plastherm®

Technical Catalogue

American Qualitiy Assessors
ANSI-RAB QMS ACCREDITED
ISO 9001 REGISTERED COMPANY

DVGW

TSE

TZW

Company Profile

Plastherm has been the leader in the sector for over 12 years, producing PPR (polypropylene random copolymer) pipes and fittings with highest German technology agreeable to German DIN 8077-8078 standarts, with TYP-3 raw material and Borealis raw material which is accepted as one of the best raw materials in the world.

Our major concern has always been the quality and enviromentally harmless and non-polluting products, as well a satisfacting customer service even after the sales.

Exporting our products to more that 27 countries throughout the world, our vision is to expand and offer this quality and safety to many as we can.

Hoping that this catalogue will be a bright guideline for you to overview our company, our products, application areas, our quality and hygiene standarts, we would like to thank you for choosing PLASTHERM quality and service. We are looking for perfectionism...

General Manager

Quality Assurance Manager

A view of our production plant

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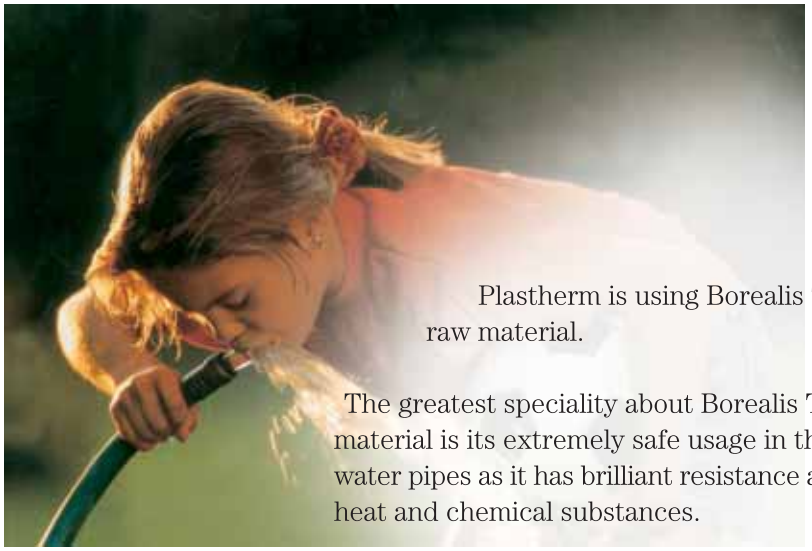
1. The Plastherm System



Plastherm is using Borealis TYP-3 raw material.

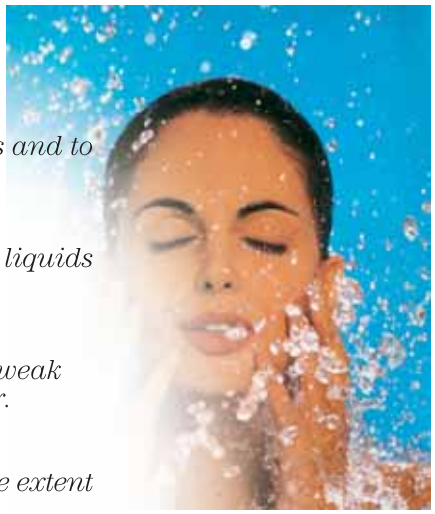
The greatest speciality about Borealis TPY-3 material is its extremely safe usage in the hot water pipes as it has brilliant resistance against heat and chemical substances.

The products which are produced from this raw material are hygienic and complies perfect with nutriment charter because it is not also affected by any biological substances.

Our system consists of a wide range of products with variety of application areas.

From the raw material itself, to the distribution stage of our products, every level of production remains with environment-friendly material.

2. The System Features



• No abrasion
It is resistant to water and chemicals and to acids and alkalis.

• No crust formation
No deposit or lime formations which liquids leave in other type of pipes.

• Less condensation and heat loss
Like all plastic materials, PP-R is a weak conductor of heat but a good isolator.

• Resistant to ice formation
To the frozen liquids it resists on the extent of its elasticity by widening.

• Less presure loss
As surface roughness is less, the abrasion losses are much less.

• Less noise
Ear disturbing vibration and noises are not transmitted.

• High life duration and stability
Plastherm pipes are appropriate for water flowing with high speed without any corrosion problems. 50 years of warranty according to the pressure and temperature used.

• Hygenic and Healthy
All products in the Plastherm system are non toxic, hygenic and healthy.

3. Our Product Range

- Pipes
- Fittings
- Welding Machine
- Accesorries

4. Application Areas

- Clean water installations in all type of buildings
- Hotels, motels and holiday villages
- Hospital, thermal springs and dormitories
- City drinking water networks
- Sera, garden and agricultural administratings
- Combi, air pressure tank and geyzer connections
- Cold water radiator connections
- Can be used safely in acidic, alkaline, airy, salty and greasy environments.

5. Quality Standarts

In accordance with our company objectives, our quality management in conformity with DIN ISO 9001 is mainly directed towards our customers and the market. Our inner factory quality standarts include raw material testing, production survey, and testing finished products as prescribes in DIN standarts.

Tests are conducted continuously in our own laboratory , guaranteeing maximum safety. All results are filed to provide the proceeding surveys and individual data measurement.

We also get the collaboration of the independent testing institues to ensure that our products fits well with the other applicable specifications like DIN, Ö-Norm and ISO and that thier quality remains at a constant high level.

All pipes and fittings of our factory production undergo the following tests:

- Melting index test of raw materials
- Testing accurancy of dimensions and surface nature
- Interior long-term pressure test of 1 hour at 20°C and up to 80 bar depending on the nominal pressure degree
- Notched bar impact test
- Thermal test
- Welding index of processed materials
- Microscopic examination
- Continuous tube sheet thickness survey and measurement

Samples of all feeds are submitted to a long,term internat pressure test lasting 1,000 hours at 95°C and up to 18 bar.

It is our objective to carry out practice- oriented problem solving, by appliying scientific methods and to satisfy our customers by quality and depenable delivery.

6. Standarts

Here are some major standarts and their definitions

- DIN 8077 A1
Polypropylene pipes, dimensions

- DIN 8078
Polypropylene pipes, overall quality requirement test

- Insert 1 to DIN 8078
Polypropylene pipes- chemical resistance of pipes and pipe secitons

- DIN 16962
Pipe connections and pipe sections for polypropylene (PP) pressure pipe systems, Section 5-9, 12

- DIN 16928
Pipe connections, pipe sections, installation, general guidelines

- DIN 1988
Technical regulations for drinking water installations (TRW1)
Technical regulations of the DVGW

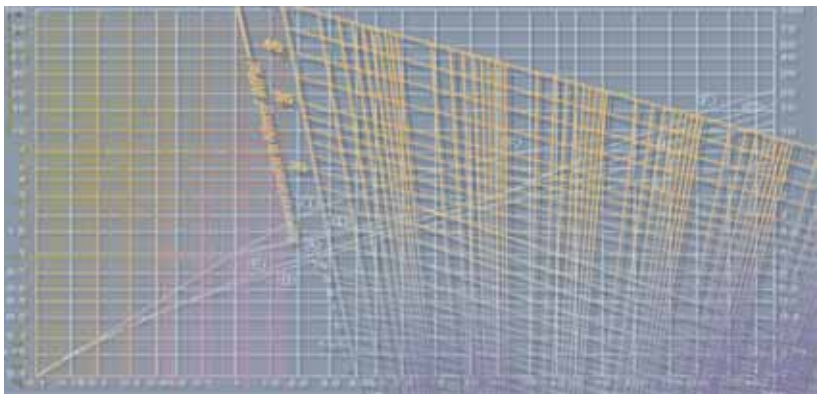
- DIN 4046
Water suuply, designations, technical regulations of the DVGW

- DVS 2207 T11
Heating elements for welding of thermoplastic synthetics, polypropylene (PP) piping

- DVS 2205 T1
Calculation of thermoplastic containers and devices, parameters

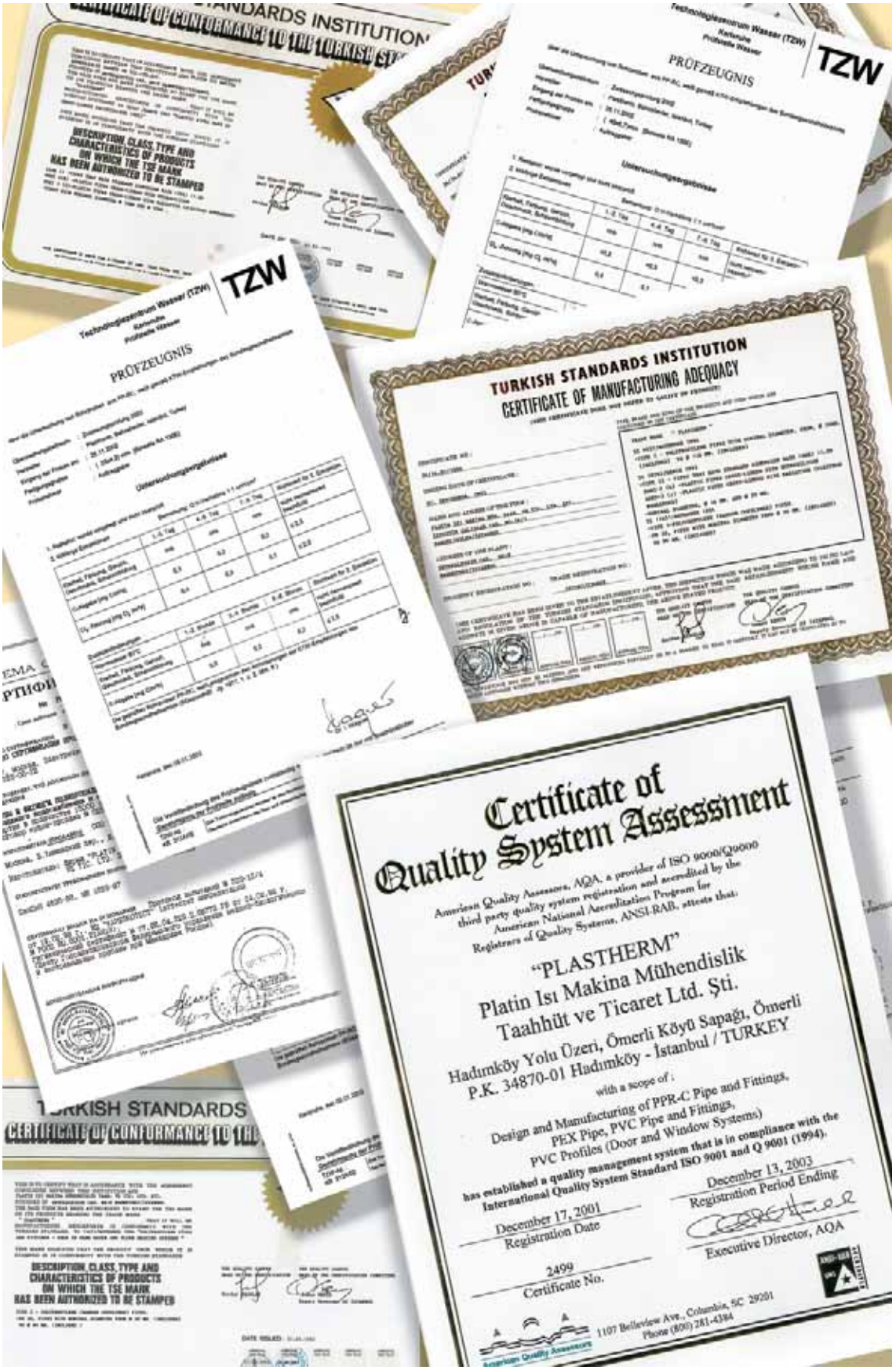
- Ö-NORM B5174
Polypropylene pipes, dimensions, requirements, tests, standart coefficients

- Ö-NORM B5157
Plastic compound pipe systems for hot and cold water, dimesions, requirements, tests, standart coefficients



DVGW : German Association of Gasavd Water Specialists.

7. Certificates



8. Technical Data

8.1. Material Properties

Property	Measuring technique	Unit	Value
Coefficient of viscosity J. Average molar weight	ISO 1191 Solvent viscosity c = 0.001 g/cm3	cm^3 /g -	400 470.000
Melting index MFI 190/5 MFI 230/S	ISO / R1133 Procedure 5 Procedure 14	 g/10 min g/10 min	 0.5 1.5
Density	ISO / R1183	g/cm^3	0.895
Melting range	Polarizing microscope	°C	140-150
Double voltage Ultimate tensile strenght Expansion at tear	ISO / R 527 Char Speed D test bar fig. 2	N/mm^2 N/mm^2 %	21 40 800
Ball-pressure hardness	ISO 2039 (H 358 / 30)	N/mm^2	40
Bending stress at 3,5 % Edge fibre expansion	ISO 178 Test specimen 5.1	N/mm^2	20
Modulus of elasticity	ISO 178	N/mm^2	800
Modulus of transverse elasticity -10 ºC 0 ºC 10ºC 20ºC 30 ºC 40 ºC 50 ºC 60 ºC	ISO / R 537 Method A	 N/mm^2 N/mm^2 N/mm^2 N/mm^2 N/mm^2 N/mm^2 N/mm^2 N/mm^2	 1,100 770 500 370 300 240 180 140
Tensile properties further to impact bending test at 0 ºC	DIN 8078		No fracture
Impact strength (according to Charpy) RT 0 ºC -10 ºC	ISO / R179 Test bar in conformity with fig. 2	 mJ/mm^2 mJ/mm^2 mJ/mm^2	 No fracture No fracture No fracture
Notched bar impact value (according to Charpy) RT 0 ºC -20 ºC	ISO / R179 Test bar in conformity with fig. 2	 mJ/mm^2 mJ/mm^2 mJ/mm^2	 15 4.2 2.5
Expansion coefficient	VDE 0304 Part 1§ 4	 K^{-1}	 1.5×10^{-4}
Caloric conductibility at 20 ºC	DIN 52612	W/m K	0.24
Specific heat at 20 ºC	Adiabatic calorimeter	kJ/kg K	2.0

8.2. Chemical Resistance

Chemicals	Conc. %	POLYPROPYLENE °C 20° 60° 100°
A		
Acetic acid Δ	100	+ 0 -
(glacial acedik acid)		
Acetic acid aq. Δ	50	+ +
(see also vinegar)	10	+ + +
Acetic anhydride	100	+
Acetone	100	+ 0
(Boiling point 56,3 °C)		
Alcoholic iodine		+
Alum	sat.	+ +
Alums aq.	any	+ +
Aluminium salts aq.	any	+ + +
Ammonia, gaseous	100	+ +
Ammonia aq.	conc.	+ +
	10	+ +
Ammonium acetate aq.	any	+ + +
Ammonium carbonate aq.	any	+ + +
Ammonium chloride aq.	any	+ + +
Ammonium nitrate aq.	any	+ + +
Ammonium phosphate aq.	any	+ + +
Ammonium sulphate aq.	any	+ + +
Amyl alcohol, pure		+ +
(fermentation amyl alcohol)		
Aniline	100	+ (+)
Antifreeze agent (cars)** Δ		+ +
Apple juice		+ +
Apple sauce		+ + (+)
Aqua regia		+ -
Asphalt**		+ 0
ASPIRIN®		+
B		
Barium salts	any	
Beef suet		+ + +
Beer		+ +
Benzaldehyde	100	+
Benzaldehylde aq.	sat.	+
	(0.3)	+
Benzene □	100	
Benzoic acid	100	(-) -
benzoik acid aq.	sat.	+ +
Bleaching solution		+ + +
(12.5 %active chlorine)		0 0
Bone oil		
Borax aq.	sat.	+ (+)
Boric acid	100	+ +
Boric acid aq.	sat.	+ +
	(4.9)	+ +
Brake Fluid** Δ		
		+ +
Brandy		
Bromine liquid	100	+
bromina, vapours	high	-
	low	- -
Bromine water	sat.	0 -
Butane, gaseous	100	- -
Butane liquid □	100	+ +
		+
Butter		+ +
Buttermilk	100	+
Butly acetate Δ	100	+ 0
n- Butly alcohol (n-butanol) Δ		+ +

** Chemical resistance depends upon the composition

Chemicals	Conc. %	POLYPROPYLENE °C 20° 60° 100°
C		
Cake		+ + (+)
Calcium chloride aq.	sat.	+ + +
Calcium nitrate aq.	sat.	+ + +
Camphor		+
Carbon bisulphide	100	0
(Bolling point 46,2 °C)		
Carbon tetrachloride Δ	100	0 -
Caustic potash solution	50	+ +
	25	+ +
	10	+ +
Caustic soda solution Δ	50	+ +
	25	+ +
	10	+ + +
Cheese		+
Chloride of lime		+ +
(aqueous suspension)		
Chlorine, gas, dry	100	- - -
Chlorine, gas, humid	10	0 - -
Chlorine liquid	100	-
Chlorine water	sat.	0 -
Chlorobenzene	100	(-) -
Chloroform Δ	100	- -
Chlorosulphonic acid	100	+ +
Chromic acid	sat.	
	20	
Chromic/sulfiric acid		+ +
Chromium plating solution**		+
		+
		+ + +
Chromium salts	sat.	+ 0
(bi-and trivalent) aq.		
Cinnamon (cane)		+
Cinnamon (ground)		+
Citric acid aq.	sat.	+ + +
Clove oil		+ 0
Cloves		
Coca-cola®		+
Cocoa (powdered)		+
Cocoa (ready to drink)		+ + (+)
Coconut oil		+ (+)
Cod-liver oil		+ +
Coffee (beans and ground)		+
Coffee (ready to drink)		+ + +
Common salt, dry		+ + +
Copper salts aq.	sat.	+ + +
Corn seed oil		+ 0
Cream, whipped cream		+
Cresol solution		+
Cresol	100	+ 0
Cresols aq.	sat.(0.25)	+ 0
Curds		+
Cyclohexane Δ□	100	+
Cyclohexanol Δ	100	+ +
Cyclohexanone	100	+ -

Resistances
+ = resistant
(+) = practically resistant
0 = of limited chemical resistance
(0) = poorly resistant
- = not resistant

Concentrations
aq. = aqueous
sat. = saturated at room temperature
c = coloured

Chemicals		Conc. %	POLYPROPYLENE °C 20° 60° 100°
D			
Decahydrünaphthalene		100	0 - -
Detergents, synthetic**		high	+ +
(Without solvents, plasticizers		ready for	
and other additives)		use	
Dibutylphthalate			
(see palsticizers)			
Diesel oil, see Fuels			
Dimethylformarnide		100	+
1,4-Dioxane		100	+ 0 -
Dish -washing agents.**			
liquid		+	+ +
DIXAN®		ready for	
		use	
E			
Eggs (uncooked and cooked)			
Ether (Diethyl eteher)**	Δ	100	
Ethyl acetate		100	
Ethyl alcohol	Δ	100	
not denatured			
Ethyl alcohol aq.			
not denatured			
Ethyl benezene	Δ		
Ethyl chloride**	Δ		
Ethylene chloride	Δ		
2- Ethyl hexanol	Δ		
F			
Fixing salt (see also Sodium		10	+ +
thiosulphate)			
Floor wax**			+ o
Flour			+
Fluoric acid		40	+ +
Formaldehyde aq.	Ghc	40	+ +
		30	+ +
		10	+ +
FORMALIN®			+ +
Formic acid	Δ	98	+ o
		90	+
		50	+ +
		10	+ + +
Fruit juice			+ +
Fruit salad			+
Fuel	q		
Petrol, normal			+ o
according to DIN 51635	q		
petrol, regular			(+) -
Petrol, super	q		o -
Diesel oil**	q		+ o
Fuel oil**	q		+ o
Furniture polish**			+ o -

** Chemical resistance depends upon the composition

Chemicals		Conc. %	POLYPROPYLENE °C 20° 60° 100°
G			
Gin		40	+
Glycerine		100	+ +
Glycerine aq.		high	+ +
		low	+ + +
Glycol		100	+ +
Glycol aq.		high	+ +
		low	+ + +
Grapefruit juice			+ +
Gravy			+ + (+)
H			
Hair shampoo**			+ +
Heptane		100	+ o
Hexane		100	+ o
Honey			+ +
Horse-radish, ready-to-eat			+
Hydrochloric acid	Δ	conc.	+ +
		10	+ +
Hydrogen chloride, gaseous (see		high	+ +
also Hydrocloric acid)		low	+ +
Hydrogen peroxide aq.		90	
		30	+ o
		10	+ +
		3	+ + +
Hydrogen sulphide		low	+ +
(Colouration with lead stabilizers)			
I			
Ink**			+ +
Iron salts aq.		sat.	+ + +
Isooctane		100	+ o
Isopropyl alcohol		100	+ +
J			
Jam			+ + (+)
Jelly			+ + (+)
L			
Lactic acid aq.		90	+ +
		50	+ +
		10	+ + +
LANOLIN®			+ o
Lard			+ + o
Lemonades			+
Lemon aroma			+
Lemon juice			+ +
Lemon peel			+
Lemon peel oil			+
Linseed oil			+ +
LITEX®			+ +
Liqueur		any	+
LYSOL®			+ o

Resistances
+ = resistant
(+) = practically resistant
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Concentrations
aq. = aqueous
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c = coloured

Chemicals	Conc. %	POLYPROPYLENE °C 20° 60° 100°
M		
Magnesium salts aq.	sat.	+ + +
Margarine		+ +
MARLIPAL® MG Δ	50	+ +
MARLON® Δ		+ +
(42% active detergent)	100	+
MARLOPHEN® 83	20	+
MARLOPHEN 89	100	+
	5	+
MARLOPHEN 810 Δ	100	+
	20	+
	5	+
MARLOPHEN 820 Δ	100	+
	20	+ +
	5	+ +
Mashed potatoes		+ + (+)
Mayonnaise		+
Menthol		+
Mercuric salts aq.	sat.	+ +
Mercury	100	+ +
Methyl alcohol	100	+ +
Methyl alcohol aq.	50	+ +
Methylene chloride Δ	100	o
(Boiling point 40.7 °C		
Methyl ethyl ketone	100	+ o
Milk		+ + (+)
Milk food		+ + (+)
Mineral oil**		+ o -
(without aromatic		
hydrocarbons)		
		+
Moth balls**		
		+ o -
Motor oil (cars)**		
(see also Two-stroke oil and oil		
according to ASTM)		
		+
Mustard		
N		
Nail Polish		+ o
(Boiling point 40.7 °C)		
Nail polish remover		+ o
(Boiling point 40.7 °C)		
Naphtalene	100	+
Nickel salts aq.	sat.	+ +
Nitric acid	50	o -
	25	+ +
	10	+ +
Nitrobenzene	100	o o
O		
Octance (see Isooctane)		
Oil No.3 according to ASTM D	100	+ o -
380-59		
Oil of bitter almonds		+
Oleic acid	100	+
Oleum	any	- -
Olive oil		+ +
Orange juice		+ +
Orange peel		+
Orange peel oil		+
Oxalic acid aq.	sat.	+ + +
Ozone (<0.5 ppm)		(+) (-)

** Chemical resistance depends upon the composition

Chemicals	Conc. %	POLYPROPYLENE °C 20° 60° 100°
P		
Palm oil		+ o
Paprika		+ +
Paraffin	100	+ + -
Paraffin oil	100	+ o -
Peanut oil		+ (+) (-)
Pectin	sat.	+ +
Pepper		+ +
Peppermint oil		+
Perchlorethylene		
(see Tetrachlorethylene)		
Perfume		+
(The permeability for scents		
should be considered)		
Petrol (see Fuels)		
Petroleum	100	+ o
Petroleum ether	100	+ o
Phenol (aqueous phase)	sat.(appr. 9)	+ +
(phenolic phase)	sat.(appr.70)	+
Phosphoric acid	sat.(85)	+ o
	50	+ +
	10	+ + +
Phosphorus pentoxide	100	+
Photographic developers**	comm.	+ +
	ready	+ +
	for use	
Pickled cabbage, ready-to-eat		+ + (+)
Pickled fish		+ + (+)
Pickled hering		
Pineapple juice		+ +
Pine needle oil	100	+ (+)
Plasticizers		
Dibutylphthalate		+ o
(VESTİNOL®C Δ		
Dibutylsebecate		+
Dihexylphthalate		+
Dinonyladipate		+
Diisononylphthalate		+
(VESTİNOL N) Δ		
Dioctyladipate		
(VESTİNOL OA) Δ		
Dioctylphthalate		+
(VESTİNOL AH) Δ		
Tricesylphosphate		+
Trictylphosphate		+
Porridge		+ + (+)
Potassium carbonate aq. (Potash)	sat.	+ +
Potassium chlorate aq.	sat.	+ +
	(7.3)	
Potassium chloride aq.	sat.	+ + +
Potassium dichromate aq.	sat.	+ + +
	(12)	
Potassium iodide aq.	sat.	+ +
Potassium nitrate aq.	sat.	+ +
Potassium permanganate aq.	sat.	+ (+)
	(6.4)	
Potassium persulphate aq.	sat.	+
	(0.5)	
Potassium sulphate aq.	sat.	+ + +
Potato salad		+
Propane,gaseous	100	+ +
Propane, liquid	100	+
Pudding		+ + (+)
Pyridine	100	+ o

Chemicals	Conc. %	POLYPROPYLENE °C 20° 60° 100°
Q		
Qinine		
R		
Rum	40	+ +
Rum aroma		+
S		
SAGROTAN®		+ o
Salad oil, animal	+	o
Salad oil, vegetable	+	o
Salted water	any	+ + +
Sausage		+ +
Sea water		+ + +
Shoe polish**		+ o
Silicone oil**		+ (+)
Silver salts aq.	sat.	+ +
Soap, cake soap		+ +
Soap solution	sat.	+ +
	10	+ + +
Soda (see Sodium Carbonate)		
Soda water		+
Sodium bicarbonate aq.	sat.	+ + +
Sodium bisuiphite aq.	sat.	+ +
Sodium carbonate aq.	sat.	+ +
	10	+ +
Sodium chlorate aq.	25	+ +
Sodium chloride aq.	sat.	+ + +
(Common salt)		
Sodium chlorite aq.	5	+
Sodium hydroxide		
(Caustic soda)		
Sodium hypochlorite aq.	5	+ +
Sodium nitrate aq.	sat.	+ +
Sodium nitrite aq.	sat.	+
Sodium perborate aq.	sat.	+ + +
	(1.4)	
Sodium phospates aq.	sat.	+ + +
Sodium sulphate aq.	sat.	+ + +
(Glauber's salt)		
Sodium sulphide aq.	sat.	+ +
(Colouration with lead stabilizers)		
Sodium sulphide aq.	sat.	+ +
Sodium thiosulphate aq.	sat.	+ + +
(Photographic fixer)		
Soft soap		+ +
Soybean oil		+ o
Stannous chloride	sat.	+ +
Starch, starch solution aq.	any	+ +
Stearic acid	100	+
Storage-battery acid		+
Succinic acid aq.	sat.	+ +
Sugar (dry)		+ +
Sugar beet sirup		+ + +
Sugar solution aq.	any	+ + (+)
Sulphur	100	+ + (+)
Sulphur dioxide	low	+ + +
(Sulphurous anhydride)		
Sulphuric acid	96	+ o
	50	+ +
	25	+ +
	10	+ + +

Chemicals	Conc. %	POLYPROPYLENE °C 20° 60° 100°
Q		
Tar	sat.	+ o
(Chemical resistance depends upon the composition)		
Tartaric acids aq.	100	+ +
Tea (leaves)	100	+ +
Tea (ready-to-drink)		+ + (+)
Tetrachlorethane	100	(-) -
Tetrachlorethylene Δ (Perchlorethylene)	100	o -
Tetrahydrofuran GhC	100	o -
Tetrahydronapthalene Δ	100	o -
Thick (semolina) gruel		+ + (+)
Thiophene		o -
Toluene		o -
Tomato juice	+	+ +
Tomato ketchup		+ +
Toothpastes		+ +
Transformer oil**	100	o
Trichlorethylene Δ		o (-)
Turpentine oil		o -
Two-stroke oil		o o
Typewriter oil		+ (+)
U		
Urea aq.	sat.	+ +
V		
Vanilla		+ +
Vaseline		+ o
Vegetables (ready-to-eat)		+ + (+)
Vinegar	comm.	+ +
Vinegar essence Δ	comm.	+ +
(here is reterred to a 50% concentration)		
W		
Water	100	+ + +
Water glass		+ +
Whisky	40	+
White spirit		+ o
Wine, mulled claret		+ +
X		
Xylene ❑	100	o -
Z		
Zinc salts aq.	sat.	+ +

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+ = resistant
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8.3. Long-term Behaviour / Durability

By means of the long-term internal pressure diagram and the given formula for determination of the referance tension, it is rather simple to determine the durability.

$$\sigma_v = p \frac{(da-s)}{2s}$$

Explanation of the formula:

σ_v = referance tension [N/mm^2]
p = internal pressure [N/mm^2]
da = external diameter of the pipe [mm]
s = wall thickness of the pipe [mm]

Applicable :

1 bar = 0.1 N/mm^2

Example :

Tube employed 20 X 3.4, nominal pressure degree PN 20, operational pressure 10 bar. The resulting referance tension will be:

$$\sigma_v = 1 \text{ N/mm}^2 \frac{(20 \text{ mm} - 3.4 \text{ mm})}{6.8 \text{ mm}} = 2.44 \text{ N/mm}^2$$

If the referance tension is drawn as a straight line in the long-term internal pressure diagram and is caused to intersect with the isotherms of the corresponding operating temperature, the durability of the pipe to be anticipated in hours will result from the projection onto the X-axis.

In general, however, no point of intersection is reached under the operating conditions encountered in practice. Life > 50 years.

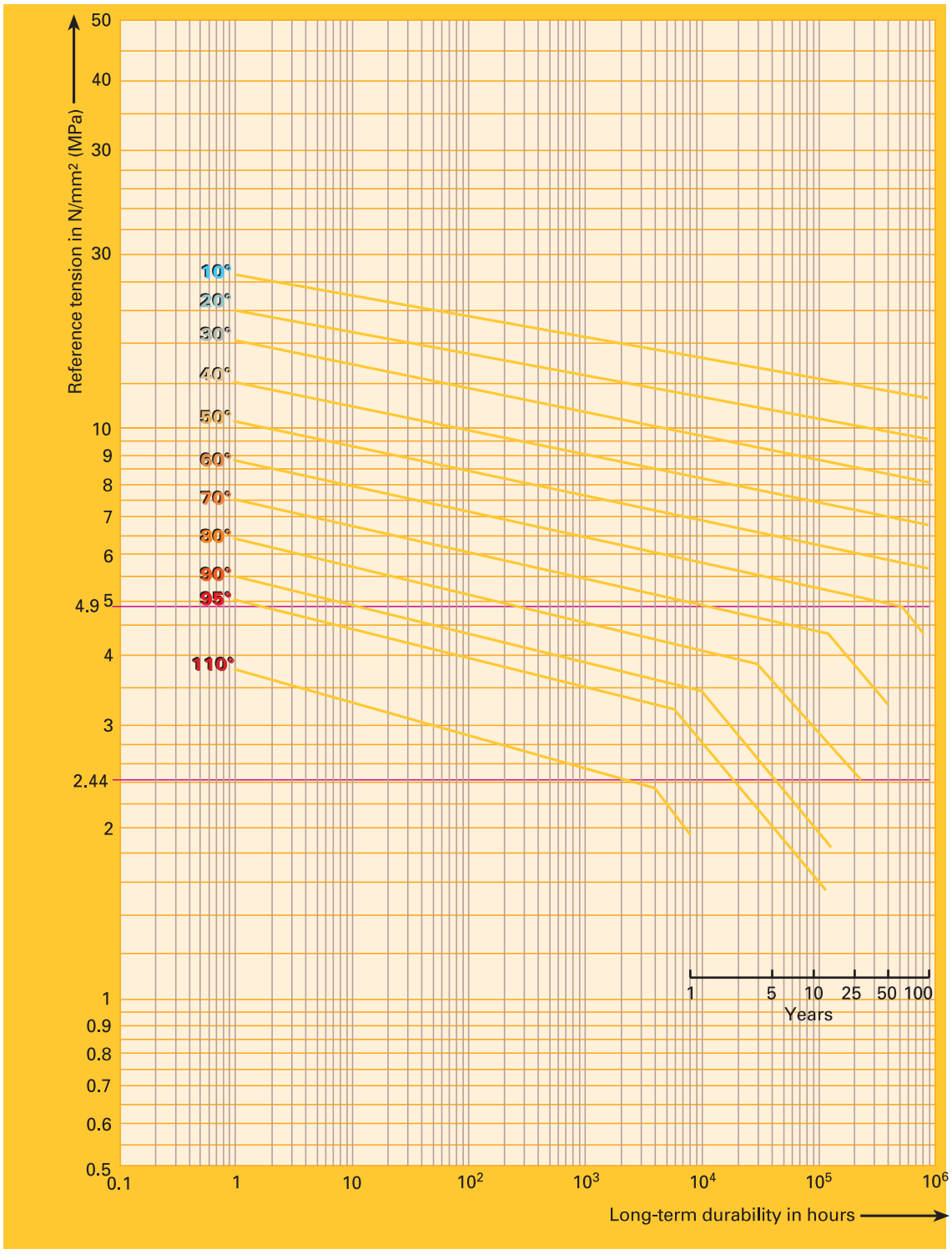
Calculating of security factor SF:

σ_v (e.g. 50 years, temp. 60 °C) = 4,9 N/mm^2 established from the diagram.

It becomes clear that **Plastherm** pipes present tremendous safety margins in real application situations.

In the planning phase, it is cunstomary to start from the peak temperatures to be anticipated; if we take into account the operationaş temperatures, which in most cases are considerably lower, and their effective periods, the safety margin is even higher.

8.4. Behaviour Under Long Term Stress



8.5. Consistency Properties

From the requirements of the temperature/pressure ratio in accordance with DIN 1988 T2 and the long-term durability properties in accordance with DIN 16962 and DVS 2207, the **Plastherm** pipe with a pressure degree PN 20 meets the specified safety correction value of s=1.5 .

In accordance with DIN 1988 T2, the following requirements are stipulated as regards service on drinking water pipe systems.

Table 2 shows the admissible operational pressures depending on temperatures with a maximum number of years fo operation for the transport of water.

	Operational exess pressure bar	Temperature °C	Hours p.a. h
Cold water	0 to 10 Fluctuating	to 25	8760
Hot water	0 to 10 Fluctuating	to 60 up tu 85	8760 50

Table 1: Operational requirements for pipes

Temp (°C)	Max. op. (Years)	Adm. pressure
10	50	29.3
20	50	25.9
30	50	22.1
40	50	18.4
50	50	14.7
60	50	10.9
70	50	8.0

Table 2:Adminisible operational pressures

With regard to the demads of the temperature/pressure ratio in accordance with Dın 1988 T2 and the long-term durability properties in accordance with DIN 16962 and DVS 2207, the **Plastherm** pipe with a pressure degree PN 25 meets the specified safety corection value of s=1.5 .

Table 4 demonstrates the admissible operational pressures depending on temperatures for the flow media water, taking into account a maximum number of years of operation.

	Operational exess pressure bar	Temperature °C	Hours p.a. h
Cold water	0 to 10 Fluctuating	to 25	8760
Hot water[1]	0 to 10 Fluctuating	to 60 up tu 85	8030 730

Table 3: Operational requirements for pipes

[1] Referece for temp for long-term stress resistence 70 °C

Temp (°C)	Max. op. (Years)	Adm. pressure
10	50	36.7
20	50	32.3
30	50	27.7
40	50	23.0
50	50	18.3
60	50	13.7
70	50	10.0

Table 4:Admissible operational pressures

The following items need to be taken into consideration when calculating modifications in length:

- Ambient and materials temperature upon installation
- Temperature difference between lowest and highest pipe wall temeperatures
- Expansion coefficient

Below the formula for the calculation of length alterations:

$$\Delta L=\alpha \cdot L \cdot \Delta T$$

Explanation:

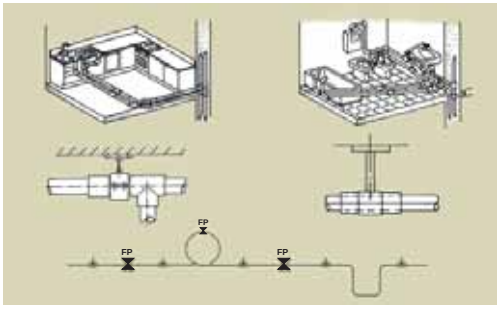
ΔL = Length alteration in mm
α = Expansion coeffizent in K^{-1}
polypropylene pipes $\alpha = 0.15$
prostab AL/PPR composite pipes $\alpha = 0.05$
L = Pipe length in m
ΔT = Difference in temperatures in K

Example:

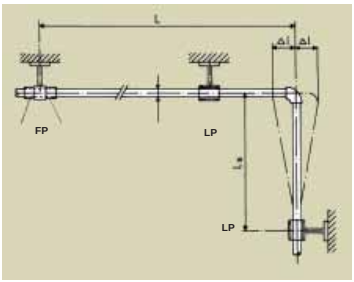
Pipe length= 6m	Temperature range	
	Pipe wall temperature	60 °C
	Temp. at installation	15 °C
	Difference in temp	45 K

$\Delta L_2=0.15 \cdot 6 \cdot 45= 40.5$ mm

The alteration af length may be compensated by means of extension loops, bending legs, extension bows or appropriate adapters.



FP = Fixing point
LS = Length of bending leg
L = Length of pipe
LP = Gliding rail
$\Delta L = \Delta L_1 + \Delta L_2$

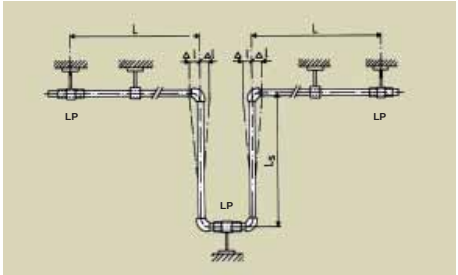


The minimum length of the bending leg results from:

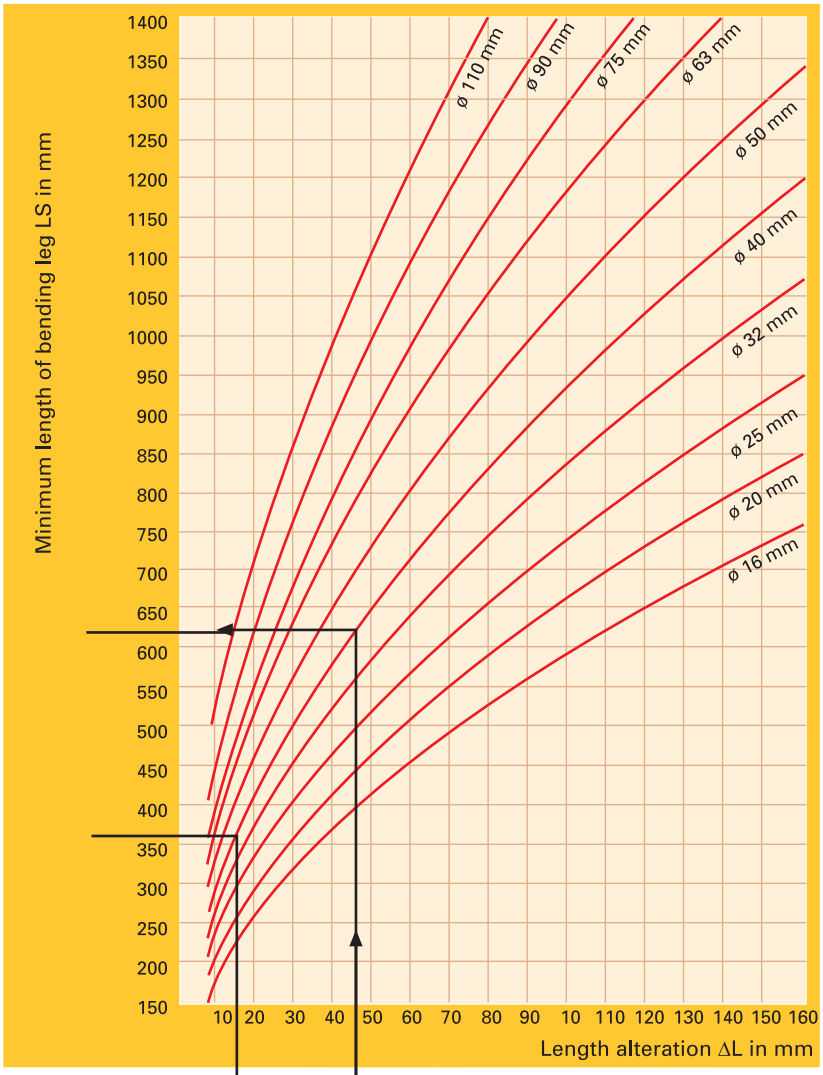
$$L_s= K \cdot \sqrt{d \cdot \Delta L}$$

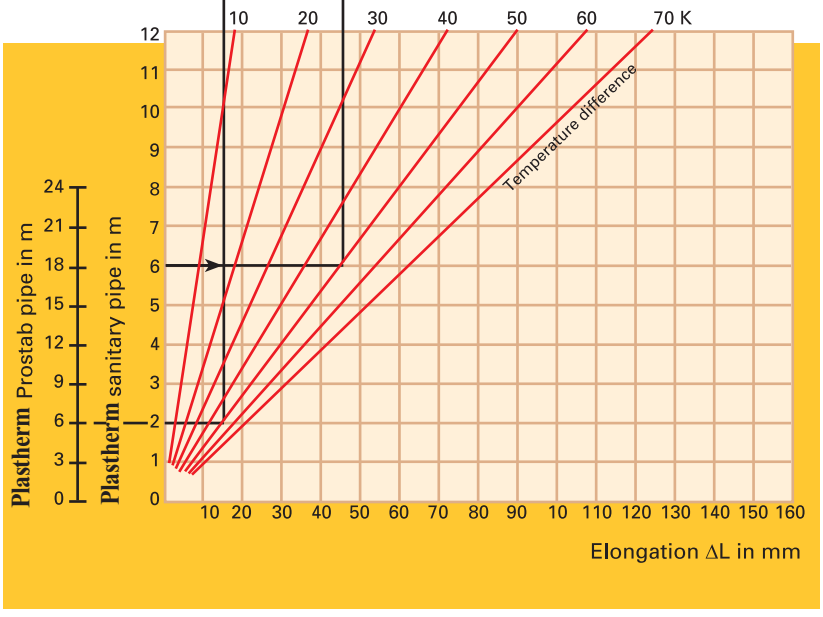
Explanation:

L_s = Length of bending leg in mm
K = Constant depending on material (K value for PP = 15)
d = Pipe diameter in mm
Δ = Elongation in mm, calculated by equation $\Delta L=\alpha \cdot L \cdot \Delta T$



Vide also following example of graphic and mathematical determination of the bending leg.





Example 1:
To be established:
Minimum bending leg for a **Plastherm** pipe ø=40, pipe length 6 m, ΔT= 50K

1.Expansion
ΔL= 0.15x6x50=45mm

2.Minimum bending leg length:
$L_s = 15\sqrt{40x45}$=636mm

Example 2:
To be established:
Minimum bending leg for a **Plastherm** prostab pipe

1.Expansion
ΔL= 0.05x5 x50=15mm

2.Minimum bending leg length:
$L_s = 15\sqrt{40x15}$=367mm

8.7. Bearing Distances / Fixed referance Point Version

Bearing Distances

Arrangement of fix points for horizontal piping

Bearing distances for Plastherm pipe PN 10 – PN 25

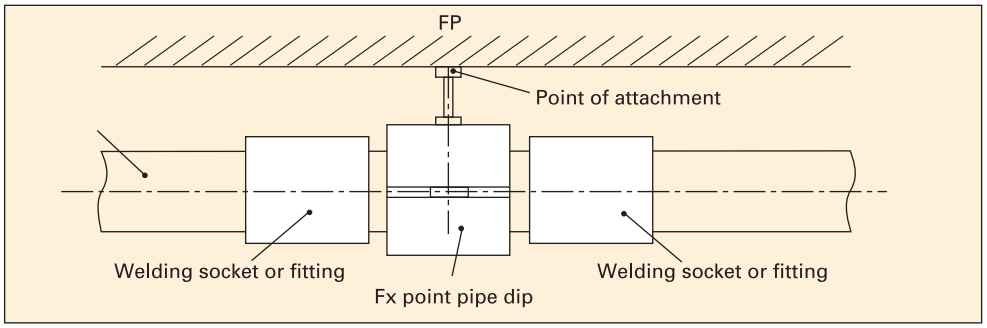
Temp. °C	External diameter pipe mm									
	16	20	25	32	40	50	63	75	90	110
	Fixing intervals cm									
0	70	85	105	125	140	165	190	205	220	225
20	50	60	75	90	100	120	140	160	160	220
30	50	60	75	90	100	120	140	150	160	215
40	50	60	70	80	90	110	130	140	150	210
50	50	60	70	80	90	110	130	140	150	200
60	50	55	65	75	85	100	115	125	140	180
70	50	50	60	70	80	95	105	115	125	175

Bearing distances for Plastherm prostab pipe

Temp. °C	External diameter pipe mm								
	16	20	25	32	40	50	63	75	90
	Fixing intervals cm								
0	130	155	170	195	220	245	270	285	300
20	100	120	130	150	170	190	210	220	230
30	100	120	130	150	170	190	210	220	230
40	100	110	120	130	160	180	200	210	230
50	100	110	120	140	160	180	200	210	220
60	80	100	110	130	150	170	190	200	210
70	70	90	100	120	140	160	180	190	200

Fixed Point Version

A fix point is established by welding sleeves or other moulded parts on either side of the pipe clip. Fixed points to be arranged in a line needto be so selected that alterations in direction in the pipe route are exploited.



8.8. Insulation

Installation sites	Installation layer thickness at L= 0.040 Wm^{-1} $K^{-1(*)}$
Piping in unheated sites, uncovered installation (e.g. basement)	4 mm
Piping in heated sites, uncovered installation	9 mm
Piping inserted into a channel witout heat conveying piping	4 mm
Piping inserted into a channel next to heat conveying piping	13 mm
piping in wall slots, ascending piping and piping installed on concrete floor	4 mm
Piping in wall chases next to heat conveying piping	13 mm
Piping on concrete flooring	4 mm in accordance with DIN 1988 Part 2

(*) When materials with different heat conducting capacity values are employed, the thickness of insulating layers, relating to a pipe diameter of d = 20 mm must be converted accordingly.

Nominal widths (NW) of piping/ fittings in mm	Uncovered piping	Pipes and fittings in wall and ceiling passages, in cross sections, at pipe connections, for central pipe net distributors, radiator connecting piping not exceeding 8 m in length. (in accordance with Heating Installations Decree of 22 March 1994)
up to NW 20	20 mm	10 mm
from NW 22 to NW 35	30 mm	15 mm
from NW 40 to NW 100	equal NW	1/2NW
over NW 100	100 mm	50 mm

8.9. Calculations acc. to DIN 1988

Planning and dimensioning systems to be installed are executed in accordance with DIN 1988. In section 3 of DIN 1988, a large number of calculation examples are demonstrated and all necessary tables and diagrams are explained in detail.

Below you will find diagrams and tables which are required for the establishment of calculation forms.

8.9.1. Minimum flow Pressures

Recommended values for minimum flow pressures and calculated flow at standart drinking water tapping spots.

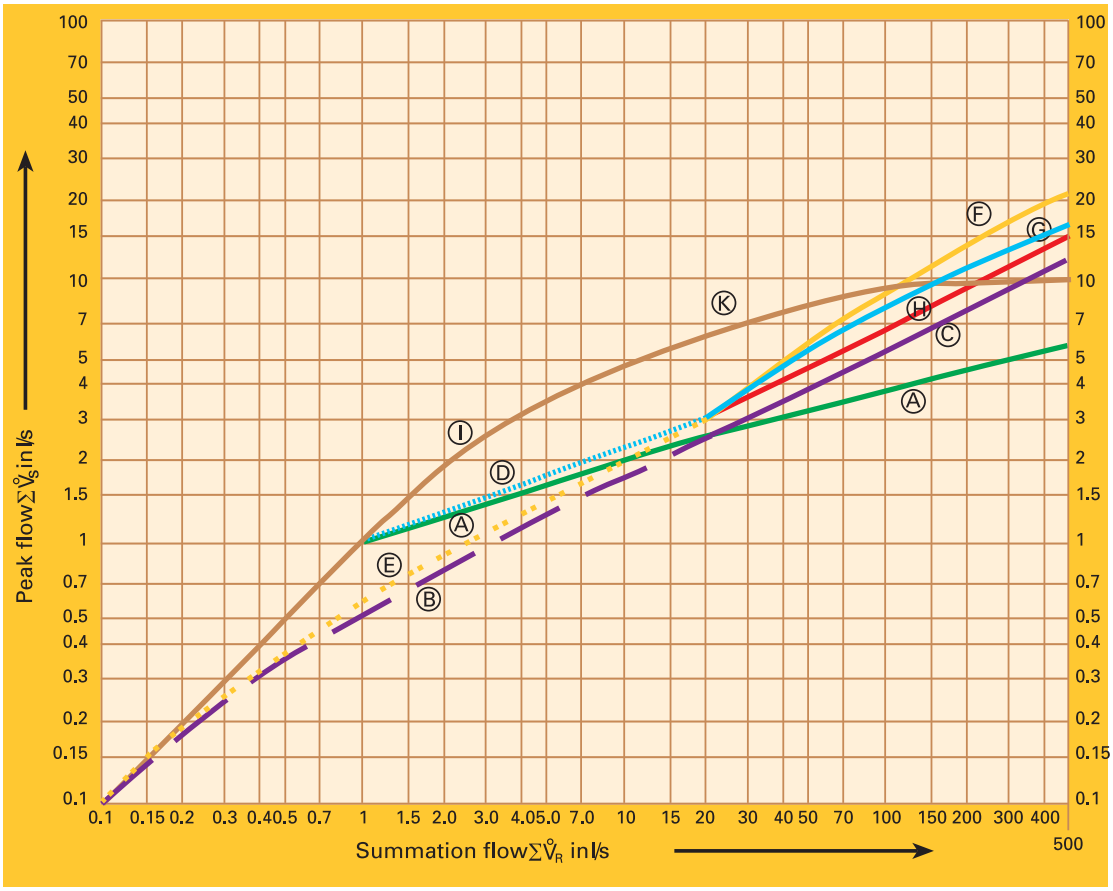
Minimum flow pressure $P_{min\ Fl}$ bar	Type of drinking water tapping point		Calculation flow for a tapping		
			Mixed water		Only cold or hot water
			Volume flow cold l/s	Volume flow hot l/s	Volume flow l/s
	Draw-off taps				
0.5	witout air whirler	DN 15	-	-	0.30
0.5		DN20	-	-	0.50
0.5		DN 25	-	-	1.00
1.0	With air whirler	DN10	-	-	1.15
1.0		DN 15	-		0.15
1.0	Shower heads	DN 15	0.10	0.10	0.20
1,2	Pressure rinser in acc, with DIN 3265 Teil 1	DN 15	-	-	0.70
1,2	Pressure rinser in acc, with DIN 3265 Teil 1	DN 20	-	-	1.00
0.4	Pressure rinser in acc, with DIN 3265 Teil 1	DN 25	-	-	1.00
1.0	Pressure rinser For urinal basin	DN 15	-	-	0.30
0.5	Corner valve for urinal basin	DN 15	-	-	0.30
1.0	Household dish washer	DN 15	-	-	0.15
1.0	Household washing machine	DN 15			0.25
	Combination set for				
1.0	shower tubs	DN 15	0.15	0.15	-
1.0	bath tubs	DN 15	0.15	0.15	-
1.0	kitchen sinks	DN 15	0.07	0.07	-
1.0	washstands	DN 15	0.07	0.07	-
1.0	pedestal bidet	DN 15	0.07	0.07	-
1.0	combination set	DN 20	0.30	0.30	-
0.5	Flussing box in acc. with DIN 19542	DN 15	-	-	013
	Drinking water heather for supply of a tapping point (inclusive of combinend tap fittings)				
1.0	Electro water-boiler	DN 15	-	-	0.10*)
	Electro Hot-water tank and boiler				
1.1**)	with nominal contents of 5 to 15 l	DN 15	-	-	0.10
1.2**)	with noinal contents of 30 to 150 l	DN 15	-	-	0.20
	Electro flow water-heater, hydraulic control, without flow limination				
1.5	Nominal capasity	12kW	-	-	0.06
1.9		18kW	-	-	0.08
2.1		21 kW	-	-	0.09
2.4		24 kW	-	-	0.10
1.0	Gas flow water heater	12kW	-	-	0.10

*) with fully open throttle
**) values under unfavourable conditions (shower)
Not : Tapping points which are not included in the table and devices of identical nature with larger fittings flows than indicated are to be treated in accordance with manufacturer's recommendations when determining pipe diameters.

8.9.2. Peak Flow

Peak flow $\mathring{V}_S$ depending on summation flow $\Sigma\mathring{V}_R$

Area of application [$\mathring{V}_R \leq 20$ l/s]		
	[$\mathring{V}_R \geq 0.5$ l/s]	[$\mathring{V}_R < 0.5$ l/s]
Rdesidential buildings	Ⓐ	Ⓑ
Ofice and admini-strative buildings	Ⓐ	Ⓑ
Hotel buildings	Ⓓ	Ⓔ
Deportment stores	Ⓓ	Ⓔ
Hospitals (only ward sections)	Ⓓ	Ⓔ
Schools $\Sigma\mathring{V}_R = \mathring{V}_S$ von 0.1 bis 1.5 l/s		
$\Sigma\mathring{V}_R$ > 1.5 l/s] Ⓘ		



Area of application [$\mathring{V}_R > 20$ l/s]	
Rdesidential buildings	Ⓐ
Ofice and admini-strative buildings	Ⓒ
Hotel buildings	Ⓕ
Deportment stores	Ⓖ
Hospitals (only ward sections)	Ⓗ
Schools	Ⓚ

8.9.3 Drop in Pressure Owing to Pipe Friction

Pressure drops owing to pipe friction and calculated flow speed depending on peak flow for all pipes of the Plastherm installation system.

Following charts of pressure drops resulting from pipe friction were established in analogy to DIN 1988, Section 3:

Starting values:

- Reference temperature 10 °C
- Reference pressure 10 bar
- Absolute roughness of interior pipe wall k = 0.007 mm (calculation of pipe friction coefficient λ according to Colebrook-White)

Note:

Pressure losses resulting from pipe friction change only insignificantly in the operating temperature range (up to 60 °C) of drinking water systems, there fore it is customary for house installations to calculate with an overall reference temperature of 10 °C (DIN 1988, Section 3, Page 10)

The legal unit used (SI unit) for pressure is the Pa (Pascal) value, however, DIN standard refers to the bar unit or mbar, respectively. Should the loss in pressure required in practice be the Pascal value, the following ratio will aply: 1 mbar = 100 Pa.

Intermediate values not indicated in the tables may be inter polated. It should be noted, however, that no linear functions serve as basis.

Losses in pressure of the Prostab pipes may be seen from the tables of nominal pressure degree PN 20, as the inner pipes have the same dimensions.

Pressure drops owing to pipe friction R and calculated flow speed v depending on peak flow V_S

Polypropylene pipes

Typ 3 in acc. with DIN 8077, nominal pressure degree **PN 10**

Peak Flow	DN 15 d_a= 20 mm d_i= 16.2 mm v= 0.206 l/m		DN 20 d_a= 25 mm d_i= 20.4 mm v= 0.327 l/m		DN 25 d_a= 32 mm d_i= 26.0 mm v= 0.531 l/m	
V_S l/s	R mbar/m	v m/s	R mbar/m	v m/s	R mbar/m	v m/s
0,01	0,05	0,05	0,02	0,03	0,01	0,02
0,02	0,17	0,10	0,06	0,06	0,02	0,04
0,03	0,33	0,15	0,11	0,09	0,04	0,06
0,04	0,54	0,19	0,18	0,12	0,06	0,08
0,05	0,79	0,24	0,27	0,15	0,09	0,09
0,06	1,07	0,29	0,36	0,18	0,12	0,11
0,07	1,40	0,34	0,47	0,21	0,15	0,13
0,08	1,76	0,39	0,59	0,24	0,19	0,15
0,09	2,16	0,44	0,72	0,28	0,23	0,17
0,10	2,59	0,49	0,87	0,31	0,28	0,19
0,15	5,23	0,73	1,75	0,46	0,55	0,28
0,20	8,69	0,97	2,89	0,61	0,91	0,38
0,25	12,85	1,21	4,27	0,76	1,34	0,47
0,30	17,78	1,46	5,88	0,92	1,85	0,57
0,35	23,40	1,70	7,73	1,07	2,42	0,66
0,40	29,63	1,94	9,80	1,22	3,06	0,75
0,45	36,62	2,18	12,08	1,38	3,77	0,85
0,50	44,31	2,43	14,57	1,53	4,54	0,94
0,60	61,45	2,91	20,15	1,84	6,26	1,13
0,70	81,50	3,40	26,64	2,14	8,26	1,32
0,80	103,66	3,88	33,76	2,45	10,48	1,51
0,90	128,84	4,37	41,80	2,75	12,93	1,70
1,00	156,16	4,85	50,69	3,06	15,62	1,88
1,10	186,32	5,34	60,23	3,37	18,57	2,07
1,20			70,69	3,67	21,71	2,26
1,30			81,79	3,98	25,13	2,45
1,40			93,51	4,28	28,74	2,64
1,50			106,32	4,59	32,54	2,83
1,60			119,79	4,90	36,49	3,01
1,70			133,91	5,20	40,80	3,20
1,80					45,30	3,39
1,90					49,99	3,58
2,00					54,84	3,77
2,10					66,16	3,96
2,20					65,37	4,14
2,30					71,08	4,33
2,40					76,61	4,52
2,50					82,70	4,71
2,60					88,99	4,90
2,70					95,47	5,09
2,80					102,14	5,27

Pressure drops owing to pipe friction R and calculated flow speed v depending on peak flow V_S

Polypropylene pipes

Typ 3 in acc. with DIN 8077, nominal pressure degree **PN 10**

Peak Flow	DN 32 d_a= 40 mm d_i= 32.6 mm v= 0.835 l/m		DN 40 d_a= 50 mm d_i= 40.8 mm v= 1.307 l/m	
V_S **l/s**	**R** **mbar/m**	**v** **m/s**	**R** **mbar/m**	**v** **m/s**
0,10	0,10	0,12	0,03	0,08
0,20	0,31	0,24	0,11	0,15
0,30	0,63	0,36	0,22	0,23
0,40	1,04	0,48	0,36	0,31
0,50	1,54	0,60	0,53	0,38
0,60	2,12	0,72	0,73	0,46
0,70	2,78	0,84	0,95	0,54
0,80	3,54	0,96	1,21	0,61
0,90	4,35	1,08	1,49	0,69
1.00	5,26	1,20	1,79	0,76
1,25	7,84	1,50	2,67	0,96
1,50	10,85	1,80	3,68	1,15
1,75	14,36	2,10	4,85	1,34
2,00	18,22	2,40	6,16	1,53
2,25	22,62	2,70	7,62	1,72
2,50	27,37	3,00	9,23	1,91
2,75	32,62	3,29	10,95	2,10
3,00	38,23	3,59	12,84	2,29
3,25	44,17	3,89	14,84	2,49
3,50	50,69	4,19	16,95	2,68
3,75	57,57	4,49	19,25	2,87
4,00	64,80	4,79	21,68	3,06
4,25	72,35	5,09	24,21	3,25
4,50	80,67	5,39	26,85	3,44
4,75			29,60	3,63
5,00			32,61	3,82
5,25			35,56	4,02
5,50			38,81	4,21
5,75			42,19	4,40
6,00			45,67	4,59
6,25			49,00	4,78
6,50			52,70	4,97
6,75			56,50	5,16
7,00			60,41	5,35

Pressure drops owing to pipe friction R and calculated flow speed v depending on peak flow V_S

Polypropylene pipes

Typ 3 in acc. with DIN 8077, nominal pressure degree **PN 10**

Peak Flow	DN 50 d_a= 63 mm d_i= 51.4 mm v= 2.075 l/m		DN 60 d_a= 75 mm d_i= 61.2 mm v= 2.942 l/m		DN 70 d_a= 90 mm d_i= 73.6 mm v= 4.254 l/m		DN 90 d_a= 110 mm d_i= 90.0 mm v= 6.360 l/m	
V_S l/s	R mbar/m	v m/s	R mbar/m	v m/s	R mbar/m	v m/s	R mbar/m	v m/s
0.25	0.05	0.12	0.02	0.08	0.01	0.06	0.00	0.04
0.50	0.18	0.24	0.08	0.17	0.03	0.12	0.01	0.08
0.75	0.36	0.36	0.16	0.25	0.07	0.18	0.03	0.12
1.00	0.59	0.48	0.26	0.34	0.11	0.24	0.04	0.16
1.25	0.88	0.60	0.38	0.42	0.16	0.29	0.06	0.20
1.50	1.21	0.72	0.53	0.51	0.22	0.35	0.08	0.24
1.75	1.60	0.84	0.69	0.59	0.29	0.41	0.11	0.28
2.00	2.03	0.96	0.88	0.68	0.36	0.47	0.14	0.31
2.25	2.50	1.08	1.08	0.76	0.45	0.53	0.17	0.35
2.50	3.02	1.20	1.31	0.85	0.54	0.59	0.21	0.39
2.75	3.59	1.33	1.51	0.93	0.64	0.65	0.24	0.43
3.00	4.21	1.45	1.81	1.02	0.75	0.71	0.29	0.47
3.25	4.84	1.57	2.09	1.10	0.86	0.76	0.33	0.51
3.50	5.53	1.69	2.39	1.19	0.98	0.82	0.37	0.55
3.75	6.29	1.81	2.71	1.27	1.11	0.88	0.42	0.59
4.00	7.05	1.93	3.04	1.36	1.25	0.94	0.48	0.63
4.25	7.87	2.05	3.39	1.44	1.39	1.00	0.53	0.67
4.50	8.74	2.17	3.77	1.53	1.54	1.06	0.59	0.71
4.75	9.63	2.29	4.13	1.61	1.70	1.12	0.65	0.75
5.00	10.56	2.41	4.55	1.70	1.87	1.18	0.71	0.79
5.25	11.58	2.53	4.97	1.78	2.04	1.23	0.77	0.83
5.50	12.57	2.65	5.40	1.87	2.21	1.29	0.84	0.86
5.75	13.67	2.77	5.87	1.95	2.39	1.35	0.91	0.90
6.00	14.72	2.89	6.32	2.04	2.59	1.41	0.98	0.94
6.25	15.88	3.01	6.82	2.12	2.79	1.47	1.06	0.98
6.50	17.08	3.13	7.30	2.21	3.00	1.53	1.14	1.02
6.75	18.32	3.25	7.83	2.29	3.20	1.59	1.21	1.06
7.00	19.59	3.37	8.37	2.38	3.42	1.65	1.30	1.10
7.25	20.90	3.49	8.93	2.46	3.65	1.70	1.38	1.14
7.50	22.24	3.61	9.50	2.55	3.88	1.76	1.47	1.18
7.75	23.61	3.73	10.09	2.63	4.12	1.82	1.56	1.22
8.00	25.01	3.86	10.69	2.72	4.73	1.88	1.65	1.26
8.25	26.44	3.98	11.31	2.80	4.62	1.94	1.75	1.30
8.50	27.91	4.10	11.93	2.89	4.88	2.00	1.84	1.34
8.75	29.40	4.22	12.58	2.97	5.14	2.06	1.94	1.38
9.00	31.10	4.34	13.23	3.06	5.41	2.12	2.05	1.41
9.25	32.66	4.46	13.89	3.14	5.68	2.17	2.15	1.45
9.50	34.25	4.58	14.65	3.23	5.96	2.23	2.25	1.49
9.75	36.07	4.70	15.34	3.31	6.24	2.29	2.36	1.53
10.00	37.72	4.82	16.05	3.40	6.53	2.35	2.47	1.57
10.25	39.40	4.94	16.86	3.48	6.86	2.41	2.58	1.61
10.50	41.34	5.06	17.59	3.57	7.16	2.47	2.69	1.65
10.75	43.07	5.18	18.33	3.65	7.46	2.53	2.82	1.69
11.00	45.10	5.30	19.19	3.74	7.81	2.59	2.94	1.73

Pressure drops owing to pipe friction R and calculated flow speed v depending on peak flow V_s

Polypropylene pipes
(Continued)

Typ 3 in acc. with DIN 8077, nominal pressure degree **PN 10**

Peak Flow	DN 60 d_a= 75 mm d_i= 61.2 mm v= 2.942 l/m		DN 70 d_a= 90 mm d_i= 73.6 mm v= 4.254 l/m		DN 90 d_a= 110 mm d_i= 90.0 mm v= 6.360 l/m	
V_s	R	v	R	v	R	v
l/s	mbar/m	m/s	mbar/m	m/s	mbar/m	m/s
11.25	19.95	3.82	8.12	2.64	3.06	1.77
11.50	20.72	3.91	8.44	2.70	3.18	1.81
11.75	21.63	3.99	8.81	2.76	3.32	1.85
12.00	22.43	4.08	9.13	2.82	3.44	1.89
12.25	23.37	4.16	9.46	2.88	3.56	1.93
12.50	24.19	4.25	9.85	2.94	3.71	1.96
12.75	25.17	4.33	10.19	3.00	3.84	2.00
13.00	26.00	4.42	10.59	3.06	3.99	2.04
13.25	27.01	4.50	10.94	3.11	4.12	2.08
13.50	27.87	4.59	11.35	3.17	4.25	2.12
13.75	28.91	4.67	11.71	3.23	4.41	2.16
14.00	29.79	4.76	12.14	3.29	4.55	2.20
14.25	30.86	4.84	12.50	3.35	4.71	2.24
14.50	31.95	4.93	12.94	3.41	4.85	2.28
14.75	32.86	5.01	13.31	3.47	5.02	2.32
15.00	33.98	5.10	13.76	3.53	5.16	2.36
15.25	34.90	5.18	14.14	3.58	5.33	2.40
15.50	36.06	5.27	14.60	3.64	5.47	2.44
15.75	37.23	5.35	15.08	3.70	5.65	2.48
16.00			15.47	3.76	5.80	2.52
16.25			15.95	3.82	5.98	2.55
16.50			16.35	3.88	6.17	2.59
16.75			16.84	3.94	6.31	2.63
17.00			17.35	4.00	6.50	2.67
17.25			17.75	4.05	6.66	2.71
17.50			18.27	4.11	6.85	2.75
17.75			18.80	4.17	7.05	2.79
18.00			19.21	4.23	7.20	2.83
18.25			19.75	4.29	7.41	2.87
18.50			20.29	4.35	7.56	2.91
18.75			20.71	4.41	7.77	2.95
19.00			21.27	4.47	7.98	2.99
19.25			21.83	4.52	8.84	3.03
19.50			22.26	4.58	8.35	3.07
19.75			22.83	4.64	8.57	3.10
20.00			23.42	4.70	8.73	3.14
20.25			24.00	4.76	8.95	3.18
20.50			24.44	4.82	9.17	3.22
20.75			25.04	4.88	9.34	3.26
21.00			25.65	4.94	9.56	3.30
21.25			26.09	4.99	9.79	3.34
21.50			26.71	5.05	9.96	3.38
21.75			27.34	5.11	10.19	3.42
22.00			27.97	5.17	10.43	3.46

Pressure drops owing to pipe friction R and calculated flow speed v depending on peak flow V_S

Polypropylene pipes

Typ 3 in acc. with DIN 8077, nominal pressure degree **PN 20**

Peak Flow	DN 10 d_a= 16 mm d_i= 10.6 mm v= 0.088 l/m		DN 12 d_a= 20 mm d_i= 13.2 mm v= 0.137 l/m		DN 16 d_a= 25 mm d_i= 16.6 mm v= 0.216 l/m	
V_S l/s	R mbar/m	v m/s	R mbar/m	v m/s	R mbar/m	v m/s
0,01	0,39	0,11	0,14	0,07	0,05	0,05
0,02	1,23	0,23	0,44	0,15	0,15	0,09
0,03	2,44	0,34	0,87	0,22	0,30	0,14
0,04	3,98	0,45	1,41	0,29	0,48	0,18
0,05	5,84	0,57	2,07	0,37	0,70	0,23
0,06	8,00	0,68	2,83	0,44	0,96	0,28
0,07	10,47	0,79	3,69	0,51	1,25	0,32
0,08	13,22	0,91	4,65	0,58	1,57	0,37
0,09	16,24	1,02	5,70	0,66	1,92	0,42
0,10	19,50	1,13	6,86	0,73	2,30	0,46
0,15	39,92	1,70	13,92	1,10	4,66	0,69
0,20	66,61	2,27	23,13	1,46	7,72	0,92
0,25	99,54	2,83	34,38	1,83	11,45	1,16
0,30	138,44	3,40	47,68	2,19	15,80	1,39
0,35	183,23	3,97	62,92	2,56	20,79	1,62
0,40	233,51	4,53	79,92	2,92	26,33	1,85
0,45	289,41	5,10	99,10	3,29	32,55	2,08
0,50	351,24	5,67	119,82	3,65	39,38	2,31
0,55			142,53	4,02	46,68	,2,54
0,60			167,44	4,38	54,62	2,77
0,65			193,092	4,75	72,14	3,00
0,70			21,96	5,12	82,09	3,23
0,75			251,39	5,48	92,17	3,47
0,80					103,12	3,70
0,85					114,05	3,93
0,90					125,91	4,16
0,95					138,87	4,39
1,00					151,69	4,62
1,05					164,92	4,85
1,10					179,41	5,08
1,15					193,50	5,31
1,20						5,54

Pressure drops owing to pipe friction R and calculated flow speed v depending on peak flow V_S

Polypropylene pipes

Typ 3 in acc. with DIN 8077, nominal pressure degree **PN 20**

Peak Flow	DN 20 d_a= 32 mm d_i= 21.2 mm v= 0.352 l/m		DN 25 d_a= 40 mm d_i= 26.6 mm v= 0.556 l/m		DN 32 d_a= 50mm d_i= 33.2 mm v= 0.866 l/m	
V_S **l/s**	**R** **mbar/m**	**v** **m/s**	**R** **mbar/m**	**v** **m/s**	**R** **mbar/m**	**v** **m/s**
0,05	0,22	0,14	0,08	0,09	0,03	0,06
0,10	0,72	0,28	0,25	0,18	0,09	0,12
0,15	1,46	0,42	0,50	0,27	0,17	0,17
0,20	2,40	0,57	0,82	0,36	0,29	0,23
0,25	3,55	0,71	1,21	0,45	0,42	0,29
0,30	4,89	0,85	1,65	0,54	0,58	0,35
0,35	6,42	0,99	2,17	0,63	0,76	0,40
0,40	8,15	1,13	2,75	0,72	0,95	0,46
0,45	10,04	1,27	3,38	0,81	1,17	0,52
0,50	12,11	1,42	4,06	0,90	1,41	0,58
0,60	16,76	1,70	5,63	1,08	1,95	0,69
0,70	22,07	1,98	7,40	1,26	2,55	0,81
0,80	28,10	2,27	9,39	1,44	3,24	0,92
0,90	34,64	2,55	11,58	1,62	3,99	1,04
1,00	42,01	2,83	14,00	1,80	4,82	1,16
1,10	49,92	3,12	16,64	1,98	5,71	1,27
1,20	58,59	3,40	19,45	2,16	6,65	1,39
1,30	67,80	3,68	22,42	2,34	7,71	1,50
1,40	77,52	3,97	25,64	2,52	8,78	1,63
1,50	88,14	4,25	29,16	2,70	9,95	1,73
1,60	98,83	4,53	32,72	2,88	11,16	1,85
1,70	110,48	4,82	36,58	3,06	12,48	1,96
1,80	122,63	5,10	40,62	3,24	13,80	2,08
1,90	135,95	5,38	44,82	3,42	15,23	2,19
2,00			49,17	3,64	16,72	2,31
2,10			53,67	3,78	18,25	2,43
2,20			58,61	3,96	19,84	2,54
2,30			63,42	4,14	21,58	2,66
2,40			68,70	4,32	23,26	2,77
2,50			73,79	4,50	25,11	2,89
2,60			79,40	4,68	26,89	3,00
2,70			85,18	4,86	28,85	3,12
2,80			91,13	5,04	30,87	3,23
2,90			97,24	5,22	32,78	3,35
3,00			103,51	5,40	34,90	3,47
3,10					37,07	3,58
3,20					39,30	3,70
3,30					41,57	3,81
3,40					43,90	3,93
3,50					46,27	4,04
3,60					48,95	4,16
3,70					51,43	4,27
3,80					53,96	4,39
3,90					56,53	4,51
4,00					59,15	4,62
4,10					62,14	4,74
4,20					64,86	4,85
4,30					67,61	4,97
4,40					70,79	5,08
4,50					73,64	5,20

Pressure drops owing to pipe friction R and calculated flow speed v depending on peak flow V_S

Polypropylene pipes

Typ 3 in acc. with DIN 8077, nominal pressure degree **PN 20**

Peak Flow	DN 40 d_a= 63 mm d_i= 42,0 mm v= 1,385 l/m		DN 50 d_a= 75 mm d_i= 50,0 mm v= 1,963 l/m		DN 60 d_a= 90 mm d_i= 60,0 mm v= 2,827 l/m		DN 90 d_a= 110 mm d_i= 73,2 mm v= 4,200 l/m	
V_S l/s	R mbar/m	v m/s	R mbar/m	v m/s	R mbar/m	v m/s	R mbar/m	v m/s
0,25	0,03	0,07	0,01	0,05	0,01	0,04	0,01	0,06
0,50	0,09	0,14	0,04	0,10	0,02	0,07	0,03	0,12
0,75	0,19	0,22	0,08	0,15	0,04	0,11	0,07	0,18
1,00	0,31	0,29	0,14	0,20	0,06	0,14	0,11	0,24
1,25	0,46	0,36	0,20	0,25	0,08	0,18	0,16	0,30
1,50	0,94	0,54	0,41	0,38	0,17	0,27	0,22	0,36
1,75	1,56	0,72	0,68	0,51	0,28	0,35	0,29	0,42
2,00	2,32	0,90	1,00	0,64	0,42	0,44	0,37	0,48
2,25	3,21	1,08	1,39	0,76	0,58	0,53	0,46	0,53
2,50	4,22	1,26	1,83	0,89	0,76	0,62	0,55	0,59
2,75	5,36	1,44	2,31	1,02	0,97	0,71	0,66	0,65
3,00	6,62	1,62	2,86	1,15	1,19	0,80	0,77	0,71
3,25	8,02	1,80	3,45	1,27	1,44	0,88	0,88	0,77
3,50	9,52	1,98	4,10	1,40	1,70	0,97	1,01	0,83
3,75	11,16	2,17	4,81	1,53	1,99	1,06	1,14	0,89
4,00	12,90	2,35	5,53	1,66	2,30	1,15	1,28	0,95
4,25	14,74	2,53	6,32	1,78	2,63	1,24	1,43	1,01
4,50	16,74	2,71	7,18	1,91	2,98	1,33	1,59	1,07
4,75	18,85	2,89	8,05	2,04	3,34	1,41	1,75	1,13
5,00	21,06	3,07	8,99	2,16	3,73	1,50	1,92	1,19
5,25	23,36	3,25	9,98	2,29	4,14	1,59	2,09	1,25
5,50	25,74	3,43	11,00	2,42	4,56	1,68	2,27	1,31
5,75	28,21	3,61	12,12	2,55	5,00	1,77	2,46	1,37
6,00	30,94	3,79	13,22	2,67	5,46	1,86	2,67	1,43
6,25	33,76	3,97	14,43	2,80	5,96	1,95	2,86	1,49
6,50	36,49	4,15	15,60	2,93	6,44	2,03	3,08	1,54
6,75	39,51	4,33	16,90	3,06	6,98	2,12	3,29	1,60
7,00	42,63	4,51	18,23	3,18	7,49	2,21	3,51	1,66
7,25	45,85	4,69	19,50	3,31	8,06	2,30	3,75	1,72
7,50	49,16	4,87	20,91	3,44	8,64	2,39	3,99	1,78
7,75	52,57	5,05	22,36	3,57	9,19	2,48	4,24	1,84
8,00	56,06	5,25	23,85	3,69	9,81	2,56	4,47	1,90
8,25			25,38	3,82	10,43	2,65	4,72	1,96
8,50			26,95	3,95	11,08	2,74	4,99	2,02
8,75			28,55	4,07	11,74	2,83	5,26	2,08
9,00			32,04	4,33	13,10	3,01	5,56	2,14
9,25			35,50	4,58	14,60	3,18	5,84	2,20
9,50			39,32	4,84	16,08	3,36	6,13	2,26
9,75			43,31	5,09	17,72	3,54	6,41	2,32
10,00			47,18	5,35	19,30	3,71	6,71	2,38
10,25					21,06	3,89	7,05	2,44
10,50					22,88	4,07	7,35	2,50
10,75					24,76	4,24	7,66	2,55
11,00					26,71	4,42	7,98	2,61
11,25					28,71	4,60	8,35	2,67
11,50					30,77	4,77	8,67	2,73
11,75					32,89	4,95	9,00	2,79
12,00					35,06	5,13	9,38	2,85
12,25					37,28	5,31	9,72	2,91

Pressure drops owing to pipe friction R and calculated flow speed v depending on peak flow V_s

Polypropylene pipes

Typ 3 in acc. with DIN 8077, nominal pressure degree **PN 25**

Peak Flow	DN 12 d_a=20 mm d_i= 12.0 mm v= 0.1132 l/m		DN 15 d_a= 25 mm d_i= 15.0 mm v= 0.177 l/m		DN 20 d_a= 31 mm d_i= 19.2 mm v= 0.290 l/m	
V_s l/s	R mbar/m	v m/s	R mbar/m	v m/s	R mbar/m	v m/s
0,01	0,22	0,09	0,08	0,06	0,02	0,03
0,02	0,69	0,18	0,24	0,11	0,08	0,07
0,03	1,36	0,27	0,48	0,17	0,15	0,10
0,04	2,21	0,35	0,78	0,23	0,24	0,14
0,05	3,25	0,44	1,13	0,28	0,35	0,17
0,06	4,44	0,53	1,54	0,34	0,48	0,21
0,07	5,79	0,62	2,01	0,40	0,63	0,24
0,08	7,32	0,71	2,53	0,45	0,79	0,28
0,09	8,97	0,80	3,10	0,51	0,96	0,31
0,10	10,78	0,88	3,72	0,57	1,16	0,35
0,15	21,98	1,33	7,56	0,85	2,33	0,52
0,20	36,61	1,77	12,55	1,13	3,85	0,69
0,25	54,55	2,21	18,61	1,41	5,71	0,86
0,30	75,62	2,65	25,74	1,70	7,85	1,04
0,35	99,74	3,09	33,86	1,98	10,31	1,21
0,40	127,15	3,54	43,03	2,26	13,07	1,38
0,45	157,62	3,98	53,16	2,55	16,16	1,55
0,50	191,34	4,42	64,30	2,83	19,49	1,73
0,55	227,58	4,86	76,51	3,11	23,11	1,90
0,60	266,15	5,31	89,52	3,40	27,06	2,07
0,65			103,71	3,68	31,23	2,25
0,70			118,71	3,96	35,61	2,42
0,75			134,47	4,24	40,36	2,59
0,80			150,95	4,53	45,32	2,76
0,85			168,86	4,81	50,72	2,94
0,90			187,58	5,09	56,10	3,11
0,95			207,08	5,38	61,95	3,28
1,00					68,02	3,45
1,05					74,31	3,63
1,10					80,80	3,80
1,15					87,90	3,97
1,20					94,82	4,14
1,25					102,40	4,32
1,30					109,71	4,49
1,35					117,74	4,66
1,40					126,02	4,84
1,45					134,52	5,01
1,50					143,26	5,18
1,55					151,48	5,35

Pressure drops owing to pipe friction R and calculated flow speed v depending on peak flow V_S

Polypropylene pipes

Typ 3 in acc. with DIN 8077, nominal pressure degree **PN 25**

Peak Flow	DN 25 d_a= 40 mm d_i= 24.0 mm v= 0.452 l/m		DN 30 d_a= 50 mm d_i= 30.0 mm v= 0.707 l/m	
V_S l/s	R mbar/m	v m/s	R mbar/m	v m/s
0,05	0,12	0,11	0,04	0,07
0,10	0,40	0,22	0,14	0,14
0,15	0,81	0,33	0,28	0,21
0,20	1,33	0,44	0,46	0,28
0,25	1,97	0,55	0,68	0,35
0,30	2,70	0,66	0,93	0,42
0,35	3,54	0,77	1,22	0,50
0,40	4,49	0,88	1,55	0,57
0,45	5,52	0,99	1,90	0,64
0,50	6,67	1,11	2,28	0,71
0,60	9,20	1,33	3,16	0,85
0,70	12,12	1,55	4,15	0,99
0,80	15,44	1,77	5,27	1,13
0,90	19,04	1,99	6,48	1,27
1,00	23,00	2,21	7,84	1,14
1,10	27.34	2,43	9,28	1,56
1,20	31,95	2,65	10,85	1,70
1,30	36,98	2,87	12,57	1,84
1,40	42,29	3,09	14,32	1,98
1,50	48,09	3,32	16,21	2,12
1,60	53,93	3,54	18,27	2,26
1,70	60,30	3,76	20,34	2,41
1,80	66,94	3,98	22,58	2,55
1,90	73,85	4,20	24,92	2,69
2,00	81,01	4,42	27,35	2,83
2,10	88,87	4,64	29,86	2,97
2,20	96,55	4,86	32,61	3,11
2,30	104,99	5,08	35,28	3,25
2,40	113,73	5,31	38,04	3,40
2,50			41,06	3,54
2,60			44,19	3,68
2,70			47,17	3,82
2,80			50,46	3,96
2,90			53,85	4,10
3,00			57,33	4,24
3,10			60,89	4,39
3,20			64,54	4,53
3,30			68,28	4,67
3,40			72,09	4,81
3,50			75,99	4,95
3,60			80,39	5,09
3,70			84,46	5,23
3,80			88,61	5,38

Pressure drops owing to pipe friction R and calculated flow speed v depending on peak flow V_S

Polypropylene pipes

Typ 3 in acc. with DIN 8077, nominal pressure degree **PN 25**

Peak Flow	DN 40 d_a= 63mm d_i= 37.8mm v= 1.122 l/m		DN 45 d_a= 75mm d_i= 45.0 mm v= 1.590 l/m	
V_S l/s	R mbar/m	v m/s	R mbar/m	v m/s
0,10	0,05	0,09	0,02	0,06
0,20	0,15	0,18	0,07	0,13
0,30	0,31	0,27	0,14	0,19
0,40	0,51	0,36	0,22	0,25
0,50	0,76	0,45	0,33	0,31
0,75	1,55	0,67	0,67	0,47
1,00	2,58	0,89	1,12	0,63
1,25	3,84	1,11	1,66	0,79
1,50	5,32	1,34	2,30	0,94
1,75	7,01	1,56	3,03	1,10
2,00	8,91	1,78	3,85	1,26
2,25	11,06	2,00	4,76	1,41
2,50	13,32	2,23	5,74	1,57
2,75	15,88	2,45	6,81	1,73
3,00	18,62	2,67	7,98	1,89
3,25	21,52	2,90	9,23	2,04
3,50	24,57	3,12	10,54	2,20
3,75	27,91	3,34	11,98	2,36
4,00	31,42	3,56	13,42	2,52
4,25	35,09	3,79	14,99	2,67
4,50	38,92	4,01	16,63	2,83
4,75	43,12	4,23	18,43	2,99
5,00	47,26	4,46	20,20	3,14
5,25	51,81	4,68	22,03	3,30
5,50	56,54	4,90	24,05	3,46
5,75	61,11	5,12	26,14	3,62
6,00	66,16	5,35	28,14	3,77
6,25			30,37	3,93
6,50			32,66	4,09
6,75			35,02	4,24
7,00			37,44	4,40
7,25			39,94	4,56
7,50			42,49	4,72
7,75			45,11	4,87
8,00			48,06	5,03
8,25			50,82	5,19
8,50			53,62	5,34

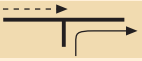
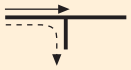
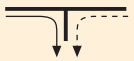
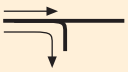
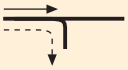
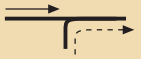
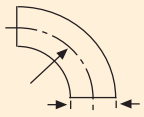
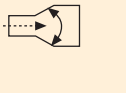
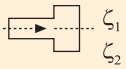
Determination of total pressure loss of the installation
1. The calculated flow rates of the individual take-off points are summed in a direction opposite to the flow direction and are assigned to the corresponding pipe sections as cumulative flow rates.
2. The pipe dimensions are calculated from the sum of continuous flow rates and peak flow rates.
3. The continuous flow rate is regarded as the quantity which emrges when water is removed for more than 15 minutes, converted to litres per second.
4. Values for the conversion of cumulative flow rates into peak flow rates are shown in diagram 8.9.2..
5. In association with the internal pipe diameter, the peak flow rates determine the pressure gradient due to pipe friction.
6. The total pressure loss of the pipe (without equipment resistances) is the sum of the pressure losses due to pipe friction and individual resistances.
7. The coefficients of resistance of pipeline sections and individual resistances are shown in table 8.9.4..
8. The total pressure loss of the pipe can be determined with the aid of the relevant equation:

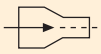
$$\Delta P = \sum (R \times L + Z)$$

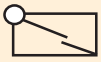
$$Z = \zeta \cdot \frac{v^2 \cdot \varrho}{2}$$

8.9.4. Resistance Coefficient Values

Resistance coefficient values ζ_u for piping juncetions

No	Designation	Graphic Symbols	Loss coefficients
1	Branching, one-sided, dividing flow		1.3
2	Branching, one-sided, merging flow		0.9
3	Branching, one-sided, passage for dividing flow		0.3
4	Branching, one-sided, passage for merging flow		0.6
5	Branching, one-sided, counter-current for merging flow		3.0
6	Branching, one-sided, counter-current for dividing flow		1.3
7	Branching, one-sided, bow-shaped, dividing flow		0.9
8	Branching, one-sided, bow-shaped, merging flow		0.4
9	Branching, one-sided, bow-shaped, passage for dividing flow		0.3
10	Branching, one-sided, bow-shaped, passage for merging flow		0.2
11	Branching with 2 exit pipes (casing, reservoir)		0.5
12	Branching with 2 entry pipes (casing, reservoir)		1.0
13	Bow 90°, smooth R = d = 2d = 4d = 6d = 10 d Bow 90°, rough R = d = 2d = 4d = 6d = 10d		 0.21 0.14 0.11 0.09 0.11 0.51 0.30 0.23 0.18 0.20
14	Elbow joints 90°smooth Elbow joints 90°, rough		1.13 1.27
15	Widening, steady ß = 10° = 20° = 30° = 40° Widening, sudden Widening, free discharge	  	 0.20 0.45 0.60 0.75 $\left(\frac{F_1}{F_2}-1\right)^2$ 1.0

No	Designation	Graphic Symbols	Loss coefficients
16	Narrowing, steady Reductions 1 dimensions 2 dimensions 3 dimensions 4 dimensions 5 dimensions 6 dimensions		 0.40 0.50 0.60 0.70 0.80 0.90

No	Designation	Graphic Symbols	Loss coefficients
17	Smooth comp, tube bend Quill comp, tube bend Corrugated comp, tube		0.7 1.4 2
18	Screw-down stop globe valve DN 15 DN 20 DN 25 DN 32 DN 40 to 100 Slanted seat valves DN 15 DN 20 DN 25 to DN 50 DN 65		 10.0 8.5 7.0 6.0 5.0 3.5 2.5 2.0 0.7
19	Full current valves DN 15 DN20 to DN 25 DN 32 to DN 50 DN 65 to DN 80 over DN 100		 2 1.5 1 0.7 0.6
20	Corner valves DN 15 DN 20 to DN 40 DN 50 to DN 100		 4.0 2.0 3.5
21	Main slide valve DN 10 to DN 15 DN 20 to DN 25 DN 32		 1.0 0.5 0.3
22	Reflux valve without shut-off DN 25 to DN 40 DN 50 with shut-off DN 20 DN 25 to DN 50	 	 2.5 1.9 4.6 3.6
23	Flap trap DN 50 DN 100 DN 200		 1.5 1.2 1.0
	Check valve DN 15 to DN 20 DN 20 to DN 50		 15 13
24	Valve tapping clip DN 25 to DN 70		 5.0

8.9.5. Comperative Table of Nominal Widths

Compartive table of naminal widiths for differend pipes types

Nominal width acc. DIN 2402	Plastherm PP Tye 3 pipes in accordance with DIN 8087			Medium heavy zinc coated threaded pipes acc. DIN 2440	Copper pipes acc. DIN 1754 and 1786	Stainless steel conduct pipes
	PN 10	PN 20	PN 25			
10	...	16x2.7 (10.6)	...	...	12x1.0 (10)	...
12	...	20x3.4 (13.2)	20x4.0 (12)	3/8" (12.5)	15x1.0 (13)	15x1.0 (13)
15	...	...	25x5.0 (15)	...	...	...
16	20x1.9 (16.2)	25x4.2 (16.6)	...	1/2" (16)	18x1.0 (16)	...
20	25x2.3 (20.4)	32x5.4 (21.2)	32x6.4 (19.2)	3/4" (21.6)	22x1.0 (20)	22x1.2 (19.6)
25	32x3.0 (26)	40x6.7 (26.6)	40x8.0 (24)	1" (27.2)	28x1.5 (25)	28x1.2 (25.6)
[30]	...	...	50x10.0 (30)	...	...	...
32	40x3.7 (32.6)	50x8.4 (33.2)	63x12.6 (37.8)	11/4" (35.9)	35x1.5 (32)	35x1.5 (32)
40	50x4.6 (40.8)	63x10.5 (42)	75x15.0 (45)	11/2" (41.8)	42x1.5 (39)	42x1.5 (39)
50	63x5.8 (51.4)	75x12.5 (50)	...	2" (53)	54x2.0 (50)	54x1.5 (51)
[60]	75x6.9 (61.2)	90x15.0 (60)	...	...	64x2.0 (60)	...
65	...	...	...	21/2" (68.8)	...	...
70	90x8.2 (73.6)	110x18.4 (73.2)	...		76.1x2.0 (72.1)	76.1x2.0 (72.1)
90	110x10.0 (90)	...	...			...

As a rule, it is possible to employ smaller pipe widths for Plastherm pipes as compared to steel pipes, owing to the considerably lower pipe friction pressure drops in addition to the fact that furring is unlikely.

In most cases, for the most frequently employed Plastherm pipes of nominal pressure degree PN 20, experience suggests the following allocation:

Plastherm pipe, PN 20	Medium heavy zinc coated steel pipes	
Diameter [mm]	Dimension [inch]	DN
16	3/8"	12
20	1/2"	15
25	3/4"	20
32	1"	25
40	11/4"	32
50	11/2"	40
63	2"	50
75	21/2"	65
90	-	-
110	3"	80

In all cases, however, pipe diameters should be determined in accordance with DIN 1988 "Technical Regulations for Drinking water systems". Section 3.

9. Installation

9.1. Installation Recommendations

• Handling the plastherm installation system does basically not differ from the instalation scheme for metallic pipes.
• Fittings and fixtures customary in the trade as well as insulating materials in accordance with the heating installation prescriptions may be applied in the traditional manner.
• Planning and execution of drinking water systems are carried out in conformity with DIN 1988 “Technical Regulations on Drinking Water Systems”.
• Use on mixed systems, e.g. during repair work is problem-free.
• The exceedingly small number of tools required, simplifies the processing of entire system.
• Owing to the extensitive fitting programme, appropriate moulded parts required for each mode of installation e.g. wall installations are available.
• Coupling with existing plastherm systems can easily be carried out using welding saddles.
• Installations elements subject to frequent use can easily be pre-assembled (welded) in the workshop.

To make sure that our systems are installed in a professional manner, the following recommendations should be observed:

• Avoid the bubbles inside the piping
• Mount piping upwards towards the tapping point
• Install aerators and ventilation device at the upper end of the ascending part of the line, evacuation at the lower end
• Seperate cut-offs should be mounted for ascending phases, apartment piping, pressure rinsers, hot water boilers, and garden piping
• For condensation reasons, the hoter water piping should be mounted above the cold water piping
• Pipe fittings should always be fixed with inserts to avoid sound transmission
• Contacts with wall structures ought to be avoided for passages through walls and ceilings to eliminate sound transmission
• Pipe elongation should be taken into account
Welding at outdoor temperatures below 0∞C is possible only under specific conditions

9.2. Welding Operation

The welding operation is simple and fast:

1; Cut the pipe perpendicular to its axis

2; Heat the pipe and the fitting at the same time

3; Within the allowed time interval, connect the pipe and the fitting (do not twist.)

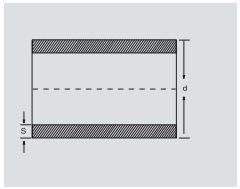
4; Join pipe and fittings. Finished! 100% safe welding

1	2	3	4	5	DVS 2207
Externel pipe diameter mm	Insert depths mm	Heating period secs	Processing period secs	Cooling period mins	
16 20 25	13 14 15	5 5 7	4	2	with hand welding device
32 40 50	16.5 18 20	8 12 18	6	4	
63	24	24	8	6	with welding machine
75 90	26 32	30 40	10 10	8 8	
100	38.5	50	15	10	

Recommended values for welding of PPR pipe at an outdoor temperature of 20 °C and medium air movement (time requirement)

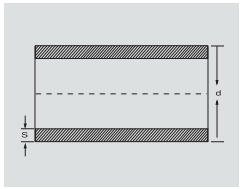
10. Plastherm Products

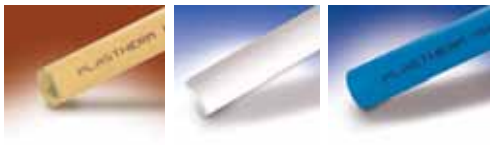
PIPE PN 10 (10 ATU)

Code	Measure	Packet
PN101	20x1.9 mm	100
PN102	25x2.3 mm	100
PN103	32x3.0 mm	60
PN104	40x3.7 mm	40
PN105	50x4.6 mm	20
PN106	63x 5.8 mm	12
PN107	75x 6.9 mm	4
PN108	90x8.2 mm	4
PN109	110x10 mm	4
PN110	125x11.4 mm	3

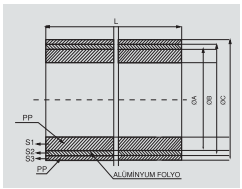
PIPE PN 20 (20 ATU)



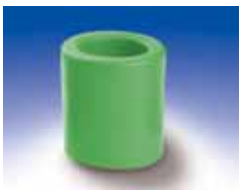
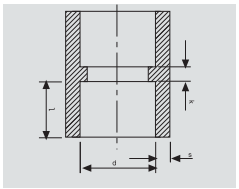
Code	Measure	Packet
P0101	20x3.4 mm	100
P0102	25x4.2 mm	100
P0103	32x5.4 mm	60
P0104	40x6.7 mm	40
P0105	50x8.4 mm	20
P0106	63x10.5 mm	16
P0107	75x 12.5 mm	12
P0108	90x15 mm	8
P0109	110x18.4 mm	4
P0110	125x20.9 mm	3

STABLE PIPE PN 25 (25 ATU)

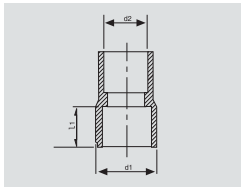
Code	Measure	Packet
PS101	20x2.8 mm	100
PS102	25x3.5 mm	100
PS103	32x4.5 mm	60
PS104	40x5.6 mm	40
PS105	50x6.9 mm	20
PS106	63x 8.7mm	16
PS107	75x 10.4 mm	12

SOCKET, EQUAL

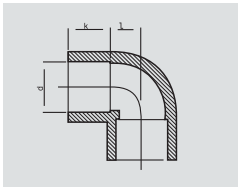

Code	Measure	Box
P0201	20 mm	500
P0202	25 mm	320
P0203	32 mm	200
P0204	40 mm	100
P0205	50 mm	60
P0206	63 mm	32
P0207	75 mm	24
P0208	90 mm	16
P0209	110 mm	10
P0210	125 mm	6

REDUCER



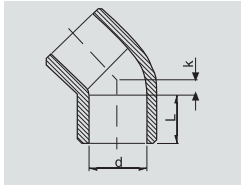
Code	Measure	Box
P0301	25/20 mm	500
P0302	32/20 mm	300
P0303	32/25 mm	300
P0304	40/20 mm	200
P0305	40/25 mm	200
P0306	40/32 mm	160
P0307	50/20 mm	100
P0308	50/25 mm	100
P0309	50/32 mm	80
P0310	50/40 mm	80
P0311	63/25 mm	80
P0312	63/32 mm	80
P0313	63/40 mm	60
P0314	63/50 mm	40
P0315	75/50 mm	40
P0316	75/63 mm	32

ELBOW 90°



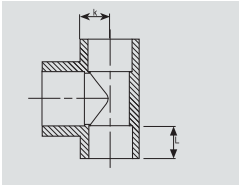
Code	Measure	Box
P0401	20 mm	320
P0402	25 mm	200
P0403	32 mm	100
P0404	40 mm	75
P0405	50 mm	32
P0406	63 mm	20
P0407	75 mm	12
P0408	90 mm	8
P0409	110 mm	3
P0410	125 mm	2

ELBOW 45°



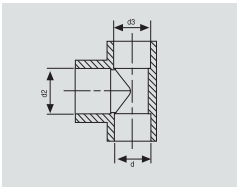
Code	Measure	Box
P0701	20 mm	400
P0702	25 mm	250
P0703	32 mm	150
P0704	40 mm	75
P0705	50 mm	32
P0706	63 mm	20
P0707	75 mm	12

TEE 90°



Code	Measure	Box
P0801	20 mm	250
P0802	25 mm	150
P0803	32 mm	80
P0804	40 mm	50
P0805	50 mm	30
P0806	63 mm	20
P0807	75 mm	10
P0808	90 mm	5
P0809	110 mm	3
P0810	125 mm	2

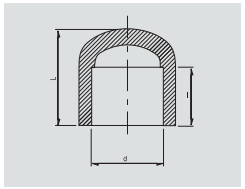
TEE 90° REDUCING



Code	Measure	Box
P0901	25x20x20 mm	180
P0902	25x25x20 mm	180
P0903	25x20x25 mm	180
P0904	32x25x32 mm	100
P0905	32x20x32 mm	100
P0906	32x20x20 mm	100
P0907	32x25x25 mm	100
P0908	32x25x20 mm	100
P0909	32x20x25 mm	100
P0910	32x32x20 mm	100
P0911	32x32x25 mm	100
P0912	40x20x40 mm	100
P0913	40x25x40 mm	100
P0914	40x32x40 mm	100

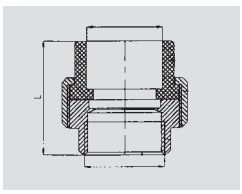
END CAP

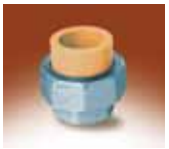





Code	Measure	Box
P1101	20 mm	500
P1102	25 mm	500
P1103	32 mm	240
P1104	40 mm	200
P1105	50 mm	100
P1106	63 mm	50
P1107	75 mm	40

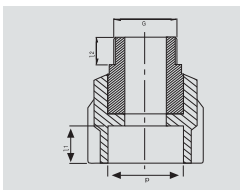
ADAPTOR UNION PP/BRASS FEMALE THREADED



Code	Measure	Box
P3701	20x1/2"	200
P3702	25x3/4"	100
P3703	32x1"	100
P3704	40x1 1/4"	50
P3705	50x1 1/2"	40

ADAPTOR UNION PP/BRASS MALE THREADED



Code	Measure	Box
P3601	20x1/2"	200
P3602	25x3/4"	100
P3603	32x1"	100
P3604	40x1 1/4"	40
P3605	50x1 1/2"	32

ADAPTOR FEMALE THREADED

Code	Measure	Box
P1301	20x1/2"	200
P1302	20x3/4"	150
P1303	25x3/4"	150
P1304	25x1/2"	150
P1305	32x3/4"	150
P1306	32x1"	150

ADAPTOR MALE THREADED

Code	Measure	Box
P1501	20x1/2"	180
P1502	20x3/4"	100
P1503	25x3/4"	100
P1504	25x1/2"	100
P1505	32x3/4"	100
P1506	32x1"	100

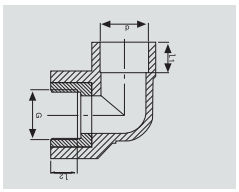
HEXAGONAL ADAPTOR FEMALE THREADED

Code	Measure	Box
P1404	32x1"	80
P1405	40x1 1/4"	50
P1406	50x1 1/2"	40
P1407	63x2"	20
P1408	75x2 1/2"	15
P1409	90x3"	8
P1410	110x4"	5
P1411	125x5"	2

HEXAGONAL ADAPTOR MALE THREADED

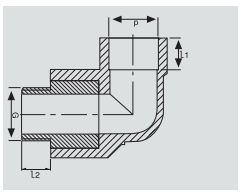
Code	Measure	Box
P1603	32x3/4"	80
P1604	32x1"	80
P1605	40x1 1/4"	40
P1606	50x1 1/2"	32
P1607	63x2"	16
P1608	75x2 1/2"	12
P1609	90x3"	8
P1610	110x4"	5
P1611	125x5"	2

ELBOW 90° FEMALE THREADED

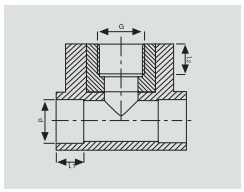

Code	Measure	Box
P1701	20x1/2"	200
P1702	20x3/4"	150
P1703	25x1/2"	150
P1704	25x3/4"	150
P1705	32x3/4"	50
P1706	32x1"	50

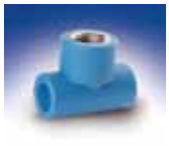
ELBOW 90° MALE THREADED


Code	Measure	Box
P1801	20x1/2"	200
P1802	20x3/4"	100
P1803	25x3/4"	100
P1804	32x3/4"	50
P1805	32x1"	50
P1806	25x1/2"	100

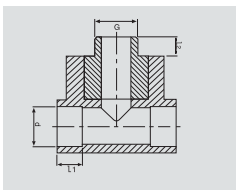
TEE 90° FEMALE THREADED

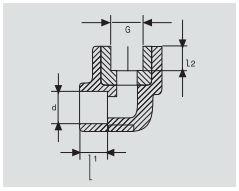
Code	Measure	Box
P1901	20x1/2x20	160
P1902	20x3/4x20	160
P1903	25x1/2x25	100
P1904	25x3/4x25	100
P1905	32x3/4x32	50
P1906	32x1x32	50

TEE 90° MALE THREADED

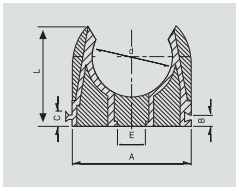

Code	Measure	Box
P2001	20x1/2x20	150
P2002	25x3/4x25	100
P2003	32x1x32	50
P2004	25x1/2x25	100

FEMALE THREADED BATTERY CONNETCTION



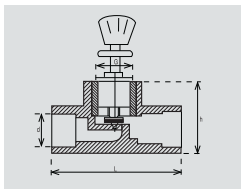
Code	Measure	Box
P1201	20x1/2"	160

BRACELET



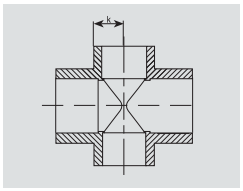
Code	Measure	Box
P2401	20 mm	1000
P2402	25 mm	800
P2403	32 mm	500
P2404	40 mm	300

VALVE CHROMEPLATED



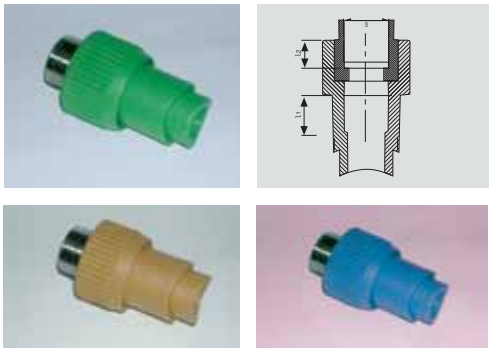
Code	Measure	Box
P2301	20x3/4	50
P2302	25x3/4	50

CROSS TE



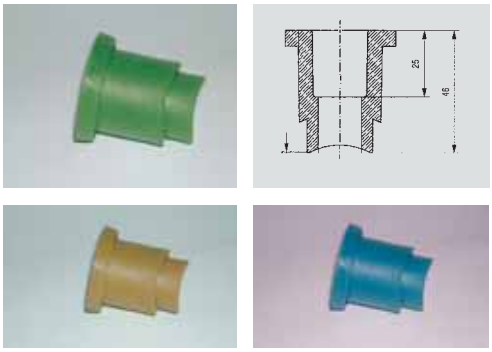
Code	Measure	Box
P0601	20 mm	200
P0602	25 mm	130
P0603	32 mm	60
P0604	40 mm	40

WELD IN SADDLE ADAPTOR MALE



Code	Measure	Box
P4001	25x1/2	100
P4002	25x3/4	100

SOCKET WELD IN SADDLE



Code	Measure	Box
P2601	25 mm	320

CROSSOVER PIPE

Code	Measure	Box
P0501	20 mm	100
P0502	25 mm	60
P0503	32 mm	40

PLUG

Code	Measure	Box
P2501	20 mm	1000
P2502	25 mm	800
P2503	32 mm	500

DOUBLE BRACELET

Code	Measure	Box
P3301	20 mm	900
P3302	25 mm	720
P3303	22 mm	900
P3304	27 mm	720
P3305	32 mm	720

CHROMED UPPER PART

Code	Measure	Box
P4201	3/4	150

STRAIGHT VALVULA

Code	Measure	Box
P4101	1/2	150
P4102	3/4	150
P4103	1	100
P4104	1 1/4	60

CONCEALED CHROME - PLATED

Code	Measure	Box
P4301	3/4	120

WELDING MACHINE SET

Code	Measure	Box
P3001		1

WELDING MACHINE (BIG)

Code	Measure	Box
P3003	50-160 mm	1

PIPE CUTTER

Code	Measure	Box
P2801	16-40	1
P2802	50-110	1

ONLY WELDING MACHINE

Code	Measure	Box
P3002	20-50 mm	1

WELDING SOCKET

Code	Measure	Box
P2701	20 mm	1
P2702	25 mm	1
P2703	32 mm	1
P2704	40 mm	1
P2705	50 mm	1
P2706	63 mm	1
P2707	75 mm	1

REPAIRING TOOL

Code	Measure	Box
P4401		1

PIPE PELING APPARAT

Code	Measure	Box
P3501	20-25	1
P3502	32-40	1

PIN FOR PIPE REPAIR

Code	Measure	Box
P4501		1

TEMP LATE

Code	Measure	Box
P4801		1

PLUG FOR REHEARSAL TESTS

Code	Measure	Box
P2901	20 mm	1