fritherm®

PP-Rc PIPES & FITTINGS



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fritherm System
Spitzen technolgie



fritherm ist auf die Herstellung und Lieferung modernster Produkte der Sanitärtechnik spezialisiert. Diese Produkte sind ein Ergebnis der Kombination aller Erfolgsfaktoren zusammen mit der Anwendung höchster Fertigungstechnologien unter Einsatz modernster Produktionsanlagen, Spritzguss-Maschinen, hoher Standardausstattung, Laborgeräten, Qualitätskontroll-Techniken und vor allem der Anwendung der strengsten internationalen Normen, um alle anerkannten Zertifizierungen zu erhalten.

Unser Labor ist mit dem höchsten Standard an Prüfeinrichtungen ausgestattet. Höchste Produktqualität ist garantiert.

Unsere werksinternen Maßnahmen zum Qualitätsstandard umfassen Rohstofftests, Produktionsüberwachung und Tests an fertigen Produkten und werden kontrolliert nach internationalen Standards. Die Tests werden kontinuierlich im eigenen Labor durchgeführt. Ein Maximum an Sicherheit wird garantiert.
Es erfolgt eine kontinuierliche Zusammenarbeit mit unabhängigen Prüfinstituten, um sicherzustellen, dass unsere Produkte allen Anforderungen entsprechen.

fritherm - modernste und hygienische Systeme zum Transport von Wasser und Flüssigkeiten mit dem Vertrauen und dem Hintergrund einer kompletten Produktpalette, die es zu einem der praktischsten und ökonomischsten Systeme auf dem Markt macht.

fritherm Produkte sind die richtige Wahl für die richtige Lösung.

fritherm system
Advanced Technology



fritherm is specialized in manufacturing and supply one of most advanced products in plumbing. The product is a result of combining all factors of success together by means of implementing highest manufacturing technology processes in using most modern production lines, injection moulding machines, high standard equipment, lab test devices, quality control technique and above all, implementing the strictest international standards to obtain all necessary accredited certifications

Our laboratory is well equipped with highest standards testing equipment guarantee the highest quality products. Our inner factory quality standards measures include raw materials testing, production survey and testing finished products are all controlled according to international standards. Tests are conducted continuously in our own laboratory guaranteeing maximum safety. Continuously we get the collaboration of independent testing institutes to ensure that our products comply with other applicable specifications.

fritherm, most advanced and hygienic systems, are available for conveying water and fluids, used with confidence and complete piece of mind due to the complete range of products that makes it one of most practical and economical systems in the market

fritherm products are the right choice for the right solution.

System Introduction

Most advanced and hygienic system available for conveying potable water and fluid. Confidence with complete piece of mind due to resistance to most chemicals, through the complete range of pipes and fittings that makes it most practical and economical system for transferring fluids.

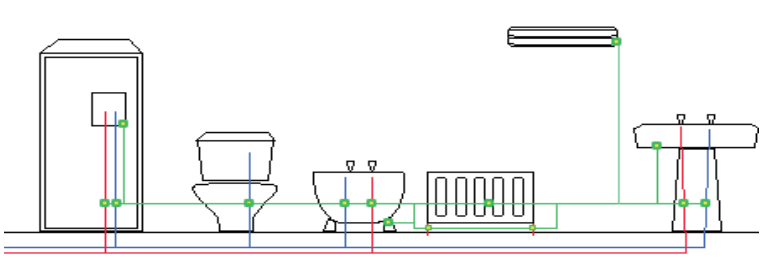
Areas of Applications

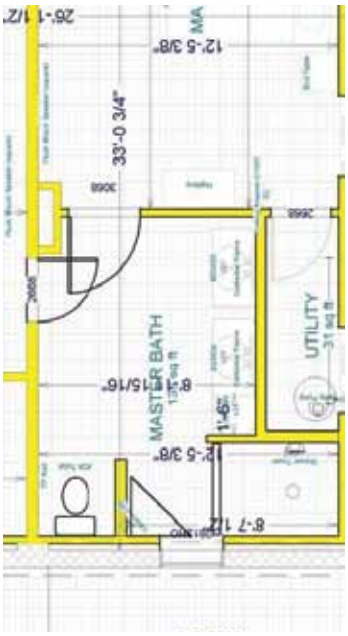


- **Transferring Potable water**
- **Transferring fluid**
- **Sanitary hot & cold net works**
- **Air conditioning & Chillers**
- **Central heating systems**
- **Industrial applications, air, fluids …**
- **Swimming pools net works**

Advantages

- **Lower pressure drops since smooth inner surface**
- **No deposit or scaling since smooth inner surface**
- **High resistance to chemicals**
- **Simple installation, easy maintenance**
- **Hygienic and healthy**
- **Long service life of around 50 years**
- **Low thermal conductivity hence no condensation & heat loss**
- **Sound proof silent system**
- **Environmental friendly, recyclable**





Quality Assurance & Measures

fritherm has always maintained high level of quality products. It is produced under the stricts technical conditions to comply with the stated requirements by both national and international authorities and institutes apparent in the European EN ISO 15874 and other related German standards of DIN 8077, DIN 8078
Our laboratory is well equipped with highest standards testing equipment and devices to guarantee the highest quality products. Our inner factory quality standards measures include raw materials testing, production survey and testing finished products according to DIN standards. Tests are conducted continuously in our own laboratory guaranteeing maximum safety. Continuously we get the collaboration of the independent testing institutes to ensure that our products comply with other applicable specifications such as DIN, P-Norm & ISO.

Quality Tests

- **Melting index test of raw materials**
- **Testing accuracy of dimensions and surface nature.**
- **Interior long term pressure test of 1 hour at 20 ˚C and up to 80 bar**
- **Notched bar impact thermal test**
- **Welding index of processed materials.**
- **Microscopic examination**
- **Samples of all feeds are submitted to a long term internal pressure test lasting 1,000 hours at 95 ˚C and up to 18 bar.**



Certifications

- **DVGW**
- **SKZ**





Standards

International Standards

DIN 8077	Polypropylene pipes dimensions
DIN 8078	General quality requirements for Polypropylene pipes
DIN 8078/ Insert 1	chemical resistance of pipes and fittings
DIN 16928	Pipes & fittings Installation connections
DIN 1988	DVGW practice code for drinking water installations
DIN 4046	DVGW water supply technical regulations
ISO EN15874	Vestolen raw material PP-R Type 3
O-NORM B5174	Polypropylene pipes, dimensions, requirements, tests standard coefficient
O-NORM B5157	Plastic compound pipes system for hot & cold water, dimensions, requirements, tests, standard coefficient.
DVS 2207	Thermoplastic pipes & fittings welding
DVS 2208	Welding machines & devices of thermoplastic



Technical Data

Material Properties

Pipes and fittings of fritherm are made of Polypropylene Random Copolymer Type 3, PPRc, this material is known for its strength, stability and resistance to high temperatures. physical & chemical properties of the material meet the special requirements of drinking water supply and heating system.

Properties	Test Method	Unit	PPR Values
Physical Properties			
Melting index	ASTM D1238		
MFI 190 ˚C /5.0 kg	ASTM D1238	g/10 min	0.25
MFI 230 ˚C/2.16 kg	ASTM D1238	g/10 min	0.45
Density	ASTM D792	g/cm³	0.91
Melting range	Polarizing microscope	˚C	140 - 150
Tensile Strength			
Yield Point	ASTM D638	kg/cm²	270
Break Point	ASTM D638	kg/cm²	230
Elongation	ASTM D638	%	> 400
Flexural Modulus	ASTM D790	kg/cm²	8,500
Izod Impact Strength			
23 ˚C			30
0 ˚C	ASTM D256	kg.cm/cm	8
-20˚C			3
Vicat Softening Point	ASTM D1525	˚C	130
Melting Temperature	HS Method	˚C	141
Surface Resistance	HS Method		> 10^{13}
Expansion coefficient			
Mean Coefficient of Linear thermal expansion 0 ˚C - 110 ˚C	Dilatometer	K^{-1}	$1.5x10^{-4}$

Resistance to Internal Hydrostatic Pressure

Condition	Required	Value	Test Method
20˚C at 16 MPa	1 hr	> 10 hrs	ISO 1167
95˚C at 3.5 MPa	1,000 hrs	> 5,000 hrs	ISO 1167
110˚C at 1.9 MPa	8,760 hrs	> 10,000 hrs	ISO 1167

Durability

Durability can be calculated using the long term internal pressure diagram and the given formula for determination of the reference tension.

$\delta v = P \times (Dia - S) / 2 \times S$

Where

δv is reference tension, N/mm²

P is internal pressure, N/mm²

Dia is external diameter of pipe in mm

S is wall thickness of pipe in mm

Note:

1 bar = 0.1 N/mm²



Example

To calculate the resulting reference tension for a certain pipe size,

Pipe of size 20mm & thickness is 3.4mm,

nominal pressure PN20

Operational pressure is 10 bar

$\delta v = 1$ N/mm² x (20mm - 3.4mm) / 6.8mm

$\delta = 2.44$ N/mm2

If reference tension is drawn as a staright 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, no point of intersection is reached under the operating conditions encountered in practice. Life > 50 years.



SF Security Factor calculation

δv (eg 50 years, temp 60 ˚C) = 4,9 N/mm² established from diagram

It is clear that fritherm pipes present tremendous safety margin in real application.

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

Long Term Stress Behaviour



Consistancy Properties

Consistancy Properties PN20

From the requirement of the temperature / pressure ration in accordance to DIN 1988 T2 and the long term durability properties in accordance to DIN 16962 and DVS 2207, fritherm pipe with a pressure rate PN20 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 temp with a maximum number of years of operation transporting water.

	Operational excess 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 to 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: Admissible operational pressures

Consistancy Properties PN25

From the requirement of the temperature / pressure ration in accordance to DIN 1988 T2 and the long term durability properties in accordance to DIN 16962 and DVS 2207, fritherm pipe with a pressure rate PN20 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 4 shows the admissible operational pressures depending on temp with a maximum number of years of operation transporting water.

	Operational excess 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 to 85	8760 50

Table 3: Operational requirements for pipes

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

Elongation & Bending

The following items need to be taken into considerations when calculating modifications in length.
1- Ambient and materials temperature upon installation

2- Temperature difference between lowest and highest pipe wall temperatures.

3- Expansion coefficient

Formula for calculating length alterations:

$$\Delta L = \alpha.L.\Delta T$$

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

FP = Fixing point
LS = Length of bending leg
L = Length of pipe
LP = Gliding rail
$\Delta L = \Delta L1_1 + \Delta L_2$

The minimum length of the bending leg results from:

$$Ls = K.\sqrt{d}.\Delta L$$

Explanation

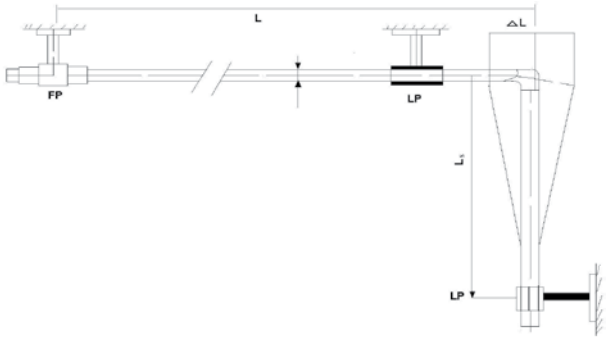
Ls = Length of bending leg in mm
K = Constant depending on material
(K value for PP = 15)
d = Pipe diameter in mm
Δ = Elongation in mm, calculated from equation $\Delta L = \alpha.L.\Delta T$

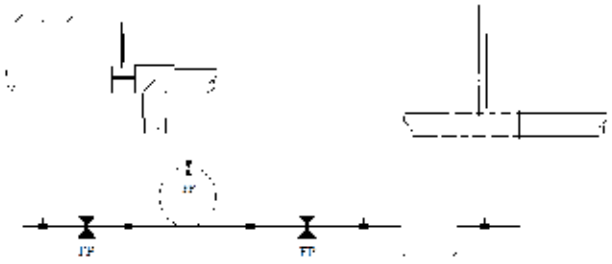
Explanation:
ΔL = Length alteration in mm
α = Expansion coefficient in K^{-1}
Polypropylene pipes α = 0.15
Stabi pipe AL/PPR Composite pipes α= 0.05
L = Pipe length in mm
ΔT = Difference in temperature in K

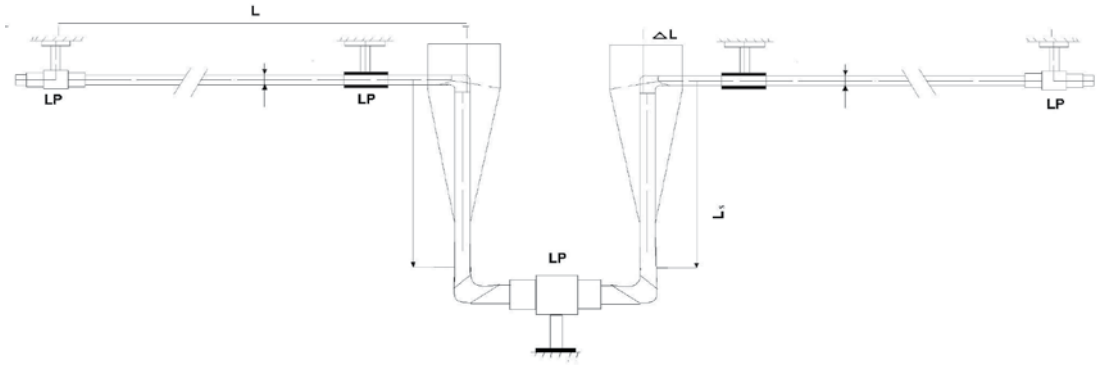
Example:

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

ΔL = 0.15x6x45 = 40.5 mm







Bearing Distance. Fixed Reference Point Version

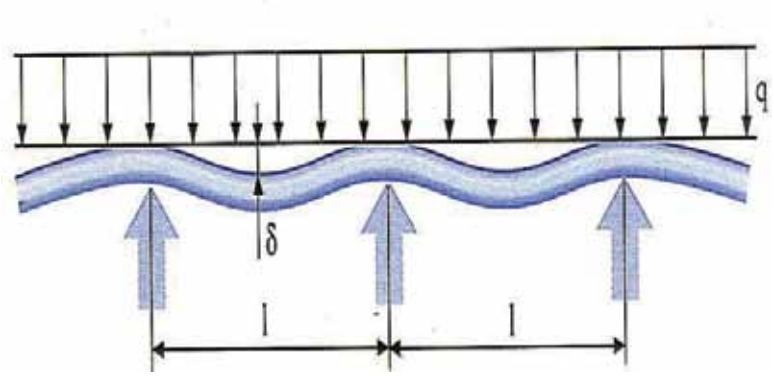
Arrangement of fix points for horizontal piping

Bearing distance for fritherm pipe PN10 up to PN25

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 distance for fritherm Stabi 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



Insulation

Thermal insulation should be installed on either hot water applications or heating systems. Despite that fritherm pipes and fittings have a heat conductivity value of 0.15 W/mK which indicate a significantly higher degree of natural insulation properties, but still and for many purposes minimum requirements specified should comply with international heating regulations.

Even cold water piping networks should be considered during insulation design. From drinking water health requirements point of view, the insulation of cold water system is important to keep temperature level around 20 ˚C.

Keeping water temperature at the required temperature level together with proper functioning circulation are important parts of protection against bacteria, such as Legionella.

The thickness and type of insulation and layers are determined on the basis of thermal resistance of the insulation system to be used, air humidity in the area of the piping system and the difference between the room temperature and that of flowing water.

Example of thermal insulation layer for cold water is shown in following table.

Piping Net Work Routing	Insulation Layer Thickness $L=0.04\ WM^{-1}\ K^{-1}$
freely laid network in unheated area	4 mm
freely laid network in heated area	9 mm
Network in crawl ways without a hot water line running in parallel	4 mm
Network in crawl ways with a hot water line running in parallel	13 mm
Networks under plaster	4 mm
Networks under plaster running in parallel with hot water lines	13 mm
Network cast over with concrete	4 mm

Note: different thermal characteristics may be considered
If hot water is transferred then it should be taken into consideration that plastic pipes possess better thermal insulation properties than metal ones.



Insulation Layer Thickness

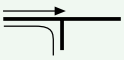
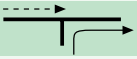
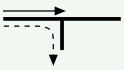
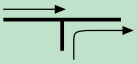
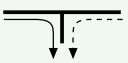
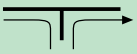
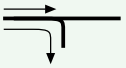
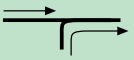
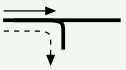
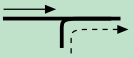
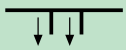
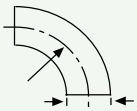
Installation sites	installation layer thickness at $L=0.04\ WM^{-1}\ K^{-1}$
Piping in unheated sites, uncovered installations (eg. Basement)	4mm
Piping in heated sites, uncovered installations	9mm
Piping inserted into a channel without heat conveying piping	4mm
Piping inserted into a channel next to heat conveying piping	13mm
Piping in wall slots, ascending piping and piping installed on concrete floor	4mm
Piping in wall chases next to heat conveying piping	13mm
Piping on concrete flooring	4mm

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

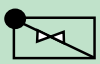
Nominal width (NW) of piping / fittings in mm	Uncovered piping	Pipes & fittings in wall & ceiling passages, in cross section, at pipe connection, for central pipe net distributors, radiators connecting piping not exceeding 8 m in length
up to NW 20	20mm	10mm
From NW 22 to NW 35	30mm	15mm
from NW 40 to NW 100	equal NW	1/2 NW
over NW 100	100mm	50mm

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

Calculations According to DIN 1988

DIN 1988 section 3 has to be implemented when sizing and dimensioning systems. A large number of calculation examples are demonstrated and all necessary tables and diagrams are explained in detail.
The required diagrams and tables for the calculations are shown below

Minimum Flow Pressure

Recommended values for minimum flow pressure and calculated flow at standard drinking water tapping.

Min. flow pressure bar	Type of drinking water tapping point		Calculation flow for tapping		
			Mixed water		Only cold or hot water
			Vol. flow cold	Vol. flow hot	Vol. flow cold
	Draw off taps				
0.5	without air whirled	DN 15	~	~	0.30
0.5		DN 20	~	~	0.50
0.5		DN 25	~	~	1.00
1.0	without air whirled	DN 10	~	~	1.15
1.0		DN 15	~	~	0.15
1.0	Shower heads	DN 15	0.1	0.1	0.20
1.2	pressure rinse acc DIN 3265	DN 15	~	~	0.70
1.2	pressure rinse acc DIN 3265	DN 20	~	~	1.00
0.4	pressure rinse acc DIN 3265	DN 25	~	~	1.00
1.0	pressure rinser for urinal basin	DN 15	~	~	0.30
					0.30
0.5	Corner valve urinal basin	DN 15	~	~	0.15
1.0	Household dish washer	DN 15	~	~	0.25
1.0	Household W/M	DN 15	~	~	~
	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	bidet	DN 15	0.07	0.07	~
1	Combination set	DN 20	0.30	0.30	~
0.5	Flushing box acc to DIN 19542	DN 15	~	~	0.13
	Drinking water heater for supply of tapping point, inclusive tap fittings				
1	Electric water boiler	DN 15	~	~	0.10
1.1	Electric water boiler UP 15L	DN 15	~	~	0.10
1.2	Electric water boiler UP 150L	DN 15	~	~	0.20
	Electro flow water heater, hydraulic control without flow limitation				
1.5	Nominal capacity	12 KW	~	~	0.06
1.9	18 KW		~	~	0.08
2.1	21 KW		~	~	0.09
2.4	24 KW		~	~	0.10
1	Gas flow water heater	12 KW	~	~	0.10



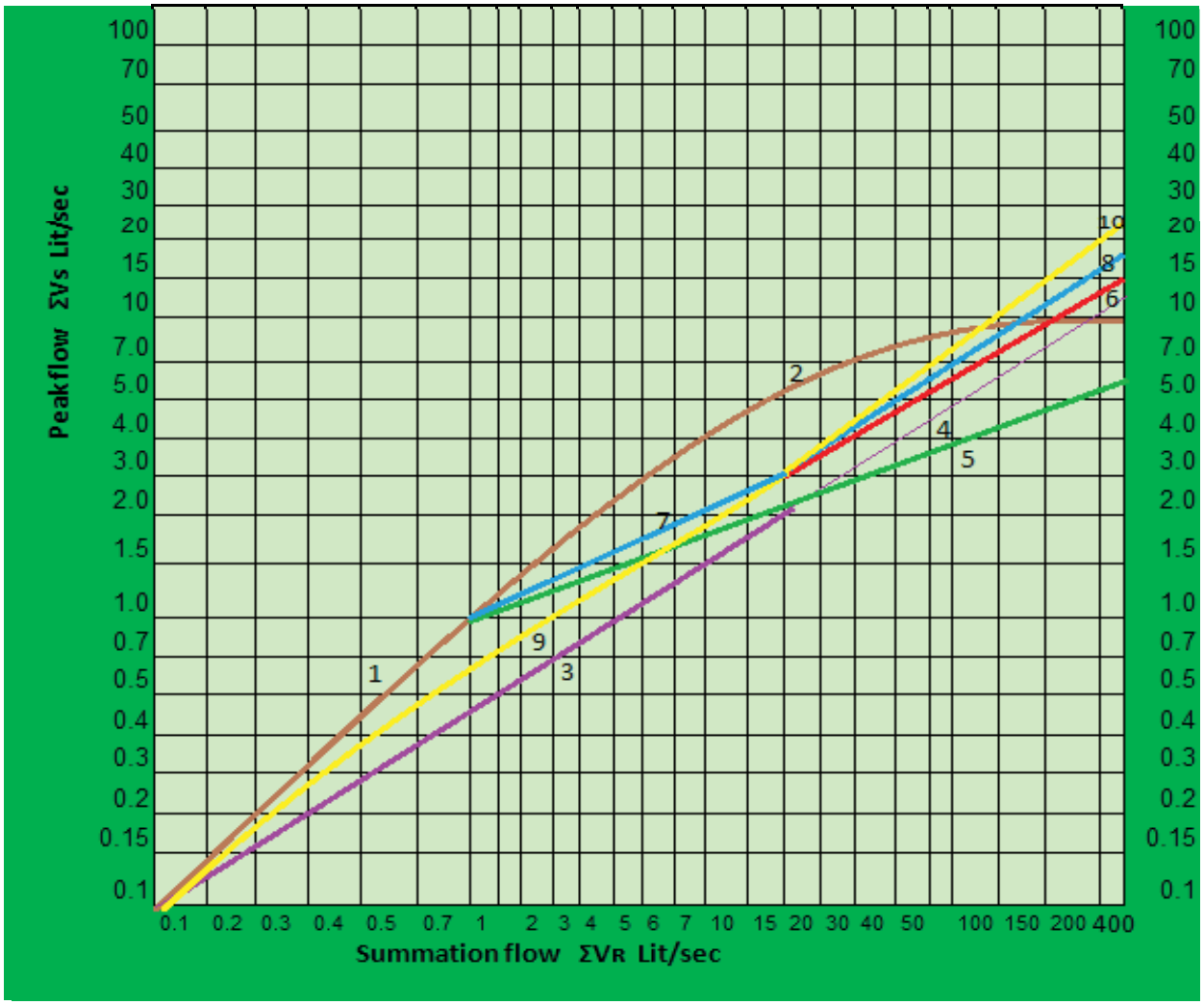
Peak flow Vs depends on total Flow ΣV_R

Area of application $V_R \leq 20$ l/s

	$V_R \geq 0.5$ l/s	$V_R < 0.5$ l/s
Residential	❺	❸
Offices	❺	❸
Hotel	❼	❾
Malls	❼	❾
Hospitals	❼	❾
Schools	❶	❶

Area of application $V_R > 20$ l/s

Residential	❺
Offices	❹
Hotel	❿
Malls	❽
Hospitals	❻
Schools	❷



Pressure Drop Due To Friction

Main factors have to be considered when calculating pressure drops such as pipe friction and flow speed during peak flow.

In accordance to DIN 1988 section 3 the following pressure drops charts resulting from pipe friction were recorded.

Starting values:

1 - Reference temperature 10 ˚C
2- Reference pressure 10 bar
3- Absolute roughness of interior pipe wall k = 0.007 mm
calculation of pipe friction coefficient according to Colebrook White

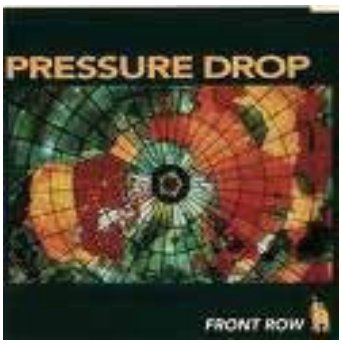
Note:

Pressure losses resulting from pipe friction change only in the operating temperature range (upto 60C) of drinking water system, hence it is customary for house installations to calculate with an over 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 refer to the bar unit or mbar. Should the loss in pressure required in practice be the Pascal value, the following ratio will apply: 1 mbar = 100 Pa

Intermediate values not indicated in the tables may be interpolated. It should be noted that no functions serve as basis.

Losses in pressure of the Postab pipes may be seen from the table of normal pressure degree PN20 as the inner pipes have the same dimensions.





PPR-C Type 3 DIN 8077 & Pressure PN 10

Factors of Pressure drop: Peak Flow V , Pipe Friction R & Flow Speed v

Peak Flow	DN 15 da =20mm di = 16.2 mm V = 0.206 l/m		DN 20 da =25mm di = 20.4 mm V = 0.327 l/m		DN 25 da =32mm di = 26.0 mm V = 0.531 l/m	
Vs 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	
0.90	128.84	4.37	41.80	2.75	12.93	
1.00	156.16	4.85	50.69	3.06	15.62	
1.10	186.32	5.34	60.23	3.37	18.57	
1.20			70.69	3.67	21.71	
1.30			81.79	3.98	25.13	
1.40			93.51	4.28	28.74	
1.50			106.32	4.59	32.49	
1.60			119.79	4.90	36.49	
1.70			133.91	5.20	40.80	
1.80					45.30	
1.90					49.99	
2.00					54.84	
2.10					66.16	
2.20					65.37	
2.30					71.08	
2.40					76.61	
2.50					82.70	
2.60					88.99	
2.70					95.47	
2.80					102.14	

PPR-C Type 3 DIN 8077 & Pressure PN 10

Factors of Pressure drop: Peak Flow V , Pipe Friction R & Flow Speed v

Peak Flow	DN 32 da =40 mm di = 32.6 mm V = 0.835 l/m		DN 40 da =50 mm di = 40.8 mm V = 1.307 l/m	
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

PPR-C Type 3 DIN 8077 & Pressure PN 10

Factors of Pressure drop: Peak Flow V , Pipe Friction R & Flow Speed v

Peak Flow	DN 50 da =63 mm di = 51.4 mm V = 2.075 l/m		DN 60 da =75 mm di = 61.2 mm V = 2.942 l/m		DN 70 da =90 mm di = 73.6 mm V = 4.254 l/m		DN 90 da =110 mm di = 90.0 mm V = 6.36 l/m	
Vs 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

PPR-C Type 3 DIN 8077 & Pressure PN 10

Factors of Pressure drop: Peak Flow V , Pipe Friction R & Flow Speed v

Peak Flow	DN 60 da =75 mm di = 61.2 mm V = 2.942 l/m		DN 70 da =90 mm di = 73.6 mm V = 4.254 l/m		DN 90 da =110 mm di = 90.0 mm V = 6.36 l/m	
Vs l/s	R mbar/m	v m/s	R mbar/m	v m/s	R mbar/m	v 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

PPR-C Type 3 DIN 8077 & Pressure PN 10

Factors of Pressure drop: Peak Flow V , Pipe Friction R & Flow Speed v

Peak Flow	DN 10 da = 16 mm di = 10.6 mm V = 0.088 l/m		DN 12 da = 20 mm di = 13.2 mm V = 0.137 l/m		DN 16 da = 25 mm di = 16.6 mm V = 0.216 l/m	
Vs 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

PPR-C Type 3 DIN 8077 & Pressure PN 10

Factors of Pressure drop: Peak Flow V , Pipe Friction R & Flow Speed v

Peak Flow	DN 20 da = 32 mm di = 21.2 mm V = 0.352 l/m		DN 25 da = 40 mm di = 26.6 mm V = 0.556 l/m		DN 32 da = 50 mm di = 33.2 mm V = 0.866 l/m	
Vs 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



PPR-C Type 3 DIN 8077 & Pressure PN 10

Factors of Pressure drop: Peak Flow V , Pipe Friction R & Flow Speed v

Peak Flow	DN 40 da = 63 mm di = 42.0 mm V = 1.385 l/m		DN 50 da =75 mm di = 50.0 mm V = 1.963 l/m		DN 60 da =90 mm di = 60.0 mm V = 2.827 l/m		DN 90 da =110 mm di = 73.2 mm V = 4.200 l/m	
Vs 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
0,5	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	9,18	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

PPR-C Type 3 DIN 8077 & Pressure PN 10

Factors of Pressure drop: Peak Flow V , Pipe Friction R & Flow Speed v

Peak Flow	DN 12 da =20mm di = 12.0 mm V = 0.1132 l/m		DN 15 da =25mm di = 15.0 mm V = 0.177 l/m		DN 20 da =32mm di = 19.2 mm V = 0.290 l/m	
Vs 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



PPR-C Type 3 DIN 8077 & Pressure PN 10

Factors of Pressure drop: Peak Flow V , Pipe Friction R & Flow Speed v

Peak Flow	DN 25 da =40 mm di = 24.0 mm V = 0.452 l/m		DN 30 da =50 mm di = 30.0 mm V = 0.707 l/m	
Vs 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

PPR-C Type 3 DIN 8077 & Pressure PN 10

Factors of Pressure drop: Peak Flow V , Pipe Friction R & Flow Speed v

Peak Flow	DN 40 da = 63 mm di = 37.8 mm V = 1.122 l/m		DN 45 da = 75 mm di = 45.0 mm V = 1.590 l/m	
Vs 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



Chemical resistance

+ = resistant
(+) - less resistant
0 = limited chemical resistance
(-) = poor resistance
- = not resistant
aq = aqueous solution
sat. = saturated solution at room temperature
c = colour

		Conc. %	Temp. (°C) 20	60	100
A					
Acetic acid		100	+	0	-
(Glacial acetic acid)					
Acetic acid aq.		50	+	+	
(see also vineger)		10	+	+	+
Acetic anhydride		100	+		
Acetone*		100	+	0	
Alcoholic iodine			+	0	
Alum		sat	+	+	
Alums aq		any	+	+	
Aluminium salts aq		any	+	+	+
Ammonia gaseous		100	+	+	
Ammonia aq		cone	+	+	
		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	+	+	+
Amly alcohol, pure			+	+	
Aniline		100	+	(+)	
Antifreeze agent. (cars)**			+	+	
Apple Juice			+	+	
Apple sauce			+	+	(+)
Aqua regia			+	-	
Asphall**			+	0	
ASPIRIN8			+		
B					
Barium salts		any	+	+	+
Beef suet			+	+	
beer			+		
benzaldhyde		100	+		

		Conc. %	Temp. (°C) 20	60	100
Benzaldehyde aq.		sat.	+		
		(0.3)			
Benzene		100	(-)	-	
Benzoic acid		100	+	+	
Benzoic acid aq.		sat	+	+	+
Bleaching solution			0	0	
(12.5 % active chlorine)					
Boneoi			+	(+)	
Borax aq		sat.	+	+	
Boric acid		100	+	+	
Boric acid aq.		sat.(4.9)	+	+	
Brake fluid*			+	+	
Brendly			+		
Bromine, liquid		100	-		
Bromine, vapours		high	-	-	
		Low	0	+	
Bromine water		sat.	-	-	
Butene, gassous		100	+	+	
Butane, liquid		100	+		
Butter			+	+	
Buttermik			+		
Butylacetate		100	+	0	
n-Butyl alcohol In-butanol		100	+	+	
C					
Cake			+	+	(+)
Calcium chloride aq.		sat.	+	+	+
Calcium nitrate aq.		sat.	+	+	
Camphor			+		
Carbon bisulphide**		100	0		
Carbon tetrachlonde		100	0	-	
Caustic potash solution		50	+	+	
		25	+	+	
		10	+	+	+
Caustic soda solution		50	+	+	
		25	+	+	
		10	+	+	
Cheese			+		
Chloride of lite			+	+	
(aquesous suspension)					
Chlorine, gas, dry		100	-	-	-
Chlorine, gas humid		10	0		-
Chlorine, liquid		100	-		
Chlorine water		sat.	0		
Chlorobenzene		100			
Chloroform		100	(-)	-	
Chlrosulphonic acid		100	-	-	
Chromic acid		sat.	+	-	
		20	+	0	
Chromic/sulphuric acid			-	-	
Chromium plating solution*			+	+	

	Conc. %	Temp. (°C) 20	60	100
Chromium salts (bi-and trivalent) aq.	sat.	+	+	
Cinnamon (cane)		+		
Cinnamon (ground)		+		
Citric acid aa.	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, driy		+	+	+
Copper salts aq.	sat.	+	+	+
Com seed oil		+	0	
Cream, whipped cream		+		
Cresol solution		+		
Cresol	100	+	0	
Cresols aq.	sat.	+	0	
	(0.25)			
Curds		+		
Cyclohexane	100	+		
Cyclohexanol	100	+	+	
Cyclohexanone	100	+	-	
D				
Decahydronaphthalene	100	0	-	-
Detergents. synhetic**	high	+	+	
	ready-for-use	+	+	+
Dibutylphthatate (see plasticizers)				
Diesel oil, see Fuels				
Dimethylformamide	100	+		
I .4-Dioxane	100	+	0	-
Dish-washing agents, liquid*		+	+	+
DIXAN® solution	ready-for-use	+	+	+
E				
Eggs Iuncooked & cooked)	100	+	+	(+)
Ether* (diethylene ether)	100	0		
Ethyl acetate		0	0	
Ethyl alcohol not denatured	100	+		
Ethyl alcohol aa.. not denatured	96	+	+	
	50	+	+	
	10	+	+	
Ethyl benzene	100	0	-	
Ethyl chloride***	100	-		

	Conc. %	Temp. (°C) 20	60	100
Ethylene chloride	100	(-)	(-)	
2-Ethyl hexanoi	10	+		
F				
Flxing salt (see also Sodium thiosulphat)	100	+	+	
Floor wax***		+	0	
Flour		+		
Flouric acid	40	+	+	
Folmaldehyde aq	40	+	+	
	30	+	+	
	10	+	+	
FORMALIN®		+	+	
Formie acid	98	+	0	
	90	+		
	50	+	+	
	10	+	+	+
FruitJuice		+	+	
Fruit salad		+		
Fuel				
Petrol normal		+	0	
according to DIN 5 1 635				
petrol, regular		(+)	-	
petrol, super		0	-	
Diesel oil*		+	0	
Fuel oil*		+	0	
Furniture pofeh*		+	0	
G				
Gin	40	+		
Glycerine	100	+	+	
Glycerine aq.	high	+	+	
	Iow	+	+	+
Glycol	100	+	+	
Glycol aq.	high	+	+	
	Iow	+	+	+
Grapefruitjuice		+	+	
Gravy		+	+	(+)
H				
Hair shampoo*		+	+	
Heptane	100	+	0	
Hexane	100	+	0	
Honey		+	+	
Horse-radish, ready-to-eat		+		
Hydrocloric,chloride gaseous	conc.	+	+	
(see also Hydrocloric acid)	10	+	+	
Hydrogen perioxide aq.	high	+	+	
	low	+	+	
	90			
	30	+	0	
	10	+	+	
	3	+	+	+
Hydrogen sluphide**	low	+	+	

	Conc. %	Temp. (°C) 20	60	100
I				
Ink*		+	+	
Iron salts aq.	sat.	+	+	+
Isooctone	100	+	0	
Isoproply alcohol	100	+	+	
J				
Jam		+	+	(+)
Jelly		+	+	(+)
L				
Lactic acid aq.	90	+	+	
	50	+	+	
	10	+	+	+
LANOLIN®		+	0	
Lard		+	+	0
Lemonadas		+		
Lemon arome		+		
Lemon peel		+	+	
Lemon peel oil		+		
Linseed oil		+		
LITEX®		+	+	
Liqueur	any	+		
LYSOL		+	0	
M				
Magnesiurn salts aq.	sat.	+	+	+
Margarine		+	+	
MARLIPAL MG	50	+	+	
MARLON (42 % active detergent)	100	+	+	
MARLOPHEN 83	20	+		
MARLOPHEN 89	100	+		
	5	+		
MARLOPHEN 810	100	+		
	20	+	+	
	5	+	+	
Mashed potatoes		+	+	(+)
Mayonnaise		+		
Menthol		+		
Mercurie salta aq.	salt.	+	+	
Mercury	100	+	+	
Methyl alcohol	100	+	+	
Methl alcohol aq.	50	+	+	
Methylene chloride*	100	0		
Methyl ethyl ketone	100	+		
Milk		+		
Milk food		+	+	(+)
Mineral oil (whitout aromatic hydrocarbons)**		+	0	-
Moth bals***		+		
Motor oil (cars)** (see also Two-stroke oil and oil according to ASTM)		+	0	-
Mustard		+		

	Conc. %	Temp. (°C) 20	60	100
N				
Nail polish*		+	0	
Nail polish remover*		+	0	
Naphtalane	100	+		
Nickel salts. aq.	sat.	+	+	
Nitric acid	50	0		
	25	+	+	
	10	+	+	
Nitrobenzene	100	0	0	
O				
Octane (see leoctane) Oil no. 3 according to ASTMD38O59	100	+	0	-
Oil of bitter almonds		+		
Oleic acid	100	+		
Oleum	any	-	-	
Olive oil		+	+	
Orangejuice		+	+	
Orange peell		+		
Orange peel oil		+		
Oxalix acid aq.	sat	+	+	+
Ozone (0,5 ppm)		+	-	
P				
Palm oil		+	0	
Paperika		+	+	
Paraffin	100	+	+	
Paraffin oil	100	+	0	
Peanul oil		+	(+)	(-)
Pectin	sat.	+	+	
Pepper		+	+	
Peppermint oil		+		
Perchlorethylene		+		
(see Tetrachlorettylene)				
Perfume**		+		
Petrol (see Fuels)				
Petroleum	100	+	0	
Petroleum ether	100	+	0	
Phenol (agueous phase)	sat.	+	+	
	(appr.9)			
(Phenolic Phase)	sat.	+		
	(appr70)			
Phosphoric acid	sat.(85)	+	0	
	50	+	+	
	10	+	+	+
Phosphorous pentoxide	100	+		
Photographic developers*	comm.	+	+	
	ready-	+	+	
	for-			
	use			
Pickled cabbage, ready-to-sat		+	+	(+)
Picled fish		+	+	(+)

	Conc. %	Temp. (°C) 20	60	100
Pickled heming				
Pineapplejuice		+	+	
Pine needle oil	100	+	(+)	
Plasticizers				
Dibuthyphthalate		+	0	
(VESTINOL C)				
Dibuthyleebacate		+		
Dlhexylphathalate		+		
Dinonyladipate		+		
Dleonylphtalase		+		
VESTINOL N)				
Dloctyladipate				
(VESTINOLOA)				
Dloctylphthalate		+		
(VESTINOLAH)				
Tricresylphoapate		+		
Tricotylphosphate		+		
Porridge		+	+	(+)
Potassium carbonade aq. (Potash)	sat.	+	+	
Potassium chlorate ag.	sat	+	+	
	(7.3)			
Potassium chloride aq.	sat.	+	+	+
Potassium dichromate aq.	sat.	+	+	+
Potassium lodide aq.	sat.	+	+	
Potassium nitrateaq.	sat.	+	+	
Potassium	sat.	+	(+)	
Permanagate aq.	(6.4)			
Potassium persulphate aq.	sat.	+		
	(0.5)			
Potasssium sulphate aq.	sat.	+	+	+
Potato salad		+		
Propane, gassous	100	+	+	
Propane, liguid	100	+		
Pudding		+	+	0
Pyridine	100	+	0	
Q				
Quinine				
R				
Rum	40	+	+	
Rum aroma		+		
S				
SAGRATON		+	0	
Salad oil, animal		+	0	
Salad oil vegetable		+	+	' +
Salted water	any	+	+	
Sausage		+	+	+
Sea water		+	0	
Shoe polish*		+	(+)	
Siliconeoil*		+	+	
Silver salts aq.	sat.	+	+	
Soap, solution	sat.	+	+	
	10	+	1 +	+
Soda (see Sodium carbona-te)				
Soda water		+		
Sodium bicarbonate aq.	sat.	+	+	+
Sodium busilphite aq.	sat.	+	+	
Sodium carbonate aq.	sat.	+	+	
	10	+	+	
Sodium chlorateaq.(common salt)	sat.	+	+	+

	Conc. %	Temp. (°C) 20	60	100
Sodium chlorite aq.	5	+		
Sodium hydroxide (caustic soda;				
Sodium hyphochlorite aq.	5	+	+	
Sodium nitrate aq.	sat.	+	+	
Sodium nitride aq.	sat.	+		
Sodium parbrot aq.	sat.	+	+	+
	(1.4)			
Sodium phosphates aq.	sat.	+	+	+
Sodium sulphate aq.	sat.	+	+	+
(Glauber's salt)				
Sodium sulphite ag.**	sat.	+	+	
Sodium sulphite ag.	sat.	+	+	
Sodium thlosulphate aq.	sat.	+	+	+
(Photographic fixer)				
Soft soap		+	+	
Soybaan oil		+	0	
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	Iow.	+	+	
(Sulphurous anhydride)				
Sulphuric acid	96	+	0	
	50	+	+	
	25	+	+	
	10	+	+	+
T				
Tar*		+	0	
Tarta ric acide aq.	sat.	+	+	
Tea (leaves)		+	+	
Tea (ready-to-drink)		+	+	(+)
Tetrachlorethane	100	0	-	
Tetrachloorethylene	100	0	-	
(Perchlorethylene)				
Tetrahydrofuran Ghc	100	0	-	
Tetrahydronaphtlens	100	0	-	
Thick (semolina) gruel		+	+	0
Thlophene	0			
Toluene		0		
Tomatajuice		+	+	
Tomata ketchup		+	+	
Toothpastes		+	+	
Transformer oil*		+	0	
Trichlorsthylene	100	0	0	
Turpentine oil		0	-	
Two-stroke oil		0	0	
Typewritero oil		+	(+)	
U				
Uree aq.	sat.	+	+	
V				
Vanills		+	+	
Vaseline		+	0	
Vegetables		+	+	
Vinegar		+	+	
Vinegar essence**		+	+	
W				
Water		+	+	
Water glass		+	+	
X				
Xylene		+	0	-
Z				
Zinc salts aq.		+	+	+



Products Range

PP-R Solid

PP-R Pipe PN10 / SDR 11

PPR Series	Pressure	Standard	Application	Note
SDR 11	PN 10	DIN 8077/78	Potable cold water Air conditioning Rain water Fluid transfer	

Code	Dimensions mm	Thickness mm	Weight kg/m	DN mm
fri SDR 11 So	20	1.9	0.109	15
	25	2.3	0.165	20
	32	2.9	0.265	25
	40	3.7	0.415	32
	50	4.6	0.645	40
	63	5.8	1.015	50
	75	6.8	1.415	65
	90	8.2	2.045	80
	110	10.0	3.136	80
	125	11.4	3.927	100
	160	14.6	6.416	125

PP-R Pipe PN16 / SDR 7.4

PPR Series	Pressure	Standard	Application	Note
SDR 7.4	PN 16	DIN 8077/78	Hot & cold water Air conditioning Central heating Fluid transfer	

Code	Dimensions mm	Thickness mm	Weight kg/m	DN mm
fri SDR 7.4 So	20	2.8	0.148	15
	25	3.5	0.232	20
	32	4.4	0.376	25
	40	5.5	0.583	32
	50	6.9	0.896	40
	63	8.6	1.420	50
	75	10.3	2.020	65
	90	12.3	2.190	65
	110	15.1	4.320	80
	125	17.1	5.580	100
	160	21.9	9.120	125



PP-R Solid

PP-R Pipe PN20 / SDR 6

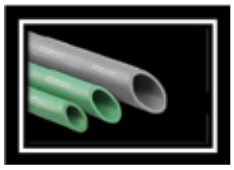
PPR Series	Pressure	Standard	Application	Note
SDR 6	PN 20	DIN 8077/78	Hot & cold water Air conditioning Central heating Fluid transfer	

Code	Dimensions	Thickness	Weight	DN
	mm	mm	kg/m	mm
fri SDR 6 So	20	3.4	0.171	13.2
	25	4.2	0.266	16.6
	32	5.4	0.472	21.2
	40	6.7	0.66	26.6
	50	8.3	1.054	33.4
	63	10.5	1.697	42
	75	12.5	2.328	50
	90	15	3.415	60
	110	18.3	5.15	75
	160	26.6	10.5	110

PP-R Pipe PN25 / SDR 5

PPR Series	Pressure	Standard	Application	Note
SDR 5	PN 25	DIN 8077/78	Potable cold water Air conditioning Central heating Fluid transfer	

Code	Dimensions	Thickness	Weight	DN
	mm	mm	kg/m	mm
fri SDR 5 So	20	4.0	0.201	12
	25	5.0	0.317	15
	32	6.4	0.56	20
	40	8.0	0.788	25
	50	10.0	1.27	32
	63	12.6	2.036	40
	75	15.0	2.794	45
	90	18.0	4.098	55
	110	22.0	6.191	66
	160	32.0	11.5	100



PP-R Stabi Multilayer AL -PPR

Stabi AL - PP-R Pipe PN 20 / SDR 6

PPR Stabi	Pressure	Standard	Application	Note
SDR 6	PN 20	DIN 8077/78	Hot & cold water Air conditioning Central heating Fluid transfer	

Code	Dimensions mm	Thickness mm	Weight kg/m	DN mm
fri SDR 6 St	20	2.8	0.192	15
	25	3.5	0.297	20
	32	4.4	0.456	25
	40	5.5	0.679	32
	50	6.9	1.044	40
	63	8.6	1.576	50
	75	10.3	2.197	60
	90	12.3	3.230	65
	110	15.1	4.875	80

Stabi AL - PP-R Pipe PN 25 / SDR 5

PPR Stabi	Pressure	Standard	Application	Note
SDR 5	PN 25	DIN 8077/78	Hot & cold water Air conditioning Central heating Fluid transfer	

Code	Dimensions mm	Thickness mm	Weight kg/m	DN mm
fri SDR 5 St	20	3.4	0.215	13
	25	4.2	0.329	17
	32	5.4	0.515	22
	40	6.7	0.775	27
	50	8.3	1.198	34
	63	10.5	1.816	42
	75	12.5	2.527	50
	90	15	3.720	60
	110	18.3	5.372	74



Fibre Composite Piping System

Fibre Composite Piping System PN 20

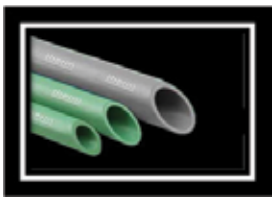
Characteristics

Low Heat Loss, Hence Less Insulation Layer
Low Thermal Expansion
No UV effect
Lighter Compared to Standard PPR
Higher Flow Compared to Standard PPR

PP-R Pipe PN 20 / SDR 6

PPR Series	Pressure	Standard	Application	Note
SDR 6	PN 20	DIN 8077/78	Hot & cold water Air conditioning Central heating	

Code	Dimensions mm	Thickness mm	Weight kg/m	DN mm
fri SDR 6 FC	20	2.8	0.16	15
	25	3.5	0.25	20
	32	4.4	0.40	25
	40	5.5	0.61	32
	50	6.9	0.95	40
	63	8.6	1.50	50
	75	10.3	2.13	65
	90	12.3	3.06	65
	110	15.1	4.58	80
	125	17.1	5.90	100
	160	21.9	9.54	125



Climate PP-RCT Air Conditioning Piping System

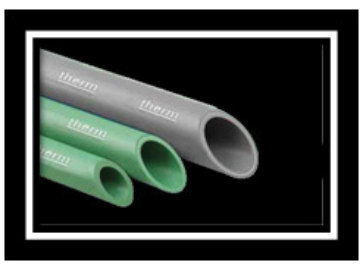
Climate PP-RCT Air Conditioning Piping System PN 16 Characteristics

Best Solution for Central Air Conditioning Piping System
Low Temperature down to - 40 ˚C
Low Heat Loss, Hence Less Insulation Layer
Low Thermal Expansion
No UV effect
Lighter Compared to Standard PPR
Higher Flow Compared to Standard PPR

PP-R Pipe PN16 / SDR 7.4

PPR Series	Pressure	Standard	Application	Note
SDR 7.4	PN 16	DIN 8077/78	Air conditioning Piping System	

Code	Dimensions mm	Thickness mm	Weight kg/m	DN mm
fri SDR 7.4 CT	20	1.9	0.11	15
	25	2.3	0.16	20
	32	2.9	0.26	25
	40	3.7	0.41	32
	50	4.6	0.64	40
	63	5.8	1.00	50
	75	6.8	1.40	65
	90	8.2	2.05	80
	110	10.0	3.10	80
	125	11.4	3.90	100
	160	14.6	6.42	125



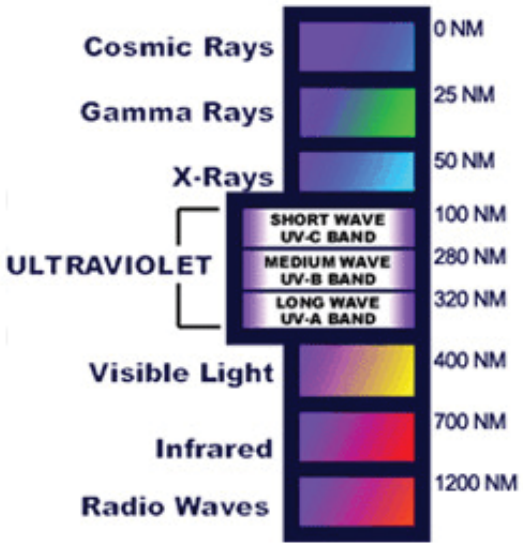
UV PP-Rc Piping System

UV PP-Rc Piping System

PROTECTION FROM SUNLIGHT & UV RADIATION

Double Layers Piping System
Strong UV Stabilized Black Layer
Complete Protection For Exposed piping System
Complete Protection For Open Air installations
Available On Request to All Our Piping Range PN10 up to PN 25





fritherm Fittings Range

fritherm PN10 Pipes

Code	Size (mm)	Pipes/Bundle
FPR2010	fritherm PN10 pipe 20x2.0	25
FPR2510	fritherm PN10 pipe 25x2.3	25
FPR3210	fritherm PN10 pipe 32x2.9	15
FPR4010	fritherm PN10 pipe 40x3.7	10
FPR5010	fritherm PN10 pipe 50x4.6	5
FPR6310	fritherm PN10 pipe 63x5.6	4
FPR7510	fritherm PN10 pipe 75x6.8	3
FPR9010	fritherm PN10 pipe 90x8.2	2
FPR11010	fritherm PN10 pipe 110x10.0	1
FPR16010	fritherm PN10 pipe 160x14.6	1



fritherm PN16 Pipes

Code	Size (mm)	Pipes/Bundle
FPR2016	fritherm PN16 pipe 20x2.8	25
FPR2516	fritherm PN16 pipe 25x3.5	25
FPR3216	fritherm PN16 pipe 32x4.4	15
FPR4016	fritherm PN16 pipe 40x5.5	10
FPR5016	fritherm PN16 pipe 50x6.9	5
FPR6316	fritherm PN16 pipe 63x8.6	4
FPR7516	fritherm PN16 pipe 75x10.3	3
FPR9016	fritherm PN16 pipe 90x12.3	2
FPR11016	fritherm PN16 pipe 110x15.1	1
FPR16016	fritherm PN16 pipe 160x21.9	1



fritherm PN20 Pipes

Code	Size (mm)	Pipes/Bundle
FPR2020	fritherm PN20 pipe 20x3.4	25
FPR2520	fritherm PN20 pipe 25x4.2	25
FPR3220	fritherm PN20 pipe 32x5.4	15
FPR4020	fritherm PN20 pipe 40x6.7	10
FPR5020	fritherm PN20 pipe 50x8.4	5
FPR6320	fritherm PN20 pipe 63x10.5	4
FPR7520	fritherm PN20 pipe 75x12.5	3
FPR9020	fritherm PN20 pipe 90x15.0	2
FPR11020	fritherm PN20 pipe 110x18.3	1



fritherm PN25 Pipes

Code	Size (mm)	Pipes/Bundle
FPR2025	fritherm PN25 pipe 20x4.0	25
FPR2525	fritherm PN25 pipe 25x5.0	25
FPR3225	fritherm PN25 pipe 32x6.4	15
FPR4025	fritherm PN25 pipe 40x8.0	10
FPR5025	fritherm PN25 pipe 50x10.0	5
FPR6325	fritherm PN25 pipe 63x12.6	4
FPR7525	fritherm PN25 pipe 75x15.0	3
FPR9025	fritherm PN25 pipe 90x18.0	2
FPR11025	fritherm PN25 pipe 110x22.0	1



fritherm PN25 Pipes W/Aluminium

Code	Size (mm)	Pipes/Bundle
FPR20A	fritherm PN25 Pipe 20x3.4	25
FPR25A	fritherm PN25 Pipe 25x4.2	25
FPR32A	fritherm PN25 Pipe 32x5.4	15
FPR40A	fritherm PN25 Pipe 40x6.7	10
FPR50A	fritherm PN25 Pipe 50x8.3	5
FPR63A	fritherm PN25 Pipe 63x10.5	4
FPR75A	fritherm PN25 Pipe 75x12.5	3
FPR90A	fritherm PN25 pipe 90x15.0	2
FPR110A	fritherm PN25 pipe 110x18.3	1



Equal Socket

Code	Size (mm)	Pcs./Box
FPS1	Equal Socket 20 mm	500
FPS2	Equal Socket 25 mm	320
FPS3	Equal Socket 32 mm	200
FPS4	Equal Socket 40 mm	100
FPS5	Equal Socket 50 mm	60
FPS6	Equal Socket 63 mm	32
FPS7	Equal Socket 75 mm	24
FPS9	Equal Socket 90 mm	16
FPS10	Equal Socket 110 mm	10
FPS16	Equal Socket 160 mm	3



Reduced Socket

Code	Size (mm)	Pcs./Box
FPRS21	Reduced Socket 25/20 mm.	500
FPRS31	Reduced Socket 32/20 mm.	300
FPRS32	Reduced Socket 32/25 mm.	300
FPRS43	Reduced Socket 40/32 mm.	160
FPRS54	Reduced Socket 50/40 mm.	100
FPRS65	Reduced Socket 63/50 mm.	40
FPRS76	Reduced Socket 75/63 mm.	32
FPRS96	Reduced Socket 90/63 mm.	16
FPRS97	Reduced Socket 90/75 mm.	16
FPRS109	Reduced Socket 110/90 mm.	10
FPRS1610	Reduced Socket 160/110 mm.	3



90° Elbow

Code	Size (mm)	Pcs./Box
FPE190	Elbow 90° - 20 mm	400
FPE290	Elbow 90° - 25 mm	200
FPE390	Elbow 90° - 32 mm	100
FPE490	Elbow 90° - 40 mm	75
FPE590	Elbow 90° - 50 mm	40
FPE690	Elbow 90° - 63 mm	20
FPE790	Elbow 90° - 75 mm	12
FPE990	Elbow 90° - 90 mm	8
FPE1090	Elbow 90° - 110 mm	3
FPE1690	Elbow 90° - 160 mm	2



45° Elbow

Code	Size (mm)	Pcs./Box
FPE145	Elbow 45° - 20 mm	400
FPE245	Elbow 45° - 25 mm	250
FPE345	Elbow 45° - 32 mm	150
FPE445	Elbow 45° - 40 mm	80
FPE545	Elbow 45° - 50 mm	40
FPE645	Elbow 45° - 63 mm	20



Equal Tee

Code	Size (mm)	Pcs./Box
FPT1	Equal Tee 20 mm	250
FPT2	Equal Tee 25 mm	150
FPT3	Equal Tee 32 mm	80
FPT4	Equal Tee 40 mm	50
FPT5	Equal Tee 50 mm	30
FPT6	Equal Tee 63 mm	20
FPT7	Equal Tee 75 mm	10
FPT9	Equal Tee 90 mm	5
FPT10	Equal Tee 110 mm	3
FPT16	Equal Tee 160 mm	1



End Cap

Code	Size (mm)	Pcs./Box
FPEC1	End Cap 20 mm	500
FPEC2	End Cap 25 mm	500
FPEC3	End Cap 32 mm	300
FPEC4	End Cap 40 mm	160
FPEC5	End Cap 50 mm	100
FPEC6	End Cap 63 mm	50
FPEC7	End Cap 75 mm	32



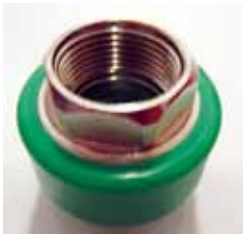
Female Adaptor

Code	Size (mm)	Pcs./Box
FPFA10	Fem. Adaptor 20 x ½ "	200
FPFA20	Fem. Adaptor 25 x ½"	150
FPFA21	Fem. Adaptor 25 x ¾"	150



Hexa. Female Adaptor

Code	Size (mm)	Pcs./Box
FPFA32	Hex.Fem. Adaptor 32 x 1"	80
FPFA43	Hex.Fem. Adaptor 40 x 1 ¼"	50
FPFA54	Hex.Fem. Adaptor 50 x 1 ½"	40





Male Adaptor

Code	Size (mm)	Pcs./Box
FPMA10	Male Adaptor 20 x ½ "	200
FPMA20	Male Adaptor 25 x ½"	100
FPMA21	Male Adaptor 25 x ¾"	100
FPMA32	Male Adaptor 32 x 1"	80



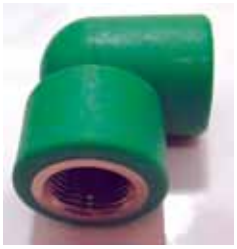
Hexa. Male Adaptor

Code	Size (mm)	Pcs./Box
FPMA32H	Hex.Male Adaptor 32 x 1"	80
FPMA43	Hex.Male Adaptor 40 x 1 ¼"	40
FPMA54	Hex.Male Adaptor 50 x 1 ½"	32
FPMA65	Hex.Male Adaptor 63 x 2"	16



Female Elbow

Code	Size (mm)	Pcs./Box
FPFE10	Female Elbow 20 x ½"	200
FPFE20	Female Elbow 25 x ½"	150
FPFE21	Female Elbow 25 x ¾"	150
FPFE31	Female Elbow 32 x ¾"	50
FPFE32	Female Elbow 32 x 1"	50



Male Elbow

Code	Size (mm)	Pcs./Box
FPME10	Male Elbow 20 x ½"	200
FPME20	Male Elbow 25 x ½"	100



Female Tee

Code	Size (mm)	Pcs./Box
FPFT10	Female Tee 20x ½" x20 mm.	160
FPFT20	Female Tee 25x ½" x25 mm.	100
FPFT21	Female Tee 25 x ¾" x 25	100
FPFT31	Female Tee 32 x ¾" x 32	50
FPFT32	Female Tee 32 x 1" x 32	50



Male Tee

Code	Size (mm)	Pcs./Box
FPMT10	Male Tee 20x ½" x20 mm.	150
FPMT20	Male Tee 25x ½" x25 mm.	100



Female Union

Code	Size (mm)	Pcs./Box
FPFU21	Fem. Union 25 x ¾" Fem	100
FPFU32	Fem. Union 32 x 1" Fem	100
FPFU43	Fem. Union 40 x 1 ¼" Fem	50
FPFU54	Fem. Union 50 x 1 ½" Fem	40
FPFU65	Fem. Union 63 x 2" Fem	20
FPFU76	Fem. Union 75 x 2 ½" Fem	15
FPFU97	Fem. Union 90 x 3" Fem	8
FPFU108	Fem. Union 110 x 4" Fem	5



Male Union

Code	Size (mm)	Pcs./Box
FPMU21	Male Union 25 x ¾" M	100
FPMU32	Male Union 32 x 1" M	100
FPMU43	Male Union 40 x 1 ¼" M.	40
FPMU54	Male Union 50 x 1 ½" M.	32
FPMU65	Male Union 63 x 2" M.	16
FPMU76	Male Union 75 x 2 ½" M.	12
FPMU97	Male Union 90 x 3" M.	8
FPMU108	Male Union 110 x 4" M.	5



Pipe Bridge

Code	Size (mm)	Pcs./Box
FPB1	Pipe Bridge 20 mm	100
FPB2	Pipe Bridge 25 mm	60
FPB3	Pipe Bridge 32 mm	40





PP- Threaded End Cap

Code	Size (mm)	Pcs./Box
FPMC0	Plastic Threaded Cap ½" Male	500
FPMC1	Plastic Threaded Cap ¾" Male	500
FPMLC0	Plastic Thread Cap ½" Male (Lon	300
FPMLC1	Plastic Thread Cap ¾" Male (Lor	200



Pipe Clamp

Code	Size (mm)	Pcs./Box
FPPC1	Pipe Clamp 20 mm	800
FPPC2	Pipe Clamp 25 mm	600
FPPC3	Pipe Clamp 32 mm	400



Reduced Tee

Code	Size (mm)	Pcs./Box
FPRT212	Reduced Tee 25 x 20 x 25 mm.	160
FPRT313	Reduced Tee 32 x 20 x 32 mm	100
FPRT323	Reduced Tee 32 x 25 x 32 mm.	100
FPRT414	Reduced Tee 40 x 20 x 40 mm	50
FPRT424	Reduced Tee 40 x 25 x 40 mm	50
FPRT434	Reduced Tee 40 x 32 x 40 mm	50



Brass Gate Valve

Code	Size (mm)	Pcs./Box
FPGV1	Brass Gate Valve 20 mm	80
FPGV2	Brass Gate Valve 25 mm	50
FPGV3	Brass Gate Valve 32 mm	42



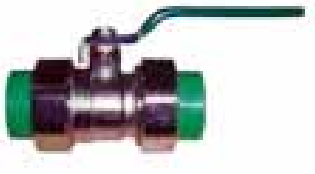
Chrom. Gate Valve

Code	Size (mm)	Pcs./Box
FPCV1	Chrom. Gate Valve 20 mm	50
FPCV2	Chrom. Gate Valve 25 mm	50
FPCV3	Chrom. Gate Valve 32 mm	30



Ball Valve

Code	Size (mm)	Pcs./Box
FPBV1	PP Ball Valve 20 mm	80
FPBV2	PP Ball Valve 25 mm	50
FPBV3	PP Ball Valve 32 mm	42
FPBV4	PP Ball Valve 40 mm	30



F.Tee for Gate Valve

Code	Size (mm)	Pcs./Box
FPTV11	Tee for Gate Valve 20mmx¾" Fer	100
FPTV21	Tee for Gate Valve 25mmx¾" Fer	100
FPTV32	Tee for Gate Valve 32mmx 1" Fer	50



Chrom. Handle for Gate Valve

Code	Size (mm)	Pcs./Box
FPCH1	Chrom. Handle ¾" Male	50
FPCH2	Chrom. Handle 1" Male	30



Brass Handle for Gate Valve

Code	Size (mm)	Pcs./Box
FPBH1	Brass Handle ¾" Male	100
FPBH2	Brass Handle 1" Male	50





Pipe Flange

Code	Size (mm)	Pcs./Box
FPF4	Pipe Flange 40 mm	100
FPF5	Pipe Flange 50 mm	60
FPF6	Pipe Flange 63 mm	32
FPF7	Pipe Flange 75 mm	24
FPF9	Pipe Flange 90 mm	16
FPF10	Pipe Flange 110 mm	10



PPR - Union

Code	Size (mm)	Pcs./Box
FPPU1	Plastic Union 20 mm	200
FPPU2	Plastic Union 25 mm	100
FPPU3	Plastic Union 32 mm	100
FPPU4	Plastic Union 40 mm	50
FPPU5	Plastic Union 50 mm	50
FPPU6	Plastic Union 63 mm	40



fritherm Tools & Accessories

Welding	Adaptor
Code	**Size**
WA1	20 mm
WA2	25 mm
WA3	32 mm
WA4	40 mm
WA5	50 mm
WA6	63 mm
WA7	75 mm
WA9	90 mm
WA10	110 mm
WA16	160 mm



Peeling	Toll (Sharpner)
Code	**Size**
PSH12	Ø20-25 mm
PSH34	Ø32-40 mm
PSH56	Ø50-63 mm
PSH67	Ø63-75 mm
PSH109	Ø90-110 mm



COBRA	Welding Machine
Code	**Size**
GMCO	20-90 mm
Temp.	50-300 C
Power	1500 W



GM	Welding Machine
Code	**Size**
GM021	20-160 mm
Temp.	50-300 C
Power	2000 W



Pipe cutter	
Code	**Size**
SPC	20-40 mm
GM012	20-50 mm
GM027	20-75 mm
GM028	20-63 mm



Pipe Repair Tool	
Code	**Size**
PRT	2-8 mm



Pressure Testing Machine	
Code	**Size**
TPP	52x30x19 cm
Test Pressure : 0-50 Bar	
Tank Volume : 12 Litre	



GM	Welding Machine
Code	**Size**
GM003	50-200 mm
Temp.	50-300 C
Power	2000 W



Welding / Fusion

Welding Process

1. Cutting pipe
Cut pipes to required length and at right angle to pipe axis with rotary pipe cutter



2. Cleaning & marking pipe
Clean up the end of pipe & fitting and mark the depth of insertion of pipe into fitting before the welding process.



3. Temperature setting & welding
Set temperature control to the actual degree 260 ˚C and when reached, insert both pipe & fitting in welding molds use table No.1 below for welding timing



4. Jointing process
Take off both pipe and fitting from molds and join by pushing them to the marked welding depth without rotation



5. Adjusting & checking
The welding process and/or correction must be done within the allowed time see table No. 1

Welding Requirements

Data for preparation of fusion

Pipe Size mm	Heating Time s PN16 , PN20	Welding Time s	Cooling Time Minutes	Welding Depth mm
16	5	4	2	13.0
20	5	4	2	14.0
25	7	4	2	15.0
32	8	6	4	16.5
40	12	6	4	18.0
50	18	6	4	20.0
63	24	8	6	24.0
75	30	8	6	26.0
90	40	10	8	29.0
110	50	10	8	32.0
125	60	10	8	40.0

Table No.1

Observations for ultimate welding

1. Make sure same materials are used for both pipes and fittings

2. Both, pipes & fittings should be heated at same time and not more than once.

3. Don't turn pipe or fitting during welding process.



4. For best welding results, always take data in table No. 1 above into considerations.

5. As rule of thumb, welding time for PN10 should require half time for PN16 or PN20

6. Room temperature should be at least 5 ˚C and lower temperature should be avoided.

7. Double and even layers on surronding welding area are indication of good welding

8. Make sure to remove the Aluminum layer in case of Stabi pipes.

Hydraulic Pressure Test

Pressure test has to be conducted once the piping net work is completely installed according to DIN 1988 and the test has to be hydraulically done. Normally, the pressure test should be 1.5 times the operating pressure.

Ambient temperature is an important factor to consider when applying the pressure test. A temperature change of 10 K corresponds to a pressure difference of 0.5 to 1 bar, hence the highest possible constant temperature of the test medium has to be ascertained at the hydraulic pressure test.

The hydraulic pressure test should be conducted in 3 consecutive test methods:

Preliminary Test:

- **The pressure test should be 1.5 times the highest operating pressure**
- **The pressure test has to be done twice within an interval of 10 minutes**
- **Piping net work should sustain the pressure for 30 minutes with pressure drop of maximum 0.6 bar providing no leakage appear in the net work.**

Principal Test:

- **To be followed and continued directly after the preliminary test.**
- **Test time is 2 hours.**
- **Pressure drop of maximum 0.2 bar is allowed providing no leakage appear in the net work.**

Final Test:

- **To be followed and continued directly after the principal test.**
- **Test time is 24 hours.**
- **Main objective of the final test is to check for leakage as pressure drop could vary according to ambient temperature as was mentioned earlier.**

Measuring of Test Pressure

Pressure manometer with a change of 0.1 bar

has to be used for measuring pressure readings.

One or more manometers could be used but ensure

to install at highest point of piping net work.



Comparison of PP-R system with various materials

CRITERIA	GI PIPE	COPPER PIPE	HDPE PIPE	PVC PIPE	PP-R PIPE
HARD WATER EFFECT	High scale formation	No Scale formation due to smooth bore	No Scale formation due to smooth bore	No Scale formation due to smooth bore	No Scale formation due to smooth bore
SOFT WATER EFFECT	Gets corroded	Gets corroded	No Effect	No Effect	No Effect
HEALTH CRITERION	Low due to lead content and corrosion	Good with ferrule but lead content in solder is not healthy	Very good	Very good	Very good
JOINTING TECHNIQUES	Threaded	Soldered/Ferrule	Fusion Weld	Solvent cement	Fusion weld
CORROSION RESISTANCE	Very Low	Low	No Effect	No Effect	No Effect
THERMAL STRENGTH PROPERTY AT 60 ˚C TEMP.	Very good	Very good	Limited	Not Recommended	Very good
THERMAL EXPANSION	Low, good for concealed piping	Low, good for concealed piping	Very High, not to be used for concealed piping	Very special care is required for concealed piping	Low, good for concealed piping
EFFECT OF SUB-ZERO TEMP.	Up to 0 ˚C	Up to 0 ˚C	Up to - 40 ˚C	Up to 0 ˚C	Up to - 40 ˚C
UV RESISTANCE	Very good	Very good	Very good	Low	Very good
EASE IN INSTALLATION	Low	Average	Low	Good	Very good
FLOW PROPERITES FOR FRICTION	Low	Very good	Very good	Very good	Very good

Service life & Warranty

Life service is determined experimentally by defining its survivability in the function of temperature and water pressure.
Table No. 1 below indicates a service life of 50 years at certain working conditions for temperature and pressure.

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 No. 1



A written warranty is normally issued to cover both pipes and fittings for a period of 10 years from date of purchasing the products, such warranty will cover for any manufacturing defects when network is installed and used according to standards and regulations.

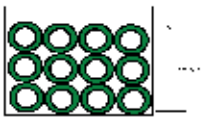


Storage & Handling

There are some measures to be followed when considering storage and handling of pipes such as:



The PPR network, pipes and fittings should be protected against ultraviolet radiation, weather and contamination. UV is damaging to propylene as long term exposure to sunlight can degrade the operating properties of the system.
When products are stored out doors or installed unprotected out side they have to be covered or protedted with suitable insulation.



Pipes are usually stored indoor on palletts. Maximum storing height of 1.2 m must be followed.

During handling, it is not allowed to drag pipes over the ground or a lorry track reck. The pipes must be moved handeled in right way by lifting manually or by lifting crane

During transportation, pipes must be protected against any mechanical damage and placed on a suitable underlay where protected against dirt, solvent, oil and direct heat.



Pipes must be inserted as bundlles in protective plastic bagas and kept in bags until used.



Pipes and fittings should be treated with special caution when ambient temperature at zero or below







BSCIC Certifications
BSCIC
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DVGW CERT

DVGW CERT GMBH

DVGW-Baumusterprüfzertifikat
DVGW type examination certificate

DW-8317BP0223
Registriernummer
registration number

Anwendungsbereich *field of application*	Produkte der Wasserversorgung *products of water supply*
Vertreiber *distributor*	Al Hattab B.M Trdg.L.L.C. P.O. Box 36119, V- Dubai
Produktart *product category*	Kunststoffrohre für die Trinkwasserinstallation: PP-R, PN 20 (8317)
Produktbezeichnung *product description*	Kunststoffrohr aus PP-R für die Trinkwasserinstallation
Modell *model*	fritherm
Prüfberichte *test reports*	Mechanikprüfung: 371708/1.1/83633 vom 13.07.2009 (SKZ) Mechanikprüfung: 48326/02 vom 05.05.2004 (SKZ) KTW-Prüfung: 099609_203 vom 31.08.2009 (TZW) Mikrobiologische Prüfung: MO 142/06 vom 30.07.2006 (TZW)
Prüfgrundlagen *basis of type examination*	DVGW W 544 (01.05.2007) UBA KTW (18.05.2007) DVGW W 270 (01.11.2007)
Ablaufdatum / AZ *date of expiry / file no.*	05.05.2014 / 09-0616-WNR

26.11.2009 GI C-1/2
Datum, Bearbeiter, Stelle / Leiter der Zertifizierungsstelle
date, issued by, sheet, head of certification body

DVGW CERT GmbH - von der Deutschen Akkreditierungsstelle Technik (DATech) in der TGA GmbH akkreditiert für die Konformitätsbewertung von Produkten der Gas- und Wasserversorgung

DVGW CERT GmbH - accredited by Deutsche Akkreditierungsstelle Technik (DATech) in the TGA GmbH for conformity assessment of products of gas and water supply

Deutscher Akkreditierungs Rat
DAR
DAT-ZE-009/96-02

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PP-Rc PIPES & FITTINGS

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