
1,40	3,96	14.260	285.005	213.754
1,50	4,24	15.268	305.363	229.022
1,60	4,52	16.286	325.720	244.290

Pipe diameter	110 mm	Wall thickness	18,4 mm	
m/s	l/s	kg/h	kcal/h* 20K	kcal/h* 15K
0,50	2,12	7.616	152.330	114.247
0,60	2,54	9.140	182.796	137.097
0,70	2,96	10.663	213.262	159.946
0,80	3,39	12.186	243.727	182.796
0,90	3,81	13.710	274.193	205.645
1,00	4,23	15.233	304.659	228.495
1,10	4,85	16.756	335.125	251.344
1,20	5,08	18.280	365.591	274.193
1,30	5,5	19.803	396.057	297.043
1,40	5,92	21.326	426.523	319.892
1,50	6,35	22.849	458.989	342.742
1,60	6,77	24.373	487.455	365.591

Pipe diameter 125 mm		Wall thickness 17,1 mm		
m/s	l/s	kg/h	kcal/h* 20K	kcal/h* 15K
0,50	3,23	11.370	227.401	170.551
0,60	3,88	13.644	272.882	204.661
0,70	4,53	15.918	318.362	238.771
0,80	5,17	18.192	363.842	272.882
0,90	5,82	20.466	409.323	306.992
1,00	6,47	22.740	454.803	341.102
1,10	7,11	25.014	500.283	375.212
1,20	7,76	27.288	545.764	409.323
1,30	8,41	29.562	591.244	443.433
1,40	9,06	31.836	636.724	477.543
1,50	9,70	34.110	682.205	511.653
1,60	10,3	36.384	727.685	545.764

Pipe diameter 160 mm		Wall thickness 21,9 mm		
m/s	l/s	kg/h	kcal/h* 20K	kcal/h* 15K
0,50	5,29	18.621	372.421	279.315
0,60	6,35	22.345	446.905	335.179
0,70	7,41	26.069	521.389	391.042
0,80	8,47	29.793	595.873	446.905
0,90	9,53	33.517	670.357	502.768
1,00	10,59	37.242	744.842	558.631
1,10	11,65	40.966	819.326	614.494
1,20	12,71	44.690	893.810	670.357
1,30	13,77	48.414	968.294	726.221
1,40	14,83	52.138	1.042.779	782.084
1,50	15,89	55.863	1.117.263	837.947
1,60	16,95	59.587	1.191.747	893.810

15.3 | TABLE FOR HEAT TRANSFER CAPACITIES FOR SDR 7,4

Pipe diameter	**20 mm**			
Wall thickness	**2,8 mm**			
m/s	l/s	kg/h	kcal/h* 20K	kcal/h* 15K
0,50	0,08	285	5.719	4.289
0,60	0,10	343	6.863	5.147
0,70	0,11	400	8.007	6.005
0,80	0,13	457	9.150	6.863
0,90	0,15	514	10.294	7.721
1,00	0,16	571	11.438	8.579
1,10	0,18	629	12.582	9.436
1,20	0,20	686	13.726	10.294
1,30	0,21	743	14.870	11.152
1,40	0,23	800	16.014	12.010
1,50	0,24	857	17.158	12.868
1,60	0,26	915	18.301	13.726

Pipe diameter	**25 mm**			
Wall thickness	**3,5 mm**			
m/s	l/s	kg/h	kcal/h* 20K	kcal/h* 15K
0,50	0,13	446	8.936	6.702
0,60	0,15	536	10.723	8.042
0,70	0,18	625	12.511	9.383
0,80	0,20	714	14.298	10.723
0,90	0,23	804	16.085	12.064
1,00	0,25	893	17.872	13.404
1,10	0,28	983	19.660	14.745
1,20	0,31	1.072	21.447	16.085
1,30	0,33	1.161	23.234	17.426
1,40	0,36	1.251	25.022	18.766
1,50	0,38	1.340	26.809	20.107
1,60	0,41	1.429	28.596	21.447

Pipe diameter 32 mm Wall thickness 4,4 mm				
m/s	l/s	kg/h	kcal/h* 20K	kcal/h* 15K
0,50	0,21	742	14.845	11.134
0,60	0,25	890	17.814	13.361
0,70	0,30	1.039	20.783	15.587
0,80	0,34	1.187	23.752	17.814
0,90	0,38	1.336	26.722	20.041
1,00	0,42	1.484	29.691	22.268
1,10	0,46	1.633	32.660	24.495
1,20	0,51	1.781	35.629	26.722
1,30	0,55	1.929	38.598	28.948
1,40	0,59	2.078	41.567	31.175
1,50	0,63	2.226	44.536	33.402
1,60	0,68	2.375	47.505	35.629

Pipe diameter 40 mm Wall thickness 5,5 mm				
m/s	l/s	kg/h	kcal/h* 20K	kcal/h* 15K
0,50	0,33	1.159	23.196	17.397
0,60	0,40	1.391	27.835	20.876
0,70	0,46	1.623	32.474	24.356
0,80	0,53	1.855	37.114	27.835
0,90	0,59	2.087	41.753	31.314
1,00	0,66	2.319	46.392	34.794
1,10	0,73	2.551	51.031	38.273
1,20	0,79	2.783	55.671	41.753
1,30	0,86	3.015	60.310	45.232
1,40	0,92	3.247	64.949	48.712
1,50	0,99	3.479	69.588	52.191
1,60	1,06	3.711	74.228	55.671

Pipe diameter	50 mm			
Wall thickness	6,9 mm			
m/s	l/s	kg/h	kcal/h* 20K	kcal/h* 15K
0,50	0,51	1.807	36.144	27.108
0,60	0,62	2.168	43.373	32.529
0,70	0,72	2.530	50.601	37.951
0,80	0,82	2.891	57.830	43.373
0,90	0,93	3.252	65.059	48.794
1,00	1,03	3.614	72.288	54.216
1,10	1,13	3.975	79.517	59.637
1,20	1,23	4.337	86.746	65.059
1,30	1,34	4.698	93.974	70.481
1,40	1,44	5.060	101.203	75.902
1,50	1,54	5.421	108.432	81.324
1,60	1,65	5.783	115.661	86.746

Pipe diameter	63 mm			
Wall thickness	8,6 mm			
m/s	l/s	kg/h	kcal/h* 20K	kcal/h* 15K
0,50	0,82	2.892	57.856	43.392
0,60	0,99	3.471	69.427	52.070
0,70	1,15	4.049	80.999	60.749
0,80	1,32	4.628	92.570	69.427
0,90	1,48	5.207	104.141	78.106
1,00	1,65	5.785	115.713	86.784
1,10	1,81	6.364	127.284	95.463
1,20	1,98	6.942	138.855	104.141
1,30	2,14	7.521	150.427	112.820
1,40	2,30	8.099	161.998	121.498
1,50	2,47	8.678	173.569	130.177
1,60	2,63	9.257	185.141	138.855

Pipe diameter	75 mm			
Wall thickness	10,3 mm			
m/s	l/s	kg/h	kcal/h* 20K	kcal/h* 15K
0,50	1,16	4.081	81.624	61.218
0,60	1,39	4.897	97.949	73.461
0,70	1,63	5.713	114.274	85.705
0,80	1,86	6.529	130.599	97.949
0,90	2,09	7.346	146.923	110.192
1,00	2,32	8.162	163.248	122.436
1,10	2,55	8.978	179.573	134.680
1,20	2,79	9.794	195.898	146.923
1,30	3,02	10.611	212.223	159.167
1,40	3,25	11.427	228.548	171.411
1,50	3,48	12.243	244.873	183.654
1,60	3,72	13.059	261.197	195.898

Pipe diameter	90 mm			
Wall thickness	12,3 mm			
m/s	l/s	kg/h	kcal/h* 20K	kcal/h* 15K
0,50	1,68	5.898	117.971	88.478
0,60	2,01	7.078	141.565	106.174
0,70	2,35	8.258	165.160	123.870
0,80	2,69	9.437	188.754	141.565
0,90	3,02	10.617	212.348	159.261
1,00	3,35	11.797	235.943	176.957
1,10	3,69	12.976	259.537	194.653
1,20	4,03	14.156	283.131	212.348
1,30	4,36	15.336	306.726	230.044
1,40	4,70	16.516	330.320	247.740
1,50	5,03	17.695	353.914	265.436
1,60	5,37	18.875	377.509	283.131

Pipe diameter	110 mm			
Wall thickness	15,1 mm			
m/s	l/s	kg/h	kcal/h* 20K	kcal/h* 15K
0,50	2,50	8.782	175.641	131.731
0,60	3,00	10.538	210.770	158.077
0,70	3,50	12.294	245.898	184.423
0,80	4,00	14.051	281.026	210.770
0,90	4,50	15.807	316.155	237.116
1,00	5,00	17.564	351.283	263.462
1,10	5,50	19.320	386.411	289.808
1,20	6,00	21.077	421.540	316.155
1,30	6,50	22.833	456.668	342.501
1,40	7,00	24.589	491.796	368.847
1,50	7,50	26.346	526.925	395.193
1,60	8,00	28.102	562.053	421.540

Pipe diameter	125 mm			
Wall thickness	17,1 mm			
m/s	l/s	kg/h	kcal/h* 20K	kcal/h* 15K
0,50	3,24	11.370	227.401	170.551
0,60	3,88	13.644	272.882	204.661
0,70	4,53	15.918	318.362	238.771
0,80	5,18	18.192	363.842	272.882
0,90	5,82	20.466	409.323	306.992
1,00	6,47	22.740	454.803	341.102
1,10	7,12	25.014	500.283	375.212
1,20	7,77	27.288	545.764	409.323
1,30	8,41	29.562	591.244	443.433
1,40	9,06	31.836	636.724	477.543
1,50	9,70	34.110	682.205	511.653
1,60	10,35	36.384	727.685	545.764

Pipe diameter **160 mm** **Wall thickness** **21,9 mm**				
m/s	l/s	kg/h	kcal/h* 20K	kcal/h* 15K
0,50	5,30	18.621	372.421	279.315
0,60	6,36	22.345	446.905	335.179
0,70	7,42	26.069	521.389	391.042
0,80	8,48	29.793	595.873	446.905
0,90	9,54	33.517	670.357	502.768
1,00	10,60	37.242	744.842	558.631
1,10	11,66	40.966	819.326	614.494
1,20	12,72	44.690	893.810	670.357
1,30	13,78	48.414	968.294	726.221
1,40	14,84	52.138	1.042.779	782.084
1,50	15,90	55.863	1.117.263	837.947
1,60	16,96	59.587	1.191.747	893.810

THERMAL ELONGATION

Every material subjected to a change in temperature reacts by changing its size.
This phenomenon is called thermal expansion. A body will expand when the temperature rises or contract when it falls. Thermal expansion can be linear, superficial or cubic depending on whether one, two or three dimensions are affected.

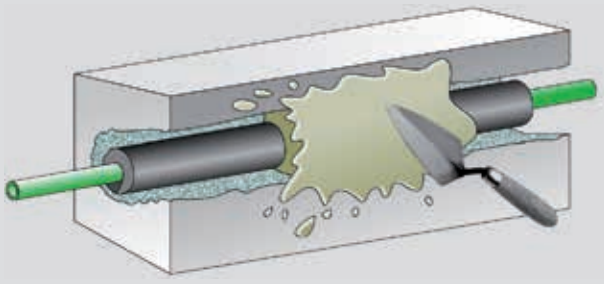
In the case of pipes, expansion is mainly linear since their lengths exceeds the other dimensions.

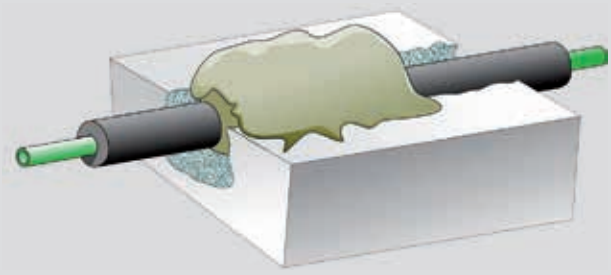
The parameter that determines the potential expansion or contraction of the pipe upon a change in temperature is the coefficient of linear expansion.

Thus, when designing the installation is fundamental to know the value of this coefficient in order to calculate the amount of expansion or contraction and adopt the necessary measures so as to avoid damage to the pipes.

Distinction should be made between the two types of installation:
- Underfloor and in-wall installation
- External installation (visible)

In the first case the plaster or cement covering of the pipes must be at least 3cm thick so as to prevent any thermal elongation of the pipes.





In the second case it is very important to calculate the expansion of the pipe which is caused by the potential difference between the initial temperature and operating temperature.

The coefficient of linear expansion a gives the elongation of one pipe one meter in length for a **1°C rise** in temperature.

The maximum value of this coefficient for Aqua plus pipe is 0.07mm/m°C, for the pipes Aqua plus fiber glass **0.030 mm/m°C** and for aluminum pipes **0.025mm/m°C**

The formula relating the above parameters is:

$$\Delta L = a \times L \times \Delta T$$

Where
ΔL: variation in length
A: coefficient of linear expansion of Aqua plus pipes
L: initial length of pipe
ΔT: temperature difference

Thus, for a 20 meter network where the initial temperature is 20°C and operating temperature 60°C (a temperature difference of 40°C) the linear expansion is:

SDR 6

ΔL = 0,07 mm/m°C x 20,0 m x 40°C = 56 mm

SDR 7,4 & SDR11 - FIBERGLASS

ΔL = 0,030 mm/m°C x 20,0 m x 40°C = 24 mm

SDR 6 ALUMINIUM

ΔL = 0,025 mm/m°C x 20,0 m x 40°C = 20 mm

The linear thermal elongation coefficient for Aqua plus pipes is 0,070mm/m/°C, for the Aqua aluminum is 0,025mm/m/°C and for Aqua fiberglass is 0,030mm/m/°C. For the calculation of the increase of the length the following tables are used:

TABLE OF THERMAL ELONGATION SDR-6 (a=0,07 mm/m/°C)								
L	ΔTI0	ΔT20	ΔT30	ΔT40	ΔT50	ΔT60	ΔT70	ΔT80
5m	4	8	12	15	19	23	27	30
10m	8	15	23	30	38	45	53	60
15m	12	23	34	45	57	68	79	90
20m	15	30	45	60	75	90	105	120
25m	19	38	57	75	94	113	132	150
30m	23	45	68	90	113	135	158	180
35m	27	53	79	105	132	158	184	210
40m	30	60	90	120	150	180	210	240
45m	34	68	102	135	169	203	237	270
50m	38	75	113	150	188	225	263	300

TABLE OF THERMAL ELONGATION AQUA-PLUS-ALUMINIUM SDR 6 (a=0,025 mm/m/°C)								
L	ΔTI0	ΔT20	ΔT30	ΔT40	ΔT50	ΔT60	ΔT70	ΔT80
10m	3	6	9	12	15	18	21	24
20m	6	12	18	24	30	36	42	48
30m	9	18	27	36	45	54	63	72
40m	12	24	36	48	60	72	84	96
50m	15	30	45	60	75	90	105	120
60m	18	36	54	72	90	108	126	144
70m	21	42	63	84	105	126	147	168
80m	24	48	72	96	120	144	168	192
90m	27	54	81	108	135	162	189	216
100m	30	60	90	120	150	180	210	240

TABLE OF THERMAL ELONGATION AQUA-PLUS-FIBERGLASS SDR 7,4 & SDRII (a=0,030 mm/m/°C)								
L	ΔTI0	ΔT20	ΔT30	ΔT40	ΔT50	ΔT60	ΔT70	ΔT80
10m	4	7	11	14	18	21	25	28
20m	7	14	21	28	35	42	49	56
30m	11	21	32	42	53	63	74	84
40m	14	28	42	56	70	84	98	112
50m	18	35	53	70	88	105	123	140
60m	21	42	63	84	105	126	147	168
70m	25	49	74	98	123	147	172	196
80m	28	56	84	112	140	168	196	224
90m	32	63	95	126	158	189	221	252
100m	35	70	105	140	175	210	245	280

TI (°C): Starting temperature
ΔT: Temperature difference of starting and operation of the installation

DISTANCE BETWEEN SUPPORTS FOR HORIZONTAL PIPE NETWORKS AQUA PLUS SDR 6

Temperature difference ΔT (°C)	Pipe outer diameter D (mm)										
	20	25	32	40	50	63	75	90	110	125	160
	Support distance (cm)										
20	70	85	100	110	130	150	160	170	190	215	245
30	70	85	100	110	130	150	160	170	190	205	225
40	70	80	90	100	120	140	150	160	180	195	215
50	70	80	90	100	120	140	150	160	180	185	195
60	65	75	85	95	110	125	135	150	170	175	185
70	60	70	85	90	105	115	125	135	150	155	165

DISTANCE BETWEEN SUPPORTS FOR HORIZONTAL PIPE NETWORKS AQUA-PLUS-ALUMINIUM SDR 6

Temperature difference ΔT (°C)	Pipe outer diameter D (mm)								
	20	25	32	40	50	63	75	90	110
	Support distance (cm)								
20	120	130	150	170	190	210	220	230	250
30	120	130	150	170	190	210	220	230	240
40	110	120	140	160	180	200	210	220	230
50	110	120	140	160	180	200	210	220	230
60	100	110	130	150	170	190	200	210	220
70	90	100	120	140	160	180	190	200	210

DISTANCE BETWEEN SUPPORTS FOR HORIZONTAL PIPE NETWORKS AQUA-PLUS-FIBERGLASS SDR 7,4 & SDR 11

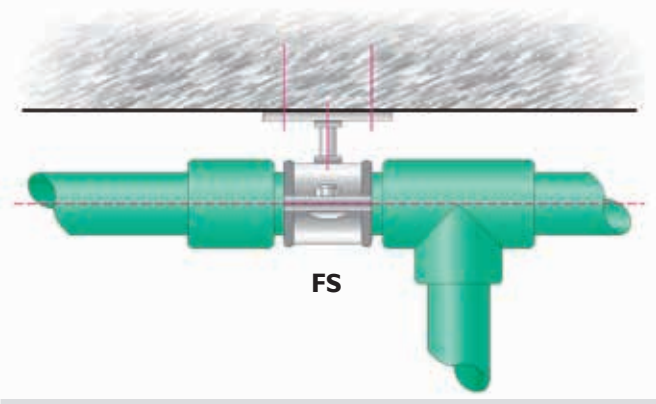
Temperature difference ΔT (°C)	Pipe outer diameter D (mm)										
	20	25	32	40	50	63	75	90	110	125	160
	Support distance (cm)										
20	90	105	120	135	155	175	185	195	215	240	270
30	90	105	120	135	155	175	185	195	210	225	245
40	85	95	110	125	145	165	175	185	200	215	235
50	85	95	110	125	145	165	175	185	190	195	205
60	80	90	105	120	135	155	165	175	180	185	195
70	70	80	95	110	130	145	155	165	170	175	185

* In vertically positioned pipes the values should increase by 20%

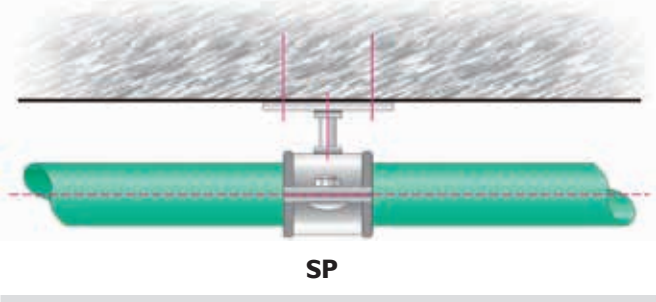
When designing the installation points must be chosen for the fixed supports and sliding supports. Naturally in both cases only supports that will not damage the pipe surface should be used.

Fixed supports (FS) are located between the joints of the pipe and are fitted very tightly to the pipe. They restrict axial movement of the pipe and are used to seperate the piping system into appropriate segments that automatically elognate with changes in temperature (the linear expansion does not extend beyond the fixed support).

Use of these fixed supports is mandatory in the following circumstances:
- Next to the discharge points
- In front of and behind additional devices mounted on the pipes (filters, flow meters, settling tanks.)



Sliding points (**SP**) are used to support the pipes in the structural elements of the building and to protect pipes from excessive bending. The distance between these two points depends on the temperature of the conveyed medium and the diameter of the pipes. When placing a sliding support the pipe must not be obstructed by fittings or equipment installed right next to it. The maximum permitted distance is given by the tables of the previous page



The pipes must be routed in such a way that the pipe can move freely within the defined area of expansion. The following devices can be used to compensate for linear expansion
- Flexible arm
- Omega loop

Flexible Arm

Flexible arms are particularly useful in absorbing linear expansion, if there is enough space, thermal elongation of the horizontal sections of the pipes can be compensated by guiding the piping length wise into a loop, that is to say in an unidirectional continuous piping bend .

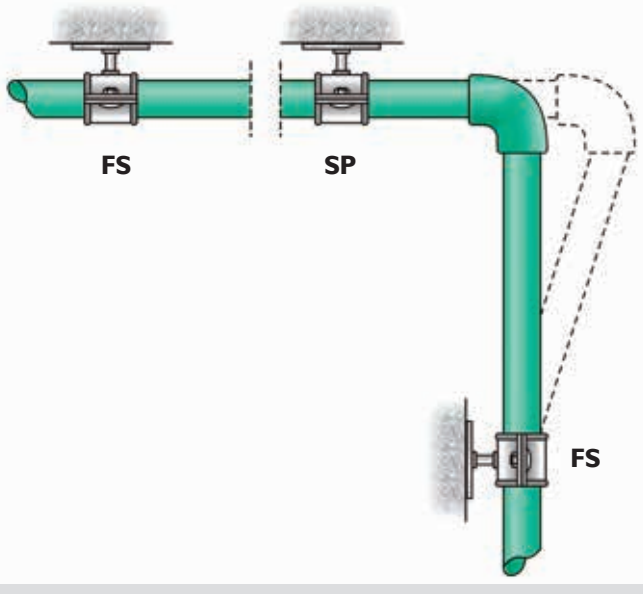
The length of the flexible arm is calculated according to the following formula:

$$Ls = K \times Dz \times \Delta L$$

Where
Ls: required length of flexible section
K: constant of material (for polypropylene type 3, K= 15)
Dz : pipe outer diameter
Δl: linear expansion

$$\mathbf{Ls = 15 \times \sqrt{40{,}0\ mm \times 56\ mm} = 709\ mm}$$

Length of flexible arm (Ls) = 70.9 cm



Omega Loop

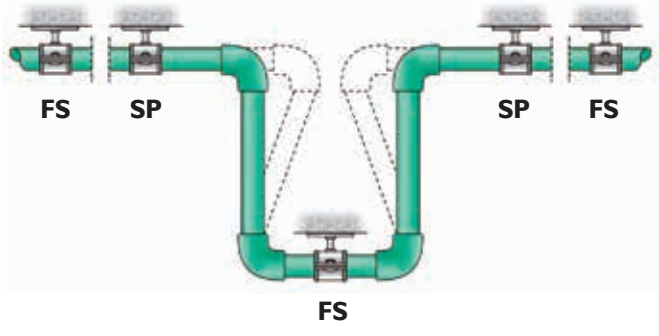
If linear expansion cannot be compensated through a change in direction Omega loop must be installed. It is obvious that the expansion Omega is applied only between fixed-stable points. The necessary length of the pipe and the elbows of 90°C are essential for the construction. The unknown in this case is the distance(A min) between the two arms of the Omega loop (width Omega). The distance is calculated according to the following formula:

$$A\ min = 2 \times \Delta L + SG$$

where
A min : Omega width
ΔL : linear expansion
SG: safety distance (for polypropylene type 3 , SG= 150 mm)

$$\mathbf{A\ min = 2 \times 56\ mm + 150\ mm = 262\ mm}$$

The width of the diastolic Omega should be at least 26,2cm.
The length of the arms calculated with the same method in which the length of flexible arm.
The support on Omega basis is tightly placed on the pipe



Prestressing Omega Arm

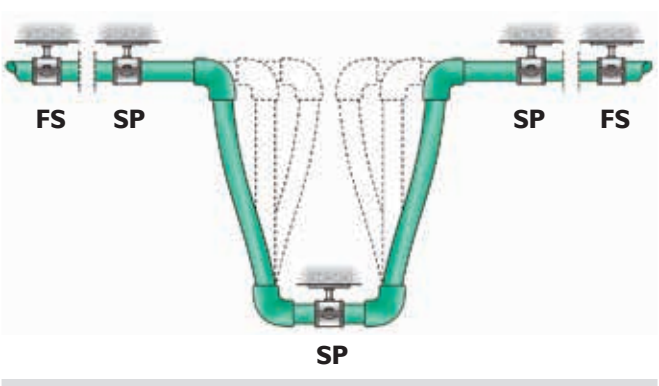
When space is limited it is possible to reduce the length of the omega armwithits prestress as it is presented in the diagram below. In this case the length of the Omega arm is calculated using the following formula

$$Ls = K \times \sqrt{Dz \times \Delta L / 2}$$

where
Ls: required length of flexible arm
K: constant of material
Dz: pipe outer diameter
Δl: linear expansion

$$\mathbf{Ls = 15 \times \sqrt{40{,}0\ mm \times 56\ mm / 2} = 502\ mm}$$

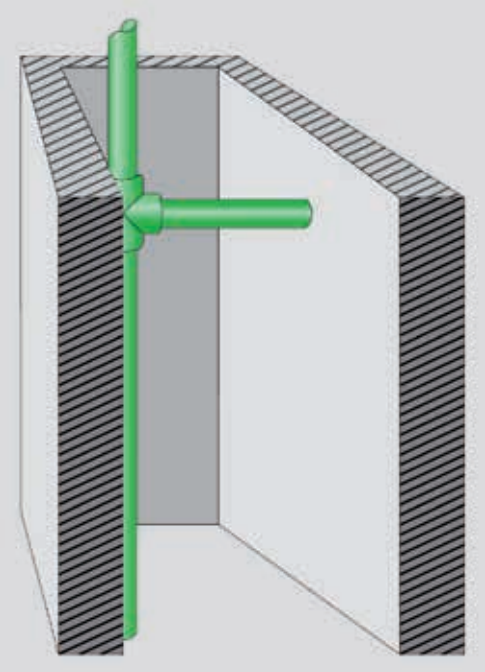
If the installations of the prestress are carefully designed and applied, they offer a perfect visually installation since the linear expansion is not clearly visible.



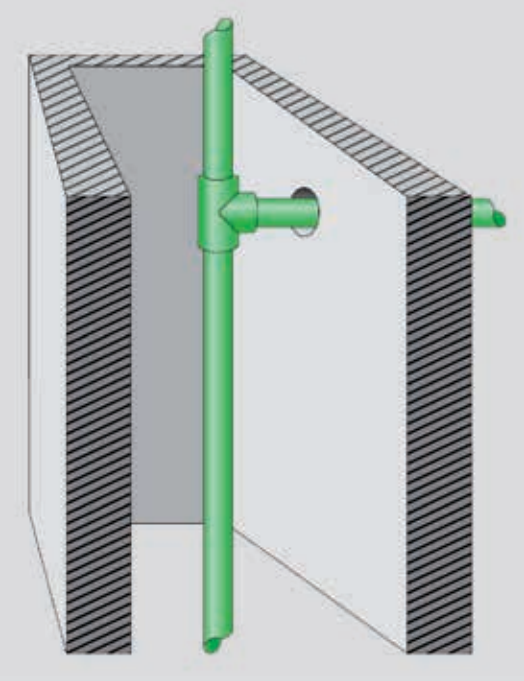
Risers

The installation of risers with Aqua plus pipes and fittings requires a flexible branch pipe in order to accommodate the expansion of the riser. This is ensured by correct stabilization with supports which allow free movement of the pipe. Different ways of installing the pipe are shown in the following diagrams. It is also possible to use the special brass expansion joints available on the market.

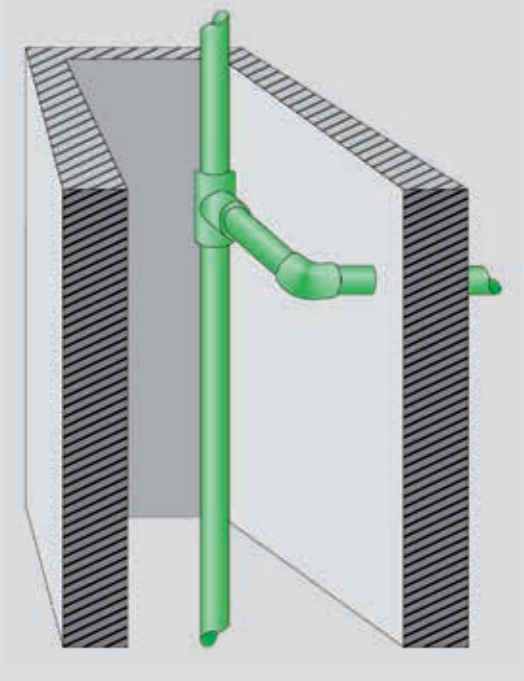
a) Distancing of risers from the wall branch of the horizontal supply.



b) Making a hole in the wall for passage of the horizontal supply branch. Diameter of the hole should be 1.5 times greater than the outer diameter of the horizontal branch. It is recommended that the gap between the pipe and hole be filled with foam insulator.



c) Construction of flexible arm so that the outer part of the branch pipe can move freely when the riser contracts or expands.



SUPPORT OF PIPING

1. Divided Supports with rubberM8/M10 for plastic pipes Standard types

The support is used for inner installations and it is manufactured for plastic pipes only. At the tightening points there are things that do not allow the support to press the pipe. At the same time, the special elastic material which is cover with cloth allow the pipe to slide without sticking. In this way, the necessary move of the pipes and the expansions- contractions at the calculated points are ensured without deforming the network. The elastic material protects from the sound transmission and vibrations.. the accepted charge values are from 0,6kN to 1,9kN

Technical specifications:
Support: steel DX5ID+Z275-EN 10327 (<40mm) +DDII-en10111
Rubber: EPDM/SBR with felt, SHRE A = 45° +- 5°
Temperature endurance: -40°C to +100°C
Average value of sound depreciation: 17 dB(A)
Surface support protection: electro galvanized EN ISO 12329 (>50mm)

2. Divided Supports with rubber M8/M10 Perfect type

The support is used for inner installations at points where fixed support point is required. The special design of the screws aside allows the easy assemble and disassemble of the support. The rubber is incorporated in the support and gives protection from the sound and the vibrations. The accepted charge values are from 0,8kN to 1,9kN.

Technical specifications:
Support: steel DDII-EN 10111
Rubber: EPDM/SBR black SHRO A = 45° +- 5°
Temperature endurance: -40°C to +100°C
Average value of sound depreciation: 17 dB(A)
Surface support protection: electro galvanized EN ISO 12329

3. Divided Supports without rubber M8/M10 Perfect type

The support is used for outer installations exposed to sun rays. It can be used at points where fixed or not support is required according to the rate of tightening on the pipe. The special design of the screws aside allows the easy assemble and disassemble of the support. The accepted charge values are from 0,8kN to 1,9kN.

4. Polyurethane shells with supports without rubber

The polyurethane shells are used for the support points of insulated pipes for inner and outer installations. Due to their hardness, the shells have perfect mechanical properties while they provide with excellent thermo insulation because of the polyurethane (W=0,030W/mK). In this way, thermo bridges with the outer environment are avoided at the support points and the injuries on the insulation of the pipe. The shells are 10cm and thickness of 15mm (for diameter <=63mm) or 20mm (for diameter >63mm). There is a cover of black aluminum which protects the polyurethane from steam.
Thickness of polyurethane 50kg/m³, diameter 90mm, 80kg/m³ and up
Temperature endurance -50°C to +105°C

ENDURANCE OF THE PIPE PP-R ON THE EFFECT OF THE OUTER PRESSURE

The definition of the mechanical endurance of a PP-R pipe during the effect of the outer strain according to the measurement of elasticity and the Poisson of the specific material as they are defined by the manufacturers of the material A (E=8.508 kfg/cm² & v=0,45), comes from

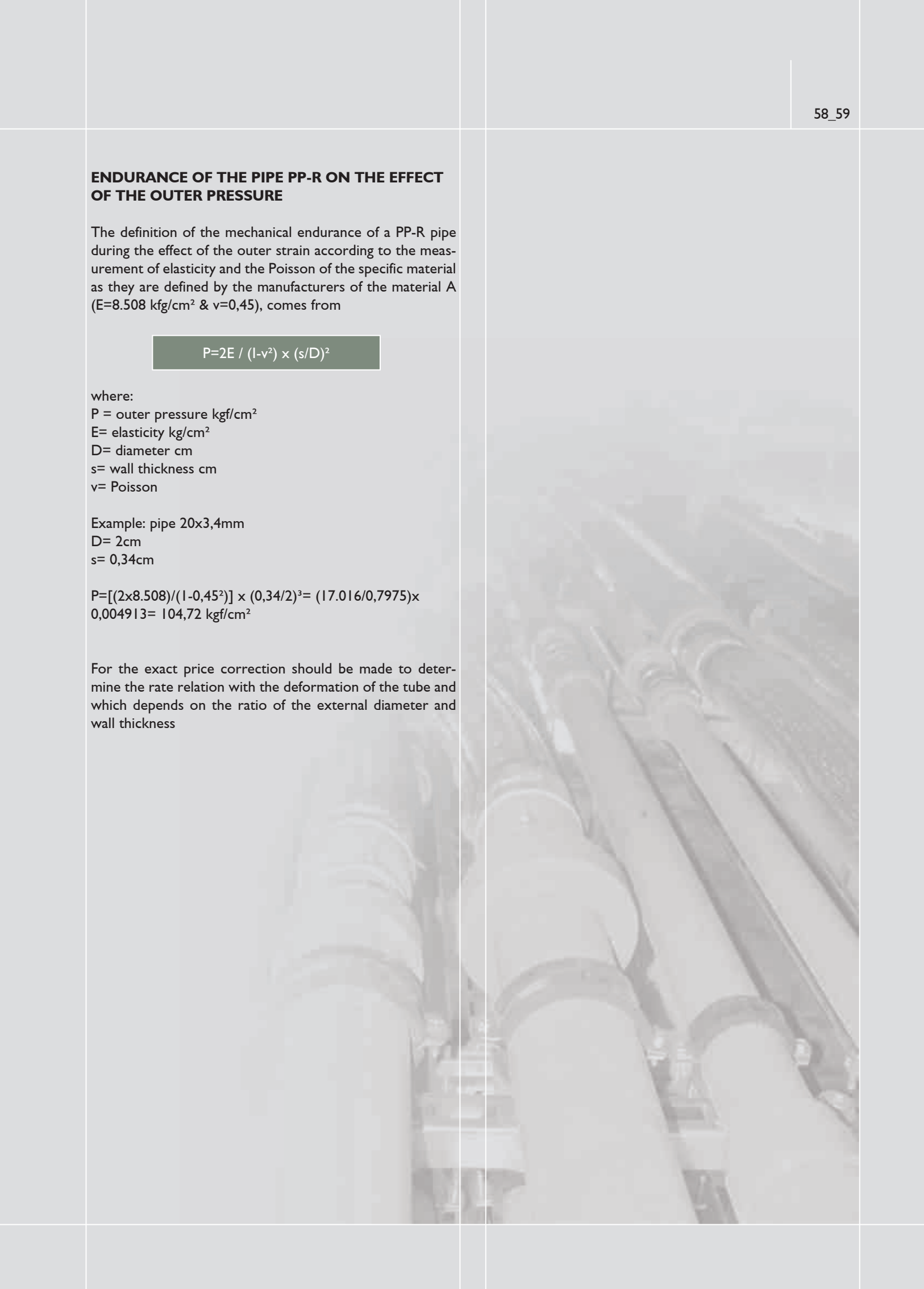
$$P=2E / (1-v^2) \times (s/D)^2$$

where:
P = outer pressure kgf/cm²
E= elasticity kg/cm²
D= diameter cm
s= wall thickness cm
v= Poisson

Example: pipe 20x3,4mm
D= 2cm
s= 0,34cm

$P=[(2x8.508)/(1-0,45^2)] \times (0,34/2)^3= (17.016/0,7975)x$ 0,004913= 104,72 kgf/cm²

For the exact price correction should be made to determine the rate relation with the deformation of the tube and which depends on the ratio of the external diameter and wall thickness



17 PIPE INSULATION

In comparison to the traditional materials polypropylene offers excellent heat insulation. The thermal conductivity of PP-R type 3 is equal to 0.17 W/(mK). Nevertheless, polypropylene systems must be thermally insulated against heat loss for the following reasons.

- Condensation and increase in temperature of the conveyed water (cold water systems)

- Decrease in temperature of the conveyed water (hot water and heating systems)

Overall heat transmission coefficient	0,030 W/mk	0,035 W/mk	0,040 W/mk
Dimension	**Insulation thickness (mm)**		
20 mm	6,1	7,8	9,7
25 mm	6,0	7,6	9,3
32 mm	9,4	11,8	14,4
40 mm	9,3	11,5	13,9
50 mm	9,0	11,0	13,2
63 mm	13,1	15,9	19,0
75 mm	15,6	19,0	22,6
90 mm	18,8	22,8	27,1
110 mm	23,1	27,9	33,1
125 mm	28	32	38
160 mm	28	32	38

The installations of cold potable water should be protected by the heat and the creation of condensations. The values for the thickness of insulation should be taken by the following table:

Pipe locations	Thickness of insulation with thermal conductivity 0,04 W/mK
Pipes in non-heated areas	**4 mm**
Pipes in heated areas	**9 mm**
Pipes in ducts without hot water pipes or central heating	**4 mm**
Pipes in ducts with hot water pipes or central heating	**13 mm**
Pipes embedded in walls	**4 mm**
Pipes embedded in walls next to hot water pipes or central heating	**13 mm**
Under floor piping	**4 mm**

Is Aqua plus suitable for drinking water?

The pipes and fittings of Aqua plus system are non-toxic and totally safe for use in contact with drinking water and food.

Besides, most food packaging is made from PP-R, the same material from which Aqua plus products are made.

Can Aqua plus pipe be used in heating systems?

According to the tests to which Aqua plus is subjected the relevant diagrams for service life in conjunction with pressure and increased temperature together with the properties of the material render the Aqua plus system suitable for heating installations.

A very good combination of materials for heating systems is use of Aqua plu system for central risers of supply and return supplying hot water for heating to the distribution manifolds of the central heating system and use of cross-linked polyethylene pipe Como-pex from the manifolds to the radiators.

Is Aqua plus piping frost-resistant?

Like all other materials Aqua plus pipe require special attention during installation when ambient temperatures are close to 0°C.

However, from the moment Aqua plus system is installed and working due to the elasticity of the material in conjunction with the relatively thick wall it performs better than any other traditional material in cases of freezing water thus reducing maintenance costs of the installation.

Can we heat Aqua plus pipe to make bends?

A full range of elbows is available (45 and 90) as well as vertical pipe "V" diversions; nevertheless, if considered necessary the pipe can be heated by use of hot air blowing device regulated at 135°C.

Is the pipe resistant to ultra violet rays?

In general plastic pipes should not be exposed to the sun rays for a long period of time. If outdoor installation is required then the pipes must be protected with external insulation or they should be coated with plastic paint. Indoor installations (e.g. basements) are not needed to be covered.

How much do Aqua plus pipes expand and contract?

In general plastic pipes are subject to greater thermal expansion and contraction in comparison with metal ones. For this reason, with long straight lengths of piping provisions must be made for thermal expansion and contraction trough the use of expansion joints, supports and connections (e.g flexible arm). Of course, when Aqua plus aluminum or fiberglass pipes are used, the expansion of the pipes are significantly reduced. When the pipe is embedded in concrete it follows the general rule for plastic pipes whereby it does not expand longitudinally but inwards. In this case and for in-wall installation of pipes, the recommended thickness of plaster is 3cm.

How are Aqua plus pipes and fittings tested?

Interplast is certified to ISO 9001and complies with all Quality Assurance System procedures. The tests to which our products are subjected range from acceptance tests for raw materials trough to tests on the final products which include dimensional and visual tests, pressure and temperature tests, reversion tests, impact tests during the packaging phase and tests on specimens during the warehouse phase.

At the same time certifications of SKZ, AENOR, WRAS, DVGW test the quality of our pipes on a regular basis (every 6 months) carrying out sampling testing from the warehouse and the production lines.

What is the service life of Aqua plus pipes and fittings?

The Aqua plus system has been designed for a service life of over 50 years for continuous use(24 hours, 365 days) at high temperature(70°C) and high pressures(12,9 bar).

If an Aqua plus pipe is punctured or breaks what can we do?

Provision has been made in the Aqua plus pipe and fitting system for cases of accidental puncture.

By using a special item (restore tack 7/11mm) we can repair the damage at negligible cost.

If for any reason it is necessary to repair a pipe which at some point along its length there is a crack or burst we can use an electric coupling or brass mechanical clamping device if this occurs in cold water installations.

In Aqua plus pipes does the inner dimension tend to clog up after a number of years as in metal ones?

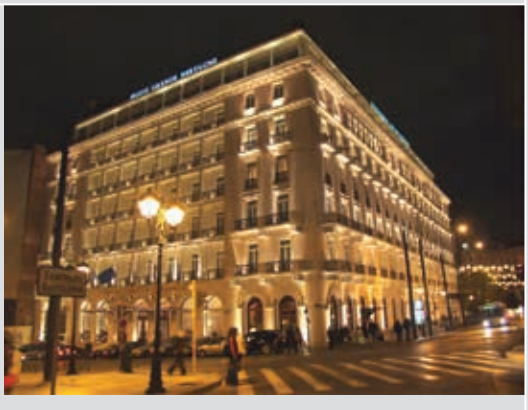
A great advantage of Aqua plus system is the smooth inner surface in conjunction with the properties of the material is not susceptible to electro chemical corrosion or scaling. Thus the pipes remaine unaltered through the time making the operation of the installation more economical since it is not subject to change or other problems.

Are Aqua plus pipes guaranteed?

The Aqua plus pipes and fittings system carries a 10 year guarantee covered by the Allianz insurance company against damages owing to faulty pipe and fitting production to a sum of €500,000 per incident and up to a maximum of €3,000,000 within a period of time

The recognition of Interplast in Greek market resulted in its participation in great projects some of them are the following:

- Olympic village, Athens
- Airport of Athens El.Venizelos, Spata
- Mediterranean Cosmos Shopping and entertainment center Thessaloniki
- Saida Tyros Lebanon
- Ministry of housing Bahrain
- Court Hall Pieria
- Hondos Center Thessaloniki
- Aquarium "thalassokosmo" Iraklio Crete
- Hotel Grande Bretagne, Luxury Collection Hotel, Athens
- Domes of Elounda Elounda, Luxury Hotels
- St Regis Hotel & residential Towers, Doha Catar Luxury Hotels
- Murex Hotel 5* Lebanon
- Grecotel Olympia Riviera 5* kyllini
- Aldemar Royal Olympian 5* Pyrgos Ileia
- Aldemar Knossos Royal 5* Crete
- Aldemar Royal MARE 5* Crete
- Olympian Village 5* Eilia
- Zormpas 5* Tigkaki Crete
- Gaia Palace Mastichari Kos
- Blue Lagoon 5* Kos
- Iberostar Astir Odysseus 5* Tigaki Kos
- Lindosbay Lindos Rhodes
- 505 Villas Uptown Emirates City UAE
- Bab Al Rayan 400 - Village Villas DohaCatar
- 14 Villas (Westar Prop) Jumeirah Village Dubai
- Alia Apartments Bucharest Romania
- General Hospital of Kavala
- General Hospital of Igoumenitsa
- 424 Army Hospital Thessaloniki
- Obstetrics clinic «genesis» Thessaloniki
- Bioclimatic schools of Yalisos, Afantou and Kremastis Rhodes



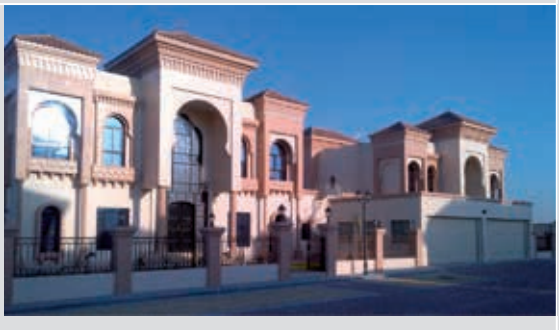
Hotel Grande Bretagne, Athens

"St.Regis" Hotel, Doha Catar

"Mediterranean Cosmos", Mall, Thessaloniki

General Hospital of Kavala

Green Lake Residences, Bucharest, Romania



Villas, Bahrain

GUARANTEE

Guarantee No:……..……..

Customer (Beneficiary)…….……

Person in charge of installation:…….……..……

Installation date: …….……..……

Sales outlet:…….……..……

Date of purchase:…….……...

Pipe Manufacturing Lot no. …….……..

This guarantee covers Aqua-plus pipes and fittings such as described in the Polypropylene Random handbook, for a period of 10 years.

Interplast S.A. will, in the case of defect, undertake to disassemble and assemble the articles in question and repair consequential damages arising from its products, under its own supervision or at its own expense, subject to prior inspection and approval by Interplast of its estimated responsibility.

In addition, Interplast will award compensation for damages arising out of product liability and for any manufacturing defect of the abovementioned products.

We guarantee said products for the aforementioned number of years from the date of purchase to a sum of €500,000 per incident and up to a maximum of €3,000,000 in a year through cover of the Allianz Insurance Company.

Conditions

The guarantee is only valid if:

a) The damage is reported within a maximum of 14 days.

b) The guidelines (see handbook) have been closely and accurately followed as regards method of installation and operation of Interplast pipes and fittings.

c) The declaration herein has been duly signed at our company within a maximum of 15 days from the start of operation.

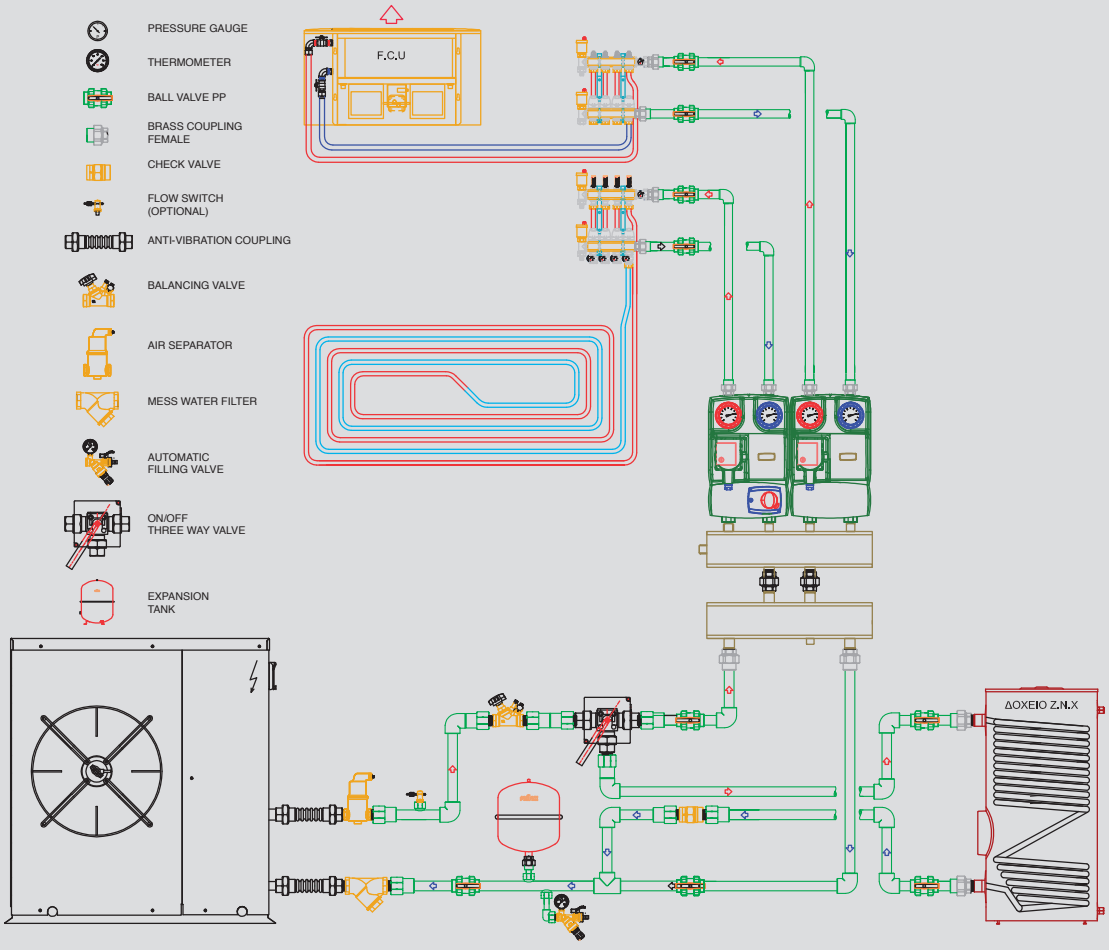
For **Interplast S.A.**

…….

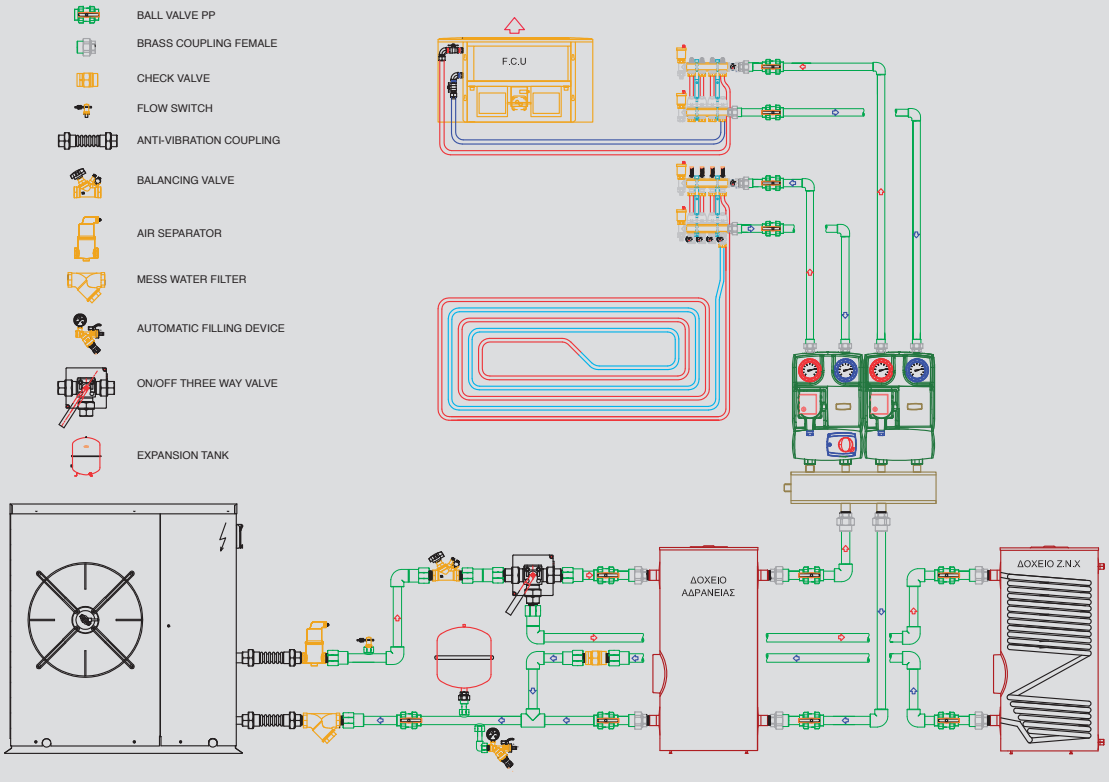
We certify that in the work carried out by us, we installed Interplast S.A. pipes and fittings according to the guidelines in the handbook.

.....	.....	.....
Place	Date	Plumbing Technician (Stamp-Signature)

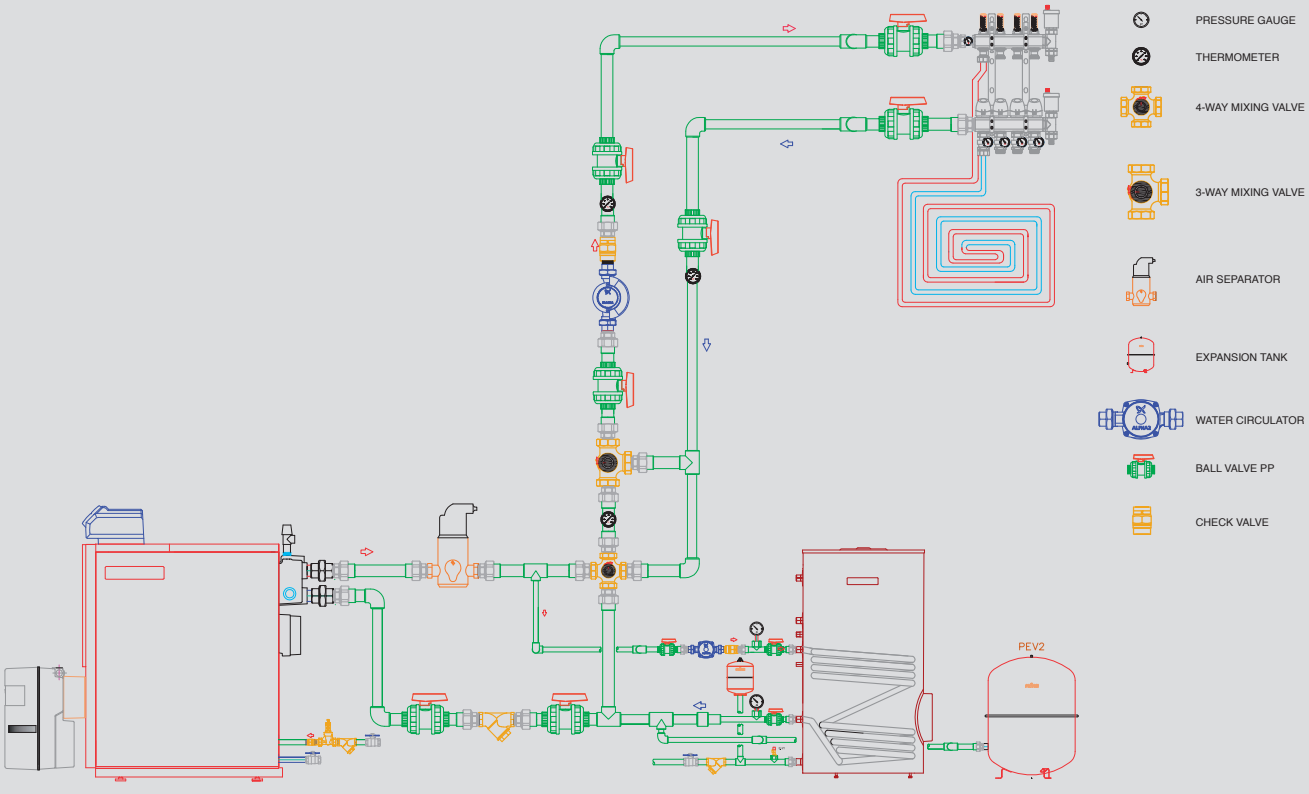
1. Mechanical drawing of the pumped storage room with heat-pump Inverter working with underfloor heating, Fcu and DHW



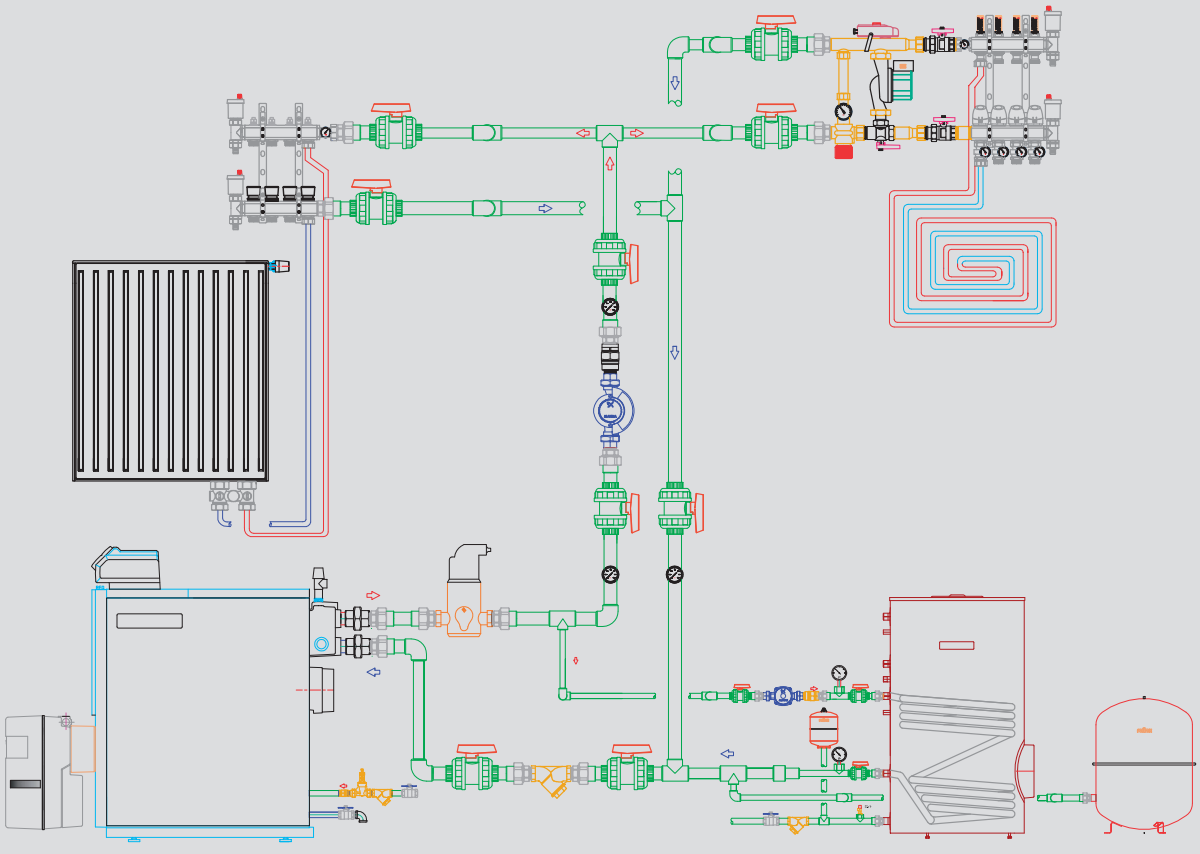
2. Mechanical drawing of the pumped storage room with fixed power heat-pump Inverter working with underfloor heating, Fcu and DHW



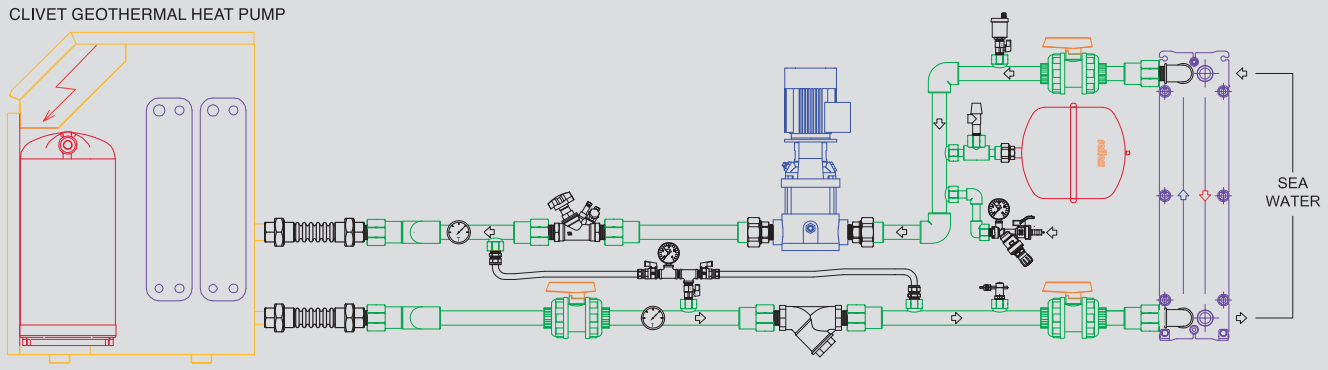
3. Mechanical drawing of the pumped storage room for underflorr heating and DHW



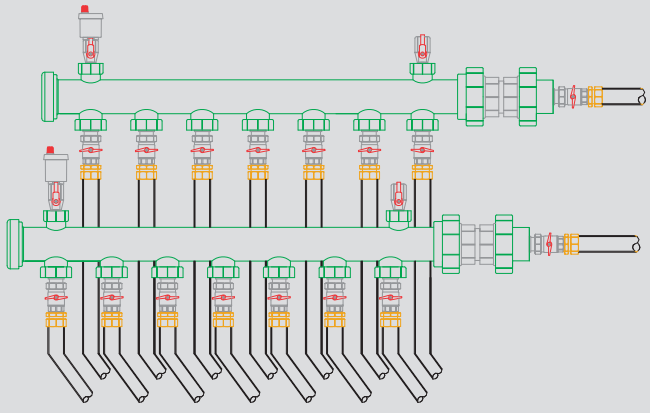
4. Mechanical drawing of the pumped storage room with two central risers for supply conventional and underfloor heating system



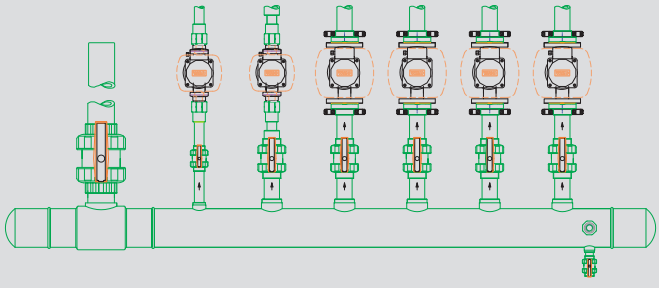
5. Mechanical drawing of geothermal pump in combination with changing machine for exploitation of sea water



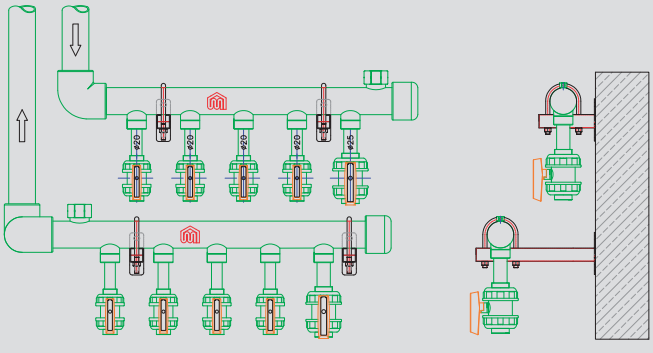
6. Geothermal PP Manifold



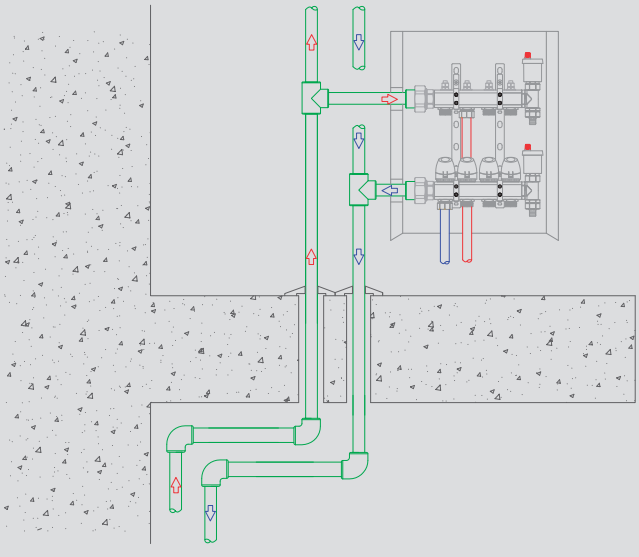
7. PP Manifold for central networks



8. Support of the Manifold in central networks



9. PP Central risers and connection
of group manifolds for underfloor heating



1.TABLE OF MANUFACTURED PRODUCTS

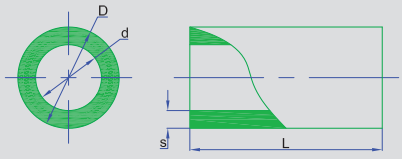
2. PRESSURE UNITS CONVERSION TABLE

3. FLOW UNITS CONVERSION TABLE

4. TABLE OF CALCULATION OF REQUIRED NETWORK SUPPLY ON THE BASIS OF TOTAL SUPPLY OF OUTFLOW POINTS

5. TABLE OF PRESSURE LOSSES AND CALCULATION OF DIMENSION OF THE PIPES

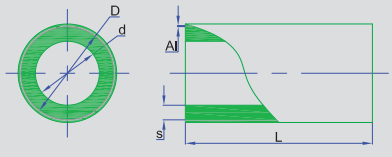
6 TABLE OF MATERIAL CHEMICAL ENDURANCE



D=External diameter
d=Internal diameter
s=Wall thickness
L=Pipe length
SDR=D/s

SDR 6 Pipe

External diameter (mm)	Wall thickness (mm)	Internal diameter (mm)	Water capacity l/m	Pipe weight kgr/m	Package m
20	3,4	13,2	0,137	0,172	100
25	4,2	16,6	0,216	0,267	80
32	5,4	21,2	0,353	0,435	60
40	6,7	26,6	0,556	0,671	40
50	8,4	33,2	0,866	1,050	16
63	10,5	42	1,385	1,650	12
75	12,5	50	1,963	2,340	8
90	15	60	2,827	3,400	4
110	18,4	73,2	4,208	5,040	4
125	17,1	90,8	6,472	5,530	4
160	21,9	116,2	10,599	9,040	4

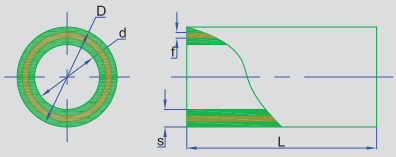


D=External diameter
d=Internal diameter
s=Wall thickness
Al=Aluminum layer
L=Pipe length
SDR=D/s

Aqua Plus Aluminum Pipe

External diameter (mm)	Wall thickness (mm)	Internal diameter (mm)	Water capacity l/m	Pipe weight kgr/m	Package m
20	3,4	13,2	0,137	0,194	100
25	4,2	16,6	0,216	0,290	80
32	5,4	21,2	0,353	0,463	60
40	6,7	26,6	0,556	0,695	40
50	8,4	33,2	0,866	1,109	16
63	10,5	42	1,385	1,778	12
75	12,5	50	1,963	2,416	8
90	15	60	2,827	3,542	4
110	18,4	73,2	4,208	5,171	4

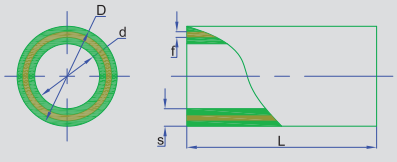
*In the outlet diameter the aluminum layer and the outside PP-R layer are not included.



D=External diameter
d=Internal diameter
s=Wall thickness
f=fiberglass layer
L=Pipe length
SDR=D/s

Aqua Plus SDR 7.4 Pipe

External diameter (mm)	Wall thickness (mm)	Internal diameter (mm)	Water capacity l/m	Pipe weight kgr/m	Package m
20	2.8	14.4	0.163	0.158	100
25	3.5	18.0	0.254	0.246	80
32	4.4	23.2	0.423	0.394	60
40	5.5	29.0	0.660	0.613	40
50	6.9	36.2	1.029	0.955	16
63	8.6	45.8	1.647	1.500	12
75	10.3	54.4	2.323	2.135	8
90	12.3	65.4	3.358	3.058	4
110	15.1	79.8	4.999	4.576	4
125	17.1	90.8	6.472	5.891	4
160	21.9	116.2	10.599	9.538	4

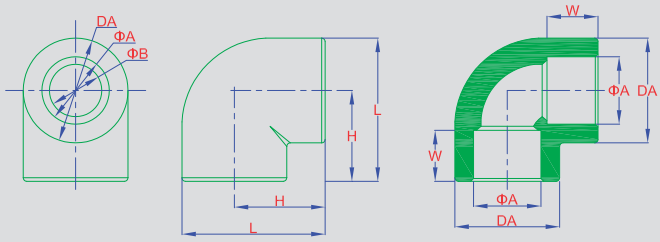


D=External diameter
d=Internal diameter
s=Wall thickness
f=fiberglass layer
L=Pipe length
SDR=D/s

Aqua-Plus SDR 11 Pipe

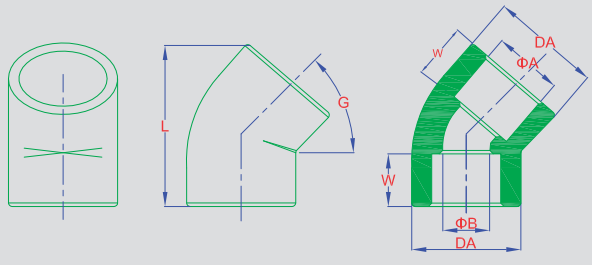
External diameter (mm)	Wall thickness (mm)	Internal diameter (mm)	Water capacity l/m	Pipe weight kgr/m	Package m
20	1.9	16.2	0.206	0.107	100
25	2.3	20.4	0.327	0.164	80
32	2.9	26.2	0.539	0.261	60
40	3.7	32.6	0.834	0.412	40
50	4.6	40.8	1.307	0.638	16
63	5.8	51.4	2.074	1.010	12
75	6.8	61.4	2.959	1.410	8
90	8.2	73.6	4.252	2.030	4
110	10.0	90.0	6.359	3.010	4
125	11.4	102.2	8.199	3.910	4
160	14.6	130.8	13.430	6.380	4

Elbow 90° - PN25



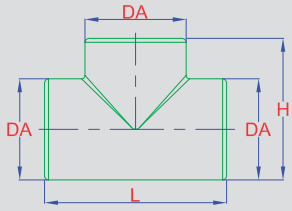
Code	Dimensions	Package item/carton	Package item/bag	kgr/item	DA	ΦA	ΦB	H	W	L
790030020	20	140	20	0,019	30	19	13,5	26	14,5	41
790030025	25	80	10	0,030	36	24	17	30	16	48
790030032	32	50	10	0,050	44	31	21	34	19	57
790030040	40	50	10	0,110	57	39	30	43	22,5	71
790030050	50	30	10	0,170	66,5	49	41	53	25	86
790030063	63	15	5	0,315	84	62	52	64	29	106
790030075	75	10	2	0,524	98	74	62	73	33,5	44
790030090	90	5	1	0,892	118	89	74	89	38	148
790030110	110	2	1	1,452	140	108,5	91	100	43	170
790030125	125	2	1	1,596	166	124	116	110	43,5	195
790030160	160	1	1	3,959	160	159	155	212	130	292

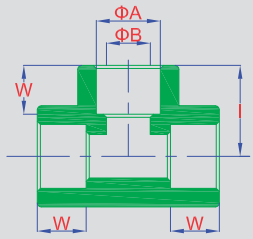
Elbow 45° - PN25



Code	Dimensions	Package item/carton	Package item/bag	kgr/item	DA	ΦA	ΦB	W	G	L
790040020	20	140	20	0,016	30	19	13,5	14,5	45	44,5
790040025	25	80	10	0,025	36	24	17	16	45	53
790040032	32	50	10	0,036	44	31	21	18,5	45	63
790040040	40	50	10	0,078	56,5	39	30	21,5	45	78
790040050	50	30	10	0,140	66	49	41	25	45	95
790040063	63	15	5	0,260	83	61,7	52	29	45	123
790040075	75	10	2	0,426	98	73,5	62	33	45	143
790040045	90	6	1	0,758	116,5	88,5	74	38	45	170
790040110	110	4	1	1,187	137	108,5	91	43	45	205
7900400125	125	2	1	1,603	165	123,5	116	44	45	220
7900400160	160	1	1	3,153	158	114	114	-	45	340

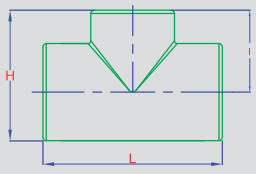
Tee - PN25

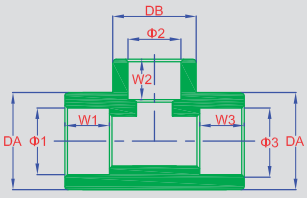




Code	Dimensions	Package item/carton	Package item/bag	kgr/item	DA	ΦA	ΦB	H	W	L	I
790070020	20-20-20	100	10	0,027	30	19	13	42	14,5	54	27
790070025	25-25-25	60	10	0,042	36	24	17	49	16	62	31
790070032	32-32-32	30	6	0,070	44	31	21	60	20	75	38
790070040	40-40-40	40	10	0,124	57	39	30	71	21	85	42,5
790070050	50-50-50	24	8	0,210	66	49	41	87	25	106	54
790070063	63-63-63	12	4	0,404	83	62	52	108	29	130	66
790070075	75-75-75	9	3	0,672	98	74	62	129	33	153	80
790070090	90-90-90	2	1	1,118	116	89	74	151	37,5	180	93
790070110	110-110-110	2	1	2,072	137	108,5	91	180	43,5	210	111
790070125	125-125-125	1	1	2,500	165	124	115	200	44	242	117
790070160	160-160-160	1	1	5,400	161	116	116	302	111	433	218

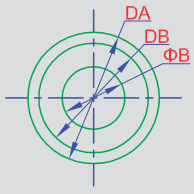
Reducing Tee - PN 25

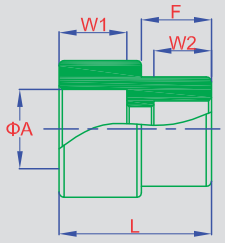




Code	Dimensions	Package item/carton	Package item/bag	kgr/item	DA	DB	Φ1	Φ2	Φ3	W1	W2	W3	L	H	I
790060001	25x20x25	60	10	0,039	36	30	24	19	24	16	14,5	16	62	48	30
790060017	25x20x20	50	10	0,048	36	36	24	13	19	16	14,5	14,5	62	49	31
790060018	25x25x20	50	10	0,044	36	36	24	24	19	16	16	14,5	62	49	31
790060003	32x25x32	30	6	0,063	44	36	31	24	31	20	16	20	75	55	33
790060024	32x32x20	30	6	0,070	44	30	31	19	31	20	14,5	20	76	55	33
790060019	32x25x25	30	6	0,066	44	36	31	24	24	20	16	16	76	56	35
790060025	32x20x20	30	6	0,066	44	30	31	19	19	20	14,5	14,5	76	55	35
790600022	32x25x20	30	6	0,066	44	36	31	24	19	20	16	14,5	76	56	35
790060023	32x20x25	30	6	0,066	44	30	31	19	24	20	14,5	16	76	55	35
790600021	32x32x25	30	6	0,072	44	44	31	31	24	20	20	16	76	60	38
790060002	32x20x32	30	6	0,062	44	30	31	19	31	20	14,5	20	76	55	33
790060016	40x25x40	20	4	0,114	57	36	39	24	39	21	16	21	85	66	37
790060004	40x32x40	20	4	0,116	57	44	39	31	39	21	18	21	85	68	40
790060007	50x32x50	10	2	0,214	66	53	49	31	49	25	20	25	106	88	53
790060005	50x40x50	10	2	0,204	66	54	49	39	49	25	19	25	106	88	54
790060010	63x25x63	14	2	0,400	84	67	62	24	62	29	16	29	130	109	65
790060015	63x32x63	14	2	0,412	84	67	62	31	62	29	19	29	130	109	65
790060020	63x40x63	14	2	0,406	84	67	62	39	62	29	21	29	130	109	65
790060006	63x50x63	14	2	0,386	84	67	62	49	62	29	25	29	130	109	65
790060011	75x50x75	10	1	0,682	98	83	74	49	74	33	25	33	153	128	76
790060012	75x63x75	10	1	0,662	98	84	74	62	74	33	22	33	153	128	76
790060028	90x63x90	6	1	1,130	117	120	89	62	89	38	29	38	180	151	90
790060008	90x75x90	6	1	1,154	117	116	89	74	89	38	32	38	180	151	90
790060013	110x63x110	3	1	1,801	137	137	108	62	109	43	28	43	215	180	107
790060027	110x75x110	3	1	1,827	144	141	109	74	109	44	33	44	213	180	107
790060026	110x90x110	3	1	1,985	144	120	109	89	109	45	39	45	213	180	107
790060030	125x75x125	2	1	2,77	164	164	124	74	124	44	33	44	240	205	107
790060031	125x90x125	2	1	2,77	164	164	124	89	124	44	38	44	240	205	128
790060032	125x110x125	2	1	2,82	164	166	124	109	124	44	44	44	245	205	123
790060040	160x90x160	1	1	4,65	161	91	115	64	115	111	86	111	429	276	196
790060041	160x110x160	1	1	4,85	161	166	115	77	115	111	93	111	429	287	203

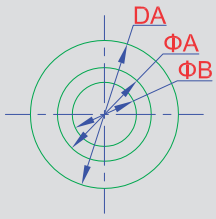
Redusing bush - PN25

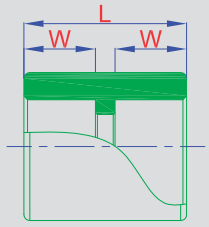




Code	kgr/item	Dimensions	Package item/carton	Package item/bag	DA	DB	ΦA	ΦB	F	wl	w2	L
790082520	0,012	25x20	200	20	36	25	19	13,5	16	14,5	13.5	35
790083220	0,022	32x20	160	20	44	32	19	13,5	20	14,5	13.5	40
790083225	0,024	32x25	90	10	44	32	24	21	20	16	14.5	40
790084020	0,027	40x20	80	10	57	40	19	19	18	16	13.5	45
790084025	0,028	40x25	80	10	57	40	24	20	23	17	14.5	45
790084032	0,030	40x32	80	10	57	40	31	27	22	17	16	45
790085025	0,054	50x25	40	8	66	50	24	24	24	20	14.5	62
790085020	0,052	50x20	40	8	66	50	19	19	20	20	13.5	61
790085032	0,052	50x32	40	8	66	50	31	23	31	20	16	60
790085040	0,060	50x40	40	8	66	50	39	36	23	20	17	61
790086320	0,113	63x20	20	5	83	63	19	19	39	21	14.5	70
790086325	0,104	63x25	20	5	83	63	24	16	40	21	16	70
790086332	0,106	63x32	20	5	83	63	31	23	40	19	16	70
790086340	0,106	63x40	20	5	83	63	39	36	40	22	16	70
790086350	0,106	63x50	20	5	83	63	49	45	35	21	20	71
790087550	0,164	75x50	16	2	89	75	49	41	50	25	20	85
790087563	0,188	75x63	12	2	89	75	62	52	44	25	21	84
790089063	0,282	90x63	12	2	116	90	62	53	46	29	21	100
790089075	0,322	90x75	6	2	116	90	74	64	47	29	25	100
790081075	0,500	110x75	5	1	137	110	74	62	60	33	25	120
790081090	0,552	110x90	5	1	137	110	89	77	60	37	29	119
790081290	0,592	125x90	6	1	165	125	89	79	30	39	29	100
790081211	0,913	125x110	4	1	165	125	108	80	50	45	33	123
790081611		160x110	1	1	171	110	114	79	122	103	85	226
790081612		160x125	1	1	171	125	114	89	112	99	98	220

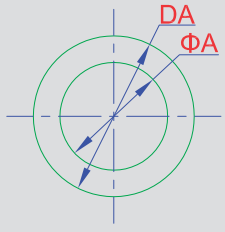
Coupling - PN25

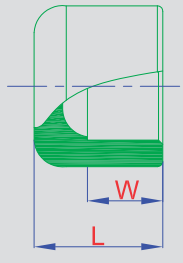




Code	Dimensions	Package item/carton	Package item/bag	kgr/item	DA	ΦA	ΦB	W	L
790020020	20	180	20	0,013	30	19	13	14,5	33
790020025	25	130	10	0,020	36	24	17	16	36
790020032	32	70	10	0,030	44	31	20	20	44
790020040	40	40	10	0,058	57	39	30	21,5	50
790020050	50	25	5	0,094	66	49	41	25	56
790020063	63	20	2	0,174	82	62	52	28,5	69
790020075	75	20	2	0,312	94	74	62	34	83
790020090	90	12	2	0,516	117	89	74	39	100
790020110	110	6	1	0,758	138	108,5	91	44	122
790020125	125	6	1	0,784	166	124	116	38	90

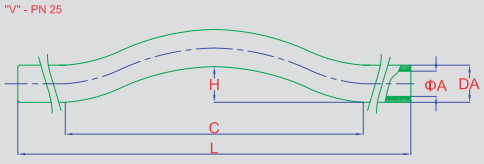
End cap - PN25





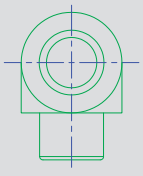
Code	Dimensions	Package item/carton	Package item/bag	kgr/item	DA	ΦA	W	L
790090020	20	200	20	0,010	30	19	16	24
790090025	25	200	20	0,014	36	24	17	26
790090032	32	100	10	0,020	44	31	19	28
790090040	40	50	8	0,056	57	39	23	41
790090050	50	40	10	0,068	66	49	24	44
790090063	63	40	5	0,148	83	62	29	50
790090075	75	11	1	0,247	94	74	29	56
790090090	90	12	3	0,400	117	89	38	60
790090110	110	10	2	0,714	138	108,5	43	66
790090125	125	10	1	0,739	166	124	41	78
790090160	160	1	1	1,266	161	114	97	143

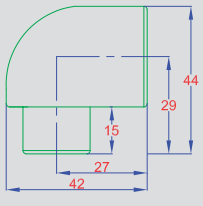
V - PN25

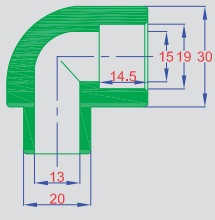


Code	Dimensions	Package item/carton	Package item/bag	kgr/item	DA	ΦA	C	H	L
790050020	20	80	20	0,069	20	13	16	22	40
790050025	25	60	10	0,097	25	16	18	26	40
790050032	32	32	8	0,157	32	22	25	20	40

Elbow I/O 90° - PN25

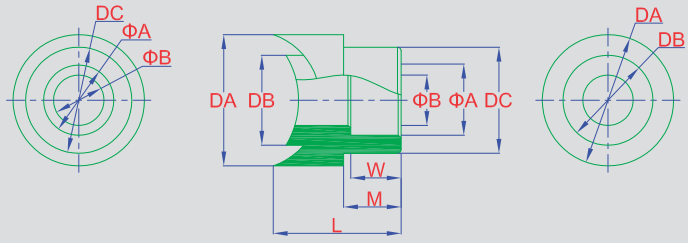






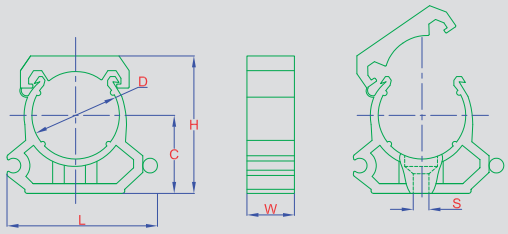
Code	Dimensions	Package item/carton	Package item/bag	kgr/item
700190020	20	140	20	0,022
700190025	25	80	20	0,030

CONVEX Socket - PN25



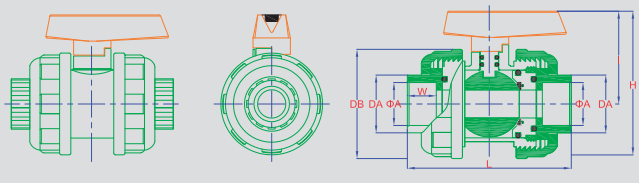
Code	Dimensions	Package item/carton	Package item/bag	kgr/item	DA	DB	DC	ΦA	ΦB	W	M	L
790404020	40-20	100	10	0.015	37	20	30	19	13,5	14,5	15,5	35
790404025	40-25	100	10	0.0155	36	25	36	24	17	16	-	35
790405020	50-20	100	10	0.0152	37	20	30	19	13,5	14,5	15	34
790405025	50-25	100	10	0.0156	35	25	36	24	17	16	-	35
790406320	63-20	100	10	0.0157	37	20	30	19	13,5	14,5	15,5	36
790406325	63-25	100	10	0.0162	36	25	36	24	17	16	-	37
790406332	63-32	100	10	0.0257	42	32	42	31	21	20	-	44
790407520	75-20	100	10	0.0162	37	20	30	19	13,5	14,5	15,5	37
790407525	75-25	100	10	0.0163	35,5	25	35,5	24	17	16	-	39
790407532	75-32	50	10	0.0272	43	32	43	31	21	20	-	46
790409020	90-20	100	10	0.016	37	20	30	19	13,5	14,5	15,5	36
790409025	90-25	100	10	0.016	36	25	36	24	17	16	-	37
790409032	90-32	50	10	0.0285	43	32	43	31	21	20	-	48
790409040	90-40	40	10	0.049	57	40	57	39	30	21	-	50
790401120	110-20	100	10	0.016	37	20	30	19	13,5	14,5	15,5	36
790401125	110-25	100	10	0.016	35,5	25	35,5	24	17	16	-	37
790401132	110-32	50	10	0.0306	43	32	43	31	21	20	-	52
790401140	110-40	40	10	0.0514	57	40	57	39	30	21	-	54
790401220	125-20	140	20	0.0101	29,5	20	30	19	13,5	15	-	36
790401225	125-25	100	10	0.0158	35,5	25	35,5	24	17	16	-	38
790401232	125-32	100	10	0.0234		32	43	31	20	20		
790401240	125-40	50	5	0.0442	57	40	57	39	30	21	-	46

Pipe holder



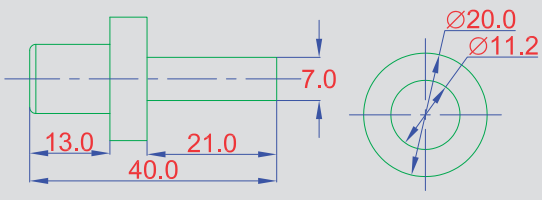
Code	Dimensions (Ø)	Package item/carton	Package item/bag	kgr/item	D	H	C	W	S	L
790200020	20	100	30	0,008	20	36	21	15	5	40
790200025	25	100	30	0,009	25	42	23	15	5	45
790200032	32	50	20	0,010	32	49	26,5	15	5	52
790200040	40	50	10	0,026	40	57	32,5	15	5	64
790200050	50	50	10	0,032	50	75	46,5	25	6,5	69
790200063	63	50	10	0,048	63	92	56,5	25	8,5	83

Ball valve



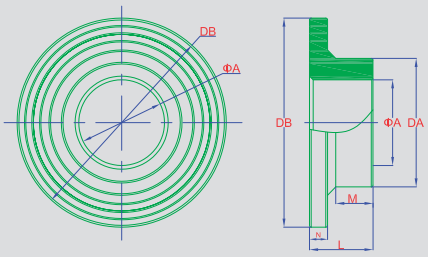
Code	Dimensions (Ø)	Package item/carton	Package item/bag	kgr/item	DA	DB	ΦA	H	I	W	L
700390020	20	20	20	0.103	27	54	19	75	48	15,5	85
700390025	25	12	12	0.144	33	60	24	88	58	18	95
700390032	32	8	8	0.203	41	68	31	98	64	21	104
700390040	40	13	13	0.323	50	83	39	115	73	25	122
700390050	50	10	10	0.493	61	97	49	135	87	30	143
700390063	63	7	7	0.828	75,5	116	62	158	100	37	164
700390075	75	2	2	1.326	89	142	74	182	111	43	196
700390090	90	2	2	2.519	106	178	89	233	144	50	240
7003900110	110	2	2	3.573	130	200	109	265	165	58	277

Hole repairing plug



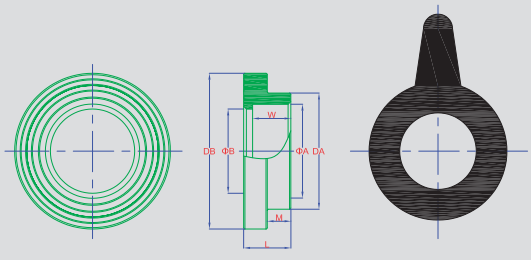
Code	Dimensions	Package item/carton	Package item/bag	kgr/item
700220711	7/11	500	100	0,0045

Male neck



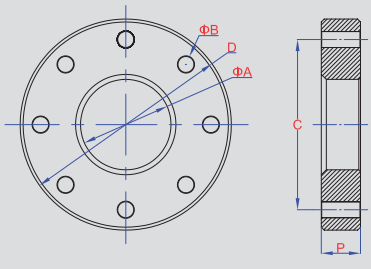
Code	Dimensions (Ø)	Package item/carton	kgr/item	DA	DB	ΦA	M	N	L
700210075	75	1	2,716	75		50	60	10,5	76
700210090	90	1	3,552	90		60	72	12,5	91
700210110	110	1	4,198	110		73	87	14	110

Female neck



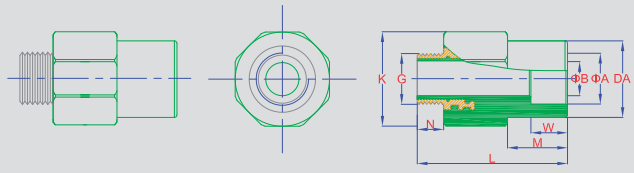
Code	Dimensions (Ø)	Package item/carton	kgr/item	DA	DB	ΦA	ΦB	W	M	L
790350075	75	10	0.210	91	121	74	66	30	20	38
790350090	90	8	0.294	110	136	89	71	31	21	42
7903500110	110	12	0.369	130	158	109	91	36	26	47
7903500125	125	10	0.532	148	180	124	95	40	25	50
7903500160	160	2	2.261	160	213	115	115	165	168	191

Metal gasket



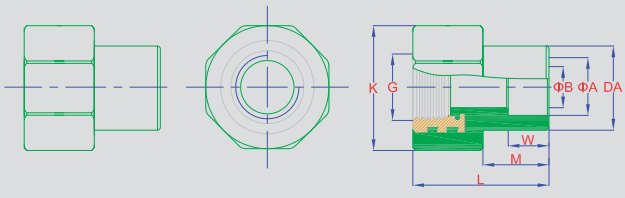
Code	Dimensions (Ø)	Package item/carton	kgr/item	D	ΦA	ΦB	C	P
700070075	75	1	0,244	185	86	18	145	18
700070090	90	1	0,372	200	98	18	158	19
700070110	110	1	0,616	220	128	18	179	22
700070125	125	1	2,775	240	148	18	198	16

Coupling male - PN25



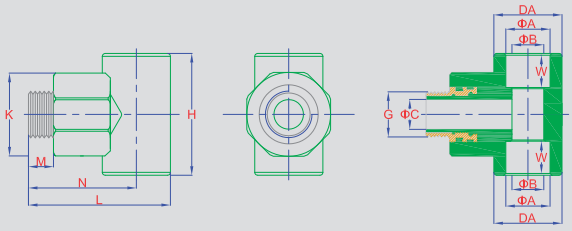
Code	Dimensions	Package item/carton	Package item/bag	kgr/item	DA	ΦA	ΦB	K	G	W	M	N	L
790112012	20x1/2"	90	10	0,087	30	19	12,5	37	1/2"	14,5	23	15	63
790112034	20x3/4"	60	10	0,141	36	19	16,5	45	3/4"	14,5	23	16	64
790112512	25x1/2"	60	10	0,100	36	24	13	44	1/2"	15,5	23	15	64
790112534	25x3/4"	60	10	0,139	36	24	16,5	44	3/4"	15	23	16	64
790113234	32x3/4"	30	6	0,161	44	31	16,5	56	3/4"	21	19	16	62
790113201	32x1"	30	6	0,316	44	31	22,3	56,5	1"	21	20	17	74
790114001	40x1"	16	4	0,368	54	39	20,5	68	1"	21	21	17	82
790114014	40x11/4"	16	4	0,488	54	39	27,5	68	11/4"	21	21	21	90
790115014	50x11/4"	12	2	0,545	70	49	28	79	11/4"	25	24	21	93
790115012	50x11/2"	12	2	0,6410	70	49	34,5	79	11/2"	25	24	18	89
790116312	63x11/2"	10	2	0,6850	83	62	35	88	11/2"	28	30	20	93
790116302	63x2"	10	2	0,8930	83	62	45	88	2"	28	30	24	104
790117502	75x2"	2	1	1,0283	98	74	45,5	111	2"	34	30	24	113
790117512	75x21/2"	2	1	1,6990	98	74	61	112	21/2"	34	30	26	117
790119003	90x3"	2	1	1,600	117	89	70	138	3"	39	42	30	129
790111104	110x4"	1	1	0,780	137	109	86	163	4"	45	49	39	152
790111255	125x5"	1	1		167	124	103	198	5"	40	40	43	165

Female coupling - PN25



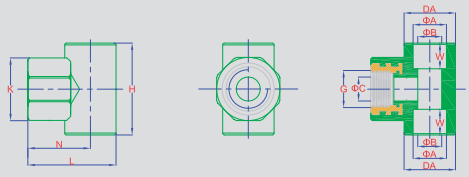
Code	Dimensions	Package item/carton	Package item/bag	kgr/item	DA	ΦA	ΦB	K	G	W	M	L
790122012	20x1/2"	100	10	0,075	30	19	12,5	37	1/2"	14,5	23	48
790122034	20x3/4"	70	10	0,116	36	19	16,5	44	3/4"	14,5	23	48
790122512	25x1/2"	70	10	0,089	36	24	13	44	1/2"	15,5	23	48
790122534	25x3/4"	70	10	0,095	36	24	16,5	44	3/4"	15	23	48
790123234	32x3/4"	30	6	0,1170	44	31	16,5	56	3/4"	21	20	47
790123201	32x1"	30	6	0,23	44	31	22,3	56,5	1"	21	20	57
790124001	40x1"	16	4	0,273	54	39	20,5	68	1"	21	22	63
790124014	40x11/4"	16	4	0,376	54	39	27,5	68	11/4"	21	21	68
790125014	50x11/4"	12	2	0,428	70	49	28	79	11/4"	25	24	71
790125012	50x11/2"	12	2	0,5560	70	49	34,5	79	11/2"	25	24	71
790126312	63x11/2"	10	2	0,6070	83	62	35	88	11/2"	28	30	75
790126302	63x2"	10	2	0,6900	83	62	45	88	2"	28	30	80
790127502	75x2"	2	1	0,8431	98	74	45,5	111	2"	34	30	88
790127512	75x21/2"	2	1	1,2353	98	74	61	112	21/2"	34	30	88
790129003	90x3"	4	1	1,469	117	89	70	138	3"	39	42	99
790121104	110x4"	2	1	3,071	137	109	86	163	4"	45	49	117
790121255	125x5"	1	1		167	124	103	198	5"	40	40	124

Male tee - PN25



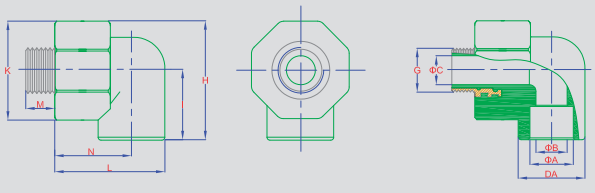
Code	Dimensions	Package item/carton	Package item/bag	kgr/item	DA	ΦA	ΦB	ΦC	K	G	W	M	N	H	L
790152012	20x1/2"x20	60	10	0,100	30	19	13	13	37	1/2"	15	15	50	54	65
700152512	25x1/2"x25	36	6	0,123	36	24	13	13	44	1/2"	16	15	55	62	73
790152534	25x3/4"x25	36	6	0,159	36	24	16,5	16,5	44	3/4"	16	16	55	62	73
790153201	32x1"x32	20	4	0,356	45	31	24	21,5	57	1"	21	53	69	76	92

Female tee - PN25



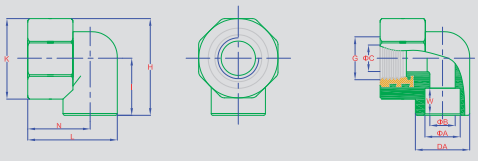
Code	Dimensions	Package item/carton	Package item/bag	kgr/item	DA	ΦA	ΦB	ΦC	K	G	W	M	N	H	L
790162012	20x1/2"x20	70	10	0,085	30	19	13	13	37	1/2"	15	15	34	54	49
700162512	25x1/2"x25	40	6	0,112	36	24	13	13	44	1/2"	16	15	42	62	60
790162534	25x3/4"x25	40	6	0,116	36	24	16,5	16,5	44	3/4"	16	16	42	62	60
790163201	32x1"x32	18	4	0,267	45	31	24	21,5	39	1"	20	53	52,5	76	75

Male elbow - PN25



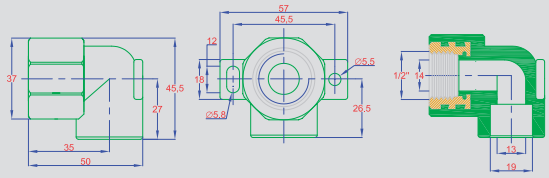
Code	Dimensions	Package item/carton	Package item/bag	kgr/item	DA	ΦA	ΦB	ΦC	K	G	W	M	N	H	I	L
790132012	20x1/2"	70	10	0,093	30	19	13	13	37	1/2"	14,5	15	50	45	26,5	65
700132512	25x1/2"	40	8	0,117	36	24	13	13	44	1/2"	16	15	56	53	31	74
790132534	25x3/4"	40	8	0,151	36	24	16,5	16,5	44	3/4"	16	16	57	53	31	75
790133201	32x1"	24	4	0,346	45	31	24	21,5	39	1"	20	17	68,5	66	38	91

Female elbow - PN25



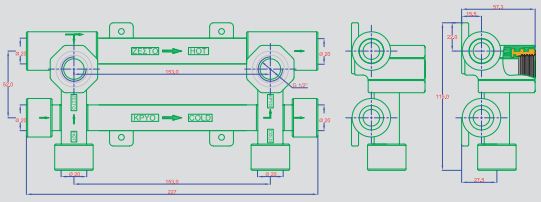
Code	Dimensions	Package item/carton	Package item/bag	kgr/item	DA	ΦA	ΦB	ΦC	K	G	W	N	H	I	L
790142012	20x1/2"	80	10	0,080	30	19	13	13	37	1/2"	14,5	34	45	26,5	49
700142512	25x1/2"	40	8	0,104	36	24	13	13	44	1/2"	16	41	53	31	59
790142534	25x3/4"	40	8	0,109	36	24	16,5	16,5	44	3/4"	16	41	53	31	59
790143201	32x1"	24	4	0,253	45	31	24	21,5	39	1"	20	51,5	66	38	74

Wall plate elbow - PN25



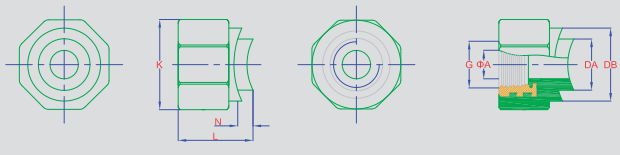
Code	Dimensions	Package item/carton	Package item/bag	kgr/item
790172012	20 x 1/2″	70	10	0,085

Aligning water intake template - PN25



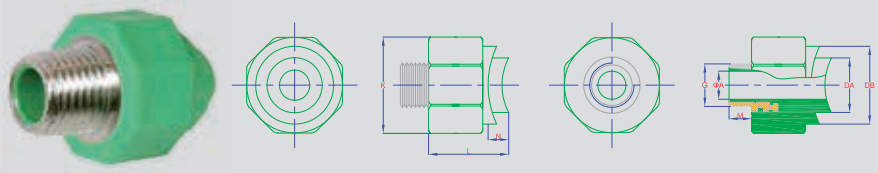
Code	Dimensions	Package item/carton	Package item/bag	kgr/item
790210000	20 x 1/2″	16	1	0,336

Supply saddle female - PN25



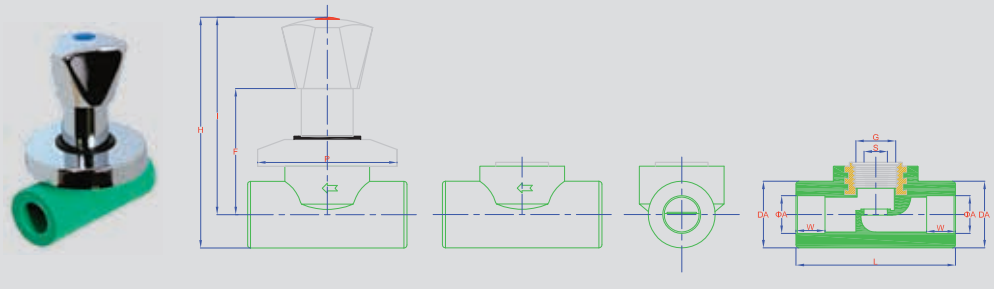
Code	Dimensions	Package item/carton	Package item/bag	kgr/item	DA	DB	ΦA	K	G	N	L
790224012	40x1/2"x25	100	10	0.0830	25	36	14,5	44	1/2"	7	42
790224034	40x3/4"x25	80	10	0.0890	25	36	16,5	44	3/4"	7	38
790224011	40x1"x25	30	6	0.230	25	37	16,5	57	1"	6,5	55,5
790225012	50x1/2"x25	100	10	0.0830	25	36	14,5	44	1/2"	8,5	39
790225034	50x3/4"x25	80	10	0.0840	25	36	16,5	44	3/4"	8,5	39
790225011	50x1"x32	30	6	0.230	32	43	16,5	57	1"	8,5	55
790226312	63x1/2"x25	100	10	0.072	25	36,5	15	38	1/2"	8,5	40,5
790226334	63x3/4"x25	90	10	0.089	25	36,5	16,5	44	3/4"	8,5	40,5
790226301	63x1"x32	30	6	0.231	32	43	22	57	1"	10,5	61
790226314	63x11/4"x40	16	4	0.384	40	57	32	74	11/4"	10,5	71
790227512	75x1/2"x25	100	10	0.072	25	36	14	38	1/2"	9,5	41
790227534	75x3/4"x25	90	10	0.089	25	43	16,5	44	3/4"	10	41
790227501	75x1"x32	30	6	0.227	32	43	22,5	57	1"	12,5	61,5
790227514	75x11/4"x40	16	4	0.362	40	57	32	74	11/4"	12,5	70
790229012	90x1/2"x25	100	10	0.080	25	36	13,5	44	1/2"	?	37
790229034	90x3/4"x25	80	10	0.087	25	36	16,5	44	3/4"	13	43
790229001	90x1"x32	30	6	0.230	32	42	21	57	1"	13	61
790221112	110x1/2"x25	100	10	0.081	25	36	14	44	1/2"	12,5	42
790221134	110x3/4"x25	80	10	0.086	25	36	16,5	44	3/4"	12,5	42
790221101	110X1"x32	30	6	0.0228	32	43	21	57	1"	12,5	60

Supply saddle male - PN25



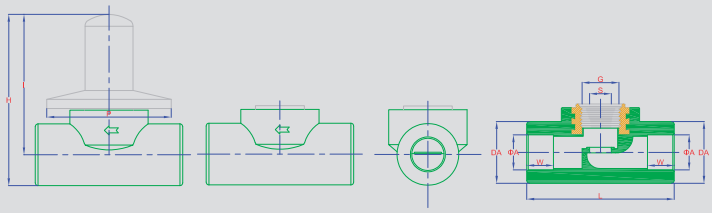
Code	Dimensions	Package item/carton	Package item/bag	kgr/item	DA	DB	ΦA	K	G	M	N	L
790394012	40x1/2"x25	80	10	0.093	25	36	13	44	1/2"	15	8,5	57
790394034	40x3/4"x25	80	10	0.132	25	36	16,5	44	3/4"	16	7	54
790394011	40x1"x25	30	6	0.322	25	37	21,5	57	1"	17	6,5	73
790395012	50x1/2"x25	80	10	0.093	25	36	14,5	44	1/2"	15	8,5	54
790395034	50x3/4"x25	80	10	0.132	25	36	16,5	44	3/4"	16	8,5	55
790395011	50x1"x25	30	6	0.319	25	43	21,5	57	1"	17	8,5	72
790399011	90x1/2"x25	80	10	0.091	25	36	13	44	1/2"	15	6	53
790399034	90x3/4"x25	80	10	0.132	25	36	16,5	44	3/4"	16	13	58
790399001	90x1"x32	30	6	0.327	32	42	21,5	57	1"	17	13	78
790391112	110x1/2"x25	80	10	0.094	25	36	13	44	1/2"	15	12,5	57
790391134	110x3/4"x25	80	10	0.131	25	36	16,5	44	3/4"	16	12,5	58
790391101	110X1"x32	30	6	0.325	32	43	21,5	57	1"	17	12,5	77

Stop cock



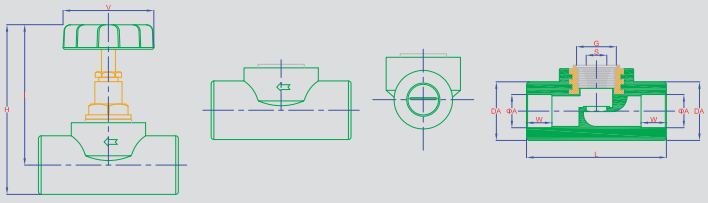
Code	Dimensions (Ø)	Package item/carton	Package item/bag	kgr/item	DA	ΦA	G	S	H	I	F	W	P	L
790100020	20	16	1	0,361	34	19	1/2"	10	112	95	60	14,5	70	80
700100025	25	16	1	0,367	36	24	1/2"	10	124	106	42	16	68	85
700100032	32	12	1	0,516	44	31	1"	19	140	118	45	20	69	90

Stop cock with short neck- PN25



Code	Dimensions (Ø)	Package item/carton	Package item/bag	kgr/item	DA	ΦA	G	S	H	I	W	P	L
790300020	20x1/2"	16	1	0.254	34	19	1/2"	10	86	69	14,5	70	80
790300025	25x1/2"	16	1	0.265	36	24	1/2"	10	87	69	16	70	85
790300032	32x1"	16	1	0.455	43,5	31	1"	19	90	69	20	70	90

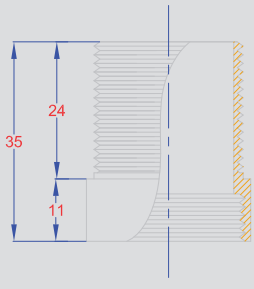
Rotative valve - PN25

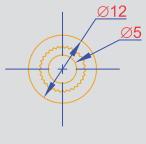


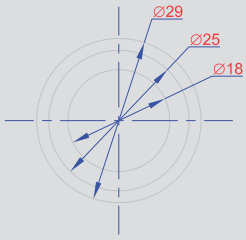
Code	Dimensions	Package item/carton	Package item/bag	kgr/item	DA	ΦA	G	S	H	I	W	V	L
790100120	Ø20x1/2"	16	1	0.180	34	19	1/2"	10	102	87	14,5	52	80
790100125	Ø25x1/2"	16	1	0.186	36	24	1/2"	10	105	87	16	52	86
790100132	Ø32x1"	16	1	0.349	43,5	31	1"	19	118	97	20	58	90

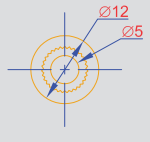
Extension for stop cock

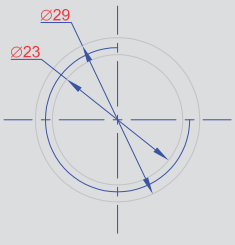
Code	Package item/carton	Package item/bag	kgr/item
542240000001	10	1	0,074

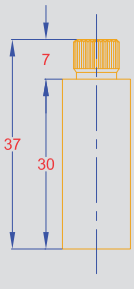


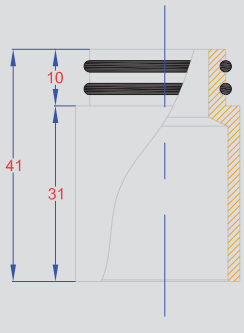


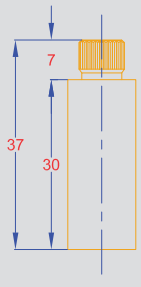




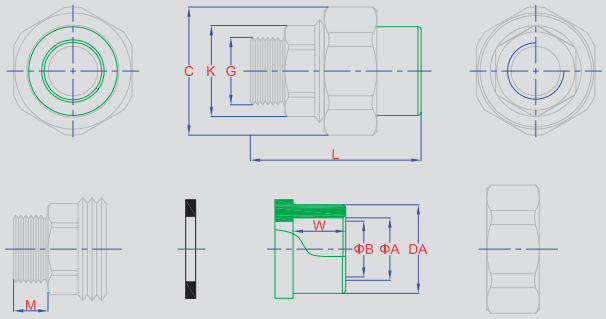






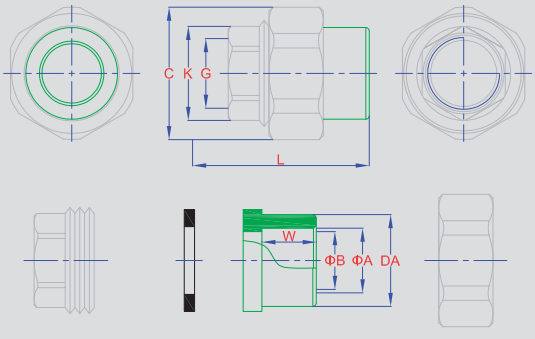


Brass coupling male



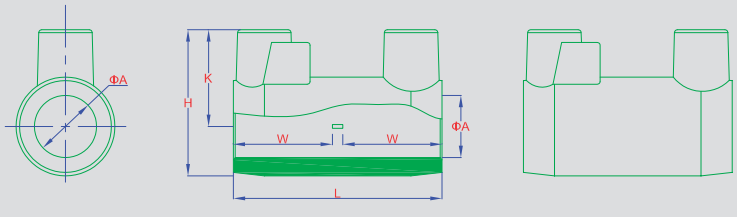
Code	Dimensions	Package item/carton	Package item/bag	kgr/item	DA	ΦA	ΦB	C	K	G	M	W	L
700422012	20x1/2"	80	10	0.106	27	19	17	36	27	1/2"	12	16	55
700422534	25x3/4"	50	10	0.150	35	24	21	46	32	3/4"	12	17	55
700423201	32x1"	30	6	0.231	40	31	29	52	37	1"	14	19	63
700424014	40x11/4"	16	4	0.428	51	39	37	65	46	11/4"	16	21	66

Brass coupling female



Code	Dimensions	Package item/carton	Package item/bag	kgr/item	DA	ΦA	ΦB	C	K	G	W	L
700412012	20x1/2"	80	10	0.085	27	19	17	36	27	1/2"	16	41
700412534	25x3/4"	60	10	0.152	35	24	21	45	32	3/4"	17	45
700413201	32x1"	30	6	0.180	40	31	29	52	37	1"	19	48
700414014	40x11/4"	16	4	0.328	51	39	37	65	46	11/4"	21	53

Electrosocket



Code	Dimensions (Ø)	Package item/carton	kgr/item	ΦA	H	K	W	L
790100020	20	20	0,038	20,5	51	34	34	71
700100025	25	15	0,052	25,5	56	37	34	71
700100032	32	10	0,088	32,5	65	42	38	81
700100040	40	6	0,172	40,5	73	47	45	94
700100050	50	3	0,252	50,5	84	50		101
700100063	63	2	0,428	63,5	101	58		107

2 | PRESSURE UNITS CONVERSION TABLE

bar	m H_2O	at	daPa	hPa	Mpa
0	0	0	0	0	0,0
1	10	1	10000	1000	0,1
2	20	2	20000	2000	0,2
3	30	3	30000	3000	0,3
4	40	4	40000	4000	0,4
5	50	5	50000	5000	0,5
6	60	6	60000	6000	0,6
7	70	7	70000	7000	0,7
8	80	8	80000	8000	0,8
9	90	9	90000	9000	0,9
10	100	10	100000	10000	1,0

3 | FLOW UNITS CONVERSION TABLE

dm^3/s	dm^3/min	M^3/h
0	0	0
2	120	7,2
4	240	14,4
6	360	21,6
8	480	28,8
10	600	36
12	720	43,2
14	840	50,4
16	960	57,6
18	1080	64,8
20	1200	72

4.1| CALCULATION OF REQUIRED NETWORK SUPPLY ON THE BASIS OF TOTAL SUPPLY OF DISCHARGE POINTS

Σq_n		q	Σq_n	q	Σq_n	q
<0,5 l/s	≥0,5 l/s	l/s	l/s	l/s	l/s	l/s
0,06		0,05	21,89	2,55	331	5,05
0,10		0,10	23,54	2,60	345	5,10
0,15		0,15	25,28	2,65	360	5,15
0,21		0,20	27,13	2,70	374	5,20
0,29		0,25	29,08	2,75	390	5,25
0,38		0,30	31,15	2,80	406	5,30
0,48		0,35	33,32	2,85	422	5,35
0,60		0,40	35,62	2,90	439	5,40
0,72		0,45	38,04	2,95	456	5,45
0,87	0,50	0,50	40,58	3,00	474	5,50
1,03	0,55	0,55	43,26	3,05	493	5,55
1,20	0,60	0,60	46,08	3,10	512	5,60
1,39	0,65	0,65	49,04	3,15		
1,59	0,70	0,70	52,15	3,20		
1,81	0,75	0,75	55,41	3,25		
2,04	0,80	0,80	58,83	3,30		
2,29	0,85	0,85	62,41	3,35		
2,55	0,90	0,90	66,17	3,40		
2,83	0,95	0,95	70,10	3,45		
3,13	1,00	1,00	74,21	3,50		
3,45	1,15	1,05	78,51	3,55		
3,78	1,31	1,10	83,01	3,60		
4,12	1,50	1,15	87,84	3,65		
4,49	1,70	1,20	92,62	3,70		
4,87	1,92	1,25	97,74	3,75		
5,26	2,17	1,30	103,08	3,80		
5,68	2,44	1,35	108,65	3,85		
6,11	2,74	1,40	114,45	3,90		
6,56	3,06	1,45	120,50	3,95		
7,03	3,41	1,50	126,79	4,00		
7,51	3,80	1,55	133	4,05		
8,02	4,22	1,60	140	4,10		
8,54	4,67	1,65	147	4,15		
9,08	5,17	1,70	155	4,20		
9,63	5,70	1,75	162	4,25		
10,21	6,27	1,80	170	4,30		
10,80	6,89	1,85	178	4,35		
11,41	7,56	1,90	187	4,40		
12,04	8,28	1,95	196	4,45		
12,69	9,05	2,00	205	4,50		
13,36	9,88	2,05	215	4,55		
14,05	10,76	2,10	225	4,60		
14,76	11,84	2,15	235	4,65		
15,48	12,72	2,20	246	4,70		
16,23	13,80	2,25	257	4,75		
16,99	14,95	2,30	268	4,80		
17,78	16,17	2,35	280	4,85		
18,58	17,48	2,40	292	4,90		
19,40	18,86	2,45	305	4,95		
20,24	20,33	2,50	318	5,00		

4.2 | CALCULATION OF REQUIRED SUPPLY FOR HOMES

Σq_n σε l/s for discharge points with <0,5 l/s	Σq_n σε l/s for discharge points with ≥0,5 l/s	q in l/s	Σq_n in l/s	q in l/s	Σq_n in l/s	q in l/s
0,06		0,05	21,89	2,55	331	5,05
0,10		0,10	23,54	2,60	345	5,10
0,15		0,15	25,28	2,65	360	5,15
0,21		0,20	27,13	2,70	374	5,20
0,29		0,25	29,08	2,75	390	5,25
0,38		0,30	31,15	2,80	406	5,30
0,48		0,35	33,32	2,85	422	5,35
0,60		0,40	35,62	2,90	439	5,40
0,72		0,45	38,04	2,95	456	5,45
0,87	0,50	0,50	40,58	3,00	474	5,50
1,03	0,55	0,55	43,26	3,05	493	5,55
1,20	0,60	0,60	46,08	3,10	512	5,60
1,39	0,65	0,65	49,04	3,15		
1,59	0,70	0,70	52,15	3,20		
1,81	0,75	0,75	55,41	3,25		
2,04	0,80	0,80	58,83	3,30		
2,29	0,85	0,85	62,41	3,35		
2,55	0,90	0,90	66,17	3,40		
2,83	0,95	0,95	70,10	3,45		
3,13	1,00	1,00	74,21	3,50		
3,45	1,15	1,05	78,51	3,55		
3,78	1,31	1,11	83,01	3,60		
4,12	1,50	1,15	87,71	3,65		
4,49	1,70	1,20	92,62	3,70		
4,87	1,92	1,25	97,74	3,75		
5,26	2,17	1,30	103,08	3,80		
5,68	2,44	1,35	108,65	3,85		
6,11	2,74	1,40	114,45	3,90		
6,56	3,06	1,45	120,50	3,95		
7,03	3,41	1,50	126,79	4,00		
7,51	3,80	1,55	133	4,05		
8,02	4,22	1,60	140	4,10		
8,54	4,67	1,65	147	4,15		
9,08	5,17	1,70	155	4,20		
9,63	5,70	1,75	162	4,25		
10,21	6,27	1,80	170	4,30		
10,80	6,89	1,85	178	4,35		
11,41	7,56	1,90	187	4,40		
12,04	8,28	1,95	196	4,45		
12,69	9,05	2,00	205	4,50		
13,36	9,88	2,05	215	4,55		
14,05	10,76	2,10	225	4,60		
14,76	11,71	2,15	235	4,65		
15,48	12,72	2,20	246	4,70		
16,23	13,80	2,25	257	4,75		
16,99	14,95	2,30	268	4,80		
17,78	16,17	2,35	280	4,85		
18,58	17,48	2,40	292	4,90		
19,40	18,86	2,45	305	4,95		
20,24	20,33	2,50	318	5,00		

4.3 | CALCULATION OF REQUIRED SUPPLY FOR OFFICES

Σq_n in l/s	q in l/s	Σq_n in l/s	q in l/s	Σq_n in l/s	q in l/s
for Σq_n Σq less than 20 l/s please refer to table 4.2					
20,00	2,50				
20,93	2,55	90,58	5,05	293,0	9,1
21,87	2,60	92,42	5,10	299,3	9,2
22,84	2,65	94,28	5,15	305,7	9,3
23,82	2,70	96,16	5,20	312,2	9,4
24,82	2,75	98,05	5,25	318,7	9,5
25,84	2,80	99,96	5,30	325,2	9,6
26,88	2,85	101,89	5,35	331,8	9,7
27,94	2,90	103,83	5,40	338,5	9,8
29,02	2,95	105,79	5,45	345,3	9,9
30,11	3,00	107,77	5,50	352,1	10,0
31,23	3,05	109,76	5,55	359,0	10,1
32,36	3,10	111,77	5,60	365,9	10,2
33,51	3,15	113,80	5,65	372,9	10,3
34,68	3,20	115,85	5,70	380,0	10,4
35,87	3,25	117,91	5,75	387,1	10,5
37,08	3,30	119,98	5,80	394,3	10,6
38,31	3,35	122,08	5,85	401,5	10,7
39,55	3,40	124,19	5,90	408,8	10,8
40,81	3,45	126,32	5,95	416,1	10,9
42,09	3,50	128,46	6,00	423,6	11,0
43,39	3,55	132,8	6,1	431,0	11,1
44,71	3,60	137,2	6,2	438,6	11,2
46,04	3,65	141,7	6,3	446,2	11,3
47,39	3,70	146,2	6,4	453,8	11,4
48,76	3,75	150,8	6,5	461,6	11,5
50,15	3,80	155,5	6,6	469,3	11,6
51,56	3,85	160,2	6,7	477,2	11,7
52,98	3,90	165,0	6,8	485,1	11,8
54,43	3,95	169,0	6,9	493,0	11,9
55,88	4,00	174,8	7,0	501,0	12,0
57,36	4,05	179,8	7,1		
58,86	4,10	184,9	7,2		
60,37	4,15	190,0	7,3		
61,90	4,20	195,2	7,4		
63,45	4,25	200,4	7,5		
65,01	4,30	205,7	7,6		
66,60	4,35	211,1	7,7		
68,20	4,40	216,5	7,8		
69,82	4,45	222,0	7,9		
71,45	4,50	227,6	8,0		
73,10	4,55	233,2	8,1		
74,77	4,60	238,9	8,2		
76,46	4,65	244,7	8,3		
78,17	4,70	250,5	8,4		
79,89	4,75	256,4	8,5		
81,63	4,80	262,3	8,6		
83,38	4,85	268,4	8,7		
85,16	4,90	274,4	8,8		
86,95	4,95	280,6	8,9		
88,76	5,00	286,7	9,0		

4.4 | CALCULATION OF REQUIRED SUPPLY FOR HOTELS

Σq_n for discharge points with		q	Σq_n for discharge points with		q	Σq_n	q	Σq_n	q	Σq_n	q
<0,5 l/s	≥0,5 l/s	in l/s	<0,5 l/s	≥0,5 l/s	in l/s	in l/s	in l/s	in l/s	in l/s	in l/s	in l/s
0,10		0,10	14,63	12,85	2,55	41,2	5,1	122,2	10,1	248,6	15,2
0,15		0,15	15,19	13,54	2,60	42,4	5,2	1245,1	10,2	254,5	15,4
0,21		0,20	15,75	14,27	2,65	43,6	5,3	126,1	10,3	260,5	15,6
0,28		0,25	16,32	15,01	2,70	44,8	5,4	128,2	10,4	266,5	15,8
0,36		0,30	16,91	15,78	2,75	46,1	5,5	130,3	10,5	272,6	16,0
0,45		0,35	17,50	16,58	2,80	47,3	5,6	132,5	10,6	278,7	16,2
0,56		0,40	18,11	17,40	2,85	48,6	5,7	134,6	10,7	284,9	16,4
0,67		0,45	18,72	18,24	2,90	49,9	5,8	136,8	10,8	291,2	16,6
0,79	0,50	0,50	19,34	19,11	2,95	51,2	5,9	138,9	10,9	297,6	16,8
			19,98	20,01	3,00	52,6	6,0	141,1	11,0	304,0	17,0
0,92	0,55	0,55									
1,06	0,60	0,60	20,42		3,05	53,9	6,1	143,3	11,1	310,5	17,2
1,22	0,65	0,65	20,84		3,10	55,3	6,2	145,6	11,2	317,0	17,4
1,38	0,70	0,70	21,26		3,15	56,7	6,3	147,8	11,3	323,7	17,6
1,55	0,75	0,75	21,69		3,20	58,1	6,4	150,1	11,4	330,4	17,8
1,74	0,80	0,80	22,12		3,25	59,5	6,5	152,3	11,5	337,1	18,0
1,93	0,85	0,85	22,56		3,30	60,3	6,6	154,6	11,6	344,0	18,2
2,14	0,90	0,90	23,00		3,35	62,4	6,7	156,9	11,7	350,9	18,4
2,35	0,95	0,95	23,45		3,40	63,9	6,8	159,3	11,8	357,8	18,6
2,57	1,00	1,00	23,90		3,45	65,3	6,9	161,6	11,9	364,9	18,8
			24,36		3,50	66,8	7,0	164,0	12,0	372,0	19,0
2,81	1,14	1,05									
3,05	1,30	1,10	24,82		3,55	68,4	7,1	166,4	12,1	379,2	19,2
3,31	1,46	1,15	25,28		3,60	69,9	7,2	168,8	12,2	386,4	19,4
3,58	1,64	1,20	25,75		3,65	71,5	7,3	171,2	12,3	393,7	19,6
3,85	1,84	1,25	26,22		3,70	73,0	7,4	173,6	12,4	401,1	19,8
4,14	2,05	1,30	26,69		3,75	74,6	7,5	176,1	12,5	408,6	20,0
4,44	2,27	1,35	27,17		3,80	76,2	7,6	178,5	12,6	416,1	20,2
4,74	2,50	1,40	27,66		3,85	77,9	7,7	181,0	12,7	423,7	20,4
5,06	2,75	1,45	28,15		3,90	79,5	7,8	183,5	12,8	431,3	20,6
5,39	3,02	1,50	28,64		3,95	81,2	7,9	186,0	12,9	439,1	20,8
			29,14		4,00	82,8	8,0	188,6	13,0	446,9	21,0
5,72	3,30	1,55									
6,07	3,60	1,60	29,64		4,05	84,5	8,1	191,1	13,1	454,7	21,2
6,43	3,92	1,65	30,15		4,10	86,2	8,2	193,7	13,2	462,6	21,4
6,80	4,25	1,70	30,66		4,15	88,0	8,3	196,3	13,3	470,6	21,6
7,18	4,60	1,75	31,17		4,20	89,7	8,4	198,9	13,4	478,7	21,8
7,57	4,97	1,80	31,69		4,25	91,5	8,5	201,5	13,5	486,9	22,0
7,97	5,35	1,85	32,22		4,30	93,3	8,6	204,1	13,6	495,1	22,2
8,38	5,76	1,90	32,74		4,35	95,1	8,7	206,8	13,7	50,3	22,4
8,79	6,18	1,95	33,28		4,40	96,9	8,8	209,4	13,8		
9,22	6,62	2,00	33,81		4,45	98,7	8,9	212,1	13,9		
			34,35		4,50	100,6	9,0	214,8	14,0		
9,67	7,08	2,05									
10,12	7,56	2,10	34,90		4,55	102,4	9,1	217,6	14,1		
10,58	8,07	2,15	35,45		4,60	104,3	9,2	220,3	14,2		
11,05	8,59	2,20	36,00		4,65	106,2	9,3	222,1	14,3		
11,53	9,13	2,25	36,56		4,70	108,1	9,4	225,8	14,4		
12,02	9,69	2,30	27,12		4,75	110,1	9,5	228,6	14,5		
12,52	10,28	2,35	37,69		4,80	112,0	9,6	231,4	14,6		
13,03	10,89	2,40	38,26		4,85	114,0	9,7	234,3	14,7		
13,56	11,52	2,45	38,83		4,90	116,0	9,8	237,1	14,8		
14,09	12,17	2,50	39,41		4,95	118,0	9,9	240,0	14,9		
			39,99		5,00	120,0	10,0	242,8	15,0		

Σq_n in l/s	q in l/s	Σq_n in l/s	q in l/s	Σq_n in l/s	q in l/s
for Σq_n Σq less than 20 l/s please refer to table 4.4					
20,00	3,00				
20,39	3,05	47,70	5,55	154,4	10,1
20,78	3,10	48,43	5,60	157,9	10,2
21,18	3,15	49,16	5,65	161,4	10,3
21,58	3,20	49,91	5,70	164,9	10,4
21,99	3,25	50,66	5,75	168,5	10,5
22,41	3,30	51,42	5,80	172,2	10,6
22,83	3,35	52,19	5,85	175,9	10,7
23,25	3,40	52,97	5,90	179,7	10,8
23,68	3,45	53,76	5,95	183,6	10,9
24,12	3,50	54,55	6,00	187,5	11,0
24,56	3,55	56,2	6,1	191,4	11,1
25,01	3,60	57,8	6,2	195,5	11,2
25,47	3,65	59,5	6,3	199,5	11,3
25,93	3,70	61,2	6,4	203,7	11,4
26,40	3,75	63,0	6,5	207,9	11,5
26,87	3,80	64,8	6,6	212,2	11,6
27,35	3,85	66,6	6,7	216,5	11,7
27,84	3,90	68,5	6,8	220,9	11,8
28,33	3,95	70,4	6,9	225,4	11,9
28,83	4,00	72,3	7,0	229,9	12,0
29,33	4,05	74,3	7,1	234,5	12,1
29,34	4,10	76,3	7,2	239,2	12,2
30,36	4,15	78,4	7,3	243,9	12,3
30,88	4,20	80,5	7,4	248,8	12,4
31,42	4,25	82,6	7,5	253,6	12,5
31,95	4,30	84,8	7,6	258,6	12,6
32,50	4,35	87,0	7,7	263,6	12,7
33,05	4,40	89,3	7,8	268,7	12,8
33,61	4,45	91,6	7,9	273,8	12,9
34,17	4,50	94,0	8,0	279,1	13,0
34,74	4,55	96,4	8,1	284,3	13,1
35,32	4,60	98,8	8,2	289,7	13,2
35,90	4,65	101,3	8,3	295,2	13,3
36,50	4,70	103,9	8,4	300,7	13,4
37,10	4,75	106,4	8,5	306,3	13,5
37,70	4,80	109,1	8,6	312,0	13,6
38,32	4,85	111,7	8,7	317,7	13,7
38,94	4,90	114,5	8,8	323,5	13,8
39,57	4,95	117,2	8,9	329,4	13,9
40,20	5,00	120,0	9,0	335,4	14,0
40,84	5,05	122,9	9,1	348	14,2
41,50	5,10	125,8	9,2	360	14,4
42,15	5,15	128,8	9,3	373	14,6
42,82	5,20	131,8	9,4	386	14,8
43,49	5,25	134,9	9,5	400	15,0
44,17	5,30	138,0	9,6	414	15,2
44,86	5,35	141,2	9,7	428	15,4
45,56	5,40	144,4	9,8	442	15,6
46,26	5,45	147,7	9,9	457	15,8
46,98	5,50	151,0	10,0	472	16,0
				488	16,2
				504	16,4

Σq_n in l/s	q in l/s	Σq_n in l/s	q in l/s	Σq_n in l/s	q in l/s
for Σq_n Σq less than 20 l/s please refer to table 4.4					
20,00	3,00				
20,88	3,05	79,80	5,55	242,4	10,1
21,78	3,10	81,23	5,60	246,6	10,2
22,70	3,15	82,67	5,65	250,9	10,3
23,62	3,20	84,12	5,70	255,2	10,4
24,56	3,25	85,58	5,75	259,5	10,5
25,51	3,30	87,05	5,80	263,8	10,6
26,48	3,35	88,53	5,85	268,2	10,7
27,45	3,40	90,01	5,90	272,5	10,8
28,44	3,45	91,51	5,95	277,0	10,9
29,44	3,50	93,01	6,00	281,4	11,0
30,46	3,55	96,0	6,1	285,8	11,1
31,48	3,60	99,1	6,2	290,3	11,2
32,52	3,65	102,2	6,3	294,8	11,3
33,57	3,70	105,3	6,4	299,3	11,4
34,63	3,75	108,5	6,5	303,9	11,5
35,70	3,80	111,7	6,6	308,5	11,6
36,78	3,85	114,9	6,7	313,1	11,7
37,88	3,90	118,2	6,8	317,7	11,8
38,98	3,95	121,5	6,9	322,3	11,9
40,10	4,00	124,8	7,0	327,0	12,0
41,23	4,05	128,2	7,1	331,7	12,1
42,37	4,10	131,6	7,2	336,4	12,2
43,51	4,15	135,0	7,3	341,2	12,3
44,68	4,20	138,4	7,4	345,9	12,4
45,85	4,25	141,9	7,5	350,7	12,5
47,03	4,30	145,4	7,6	355,5	12,6
48,22	4,35	149,0	7,7	360,4	12,7
49,42	4,40	152,5	7,8	365,2	12,8
50,63	4,45	156,1	7,9	370,1	12,9
51,86	4,50	159,8	8,0	375,0	13,0
53,09	4,55	163,4	8,1	379,9	13,1
54,33	4,60	167,1	8,2	384,9	13,2
55,59	4,65	170,8	8,3	389,8	13,3
56,85	4,70	174,6	8,4	394,8	13,4
58,12	4,75	178,3	8,5	399,9	13,5
59,41	4,80	182,1	8,6	404,9	13,6
60,70	4,85	186,0	8,7	409,9	13,7
62,00	4,90	189,8	8,8	415,0	13,8
63,32	4,95	193,7	8,9	420,1	13,9
64,64	5,00	197,6	9,0	425,3	14,0
65,97	5,05	201,6	9,1	436	14,2
67,31	5,10	205,5	9,2	446	14,4
68,66	5,15	209,5	9,3	456	14,6
70,02	5,20	213,5	9,4	467	14,8
71,39	5,25	217,6	9,5	478	15,0
72,77	5,30	221,7	9,6	488	15,2
74,16	5,35	225,8	9,7	499	15,4
75,55	5,40	229,9	9,8	510	15,6
76,96	5,45	234,0	9,9		
78,37	5,50	238,2	10,0		

4.7 | CALCULATION OF REQUIRED SUPPLY FOR SCHOOLS

Σq_n in l/s	q in l/s	Σq_n in l/s	q in l/s	Σq_n in l/s	q in l/s	Σq_n in l/s	q in l/s
0,05		2,22	2,05	7,07	4,05	26,15	7,10
0,10		2,30	2,10	7,24	4,10	27,38	7,20
0,15		2,38	2,15	7,42	4,15	28,70	7,30
0,20		2,46	2,20	7,61	4,20	30,12	7,40
0,25		2,54	2,25	7,79	4,25	31,64	7,50
0,30		2,63	2,30	7,98	4,30	33,28	7,60
0,35		2,71	2,35	8,18	4,35	35,06	7,70
0,40		2,80	2,40	8,37	4,40	36,98	7,80
0,45		2,89	2,45	8,57	4,45	39,06	7,90
0,50		2,98	2,50	8,78	4,50	41,33	8,00
0,55		3,08	2,55	8,99	4,55	43,79	8,10
0,60		3,17	2,60	9,20	4,60	46,49	8,20
0,65		3,27	2,65	9,41	4,65	49,44	8,30
0,70		3,37	2,70	9,63	4,70	52,68	8,40
0,75		3,48	2,75	9,85	4,75	56,25	8,50
0,80		3,58	2,80	10,08	4,80	60,20	8,60
0,85		3,69	2,85	10,31	4,85	64,57	8,70
0,90		3,80	2,90	10,54	4,90	69,44	8,80
0,95		3,91	2,95	10,78	4,95	74,89	8,90
1,00		4,03	3,00	11,02	5,00	81,00	9,00
1,05		4,15	3,05	11,51	5,10	87,89	9,10
1,10		4,27	3,10	12,02	5,20	95,70	9,20
1,15		4,39	3,15	12,54	5,30	104,60	9,30
1,20		4,51	3,20	13,08	5,40	114,80	9,40
1,25		4,64	3,25	13,64	5,50	126,56	9,50
1,30		4,77	3,30	14,22	5,60	140,24	9,60
1,35		4,91	3,35	14,81	5,70	156,25	9,70
1,40		5,04	3,40	15,42	5,80	175,17	9,80
1,45		5,18	3,45	16,05	5,90	197,75	9,90
1,50		5,32	3,50	16,70	6,00	225,00	10,00
1,56	1,55	5,47	3,55	17,37	6,10	258,29	10,10
1,62	1,60	5,61	3,60	18,05	6,20	299,56	10,20
1,68	1,65	5,76	3,65	18,76	6,30	351,56	10,30
1,74	1,70	5,91	3,70	19,48	6,40	418,39	10,40
1,80	1,75	6,07	3,75	20,25	6,50	506,25	10,50
1,87	1,80	6,23	3,80	21,08	6,60		
1,94	1,85	6,39	3,85	21,97	6,70		
2,01	1,90	6,55	3,90	22,92	6,80		
2,08	1,95	6,72	3,95	23,92	6,90		
2,15	2,00	6,89	4,00	25,00	7,00		

5.1 | TABLE OF PRESSURE LOSSES AND CALCULATION OF PIPE DIMENSIONS SDR 6 & SDR AL

q (supply) (l/s)	R (m/s) (pressure loss) v (m/s) (velocity)	COLD WATER								
		Category PN 20								
		20	25	32	40	50	63	75	90	110
0,01	R	0.13	0.04	0.01						
	v	0.07	0.05	0.03						
0,02	R	0.41	0.14	0.04						
	v	0.15	0.09	0.06						
0,03	R	0.81	0.28	0.09						
	v	0.22	0.14	0.08						
0,04	R	1.32	0.45	0.14	0.05					
	v	0.29	0.18	0.11	0.07					
0,05	R	1.94	0.66	0.21	0.07					
	v	0.37	0.23	0.14	0.09					
0,06	R	2.66	0.90	0.28	0.01					
	v	0.44	0.28	0.17	0.11					
0,07	R	3.47	1.17	0.37	0.13	0.04				
	v	0.51	0.32	0.20	0.13	0.08				
0,08	R	4.38	1.47	0.46	0.16	0.05				
	v	0.58	0.37	0.23	0.14	0.09				
0,09	R	5.37	1.81	0.57	0.19	0.07				
	v	0.66	0.42	0.25	0.16	0.10				
0,10	R	6.46	2.17	0.68	0.23	0.08				
	v	0.73	0.46	0.28	0.18	0.11				
0,12	R	8.90	2.98	0.93	0.32	0.11	0.04			
	v	0.88	0.55	0.34	0.22	0.14	0.09			
0,16	R	14.79	4.93	1.54	0.52	0.18	0.06			
	v	1.17	0.74	0.45	0.29	0.18	0.12			
0,18	R	18.24	6.07	1.89	0.64	0.22	0.07			
	v	1.32	0.83	0.51	0.32	0.21	0.13			
0,20	R	22.00	7.31	2.27	0.77	0.26	0.09	0.04		
	v	1.46	0.92	0.57	0.36	0.23	0.14	0.10		
0,30	R	45.52	15.02	4.63	1.57	0.53	0.18	0.08	0.03	
	v	2.19	1.39	0.85	0.54	0.34	0.22	0.15	0.11	
0,40	R	76.63	25.16	7.73	2.60	0.88	0.29	0.13	0.05	
	v	2.92	1.85	1.13	0.72	0.46	0.29	0.20	0.14	
0,50	R	115.12	37.63	11.51	3.86	1.30	0.43	0.19	0.08	
	v	3.65	2.31	1.42	0.90	0.57	0.36	0.25	0.18	
0,60	R	160.87	52.38	15.97	5.34	1.79	0.60	0.26	0.11	
	v	4.38	2.77	1.70	1.08	0.68	0.43	0.31	0.21	
0,70	R	213.78	69.37	21.09	7.04	2.35	0.79	0.34	0.14	0.05
	v	5.12	3.23	1.98	1.26	0.80	0.51	0.36	0.25	0.17
0,80	R		88.57	26.85	8.94	2.99	1.00	0.43	0.18	0.07
	v		3.70	2.27	1.44	0.91	0.58	0.41	0.28	0.19
0,90			109.97	33.25	11.05	3.69	1.23	0.53	0.22	0.09
			4.16	2.55	1.62	1.03	0.65	0.46	0.32	0.21

q (supply) (l/s)	R (m/s) (pressure loss) v (m/s) (velocity)	COLD WATER								
		Category PN 20								
		20	25	32	40	50	63	75	90	110
1,00	R		133.53	40.28	13.37	4.45	1.48	0.64	0.27	0.10
	v		4.62	2.83	1.80	1.14	0.72	0.51	0.35	0.24
1,20	R		187.12	56.21	18.60	6.17	2.05	0.89	0.37	0.14
	v		5.54	3.40	2.16	1.37	0.87	0.61	0.42	0.28
1,40	R			74.61	24.61	8.15	2.70	1.17	0.49	0.19
	v			3.97	2.52	1.60	1.01	0.71	0.50	0.33
1,60	R			95.44	31.40	10.38	3.43	1.48	0.62	0.24
	v			4.53	2.88	1.83	1.15	0.81	0.57	0.38
1,80	R			118.68	38.95	12.85	4.24	1.83	0.76	0.29
	v			5.01	3.24	2.05	1.30	0.92	0.64	0.43
2,00	R				47.26	15.56	5.12	2.21	0.92	0.35
	v				3.60	2.28	1.44	1.02	0.71	0.47
2,20	R				56.32	18.51	6.09	2.62	1.09	0.41
	v				3.96	2.51	1.59	1.12	0.78	0.52
2,40	R				66.13	21.70	7.12	3.07	1.27	0.48
	v				4.32	2.74	1.73	1.22	0.85	0.57
2,60	R				76.68	25.12	8.24	3.54	1.47	0.56
	v				4.68	2.97	1.88	1.32	0.92	0.61
2,80	R				87.97	28.78	9.42	4.05	1.68	0.64
	v				5.04	3.20	2.02	1.43	0.99	0.66
3,00	R					32.66	10.68	4.59	1.90	0.72
	v					3.42	2.17	1.53	1.06	0.71
3,20	R					36.78	12.02	5.15	2.13	0.81
	v					3.65	2.31	1.63	1.13	0.76
3,40	R					41.13	13.42	5.75	2.38	0.90
	v					3.88	2.45	1.73	1.20	0.80
3,60	R					45.71	14.90	6.38	2.64	1.00
	v					4.11	2.60	1.83	1.27	0.85
3,80	R					50.51	16.45	7.04	2.91	1.10
	v					4.34	2.74	1.94	1.34	0.90
4,00	R					55.54	18.07	7.73	3.19	1.21
	v					4.57	2.89	2.04	1.41	0.95
4,20	R					60.80	19.77	8.45	3.49	1.32
	v					4.79	3.03	2.14	1.49	0.99
4,40	R					66.28	21.53	9.20	3.80	1.43
	v					5.02	3.18	2.24	1.56	1.04
4,60	R						23.36	9.98	4.12	1.55
	v						3.32	2.34	1.63	1.09
4,80	R						25.27	10.78	4.45	1.68
	v						3.46	2.44	1.70	1.13
5,00							27.24	11.62	4.79	1.81
							3.61	2.55	1.77	1.18

q (supply) (l/s)	R (m/s) (pressure loss) v (m/s) (velocity)	COLD WATER								
		Category PN 20								
		20	25	32	40	50	63	75	90	110
5.20	R						29.28	12.49	5.14	1.94
	v						3.75	2.65	1.84	1.23
5.40	R						31.40	13.38	5.51	2.07
	v						3.90	2.75	1.91	1.28
5.60	R						33.58	14.30	5.89	2.22
	v						4.04	2.85	1.98	1.32
5.80	R						35.83	15.25	6.28	2.36
	v						4.19	2.95	2.05	1.37
6.00	R						38.15	16.23	6.68	2.51
	v						4.33	3.06	2.12	1.42
6.20	R						40.54	17.24	7.09	2.66
	v						4.48	3.16	2.19	1.47
6.40	R						43.00	18.28	7.51	2.82
	v						4.62	3.26	2.26	1.51
6.60	R						45.53	19.35	7.95	2.99
	v						4.76	3.36	2.33	1.56
6.80	R						48.12	20.44	8.39	3.15
	v						4.91	3.46	2.41	1.61
7.00	R						50.79	21.56	8.85	3.32
	v						5.05	3.57	2.48	1.65
7.50	R							24.49	10.04	3.77
	v							3.82	2.65	1.77
8.00	R							27.60	11.31	4.24
	v							4.07	2.83	1.89
9.00	R							34.33	14.04	5.25
	v							4.58	3.18	2.13
10.0	R							41.76	17.05	6.37
	v							5.09	3.54	2.36
12.0	R								23.89	8.90
	v								4.24	2.84
14.0	R									11.83
	v									3.31

5.2| TABLE OF PRESSURE LOSSES AND CALCULATION OF PIPE DIMENSIONS SDR 6 & SDR AL

q (supply) (l/s)	R (m/s) (pressure loss) v (m/s) (velocity)	HOT WATER								
		Category PN 20								
		20	25	32	40	50	63	75	90	110
0,01	R	0.01								
	v	0.07								
0,02	R	0.32	0.11	0.03						
	v	0.15	0.09	0.06						
0,03	R	0.64	0.22	0.07						
	v	0.22	0.14	0.08						
0,04	R	1.06	0.36	0.11	0.04					
	v	0.29	0.18	0.11	0.07					
0,05	R	1.57	0.53	0.16	0.06					
	v	0.37	0.23	0.14	0.09					
0,06	R	2.16	0.72	0.23	0.08					
	v	0.44	0.28	0.17	0.11					
0,07	R	2.84	0.95	0.30	0.10	0.03				
	v	0.51	0.32	0.20	0.13	0.08				
0,08	R	3.60	1.20	0.37	0.13	0.04				
	v	0.58	0.37	0.23	0.14	0.09				
0,09	R	4.43	1.47	0.46	0.16	0.05				
	v	0.66	0.42	0.25	0.16	0.10				
0,10	R	5.35	1.78	0.55	0.19	0.06				
	v	0.73	0.46	0.28	0.18	0.11				
0,12	R	7.42	2.45	0.76	0.26	0.09	0.03			
	v	0.88	0.55	0.34	0.22	0.14	0.09			
0,16	R	12.46	4.10	1.26	0.43	0.14	0.05			
	v	1.17	0.74	0.45	0.29	0.18	0.12			
0,18	R	15.42	5.07	1.56	0.52	0.18	0.06			
	v	1.32	0.83	0.51	0.32	0.21	0.13			
0,20	R	18.68	6.12	1.88	0.63	0.21	0.07	0.03		
	v	1.46	0.92	0.57	0.36	0.23	0.14	0.10		
0,30	R	39.26	12.77	3.89	1.30	0.44	0.15	0.06	0.03	
	v	2.19	1.39	0.85	0.54	0.34	0.22	0.15	0.11	
0,40	R	66.87	21.61	6.54	2.18	0.73	0.24	0.11	0.04	
	v	2.92	1.85	1.13	0.72	0.46	0.29	0.20	0.14	
0,50	R	101.42	32.59	9.82	3.26	1.08	0.36	0.16	0.07	
	v	3.65	2.31	1.42	0.90	0.57	0.36	0.25	0.18	
0,60	R	142.83	45.70	13.71	4.53	1.50	0.50	0.22	0.09	
	v	4.38	2.77	1.70	1.08	0.68	0.43	0.31	0.21	
0,70	R	191.08	60.91	18.21	6.00	1.99	0.66	0.28	0.12	0.05
	v	5.12	3.23	1.98	1.26	0.80	0.51	0.36	0.25	0.17
0,80	R		78.20	23.30	7.66	2.53	0.83	0.36	0.15	0.06
	v		3.70	2.27	1.44	0.91	0.58	0.41	0.28	0.19
0,90	R		97.57	28.98	9.50	3.13	1.03	0.44	0.19	0.07
	v		4.16	2.55	1.62	1.03	0.65	0.46	0.32	0.21

q (supply) (l/s)	R (m/s) (pressure loss) v (m/s) (velocity)	HOT WATER								
		Category PN 20								
		20	25	32	40	50	63	75	90	110
1,00	R		119.0	35.25	11.53	3.79	1.25	0.54	0.22	0.08
	v		4.62	2.83	1.80	1.14	0.72	0.51	0.35	0.24
1,20	R		168.05	49.55	16.14	5.29	1.74	0.75	0.31	0.12
	v		5.54	3.40	2.16	1.37	0.87	0.61	0.42	0.28
1,40	R			66.18	21.48	7.02	2.30	0.99	0.41	0.15
	v			3.97	2.52	1.60	1.01	0.71	0.50	0.33
1,60	R			85.11	27.55	8.98	2.93	1.26	0.52	0.20
	v			4.53	2.88	1.83	1.15	0.81	0.57	0.38
1,80	R			106.35	34.33	11.16	3.63	1.56	0.64	0.24
	v			5.01	3.24	2.05	1.30	0.92	0.64	0.43
2,00	R				41.82	13.56	4.41	1.88	0.78	0.29
	v				3.60	2.28	1.44	1.02	0.71	0.47
2,20	R				50.03	16.19	5.25	2.24	0.93	0.35
	v				3.96	2.51	1.59	1.12	0.78	0.52
2,40	R				58.95	19.04	6.17	2.63	1.08	0.41
	v				4.32	2.74	1.73	1.22	0.85	0.57
2,60	R				68.57	22.11	7.15	3.05	1.25	0.47
	v				4.68	2.97	1.88	1.32	0.92	0.61
2,80	R				78.90	25.39	8.20	3.49	1.43	0.54
	v				5.04	3.20	2.02	1.43	0.99	0.66
3,00	R					28.90	9.32	3.96	1.63	0.61
	v					3.42	2.17	1.53	1.06	0.71
3,20	R					32.62	10.50	4.46	1.83	0.69
	v					3.65	2.31	1.63	1.13	0.76
3,40	R					36.56	11.76	4.99	2.05	0.77
	v					3.88	2.45	1.73	1.20	0.80
3,60	R					40.72	13.08	5.54	2.27	0.85
	v					4.11	2.60	1.83	1.27	0.85
3,80	R					45.01	14.46	6.13	2.51	0.94
	v					4.34	2.74	1.94	1.34	0.90
4,00	R					49.69	15.92	6.74	2.76	1.03
	v					4.57	2.89	2.04	1.41	0.95
4,20	R					54.49	17.44	7.38	3.02	1.13
	v					4.79	3.03	2.14	1.49	0.99
4,40	R					59.51	19.03	8.04	3.29	1.23
	v					5.02	3.18	2.24	1.56	1.04
4,60	R						20.68	8.74	3.57	1.33
	v						3.32	2.34	1.63	1.09
4,80	R						22.40	9.46	3.86	1.44
	v						3.46	2.44	1.70	1.13
5,00	R						24.19	10.20	4.16	1.55
	v						3.61	2.55	1.77	1.18

q (supply) (l/s)	R (m/s) (pressure loss) v (m/s) (velocity)	HOT WATER								
		Category PN 20								
		20	25	32	40	50	63	75	90	110
5.20	R						26.04	10.98	4.48	1.67
	v						3.75	2.65	1.84	1.23
5.40	R						27.96	11.78	4.80	1.79
	v						3.90	2.75	1.91	1.28
5.60	R						29.94	12.61	5.13	1.91
	v						4.04	2.85	1.98	1.32
5.80	R						31.99	13.46	5.48	2.04
	v						4.19	2.95	2.05	1.37
6.00	R						34.11	14.35	5.84	2.17
	v						4.33	3.06	2.12	1.42
6.20	R						36.29	15.26	6.20	2.31
	v						4.48	3.16	2.19	1.47
6.40	R						38.53	16.19	6.58	2.45
	v						4.62	3.26	2.26	1.51
6.60	R						40.85	17.15	6.97	2.59
	v						4.76	3.36	2.33	1.56
6.80	R						43.22	18.14	7.37	2.74
	v						4.91	3.46	2.41	1.61
7.00	R						45.67	19.16	7.77	2.89
	v						5.05	3.57	2.48	1.65
7.50	R							21.82	8.84	3.28
	v							3.82	2.65	1.77
8.00	R							24.64	9.98	3.70
	v							4.07	2.83	1.89
9.00	R							30.79	12.44	4.60
	v							4.58	3.18	2.13
10.0	R							37.60	15.16	5.60
	v							5.09	3.54	2.36
12.0	R								21.39	7.87
	v								4.24	2.84
14.0	R									10.51
	v									3.31

5.3 | TABLE OF PRESSURE LOSSES AND CALCULATION OF PIPE DIMENSIONS AQUA-PLUS-FIBERGLASS SDR 7.4

q (supply) (l/s)	R (m/s) (pressure loss) v (m/s) (velocity)	COLD WATER										
		D (External diameter in mm)										
		20	25	32	40	50	63	75	90	110	125	160
0.01	R	0.09										
	v	0.06										
0.02	R	0.27										
	v	0.12										
0.03	R	0.54	0.19									
	v	0.18	0.12									
0.04	R	0.88	0.31									
	v	0.25	0.16									
0.05	R	1.28	0.45	0.14								
	v	0.31	0.20	0.12								
0.06	R	1.76	0.61	0.18								
	v	0.37	0.24	0.14								
0.07	R	2.29	0.80	0.24	0.08							
	v	0.43	0.28	0.17	0.11							
0.08	R	2.89	1.00	0.30	0.11							
	v	0.49	0.31	0.19	0.12							
0.09	R	3.55	1.23	0.37	0.13							
	v	0.55	0.35	0.21	0.14							
0.10	R	4.27	1.48	0.44	0.15							
	v	0.61	0.39	0.24	0.15							
0.12	R	5.87	2.03	0.61	0.21	0.07						
	v	0.74	0.47	0.28	0.18	0.12						
0.16	R	9.74	3.35	1.00	0.35	0.12						
	v	0.98	0.63	0.38	0.24	0.16						
0.18	R	12.00	4.12	1.23	0.43	0.15	0.05					
	v	1.11	0.71	0.43	0.27	0.17	0.11					
0.20	R	14.47	4.96	1.48	0.51	0.18	0.06					
	v	1.23	0.79	0.47	0.30	0.19	0.12					
0.30	R	29.85	10.17	3.01	1.04	0.36	0.12	0.05				
	v	1.84	1.18	0.71	0.45	0.29	0.18	0.13				
0.40	R	50.15	17.00	5.01	1.72	0.60	0.19	0.09	0.04			
	v	2.46	1.57	0.95	0.61	0.39	0.24	0.17	0.12			
0.50	R	75.21	25.40	7.45	2.55	0.88	0.29	0.13	0.05			
	v	3.07	1.96	1.18	0.76	0.49	0.30	0.22	0.15			
0.60	R	104.94	35.31	10.33	3.53	1.22	0.40	0.17	0.07			
	v	3.68	2.36	1.42	0.91	0.58	0.36	0.26	0.18			
0.70	R	139.27	46.72	13.62	4.64	1.60	0.52	0.23	0.01			
	v	4.30	2.75	1.66	1.06	0.68	0.42	0.30	0.21			

q (supply) (l/s)	R (m/s) (pressure loss) v (m/s) (velocity)	COLD WATER										
		D (External diameter in mm)										
		20	25	32	40	50	63	75	90	110	125	160
0.80	R	178.15	59.60	17.33	5.90	2.03	0.66	0.29	0.12	0.05		
	v	4.91	3.14	1.89	1.21	0.78	0.49	0.34	0.24	0.16		
0.90	R		73.92	21.45	7.28	2.50	0.81	0.36	0.15	0.06		
	v		3.54	2.13	1.36	0.87	0.55	0.39	0.27	0.18		
1.00	R		89.69	26.97	8.80	3.02	0.98	0.43	0.18	0.07	0.04	
	v		3.93	2.37	1.51	0.97	0.61	0.43	0.30	0.20	0.15	
1.20	R		125.51	36.19	12.23	4.19	1.35	0.59	0.25	0.09	0.05	
	v		4.72	2.84	1.82	1.17	0.73	0.52	0.36	0.24	0.19	
1.40	R		166.98	47.97	16.17	5.52	1.78	0.78	0.32	0.12	0.07	0.02
	v		5.50	3.31	2.12	1.36	0.85	0.60	0.42	0.28	0.22	0.13
1.60	R			61.29	20.61	7.03	2.26	0.99	0.41	0.16	0.09	0.03
	v			3.78	2.42	1.55	0.97	0.69	0.48	0.32	0.25	0.15
1.80	R			76.14	25.55	8.69	2.79	1.22	0.50	0.19	0.10	0.03
	v			4.26	2.73	1.75	1.09	0.77	0.54	0.36	0.28	0.17
2.00	R			92.51	30.97	10.52	3.37	1.47	0.61	0.23	0.13	0.04
	v			4.73	3.03	1.94	1.21	0.86	0.60	0.40	0.31	0.19
2.20	R				36.89	12.51	4.00	1.75	0.72	0.28	0.15	0.05
	v				3.33	2.14	1.34	0.95	0.65	0.44	0.34	0.21
2.40	R				43.28	14.66	4.68	2.04	0.84	0.32	0.17	0.05
	v				3.63	2.33	1.46	1.03	0.71	0.48	0.37	0.23
2.60	R				50.15	16.96	5.41	2.36	0.97	0.37	0.20	0.06
	v				3.94	2.53	1.58	1.12	0.77	0.52	0.40	0.25
2.80	R				57.51	19.42	6.19	2.69	1.11	0.43	0.23	0.07
	v				4.24	2.72	1.70	1.20	0.83	0.56	0.43	0.26
3.00	R				65.33	22.04	7.02	3.05	1.25	0.48	0.26	0.08
	v				4.54	2.91	1.82	1.29	0.89	0.60	0.46	0.28
3.20	R					24.81	7.89	3.43	1.41	0.54	0.29	0.09
	v					3.11	1.94	1.38	0.95	0.64	0.49	0.30
3.40	R					27.73	8.81	3.82	1.57	0.60	0.32	0.10
	v					3.30	2.06	1.46	1.01	0.68	0.53	0.32
3.60	R					30.80	9.78	4.24	1.74	0.67	0.36	0.11
	v					3.50	2.19	1.55	1.07	0.72	0.56	0.34
3.80	R					34.02	10.79	4.68	1.92	0.74	0.40	0.12
	v					3.69	2.31	1.63	1.13	0.76	0.59	0.36
4.00	R					37.40	11.85	5.13	2.11	0.81	0.43	0.13
	v					3.89	2.43	1.72	1.19	0.80	0.62	0.38
4.20	R					40.93	12.95	5.61	2.30	0.88	0.47	0.14
	v					4.08	2.55	1.81	1.25	0.84	0.65	0.40

q (supply) (l/s)	R (m/s) (pressure loss) v (m/s) (velocity)	COLD WATER										
		D (External diameter in mm)										
		20	25	32	40	50	63	75	90	110	125	160
4.40	R					44.60	14.10	6.11	2.50	0.96	0.51	0.16
	v					4.28	2.67	1.89	1.31	0.88	0.68	0.41
4.60	R					48.43	15.30	6.62	2.71	1.04	0.56	0.17
	v					4.47	2.79	1.98	1.37	0.92	0.71	0.48
4.80	R	5337.07	1714.51	477.24	156.81	52.40	16.54	7.15	2.93	1.12	0.60	0.18
	v	29.47	18.86	11.35	7.27	4.66	2.91	2.07	1.43	0.96	0.74	0.45
5.00	R						17.83	7.71	3.15	1.21	0.65	0.20
	v						3.03	2.15	1.49	1.00	0.77	0.47
5.20	R						19.16	8.28	3.39	1.29	0.69	0.21
	v						3.16	2.24	1.55	1.04	0.80	0.49
5.40	R						20.54	8.87	3.63	1.39	0.74	0.23
	v						3.28	2.32	1.61	1.08	0.83	0.51
5.60	R						21.96	9.48	3.87	1.48	0.79	0.24
	v						3.40	2.41	1.67	1.12	0.86	0.53
5.80	R						23.43	10.11	4.13	1.58	0.85	0.26
	v						3.52	2.50	1.73	1.16	0.90	0.55
6.00	R						24.94	10.76	4.39	1.68	0.90	0.27
	v						3.64	2.58	1.79	1.20	0.93	0.57
6.20	R						26.50	11.42	4.66	1.78	0.95	0.29
	v						3.76	2.67	1.85	1.24	0.96	0.58
6.40	R						28.10	12.11	4.94	1.88	1.01	0.31
	v						3.88	2.75	1.91	1.28	0.99	0.60
6.60	R						29.74	12.81	5.23	1.99	1.07	0.33
	v						4.01	2.84	1.96	1.32	1.02	0.62
6.80	R						31.43	13.53	5.52	2.10	1.13	0.34
	v						4.13	2.93	2.02	1.36	1.05	0.64
7.00	R						33.16	14.27	5.82	2.22	1.19	0.36
	v						4.25	3.01	2.08	1.40	1.08	0.66
7.50	R						37.69	16.21	6.60	2.51	1.34	0.41
	v						4.55	3.23	2.23	1.50	1.16	0.71
8.00	R							18.25	7.43	2.82	1.51	0.46
	v							3.44	2.38	1.60	1.24	0.75
9.00	R							22.69	9.22	3.50	1.87	0.57
	v							3.87	2.68	1.80	1.39	0.85
10.0	R							27.58	11.19	4.24	2.27	0.69
	v							4.30	2.98	2.00	1.54	0.94
12.0	R							38.70	15.66	5.92	3.16	0.96
	v							5.16	3.57	2.40	1.85	1.13
14.0	R								20.83	7.86	4.19	1.27
	v								4.17	2.80	2.16	1.32

q (supply) (l/s)	R (m/s) (pressure loss) v (m/s) (velocity)	COLD WATER										
		D (External diameter in mm)										
		20	25	32	40	50	63	75	90	110	125	160
16.0	R									10.05	5.35	1.61
	v									3.20	2.47	1.51
18.0	R										6.65	2.00
	v										2.78	1.70
20.0	R										8.07	2.43
	v										3.09	1.89
22.0	R										9.62	2.89
	v										3.40	2.07
24.0	R											3.39
	v											2.26
26.0	R											3.92
	v											2.45
28.0	R											4.50
	v											2.64
30.0	R											5.11
	v											2.83
32.0	R											5.75
	v											3.02
34.0	R											6.44
	v											3.21
36.0	R											7.15
	v											3.39
38.0	R											7.91
	v											3.58
40.0	R											8.70
	v											3.77
42.0	R											9.52
	v											3.96
44.0	R											10.38
	v											4.15
46.0	R											11.28
	v											4.34
48.0	R											12.21
	v											4.53
50.0	R											13.17
	v											4.71
52.0	R											14.18
	v											4.90
54.0	R											15.21
	v											5.09

q (supply) (l/s)	R (m/s) (pressure loss) v (m/s) (velocity)	COLD WATER										
		D (External diameter in mm)										
		20	25	32	40	50	63	75	90	110	125	160
56.0	R											16.28
	v											5.28
58.0	R											17.39
	v											5.47
60.0	R											18.53
	v											5.66
62.0	R											19.70
	v											5.85
64.0	R											20.91
	v											6.04
66.0	R											22.15
	v											6.22
68.0	R											23.43
	v											6.41
70.0	R											24.74
	v											6.60
72.0	R											26.09
	v											6.79
74.0	R											27.47
	v											6.98
76.0	R											28.88
	v											7.17
78.0	R											30.33
	v											7.36
80.0	R											31.81
	v											7.54
85.0	R											35.67
	v											8.02
90.0	R											39.74
	v											8.49
95.0	R											44.03
	v											8.96
100.0	R											48.52
	v											9.43
105.0	R											53.23
	v											9.90

5.4 | TABLE OF PRESSURE LOSSES AND CALCULATION OF PIPE DIMENSIONS AQUA-PLUS-FIBERGLASS SDR 7.4

q (supply) (l/s)	R (m/s) (pressure loss) v (m/s) (velocity)	HOT WATER										
		D (External diameter in mm)										
		20	25	32	40	50	63	75	90	110	125	160
0.01	R	0.07										
	v	0.06										
0.02	R	0.21										
	v	0.12										
0.03	R	0.43	0.15									
	v	0.18	0.12									
0.04	R	0.70	0.24									
	v	0.25	0.16									
0.05	R	1.04	0.36	0.11								
	v	0.31	0.20	0.12								
0.06	R	1.43	0.49	0.15								
	v	0.37	0.24	0.14								
0.07	R	1.87	0.64	0.19	0.07							
	v	0.43	0.28	0.17	0.11							
0.08	R	2.37	0.81	0.24	0.08							
	v	0.49	0.31	0.19	0.12							
0.09	R	2.92	1.00	0.30	0.10							
	v	0.55	0.35	0.21	0.14							
0.10	R	3.52	1.20	0.36	0.12							
	v	0.61	0.39	0.24	0.15							
0.12	R	4.87	1.66	0.49	0.17	0.06						
	v	0.74	0.47	0.28	0.18	0.12						
0.16	R	8.16	2.77	0.82	0.28	0.01						
	v	0.98	0.63	0.38	0.24	0.16						
0.18	R	10.01	3.43	1.00	0.35	0.12	0.04					
	v	1.11	0.71	0.43	0.27	0.17	0.11					
0.20	R	12.22	4.14	1.22	0.42	0.14	0.05					
	v	1.23	0.79	0.47	0.30	0.19	0.12					
0.30	R	25.60	8.60	2.51	0.86	0.30	0.01	0.04				
	v	1.84	1.18	0.71	0.45	0.29	0.18	0.13				
0.40	R	43.49	14.53	4.22	1.43	0.49	0.16	0.07	0.03			
	v	2.46	1.57	0.95	0.61	0.39	0.24	0.17	0.12			
0.50	R	65.82	21.88	6.33	2.14	0.73	0.24	0.10	0.04			
	v	3.07	1.96	1.18	0.76	0.49	0.30	0.22	0.15			
0.60	R	92.54	30.64	8.82	2.98	1.02	0.33	0.14	0.06			
	v	3.68	2.36	1.42	0.91	0.58	0.36	0.26	0.18			
0.70	R	123.62	40.78	11.70	3.94	1.34	0.43	0.19	0.08			
	v	4.30	2.75	1.66	1.06		0.42	0.30	0.21			

q (supply) (l/s)	R (m/s) (pressure loss) v (m/s) (velocity)	HOT WATER										
		D (External diameter in mm)										
		20	25	32	40	50	63	75	90	110	125	160
0.80	R	159.04	52.30	14.96	5.02	1.71	0.55	0.24	0.01	0.04		
	v	4.91	3.14	1.89	1.21	0.78	0.49	0.34	0.24	0.16		
0.90	R		65.19	18.59	6.23	2.12	0.68	0.30	0.12	0.05		
	v		3.54	2.13	1.36	0.87	0.55	0.39	0.27	0.18		
1.00	R		79.44	22.59	7.55	2.56	0.82	0.36	0.15	0.06	0.03	
	v		3.93	2.37	1.51	0.97	0.61	0.43	0.30	0.20	0.15	
1.20	R		112.01	31.70	10.56	3.57	1.14	0.50	0.20	0.08	0.04	
	v		4.72	2.84	1.82	1.17	0.73	0.52	0.36	0.24	0.19	
1.40	R		149.97	42.27	14.04	4.74	1.51	0.66	0.27	0.10	0.06	0.02
	v		5.50	3.31	2.12	1.36	0.85	0.60	0.42	0.28	0.22	0.13
1.60	R			54.30	17.98	6.05	1.92	0.83	0.34	0.13	0.07	0.02
	v			3.78	2.42	1.55	0.97	0.69	0.48	0.32	0.25	0.15
1.80	R			67.78	22.38	7.52	2.38	1.03	0.42	0.16	0.09	0.03
	v			4.26	2.73	1.75	1.09	0.77	0.54	0.36	0.28	0.17
2.00	R			82.69	27.25	9.13	2.89	1.25	0.51	0.20	0.11	0.03
	v			4.73	3.03	1.94	1.21	0.86	0.60	0.40	0.31	0.19
2.20	R				32.57	10.89	3.44	1.49	0.61	0.23	0.13	0.04
	v				3.33	2.14	1.34	0.95	0.65	0.44	0.34	0.21
2.40	R				38.34	12.80	4.04	1.74	0.71	0.27	0.15	0.04
	v				3.63	2.33	1.46	1.03	0.71	0.48	0.37	0.23
2.60	R				44.57	14.85	4.68	2.02	0.83	0.32	0.17	0.05
	v				3.94	2.53	1.58	1.12	0.77	0.52	0.40	0.25
2.80	R				51.25	17.05	5.36	2.31	0.94	0.36	0.19	0.06
	v				4.24	2.72	1.70	1.20	0.83	0.56	0.43	0.26
3.00	R				58.38	19.39	6.09	2.62	1.07	0.41	0.22	0.07
	v				4.54	2.91	1.82	1.29	0.89	0.60	0.46	0.28
3.20	R					21.88	6.86	2.95	1.20	0.46	0.25	0.07
	v					3.11	1.94	1.38	0.95	0.64	0.49	0.30
3.40	R					24.51	7.67	3.30	1.35	0.51	0.27	0.08
	v					3.30	2.06	1.46	1.01	0.68	0.53	0.32
3.60	R					27.29	8.53	3.67	1.49	0.57	0.30	0.09
	v					3.50	2.19	1.55	1.07	0.72	0.56	0.34
3.80	R					30.21	9.43	4.05	1.65	0.63	0.34	0.10
	v					3.69	2.31	1.63	1.13	0.76	0.59	0.36
4.00	R					33.27	10.38	4.45	1.81	0.69	0.37	0.11
	v					3.89	2.43	1.72	1.19	0.80	0.62	0.38
4.20	R					36.47	11.37	4.88	1.98	0.75	0.40	0.12
	v					4.08	2.55	1.81	1.25	0.84	0.65	0.40
4.40	R					39.82	12.40	5.31	2.16	0.82	0.44	0.13
	v					4.28	2.67	1.89	1.31	0.88	0.68	0.41

q (supply) (l/s)	R (m/s) (pressure loss) v (m/s) (velocity)	HOT WATER										
		D (External diameter in mm)										
		20	25	32	40	50	63	75	90	110	125	160
4.60	R					43.31	13.47	5.77	2.34	0.89	0.47	0.14
	v					4.47	2.79	1.98	1.37	0.92	0.71	0.43
4.80	R						14.58	6.24	2.53	0.96	0.51	0.16
	v						2.91	2.07	1.43	0.96	0.74	0.45
5.00	R						15.74	6.73	2.73	1.03	0.55	0.17
	v						3.03	2.15	1.49	1.00	0.77	0.47
5.20	R						16.94	7.24	2.93	1.11	0.59	0.18
	v						3.16	2.24	1.55	1.04	0.80	0.49
5.40	R						18.18	7.77	3.15	1.19	0.64	0.19
	v						3.28	2.32	1.61	1.08	0.83	0.51
5.60	R						19.47	8.31	3.36	1.27	0.86	0.53
	v						3.40	2.41	1.67	1.12	0.86	0.53
5.80	R						20.80	8.88	3.59	1.36	0.72	0.22
	v						3.52	2.50	1.73	1.16	0.90	0.55
6.00	R						22.17	9.46	3.82	1.44	0.77	0.23
	v						3.64	2.58	1.79	1.20	0.93	0.57
6.20	R						23.58	10.05	4.06	1.53	0.82	0.25
	v						3.76	2.67	1.85	1.24	0.96	0.58
6.40	R						25.03	10.67	4.31	1.63	0.87	0.26
	v						3.88	2.75	1.91	1.28	0.99	0.60
6.60	R						26.52	11.30	4.56	1.72	0.92	0.28
	v						4.01	2.84	1.96	1.32	1.02	0.62
6.80	R						28.06	11.95	4.82	1.82	0.97	0.29
	v						4.13	2.93	2.02	1.36	1.05	0.64
7.00	R						29.64	12.61	5.09	1.92	1.02	0.31
	v						4.25	3.01	2.08	1.40	1.08	0.66
7.50	R						33.77	14.36	5.78	2.18	1.16	0.35
	v						4.55	3.23	2.23	1.50	1.16	0.71
8.00	R						38.16	16.21	6.52	2.45	1.31	0.39
	v						4.86	3.44	2.38	1.60	1.24	0.75
9.00	R							20.23	8.12	3.05	1.62	0.49
	v							3.87	2.68	1.80	1.39	0.85
10.0	R							24.68	9.89	3.71	1.97	0.59
	v							4.30	2.98	2.00	1.54	0.94
12.0	R							34.87	13.94	5.21	2.76	0.83
	v							5.16	3.57	2.40	1.85	1.13
14.0	R								18.64	6.95	3.68	1.01
	v								4.17	2.80	2.16	1.32
16.0	R									8.93	4.72	1.40
	v									3.20	2.47	1.51

q (supply) (l/s)	R (m/s) (pressure loss) v (m/s) (velocity)	HOT WATER										
		D (External diameter in mm)										
		20	25	32	40	50	63	75	90	110	125	160
18.0	R										5.88	1.75
	v										2.78	1.70
20.0	R										7.16	2.12
	v										3.09	1.89
22.0	R										8.57	2.54
	v										3.40	2.07
24.0	R											2.98
	v											2.26
26.0	R											3.46
	v											2.45
28.0	R											3.98
	v											2.64
30.0	R											4.53
	v											2.83
32.0	R											5.11
	v											3.02
34.0	R											5.73
	v											3.21
36.0	R											6.38
	v											3.39
38.0	R											7.07
	v											3.58
40.0	R											7.78
	v											3.77
42.0	R											8.54
	v											3.96
44.0	R											9.32
	v											4.15
46.0	R											10.14
	v											4.34
48.0	R											10.99
	v											4.53
50.0	R											11.88
	v											4.71
52.0	R											12.80
	v											4.90
54.0	R											13.75
	v											5.09
56.0	R											14.74
	v											5.28

q (supply) (l/s)	R (m/s) (pressure loss) v (m/s) (velocity)	HOT WATER										
		D (External diameter in mm)										
		20	25	32	40	50	63	75	90	110	125	160
58.0	R											15.75
	v											5.47
60.0	R											16.81
	v											5.66
62.0	R											17.89
	v											5.85
64.0	R											19.01
	v											6.04
66.0	R											20.16
	v											6.22
68.0	R											21.35
	v											6.41
70.0	R											22.56
	v											6.60
72.0	R											23.82
	v											6.79
74.0	R											25.01
	v											6.98
76.0	R											26.42
	v											7.17
78.0	R											27.77
	v											7.36
80.0	R											29.15
	v											7.54
85.0	R											32.75
	v											8.02
90.0	R											36.56
	v											8.49
95.0	R											40.58
	v											8.96
100.0	R											44.80
	v											9.43
105.0	R											49.22
	v											9.90

5.5 | TABLE OF PRESSURE LOSSES AND CALCULATION OF PIPE DIMENSIONS AQUA-PLUS-CLIMA-FIBERGLASS SDR II

q (supply) (l/s)	R (m/s) (pressure loss) v (m/s) (velocity)	COLD WATER										
		D (External diameter in mm)										
		20	25	32	40	50	63	75	90	110	125	160
0.01	R	0,05										
	v	0,05										
0.02	R	0,16										
	v	0,01										
0.03	R	0,31										
	v	0,15										
0.04	R	0,50	0,17									
	v	0,19	0,12									
0.05	R	0,74	0,25									
	v	0,24	0,15									
0.06	R	1,01	0,34	0,10								
	v	0,29	0,18	0,11								
0.07	R	1,31	0,44	0,14								
	v	0,34	0,21	0,13								
0.08	R	1,65	0,55	0,17								
	v	0,39	0,24	0,15								
0.09	R	2,03	0,68	0,21	0,07							
	v	0,44	0,28	0,17	0,11							
0.10	R	2,43	0,81	0,25	0,09							
	v	0,49	0,31	0,19	0,12							
0.12	R	3,35	1,12	0,34	0,12							
	v	0,58	0,37	0,22	0,14							
0.16	R	5,54	1,84	0,56	0,20	0,07						
	v	0,78	0,49	0,30	0,19	0,12						
0.18	R	6,82	2,27	0,69	0,24	0,08						
	v	0,87	0,55	0,33	0,22	0,14						
0.20	R	8,22	2,73	0,83	0,29	0,10						
	v	0,97	0,61	0,37	0,24	0,15						
0.30	R	16,90	5,57	1,68	0,59	0,20	0,07					
	v	1,46	0,92	0,56	0,36	0,23	0,14					
0.40	R	28,31	9,30	2,80	0,98	0,34	0,11	0,05				
	v	1,94	1,22	0,74	0,48	0,31	0,19	0,14				
0.50	R	42,36	13,86	4,15	1,46	0,50	0,17	0,07	0,03			
	v	2,43	1,53	0,93	0,60	0,38	0,24	0,17	0,12			
0.60	R	58,99	19,24	5,75	20,1	0,69	0,23	0,01	0,04			
	v	2,91	1,84	1,11	0,72	0,46	0,29	0,20	0,14			
0.70	R	78,16	25,41	7,57	2,65	0,90	0,30	0,13	0,05	0,02		
	v	3,40	2,14	1,30	0,84	0,54	0,34	0,24	0,16	0,11		

q (supply) (l/s)	R (m/s) (pressure loss) v (m/s) (velocity)	COLD WATER										
		D (External diameter in mm)										
		20	25	32	40	50	63	75	90	110	125	160
0.80	R	99,83	32,37	9,62	3,36	1,14	0,38	0,16	0,07	0,03		
	v	3,88	2,45	1,48	0,96	0,61	0,39	0,27	0,19	0,13		
0.90	R	123,97	40,10	11,90	4,14	1,41	0,47	0,20	0,08	0,03		
	v	4,37	2,75	1,67	1,08	0,69	0,43	0,30	0,21	0,14		
1.00	R	150,58	48,60	14,39	5,00	1,70	0,56	0,24	0,10	0,04	0,02	
	v	4,85	3,06	1,85	1,20	0,76	0,48	0,34	0,24	0,16	0,12	
1.20	R		67,87	20,02	6,94	2,35	0,78	0,33	0,14	0,05	0,03	
	v		3,67	2,23	1,44	0,92	0,58	0,41	0,28	0,19	0,15	
1.40	R		90,12	26,49	9,17	3,10	1,02	0,44	0,18	0,07	0,04	
	v		4,28	2,60	1,68	1,07	0,67	0,47	0,33	0,22	0,17	
1.60	R		115,34	33,81	11,67	3,94	1,30	0,55	0,23	0,09	0,05	0,01
	v		4,90	2,97	1,92	1,22	0,77	0,54	0,38	0,25	0,20	0,12
1.80	R		143,49	41,95	14,45	4,87	1,60	0,68	0,29	0,11	0,06	0,02
	v		5,51	3,34	2,16	1,38	0,87	0,61	0,42	0,28	0,22	0,13
2.00	R			50,90	17,51	5,89	1,93	0,82	0,34	0,13	0,07	0,02
	v			3,71	2,40	1,53	0,96	0,68	0,47	0,31	0,24	0,15
2.20	R			60,67	20,83	7,00	2,29	0,98	0,41	0,16	0,08	0,03
	v			4,08	2,64	1,68	1,06	0,74	0,52	0,35	0,27	0,16
2.40	R			71,25	24,42	8,20	2,68	1,14	0,48	0,18	0,01	0,03
	v			4,45	2,88	1,84	1,16	0,81	0,56	0,38	0,29	0,18
2.60	R				28,28	9,48	3,01	1,32	0,55	0,21	0,11	0,04
	v				3,11	1,99	1,25	0,88	0,61	0,41	0,32	0,19
2.80	R				32,40	10,85	3,54	1,50	0,63	0,24	0,13	0,04
	v				3,35	2,14	1,35	0,95	0,66	0,44	0,34	0,21
3.00	R				36,78	12,30	4,01	1,70	0,71	0,27	0,15	0,05
	v				3,59	2,29	1,45	1,01	0,71	0,47	0,37	0,22
3.20	R				41,42	13,84	4,51	1,91	0,80	0,30	0,17	0,05
	v				3,83	2,45	1,54	1,08	0,75	0,50	0,39	0,24
3.40	R					15,46	5,03	2,13	0,89	0,34	0,18	0,06
	v					2,60	1,64	1,15	0,80	0,53	0,41	0,25
3.60	R					17,16	5,58	2,36	0,99	0,37	0,20	0,06
	v					2,75	1,73	1,22	0,85	0,57	0,44	0,27
3.80	R					18,95	6,16	2,60	1,09	0,41	0,22	0,07
	v					2,91	1,83	1,28	0,89	0,60	0,46	0,28
4.00	R					20,82	6,76	2,86	1,19	0,45	0,25	0,08
	v					3,06	1,93	1,35	0,94	0,63	0,49	0,30
4.20	R					22,77	7,39	3,12	1,30	0,49	0,27	0,08
	v					3,21	2,02	1,42	0,99	0,66	0,51	0,31

q (supply) (l/s)	R (m/s) (pressure loss) v (m/s) (velocity)	COLD WATER										
		D (External diameter in mm)										
		20	25	32	40	50	63	75	90	110	125	160
4.40	R					24,81	8,04	3,40	1,41	0,54	0,29	0,09
	v					3,37	2,12	1,49	1,03	0,69	0,54	0,33
4.60	R					26,92	8,72	3,68	1,53	0,58	0,32	0,01
	v					3,52	2,22	1,55	1,08	0,72	0,56	0,34
4.80	R						9,43	3,98	1,65	0,63	0,34	0,10
	v						2,31	1,62	1,13	0,75	0,59	0,36
5.00	R						10,16	4,28	1,78	0,68	0,37	0,11
	v						2,41	1,69	1,18	0,79	0,61	0,37
5.20	R						10,91	4,60	1,91	0,72	0,39	0,12
	v						2,51	1,76	1,22	0,82	0,63	0,39
5.40	R						11,69	4,93	2,05	0,78	0,42	0,13
	v						2,60	1,82	1,27	0,85	0,66	0,40
5.60	R						12,50	5,26	2,19	0,83	0,45	0,14
	v						2,70	1,89	1,32	0,88	0,68	0,42
5.80	R						13,33	5,61	2,33	0,88	0,48	0,15
	v						2,80	1,96	1,36	0,91	0,71	0,43
6.00	R						14,19	5,97	2,48	0,94	0,51	0,16
	v						2,89	2,03	1,41	0,94	0,73	0,45
6.20	R						15,07	6,34	2,63	0,99	0,54	0,16
	v						2,99	2,09	1,46	0,97	0,76	0,46
6.40	R						15,97	6,71	2,79	1,05	0,57	0,17
	v						3,08	2,16	1,50	1,01	0,78	0,48
6.60	R						16,90	7,10	2,95	1,11	0,60	0,18
	v						3,18	2,23	1,55	1,04	0,80	0,49
6.80	R						17,86	7,50	3,11	1,18	0,64	0,19
	v						3,28	2,30	1,60	1,07	0,83	0,51
7.00	R						18,84	7,91	3,28	1,24	0,67	0,20
	v						3,37	2,36	1,65	1,10	0,85	0,52

q (supply) (l/s)	R (m/s) (pressure loss) v (m/s) (velocity)	COLD WATER										
		D (External diameter in mm)										
		20	25	32	40	50	63	75	90	110	125	160
7.50	R						21,39	8,97	3,72	1,40	0,76	0,23
	v						3,61	2,53	1,76	1,18	0,91	0,56
8.00	R						24,10	10,10	4,18	1,58	0,85	0,26
	v						3,86	2,70	1,88	1,26	0,98	0,60
9.00	R						29,98	12,54	5,18	1,95	1,06	0,32
	v						4,34	3,04	2,12	1,41	1,01	0,67
10.0	R						36,45	15,23	6,29	2,37	1,28	0,39
	v						4,82	3,38	2,35	1,57	1,22	0,74
12.0	R							21,34	8,79	3,30	1,78	0,54
	v							4,05	2,82	1,89	1,46	0,89
14.0	R							28,40	11,67	4,37	2,36	0,71
	v							4,73	3,29	2,20	1,71	1,04
16.0	R							36,43	14,94	5,59	3,01	0,91
	v							5,40	3,76	2,52	1,95	1,19
18.0	R							45,40	18,59	6,94	3,73	1,13
	v							6,08	4,23	2,83	2,19	1,34
20.0	R									8,43	4,53	1,37
	v									3,14	2,44	1,49
22.0	R									10,05	5,40	1,62
	v									3,46	2,68	1,64
24.0	R										6,34	1,90
	v										2,93	1,79
26.0	R										7,85	2,21
	v										3,17	1,93
28.0	R											2,53
	v											2,08
30.0	R											2,87
	v											2,23

5.6 | TABLE OF PRESSURE LOSSES AND CALCULATION OF PIPE DIMENSIONS AQUA-PLUS-FIBERGLASS SDR 11

q (supply) (l/s)	R (m/s) (pressure loss) v (m/s) (velocity)	HOT WATER										
		D (External diameter in mm)										
		20	25	32	40	50	63	75	90	110	125	160
0.01	R	0,04										
	v	0,05										
0.02	R	0,12										
	v	0,01										
0.03	R	0,23										
	v	0,15										
0.04	R	0,38	0,13									
	v	0,19	0,12									
0.05	R	0,57	0,19									
	v	0,24	0,15									
0.06	R	0,78	0,26	0,08								
	v	0,29	0,18	0,11								
0.07	R	1,02	0,34	0,10								
	v	0,34	0,21	0,13								
0.08	R	1,30	0,43	0,13								
	v	0,39	0,24	0,15								
0.09	R	1,60	0,53	0,16	0,06							
	v	0,44	0,28	0,17	0,11							
0.10	R	1,92	0,64	0,19	0,07							
	v	0,49	0,31	0,19	0,12							
0.12	R	2,66	0,88	0,27	0,09							
	v	0,58	0,37	0,22	0,14							
0.16	R	4,46	1,47	0,44	0,16	0,05						
	v	0,78	0,49	0,30	0,19	0,12						
0.18	R	5,51	1,81	0,54	0,19	0,07						
	v	0,87	0,55	0,33	0,22	0,14						
0.20	R	6,67	2,18	0,65	0,23	0,08						
	v	0,97	0,61	0,37	0,24	0,15						
0.30	R	13,96	4,53	1,35	0,47	0,16	0,05					
	v	1,46	0,92	0,56	0,36	0,23	0,14					
0.40	R	23,69	7,65	2,27	0,79	0,27	0,09	0,04				
	v	1,94	1,22	0,74	0,48	0,31	0,19	0,14				
0.50	R	35,82	11,51	3,39	1,18	0,40	0,13	0,06	0,02			
	v	2,43	1,53	0,93	0,60	0,38	0,24	0,17	0,12			
0.60	R	50,32	16,10	4,73	1,64	0,55	0,18	0,08	0,03			
	v	2,91	1,84	1,11	0,72	0,46	0,29	0,20	0,14			
0.70	R	67,17	21,42	6,27	2,16	0,73	0,24	0,10	0,04	0,02		
	v	3,40	2,14	1,30	0,84	0,54	0,34	0,24	0,16	0,11		

q (supply) (l/s)	R (m/s) (pressure loss) v (m/s) (velocity)	HOT WATER										
		D (External diameter in mm)										
		20	25	32	40	50	63	75	90	110	125	160
0.80	R	86,36	27,45	8,01	2,76	0,93	0,30	0,13	0,05	0,02	0,01	0,00
	v	3,88	2,45	1,48	0,96	0,61	0,39	0,27	0,19	0,13	0,01	0,06
0.90	R	107,89	34,20	9,95	3,42	1,15	0,38	0,16	0,07	0,03	0,01	0,00
	v	4,37	2,75	1,67	1,08	0,69	0,43	0,30	0,21	0,14	0,11	0,07
1.00	R	131,73	41,65	12,09	4,14	1,39	0,45	0,19	0,08	0,03	0,02	0,01
	v	4,85	3,06	1,85	1,20	0,76	0,48	0,34	0,24	0,16	0,12	0,07
1.20	R	186,37	58,66	16,95	5,79	1,94	0,63	0,27	0,11	0,04	0,02	0,01
	v	5,82	3,67	2,23	1,44	0,92	0,58	0,41	0,28	0,19	0,15	0,09
1.40	R		78,49	22,59	7,69	2,57	0,84	0,35	0,15	0,06	0,03	0,01
	v		4,28	2,60	1,68	1,07	0,67	0,47	0,33	0,22	0,17	0,10
1.60	R		101,10	29,00	9,84	3,28	1,06	0,45	0,19	0,07	0,04	0,01
	v		4,90	2,97	1,92	1,22	0,77	0,54	0,38	0,25	0,20	0,12
1.80	R		126,50	36,17	12,25	4,07	1,32	0,56	0,23	0,09	0,05	0,01
	v		5,51	3,34	2,16	1,38	0,87	0,61	0,42	0,28	0,22	0,13
2.00	R		154,68	44,11	14,91	4,94	1,60	0,67	0,28	0,11	0,06	0,02
	v		6,12	3,71	2,40	1,53	0,96	0,68	0,47	0,31	0,24	0,15
2.20	R			52,81	17,81	5,89	1,90	0,80	0,33	0,13	0,07	0,02
	v			4,08	2,64	1,68	1,06	0,74	0,52	0,35	0,27	0,16
2.40	R			62,27	20,96	6,92	2,23	0,94	0,39	0,15	0,08	0,02
	v			4,45	2,88	1,84	1,16	0,81	0,56	0,38	0,29	0,18
2.60	R				24,36	8,03	2,59	1,09	0,45	0,17	0,09	0,03
	v				3,11	1,99	1,25	0,88	0,61	0,41	0,32	0,19
2.80	R				28,00	9,21	2,96	1,24	0,52	0,20	0,11	0,03
	v				3,35	2,14	1,35	0,95	0,66	0,44	0,34	0,21
3.00	R				31,88	10,48	3,37	1,41	0,59	0,22	0,12	0,04
	v				3,59	2,29	1,45	1,01	0,71	0,47	0,37	0,22
3.20	R				36,01	11,82	3,79	1,59	0,66	0,25	0,13	0,04
	v				3,83	2,45	1,54	1,08	0,75	0,50	0,39	0,24
3.40	R						4,24	1,78	0,74	0,28	0,15	0,05
	v						1,64	1,15	0,80	0,53	0,41	0,25
3.60	R						4,72	1,97	0,82	0,31	0,17	0,05
	v						1,73	1,22	0,85	0,57	0,44	0,27
3.80	R						5,21	2,18	0,90	0,34	0,18	0,06
	v						1,83	1,28	0,89	0,60	0,46	0,28
4.00	R						5,73	2,40	0,99	0,37	0,20	0,06
	v						1,93	1,35	0,94	0,63	0,49	0,30
4.20	R						6,28	2,62	1,08	0,41	0,22	0,07
	v						2,02	1,42	0,99	0,66	0,51	0,31
4.40	R						6,85	2,86	1,18	0,44	0,24	0,07
	v						2,12	1,49	1,03	0,69	0,54	0,33
4.60	R						7,44	3,10	1,28	0,48	0,26	0,08
	v						2,22	1,55	1,08	0,72	0,56	0,34

q (supply) (l/s)	R (m/s) (pressure loss) v (m/s) (velocity)	HOT WATER										
		D (External diameter in mm)										
		20	25	32	40	50	63	75	90	110	125	160
4.80	R						8,05	3,36	1,38	0,52	0,28	0,09
	v						2,31	1,62	1,13	0,75	0,59	0,36
5.00	R						8,69	3,62	1,49	0,56	0,30	0,09
	v						2,41	1,69	1,18	0,79	0,61	0,37
5.20	R						9,35	3,89	1,60	0,60	0,32	0,01
	v						2,51	1,76	1,22	0,82	0,63	0,39
5.40	R						10,03	4,18	1,72	0,64	0,35	0,11
	v						2,60	1,82	1,27	0,85	0,66	0,40
5.60	R						10,74	4,47	1,84	0,69	0,37	0,11
	v						2,70	1,89	1,32	0,88	0,68	0,42
5.80	R						11,47	4,77	1,96	0,73	0,40	0,12
	v						2,80	1,96	1,36	0,91	0,71	0,43
6.00	R						12,23	5,08	2,09	0,78	0,42	0,13
	v						2,89	2,03	1,41	0,94	0,73	0,45
6.20	R						13,00	5,40	2,22	0,83	0,45	0,14
	v						2,99	2,09	1,46	0,97	0,76	0,46
6.40	R						13,80	5,73	2,35	0,88	0,47	0,14
	v						3,08	2,16	1,50	1,01	0,78	0,48
6.60	R						14,63	6,07	2,49	0,93	0,50	0,15
	v						3,18	2,23	1,55	1,04	0,80	0,49
6.80	R						15,47	6,41	2,63	0,98	0,53	0,16
	v						3,28	2,30	1,60	1,07	0,83	0,51
7.00	R						16,34	6,77	2,77	1,04	0,56	0,17
	v						3,37	2,36	1,65	1,10	0,85	0,52
7.50	R						18,61	7,70	3,15	1,18	0,63	0,19
	v						3,61	2,53	1,76	1,18	0,91	0,56

q (supply) (l/s)	R (m/s) (pressure loss) v (m/s) (velocity)	HOT WATER										
		D (External diameter in mm)										
		20	25	32	40	50	63	75	90	110	125	160
8.00	R						21,03	8,70	3,56	1,33	0,71	0,21
	v						3,86	2,70	1,88	1,26	0,98	0,60
9.00	R						26,29	10,85	4,43	1,65	0,89	0,27
	v						4,34	3,04	2,12	1,41	1,01	0,67
10.0	R						32,12	13,23	5,39	2,00	1,07	0,32
	v						4,82	3,38	2,35	1,57	1,22	0,74
12.0	R							18,68	7,59	2,81	1,51	0,45
	v							4,05	2,82	1,89	1,46	0,89
14.0	R							25,03	10,14	3,75	2,01	0,60
	v							4,73	3,29	2,20	1,71	1,04
16.0	R							32,29	13,05	4,81	2,57	0,77
	v							5,40	3,76	2,52	1,95	1,19
18.0	R							40,44	16,32	6,00	3,20	0,95
	v							6,08	4,23	2,83	2,19	1,34
20.0	R									7,32	3,90	1,16
	v									3,14	2,44	1,48
22.0	R									8,76	4,67	1,38
	v									3,46	2,68	1,64
24.0	R										5,49	1,63
	v										2,93	1,79
26.0	R										6,39	1,89
	v										3,17	1,93
28.0	R											2,17
	v											2,08
30.0	R											2,47
	v											2,23

6 | TABLE OF CHEMICAL RESISTANCE OF MATERIAL

Compounds or elements	Concentration	Temperature		
		20°C	60°C	100°C
A	100%	S	-	-
acetic anhydride	above 96%	S	L	NS
acetic acid	up to 40%	S	S	-
acetic acid	50%	S	S	L
acetic acid	100%	S	S	-
acetone	100%	S	L	-
acetophenone	100%	S	-	-
acrylonitrile	-	S	S	S
air	-	NS	NS	NS
aliphatic hydrocarbons	sol	S	-	-
alum	100%	L	-	-
amyl acetate	100%	S	S	S
amyl alcohol (	100%	S	-	-
ammonia (gas)	100%	S	-	-
ammonia (saturated)	up to 30%	S	-	-
ammonia liquor	sat. sol.	S	S	-
ammonium acetate	sat. sol.	S	S	-
ammonium bicarbonate	sat. sol.	S	-	-
ammonium chloride	sol.	S	S	-
ammonium fluoride	sol.	S	-	-
ammonium hydroxide	sat. sol.	S	S	S
ammonium metaphosphate	sat. sol.	S	S	S
ammonium nitrate	sat. sol.	S	-	-
ammonium phosphate	sat. sol.	S	S	S
ammonium sulphate	100%	S	S	-
aniline	100%	L	-	-
anisole	-	S	-	-
apple jyice				
aqua regia (HCl/HNO3=3/1)	-	NS	NS	NS
B				
barium carbonate	sat. sol.	S	S	S
barium chloride	sat. sol.	S	S	S
barium hydroxide	sat. sol.	S	S	S
barium sulphate	sat. sol.	S	S	S
benzene	100%	L	NS	NS
benzoic acid	sat. sol.	S	-	-
benzoic chloride	100%	L	-	-
benzoyl alcohol	100%	S	L	-
borax	sol.	S	S	-
boric acid	sat. sol.	S	-	-
bromine (dry vapour)	-	S	NS	NS
bromine (liquid)	100%	NS	NS	NS
bromine water	sol.	NS	NS	NS
butane	100%	S	-	-
butyl acetate	100%	L	NS	NS
butanol	100%	S	L	L
butylglycol	100%	S	-	-

Compounds or elements	Concentration	Temperature		
		20°C	60°C	100°C
butylphenol	cold st. sol.	S	-	-
butyl phtalate	100%	S	L	L
C				
calcium carbonate	sat. sol.	S	S	S
calcium chloride	sat. sol.	S	S	S
calcium hydroxide	sat. sol.	S	S	-
calcium hypochlorite	sol.	S	-	-
calcium nitrate	sat. sol.	S	S	-
carbon dioxide, gaseous, dry	100%	S	S	-
carbon dioxide, gaseous, wet	-	S	S	-
carbon disulphide	100%	S	NS	NS
carbon tetrachloride	100%	NS	NS	NS
chlorine (gaseous, dry)	100%	NS	NS	NS
chlorine (liquid)	100%	NS	NS	NS
chloroacetic water	sat. sol.	S	L	-
chloroacetic acid	sol.	S	-	-
chloroethanol	100%	S	-	-
chloroform	100%	L	NS	NS
chlorosulphonic acid	100%	NS	NS	NS
chrome alum	sol.	S	S	-
chromic acid	up to 40%	S	L	NS
citric acid	10%	S	S	S
copper (cu'') nitrate	sat. sol.	S	S	-
cresol	above 90%	S	-	-
cupric (cu'') nitrate	30%	S	S	S
cupric (cu'') sulphate	sat. sol.	S	S	-
cyclohexane	100%	S	-	-
cyclohexanol	100%	S	L	-
cyclohexanone	100%	S	L	-
D				
dekalin (dekalydronaphtalene)	100%	NS	NS	NS
dextrin	sol.	S	S	-
dextrose	sol.	S	S	-
dibutyl phtalate	100%	S	L	NS
dichloroacetic acid	100%	L	-	-
dichloroethylene	100%	L	-	-
diethanolamine	100%	S	-	-
diethylene glycol	100%	S	S	-
diethyl ether	100%	S	L	-
diglycolic acid	sat. sol.	S	-	-
diisoctyl phtalate	100%	S	L	-
dimethylamine	100%	S	-	-
dimethylformamide	100%	S	S	-
dioctyl phtalate	100%	L	L	-
dioxan	100%	L	L	-

Compounds or elements	Concentration	Temperature		
		20°C	60°C	100°C
E				
ethanolamine	100%	S	-	-
ethyl acetate	100%	L	NS	NS
ethylalcohol	up to 95%	S	S	S
ethyl chloride	100%	NS	NS	NS
ethylene chloride	100%	L	L	-
ethylene glycol	100%	S	S	S
F				
formaldehyde	40%	S	-	-
formic acid	10%	S	S	L
formic acid	85%	S	NS	NS
formic acid	100%	S	L	L
fructose	sol.	S	S	S
fruit juice	-	S	S	S
G				
gelatin	-	S	S	-
glucose	20%	S	S	S
glycerine	100%	S	S	S
glycolic acid	30%	S	-	-
H				
heptane	100%	L	NS	NS
hexane	100%	S	L	-
hydrobromic acid	up to 48%	S	L	NS
hydrobromic acid	2-7%	S	S	S
hydrobromic acid	10-20%	S	S	-
hydrobromic acid	30%	S	L	L
hydrobromic acid	35-36%	S	-	-
hydrobromic acid	100%	S	S	-
hydrofluoric acid	dil. sol.	S	-	-
hydrofluoric acid	40%	S	-	-
hydrogen	100%	S	-	-
hydrogen peroxide	up to 10%	S	-	-
hydrogen peroxide	up to 30%	S	-	-
hydrogen sulphide, gaseous, dry	100%	S	-	-
I				
iodine (alcoholic solution)	-	S	-	-
isoctane	100%	L	NS	NS
isopropylalcohol	100%	S	S	S
isopropylether	100%	L	-	-
L				
lactic acid	up to 90%	S	S	-
lanoline	-	S	L	-

Compounds or elements	Concentration	Temperature		
		20°C	60°C	100°C
M				
magnesium carbonate	sat. sol.	S	S	S
magnesium cloride	sat. sol.	S	S	-
magnesium sulphate	sat. sol.	S	S	-
malic acid	sol.	S	S	-
mercuric cyanide	sat. sol.	S	S	-
mercuric chloride	sat. sol.	S	S	-
mercurous nitrate	sol.	S	S	-
mercury	100%	S	S	-
methyl acetate	100%	S	S	-
methyl alcohol	5%	S	L	L
methylamine	up to 32%	S	-	-
methyl bromide	100%	NS	NS	NS
methylene chloride	100%	L	NS	NS
methyl ketone	100%	S	-	-
milk	-	S	S	S
monochloroacetic acid	-	S	S	-
N				
naphta	-	S	NS	NS
nickel chloride	sat. sol.	S	S	-
nickel nitrate	sat. sol.	S	S	-
nickel sulphate	sat. sol.	S	S	-
nitric acid	10%	S	NS	NS
nitric acid	30%	S	-	-
nitric acid	40-50%	L	NS	NS
nitric acid, fuming (with nitric oxide)	-	NS	NS	NS
nitrobenzene	100%	S	-	-
O				
oil	-	S	-	-
almond	-	NS	NS	NS
camphor	-	S	S	-
castor	100%	S	-	-
coconut	-	S	L	-
corn	-	S	S	-
cotton	-	S	S	S
linseed	-	S	S	L
olive	-	S	L	NS
paraffin (FL 65)	-	S	S	-
peanut	-	S	-	-
peppermint	-	S	S	S
silicone	-	S	L	-
soyabean	-	S	-	-
oleic acid	100%	S	L	-
oleum (sulphuric acid contain 60% So_3)	-	NS	NS	NS
oxalic acid	sat. sol.	S	L	NS
oxygen	100%	S	-	-

Compounds or elements	Concentration	Temperature		
		20°C	60°C	100°C
P				
perchloric acid	2N	S	-	-
petroleum ether (ligroin)	-	L	L	-
phenol	5%	S	S	-
phenol	90%	S	-	-
phosphoric acid	25%	S	S	S
phosphoric acid	25-85%	S	S	S
phosphorus oxychloride	100%	L	-	-
picric acid	sat. sol.	S	-	-
potassium bicarbonate	sat. sol.	S	S	-
potassium borate	sat. sol.	S	S	-
potassium bromate	up to 10%	S	S	-
potassium bromide	sat. sol.	S	S	-
potassium carbonate	sat. sol.	S	-	-
potassium chlorate	sat. sol.	S	S	-
potassium chloride	sat. sol.	S	-	-
potassium chromate	sat. sol.	S	S	-
potassium cyanide	sol.	S	-	-
potassium fluoride	sat. sol.	S	S	-
potassium hydroxide	up to 50%	S	S	S
potassium iodide	sat. sol.	S	-	-
potassium nitrate	sat. sol.	S	S	-
potassium perchlorate	10%	S	S	-
potassium permanganate	2N	S	-	-
potassium persulphate	sat. sol.	S	-	-
potassium sulphate	sat. sol.	S	-	-
propane	100%	S	-	-
propionic acid	above 50%	S	-	-
pyridine	100%	L	-	-
S				
silver nitrate	sat. sol.	S	S	L
sodium acetate	sat. sol.	S	S	S
sodium benzoete	35%	S	-	-
sodium bicarbonate	sat. sol.	S	S	S
sodium bisulfite	sol.	S	-	-
sodium bisulphate	sat. sol.	S	S	-
sodium carbonate	up to 50%	S	S	L
sodium chlorate	sat. sol.	S	-	-
sodium chloride	10%	S	S	S
sodium chlorite	2%	S	L	NS
sodium chlorite	20%	S	L	NS
sodium dichromate	sat. sol.	S	S	S
sodium hydroxide	up to 60%	S	S	S
sodium hypochlorite	5%	S	S	-
sodium hypochlorite	10%	S	-	-
sodium hypochlorite	20%	S	L	-

Compounds or elements	Concentration	Temperature		
		20°C	60°C	100°C
sodium metaphosphate	sol.	S	-	-
sodium nitrate	sat. sol.	S	S	-
sodium orthophosphate	sat. sol.	S	S	S
sodium perborate	sol.	S	S	-
sodium silicate	sat. sol.	S	-	-
sodium sulfide	40%	S	S	S
sodium sulphate	sat. sol.	S	-	-
sodium thiosulphate (hypo)	sat. sol.	S	S	-
stannic chloride	sat. sol.	S	S	-
stannous chloride	sat. sol.	S	S	-
succinic acid	100%	S	-	-
sulphuric acid	up to 10%	S	S	S
sulphuric acid	10 until 30%	S	S	S
sulphuric acid	50%	S	S	-
sulphuric acid	96%	S	L	NS
sulphuric acid	98%	L	NS	NS
sulphurous acid	sol.	S	-	-
T				
tertatic acid	10%		S	
tetrahydrofuran	100%	S	NS	-
tetrahydronaphtalene	100%	L	NS	NS
thiophene	100%	NS	L	NS
toluene	100%	S	NS	-
trichloroacetic acid	up to 50%	L	S	NS
trichlotoethylene	100%	S	NS	-
triethanolamine	sol.	NS	-	NS
turpentine	-	S	NS	-
		NS		NS
U				
urea	sat. sol.		-	
		S		-
W				
water, brackish		S	S	S
mineral-drinkable	-	S	S	S
water, distilled	100%	S	S	S
water (sea water)	-	S	S	S

Compounds or elements (The following solutions must be avoided)	Concentration
aliphatic hydrocarbons	100%
aqua regia	HCl/HNO_3=3/1
benzol	100%
bromine water	sol.
bromine (dry vapour)	dil.
bromine (liquid)	100%
butyl acetate	100%
camphor oil	-
chlorine, gaseous, dry	100%
chlorine (liquid)	100%
chloroform	100%
chlorosulfonic acid	100%
cyclohexanone	100%
dekalin	100%
ethylacetate	100%
ethylchloride	100%
heptane	100%
issoctane	100%
nitric acid	above 40%
methyl bromide	100%
methylene chloride	100%
oleic acid	100%
oleum (suphuric acid with 60% SO3)	-
paraffin oil	-
sulfuric acid	98%
tetrahydrofuran	100%
tetrahydronaphtalene	100%
toluene	100%
trichloroethylene	100%
turpentine	-
xilene	100%

Observations:
Concentrations are expressed by volume. Aqueous solutions of soluble chemicals are considered as saturated when calculating their effect on polypropylene. The above table contains the chemical names and their conventional symbols.

S = satisfactory
L = limit
NS = not satisfactory
Sat. sol. = saturated aqueous solutions ready at 20°C
Sol. = aqueous solutions of maximum concentration 10%
Dil. Sol. = diluted solutions of maximum concentration 10%

NOTES

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aliphatic hydrocarbons	100%
aqua regia	HCl/HNO_3=3/1
benzol	100%
bromine water	sol.
bromine (dry vapour)	dil.
bromine (liquid)	100%
butyl acetate	100%
camphor oil	-
chlorine, gaseous, dry	100%
chlorine (liquid)	100%
chloroform	100%
chlorosulfonic acid	100%
cyclohexanone	100%
dekalin	100%
ethylacetate	100%
ethylchloride	100%
heptane	100%
issoctane	100%
nitric acid	above 40%
methyl bromide	100%
methylene chloride	100%
oleic acid	100%
oleum (suphuric acid with 60% SO3)	-
paraffin oil	-
sulfuric acid	98%
tetrahydrofuran	100%
tetrahydronaphtalene	100%
toluene	100%
trichloroethylene	100%
turpentine	-
xilene	100%

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