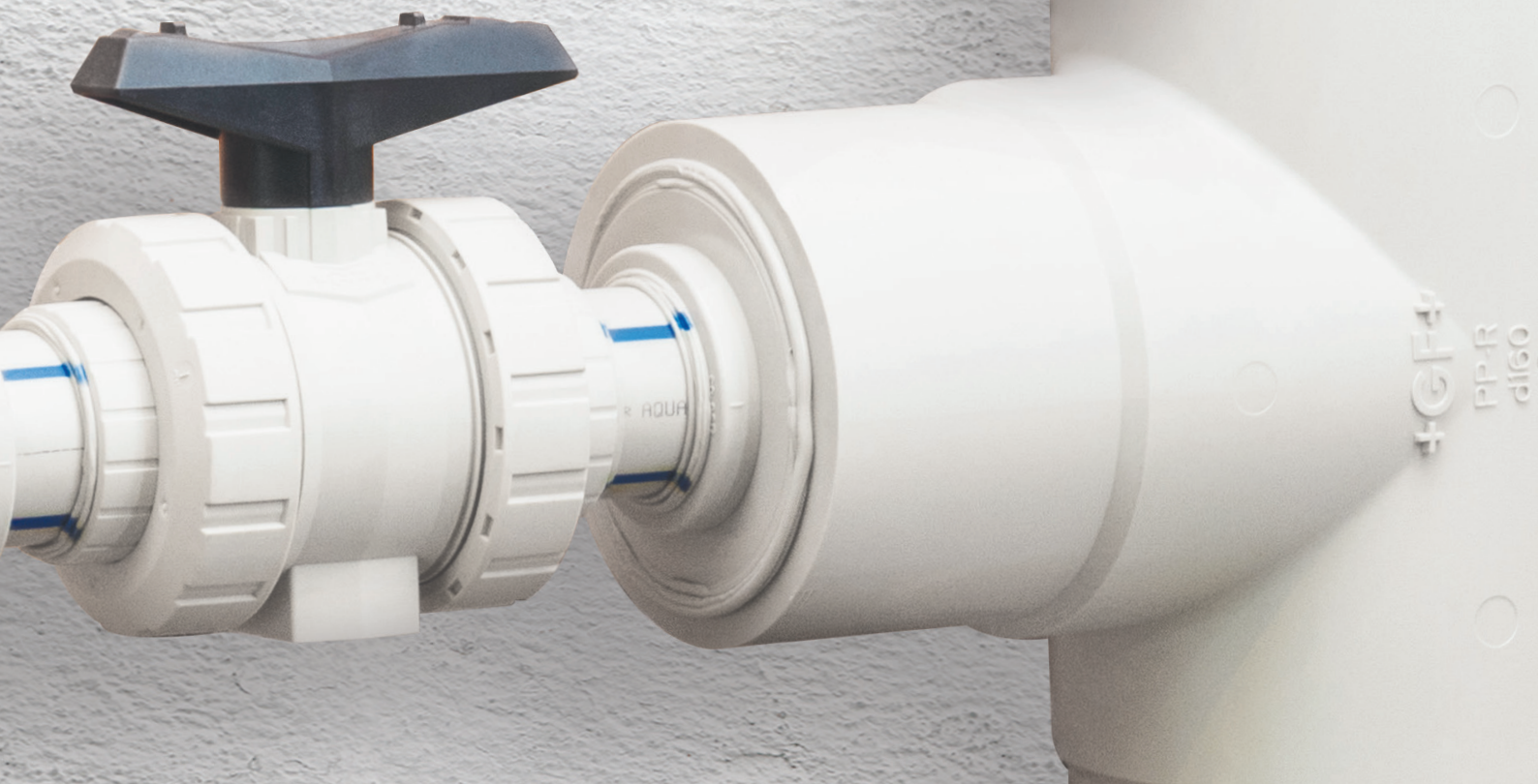


GF Piping Systems

+GF+

AQUASYSTEM PP-R

Strong Veins for Your Building



Who we are

Connections for Life

GF Piping Systems is the leading flow solutions provider across the world. We enable the safe and sustainable transport of fluids. Our business is driven by maintaining industry-leading sustainability levels, innovating through digitally enabled solutions, and investing in a culture built on caring, learning, and performance.

Your partner for modern plastic piping systems

The plastic piping systems from GF Piping Systems are non-corrosive and do not need replacing throughout the system's entire service life. Therefore, they contribute to the increased reliability of the system while lowering maintenance costs and staff requirements. They are excellently suited for applications involving potable and sewage water, coolants, acids, leaches, and other chemicals, as well as abrasive compounds.



GF Piping Systems, founded more than 200 years ago in Switzerland, supports its customers both in the initial switch from metal to plastic and in retrofits – across all project phases. They benefit from more than 60 years of experience in plastic systems and application knowledge from 100 countries. With Specialized Solutions, GF Piping Systems supports the design and installation of state-of-the-art plastic piping systems, so that owners and planners can concentrate on their daily business without interruption. GF Piping Systems is present every step of the way, from the design phase all the way through to installation and maintenance.



Strong regional footprint

GF Piping Systems has been present in the Southeast Asian market since 1994, when the first office in the region was registered in Singapore. Today, with seven offices in six countries, production facilities in Malaysia and Indonesia and numerous regional partners across Southeast Asia, GF Piping Systems is committed to the region and ensures competent customer support and technical on-site training.



-  Sales / Representative office
-  Production and prefabrication facility

GF Piping Systems Malaysia



We Bring You Clean Water



Supplying the world with clean water is one of the major challenges of the 21st century. GF Piping Systems rises to this challenge by providing high quality piping systems. We develop and produce pipes, fittings, valves, flow measurement devices and fusion machines. These application-oriented system solutions allow transporting water, gas and industrial liquids safely and reliably. Whether in industry, utilities or building technology - GF Piping Systems has the right solution for you.

Innovation and technology

GF Piping Systems, through focussed research, is continually developing new products and technologies, setting new global standards in quality and performance for our customers.

All from one source

GF Piping Systems covers the growing demand for complete solutions from a single source in a wide range of applications.

Quality management

All system components are stringently tested in accredited test laboratories. Management and production procedures are certified to ISO 9001 and ISO 14001 to guarantee form, fit, function and compliance in whatever application they may be used throughout the world.

Sales and service — worldwide

Our local sales companies and representatives in over 100 countries provide one stop" shopping, including planning support, training and product availability.

Facts and figures

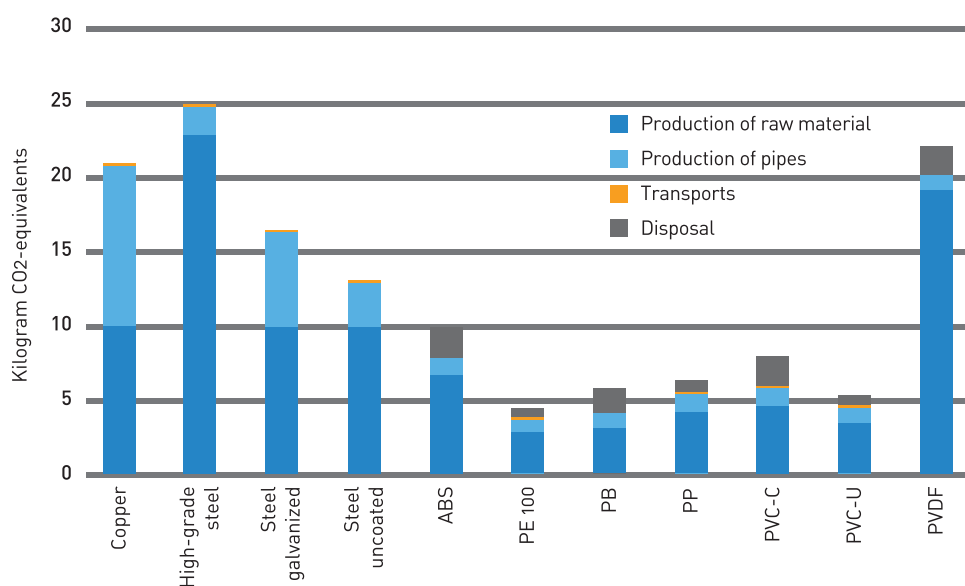
In 2021, GF Piping Systems with its 7'700 employees, 36 production sites and 31 sales companies achieved an annual turnover of 1.97 billion CHF respectively 2 billion USD. GF Piping Systems is part of the Georg Fischer Corporation.

Pioneering Towards a Green Solutions

In focus: Plastics and metal

Climate change, the finiteness of fossil fuels and a rapidly rising demand for energy are among the challenges we face in the future.

For companies it will become even more important to offer products and solutions which match these challenges. For example, piping systems made of plastic cause less carbon dioxide emissions than metal piping systems. We offer complete plastic systems for nearly every application, whether in building technology, water treatment, cooling or other segments. Our plastic piping systems are leak proof, corrosion-resistant, lightweight and long-lived.

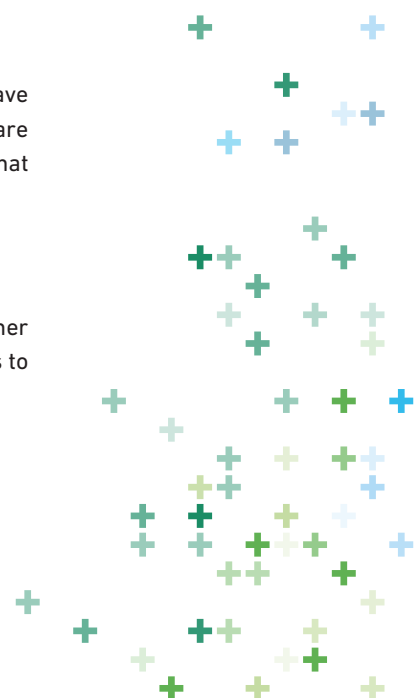


The added value of our solutions: plastics are greener” than metals

Plastic piping systems of Georg Fischer offered applications and dimensions almost ever have better results than competitive materials. In the case of PP-R the carbon dioxide emissions are roughly five times lower than those of a comparable steel pipe. This is the result of an study that focused on the ecological footprint of various piping materials.

Our devotion

The environment and nature form the foundation of our lives. For that reason, Georg Fischer considers the consumption of energy and resources as well as the production of air emissions to be major challenges for an industry devoted to people.



AQUASYSTEM PP-R



AQUASYSTEM is a comprehensive plastic piping system which complies with the requirements for hot and cold plumbing system. The wide product range provides the right solution for each application: pipes for hot water (PN 20 & PN 16) and cold water (PN 16 & PN 10) as well as socket fusion fittings and a wide selection of metal transition fittings.

As a full system "AQUASYSTEM" is totally corrosion free, reduce noise transmission through pipes and save energy due to low thermal conductivity. The outstanding properties of PP-R and superior GF product quality make AQUASYSTEM a practically maintenance free and extremely durable system. High quality plastic valves are also available.

Water services in buildings are complex, requiring both experience and careful material selection. The goal is to design and produce a piping system for hot and cold water supply that is easy to use and instal. All components are fully integrated and sturdy, whilst maintaining a competitive price.

GF is a leader producer of pipe fittings made of various materials since 1858. In the field of thermoplastic materials, GF is considered to be a pioneer, as well as one of the best known producers, utilising the most advanced technology in the world.

The test laboratory is one of the most established in the world in the field of plastic materials, and it is completely dedicated to research, development and testing of new products. The equipment and instruments used are the most modern and up-to-date in the market today, this makes it possible to carry out the most sophisticated tests.

This all comes together with the highest standard of technology, production and logistics, which contributes to guaranteeing the best product for the end users:

- quality
- experience
- reliability



AQUASYSTEM Added Value



- Longevity
Designed To Operate More Than 50 years
- Low Density At 0.91g/cm³
(1/9 of Metal Pipes)
- High Elasticity
 - » Resistance against impact and bending stresses
 - » Abrasion resistance
 - » Noise level reduced (water hammer)
- Chemical Resistance:
 - » Hygienically safe
 - » No corrosion
- Neutral Taste & Odour
 - » Suitable for food processing
- Low Thermal Conductivity:
 - » Thermal losses reduced
 - » Low formation of condensation
- Smooth Surfaces:
 - » Pressure losses reduced
 - » No incrustation
 - » Bacteriologically neutral
- Low Electrical Conductivity
 - » No electrolytic corrosion
- Fast & Easy installation
- Leak Proof with homogenous Joints

Benefits of Fusion Jointing:

- Homogeneous connection
 - » No cement / glue used
 - » Fitting and pipe become one unit = Homogeneous
 - » Joint with same characteristics of pipe material
 - » No solvent that could affect the water quality
- Easy and fast
 - » Socket Fusion jointing is done in seconds
 - » Only simple and inexpensive 230V tooling used
- Reliable and long lasting
 - » No more leaking joints
 - » Life time of 50 Years or more
 - » Jointing system tested according to EN ISO 15874 - 5 & 7
- No theft value

Market segments

Covering Your Needs in Building Technologies

The right solutions for your potable water supply, heating and cooling applications - durable piping solutions developed to meet the highest standards of the modern building.

Potable water installations must comply with the highest hygiene standards. Hot water distribution requires an energy-efficient system including reliable measurement and control technology to ensure a high level of comfort. GF Piping Systems supplies long-lasting and efficient piping systems and valves for residential houses, hotels, hospitals, industrial buildings, recreational facilities, and ships.



Characteristics of The Material PP-R

Pipes and fittings are made of Polypropylene Random, also known as type 3. The quality of our material can guarantee a long life(50 years), high resistance to pressure and temperature. This material is suitable for hot and cold water and heating systems.

The special properties of the material, compared to the other materials, give the following advantages:

- high dimensional stability (when hot)
- maximum resilience

Properties	ISO	DIN	Unit	Values
Flow index	ISO 1133	DIN 53735		
MFI 190/5	Procedure 18a	Code T	g/10 min	0,4
MFI 230/2,16	Procedure 12	Code M	g/10 min	0,25
MFI 230/5	Procedure 20	Code V	g/10 min	1,25
Density a 23°C	ISO/R 1183	DIN 53479	g/cm ³	0,90-0,91
Resilience (Charpy)				
23°C	ISO 179/2D	DIN 53479	kJ/ m ²	n.r.
-30°C	ISO 179/2D	normal scale	kJ/ m ²	40
Chipping resilience (notch-engraved sample test)				
23°C	ISO 179/2C	DIN 53453	kJ/ m ²	25
-30°C	ISO 179/2C	normal scale	kJ/ m ²	2,5
Resilience (Izod)				
23°C	ISO 180/1C	-	kJ/ m ²	n.r.
-30°C	ISO 180/1C	-	kJ/ m ²	28
Scratching resilience (engraved sample test) (Izod)				
23°C	ISO 180/1A	-	kJ/ m ²	23
-30°C	ISO 180/1A	-	kJ/ m ²	2,5
23°C	ASTM D 256	-	kJ/ m ²	27
-30°C	ASTM D 256	-	kJ/ m ²	4
Traction test				
Yield test	ISO 527	DIN 53455	N/mm ²	27
Yield Elasticity	Forwarding speed	Forwarding speed	%	11
Breakage Elongation	-		%	> 800
Traction Module E	ISO 527	DIN 53457	N/mm ²	900
Elasticity yield to tangential tension	ISO/R 537Metod A.	DIN 53445	N/mm ²	450
Bending stress 3.5%	ISO 178 standard test 5.1	DIN 53452	N/mm ²	24
Brinell hardness test	ISO 2039 (H358/30)	DIN 53456 (H358/30)	N/mm ²	49
VICAT A/°C Melting point	ISO 306	DIN 53460	°C	135-145
Dimensional heat stability °C	ISO 75/B	DIN 53461	°C	75
Surface Resistance		DIN 53482	Ω	>10 ¹³
Mass resistivity		DIN 53482	Ω cm	>10 ¹⁶
Dielectric loss angle (tg.) (106Hz)		DIN 53483	-	2 x 10 ⁻⁴
Relative dielectric constant (10-6Hz)		DIN 53483	-	2,3
Dielectric rigidity		ASTM D149	kV/mm	75
Thermal conductivity at 20° C	VDE 0304 (1-4)	52612	W/mK	0,22
Thermal expansion factor			mm/m°C	0,15
Specific heat 20°C			Kj/KgK	2,0

Resistance to internal hydrostatic pressure

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

The characteristics are the results of the tests on extruded samples after 96 hours storage at normal room conditions 23/50 (2) DIN 50014 and represent indicative values.

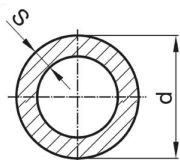
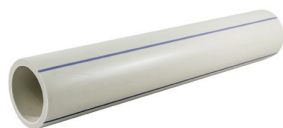
AQUASYSTEM PP-R

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Pipes

AQUASYSTEM PP-R - Pipe



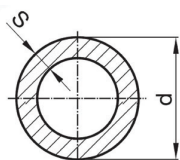
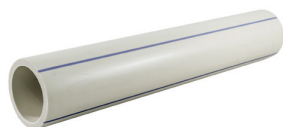
Model:

- Material: PP-R
- PN14, SDR 11, S5 (MS 2286)
- PN10, SDR 11, S5 (EN ISO 15874, DIN 8077, DIN 8078)
- Colour: Grey / Blue Strips
- **SIRIM certified / SPAN approved**
- **SLS certified / PUB approved (20mm – 110mm)**

Note: **MS 2286** - Applicable to Malaysia market only

d x s (mm)	Blue Strips Code	SP (m)	kg/m (kg/m)	Length (m)
20.0 x 2.0	300 206 012	100	0.107	4
25.0 x 2.3	300 206 013	60	0.164	4
32.0 x 2.9	300 206 014	48	0.261	4
40.0 x 3.7	300 206 015	32	0.412	4
50.0 x 4.6	300 206 016	20	0.638	4
63.0 x 5.8	300 206 017	16	1.010	4
75.0 x 6.8	300 206 018	12	1.410	4
90.0 x 8.2	300 206 019	8	2.030	4
110.0 x 10.0	300 206 020	4	3.010	4
125.0 x 11.4	300 206 021	4	3.910	4
160.0 x 14.6	300 206 945	4	6.380	4

AQUASYSTEM PP-R - Pipe



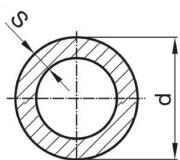
Model:

- Material: PP-R
- PN22, SDR 7.4, S3.2 (MS 2286)
- PN16, SDR 7.4, S3.2 (EN ISO 15874, DIN 8077, DIN 8078)
- Colour: Grey / Blue Strips
- **SIRIM certified / SPAN approved**

Note: **MS 2286** - Applicable to Malaysia market only

d x s (mm)	Blue Strips Code	SP (m)	kg/m (kg/m)	Length (m)
20.0 x 2.8	300 206 932	100	0.148	4
25.0 x 3.5	300 206 933	60	0.230	4
32.0 x 4.4	300 206 934	48	0.370	4
40.0 x 5.5	300 206 935	32	0.575	4
50.0 x 6.9	300 206 936	20	0.896	4
63.0 x 8.6	300 206 937	16	1.410	4
75.0 x 10.3	300 206 938	12	2.010	4
90.0 x 12.3	300 206 939	8	2.870	4
110.0 x 15.1	300 206 940	4	4.300	4
125.0 x 17.1	300 206 941	4	5.530	4
160.0 x 21.9	300 206 942	4	9.040	4

AQUASYSTEM PP-R - Pipe

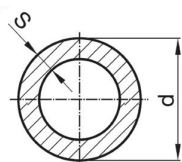


Model:

- Material: PP-R
- PN28, SDR 6, S2.5 (MS 2286)
- PN20, SDR 6, S2.5 (EN ISO 15874, DIN 8077, DIN 8078)
- Colour: Grey / Blue Strips
- **SIRIM certified / SPAN approved**
- **SLS certified / PUB approved (20mm – 110mm)**

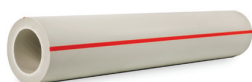
Note: **MS 2286** - Applicable to Malaysia market only

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d x s (mm)	Blue Strips Code	SP (m)	(kg/m)	Length (m)
20.0 x 3.4	300 206 970	100	0.172	4
25.0 x 4.2	300 206 971	60	0.266	4
32.0 x 5.4	300 206 972	48	0.434	4
40.0 x 6.7	300 206 973	32	0.671	4
50.0 x 8.3	300 206 974	20	1.04	4
63.0 x 10.5	300 206 975	16	1.65	4
75.0 x 12.5	300 206 976	12	2.34	4
90.0 x 15.0	300 206 977	8	3.36	4
110.0 x 18.3	300 206 978	4	5.01	4

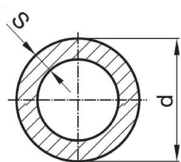
AQUASYSTEM PP-R - Pipe



Model:

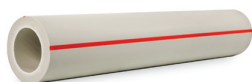
- Material: PP-R
- PN22, SDR 7.4, S3.2 (MS 2286)
- PN16, SDR 7.4, S3.2 (EN ISO 15874, DIN 8077, DIN 8078)
- Colour: Grey / Red Strips
- **SIRIM certified / SPAN approved**

Note: **MS 2286** - Applicable to Malaysia market only



d x s (mm)	Red Strips Code	SP (m)	(kg/m)	Length (m)
20 x 2.8	300 206 950	100	0.148	4
25 x 3.5	300 206 951	60	0.23	4
32 x 4.4	300 206 952	48	0.37	4
40 x 5.5	300 206 953	32	0.575	4
50 x 6.9	300 206 954	20	0.896	4
63 x 8.6	300 206 955	16	1.41	4
75 x 10.3	300 206 956	12	2.01	4
90 x 12.3	300 206 957	8	2.87	4
110 x 15.1	300 206 958	4	4.3	4
125 x 17.1	300 206 959	4	5.53	4
160 x 21.9	300 206 960	4	9.04	4

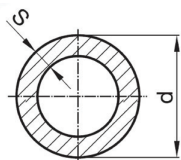
AQUASYSTEM PP-R - Pipe



Model:

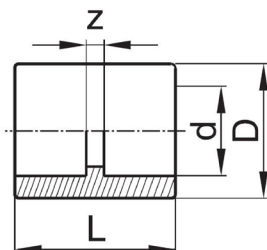
- Material: PP-R
- PN28, SDR 6, S2.5 (MS 2286)
- PN20, SDR 6, S2.5 (EN ISO 15874, DIN 8077, DIN 8078)
- Colour: Grey / Red Strips
- **SIRIM certified / SPAN approved**
- **SLS certified / PUB approved (20mm – 110mm)**

Note: **MS 2286** - Applicable to Malaysia market only



d x s (mm)	Red Strips Code	SP (m)	(kg/m)	Length (m)
20 x 3.4	300 206 002	100	0.172	4
25 x 4.2	300 206 003	60	0.266	4
32 x 5.4	300 206 004	48	0.434	4
40 x 6.7	300 206 005	32	0.671	4
50 x 8.3	300 206 006	20	1.04	4
63 x 10.5	300 206 007	16	1.65	4
75 x 12.5	300 206 008	12	2.34	4
90 x 15	300 206 009	8	3.36	4
110 x 18.3	300 206 010	4	5.01	4

Socket Fusion Fittings

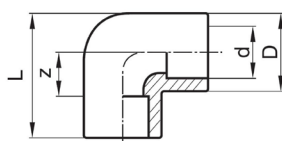


AQUASYSTEM Socket PP-R

Model:

- Polypropylene - Random (PP-R)
- EN ISO 15874, MS 2286
- Colour: grey
- **SIRIM certified / SPAN approved**
- **SLS certified / PUB approved (20mm – 110mm)**

d (mm)	Code	GP	g	D (mm)	L (mm)	z (mm)
20	300 206 022	300	12	29	34	2
25	300 206 023	200	16	34	38	2
32	300 206 024	160	27	43	43	3
40	300 206 025	200	50	55	47	3
50	300 206 026	120	92	70	53	3
63	300 206 027	60	177	88	62	4
75	300 206 028	25	242	103	67	5
90	300 206 029	16	347	122	73	5
110	300 206 030	10	586	148	83	5
125	300 206 031	8	699	160	91	5

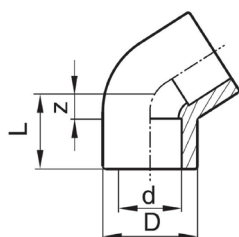


AQUASYSTEM Elbow 90° PP-R

Model:

- Polypropylene - Random (PP-R)
- EN ISO 15874, MS 2286
- Colour: grey
- **SIRIM certified / SPAN approved**
- **SLS certified / PUB approved (20mm – 110mm)**

d (mm)	Code	GP	g	D (mm)	L (mm)	z (mm)
20	300 206 032	250	18	29	42	5
25	300 206 033	150	30	34	48	6
32	300 206 034	200	46	43	60	10
40	300 206 035	120	90	55	71	14
50	300 206 036	60	188	70	88	19
63	300 206 037	30	343	88	106	24
75	300 206 038	10	490	103	124	31
90	300 206 039	6	775	122	145	39
110	300 206 040	8	1260	148	171	47
125	300 206 041	1	2311	160	195	55



AQUASYSTEM Elbow 45° PP-R

Model:

- Polypropylene - Random (PP-R)
- EN ISO 15874, MS 2286
- Colour: grey
- **SIRIM certified / SPAN approved**
- **SLS certified / PUB approved (20mm – 110mm)**

d (mm)	Code	GP	g	D (mm)	L (mm)	z (mm)
20	300 206 052	300	15	29	21	5
25	300 206 053	200	20	34	24	6
32	300 206 054	300	31	43	27	7
40	300 206 055	150	69	55	31	9
50	300 206 056	80	124	70	37	12
63	300 206 057	40	237	88	45	16

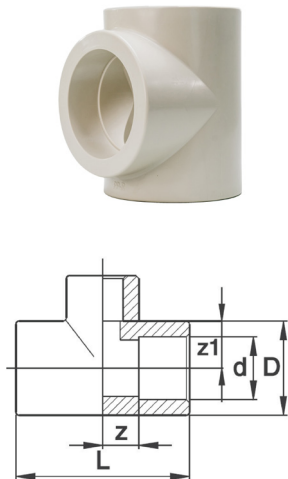
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d (mm)	Code	GP	g	D (mm)	L (mm)	z (mm)
75	300 206 058	10	365	103	121	20
90	300 206 059	6	592	122	142	22
110	300 206 060	8	952	148	164	33
125	300 206 061	1	1080	160	185	52

AQUASYSTEM Equal Tee 90° PP-R

Model:

- Polypropylene - Random (PP-R)
- EN ISO 15874, MS 2286
- Colour: grey
- **SIRIM certified / SPAN approved**
- **SLS certified / PUB approved (20mm – 110mm)**

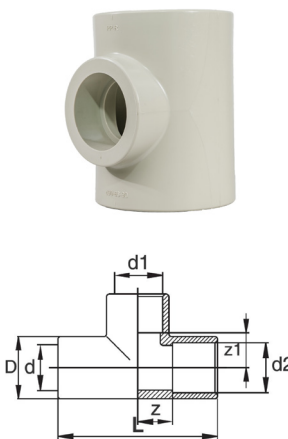


d (mm)	Code	GP	g	D (mm)	L (mm)	z (mm)	z1 (mm)
20	300 206 062	200	23	29	55	12	10
25	300 206 063	300	36	34	64	14	14
32	300 206 064	160	69	43	77	19	19
40	300 206 065	80	126	55	87	22	23
50	300 206 066	50	229	70	105	28	28
63	300 206 067	25	444	88	126	34	35
75	300 206 068	20	584	103	141	40	42
90	300 206 069	10	932	122	163	48	46
110	300 206 070	6	1077	145	197	60	59
125	300 206 100	1	1685	160	216	65	64

AQUASYSTEM Reducing Tee 90° PP-R

Model:

- Polypropylene - Random (PP-R)
- EN ISO 15874, MS 2286
- Colour: grey
- **SIRIM certified / SPAN approved**
- **SLS certified / PUB approved (20mm – 110mm)**



d-d1-d2 (mm)	Code	GP	g	D (mm)	L (mm)	z (mm)	z1 (mm)
25 - 20 - 25	300 206 071	250	38	34	64	14	16
32 - 20 - 32	300 206 074	160	64	43	77	19	22
32 - 25 - 32	300 206 075	60	65	43	77	19	20
40 - 20 - 40	300 206 078	100	113	55	88	22	28
40 - 25 - 40	300 206 079	100	114	55	88	22	26
40 - 32 - 40	300 206 080	80	115	55	88	22	24
50 - 20 - 50	300 206 081	60	208	70	106	28	36
50 - 25 - 50	300 206 082	60	210	70	106	28	34
50 - 32 - 50	300 206 083	60	215	70	106	28	32
50 - 40 - 50	300 206 084	50	218	70	106	28	30
63 - 25 - 63	300 206 085	25	397	88	128	35	45
63 - 32 - 63	300 206 086	10	399	88	128	35	43
63 - 40 - 63	300 206 087	25	403	88	128	35	41
63 - 50 - 63	300 206 088	25	414	88	128	35	38
75 - 25 - 75	300 206 097	20	532	103	141	40	51
75 - 32 - 75	300 206 089	20	533	103	141	40	49
75 - 40 - 75	300 206 090	20	537	103	141	40	47
75 - 50 - 75	300 206 091	20	548	103	141	40	44
75 - 63 - 75	300 206 092	20	564	103	141	40	40
90 - 32 - 90	300 206 093	10	866	122	163	48	57
90 - 40 - 90	300 206 094	10	871	122	163	48	55

table continued on the next page

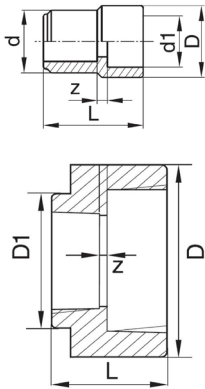
d-d1-d2 (mm)	Code	GP	g	D (mm)	L (mm)	z (mm)	z1 (mm)
90 - 50 - 90	300 206 095	10	878	122	163	48	52
90 - 63 - 90	300 206 096	10	889	122	163	48	48
110 - 50 - 110	300 206 098	6	1490	148	197	60	61
110 - 63 - 110	300 206 099	6	1490	148	197	60	57

AQUASYSTEM Reducing Bush PP-R

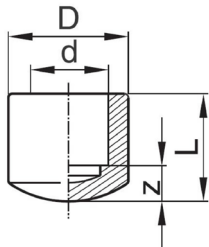


Model:

- Polypropylene - Random (PP-R)
- EN ISO 15874, MS 2286
- Colour: grey
- **SIRIM certified / SPAN approved**
- **SLS certified / PUB approved (20mm – 110mm)**



d-d1 (mm)	Code	GP	g	D (mm)	L (mm)	z (mm)	D1 (mm)
25 - 20	300 206 102	400	10	29	38	4	
32 - 20	300 206 103	240	16	29	39	5	
32 - 25	300 206 104	200	18	34	43	4	
40 - 20	300 206 105	150	23	29	44	5	
40 - 25	300 206 106	150	24	34	44	5	
40 - 32	300 206 107	250	34	43	50	7	
50 - 20	300 206 108	100	41	29	50	5	
50 - 25	300 206 109	100	40	34	50	6	
50 - 32	300 206 110	40	44	43	50	4	
50 - 40	300 206 111	40	61	55	57	5	
63 - 20	300 206 112	60	73	29	63	9	
63 - 25	300 206 113	80	74	34	63	10	
63 - 32	300 206 114	50	73	43	59	8	
63 - 40	300 206 115	50	74	55	55	4	
63 - 50	300 206 116	40	111	70	64	6	
75 - 25	300 206 118	25	251	103	54	5	34
75 - 32	300 206 119	25	255	103	56	5	44
75 - 40	300 206 120	25	247	103	58	5	55
75 - 50	300 206 121	25	245	103	61	5	70
75 - 63	300 206 122	25	252	103	65	5	88
90 - 50	300 206 125	10	357	122	64	5	70
90 - 63	300 206 126	16	357	112	68	5	88
90 - 75	300 206 127	16	361	112	70	5	103
110 - 63	300 206 129	10	604	148	74	6	88
110 - 75	300 206 130	10	589	148	75	5	103
110 - 90	300 206 131	10	585	148	78	5	122
125 - 110	300 206 132	10	920	160	90	8	148



AQUASYSTEM End Cap PP-R

Model:

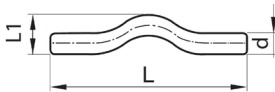
- Polypropylene - Random (PP-R)
- Colour: grey
- **SIRIM certified / SPAN approved**
- **SLS certified / PUB approved (20mm – 110mm)**

d (mm)	Code	GP	g	D (mm)	L (mm)	z (mm)
20	300 203 132	300	7	28	22	9
25	300 203 133	200	9	35	25	7
32	300 203 134	200	15	42	30	9
40	4301904006321	150	31	53	31	11
50	4301905006421	80	69	67	41	7
63	4301906306522	50	115	83	44	17

AQUASYSTEM Swan Neck PP-R

Model:

- Polypropylene - Random (PP-R)
- Colour: grey
- **SLS certified / PUB approved (20mm – 110mm)**



d (mm)	Code	GP	g	L (mm)	L1 (mm)
20	4301902000121	80	38	163	48
25	300 203 143	50	75	320	60
32	300 203 144	30	126	350	64

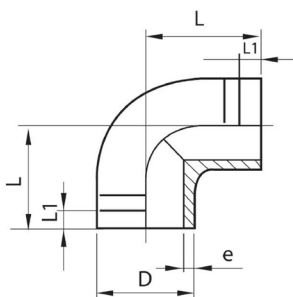
Butt Fusion Fittings



AQUASYSTEM Elbow 90° PP-R

Model:

- Polypropylene - Random (PP-R)
- Colour: grey
- EN ISO 15874, MS 2286
- **SIRIM certified / SPAN approved**



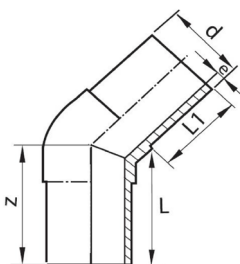
d (mm)	Code	GP	Weight (kg)	L (mm)	L1 (mm)	e (mm)	PN (bar)
160	300 206 601	1	4.47	231	99	21.9	16
160	300 206 605	1	4.27	231	99	14.6	10



AQUASYSTEM Elbow 45° PP-R

Model:

- Polypropylene - Random (PP-R)
- Colour: grey
- EN ISO 15874, MS 2286
- **SIRIM certified / SPAN approved**



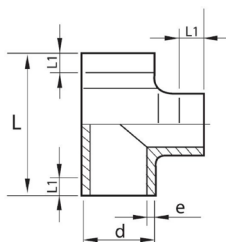
d (mm)	Code	GP	Weight (kg)	L (mm)	L1 (mm)	e (mm)	PN (bar)
160	300 206 611	1	3.74	151	99	21.9	16
160	300 206 615	1	3.54	151	99	14.6	10



AQUASYSTEM Equal Tee 90° PP-R

Model:

- Polypropylene - Random (PP-R)
- Colour: grey
- EN ISO 15874, MS 2286
- **SIRIM certified / SPAN approved**



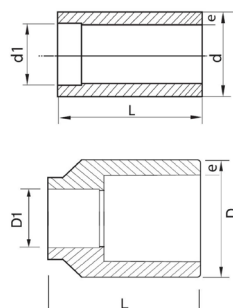
d (mm)	Code	GP	Weight (kg)	L (mm)	L1 (mm)	e (mm)	PN (bar)
160	300 206 621	1	6.18	475	99	21.9	16
160	300 206 625	1		475	99	14.6	10



AQUASYSTEM Reducer PP-R

Model:

- Polypropylene - Random (PP-R)
- Colour: grey
- Fabricated fittings
- Below 160mm fittings ends are only suited for socket fusion welding
- **SIRIM certified / SPAN approved**

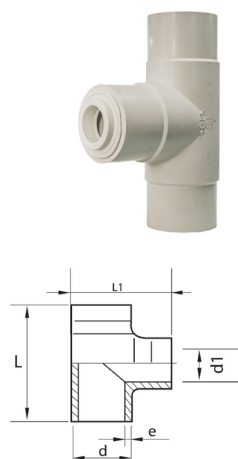


d (mm)	Code	GP	Weight (kg)	L (mm)	e (mm)	d	d1	PN (bar)
160 - 110	300 206 138	1	1.31	164	21.9	160	110	16
160 - 110	300 206 139	1	1.20	164	14.6	160	110	10
160 - 125	300 206 642	1	2.30	255	21.9	160	125	16
160 - 125	300 206 662	1	2.15	255	14.6	160	125	10

AQUASYSTEM Reducing Tee 90° PP-R

Model:

- Polypropylene - Random (PP-R)
- Colour: grey
- EN ISO 15874, MS 2286
- **SIRIM certified / SPAN approved**

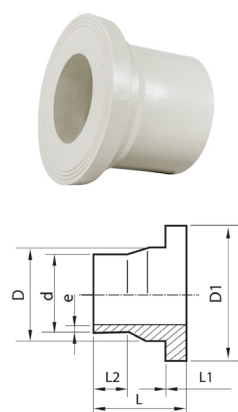


d-d1 (mm)	Code	GP	Weight (kg)	L (mm)	L1 (mm)	e (mm)	PN (bar)
160 - 63	300 206 151	1	6.77	475	312	21.9	16
160 - 75	300 206 152	1	6.79	475	324	21.9	16
160 - 90	300 206 153	1	6.80	475	327	21.9	16

AQUASYSTEM Flange Adaptor PP-R

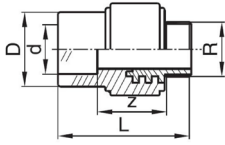
Model:

- Polypropylene - Random (PP-R)
- Colour: grey
- Socket fusion
- **SIRIM certified / SPAN approved**



d (mm)	Code	GP	Weight (kg)	L (mm)	L1 (mm)	L2 (mm)	D (mm)	D1 (mm)	e (mm)	PN (bar)
160	300 206 651	1	1.74	158	25	99	175	212	22.0	16
160	300 206 657	1	1.54	158	25	99	175	212	14.6	10

Transition Fittings

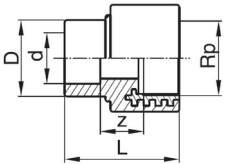


AQUASYSTEM Threaded Male Coupling PP-R

Model:

- Polypropylene - Random (PP-R)
- British Standard Pipe Taper (BPST) Threads: Brass Male - Threaded
- EN ISO 15874, MS 2286
- Colour: grey
- Nickel Coating
- DZR brass product codes are available upon request, SLS certified / PUB approved
- **SIRIM certified / SPAN approved**

d-R (mm/inch)	Code	GP	g	D (mm)	L (mm)	z (mm)
20-½	300 206 241	80	75	28	56	25
20-¾	300 206 242	60	98	34	59	24
25-½	300 206 243	60	75	33	58	25
25-¾	300 206 244	60	96	34	59	24
32-¾	300 206 245	60	99	42	61	23
32-1	300 206 246	30	204	43	75	22
40-1¼	300 206 248	10	402	54	90	31
50-1½	300 206 249	10	526	68	93	31
63-2	300 206 250	6	719	86	105	30

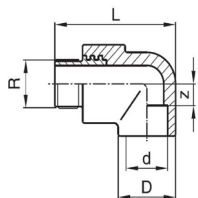


AQUASYSTEM Threaded Female Coupling PP-R

Model:

- Polypropylene - Random (PP-R)
- British Standard Pipe Taper (BPST) Threads: Brass Female - Threaded
- EN ISO 15874, MS 2286
- Colour: grey
- Nickel Coating
- DZR brass product codes are available upon request, SLS certified / PUB approved
- **SIRIM certified / SPAN approved**

d-Rp (mm/inch)	Code	GP	g	D (mm)	L (mm)	z (mm)
20-½	300 206 271	80	50	28	41	25
20-¾	300 206 272	80	67	34	42	26
25-½	300 206 273	80	52	33	43	25
25-¾	300 206 274	60	65	34	42	24
32-¾	300 206 275	60	69	42	44	22
32-1	300 206 276	30	130	43	56	23
40-1¼	300 206 278	10	274	54	69	31
50-1½	300 206 279	10	384	68	72	31
63-2	300 206 280	6	492	86	80	31

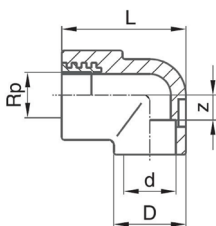


AQUASYSTEM Threaded Male Elbow 90° PP-R

Model:

- Polypropylene - Random (PP-R)
- British Standard Pipe Thread (BPST) Threads: Brass Male - Threaded
- EN ISO 15874, MS 2286
- Colour: grey
- Nickel Coating
- DZR brass product codes are available upon request, SLS certified / PUB approved
- **SIRIM certified / SPAN approved**

d-R (mm/inch)	Code	GP	g	D (mm)	L (mm)	z (mm)
20-½	300 206 291	50	81	30	65	12
20-¾	300 206 292	50	102	30	66	12
25-½	300 206 293	40	94	34	72	14
25-¾	300 206 294	40	113	34	74	14
32-¾	300 206 295	25	128	42	82	16
32-1	300 206 296	20	165	44	95	19

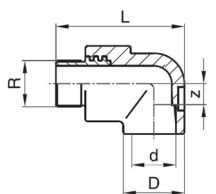


AQUASYSTEM Threaded Female Elbow 90° PP-R

Model:

- Polypropylene - Random (PP-R)
- British Standard Pipe Taper (BPST) Threads: Brass Female - Threaded
- EN ISO 15874, MS 2286
- Colour: grey
- Nickel Coating
- DZR brass product codes are available upon request, SLS certified / PUB approved
- **SIRIM certified / SPAN approved**

d-Rp (mm/inch)	Code	GP	g	D (mm)	L (mm)	z (mm)
20-½	300 206 301	50	59	30	50	12
20-¾	300 206 302	50	72	30	50	12
25-½	300 206 303	50	70	34	57	14
25-¾	300 206 304	40	93	34	57	14
32-¾	300 206 305	30	96	42	65	16
32-1	300 206 306	20	163	44	77	19

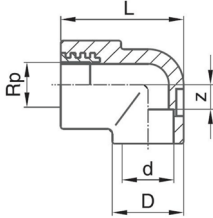


AQUASYSTEM Threaded Male Elbow 90° with Bracket PP-R

Model:

- Polypropylene - Random (PP-R)
- Brass Male - Threaded
- Colour: grey
- Nickel Coating
- British Standard Pipe Taper (BSPT) Threads: Brass Male - Threaded
- DZR brass product codes are available upon request, SLS certified / PUB approved

d-R (mm/inch)	Code	GP	g	D (mm)	L (mm)	z (mm)
20-½	300 206 321	50	83	30	65	12

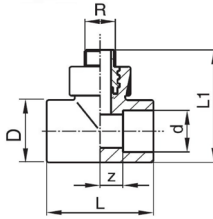


AQUASYSTEM Threaded Female Elbow 90° with Bracket PP-R

Model:

- Polypropylene - Random (PP-R)
- Brass Female - Threaded
- Colour: grey
- Nickel Coating
- British Standard Pipe Taper (BSPT) Threads: Brass Female- Threaded
- DZR brass product codes are available upon request, SLS certified / PUB approved

d-Rp (mm/inch)	Code	GP	g	D (mm)	L (mm)	z (mm)
20-½	300 206 331	50	61	30	50	12

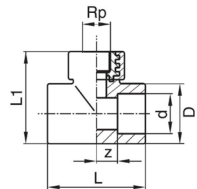


AQUASYSTEM Threaded Male Tee PP-R

Model:

- Polypropylene - Random (PP-R)
- British Standard Pipe Taper (BPST) Threads: Brass Male - Threaded
- EN ISO 15874, MS 2286
- Colour: grey
- Nickel Coating
- DZR brass product codes are available upon request, SLS certified / PUB approved
- **SIRIM certified / SPAN approved**

d-R (mm/inch)	Code	GP	g	D (mm)	L (mm)	L1 (mm)	z (mm)
20-½	300 206 341	50	85	29	55	65	12
25-½	300 206 343	50	97	34	64	72	14
25-¾	300 206 344	40	119	34	64	74	14
32-¾	300 206 345	30	145	44	77	81	19
32-1	300 206 346	20	247	43	77	96	19

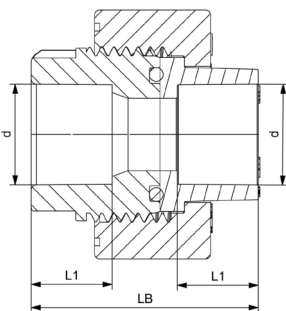


AQUASYSTEM Threaded Female Tee PP-R

Model:

- Polypropylene - Random (PP-R)
- British Standard Pipe Taper (BPST) Threads: Brass Female - Threaded
- EN ISO 15874, MS 2286
- Colour: grey
- Nickel Coating
- DZR brass product codes are available upon request, SLS certified / PUB approved
- **SIRIM certified / SPAN approved**

d-Rp (mm/inch)	Code	GP	g	D (mm)	L (mm)	L1 (mm)	z (mm)
20-½	300 206 351	50	62	29	55	50	12
25-½	300 206 353	50	74	34	64	57	14
25-¾	300 206 354	40	86	34	64	57	14
32-¾	300 206 356	30	114	44	77	64	19
32-1	300 206 357	20	174	43	77	78	19



AQUASYSTEM Union PP-R

Attention:

- * PN10 hot and cold water applications.
- ** PN10 cold water applications only.

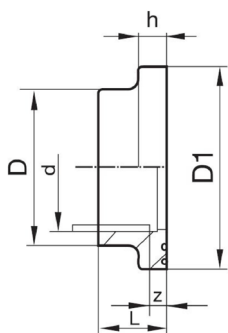
DN (mm)	Code	GP	SP	PN (bar)	d (mm)	L1 (mm)	LB (mm)
20	4300902028021	100	50	10	19.2	15.4	43.2
25	4300902528121		50	10	24.3	18.5	46.7
32	4300903228221	80	20	10	31.2	20.5	52.2
40	4300904028321	20	10	10	39.0	23.9	60.5
50	4300905028421	15	5	10	48.9	24.0	65.4
63	4300906328521	20	4	10	61.9	27.5	71.0
75	4300907528621		16	10	74.3	31.0	79.0
90	4300909032521	8	1	10	89.2	35.5	90.5

AQUASYSTEM Flange Adaptor PP-R

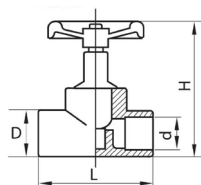
Model:

- Polypropylene - Random (PP-R)
- Colour: grey
- Socket fusion
- SLS certified / PUB approved
- **SIRIM certified / SPAN approved**

d (mm)	Code	GP	g	D (mm)	L (mm)	D1 (mm)	z (mm)	h (mm)
40	300 206 415	200	30	50	28	62	6	10
50	300 206 416	120	45	61	31	74	6	12
63	300 206 417	60	74	76	35	91	6	14
75	300 206 418	25	110	90	37	108	6	13
90	300 206 419	16	163	108	40	128	6	16
110	300 206 420	10	242	131	45	151	6	19
125	300 206 421	8	337	148	53	169	10	20



Valves

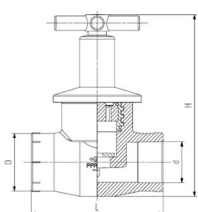


AQUASYSTEM Stop Valve PP-R

Model:

- Polypropylene - Random (PP-R)
- Colour: grey
- EPDM Gasket
- Nickel Coating
- DZR brass product codes are available upon request, SLS certified / PUB approved (20mm – 32mm)

d (mm)	Code	GP	g	L (mm)	H (mm)	D (mm)
20	300 206 832	30	120	72	82	29
25	300 206 833	20	207	84	90	37
32	300 206 834	10	370	104	95	47

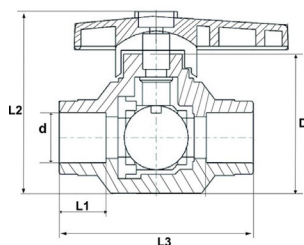


AQUASYSTEM Chrome Handle Valve PP-R

Model:

- Polypropylene - Random (PP-R)
- Colour: grey

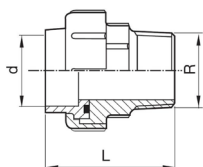
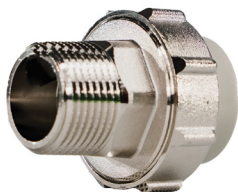
d (mm)	Code	GP	g	L (mm)	H (mm)	D (mm)
20	300 206 814	20	320	111.5	72	29
25	300 206 815	20	389	119.0	84	34
32	300 206 816	20	560	138.7	104	44



AQUASYSTEM Ball Valve (Welt-In) PP-R

DN (mm)	Code	GP	SP	PN (bar)	d (mm)	D (mm)	L1 (mm)	L2 (mm)	L3 (mm)
20	4300802042822	30	10	20	20	50.0	16.0	72.0	88.0
25	4300802542922	30	10	20	25	57.5	19.0	82.0	76.0
32	4300803243022	45	5	20	32	70.3	20.0	92.0	68.0
40	4300804043622	10	1	20	40	88.0	36.1	121.4	109.1
50	4300805043722	20	1	20	50	98.0	36.5	140.0	125.2
63	4300806343822	3	1	20	63	106.0	35.9	121.1	119.3
75	4300807543322	8	1	20	75	125.5	42.6	159.5	144.9

Unions

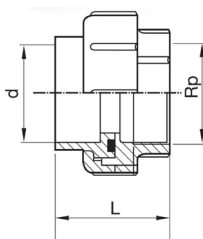


AQUASYSTEM Adaptor Union Male Thread PP-R

Model:

- Polypropylene - Random (PP-R)
- EPDM O-Ring
- Colour: grey
- Nickel Coating
- British Standard Pipe Taper (BPST) Threads
- DZR brass product codes are available upon request, SLS certified / PUB approved

d-R (mm/inch)	Code	GP	g	L (mm)
20-½	300 206 702	80	140	52
25-¾	300 206 703	60	160	56
32-1	300 206 704	30	220	61
40-1¼	300 206 705	10	280	76
50-1½	300 206 706	10	360	79
63-2	300 206 707	6	480	89

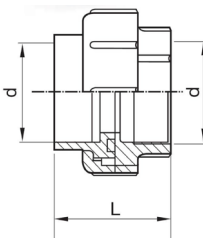


AQUASYSTEM Adaptor Union Female Thread PP-R

Model:

- Polypropylene - Random (PP-R)
- EPDM O-Ring
- Colour: grey
- Nickel Coating
- British Standard Pipe Taper (BPST) Threads
- DZR brass product codes are available upon request, SLS certified / PUB approved

d-Rp (mm/inch)	Code	GP	g	L (mm)
20-½	300 206 712	80	120	39
25-¾	300 206 713	60	140	41
32-1	300 206 714	30	200	43
40-1¼	300 206 715	10	240	54
50-1½	300 206 716	10	320	57
63-2	300 206 717	6	440	63



AQUASYSTEM Union Socket-Socket PP-R

Model:

- Polypropylene - Random (PP-R)
- EPDM O-Ring
- Colour: grey
- Nickel Coating
- British Standard Pipe Taper (BPST) Threads
- DZR brass product codes are available upon request, SLS certified / PUB approved

d (mm)	Code	GP	g	L (mm)
20	300 206 731	80	120	41
25	300 206 732	60	140	45
32	300 206 733	30	200	49
40	300 206 734	10	240	60
50	300 206 735	10	320	66
63	300 206 736	6	440	74

Machines & Tools



Complete Socket Welder (Set)

- Available as a complete set in a practical metal case
- Heating bushes and spigots
- Timer
- Fusion marking template
- Floor stand
- Pipe shears

Model:

- Socket welder with electronic temperature control
- Instruction manual

d (mm)	Code	SP	Weight (kg)	Performance
20 - 32	300 206 539	1	7.10	230V / 800W
20 - 63	300 206 540	1	13.10	230V / 800W
75 - 110	300 206 541	1	14.20	230V / 1500W



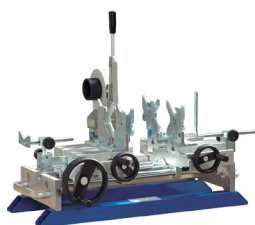
Standard Socket Welder

- Floor stand
- Heating bushes and spigots
- Excluding heating bushes

Model:

- Socket welder with electronic temperature control
- Instruction manual

d (mm)	Code	SP	Weight (kg)	Performance
20 - 63	300 206 518	1	1.80	230V / 800W
20 - 110	300 206 519	1	3.55	230V / 1500W

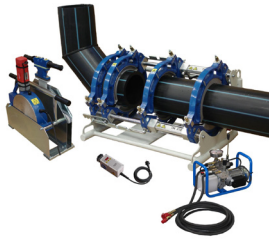


SG 125

Socket fusion machine

- Portable heating element - socket fusion machine for use in the workshop and on job sites.
- For fusion jointing of PP and PE pipes and fittings
- **BASE MACHINE**
 - Compact, sturdy design, distortion-free machine bed
 - Handwheel with torque locking mechanism for the slide movement
 - Fast selection of insertion depth according to the pipe dimension
- **HEATER**
 - With electronic temperature control
 - High temperature accuracy over the entire heating surface
- **ADDITIONAL STANDARD EQUIPMENT**
 - Universal, left and right prismatic clamping devices, complete, for clamping pipe and fittings. Additional set of prismatic clamping devices for outer clamping of pipes available as an option.
 - V-shaped pipe support
 - Back stop
 - Machine specific tool set
 - Timer to clock fusion times
- Including transport packaging, without accessories

d-d (mm)	Performance	Code	Weight (kg)
16 - 125	230 V/1500 W	790 310 034	65.000
16 - 125	115 V/1500 W	790 310 036	65.000



TM 160 ECO Butt Fusion Machines

- Flexible and user-friendly heating element Butt Fusion machine for fusion joining PE, PP, PB and PVDF pipes and fittings on building sites and in trenches
- Scope of delivery includes: lightweight ECO hydraulic unit, flexible base machine, powerful planer, high performance heating element with electronic temperature control box, storage case for the planer and heater
- 115 V on request!
- Including transport packaging (carton pallet), without accessories and without reduction inserts

Type	d-d (mm)	Code	Weight (kg)	Performance
TM 160 ECO	40 - 160	790 150 010	86	230V/1900W

Heating Bushes



Model:

- Coated with Polytetrafluoroethylene (PTFE)
- Incrustation free
- ISO 15874, DIN 16962
- Corrosion free
- Low thermal conductivity

d (mm)	Code	SP	Weight (kg)
20	300 206 561	1m + 1f	0.120
25	300 206 562	1m + 1f	0.150
32	300 206 563	1m + 1f	0.210
40	300 206 564	1m + 1f	0.310
50	300 206 565	1m + 1f	0.450
63	300 206 566	1m + 1f	0.600
75	300 206 567	1m + 1f	0.965
90	300 206 568	1m + 1f	1.440
110	300 206 569	1m + 1f	2.210
125	300 206 570	1m + 1f	2.900

Storage, Transportation and Handling of Plastics Pipes

Storage

- All storage areas should be flat and kept free from stones and sharp-edged objects.
- Single point contact support for any pipe is to be avoided.
- Pipes are to be stored in such a way to prevent any contamination of the insides.
- Storing pipes on their pallets will offer basic protection from damage.
- Storage zones and stack heights are to be chosen which avoid possible damage or permanent deformation.
- Stacks should be wedged to prevent movement.
- Pipes should be stacked in heights not exceeding 1 meter, pipe spacer must be used, ensure that there are no excessive loads on pipe sockets and full weight is supported by the frame of the pallet
- Wrapping film should be applied at all time and fastening bands secured against lateral movement should not be removed until shortly before installation.
- The location where pipe, fittings and other components are stored must provide as much protection as possible from UV exposure, dust, moist, excessive heat, corrosive or dangerous materials and other sources of contaminant. Pipes, fittings and other components should not be allowed to come into contact with soils, sands, fuels, solvents, oil, greases, paints (silicones) or heat sources during storage.
- Friction on pipes and fittings surface, or dragging pipes over the ground must be avoided at all times.
- Fittings packed in carton boxes should be sealed and stored in a dry area to protect against moisture.
- Significant impact or shock loads on thermoplastic pipe at low temperatures can fracture the pipe. Care should be taken to avoid dropping or striking the pipe with handling equipment, tools, or other objects.

Transportation & Handling

- Vehicles for transporting pipes should be selected in such a way so that the pipes can lay completely flat on the bed of the vehicle without any over-hang.
- All pipes are to be supported so that they cannot bend or become deformed.
- The area of the truck where the pipes are laid should be covered with either protective sheeting or clean cardboard (including all side supports) in order to prevent any possible damage from protruding rivets or nails etc.
- Pipes with higher pressure ratings or higher ring stiffness should be placed at the bottom of the load, ensure that there are no excessive loads on pipe sockets.
- Check that each individual bundle, package and pallet is securely tied, pipes should be secured and restrained during transport to ensure that no movement occurs.
- Care should be taken to avoid rough handling of plastic pipe. It should not be dropped or have other objects dropped upon it, nor should it be pushed or pulled over sharp projections. Surfaces friction must be avoided at all time.
- Pipes and fittings should always be loaded and unloaded with extreme care. Special support frames are to be employed when using equipment for loading or unloading from vehicles.
- Sudden shock impacts are to be avoided under all circumstances. This is especially important at ambient temperatures around or below 0° C under which circumstances the impact resistance of almost all materials is considerably reduced.
- Pipes and fittings are to be transported and stored in such a way so that they do not become contaminated by earth, mud, sand, stones, water, oils, chemicals, solvents, other liquids, animal excrement, the effects of weather and etc.
- We strongly recommend that all open pipe ends are covered by protective caps/wrapping film to prevent the ingress of foreign substances and matter inside the pipes.

Influence of Weather

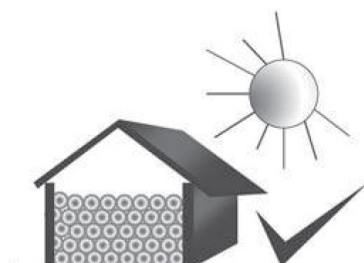
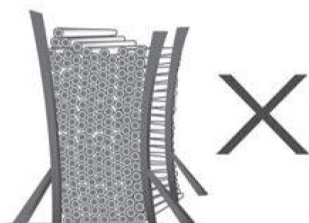
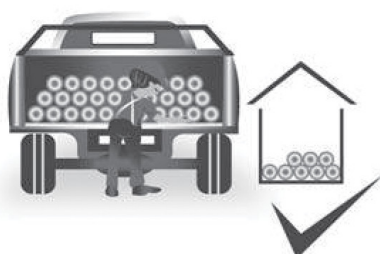
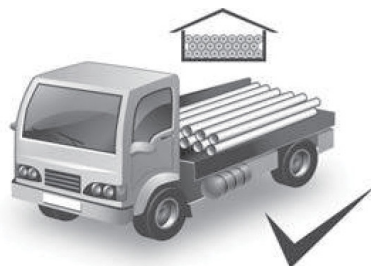
- The influence of weather on all stored piping components is to be kept to an absolute minimum, i.e. such items should be kept in a covered and well ventilated warehouse. If pipes are stored in the open (for example, on construction sites) they must be covered with suitable coloured or plain black sheeting to protect them from the effects of weather (e.g. UV radiation) and/or effects of environment condition. Furthermore, a one-sided exposure to direct sunshine can ultimately lead to deformation and discoloration of the pipe.
- Pipes and fittings should be checked before use to ensure their perfect condition and complete compliance with national marking regulations.

Transport and Storage of Plastic Pipes

Wrong



Correct



Products that are not resistant to UV should not be stored outdoors and should be protected against sunlight.

Selection of Pipe Diameter

In order to select the best water flow depending on the available water pressure and corresponding usage, please refer to the table here below:

Table For The Selection Of Pipes Diameters And Water Flow

Water Connection Point	Flow (l/sec).	Pressure (bar)	Pipe Diameter (mm)
Wash Basin			
Tap DN 15	0.07	0.50	20
Mixer Tap DN 15	0.07	1.00	20
Bidet			
Tap DN 15	0.07	0.50	20
Mixer Tap DN 15	0.07	1.00	20
Bath tub			
Mixer Tap DN 15	0.15	1.00	20
Mixer Tap DN 20	0.40	1.00	25
Mixer Tap DN 25	1.00	1.00	32
Shower			
Sprinkler DN 15	0.15	1.00	20
Sprinkler DN 15	0.06	1.00	20
Sprinkler DN 20	0.18	1.00	20
Sprinkler DN 25	0.31	1.00	20
Flush and flushing tank			
Flush DN 20	1.00	1.20	32
Flush Tank DN 15	0.13	0.50	20
Electric and gas boilers			
6 kW	0.07	1.00	20
12kW	0.10	1.00	20
18kW	0.15	1.00	20
21kW	0.17	1.00	20
24kW	0.20	1.00	20
33kW	0.30	1.00	20
Sinks			
Mixer DN 15	0.07	1.00	20
Mixer DN 20	0.02	1.00	20
Dishwashers Washing Machines			
	0.15	1.00	20
	0.25	1.00	20
Urinals			
Flush DN 15	0.30	1.20	20
Flushing Tank DN 15	0.13	0.50	20

Assessment of Pressure

The pressure losses for distribution in the GF Piping Systems can be assessed by means of the following chart or by means of the following formula:

$$\Delta p = \lambda \cdot \frac{L \cdot \rho \cdot v^2}{d_i \cdot 2 \cdot 10}$$

$$\Delta p = \lambda \cdot \frac{L \cdot \rho \cdot v^2}{d_i \cdot 2 \cdot 10}$$

Where:

Δp pressure loss in a straight pipe (bar)

λ A pipe friction factor (in most cases 0.02 is sufficient)

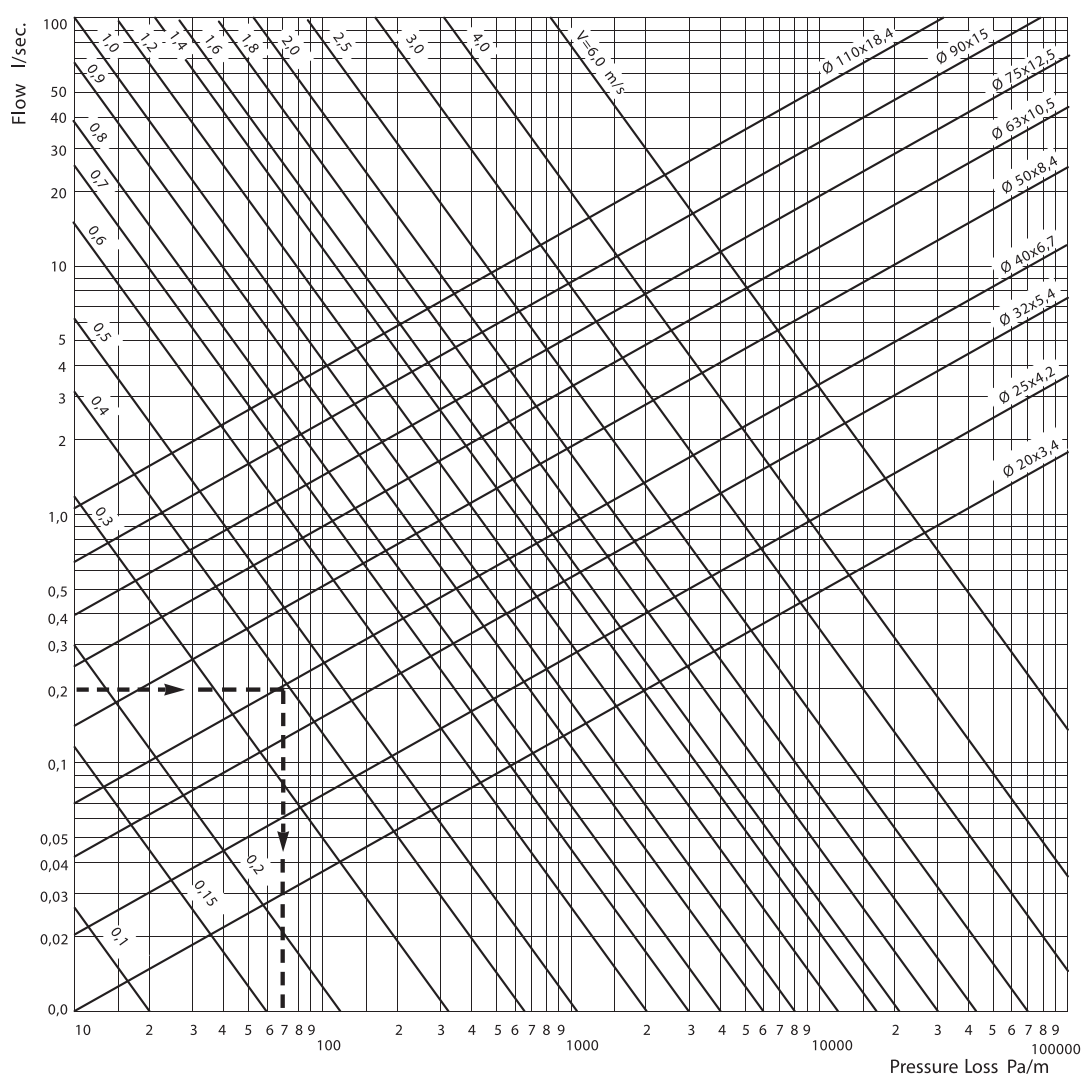
L length of straight pipe (m)

ρ density of transported media (kg/m³)

v flow velocity (m/s)

d_i inside diameter of pipe (mm)

Loss Pressure Diagram for PN20 / PN28 Pipe



Example:

Pipe: 40 X 6.7 mm

Flow = 0.2 l/s

Water velocity = 0.4 m/s

From the diagram,

Pressure loss

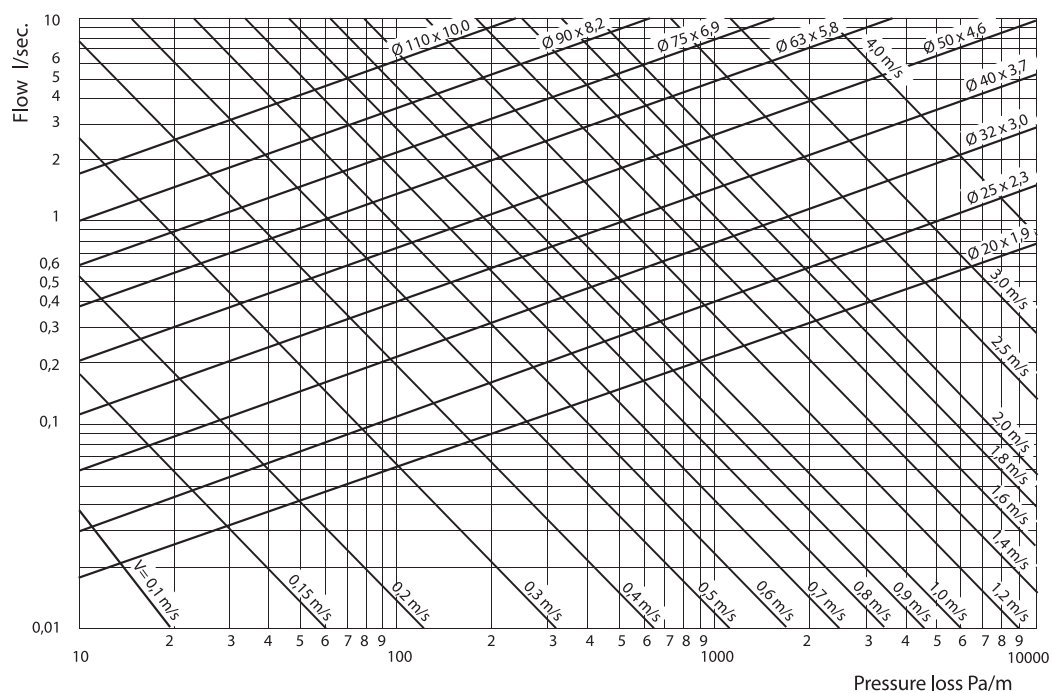
= 70 Pa/m

= 0.7 mbar

[10,000 Pa = 0.1 bar = 100 mbar]















Assessment of Pressure

Loss Pressure Diagram for PN10 / PN14 Pipe



Assessment of Pressure

Pressure Losses in GF Fittings

Description	Symbol	Coefficient of resistance
Equal coupling		0.25
Elbow 90°		2.00
Elbow 45°		0.60
Equal tee 90°		1.80
Reduced tee 90°		3.60
Equal tee 90°		1.30
Reduce tee 90°		2.60
Equal tee 90°		4.20
Reduced tee 90°		9.00
Equal tee 90°		2.20
Reduce tee 90°		5.00
Threaded tee 90°, male		0.80
Concentric reductions up to 2 size		0.55
Concentric reductions up to 3 size		0.85
Threaded fitting, male		0.40
Threaded fitting, male, reduced		0.85
Threaded elbow, male		2.20
Threaded elbow, male, reduced		3.50

Example

Assume we have a water services system with the following characteristics:

- pipe diameter 25 mm
- total pipe length 10 m
- fittings used:
 - 4 coupling
 - 3 elbows 90°
 - 2 equal tees
 - 1 threaded coupling, male
- velocity 1.5 m/s
- flow rate 0.35 l/s
- T = 20°C

From the table,
 ξ_1 (coupling) = 0.25×4
 ξ_2 (elbow 90°) = 2.00×3
 ξ_3 (equal tees) = 1.80×2
 ξ_4 (threaded coupling, male) = 0.40×1

Total $\xi = 11$

$$\text{Total } P = \Delta p + H$$

From graph above,
 $\Delta p = 1100 \text{ Pa/m}$
 $= 11 \text{ mbar}$

For 10m length pipe,
 $\Delta p = 11 \times 10$
 $= \underline{110 \text{ mbar}}$

$$\begin{aligned} \text{Total } P &= H + \Delta p \\ &= 110 + 126 \\ &= \underline{236 \text{ mbar}} \end{aligned}$$

$$H = 10 \cdot \xi \cdot v^2 \cdot \rho$$

$$2g$$

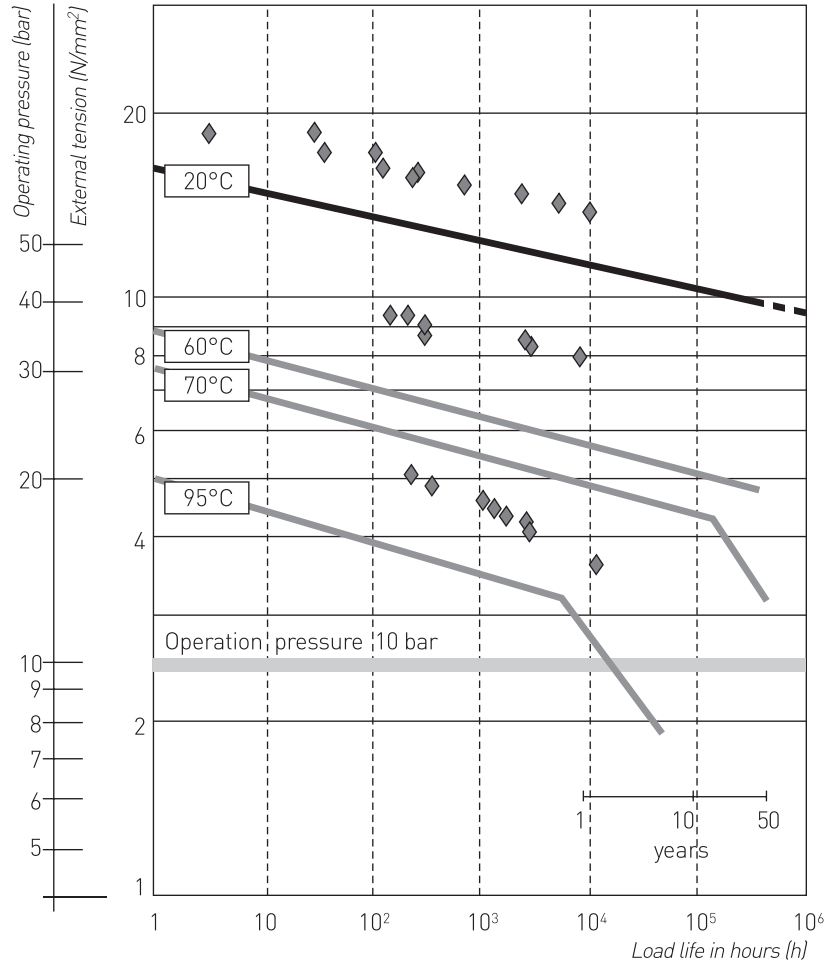
where:
H = pressure losses in fittings
v = water velocity (m/s)
g = specific gravity of water (kg/m³)
= 9.8 m/s²
 ξ = coefficient of resistance

$$\begin{aligned} H &= \frac{10 \times 11 \times 1.5^2 \times 1000}{2 \times 9.8} \\ &= 12630 \text{ Pa} \\ &= \underline{126 \text{ mbar}} \end{aligned}$$

Regression Curve

The regression curves affect pipe life depending on the fluid pressure, temperature and outer stress (see chart).

Regression curves



— Regression curves according to **ISO 15874 & MS 2286**

◆ Actual data of PP-R measured with S2.5 pipes

Hydrostatic stress

Expressed in megapascals, induced in the wall of pipe when a pressure is applied using water as a medium. Using Hydrostatic stress and dimensions, the maximum working pressure can be calculated with the following equation:

The formula joining these parameters is : $R = P \times \frac{d-s}{2s}$

P = maximum inner pressure
d = outer diameter
s = thickness
R = outer stress

Example

T = 60°C Continuous operating life: 50 years
From the regression curve the result is: R = 4,9 Mpa
Calculation (from the formula)
P = 19,7 bar
Or P = 13 bar
(using safety coefficient of 1.5)

Permissible Operating Pressure

Water Temperature	Working years	Type of pipe		
		SDR 11	SDR 7.4	SDR 6
		S 5	S 3.2	S 2.5
		Pressure bar		
10°C	1	17.6	27.8	35.0
	5	16.6	26.4	33.2
	10	16.1	25.5	32.1
	25	15.6	24.7	31.1
	50	15.2	24.0	30.3
20°C	1	15.0	23.8	30.0
	5	14.1	22.3	28.1
	10	13.7	21.7	27.3
	25	13.3	21.1	26.5
	50	12.9	20.4	25.7
30°C	1	12.8	20.2	25.5
	5	12.0	19.0	23.9
	10	11.6	18.3	23.1
	25	11.2	17.7	22.3
	50	10.9	17.3	21.8
40°C	1	10.8	17.1	21.5
	5	10.1	16.0	20.2
	10	9.8	15.6	19.6
	25	9.4	15.0	18.8
	50	9.2	14.5	18.3
50°C	1	9.2	14.5	18.3
	5	8.5	13.5	17.0
	10	8.2	13.1	16.5
	25	8.0	12.6	15.9
	50	7.7	12.2	15.4
60°C	1	7.7	12.2	15.4
	5	7.2	11.4	14.3
	10	6.9	11.0	13.8
	25	6.7	10.5	13.3
	50	6.4	10.1	12.7
70°C	1	6.5	10.3	13.0
	5	6.0	9.5	11.9
	10	5.9	9.3	11.7
	25	5.1	8.0	10.1
	50	4.3	6.7	8.5
80°C	1	5.5	8.6	10.9
	5	4.8	7.6	9.6
	10	4.0	6.3	8.0
	25	3.2	5.1	6.4
95°C	1	3.9	6.1	7.7
	5	2.5	4.0	5.0

DIN 8077 edition 07/1999 - coefficient factor 1.5



Thermal Expansion & Contraction

Thermoplastics are subject to greater thermal expansion and contraction than metals.

Pipes installed above ground, against walls or in ducts, especially those exposed to temperature variations, require changes in length to be absorbed in order to prevent strain on the pipes. Length changes can be absorbed by:

- a) Flexible sections
- b) Compensators

Flexible sections are the most common solution, being the simplest and the most economical. Calculation of the positioning of flexible section are therefore described in detail.

Calculation of change in length

During the design and installation of plastic pipes, it is very important to calculate the expansion caused by the possible difference between operating temperature and installation temperature.

The change in length is calculated with the following formula:

$$\Delta L = L \times \Delta T \times \alpha$$

Where:

ΔL = change in length (mm)

L = initial pipe length (m)

ΔT = temperature difference (°C)

α = expansion coefficient (mm/m°C)

The Expansion Coefficient

α indicates the elongation of a 1m pipe under a temperature increase of 1°C

Medium thermal expansion coefficient for PP-R pipelines :

$$\alpha = 0.15 \text{ mm/m}^\circ\text{C}$$

Example

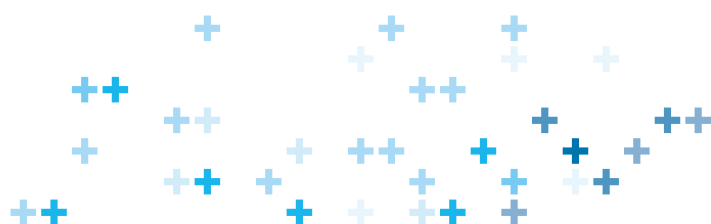
Changes in length for PP-R pipe:

$L = 5 \text{ m}$

$\Delta T = 50^\circ\text{C}$

$\alpha = 0.15 \text{ mm/m}^\circ\text{C}$

$$\begin{aligned} L &= 5 \times 50 \times 0.15 \\ &= 37.5 \text{ mm} \end{aligned}$$



Position of The Flexible Arms

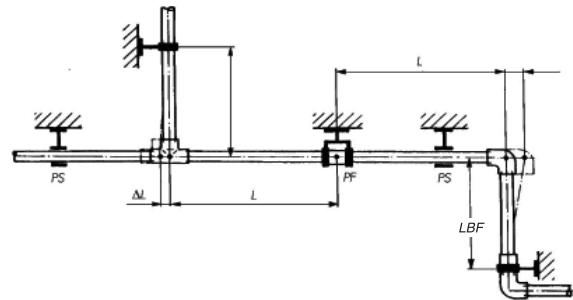
The low modules of elasticity of thermoplastics allows changes in length to be absorbed by special pipe sections where pipe supports are positioned so that they can take advantage of the natural flexibility of the material.

The length of such sections is determined by the diameter of the pipeline and the extent of the thermal expansion to be compensated.

In order to simplify design and installation, the temperature of the pipe wall, a third factor, will not be taken into account, especially since most pipes are installed in an environment with ambient temperature in the range of 5 to 30°C.

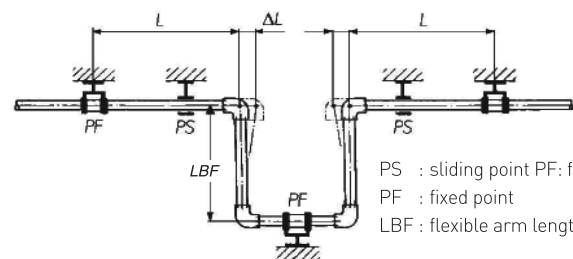
Arrangement of fixed point support clamps (PF)

Fixed points direct thermal expansion of the pipe in the desired direction. Fixed points should always be installed at the fitting and should support it on both sides or be installed in between two fittings.



Sliding support clamps (PS)

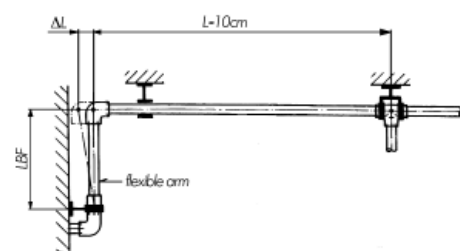
Sliding fasteners allow an axial movement of the pipe. The clamp must be in line with the pipe. Sliding clamps must be lined with rubber inserts suitable for plastic pipe movement to avoid pipe damage.



PS : sliding point PF: fixed point
PF : fixed point
LBF : flexible arm length

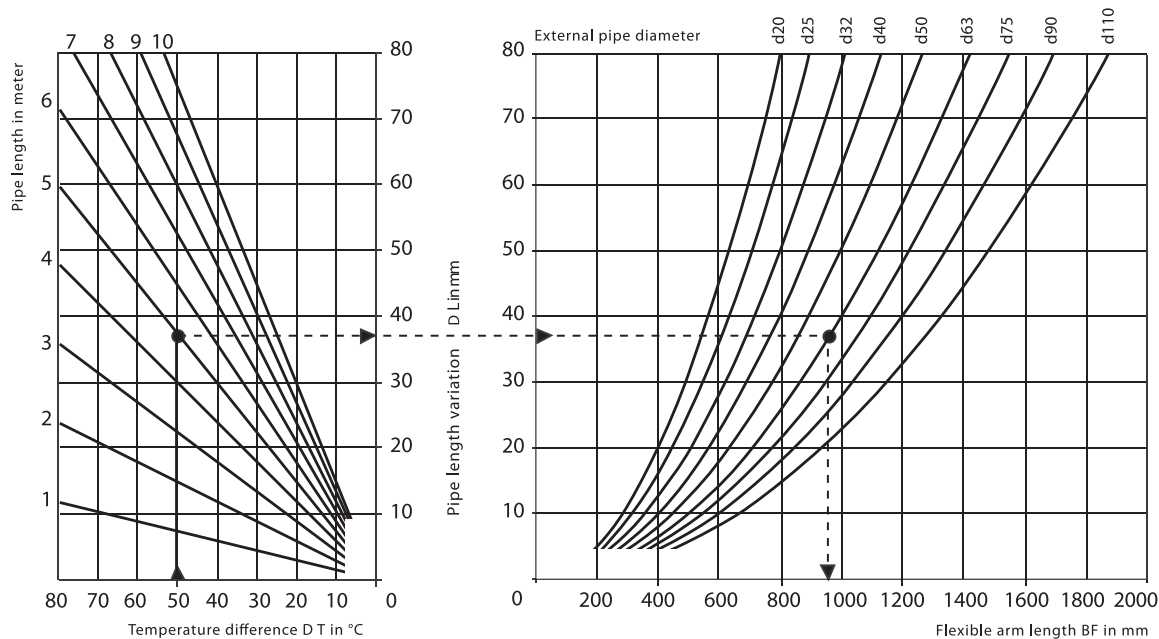
Example for the assessment of the flexible arm

Data: $L = 10 \text{ m}$
 $d = 50 \text{ mm}$
 $T_{\text{installation}} = 15 \text{ }^{\circ}\text{C}$
 $T_{\text{max operation}} = 80 \text{ }^{\circ}\text{C}$
 $\Delta L = 0,15 \cdot 10 \cdot 65 = 97,5 \text{ mm}$



Position of The Flexible Arms

Assessment of the flexible arm for PP-R pipe



$$L_{BF} = C \times \sqrt{\Delta L \times d_e}$$

L_{BF} = flexible arms length
 C = constant PP-R = 20
 ΔL = change in length (mm)
 d_e = outer pipe diameter

Example

What is the flexible arms length if the expansion ΔL is 37 mm on a d63 pipe?

$$L_{BF} = 20 \times \sqrt{37 \times 63} = 966\text{mm}$$



Insulation & Thermal Conductivity

AQUASYSTEM PP-R for Polypropylene - Random (PP-R) pipes and fittings are designed to have low thermal conductivity. Generally it would not be required to install thermal insulations for concealed or exposed pipes and fittings within an enclosed environment. However insulation may be needed, depending on the countries regulations, warm or cold application or that of energy-saving requirement. Insulation guidelines, as per DIN 1988, depends on the respective installation; the use of hot or cold water and the wall thickness.

Thermal conductivity

There is a time-dependent transfer of heat (Q) between two points of a body which have different temperatures. Considering a wall of cross-sectional area A and thickness e, the heat conducted from one side to the other is directly proportional to the (maintained) temperature difference between the sides, to the area A and to the time t, It is inversely proportional to the thickness e:

$$Q = \lambda \cdot A \cdot t \cdot \Delta T / e$$

The constant of proportionality k depends on the wall's material and is called its coefficient of thermal conductivity.

$$[\lambda] = W / (m \cdot K) = Wm^{-1} K^{-1}$$

W = watt, m = meter, K = Kelvin (= °C)

Substance	Coefficient of thermal conductivity (Wm ⁻¹ K ⁻¹)
Foam Plastics	0.02 - 0.05
PVC-U	0.16
PVC-C	0.17
PP	0.22
PE-HD	0.41
Copper	400
Water	0.61
Air	0.023

Cold Water

Type of Installation	Guidelines value for minimum thickness of insulation for cold water system A= 0.040 w/mK
Exposed installed Pipe in a unheated room (e.g cellar)	4 mm
Exposed installed Pipe in a heated room	9 mm
Pipes installed in a channel without additional heated pipelines	4 mm
Pipes installed in a channel besides additional heated pipelines	13 mm
Pipes installed in building slit / Raising main	4 mm
Pipes installed in wall recess next to heated pipelines	13 mm
Pipes laid on cement floor	4 mm

The insulation thickness, applied to a diameter of d = 20mm, for other coefficients of thermal conductivity have to be calculated correspondingly. (DIN 1988 PART 2)

Thermal Conductivity for Hot Water

Based on 60°C water temperature and environment temperature of 30°C per meter (unit in J/s)

Dimension		20	25	32	40	50	63	75	90	110	125	160
Material	PP-R S2.5	99.84	101.31	100.75	101.69	102.82	108.62	102.31	102.31	102.54		
	PP-R S3.2	126.29	126.29	129.00	129.00	128.45	130.11	129.19	129.93	129.26	129.73	129.70

- Calculation is not considered the friction factor, head loss and any other factor that could effect on the fluid temperature. Calculation is based on steady state condition
- Theoretical value may differ from the actual condition

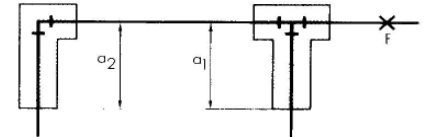
Installation Recommendations

Direct embedding of PP-R pipes

PP-R pipes can be embedded directly in concrete. The pipes can withstand the additional axial strains, which occur due to impeded expansion. In such cases, the stress present in the pipe and fittings must be calculated to prevent too high internal stress. It is important to prevent any exposed pipes when the pipe is covered with mortar.

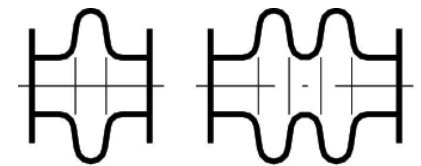
Indirect embedding of PP-R pipes

Where pipework is installed under plaster or embedded into concrete, the flexible sections at bends and branches must be padded for the calculated distance a , as also the branches and elbows in the affected section



Installing compensators

The low modulus of elasticity means that the reaction force of plastic pipes to thermal changes is low compared to metal pipes. This makes normal compensators designed for use with metal pipes unsuitable because of their high inherent resistance. Only freely moving compensators may be considered: rubber compensators, PTFE-corrugated compensators or suitable selected metal multi-disc compensators.



Pipes brackets

Plastic pipes need regularly space support (see blow table), the bracket distance depends on many factors such as temperature, pressure, diameter and material. In every case, the inner diameter of the support must be greater than the external diameter of the pipe, so as to permit pipe movement due to pipe expansion.



PP-R PN28/PN22/PN14 Bracket Spacing

distance between two brackets in cm

d (mm)	PN10 / PN14	PN16 / PN22		PN20 / PN28	
	20°C	30°C	40°C	50°C	60°C
20	75	75	70	65	60
25	85	85	85	80	75
32	100	100	95	90	85
40	110	110	105	100	95
50	130	125	115	110	105
63	150	145	140	125	120
75	170	165	160	150	145
90	180	175	170	165	160
110	190	185	175	170	165
125	195	205	170	-	-
160	210	210	180	-	-

Socket Fusion Installation



1

Fix heating bushes

Attach the heating bushes on the heating tool. A maximum of two sets of bushes can be attached at the same time.



2

Clean the heating tools

The heating elements must be cleaned with lint free cloth before switch ON the machine. There must no residues of cloth fibre on the heating bushes.



3

Check the temperature

Once the socket fusion machine is turned on, set the temperature on the electronic display which must range between 255°C and 265°C. To ensure correct temperature, regular calibration is recommended.



4

Cut the pipe

Cut the pipe at right angle; if necessary, remove burrs from inside and cut deformed or damaged pipe ends of 5 cm.



5

Bevelling of the pipe end

The pipe end must be bevelled according to Figure 1 & Table 1. Use of chamfering tool is recommended.



6

Clean pipe and fitting

Use of Tangit KS cleaner and lint free cloth is recommended to remove any swarf without direct hand touching the joint surfaces. Clean the socket of the fittings on the inside and the outer wall of the pipe (the presence of dust, grease or other impurities can affect the fusion quality and lead to weak jointing).



7

Mark the pipe

The insertion depth must then be marked on the pipe end at distance specified in table 1, or use of marking plate is recommended. The mark must remain visible under heating & jointing.



8

Heat pipe and fitting

Push the pipe and the fitting straight into the heating bushes. Pull out the pipe and fitting slowly and without twisting once the heating time has elapsed.



9

Joint pipe and fitting

Push the pipe into the fitting so that welding beads of pipe and fitting touch together. During the jointing time, small adjustments in angle and alignment can be made. During the cooling time, hold the pipe and fitting in position according to 'Summary value table', any stress on the joint must be avoided.



10

Fusion inspection

The outer fusion bead must be inspected. A double bead must be uninterrupted all around the pipe circumference.

Summary value table

Pipe diameter (mm)	Insertion depth (mm)	Heating time (sec.)	Jointing time (sec.)	Cooling fixed (sec.)	Cooling time (min.)
20	14	6 (5 sec. for PN10)	4	6	2
25	16	7	4	6	3
32	18	8	6	10	4
40	20	12	6	10	4
50	23	18	6	20	5
63	26	25	8	20	6
75	28	30	8	30	8
90	31	40	10	30	8
110	33	50	10	40	8
125	40	60	10	50	8

Figure 1. Beveling of the pipe and insertion depth of various pipe dimensions

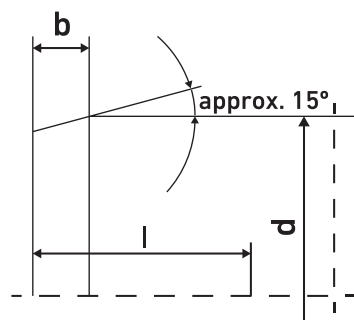


Table 1: Pipe dimension and pipe bevel

Pipe outside diameter d (mm)	Pipe level b (mm)
16	2
20	
25	
32	
40	
50	3
63	
75	
90	
110	
125	

Butt Fusion Installation

Butt Fusion Jointing of PP Piping Systems

Butt fusion jointing method

The fusion areas of the pipes and fittings are heated to fusion temperature and joined by means of mechanical pressure, without using additional tools. A homogeneous joint results. Butt fusion must only be carried out with fusion jointing machines which allow the jointing pressure to be regulated. Details of the requirements for machines and equipment used for butt fusion jointing thermoplastics are contained in DVS 2208 Part 1. The drawing to the left illustrates the principle of fusion jointing.

General requirements

The basic rule is that only similar materials can be fusion jointed. For best results, only components which have a melt flow index in the range from MFR 190/5 0.4 to 1.0 g/10 min should be fusion jointed. This requirement is met by PP butt fusion fittings from GF.

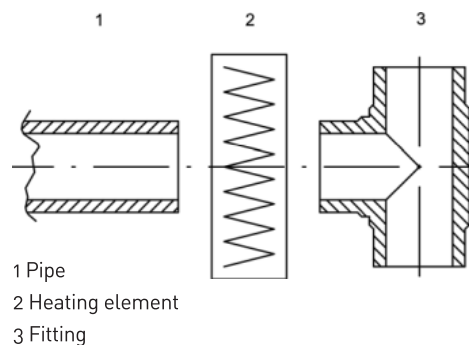
The components to be jointed must have the same wall thicknesses at the fusion area. Butt fusion jointing may only be performed by adequately trained personnel.

Check the temperature

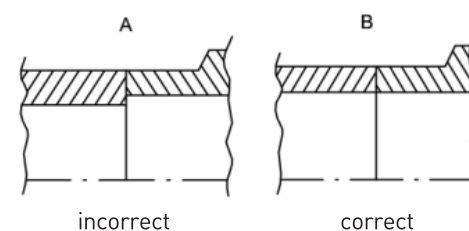
Recommended temperature of heating element between 200°C to 220°C. Check temperature before commencing the fusion jointing, this is best carried out with the use of a digital thermometer with a sensor for measuring surface temperature.

To ensure the right temperature setting should be checked from time to time during the jointing work. The temperature of the heating element is particularly sensitive to ambient temperature and drafts.

The principle of fusion jointing



Join only components with similar wall thicknesses



Butt Fusion Installation

Fusion jointing procedure

Once it has attained the fusion temperature, position the heating element in the fusion jointing machine. Press the surfaces to be jointed against the heating element with the force required for equalisation until the entire circumference of each of the jointing faces rests completely against it and a bead (see the table) has formed. Reduce the equalisation pressure almost to 0 ($p \approx 0.01 \text{ N/mm}^2$). The heating time listed in the table is measured from this moment.

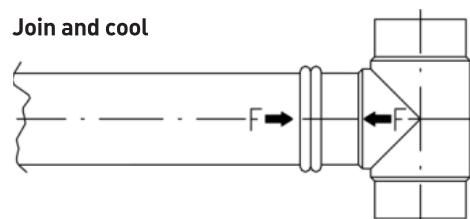
Once the heating period has elapsed, remove the parts from the heating element which should then be removed without touching the jointing surfaces and push the heated surfaces together immediately. The changeover time must not exceed the value listed in the table. Pay particular attention during jointing that the parts be moved together swiftly until the surfaces are about to touch. Then they should be moved together so that they are in contact along the entire circumference. Next the pressure should be increased rapidly to the present jointing pressure within the period of time specified in the table. This pressure must be maintained during the entire cooling period. Adjustment may be necessary, especially shortly after the jointing pressure has been attained.

The jointed parts must stay in the fusion jointing machine under jointing pressure until the end of the cooling period specified in the table.

Carrying out the pressure test

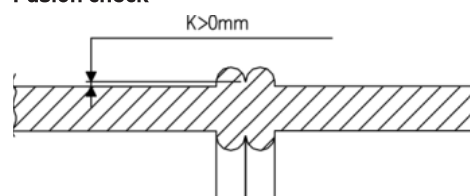
All fusion joints must be allowed to naturally cooled completely before pressure testing, i.e. as a rule wait about 1 hour after the last joint has been completed.

Join and cool



Leave parts in the fusion jointing machine at fusion pressure until the end of the cooling period!

Fusion check



A bead should form around the entire circumference of the pipe. K in the diagram to the left should always be positive.

Approximate values for Butt Fusion of PP₁

Wall thickness (mm)	Equalisation at $p=0.10 \text{ N/mm}^2$ Height of bead (mm)	Heating time ²⁾ $p=0.01 \text{ N/mm}^2$ (sec)	Changeover time max. (sec)	Time to reach full jointing (sec)	Cooling time ²⁾ under jointing $p=0.10 \text{ N/mm}^2$ (min)
up to 4.5	0.5	up to 135	5	6	6
4.5 - 7	0.5	135 - 175	5 - 6	6 - 7	6 - 12
7 - 12	1.0	175 - 245	6 - 7	7 - 11	12 - 20
12 - 19	1.0	245 - 330	7 - 9	11 - 17	20 - 30
19 - 26	1.5	330 - 400	9 - 11	17 - 22	30 - 40
26 - 37	2.0	400 - 485	11 - 14	22 - 32	40 - 55

- For exact welding value please refer to our technical support team.
- In accordance with DVS 2207-11

Local support around the world

Visit our webpage to get in touch with your local specialist:

www.gfps.com/our-locations



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