

REPOLEN

TECHNICAL MANUAL
2024 PPR


REPOLEN

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COMPANY



REBOCA, SL is a company with 100% Spanish capital, founded in 1981, whose main activity was initially the recovery and recycling of plastic materials.

After a period of time, the company began to diversify its product range, entering the market of drip irrigation pipes and fittings. Gradually, the range of fittings was expanded, until in 1985, REBOCA, SL started manufacturing pipes for pressurized water conveyance.

This represented significant growth for the company, as customer service was no longer limited solely to pipes, but also extended to all the fittings required for the assembly of installations, both for irrigation systems and pressurized water systems.

At the same time as the company grew in this direction, it discontinued the recovery and recycling of materials in order to focus its efforts entirely on pipe manufacturing.

In 1992, the REPOLEN product range made of random polypropylene (PP-R) was incorporated into our catalogue, including pipes and fittings for the conveyance of cold and hot pressurized water, for heating, cooling, DHW (ACS), sanitary water and drinking water systems.

In 1994, a complete line of high-density polyethylene (PE-100) pipes and fittings was also added for cold pressurized water conveyance, sanitary and drinking water, recycled water, gas and hydrocarbons, joined by polyfusion using the socket system, thus achieving a complete range of products that are easy to install and use the same jointing technique, allowing the installation offer to be fully completed.

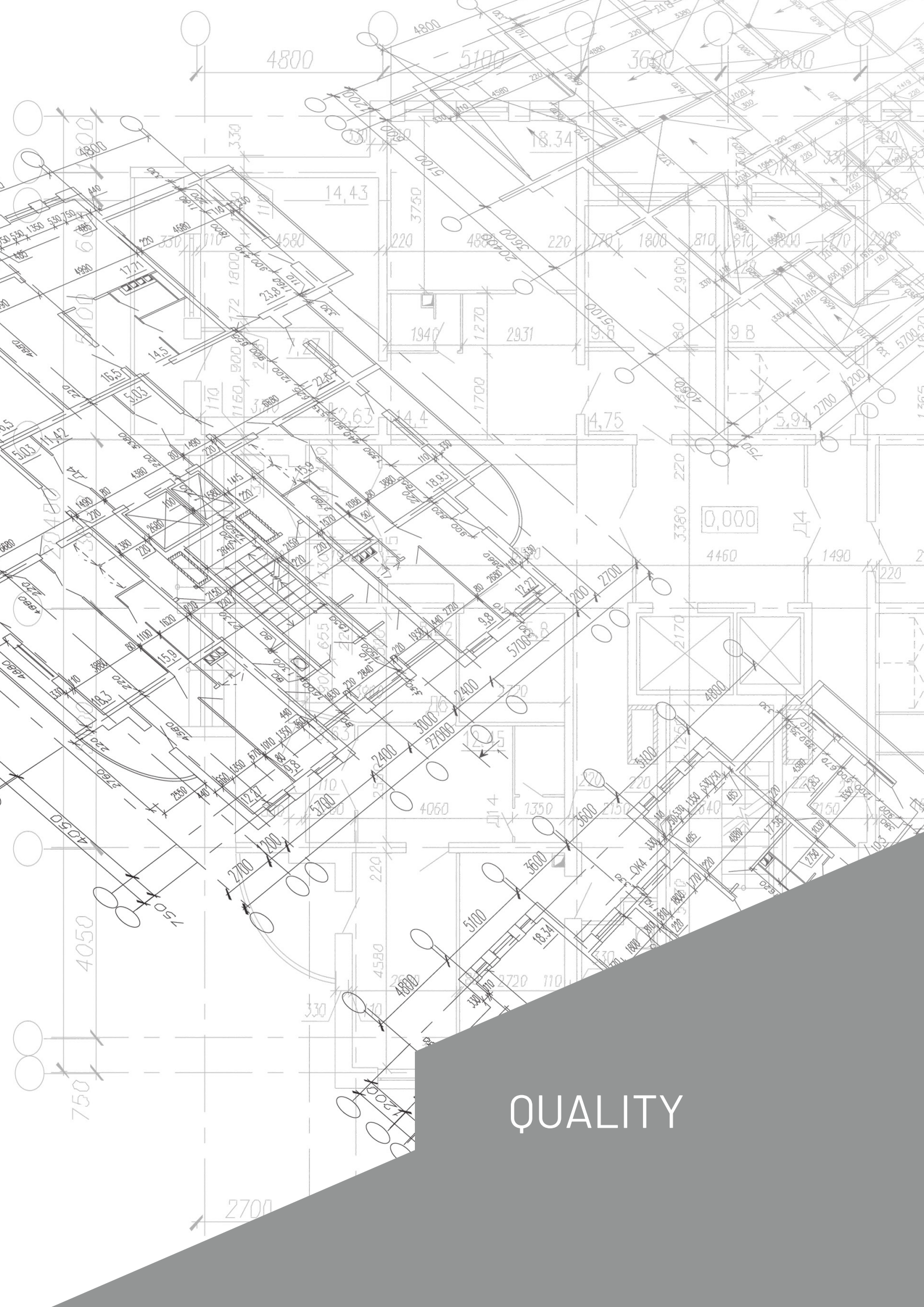
From then until now, REBOCA, S.L. has been engaged in the manufacture of PE-32 and PE-40 pipes for irrigation and pressure, PE-100 pipes for cold pressurized water, and PP-R pipes for cold and hot pressurized water, as well as the necessary fittings.

- In January 2001, the company obtained the Company Registration Certification according to UNE-EN ISO 9001 issued by AENOR. At the end of March of the same year, the AENOR N Mark was granted for the manufacture of PP-R pipes produced at our facilities in L'Ollería (Valencia).
- In December of the same year, the AENOR N Mark was granted for the manufacture of PE-100 pipes.
- In June 2002, the AENOR N Mark was granted for PE-40 and PE-32 pipes for micro-irrigation.
- In 2007, PP-R fittings were certified.
- In 2009, the REPOLEN PP-R system was certified.
- In 2010, DNV certification was obtained for PE-100 and PP-R, as well as the AENOR N Mark for PE-100 and PP-R manifolds and collectors.
- In 2011, the AENOR N Mark was obtained for PE-100 gas pipes.
- In 2013, the AENOR N Mark certification was obtained for PE-RT pipes (temperature-resistant polyethylene) for heating water and underfloor heating systems.
- In 2015, certification was obtained for the FASER multilayer pipe (PP-R / PP-R with glass fiber / PP-R) for hot pressurized water, cooling and DHW (ACS).

Currently, and by exclusive decision of REBOCA, S.L., under commercial criteria, the following certifications are maintained:

- PP-R Pipes
- PP-R Fittings
- REPOLEN PP-R System
- PE-100 Pipes for Water
- PE-100 Pipes for Gas
- PE-40 Pipes
- FASER Multilayer Pipes

One of the main concerns of REBOCA, S.L. has been and continues to be to offer our customers products of the highest quality. To this end, we have continuously adapted our facilities and product catalogue to meet their needs.



QUALITY

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02.I APPLICATION STANDARDS

UNE EN 1555 Plastic piping systems for the supply of gaseous fuels. Polyethylene (PE)

UNE EN 12201 Plastic piping systems for water supply. Polyethylene (PE)

UNE EN ISO 15874 Plastic piping systems for hot and cold water installations. Polypropylene (PP)

UNE 53394 IN Plastics. Installation and handling code for polyethylene (PE) pipes for pressurized water conveyance.

UNE 53943 Plastic manifolds and collectors for centralized water metering. Polyethylene (PE) and polypropylene (PP) manifolds and meters with thermally welded joints.

RP 001.01 Regulations of the AENOR N Mark for polyethylene (PE) pipes for pressurized water supply and sewerage.

RP 001.52 Regulations of the AENOR N Mark for plastic piping systems for hot and cold water installations.

RP 001.72 Regulations of the AENOR conformity certificate for polypropylene (PP-R) and glass fiber (GF) piping systems for hot and cold water installations inside building structures.

RP 01.73 Regulations of the AENOR N Mark for polyethylene (PE) fittings for the supply of gaseous fuels.

02.II REFERENCE DOCUMENTS

CTE Building Technical Code.

RITE Regulation on Thermal Installations in Buildings.

ISO 9001 Quality Management Systems. Requirements.

ISO 14001 Environmental Management Systems. Requirements with guidance for use.

UNE 53943 Plastic manifolds and collectors for centralized water metering. Polyethylene (PE) and polypropylene (PP) manifolds and meters with thermally welded joints.

UNE 53959 IN Plastics. Pipes and fittings made of thermoplastic materials for the transport of pressurized liquids. Head loss calculation.

UNE EN 476 General requirements for components used in drainage pipelines, gullies and sewers for gravity systems.

UNE EN 752 Drainage and sewerage systems outside buildings.

UNE EN 805 Water supply: Specifications for networks outside buildings and their components.

UNE EN 806 Specifications for installations conveying water intended for human consumption inside buildings.

UNE EN 1295 Calculation of the mechanical strength of buried pipelines under different loading conditions

UNE EN 1610 Installation and testing of drains and sewer networks.

UNE EN 12666 Plastic piping systems for buried non-pressure drainage and sewerage. Polyethylene (PE).

UNE EN 13244 Plastic piping systems, buried or above ground, for general water supply and pressurized sewerage. Polyethylene (PE).

UNE EN 13476 Plastic piping systems for buried non-pressure drainage and sewerage. Structured-wall piping systems of unplasticized polyvinyl chloride (PVC-U), polypropylene (PP) and polyethylene (PE).

UNE EN 13689 Guidelines for the classification and design of plastic piping systems used in renovation.

UNE EN 14409 Plastic piping systems for the renovation of buried water supply networks.

UNE EN 50086 Conduit systems for cable management.

UNE EN ISO 15494 Plastic piping systems for industrial applications. Polybutylene (PB), polyethylene (PE) and polypropylene (PP). Specifications for components and the system. Metric series

UNE ENV 12108 Plastic piping systems. Recommended practice for installation within building structures of pressurized hot and cold water piping systems intended for human consumption.

Polyethylene Pipes. Technical Manual. ASETUB.

02.III QUALITY CONTROL LABORATORY

Equipment for Melt Flow Index Control.ç

Equipment for the Control of Glass Fiber Content, Ash Content, Carbon Black, etc.

Dimensional Control Equipment (internal and external calipers, circumference tape, micrometer, graduated magnifying glass).

Equipment for Leak Tightness Control.

Equipment for Longitudinal Shrinkage Control.

Equipment for Resistance to Cracking Control.

Equipment for Tensile Testing Control.

Equipment for Impact Resistance Control.

Equipment for Internal Pressure Resistance Control.

02.VI CERTIFICATES

COMPANY CERTIFICATES



AENOR



IQNET

PRODUCT CERTIFICATES



AENOR THERMALLY WELDED PPR SYSTEM



AENOR PPR PIPES



AENOR PPR FITTINGS



AENOR PE 100 PIPES



AENOR GAS PIPES

PRODUCT CONFORMITY CERTIFICATES



AENOR FASER PIPES



WARRANTY

The REPOLEN® system used in hydrosanitary installations, in accordance with the guidelines set out in the Technical Manual, is covered by an insurance policy taken out by REBOCA, S.L. TRANSFORMADOS PLÁSTICOS with the company GROUPAMA; Policy No. 63.132.771, for an insured amount of 1,202,040 euros.

The conditions governing this warranty are:

- Send, within 10 days following the completion of the installation, the warranty receipt.
- Pipes and fittings must be installed in accordance with the instructions, warnings and recommendations contained in the REPOLEN® Technical Manual.
- Insurance coverage shall be 10 years from the production date marked on the pipe and fittings. Within this period, damages of up to 1,202,040 euros shall be compensated for damage to property or persons, caused by the failure of a REPOLEN® pipe or fitting due to manufacturing defects.

The warranty is not valid in the following cases:

- Joining of the pipe and fitting using a heat source with temperature and pressure limits, even if accidental, not compatible with the characteristics of the material used in the REPOLEN® system.
- Failure to comply with the instructions for use, warnings and recommendations indicated in the REPOLEN® Technical Manual.
- Use of clearly defective materials (pipes and fittings with cracks, etc.).
- Use, for the execution of the installation, of components not manufactured by REPOLEN® / REBOCA, S.L.
- Welding carried out incorrectly or defectively due to the use of unsuitable accessories.

Instructions for requesting warranty intervention:

In the event of damage attributable to the pipe or fitting, and only for the causes previously described, the customer must notify REBOCA, S.L. by registered letter, indicating the type of damage, and send the section of pipe or the damaged fitting, together with a copy of the Warranty Certificate, which must include:

- Place and date of the installation.
- Name and address of the installer.
- Pipe or fitting marking, preferably on the product itself or on the packaging.

After receipt of the above by our Company, within a reasonable period, our company will carry out the necessary procedures and forward the received documentation to the Insurance Company.

Any payment made by REBOCA, S.L. to carry out procedures with the Insurance Company shall be charged to the claimant if the causes of the failure are not covered under the warranty.



PPR

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MATERIAL PROPERTIES página 14

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04.I TYPES OF POLYPROPYLENES



Polypropylene is a polymer formed by monomeric propylene chains, with a high molecular weight, which provides it with excellent mechanical properties, making it suitable for both hot and cold water installations.

Depending on the type of monomers and their molecular arrangement, there are three types of polypropylene:

- **PP-H (homopolymer polypropylene)** Contains only propylene monomers. It is not suitable for drinking water, nor for cold pressurized water, and is therefore used for hot water conveyance, wastewater, industrial fluids, etc.
- **PP-B (block copolymer polypropylene)** Contains propylene and ethylene monomers arranged in blocks within the polymer chains. It has very high impact resistance, even at low temperatures, but limited pressure resistance. It is not suitable for drinking water. It is rarely used and mainly for drainage applications.
- **PP-R (random copolymer polypropylene)** Propylene and ethylene monomers are arranged randomly within the chains, providing very good mechanical properties, especially under pressure with or without temperature. It is suitable for drinking water.

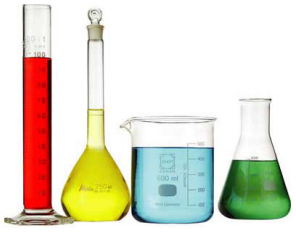
04.II PROPIEDADES FÍSICO-MECÁNICAS

REPOLEN® pipes and fittings are manufactured from Random Copolymer Polypropylene Type 3, a copolymer of propylene and ethylene with a very high molecular weight and a random arrangement of monomers, providing excellent mechanical resistance up to 100ºC and exceptional chemical resistance, making it the ideal system for the conveyance of food-grade liquids and other pressurized fluids at high temperature.

It also features high impact resistance, ensuring easy handling during installation and transport, even at temperatures below 0ºC.

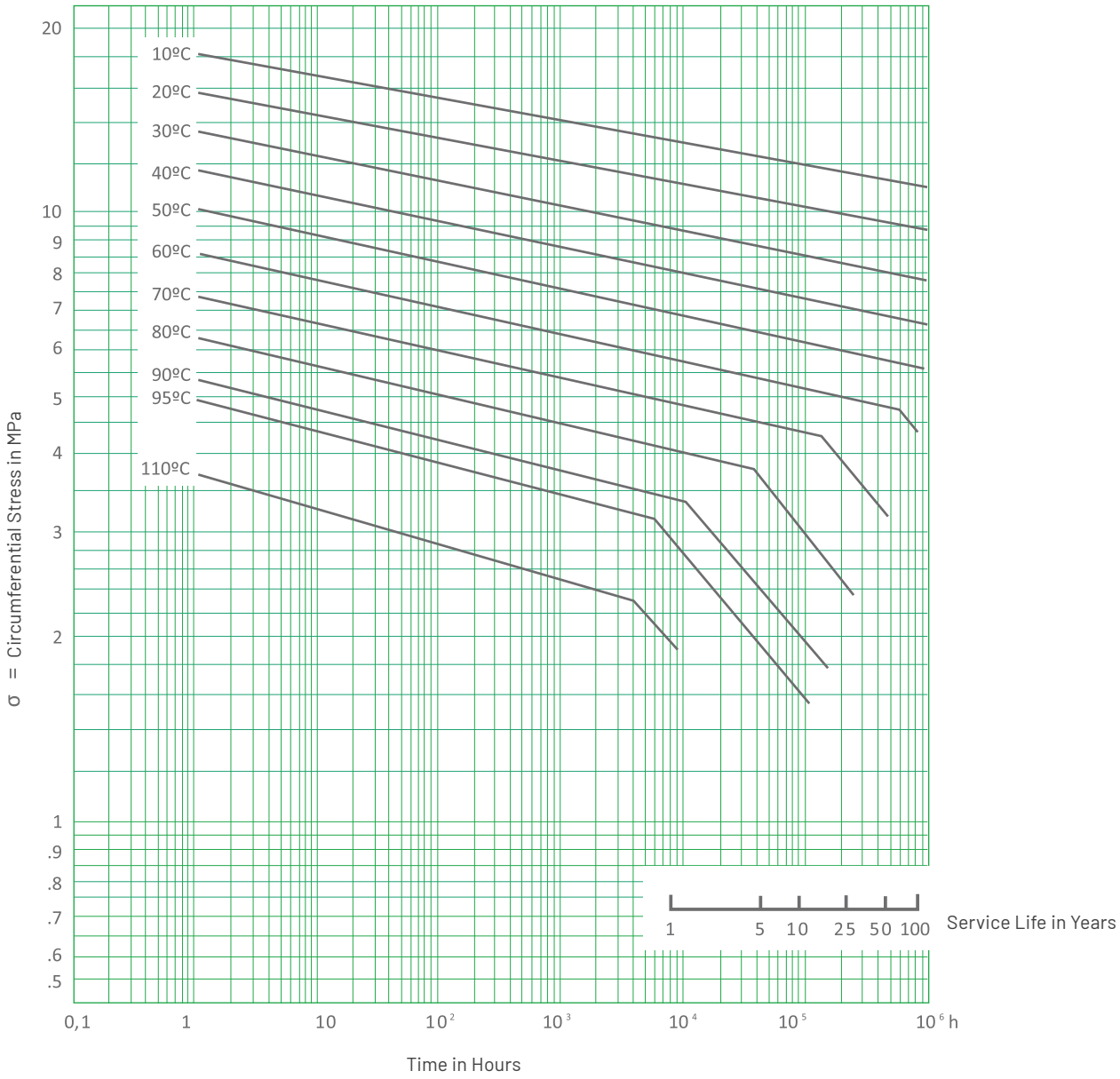
Melt Flow Index (230ºC; 2.16 kg)	0.3	g/10 min	ISO 1133
Melt Flow Index (230ºC; 5 kg)	1.2	g/10 min	ISO 1133
Density at 23ºC	905	Kg/m3	ISO 1183
Flexural Elastic Modulus	815	MPa	ISO 178
Notched Charpy Impact Resistance, 23ºC	> 9	kJ/m2	ISO 179
Tensile Strength at Yield Point	26	MPa	ISO 527-2
Tensile Strength at Break	27	MPa	ISO 527-2
Elongation at Break	> 520	%	ISO 527-2
VICAT, 9.8 N	70	ºC	ISO 306
HDT 0.45 MPa	45	ºC	ISO 75
Long-Term Hydrostatic Strength at 50 years and 20ºC (97.5 % LCL), MRS	> 8.0	MPa	ISO TR 9080
Fire Classification. Multilayer FASER Pipe. Halogen-Free	B2	-	DIN 4102

04.III CHEMICAL RESISTANCE



Chemical resistance can be described as the process by which a material exhibits high durability when exposed to chemical products; that is, such resistance is the ability of a material to withstand the harmful effects of corrosive substances. Due to the nature of PP, pipes manufactured from this material display very high chemical resistance properties, being resistant to both acids and alkalis, as well as to a large number of industrial substances. Further information on the chemical resistance of our products can be found in 09. ANNEXES (page 70).

04.IV REGRESSION CURVES





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PRODUCT RANGE page 18

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TUBERÍA REPOLEN PP-R
REPOLEN PP-R PIPE
TUYAU REPOLEN PP-R

SERIE 2,5 - SDR6



S - SDR	code	d (mm)	di (mm)	e (mm)	capacidad (L/Mts.) capacity (L/Mts.)	peso (kg/m) weight (kg/m)
S 2,5 - SDR 6	400000001	16	10,6	2,7	0,088	0,108
	400000003	20	13,2	3,4	0,137	0,165
	400000006	25	16,6	4,2	0,216	0,255
	400000005	32	21,2	5,4	0,353	0,420
	400000004	40	26,6	6,7	0,556	0,640
	400000009	50	33,4	8,3	0,876	0,985
	400000010	63	42,0	10,5	1,385	1,675
	400000011	75	50,0	12,5	1,963	2,200
	400000012	90	60,0	15	2,827	3,225
	400000013	110	73,4	18,3	4,231	4,800
	* 400000014	125	83,4	20,8	5,463	6,200

TUBERÍA REPOLEN PP-R
REPOLEN PP-R PIPE
TUYAU REPOLEN PP-R

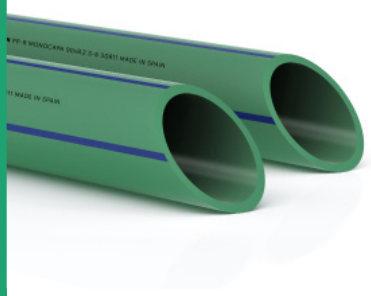
SERIE 3,2 - SDR7,4



S - SDR	code	d (mm)	di (mm)	e (mm)	capacidad (L/Mts.) capacity (L/Mts.)	peso (kg/m) weight (kg/m)
S 3,2 - SDR 7,4	420000001	16	11,6	2,2	0,106	0,091
	420000003	20	14,4	2,8	0,163	0,145
	420000006	25	18,0	3,5	0,254	0,225
	420000005	32	23,2	4,4	0,423	0,360
	420000004	40	29,0	5,5	0,661	0,555
	420000009	50	36,2	6,9	1,029	0,875
	420000010	63	45,8	8,6	1,647	1,355
	* 420000011	75	54,4	10,3	2,324	1,915
	* 420000012	90	65,4	12,3	3,359	2,765
	* 420000013	110	79,8	15,1	5,001	4,105

TUBERÍA REPOLEN PP-R
REPOLEN PP-R PIPE
TUYAU REPOLEN PP-R

SERIE 5 - SDR11



S - SDR	code	d (mm)	di (mm)	e (mm)	capacidad (L/Mts.) capacity (L/Mts.)	peso (kg/m) weight (kg/m)
S 5 - SDR 11	440000003	20	16,2	1,9	0,206	0,105
	440000006	25	20,4	2,3	0,327	0,165
	440000005	32	26,2	2,9	0,539	0,260
	440000004	40	32,6	3,7	0,835	0,410
	440000009	50	40,8	4,6	1,307	0,620
	440000010	63	51,4	5,8	2,075	0,980
	440000011	75	61,4	6,8	2,961	1,340
	440000012	90	73,6	8,2	4,254	2,000
	440000013	110	90,0	10,0	6,362	2,900
	440000014	125	102,2	11,4	8,203	3,800
	440000016	160	130,8	14,6	13,437	6,300

RELACIÓN DE PRESIONES DE TRABAJO ADMISIBLES PARA
CIRCUITOS ABIERTOS EN TUBOS REPOLEN PPR MONOCAPA
RELATIONSHIP OF WORK PRESSURES ADMISSIBLE FOR
OPEN CIRCUITS IN PIPES REPOLEN PPR MONOLAYER

TEMPERATURA	VÍDA UTIL DE SERVICIO	REPOLEN PPR SERIE 5 - SDR 11		REPOLEN PPR SERIE 3,2 - SDR 7,4		REPOLEN PPR SERIE 2,5 - SDR 6	
TEMPERATURE	UTILITY SERVICE LIFE	BAR	PSI	BAR	PSI	BAR	PSI
10 ºC	1	17,50	253,75	27,80	403,10	35,10	508,95
	5	16,50	239,25	26,20	379,90	33,00	478,50
	10	16,10	233,45	25,60	371,20	32,20	466,90
	25	15,60	226,20	24,70	358,15	31,10	450,95
	50	15,20	220,40	24,10	349,45	30,30	439,35
	100	14,80	214,60	23,50	340,75	29,60	429,20
20 ºC	1	15,00	217,50	23,70	343,65	29,90	433,55
	5	14,10	204,45	22,30	323,35	28,10	407,45
	10	13,70	198,65	21,70	314,65	27,40	397,30
	25	13,20	191,40	21,00	304,50	26,40	382,80
	50	12,90	187,05	20,40	295,80	25,70	372,65
	100	12,50	181,25	19,90	288,55	25,00	362,50
30 ºC	1	12,70	184,15	20,20	292,90	25,40	368,30
	5	11,90	172,55	18,90	274,05	23,80	345,10
	10	11,60	168,20	18,40	266,80	23,20	336,40
	25	11,20	162,40	17,70	256,65	22,30	323,35
	50	10,90	158,05	17,20	249,40	21,70	314,65
	100	10,60	153,70	16,80	243,60	21,10	305,95
40 ºC	1	10,80	156,60	17,10	247,95	21,60	313,20
	5	10,10	146,45	16,00	232,00	20,20	292,90
	10	9,80	142,10	15,50	224,75	19,60	284,20
	25	9,40	136,30	15,00	217,50	18,80	272,60
	50	9,20	133,40	14,50	210,25	18,30	265,35
	100	8,90	129,05	14,10	204,45	17,80	258,10
50 ºC	1	9,10	131,95	14,50	210,25	18,20	263,90
	5	8,50	123,25	13,50	195,75	17,00	246,50
	10	8,20	118,90	13,10	189,95	16,50	239,25
	25	7,90	114,55	12,60	182,70	15,90	230,55
	50	7,70	111,65	12,20	176,90	15,40	223,30
	100	7,50	108,75	11,80	171,10	14,90	216,05
60 ºC	1	7,70	111,65	12,20	176,90	15,40	223,30
	5	7,10	102,95	11,30	163,85	14,30	207,35
	10	6,90	100,05	11,00	159,50	13,90	201,55
	25	6,60	95,70	10,50	152,25	13,30	192,85
	50	6,40	92,80	10,20	147,90	12,90	187,05
70 ºC	1	6,50	94,25	10,30	149,35	12,90	187,05
	5	6,00	87,00	9,50	137,75	12,00	174,00
	10	5,80	84,10	9,20	133,40	11,60	168,20
	25	5,00	72,50	8,00	116,00	10,00	145,00
	50	4,20	60,90	6,70	97,15	8,50	123,25
80 ºC	1	5,40	78,30	8,60	124,70	10,80	156,60
	5	4,80	69,60	7,60	110,20	9,60	139,20
	10	4,00	58,00	6,40	92,80	8,10	117,45
	25	3,20	46,40	5,10	73,95	6,50	94,25
95 ºC	1	3,80	55,10	6,10	88,45	7,60	110,20
	5	2,60	37,70	4,10	59,45	5,20	75,40

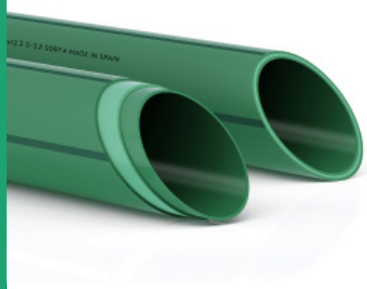
CIRCUITO ABIERTO: Factor de Seguridad aplicado según Normas UNE EN 15874 y DIN 8077 (SF=1,50)
OPEN CIRCUIT: Safety Factor applied according to UNE EN 15874 and DIN 8077 Standards (SF=1,50)
1bar=14,5psi

TUBERÍA REPOLEN FASER

FASER REPOLEN PIPE

TUYAU REPOLEN FASER

SERIE 3,2 - SDR7,4



S - SDR	code	d (mm)	di (mm)	e (mm)	capacidad (L/Mts.) / capacity (L/Mts.)	peso (kg/m) / weight (kg/m)
S 3,2 - SDR 7,4	430000003	20	14,4	2,8	0,163	0,150
	430000006	25	18,0	3,5	0,254	0,230
	430000005	32	23,2	4,4	0,423	0,370
	430000004	40	29,0	5,5	0,661	0,565
	430000009	50	36,2	6,9	1,029	0,890
	430000010	63	45,8	8,6	1,647	1,375
	430000011	75	54,4	10,3	2,324	1,960
	430000012	90	65,4	12,3	3,359	2,800
	* 430000013	110	79,8	15,1	5,001	4,205
	* 430000014	125	90,8	17,1	6,475	5,500
	* 430000016	160	116,2	21,9	10,605	8,750

TUBERÍA REPOLEN FASER RP

FASER RP REPOLEN PIPE

TUYAU REPOLEN FASER RP

SERIE 3,2 - SDR7,4
SERIE 4 - SDR 9



S - SDR	code	d (mm)	di (mm)	e (mm)	capacidad (L/Mts.) / capacity (L/Mts.)	peso (kg/m) / weight (kg/m)
3,2 - 7,4	430200003	20	14,4	2,8	0,163	0,150
	430200006	25	18	3,5	0,254	0,230
S 4 - SDR 9	430200005	32	24,8	3,6	0,483	0,320
	430200004	40	31	4,5	0,755	0,490
	430200009	50	38,8	5,6	1,182	0,765
	430200010	63	48,8	7,1	1,87	1,235
	430200011	75	58,2	8,4	2,66	1,695
	430200012	90	69,8	10,1	3,826	2,425
	430200013	110	85,4	12,3	5,728	3,555
	430200014	125	97	14	7,39	4,565
	430200016	160	124,2	17,9	12,115	7,255

TUBERIA REPOLEN FASER CLIMA UV

FASER CLIMA UV REPOLEN PIPE

TUYAU REPOLEN FASER CLIMA UV

SERIE 5 - SDR 11



S - SDR	code	d (mm)	di (mm)	e (mm)	capacidad (L/Mts.) / capacity (L/Mts.)	peso (kg/m) / weight (kg/m)
S 5 - SDR 11	430400005	32	26,2	2,9	0,539	0,270
	430400004	40	32,6	3,7	0,835	0,420
	430400009	50	40,8	4,6	1,307	0,645
	430400010	63	51,4	5,8	2,075	1,020
	430400011	75	61,4	6,8	2,961	1,390
	430400012	90	73,6	8,2	4,254	2,050
	430400013	110	90	10	6,362	3,030
	430400014	125	102,2	11,4	8,203	3,900
	430400016	160	130,8	14,6	13,437	6,430

RELACIÓN DE PRESIONES DE TRABAJO ADMISIBLES PARA
CIRCUITOS ABIERTOS EN TUBOS REPOLEN FASER PPR
RELATIONSHIP OF WORK PRESSURES ADMISSIBLE FOR
OPEN CIRCUITS IN PIPES REPOLEN FASER PPR

TEMPERATURA	VÍDA UTIL DE SERVICIO	REPOLEN FASER CLIMA SERIE 5 - SDR 11		REPOLEN FASER SERIE 3.2 - SDR 7.4	
TEMPERATURE	UTILITY SERVICE LIFE	BAR	PSI	BAR	PSI
10 ºC	1	21,90	317,55	27,80	403,10
	5	20,70	300,15	26,40	382,80
	10	20,20	292,90	25,50	369,75
	25	19,20	282,75	24,70	358,15
	50	19,00	275,50	24,00	348,00
20 ºC	1	18,80	272,60	23,80	345,10
	5	17,70	256,65	22,30	323,35
	10	17,20	249,40	21,70	314,65
	25	16,60	240,70	21,10	305,95
	50	16,20	234,90	20,40	295,80
30 ºC	1	16,00	232,00	20,20	292,90
	5	15,00	217,50	19,00	275,50
	10	14,60	211,70	18,30	265,35
	25	14,10	204,45	17,70	256,65
	50	13,70	198,65	17,30	250,85
40 ºC	1	13,60	197,20	17,10	247,95
	5	12,80	185,60	16,00	232,00
	10	12,40	179,80	15,60	226,20
	25	11,90	172,55	15,00	217,50
	50	11,60	168,20	14,50	210,25
50 ºC	1	11,60	168,20	14,50	210,25
	5	10,80	156,60	13,50	195,75
	10	10,50	152,25	13,10	189,95
	25	10,10	146,45	12,60	182,70
	50	9,80	142,10	12,20	176,90
60 ºC	1	9,80	142,10	12,20	176,90
	5	9,10	131,95	11,60	168,20
	10	8,80	127,60	11,00	159,50
	25	8,50	123,25	10,50	152,25
	50	8,20	118,90	10,10	146,45
70 ºC	1	8,30	120,35	10,30	149,35
	5	7,70	111,65	9,50	137,75
	10	7,40	107,30	9,30	134,85
	25	6,90	100,05	8,00	116,00
	50	6,30	91,35	6,70	97,15
80 ºC	1	6,80	98,60	8,60	124,70
	5	6,00	87,00	7,60	110,20
	10	5,20	75,40	6,30	91,35
	25	4,10	59,45	5,10	73,95
95 ºC	1	3,80	55,10	6,10	88,45
	5	2,60	37,70	4,00	58,00

CIRCUITO ABIERTO: Factor de Seguridad aplicado según Normas UNE EN 15874 y DIN 8077 (SF=1,50)
OPEN CIRCUIT: Safety Factor applied according to UNE EN 15874 and DIN 8077 Standards (SF=1,50)
1bar=14,5psi

RELACIÓN DE PRESIONES DE TRABAJO ADMISIBLES PARA
CIRCUITOS ABIERTOS EN TUBOS REPOLEN FASER RP
RELATIONSHIP OF WORK PRESSURES ADMISSIBLE FOR
OPEN CIRCUITS IN PIPES REPOLEN FASER RP

TEMPERATURA	VÍDA UTIL DE SERVICIO	REPOLEN FASER RP CLIMA SERIE 8 - SDR 17		REPOLEN FASER RP CLIMA SERIE5 - SDR11		REPOLEN FASER RP SERIE 4 - SDR 9	
TEMPERATURE	UTILITY SERVICE LIFE	BAR	PSI	BAR	PSI	BAR	PSI
10 °C	1	13,10	189,97	20,74	300,79	26,20	379,95
	5	12,67	183,67	20,09	291,35	25,33	367,35
	10	12,56	182,16	19,88	288,28	25,02	362,73
	25	12,31	178,43	19,49	282,65	24,50	355,29
	50	12,09	175,27	19,28	279,49	24,18	350,55
	100	11,99	173,86	18,97	275,01	23,87	346,13
20 °C	1	11,39	165,16	18,18	263,61	22,89	331,90
	5	11,06	160,36	17,52	254,04	22,12	320,73
	10	10,92	158,38	17,26	250,25	21,74	315,18
	25	10,68	154,89	16,90	244,98	21,36	309,78
	50	10,47	151,87	16,69	242,04	21,06	305,32
	100	10,35	150,01	16,44	238,44	20,69	300,02
30 °C	1	9,77	141,72	15,53	225,18	19,66	285,02
	5	9,47	137,38	15,14	219,49	18,95	274,75
	10	9,36	135,67	14,80	214,55	18,71	271,35
	25	9,13	132,40	14,57	211,20	18,37	266,37
	50	9,01	130,70	14,34	207,86	18,03	261,40
	100	8,86	128,53	14,05	203,77	17,73	257,06
40 °C	1	8,57	124,33	13,52	196,06	17,04	247,07
	5	8,21	118,97	13,02	188,77	16,41	237,95
	10	8,10	117,39	12,80	185,60	16,08	233,19
	25	7,87	114,11	12,57	182,26	15,74	228,22
	50	7,72	111,91	12,28	178,10	15,44	223,81
	100	7,60	110,23	12,05	174,79	15,20	220,46
50 °C	1	7,44	107,93	11,84	171,71	15,00	217,50
	5	7,17	103,94	11,31	164,02	14,34	207,87
	10	6,99	101,40	11,10	160,95	13,99	202,80
	25	6,80	98,53	10,81	156,68	13,70	198,68
	50	6,66	96,57	10,66	154,51	13,43	194,75
	100	6,49	94,11	10,34	149,93	13,09	189,81
60 °C	1	6,33	91,77	10,06	145,85	12,66	183,54
	5	6,10	88,48	9,72	140,91	12,20	176,96
	10	6,03	87,38	9,55	138,49	12,05	174,76
	25	5,92	85,81	9,33	135,31	11,84	171,61
	50	5,76	83,56	9,15	132,72	11,53	167,13
70 °C	1	5,40	78,36	8,62	125,04	10,81	156,72
	5	5,13	74,39	8,21	119,02	10,37	150,42
	10	5,03	72,92	8,00	116,01	10,17	147,50
	25	4,92	71,39	7,90	114,56	9,96	144,44
	50	4,79	69,43	7,75	112,40	9,69	140,51
80 °C	1	4,49	65,05	7,13	103,41	9,09	131,77
	5	4,26	61,70	6,90	100,05	8,63	125,06
	10	4,24	61,43	6,76	97,95	8,47	122,86
	25	4,14	60,03	6,56	95,05	8,28	120,06
95 °C	1	3,58	51,86	5,80	84,05	7,28	105,51
	5	3,47	50,34	5,46	79,11	6,94	100,69

CIRCUITO ABIERTO: Factor de Seguridad aplicado según Normas UNE EN 15874 y DIN 8077 (SF=1,50)
OPEN CIRCUIT: Safety Factor applied according to UNE EN 15874 and DIN 8077 Standards (SF=1,50)
1bar=14,5psi

05.III FITTINGS

THERMOFUSION


End cap


Coupling


Male/Female Reduction


Female/Female Reduction


Female Plain Tee


Female Reduced Center Tee


Male Center Tee


90º Female/Female Elbow


45º Female/Female Elbow


Female Threaded Tee

* Available in INOX 316


Male Threaded Tee

* Available in INOX 316


90º Female Threaded Elbow

* Available in INOX 316

THERMOFUSION


90º Male Threaded Elbow

* Available in INOX 316


Female Threaded Coupling

* Available in INOX 316


Male Threaded Coupling


Straight Union with Female Loose Nut


90º Female Threaded Wall Elbow

* Available in INOX 316


90º Male Threaded Wall Elbow

* Available in INOX 316


Universal Connector


Threaded Connector

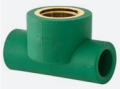

Flange Neck with Gasket


Long Flange Neck


PP-Coated Flat Steel Flange

VALVES AND SHUT-OFF VALVES


Valve with Escutcheon


Valve Body


Trim for Valve with Escutcheon


Valve Escutcheon


Valve with Long Handle Knob


Trim for Long Handle Valve Escutcheon


Valve Escutcheon with Long Handle Knob


Extension for Concealed Valve


Brass Shut-Off Valve


Trim Kit for Brass Shut-Off Valve


Angled Valve



PPR

06.
SYSTEM CHARACTERISTICS page 26

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06.I MAIN ADVANTAGES

- **High resistance to long-term internal pressure** and to high temperatures.
- **Non-toxic.** Suitable for drinking water use. It does not impart any odor, color or taste, making it especially suitable for the transport of a wide range of food-grade products.
- **High resistance to chemical corrosion** from both acids and alkalis. Full reliability in saline environments (seawater, etc.).
- **Complete absence of scale build-up** and extremely low head loss thanks to its mirror-finish inner surface.
- **Low thermal conductivity coefficient**. Minimal heat loss. Very low condensation.
- **Electrical insulation.** High resistance to stray currents.
- **Easy installation.** Much lighter than other traditional materials.
- **High abrasion resistance.**
- Excellent performance under **anti-legionella treatments** in accordance with standards.
- **Cold resistance.** Due to the material's plasticity, it is capable of absorbing a large part of the volume increase in freezing conditions.
- **Acoustic insulation.** Thanks to the low wave propagation velocity of the material, it provides an excellent damping effect against noise transmission caused by fluid flow.
- **100% recyclable.**

06.II FIELDS OF APPLICATIONS

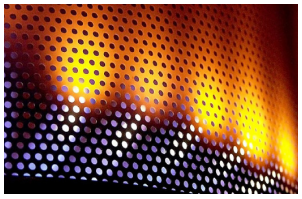
REPOLEN systems are designed to provide solutions for all applications requiring the conveyance of cold and hot pressurized water, whether for human consumption, domestic or industrial use. The characteristics of the system allow it, in addition to its basic applications, to be used in a wide variety of different installations. The main difference between the REPOLEN system and the REPOLEN FASER system lies in their thermal expansion behavior, allowing adaptation to the specific requirements of each installation. Among the most common applications are:



Compressed Air Installations



Air Conditioning Systems, both with Fan Coils and Underfloor Heating



Heating installations, including high-temperature boilers, underfloor heating, radiators, etc.



Thermal Waters, Swimming Pools, Geothermal Installations



Installations sensitive to anti-Legionella disinfection, such as hospitals, schools, institutional buildings, hotels, sports facilities, etc.



Recycled Water Installations where the entrainment of solids may even occur



Industrial Liquid Conveyance Installations: industrial refrigeration, chemical industries, food industries, etc.



Hydrosanitary Installations: service connections, meter panels and manifolds, risers, distribution lines, branches, boilers, storage tanks, return lines, etc.

06.III MARKING AND TRACEABILITY

Pipe marking is carried out in accordance with UNE EN ISO 15874 and the requirements of the AENOR Particular Regulations RP.001.52 and RP.001.72. The purpose of pipe marking is to provide the necessary information to the installer, the end user and the manufacturer, if required. The marking includes:

- Trade Mark: REPOLEN
- Reference to the AENOR Mark (Product Certificate or Certificate of Conformity) and contract number
- Material used for manufacture
- Nominal diameter and wall thickness
- Application class and nominal pressure (see below)
- Manufacturing period
- Reference standard
- Symbol indicating suitability for food contact
- Reference to 100% national manufacturing

The manufacturing period is unique for each pipe production, allowing full traceability of the finished product. By means of this number, complete traceability can be ensured, from raw material intake through to delivery to our customers' premises.

With regard to the application class, according to the standard, pipes are marked with the design pressure (not nominal nor operating pressure) for a given application class. Design pressure is defined as the maximum pressure relative to the conditions for which the system has been designed, and under the standard these pressures are 4, 6, 8 and 10 bar.

Regarding the application class, the standard distinguishes four classes:

Application Class	Design Temperature (ºC) TD	Time at TD (years)	Maximum Temperature (ºC) Tmax	Time at Tmax (years)	Malfunction Temperature Tmal (ºC)	Time at Tmal (years)	Typical Field of Applicationn
1	60	49	80	1	95	100	Suministro agua caliente (60ºC)
2	70	49	80	1	95	100	Suministro agua caliente (70ºC)
4	20 followed by 40 followed by 60	2.5 20 25	70	2.5	100	100	Calefacción por suelo radiante y radiadores a baja temperatura
5	20 followed by 40 followed by 80	14 25 10	90	1	100	100	Radiadores a alta temperatura

However, in order to facilitate the use of the pipes, they are also marked with the theoretical nominal pressure if they were to operate at 20ºC for 50 years. Although it is not marked on the pipe, it is advisable to be familiar with the SDR and the S:

- SDR is the ratio between the outside diameter and the pipe wall thickness, according to the equation: **SDR = φ ext / espesor**
- S is a dimensionless number that classifies the pipe according to ISO 4065 and indicates the relationship between hoop stress (σ) and operating pressure (P) at a given temperature, according to: **S = σ / P**

06.VI HANDLING AND STORAGE

RESISTANCE TO ULTRAVIOLET (UV) RADIATION

PPR must not be exposed to solar radiation. Even when stabilized against such radiation, prolonged exposure causes material degradation, thereby accelerating its ageing.

RESISTANCE TO LOW TEMPERATURES

At temperatures below 0ºC, PPR, being a crystalline material, becomes brittle. Therefore, it is important, especially during transport and handling, to avoid any type of impact. However, once installed, its plasticity allows it to absorb volume variations caused by the freezing of the fluids flowing inside.

PIPE LAYOUT

It is important to ensure that pipes are always kept horizontal and, as far as possible, to avoid bending, in order to prevent deformations that could hinder subsequent installation.



BENDING

Thanks to the plasticity of the pipes, a certain degree of bending is permitted. The maximum bending radius is eight times the pipe diameter. If bending is required, hot air heaters may be used; direct flame or torch heating must never be used, as this could damage the molecular structure of the pipe.

THREADS

On female threaded ends, conical plugs must be avoided, as they may damage the threads. To ensure tightness, PTFE tape or similar materials may be used in appropriate quantities.

06.V ANTI-LEGIONELLA TREATMENT

REPOLEN pipes, due to their characteristics, do not promote the growth of any type of known microorganism or bacteria. Nevertheless, in cases where disinfection is required, REPOLEN pipes do not present any problems provided that such disinfection is carried out in accordance with current regulations.

In accordance with current regulations for the control and prevention of Legionella (UNE 100030) and Royal Decree RD 863/2003, the following disinfection methods are recommended:

- **Chemical treatment in storage tanks:** For cold water intended for human consumption, maximum concentrations in tanks of between 20 and 30 ppm of free residual chlorine for a maximum period of between 3 and 1 hour respectively, for water at pH 7.
- **Chemical treatment in piping:** Disinfection may be carried out twice a year using 50 mg/l of free chlorine for more than 12 hours, or alternatively 150 mg/l of hydrogen peroxide for 24 hours; in both cases, the temperature must never exceed 30ºC.
- **Thermal treatment:** For domestic hot water (DHW / ACS). 70ºC or higher for 2 hours.

It is very important to bear in mind that both methods must never be used simultaneously (the combination of high temperatures with high chlorine concentrations may damage the installations).

In some areas, the use of chlorine dioxide as a disinfectant is widespread due to its low cost and high disinfecting effectiveness. However, its use is not recommended, as its high oxidation potential eventually affects installations, whether metallic or plastic.

06.VI RECYCLING AND ECOLOGY

All REPOLEN products are manufactured using a non-toxic material that generates no waste during the manufacturing process, promoting the production of goods aimed at achieving zero discharge. REPOLEN PPR pipes are manufactured from 100% virgin materials (regulations do not allow the use of recycled materials for drinking water applications) and are also 100% recyclable. Furthermore, these materials are highly environmentally friendly, as their impact is purely visual.

In addition, the design characteristics of REPOLEN products allow for reduced consumption due to their high durability and efficiency throughout their service life, and once this life cycle has ended, they allow for proper reintegration into the production cycle, thanks to their recyclability, being transformed once again into raw material for different products.

REBOCA, S.L. takes a further step in its commitment to the environment by implementing the international environmental management standard ISO 14001:2015. Through this system, the organization will improve its environmental performance and promote environmental protection in the development of its various activities, in compliance with the company's key principles.



PPR

07.
INSTALLATION CRITERIA

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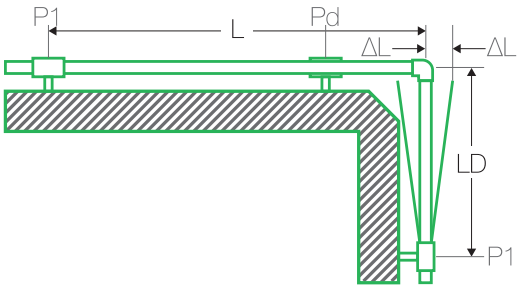
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07.I THERMAL EXPANSION CALCULATION

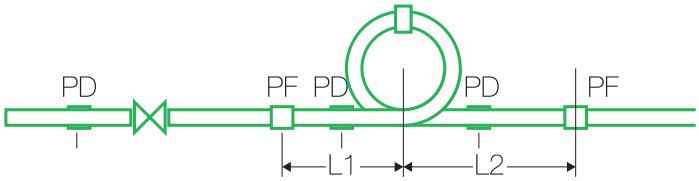
REPOLEN PP-R and PPR FASER pipes are subject to thermal expansion, exactly like other construction materials. This makes it necessary to compensate for such expansion when calculating the installation. Concealed pipes absorb this expansion towards the interior.

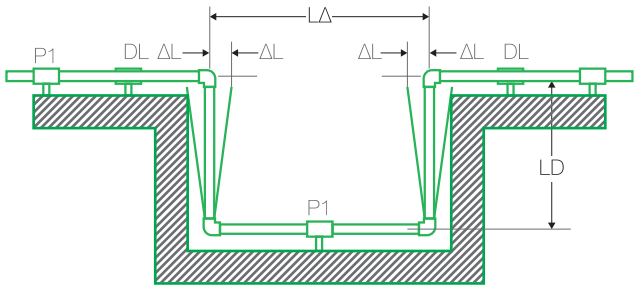
There are several formulas according to ENV 12108. The calculation equation is as follows: $\Delta L = L * \lambda * \Delta T$

Where: ΔL is the increase in length of the pipe due to thermal expansion, in millimeters
L is the pipe length over which expansion is calculated, in meters
λ is the linear expansion coefficient, in mm/mºC. It depends on each materia
λ PPR = 0.15 mm/mºC
λ faser = 0.03 mm/mºC
ΔT is the temperature difference between the conveyed fluid and the ambient temperature



These expansions must be calculated between fixed points or changes of direction. If the expansion is not significant and the installation can absorb it, the best solution is to allow movement at the pipe ends. If such movement cannot be allowed and the expansion is still moderate, expansion couplings may be used. The most common solution is to install expansion loops, either loop-type (if permitted by the pipe, which is not very common) or U-shaped loops.





Clamps marked as PF are clamps that fix the pipe (anchor), not allowing any movement, whereas PD clamps do allow movement and only provide support (guide).

The equation used for the calculation of expansion loops is: $LB = 2 * LD + LA = k\sqrt{D * \Delta L}$

Where: LB is the total flexible arm length
LD is the length of the transverse arm
LA is the length of the longitudinal arm LA = 0.5 · LD
k is a material-specific constant, which for PPR is 20
D is the nominal diameter of the pipe

EXAMPLE:

A pipe 8 m long and 25 mm in diameter is to be installed to convey water at 70ºC in an environment of approximately 25ºC.

Installations with REPOLEN MONOLAYER PPR

$\Delta L = 8 * 0.15 * (70 - 25) = 54$ mm We will have to compensate 54 mm. For the expansion loop calculation:

$LB = 20 * \sqrt{25 * 54} = 734.85 \cong 735$ mm

$LB = 2 * LD + 0.5 * LD \Rightarrow LD = {}^{735}/_{2.5} = 294$ mm

$LA = 294 * 0.5 = 147$ mm

That is, the expansion loop will have two transverse arms of 294 mm each and one longitudinal arm of 147 mm.

Installations REPOLEN FASER PPR

$\Delta L = 8 * 0.03 * (70 - 25) = 10.8$ mm We will have to compensate 10.8 mm. For the expansion loop calculation:

$LB = 20 * \sqrt{25 * 10.8} = 328.63 \cong 329$ mm

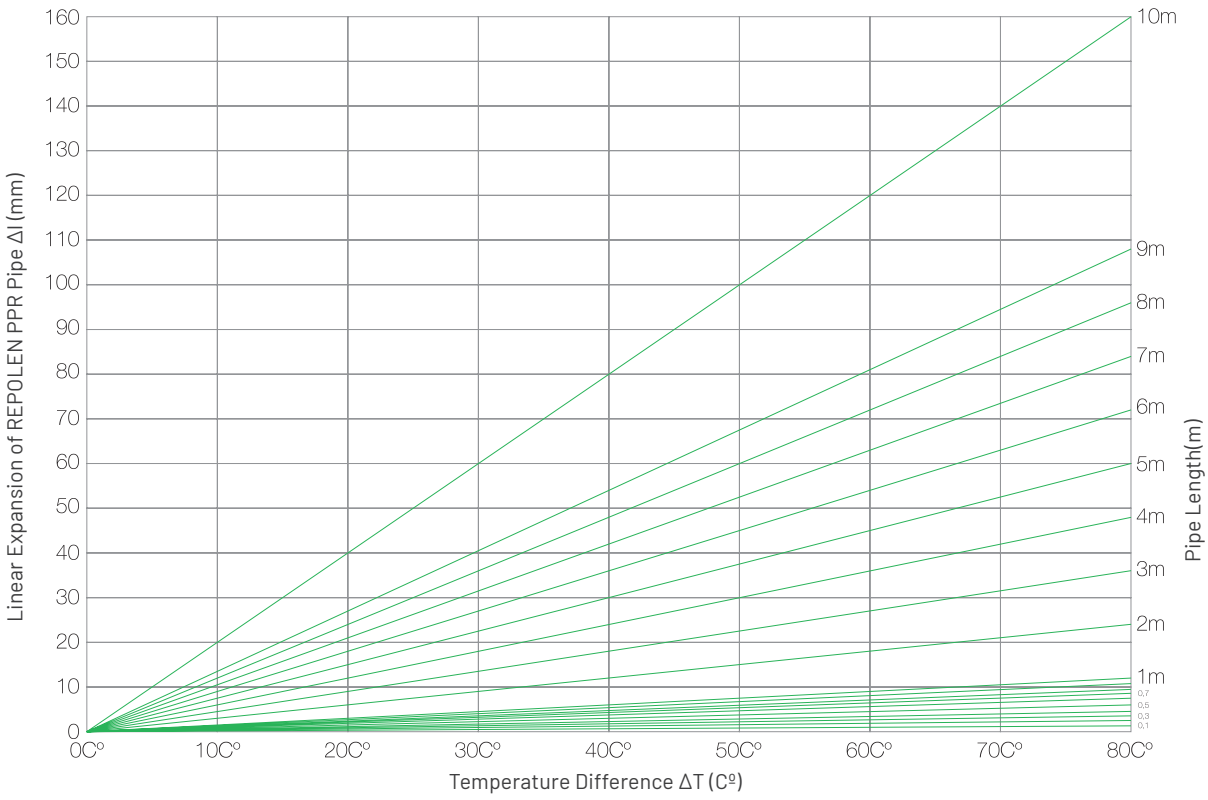
$LB = 2 * LD + 0.5 * LD \Rightarrow LD = {}^{329}/_{2.5} = 131.6$ mm $\cong 132$ mm

$LA = 132 * 0.5 = 66$ mm

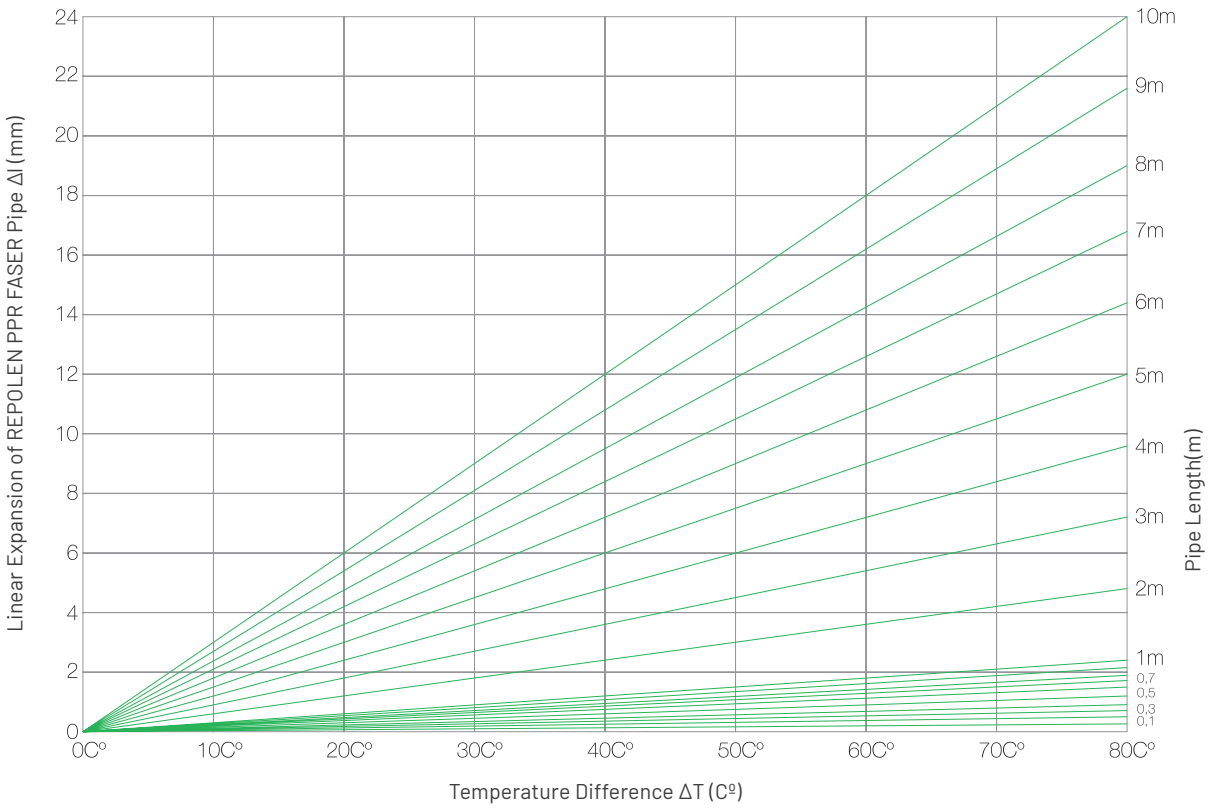
That is, the expansion loop will have two transverse arms of 132 mm each and one longitudinal arm of 66 mm.

Below, expansion tables are included with the aim of facilitating calculations.

λ = 0,15mm/mºC								
Pipe Length (m)	Temperature Difference ΔT (ºC)							
	10	20	30	40	50	60	70	80
	Linear Expansion of REPOLEN PPR Pipe Δl (mm)							
0,1	0,15	0,3	0,45	0,6	0,75	0,9	1,05	1,2
0,2	0,3	0,6	0,9	1,2	1,5	1,8	2,1	2,4
0,3	0,45	0,9	1,35	1,8	2,25	2,7	3,15	3,6
0,4	0,6	1,2	1,8	2,4	3	3,6	4,2	4,8
0,5	0,75	1,5	2,25	3	3,75	4,5	5,25	6
0,6	0,9	1,8	2,7	3,6	4,5	5,4	6,3	7,2
0,7	1,05	2,1	3,15	4,2	5,25	6,3	7,35	8,4
0,8	1,2	3,6	3,6	4,8	6	7,2	8,4	9,6
0,9	1,35	2,7	4,05	5,4	6,75	8,1	9,45	10,8
1	1,5	3	4,5	6	7,5	9	10,5	12
2	3	6	9	12	15	18	21	24
3	4,5	9	13,5	18	22,5	27	31,5	36
4	6	12	18	24	30	36	42	48
5	7,5	15	22,5	30	37,5	45	52,5	60
6	9	18	27	36	45	54	63	72
7	10,5	21	31,5	42	52,5	63	73,5	84
8	12	24	36	48	60	72	84	96
9	13,5	27	40,5	54	67,5	81	94,5	108
10	20	40	60	80	100	120	140	160



λ = 0,03 mm/mºC								
Pipe Length (m)	Temperature Difference ΔT (ºC)							
	10	20	30	40	50	60	70	80
	Linear Expansion of REPOLEN PPR FASER Pipe Δl (mm)							
0,1	0,03	0,06	0,09	0,12	0,15	0,18	0,21	0,24
0,2	0,06	0,12	0,18	0,24	0,3	0,36	0,42	0,48
0,3	0,09	0,18	0,27	0,36	0,45	0,54	0,63	0,72
0,4	0,12	0,24	0,36	0,48	0,6	0,72	0,84	0,96
0,5	0,15	0,3	0,45	0,6	0,75	0,9	1,05	1,2
0,6	0,18	0,36	0,54	0,72	0,9	1,08	1,26	1,44
0,7	0,21	0,42	0,63	0,84	1,05	1,26	1,47	1,68
0,8	0,24	0,44	0,72	0,96	1,2	1,44	1,68	1,92
0,9	0,27	0,54	0,81	1,08	1,35	1,62	1,89	2,16
1	0,3	0,6	0,9	1,2	1,5	1,8	2,1	2,4
2	0,6	1,2	1,8	2,4	3	3,6	4,2	4,8
3	0,9	1,8	2,7	3,6	4,5	5,4	6,3	7,2
4	1,2	2,4	3,6	4,8	6	7,2	8,4	9,6
5	1,5	3	4,5	6	7,5	9	10,5	12
6	1,8	3,6	5,4	7,2	9	10,8	12,6	14,4
7	2,1	4,2	6,3	8,4	10,5	12,6	14,7	16,8
8	2,4	4,8	7,2	9,6	12	14,4	16,8	19,2
9	2,7	5,4	8,1	10,8	13,5	16,2	18,9	21,6
10	3	6	9	12	15	18	21	24



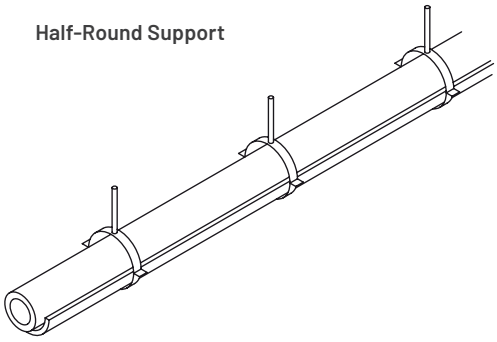
07.II DISTANCE BETWEEN SUPPORTS

Pipes may be installed on trays or half-round supports, which act as pipe supports. In this way, when there are long exposed runs, thermal expansion allows the pipe to move along the tray, while avoiding the unsightly effect that expansion may cause.

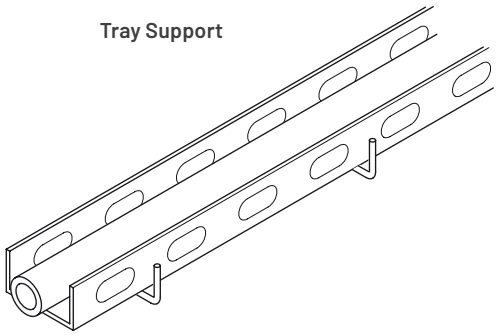
The recommended distances are:

Diameter	PPR - MONOLAYER PIPE				FASER - MULTILAYER PIPE			
	Tray Support Distance		Pipe-to-Tray Fixing Distance		Tray Support Distance		Pipe-to-Tray Fixing Distance	
	Water < 30ºC	Water > 30ºC	Water < 30ºC	Water > 30ºC	Water < 30ºC	Water > 30ºC	Water < 30ºC	Water > 30ºC
16 / 20	1500	1000	500	200	1950	1300	650	260
25	1500	1200	500	300	1950	1560	650	390
32	1500	1200	750	400	1950	1560	975	520
40	1500	1200	750	600	1950	1560	975	780
50 / 63 / 75	1500	1500	750	750	1950	1950	975	975
90 / 100 / 125	2000	2000	1000	1000	2600	2600	1300	1300
160	2500	2500	1250	1250	3250	3250	1625	1625

Half-Round Support



Tray Support



When a riser with branches is installed, it is very important that it can absorb thermal expansion without transferring stresses to the branches. According to ENV 12108, the recommended distance between two guide clamps or between a guide clamp and an anchor clamp is:

Outer Diameter (mm)	L* (mm)							
	PPR monolayer				FASER multilayer			
	Pipes Allowing Length Variations		Pipes Not Allowing Length Variations		Pipes Allowing Length Variations		Pipes Not Allowing Length Variations	
	Cold water	Hot water	Cold water	Hot water	Cold water	Hot water	Cold water	Hot water
16	750	400	600	250	975	520	780	325
20	800	500	700	300	1040	650	910	390
25	850	600	800	350	1105	780	1040	455
32	1000	650	900	400	1300	845	1170	520
40	1100	800	1100	500	1430	1040	1430	650
50	1250	1000	1250	600	1625	1300	1625	780
63	1400	1200	1400	750	1820	1560	1820	975
75	1500	1300	1500	900	1950	1690	1950	1170
90	1650	1450	1650	1100	2145	1885	2145	1430
110	1900	1600	1850	1300	2470	2080	2405	1690
125	2100	1850	2000	1400	2730	2405	2600	1820
160	2500	2300	2300	1800	3250	2990	2990	2340

Para tubos verticales, multiplicar por 1.3

07.III INSULATION

The thermal conductivity coefficient of PPR is 0.24 W/mK. If we compare it with copper (384 W/mK) or iron (58 W/mK), it can be understood that with REPOLEN PPR pipes the problem of condensation is almost negligible.

However, according to the RITE, all installations containing refrigerated fluid at a temperature lower than the ambient temperature or fluid at a temperature higher than 40ºC must be fitted with insulation, whose thickness (insulation thermal conductivity 0.04 W/mK), in order to prevent condensation, must comply with the following tables:

Maximum Fluid Temperature (ºC)						
Outside Diameter of Pipe to be Insulated(mm)	Hot Fluids Inside Buildings			Hot Fluids Outside Buildings		
	40 < T < 60	60 < T < 100	100 < T < 180	40 < T < 60	60 < T < 100	100 < T < 180
φ < 35	25	25	30	35	35	40
35 < φ < 60	30	30	40	40	40	50
60 < φ < 90	30	30	40	40	40	50
90 < φ < 140	30	40	50	40	50	60
140 < φ	35	40	50	45	50	60

Maximum Fluid Temperature (ºC)						
Outside Diameter of Pipe to be Insulated(mm)	Hot Fluids Inside Buildings			Hot Fluids Outside Buildings		
	40 < T < 60	60 < T < 100	100 < T < 180	40 < T < 60	60 < T < 100	100 < T < 180
φ < 35	30	20	20	50	40	40
35 < φ < 60	40	30	20	60	50	40
60 < φ < 90	40	30	30	60	50	50
90 < φ < 140	50	40	30	70	60	50
140 < φ	50	40	30	70	60	50

If the network operates continuously throughout the year, 5 mm must be added to the insulation thicknesses indicated in the tables. For pipes with an outside diameter equal to or less than 20 mm and a length of less than 5 m from the connection to the main line to the terminal, concealed in walls or floors, or installed in interior ducts, the insulation thickness shall be 10 mm.

If insulation materials with a thermal conductivity different from the reference value are used, the thickness is calculated using the following equation:

$$d = \lambda \ \Delta T$$

Where: d is the thickness of the new insulation
D is the outside diameter of the pipe to be insulated
λ is the thermal conductivity of the new insulation material (W/mK)
λref is the thermal conductivity of the insulation material for which the tables have been calculated (0.04 W/mK)
dref is the thickness indicated in the tables for the reference insulation material

EXAMPLE:

A 75 mm diameter pipe is to be insulated, installed inside a building, conveying water at 80ºC, and an insulation material with a thermal conductivity of 0.037 W/mK is to be used:

D = 75mm λ = 0.037 W/mK λref = 0.04 W/mK

According to the table, if we cross the row 60 < D < 90 with the column 60 < T < 100, dref = 30 mm.

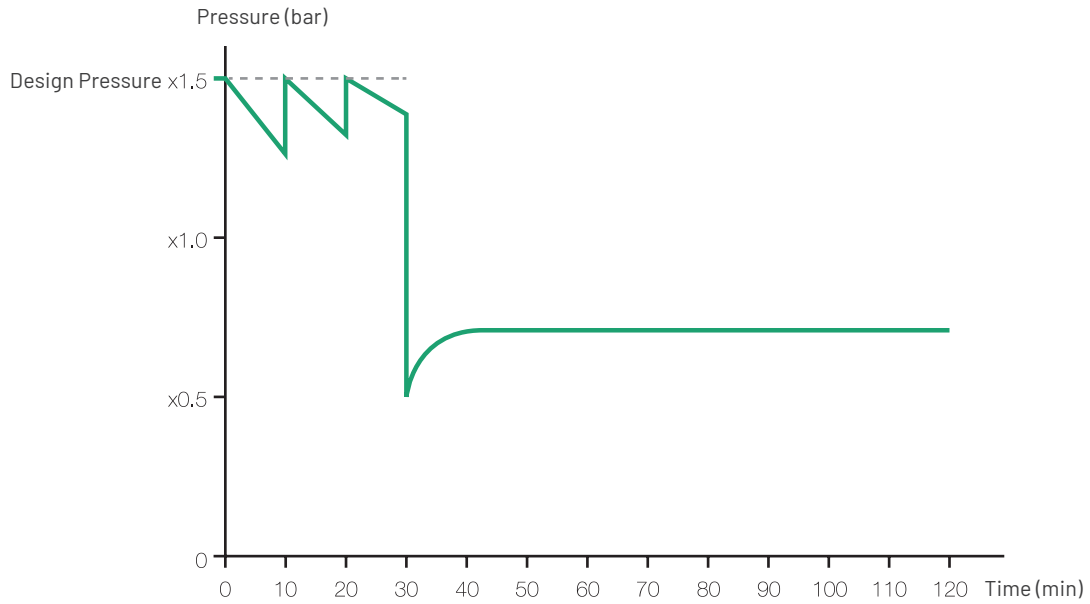
07.IV HYDRAULIC COMMISSIONING TEST

Ensure that the installation is in good condition, free from stresses or accidental damage. The test shall be carried out on sections shorter than 100 linear meters. If longer sections exist, they must be divided into sections. The test shall be performed using clean water at ambient temperature. Slowly fill the entire installation, ensuring that no air pockets remain, as these could cause water hammer. To do this, purge the installation until all air has been completely removed.

According to ENV 12108, apply 1.5 times the design pressure (Pd) of the installation; after 10 minutes, pump again up to this pressure (1.5 Pd); after 20 minutes, pump again, and continue until 30 minutes, inspecting for any possible leaks or defects. For hot water, the test pressure shall be 2 times Pd. In both cases, a minimum pressure of 6 bar shall be applied. From minute 30 onwards, two methods may be used:

METHOD A

Reduce the pressure to 0.5 times the design pressure using the purge valve. Close it. If the pressure stabilizes above 0.5 Pd and remains stable for 90 minutes, the installation is considered satisfactory. This method is recommended for cold water (according to RITE).



METHOD B

Take two pressure readings at 30 and 60 minutes. The pressure difference must be less than 0.6 bar. Maintain the pressure for 2 hours, observing the installation for any leaks or moisture, and if after this time the pressure drop is less than 0.2 bar, the installation is considered satisfactory.

07.V WATER HAMMER

When a liquid is flowing through a pipe under steady-state conditions and, at a given moment, an operation is performed on any element of the installation (such as a valve opening or closing, a change in pump operating regime, etc.), an overpressure is generated, causing an imbalance in the flow regime of the liquid that alters flow rates and pressures at different points along the pipeline. This overpressure is known as water hammer and must be added to the service or operating pressure.

The pressure and flow variations that give rise to water hammer propagate through the entire liquid mass as a wave motion. The propagation velocity of this wave is known as the celerity and is a function of the elastic modulus of the water, whose value varies depending on temperature, and the elastic modulus of the pipe material.

The lower the elastic modulus of the pipe material, the lower the celerity and, consequently, the lower the overpressure that may be generated in the pipeline. For this reason, the use of polyethylene pipes is advisable due to their low elastic modulus, as under the same operating conditions they generate pressures that are significantly lower than those produced when using traditional, much more rigid materials.

The calculation of overpressure due to water hammer can be performed using the Michaud equation:

$$\Delta H = \pm \frac{2 * L * v}{g * T}$$

for

$$T > \frac{2 * L}{a}$$

Where: ΔH = pressure or head increase, or water hammer (overpressure in m.w.c.)

a = wave propagation velocity or celerity in m/s

v = water velocity under steady-state conditions in m/s

L = pipe length in m

g = acceleration due to gravity in m/s2

T = shut-off operating time in s

The celerity is calculated using the equation:

$$a = \frac{9900}{\sqrt{48.3 + K_c * D_m / e}}$$

$$K_c = \frac{10^{10}}{E}$$

Where: K_c = dimensionless parameter

E = elastic modulus of the pipe in kg/m2 (≅ 10^8 for PE)

In the case of very long pipelines, water hammer does not reach its maximum value at the closing end (or change of direction), but rather at a generic point within the pipe. In this case, the Allievi equation is used:

$$\Delta H = \pm \frac{a * v}{g}$$

if

$$T < \frac{2 * L}{a}$$

Water hammer can be mitigated in different ways:

- Check valves: Installed on pumping lines to protect the pumping unit and to prevent emptying of the pipeline through the pump. They may also be installed at changes in pipeline alignment.
- Flywheel: Also known as a pump shut-down delay device. It consists of a flywheel coupled to the motor shaft.
- Air vessel: A tank connected to the pipeline containing water and pressurized air. The air absorbs pressure variations within the pipeline. It requires maintenance, as the air gradually dissolves into the water over time.
- Surge tank: A vertical tank connected to the pipeline, with a height greater than that equivalent to the maximum pressure the pipeline can withstand.
- Air release valves: Prevent cavitation at high points of the installation.
- Safety valves: Used when there is a risk of cavitation that may generate severe overpressures.

07.VI HEAD LOSSES

REPOLEN pipes exhibit head losses significantly lower than those of pipes made from other materials, such as copper, thanks to their very low roughness coefficient: 0.007 for PPR, 0.011 for clean copper, and 0.025 for clean brass. It should be noted that, since plastic materials do not undergo oxidation, no scale build-up occurs, meaning that the pipe roughness remains practically unchanged (depending on the pipe's use, the conveyed fluid, disinfection treatments, etc.). For example, iron pipes start with a roughness of 0.25, which over time can increase to as much as 4.

Head losses in installations are caused by the friction of the fluid against the pipe walls and by local losses due to obstacles present in the installation (tees, elbows, reducers, branches, etc.).

The head losses of REPOLEN pipes at a water temperature of 10ºC are those indicated in the following tables. At higher temperatures, head losses are slightly lower.

REPOLEN SDR 6

The first value corresponds to the head loss in mm/m.w.c., and the second to the average velocity in m/s.

Flow Rate		φ - REPOLEN SDR 6										
l/s	kg/h	16x2.7	20x3.4	25x4.2	32x5.4	40x6.7	50x8.4	63x10.5	75x12.5	90x15	110x18.4	125x20.8
0.02	70	10	2	0.9								
		0.22	0.14	0.09								
0.04	140	33	8	3	1							
		0.44	0.29	0.18	0.11							
0.05	180	52	13	4	2							
		0.57	0.37	0.23	0.14							
0.06	220	73	19	6	2							
		0.7	0.45	0.28	0.17							
0.08	290	118	30	10	4	1.5	0.5					
		0.92	0.59	0.37	0.23	0.15	0.09					
0.1	360	164	42	15	6	2	0.7					
		1.11	0.71	0.45	0.28	0.18	0.11					
0.12	430	234	61	21	8	3	1.07	0.33				
		1.36	0.88	0.55	0.34	0.22	0.14	0.09				
0.14	510		83	29	11	4	1.44	0.45				
			1.04	0.66	0.4	0.26	0.16	0.1				
0.16	580		104	37	14	5	1.8	0.56				
			1.18	0.75	0.46	0.29	0.19	0.12				
0.18	655		129	45	18	6	2.02	0.7				
			1.34	0.84	0.52	0.33	0.21	0.13				
0.2	730		156	55	22	7.5	2.69	0.84				
			1.49	0.94	0.58	0.37	0.24	0.15				
0.23	830		290	69	27	9	3.3	1				
			1.65	1.07	0.66	0.42	0.27	0.17				
0.25	900		353	85	33	11	4.1	1.3				
			1.83	1.2	0.74	0.47	0.3	0.19				

Flow Rate		φ - REPOLEN SDR 6										
l/s	kg/h	16x2.7	20x3.4	25x4.2	32x5.4	40x6.7	50x8.4	63x10.5	75x12.5	90x15	110x18.4	125x20.8
0.3	1080			110	43	15	5.3	1.6				
				1.39	0.85	0.54	0.35	0.22				
0.35	1280			149	59	20	7.1	2.2				
				1.65	1.01	0.64	0.41	0.26				
0.4	1430			270	71	24	8	2.7				
				1.85	1.13	0.72	0.46	0.29				
0.45	1605				87	30	10	3.4				
					1.27	0.81	0.52	0.32				
0.5	1805				107	36	13	4.2				
					1.43	0.91	0.58	0.36				
0.55	2005				135	44	15	5				
					1.55	1.01	0.65	0.4				
0.65	2155				172	50	17	5.7				
					1.7	1.08	0.69	0.43				
0.7	2530				225	66	23	7.6				
					1.98	1.27	0.82	0.51				
0.75	2705					74	26	8.5				
						1.36	0.87	0.54				
0.8	2280					83	29	9.5				
						1.45	0.93	0.58				
0.85	3005					89	31	10				
						1.51	0.97	0.61				
0.9	3255					103	36	11				
						1.63	1.05	0.66				
1	3600					143	43	14	7.9	2.8		
						1.8	1.16	0.73	0.5	0.35		
1.2	4320					198	59	19	9.2	3.9		
						2.16	1.4	0.87	0.61	0.42		
1.3	4680						66	22	10.6	4.5		
							1.49	0.93	0.66	0.46		
1.4	5040						76	25	12.1	5.1		
							1.62	101	0.71	0.5		
1.6	5760						14	32	15.3	6.4		
							1.85	1.16	0.81	0.57		
1.8	6480						141	40	18.8	7.9		
							2.08	1.32	0.92	0.64		
2	7200						170	48	22.7	9.5	3.7	
							2.31	1.46	102	0.71	0.48	
2.2	7920							57	26.9	11.3	4.4	
								1.6	1.12	0.78	0.52	
2.4	8640							66	31.4	13.1	5.1	
								1.74	1.22	0.85	0.57	
2.6	9360							76	36.1	15.1	5.9	3.1
								1.88	1.32	0.92	0.62	0.48

Flow Rate		φ - REPOLEN SDR 6										
l/s	kg/h	16x2.7	20x3.4	25x4.2	32x5.4	40x6.7	50x8.4	63x10.5	75x12.5	90x15	110x18.4	125x20.8
2.8	10080							87	41.2	17.3	6.7	3.6
								2.02	1.43	0.99	0.67	0.51
3	10800							111.3	46.6	19.5	7.5	4.1
								2.17	1.53	1.06	0.71	0.55
3.5	12600							149	61.4	25.7	9.9	5.3
								2.53	1.78	1.24	0.83	0.64
4	14400								77.9	32.6	12.6	6.7
									2.04	1.41	0.95	0.73
4.5	16200								96.2	40.2	15.5	8.3
									2.29	1.59	1.07	0.82
5	18000								116.2	48.5	18.7	10
									2.55	1.77	1.19	0.92
6	21600								161.1	67.2	25.9	13.9
									3.06	2.12	1.43	1.1
7	25200									88.6	34.2	18.3
										2.48	1.66	1.28
8	28800									112.7	43.4	23.2
										2.83	1.9	1.46
9	32400									139.3	53.6	28.7
										3.18	2.14	1.65
10	36000										64.8	34.7
											2.38	1.83
11	39600										77	41.1
											2.61	2.01
12	43200										90	48.1
											2.85	2.2
13	46800										104	55.6
											3.09	2.38
15	54000											71.9
												2.75
17	61200											92.1
												3.11

REPOLEN SDR 7.4

The first value corresponds to the head loss in mm/m.w.c., and the second to the average velocity in m/s.

Flow Rate		φ - REPOLEN SDR 7.4									
l/s	kg/h	25x3.5	32x4.4	40x5.5	50x6.9	63x8.6	75x10.3	90x12.3	110x15.1	125x17.1	160x21.9
0.1	360	16.9	5.2								
		0.39	0.24								
0.15	540	33.8	10.21								
		0.59	0.35								
0.2	720	55.4	16.7								
		0.79	0.47								
0.25	864	81.4	24.5								
		0.98	0.59								
0.3	1080	111.6	33.6	11.7							
		1.18	0.71	0.45							
0.35	1260	145.9	43.9	15.3							
		1.38	0.83	0.53							
0.4	1440	184.2	55.3	19.2	6.7						
		1.57	0.95	0.61	0.39						
0.45	1620	226.3	67.9	23.6	8.3						
		1.77	1.06	0.68	0.44						
0.5	1800	272.2	81.5	28.3	9.9						
		1.96	1.18	0.76	0.49						
0.55	1980	321.7	96.3	33.4	11.7						
		2.16	1.3	0.83	0.53						
0.6	2160		112.2	38.9	13.6						
			1.42	0.91	0.58						
0.65	2340		129	44.7	15.6	5.2					
			1.54	0.98	0.63	0.4					
0.7	2520		147	50.9	17.8	6					
			1.66	1.06	0.68	0.439					
0.75	2700		165.9	57.4	20	6.7					
			1.77	1.14	0.73	0.46					
0.8	2880		185.9	64.3	22.4	7.5					
			1.89	1.21	0.78	0.49					
0.85	3060		206.8	71.5	24.9	8.3					
			2.01	1.29	0.83	0.52					
0.9	3240		228.7	79.1	27.6	9.2					
			2.13	1.36	0.87	0.55					
1	3600			95.2	33.1	11.1	4.9				
				1.51	0.97	0.61	0.43				
1.2	4320			131.2	45.6	15.2	6.7				
				1.82	1.17	0.73	0.52				
1.4	5040			172.3	59.9	20	8.8	3.7			
				2.12	1.36	0.86	0.61	0.42			

Flow Rate		φ - REPOLEN SDR 7.4									
l/s	kg/h	25x3.5	32x4.4	40x5.5	50x6.9	63x8.6	75x10.3	90x12.3	110x15.1	125x17.1	160x21.9
1.6	5760				75.8	25.2	11.1	4.7			
					1.55	0.98	0.69	0.48			
1.8	6480				9.3	31.1	13.6	5.7			
					1.75	1.1	0.78	0.54			
2	7200				112.5	20	16.4	6.9			
					1.94	1.22	0.87	0.6			
2.2	7920				133.2	44.3	19.4	8.2			
					2.14	1.35	0.95	0.66			
2.4	8640					51.6	22.7	9.05			
						1.47	1.04	0.72			
2.6	9360					69.5	26.1	11			
						1.59	1.13	0.78			
2.8	10080					67.9	29.8	12.5	4.6		
						1.71	1.21	0.84	0.56		
3	10800					76.7	33.6	14.1	5.4	2.9	
						1.84	1.3	0.9	0.6	0.46	
3.5	12600					100.9	44.2	18.6	7.1	3.8	
						21.4	1.52	1.05	0.7	0.54	
4	14400					128	56	23.5	8.9	4.8	
						2.45	1.73	1.21	0.8	0.62	
4.5	16200					158	69.1	29	11	5.9	
						2.76	1.95	1.36	0.9	0.69	
5	18000						83.4	35	13.3	7.1	2.2
							2.17	1.51	1	0.77	0.47
5.5	19800						98.9	41.5	15.7	8.4	2.6
							2.38	1.66	1.11	0.85	0.52
6	21600						115.6	48.4	18.4	9.8	3
							2.6	1.81	1.21	0.93	0.57
6.5	23400							55.9	20.6	11.3	3.5
								1.96	1.29	1	0.61
7	25200							63.8	24.2	12.9	4
								2.11	1.41	1.08	0.66
7.5	27000							72.2	27.3	14.6	4.5
								2.26	1.51	1.16	0.71
8	28800							81	30.7	16.3	5
								2.41	1.61	1.24	0.75
9	32400							100	97.9	20.2	6.2
								2.71	1.81	1.39	0.85
10	36000								45.8	24.4	7.5
									2.01	1.54	0.94
11	39600								54.3	28.9	8.9
									2.21	1.7	1.04
12	43200								63.5	33.8	10.4
									2.41	1.85	1.13

Flow Rate		φ - REPOLEN SDR 7.4									
l/s	kg/h	25x3.5	32x4.4	40x5.5	50x6.9	63x8.6	75x10.3	90x12.3	110x15.1	125x17.1	160x21.9
13	46800								73.3	39	12
									2.61	2.01	1.23
14	50400									44.5	13.6
										2.16	1.32
15	54000									50.4	15.4
										2.32	141
16	57600									56.6	17.1
										2.47	1.5
17	61200									63.1	19.3
										2.63	1.6
20	72000										25.9
											1.89
30	108000										53.8
											2.83

REPOLEN SDR 9

The first value corresponds to the head loss in mm/m.w.c., and the second to the average velocity in m/s.

Flow Rate		φ - REPOLEN SDR 9					
l/s	kg/h	32x2.9	40x3.7	50x4.6	63x5.8	75x6.8	90x8.2
0.1	360	3,78	1,33				
		0,21	0,13				
0,15	540	7,49	2,63				
		0,31	0,2				
0.2	720	12,22	4,28	1,49	0,51		
		0,41	0,26	0,17	0,11		
0.3	1080	24,51	8,55	2,97	1,01		
		0,62	0,4	0,25	0,16		
0.4	1440	40,33	14,03	4,86	1,65		
		0,83	0,53	0,34	0,21		
0.5	1800	59,45	20,65	7,14	2,42		
		1,04	0,66	0,42	0,27		
0,6	2160	81,74	28,35	9,79	3,31		
		1,24	0,79	0,51	0,32		
0.7	2520	107,07	37,09	12,79	4,32		
		1,45	0,93	0,59	0,37		
0.8	2880	135,36	46,85	16,14	5,44		
		1,66	1,06	0,68	0,43		
0.9	3240	166,52	57,6	19,83	6,68		
		1,86	1,19	0,76	0,48		
1	3600	200,51	69,3	23,84	8,03		
		2,07	1,32	0,85	0,53		

Flow Rate		φ - REPOLEN SDR 9					
l/s	kg/h	32x2.9	40x3.7	50x4.6	63x5.8	75x6.8	90x8.2
1,1	3960	237,25	81,95	28,18	9,48		
		2,28	1,46	0,93	0,59		
1.2	4320	276,7	95,53	32,82	11,04		
		2,48	1,59	1,01	0,64		
1.3	4680	318,82	110,02	37,78	12,7		
		2,69	1,72	1,1	0,7		
1.4	5040	363,57	125,4	43,05	14,46		
		2,9	1,85	1,18	0,75		
1,5	5400	410,9	141,67	48,61	16,32		
		3,11	1,99	1,27	0,8		
1.6	5760	460,8	158,82	54,47	18,28		
		3,31	2,12	1,35	0,86		
1,7	6120	513,22	176,82	60,63	20,34		
		3,52	2,25	1,44	0,91		
1.8	6480	568,14	195,68	67,07	22,49		
		3,73	2,38	1,52	0,96		
1,9	6840	625,54	215,39	73,8	24,74		
		3,93	2,52	1,61	1,02		
2	7200	685,38	235,93	80,81	27,08	11,71	
		4,14	2,65	1,69	1,07	0,75	
2.2	7920		279,49	95,68	32,05	13,84	
			2,91	1,86	1,18	0,83	
2.4	8640		326,3	111,66	37,38	16,14	
			3,18	2,03	1,28	0,9	
2.6	9360		376,33	128,72	43,07	18,59	
			3,44	2,2	1,39	0,98	
2.8	10080		429,51	146,85	49,11	21,19	
			3,71	2,37	1,5	1,05	
3	10800		485,81	166,04	55,51	23,95	10,07
			3,97	2,54	1,6	1,13	0,78
3.5	12600			218,56	73	31,47	13,22
				2,96	1,87	1,32	0,91
4	14400			277,42	92,6	39,89	16,75
				3,38	2,14	1,5	1,05
4.5	16200			342,49	114,25	49,2	20,64
				3,81	2,41	1,69	1,18
5	18000				137,91	59,36	24,89
					2,67	1,88	1,31
6	21600				191,11	82,2	34,45
					3,21	2,26	1,57
7	25200				251,96	108,31	45,36
					3,74	2,63	1,83
8	28800					137,6	57,59
						3,01	2,09

Flow Rate		φ - REPOLEN SDR 9					
l/s	kg/h	32x2.9	40x3.7	50x4.6	63x5.8	75x6.8	90x8.2
9	32400					169,99	71,12
						3,38	2,35
10	36000					205,44	85,92
						3,76	2,6
11	39600						101,95
							2,87
12	43200						119,22
							3,14
13	46800						137,68
							3,4
14	50400						157,34
							3,66

REPOLEN SDR 11

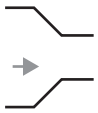
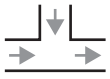
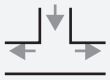
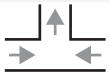
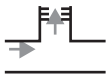
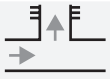
The first value corresponds to the head loss in mm/m.w.c., and the second to the average velocity in m/s.

Flow Rate		φ - REPOLEN SDR 11								
l/s	kg/h	32x2.9	40x3.7	50x4.6	63x5.8	75x6.8	90x8.2	110x10	125x11.4	160x14.6
0.1	360	2.9								
		0.19								
0.16	576	6.5								
		0.3								
0.2	720	9.4								
		0.37								
0.25	864	13.8								
		0.46								
0.3	1080	18.9	6.7							
		0.56	0.36							
0.35	1260	24.7	8.8							
		0.65	0.42							
0.4	1440	31.1	11.1	3.8						
		0.74	0.48	0.31						
0.45	1620	38.1	13.6	4.7						
		0.83	0.6	0.34						
0.5	1800	45.8	16.3	5.6						
		0.93	0.6	0.38						
0.55	1980	54.1	19.2	6.6						
		1.02	0.66	0.42						
0.6	2160	63	22.3	7.7						
		1.11	0.72	0.46						

Flow Rate		φ - REPOLEN SDR 11								
l/s	kg/h	32x2.9	40x3.7	50x4.6	63x5.8	75x6.8	90x8.2	110x10	125x11.4	160x14.6
0.65	2340	72.1	25.7	8.9	3					
		1.21	0.78	0.5	0.31					
0.7	2520	82.5	29.2	10.1	3.4					
		1.3	0.84	0.54	0.34					
0.75	2700	93.1	33	11.4	3.8					
		1.39	0.9	0.57	0.36					
0.8	2880	104.2	36.9	12.7	4.3					
		1.48	0.96	0.61	0.39					
0.85	3060	116	41	14.1	4.7					
		1.58	1.02	0.65	0.41					
0.9	3240		45.3	15.6	5.2					
			1.08	0.69	0.43					
1	3600		54.5	18.8	6.3	2.7				
			1.2	0.76	0.48	0.34				
1.2	4320		75.2	25.8	8.6	3.7				
			1.44	0.92	0.58	0.41				
1.4	5040		98.7	33.9	11.3	4.9	2.1			
			1.68	1.07	0.67	0.47	0.33			
1.6	5760			42.9	14.3	6.1	2.6			
				1.22	0.77	0.54	0.38			
1.8	6480			52.8	21.1	9.1	3.8			
				1.38	0.96	0.68	0.47			
2	7200			63.6	25	9.1	3.8			
				1.53	1.06	0.68	0.47			
2.2	7920			73.2	25	10.7	4.5			
				1.68	1.06	0.74	0.52			
2.4	8640				29.2	12.5	5.3			
					1.16	0.81	0.56			
2.6	9360				33.6	14.4	6.0			
					1.25	0.9	0.6			
2.8	10080				38.3	16.4	6.9	2.7		
					1.35	0.9	0.7	0.4		
3	10800				43.3	18.5	7.8	3	1.6	
					1.45	1.01	0.71	0.47	0.37	
3.5	12600				57	24.4	10.3	3.9	2.1	
					1.69	1.18	0.9	0.55	0.43	
4	14400				72.2	30.9	13	5	2.7	
					1.93	1.4	0.9	0.6	0.5	
4.5	16200					38.1	16	6.1	3.3	
						1.5	1.1	0.7	0.5	
5	18000					46	19.3	7.4	4	1.2
						1.69	1.18	0.79	0.61	0.37
5.5	19800					54.5	22.9	8.8	4.8	1.5
						1.86	1.29	0.86	0.67	0.41

Flow Rate		φ - REPOLEN SDR 11								
l/s	kg/h	32x2.9	40x3.7	50x4.6	63x5.8	75x6.8	90x8.2	110x10	125x11.4	160x14.6
6	21600					63.6	26.7	10.2	5.6	1.7
						2	1.4	0.9	0.7	0.4
7	25200						35.2	13.4	7.3	23
							1.6	1.1	0.9	0.5
8	28800						44.7	17.1	9.3	2.9
							1.9	1.3	1	0.6
9	32400							21.1	11.5	3.5
								1.4	1.1	0.7
10	36000							25.4	13.8	4.2
								1.57	1.22	0.74
11	39600							30.1	16.4	5
								1.73	1.34	0.82
12	43200							35.2	19.2	5.9
								1.89	1.46	0.89
13	46800							40.7	22.1	6.8
								2.04	1.58	0.97
14	50400								25.3	7.7
									1.71	1.04
15	54000								28.6	8.8
									1.83	1.12
16	57600								32.1	9.8
									1.95	1.19
17	61200									11
										1.27
18	64800									12.1
										1.34
19	68400									13.4
										1.41
20	72000									14.7
										1.49
25	90000									21.9
										1.86
30	108000									30.25
										2.23

FITTINGS

Description	Diagram	Resistance Coefficient (r)
Coupling		0.25
Female Threaded Coupling		0.5
Male Threaded Coupling		0.7
One-Diameter Reduction		0.4
Two-Diameter Reduction		0.5
Three-Diameter Reduction		0.6
Four-Diameter Reduction		0.7
Five-Diameter Reduction		0.8
Six-Diameter Reduction		0.9
90º Elbow		1.2
90º Male Threaded Elbow		1.6
90º Female Threaded Elbow		1.4
45º Elbow		0.6
Tee Divergent Flow		1.8
Tee Convergent Flow		1.3
Opposed Tee with Divergent Flow		2.2
Opposed Tee with Convergent Flow		4.2
Reduced Tee	The result will be the sum of the tee and the reduction.	
Female Threaded Tee		1.6
Male Threaded Tee		1.8

EXAMPLE:

Assuming an installation with REPOLEN piping of 10 linear meters and diameter 25 x 4.2 mm, in which there are 4 couplings, 3 90º elbows, 2 tees, and one female threaded coupling, and it is required to convey 0.35 l/s of water at 10ºC. The total head loss will be the head loss of the pipe, plus that of the fittings:

H = Ht + Ha

Where: H is the total head loss in mm.w.c.
Ht is the pipe head loss in mm.w.c.
Ha is the fittings head loss in mm.w.c.

To calculate the pipe head loss, the previous tables must be consulted. Thus, for the selected pipe and 0.35 l/s, we have a water velocity of 1.65 m/s and a head loss of 149 mm.w.c. Since we have 10 linear meters:

Ht = 149 * 10 = 1490 mm.c.a.

The head loss of several fittings is calculated using the equation: $Ha = \sum r \; v^2 \; * \; \gamma / 2g$

Where: r is the resistance coefficient of the fitting
v is the velocity of the conveyed fluid in m/s
γ is the specific weight of the conveyed fluid. Since it is water, it is 1 kg/l
g is the acceleration due to gravity, 9.8 m/s^2

$$Ha = (4 * 0.25 + 3 * 1.2 * 2 * 1.8 + 0.5) * 1.652 * \frac{1}{2 * 9.8} = 8.7 * 2.72 * 0.05 = 1.183 \text{ m.c.a.} = 1183 \text{ mm .c .a}$$

H = 1490 + 1183 = 2673 mm.c.a.

07.VII PEAK FLOW RATE

Determination of the peak flow rate Vs from the sum of flow rates ΣVR for residential buildings

acc. to DIN 1988 Teil 3 VS = 0.682 · (ΣVR)0.45 – 0.7 [l / s]

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

* This table is valid if the circulating flow rate VR of the individual draw-off points is less than 0.5 l/s.

Determination of the peak flow rate Vs from the sum of flow rates ΣVR for residential buildings

acc. to DIN 1988 Teil 3 VS = 1.7 · (ΣVR)0.21 – 0.7 [l / s]

∑VR	VS	∑VR	VS	∑VR	VS	∑VR	VS	∑VR	VS	∑VR	VS	∑VR	VS	∑VR	VS
1,00	1,00	5,10	1,69	10,10	2,06	15,10	2,31	22,40	2,57	142,20	4,12	262,40	4,78	382,40	5,23
1,05	1,02	5,20	1,70	10,20	2,07	15,20	2,31	24,80	2,64	144,80	4,13	264,80	4,79	384,80	5,23
1,10	1,03	5,30	1,71	10,30	2,07	15,30	2,31	27,20	2,70	147,20	4,15	267,20	4,81	387,20	5,24
1,15	1,05	5,40	1,72	10,40	2,08	15,40	2,32	29,60	2,76	149,60	4,17	269,60	4,81	389,60	5,25
1,20	1,07	5,50	1,73	10,50	2,09	15,50	2,32	32,00	2,82	152,00	4,18	272,00	4,82	392,00	5,26
1,25	1,08	5,60	1,74	10,60	2,09	15,60	2,33	34,40	2,87	154,40	4,20	274,40	4,83	394,40	5,26
1,30	1,10	5,70	1,75	10,70	2,10	15,70	2,33	36,80	2,92	156,80	4,21	276,80	4,84	396,80	5,27
1,35	1,11	5,80	1,76	10,80	2,10	15,80	2,34	39,20	2,97	159,20	4,23	279,20	4,85	399,20	5,28
1,40	1,12	5,90	1,77	10,90	2,11	15,90	2,34	41,60	3,02	161,60	4,25	281,60	4,86	401,60	5,29
1,45	1,14	6,00	1,78	11,00	2,11	16,00	2,34	44,00	3,06	164,00	4,26	284,00	4,87	404,00	5,29
1,50	1,15	6,10	1,79	11,10	2,12	16,10	2,35	46,40	3,11	166,40	4,28	286,40	4,88	406,40	5,30
1,55	1,16	6,20	1,79	11,20	2,12	16,20	2,35	48,80	3,15	168,80	4,29	288,80	4,89	408,80	5,31
1,60	1,18	6,30	1,80	11,30	2,13	16,30	2,35	51,20	3,19	171,20	4,31	291,20	4,90	411,20	5,32
1,65	1,19	6,40	1,81	11,40	2,13	16,40	2,36	53,60	3,22	173,60	4,32	293,60	4,91	413,60	5,32
1,70	1,20	6,50	1,82	11,50	2,14	16,50	2,36	56,00	3,26	176,00	4,34	296,00	4,92	416,00	5,33
1,75	1,21	6,60	1,83	11,60	2,14	16,60	2,37	58,40	3,29	178,40	4,35	298,40	4,93	418,40	5,34
1,80	1,22	6,70	1,83	11,70	2,15	16,70	2,37	60,80	3,33	180,80	4,36	300,80	4,93	420,80	5,35
1,85	1,23	6,80	1,84	11,80	2,15	16,80	2,37	63,20	3,36	183,20	4,38	303,20	4,94	423,20	5,35
1,90	1,25	6,90	1,85	11,90	2,16	16,90	2,38	65,60	3,39	185,60	4,36	305,60	4,95	425,60	5,36
2,00	1,27	7,00	1,86	12,00	2,16	17,00	2,38	68,00	3,42	188,00	4,41	308,00	4,96	428,00	5,37
2,10	1,29	7,10	1,87	12,10	2,17	17,10	2,39	70,40	3,45	190,40	4,42	310,40	4,97	430,40	5,38
2,20	1,31	7,20	1,87	12,20	2,17	17,20	2,39	72,80	3,48	192,80	4,43	312,80	4,98	432,80	5,38
2,30	1,32	7,30	1,88	12,30	2,18	17,30	2,39	75,20	3,51	195,20	4,45	315,20	4,99	435,20	5,39
2,40	1,34	7,40	1,89	12,40	2,18	17,40	2,40	77,60	3,54	197,60	4,46	317,60	5,00	437,60	5,40
2,50	1,36	7,50	1,90	12,50	2,19	17,50	2,40	80,00	3,57	200,00	4,47	320,00	5,01	440,00	5,40
2,60	1,38	7,60	1,90	12,60	2,19	17,60	2,40	82,40	3,59	202,40	4,49	322,40	5,02	442,40	5,41
2,70	1,39	7,70	1,91	12,70	2,20	17,70	2,41	84,80	3,62	204,80	4,50	324,80	5,03	444,80	5,42
2,80	1,41	7,80	1,92	12,80	2,20	17,80	2,41	87,20	3,64	207,20	4,51	327,20	5,04	447,20	5,42
2,90	1,43	7,90	1,92	12,90	2,21	17,90	2,42	89,60	3,67	209,60	4,52	329,60	5,04	452,00	5,43
3,00	1,44	8,00	1,93	13,00	2,21	18,00	2,42	92,00	3,69	212,00	4,54	332,00	5,05	454,40	5,44
3,10	1,46	8,10	1,94	13,10	2,22	18,10	2,42	94,40	3,72	214,40	4,55	334,40	5,06	456,80	5,44
3,20	1,47	8,20	1,94	13,20	2,22	18,20	2,43	96,80	3,74	216,80	4,56	336,80	5,07	459,20	5,45
3,30	1,48	8,30	1,95	13,30	2,23	18,30	2,43	99,20	3,76	219,20	4,57	339,20	5,08	461,60	5,46
3,40	1,50	8,40	1,96	13,40	2,23	18,40	2,43	101,60	3,79	221,60	4,58	341,60	5,09	464,00	5,47
3,50	1,51	8,50	1,96	13,50	2,24	18,50	2,44	104,00	3,81	224,00	4,60	344,00	5,10	466,40	5,47
3,60	1,52	8,60	1,97	13,60	2,24	18,60	2,44	106,40	3,83	226,40	4,61	346,40	5,10	468,80	5,48
3,70	1,54	8,70	1,98	13,70	2,25	18,70	2,44	108,80	3,85	228,80	4,62	348,80	5,11	471,20	5,49
3,80	1,55	8,80	1,98	13,80	2,25	18,80	2,45	111,20	3,87	231,20	4,63	351,20	5,12	473,60	5,49
3,90	1,56	8,90	1,99	13,90	2,25	18,90	2,45	113,60	3,89	233,60	4,64	353,60	5,13	476,00	5,50
4,00	1,57	9,00	2,00	14,00	2,26	19,00	2,45	116,00	3,91	236,00	4,66	356,00	5,14	478,40	5,51
4,10	1,59	9,10	2,00	14,10	2,26	19,10	2,46	118,40	3,93	238,40	4,67	358,40	5,15	480,80	5,51
4,20	1,60	9,20	2,01	14,20	2,27	19,20	2,46	120,80	3,95	240,80	4,68	360,80	5,15	483,20	5,52
4,30	1,61	9,30	2,02	14,30	2,27	19,30	2,47	123,20	3,97	243,20	4,69	363,20	5,16	485,60	5,52
4,40	1,62	9,40	2,02	14,40	2,28	19,40	2,47	125,60	3,99	245,60	4,70	365,00	5,17	488,00	5,53
4,50	1,63	9,50	2,03	14,50	2,28	19,50	2,47	128,00	4,01	248,00	4,71	368,00	5,18	490,40	5,54
4,60	1,64	9,60	2,03	14,60	2,29	19,60	2,48	130,40	4,03	250,40	4,72	370,40	5,19	492,40	5,54
4,70	1,65	9,70	2,04	14,70	2,29	19,70	2,48	132,80	4,05	252,80	4,76	372,80	5,19	492,80	5,55
4,80	1,66	9,80	2,05	14,80	2,29	19,80	2,48	135,20	4,06	255,20	4,74	375,20	5,20	495,20	5,56
4,90	1,67	9,90	2,05	14,90	2,30	19,90	2,49	137,60	4,08	257,60	4,75	377,60	5,21	497,60	5,56
5,00	1,68	10,00	2,06	15,00	2,30	20,00	2,49	140,00	4,10	260,00	4,77	380,00	5,22	500,00	5,57

* This table is valid if the circulating flow rate VR of the individual draw-off points is less than 0.5 l/s.

07.VIII SIZING OF INSTALLATIONS

According to CTE HS4, the flow rates to be taken into consideration are:

Equipment	Instantaneous Minimum Flow Rate (l/s)		Nominal Diameter of the Service Branch	
	Cold Water	Hot Water (DHW)	Steel Pipe (")	Copper or Plastic Pipe (mm)
Bathtub < 1.4 m	0.2	0.15	¾	20
Bathtub > 1.4 m	0.3	0.2	¾	20
Bidet	0.1	0.065	½	12
Shower	0.2	0.1	½	12
Kitchen Sink	0.2	0.1	½	12
Non-Domestic Sink	0.3	0.2	¾	20
Single Tap	0.15	0.1	-	-
Garage Tap	0.2	-	-	-
WC with Cistern	0.1	-	½	12
WC with Flush Valve	1.25	-	1 – 1 ½	25 – 40
Bathroom Sink	0.1	0.065	½	12
Laundry Tub	0.2	0.1	-	-
Domestic Washing Machine	0.2	0.15	¾	20
Industrial Washing Machine (> 8 kg)	0.6	0.4	1	25
Washbasin	0.05	0.03	½	12
Domestic Dishwasher	0.15	0.1	½ (threaded to ¾)	12
Industrial Dishwasher (20 place settings)	0.25	0.2	¾	20
Urinal with Cistern	0.04	-	½	12
Urinal with Timed Tap	0.15	-	½	12
Slop Sink	0.2	-	¾	20

- The minimum pressures shall be:
  100 kPa for standard taps.
  150 kPa for flush valves and water heaters.
- Pressure at any consumption point must not exceed 500 kPa.
- The temperature at DHW (ACS) consumption points must be between 50 and 65 ºC.
- Installations shall be sized by dividing the system into sections, always considering the most unfavorable section (the one with the greatest pressure loss).
- The design velocity must be between 0.5 and 3.5 m/s (for plastic pipes).
- The minimum supply diameters are:

Section Considered	Steel Pipe (")	Copper or Plastic Pipe (mm)
Supply to private wet rooms: bathroom, toilet, kitchen	¾	20
Supply to individual branch: dwelling, apartment, commercial premises	¾	20
Riser (upward or downward)	¾	50
Main distributor	1	25
Supply to air-conditioning equipment	< 50 kW	12
	50 – 250 kW	20
	250 – 500 kW	25
	> 500 kW	32

For DHW (ACS), the supply circuit is calculated in the same way as for cold water. For the return circuit, the flow rate shall be estimated so that, at the most distant tap, the temperature drop is no more than 3ºC from the outlet of the storage tank or heat exchanger. In any case, no less than 250 l/h shall be recirculated in each riser. It must be taken into account that at least 10% of the supply water is recirculated. The minimum internal diameter of the return pipe shall be 16 mm.

The diameters as a function of the recirculated flow rate are:

Diámetro tubería (“)	Caudal recirculado (l/h)
½	14
¾	300
1	600
1 ¼	1100
1 ½	1800
2	3300

07.IX ON-SITE RECOMMENDATIONS

- Take environmental conditions into account when carrying out welding operations, avoiding drafts that could cause undesired cooling.
- REPOLEN PPR pipes must never be exposed directly to sunlight, as they do not incorporate protection against ultraviolet radiation.
- In the event of low temperatures, check the condition of the pipe ends in case any involuntary impacts may have occurred during handling or transport.
- REPOLEN PPR pipes can be installed in direct contact with any traditional construction material.
- Pay special attention to thermal expansion, both in concealed and exposed installations, allowing for movement and placing supports where necessary and appropriate.
- In the case of buried installations, pipes must be laid at a depth of 0.8 m if no vehicular traffic is expected above, and 1 m if vehicular traffic may occur.



PPR

08.
JOINTING SYSTEMS page 58

08.I
JOINTING BY THERMOFUSION OR SOCKET WELDING 60

08.II
BUTT FUSION JOINTING 62

08.III
ELECTROFUSION JOINTING 63

08.IV
FLANGED SYSTEMS 64

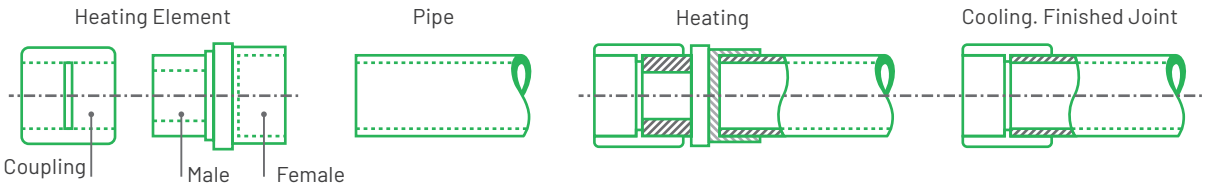
08.V
INSTALLATION OF BRANCHING SYSTEMS 65

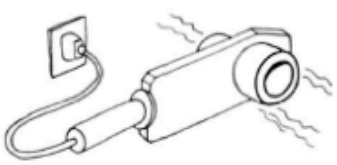
08.VI
REPAIRS 65

08.I JOINTING BY THERMOFUSION OR SOCKET WELDING

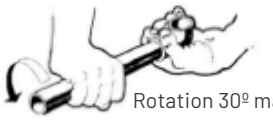
The process consists of joining a pipe and a fitting by applying heat to the outer surface of the pipe and the inner surface of the fitting. To do this, the pipe is inserted into the heating die, while another heating die is simultaneously inserted into the fitting.

Once the corresponding time has elapsed (see time table), the dies are removed and the pipe is inserted into the fitting, maintaining pressure for the specified time. This type of welding guarantees a perfect pipe-to-fitting joint. The final result behaves as a single homogeneous piece, thereby eliminating the risk of leaks.









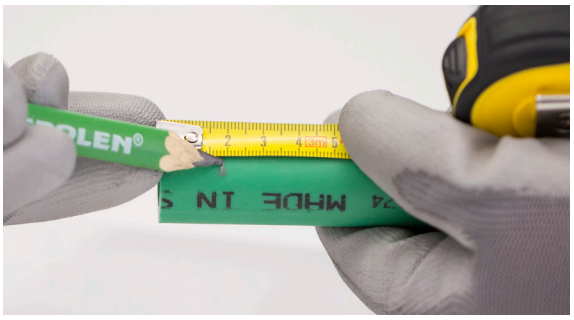
WELDING INSTRUCTIONS

- The temperature of the heating dies must be checked (275-285 ºC). Air drafts must be avoided, as they could cool one side of the die. Temperature differences do not guarantee a proper weld.
- Clean the pipe and the fitting with a clean cloth.
- Mark the insertion depth of the pipe.
  Insert the pipe and the fitting, applying slight pressure, allowing the material to melt gradually.
- Then time the heating period indicated in the attached table according to the pipe diameter.
- Remove the pipe and the fitting from the dies and insert the pipe into the fitting, maintaining pressure for the time indicated in the table.
- During this time, minor alignment corrections may be made. When using a bench welding machine (large diameters), the procedure is essentially the same, except that the pressure is applied by the machine frame.
- A correct weld will produce a uniform bead around the entire welded perimeter (see butt fusion weld bead).
- Wait approximately two hours before carrying out hydraulic tests.

Steps for Manual Welding



Check the length of pipe to be inserted into the fitting



Mark the measured length on the pipe



Apply the heating dies to the pipe and fitting



Insert the pipe into the fitting

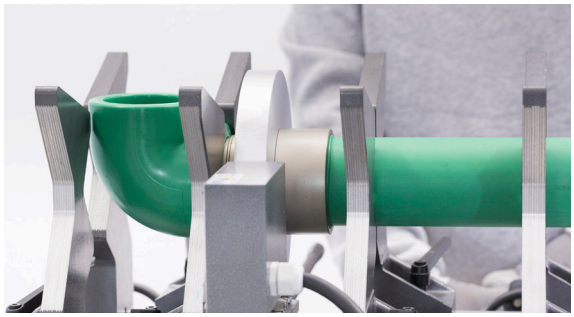
Steps for Machine Welding



Level the fitting on the machine



Apply the heating dies to pipes and fittings



Remove the heating dies

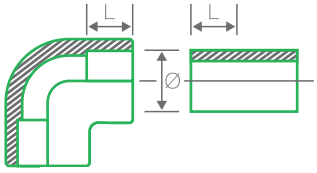


Insert the pipe into the fitting

Nominal Diameter (mm)	Heating Time (s)	Assembly Time (s)	Cooling Time (seg)
16	5	4	20
20	5	4	20
25	7	4	25
32	8	6	25
40	12	6	35
50	18	6	35
63	25	8	40
75	30	8	40
90	40	10	50
110	50	10	60
125	60	10	65
140	65	12	90
160	70	12	100

Note: It is recommended to wait at least a couple of hours before carrying out leak-tightness tests.

Working Depth Table	
Nominal Diameter (mm)	Minimum Depth (mm)
16	13
20	14.5
25	16
32	18
40	20.5
50	23.5
63	27.5
75	30
90	33
110	37
125	40
140	39.8
160	43.2



L = Length
Ø =Coupling Diameter

SPECIAL CARE OF HEATING DIES

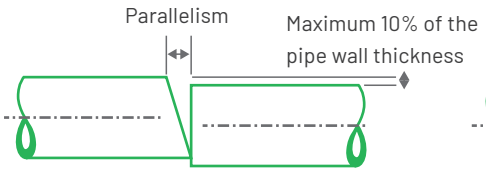
- It is important to keep them in good condition, preventing impacts or scratches.
- Always keep them clean. If any material remains adhered, remove it while hot using a clean cloth.
- If they are used for more than one material, cleaning after use is especially important.
- If they become damaged, replace them with new ones. The heating dies have a PTFE (Teflon) coating responsible for uniform heat distribution. If this coating is damaged, the die will not heat evenly across its surface and a proper weld cannot be guaranteed.

08.II BUTT FUSION JOINTING

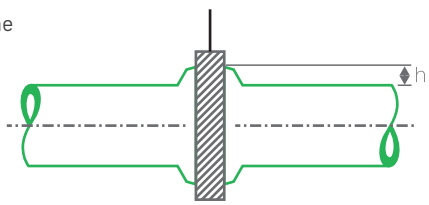
The procedure consists of heating two pipes (or a pipe and a fitting with the same outside diameter and wall thickness as the pipe) by means of a heating plate, and then achieving the joint by applying pressure to the two elements. It is generally used for large diameters. It is very important that it is always carried out between equal wall thicknesses and diameters.

WELDING INSTRUCTIONS

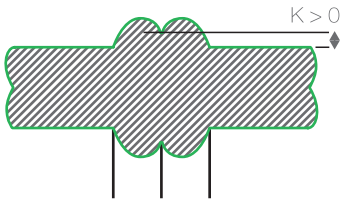
- Place the elements aligned in the welding machine.
- Face the pipes (using the machine's facing tool) to thoroughly clean and level the surfaces.
- Remove the facing tool and the burrs produced without touching the surfaces to be joined.
- Ensure the parallelism of the surfaces.
  Check that the heating plate is clean and at the correct temperature.
- Follow the pressure curve indicated by the machine manufacturer.
- Apply an initial pressure P1 for a time T1 to form the initial bead of height h.
- After this time, reduce the pressure to ensure complete heating P2 (preset welding pressure = 1.5 bar).
- After the heating time T2, retract the elements, remove the heating plate, and quickly join the pipe ends during T3.
- Gradually increase the pressure until reaching the value specified by the manufacturer P1 – T4.
- Maintain this pressure for the specified time until the weld has cooled (T5).
- Wait approximately two hours before carrying out hydraulic tests.



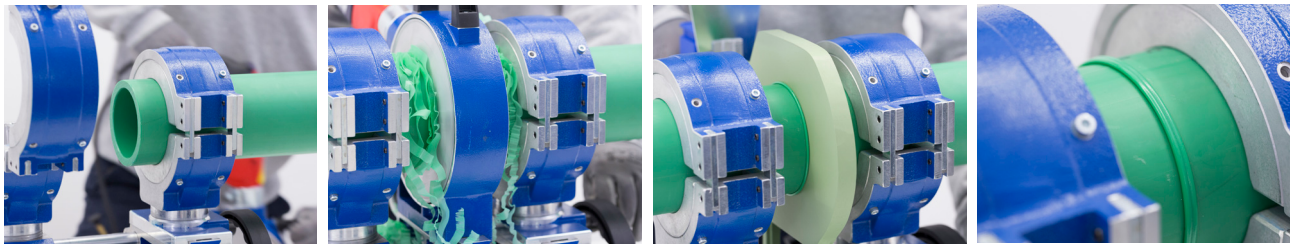
ALIGNMENT
Maximum admissible deviations

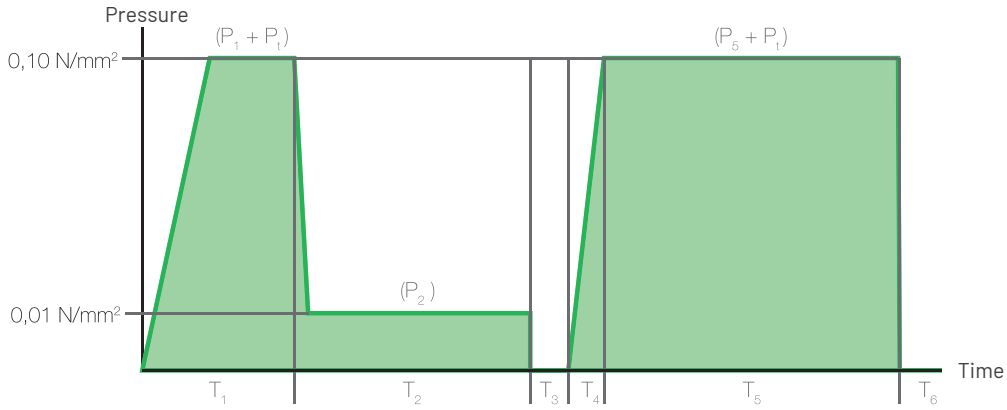


h = Initial bead height within time T



Final bead





08.III UNIÓN POR ELECTROFUSIÓN

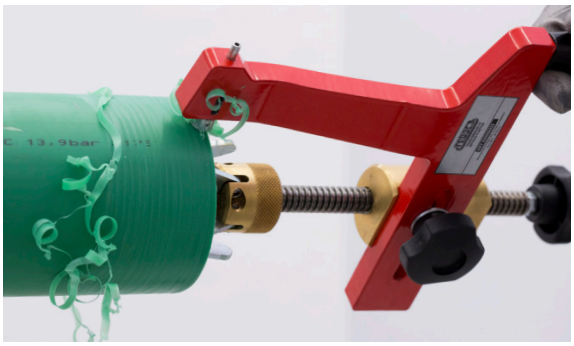
The system consists of passing a low-voltage electric current through metallic coils located inside the fittings, embedded in the polypropylene, generating heating by the Joule effect, which causes the fusion welding of the fitting to the pipe previously inserted into it.



Check the length of pipe to be inserted into the fitting



Mark the measured length on the pipe



Scrape the surface to be welded (preferably using an automatic scraper)



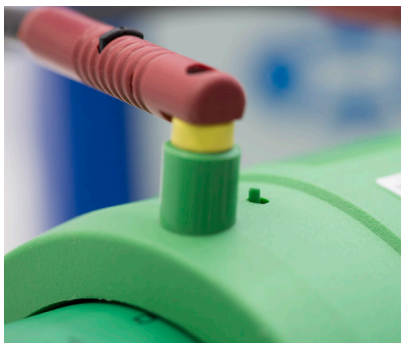
Insert the pipe into the fitting without forcing it (the pipe must enter smoothly, without force and without play)



Connect the machine terminals to the fitting



Read the code on the fitting label



Wait until the welding process is completed (indicator pins pop out)

08.IV FLANGED SYSTEMS

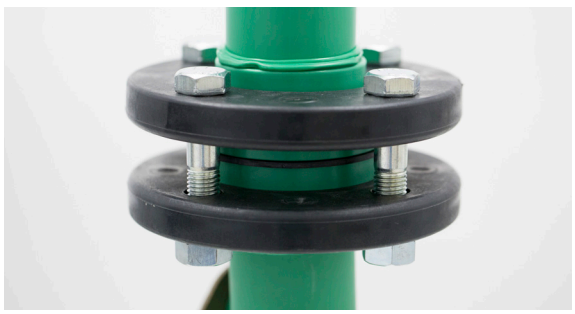
Reboca, S.L. provides flanged systems that allow the connection between pipelines. REPOLEN flanges are PN16. Please note that bolt tightening must always be carried out in a crosswise pattern and progressively, in order to ensure a perfect seating of the gasket.

Size	PN	Thickness (mm)	Outside Diameter (mm)	Inside Diameter (mm)	Nº of Holes
32	16	16,8	117	42,5	4
40	16	18	141,5	51	4
50	16	18	151	62,5	4
63	16	19,5	165	78	4
75	16	19,5	188,5	93	4
90	16	19,5	199	113	8
110	16	19,5	224,5	134	8
125	16	25	250	168	8
140	16	25	250	159	8
160 PPR	16	19,5	285	191,5	8
160 PE	16	19,5	285	179,5	8
200	16	24	341,5	236	12
250	16	30	404,5	288,5	12
315	16	34	462,5	338	12



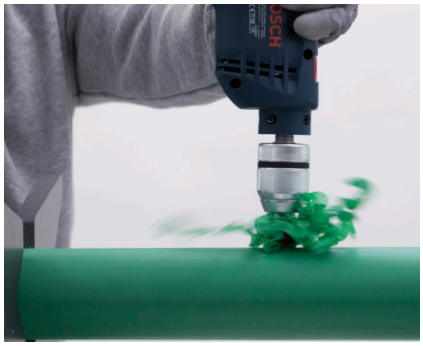




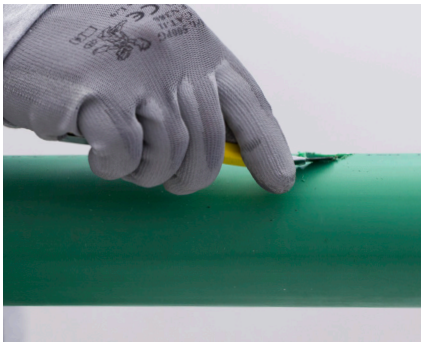


08.V BRANCHING SYSTEM INSTALLATIONS

The REPOLEN socket system allows modifications to be made to existing installations with great ease.



Make a hole in the pipe at the point where the new connection is to be made, using the appropriate drill bit



Cut off any remaining edges, taking care not to damage the pipe



The heating dies must be applied both to the pipe and to the branch fitting to be inserted, proceeding in the same manner as with any socket fusion weld



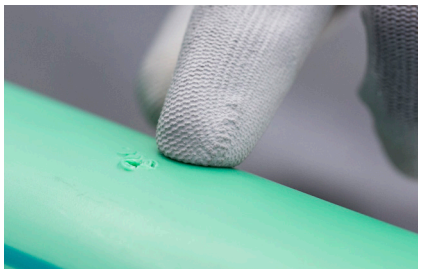
Remove the heating dies and insert the branch fitting into the hole



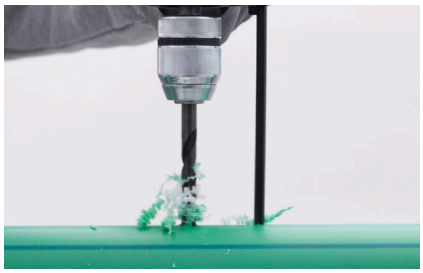
Level the outlet before the weld cools down

08.VI SYSTEM REPAIR

If, on an already completed installation, a minor break, an involuntary hole, etc. occurs, it will be sufficient to use a repair plug, together with the appropriate heating die, to resolve it.



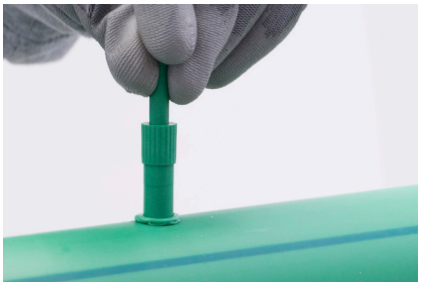
Depending on the size of the hole, apply a 6 mm or 10 mm drill bit



The hole must be perfectly round



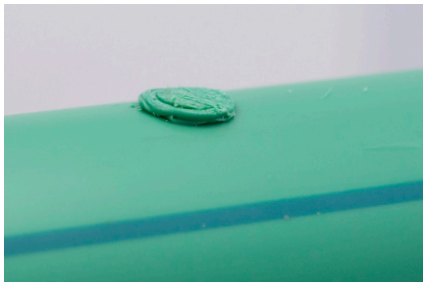
Apply the repair heating dies both to the hole and to the repair plug



Insert the repair plug into the hole, taking care not to insert it too deeply, in order to avoid creating turbulence in the water flow



Cut off the excess plug material



Final appearance



PPR

09.I CHEMICAL RESISTANCE TABLE

- **+** Resistant with insignificant variations
- **/** Low resistance under certain conditions, undergoing alterations
- **-** Not resistant

sat. fr. Cold saturated
e Boiling
a Aqueous solution

PRODUCT	CONCENT.	TEMPERATURE		
	%	20ºC	60ºC	100ºC
Oil No. 3 according to ASTM D380-59	100	+	/	-
Camphorated Oil		-		
Animal Oil		+	+	
Peanut Oil	100	+	+	/
Coconut Oil		+	+	
Fish Liver Oil		+		
Linseed Oil	100	+	+	+
Corn Oil	100	+	/	
Animal-Origin Oil	100	+	/	
Vegetable-Origin Oil	100	+	/	
Olive Oil	100	+	+	+
Palm Kernel Oil		+	/	
Silicone Oil	100	+	+	+
Soybean Oil	100	+	/	
Vaseline Oil		+	/	-
Fine Spindle Oil	100	+	-	
Transformer Oil	100	+	/	
Lubricating Oils	100	/		
Mineral Oils (without aromatic components)	100	+	/	-
Machine Oils	100	+	/	-
Engine Oils	100	+	/	-
Acetaldehyde	100	/	-	
	a. 40	+	+	
Ammonium Acetate	a. cualq.	+	+	+
Amyl Acetate	100	/	-	
Butyl Acetate	100	/	-	-
Ethyl Acetate	100	+	/	
Methyl Acetate	100	+	+ e	
Lead Acetate	a. sat. fr.	+	+	
Vinyl Acetate	100	+	/	
Sodium Acetate	a. sat. fr.	+	+	+
Acetophenone	100	+	/	
Acetone	100	+	+ e	
Acetic Acid (glacial)	100	+	/	-

PRODUCT	CONCENT.	TEMPERATURE		
	%	20ºC	60ºC	100ºC
Acetic Acid	70	+	+	
	50	+	+	
	30	+	+	
	10	+	+	+
Battery Acid	d = 1,28	+	+	
Adipic Acid	a.	+	+	
Anthraquinone Sulfonic Acid	a. (susp)	+		
Arsenic Acid	a. 80	+	+	
	a. dil.	+	+	
Benzoic Acid	100	+	+	
	a. cualq.	+	+	+
Boric Acid	100	+	+	+
	a. sat. fr.	+	+	+
Hydrobromic Acid	conc.	+		
Bromic Acid	conc.	+		
Butyric Acid	a. 20	+		
	100	+		
Citric Acid	a. cualq.	+	+	+
Hydrochloric Acid	36	+	+	
	10	+	+	+
Chloric Acid	a. 1	+	/	-
Chloroacetic Acid	(di) 100	+	/	
	(mono) 100	+	+	
	(tri) 100	+	+	
Chlorosulfonic Acid	100	-	-	-
Chromic Acid	50	+	+	
	20	+	+	
Diglycolic Acid	a. 30	+	+	
	a. sat. fr.	+		
Stearic Acid	100	+	/	
Hydrofluoric Acid	70	+		
	40	+	+	

PRODUCT	CONCENT.	TEMPERATURE		
	%	20ºC	60ºC	100ºC
Formic Acid	100	+	/	
	a. 85	+	/	
	a. 50	+	/	
	a. 2n (~9)	+	+	
Phosphoric Acid	85	+	+	+
	60	+	+	
	to 30	+	+	
Phthalic Acid	a. 50	+	+	
Glycolic Acid	100	+		
Palm Kernel Fatty Acid	100	/	-	
Lactic Acid	a. 90	+	+	+
	a. 50	+	+	+
	a. 20	+	+	+
	a. 10	+	+	+
Maleic Acid	100	+	+	
	a. sat. fr.	+	+	
Malic Acid	a. sat. fr.	+	+	
Nitric Acid	68	-	-	
	50	/	-	
	to 30	+	/	
Oleic Acid	100	+	/	-
Oxalic Acid	a. 50	+	/	
	a. 30	+	+	+
	a. sat. fr.	+	/	
Perchloric Acid	a. 2n	+	+	
Picric Acid	1	+		
Propionic Acid	a. 50	+	+	
Prussic Acid	a. cualq.	+	+	
Silicofluoric Acid	a. hasta 32	+		
Succinic Acid	100	+	+	
	a. sat. fr.	+	+	
Sulfuric Acid	98	/	-	
	85	+	/	
	50	+	+	
	10	+	+	+
Fatty Acids (C6)	100	+	+	
Tartaric Acid	a. 10	+	+	
	a. sat. fr.	+	+	
Acrylonitrile	100	+		
Dinonyl Adipate	100	+		
Dioctyl Adipate	100	+		
Water (drinking, distilled)		+	+	+
Bromine Water	sat. fr.	-	-	-
Chlorine Water	sat. fr.	/	-	

PRODUCT	CONCENT.	TEMPERATURE		
	%	20ºC	60ºC	100ºC
Seawater		+	+	+
Soda Water		+	+	
Mineral Water		+	+	+
Hydrogen Peroxide	30	+	/	
	10	+	+	
	4	+	+	
Aqua Regia		/	-	
Camphor	100	+		
Allyl Alcohol	96	+	+	
Amyl Alcohol	100	+	+	+
Benzyl Alcohol	100	+	/	
Wax Alcohol	100	/	-	
Copra Alcohol	100	+	/	
Ethyl Alcohol	100	+		
	96	+	+	+
Ethyl Alcohol (fermenting)	usual	+		
Ethyl Alcohol + Acetic Acid (fermenting)	usual	+		
Furfuryl Alcohol	100	+	/	
Methoxybutyl Alcohol	100	+		
Propargyl Alcohol	a. 7	+	+	
Starch	100	+	+	
	solution	+	+	
Tar		+	/	
Alums (all types)		+	+	
Ammonia	a. 30	+	+	
	a. 15	+		
	a. 10	+	+	
	gas 100	+	+	
	liquid 100	+		
Acetic Anhydride	100	+	/	-
Sulfurous Anhydride	cualq.	+	+	+
Aniline	100	+	+	
Anisole		/	/	
Antifreeze		+	+	+
Antiformin (benzaldoxime)	a. 2	+	+	
Salted Herrings		+		
Rum Flavoring		+		
Asphalt		+	/	
Aspirin		+		
Sugar (dry)	100	+	+	+
Sugar (solution)	a. cualq.	+	+	+
Sulfur	100	+	+	+
Chrome Baths		+	+	

PRODUCT	CONCENT.	TEMPERATURE		
	%	20ºC	60ºC	100ºC
Benzene	100	/	-	
Benzaldehyde	100	+		
	a. sat. fr.	+		
Sodium Benzoate	a. sat. fr.	+	+	
Carbon Dioxide	(wet) cualq	+	+	
	(dry) 100	+	+	
Sodium Bisulfite	a. sat. fr.	+	+	
Mothballs		+		
Potassium Borate	a. 1	+	+	
Borax	a. sat. fr.	+	+	+
Potassium Bromate	a. sat. fr.	+	+	+
Bromine	(liquid) 100	-		
	(gas) Alta	-	-	
	(gas) Baja	/	-	
Potassium Bromide	a. sat. fr.	+	+	+
Butadiene	100	/	-	
Butane	(gas) 100	+	+	
	(liquid) 100	+		
Butanediol	a. 100	+	+	
Butanol	100	+	/	/
Butanetriol	a. 100	+	+	
Butylphenol	sat. fr.	+		
Butylphenone	100	-		
Butyl Glycol	100	+		
Butynediol	100	+		
Butyraldehyde	100	/		
Butoxyl		+		
Cocoa	ready for consumption	+	+	+
	powder	+		
Coffee	ready for consumption	+	+	+
	beans and ground	+		
Cinnamon		+		
Sodium Bicarbonate (Sodium Hydrogen Carbonate)	a. sat. fr.	+	+	+
Ammonium Carbonate	a. cualq.	+	+	+
Calcium Carbonate	a. sat. fr.	+	+	+
Potassium Carbonate	a. sat. fr.	+	+	
Sodium Carbonate	a. 10	+	+	+
	a. sat. fr.	+	+	
Beeswax		+	/	
Encaustic Wax	100	+	/	
Beer		+		
Potassium Cyanide	100	+		
	a. sat. fr.	+	+	

PRODUCT	CONCENT.	TEMPERATURE		
	%	20ºC	60ºC	100ºC
Cyclohexane	100	+		
Cyclohexanol	100	+	/	
Cyclohexanone	100	+	/	
Clofenos		+	/	-
Chloramine	a. cualq.	+		
Potassium Chlorate	a. sat. fr.	+	+	+
Sodium Chlorate	a. sat. fr.	+	+	
Aniline Hydrochloride	a. sat.	+	+	-
Phenylhydrazine Hydrochloride	a.	+	/	
Sodium Chlorite	a. sat.	+	/	
Chlorine	gas, dry 100	-	-	-
	gas, wet 10	/	-	-
	liquid 100	-		
Chlorobenzene	100	+		
Chloroethanol	100	+	+	
Chloroform	100	/	-	-
Ammonium Chloride	a. cualq.	+	+	+
Antimony Chloride	a. 90	+		
Benzoyl Chloride	100	/		
Chlorinated Lime	aqueous	+	+	
Calcium Chloride	a. 50	+	+	+
	a. 10	+	+	+
	a. sat. fr.	+	+	+
Ethyl Chloride	100	/		
Ethylene Chloride	100	/		
Hydrogen Chloride (gaseous, dry and humid)	cualq.	+	+	
Methylene Chloride	100	/	- e	
Methyl Chloride	100	/	-	
Sulfuryl Chloride	100	-		
Thionyl Chloride	100	-		
Tricyanogen Chloride	100	+		
Stannous Chloride	a. sat. fr.	+	+	
Potassium Chloride	100	+	+	+
Sodium Chloride	a. sat. fr.	+	+	+
	a. 10	+	+	+
	a. 50	+		
Coca-cola		+		
Calendering Adhesive		+	+	
Apple Compote		+	+	+
Cognac		+		
Shoe Polish Cream		+	/	
Cresols	100	+	/	
	solution	+		

PRODUCT	CONCENT.	TEMPERATURE		
	%	20ºC	60ºC	100ºC
Potassium Chromate	a. 40	+	+	+
Crotonaldehyde	100	+		
CY3 (machine oil)		+	/	-
Shampoo		+	+	
Sauerkraut (ready to serve)		+	+	+
Decalin	100	/	/	
Dextrin	a. sat. fr.	+		
Dichlorobenzene	100	/		
Dichloroethane	100	+		
Dichloroethylene	100	+		
Potassium Dichromate	a. sat. fr.	+	+	+
Diethanolamine	100	+		
Diisobutyl Ketone	100	+	-	-
Dimethylamine	100	+		
Dimethylformamide	100	+	+	
Dioxane	100	/	/	-
Light DTE (turbine oil)		-	-	
Processed Meat		+	+	
False Fir Needle Essence	100	+	+	
Scots Pine Needle Essence		+	+	
Bitter Almond Essence		+		
Clove Essence		+	/	
Lemon Peel Essence		+		
Orange Peel Essence		+		
Lemon Essence		+		
Mint Essence		+		
Nail Polish		+	/	
Yeast Spices		+	+	
Whale Spermaceti		+		
Amyl Acetate Ester	100	/	-	
Butyl Acetate Ester	100	/	-	
Ethyl Ester of Monochloroacetic Acid	100	+	+	
Methyl Acetate Ester	100	+	+ e	
Methyl Ester of Dichloroacetic Acid	100	+	+	
Methyl Ester of Monochloroacetic Acid	100	+	+	
Isopropyl Ester	100	/	-	
Petroleum Ether	100	+	/	
Dibutyl Ether	100	/	-	
Ethyl Ether	100	/		
Ethylbenzene	100	/	-	
Ethylene Glycol	100	+	+	+
Ethyl Acetate	100	+	/	
Ethylhexanol	100	+		

PRODUCT	CONCENT.	TEMPERATURE		
	%	20ºC	60ºC	100ºC
Cellulose Tanning Extracts	usual	+		
Vegetable Tanning Extracts	usual	+		
Phenol	a. sat. cal.	+	+	
	comerc.	+	+	
Fluorine (dry)	100	-		
Ammonium Fluoride	a. to 20	+	+	
Formaldehyde	a. 30/40	+	+	
	a. 10	+	+	
Ammonium Phosphate	a. cualq.	+	+	+
Tricresyl Phosphate	100	+	/	
Trioctyl Phosphate		+		
Sodium Phosphates	a. sat. cal.	+	+	+
Phosgene	100	/	/	
Freon 113	100	-		
Fructose		+	+	+
Butyl Phthalate	100	+	/	/
Dibutyl Phthalate	100	+	/	/
Dihexyl Phthalate	100	+	/	
Dinonyl Phthalate	100	+		
Dioctyl Phthalate	100	+	/	
Fuel oils	100	+	/	
Roasting Gas (dry)	cualq.	+	+	
Illuminating Gas (benzene-free)		+		
Carbonated Beverages		+		
Diesel Oil	100	/		
Crude Gasoline	100	/	-	
Regular Gasoline	100	/	-	
Super Gasoline	100	/	-	
Gasoline b.p. 100-140 ºC	100	/	-	
Gelatin	a. cualq.	+	+	
Gin		+		
Glycerin	100	+	+	+
	a. cualq.	+	+	+
Glycine	a. 10	+		
Glycol	100	+	+	+
	cualq.	+	+	+
Glucose	a. sat. cal.	+	+	+
Glucose (grape sugar)	a. sat. cal.	+	+	
Flour	100	+		
Heptane	100	/	/	
Hexane	100	+	/	
Hexanetriol	100	+	+	+
Chloral Hydrate	cualq.	/	-	
Hydrazine Hydrate		+		

PRODUCT	CONCENT.	TEMPERATURE		
	%	20ºC	60ºC	100ºC
Hydrogen	100	+	+	-
Hydroquinone	100	+		
Barium Hydroxide	a. cualq.	+	+	
Sodium Hydroxide	100	+	+	
Calcium Hypochlorite	a. cualq.	+	+	
Sodium Hypochlorite	a. 20	+	/	
	a. 10	+	+	
	a. 6	+	+	+
Isobutyraldehyde	100	/		
Isooctane	100	+	/	
Isopropanol	100	+	+	+
	a. cualq.	+	+	
Soap	liquid	+	+	
	in bar	+	+	
Jelly		+	+	+
Tomato Juice		+	+	
Tomato Ketchup		+	+	
Lanolin (Wool Grease)		+	/	
Milk		+	+	+
Legumes		+	+	+
Bisulfite Bleach, SO_2 content	a. sat. cal.	+	+	
Bleaching Agent, 12.5% Active Chlorine		+	/	-
Yeast	a. cualq.	+		
Liqueurs		+		
Brake Fluid	100	+		
Lysol		+	/	
Fruit Salad		+	-	
Mayonnaise		+		
Lard		+	+	/
Butter		+	+	
Margarine		+	+	
Molasses	usual	+	+	
Beet Molasses		+	+	+
Menthol	100	+		
Mercury	100	+	+	
Jam		+	+	+
Methanol	100	+	+ e	
	a. 50	+	+	
Methylamine	100	+		
	a. 32	+		
Methyl Bromide	100	-	-	
Methyl Ethyl Ketone	100	+	/	
Chromic Mixture		-	-	
Mixture of Naphthene and Liquid Paraffin 8.5ºE	100	+	/	-

PRODUCT	CONCENT.	TEMPERATURE		
	%	20ºC	60ºC	100ºC
Mixture of Liquid Paraffins 12–15ºE		+	/	
Honey		+	+	
Morpholine		+	+	
Mustard		+		
Mowilith D		+		
Naphthalene	100	+		
Cream		+		
Ammonium Nitrate	a. cualq.	+	+	+
Calcium Nitrate	a. 50	+	+	
Silver Nitrate	a. 20	+	+	+
Potassium Nitrate	100	+	+	
	a. sat. fr.	+	+	
Sodium Nitrate	a. sat. fr.	+	+	
Nitrobenzene	100	+	+	
Nitrotoluene		+	/	
Octylcresol	100	/	-	
Oleum	cualq.	-	-	-
Urine		+	+	
Phosphorus Oxychloride	100	+	/	
Ethylene Oxide	100	/ e		
Oxygen	cualq.	+	/	
Ozone	50 pphm	+	/	
Sodium Palmitate	5	+	+	+
Paraffin	100	+	+	-
	liquida 100	+	/	-
Toothpaste		+	+	
Pectin	a. sat. fr.	+	+	
Phosphorus Pentoxide	100	+		
Sodium Perborate	a. sat. fr.	+	+	+
Potassium Perchlorate	a. 1	+	+	
Perchloroethylene	100	/	-	
Perfume		+		
Potassium Permanganate	a. sat. fr.	+	+	
Potassium Persulfate	100	+		
	a. cualq.	+	+	
Fish	escabeche	+	+	+
Petroleum	100	+	/	
Paprika		+	+	
Pepper		+	+	
Pyridine	100	/	/	
Caustic Potash	55	+	+	+
	25	+	+	+
	2n	+	+	+
Dairy Products		+	+	+

PRODUCT	CONCENT.	TEMPERATURE		
	%	20ºC	60ºC	100ºC
Dishwashing Products		+	+	+
Propane	gas 100	+	+	
	liquid 100	+		
i-Propanol + n-Propanol	100	+	+	
Propylene Glycol	a. 100	+	+	
Pudding		+	+	+
Furniture Polish		+	/	-
Kerosene	100	/	/	-
Cheese		+		
Quinine		+		
Nail Polish Remover		+	/	
Horseradish		+		
Cottage Cheese		+		
Photographic Developers	ready to use	+		
	comercial	+	+	
Rum		+	+	
Sagrotan		+	/	
Common Salt	a. cualq.	+	+	
Fertilizer Salt	a. sat.	+	+	
Fixing Salt Solution	cualq.	+	+	
Aluminum Salts	a. cualq.	+	+	+
Barium Salts	a. cualq.	+	+	+
Zinc Salts	a. sat. fr.	+	+	
Copper Salts	a. sat. fr.	+	+	
Chromium Salts (divalent and trivalent)	a. sat. fr.	+	+	
Iron Salts	a. sat. fr.	+	+	+
Mercury Salts	a. sat. fr.	+	+	
Nickel Salts	a. sat. fr.	+	+	
Silver Salts	a. sat. fr.	+	+	
Magnesium Salts	a. sat. fr.	+	+	+
Dibutyl Sebacate	100	+		
Beef Tallow	100	+	+	
	sulfur emission	+		
Shell-Dromus	a. 0,5	+	/	/
Soluble Silicate		+	+	
Silicone Emulsion		+	+	+
Viscose Solution for Spinning		+	+	
Soapy Solution	cualq.	+	+	
Iodine-Iodide Solution	50	+	+	
Caustic Soda	52	+	+	+
	30	+	+	+
	2n	+	+	+
Skimmed Whey		+		
Ammonium Sulfate	a. cualq.	+	+	+

PRODUCT	CONCENT.	TEMPERATURE		
	%	20ºC	60ºC	100ºC
Dimethyl Sulfate	100	/	-	
	a. 50	/	/	
Hydrazine Sulfate	10	+	+	
Hydroxylamine Sulfate	a. 12	+	+	
Potassium Sulfate	a. sat. fr.	+	+	
Sodium Sulfate (Glauber's Salt)	a. sat. fr.	+	+	
Sodium Sulfide	a. 40	+	+	
	a. sat. fr.	+	+	
Fatty Alcohol Sulfonate		+	/	
Ammonium Sulfide	a. cualq.	+	+	
Carbon Disulfide	100	+		
Hydrogen Sulfide	(seco) 100	+	+	
	a. cualq.	+	+	
Tea	consumption	+	+	+
	hojas	+	+	
Tetrachloroethane	100	/	-	
Tetrachloroethylene	100	/	-	
Carbon Tetrachloride	100	-	-	
Tetraethyl Lead	100	+		
Tetrahydrofuran	100	/	-	
Tetralin (Tetrahydronaphthalene)	100	-	-	
Ink		+	+	
Iodine Tincture	usual	+		
Thiophene	100	/	-	
Sodium Thiosulfate	a. sat. fr.	+	+	
Toluene	100	/	-	
Turpentine	100	-	-	-
Trichloroethylene	100	/	/	
Antimony Trichloride	100	+	+	
Phosphorus Trichloride	100	+		
Triethanolamine	100	+		
Urea	a. sat. fr.	+	+	
Vanilla		+	+	
Nitrous Vapors	conc.	+	-	-
Petroleum Jelly		+	/	
Wine		+	+	
Whisky		+		
White spirit	100	/	-	
p-Xylene	100	-	-	
Potassium Iodide	a. sat. fr.	+	+	
Lemon Juice		+	+	
Apple Juice		+	+	
Pineapple Juice		+	+	
Fruit Juice		+	+	+

MADE IN SPAIN

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