ComoPex

interplast.gr

TECHNICAL MANUAL FOR PEX PIPES & FITTINGS UNDERFLOOR HEATING & RENEWABLE SOURCES OF ENERGY

interplast

Green line

Our Company

Interplast produces plastic pipes and fittings of high standards used in plumbing, heating, drainage and energy applications, covering a vast range of the building, technical works and industrial plant construction sectors.

The company's headquarters are located in Sindos, Thessaloniki, from where the daily production activities of the following industrial units are coordinated:

In the Industrial Area of Komotini, in an area of 40,000 sq.mtrs., where the production of plastic pipes and fittings is located (PE, PB, PP-R and PVC)

In Menidi, Attica, in an area of 6,000 sq.mtrs, where Interplast's clientele customer service for Southern Greece is located, as well as the production unit of the brass fittings of its subsidiary ELVIOM S.A.

Our Philosophy

People who dedicate work, energy, qualifications and knowledge.
A company amongst the elite of the major European names of its field.
Consistent and confident steps of development.
Production capacity that ensures the present and sets solid foundations for the future.
Vertical production process.
Very strict quality controls.

These are some of the constant values that constitute our philosophy but also ascertain the absolute quality of our final products for you.
Because consistency, reliability and a trusting relationship with our clients and partners constitute our strength.
Because we believe that these are the values which enable a company to serve as a raw model.

Our Work

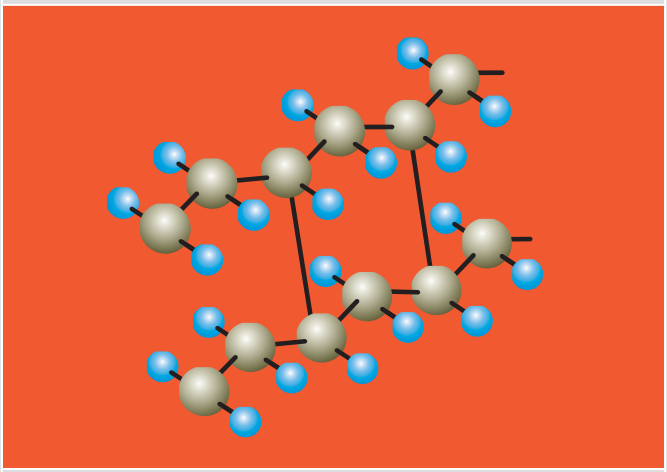
Our steady and constant growth sets **Interplast** in the **first place** in sales of plastic piping systems for plumbing and heating-cooling applications in the Greek market.
And even for us, our lead is proven by projects such as the Olympic Village, the drastic renovation of the historic Grande Bretagne Hotel, the two biggest commercial Mall centers in the country – the Mall in Maroussi Athens and Mediterranean Cosmos in Thessaloniki, as well as with our participation in the construction of numerous hotels, hospitals and residential units.
Furthermore, our dynamic and constant investments and the exports of our products to more than 30 countries around the world indicate that "the development never stops"!

This is our motto which governs our production process, is put into practice, promotes high quality work and competitiveness, and it is the direction of the compass that orients us firmly to the top.

The applications of plastic pipes are so common in our daily life that these types of pipes have come to replace conventional pipes on a large scale. One of the most important breakthroughs is their use in hot water networks. The raw materials used are polypropylene (PP) and cross-linked polyethylene (PE-X) produced from a special composition of high density polyethylene (HDPE).

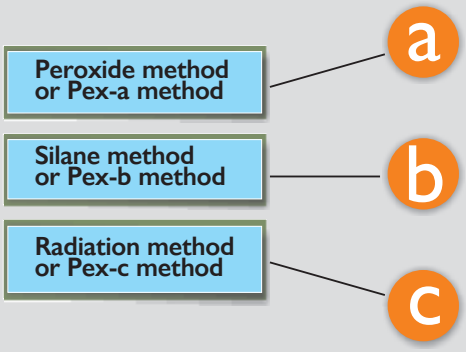
In HDPE, a reaction is induced in the double bonds, so that many of them get connected and by the help of silane molecules, a three-dimensional homogenous network is created of high molecular weight. The final product (cross-linked polyethylene) has excellent performance at high temperatures combined with high pressures, has improved resistance to impact and to chemicals and has a longer lifespan.

Today, 40 years after their first applications and based on their successful history, Pex pipes are constantly growing in demand gaining a significant market share.



Cross-linking methods

The most common cross-linking methods used in industrial production are:



All aforementioned methods achieve the same results in PE-X pipes and meet the DIN 16892/16893 and the recent European EN ISO 15875-1/2 standards.

Their only difference lies in the cross-linking degree specified in the DIN and EN standards. 70% for method –a, 65% for method –b, and -60% for method –c. For example, a pipe with a cross-linking degree of 68% that has been produced using method –a does not meet the specifications, while a pipe with the same cross-linking degree produced by method –b does.

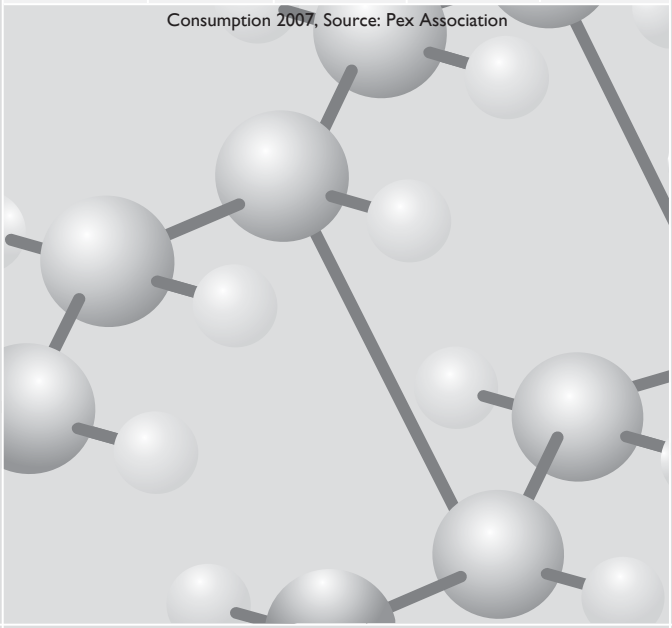
The Como-pex pipes of **Interplast** are produced using the –b method. It is a method that has managed to improve the characteristics of Pex pipes since the fact that cross-linking degree continues over time, which is considered as a huge advantage, leading as such to exceptional properties of the product during its use. Furthermore, -b method pipes, in varying degrees of cross-linking, are more homogenous in their behavior.

Characteristic is the ever increasing demand of method –b in the markets, with ever increasing trends in the recent years compared to cross-linked manufactured products of the other alternatives.

GLOBAL CONSUMPTION IN TONS PEX

AREA	PE-Xa	PE-Xb	PE-Xc	PE-X OVERALL
Europe	24.000	38.000	20.000	82.000
Middle East & Africa	1.300	8.000	1.800	11.100
Russia	200	4.000		4.200
North America	9.000	14.000		23.000
South America		5.000		5.000
Asia (Pacific)	3.000	20.000		23.000
Total:	37.500	89.000	21.800	148.300

Consumption 2007, Source: Pex Association



ADVANTAGES OF PEX-b PIPES

The production method of PEX-b pipes was discovered in the laboratories of Sioplast in 1970. It had an initial cross-linking degree of 65%, which increased over time and reached about 89%, in contrast to the degrees of the other two methods (PEX –c & PEX-a) that stop at 60% and 70% respectively. **It is considered to be the best cross-linking method for many reasons, but mainly due to its fully three-dimensional dense networking structure and its high chemical resistance to chlorinated water because of its sufficient amounts of antioxidant additives in its material. For these reasons, it is used by most manufacturers of PEX pipes around the world.**

The advantages of method –b are:

- Higher mechanical strengths, such as resistance to pressure especially at high temperatures compared to the other two methods, due to the fully three-dimensional structure and the homogenous structure of the material.
Long lasting tests assessing the mechanical properties, aiming at "predicting" the life span exceeding the 50 years, are starting to converge towards the direction that PEX-b pipes present a smoother and more predictable mechanical behavior with respect to PEX-a and PEX-c and certainly more resistant to chlorinated water and generally to waters with high corrosiveness.
The chart on the next page shows the resistance to pressure of a PEX-b pipe and a PEX-a pipe in long term hydrostatic pressure tests conducted at the renowned Swedish Institute Bodycote Polymer. The prediction for the strength of the PEX-b pipe at 20°C for 50 years is 11.20MPa, while for PEX-a pipe is 10.30MPa. At 95°C, the strengths are 4.20MPa and 3.81MPa respectively, whereas at 110°C 3.06MPa and 2.60MPa respectively. **The results show the clear superiority of the PEX-b pipe in pressure strength by 9% at 20°C, by 10.3% at 95°C and by 17.7% in 110°C compared to PEX-a pipe.**

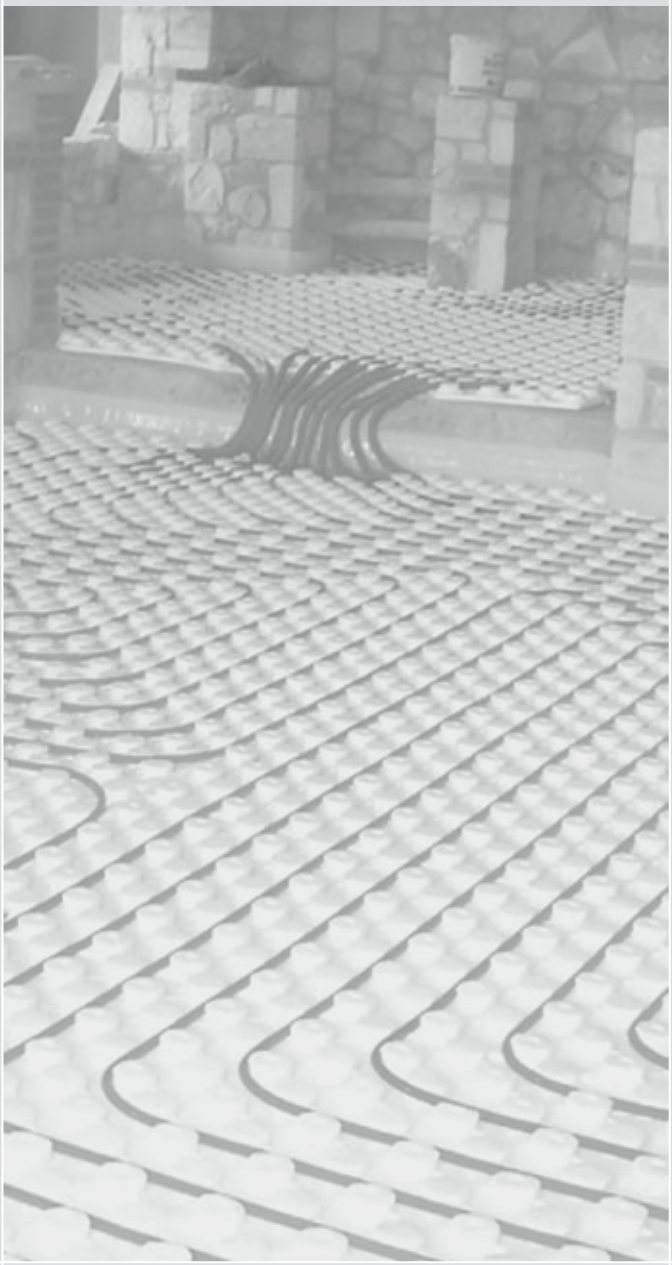
- The small amount of antioxidants in the material of methods –a and –c results in a reduced life span of the particular pipes compared to the –b method in areas with high water chlorination or with high water acidity or alkalinity.

- Greater resistance to thermo-oxidation phenomenon that develops during high temperature operations (85-110°C) and higher resistance to solar radiation.

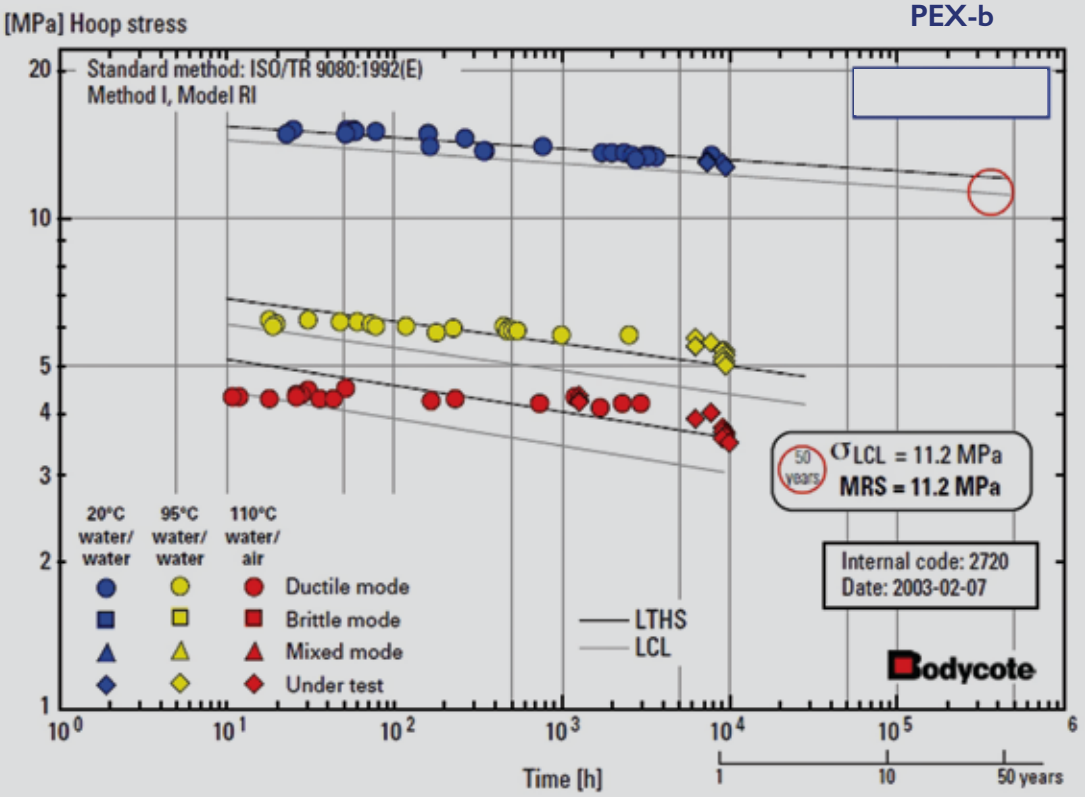
- Better chemical resistance to corrosive liquids and detergents and to a wider range of aggressive chemicals and especially to peroxide radicals by chlorinated water.

- Lower pipe permeability of gas primarily from corrosive oxygen. PEX-b pipes have an oxygen permeability of 3.22 g/m³/day, in contrast to 4.54 g/m³/day for PEX-c pipes and 3.87 g/m³/day for PEX-a pipes, according to relevant measures of the independent Dutch Institute Kiwa. This translates into a maximum protection of the metal parts of the installation.

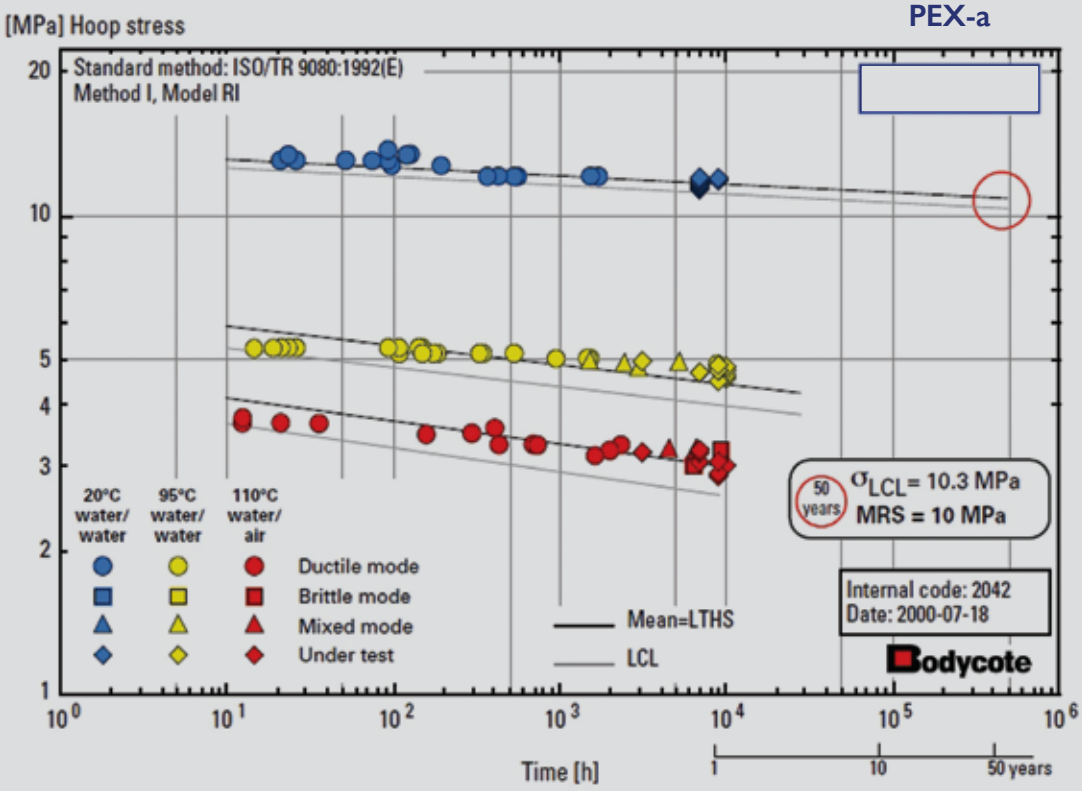
- Percentage of cross-linking degree that increases over time and enhances pressure resistance.



PEX-b



PEX-a



Source: Bodycote Polymers, www.bodycote.com

BEHAVIOR OF POLYETHYLENE IN DRINKING WATER

Drinking water was for centuries a valuable commodity. In modern urban centers, its quality assurance constitutes an urgent priority. Designated as drinking water is the water that is free of chemical and microbiological substances and that can be consumed by humans without putting at risk their health, in the short or long term. Its organoleptic characteristics should not include the presence of odor, flavor, color, heavy metals, toxical and microbiological agents.
The health care provision for drinking water, which is in force today, is in accordance with the relevant directive of the EU Council. Included are 62 parameters, grouped into 5 major groups: organoleptic, physiochemical, undesirable, toxic and microbiological. For each parameter, an indicative level and a maximum concentration are set.

The water piping systems of buildings constitute a very critical parameter for ensuring the quality of drinking water and should be given special attention in their maintenance and in the proper selection of the suitable construction materials. The materials used nowadays for water supply systems in buildings are plastic and metal, while in the municipal pipe water system, solely plastic is used.

Metal pipes present electrochemical corrosion and are not resistant to acid waters (pH<7). Due to their corrosion, significant amounts of metal parts are dissolved in the drinking water and if the water remains stagnant in the pipe for 12hours, the concentration of the metal may exceed 20mg/l, with maximum being 2mg/l. For this reason, the health provision indicated two indicative levels in metal piping: in the output of the installation and after a stagnation of 12hours.

The metal is also an energy intensive material, which means that for its production a substantial amount of energy is to be needed, without taking into account the adverse environmental impacts from their mining.

For all the aforementioned reasons, **Greenpeace, as shown in the table next page, and other relevant environmental non-governmental organizations, propose specific types of plastic pipe for water systems in buildings** because they have low energy charges, provide clean drinking water without harmful substances, while not having the problems of metal corrosion. They ideally propose as first alternatives for plumbing, the use of plastic polypropylene pipes (PP), of polyethylene pipes (PE) and of polybutylene pipes (PB).

PE is a material that does not react with water or its components (completely inert), does not extract any chemicals that can harm the quality of the water, does not develop on its surface any microbiological or bacterial substances, does not corrode from any chemical agents, cement, lime or acid waters and has very low roughness (mean surface anomalies in mm), resulting in that the pipes and fittings are protected against damages caused by the friction of water with the inner walls of the pipe, while the pressure drop coefficients remain very low.

SPECIFIC EXAMPLES OF ALTERNATIVE CHOICES IN CONSTRUCTION PRODUCTS				
Application	**1st choice**	**2nd choice**	**3rd choice**	**Not recommended**
Wall insulation	Cork Cellulose Wool Biofiber	Rock wool	Expanded polystyrene (EPS)	Extruded polystyrene (XPS)
Internal drainage pipes	Ceramic pipes	Polyethylene (PE) Polypropylene (PP)	-	PVC
Water pipes	**Polypropylene (PP)** **Polyethylene (PE)** **Polybutylene**	Stainless steel	Copper	PVC
External doors	Certified hard timber of sustainable management Conifer timber without preservatives	Conifer timber with borates implants Plywood timber of sustainable management	Aluminium Conifer timber without preservatives	Non certified tropical timber PVC

Source: Greenpeace, www.greenpeace.org/greece/el

PROPERTIES OF COMO-PEX RAW MATERIAL

Property	Metric Unit	Standard Value	Test
Density	gr/cm^3	0,942	DIN 53479/ASTM D 1505
Volume density	gr/cm^3	0,55	DIN 53466
Melt flow index 190C-5kg	gr/10min	2,5	CON 2.2
Overall volatility	%	< 0,1	CON 4.3
Cross-linking agent content	%	74	DIN 16892/ ASTM F 876 99a
Humidity absorption	%	< 0,02	CON 45.1
Tensile strength	Mpa	20	ISO R 527
Tension limit			
23°C 1mm/min	Mpa	770	ISO R 527
100°C 1mm/min	Mpa	105	ISO R 527
Bend limit			
+23°C 1mm/min	Mpa	710	ISO R 527
-40°C 1mm/min	Mpa	1500	ISO R 527
Impact strength -40°C	Kj/m^2	12	ISO 179/1A
Burst elongation	%	250	ISO R 527
VICAT softening temperature	°C	121	ISO 306
Linear expansion coefficient	°K - 1	$1,9x10^{-4}$	ASTM D 696-70

TABLE OF COMO-PEX CHEMICAL RESISTANCE

CHEMICAL SUBSTANCES	CONCENTRANTION Conc.	TEMPERATURES 20°c	60°c
Acetone	100	S	
Acetic acid	100	S	S
Benzoic acid	aqueous	S	S
Hydrochloric acid	dense	S	S
Chromic acid	50%	S	NS
Phosphoric acid	95%	S	S
Formic acid		S	S
Hydrofluoric acid	70%	S	NS
Nitric acid	30%	S	S
Nitric acid	50%	L	NS
Sulphuric acid	50%	S	S
Sulphuric acid	98%	L	NS
Water		S	S
Demineralised water	100	S	S
Potable water		S	S
Sea water		S	S
Aqua regia		NS	NS
Ethyl alcohol	100	S	S
Liquid ammonium		S	S
Carbon dioxide		S	S
Aniline		S	S
Plant insecticide		S	S
Gasoline		S	L
Benzene		S	L
Beer		S	S
Butane		S	S
Ammonium chloride	aqueous	S	S
Potassium chloride	aqueous	S	S
Chemical detergents		S	S
Laundry detergents		S	S
Hexane		S	S
Petroleum ether		S	
Fluoride		NS	NS
Liquid chloride gas		L	NS
Methane gas		S	
Diesel		S	L
Glycerin		S	S
Ethylene glycol		S	S
Sulphite liquor		S	S
Sodium hypochlorite		S	L
Milk		S	S
Alkalic Bleaching Solution		S	
Engine lubricants		S	L
Methanol		S	S
Naphtha		S	L
Mazut		S	L
Linseed oil		S	S
Paraffin oil		S	S
Transformer oil		S	L
Silicon oil		S	S
Vegetable oils		S	L
Potassium permanganate	20%	S	S
Hydrogen peroxide	30%	S	S
Hydrogen peroxide	100%	S	NS
Petroleum		S	L
Propane		S	S
Liquid soap		S	S
Caustic soda		S	S
Toluole		L	NS
Vaseline		S	L
Wine		S	S

S=Satisfactory, L=Limited, NS=Not Satisfactory

PROPERTIES OF COMO-PEX PIPES

Excellent thermal properties
They have been designed for a life span of over 50 years at temperatures of up to 95°C and at 6 to 10 bar operating pressure. **Temperature peaks of 110°C at 4 bar operating pressure do not affect Como-pex pipes.**

Thermal memory
Due to their cross-linked structure, **Como-pex pipes have thermal memory** enabling them to return to their original shape after thermal stress. Essentially, the internal structure of the material "remembers" the shape it was given at production.

Chemical resistance
The material is resistant to most chemical substances, even at high temperatures. The chemical substances that usually cause alteration or bursting of common plastic pipes do not affect Como-pex.

Resistant to corrosion
Como-pex pipes are exceptionally resistant to corrosion, even in areas with very hard water, remaining unaltered over the course of time. In contrast to metal pipes, they do not present any sign of electrochemical corrosion. Moreover, high water velocity does not cause any corrosion.

Mechanical strength
Cross-linked polyethylene pipes display exceptionally high mechanical strength to impact. For example, they can be used as a protective coating on rolling bearings used to transport very sharp items in hard-metal industrial plants.

Low friction factor
The structure of the material and the smooth texture of the surface ensure low friction losses resulting in low resistance and low pressure drop in the piping. For these reasons, the installations are more economical, as smaller diameter pipes and lower wattage pumps can be used for the same quantity of water. In the case of metal pipes, the combination of the friction and corrosion consequences worsens the problem.

Clean and non-toxic
Como-pex is free of toxic substances. Hygiene and toxicological analyses have ensured its approval for drinking water. The pipes are regularly tested by official institutes and bodies (General State Laboratory, WRAS-NSF Great Britain) for taste, odor, development of microorganisms, extraction of substances and metals dangerous to human health (cadmium, arsenic, etc.)

Thermal conductivity
Thermal conductivity is one of the thermal properties of Como-pex pipes, whose value is:

Thermal conductivity = 0.46 W/m.k

Specific heat
The specific heat of Como-pex pipes is measured according to MADSC-02004-15011357-4 and equals for example at 40°C to 2.1 Cp (j.g.k).

Soundproof
The Como-pex system operates noise-free. The pipes have a safe insulation for water flow velocities up to 1m/sec unlike metal pipes.

Certified
The pipes are regularly tested by official institutes and bodies for their mechanical strengths (SKZ Germany, CSA Canada, AENOR Spain, ELOT Greece) and their suitability for drinking water (WRAS-NSF Great Britain, General Chemical State Laboratory). Como-pex pipes with oxygen barrier, apart of the above, are further tested against oxygen diffusion by MPA-NRW Germany.

Guarantee
Interplast offers a guarantee for a period of 30 years covered by ALLIANZ Insurance against damages owing to faulty pipe production at the amount of €3,000,000 and up to €500,000 per incident.

PRODUCED PIPE DIMENSIONS

Como-pex pipes are manufactured in white and in black if they are to be used under continuous exposure to solar radiation. Upon request, they can also be produced in blue or gray color.

Como-pex pipes are delivered in 100m coils and in 50m coils for diameters 28 and 32mm. Straight lengths or longer coils can be produced according to the needs of the customer.

Como-pex pipes bear a marking per meter, indicating the brand, the outer diameter, the cross-linking method, the wall thickness, the specifications under which the pipes are produced and controlled (EN, DIN), the institutes and bodies having certified the pipes (SKZ, AENOR, CSA, MPA-NRW, WRAS), the operating pressure at 20oC and 95oC, their class defining the fields of application and a lot number that indicates the date and time of production.

The coils are packed in cardboard boxes bearing a printing with the pipe's brand name and its characteristics (outer diameter, wall thickness, color and certificates).

It is recommended that the white colored pipes be kept in their cartons until the time of installation.

The following table shows some of the main characteristics of Como-pex pipes.

These characteristics have resulted from lifespan diagrams in conjunction with various tests.

TABLE OF MAIN CHARACTERISTICS OF COMO-PEX PIPE

Outer diameter	Wall thickness	Weight	Packaging	Operating pressure at 20°C (bar) 50 years continuous operation	Operating pressure at 95°C (bar) 50 years continuous operation	Content
mm	mm	kgr/m	m/roll			lt/m
12	1.10*	0,041	100	12,5	5,5	0,075
12	2.00*	0,067	100	25	10	0,050
14	2.00*	0,076	100	20	8,7	0,078
15	1,50*	0,069	100	12,5	5,5	0,113
15	2.50	0,097	100	25	10	0,078
16	1.50*	0,070	100	12,5	5,5	0,132
16	1.80*	0,082	100	16	6,9	0,120
16	2.00	0,090	100	18	7,8	0,113
16	2.20	0,098	100	20	8,7	0,105
17	2.00*	0,096	100	17	7,2	0,132
18	2.00	0,102	100	16	6,9	0,153
18	2.50	0,122	100	20	8,7	0,132
20	1.90*	0,117	100	12	5,2	0,206
20	2.00	0,119	100	12,5	5,5	0,201
20	2.80*	0,155	100	20	8,7	0,162
22	2.00*	0,129	100	12,5	5,5	0,254
22	3.00	0,177	100	20	8,7	0,201
25	2.30*	0,166	100	12,5	5,5	0,326
25	3.50*	0,234	100	20	8,7	0,254
28	3.00	0,230	50	16	6,9	0,380
32	2.90*	0,265	50	12	5,2	0,539
32	3.00	0,270	50	12,5	5,5	0,530

* On demand

For the convenience of the installer, **Interplast** offers the **Como-pex pipe within the corrugated pipe (Pipe in Pipe)** in the following diameters.

TABLE OF DIMENSIONS

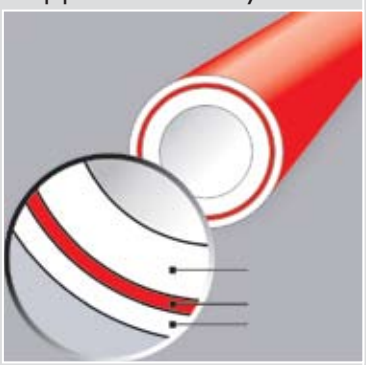
Como-pex	Corrugated pipe	Packaging
12x2.00*	25	50
14x2.00*	25	50
15x2.50	25	50
16x1.50*	25 ή 28	50
16x2.00	25 ή 28	50
16x2.20	25 ή 28	50
18x2.00	28	50
18x2.50	28	50
20x2.00*	28 ή 35	50
22x3.00*	35	50
20x2.80*	28 ή 35	50
25x2.30*	35	50
25x3.50*	35	50
28x3.00*	42	50
32x3.00*	42	50

* On demand

Como-pex Oxygen Barrier

Particularly for central heating and underfloor heating installations (closed circuits), **Interplast** manufactures Cross Linked Polyethylene pipe with an oxygen barrier.

The Como-pex Oxygen Barrier pipe consists of 3 layers:



-Inner layer of Cross Linked Polyethylene
-Bonding layer for better adhesion of EVOH to the main pipe
-Oxygen Barrier layer (EVOH-ethylene vinyl alcohol polymer)

The additional properties, as compared to ordinary Pex pipe, are analyzed below:

- The special oxygen barrier prevents oxygen and other gases from entering the closed heating circuit through the pipe and corroding the metal components of the system (e.g. radiators, boiler, valves etc). In the case of underfloor heating, where the circuits are quite long, it is considered as a must.

- Oxygen barrier pipes have higher mechanical strengths than ordinary Pex pipes, as the two additional layers that are 0,15mm thick add extra material. For example, ordinary Pex pipes should have a minimum outer diameter of 16mm and minimum wall thickness of 2.00mm to meet DIN 16892. The oxygen barrier pipe should have a minimum outer diameter of 16.3mm and minimum wall thickness of 2.15mm to meet DIN 16892 (mechanical strength) and DIN 4726 (which defines oxygen diffusion).

- Present lower linear heat reversion. Laboratory tests have shown that Como-pex pipe specimens at 120°C present 0,8 % heat reversion (with a limit according to DIN being at 3%). Como-pex Oxygen barrier pipes present 0.5% heat reversion.

For all the aforementioned reasons, Pex pipes with oxygen barrier are used in all applications all over the countries of Northern Europe.

The main characteristics of Como-pex oxygen Barrier pipe are shown in the following table.

TABLE OF MAIN CHARACTERISTICS OF COMO-PEX OXYGEN BARRIER PIPE

NOMINAL OUTER DIAMETER	ACTUAL OUTER DIAMETER	NOMINAL WALL THICKNESS	ACTUAL WALL THICKNESS	WEIGHT	PACKAGING
mm	mm	mm	mm	gr/m	m
14*	14.3	2.00	2.15	0,081	200
15*	15.3	2.50	2.65	0,103	200
16	16.3	2.00	2.15	0,097	200
16*	16.3	2.20	2.35	0,105	200
17	17.3	2.00	2.15	0,105	200
18*	18.3	2.00	2.15	0,111	200
18	18.3	2.50	2.65	0,131	200
20*	20.3	2.00	2.15	0,130	200
20*	20.3	2.80	2.95	0,166	200

* On demand

Due to the differences between nominal and actual dimensions, certain brass fittings do not join well the plastic pipe.

Interplast manufactures brass fittings that join equally well on ordinary Pex and Como-pex Oxygen Barrier pipe.
Pipes with an outside diameter of 17mm are also available in 600m coils and can be fitted on a special unwinder for underfloor heating applications.

For the convenience of the installer, Como pex Oxygen Barrier pipe is also available inside corrugated piping.

TABLE OF COMO-PEX OXYGEN BARRIER PIPE DIMENSIONS

Como-pex Oxygen Barrier	Corrugated conduit pipe	Packaging
14x2.0 *	25	50m
15x2.5 *	25	50m
16x2.0	25 ή 28	50m
16x2,2 *	25 ή 28	50m
17x2.0 *	28	50m
18x2.0	28	50m
18x2.5	28	50m
20x2.0*	28 ή35	50m
20x2.8*	28 ή35	50m

Pex pipes have been used safely and reliably all over the world for the past 40 years. **They have been designed for a lifespan of more than 50 years, for temperatures up to 95°C and operating pressure from 6 to 10 bar.**

Como-pex pipes are exceptionally resistant to ageing, in conjunction with high temperatures and pressure conditions. The lifespan diagram confirms their exceptional performance, when used in accordance with manufacturer specifications and recommendations.

In general, Como-pex pipes are resilient, flexible and totally reliable for plumbing and heating installations.

The lifespan of the pipe depends on the following factors: pressure, temperature and external stress.

The formula that combines these parameters is:

$$p = \frac{2 \cdot S\,min \cdot \sigma 0}{d - S\,min}$$

Where:
P: maximum internal pressure in bar
D: outer diameter in mm
S: wall thickness (minimum) in mm
σ: stress in N/mm² or MPa
Based on the above and without taking into consideration the additional strengths discussed in chapter 7 on laboratory equipment, the table below presents the lifespan of a Como-pex 18x2.5 pipe at various temperatures and a safety coefficient of 1.5.

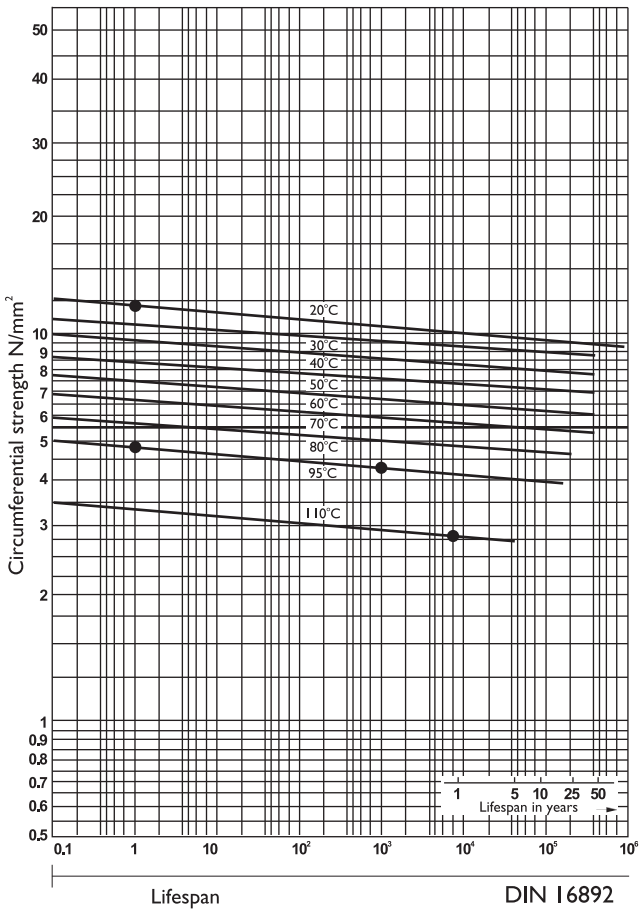


TABLE SHOWING COMO-PEX LIFESPAN AT SAFETY FACTOR 1,5

Temperature	Lifespan	Pressure	Safety coefficient
20°C	50	19.5	1.5
60°C	50	13	1.5
80°C	50	9.6	1.5
95°C	50	8.2	1.5

COMO-PEX
PIPE PROTECTION

For the protection of cross-linked polyethylene pipes, **Interplast** manufactures corrugated pipes in red, blue and black color in dimensions ranging from 25 to 42mm.

For the installer's convenience, Como-pex Oxygen Barrier pipe is distributed inside the corrugated piping.

As such, we can achieve:

- Good performance to thermal expansion and contraction

- Reduction of thermal losses

- Protection against external impact

- Easy replacement in case of damage

In very rare cases of mal-installations is the replacement of the pipe necessary. This is easily achieved by removing the cross-linked polyethylene pipe from the corrugated pipe and replacing it with a new pipe.

More specifically, the repair is facilitated by the connection of the pipes, which means removing the old pipe and simultaneously inserting a new pipe with the aid of an extractor; a procedure that constitutes yet another advantage of the properties of cross-linked polyethylene pipe.

The corrugated pipe is very flexible and resistant, with the following characteristics:

TABLE OF CORRUGATED PIPE FEATURES

Corrugated pipe		For Como-pex pipe diameter	
OUTER DIAMETER	INNER DIAMETER	PACKAGING	OUTER DIAMETER of Como-pex PIPE
mm	mm	m/roll	mm
25	20	50	16
28	23	50	18
35	29	50	22
42	36	50	32

QUALITY ASSURANCE DURING PRODUCTION

Our first and foremost commitment is the total quality assurance. A substantial part of our efforts is aimed towards this direction.
The mechanical equipment used for the manufacturing of Como-pex pipes assures quality at the utmost degree. Apart from the usual mechanical equipment required for the manufacturing of pipe, **Interplast's** production lines are equipped with the below listed equipment, 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 absorb humidity. Thus, we eliminate the problem of altered dimensions, which is quite a frequent phenomenon in plastic pipes.

-Additives mixed by aid of a gravimeter. In this way we can achieve a materials mix divergence of ±0.01%. In raw materials such as Pex it is very important to have an accurate cross-linking additive proportion. If the proportion is not absolutely accurate the pipe loses strength or becomes hard during its handling by the installer.

-Automatic correction of screw rotation. Thus we achieve steady weight per meter in the manufactured pipe, which means steady dimensions. This is 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 then regulated automatically by means of the extruder. This is the second part of the dimensional stability of the pipe and results in a proper fit of the nozzle of the brass fitting to the pipe.

Checking of outer diameter by LASER. This is the third and final part of the electronic testing. The absolute values of the LASER SCANNER ensure proper fitting of the nut to the plastic pipe.

In addition to all the aforementioned which constitute for **Interplast** a prerequisite for pipe production, the following aspects ensure the high quality of Como-pex pipes:

-Up-to-date mechanical equipment specially designed for Pex pipes, in order to prevent undesirable pre-crosslinking and failure in homogenization.

-Fitting tests with brass fittings after the production of each coil. In this way we guarantee proper fit between two components of our own production.

-Dimensional checking of each coil by the production line operator. The outer diameter is checked by means of a strap gauge, wall thickness and oval of pipe by means of an electronic thickness gauge.

-Measurements and fitting tests performed by the foreman on an hourly basis.

The strict specifications followed by **Interplast** during the Como-pex pipes production are controlled for their quality in its own laboratories with tests specified by the European norms EN ISO 15875-1/2 and the German standards DIN 16892/93. The laboratories distribute only controlled pipes that have been tested for their quality following the below procedures:

- Testing the resistance to crack growth under environmental stress (ESCR). Pipe specimens are cut in the inner part at 10% of the wall thickness, their inside is filled with a special chemical that eliminates surface tension and then they are pressed at 95°C for 1000 hours. The strength of the Como-pex pipes in this test ensures their reliability even in cases of improper handling during transportation or installation (flat, scratches, etc.)

- Testing the mechanical resistance of the pipes and the fittings with tensile tests (tensile strength at yield point, tensile strength at break, modulus of elasticity, etc.)

- Testing the melt flow rate of raw materials and pipes. This is a fixed test that is carried out each time raw materials are received. The melt flow rate of the raw materials is very important in defining the temperature profile of the EXTRUDER and thus the homogenization of the material. The melt flow rate of the pipes should not exceed the value of 20% of the melt flow rate of the raw material.

- Visual inspection of the pipe surface, measurement of the outer diameter and measurement of the wall thickness by using calibrated and certified instruments. These are checks that certify the ongoing measurements carried out throughout the production process.

- Determination of the cross-linking degree daily. The pipes that are packed have a cross-linking degree of at least 65%.

- Testing the longitudinal heat reversion of the pipes. Pipe specimens of 20cm are heated in the laboratory oven at 120°C for 2 hours. The specimens after cooling should not present elongation or shrinkage greater than 3% according to standards. The Como-pex pipes have only 0.8% shrinkage and Como-pex Oxygen Barrier pipes only 0.5%. These values prove the proper extrusion processing of the pipes and ensure their high quality.

- Microscopical material homogeneity assessment. It constitutes one of the most important controls. Excellent results prove the proper extrusion processing and the high quality of the raw materials.

Como-pex pipes present the best possible material homogeneity, proving as such their long service life.

Thermal cycling testing. It is a system of repeated cycling tests on hot (95°C) and cold (20°C) water under pressure (continuous thermal shocks). Basically, this test stimulates heating and plumbing circuits under real operating conditions. **It is the first system of cycling testing of representative circuits that operates in Greece, and one of the few operating in whole Europe.**

Hydrostatic pressure testing, remaining for 1 hour at 20°C and 95°C, 22 hours, 165 hours,1000 hours at 95°C and 8760 hours at 110°C, as specified by the European norms and the German standards. The 1 hour tests are performed for each final product lot, the 22 hours and 165 hours tests every 2 weeks and the 1000 hours and the 8760 hours tests once per year for each dimension.

COMO-PEX TESTING COMPARATIVE TABLE

DIMENSIONS	Temperature (°C)	Test duration (h)	Test pressure in accordance with regulations (bar)	Como-pex test pressure (bar)
12X1,1	20	1	24,22	42,39
	95	1000	8,88	11,10
12X,13	20	1	29,16	51,03
	95	1000	10,69	13,36
15X2,5	20	1	48	84
	95	1000	17,6	22
16X1,5	20	1	24,83	43,45
	95	1000	9,10	11,38
16X1,8	20	1	30,42	53,24
	95	1000	11,15	13,94
16X2,0	20	1	34,29	60
	95	1000	12,57	15,71
16X2,2	20	1	38,26	66,96
	95	1000	14,03	17,54
18X2,0	20	1	30	52,5
	95	1000	11	13,75
18X2,5	20	1	38,71	67,74
	95	1000	14,19	17,74
20X1,9	20	1	25,19	44,09
	95	1000	9,24	11,55
20X2,0	20	1	26,67	46,67
	95	1000	9,78	12,22
22X3,0	20	1	37,89	66,32
	95	1000	13,89	17,37
25X2,3	20	1	24,32	42,56
	95	1000	8,92	11,14
25X3,5	20	1	39,07	68,37
	95	1000	14,33	17,91
28X3,0	20	1	28,8	50,4
	95	1000	10,56	13,2
32X2,9	20	1	23,92	41,86
	95	1000	8,77	10,96
32X3,0	20	1	24,83	43,44
	95	1000	9,10	11,38

* The above comparative table presents an indicative selection of internal pressure testing

Como-pex pipes meet and exceed the specifications set by the International ISO standards, the European Norms, the internationally accepted German DIN, the Spanish UNE, and the British BS standards. This results to that Como-pex pipes have not presented a single failure in the regular biannual tests carried out by the official institutes and bodies on random samples taken from the production and the warehouse. The outcome of the above is that Como-pex has been certified as a final product by the following organizations:

- **EN ISO 9001:2008** by TÜV Germany for compliance with all international specifications pertaining to Como-pex.

- **SKZ Germany, AENOR Spain, CSA Canada, GOST Russia, ZIK Croatia,** for the physical and mechanical properties of the pipe. The procedure concerns checking the dimensions of the pipe, determining the degree of cross-linking, microscopical material homogeneity assessment, hydrostatic pressure testing at various temperatures, melt flow rate testing and testing of the longitudinal heat reversion.

- **MPA-NRW Germany** for oxygen permeability testing of Como-pex Oxygen Barrier pipes. It concerns a measurement that should comply with DIN 4726.

- **WRAS-NSF Great Britain** for the suitability of Como-pex pipes for drinking water. It concerns tests carried out at 20°C and 80°C on taste, odor, development of microorganisms, extraction of substances and metals dangerous for public health (cadmium, arsenic etc.)

Furthermore, the pipes are also controlled by **ELOT** (Greek Organization for Standardization-Laboratory of polymers) in hydrostatic pressure testing at 110°C and by the **State General Chemical Laboratory** for suitability for drinking water.

Cross-linked PE pipes present an exceptionally smooth inner surface, resulting in a very low roughness factor (0.006mm), which compared to other pipe types, even copper (κ=0.014 mm), is much reduced.

The surface of every solid material, no matter how smooth it may look, still presents some level of roughness. The level of this roughness is quantitatively expressed by a characteristic length, e, which is called absolute roughness of the surface. The length e is equal to the statistical mean of the heights of the recesses and the projections of the surface on a large (compared to their size) area.

The value of e depends on the construction material and the processing of the inner walls of the pipe. Corrosion and depositions increase roughness. Since the inner diameter also plays a role on the influence of the pressure drop, in order to decide whether the roughness is negligible or not, we use the ratio e/d that is called relative roughness.

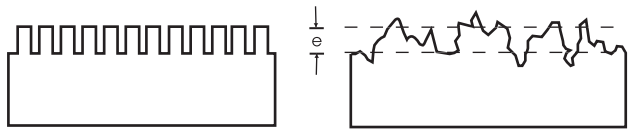
The roughness coefficient, n, is used in hydraulic calculations and is calculated by Manning's formula:

n = [R2/3xS1/2] / V

where

R = hydraulic radius,
S = the slope of the pipeline,
V = flow velocity

The roughness coefficient depends from the material of the pipe, but also from other factors such as bad connections, bad lining, etc.



Average roughness of commercial tubes

CONSTRUCTION MATERIAL	ROUGHNESS (mm)	CONSTRUCTION MATERIAL	ROUGHNESS (mm)
Commercial steel	0,046	Copper, Light metals	0,013 + 0,015
Cast iron	0,26	Concrete	0,3 + +3,0
Galvanized iron	0,15	Ceramic	~0,07
Asphalt-treated iron	0,12	Plastic	0,0016

As a result of this characteristic, the pressure losses on the pipeline sections present low values, facilitating the design calculations and rendering installations more economical by the use of pipes with smaller dimensions and pumps of lower power for the same requirements of water supply. The installation operates quietly and smoothly, allowing the possibility to use, where needed, faster water velocities, without having to worry about the noise levels or the vibrations of the pipes during operation. The diagram illustrates the curves calculated for water temperature at 80°C.

For ø16x2.0 pipe and a flow rate of Q=140l/h, the flow velocity is V = 0.37m/sec and the loss of head is equal to R = 17mmH20/m.

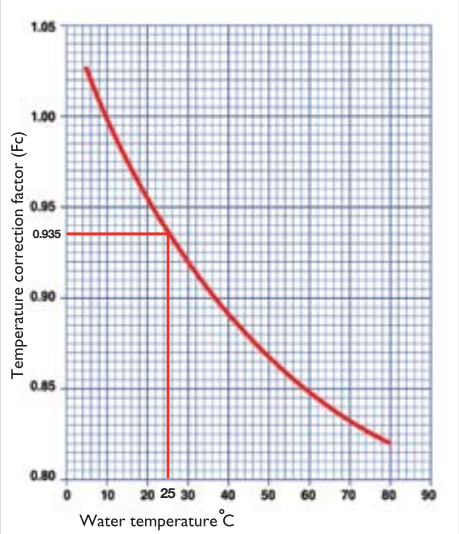
However, since we have calculated the diagram for a water temperature of 80°C (central heating), we have to divide the R= 17mm value by a correction factor (Fc), if we want to calculate the loss at a water temperature of 25°C (plumbing installation). The correction factor is provided in the following diagram and in our example equals to 0.935.

Therefore, R = 17/0,935 = 18,18mm H2O/m, which is the true value (loss of head) at 25°C.

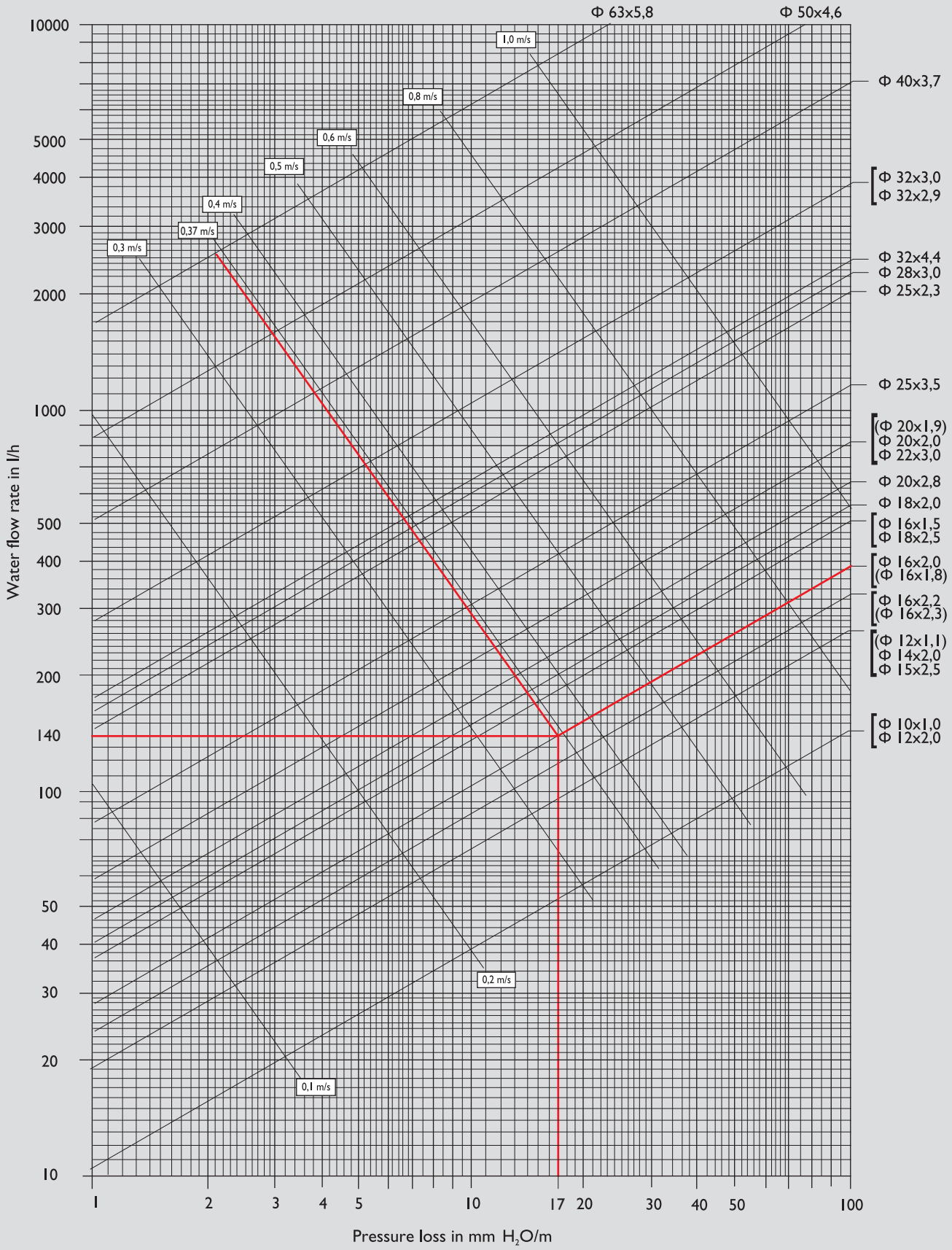
With the help of the equivalent Pa/m (1000 Pa = 0,01 Bar), the press loss converted to Bar in the specific example is 18,18/10000 = 0,001818 Bar/m.

In this diagram, it is quite simple to determine the loss of head when all other parameters are known, e.g.:

R = loss of head value in mm H_2O
V = water velocity in m/s
Q = flow rate value in l/h
L = pipe length to be calculated in m.



PRESSURE LOSS DIAGRAM OF PEX PIPES AT 80°C



TRANSPORT CALORIES TABLE

Como Pex - Ø15x2.5 PE-Xb

Outer pipe diameter: 15mm
Wall thickness: 2.5mm
Piping roughness coefficient: K = 0,006mm

				Δt 20	Δt 15	
(v) m/s	l/s	Kg/h *	m³/h	Kcal/h * 20K	Kcal/h * 15K	(R) mY.Σ
0,30	0,0236	83,57	0,085	1.695	1.273	0,016
0,40	0,0314	111,10	0,113	2.260	1.695	0,027
0,50	0,0394	139,60	0,142	2.830	2.120	0,040
0,60	0,0472	167,14	0,170	3.395	2.545	0,055
0,70	0,0550	194,67	0,198	3.960	2.967	0,073
0,80	0,0628	222,20	0,226	4.525	3.395	0,092
0,90	0,0708	250,71	0,255	5.090	3.815	0,114
1,00	0,0786	278,24	0,283	5.655	4.240	0,137
1,10	0,0864	305,77	0,311	6.220	4.665	0,163
1,20	0,0942	333,30	0,339	5.090	6.785	0,190
1,30	0,1019	360,83	0,367	7.350	5.512	0,220
1,40	0,1100	389,34	0,396	7.915	5.938	0,251
1,50	0,1178	416,87	0,424	8.480	6.360	0,285
1,60	0,1258	445,38	0,453	9.050	6.785	0,320

Kg/h * The analogy Kg/h - m³/h is given for water temperature at 60°C

Como Pex - Ø16x2.2 PE-Xb

Outer pipe diameter: 16mm
Wall thickness: 2.2mm
Piping roughness coefficient: K = 0,006mm

				Δt 20	Δt 15	
(v) m/s	l/s	Kg/h *	m³/h	Kcal/h * 20K	Kcal/h * 15K	(R) mY.Σ
0,30	0,0317	112,08	0,114	2.280	1.710	0,014
0,40	0,0422	149,44	0,152	3.040	2.280	0,022
0,50	0,0528	186,80	0,190	3.801	2.855	0,033
0,60	0,0633	224,10	0,228	4.562	3.425	0,046
0,70	0,0739	261,53	0,266	5.325	3.995	0,060
0,80	0,0847	299,87	0,305	6.091	4.565	0,077
0,90	0,0950	336,25	0,342	6.850	5.135	0,094
1,00	0,1058	374,59	0,381	7.610	5.705	0,114
1,10	0,1164	411,96	0,419	8.369	6.280	0,135
1,20	0,1269	449,32	0,457	9.130	6.850	0,158
1,30	0,1375	486,68	0,495	9.890	7.420	0,183
1,40	0,1481	524,04	0,533	10.650	7.990	0,209
1,50	0,1586	561,40	0,571	11.410	8.560	0,237
1,60	0,1692	598,76	0,609	12.180	9.130	0,267

Kg/h * The analogy Kg/h - m³/h is given for water temperature at 60°C

Como Pex - Ø16x2.0 PE-Xb

Outer pipe diameter: 16mm
Wall thickness: 2.0mm
Piping roughness coefficient: K = 0,006mm

				Δt 20	Δt 15	
(v) m/s	l/s	Kg/h *	m³/h	Kcal/h * 20K	Kcal/h * 15K	(R) mY.Σ
0,30	0,0339	119,95	0,122	2.440	1.830	0,013
0,40	0,0453	160,26	0,163	3.255	2.445	0,022
0,50	0,0567	200,57	0,204	4.070	3.055	0,032
0,60	0,0678	239,90	0,244	4.885	3.665	0,044
0,70	0,0792	280,21	0,285	5.700	4.275	0,058
0,80	0,0906	320,52	0,326	6.516	4.885	0,073
0,90	0,1019	360,83	0,367	7.331	5.495	0,090
1,00	0,1131	400,16	0,407	8.145	6.110	0,109
1,10	0,1244	440,47	0,448	8.960	6.715	0,130
1,20	0,1358	480,78	0,489	9.775	7.326	0,152
1,30	0,1469	520,11	0,529	10.580	7.941	0,175
1,40	0,1583	560,42	0,570	11.400	8.552	0,200
1,50	0,1697	600,73	0,611	12.220	9.160	0,227
1,60	0,1808	640,06	0,651	13.030	9.770	0,255

Kg/h * The analogy Kg/h - m³/h is given for water temperature at 60°C

Como Pex - Ø18x2.0 PE-Xb

Outer pipe diameter: 18mm
Wall thickness: 2.0mm
Piping roughness coefficient: K = 0,006mm

				Δt 20	Δt 15	
(v) m/s	l/s	Kg/h *	m³/h	Kcal/h * 20K	Kcal/h * 15K	(R) mY.Σ
0,30	0,0464	164,19	0,167	3.330	2.495	0,011
0,40	0,0617	218,27	0,222	4.430	3.325	0,018
0,50	0,0769	223,18	0,277	5.540	4.160	0,026
0,60	0,0925	327,40	0,333	6.650	4.990	0,036
0,70	0,1078	381,48	0,388	7.740	5.820	0,048
0,80	0,1231	435,55	0,443	8.870	6.650	0,060
0,90	0,1386	490,61	0,499	9.970	7.480	0,075
1,00	0,1539	544,69	0,554	11.080	8.310	0,090
1,10	0,1694	599,75	0,610	12.190	9.148	0,107
1,20	0,1847	653,82	0,665	13.300	9.975	0,125
1,30	0,2003	708,88	0,721	14.410	10.810	0,145
1,40	0,2158	763,94	0,777	15.520	11.650	0,166
1,50	0,2308	817,03	0,831	16.620	12.470	0,187
1,60	0,2464	872,09	0,887	17.730	13.300	0,211

Kg/h * The analogy Kg/h - m³/h is given for water temperature at 60°C

Como Pex - Ø18x2.5 PE-Xb

Outer pipe diameter: 18mm
Wall thickness: 2.2mm
Piping roughness coefficient: K = 0,006mm

				Δt 20	Δt 15	
(v) m/s	l/s	Kg/h *	m³/h	Kcal/h * 20K	Kcal/h * 15K	(R) mY.Σ
0,30	0,04	140,59	0,143	2.870	2.150	0,012
0,40	0,05	187,79	0,191	3.820	2.870	0,019
0,50	0,07	234,98	0,239	4.780	3.585	0,029
0,60	0,08	282,17	0,287	5.730	4.300	0,040
0,70	0,09	329,37	0,335	6.690	5.020	0,052
0,80	0,11	376,56	0,383	7.650	5.735	0,066
0,90	0,12	422,77	0,430	8.600	6.450	0,082
1,00	0,13	469,96	0,478	9.560	7.170	0,099
1,10	0,15	517,16	0,526	10.510	7.885	0,117
1,20	0,16	564,35	0,574	11.470	8.600	0,137
1,30	0,17	610,56	0,621	12.420	9.320	0,159
1,40	0,19	657,76	0,669	13.380	10.040	0,181
1,50	0,20	704,95	0,717	14.340	10.750	0,205
1,60	0,21	752,14	0,765	15.290	11.470	0,231

Kg/h * The analogy Kg/h - m³/h is given for water temperature at 60°C

Como Pex - Ø22x3.0 PE-Xb

Outer pipe diameter: 22mm
Wall thickness: 3.0mm
Piping roughness coefficient: K = 0,006mm

				Δt 20	Δt 15	
(v) m/s	l/s	Kg/h *	m³/h	Kcal/h * 20K	Kcal/h * 15K	(R) mY.Σ
0,30	0,06	213,35	0,217	4.350	3.260	0,009
0,40	0,08	285,12	0,290	5.797	4.340	0,015
0,50	0,10	355,91	0,362	7.240	5.430	0,022
0,60	0,12	426,70	0,434	8.680	6.510	0,031
0,70	0,14	498,48	0,507	10.140	7.600	0,040
0,80	0,16	569,27	0,579	11.580	8.690	0,051
0,90	0,18	640,06	0,651	13.030	9.770	0,063
1,00	0,20	711,83	0,724	14.480	10.860	0,076
1,10	0,22	782,62	0,796	15.930	11.940	0,091
1,20	0,24	854,40	0,869	17.370	13.030	0,106
1,30	0,26	925,19	0,941	18.820	14.110	0,123
1,40	0,28	995,98	1,013	20.260	15.200	0,140
1,50	0,30	1067,75	1,086	21.710	16.290	0,159
1,60	0,32	1138,54	1,158	23.160	17.370	0,179

Kg/h * The analogy Kg/h - m³/h is given for water temperature at 60°C

Como Pex - Ø28x3.0 PE-Xb

Outer pipe diameter: 28mm
Wall thickness: 3.0mm
Piping roughness coefficient: K = 0,006mm

				Δt 20	Δt 15	
(v) m/s	l/s	Kg/h *	m³/h	Kcal/h * 20K	Kcal/h * 15K	(R) mY.Σ
0,30	0,1139	403,11	0,410	8.200	6.150	0,006
0,40	0,1522	538,79	0,548	10.920	8.220	0,01
0,50	0,1903	673,49	0,685	13.680	10.270	0,015
0,60	0,2281	807,20	0,821	16.410	12.320	0,021
0,70	0,2661	941,90	0,958	19.150	14.370	0,027
0,80	0,3042	1076,60	1,095	21.900	16.420	0,034
0,90	0,3422	1211,30	1,232	24.630	18.480	0,043
1,00	0,3803	1346,00	1,369	27.380	20.520	0,051
1,10	0,4181	1479,71	1,505	30.100	22.580	0,061
1,20	0,4564	1615,39	1,643	32.840	24.640	0,072
1,30	0,4942	1749,11	1,779	35.580	26.680	0,083
1,40	0,5325	1884,79	1,917	38.330	28.740	0,095
1,50	0,5703	2018,50	2,053	41.050	30.800	0,107
1,60	0,6083	2153,20	2,190	43.800	32.850	0,121

Kg/h * The analogy Kg/h - m³/h is given for water temperature at 60°C

Como Pex - Ø32x3.0 PE-Xb

Outer pipe diameter: 32mm
Wall thickness: 3.0mm
Piping roughness coefficient: K = 0,006mm

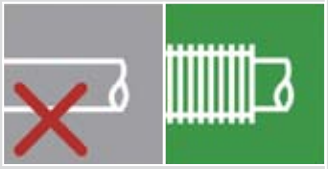
				Δt 20	Δt 15	
(v) m/s	l/s	Kg/h *	m³/h	Kcal/h * 20K	Kcal/h * 15K	(R) mY.Σ
0,30	0,1592	563,37	0,573	11.450	8.600	0,005
0,40	0,2125	752,14	0,765	15.3	11.460	0,008
0,50	0,2656	939,93	0,956	16.100	14.340	0,012
0,60	0,3189	1128,71	1,148	22.950	17.200	0,017
0,70	0,3719	1316,50	1,339	26.750	20.080	0,022
0,80	0,4250	1504,29	1,530	30.600	22.950	0,028
0,90	0,4778	1691,10	1,720	34.400	25.800	0,035
1,00	0,5311	1879,87	1,912	38.210	28.680	0,042
1,10	0,5842	2067,66	2,103	42.050	31.550	0,050
1,20	0,6369	2254,47	2,293	45.870	34.400	0,058
1,30	0,6903	2443,25	2,485	49.700	37.260	0,067
1,40	0,7436	2632,02	2,677	53.500	40.150	0,077
1,50	0,7967	2819,81	2,868	57.350	43.000	0,087
1,60	0,8497	3007,60	3,059	61.150	45.880	0,098

Kg/h * The analogy Kg/h - m³/h is given for water temperature at 60°C

Before using the pipes, but also in the event of surplus material after installation, the pipes should be stored in their original packaging to protect them from damage and should not be kept exposed to the sun for a prolonged time.

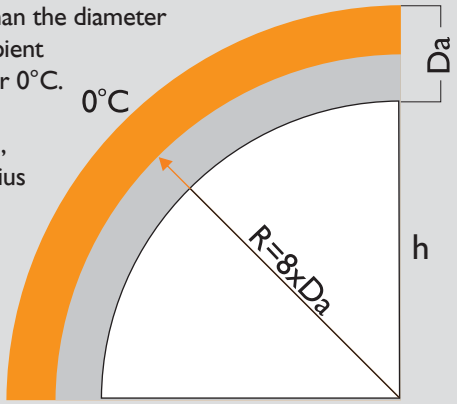
A special pipe cutter is being used for cutting the pipes, so that the cut section is perpendicular to the longitudinal axis. In this way we can achieve optimal connections with the brass fittings. Cutting by using a knife, a blade cutter or a hacksaw is forbidden.

The pipe is always installed in the designated corrugated pipe, except in the cases of underfloor heating and cooling installations where specific instructions have to be followed. It is advisable that installation be carried out in such a way that "closed" curves are avoided. By using the corrugated pipe, the pipe is protected against damage and displays excellent thermal contraction – expansion performance and enables its facile replacement in case of a possible damage. In pipes within the corrugated pipes, a metal pipe of suitable dimension is placed between the spiral and the Como-pex pipe so that the cross-linked polyethylene pipe becomes protected against damage.

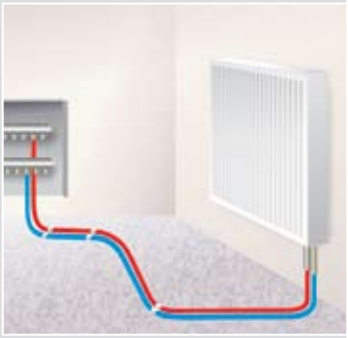


Plastic pipes should not be heated by flame. Where local heating of the pipe is required (e.g. curves), this should be done by use of warm air (135° C), and the pipe should be left alone to return to ambient temperature

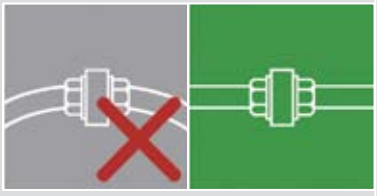
The curvature radius should be 8 times greater than the diameter of the pipe at ambient temperatures near 0°C. Under normal conditions (20°C), the curvature radius should be 6 times greater than the pipe diameter.



In heating installations (water even at 95°C), where the existence of fixed supports (such as radiator valves and manifolds) naturally impedes free expansion of the pipes, measures should be taken to prevent problems.
Between any two fixed points (manifold – valve) a snake-shaped route is to be followed, i.e. an open curved "S" before each fixed point.



The pipe–manifold and pipe–valve couplings should always be installed on straight pipe sections and never on a curve, because there is always the risk of the pipe being disconnected from the connection point with obvious consequences in the building.



In cases where we need to "loosen" the couplings e.g. in order to replace a radiator panel, we must let the circuit cool down for 24 hours before replacement. Otherwise, the pipe will contract and shorten, making reconnection impossible.

In the event of frost, such as installations that remain out of operation for long periods of time during winter (e.g. holiday homes at high altitude), despite the exceptional elasticity of Como-pex pipes, there is uneven distribution of stress and this may result in the bursting of the pipes. For this reason it is advised that the network be drained at least from the external pipes. In this way we can ensure protection of the metal components of the installation (taps, couplings), which are particularly sensitive to frost.

Upon completion of the installation, the circuits should be tested consecutively in three stages:

First stage: The circuit needs to be tested for 30 minutes under a pressure of at least 6 bar. After checking that there is no leakage and that the manometer drop is no more than 0.6 bar we may proceed to the second stage.

Second stage: The network is tested as a whole under the same testing pressures and monitored against leakage for at least 2 hours.

Third stage: The network is left full of water under pressure for the duration of the remaining building works, checking at intervals for loss or leakage. The other crews that work on the building after us (and the owner of the building of course) are requested to inform us of any leakage or damages to the pipes.

After completion of the building and prior to its use, it is advisable to "rinse" the networks with drinking water at a velocity of 0.5m/sec for at least 15 minutes, so that the networks are handed over free of dirt – and any possible stray objects – and ready for use. After having operated the hot water network for several days (at least 5), we check all couplings for possible leakages. Detailed guidelines on the care of heating – plumbing networks can be found in the DIN 1988 standard part 2.

Black Como-pex pipes contain a special stabilizing additive, which renders them extremely resilient to solar radiation. This is why we recommend that black Como-pex pipes be used for outdoor installations (e.g. solar heaters).

Interplast is one of the few companies in Europe with a vertically integrated production and the sole company in Greece that manufactures all the components of the system while offering a guarantee on the entire heating-plumbing installation. The company's subsidiary ELVIOM S.A. manufactures brass fittings for the Como-pex system.

ELVIOM is a company with 50 years of experience in the production of brass fittings, manufacturing brass fittings in compliance with the European norms 12164, 12165, 12167 and 12168. The threads on the fittings are constructed according to ISO 228, at a standard specifying length and thickness.

The brass fittings comply with the German **DIN 50930/6** which specifies the brass composites for suitability to drinking water.

ELVIOM is certified to EN ISO 9001:2008 by TÜV Germany and its products are distributed to the markets having passed the following tests.

-Visual check of fittings by means of a special Projector, where the thickness of the walls and threading is checked.
Raw materials and final product are checked by a latest generation durometer.

-Pressure tests are carried out at the three company laboratories at pressures of up to 6atm.

-The raw materials used by the company have undergone thermal processing (annealing). The fittings with female thread are subjected to thermal processing for a second time, remaining in the furnace after production for 1 hour at 350°C. Thus, processing stresses are eliminated and the products turn out with increased durability.

-Strength test by means of a special torque wrench to check torque.

-ELVIOM products are regularly tested in terms of alloy structure (metallography), chemical composition (spectrograph) and the mercury nitrate test for remaining stresses.

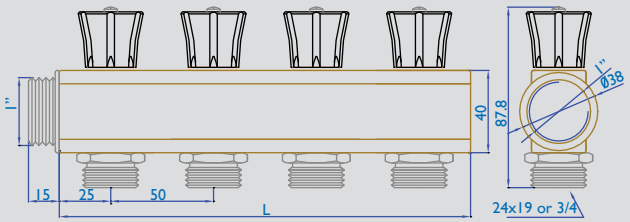
-Throughout the production process, the threads, the outlets and the dimensions are checked by means of special controllers. This is particularly important for certain fittings that cannot easily be measured by means of a thickness gauge.

MANIFOLDS AND FITTINGS DISTRIBUTION TABLE

Regulating bar manifolds (with PTFE sealing)

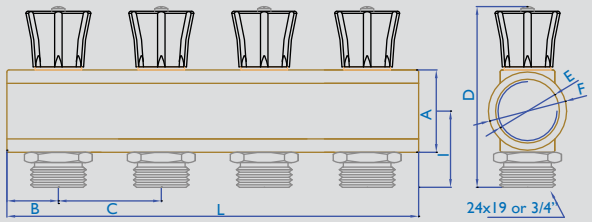
The manifolds are manufactured of brass bars compliant to the European norm EN 12167 and DIN 50930/6, which refer to the suitability of brass fittings for drinking water installations. The product has low hardness so as to be more resistant to mechanical stresses. **The mechanisms in the manifold are vertically placed therefore increasing the circuits and improving the flows.**
The manifolds are used in heating and plumbing installations of hot and cold water. They are produced in sizes ¾", 1" and 1 ¼" from 2 to 12 outlets with 24x19 or ¾" threading.

1" Manifold with balancing valves M/F



L= (Number of outlets X 5 cm) + 1,5 cm

1" Manifold with balancing valves F/F



L= Number of outlets X 5 cm

DIMENSIONS	A	B	C	D	F	E	I
1"	1"	25	50	88	38	1"	37
11/4"	11/4"	25	50	98	48	1 1/4"	42

The flow tests and the drawings of the pressure drop diagrams in the manifolds and the valves have been approved by the German Institute BAÜMER.

Advantages

- Large supplies and smooth flow.
- **Bar type mechanism.** As the wheel turns only the valve moves, without the axis moving up and down, and at the same time salt build-up is prevented. This prevents wear and tear of the O-ring of the axis.
-The water tightness of the axis is achieved by three O-rings and a PTFE sealing.
-The base of the manifolds is made watertight by EPDM O-rings together with a metal-to-metal watertight connection.
-Large distances between the manifold's supply centres (50mm).
-Prevents pressure surge upon closing of the water connection.
-Regulation of the circuits.
-Isolation of circuits in the event of damage.
-Risk of leakage from the connections between common 2, 3 and 4 port manifolds is eliminated.
-Red and blue markings and circuit identification markings (living room, bedroom etc.) to assist the homeowner.
-Due to special threading in the mechanism the supply requires only a few turns (4 turns) to be turned on/off.

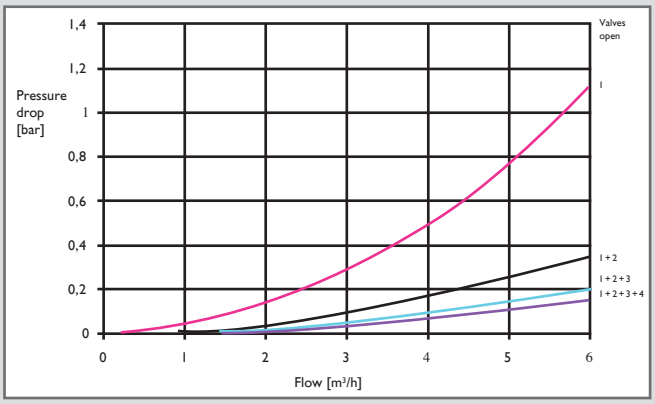
In order to facilitate our customers for warehousing purposes, male-female manifolds are manufactured, at 1" intake size with 2 to 4 connections. They have an integrated 1" M/M nipple at their end to allow the connection of manifolds with each other.

Flow measurement

Condition	(m^3/h)
1st Valve open	5,65
1st+2nd Valve open	10,1
1st+2nd+3rd Valve open	13,2
1st+2nd+3rd+4th Valve open	15,6

KV-Measurement of a fully open supply according to DIN EN 60534-2-3

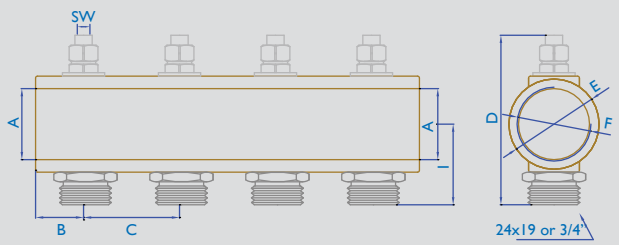
Pressure drop chart



Manifolds with regulatory valves (with PTFE sealing)

Manifolds with integrated balancing valves are manufactured of brass bars compliant to the European norm EN 12167. The brass bar is required to have a specific low hardness indicator, up to 105HB. They are nickel plated, in nominal diameter 1" and 1 ¼" from 2 to 12 outlets, without connections and ¾" or 24x19 threading. The distances between the manifold's supply systems are 50mm. **The hexagon socket valves are placed vertical compared to the vertical axis of the manifold, resulting in increased supplies and improved flows.** The manifolds are used in heating installations and hot and cold-water plumbing installations.

The mechanism of the hexagon socket valve is a bar type. During its rotation (with an H 5mm Allen key), the axis does not rise and fall but just the valve, while avoiding the settling of salts in the O-rings, preventing thereby their deterioration. The water tightness is achieved with 3 O-rings of EPDM quality and the sealing with a PTFE (Teflon) ring. The water tightness in the bases of the manifolds is achieved by a EPDM quality O-ring that simultaneously seals metal to metal.
The setting of the outlets is done manually by the use of a 5mm Allen key.

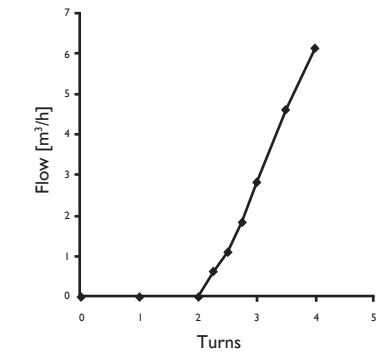


L= Number of outlets X 5 cm

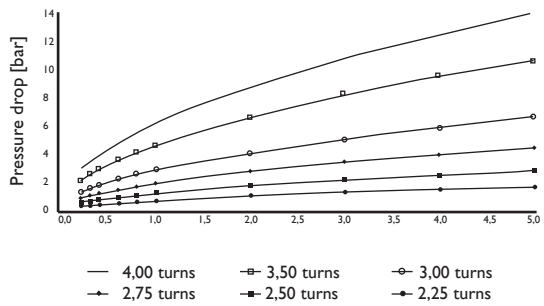
DIMENSIONS	A	B	C	D	E	F	I	SW
1"	1"	25	50	80	38	1"	37	5
11/4"	11/4"	25	50	90	48	11/4"	42	5

Flow measurement

Turns	Flow (m^3/h)
4,00	6,10
3,50	4,62
3,00	2,80
2,75	1,82
2,50	1,09
2,25	0,61
2,00	0,0
1,00	0,0
1,00	0,0
0,00	0,0



Pressure drop chart



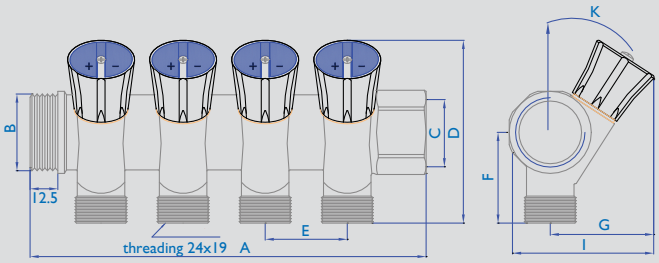
Regulating Press manifolds (with PTFE sealing)

Manufactured from CW617N brass alloy by hot forging processing. They are manufactured in 3/4" and 1" in 2, 3 and 4 supplies with male threading 24x19. The angle of the mechanisms compared to the manifold's vertical axis is 33°. The manifold is primarily used in hot and cold-water plumbing installations.

Advantages

-Isolation of circuits in the event of damage.
-Prevents pressure surge upon closing the water connection.
-Red and blue markings and circuit identification markings (wash-basin, cistern, bathroom, etc.) to assist the home-owner.
-Regulation of the circuits.
The manifold's operation **mechanism** is **bar type**. As the wheel turns only the valve moves, while the axis does not move up and down. This prevents wear and tear of the O-ring of the axis.
-The axis is made watertight by three EPDM O-rings and a PTFE sealing.

-Due to special threading in the mechanism the supply requires only a few turns (4 turns) to be turned on/off.



A=45mm+(35mm x Number of outlets)

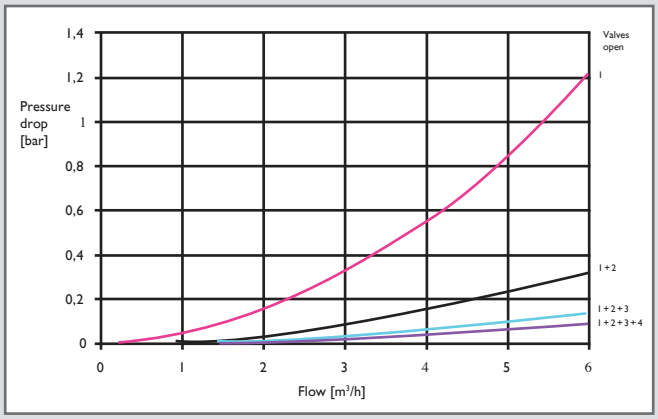
DIMENSIONS	A	B	C	D	E	F	G	I	K
1"	mm	1"	1"	84,5	38	42	48	67	33°
3/4"	mm	3/4"	3/4"	75,5	38	37,5	45,5	40	33°

Flow measurement

Condition	(m^3/h)
1st Valve open	2,87
1st+2nd Valve open	5,58
1st+2nd+3rd Valve open	8,56
1st+2nd+3rd+4th Valve open	10,7

KV-Measurement of a fully open supply according to DIN EN 60534-2-3

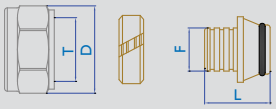
Pressure drop chart



Plastic pipe adaptors

It connects the pipes with the male threading of the manifold or the valve. It consists of 3 components:
-The conic tail with the nozzle on top, in which the inner surface of the pipe is fitted. It is made watertight by an elastic EPDM ring and metal-to-metal on the connection cone.
-The taper ring, which has two cones necessary for providing a watertight and in place connection between the brass insert and the plastic pipe.
-The nut, which is either yellow or nickel plated.
The materials used are CW 617N for the nut and CW 614N for the conic tail and the taper ring.

Nickel-plated plastic pipe adaptor (3/4" threading)



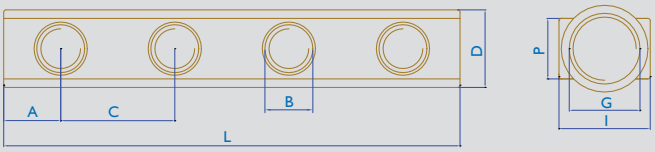
DIMENSIONS	D	F	L	T
16x2,0	30	11,8	22	3/4"
18x2,0	30	13,8	22	3/4"
18x2,5	30	12,8	22	3/4"
17x2,0	30	12,8	22	3/4"
20x2,0	30	15,8	23	3/4"

Nickel-plated plastic pipe adaptor (24x19 threading)

DIMENSIONS	D	F	L	T
15x2,2	27	9,8	22	24x19
16x2,0	27	11,8	22	24x19
16x2,2	27	11,4	22	24x19
17x2,0	27	12,8	22	24x19
18x2,0	27	13,8	22	24x19
18x2,5	27	12,8	22	24x19

Brass bar manifold

The manifolds are manufactured of CW614N alloy brass profiles compliant to European standard EN 12167 and DIN 50930/6 on the suitability of brass fittings for drinking water installations. They are manufactured in 3/4", 1" and 1 ¼" dimensions, from 2 to 10, 1/2" outlets. The manifold's threading is constructed according to EN ISO 228. The product has low hardness so that it may be more resilient to mechanical stresses and stands out for its extra thick walls.



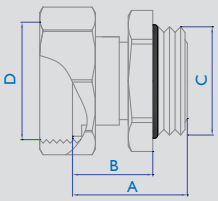
L= Number of outlets X 5 cm

DIMENSIONS	A	B	C	D	G	I	P
3/4"	25	1/2"	50	34	3/4"	34	26
1"	25	1/2"	50	38	1"	40	26
11/4"	25	1/2"	50	48	11/4"	50	26

Manifold coupling nipples

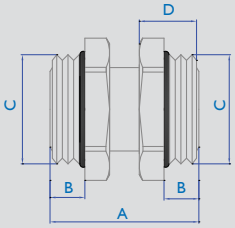
These fittings are quick and easy to install. They are manufactured in 1" and 1 1/4", male-male and male-female. When fitted, the coupling nipples are perfectly watertight with EPDM and fiber O-ring at the female threading while at the same time their independent rotation facilitates the installer with the various applications.
The material used is CW 614N.

M/F Nipple



DIMENSIONS	A	B	C	D
1"	35	25	1"	1"
11/4"	35	25	1 1/4"	1 1/4"

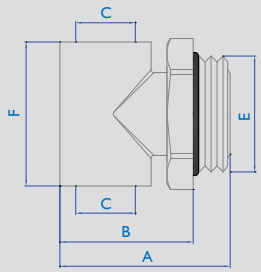
M/M Nipple



DIMENSIONS	A	B	C	D
1"	45	10	1"	17,5
11/4"	45	10	11/4"	17,5

Manifold T-piece

Manufactured in 1" and 1 ¼". The connection sockets are ½". It is fitted on the manifold's end. The body has a 360° degree of rotation. The terminal T enables the heating-plumbing technician to de-aerate, fill or drain the installation. Made watertight by means of two elastic EPDM rings.

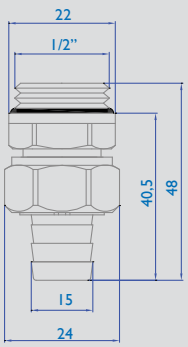


DIMENSIONS	A	B	C	E	F
1"	49	35	1/2"	1"	41
11/4"	49	38	1/2"	11/4"	50

Fill drain valve

Fitted on the manifold T-piece and made watertight by an elastic EPDM quality ring. By fitting a rubber hose with a tightening ring on its nozzle we can fill or drain the installation. It is operated by unscrewing the nut, thus releasing the built-in valve. It can also be placed on the boiler.

Attention! The nut cannot be dismounted from the valve since it has a safety restraint at its end.



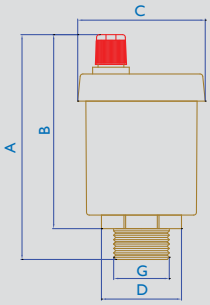
Automatic airvent

It is used for the automatic de-aeration of heating installations. It is installed at the highest point of the heating installation. Before placement, the installation should be well rinsed to prevent the accumulation of particles and impurities at the watertighting section of the automatic airvent, which could hinder its operation.
It is recommended to fit a return valve before the airvent to make cleaning easier without having to close down the network.

Technical data

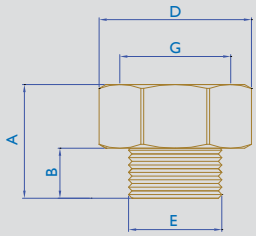
Maximum operational temperature: 110°C (230°F)
Maximum operational pressure: 12 bar (174psi)
Brass alloy: CuZn40Pb2
- CW617N, DIN EN 12165
Threading constructed according to EN ISO 228

Automatic airvent



DIMENSIONS	A	B	C	D	G
3/8"	83	72	47	27	3/8"
1/2"	83	72	47	27	1/2"

Stop valve for automatic airvent

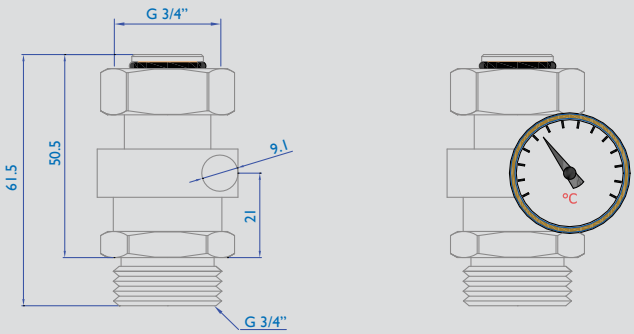


DIMENSIONS	A	B	D	E	G
3/8" X 3/8"	25,5	10	19	3/8"	3/8"
1/2" X 3/8"	23	12	21	1/2"	3/8"
1/2" X 1/2"	25	11	24	1/2"	1/2"

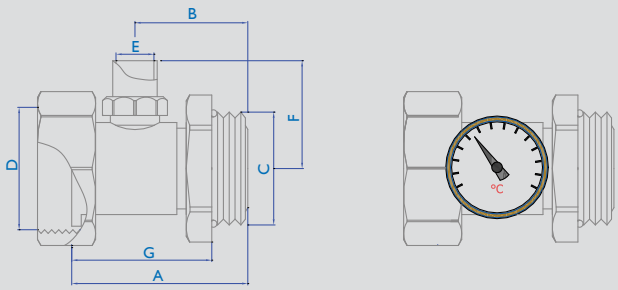
Manifold supply circuit nipple & manifold return nipple

In order to achieve optimum balance of the heating system, we propose special supply and return couplings with attached thermometers. **The success of an underfloor heating installation is based on the best possible adjustment of the supply and return water temperature.**

Return nipple



Supply nipple



DIMENSIONS	A	B	C	D	E	F	G
1"	51,5	33	1"	1"	9	31,5	41,5
11/4"	57	33	11/4"	11/4"	9	31,5	41,5

Ball valve with tail & nut self seal

Characteristics – Advantages

Manufactured in 3/4", 1" and 1 ¼" with a nut which is sealed by an EPDM O-ring at the point where applied.

-The water tightness at the rotational axis is achieved by 2 O-rings of EPDM quality.

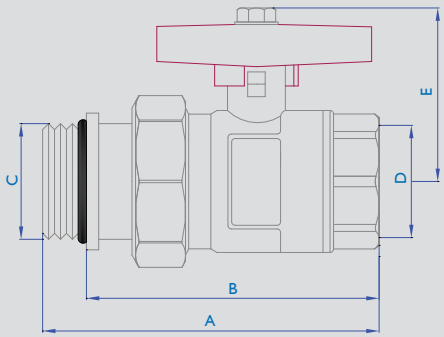
-The opening and the closing of the valve does not require a lot of torque and this is due to its design of the water tightness system.

-The Teflon seals of the valve are of exceptional quality for plumbing installations, so as to return towards their original state following various stresses such as for ex. the passage of debris. Their friction coefficient is almost zero resulting in its smooth rotation.

-Manufactured from brass CW 617N of high quality by hot forging processing.

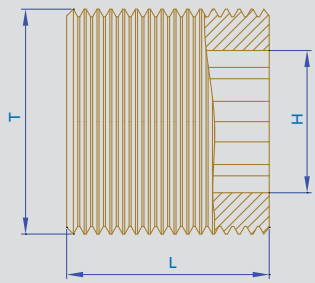
-All valves are controlled one by one during their production for any failures.

Ball valve



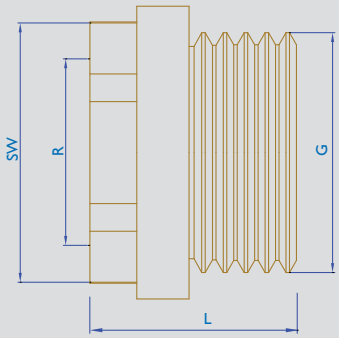
DIMENSIONS	A	B	C	D	E
3/4"	88	77	3/4"	3/4"	39
1"	111,5	100	1"	1"	49,2
11/4"	117	105	11/4"	11/4"	52

Manifold connector



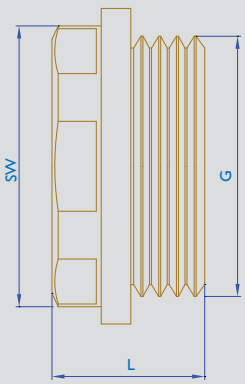
T	H	L
3/4”	13	20
1”	2	30
1 1/4”	25	20,5

Reducing bush for manifold with O-ring



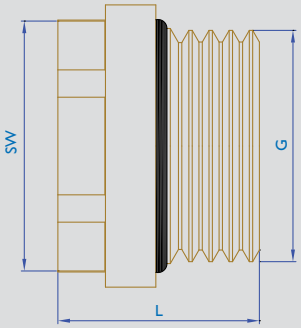
	L	G	R (Female)	SW
1”x1/2”	18	1”	1/2”	30
1”x3/4”	18	1”	34”	30

Male manifold plugs



G	L	SW
3/4”	16	27
1”	18	30
1 1/4”	19,5	36

Male manifolds plugs with O-ring



G	L	SW
3/4”	16	27
1”	18	30
1 1/4”	19,5	36

Electro-valve

The Flash Valve electro-valve is manufactured in compliance to stringent criteria, following European Union specifications (implementation of EU directive 73/23) and bears the CE mark, certified by the Labor SA laboratory.
The electro-valve comprises components which are certified and meet the mechanical requirements as well as the manufacturing standards for electrically operated water valves (ELOT EN 60730-2-8).

Characteristics – Advantages

-The rotation axis is made watertight by two EPDM quality O-rings and a PTFE sealing.
-The slow opening and closing of the electro-valve helps prevent pressure surge.
-It has a Cruzet motor and a ratchet type integrated mechanical brake.
-Its electrical circuit is designed so it always responds to the thermostat’s commands.
-Excellent quality Teflon is used in the electro-valve, suitable for plumbing installations, which allows them to return to their original condition after various stresses, e.g. debris passing through. Its friction factor is next to zero, resulting in the smooth operation of the torsion mechanism.

-High torque 17.9 Nm, certified according to "prony brake", which rotates the valve's ball even in difficult situations, thus preventing problems in the motor.

Technical characteristics

A. General

The system is equipped with a 220V relay, two limits precision switches, an eccentric command and an operating LED indicator light. As such, any theft of heat by any means is excluded. The reduction unit is designed with the advantage of a mechanical STOP in the motor actuator and with high torque in its totality compared to the spherical valve. In this way we can easily rotate the ball with low torque.

The motorized electro-valves can be installed:

1. In central heating installations
2. In air pressure installations
3. In automatic water supply facilities
4. In automatic irrigation facilities
5. In greenhouse plants
6. In renewable energy installations

B. Technical Characteristics

HYDRAULIC CONNECTION

Nominal power:	PN 40
Torque shaft:	17.9 NM
Thread Ends:	ISO 7
Time opening-closing:	57" (104" three-way ball valve)
Ambient temperature:	70°C
Installation:	vertical or horizontal
Fluid Flow:	Full
Range of operating temp.:	1-120°C
Motor power:	3,5W

ELECTRICAL CONNECTION

Operating voltage:	220V/50 Hz
Consumption:	6 VA
Electrical protection:	IP 40
Cable connection:	Flexible cable
	5 x 0,5 mm² (two-way valve)
	6 x 0,5 mm² (three-way valve)

1. Malfunction
-The actuator does not operate
2. Probable causes
-Blackout
-Failure of the actuator
3. Action
-Restore the power
-Contact the manufacturer

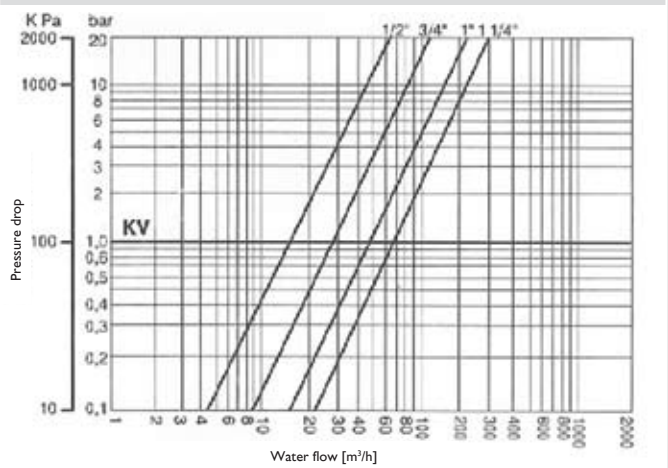
The installation (electro-hydraulic) of the motorized ball valve should be done by a certified installer. The installation of the actuator should be strictly based on technical and electrical diagrams.

Ball valve with three connectors – Remarks
1. The green cable represents the green indicator and the pink cable the red indicator.
2. When the LED is red, the fluid direction is from or to the side of the power cable of the motorized ball valve. When the LED is green, the direction of flow is on the opposite side.

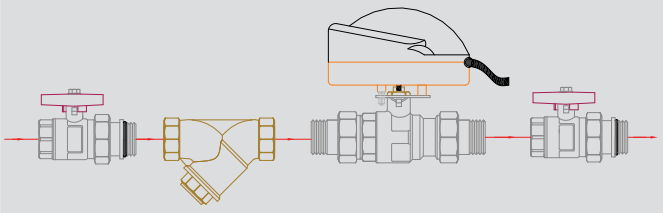
C. Maintenance of the electro-valve

1. Unscrew the two nuts which hold the actuator in the body of the ball valve.
2. Remove the actuator, without touching any of its electrical parts.
3. As the body remains free, place a screwdriver in the recess of the brass shaft, rotating it clockwise and counterclockwise several times, so as to detach any salts that have been attached to the ball of the valve.
4. Then reinstall the actuator on the body of the valve and it will be operating through an electrically ON-OFF thermostat.

Pressure drop chart

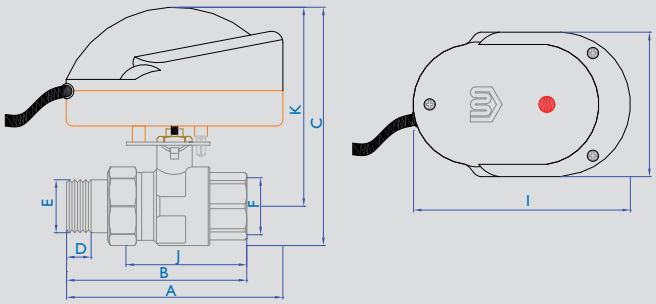


Hydraulic arrangement



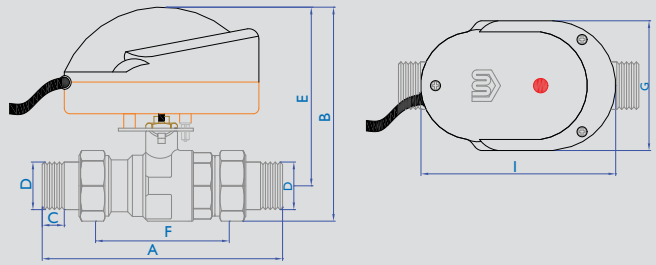
1. Manual valve 2. Filter 3. Motorized ball valve 4. Manual valve

One-way valve



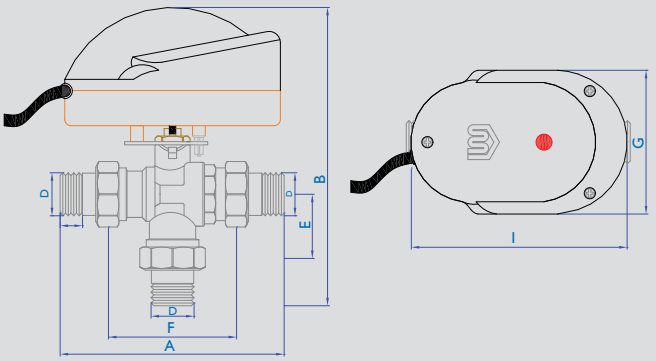
DIMENSIONS	A	B	C	D	E	F	G	I	K	J
3/4"	124	93	136	14	3/4"	3/4"	90	136	117	64
1"	135	112,5	148,5	15	1"	1"	90	136	123	76,5
11/4"	147	131	156	19	11/4"	11/4"	90	136	130	90

Two-way valve



DIMENSIONS	A	B	C	D	E	F	G	I
3/4"	140,5	137,5	15,5	3/4"	117	78,5	90	136
1"	167	148,5	15,5	1"	123	95	90	136
11/4"	182	158	18,5	11/4"	130	100	90	136

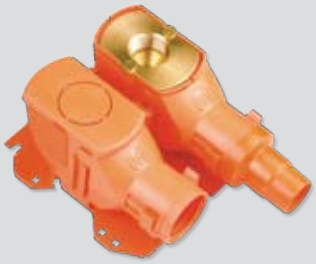
Three-way valve



DIMENSIONS	A	B	C	D	E	F	G	I
3/4"	140,5	186,5	14	3/4"	38	78,5	90	136
1"	167	200	15,5	1"	40	94,5	90	136
11/4"	182	220	18,5	11/4"	50	100	90	136

WALL PLATE ELBOWS

92° Wall Plate Elbow



A segmented wall plate elbow with secure and watertight closing composed of both plastic and metal components.

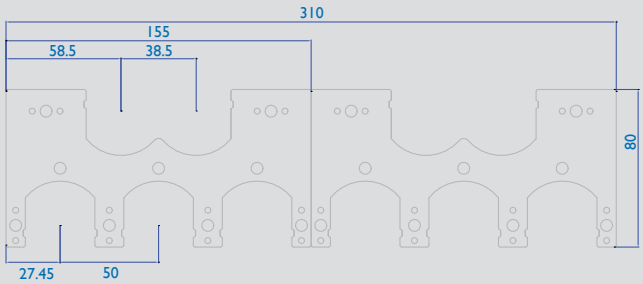
Dimensions: manufactured with a ½" female thread to be attached to the radiator or the discharge pipe.
Available with a plastic pipe adaptor ø15x2,5mm, ø16x2,0mm, ø16x2,2mm, ø18x2,0mm and ø18x2,5mm.

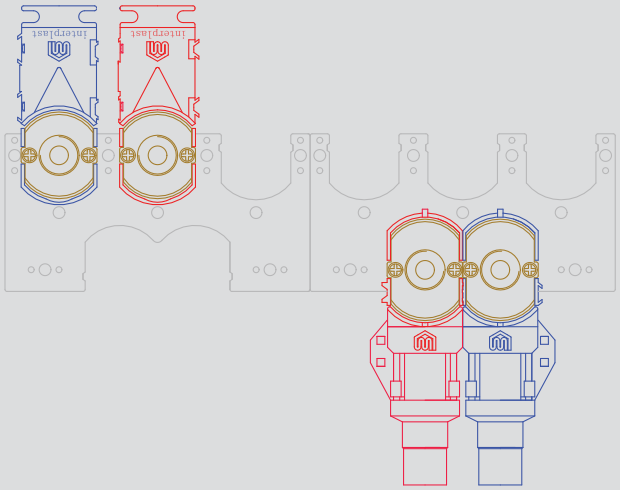
Applications:
1. Connection of radiators from the wall.
2. Connection of radiators from the floor.
3. Ability also to be used as plumbing water supply (for ex. bath mixing units).

Advantages: A system that provides several alternative solutions, such as:

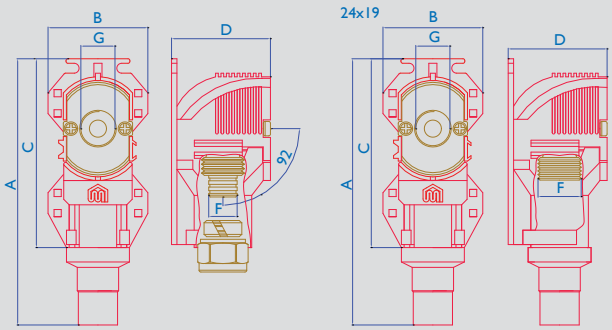
1. By applying the one next to the other we span the distance between the 38mm valves of the external or internal branch.
2. By using the specially designed spacer between the two intakes, we span the distance to 50mm for the Ventil-type heating unit valves.
3. By using the metal supports of multiple positions, it can be used either in heating or in plumbing installations.
4. Applicability of the corrugated pipe (Como-pex corrugated pipe) externally to the angle with the use of a special reducing sleeve for 25mm and 28mm corrugated pipe.
5. Applicability of the corrugated pipe (Como-pex corrugated pipe) internally to the plastic component of the angle by using the specially designed interlocking edges.
6. Perfect aesthetic appeal using the nickel-plated tube nipples with a 15mm dimension and 150mm length, as well as the single and double covers made of ABS (material used for manufacturing visible electrical components).
7. The plastic component is ideally curved to facilitate the attachment or detachment (in the event of damage) of the metal component.

Wall plate elbow 90° and 92° bracket



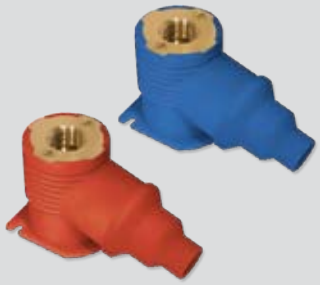


Wall plate elbow 92°



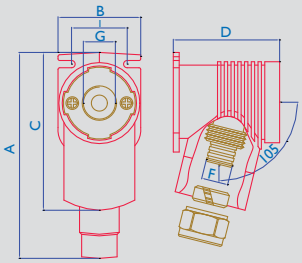
DIMENSIONS	A	B	C	D	G	F
Φ 15x1/2"x2,5	148	55,5	105	55	1/2"	9,8
Φ 16x1/2"x2	148	55,5	105	55	1/2"	11,8
Φ 16x1/2"x2,2	148	55,5	105	55	1/2"	11,4
Φ 18x1/2"x2	148	55,5	105	55	1/2"	13,8
Φ 18x1/2"x2,5	148	55,5	105	55	1/2"	12,8
Without adaptor 24x19	148	55,5	105	55	1/2"	24x19

105° Wall plate elbow



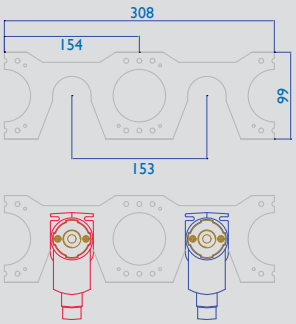
The 105° wall plate elbow facilitates the intervention by the installer in the event of replacement of the brass part or the entire pipe line.
The special cover provides full protection of the metal part from the coatings, such as for ex. the plaster.
When testing the network using the ½" male test plug, the metal section remains protected since the center of the end cap can be easily removed.
By using the reducing sleeve in the lower part of the wall plate elbow, we prevent any "water dripping out" from the corrugated pipe in case of leakage and have the capability to apply two different dimensions of corrugated pipe, 25mm and 28mm.
Available for plastic pipe Como-pex in dimensions ø15x2,5mm, ø16x2,0mm, ø16x2,2mm, ø18x2,0mm and ø18x2,5mm.

Wall plate elbow 105°

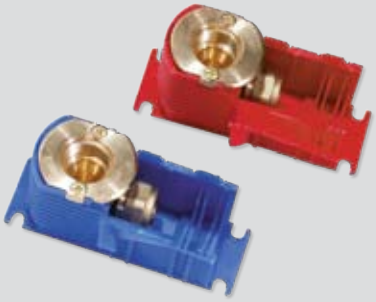


DIMENSIONS	A	B	C	D	G	F	I
Φ 15x1/2"x2,5	122	49	93,5	63	1/2"	9,8	33
Φ 16x1/2"x2	122	49	93,5	63	1/2"	11,8	33
Φ 16x1/2"x2,2	122	49	93,5	63	1/2"	11,4	33
Φ 18x1/2"x2	122	49	93,5	63	1/2"	13,8	33
Φ 18x1/2"x2,5	122	49	93,5	63	1/2"	12,8	33

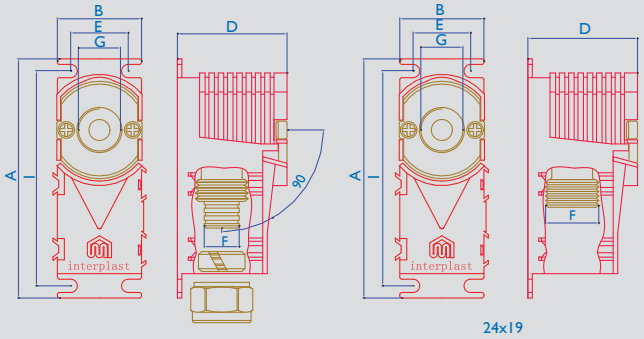
Wall plate elbow 105° bracket



90° Wall plate elbow

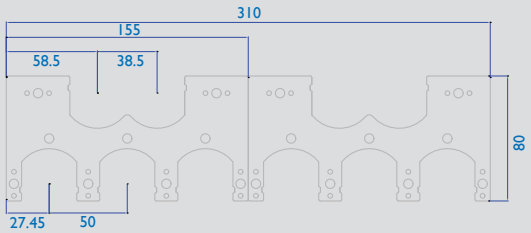


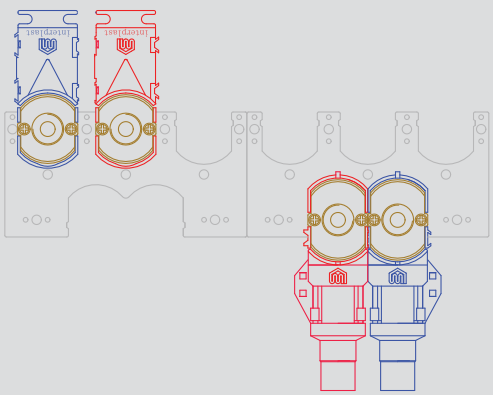
Segmented wall plate elbow with secure and watertight closing. By use of the multi-position metal bracket, it can be used in heating installations as a water connection for valves of the external and internal branch (38 mm distance), and for Ventil units (50 mm distance).
Installed from the wall where, by use of the nickel-plated pipe couplings and the white cap, an excellent aesthetic effect is achieved.



DIMENSIONS	A	B	D	G	F	E	I
Φ 15x1/2"x2,5	108	38	49,5	1/2"	9,8	26	97
Φ 16x1/2"x2	108	38	49,5	1/2"	11,8	26	97
Φ 16x1/2"x2,2	108	38	49,5	1/2"	11,4	26	97
Without adaptor 24x19	108	38	49,5	1/2"	24x19	26	97

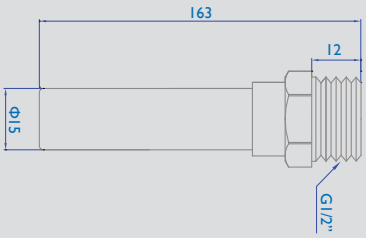
Wall plate elbow 90° and 92° bracket





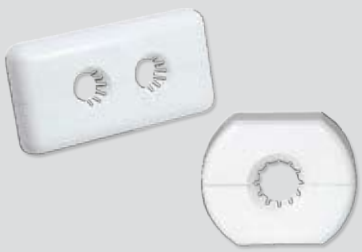
Nickel-plated tube

It is used to connect the 90° and 92° wall plate elbows to the radiators water connections. It is produced with a male ½" threading in 15mm dimension and 150mm length.



Caps for radiator supplies

Made of ABS, a material which apart from its high strength properties, is also used for visible components (for ex. electrical switches) for the excellent aesthetic appeal it offers.
It is used to cover the water connections of the 90° and 92° wall plate elbows and is available in two types:
-Double cover with a distance of 38,5mm between holes for Runtal or single-tube radiator valves.
-Single cover for use with radiator angle valves. When the two single covers are adjacent, the hole distance is 50mm and can be used with Ventil radiators.



Testing plugs

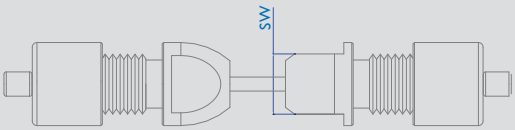
Produced with a ½" male thread in blue and red color and are easily removed by use of an Allen key or a screwdriver.

Pipe extractor

Special metal component that enables us to replace the plastic pipes in case of failure.
There are two bolts with threading in their bodies and a specially shaped head with perforations in the center from which a wire passes and ends at both ends.
The two bolts are placed back-to-back. The set includes two rings.

Usage

On the pipe that we want to replace, we firstly pass the ring and then tighten one bolt to the inner diameter of the pipe until it stops at the end. We do the exact same thing to the new pipe by tightening the other end.
After this we can pull the problematic pipe from its other end and by pulling it into its place it will penetrate into the new pipe.
Production material is st 37 – 2 (370 Kp/mm2)



DIMENSIONS	SW
Φ 15x2.5	13
Φ 16x2	13
Φ 18x2	15
Φ 18x2.5	15
Φ 20x2.0	17

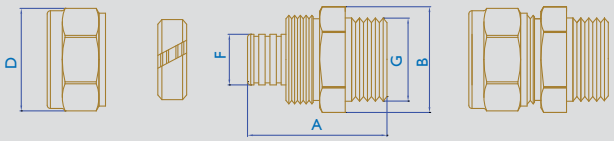
Como-pex BRASS FITTINGS

PEX pipe connection fittings

Our company manufactures a full range of connection fittings for cross-linked polyethylene pipes. The following products are available:

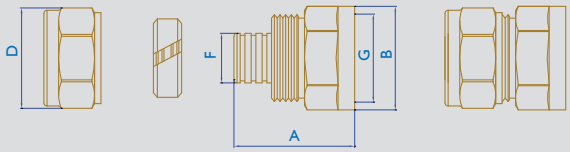
Male, female and connecting coupling.
Male, female and connecting tee
Male, female and wall plate elbow
Wall plate elbow.
Mini-ball valves for plastic pipe.

Connector Male



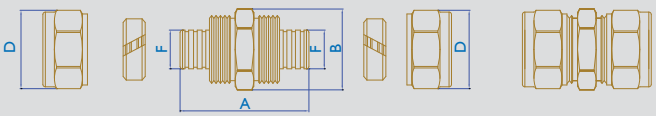
DIMENSIONS	A	B	D	G	F
Φ 15x1/2"x1,5	37	21	24	1/2"	9,8
Φ 16x1/2"x2,0	37,5	21	24	1/2"	11,8
Φ 16x1/2"x2,2	36	21	24	1/2"	11,4
Φ 17x1/2"x2,0	39	25	27	1/2"	12,8
Φ 18x1/2"x2,0	39	25	27	1/2"	13,8
Φ 18x1/2"x2,5	39	25	27	1/2"	12,8
Φ 18x3/4"x2,0	39	25	27	3/4"	13,8
Φ 18x3/4"x2,5	39	25	27	3/4"	12,8
Φ 20x1/2"x2,0	40	27	30	1/2"	15,8
Φ 20x1/2"x2,8	40	27	30	1/2"	14,2
Φ 20x3/4"x2,0	40	27	30	3/4"	15,8
Φ 20x3/4"x2,8	41	27	30	3/4"	14,2
Φ 22x3/4"x3,0	44	29	32	3/4"	15,8
Φ 25x3/4"x2,3	45,5	33	37	3/4"	20,8
Φ 25x3/4"x3,5	45	33	37	3/4"	17,8
Φ 25x1"x2,3	49	38	40	1"	20,2
Φ 28x3/4"x3,0	45	33	37	3/4"	21,8
Φ 28x1"x3,0	49	38	40	1"	21,8
Φ 32x1"x3,0	49	38	43	1"	25,8

Connector Fermale



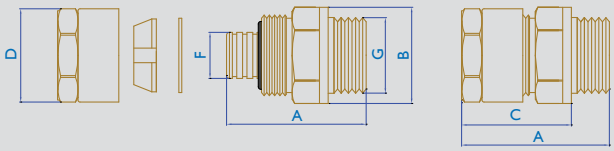
DIMENSIONS	A	B	D	G	F
Φ 15x1/2"x1,5	33	24	24	1/2"	9,8
Φ 16x1/2"x2,0	33	24	24	1/2"	11,8
Φ 16x1/2"x2,2	33,5	24	24	1/2"	11,4
Φ 17x1/2"x2,0	33,5	24	24	1/2"	12,8
Φ 18x1/2"x2,0	35	25	27	1/2"	13,8
Φ 18x1/2"x2,5	35	25	27	1/2"	12,8
Φ 18x3/4"x2,0	35	25	27	3/4"	13,8
Φ 18x3/4"x2,5	35	25	27	3/4"	12,8
Φ 20x1/2"x2,0	35	27	30	1/2"	15,8
Φ 20x1/2"x2,8	35	27	30	1/2"	14,2
Φ 20x3/4"x2,0	37,5	30	30	1/2"	15,8
Φ 20x3/4"x2,8	37	30	30	3/4"	14,2
Φ 22x3/4"x3,0	39	30	32	3/4"	15,8
Φ 25x3/4"x2,3	41	33	37	3/4"	20,15
Φ 25x3/4"x3,5	41,5	33	37	3/4"	17,8
Φ 25x1"x2,3	41	40	40	1"	22,2
Φ 28x3/4"x3,0	40,5	35	40	3/4"	21,8
Φ 28x1"x3,0	41,5	40	40	1"	21,8
Φ 32x1"x3,0	41,5	44	40	1"	25,8

Coupling



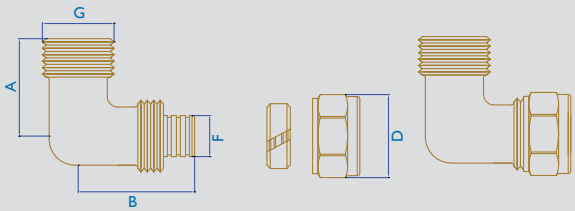
DIMENSIONS	A	B	D	F
Φ 15x15x2,5	44	21	24	9,8
Φ 16x16x1,5	44	21	24	12,8
Φ 16x16x2,0	44,5	21	24	11,8
Φ 16x16x2,2	45	21	24	11,4
Φ 17x17x2,0	45	21	24	12,8
Φ 18x18x2,0	46,5	25	27	13,8
Φ 18x18x2,5	46	25	27	12,8
Φ 20x20x2,0	47,5	27	30	15,8
Φ 20x20x2,8	47,5	27	30	14,2
Φ 22x22x3,0	53	29	32	15,8
Φ 25x25x2,3	57,5	33	37	20,2
Φ 25x25x3,5	57,5	33	37	17,8
Φ 28x28x3,0	56,5	38	40	21,8
Φ 32x32x3,0	58	38	43	25,8

Coupling Male for heavy duty plastic pipe



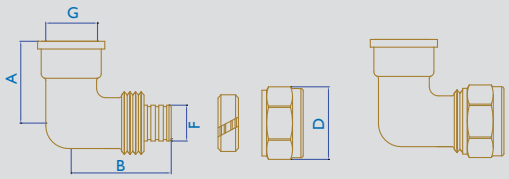
DIMENSIONS	A	B	C	D	F	G
Φ 16x1/2"x2.0	48	22	35	24	11,8	1/2"
Φ 18x1/2"x2.0	46	30	35	27	13,8	1/2"

Elbow Male



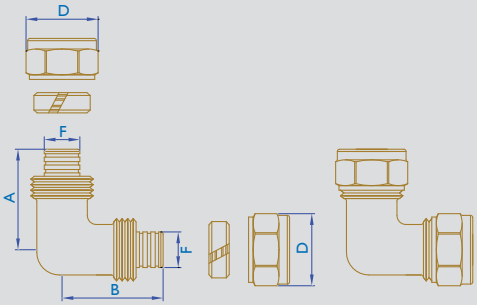
DIMENSIONS	A	B	D	G	F
Φ 15x1/2"x2,5	30	33	24	1/2"	9,8
Φ 16x1/2"x1,5	30	33,5	24	1/2"	12,8
Φ 16x1/2"x2,0	30	33,5	24	1/2"	11,8
Φ 16x1/2"x2,2	30	34	24	1/2"	11,4
Φ 18x1/2"x2,0	32	35	27	1/2"	13,8
Φ 18x1/2"x2,5	30,5	35,5	27	1/2"	12,8
Φ 20x1/2"x2,0	32	38,5	30	1/2"	15,8
Φ 20x3/4"x2,0	32	39	30	3/4"	15,8
Φ 20x3/4"x2,8	31	39	30	3/4"	14,2
Φ 22x3/4"x3,0	34	41	32	3/4"	15,8
Φ 25x3/4"x2,3	37	46	37	3/4"	20,2
Φ 25x3/4"x3,5	37	46	37	3/4"	17,8
Φ 28x1"x3,0	40	46	40	1"	21,8
Φ 32x1"x3,0	43,5	48	43	1"	25,8

Elbow Female



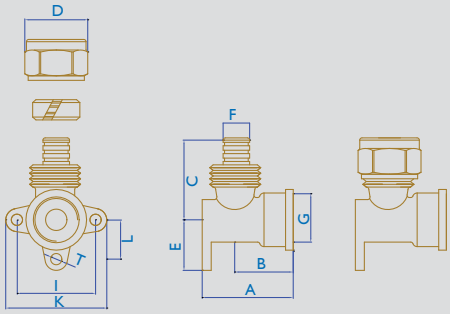
DIMENSIONS	A	B	D	G	F
Φ 15x1/2"x2,5	31,5	33,5	24	1/2"	9,8
Φ 16x1/2"x1,5	31,5	33,5	24	1/2"	12,8
Φ 16x1/2"x2,0	31,5	34	24	1/2"	11,8
Φ 16x1/2"x2,2	31,5	34	24	1/2"	11,4
Φ 18x1/2"x2,0	32	36,5	27	1/2"	13,8
Φ 18x1/2"x2,5	33	37	27	1/2"	12,8
Φ 20x1/2"x2,0	35	40	30	1/2"	15,8
Φ 20x3/4"x2,0	35	40	30	3/4"	15,8
Φ 20x3/4"x2,8	33	38	30	3/4"	14,2
Φ 22x3/4"x3,0	35	41	32	3/4"	15,8
Φ 25x3/4"x2,3	35	44	37	3/4"	20,1
Φ 25x3/4"x3,5	35	44	37	3/4"	17,8
Φ 28x1"x3,0	45	44	40	1"	21,8
Φ 32x1"x3,0	46	49	43	1"	25,8

Elbow Double



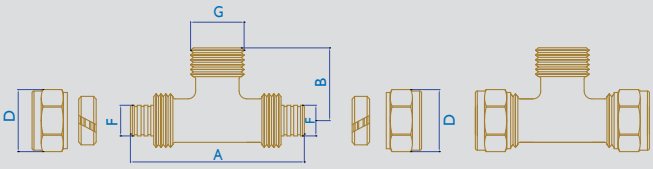
DIMENSIONS	A	B	D	F
Φ 15x15x2,5	34	34	24	9,8
Φ 16x16x1,5	34	34	24	12,8
Φ 16x16x2,0	33	33	24	11,8
Φ 16x16x2,2	33	33	24	11,4
Φ 18x18x2,0	37	37	27	13,8
Φ 18x18x2,5	36,5	36,5	27	12,8
Φ 20x20x2,0	38,5	38,5	30	15,8
Φ 20x20x2,8	39,5	39,5	30	14,2
Φ 22x22x3,0	40	40	32	15,8
Φ 25x25x2,3	45	45	32	20,2
Φ 25x25x3,5	45	45	32	17,8
Φ 28x28x3,0	48	48	40	21,8
Φ 32x32x3,0	49,5	49,5	43	25,8

Wall Plate Elbow



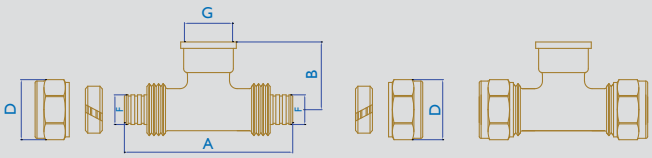
DIMENSIONS	A	B	C	D	E	F	G	I	K	L	T
Φ 15x1/2"x2,5	41	26	34	24	22	9,8	1/2"	34	44,5	17	5,3
Φ 16x1/2"x1,5	41	26	34	24	22	12,8	1/2"	34	44,5	17	5,3
Φ 16x1/2"x2,0	41	14	35	24	22	11,8	1/2"	34	44,5	17	5,3
Φ 16x1/2"x2,2	41	14	35,5	24	22	11,4	1/2"	34	44,5	17	5,3
Φ 18x1/2"x2,0	42	15	37	27	22	13,8	1/2"	34	44,5	17	5,3
Φ 18x1/2"x2,5	42,5	16,5	38,5	27	22	12,8	1/2"	34	44,5	17	5,3

Tee Male



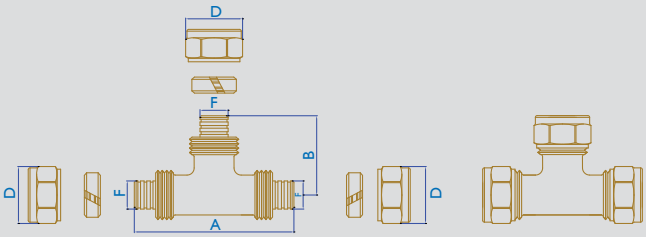
DIMENSIONS	A	B	D	G	F
Φ 15x1/2"x2,5	68	27,5	24	1/2"	9,8
Φ 16x1/2"x1,5	66	29	24	1/2"	12,8
Φ 16x1/2"x2,0	66	29	24	1/2"	11,8
Φ 16x1/2"x2,2	66	29	24	1/2"	11,4
Φ 18x1/2"x2,0	71	30	27	1/2"	13,8
Φ 18x1/2"x2,5	72	30	27	1/2"	12,8
Φ 20x3/4"x2,0	75	33	32	3/4"	15,8
Φ 20x3/4"x2,8	75	33	32	3/4"	14,2
Φ 22x3/4"x3,0	80	33	32	3/4"	15,8
Φ 25x3/4"x2,3	85	38	33	3/4"	20,2
Φ 25x3/4"x3,5	85	38	33	3/4"	17,8
Φ 28x1"x3,0	94,5	40,5	40	1"	21,8
Φ 32x1"x3,0	100	42	43	1"	25,8

Tee Female



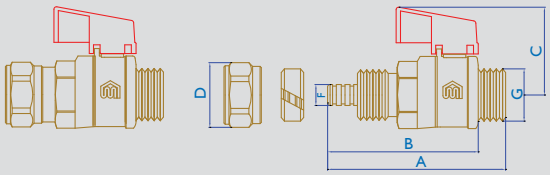
DIMENSIONS	A	B	D	G	F
Φ 15x1/2"x1,5	68	32,5	24	1/2"	9,8
Φ 16x1/2"x1,5	66	32,5	24	1/2"	12,8
Φ 16x1/2"x2,0	68	33	24	1/2"	11,8
Φ 16x1/2"x2,2	68	33	24	1/2"	11,4
Φ 18x1/2"x2,0	72	31	27	1/2"	13,8
Φ 18x1/2"x2,5	73	31	27	1/2"	12,8
Φ 20x3/4"x2,0	78	33	30	3/4"	15,8
Φ 20x3/4"x2,8	78	33	30	3/4"	14,2
Φ 22x3/4"x3,0	80	35	32	3/4"	15,8
Φ 25x3/4"x2,3	85	38	35	3/4"	20,2
Φ 25x3/4"x3,5	85	38	35	3/4"	17,8
Φ 28x1"x3,0	93	42	40	1"	21,8
Φ 32x1"x3,0	100	46,5	43	1"	25,8

Tee



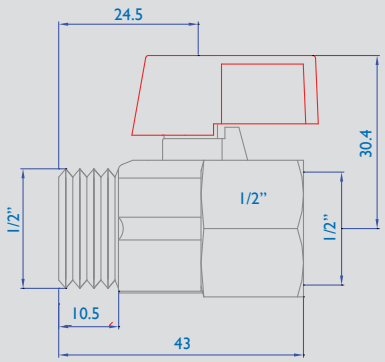
DIMENSIONS	A	B	D	F
Φ 15x15x2,5	68	35,5	24	9,8
Φ 16x16x1,5	68	35,5	24	12,8
Φ 16x16x2,0	67	33,5	24	11,8
Φ 16x16x2,2	67	33,5	24	11,4
Φ 18x18x2,0	73,5	36,5	27	13,8
Φ 18x18x2,5	73,5	36,5	27	12,8
Φ 20x20x2,0	75	38	30	15,8
Φ 20x20x2,8	77,5	38	30	14,2
Φ 22x22x3,0	79	40	32	15,8
Φ 25x25x2,3	82	40	35	20,2
Φ 25x25x3,5	89	46	37	17,8
Φ 28x28x3,0	96	48	40	21,8
Φ 32x32x3,0	101	50	43	25,8

Mini ball valve for plastic pipe

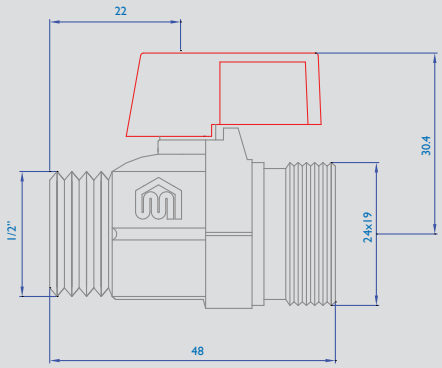


DIMENSIONS	A	B	C	D	G	F
Φ 15x1/2"x2,5	66,5	53	33	24	1/2"	9,8
Φ 16x1/2"x1,5	64	44	33	24	1/2"	12,8
Φ 16x1/2"x2,0	64	44	33	24	1/2"	11,8
Φ 16x1/2"x2,2	62	48	33	24	1/2"	11,4
Φ 17x1/2"x2,0	66,5	53	33	27	1/2"	12,8
Φ 18x1/2"x2,0	66,5	55	33	27	1/2"	13,8
Φ 18x1/2"x2,5	66,5	54	33	27	1/2"	12,8
Φ 20x1/2"x2,0	71,5	61	33	27	1/2"	15,8

Ball valve ½" x ½" M/F



Ball valve ½" x 24-19 M/M



Radiator valves

Full bore radiator valves for **greater heat load transfer** compared to conventional valves.

Characteristics - Advantages

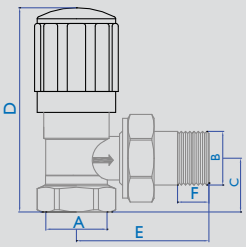
-The mechanism becomes watertight with 2 teflon-coated EPDM quality O-rings and a **PTFE sealing** to intervene in the event of leakage.

-Bar type mechanism. As the wheel turns only the valve moves, while the axis does not move up and down. This prevents wear and tear of the O-ring of the axis and the teflon.

-The base of the manifolds is made watertight by an EPDM quality O-ring together with a metal-to-metal watertight connection.

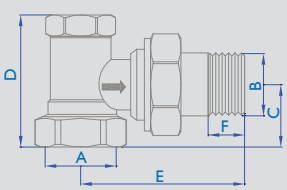
-The handwheel is made of ABS for high strength and aesthetic appeal. The upper part has a cap to hide the adjustment screw that fastens the wheel to the spindle.

Radiator Valve Angle



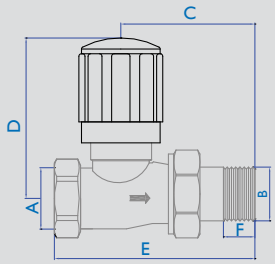
DIMENSIONS	A	B	C	D	E	F
3/8" F	3/8"	3/8"	19,5	77	48,5	12
1/2" F	1/2"	1/2"	20,5	78	51	12
24x19 M Copper	24*19	1/2"	21,5	81	52	12
1/2" M Copper	1/2"	1/2"	21,5	81	52	12
3/4" F	3/4"	3/4"	25	84	53,5	12

Regulating Angle Radiator Valve



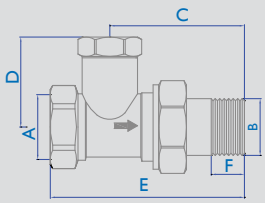
DIMENSIONS	A	B	C	D	E	F
3/8" F	3/8"	3/8"	21	41,5	45,5	12
1/2" F	1/2"	1/2"	20,5	43,5	54	12
3/4" F	3/4"	3/4"	25	48,5	53	12

Radiator Valve Straight



DIMENSIONS	A	B	C	D	E	F
3/8" F	3/8"	3/8"	43,5	61,5	65	12
1/2" F	1/2"	1/2"	51,5	61,5	76,5	12
24x19 M	24x19	1/2"	49	63	73	12
3/4" F	3/4"	3/2"	49,5	64	77	12

Regulating Radiator Valve Straight



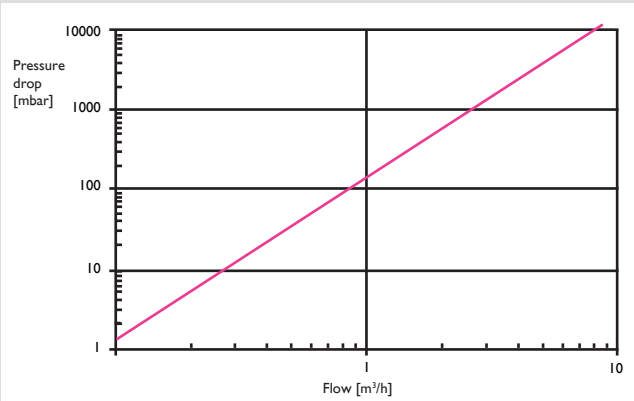
DIMENSIONS	A	B	C	D	E	F
3/8" F	3/8"	3/8"	46	27	67,5	12
1/2" F	1/2"	1/2"	48,5	32,5	70	12
3/4" F	3/4"	3/4"	49,5	34	77	12

Flow measurement

Type	(m^3/h)
Radiator valve angle, fully open	2,67
Radiator valve straight, fully open	2,65

KV-measurement of a fully open supply according to DIN EN 60534-2-3

Pressure drop chart

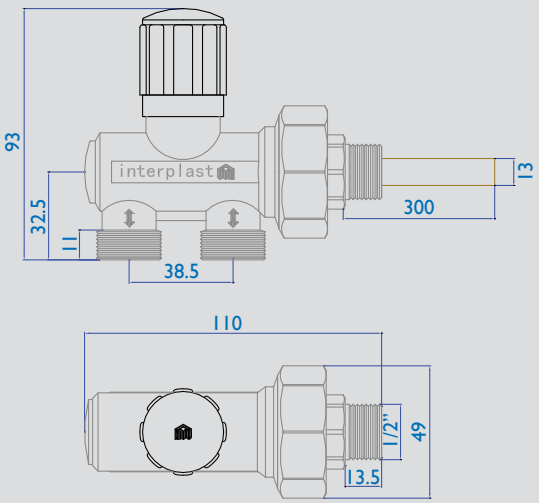


Radiator valves of internal branch (mono-tube system)

The valves of the internal branch produced by the company are heavy duty and can be rotated 360º for supply from the wall or the floor.

Characteristics-Advantages

-The axis of rotation is made watertight by two EPDM quality O-rings and a PTFE nipple sealing, in order to provide access in case of leakage.
-The piston is made watertight by two EPDM quality O-rings.
-The water distributor from the body of the valve to the branch is made of metal.
-Provision of water supply or return by using the flow divider on the branch.
-The inner piston of the valve is suitably designed to allow better circulation of the water enabling greater heat load transfer to the units and the network works at lower pressures.
-The small pipe that fills the unit is in nickel-plated brass with a height of 95 cm.
-The handwheel is made of ABS for high strength and an aesthetic appeal.



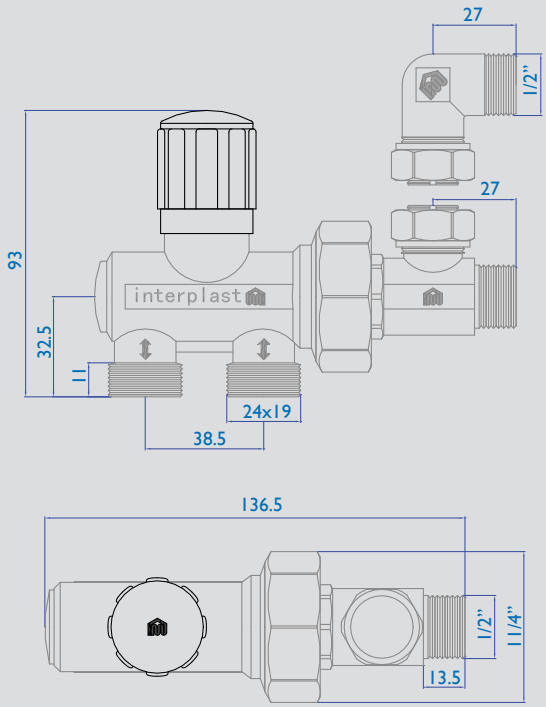
The flow tests and the drawings of the pressure drop diagrams in the manifolds and the valves have been approved by the German Institute BAÜMER.

Radiator valves of external branch

The valves of the external branch produced by the company are heavy duty and can be rotated 360º for supply from the wall or the floor.

Characteristics-Advantages

-Provision of water supply or return by using the flow divider on the branch.
-The small pipe that fills the unit is in nickel-plated brass with a height of 95 cm.
-The axis of rotation is made watertight by two EPDM quality O-rings and a PTFE nipple sealing, in order to provide access in case of leakage.
-The piston is made watertight by two EPDM O-rings.
-The water distributor from the body of the valve to the branch is made of metal.
-The inner piston of the valve is suitably designed to allow better circulation of the water enabling **greater heat load transfer to the units and the network works at lower pressures.**
-The handwheel is made of ABS for high strength and an aesthetic appeal. The upper part has a plastic cover to hide the adjustment screw that fastens the wheel to the spindle.



Instructions

The external branch radiator valve, when delivered from the factory, is ready for use (water flow) according to figure A. In case that you wish to change the water inflow or the water flow, then:

a) Remove the branch from the rest of the valve.
b) Pull out the flow divider (figure B) with the help of a thin screwdriver.
c) Rotate by 180° (figure C) and place the flow divider into the slot of the branch (figure D).

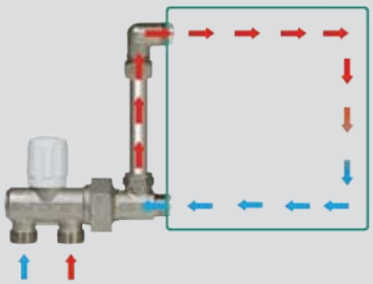


Figure A

Figure B

Figure C

Figure D

Flow measurement

Type	(m³/h)
Runtal Valve	1,85

KVS-measurement of a fully open supply according to DIN EN 60534-2-3

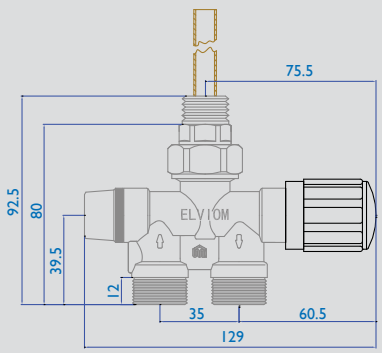
Straight Radiator Valve with straight connection (towel radiator)

The straight radiator valve is produced in 24x19 threading. It is of heavy type and can be easily adjusted to all straight radiators.

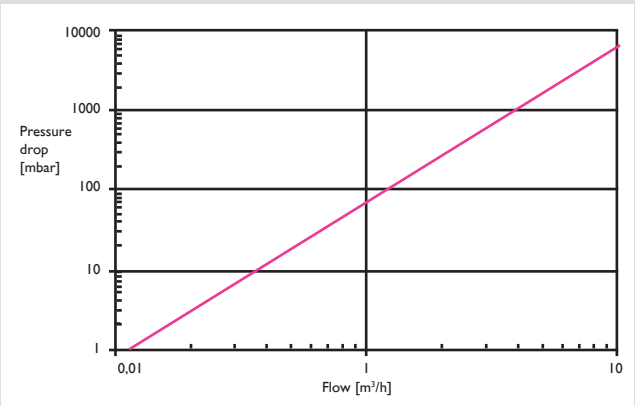
Characteristics-Advantages

-All the valves have a by-pass system.
-The valves have a large flow rate and can be adjusted in the returns.
-Bar type mechanism of the valve with 3 O-rings EPDM in its axis for total water tightness.
-The flow divider gives you the choice of the inflow.
-The brass tube is ø10x50cm with the possibility to be extended by 50cm.
-The valve comes with a closed by-pass.
-The alloy construction of the body of the valve is CW 617 N.

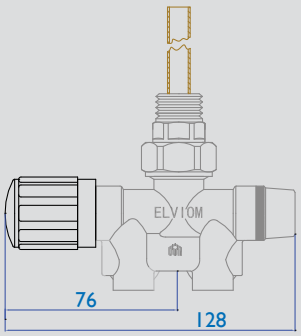
Towel radiator valve straight

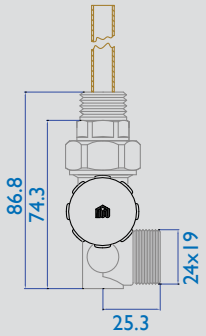


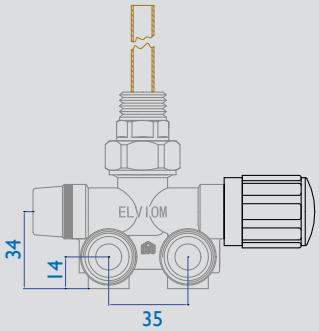
Pressure drop chart



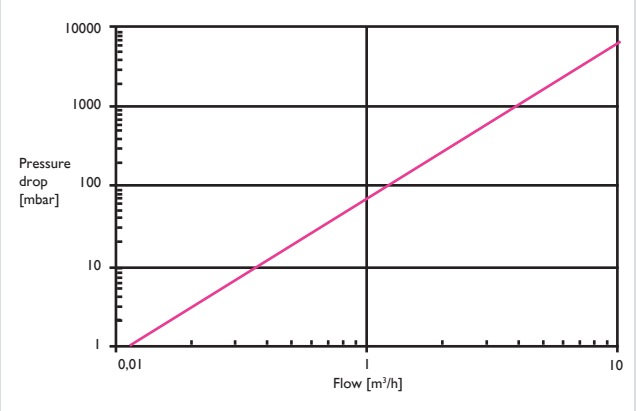
Towel radiator valve angle







Pressure drop chart



Connection

The straight radiator valve is delivered from the factory according to figure A. In case that you need to change the inflow or the flow of water, then:

a) Remove the nipple and the nut from the valve.

b) Pull out the body of the valve and the flow divider (figure B) with the help of a thin screwdriver.

c) Rotate by 180° (figure C) and place the flow divider into the socket of the vlave's body (figure D).

Note: The distances between the centers of the outlets are 35mm.

Figure A

Figure B

Figure C

Figure D

Flow measurement

Type	(m³/h)
Towel radiator valve straight	0,81
Towel radiator valve angle	0,71

KVS-measurement of a fully open supply according to DIN EN 60534-2-3

Thermostatic Radiator valves

The thermostatic radiator valves are used to automatically regulate the supply of hot water to the radiators in accordance with the room temperature.
They are produced in 3/8", ½" and ¾".

Characteristics – Advantages

-The thermostatic heads have a mechanical temperature regulation system (sensor component liquid, direct responsiveness) which automatically adjusts the opening/closing of the valve.
-All the valves are produced by ELVIOM and provide full bore for maximum heat load transfer than common valves.
-Radiator valves, nuts, nipples, joints: Brass EN 12165 CW 617N
-Operating range: 5°C-100°C
-Manufactured according to European standard EN 215.

Construction materials

Radiator valves, nuts, nipples, joints: Brass EN 12165 CW 617N
Axis: Stainless steel
Plastic parts: ABS
Ring seals: EPDM

Technical information

- Adjustment range: 5°C (Position *) 28°C (Position 5)
- Nominal pressure: PN10
- Sensor of liquid element
- Built according to European standard EN215
- Antifreeze safety: about 5°C
- Maximum operating temperature of the switch: 5°C -100°C
- Kvs: 2,66 m3 / h

Installation

Remove the plastic manual hand wheel cover of the valve.
Place the moving part of the thermostatic head to Position No 5.
Fit the thermostatic head to the valve's body and tighten the head's metal union to the valves threading.
Select the desired room temperature.

ATTENTION: The thermostatic head should always be installed horizontally.
Note: The thermostatic head is preset from the factory in Position 3, around 20°C.

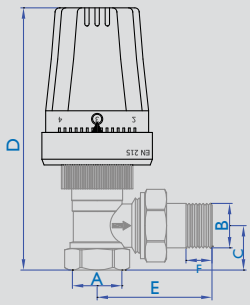
The use of thermostatic radiator valves is recommended by the company because according to the European regulations, they save up to 22% energy.

Antifreeze safety
Position –▲
During the rotation of the moving part of the head in position ▲, the antifreeze protection is cancelled (about 5°C).

Locking the settings

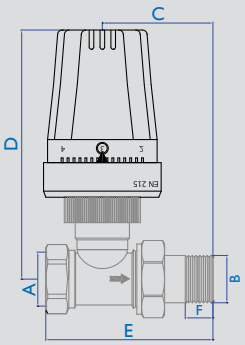
The special locking pin can be used to set the thermostat valve to any required setting.
Set the head in the required position.
Insert the pin in the socket with the same indication of the setting.
The temperature has been adjusted and simultaneously the increase of the temperature by non-specialists is prevented.

Thermostatic Radiator Valve Angle



DIMENSIONS	A	B	C	D	E	F
3/8" F	3/8"	3/8"	19,5	121	53	12
1/2" F	1/2"	1/2"	20,5	122	49,2	12
24x19 M	24*19	1/2"	21,5	125	52	12
3/4" M	3/4"	3/4"	27	132	56	12
3/4" F	3/4"	3/4"	25	128	53	12

Thermostatic Radiator Valve Straight



DIMENSIONS	A	B	C	D	E	F
3/8" F	3/8"	3/8"	43,5	103	65	12
1/2" F	1/2"	1/2"	48	108	72,5	12
24x19 M	24*19	1/2"	49	108	73	12
3/4" M	3/4"	3/4"	48	110	72	12
3/4" F	3/4"	3/4"	51	111	78,5	12

VENTIL valves

The valves are produced in ¾" and 24x19 threads. They are heavy duty and can be easily applied to all thermostatic radiators.

Characteristics - Advantages

- All valves have a by-pass system.
- The **valves have large flow rate** and can be adjusted in the outputs.
- The two Ball valve type caps are watertight from two sets made of Teflon.
- The axis of the switch has two O-rings on its body for a perfect seal.
- The hexagon handling caps are from brass nickel plated material, and have position limits for opening/closing.
- The non-return valves are placed in the returns.
- **All valves are supplied with drain plugs.**
- The alloy construction of the body of the valve is CW 617 N.

Installation

The Ventil valves can be connected to thermostatic radiators and can be installed in one-pipe or two-pipes heating systems.

Closing the valve

The valve closes by turning 90° the hexagon brass handling caps towards the by-pass side.

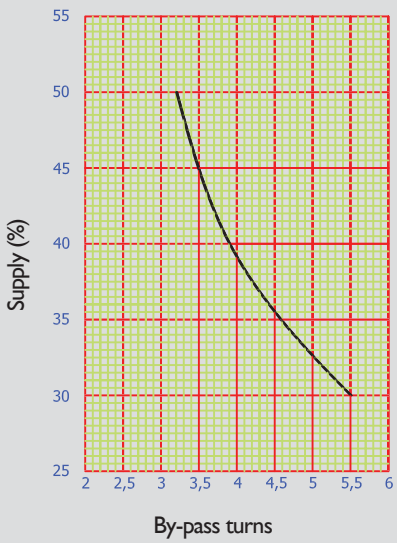
Connection

The connection of the Ventil valves can be achieved with ½" x ¾" cone inserts for radiators with female thread and with ¾" (eurocone) cone inserts for radiators with male thread.

Adjusting the By-Pass

The valves are supplied from the factory with a 35% presetting of the radiator.

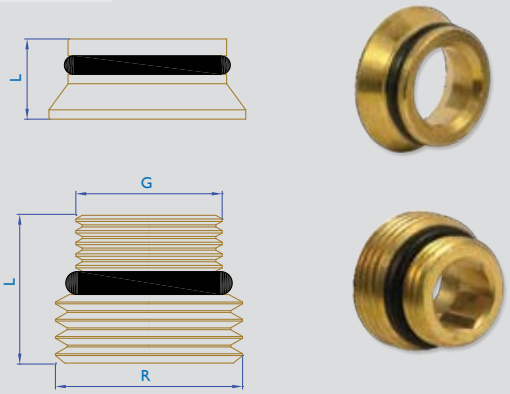
In order to change the specific presetting:
Unscrew the cap.
Tighten until the end the By-Pass by using a 6mm Allen key.
Then unscrew and adjust the desirable preset according to the diagram.



Non Return Valve

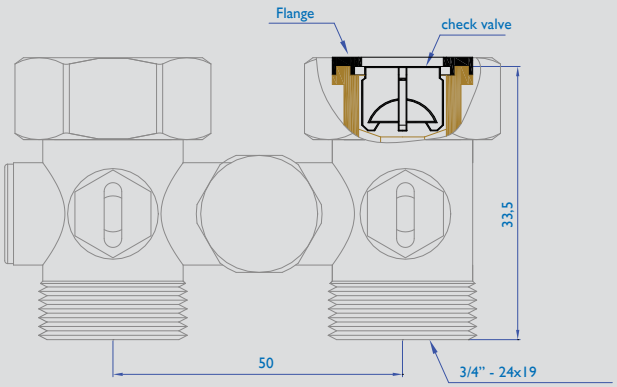
In one pipe systems the non return valve must always be installed in the return side.
The ventil valves are supplied from the factory with the non return valve placed in the right side.

Ventil adaptor



DIMENSIONS	L	G	R
1/2" X 3/4"	21	1/2"	3/4"
3/4"	8,6	-	-

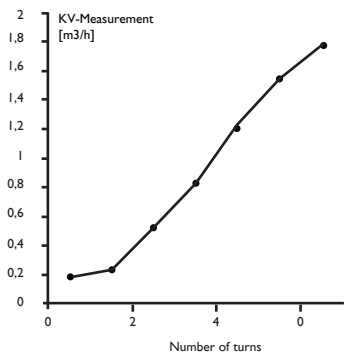
Ventil straight



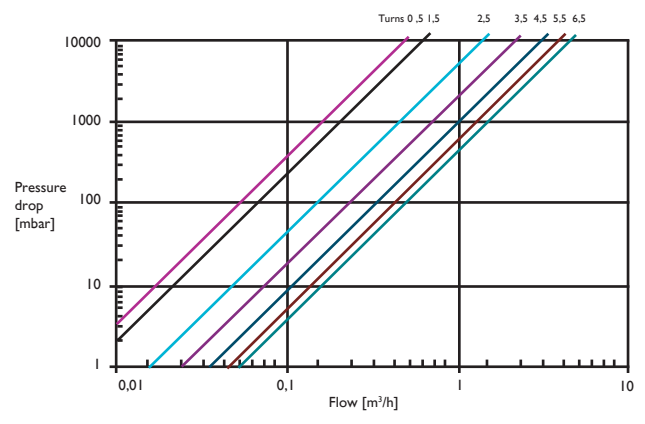
Flow measurement

Number of turns	(m³/h)
6,5	1,79
5,5	1,55
4,5	1,20
3,5	0,82
2,5	0,52
1,5	0,23
0,5	0,18

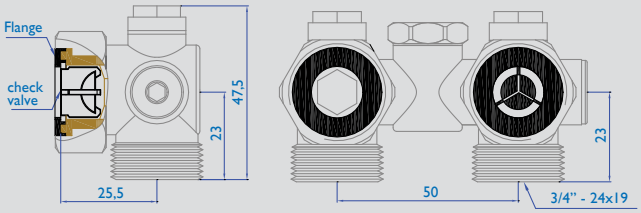
KV Measurement



Pressure drop chart



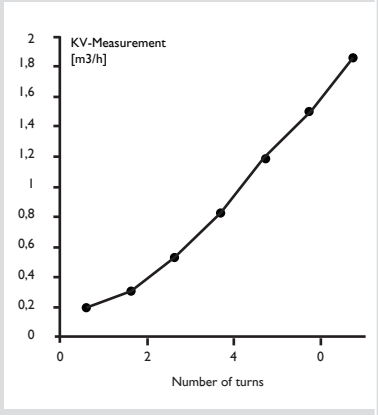
Ventil angle



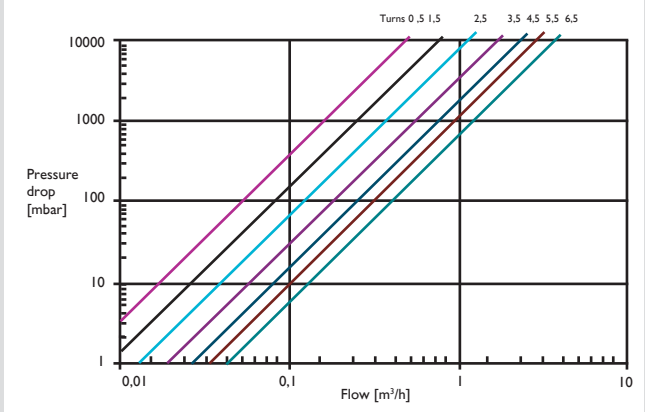
Flow measurement

Number of turns	(m³/h)
6,5	1,79
5,5	1,45
4,5	1,14
3,5	0,80
2,5	0,51
1,5	0,29
0,5	0,19

KV Measurement

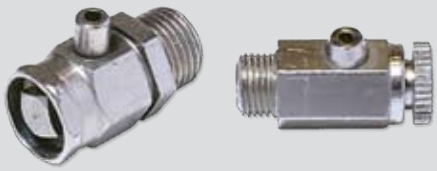


Pressure drop chart

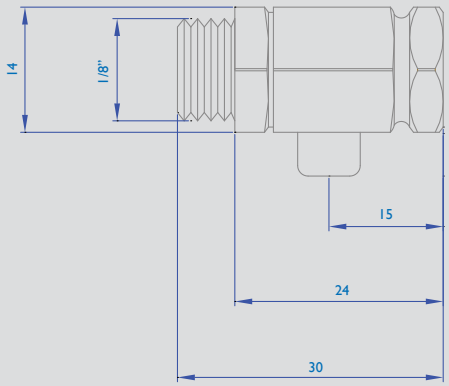


Radiator airvents

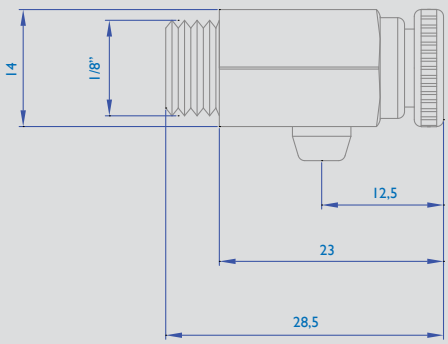
Are fitted to radiators. They are nickel-plated and are produced in two types.
Automatic, working with hydrophilic fibers, that de-aerate without any human intervention.
Manual, classical airvents.
Produced in 1/8" size.



Airvent with tail nickel-plated



Airvent with handle nickel-plated



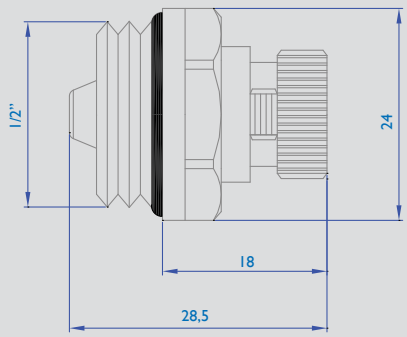
Automatic airvent

The airvent consists of two parts. The first part is the ½" body bearing an O-ring and a built-in return valve.
The second part contains the absorbent fibers and the adjusting screw. During operation, the air trapped in the network or within the radiator is automatically released. Should the second part be accidentally removed (screwed), there would be no problem with water leakage, as the return valve takes over.

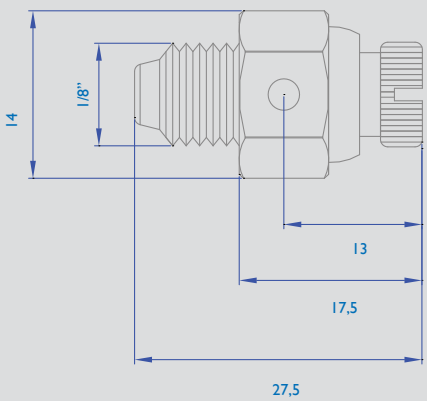
Installation

1. We screw the automatic airvent to the radiator or the network head.
2. We press the ball in the return valve, releasing the excess air from the installation out until the water starts dripping.
3. We screw the bolt and fibers onto the body of the airvent.
4. We adjust by the use of a screwdriver the airvent, unscrewing the screw by 90°. A few drops will start dripping until the fibers are moistened for the first time and the void is closed. From this point on the installation gets automatically de-aerated without us having to intervene anymore. Fitted on manifolds and on radiators.

Automatic airvent 1/2"

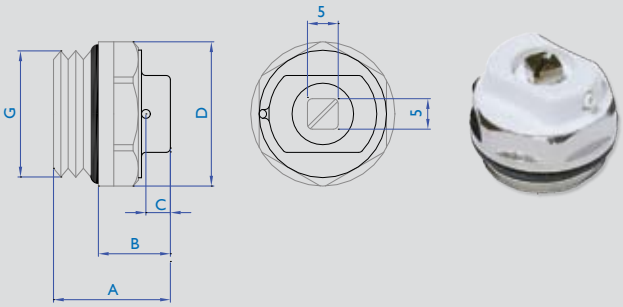


Automatic airvent 1/8"



Airvent with a rotating plastic O-ring

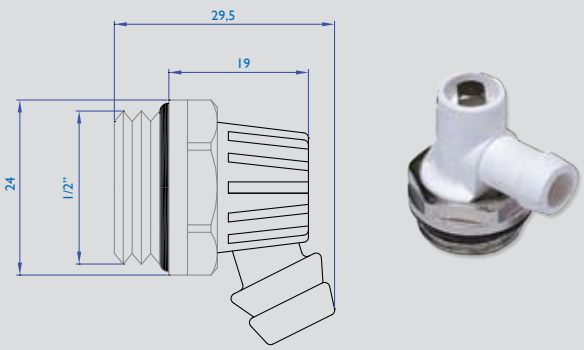
Nickel plated with a plastic rotating 360° head for improved and easier de-aeration.
Bears an EPDM watertigthing ring and is fitted on heating manifolds and on radiators. Produced in sizes 3/8" and ½". We can de-aerate either by using a key or a screwdriver.



DIMENSIONS	A	B	C	G	D
1/8"	19	13	4	1/2"	22
1/2"	19	13	4	3/8"	22

Radiator Drain cock

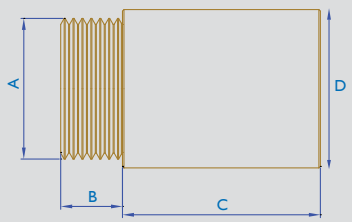
Fitted on radiators and on the boiler.
On the radiators it is used in place of conventional taps, enabling the draining of the radiator when necessary.
Rotating for better draining, manufactured in ½" size.



Extension pieces

They are produced by copper alloy CW617N and exceed the German standards.
Raw material has undergone a special thermal processing in order to obtain the desirable hardness of raw material. Within the product, during its processing, an internal stress is developed, thus increasing its hardness. The final product is subject now, **for a second time to thermal processing**, eliminating the stresses that have been developed during processing, thus **nullifying the possibilities of season cracking** and restoring the desirable hardness.

Extension pieces 1/2" & 3/4"

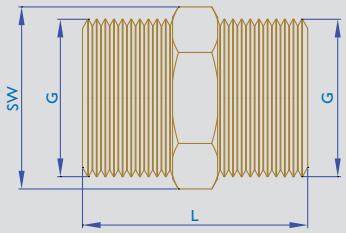


DIMENSIONS	A	B	C	D
L 10	1/2"	11	10	27
L 15	1/2"	11	15	27
L 20	1/2"	11	20	27
L 25	1/2"	11	25	27
L 30	1/2"	11	30	27
L 40	1/2"	11	40	27
L 50	1/2"	11	50	27
L 65	1/2"	11	65	27
L 80	1/2"	11	80	27
L 100	1/2"	11	100	27
L 10	3/4"	11	10	32
L15	3/4"	11	15	32
L 20	3/4"	11	20	32
L 25	3/4"	11	25	32
L 30	3/4"	11	30	32
L 40	3/4"	11	40	32
L 50	3/4"	11	50	32
L 65	3/4"	11	65	32
L 80	3/4"	11	80	32
L 100	3/4"	11	100	32

ELVIOM Brass Fittings

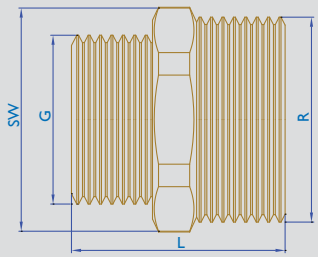
All brass bars processed by ELVIOM conform to the European standards EN 12164, EN 12165, EN 12167 and EN 12168. All incoming materials are subject to dimensional control by instruments and devices, hardness tests with a last generation stable hardness tester and controls of chemical analysis of the alloy composition with a privately-owned mass spectrograph. The dimensions of the design are strictly applied during the manufacturing of the components.
The threads of the components are manufactured according to the European standards EN ISO 228 and EN ISO 7(DIN2999) and their control is carried out by thread controllers.
All brass fittings are designed to meet the needs and demands of consumers and to be able to easily and effectively be applied by the installers.

Nipple



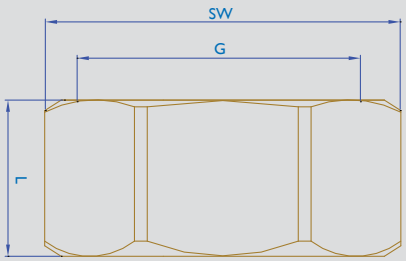
DIMENSIONS	SW	G	L
1/8"x1/8"	10	1/8"	20
1/4"x1/4"	13	1/4"	22
3/8"x3/8"	17	3/8"	25
1/2"x1/2"	21	1/2"	27
1/2"x1/2" B.T.	21	1/2"	30
1/2"x1/2" B.T. 33mm	21	1/2"	33
3/4"x3/4"	27	3/4"	33
1"x1"	33	1"	35
1 1/4"x1 1/4"	42	1 1/4"	38
1 1/2" x 1 1/2"	48	1 1/2"	43
2"x2"	60	2"	50

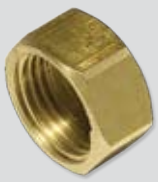
Reduced Nipple



DIMENSIONS	L	G	R	SW
1/4"x1/8"	21	1/8"	1/4"	14
3/8"x1/8"	23	1/8"	3/8"	17
3/8"x1/4"	24	1/4"	3/8"	17
1/2"x1/4"	24	1/4"	1/2"	21
1/2"x3/8"	26	3/8"	1/2"	21
3/4"x1/2"	29	1/2"	3/4"	26
1"x1/2"	32	1/2"	1"	35
1"x3/4"	33	3/4"	1"	35
1 1/4"x1/2"	34	1/2"	1 1/4"	42
1 1/4"x3/4"	35	3/4"	1 1/4"	42
1 1/4"x1"	37	1"	1 1/4"	42
1 1/2"x3/4"	39	3/4"	1 1/4"	50
1 1/2"x1"	40	1"	1 1/2"	50
1 1/2"x1 1/4"	41	1 1/4"	1 1/2"	48
2"x1 1/4"	47	1 1/4"	2"	60
2x1 1/2"	49	1 1/2"	2"	60

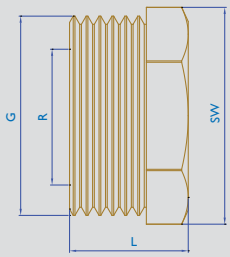
Cap





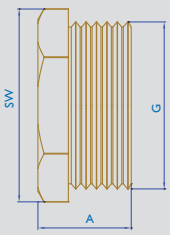
G	SW	L
1/4"	17	10
3/8"	19	11
1/2"	24	12
3/4"	30	14
1"	37	16
1 1/4"	48	15
1 1/2"	52	23
2"	67	25

Bushing



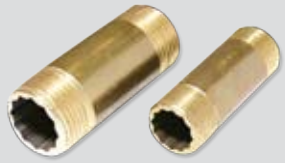
DIMENSIONS	L	G	R	SW
1/4"x1/8"	11.5	1/4"	1/8"	14
3/8"x1/8"	12	3/8"	1/8"	17
3/8"x1/4"	12	3/8"	1/4"	17
1/2"x1/8"	15	1/2"	1/8"	21
1/2"x1/4"	15	1/2"	1/4"	21
1/2"x3/8"	15	1/2"	3/8"	21
3/4"x3/8"	17	3/4"	3/8"	27
3/4"x1/2"	17	3/4"	1/2"	26
1"x1/2"	18.5	1"	1/2"	33
1"x3/4"	18.5	1"	3/4"	33
1 1/4"x1/2"	22	1 1/4"	1/2"	42
1 1/4"x3/4"	22	1 1/4"	3/4"	42
1 1/4"x1"	22	1 1/4"	1"	42
1 1/2"x1 3/4"	24	1 1/2"	3/4"	50
1 1/2"x1"	24	1 1/2"	1"	50
1 1/2"x1 1/4"	24	1 1/2"	1 1/4"	50
2"x1"	30	2"	1"	60
2"x1 1/4"	30	2"	1 1/4"	60
2x1 1/2"	30	2"	1 1/2"	60

Plug



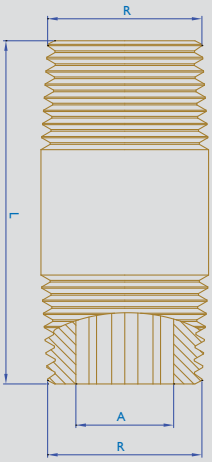
DIMENSIONS	SW	A	G
1/4"	13	13	1/4"
3/8"	18	12	3/8"
1/2"	21	15	1/2"
3/4"	26	17	3/4"
1"	33	19	1"
1 1/4"	42	20	1 1/4"
1 1/2"	48	24	1 1/2"
2"	60	26	2"
1/2" Square head	13	22	1/2"

Tube Nipples



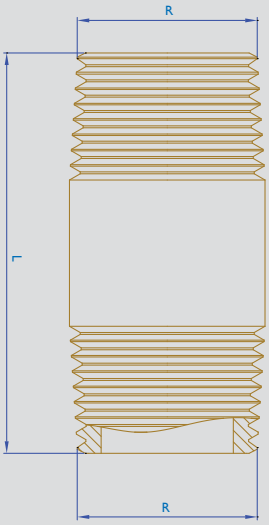
They are manufactured in dimensions from 1/2" till 2", 25 – 150 mm in length. They are produced of alloy brass CW 617N according to the European standards EN 12168 and the threads on both ends according to ISO 7 (DIN 2999).
The raw material undergoes a special thermal processing, so as to achieve the desired hardness and to avoid the accumulation of trends.
The manufacturing of the threads with the specific cone gives advantages in their application since they allow using whatever tightness means and also provide tightness between metal and metal.
The inside dimension, dodecagon profile, provides easy and quick installation using an Allen key and furthermore does not create big resistances to flow of fluid.

Brass Tube Nipples



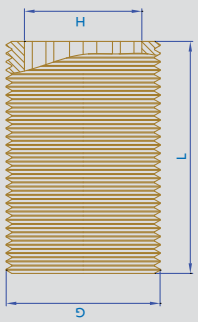
L	R	A
20	1/2"	12
30	1/2"	12
40	1/2"	12
50	1/2"	12
60	1/2"	12
80	1/2"	12
100	1/2"	12
150	1/2"	12
30	3/4"	17
40	3/4"	17
50	3/4"	17
60	3/4"	17
80	3/4"	17
100	3/4"	17
150	3/4"	17
30	1"	22
40	1"	22
50	1"	22
60	1"	22
80	1"	22
100	1"	22
150	1"	22

Tube Nipples without Dodecagon



L	R
50 mm	1 1/4"
60 mm	1 1/4"
80 mm	1 1/4"
100 mm	1 1/4"
150 mm	1 1/4"
40 mm	1 1/2"
50 mm	1 1/2"
60 mm	1 1/2"
80 mm	1 1/2"
100 mm	1 1/2"
150 mm	1 1/2"
50 mm	1 1/2"
60 mm	1 1/2"
80 mm	1 1/2"
100 mm	1 1/2"
150 mm	1 1/2"

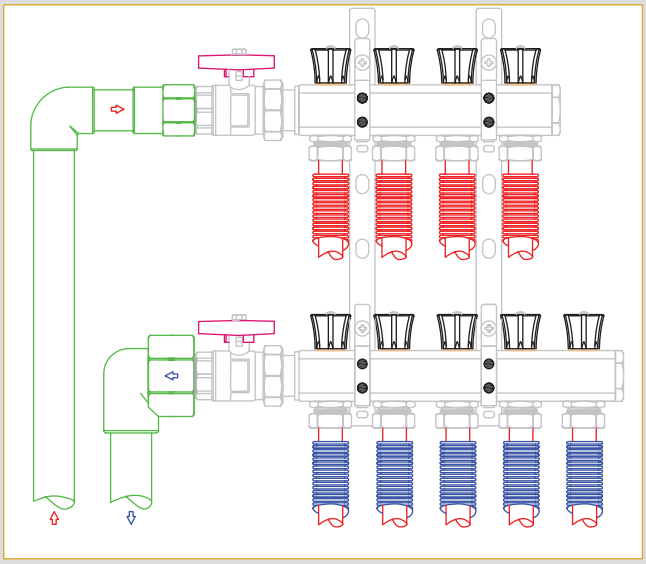
Brass Tube Nipples (all thread)



G	L	H(ALLEN)
1/2"	60	12
3/4"	60	17
1"	60	22
1/2"	100	12
3/4"	100	17
1"	100	22

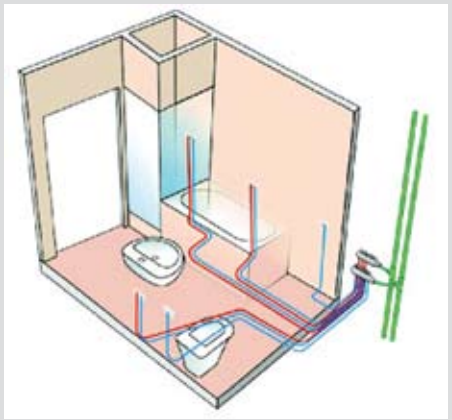
Clean and toxic-free, exceptionally corrosion-proof, low friction factor and high mechanical strengths have rendered cross-linked polyethylene pipes as the basic choice in water supply installations all over the world. The system comprises a distribution channel containing the manifolds and the pipe connectors, the Como-pex pipes inside corrugated pipe and the wall plate elbows placed in plastic compartments.

More specifically, the water supply system of **Interplast** consists of:
-The Como-pex cross-linked polyethylene pipes in black or white color.
-The corrugated protective pipes in blue, red and black color inside which Como-pex pipes are placed.
-The regulating manifolds, available from 2 to 12 outlets.
-The 105°, 92° and 90° wall plate elbows described in detail in the chapter "connection fittings".



System Advantages

-Low friction, constant inner diameter over lifetime of product.
-Signalling of whatever damage.
-Easy installation, saving time and money.
-Easy replacement of damaged pipes. **The only system offering this possibility.**
-Isolation of circuits in the event of damage.
-Easy bending.
-No need for many connections and tools.
-Easy access connections.
-Service life of pipe is at least 50 years.
-Distribution of individual lines reduces pressure difference and improves flow.
-Running water becomes a noiseless experience.
-Vibration of pipes during operation of the network is eliminated.
-In contrast to metal pipe, remains unaffected by hard water.
-White or black Como-pex pipe dot not leave any water taste and odour free.
-Certified by WRAS-NSF Great Britain for suitability for drinking water and controlled for the same reason by the State General Laboratory.



GUARANTEE

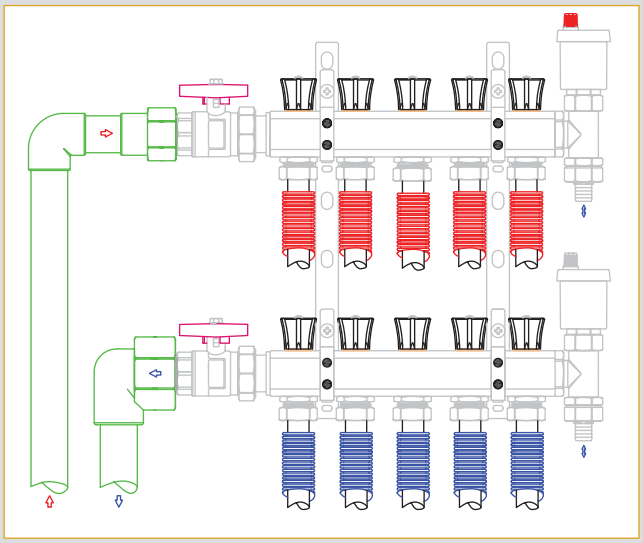
Interplast guarantees for a period of 30 years the pipe and for 10 years the metal fittings of the installation, as far as for the watertightness of the connections, covered by the ALLIANZ Insurance company against damage owing to faulty production for the amount of €3,000,000 and €500,000 per incident.

The exceptional performance of cross-linked polyethylene pipes at high temperatures reaching 110°C, high pressure up to 24 bar, a lifespan of at least 50 years and their widespread use over the past 40 years, have rendered them the most popular pipes for heating systems all over the world.

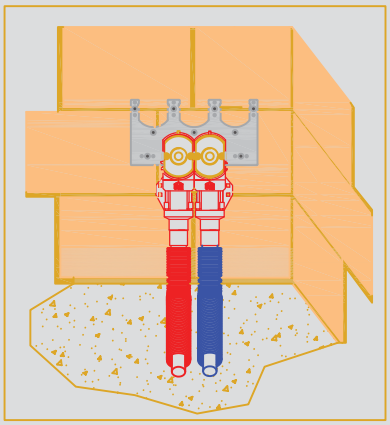
The pipes can be used in either a single pipe (manifold – radiator 1, 2 or 3 – return) or double pipe system (manifold – radiator – return). In Greece due to the climatologic conditions, and especially in the Northern regions, the safe double pipe system has prevailed.

Interplast is one of the few companies in Europe with a vertically integrated production and the only company in Greece that manufactures all the components of the system and guarantees the whole heating-plumbing installation.

The **Interplast** heating system consists of:
-Como-pex cross-linked polyethylene pipes in black or white color
-Alternatively, Como-pex Oxygen Barrier pipes can be used for extra protection of the metal components of the installation
-The corrugated protective pipes in blue, red and black color, inside which the Como-pex pipes are placed.
-The bar type manifolds, supplied as individual components (not connected) from 2 to 10 outlets.
-Alternatively, manifold pairs could be used, as are described in detail in the "Underfloor Heating" chapter.
-Complete range of brass fittings for the distribution panel, such as manifold nipples, automatic airvents, network filling and drain valves, pipe connectors, as are in detail described in the "Connection Fittings" chapter.



- 90° and 92° wall plate elbows with a series of supplementary components (supply caps, nickel-plated couplings, end cap, plug) for installation and connection to wall-mounted radiators, offering an aesthetic appeal of the installation. By use of the wall plate elbow we can easily proceed with the replacement of any corroded units.

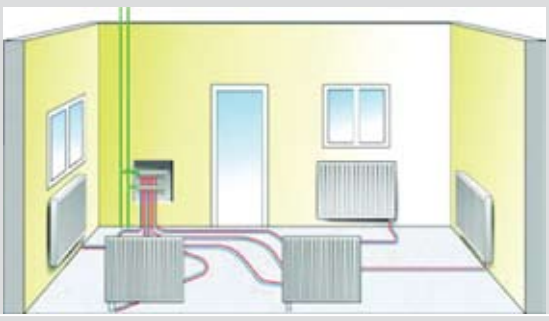


System advantages

-Easy installation, saving time and money.
-Increased protection against damage. The external conduit (corrugated pipe) provides prompt warning of damage to the pipe.
-Easy replacement of randomly damaged pipes. The old pipe is removed and the new one is inserted by aid of the pipe extractor (it is the only system offering this possibility).
-Isolation of circuits in the event of damage.
-Very flexible pipes.
-No need for many connections and tools.
-Easy access to the connections.
-Service life of pipe is at least 50 years.

GUARANTEE

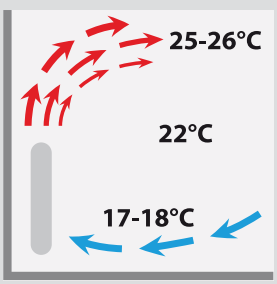
Interplast guarantees for a period of 30 years for the pipe and 10 years for the metal fittings of the installation, as far as for the watertightness of connections, covered by the ALLIANZ Insurance company against damage owing to faulty production for the amount of 3,000,000 € and 500,000 € per incident.



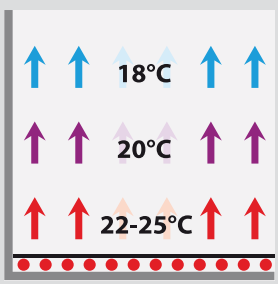
Underfloor heating, considered by many as an innovation in the field of heating applications, is a technique that first appeared in classical antiquity using logs as fuel and air flowing through underground channels as the medium of convection.
Over the past 30 years and almost simultaneously with the appearance of plastic pipes, underfloor heating has grown in popularity utilizing of course advanced techniques, methods and materials.
In the course of its ongoing effort to offer high quality products and reliable services to the technical experts and the end user alike, **Interplast** identified their needs and processed their comments and requirements for an ideal heating system.
The requirements of safe operation, of modern installation, of invisible implementation, of long-term maintenance and of hygiene requirements combining comfort and economical operation are more than covered by the **Interplast** underfloor heating system.
Interplast offers an integrated underfloor heating package and a guarantee on the entire installation.

Operation

The operation of underfloor heating is based on the circulation of hot water through plastic pipes routed across the floor.
The water temperature ranges from 35°C to 48°C depending on the thermal losses, the flooring material and the geographical location of the application.
The main feature and advantage of this heating method is that it uses the floor as a heating unit, which consequently means a significant increase in heating power.



CONVENTIONAL HEATING SYSTEM WITH RADIATORS



INTERPLAST UNDERFLOOR HEATING SYSTEM

Characteristic feature is that the areas are heated indirectly by radiation of heat from the floor.
Hot water conveys heat to the thermal concrete surrounding the plastic pipes, and the floor in turn radiates heat.
In this way, heat is evenly distributed over the area, achieving the main objective of heating systems, which is the establishment of ideal conditions of warmth, comfort and coziness while offering lower cost of operation.

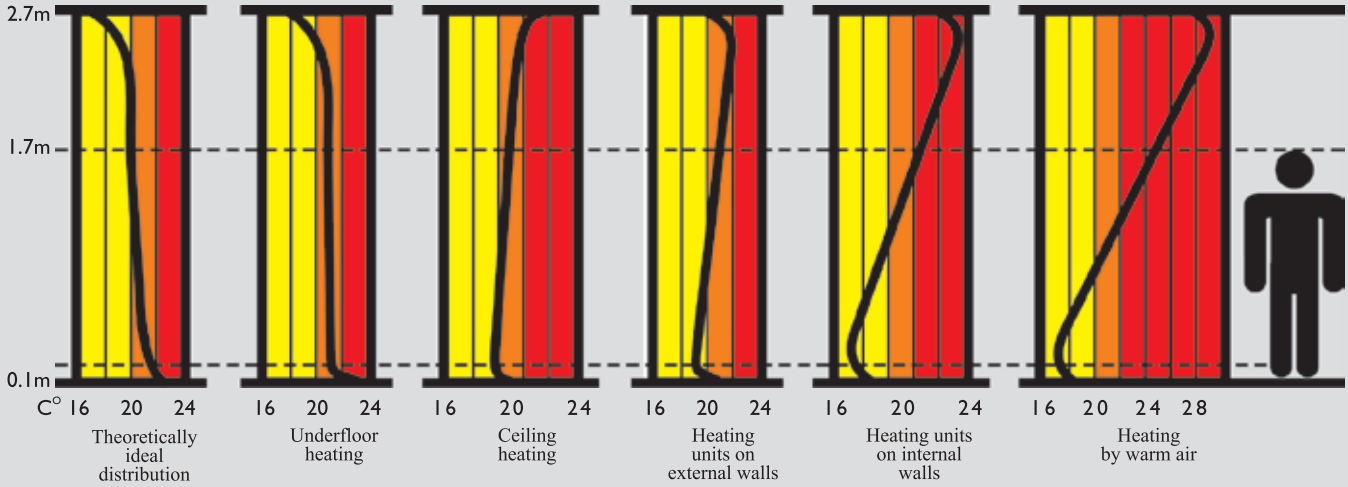
Applications

An underfloor heating installation perfectly covers the needs of residences, schools, public buildings, professional premises, hotels, underground facilities etc., without restricting its field of application only to the above.
Due to the uniform horizontal distribution of heat from the floor to the ceiling, it enables the heating of spaces with a very high ceiling. It is thus a heating application recommended for residences with indoor balconies, churches, industrial facilities (production and storage), as well as the heating of open spaces, i.e. parking facilities, garage entrances, outdoor stairwells, bridges, stadiums, air-lanes, etc.

Advantages

Using the floor as a heating unit is the feature that attributes to underfloor heating the majority of the advantages that it presents.

- Possibility of using all modern heat sources.
Due to the low temperatures and overall inertia of the system, apart from conventional energy sources we have the possibility to use mild and alternative forms of energy such as solar, geothermal, heat from the environment, which saves energy and significantly reduces CO_2 emissions.



- Uniform and comfortable distribution of heat over the area.
In underfloor heating, heat is dissipated in space via radiation (60-65%) and convection (35-40%). Thereby, reducing the temperature differences since the piping is covering the entire surface.

-Low operating cost.
Owing to the uniform distribution of heat, the almost zero heat loss from the floor and the significant reduction in ceiling losses due to the scaled temperature in relation to height, we can achieve a comfortable area at a temperature at least 2°C lower.

-Environmentally friendly.
Fewer hours of operation of the heat pump or the boiler correspond to lower releases of gases, less burden to the environment and greater energy savings (less fuel).
We can thereby use hot water supply of lower temperatures (35°C - 48°C) compared to common heating radiators (70°C - 80°C), resulting in fewer operating hours of any energy source and therefore lower fuel consumption.

-Healthier conditions.
The horizontal and indirect space heating, via heat radiation, results in achieving an optimal distribution of heat on the human body, i.e. warm feet – cool head.
Concerning the thermal stability of the human foot, moving in a heated floor, the European regulations are taken into account regarding the conduct of studies on underfloor heating.
By avoiding air currents, created by the common heating radiators and per consequence, the lack of dust and moisture preservation of the air in the room, it creates ideal conditions especially for people suffering from asthma or allergies.

-Safety.
Underfloor heating eliminates the risk of injury from hot and sharp-edged radiator units, especially for young children and the elderly.

-Space saving.
Valuable space is saved, as there are no radiators on the walls and since the floor is used as a heating radiator, not only allowing us to exploit all the area in the most functional way, but also giving us an architecturally appealing effect.

-Short-term depreciation.
Some of the factors contributing to recoup the cost of an underfloor heating installation are:
-Reduced fuel consumption, as mentioned above (more than 30% when the power source is a boiler and more than 60% if a heat pump is used).
-The reduced cost of building maintenance, as we no longer have to deal with blackening of walls and curtains.
-The zero cost for maintenance and replacement of radiators.
Increased lifespan of the boiler room equipments since they operate fewer hours.

-Possibility of combined operation with other heating systems.
With just a heat pump or with just one boiler, we can simultaneously heat certain areas with underfloor heating and with heating radiators or fan coils. From the same source of energy, we also supply the domestic hot water of the building.

STUDY

The study and the installation drawings of the horizontal underfloor heating system by **Interplast**, constitute the main tools and manuals of the installer for a correct execution of the works.

A prerequisite for a correct calculation of the underfloor heating system is the exact plan of the building, which will include all relevant data regarding its construction and insulation.

Therefore, the underfloor heating designers are very much facilitated if they have the exact floor plans and sections of the building to scale. The building plans should clearly indicate the area spaces, the openings that exist within (the frame sizes), the use of each space (kitchen, bathroom, bedroom, etc.) and the orientation of the building.

Important for the calculations are the details of the construction and insulation materials of the building in order to calculate the U-value of all the building components, as well as the floor coverings (eg tiles, parquet, etc.). Information regarding the locations of fixed structures within the building (for ex. kitchen cabinets, wardrobes, fireplaces, sanitary items, etc.) is necessary to be given to the designer so as to precisely calculate the materials used.

The basis for calculating the underfloor system of any heated surface is the proper definition of the thermal losses in accordance with DIN 4701.

The study requires a set of relationships and calculations on the corrected thermal requirement, the variation of the surface temperature, the average transported heat power, the thermal transmittance towards the floor, the surface temperatures, the water supply temperature, the density of the thermal flow, the average supply and the pressure drop in the system defined by DIN 4725-200 and DIN EN 1264.

Based on the above calculations, the circuits of each space are calculated (circuit length, density pipes, expansion joints) for a specific pipe dimension (Como-Floor ø17x2), so as to cover its losses, taking always into account the usage of the area, the final coating of the floor and the external temperatures of the region.

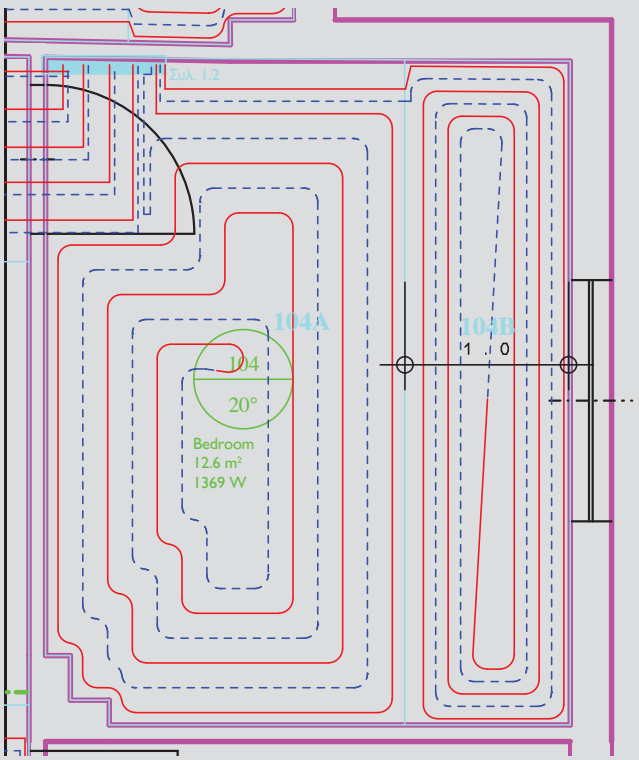
The expansion joints turn the heated floor into a "swimmer floor", separating it from the fixed components of the area and allowing it to move freely, during both the contraction due to drying and during the expansion due to temperature differences.

The interior expansion joints concern large single spaces where the thermal concrete is indispensable to be divided into areas of about 40 square meters, areas where the ratio of their sides is greater than 1:2 or have side lengths greater than 8m, or where the designer deems necessary to be placed according to the configuration of the area.

It should be noted that the joints are made known upfront to all following teams so as to be maintained during the placing of the concrete.

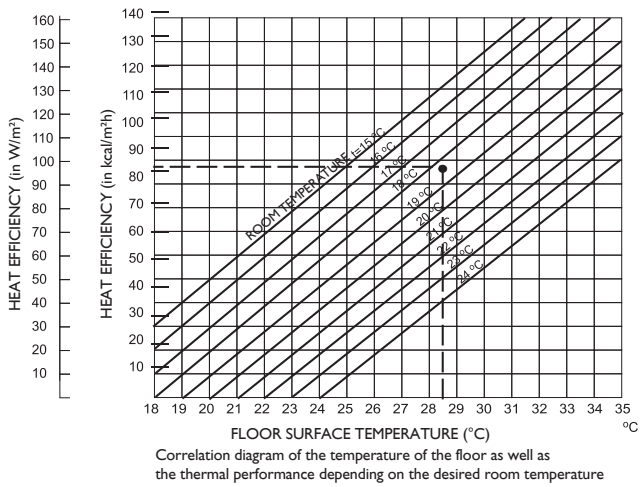
The study also determines, based on the structural components of the building, the number and length of the circuits, the optimal location and the relevant dimensions of the distribution panels at each level of the building. The distribution channel is good to be placed on the same side in each level (floor) of the building to avoid branching of the main piping on the surface of the plaque.

The ground plan (figure below) shows the location of the manifold, the heated space with its characterization (for ex. 104 Bedroom), its segregation into smaller areas (usually as many as the 104A and 104B for example circuits), the routing of the circuit from the manifold and the form of the circuit. In one legend is listed the most important information of the circuit.



104A	RA150
Type of circuit	Oz
Heated surface	8.6 m²
Total length of circuit	52,4 m
Valve regulation	2.00 T

104B	RA75
Type of circuit	sPz
Heated surface	4.0 m²
Total length of circuit	56,6 m
Valve regulation	2.50 T



Correlation diagram of the temperature of the floor as well as the thermal performance depending on the desired room temperature

Furthermore, for any future reference regarding the installation, it is necessary to maintain the study and the installation drawings in good condition within the project folder, along with any other information deemed necessary (for ex. photos of circuits).
A typical page of the main factors taken into account and the results of the study appear in the tables below.
These tables include all the elements that characterize a discrete circuit. Each area (as described) has at least one circuit, and is likely to have more (for ex. circuit 104A is in the bedroom, circuit 104B is in the bedroom - no mention of the area is given again but is indicated with a space).
The information obtained from the panels is given for each circuit separately and each column contains specific information.
In the first table, in the order of columns, appear the number and letter identifying each circuit, the description of the area, the desired internal temperature, the thermal conductivity of the floor, the performance of the underfloor heating per square meter, the thermal losses of the area that could not be covered by the underfloor heating, the temperature difference of water supply and return in each circuit, the density in which the pipes will be laid out on the floor (75mm or 150mm), the square meters of the area covered by each circuit, the floor temperature and finally how many square meters are covered by each circuit by passing through piping (supply-returns).
The second table shows data for each circuit concerning the type of circuit (Oz – occupying zone, sPz – separate Peripheral zone), the supply-return piping, the total length of the circuit, the water supply of each circuit, the pressure drop, the flow velocity and the regulation of Allen or flowmeter.

Supply Temperature 40°C

Manifold 1.2

Room No.	Room determination	ti Room Temp. [°C]	Flr Rlb Coeff. [m²K/W]	q spec Perfor, [W/m²]	Q Calc. H.pwr [W]	tf-tr Ts-Tr [K]	RA [mm]	Heated Surface [m²]	ts Floor Temp. [°C]	Area circul. pipes [m²]
INTERPLAST – UNDERFLOOR HEATING				**Laid floor, above piping: 45mm**						
101A	Bedroom	20	0,060	85		4	**150**	5,9	28,0	0,2
101B		20	0,060	118	sPz	4	**75**	5,9	30,4	
102A	Bedroom	20	0,060	75		4	**150**	8,5	28,0	0,5
102C		20	0,060	115	sPz	5	**75**	6,8	30,2	
103	Bathroom	22	0,010	93		7	**75**	7,2	33,0	
104A	Bedroom	20	0,060	66		3	**150**	7,7	28,1	0,9
104B		20	0,060	120	sPz	3	**75**	4,0	30,6	

Manifold 1.2 Manifold 1", 7 Circuits heating supply: 1383kg/h

Room	Zone	Number Heating Circuits	Supply Length [m]	Total Length [m]	Supply [kg/h]	Pressure Loss Total [Pa]	Pressure Loss Total [Pa]	V Flow speed [m/s]	Valve Regulation T1	T2	Supply [l/m]
INTERPLAST – UNDERFLOOR HEATING					Piping	17x2mm					
101A	Oz	**1**	3,4	42,9	166	6901	119	0,35	2,25	2,25	2,8
101B	sPz	**1**	4,2	82,9	255	22366	216	0,47	3,25	3,00	3,8
102A	Oz	**1**	8,7	65,3	215	16356	198	0,45	2,50	2,50	3,6
102C	sPz	**1**	13,6	104,3	205	23814	179	0,43	5,00	3,75	3,4
103	Oz	**1**	11,5	107,5	124	10280	66	0,26	2,25	2,25	2,1
104A	Oz	**1**	1,2	52,4	236	15468	238	0,49	2,50	2,50	3,9
104B	sPz	**1**	3,3	56,6	212	13879	193	0,44	2,50	2,50	3,5

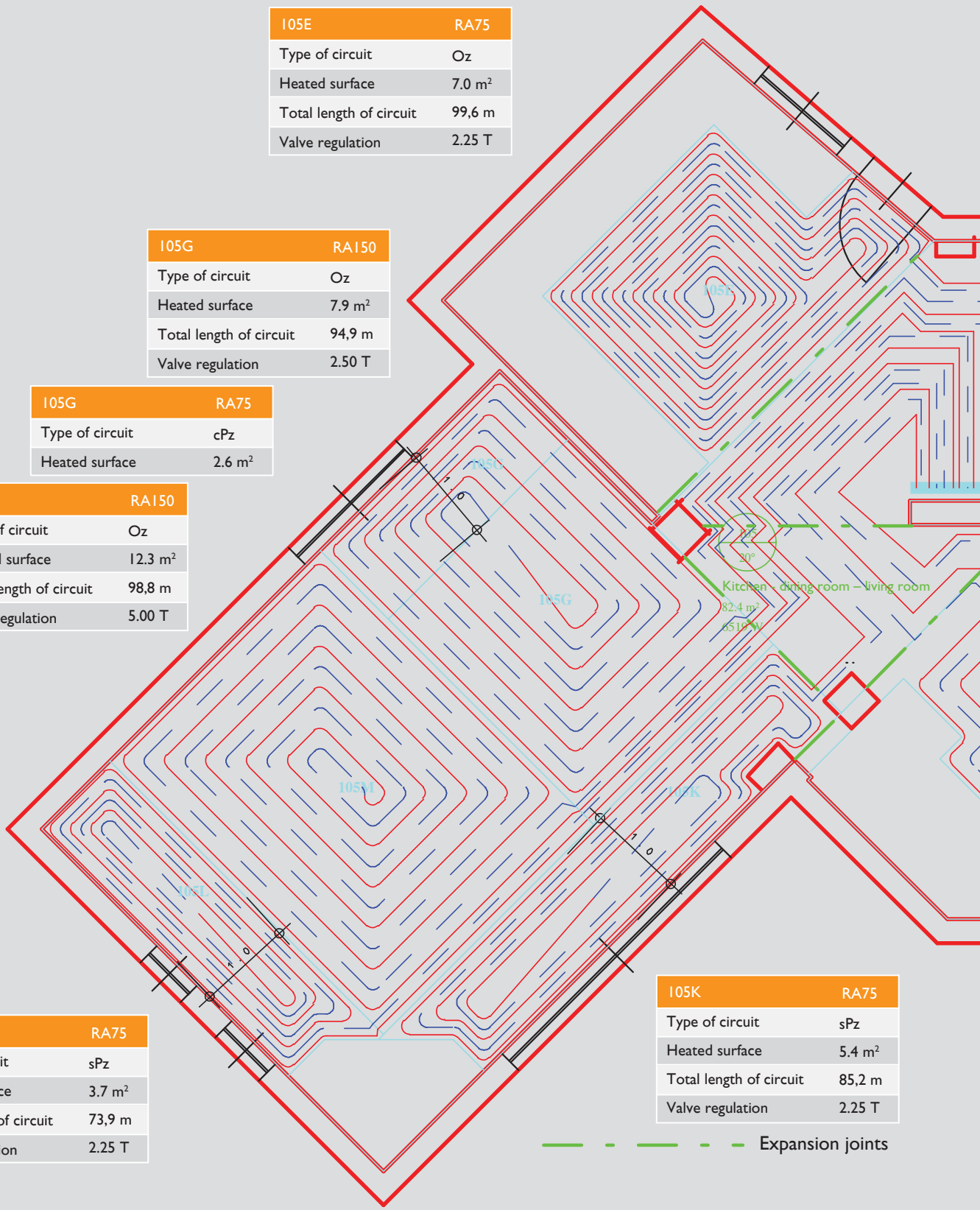
Interplast UNDERFLOOR HEATING STUDY

105E	RA75
Type of circuit	Oz
Heated surface	7.0 m²
Total length of circuit	99,6 m
Valve regulation	2.25 T

105G	RA150
Type of circuit	Oz
Heated surface	7.9 m²
Total length of circuit	94,9 m
Valve regulation	2.50 T

105G	RA75
Type of circuit	cPz
Heated surface	2.6 m²

105M	RA150
Type of circuit	Oz
Heated surface	12.3 m²
Total length of circuit	98,8 m
Valve regulation	5.00 T



105L	RA75
Type of circuit	sPz
Heated surface	3.7 m²
Total length of circuit	73,9 m
Valve regulation	2.25 T

105K	RA75
Type of circuit	sPz
Heated surface	5.4 m²
Total length of circuit	85,2 m
Valve regulation	2.25 T

Expansion joints

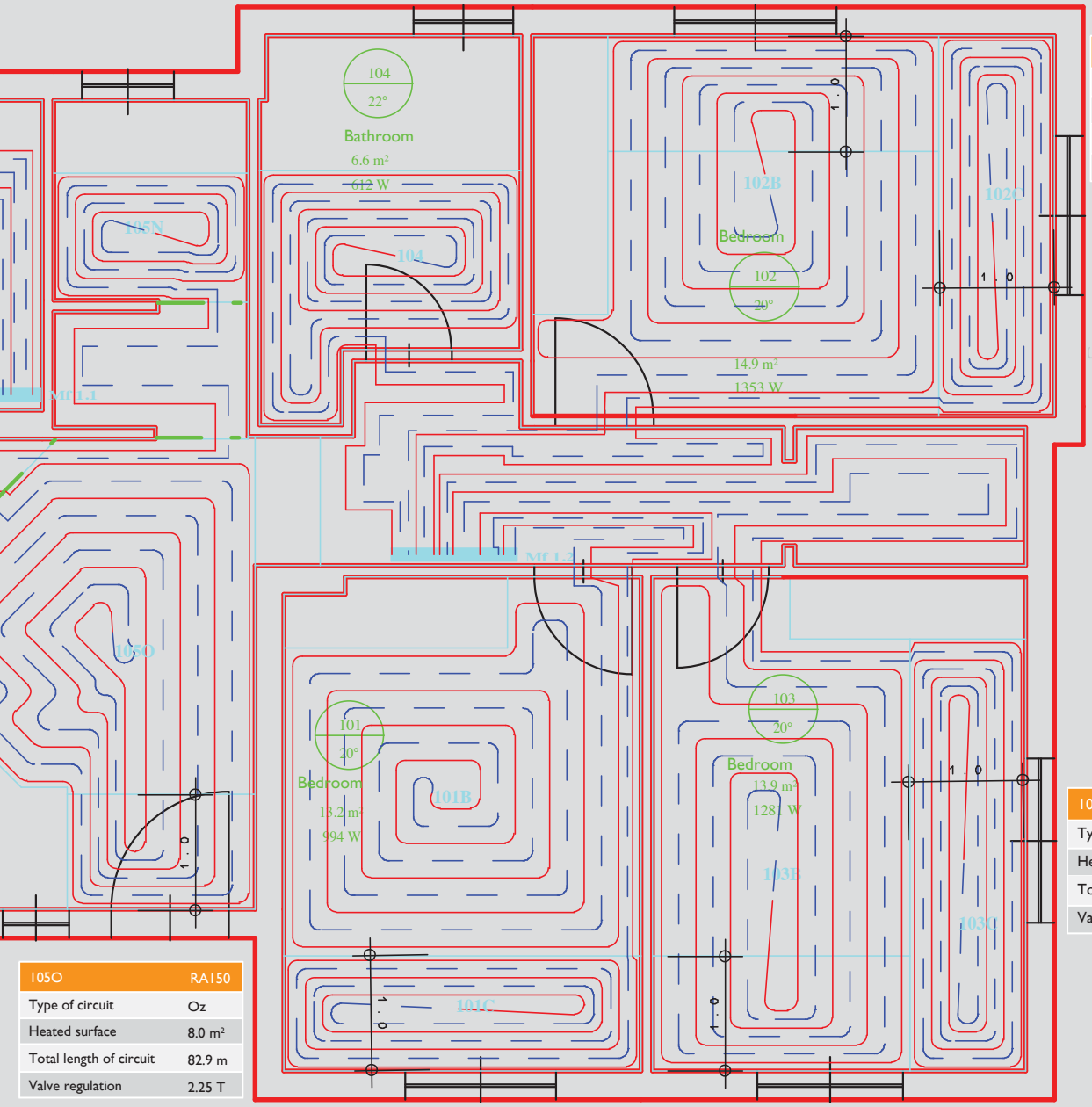
105N	RA75
Type of circuit	Oz
Heated surface	1.9 m²
Total length of circuit	45.1 m
Valve regulation	2.00 T

104	RA75
Type of circuit	Oz
Heated surface	4.0 m²
Total length of circuit	62.5 m
Valve regulation	2.50 T
Remaining heating power	41 W

102B	RA150
Type of circuit	Oz
Heated surface	7.2 m²
Total length of circuit	89.6 m
Valve regulation	5.00 T

102B	RA75
Type of circuit	cPz
Heated surface	2.9 m²

102C	RA75
Type of circuit	sPz
Heated surface	3.3 m²
Total length of circuit	60.5 m
Valve regulation	2.50 T



103C	RA75
Type of circuit	sPz
Heated surface	3.8 m²
Total length of circuit	73.7 m
Valve regulation	2.50 T

105O	RA150
Type of circuit	Oz
Heated surface	8.0 m²
Total length of circuit	82.9 m
Valve regulation	2.25 T

105O	RA75
Type of circuit	cPz
Heated surface	1.6 m²

101B	RA75
Type of circuit	Oz
Heated surface	9.0 m²
Total length of circuit	63.0 m
Valve regulation	2.00 T

101C	RA75
Type of circuit	sPz
Heated surface	3.1 m²
Total length of circuit	54.8 m
Valve regulation	2.00 T

103B	RA150
Type of circuit	Oz
Heated surface	6.8 m²
Total length of circuit	90.1 m
Valve regulation	2.50 T

103B	RA75
Type of circuit	cPz
Heated surface	2.2 m²

ROOM TEMPERATURE (°C)		20				22			
FLOOR RESISTANCE COEFFICIENTS (m^2k/w)		0.02	0.05	0.10	0.15	0.02	0.05	0.10	0.15
SUPPLY TEMPERATURE °C	PIPE DISTANCE (mm)	THERMAL EFFICIENCY OF THE FLOOR (W/m^2) FOR TEMPERATURE DIFFERENCE ΔT = 10 °C							
40	75	98	79	61	49	84	67	52	42
	150	76	64	52	44	65	55	44	38
	225	70	60	49	42	60	52	42	35
	300	61	52	43	37	53	45	37	32
45	75	133	108	83	67	119	96	74	60
	150	102	87	71	59	92	78	63	53
	225	95	82	66	55	85	73	59	50
	300	83	72	58	50	74	64	52	44
50	75	167	137	106	85	154	125	96	78
	150	129	110	89	75	118	102	82	68
	225	120	103	85	70	110	95	77	65
	300	105	90	73	62	96	83	67	58

STEPS FOR THE INSTALLATION OF UNDERFLOOR HEATING

I. BEFORE THE INSTALLATION

Underfloor heating, due top the particularities of its design details, offers the advantages mentioned earlier but nonetheless requires careful planning in its design and its implementation.
It is advisable that the provision for underfloor heating is made in the concreting phase; because then construction works will arise that will facilitate its proper implementation.

-Internal surface coating.
In the areas where underfloor heating is to be installed, the application should already have been completed.

-Fitting of external door frames.
The "fillets" at external doors, balcony doors and stairwells should be calculated for a floor thickness of approx. 10cm rather than 6-7cm for the conventional system.

-Avoid branching in the plumbing and electrical installations.
Branching and crossing of the plumbing pipes and electrical wiring on the surface of the slab should generally be avoided, as this would make installation of the underfloor heating system more difficult.
It is recommended that the said systems be installed on the perimeter and then to place the perimeter wall insulation and the castellated panels.

-Fitting the floor siphon at a point that does not obstruct underfloor heating installation.
Care should be given to the proper elevation of the floor siphon in relation to the level of the final floor surface. It is recommended that the floor siphon be fitted at a spot that would not obstruct laying of flooring, and not in the center of the bathroom, so that more free surface is available for installation of the underfloor heating pipes.
Should thermal losses not be covered by the underfloor system (underfloor heating design), a combined operation with radiators is suggested (towel radiator).

-Cleaning and leveling of slab balancing concrete.
During installation, we should pay particular attention to the condition of the slab. If we have already installed the plumbing and electrical network, before deciding to install an underfloor heating system, and a large number of pipes already transverse the floor, it is recommended to cast balancing concrete of 3 to 4cm in height so that the installer will find the slab clean, leveled and with no projections.

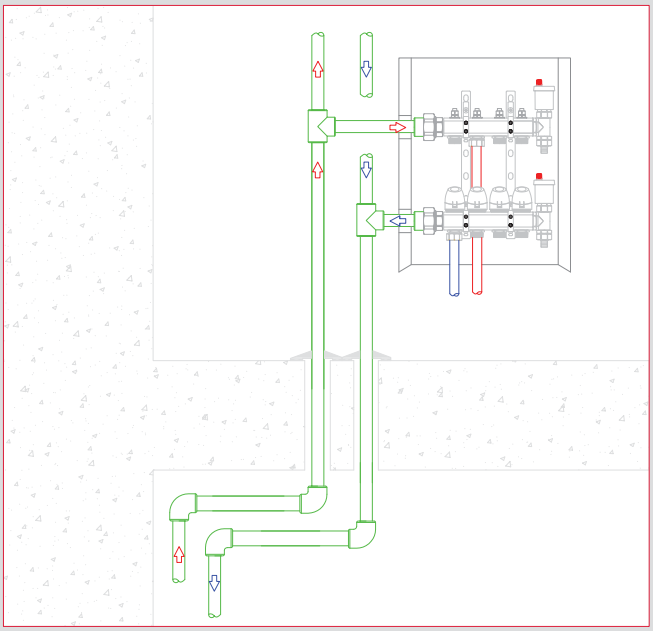
II. INSTALLATION

The use of the **Interplast** integrated underfloor heating package simplifies its implementation and comprises the following sequence of steps:

-Fitting of the distribution panel.

The placement of the distribution panel should take into account the following:

-To avoid, wherever possible, installing branches or long central heating supply pipelines on the slab, as has already been mentioned.



-To avoid installing the panel far from the majority of the heated places (for ex. on the exterior wall of a remote bedroom). In this case, we will have a long supply pipeline, and as a result, the temperature of the heating water will be substantially lower than required by the time it reaches the room to be heated.

-Not to install the panel in spaces of small surfaces, because it will be covered by the insulated supplies and returns of other circuits. This results into that the small surfaces will be unable to counter-balance the thermal losses of the area.

-To avoid placing the panel inside the kitchen cabinets, because regardless if the supplies get insulated, we create a warm environment with high humidity.

-Lastly, not to choose in areas with the lowest elevation level for the installation of the panel.

-Laying of polyethylene sheet.

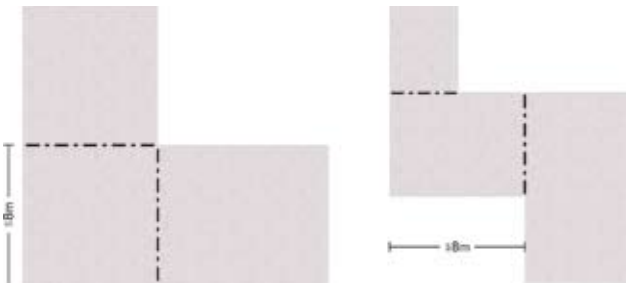
When the installation is to be made on a slab, under which there is a pilotis or ground, it would be wise before placing the motherboard to place a sheet of polyethylene, which should overlap the joints by 8cm and rise to the level of the perimetric insulation. The application of the film protects the installation against condensation that can occur on the upper surface of the slab due to the high temperature variations caused by air draughts.

-Perimeteric insulation tape – Perimetric fixing joints

The perimetric tape is placed vertically and perimetrically to the floor, in all heated areas, as well as on the casings of the external and internal doors and the internal columns, determining the perimetric joints of the installation. The perimetric tape should offer the capability of the floating floor to move at least by 5mm.

The PE film is then unfolded, which is adapted to the perimetric tape on the panels, securing the water-tightness between the floor and the cement grout.

-Internal joint fittings.
According to DIN 18560, which determines the joints to the heated floors, apart from the perimetric joints determined by the fitting of the perimetric tape, floors should be divided by internal joints when:
-The surfaces are bigger than 40m².
-The length of the heated area is larger than 8m.



-The length to width ratio of a heated surface exceeds 1:2.
-We have building joints.
-We have internal frames.
-We place different final floor finish materials in the same area (for ex. wood-marble).
-There exist height differences on the same level, doorsteps.

The longitudinal expansion of a heated floor, which depends on the thickness of the cement grout, can be calculated using the below equation:

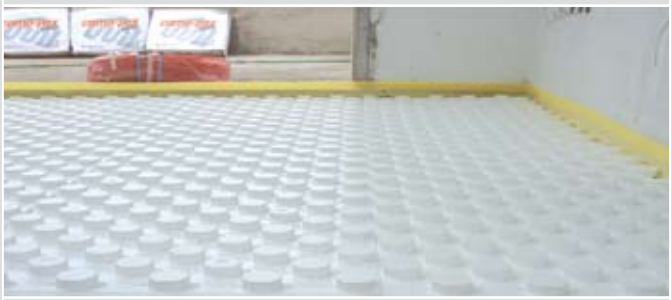
$$\Delta l = l_o \times a \times \Delta t$$

Where:
Δl = longitudinal expansion in m
l_o = area length in m
a = coefficient of thermal linear expansion in 1/K
Δt = temperature difference

- Enforcement of the expansion joints at the staircase landings.
Attention should be given at the landing of every internal stair and elevated space.

In order to preserve these joints, we should make a long mounting construction at these points for the attachment of the perimetric tape.

- Motherboard fitting.
Next step is the laying of the motherboard on the floor surface in such a way that there will be no voids which would allow the penetration of the fluid to the thermal concrete. Apart from its insulating and sound-insulating role the motherboard functions as a holder of the pipes of the underfloor heating.



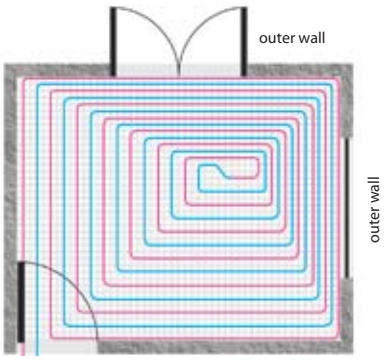
- Pipe fitting.
The pipe is installed in a helix-like pattern (snail) to allow the uniform temperature distribution on the surface of the floor and, consequently, in the area.
At the same time, helix-like installation reduces the possibility of damaging (bending) the pipe during installation. Special attention should be given to the points where the pipe bends, so that the curvature radius does not exceed 8 times the diameter of the pipe.

It is desirable that the application of the pipe starts by leaving a distance of 5cm from the wall, while the total length of the circuit should not exceed 110m.

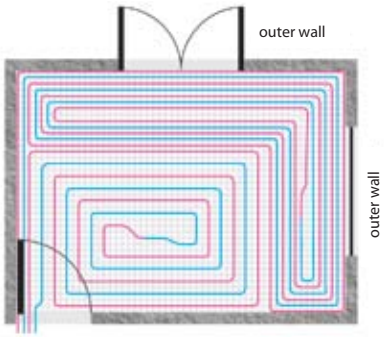
The distances between the pipes which are determined by the study, have been calculated so as to cover the thermal losses of the surfaces, without exceeding the limitations set by the DIN 1264 regulation for the floor surface temperatures: 29°C in residential areas, 33°C in bathrooms and 35°C in perimetric zones:

-In the case of heating areas with large surfaces and sufficient insulations, with a small number of openings, most of the circuits have a constant distance between the piping all along the circuit and a sparser array.

-In areas with smaller surfaces, but with a large number of openings or external walls, in order to cover the vast amount of thermal losses we apply circuits that are denser to the external walls and sparser to the partitions. The dense incorporated zone of these circuits does not exceed 1m in width and presents a surface temperature of 30°C - 32°C.



-In areas with large amounts of thermal losses we choose dense perimteric zones of 1m in width which can present a floor surface temperature of up to 35°C and can as such, cover most of the thermal losses, while the rest of the surface can be covered by a second, sparser circuit.



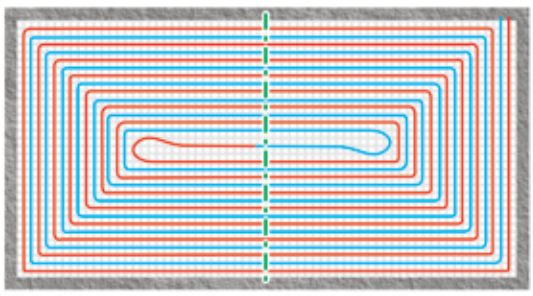
- Pipe quantity per square meter of motherboard.

The below table shows the quantity of pipe required for the circuit installation based on the distance defined by the study of each circuit. We should take into account that the theoretical calculation differs from the actual application. The differences are due to the curves of the pipe, mainly in the centre of the circuit, where the theoretical calculation considers the straight pipe array.

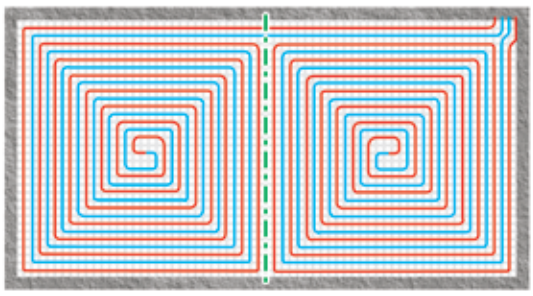
Mounting space	Quantitative pipe needs/square meter of heated surface	
	Theoretically	Practically
cm	m/m^2	m/m^2
7,5	13	11
15	6,6	5,8
22,5	4,4	3,9
30	3,3	3,0

- Pipe protection with corrugated pipe within the internal joints.

It should be noted that the arrangement of the circuits always depends on the construction of the internal joints, so that the joints do not ever pass through the circuit. The supplies and returns of the circuits are allowed to pass through the joints as long as they are coated with a protective corrugated pipe of at least 40cm in length so as to be protected against stresses, caused by the contractions and expansions of the heated circuit.



wrong



correct

- Insulation of lengthy supplies.
Particular attention should be given during the installation of the circuits, of the insulation of the supply piping in its network from the manifold to the circuit, so as to avoid big losses, but also to protect the floor from developing high temperatures, especially near the distribution panel.

III. NETWORK TESTING

After the completion of the installation, the network is tested under pressure, according to the following procedure:

-We fill the network (each circuit separately) until the air has been released.

-We then apply testing pressure which is triple the operating pressure (for ex. operating pressure 3bar, testing pressure 9bar).

-We maintain this pressure for 30minutes and inspect the connections for any possible leakages.

-We then relieve the pressure by doubling the operating pressure (6bar), leaving the system under pressure and inspecting it for 90minutes for any possible leakages.

-The testing should commence at least 24hours before the casting and the network should remain under pressure during the entire casting.

IV. CASTING OF THE THERMAL CONCRETE

The thermal concrete is a mass of material that overlaps the laid out piping of **Interplast's** underfloor heating and constitutes the heating body that achieves the heating or the cooling of the area, while simultaneously providing a sub-layer on which any decorative floor paving can be placed (e.g. tile, marble, parquet, etc.).

For these reasons, the preparation and casting must follow certain regulations which are very important for the proper functioning and performance of the system. By no means does the thermal concrete constitute a simple plasticizer.

Points of attention
A) The installations of the electric and plumbing networks according to the instructions required for the application of an underfloor heating-cooling system,
B) The application of the underfloor heating-cooling by itself following the application study that is handed over together with the relevant products by **Interplast,**

Then the following should be noted:

1. The compliance of the expansion joints according to the application study.

2. The marking of fixed points (such as fireplace, inserted wardrobes, bathtubs, etc.) as well as the leveling with suitable instruments (levels, lasers, etc.) with defined benchmarks.

3. The manufacturing of the thermal concrete, which must strictly follow the following composition per m^3:
- 70% river sand, washed, grains size 0,4-0,8mm,
- 300-350kg cement
- 250kg water
- 2-2,5kg super-plasticizer
- 900gr polypropylene fibers

4. The thermal concrete must be protected for at least 3 calendar days from conditions of solar radiation, heat, cold and cold air currents in order to avoid undesired phenomena of quick drying.

5. The spraying with water is not allowed when leveling, nor is sprinkling with cement or coating an additional thin coating (minimum thickness of thermal concrete over the pipe 4cm).

6. The drying of the thermal concrete follows the instructions described in paragraph V and lasts for at least 21days (normal) and another 7days (technical).

7. During floor laying, the instructions of paragraph VI are to be followed.

Suggested flooring materials

Ceramic tile.
Marble.
Wood.
Colored cement.
Self padded.
Carpet.
Synthetic wood with a suitable sub-layer (for underfloor heating).

Technical characteristics (DIN 18560)

Compression strength N/mm²: at least 25
Tensile strength N/mm²: at least 4
Compression strength in 4cm thickness: 19 Mpa
Bending strength in 4cm thickness: 5,2 Mpa
Density per m³: 2050 kgr/m³.

Preparation method

Supplying the mixing machine:

1. Initially a small amount of washed river sand with 0,4-0,8mm grains: approximately 1/5 the capacity of the mixing machine's drum.

2. Cement: the total capacity that corresponds to the specific capacity of the mixing machine's drum.

3. Then, water approximately 3/5 of the total quantity of water that corresponds to the specific capacity of the mixing machine's drum.

4. Super-plasticizers mixed with polypropylene fibers (for ex. 0,5lt plasticizer and 300gr fibers).

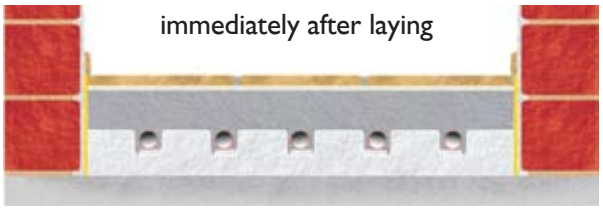
5. Finally, the remaining amount of sand (4/5) and water (2/5) according to the capacity of the mixing units drum.

The mixture is transported under pressure with the help of a suitable device (press) via elastic hoses into the under casting floors and is leveled each time in small areas by hand. The end result should be a perfectly flat, hard and lean surface.

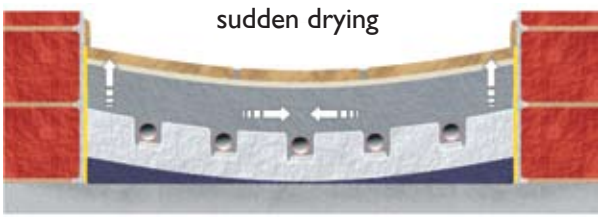
V. DRYING OF THE CEMENT GROUT

Before the placement of any final coating, it is advisable to follow the artificial drying process. The purpose of this process is to reduce the relative humidity in the thermal concrete.
This procedure can be done only after 21 days have elapsed from the placement of the thermal concrete.

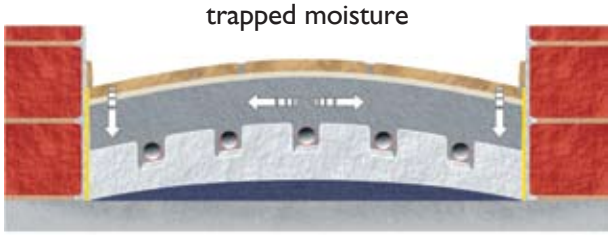
The installation should be operational for at least 7 days. For the first 3 days, the supply temperature will be 25°C. For the next four days, the supply temperature will be gradually adjusted to the maximum value, as specified by the design (in no case higher than 50°C).



During the natural drying of the thermal concrete, measures should be taken so as to avoid the early loss of the mixing water. The more sudden the drying of the concrete is, the greater its shrinkage and consequently, the more sensitive it gets to cracking and to perimetric strain. This is the reason why we do not apply artificial dehydration immediately.



After having reached the maximum temperature (50°C), we gradually decrease the temperature by 10°C every day, until the operation of the installation stops.

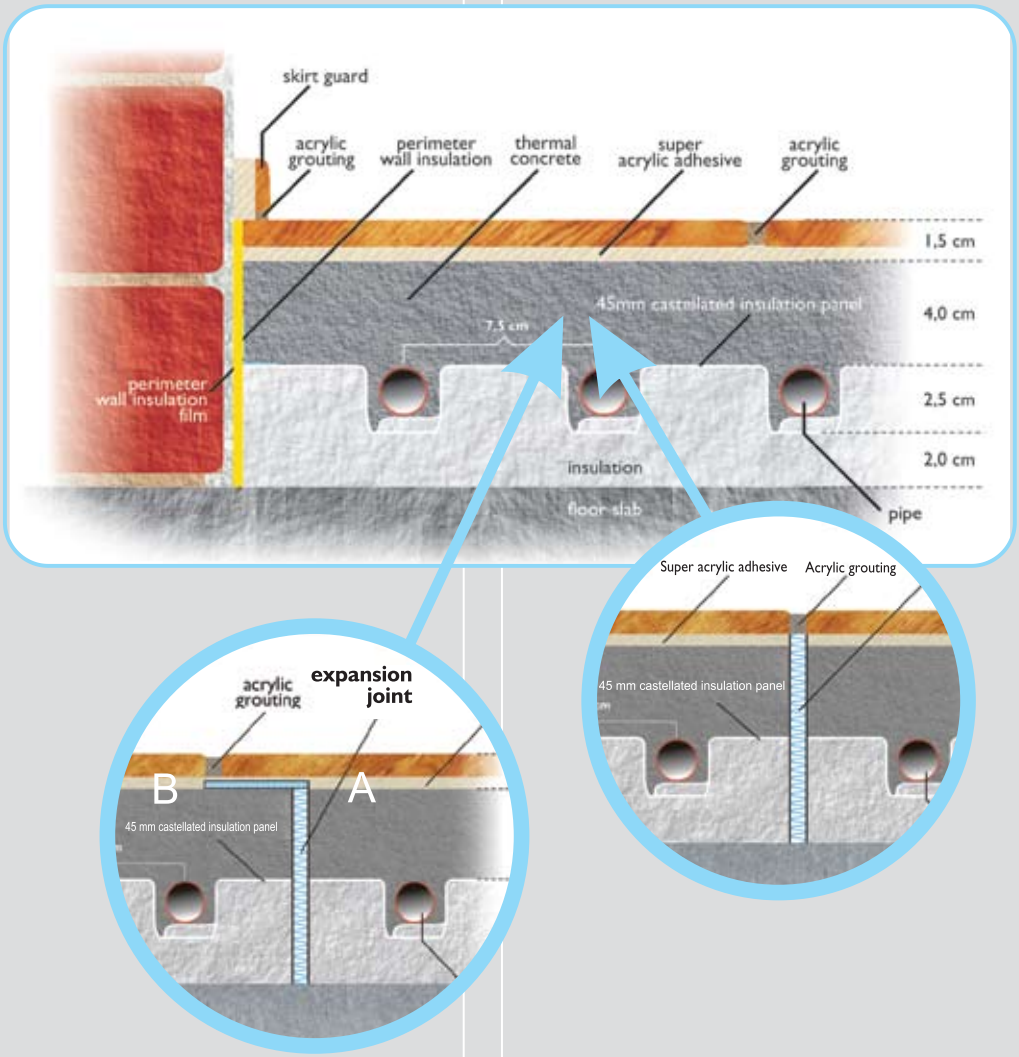


After the above process has been completed, we can then proceed with the application of the final floor finish.

VI. FLOOR FINISH

Prior to the final floor finish, we should keep in mind that the underlay we get is not a common cement grout, but a floating heated cement grout with special features.
In the underfloor heating systems, we have greater stress to the floor mortars and coatings than in common floors. For this reason, we should use adhesives of high elasticity and, generally, appropriate quality materials guaranteed by the supplier, and should furthermore follow the application instructions.
With the exception of the points for which there is a provision, no other intervention is allowed without approval (building a stable structure on the thermal concrete, piercing or cutting the thermal concrete).
We should proceed to the application of the final floor finish right after the completion of the artificial drying process, so as not to have to repeat the process under normal temperature and at relative humidity conditions.
We should keep both the perimetric and the internal expansion joints during the application of the final floor finish.
The perimetric joint should not be removed or cut only until after the complete installation of the tiles or parquet, when the wallboard is applied on the wall and in contact with the floor.
The internal joints of the thermal concrete should not be removed until the final coating, when they are replaced by permanent functional joints made of appropriate elastic materials.
For reasons of aesthetic appeal, and if the joint does not coincide with that of the final coating, the final expansion joint can be moved to a joining point of the final coating.
In order to move the joint, the following procedure should be followed:

-The expansion joint of the thermal concrete should be cleaned and then coated with silicone material.
-Then, the one side of the tile (side A) is coated with glue.
-The other side of the tile (side B) is covered with a PE sheet up to the final joint of the coating, where the joint will be transferred.
-The sealing of the joints is made with an appropriate silicone material. The common stucco is an inflexible material and is not recommended for the sealing of elastic joints.



FLOATING MARBLE FITTING

For the floating marble fitting it is necessary to use white mud suitable for marbles in order to obtain the:

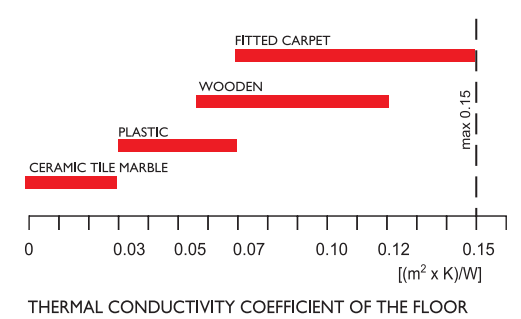
-Protection of marble against stains, cracking and scaling due to the absorption of substances and humidity by the underlay,

-Proper fixing and resistance against temperature fluctuations.

Using appropriate emulsions and avoiding the use of lime (hydrophilic).

Concerning the perimertric and the internal joints, the aforementioned instructions should be followed.

Finally, it should be avoided to use conventional silicone for the filling of the elastic joints. Marble can absorb substances, can be oxidized and can change its color. Also, for proper adhesion, it is necessary to use an appropriate primer to the sides of the joint.



THERMAL CONDUCTIVITY COEFFICIENT OF THE FLOOR

WOODEN FLOOR FITTING WITH GLUE

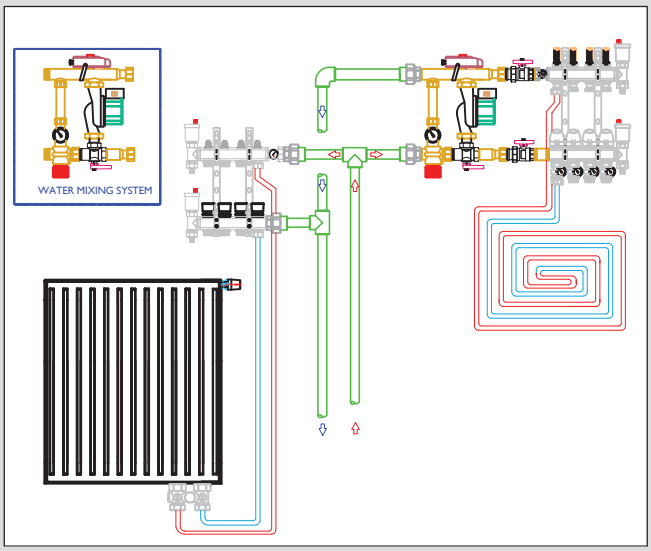
Before fitting the floor components, it is necessary to watertight the surface with a special hardening sealing agent. For the fitting of the wooden components, it is required to use an elastic glue suitable for heated floors, guaranteed by the supplier. The glue should be of high elasticity so as to be able to adapt to the coating variations, without getting deteriorated by ageing.
Concerning the perimetric and the internal joints, the aforementioned are valid and should be followed, while for the sealing of the joints, special products can be purchased from wooden floor providers (for ex. cork, strings).
Following the drying process (natural and definitely artificial for wooden floor) and after the fitting of the wooden floor, the system is gradually being put back into operation. After 4 days of continuous operation, the heating is switched off and proceeds to the processing of the surface (grinding, filling, polishing).

AUTONOMIES OF AREAS

Mixing unit

The mixing unit is a simple and reliable solution in mixed heating systems (underfloor and radiators), and in cases of buildings, it reduces the installation costs, since no special provisions and branches are required in the boiler room, and allows the autonomy of each apartment/room. It is placed in the distribution panel and regulates the temperature of the water supply in the underfloor heating system.

The mixing unit consists of:
-A mixing valve.
-A WILO RS25/6-3 circulator, which has the capability of supporting up to 12 circuits.
-A contact hydrostat, which interrupts the operation of the circulator in case the water temperature exceeds the maximum desirable set temperature.
-A supply-connecting plug with a space thermostat which controls the circulator.

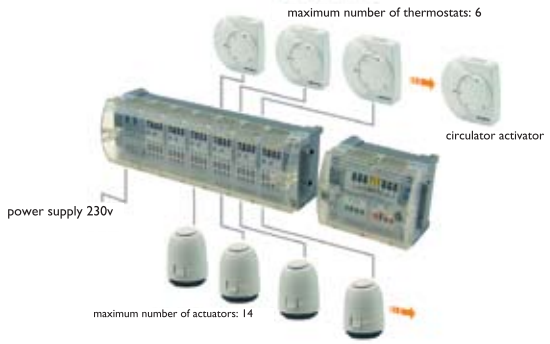


Analog autonomous system

The installation of the underfloor heating can be combined with a system that gives autonomy in each space, allowing the separate control of the temperature in each room. In this way, we achieve the desired thermal comfort in each space and increase the system performance by reducing the underfloor heating consumption. The system autonomy in each space can consist of wired or wireless thermostats depending on the capabilities provided by the electrical installation. The wired or wireless system autonomy of each area consists of:
- Wired thermostat 230V or 24V.
- Communication base, located at the distribution panel and on which the thermostats and the actuators (230V or 24V respectively) are mounted.
- The activator of the circulator, which is “hooked” on the communication base and starts or shuts off the operation of the circulator, depending on the demand of the thermostats.

- The actuators 230V or 24V respectively, which open and close the circuits.

The thermostats operate as transmitters and the communication base as receiver, giving commands to the actuators of the manifold to open and to close the circuits according to the desirable room temperature.
The wireless system is an intelligent and flexible solution to the cases where no wiring has been planned and desire at a later stage to install separate thermostats to control the temperature in each room, without having to install communication wires.



Features
- Thermostat with ON/OFF operation
- Signal distance (for wired thermostats) in indoor spaces: 25m.
- Temperature range from 10°C to 28°C.
- Maximum number of thermostats per base is 6.
- Possibility to control several circuits from one thermostat.
- Maximum supply power: 50W.
- Supplied with an installation manual.

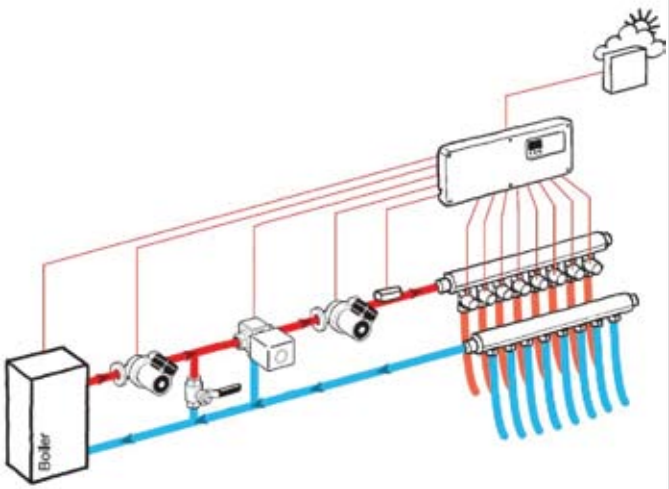
The wired or wireless analog autonomous system can also be placed and installed in an underfloor cooling application. In this case we use heating-cooling thermostats and in the communication base we mount a heating-cooling actuator which exchanges the operation of the thermostat according to the season (winter / heating, summer / cooling).

Digital autonomous system

The digital system is an autonomous control system designed for under floor heating and cooling installations, which cannot only be applied in houses/domiciles, but also in commercial applications.
The advanced software optimizes the operation of the installation, offering maximum thermal comfort with less fuel consumption. Its installation is simple and rapid with simple connections and accessible provisions.
The "brain" of the autonomous system is the digital communication base which enables the connection of up to eight room thermostats. It provides a digital display for all the functions (temperature in each area, temperature of the environment, water supply temperature), can control up to two circulators and one heat source (boiler, heat pump) while controlling and regulating the temperature of the water supply by deactivating an analogical mixing valve motor. Furthermore, it also incorporates a compensation system using an environment sensor.
The digital autonomous area system can be used in commercial applications and **has the option of creating or working with BMS systems, where all communication bases are linked and can control up to 1890 areas.**

A digital communication platform can be connected to the wired thermostats, the wireless thermostats, or simultaneously with both.
The system is supplemented by the cooling kit when we have heating and cooling. It comprises a humidity area sensor, which calculates the dewpoint of the interior space and increases the supply temperature to the underfloor heating or shuts down the circuits so as to prevent occurrence of condensation on the floor.
It also includes a switch for winter - summer operation.

A full connectivity schema of the control capabilities of a digital autonomous system are illustrated in the figure below.

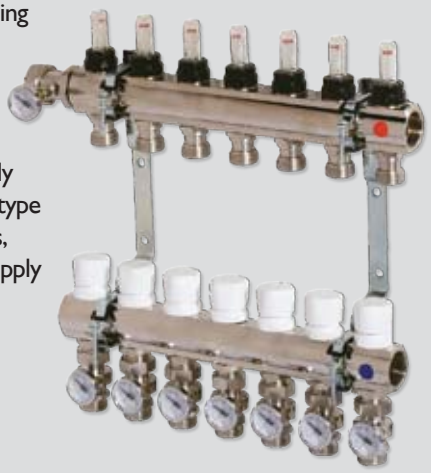


All the aforementioned systems aim to achieve the desired room temperatures, depending on their use (for ex. bedroom, living room etc.), thus achieving comfortable conditions and saving more energy through the proper management, resulting in that the heating-cooling systems consume the required energy without having to operate wastefully.

The estimate of additional savings from the use of such systems, combined with their compensation, can reach up to 20%, further increasing the benefit of the consumer in choosing an underfloor heating system.

SYSTEM REGULATION

The regulation of the system is achieved through the manifold. The manifold is the "heart" of the installation. **Interplast**, through its subsidiary ELVIOM, which has more than 50 years experience in the manufacturing of brass fittings, produces manifolds for underfloor heating, which ensure the necessary flow for the circuits and the perfect balance of the system. The manifolds are brass nickel-plated, nominal diameter 1" or 1¼" with 3/4" threading (Eurocone) and without connections, as is required by any safe installation. The supply manifold bears Allen type valves or flow meters, which regulate the supply of each circuit based on the system's design, while the return manifold has valves for the installation of thermoelectric actuators, which by the command of the thermostats, allow the autonomous operation of each circuit.



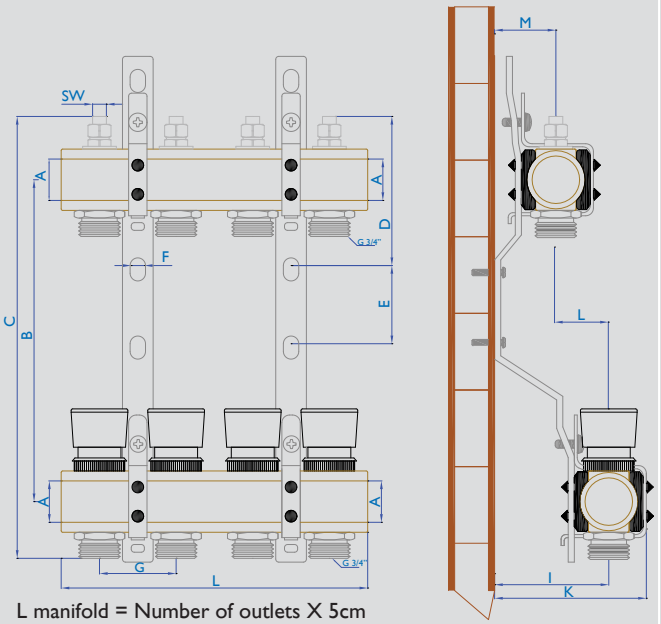
For the heating systems perfect balance, special supply and return nipples are used, on which thermostats are fitted.

System Regulation

Based always on the study, we regulate either by the Allen or the flow meters the water supply into each circuit. Our aim is to achieve a common return temperature in all circuits and a ΔT close to 5°C. The possibility of this regulation is given by the thermometers fitted in the relevant return and supply manifold circuit nipples.

Manifold with hexagon socket (Allen) & actuator Valve

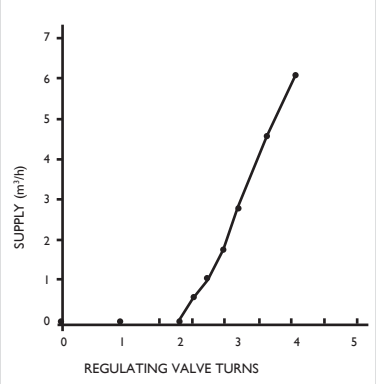
The underfloor heating manifolds with Allen are delivered from the factory tested to failure and leaks. The mechanisms are closed (sealed supply) and should remain as such until we provide water to the system. Once we open the water supply, it is good to firstly rinse the network and then to open the Allen for the regulation. The actuators must be opened till the end.
The setting of the supplies is manually achieved by a 5mm Allen hexagon tool, advising first the requirements of the study for the supply and then the supply board.

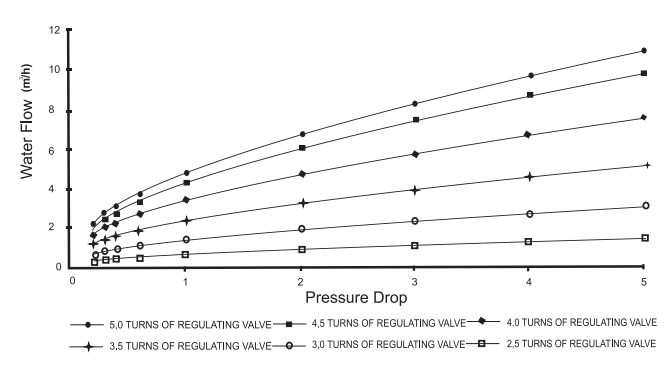


L manifold = Number of outlets X 5cm

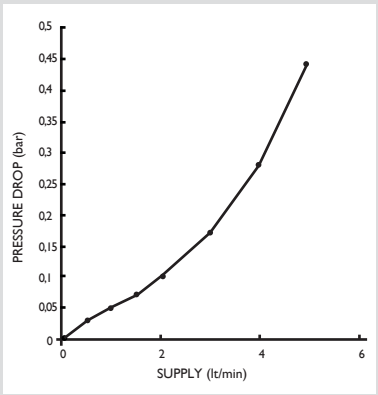
DIMENSIONS	A	B	C	D	E	F	G	I	K	L	M	SW
1"	1"	210	285	100	75	8,5	50	70	95	35	35	5
11/4"	11/4"	205	292	95	75	8,5	50	75	105	35	45	5

REGULATING VALVE TURNS	SUPPLY (m³/h)
4,00	6,10
3,50	4,62
3,00	2,80
2,75	1,82
2,50	1,09
2,25	0,61
2,00	0,0
1,00	0,0
1,00	0,0
0,00	0,0





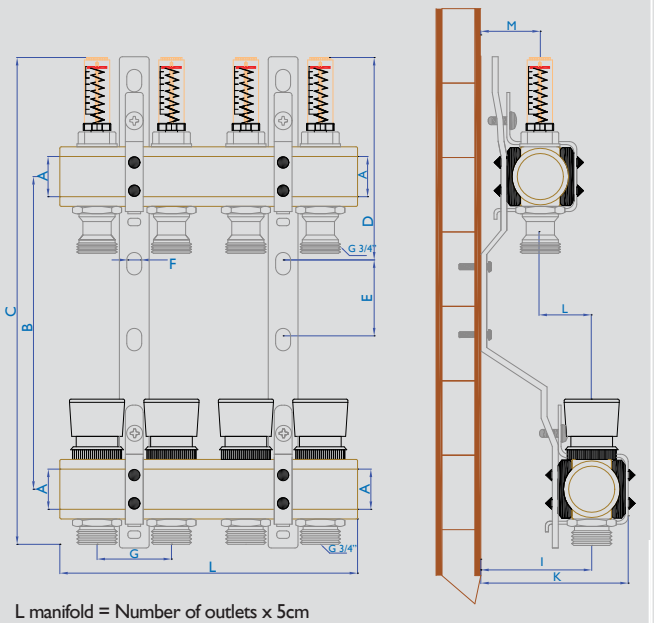
DIMENSIONS	A	B	C	D	E	F	G	I	K	L	M
1"	1"	210	337	155	75	8,5	50	70	95	35	35
11/4"	11/4"	205	347	160	75	8,5	50	75	105	35	45



Manifold with flow meters – actuator Valves

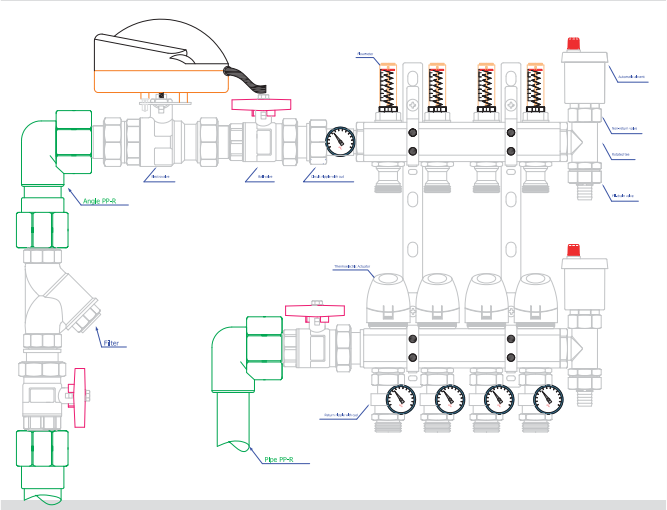
The underfloor heating manifolds with flow meters are delivered from the factory tested to failure and leaks. The flow meters are closed (no indication of supply and operate also as switches) and should be kept as such until we provide water to the system. Once we open the water supply, it is good to firstly rinse the network and then to open the flow meters for the regulation. The actuators must be open till the end.

The setting of the supplies is manually achieved from the black nut at the base of the flow meter, after removing its protective black cover. After advising the requirements of the study, we either screw or unscrew slowly the nut until the desired setting. The indication of the flow meters is in lt/min.



L manifold = Number of outlets x 5cm

Interplast's suggestion for the connection of manifolds for underfloor heating



MACHINE ROOM

The boiler or the heat pump to be used for the installation in the machine room of the underfloor heating system is determined from the installation design on the basis of thermal loss calculations in conjunction with domestic hot water needs.
In the case that a boiler is used (for heat pumps you will find detailed information in later chapters), a four-way mixing valve is placed on the supply water line from the boiler to the underfloor heating manifold. The four-way valve is adjusted to give us an initial temperature drop of the supply water (60°C), which is checked by placing a thermometer directly after the valve.
A three-way valve is then put in place, giving us the final desired temperature of water supply to the installation circuits (35°C-48°C). The three-way valve can be controlled either manually or by use of compensation, which contributes to the most optimal and economical operation of the installation.
The control and the stabilization of the water supply temperatures can be achieved by placing on the three-way valve a motor with temperature presets.
A contact hydrostat (thermostat) is also placed which stops the operation of the circulator when the temperatures exceed the set limits.

Pump station kit

The machine rooms pump station unit is a simple and reliable solution which incorporates, in one single place, the underfloor heating circulator and the three-way mixing valve, thereby saving valuable space in the boiler room and reducing the installation costs. The pump station is available in 1" and 1 ¼".

It consists of:
- The mixing valve (manual or electro-driven)
- WILO or Grundfos circulator.
- Water supply and return thermometers.
- Plug for power supply and connection to the room thermostat that controls the circulator.

Compensation

Interplast's main suggestion for underfloor heating installations when combined with a boiler, is to exploit a four-way and a three-way valve mounted in series. This connection allows us to use a system of compensation in the form of an electric motor mounted on the three-way mixing valve and a digital controller. Its operation is simple and automated, giving the possibility to alter the water supply temperature in the underfloor heating according to the temperature of the environment.

The compensation system consists of:
Environment temperature sensor.
Boiler temperature sensor (immersed in seal).
Supply temperature sensor (immersed in seal or by contact).
Hot water tank temperature sensor (immersed in seal).
Optional:
Room temperature sensor (usually a room thermostat is chosen).
Second temperature sensor in the hot water tank.

The compensation panel gives commands to:
The burner.
The heating circulator (if there exists a room sensor).
The circulator producing hot water for domestic use.
The recirculation circulator producing hot water for domestic use.
The motor of the mixing valve.

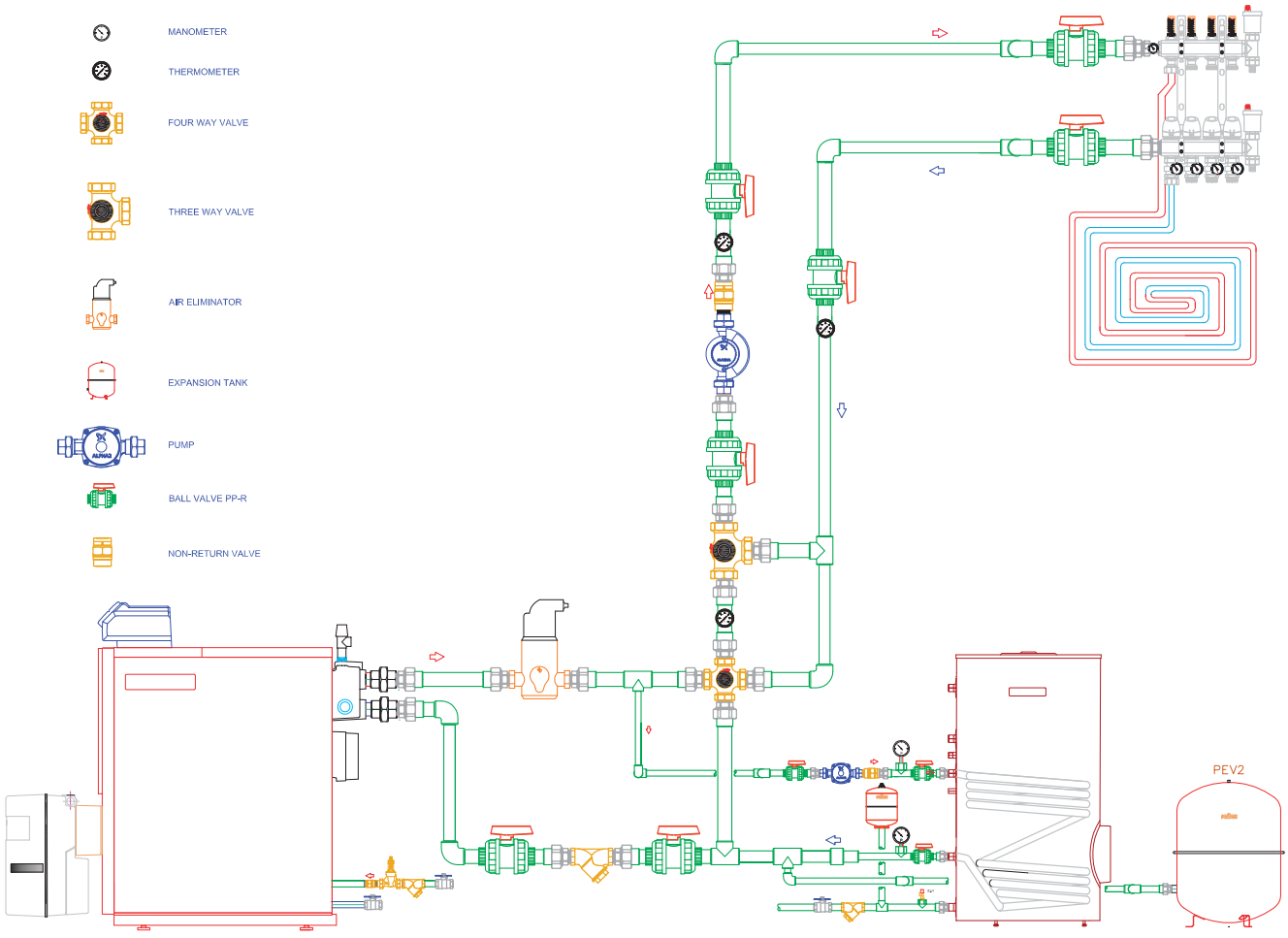
The basic settings of the system have to do:
- With the heating curve on which the supply temperature is regulated based on the outdoor temperature.
- With the setting of the desired temperature of domestic hot water within the hot water tank.
- With the minimum operation temperature of the boiler for most economical operation.

Machine room automations

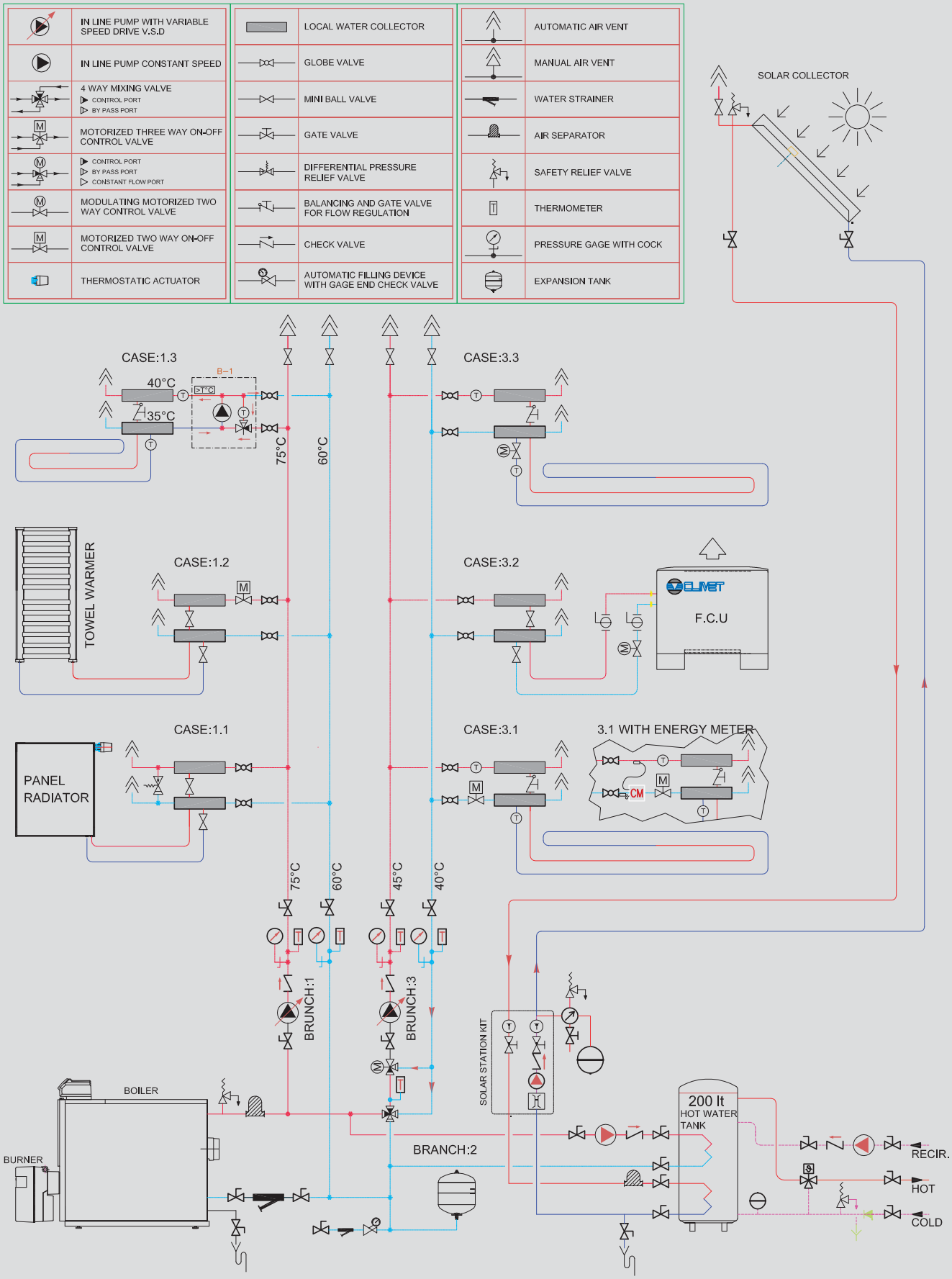
Modern requirements of a machine room using different energy sources (combi) to heat, cool and provide hot waters in a house, make it imperative for a common and simple way of controlling an installation. These modern systems may consist of a boiler, an air/water heat pump or an air/water chiller, or a water/water heat pump and a solar system for heating assistance.
The idea of using a single host controller-transmitter of the entire installation is that all different energy sources and all the components that make up a modern boiler room be controlled from one single point. The benefits that arise are, amongst others, the quick and easy management of multiple and diverse amongst the components or the subsystems, the increasing performance of the system, the reduced consumption and the trouble-free operation of the entire installation.

More specifically, the possibilities of a central boiler room controller are to:

-Control the flow of the heating-cooling installation.
-Control the flow of the geothermal exchanger if it is a water/water heat pump (geothermal).
-Control the voltage characteristics, the electrical current and the load.
-Check the heating and hot water installation circulator.
-Control and manage the energy sources in accordance with the required planning and the consumer needs (for ex. domestic hot water).
-Control and manage the solar energy only for domestic hot water when required (for ex. during summer).
-Cooperate with a compensation system that manages the required water temperatures in relation to the ambient temperature so as to achieve the perfect balance of power.



Machine room with a Geothermal Heat Pump



TYPICAL HYDRAULIC DIAGRAM FOR BOILER ROOM
INTERPLAST PROPOSAL

ARRANGEMENT OF THE BOILER ROOM

The diagram concerns new and existing heating systems and presents the typical hydraulic arrangement of a boiler room and six mixed indoor installations that can be applied both to central and to individual heating.
The proposal complies with all the Greek and European standards and heating system regulations and the rules of the arts and sciences.
Initially, in the supply line of the boiler, a safety valve and a mechanical de-aerator are placed at the point with the highest temperature near the boiler. Then, we place the 70-75°C high temperature receptors for the radiator lines (line 1) and the hot water tank (line 2). A four-way mixing valve and a thermometer are placed immediately after for the first controlling and regulating phase of the water supply temperature of 60°C to the underfloor heating line. The presence of a four-way valve has two functions. It acts as a safeguard for the temperature of the underfloor system lines and allows the temperature setting of the boiler at 70-85°C levels, averting, due to undercharging, the chimney's condensations, the creation of oxides and consequently its erosion. Then, we place a three-way mixing valve, which will regulate the second stage of the supply temperature of the floor at 35-48°C. The main supply line (line 3) of low-temperature is equipped with a variable speed circulator, the relevant switches, the check controls and a return valve. The position of the return valve is important to be placed after the circulator, because this ensures a smooth startup and a speedy recovery to support the weight of the supply line, as well as the reverse rotation of the rotor with a simultaneous start, and lastly, does so for the same scope as being placed at any other point.
Line 3 is connected to 3.1, case that corresponds to the underfloor heating system with a central control for all underfloor heating circuits by using motorized On-Off two-way valve (controlling per floor/level). The two-way valve is placed in the return because at this place it receives less mechanical and thermal stress. Smaller values result from the pressure and temperature drops provoked by the underfloor heating circuits. Result of this is its longest operation.
In line 3 we can also have the connection of case 3.2 for the use of local fan cooling units. The units have a built-in two-way motorized valve for a progressive operation control of each unit. The valve is placed in the return for the same reasons as in the case of 3.1
Similarly, line 3 can also be connected to case 3.3, concerning underfloor heating by controlling every underfloor circuit using a motorized progressive mode valve (controlling per floor/level and per circuit).
The hydraulic balance of the autonomies of line 3 is maintained by the variable speed circulator ensuring adequate fluid velocity, proper heat transfer, preventing hydraulic shock and noise, and maintaining the ΔT between 5-7°C according to the standards of DIN 1264.

Line 1 is connected to the 1.1 case, using radiators with built-in actuators in each unit (control per circuit). A differential pressure valve is installed in manifold 1.1 for cases with a constant speed circulator. When the actuator of the radiator shuts down, the differential opens accordingly, bypassing the amount of water that went to the unit, and maintaining the hydraulic and energy balance. When we have a variable speed circulator, the bypass in the manifold is unnecessary.
In the same line is also connected case 1.2, which concerns towel warmer radiators with central controlling over all circuits by using a motorized two-way On-Off valve (controlling per floor/level). Clearly, case 1.1 can also be applied here.
In high-temperature line 1 can also be connected case 1.3, underfloor heating with a prefabricated relegation and control temperature and flow kit. The kit includes a three-way manual mixing valve, a circulator that can support up to 12 circuits of 100m in length and an electric controller via a thermostat (controlling per floor/level). The main high temperature supply line (line 1) is equipped with a variable speed circulator, relevant electrical switches, check controls and a return valve.
Line 2 refers to the heating of the domestic hot water tank. The line can connect more than one heating tanks depending on the design of the system. Basic components include a constant speed circulator, relevant switches and a non-return valve. In each heating tank we can (optionally) install prefabricated solar power kits and solar panels. For greater safety of the installation of a solar system, we add a de-aerator to the tank and a second security valve in the hottest point of the solar panel.
Finally, in the installation we put an automatic filling plant with an integrated check valve, a pressure gauge, an expansion tank and water filters in a closed system and in the fill line, before the automatization.
Depending on the case and on consumption of each, energy calorimeters are installed.
These devices have two sensors and a volume-supply meter with electronic processor. The installation of the meter is in the return line after the temperature demotion (underfloor) and the sensors are placed respectively in the supply/return.

By cooling we mean the transformation of the floor of each area into an immense cool surface. This is achieved by distributing cold water through the underfloor heating pipes.

The floor cooling system maximizes comfort levels by uniformly absorbing heat from all directions and by exchanging energy with the human body which moves on the cool surface, giving the feeling of a "cave".

Due to the use of a big cooling surface, cooling provides advantages, such as:

- Comfortable and healthy environment. We have uniform temperature distribution in the area, preventing cold draughts but also noise caused by air conditioning units.

- Complete freedom in the arrangement of the areas. There are no limitations whatsoever in your space.

- Clean areas. Thanks to the lack of draughts, there is no blackening of walls as would have been the case with air conditioning units.

- Great energy savings. We exploit the wide cooling surface by supplying higher water temperatures in the pipe network, compared to the air conditioning units.

- Lower initial installation cost. By using the existing pipe network and sub-dimensioning the cooling machine, we exploit the great inertia and the heat capacity of the system.

Characteristics of the cooling system
-Water supply temperature: 18-20°C

-Floor temperature: 20-22°C

-Lower indoor are temperature: 5-7°C

-Average performance per m²: 35-50 Watt

As aforementioned, the floor cooling system operates using the existing pipeline network of the underfloor heating. This means that we can operate the cooling system a long time after the first operation of the heating system, provided that we have taken note of fan-coil units in the areas, which will serve for its dehydration during the operation of the floor cooling system. Their dimensions and positions will be defined by the design. This is why it is important to install the supply and return pipelines for the feeding of the fan-coil units, as well as the drainage system and the electrical connection for their operation. The automated circuits, which will be installed, should be suitable both for heating and cooling.

The energy source is the air-to-water heat pump, which in the summer absorbs the heat from the house, through the underfloor circuit, and discards it into the environment.
In winter, the procedure is reversed, bringing domestic hot water into the pipes of the underfloor system, using the energy that exists in the environment.
Interplast can guarantee the proper functioning of the cooling system, offering a comprehensive range of air-to-water heat pumps, supplied with all the provisions necessary to connect them to the underfloor heating system and able to comfortably meet the needs of every home.

With an operating outdoor temperature ranging from -22°C and up to +53°C, the heat pump is perfect for heating and cooling, even in the most extreme weather conditions.

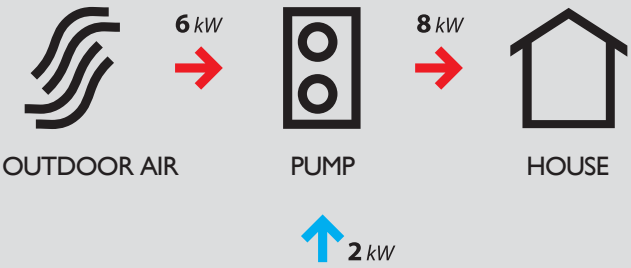
AIR-WATER HEAT PUMPS

The heating pump is an advanced device that exploits the energy offered by the environment and utilizes it for the heating and cooling of any house.

Air-to-water heat pumps "pump" the energy from the outer air and heat the water that runs through the circuits of the underfloor heating system.

Respectively, during the summer period, they produce cold water that we use to cool the house. The comparative advantages of the heat pump are indisputable.
The heat pump can provide **heating and cooling** of a house. It has increased performance **efficiency from 285 to 550%** of given external conditions and the type of pump, with low consumption,

compared to a conventional heating system with a boiler which has an efficiency of 85 to 94%. The increased efficiency of the pump is due to the fact that it is designed as such so as to absorb and exploit the heat from the environment (sun, air, soil and water). This energy is permanently added to the system that it supports in an analogy 75% environment and 25% electricity, from the power provider. That means that 1kW consumed electricity can produce up to 4kW of utilized thermal or cooling energy. The average annual coefficient of performance (COP) of the system can be more than 4, with minimal operating costs.



Consuming 2kW power delivers 8kW heat in the house.
In this case, the COP= $\frac{8}{2}$ =4

Heat pumps are classified as "green energy" because they have zero emissions. The minimal burden that they are charged with is the waste produced at the electricity plant from the electricity which it consumes.
Nevertheless, the plants are operated and controlled by strict protocols that define specific emissions and heat, something that could not be done individually in each and every house that has a conventional system with fossil fuels. For example, a villa of 150m² for its heating with petrol would burden the environment in an annual basis with 6,200 kg of CO_2.
The same villa for heating with natural gas has 3,820 kg of CO_2 emissions.
The heating of this same place with a Heat Pump and based on the electricity production protocol, pollutes the environment with only 850 kg of CO_2.

The installation of a heat pump requires no chimney, no ventilation, no fuel tank or other additional fire safety provisions and can be installed on existing and in new constructions. The location of the air / water pump may be inside or outside the machine room, can be exposed to the environment, and occupies a small area of 1m². The operating range of an air/water pump ranges from -22°C to +53°C external temperatures.
The power supply of these machines is like the power supply of any device and does not require anything special. The result is the lack of any external visual intervention to the building and flexibility of the installation of the power supply provider. If there is a possibility to install photovoltaic systems, then under ideal conditions (space, power, investment), we can speak for almost zero operating cost.

REDUCED OPERATIONAL COSTS

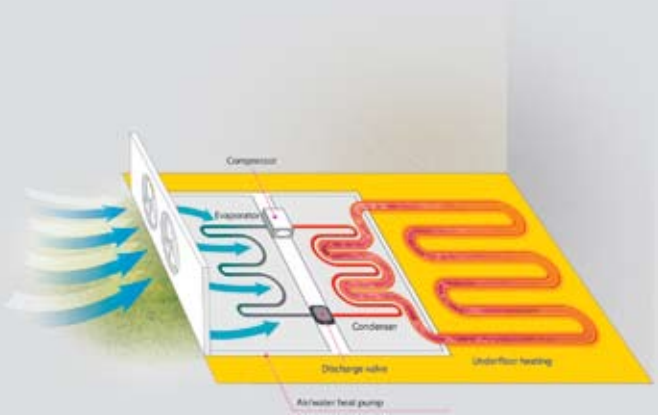
REDUCED CO_2 EMISSIONS

SIMPLIFIED SYSTEM (ONE UNIT FOR COOLING, HEATING AND HOT WATER USE)

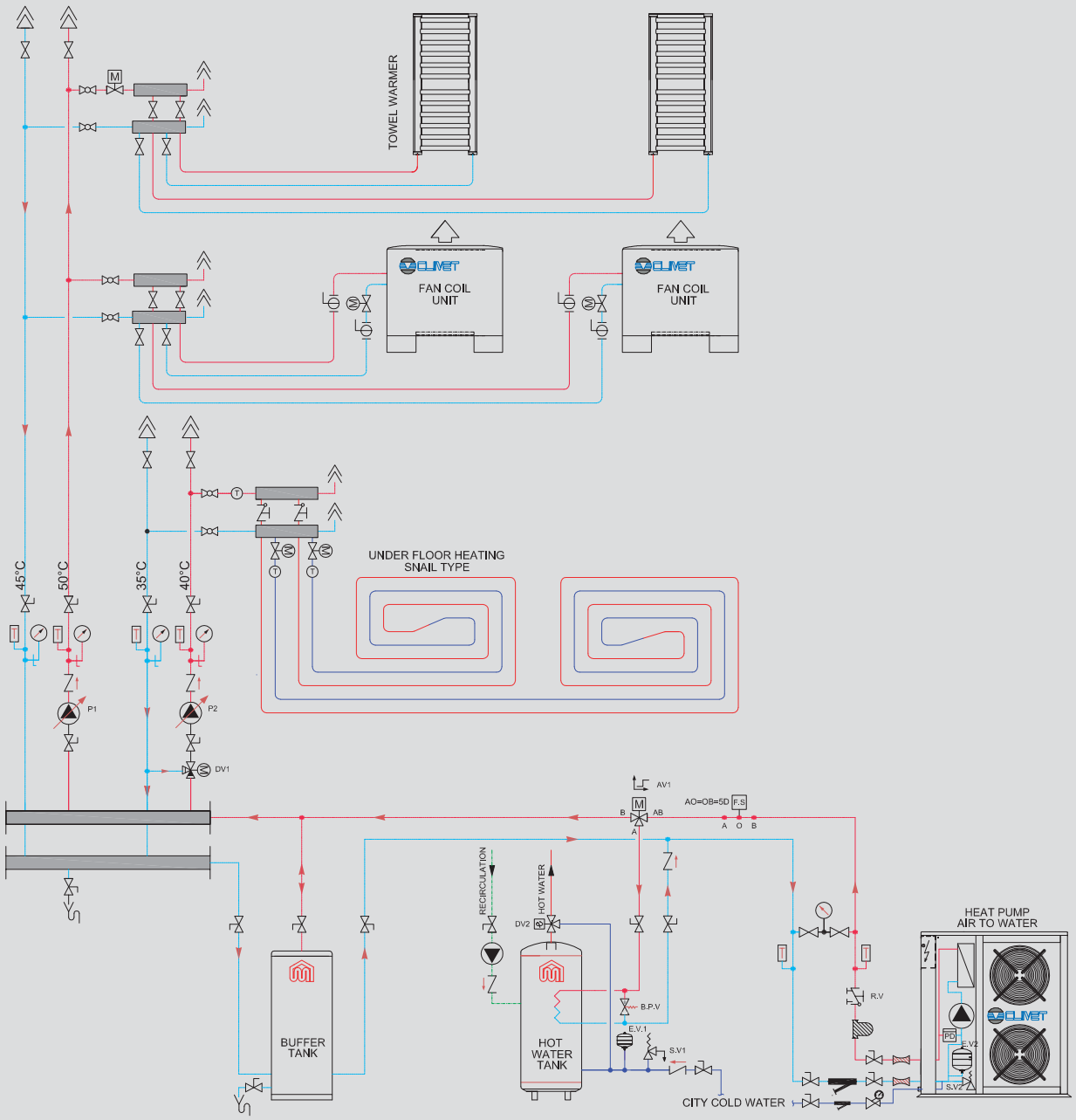
NO FIRE RISK

NO CHIMNEY

Heat Pumps can be installed on new or old buildings and can be connected to existing radiators (specific models), to underfloor heating and cooling systems, as well as to Fan Coils for heating and cooling. They can also be combined with an existing boiler or with other renewable sources of energy such as solar systems for heating assistance.
The heat pump also operates with a system of compensation for more economic management of the heating or cooling depending on the outdoor ambient conditions.
The pumps in their operation are environmentally friendly since they use the environmental friendly refrigerant R-410A and have zero pollution emissions.
Major advantages of the heat pumps are their noiseless operations and their compact unit sizes.



	IN LINE PUMP WITH VARIABLE SPEED DRIVE V.S.D		LOCAL WATER COLLECTOR		AUTOMATIC AIR VENT
	IN LINE PUMP CONSTANT SPEED		GLOBE VALVE		MANUAL AIR VENT
	FLEXIBLE CONNECTOR		MINI BALL VALVE		WATER STRAINER
M	MOTORIZED THREE WAY ON-OFF CONTROL VALVE		GATE VALVE		AIR SEPARATOR
M	CONTROL PORT BY PASS PORT CONSTANT FLOW PORT		DIFFERENTIAL PRESSURE RELIEF VALVE		SAFETY RELIEF VALVE
M	MODULATING MOTORIZED TWO WAY CONTROL VALVE		BALANCING AND GATE VALVE FOR FLOW REGULATION	T	THERMOMETER
M	MOTORIZED TWO WAY ON-OFF CONTROL VALVE		CHECK VALVE		PRESSURE GAGE WITH COCK
F.S	FLOW SWITCH		AUTOMATIC FILLING DEVICE WITH GAGE END CHECK VALVE		EXPANSION TANK



PROJECT TITLE

HYDRAULIC DIAGRAM FOR HEATING, UNDERFLOOR HEATING, AIR CONDITIONING WITH AIR TO WATER HEAT PUMP, SANITARY HOT WATER TANK AND COMMON BUFFER TANK.

ARRANGEMENT OF THE HEAT PUMP ROOM

The present technical description is intended to explain the way of operation of the diagram.

Internal consumptions

The diagram shows the heating and cooling of an underfloor heating system, the cooling or dehumidification by using local fan coil units, the supplemental heating energy of the bathrooms by using towel warmer radiators and the production of domestic hot water.

Managing internal consumptions

The managing of the consumptions according to the schematic diagram can be done per area/room or per floor/level. A two-way valve with an electro-thermal motor is placed on each underfloor heating circuit. In each area/room, a thermostat is installed, which controls one or more of the heating circuits. The connection of the thermostats can be either wireless or wired.
Local fan coil units are connected to a local controller that monitors fan speeds, temperatures and switches the operation on and off.
The towel warmer type radiators can be controlled in two ways: A) in a central level by a two-way electrical valve and a wireless bathroom thermostat, and (B) by an actuator per radiator unit. Prerequisite is the use of an Inverter pump and independent or joint central lines with the fan coil units, that is, lines that do not have three-way mixing valves.

Front automation panel

The automation panel (controller) comprises the management software of the heat pump and the PLC (Logic Controller) management of analog - digital commands. The panel bears all the relevant electrical switches.

Operation in the winter

The controller (PLC) in heating mode performs the following sequence of actions: activates the three-way directional valve AV1 into position AB-A and the air to water heat pump for the production of domestic hot water.

Heating mode

When the water temperature in the storage tank reaches 55°C, then the electrical resistance of the heating tank is activated up to 60°C (second stage) and the heat pump stops working. Subsequently, the controller activates the directional valve AV1 into position AB-B, activates the circulators P1 & P2 and then restarts the heat pump, supplying temperature of 50-55°C for the consumptions, while saving energy in the buffer tank. The hydraulic balance (flows-frictions) is guaranteed through the buffer tank and the regulatory provisions R.V. More specifically, if P1 & P2 both stop, or just one of them, the integrated circulator of the heat pump circulates water through the buffer tank ensuring Δp at 0.5Bar (ΔT 5°C) in the main circuit.
In the case of simultaneous demand for heating and domestic hot water and while the tank for the domestic hot water lacks the proper temperature, the P1 & P2 are activated, AV1 gets in AB-A position, and at the same time the heat pump starts operating, feeding the exchanger of the domestic hot water tank, while the consumptions derive energy from the buffer tank (in the storage room), which is assessed to have energy for as long as the pump produces domestic hot water retaining the Δp at 0.5Bar (ΔT 5°C) in the secondary circuit through the differential valve BPV.

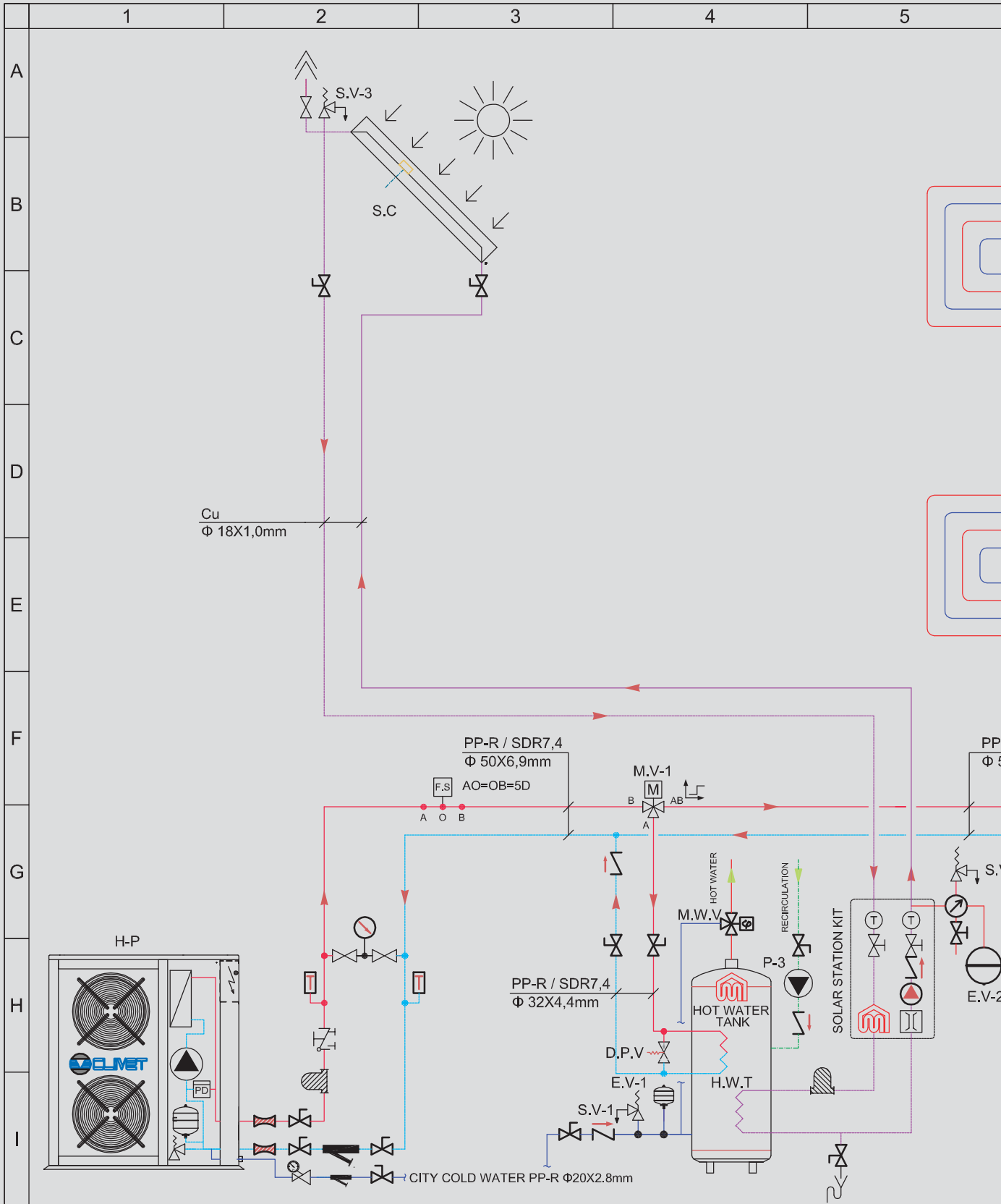
Operation in the summer

Cooling mode

The cooling operation and the production of domestic hot water is the same as described in heating.

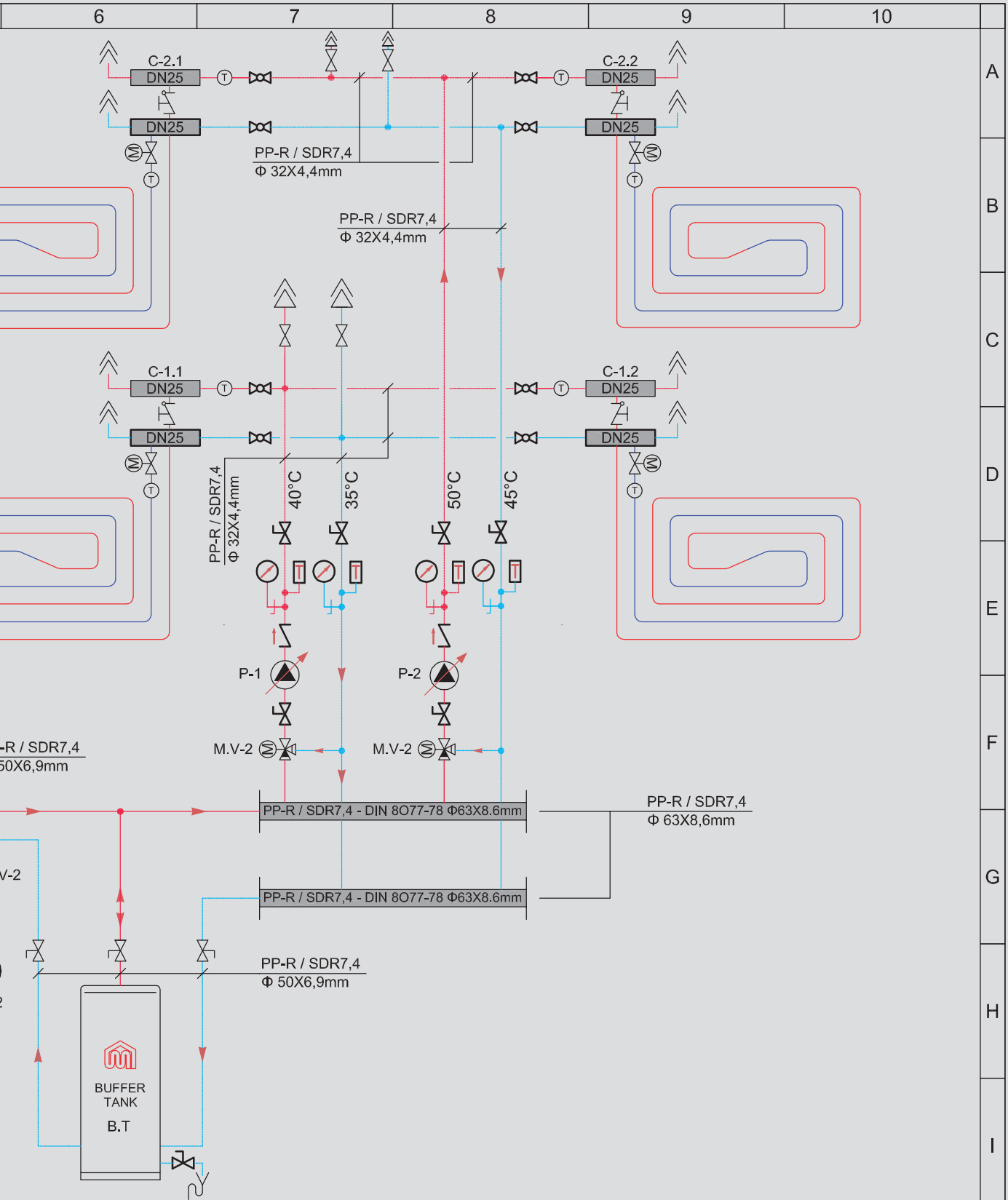
Buffer tank

The use of a buffer tank in a heat pump with constant speed compressor is essential because it ensures economic and continuous operation, creates an energy reservoir when the pump produces domestic hot water, while at the same time prevents the defrosting process of the unit when the outside temperature is below 0°C to -15°C. The selection of the proper buffer tank results from the maximum heat power of the pump (kWth), the minimum operating time of the pump (full cooling cycle) h/min, the maximum allowable compressor starts per hour and the minimum power of the lower air conditioning zone (kWth zone) of the system. An approximate calculation of the buffer tank size is 4 to 6 lt/kW power of the heat pump.
Interplast's proposal of the connection achieves the in series placement of the buffer tank in the return, while it allows where applicable the operation of a primary - secondary circuit for maintaining the hydraulic balance and the ensuring an adequate flow in the exchangers, without the help of external valves or hydraulic alterations.



PROJECT TITLE

HYDRAULIC DIAGRAM FOR UNDER FLOOR HEATING - UNDER FLOOR COOLING USING AIR TO WATER
SOLAR COLLECTOR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C-2.1
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DN25
C-2.2
DN25
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PP-R / SDR7,4
Φ 32X4,4mm
PP-R / SDR7,4
Φ 32X4,4mm
C-1.1
DN25
DN25
C-1.2
DN25
DN25
PP-R / SDR7,4
Φ 32X4,4mm
40°C
35°C
50°C
45°C
P-1
P-2
M.V-2
M.V-2
-R / SDR7,4
50X6,9mm
PP-R / SDR7,4 - DIN 8077-78 Φ63X8.6mm
PP-R / SDR7,4
Φ 63X8,6mm
PP-R / SDR7,4 - DIN 8077-78 Φ63X8.6mm
V-2
PP-R / SDR7,4
Φ 50X6,9mm
BUFFER
TANK
B.T

GAIA – THE ULTIMATE SOLUTION

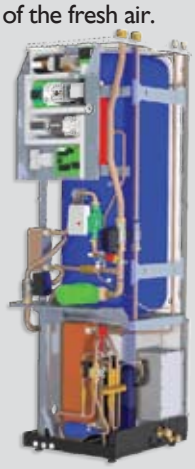
Its name derives from the ancient Greek word "Gaia" meaning "Earth".
It is the technological breakthrough in the Heat Pumps because the whole boiler room is now only one unit. We achieve high performances and the production of domestic hot water at 60°C with an external temperature of -22°C.
GAIA is an air-to-water or air-to-air heat pump that contains all system components, including a 200litres tank for domestic hot water with the possibility of connecting it to solar panels. The high performance of GAIA allows the heating, the cooling and the production of domestic hot water with minimal consumption.

Maximum Savings

The electronic control lets freely establish the desired indoor temperature, the humidity and the operating times. Once set, the control automatically manages summer or winter operation and also the production of domestic hot water. Overall energy efficiency is maximized through constant monitoring of the needs of the building and the temperature of the fresh air.

DC Inverter technology

GAIA provides heating and cooling with the outmost energy efficiency thanks to the DC INVERTER technology applied to the compressor and the pumps. As such, the operation is adjusted according to the demand, allowing further reduction in consumption and a substantial increase in seasonal efficiency.



Integrated production system of domestic hot water

GAIA is equipped with a 200litres tank for domestic hot water, which can also be connected to solar panels. Priority is always given in the production from the panels. The GAIA is equipped with a re-circulating circulator of Inverter technology to avoid the phenomena of legeonella.

Safe and Ecological

GAIA, since it does not use gas or other fuels, precludes the possibility of leakage of dangerous substances into the environment. It does not produce exhaust gas, thus not requiring a fuel tank and a chimney. It does not release CO_2 into the atmosphere and does not require thorough and continuous maintenance, as is required by an oil boiler or a gas boiler.

Complete system in one unit. Machine room of just 0,5 square meters

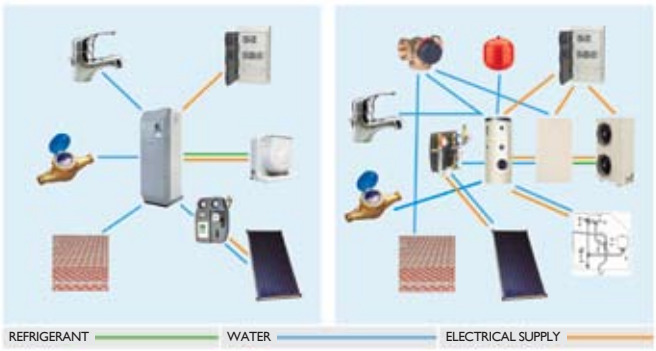
It can be combined with an underfloor system, room terminals, radiant panels and radiators. All the necessary components for heating, cooling and domestic hot water are included.

Reduced installation time

Installation times and costs are drastically reduced because GAIA contains the pumps, the domestic hot water storage tanks, all hydraulic connections, the exchanger for the solar panels, the mixing units as well as three different water outputs for three different temperatures (e.g. underfloor heating, fan coils, radiators).

Intelligent Management

GAIA offers intelligent and efficient management of the installation thanks to its exclusive central control panel for:
-Checking the temperature in the condensing cooling system
-The intelligent defrost cycles
-The flexible programming of energy waste per week/month/year



Only 8 connections

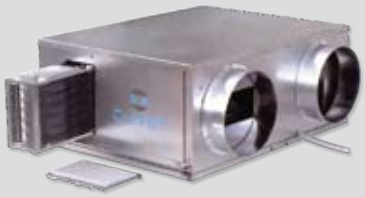
GAIA heat pumps contain all the necessary components ensuring the use of minimum space in the machine room and reducing the time of installation. GAIA requires only 8 connections (plumbing and electrical), maximizing as such the way and the control of the entire installation, when other units require more than 20 connections. Thus, the only things that the installer needs to connect are the power supply, the external energy exchanger, the solar panels for domestic hot water, the water supply of the building and the heating-cooling system.

ELFO Fresh AND ELFO CONTROL

Comfortable and clean environment 365 days a year.
High performance over time, reliable, efficient use of the energy and low power consumption are some of the components of the air refreshment system, which is controlled by the touch screen of ELFO Control.

ELFO Fresh

While renewing and purifying the air, it recovers the energy contained in the exhaust air, multiplies it thanks to the heat pump technology and gives it to the ambient (active thermodynamic recovery). In this way, it minimizes the load of the external fresh air and provides additional capacity so as to maintain the comfortable conditions inside the house.



ELFO Fresh eliminates the pollution in the buildings where we live

It expels the unhealthy and polluted air and at the same time, introduces purified and air-conditioned outer air. With the use of electronic filters, acting as high-efficiency electrostatic purifiers, it minimizes suspended pollutants such as smoke, fine dust, viruses and bacteria. Simultaneously, it reduces the high ventilation consumption generated by the pressure drops, common to traditional filters, and furthermore does not require periodic changing of the filters, but just washing.

ELFO Fresh is a highly-efficient active thermodynamic recovery unit

Unlike traditional systems, the active thermodynamic circuit recovers all year round the energy contained in the flow of exhaust air, multiplies it thanks to the heat pump technology and then transmits it to all the areas of the building. Thereby, minimizing the outer fresh air load and providing additional cooling or heating load in the area.

ELFO Control

Comprehensive and efficient monitoring control of the level of comfort.
ELFO Control manages all the elements of the system. It automatically changes over from summer to winter operation and monitors the entire system without any intervention. The touch screen of ELFO Control allows quick and easy selection of the system's parameters.

Control of the whole system: heating, cooling, humidity, air purification, domestic hot water from one source

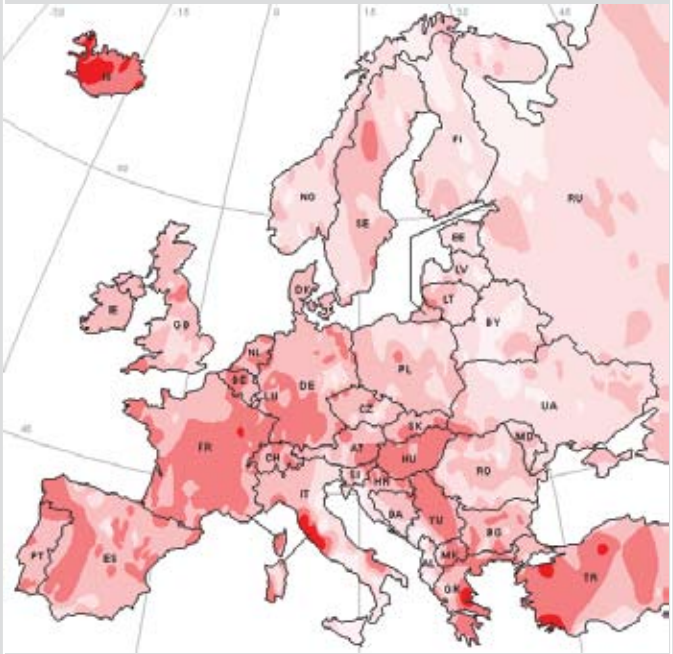
The user is free to set the temperature, the humidity and the hours of operation for each room in the residence. It provides ample flexibility in the management of the premises of the residence, since it can control 10 different areas with different levels of comfort.

Definition of Geothermy

"Geothermy" is a Greek term and derives from the greek words "Gaia" (earth) and "Thermos" (heat). Furthermore, knowledge and dissertation on the thermal activity of the Earth has important historical roots in Greece. The Eleates philosophers (7th century BC) and Heraclitus (6th Century BC) considered as a driving force of creation the "fire" that is encapsulated within the Earth's mass. Aristotle (4th century BC) in his thesis "On Meteora" states that due to the internal heat, winds are produced internally and externally of the mass. Anaxagoras (5th century BC), as stated by Aristotle, spoke of blocked hot air in the depths of the earth ("ethereal"). Worth mentioning is also that - according to speculations - the prophecy of Pythia at the Oracles of Delphi was also the result of her exposure in geothermal gases emanating from a local fault. Also, in ancient Pompeii, the high temperature geothermal water was used in the heating of the buildings. On the other hand, Thermopylae ("Hot Gates") was named as such from the heat sources found in the subsoil. In Greece there are 56 hot springs. The hot springs at Thermae of Samothrace island, known since antiquity for their great therapeutic value, hide a huge geothermal field, while one of the oldest uses of geothermal energy in the region of Thessaloniki is the hot springs of Thermi, being possibly even the first thermal baths of antiquity.

Geothermal energy

Geothermal energy is the energy derived from the Earth's interior and is contained in surface natural or underground fluids in the form of steam, in hot waters or mixtures of water and vapor or gas. Geothermal is also the energy of the hot "dry" rocks or of igneous or molten materials.
The earth is hot in its inner part, as evidenced by the physical surface hot vapors, the hot water and gases, the geysers, the volcanic eruptions, etc.. Measures have showed that the temperature increases steadily with depth. The rate of temperature increase to depth is called "geothermal gradient" and the average price in the first kilometers of the earth is 30°C/km. The term "thermal flow" is characterized by the heat transmitted from the inner to the surface depending on time. The average heat flow is estimated at 60mW/m² (mm Watt/m²). "Geothermal areas" are theoretically those that for different causes have thermal heat flow and therefore, geothermal gradient higher than the earthly average prices. Most of these areas are near the boundaries of tectonic/lithospheric plates. The thermal anomaly is just not enough for the creation of geothermal reserves and of geothermal fields. Other favorable geological conditions are also necessary, such as the existence of geothermal fluids not at great depths, with a satisfactory temperature, good to acceptable physicochemical characteristics and in significant quantities.



Geothermal fields

"Geothermal fields" are areas in which the thermal energy of the Earth is sufficiently concentrated in relatively small depths, so as to create a usable energy source. Geothermal fields are classified on the basis of their geological, hydrological and thermal characteristics.
A geothermal field consists of three main elements (Dickson MH & Fanelli 3M., 1990): a warm source, a reservoir and the fluids that constitute its means and which are transporting heat. Most times it is also necessary to have a cover with impermeable rocks or with very low permeability, which are laid on top of the reservoir and prevent the escape of reservoir's hot fluids with a rapid transfer to the surface. However, the heat loss by conduction is not prevented by the impermeable cover. Therefore, the quantity of heat that is led is much smaller than the one that would be lost through the leakage of the fluid (Gupta, 1980).
The reservoir is formed by hot and impermeable rocks, from which heat can escape from the fluids that circulate. In many, but not all cases, the reservoir is connected to a surface filling area that refreshes all or part of the fluid.

Classification of Geothermal Systems

The most common criterion for the classifying of geothermal fields is based on the enthalpy of the geothermal fluids. Based on the enthalpy, geothermal fields are identified as of low, medium and high enthalpy. Different temperature limits are taken into account and there exist various classifications, as shown in the following table.

Classification of geothermal fields on the basis of enthalpy (Dickson & Fanelli, 1990).

Geothermal Fields	Fields of low enthalpy	Fields of medium enthalpy	Fields of high enthalpy
According to Muffler & Cataldi, 1978	<90°C	90 - 150°C	<150°C
According to Hochstein, 1990	<125°C	125 - 225°C	<225°C
According to Benderitter & Corny, 1990	<100°C	100 - 200°C	100-200°C
According to Haenel, Rybach & Stegena, 1988	<150°C	-	<150°C

Extending the broader definition of geothermal energy, it can also be referred to the use of energy accumulated in shallow depths of the earth's crust (almost superficial) and is called LOW ENTHALPY GEOTHERMAL. This term designates the energy of geological formations and fluids of the surface and groundwater which are not designated as a geothermal potential. Generally, the term defines temperatures of geological formations, of ground and of surface fluids that are below 25°C. A characteristic advantage of low enthalpy geothermal energy is the stability of the soil temperature throughout the year, regardless of the climatic changes.

(Average subsurface temperature for 10-15m depths)

Low enthalpy geothermal located at depths of 100 to 150 meters is applied in several parts of Greece, in regions not designated as a geothermal potential, and can be exploited for the heating and cooling of buildings.

Uses of Geothermal Energy

Overall, the uses of geothermal energy are multiple and directly dependent on the temperature of the geothermal fluid or of the temperature of the subsoil.

Greece, thanks to the geological conditions which prevail, holds a considerable potential in geothermal energy. Despite the fact that the geothermal sources in Greece are well studied, however only their direct application, as for example in green-houses, has been so far exploited. It should be noted that there also exist sufficient high enthalpy geothermal fields which could be used to produce power energy.

Today, direct applications of geothermal energy in Greece can be mainly found in the heating of greenhouses, in fish farming, in the cultivation of spiruline and in the drying of vegetables and fruits. At present there is no production in Greece of power energy despite the existence of several high enthalpy geothermal fields in the active volcanic arc of the Aegean Sea. Moreover, in some other regions (such as in Mytilini, in Chios and in Samoth-race) it is possible to install power generating units by using binary Organic Rankine Cycle (ORC).

The breakdown of energy use in Greece is presented in the below table.

Use	Installed power (MWth)
Instant heating of spaces	1.5
Heating of greenhouses-ground	35
Drying of agricultural products	0.3
Aquacultures	9.5
Spas	39
Subtotal	**85**
Geothermal heating pumps	90
Total	**175**

The increase in the usage of geothermal energy compared to 2004 is 135%. This increase is almost exclusively due to the development of geothermal heat pumps applications.

However, the development of low enthalpy geothermal energy in Greece cannot be compared to the rest of Europe, where most geothermal heat pumps already constitute a well proven technology, gaining more and larger shares of the heating/cooling market. For example, the installed capacity in Geothermal heat pumps in Sweden is more than 4,000MW, in Germany more than 2,000MW and in Switzerland more than 1,000MW, when in Greece it is only 90MW.
The possibilities therefore offered by the technological developments and the rapidly price increases of fossil fuels, render the penetration of Renewable Sources of Energy, and in particular geothermal energy, as a feasible and an alternative solution, especially compared to conventional methods of heating in the agricultural, the residential, industrial, public and private sectors.

Renewable Sources of Energy (RSE) and Geothermy

The ceaseless energy consumption without moderation in the building and industrial sectors requires the addition of new polluting power plants in the system and continues to increase emissions, increasing the global concerns of climatic change and environmental sustainability.

The gradual reduction of oil reserves and their rising price, which is estimated to continue, are likely to mark the beginning of the end of an era when the development was based on cheap and "unlimited" energy of polluting fossil fuels. The reserves of fossil fuels on our planet (oil, coal, natural gas) are not renewable and in a predictable period of time will be run out, therefore increasing the price of oil which has already dragged along the prices of natural gas and coal.
In combination with the intense energy requirements, especially in the emerging economies - estimations for the next 15 years predict a rise in energy demand by 2.2% per year, there exists an increasing uncertainty climate of the energetic and the environmental future of the planet.
The restructuring therefore of the global energy policy and its mechanisms with the environment in mind is a priority issue.
This urgent need to protect the environment and to save energy has lead science in researching and exploiting mild forms of energy such as the renewable sources of energy (RSE).
According to an article by the Geothermal Division of the Centre for Renewable Sources of Energies (CRSE) in the Bulletin of the Greek Geological Society (Practical's of the International Conference, Thessaloniki, 2004), the applications of geothermal energy, both in Europe and globally, can be grouped into three main categories:

- Production of Solar Energy
- Use of Heat
- Geothermal Heat Pumps (GHP)

The first geothermal system has been recorded in 1912 in Switzerland. Heat pumps are used successfully since the early '30s. The Edison Electrical Institute in the USA has financed the research on closed circuits back in the '40s and '50s. Swedish researchers commenced again to study closed-loop systems in the 70s using plastic piping, which was suitable for this application.

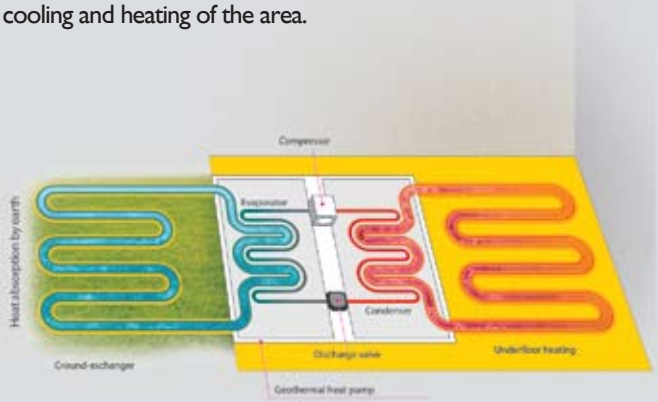
Operating Principle of the Low Enthalpy Geothermal heating-cooling System

Low enthalpy geothermy uses the principle of the earth's constant temperature throughout the year, regardless of the external weather conditions, to regulate the interior temperatures of a building.
As aforementioned, the temperature of the subsoil in Greece, in a few meters of depth, remains constant from 14 to 20°C. This "fuel", hence, in low enthalpy geothermal energy is offered free from the earth, as is the case with solar energy, while its cost is limited to the installation and the operation of the geothermal system.
The exploitation of the heat from the subsoil is achieved through a combination of a water-cooled heat pump and a ground heat exchanger.
More specifically, a complete system of low enthalpy geothermal energy that supplies a heating- cooling installation generally consists of the following components:

- The geothermal water-to-water heat pump, which with the help of the two exchangers, supplies hot or cold water to the interior heating-cooling installation (underfloor, fan coil units, low temperature radiators, etc.)
- The geothermal exchanger, located externally (closed or open loop piping network), exploiting the constant temperature of the subsoil to bind heat through the water-glycol fluid that circulates within the pipes.
- The internal heating-cooling installation of the building.

Geothermal Heating Pumps (GHP)

The procedure for transferring heat loads from the building to the subsoil and vice versa, is made through a device called a geothermal heat pump (GHP).
Geothermal heat pumps are machines that move heat in a direction opposite to that followed in a natural way, which means that they force heat to circulate from a cold to a warmer front. Heat pumps are nothing more than devices that function like common refrigerators (Rafferty, 1997). Any cooling device (air-condition, refrigerator, freezer, etc.) moves the heat from one area that needs to be kept at a low temperature and releases it at higher temperatures. The only difference between a heat pump and a cooling unit is detected in the reversible operation of the geothermal heat pumps, which is their ability to provide both cooling and heating of the area.



During winter, the water-glycol mixture circulating in the exchanger circuit absorbs energy from the ground and then leads it to the evaporator of the GHP, where it gets bound. Through the evaporator, heat is transmitted to the coolant pump (type R-410A, environmentally friendly) which converts it from liquid to gas. The refrigerant, which circulates inside a closed circuit, passes through the compressor and gets compressed so as to increase its pressure and the temperature. It is then driven to the condenser where it discards all the heat that is stored in the water circuit of the internal installation. The refrigerant is transferred to the expansion valve and expands in order to return to the evaporator and to repeat the same process.
In the summer, the system performs the reverse operation, that means that the GHP extracts heat from the building – or otherwise provides cooling - and transfer it to the ground via the heat exchanger.

The geothermal heat pumps produce temperatures in the range of 5 to 60°C. They are specially designed for underfloor heating applications, providing the required temperatures of 35 to 48°C and for cooling (7 to 18°C), ensuring a high coefficient of performance (COP up to 6.5) with the lowest consumption.
For each kilowatt of electricity consumed by the compressor, circa 6,5kW of thermal energy are produced, depending on the configurations of the system. This means savings over 70% on power bills compared to traditional systems and compared to the lower maintenance and cleaning costs.
The use of a GHP does not require a boiler. The heat pump by itself is sufficient to provide enough heating energy, even in strong cold and chilly weather conditions.
It can simultaneously also produce and provide domestic hot water at all times (summer and winter, day and night). Furthermore, it is also suitable for a geothermal system needed for pool heating, using a special stainless steel heat pool exchanger.

Advantages of an Interplast Geothermal System

- Low cost of operation, since 70 to 80% of the energy required is absorbed by the exchanger.

- Relief to the environment, since it does not exhaust energy sources and does not produce emissions (zero CO_2 emissions).

- More free space at home, since all it requires to heat and cool the areas is a small and compact pump.

- Zero maintenance of the exchanger, with a periodic check of only the heating pump.

- Noiseless and safe operation.

- Healthy heating and cooling for the human body.

Classification of Low Enthalpy Geothermal Systems

There are two main installation types of geothermal systems, closed loop systems or closed systems and open loop systems or otherwise open systems.
In closed systems, polyethylene pipes are placed in the ground, creating a closed circuit through which circulates a mixture of water and glycol. As such, the system exchanges energy with the ground.
When the pipes are placed horizontally on the ground and in layers, we refer to a closed horizontal system and when they are placed vertically in the ground in bore holes, we refer to a closed vertical system.
In the open systems, the water is pumped either from surface sources (sea, lake, river) or from underground aquifers (through drilling or wells).
After it releases its energy to the system, the water returns to the source from which it was pumped form.

HORIZONTAL GEOTHERMY

We install outside of the house a horizontal closed loop of special type PE piping circuit for geothermal applications (Geo-Flex), in which circulates a mixture of water and glycol. This external geo-exchanger is located at shallow depths (1,20 to 1,50m), where there are no temperature changes due to weather conditions and covers an area roughly twice the surface that we want to heat.

Installation steps of a horizontal geo-exchanger

- In the surroundings of the building, we install a piping network in a depth of 1,20 to 1,50m. The installation of the pipes in the ground can be done in various configurations depending on the available space, the topography and the soil morphology:
• By opening trenches of the required depth and length
• By digging out the whole area/surface that will constitute the geo-exchanger
- We fix the external PP-R manifolds, outlets according to the geo-exchanger.
- We install the circuits of the geo-exchanger, from polyethylene PE 100 pipe in dimension Ø25x2, 3. Characteristic of the pipe is its increased years of resistance to harsh operational conditions and the high thermal conductivity of the Geo-Flex pipe (λ = 0,862 W/m°C, result of a measurement conducted by the Aristotle University of Thessaloniki), which is 110% greater than common polyethylene (λ = 0,410 W/m°C-DIN 8075).
Interplast managed to achieve this improvement by using special additives in the manufacturing of the pipes. The high thermal conductivity of the Geo-Flex pipes renders them ideal for geothermal applications because of the fact that the transfer of the heat from the earth to the building has the maximum degree of efficiency.
- The distance between the pipes is at least 0,4m.
- The circuits are filled with the water-glycol mixture, with the help of an electric pump from the filler valve of the manifold.

- The connection of the manifolds with the geothermal heat pump is made with PP-R pipes.
- The dimension of the pipes, the length of the piping as well as the analogy of the water-glycol mixture are defined by the type of pump and from the study.
-The manifolds have air-vents and the supplies and returns of the pipes should be insulated.
- They are placed at a smaller depth than the geo-exchanger for better de-aeration of the system and to avoid the leakage of the water-glycol mixture.
- Shafts are created for accessing the manifolds.
- The network is tested under pressure.

What to watch in the horizontal geothermal?

-The distance between the pipes.
-The pipe insulation near the manifold.
-The distance of the geo-exchanger from the main water supply and from the sewage networks of the home/building (at least 1m).
-The equal length distances of the supply and return pipes from the geo-exchanger's manifold to the heat pump.
- For the protection of the pipes, they could be placed on a bed of sand.
-The location of the manifold, centrally to the geo-exchanger.
-The right blend of water-glycol. The addition of glycol is made after testing the system while operating with clean water. The glycol is added only if deemed necessary for the proper functioning of the system.
-The type of glycol to be used.

Common types of refrigerants as a means of heat transfer

Name	Synonym	Chemical Type	WGK	Comments
Usual refrigerant liquids				
Ethanediol	Ethylene glycol	C2H6O2	1*	
1.2-Propanediol	Propylene glycol	C3H8O2	1*	
Other refrigerant liquids				
Calcium chloride		CaCl2	1*	Corrosive
Ethanol	Ethyl alcohol	C2H5OH	1*	

According to the Regulation on harmful water substances (VwVwS) and dating from 18.04.1996, it is classified as a non-harmful substance.

-The filling and de-aeration of the circuit.
-Density, moisture and the soil composition are important factors for the design of the loop.
-The greater the density of the soil, the better the thermal conductivity of the soil. Therefore, after the placement of the pipes, the soil should be anchored with great care to avoid damage to the piping.
-The higher the soil moisture, the better the heat transfer is. It is suggested that the area below which the geo-exchanger has been placed, be planted with small root plants. Thereby obtaining:
- The conservation of soil moisture.
- The anchoring of the soil material through the root system of plants.
- Better maintenance of the soil temperature.
- According to measurements, planting can improve the behavior of soil of up to 30%. There should in no case be placed plants with big roots, since they can cause damage to the piping system.
-Planting trees is allowed around the geo-exchanger.
-The surface of the geo-exchanger should not be sealed or be later built on.

For example:

Heat extraction from horizontal geo-exchangers

Composition of the soil	Special heat termination	
	For 1800h/year	For 2400h/year
Dry non-cohesive soil	10 W/m^2	8 W/m^2
Cohesive soil, wet	20-30 W/m^2	16-24 W/m^2
Sand saturated with water	40 W/m^2	32 W/m^2

System design with a horizontal geo-exchanger

Let's assume thermal requirements of the building are 25 kW. Efficiency of the proposed heat pump COP = 5.

Calculation:

$$\text{Geo-exchanger surface} = \frac{\text{Nominal power of the pump x (1-1/COP)}}{\text{Output power from the geo-exchanger}}$$

$$\text{Geo-exchanger surface} = \frac{25.000\ \text{W x (1-1/5,0)}}{25\ \text{W/m}^2} = 800\ \text{m}^2$$

All parameters for the system should be determined by the supervising engineer and the geologist, who, according to the data, will determine the final design of the system, while having the responsibility for its proper operation.

VERTICAL SYSTEM

Pairs of type U pipes are placed in drilled depths. The drillings are then filled with a special thermally conductive mixture scoping at the maximal energy transmission from the rocks into the system and vice versa.

Installation steps of a vertical geo-exchanger

-Drillings are made at depths of 60 to120meters
• Either in the area surrounding the existing building/home, at a safe distance of 2m from the building,
• Either before the foundations, in a newly built building/home.

-The performance of the vertical geo-exchanger is mainly influenced by:
• The composition of the rocks and subsequently by their physiochemical properties.
• The temperature of the subsoil.
• The moisture in the subsoil.
• The setting up and the proper application of the thermally conductive mixture.
-In every drilling, 2 pairs of piping are installed that correspond to the length of the drilling, bearing a probe at their ends.
-PE 100 polyethylene pipes are used in dimension Ø32x3.0 and fittings of the same material, which are connected by autogenous welding. Depending on the drilling conditions and after the end of the drilling, is it only decided how the pipe will be installed within (empty, filled with water, with mounting pressure equipment, etc.).
-A spacer is placed every 10m to ensure the parallelism of the pipes and their safe placement.
-A weight is being used that is attached to the probe. Along with the insertion of the pipes, we also insert in the borehole the main pipe which is required to be filled with the thermally conductive mixture.
-The borehole is filled with the thermally conductive mixture, through the main pipe, from the probe to the surface without leaving any gaps and without trapping any air.
-By filling the borehole, we prevent the penetration of any infectious materials and do not allow groundwater abstraction.
-Ensuring a more thorough exchange of the heat with the ground.
-The paired pipes of the vertical geo-exchanger are connected in parallel to the manifold.
-The manifold is connected to the geothermal pump.
-The network is tested at a pressure of 1,5 times the pressure of the system.

What to watch in the vertical geothermal?

-The distance between the boreholes (at least 5m).

-The connections of the probes should be made by the manufacturer, according to directive DVS 2207 and 2208, and to be tested under pressure and flow in accordance with DIN 4279-7.

-To maintain the distance between the pipes inserted in the borehole, using the appropriate spacers.

-The correct piping of the drilling. The insertion of the pipes should occur the soonest possible following the drilling, so as to avoid any fall-outs.

-The pipes are tested under pressure (air or nitrogen or water, etc.) to ensure that there has been no damage during their installations. If damaged, they are extracted from the borehole and are replaced.

-The correct filling of the drilling with the thermally conductive mixture.

-For perfect construction and optimal system performance, the composition of the thermally conductive mixture should be based on the structure and the composition of the subsoil.

-The insulation of the pipes near the manifold.

-The filling and de-aeration of the circuit.

-The distance of the vertical and the horizontal piping of the geo-exchanger from the main water supply and from the sewage networks of the home/building (at least 1m).

-The authorization required in vertical geo-exchanger installations.

For example:

Special Heat extraction for vertical geo-exchangers
System design with a vertical geo-exchanger

Subsoil rock types	Special heat termination	
	For 1800h/year	For 2400h/year
Dry debris	25 W/m^2	20 W/m^2
Gravel, dry sand	<25 W/m^2	<20 W/m^2
Gravel, sand saturated with water	65-80 W/m^2	55-65 W/m^2
Clay soil, wet	35-50 W/m^2	30-40 W/m^2
Limestone (compact)	55-70 W/m^2	45-60 W/m^2
Sandstones	65-80 W/m^2	55-65 W/m^2
Granite	65-85 W/m^2	55-70 W/m^2

System study of a vertical geo-exchanger
Let's assume thermal requirements of the building are 65 kW.
Efficiency of the proposed heat pump COP = 5.
Calculation:

$$\text{Geo-exchanger length} = \frac{\text{Nominal power of the pump x (1-1/COP)}}{\text{Output power from the geo-exchanger}}$$

$$\text{Geo-exchanger length} = \frac{25.000\ \text{W x (1-1/5,0)}}{65\ \text{W/m}^2} = 307,7\ \text{m}$$

All parameters for the system should be determined by the supervising engineer and the geologist, who, according to the data, will determine the final design of the system, while having the responsibility for its proper operation.

OPEN SYSTEMS

Water is either pumped from surface sources (sea, lake, river) or from underground aquifers (through drilling or wells). After it releases its energy to the system, the water returns to the source from which it was pumped form.
Ground water is used from conventional drilling and/or surface water (sea, lake, etc.) which is pumped by submersible pumps or vacuum pumps and operates as a heat source.
A metal heat exchanger surrounds the heat pump and the hydro drilling, which transfers the energy of the pumped water into the system so as to better control the system and to protect the heat pump from possible damages (oxidation, settling of salts and small particles, etc.)

What to watch in the open loop geo-exchanger?

-To check the water properties (hardness, acidity, iron and salt content) to ensure its quality.

-The analysis will determine the construction materials of the exchangers and the other components of the system.

-The submersible pump used must be resistant to corrosion.

-Array-filters should be installed in supplying water to the heat pump (the type of filter depends on the composition of the pumped water).

-There should be the required constant supply of water and should cover the nominal operational flow of the heat pump throughout the year. Therefore, the determination of the water quantity should be made by a pumping test.

-Attention should also be given to the consequences of the extensive pumping in the surrounding area, especially when carried out in coastal areas.

-The distance between the boreholes must be at least 10m and the second well should be located in the direction of the groundwater flow.

-The lower point of the pipe in the reintroduction drilling should extend lower than the water surface when it is in a state of rest.

-Pipes carrying groundwater must be installed at required depth so as to prevent freezing or should be insulated.

-The temperature of the water to be at least 10°C.

-To meet the necessary standards/regulations (an authorization is required for the application).

-Depending on the composition of the water, the phenomenon of corrosion of the application's metal parts varies, which means that they should be in accordance with DIN 50930.

-The operation of this system requires the use of a submersible or other water pump, which consumes additional power.

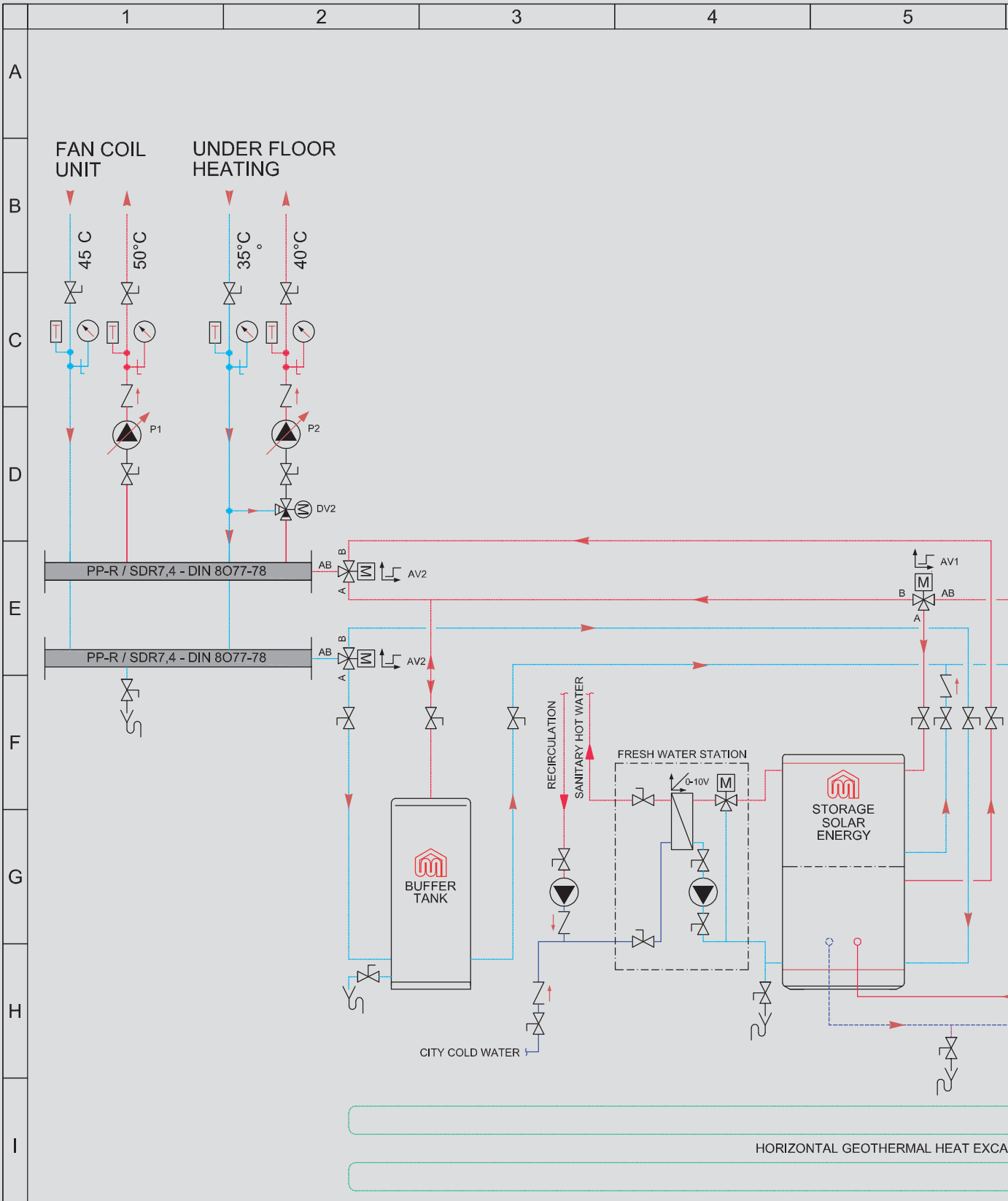
-The installation and operation costs of the system are directly related to the depth of the water horizon but also depend on the physicochemical characteristics of the pumped water.

-In large system applications, it may be required to have an analysis of all major substances of the water and its general parameters (temperature, pH, O_2 content, conductivity, corrosion potential, calcium, magnesium, etc.)

Planning of an open loop system

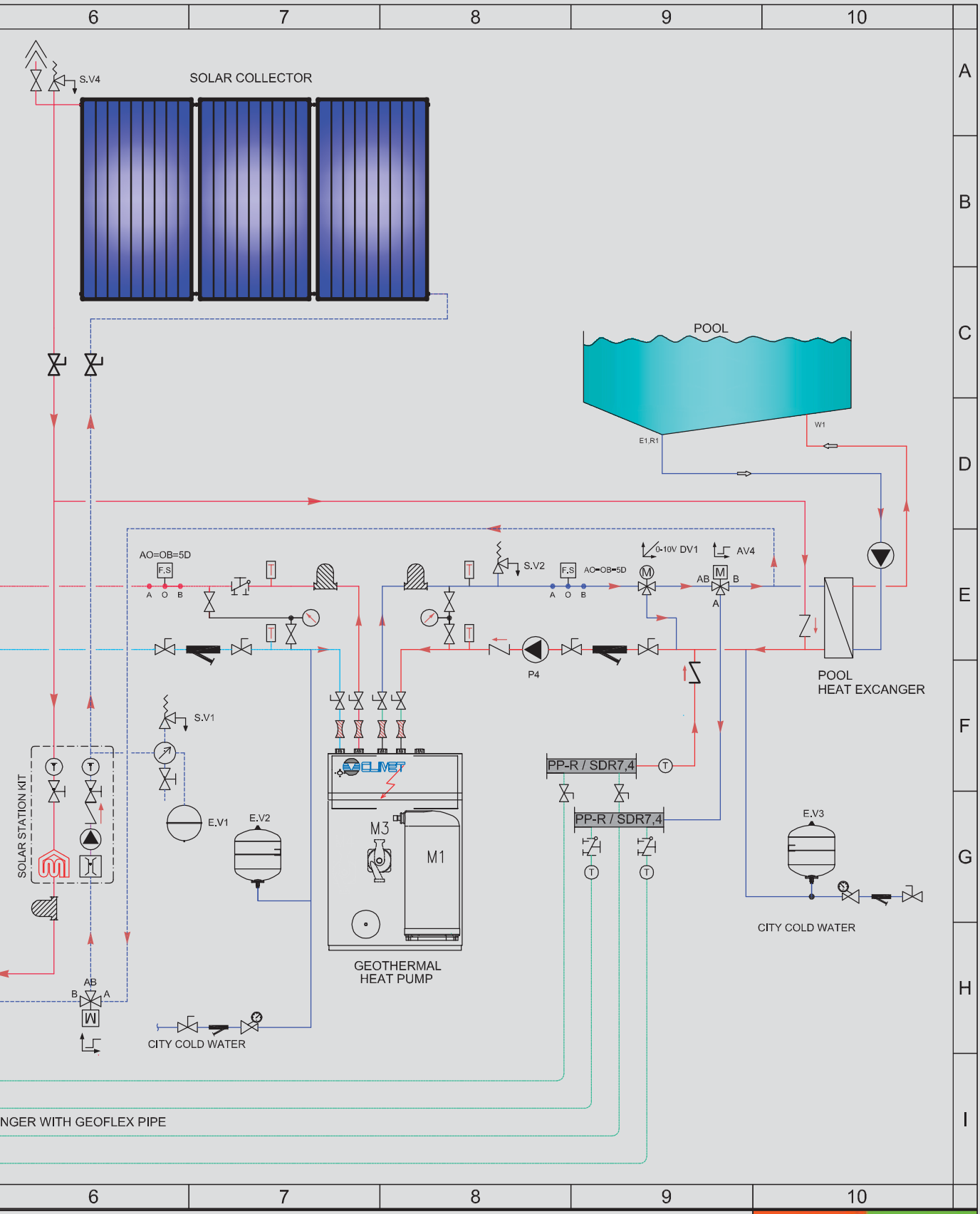
Let's assume thermal requirements of the building are 25 kW.
Efficiency of the proposed heat pump COP = 5.
Temperature difference in the evaporator is 5°C
Required drilling supply is 5m³/h

All parameters for the system should be determined by the supervising engineer and the geologist, who, according to the data, will determine the final design of the system, while having the responsibility for its proper operation.



PROJECT TITLE

HYDRAULIC DIAGRAM OF GEOTHERMAL (WATER TO WATER)HEAT PUMP, WORKING WITH CLOSED
HEATING - COOLING, FAN COIL UNIT ASSISTED BY SOLAR COLLECTOR FOR HEATING, SANITARY W



HORIZONTAL GEOTHERMAL HEAT EXCHANGER FOR UNDER FLOOR
ATER (FRESH WATER STATION AND POOL PASSIVE HEATING.

SOLAR ASSISTANCE FOR UNDERFLOOR HEATING

Interplast is making a step forward in the field of solar assistance in underfloor heating and offers a complete package for the use of solar energy in heating.
With the **Interplast Green Line** system it is easy to achieve the low temperatures required for the operation of the underfloor heating by using solar collectors in days with moderate or intense sunlight during the winter. As such, we economize and at the same time do not burden the environment by using the sun, which is a clean and inexhaustible source of energy. The number of selective solar panels and the volume of the tank in tank are chosen according to the location and the energetic needs for heating and for domestic hot water.

Advantages

The solar assistance for underfloor heating system is installed and is proportioned to give us hot water for the heating of the areas in winter and domestic hot water all year round. In this way, even in the coldest days with little sunshine, we can feed the heating system with hot water, saving energy. At the same time, we drastically reduce the emissions of gases, while protecting the environment, we upgrade the energy class of the building and increase the value of the property.

Pre-adjusted operating range

We take advantage of the water in the solar panels in mainly low temperatures, since the underfloor heating does not require temperatures above 45°C. For this reason, water temperatures in the solar system from 50 to 55°C can be supplied into the tank-in-tank independently, without the operation of a fixed power source. If the water that is contained within the solar system has a lower temperature, it is set so as to stop the flow until it reaches the desired temperature setting.
This function is set during the installation of the system using a differential solar thermostat.

Fully automated operation

The solar assistance system for heating includes all those provisions which are necessary to automate the operation. The overall system configuration takes place during the first operation and is fully automated.

Low Maintenance

Only a periodic inspection is necessary.

System calculation

The calculation of the system can be made either:
- With an hour-to-hour simulation by using a PC and by taking into account the climatic conditions in that region, or
- Approximated for each month of the year, with the help of charts and tables from the bibliography, and from the meteorological data of each region.

Approximate method – Pre cost estimate

To support the heating and the production of domestic hot water of a house, one might consider as an initial approach the following as prerequisites:
- 0,08 - 0,11m² panels surface / 1m² heated surface
- 50 - 75lt thermal tank / m² panels surface
Given that:
-The consumption of hot water use is approximately 50 lt per person and per day at 45°C.
-The average annual heating surface is 25 - 35% depending on the geographic latitude of the region.
-The annual solar radiation is about 1,000 kWh/m².

Initial table selection

From the table below we can easily and quite accurately calculate, according to the square meters of the underfloor heating, the volume of the tank-in-tank and the surface of the solar panels:

Tank-in-tank	500	750	1000	1500	2000
Underfloor heating coverage (m²)	100	150	200	300	350
Panels surface (m²)	8	12	16	24	32
Pump station	√	√	√	√	√
Solar system differential	√	√	√	√	√
Antifreeze	25%	25%	25%	25%	25%
or thermal solar operator SI (%)	100%	100%	100%	100%	100%
Solar expansion tank (lt)	35	50	80	100	150

Note: the exact selection is made at the end of the study and according to the particularities of the installation.

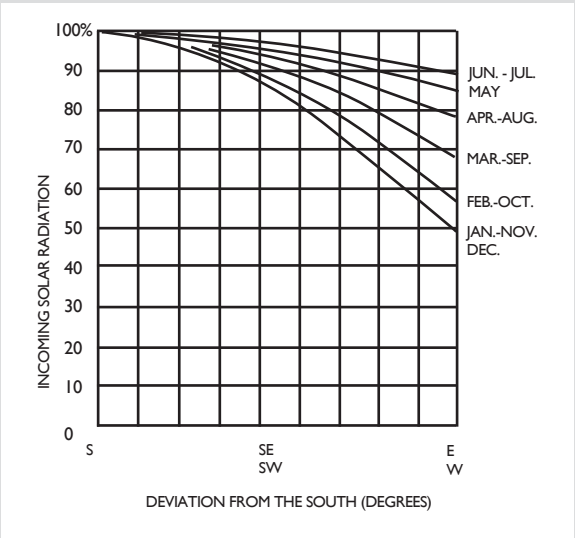
Installation of solar panels

The first step for the installation of solar panels is finding a location with sufficient orientation and inclination, bearing in mind that the main concern is their better and more efficient operation during the winter months.

Panel orientation

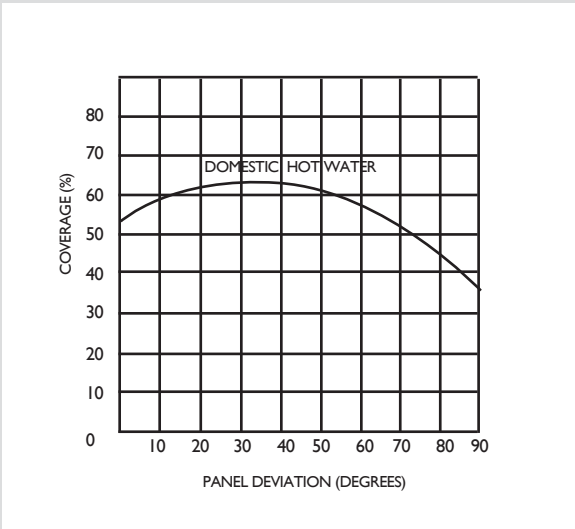
The orientation should be towards the South, with:
Inclination up to 15°.
- Least efficiency reduction.

Inclination > 15°.
- Significant reduction in efficiency during the winter months.
- Mainly lower efficiency during the summer months.



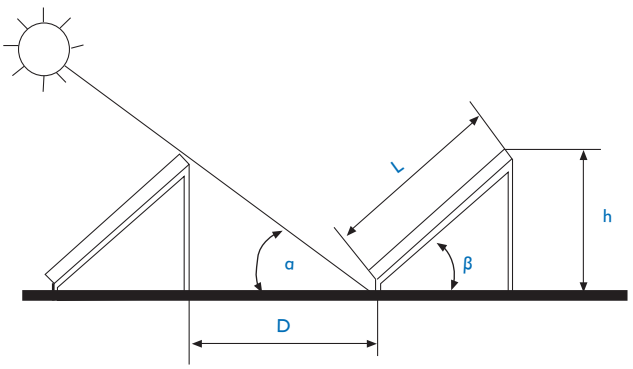
Panel inclination

For the best system performance during the winter months, the inclination angle of the solar panels should be equal to the latitude of the region plus 10-15° (for ex. 48° to 53° for Athens, Greece).



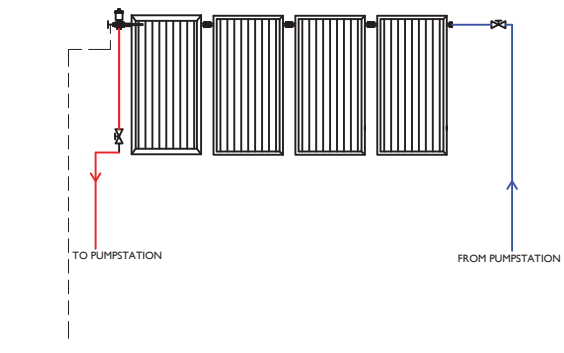
Avoidance of shading

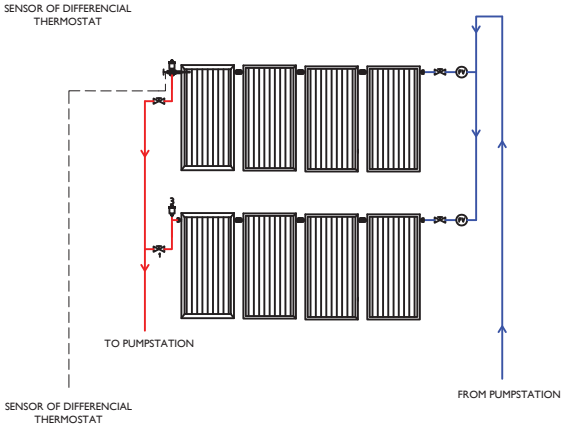
In installations where there are more than one array of solar panels, shading should be avoided. Below is shown how to calculate the minimum distance Dmin that has to be followed during the installation:
Distance D between the solar panels array D = L x sin(β)/tan(α)
Shading avoidance from obstructions Dmin = 2 x h



Examples of connection of panels

Depending on the number of solar panels that an installation includes, their connection should also be made in respective arrays. The following figures show the connection of four solar panels in an array and the connection of eight solar panels in two parallel arrays.





Each selective solar panel is connected to the adjacent panel with a mechanical compression brass coupling. The connections of three or four panels in series make up an array.
Caution: Connecting more than four panels in an array is not allowed.
Each array should contain:
- An isolation ball valve (input – output of the array)
- An automatic airvent for solar placed in the warm outlet
- A regulatory flowmeter in the input line for balancing
- A temperature sensor of the differential system
- A safety valve

In more that one array, the sensor and the safety valve are placed in only one of them.

Study – Method of analysis using a PC

The solar assistance for a heating system, as aforementioned, can cover 25 to 35% of the annual heating needs of any building with multiple benefits such as the cost reduction of the heating system, the reduction of gas emissions and the energetic upgrading of the building. **Interplast**, by using a relevant computer program, can hand over to the installer of the solar system, a solar system study of each building with the performances and the percentage savings thereof. The outcomes resulting from this calculation are proportional to the solar panels surface area, the volume of the tank-in-tank, the heating needs, but also to the location of the building.

Below is a typical layout of a solar assistance for a 150m² house in Athens, where we have taken into account all the above chapters and comprises:
- Surface of the panels is 12m²

- Tank in tank of 750 liters

- Heat pump output of 17 kW

- "Fresh Water" system for domestic hot water (alternatively we could use a tank-in-tank with an internal stainless steel coil for domestic hot water)

- Underfloor heating

Installed solar power:	8,40 kW	
Installed clean solar panels surface:	12 m²	
Radiation in the surface of the panes (Active surface.):	19,95 MWh	1.662,21kWh/m²
Produced power output from the panels:	6,28 MWh	523,39 kWh/m²
Produced power output from the solar system:	5,13 MWh	427,72 kWh/m²
Produced thermal energy for domestic hot water:	3,39 MWh	
Produced thermal energy for heating the areas:	9,74 MWh	
Solar contribution:	5,13 MWh	
Energy from secondary source:	9,31 MWh	

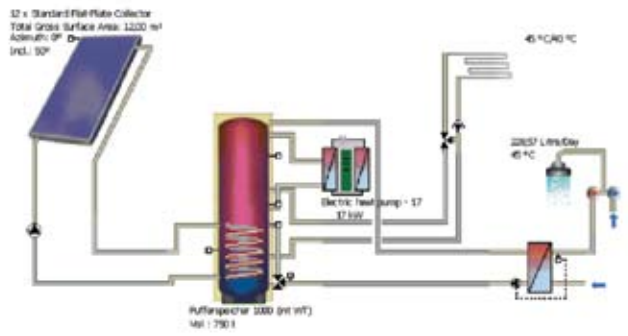
Reduction of CO_2 gases:	**926,74kg**
Total savings from solar:	**35.7%**
Total energy savings (EN 12976):	**32,1%**
System performance:	**25.8%**

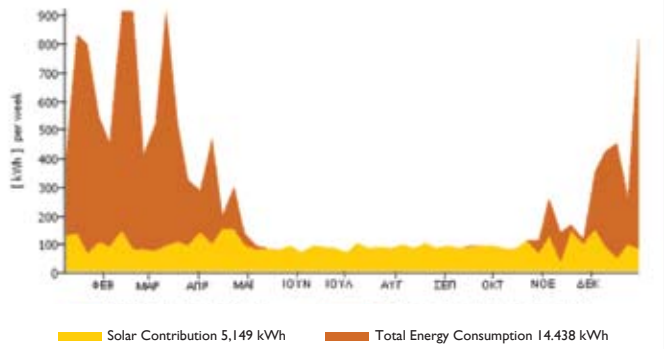
The results shown in the calculation study of the solar system reveal, in real terms for a period of one year of operation, the savings that can be achieved. For this case, indicative, we have:

Power savings -> 2.053,0 kWh
CO_2 emissions reduction -> 1.367,32 kg
Total annual energy savings -> 35.5%
Annual system efficiency -> 25.7%

These results clearly indicate the possibilities for energy savings and, consequently, financial savings that the proprietor can have.

TABLE SHOWING THE CONTRIBUTION OF SOLAR ENERGY IN THE OVERALL CONSUMPTION

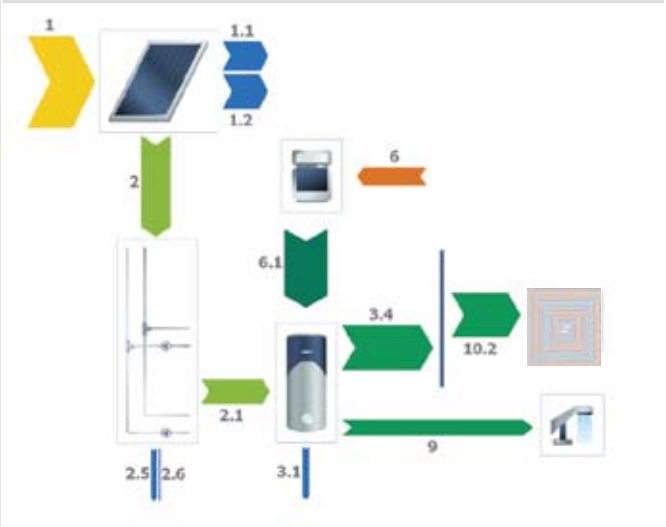




The table shows in graph format the contribution of solar energy in the overall energy needs for heating and for domestic hot water. The vertical axis of the chart is the energy in kWh and the horizontal axis shows the months of a year. In red is the energy consumption (kWh) required to meet the demand and yellow shows the "free" energy that is provided to the system from solar. In the example that we have chosen, the 150m² house in Athens, the total energy consumption is 14,438kWh and the contribution of the solar panels is 5,149kWh.

Furthermore, the calculation study of the solar system also depicts the energy balance of the whole installation, as is shown in the below schematic diagram.

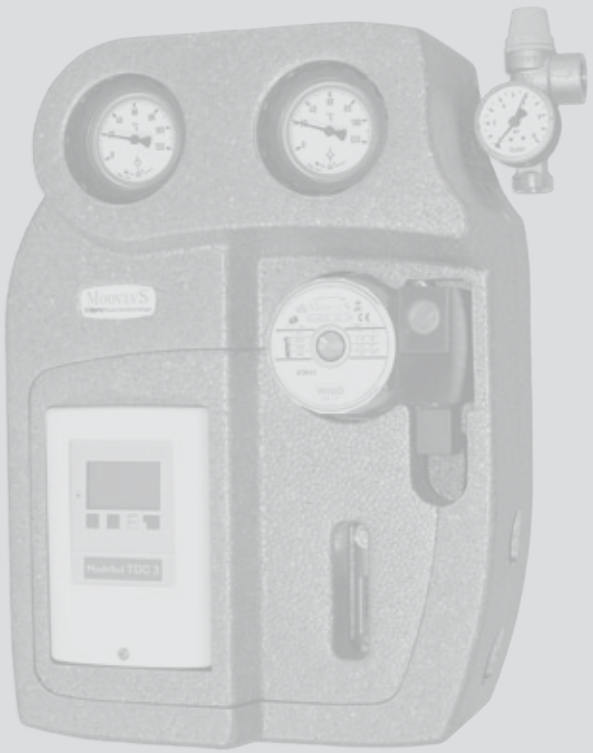
ENERGY BALANCE

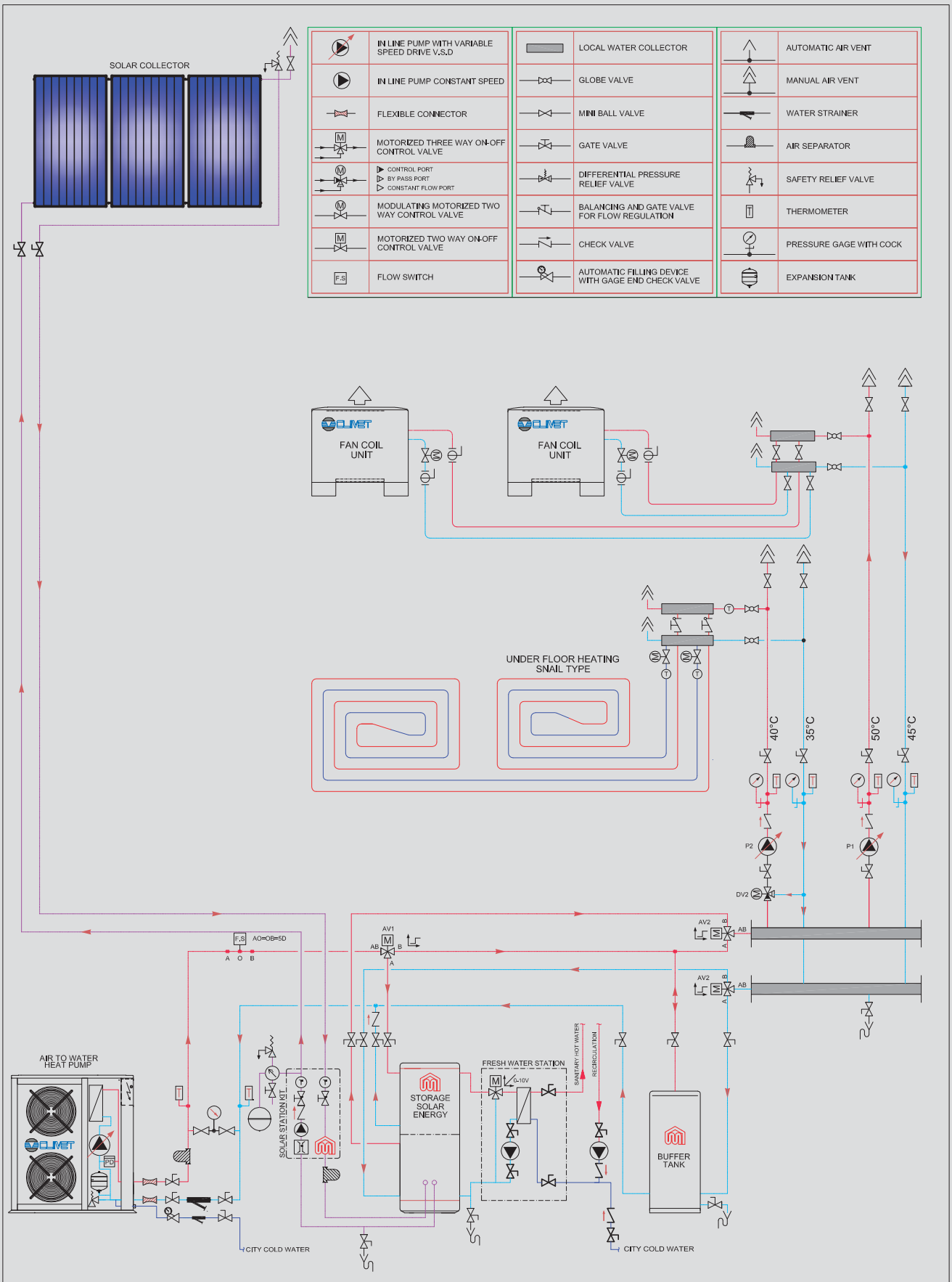


LEGEND

1. Radiation in the panels surface (active surface)	19,946 kWh
1.1 Optical panel losses	6,250 kWh
1.2 Thermal panel losses	7,401 kWh
2. Energy from panel arrays	6,295 kWh
2.1 Solar energy in the tank in tank	5,149 kWh
2.5 Internal piping losses (solar)	971 kWh
2.6 External piping losses (solar)	176 kWh
3.1 Tank losses	1.320 kWh
3.4 Energy from tank to heating system	9,744 kWh
6 Consumption of the second energy source	2,511 kWh
6.1 Supplemental energy to tank	9,289 kWh
9 Domestic hot water energy from the tank	3,386 kWh
10.2 Usable energy for heating of areas	9,744 kWh

From this diagram we can comprehend the energy flow throughout the installation and can optimize the process by taking into account the places where we have large energy losses. By using well-insulated solar panels we can reduce the heat losses to the environment (7,401 kWh (1.2) in the above example) increasing, simultaneously, the energy transferred from the solar panels arrays (2). The secondary source that we will use is also of crucial importance. In the above energy balance, by using an air/water heat pump, the energy that has been consumed is 2,511 kWh (6) and the amount of energy transferred to the tank in tank is 9,289 kWh (6.1).





PROJECT TITLE

HYDRAULIC DIAGRAM FOR AIR TO WATER HEAT PUMP, UNDER FLOORHEATING - COOLING, FAN COIL UNIT ASSISTED BY SOLAR COLLECTOR FOR HEATING, SANITARY WATER WITH FRESH WATER STATION AND COMMON BUFFER TANK

PUMP STATION WITH HEAT PUMP AND SOLAR ASSISTANCE FOR HEATING AND FOR DOMESTIC HOT WATER

The present technical description is intended to explain how the diagram operates.

Internal consumptions

The diagram shows the heating and cooling of an underfloor system, the cooling or dehumidification by using local fan coil units, the assistance in heating and the production of domestic hot water.

Energy sources

The production system of cold and hot water is hybrid because it uses two primary sources of energy (solar and electric) and also a secondary source, the ambient air of the environment.

Managing energy sources

The management of the energy sources is made from an automation panel, which includes a differential controller, temperature and pressure sensors, the management software of the heat pump, a logical analog - digital command management controller. The panel bears all the relevant electrical switches.

Operation in winter

Priority of the system is given in the exploitation of the solar energy and its use for domestic hot water and for heating of the areas. The controller, in the heating mode, performs the following sequence of actions: it activates the three-way valve AV1 in position AB-D, the AV2 in position AB-B, activates the hydraulic solar power kit to carry hot water from the solar panels into the solar energy reservoir. Within the reservoir, the control sensors in collaboration with the fresh water level, stir the hot water so as to create a uniform temperature.

Heating mode

When the temperature of the storage tank is above 55°C there is no need to have the simultaneous operation of the air cooled heat pump. The P1 & P2 circulators are activated and extract hot water from the reservoir to the underfloor heating branches and to the fan coil units. In the case where the temperature of the reservoir is low due to insufficient sunlight, then the heat pump is activated and makes up for the missing energy in the storage tank operating at least for 8-10minutes (minimum time for a complete refrigerant cycle). A time operator of the controller monitors the power recovery of the system. If it does not manage to recover the heat within a reasonable time through the reservoir – pump, then it switches off the pump and the P1 & P2 circulators. However, the hydraulic balance of this operation is ensured by regulating the supply (regulator valve) of the main circuit (pump-reservoir) with a Δp of 0.5Bar (ΔT 5°C) and of the secondary circuit (reservoir – lines) with a Δp of 0.5Bar (ΔT 5°C) with the help of Inverter circulators.
It then activates the three-way valve AV1 into position AB-B, the AV2 into position AB-A. It restarts the P1 & P2 circulators and the heat pump, and gives immediately the supply temperature of 50-55°C towards the consumptions, while saving energy in the buffer tank. In this case, the hydraulic balance is preserved through the buffer tank. More specifically, in the case that P1 & P2 or just one of them stop working, the heat pump's integrated circulator will circulate the water through the buffer tank ensuring that Δp remains at 0.5Bar (ΔT5°C) in the main circuit.
Furthermore, if domestic hot water is requested and the reservoir does not have the proper temperature, P1 & P2 get activated, AV1 takes the AB-A position and at the same time activates the heat pump, feeding instantly through the reservoir into the fresh station hot water. Simultaneously, the consumptions extract energy from the buffer tank (storage room), which is set to have energy for as long as the heat pump produces domestic hot water retaining the Δp at 0.5Bar (ΔT 5°C) in the secondary circuit.

Fresh water station

The hot water is supplied fresh to the consumer through a high efficiency stainless steel plate heat exchanger. The main difference with the common water-heater systems is that water does remain stagnant inside the tank, preventing the growth of pathogenic organisms such as the bacterium Legionella pneumophila. Another advantage is that it consumes only as much energy as needed. For example, if we require 60 liters of hot water, power will be spent to heat these liters, in contrast to thermal tanks of constant volume from which we use the quantity that is desired and the rest is saved without sometimes needing it for the rest of the day.
The recirculation of domestic hot water is functioning by a temperature and a time sensor.

Operation in the summer cooling mode

The controller, in the cooling mode, performs the following sequence of actions: it activates the three-way valve AV1 into position AB-B, the AV2 into position AB-A, enables the communication of the three-way mixing valve DV2 with the cooling controller, activates the P1 & P2 circulators and switches on the heat pump in cooling mode. In cooling mode, the solar energy reservoir and the hydraulic solar power kit support only the fresh water station for domestic hot water. In case of sun insufficiency, the operation of domestic hot water is the same as described in heating.

FLOOR LAYING

Como-Floor pipe

Polyethylene ø17x2 pipe resistant to high temperatures with oxygen barrier designed for underfloor heating. The pipe is characterized by its great flexibility and most importantly, that it exceeds the operating temperature requirements of the specific installation. As for the oxygen barrier, it protects and increases the life of the installation's metal components (for ex. boiler). Interplast Como-Floor pipe is produced in accordance with all European standards and it is certified by the greatest European and American Institutes.

Motherboard

Motherboard manufactured of expanded polystyrene with humidity insulation (PE film) and a heat insulation density of 30kg/m³, in dimensions 135x75x4.5 cm. It permits the layering of 75, 150 or 225 mm circuits. The motherboard bears slots which allow the perfect fitting of the pipe.
Due to its geometry it ensures that the pipe is perfectly supported and covered by the plaster coating and for the absorption of the whole thermal load that it carries.

Perimetric insulating tape

Manufactured from polyethylene foam, bears a nylon film (placed on the motherboard for impermeability against the concrete) and an adhesive for fixture.

Expansion joint

Placed at predetermined points, selected during our study, and at the lower cases of the building's internal doors so that they can absorb the thermal concrete's contractions and expansions.

Clips

Are used for fixing the pipe to the motherboard, when required

Pipe reel

To simplify the installer's task of laying the pipes, **Interplast** provides a special reel for carrying long pipe lengths (600m). The reel is lightweight for easy transportation in indoor areas and is painted with electrostatic paint.

Plasticizer

Improves the composition of the concrete, increases its strength, its water tightness and its plasticity. This results in its easier pumping and pouring.

PP-R fibers

They reinforce the concrete and protect it against cracking while increasing its tensile and compressive strength, resulting in improved strength of the thermal concrete and mitigating problems related to temperature changes.

DISTRIBUTION PANEL

Manifold

The manifold is the "heart" of the installation. **Interplast**, through its subsidiary ELVIOM, with more than 50 years experience in the manufacturing of brass fittings, produces a manifold for underfloor heating, which guarantees the required flows for the circuits and the system's perfect balance.
It is a bar type brass nickel-plated manifold, without connections, nominal diameter 1" or 1 ¼" with 3/4" threading (Eurocone).
The supply manifold bears Allen bolts or flowmeters for the regulation of the circuit's supplies, while the return manifold includes thermoelectric actuator valves enabling the fitting of thermoelectric actuators which receive commands from the thermostats of each area and enable independent operation of the respective circuits of each space.
In order to achieve optimum regulation of the heating system, special supply and return nipples with fitted thermometers are being used.

Manifold cabinet

Metal cabinet, suitable for in-walling, produced from galvanized steel, 1mm in width and painted with an electrostatic paint. Can be adjusted to a height of up to 815 mm. Bears an adjustable removable frame for protection from the plaster, which sets the panel depth from 115mm to 165mm.

Mixing unit system

The mixing unit system is fitted within the distribution panel and constitutes a solution for the mixing of water to obtain the desired temperature of the supply water in the horizontal system of the underfloor heating. It is mainly recommended in cases of mixed heating systems (underfloor and radiators).
If the mixing system has been chosen for the installation, then separate devices and branches to the boiler are not required.

AUTONOMIES – AUTOMATIONS

Thermoelectric actuators

Thermoelectric actuators are connected through a communication base with the corresponding thermostat and open or close the underfloor heating circuits.
In this way we can achieve independency in the areas of a house and as a result, more economical operation and the selection of different temperatures in each heating area.

Communication base – distribution 24 and 230 Volt

The 24 or 230 volt bases receive commands from the room thermostats and give further commands to the thermoelectric actuators on the manifold to open and to close the circuits depending on the desired temperature in each area.

Circulator activator

Starts or stops the circulator with the required time delay when the thermostats give start and stop heating commands to the thermoelectric actuators.

Room thermostat

With the thermostat, which reacts to temperature changes of up to 0.1°C accuracy, we achieve the desired area/room temperature. In this way we achieve a tenfold increase of temperature accuracy compared to common thermostats.

Digital communication base

A digital communication base for setting an autonomous desired temperature in every area/room of the building. It can control up to 32 thermal actuators and 8 room thermostats. Digital display of the temperature of each room, of the environment temperature and the water temperature used in underfloor heating.
It has a built-in actuator for two circulators and a heating source (boiler, heat pump). It gives the possibility to set, through an electric valve motor, the water supply temperature in the underfloor system (preset of the supply temperature).
At the same time, it incorporates a compensation system using an environment sensor. It detects and displays possible faults, can be connected to a BMS system and if necessary, more than one base can be connected in series.
The same base communicates with either wired and wireless thermostats or a combination of them.

Room thermostats with function selector

Aesthetically designed according to modern needs, a room thermostat with four functions selector and with the possibility of connecting a floor sensor. The temperature control of the area is achieved through a PI-control, achieving prompt temperature variations and preventing the inertia of the system.
The thermostats can be either wired or wireless. Heating/cooling function.

Digital room thermostat

Digital room thermostat with programming function. Easy to use menu for setting the desired room/area temperature. PI-control operated and can be either wired or wireless. Heating/cooling function.

Cooling kit

A cooling kit for the communication bases which includes a humidity sensor for avoiding floor condensation and a summer-winter operation switch.

Weekly programmable, illuminated thermostat

Digital room/area thermostat with a weekly programming option. With a precise measurement checking every ten minutes and with four levels of desired temperatures.
Involute temperature for optimal comfort conditions and energy savings.
Continuous operation of anti-icing.
Range of temperature control: 5°C to 45°C.
The thermostats are either wired or wireless. Heating/cooling function.

MACHINE ROOM

Safety thermostat

Switches of the operation of the circulator when the water temperature exceeds the maximum desired setting.

Three and four-way mixing valve

The use of a four-way mixing valve allows an initial setting of the hot water temperature supplied by the boiler (around 50°C). After the four-way, a three-way mixing valve is installed in the supply line of each group of manifolds, reducing again and differently for each manifold, the temperature of the water directed to the floor.

2-way Solar Pumping station & three way mixing valve

It contains 2 connection adaptors, a three-way mixing valve for the regulation of the water supply, a circulator, 2 valves with special thermometer handles and a return valve (20mbar). The packaging comes in an external EPP insulation. The distance of the center of the supply and return pipes is 125mm. Available in 1" and 1 ¼". Operating range: max. temperature 110°C, max. output 35kW, max. flow 1500lt/h.

The pumping station can be combined with:

Electric motor for mixing vales M21

Three-way electric motor for three and four-way mixing valves. Bi-directional with a 90° movement range. Combined with a safety thermostat for the regulation of the water supply temperature.

Electric motor for mixing vales CMP 25 with weather compensation and climatic controller

Three-way electric motor with touchscreen for three and four-way mixing valves. Bi-directional with a 90° movement range.
It identifies the ambient temperature and through a sensor activates the three-way mixing valve and the heating circulator. This prevents the inertia of the system according to the temperature changes of the environment, achieving cost-efficient heating.

2-way Solar Pumping station with three way mixing valve & integrated controller for constant water supply

It contains 2 connection adaptors, a three-way mixing valve with integrated safety thermostat for constant regulation of the water supply temperature in the desired temperature, a circulator, 2 valves with special thermometer handles and a return valve (20mbar). The packaging comes in an external EPP insulation. The distance of the center of the supply and return pipes is 125mm. Available in 1" and 1 ¼".

Safety thermostat for three or four-way valves motor with preset supply temperature

Co-operates with the M21 electric motor for mixing valves to set the desired supply temperature. Deactivates the operation of the circulator in the case that the water temperature exceeds the maximum desired setting. Includes an ANTI-STOP function, which restarts the circulator every 14 days and for a period of 30 seconds, to avoid its blocking during the period when heating is ceased.
Temperature control range: +10°C to +80°C.
Dimensions in mm: 90x150x52

Electronic Machine-room Controller

Electronic controller managing heating systems with 5 sensors and 6 commands. Capability of setting two separate circuits, for ex. three-way mixing valve and circulator activation. It includes an external ambient temperature sensor. Suitable for connection to an electrical rail. Has 4 preset programs for machine-room applications. Backlit touchscreen.
Temperature control range: -20ºC to + 99ºC
Dimensions in mm: 90x160x59

AIR-TO-WATER HEAT PUMPS

Advanced device that uses the energy offered by the environment and utilizes it for the heating and cooling of any house. Air-to-water heat pumps "pump" the energy from the external air and heat the water that runs through the circuits of the underfloor heating. Respectively, in the summer they produce cold water, which we use to cool the house. They are specially designed for use in underfloor heating and cooling applications, guaranteeing maximum performance with the lowest power consumption (COP bigger than 4). The heat pumps offered by Interplast are characterized by the advanced software and are available in a great range from 5 up to 100kW, covering the totality of installations.

Compact

An ideal solution for mild climates and for installations which require both heating and cooling. With a capacity of producing hot water up to 55°C, cool water from 5°C and domestic hot water. Very silent operation thanks to the scroll compressor. Includes a water pump (circulator), an expansion tank and a flow switch.
Capability to compensate the exterior temperature and parallel connection to the boiler. Operates with ecological means R-410A. Big capacity range from 5 to 40kW.

Extended Inverter

High efficiency units with DC Inverter, energy class A, with COP more than 4.2 for heating and cooling. Produces hot water of up to 60°C at very low ambient temperatures.

Has the capability to produce domestic hot water, to compensate and the option to use an Inverter circulator. It operates with refrigerant R-410A. Contains a built-in hydraulic module.

Horus and Horus+

Ideal for "heavy" climates with low outdoor temperatures. Have the possibility to be placed either outside or inside. They posses a scroll type compressor (Horus) or scroll injection (Horus+).
Capability of producing hot (60°C) or cold water, domestic hot water, connection to a boiler and compensation with the external temperature. Ecological refrigerant R-407C.

Vulcan

Units specially designed to produce hot water (and domestic hot water) up to 60°C even when the outdoor temperature falls to 10°C. Ideal solution for existing traditional heating systems for replacing the boiler. Highly efficient and noiseless operation. Includes a water pump, an expansion tank and a flow switch, and gives the capability to be simultaneously connected to a boiler, to a weather compensator and to an electrical resistance.

Gaia Air

Air-to-water heat pump of the latest technology with DC Inverter compressor and DC motor fan. It includes a built-instorage tank for domestic hot water able to be connected to solar thermal panels, Inverter heating and recirculation circulators, safety valves and an expansion tank.
Heating and cooling operation temperatures from -22°C to 53°C. Efficiency capacity ranging from 6 to 21kW and is adjusted according to the requirements of the heating/cooling system. Therefore, the unit becomes highly economical with a high degree of efficiency (COP 4,7). The fan of the pump can be placed either inside or outside. Included is a remote keypad for the overall control of the unit. Operates with R-410 A refrigerant.

Medium

Air to water heat pump, eurovent energy efficiency class A (COP greater than 4).
Capacity of the units ranging from 29 to 84kW for heating and from 24 to 72kW for cooling. They contain two scroll type compressors with a cooling circuit and 3-stage power, enabling maximum performance at partial or full-load.

Vulcan Medium

Heat pumps with heating capacity from 29 to 100 kW and from 25 to 93 kW for cooling. The units of the Vulcan Medium series are known for their high degree of performance (COP greater than 4) and are energy class A certified.
They contain two scroll type compressors and two cooling circuits enabling maximum performance at partial-load.
High energy efficiency particular during partial-load operation. Can operate with outdoor temperatures ranging from -18°C to +50°C and can produce hot water of up to 60°C and cold water from 7°C. Includes a built-inhydraulic module as well as a keypad for the complete control of the unit (settings, operation indications, errors). Ideal solution for big domiciles or housing residences and for commercial applications.

WATER TERMINAL UNITS

DC variable speed fan coils, slim line

Aesthetic water terminal units (fan coils) for cooling and heating the areas of any building.
The variable speed fan integrated in the units make them extremely quiet and ideal for installations such as residential bedrooms and hotel rooms.
Depending on the requirements of the installation, they are available in three different types - visible, in-wall, roof hidden. The visible type is fitted with a built-in controller/ thermostat.

Fan-coils

Water terminal units with wide range of capacities for cooling and heating from 1.5 to 9kW (cooling) and from 3.6 to 17.1kW (heating) for heating-cooling installations but also for supporting the underfloor. Available in four types (floor, roof, in-wall or roof hidden) and can satisfy the demands of any installation. Ideal for single area residential spaces and for commercial use. Available with a wide range of analog and electronic controls and thermostats.

Wall Fan-coils

Stylish and elegant wall fan-coils for heating, cooling and dehumidification of any building. The microprocessor of the units ensures smooth operation and precise control of the room temperature. Available for their operation with a wide range of analog and electronic controls and thermostats. Capacity range from 3.3 to 9,5kW for heating and from 1.5 to 4,6 kW for cooling.

"Cassette type" Fan-coils

Water terminal units of "cassette" type to be mounted on suspended ceilings. Ideal solution for heating and cooling areas in commercial malls, but also for single-spaced residential areas. The roof "cassette" type fan coils are also available in a roof model for visual installation. Available in electromechanical or electrical version. Wide range of power capacity from 3,1 kW to 13,2 kW in the heating mode and from 2,8 kW to 11,9 kW in the cooling mode.

"High static" Fan-coils

Water terminal units of this type constitute the ideal selection in installations where ducted air distribution is necessary. They are designed for installation in suspended ceilings and are distinguished by their noiseless operation obtained thanks to both the internal and the external insulations. They have built-in high static centrifugal fans allowing the installation of lengthy air ducts. The capacity range of the units varies from 20kW to 94kW and satisfies the needs of most installations.

GEOTHERMY

Ground

Water-to-water heat pump or otherwise called geothermal pump, with which we can utilize the ground's geothermal capacity by using a horizontal or vertical geo-exchanger. Solid dimensions and noiseless operation by using scroll type compressor for the refrigerant (R-410A).
It can produce hot water up to 60°C for heating, domestic hot water and cold water from 5°C to be used for cooling. It has a built-in water pump, a differential pressure valve and a buffer tank, and has the capability to include a hydraulic module as well for the geothermal circuit. The high performance coefficient (COP up to 6.5) makes their use extremely economical.

Gaia Water

A water-to-water heat pump of the latest technology with a DC Inverter. It includes a built-in tank for domestic hot water and can be connected to solar panels, inverter circulators for the heating circuit and for the outdoor close loop geothermal pipe system, an inverter recirculation circulator, safety valves and an expansion tank. Operation for heating, by producing hot water up to 60ºC, and for cooling. The output range varies from 8 up to 25 kW and gets adjusted according to the heating/cooling needs. As such, this unit has an extremely low consumption with a high COP. It includes electronic keypad for the complete control of the unit. Operates with R-410A refrigerant.

GEO-Flex pipe

Polyethylene ø25 pipe (for horizontal geo-exchanger) and ø32 pipe with welded probe (for vertical geo-exchanger). Main feature of the pipe is its high Oxidation Induction Time, which gives the advantage of high Environmental Stress Cracking Resistance, as are those of the underground installations (buried in the ground). Another advantage is the high thermal conductivity of the Geo-Flex pipes (λ = 0,862 W/m°C, as has been measured by the Aristotle University of Thessaloniki), which is 110% higher than the common polyethylene pipes (λ = 0,410 W/m°C - DIN 8075).
Interplast has managed to achieve this enhanced property by using special additives in the manufacturing process of the pipes.

The high thermal conductivity of the Geo-Flex pipes renders them ideal for geothermal applications because the heat transfer from the earth to the building has the highest efficiency.
Certification: SKZ Germany

Polypropylene manifolds

Pairs of manifolds (supply and return) made from Random polypropylene are installed for the horizontal or vertical geo-exchanger. The manifold body is available in ø63 and in ø75 and with ¾" and 1" supply saddles. The outlets depend on the circuits we shall install in the subsoil. They also have a mounted airvent and an extra valve for filling the geo-exchanger.

Weight for installing vertical geo-exchanger

Is attached to the probe and helps in the installation of the pipes in the bore hole.

Spacer for vertical circuit piping

Is placed on the group of four pipes that are installed in each bore hole and keeps them at a fixed distance.

SOLAR ASSISTANCE FOR UNDERFLOOR HEATING

Selective solar panel

It has a 2.0 m² surface with a titanium dioxide coating.
Its absorber is manufactured from successive 0.20 mm thick sheets. In this way, the absorption rate of the solar panel approaches 95% of incident solar radiation.

Domestic hot water tank

Operates as a buffer tank providing the necessary hot water for the heating of the floor. The tank is well insulated with a layer of polyurethane, provides anodic protection and the interior is specially treated with a coating for resistance to high temperatures.
The capacity of the container is chosen according to the surface of square meters to be heated and varies between 500 to 2000lt. Besides the basic type, it is also available with an internally fitted stainless steel coil through which fresh domestic hot water is produced.

Two-way solar pumping station

It includes a differential thermostat with 3-sensors and 2 commands, an adjustable flow meter, 2 valves for filling and draining, a special "low energy" pump for solar systems, 2 valves with special thermometer handles and 2 non-return valves (10mbar), a 6bar safety valve, a manometer, ¾" outlet for connection to an expansion tank and a manual circuit airvent.
The packaging comes in an external EPP insulation.

Pumping station for the instantaneous production of domestic hot water

It is connected to the hot water storage Tank and produces fresh domestic hot water, avoiding bacterial contamination phenomena, such as legionella that are created by stagnant water. Available in 20 lt/min and 40lt/min models.
Its features are:
-Very small losses of flows.
-The supply of the circulator is less than 1 lit/min due to the built-in differential pressure switch.
-The system is pre-cabled and only requires a power supply of 230 volt.
-Facile adjustment of the temperature of the thermal-mixing valve for water temperatures from 45°C to 65°C.
-EPP-insulation with special mounting brackets for the wall.
-Possibility to simultaneously connect up to 5 units for a nominal supply of 200 lit/min.

Differential thermostat

Differential thermostat for solar systems with 3 sensors and 2 commands. Possibility to choose amongst four available modes, where the differential thermostat operates on the chosen mode.
Suitable for connection to electrical rail.
Range of reading and operating temperature: -40°C to +250°C.
Dimensions in mm: 85x52x60.

Who is Interplast?
Interplast is a company that manufactures plastic PEX, PE, PE-RT, PP-R, PP-H, PB, PVC pipes and PVC, ABS, PP-R, PP-H, PS and PA plastic fittings and brass fittings. With years of experience in the field, **Interplast** has established itself amongst the elite of European manufacturers of plastic pipes for water supply, plumbing, heating, cooling, geothermal systems and sewage applications.

What are the different methods used for cross-linking of Pex?
The differences in the cross-linking methods lie in the means used to cross-link polyethylene (for example peroxide method a, silane method b, radiation method c). All methods used aim at rendering the cross-linked polyethylene pipe compliant with the strong requirements specified in the European standard EN ISO 15875 and DIN 16892/16893.

How suitable is Como-pex for drinking water?
Como-pex pipes are non-toxic and totally safe for water and foodstuffs. Toxicological tests carried out in numerous industrially developed countries certify the approval of using cross-linked polyethylene pipes for drinking water. Como-pex pipes have been granted certification of suitability for drinking water by the British Institute WRAS, member of NSF United States.

What is the guarantee offered for Como-pex pipes?
Interplast guarantees against damage owing to faulty production for a period of 30 years covered by the Insurance Company Allianz at the amount of € 500,000 per incident and a maximum of € 3,000,000 over the course of a year.

How are your pipes tested?
Interplast is certified by ISO 9001:2008 standards and implements all the procedures of the Quality Assurance System. The controls of our products commence with the quality inspection checks of the received raw materials, the various materials and the packaging materials. Testing of the final products, including, melt flow rate, hydrostatic pressure testing, heat reversion testing, impact tests, determination of the degree of cross-linking, thermal cycling testing, tensile testing, packaging controls and sampling controls in the storage phase. Meanwhile the international certification bodies SKZ, AENOR, WRAS and CSA check the quality of the pipes at regular intervals (every 6 months) by carrying out random sampling control tests from the warehouses and the production lines.

How do the products differ from German or other European pipes?
There is no difference. The quality of the pipes does not lie in the country, but in the way they are produced. **Interplast** covers all the requirements of an ultra-modern production plant with the latest automated equipment which, combined with the stringent quality controls, guarantees the supreme quality of the final product. Testimony to this is the fact that Como-pex pipes hold the same international certifications as other equally competitive European pipes.

What is the service life of Pex pipes?
Pex pipes are exceptionally resilient to ageing in conjunction with conditions of high temperature and pressure. They have been designed to endure over 50 years of continuous operation at 95°C and at a pressure of 10bar. The regression curves diagram confirms the exceptional performance of the pipe when used according to the specifications and recommendations of the manufacturer.

Can non-cross-linked polyethylene pipe be used for cold water supply installations?
No. Non-cross-linked polyethylene pipes are designed to convey drinking water. They are a cheaper alternative, but not the recommended solution. The pipes installed inside a building should be capable of meeting high requirements in mechanical strength in order to prevent hydraulic hammers.

What brass alloys are used by Elviom?
ELVIOM produces fittings from two main brass alloys, CW617N and CW614N. These alloys are selected as specified by the European standards and comply with the standards of EN12164/EN12165/EN12168: 1998, which refer to the content of individual components of the alloy brass, as well as with the standard DIN 50930/6 for potable water.

What is the annealing treatment and how important is it?
The brass fittings after some machining must undergo a thermal processing (stay in the furnace for a specific time and at specific degrees of Celsius) to smooth out any developing trends that have resulted from the treatment. This procedure practically eliminates any likelihood of season cracking, that is cracking of the fittings that have already been installed.

Why is it important that we use a bar-type manifold in the balancing valves manifolds and in the radiator valves?
In the bar type mechanism, in contrast to other types of mechanisms, when rotating the wheel only the valve moves, without the axis moving up and down. As such, this prevents the build-up of salts on the O-rings, prevents wear of the O-rings at the axis and allows the smooth and frequent operation of the mechanisms for many years of use.

Why should a bar type manifold with balancing valves be used in plumbing installations?
The advantage of a plumbing installation with a distribution panel is the isolation of the circuits in case of failure. The ON/OFF switches (mini ball valves) have a smaller cost but have the danger of malfunctioning after a short period of time due to build-up of salts. Furthermore, their uses also increase the risk of hydraulic strike.

Why should a bar type manifold with balancing valves and a 3/4 supply be used for heating installations?
The bar type manifold with balancing valves is a prerequisite for heating installations in many EU countries. Interconnections between the manifolds are not allowed because possible damage between the manifolds is difficult to repair. The Eurocone has been established in the EU countries as the permanent supply, as it enables greater quantity of water to flow through the circuits.
The balancing valves enable perfect micrometric regulation of the water supply, which is not possible with the ON/OFF valves.

What is underfloor heating?
Underfloor heating is a reliable and effective heating method which has been used for many years in the countries of Northern and Central Europe, where rather low temperatures are common. Underfloor heating is based on the circulation of hot water through pipes encased in the floor. Heat is evenly distributed over the area by radiation, offering a comfortable sensation of warmth and coziness while at the same time saving space and money, since the operating cost is lower. Underfloor heating can be used in both new residences and building renovations or extensions.

How does it work?
Water from the manifold flows through the various piping circuits. Balancing valves control the water flow according to the desired temperature set by the thermostat.

Don't the pipes run the risk of leakage?
When an installation has been carried out properly, in accordance with the design instructions, there is no risk of pipe leakage. With a lifespan of more than 50 years, Como-pex pipes display exceptional strength. All pipes are produced in accordance with the procedures of the ISO 9001 Quality Assurance System and are controlled under the most stringent specifications before being distributed to the market. In very rare incidences of leakage, the pipes can be repaired with total safety and the connection will be 100% watertight.

Is it possible that the floor reaches such a high temperature that it will be burning?
No. A well-designed underfloor heating project will provide comfortable heat. The floor temperature can reach 29°C, way below the temperature of the human body. At this temperature the floor is warm and comfortable to walk on, even barefoot.

What type of flooring can be used for underfloor heating?
All types of flooring are suitable for underfloor heating so long as the installation design makes the necessary allowances and incorporates all the necessary measures for its safe and smooth operation.

Doesn't it cost more than other heating systems?
Generally speaking, underfloor heating is indeed more expensive than heating with radiators but offers savings in the bills. The investment is quickly paid back due to the lower cost of its operation and maintenance. Finally, apart from the ideal comfort, the warmth and the coziness offered by the system, underfloor heating adds value to a residence.

Can underfloor heating cover areas with indoor balconies and large openings?
Precisely because heat is conveyed from the surface of the floor and not from the height of the radiators as is in conventional heating (1.20m) or an air conditioning unit (2.50m), we can achieve the desired temperatures even in areas with a high ceiling, as heating is provided to the effective height of the area (approx. 2.10m) and not to the ceiling of the building (as is the case with conventional systems).
Furthermore, it covers the needs of building with large openings and no available external walls for the installation of radiators. Underfloor heating is thus an invaluable tool for contemporary architectural design.

What is the required size and type of boiler/fuel?
In general terms any kind of boiler and fuel can be used as a heating source. Boilers have a physiological size according to the required thermal load, according to the thermal losses calculated and taking into consideration other needs, such as the supply of domestic hot water.

What sources of heat can be used for an underfloor heating installation?
Any kind of boiler and fuel (for ex. oil, gas, etc.) can be used as a heat source or, alternatively and closer to the demands of our era, any heat pump could also be used, either air-water or geothermal.

Why use a heat pump instead of a boiler?
Heat pumps are classified as "green energy" because they have zero emissions. The comparative advantages of the heat pump are indisputable. The heat pump can provide heating and cooling of a house/building. The heat pump has a high 285 to 550% efficiency on given outdoor conditions and type of pump and low consumption compared to a conventional heating system with a boiler which has a 85 to 94% efficiency. The installation of a heat pump does not require a chimney, no ventilation, no fuel tank or other additional fire safety insurance provisions and can be installed in existing or in new constructions.

Can the Heat Pump produce Domestic Hot Water?
All Heat Pumps have the capability of producing Domestic Hot Water.

How much space is required to install a Heat Pump?
Heat pumps are compact units, which are placed either outside the house/building (air-cooled pumps) or in the pump room (water cooled pumps), taking up very little space. The tanks associated with the pumps are much smaller in size than those of the boiler, resulting in requiring much less space in the machine room. Furthermore, installing a heat pump does not require a fuel tank which occupies a lot of space in the machine room.

What are the surrounding needs of a geothermal installation?
There are three types of geothermal installations, horizontal, vertical and open. Depending on the needs for heating and cooling of each facility, the available space/surface in the surrounding area and if there exists the necessary amount of water for drilling (in the case of the open circuit), one of the three aforementioned types of geothermal installation is proposed. The vertical and open type geothermals require less square meters of surrounding area/space compared to the horizontal geothermal for the same heating installation.

What changes are necessary to be made so that the underfloor heating system operated by a boiler is converted to an alternative form of energy?
In an existing underfloor heating system operated by a boiler, a heat pump may be added with no alterations in the interior of the house/building.

Should the main piping from Aqua-Plus be insulated when the installation operates in heating or cooling?
The thermal conductivity of the Aqua-Plus is very low rendering it possible to reduce thermal losses in the hot water circuits. This means minimum temperature drop along the piping thus saving energy and consequently not needing some sort of pipe insulation when the installation operates in underfloor heating. Furthermore, the low thermal conductivity causes a drastic reduction of condensations on the outside of the pipe when the temperature and humidity conditions are unfavorable. However, if the installation works in cooling, in order to nullify the condensations that can be created, it is wise that the main lines be insulated with the least insulation.

Can the solar system assist the operation of the Heat Pump in heating the floors?
The solar system can operate in both supporting the underfloor heating and the production of domestic hot water in conjunction with the heat pump.
With the Interplast Green Line system we easily achieve the low temperatures required for the operation of the underfloor heating in conjunction with the solar system on days with moderate or intense sunlight during the winter.

Our steady growth puts Interplast in the first place in sales of plastic pipes for water supply and heating for building establishments in the Greek market. At the same time, our increasing export activities are now reflected with a plethora of works and projects in all the manufacturing sectors throughout Europe and the Middle East. And for us, our lead is shown by our participation in numerous constructions of hotels, hospitals, commercial shops/malls and residential units.

- Olympic Village, Athens, Greece
- Athens International Airport, Spata, Grece
- "The Mall", Recreational & Shopping center, Amaroussion, Athens, Greece
- "Mediterranean Cosmos", Recreational & Shopping center, Thessaloniki, Greece
- Saida Mall, Tyros, Lebanon
- Ministry of Housing, Bahrain
- Court House, Pieria, Greece
- Hondos Shopping Center, Thessaloniki, Greece
- "Thallasokomos" Aquarium, Heraklion, Greece
- "Grande Bretagne" Hotel, Luxury Hotels, Athens, Greece
- Domes of Elounda, Luxury Hotels, Elounda - Crete, Greece
- St.Regis Hotel & Residential Towers, Luxury Hotels, Doha, Qatar
- Murex Hotel 5*, Lebanon
- Grecotel Olympia Riviera, 5*, Kyllini, Greece
- Aldemar Royal Olympian, 5*, Pyrgos - Ilia, Greece
- Aldemar Royal Mare, 5*, Crete, Greece
- Olympian Village, 5*, Ilia, Greece
- Grand Serrai, 5*, Ioannina, Greece
- Zorbas, 5*, Tigaki - Kos, Greece
- Gaia Palace, 5*, Mastichari – Kos, Greece
- Blue Lagoon, 5*, Kos, Greece
- Iberostar Astir Odysseus, 5*, Tigaki – Kos, Greece
- Lindosbay, 5*, Lindos – Rhodes, Greece
- German Sports Tower, Dubai Sports City, UAE
- 505 Villas – Uptown, Emirates City, UAE
- 14 Villas (Waster Prop), Jumeirah Village, Dubai, UAE
- Bab Al Rayyan 400 – Village Villas, Doha, Qatar
- Alia Apartments, Bucharest, Romania
- Garden View, Sin El Fil, Lebanon
- Jawad & Jaffer Villa, Bahrain
- Green Lake Residences, Bucharest, Romania
- West Park, Bucharest, Romania
- Monaco Towers, Bucharest, Romania
- General Hospital of Kavala, Greece
- General Hospital of Igoumenitsa, Greece
- 424 Military Hospital, Thessaloniki, Greece
- Genesis Maternity Clinic, Thessaloniki, Greece
- Bio-climatic schools of Ialysos, Afantou and Kremastis – Rhodes, Greece

"Mediterranean Cosmos" Mall, Thessaloniki, Greece

Green Lake Residences, Bucharest, Romania

St. Regis Hotel & Residential Towers, Doha, Qatar

Grande Bretagne Luxury Hotels, Athens, Greece

General Hospital of Kavala, Greece

Olympic Village, Athens, Greece

EN ISO 15875
Piping systems of cross-linked polyethylene for the installation of hot and cold water.

DIN 16892/93
Pipes of cross-linked polyethylene.

DIN 1988
Technical rules for domestic water use installations.

DIN 4725
Underfloor heating. Systems and components.

DIN 4726
Underfloor heating. Plastics piping systems.

EN ISO 21003
Multilayer pipes for carrying hot and cold water into buildings.

EN 1264
Heating systems of surfaces.

EN 12828
Building heating systems. Design of hot water heating installations.

EN 12831
Building heating installations. Method for calculating typical thermal load.

EN 14336
Heating buildings.

EN 15377
Heating systems in buildings.

EN 806
Technical rules for domestic water use installations.

EN 12164
Copper and copper alloys. Bars for machining applications.

EN 12165
Copper and copper alloys. Bars worked on forging.

EN 12167
Copper and copper alloys. Rectangular rods and profiles for general purposes.

EN 12168
Copper and copper alloys. Perforated rods for machining applications.

ISO 228
Pipe threads, where the water tightness is not made in the threads.

EN ISO 7 (DIN 2999)
Pipe threads, where the water tightness is made in the threads.

DIN 50930 / 6
Corrosive behavior of metallic materials in contact with water. Their effect in water quality.

EN ISO 2001:2008
Application of the quality management system.

GUARANTEE STATEMENT

Statement No.....

Owner (Beneficiary).....

Installer.....

Date of Installation.....

Pipe Lot No.....

This guarantee covers the products of Interplast and its subsidiary ELVIOM as described in the Cross-linked Polyethylene technical manual.

- 30 years for Como-pex and Como-pex Oxygen barrier pipes for the applications described in the technical manual and in accordance with the manufacturer's instructions document.
- 30 years for Como-floor pipes used in underfloor heating installations
- 10 years for brass fittings made by ELVIOM S.A.

Interplast S.A. is obliged, in the event of damage, to carry out disassembly and re-assembly of the specified items and repair all the immediate damages caused by its products, under its own management or to assume the incurred expenses after the budgeted liability has been checked and approved by Interplast.
In addition, compensation is provided for damages resulting from civil liability related to the product or our own liability owing to faultiness of the abovementioned products.
We guarantee the aforementioned lifespans from the date of installation to the amount of up to €500,000 per incident and a maximum of €3,000,000 over the course of a year.

Conditions for the compensation mentioned above:

a. Damage is reported the latest within 14.
b. Instructions have been followed precisely (see technical manual) relating to the installation and operation of **Interplast** pipes and fittings.
c. The present statement has been signed and submitted to our company within a maximum of 15 days from commencement of operation.

On behalf of INTERPLAST S.A.

.....

We confirm that our works, i.e. installation of **Interplast S.A.** pipes and fittings, were carried out in accordance with the instructions in the technical manual.

....

Place Date Plumber (Stamp – Signature)

Registered Offices: 10th km National Highway Thessaloniki-Katerini 57 400
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Plastics factory: Industrial area of Komotini, 69 100, P.O. Box. 227
Tel.: +30 25310 38811-12, Fax: +30 25310 38813, e-mail: komo@interplast.gr

Brass products factory: 4 Iou st. Monomati, 136 71, Acharnai Athens
Tel.: +30 210 6204400, Fax: +30 210 8076210, e-mail: elviom@interplast.gr

interplast.gr