

TECHNICAL CATALOGUE

PPR

PIPES AND FITTINGS DN 16-630



4.3.3 Preparation of the Welding Process Tool	38
4.3.4 Preparation and marking of pipes	38
4.4 WELDING	39
4.4.1 Preparation of the Tools for process of welding	39
4.4.2 Heating the fusion apparatus	39
4.4.3 Preparation and marking of pipes	39
4.4.4 Heating of pipes and fittings	39
4.4.5 Heating time	39
4.4.6 Connecting pipes and fittings	40
4.4.7 Correction time	40
4.4.8 Connection time	40
4.4.9 Cooling time of the joint	40
4.5 Successive welding of the Saddle couplings	41
4.5.1 Preparation of the Tools for process of welding	41
4.5.2 Preparation of pipes and saddle welding joints	41
4.5.3 Welding of a saddle attachment - heating process	42
4.5.4 Connecting the saddle pipe fittings	42
4.6 Welding the pipe through electrofusion fittings	43
4.6.1 Preparation of the electrofusion tool	43
4.6.2 Preparation of electro-tube tubes welding	43
4.6.3 Electrical fusion welding	43
4.6.4 Cooling process with electrofusion welding	44
4.7 Welding of large diameter pipes	44
4.7.1 Welding of pipes using a elding machine with stand and teflon	44
4.7.2 Butt welding	46
4.8 Pipe repair technique	47
4.9 Connection of PP-R and PP-RCT pipes with other tubular materials	48
4.9.1 Brass inserts (PP-R)	48
4.9.2 Brass inserts (PP - RCT)	49
4.9.3 Mixed pipe system PP-R, PP-RCT/Copper	49
4.9.4 Connection of PP-R and PP-RCT tubes at the outflow points	50
4.10 TYPES OF PIPELINE	51
4.10.1 Cold water pipelines	51
4.10.2 Hot water pipelines	51
4.10.3 Piping systems for recirculation systems	51
4.11 Reliance pipelines	52
4.11.1 Determination of sizes of clips and clamps for PP-R and PP-RCT pipes	52
4.11.2 Positioning of the tube supports in the visual direction and direction of the pipe through the dedicated channels	52
4.11.3 Installation of outlet points	53
4.12 Linear Scrolls, Spreads and Collections	54
4.12.1 Linear Expansion and Collection	54
4.12.1.1 Coefficient of linear expansion and shrinkage - temperature dilatation coefficient	55
4.12.2 Acceptance of tube elongation by changing the direction	56
4.12.3 Acceptance of tube elongation	56
4.12.4 Acceptance of tube elongation	57
4.13 Pipe insulation	58
5. USING OF PIPELINE	59
5.1 INSTALLATION TESTING	59
5.1.2 Measurement of pressure	59
5.1.3 Test protocol	59
5.2 EXAMPLES OF THE SYSTEM OF PP-R I PP-RCT TUBE	60
5.2.1 Pre-examination and main testing	60
5.2.2 Final examination	60
5.3 Test protocol record form	61
5.4 Flushing the pipeline	62
5.5 Shooting on the pressure	62

GENERAL NOTES

The technical catalog is subject to change in certain time intervals as a consequence of the adoption of new ones products and modifications thereof. For this reason, it is necessary Check if you have the latest version of the technical catalog. The technical catalog date is located on the cover page of the catalog and the latest version you can download from www.pestan.net or request it via mail office@pestan.net.

Quick access to chapters is provided with the help pictograms.

Important information



Safe recommendation



Legal Note



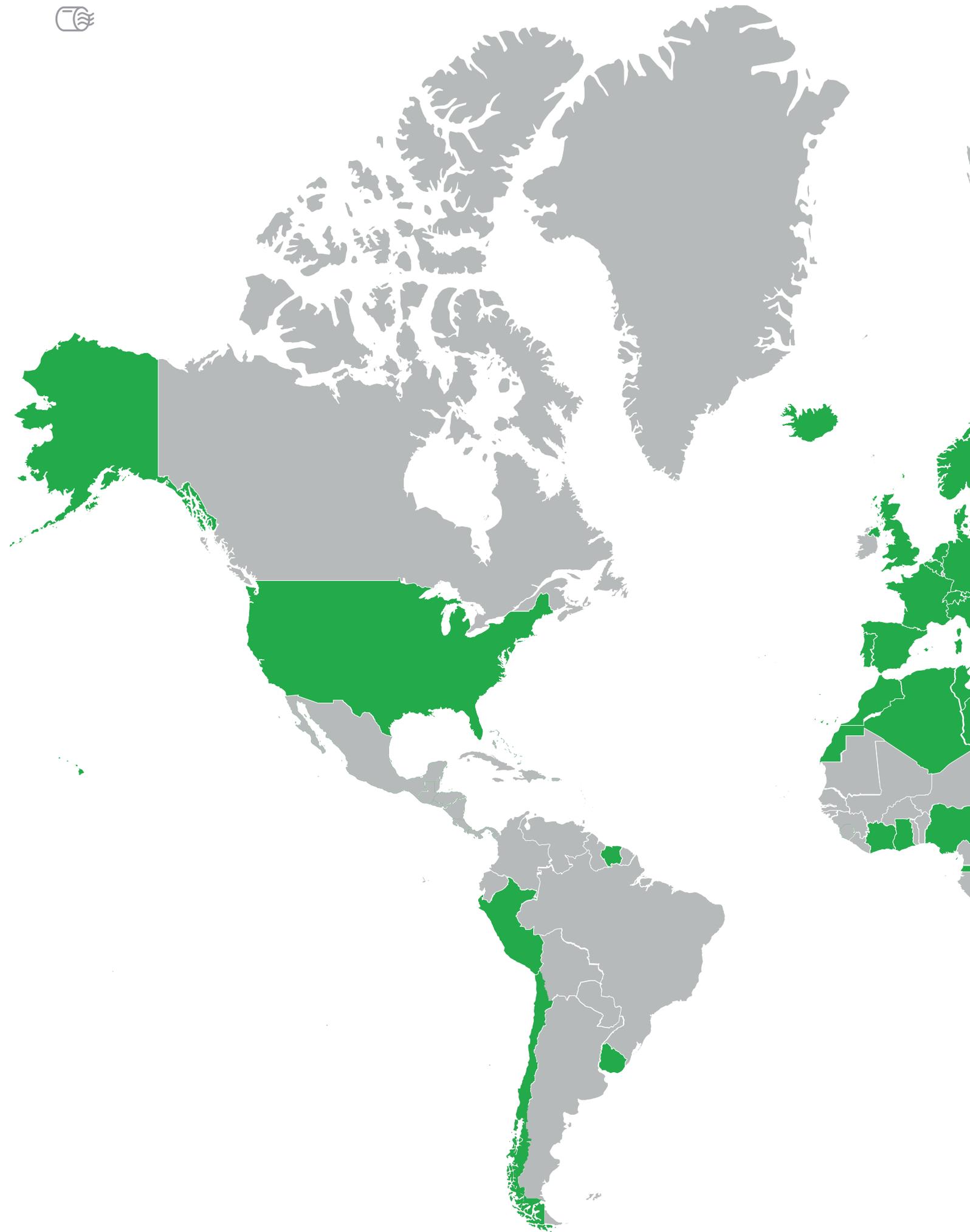
Before you start installing Pestan PP-R and PPR-CT pipes and fittings for the transport of fluids under pressure both in the household and in the industrial sector apply, be sure to read all references related for safety at work, all for your own security and safety of people around you. All time while install the system keep this instruction with you. If you some details from this technical catalog are not clear contact us at mail office@pestan.net

General safety recommendations:

- Consider the general safety rules for prevention accidents when placing pipes and fittings
- Ensure sufficient light when installing pipes and fittings
- Keep your work area clean
- Keep away children, pets and unauthorized persons from tools and places for placing pipes and fittings (this is special important in case of renovation)

Measures when installing the system:

- If you have jewelry or other items that hanging, be sure to remove them before installing
- Cutting tools should be properly disposed of and to use with great care because they have sharp edges
- When cutting pipes, a safe distance should be maintained between the hand holding the tube and cutting tools, and never put your hands near the part where the tool cuts
- When you are servicing, maintaining, or changing the place assembly, always turn off the power on the tool.





ABOUT US

Private company Peštan is the leader in the Balkans in production of plastic pipes and fittings for water, sewage and gas. The company was founded in 1989 and produces water pipes made of polyethylene. Over time, she introduced new ones materials (polypropylene and PVC) and expanded the production program. Today more than 5000 products can be found from the pipe and fittings and PVC profiles, through luxurious and modern drains, to the tape for irrigation.

Production plants are located in Arandjelovac 70 kilometers south from Belgrade, and foreign representations in countries in the region are:

Bosnia and Herzegovina, Romania, Croatia as well as in Ukraine and UAE.

The company is present on the market of Europe, Russia, the Middle East, North Africa, Latin America and the United States Country. Export is oriented and sales are realized in over 70 countries of the world!

PEŠTAN established the organization and business of the Company and certified according to the requirements of the Integrated System management,

- quality management of ISO 9001 (since 2004)
- environmental management, ISO 14001 (since 2010)
- management of health and safety at work of OHSAS 18001 (since 2010)

PEŠTAN has certified its products according to the appropriate one normative regulations in the most eminent certification bodies: DVGW, MPA, SABS, BULGARKONTROLE, EBETAM, IGH, VUPS, VUSAPL, ICC, SKZ, EMI...

We are doing our best to satisfy the needs of our customers, the company continuously introduces innovations and improves cadres and equipment. Since 2009, SAP ERP has been introduced to the company with modules MM, SD, PP, Fi and CO, and since 2012 are functionality expanded and WMS. Introduction of WCM and WMS system increased efficiency, contributed to deployment cost and professional maintenance. Since 2015 in Sap is implemented and quality management module (QM).

Employees of the company Pestan, which has over 1000, are joint Efforts justify the slogan of the company: WE BUILD THRUST!



1 STANDARDS

STANDARDS APPLYING ON PEŠTAN PP - R and PPR - CT PIPES AND FITTINGS

ISO 15874:2013 Plastics piping systems for hot and cold water installations — Polypropylene (PP) — Part 1: General

ISO 15874:2013 Plastics piping systems for hot and cold water installations — Polypropylene (PP) — Part 2: Pipes

ISO 15874:2013 Plastics piping systems for hot and cold water installations — Polypropylene (PP) — Part 3: Fittings

ISO 1167-2 Thermoplastics pipes, fittings and assemblies for the conveyance of fluids — Determination of the resistance to internal pressure — Part 2: Preparation of pipe test pieces

ISO 9854-1:1994 Thermoplastics pipes for the transport of fluids — Determination of pendulum impact strength by the Charpy method — Part 1: General test method

ISO 9854-2:1994, Thermoplastics pipes for the transport of fluids — Determination of pendulum impact strength by the Charpy method — Part 2: Test conditions for pipes of various materials

EN ISO 3126:2005 Plastics piping systems - Plastics components - Determination of dimensions

EN ISO 2505:2005 Thermoplastics pipes - Longitudinal reversion - Test method and parameters

ISO 1133-1:2011 Plastics - Determination of the melt mass-flow rate (MFR) and melt volume-flow rate (MVR) of thermoplastics - Part 1: Standard method

ASTM F 2389 Standard specification for pressure rated polypropylene (PP) piping system

NSF/ANSI 61 Drinking Water System Components-Health Effects

NSF/ANSI 61 Influence of components of water supply systems and their effect on health

2 DATA

BASIC INFORMATION ABOUT PEŠTAN PPR PIPES AND FITTINGS

2.1 Polipropilen (PP-R)



Picture no. 1: Polypropylene

Polypropylene (PP) is a linear hydrocarbon polymer, which belongs to the group of saturated polymers and represents thermoplastic polymer. It comes in the form of white transparent granules, but it can also be painted with pigments. Polypropylene is one of the most widely used materials for the production of pipes and fittings for water supply. Thanks to its application in water supply good physical-chemical properties that can be adjusted by adding different types of additives. Features that distinguish it are: moderate elasticity, good hardness, good fatigue resistance, resistance to chemicals and heat... PP has no trouble with cracking during pressure and offers excellent electro and chemical resistance.

2.1.1 Types of polypropylene

There are 3 subtypes of polypropylene. Homopolymers

PP-H (PP, PP1) - basic type of polymer (pure PP) intended for the production of a wide range of products.

Block copolymer PP-B (PP2) - it's better flexibility and hardness. This type of PP includes 5-15% of ethylene, which provides better resistance on impacts (and at low temperatures below -20 °C). An additional hardness improvement can be achieved using additional additive modifiers during production-most often elastomers.

Random copolymer PP-R (PP3) - includes comonomer units built on the random principle in polymer chains. This type of polymer is most common contains 1-7% ethylene and is used in products for which a lower point is possible or needed melting, greater flexibility and transparency. Random copolymer of crystalline temperature PP-RCT - Polypropylene random copolymer with improved crystalline structure obtained through special β -nucleation and improved temperature resistance. Proven excellent performance for PP-R, for example:

- Categorized required strength (CRS) of 5MPa at a temperature of 70 °C and 50 years (in accordance with ISO 12162), compared to PP-R with whom it is the value of categorized required strength (CRS) 3,21MPa.



2.1.2 Basic properties of PP-R and PP-RCT materials

Physical characteristics	Test method	Value Unit
Density	ISO 1183	0,897 g/cm ³
Melt flow rate (MFR)	ISO 1133	
190 °C/5.0 kg		0,55 g/10min
230 °C/2.16 kg		0,30 g/10min
230 °C/5.0 kg		1,30 g/10min
Mechanical characteristics	Test method	Value Unit
Sequential modulus of elasticity	ISO 527-2/1	850 MPa
Strength at the boundary stretching (23 °C)	ISO 527-2/50	24,0 MPa
Elongation at rupture (23 °C)	ISO 527-2/50	10 %
Stretch Module	ISO 899-1	
1 hr		650 MPa
1000 hr		350 MPa
Impact strength	Test method	Value Unit
Impact strength with a notch (Charpy)	ISO 179	
-30 °C		2,50 kJ/m ²
0 °C		4,00 kJ/m ²
23 °C		22,00 kJ/m ²
Impact-free impact strength (Charpy)	SO 179	
-30 °C		43,00 kJ/m ²
0 °C		without cracking kJ/m ²
23 °C		without cracking kJ/m ²
Hardness	Test method	Value Unit
Hardness (Shore D, 3 sec)	ISO 868	65
Hardness with a ball	ISO 2039-1	48,0 N/mm ²
Thermal characteristics	Test method	Value Unit
Melting temperature	ISO 3146	147 °C
Thermal Conductivity (20 °C)	DIN 52612	0,24 W/m
Linear expansion coefficient	DIN 53752	1.5·10 ⁻⁴ K ⁻¹
Softening temperature (Vicat)		
(A50(50 °C/h, 10N))	ISO 306/A50	132 °C
(B50(50 °C/h, 50N))	ISO 306/B50	69,0 °C
Electrical characteristics	Test method	Value Unit
Volumetric resistance	DIN 53482	>10 ¹⁷ Ω*cm
Surface resistance	DIN VDE 0303, T3	>10 ¹⁴ Ω
Dielectric constant	DIN 53483	2,3 106Hz
Resistance to frequency	DIN 53483	<5*10 ⁻⁴ 106Hz
Dielectric rigidity	DIN 53481	500/650 kV/cm

Table no. 1: Basic properties of PP-R material

Physical characteristics	Test method	Value unit
Density	ISO 1183	0,905 g/cm ³
Melt flow rate (MFR)	ISO 1133	230 °C/2,16kg
Mechanical characteristics	Test method	Value unit
Sequential modulus of elasticity	ISO 527-2/1	25 MPa
Strength at the boundary stretching (23 °C)	ISO 527-2/50	900 MPa
Elongation at rupture (23 °C)	ISO 527-2/50	10 %
Stretch Module	ISO 899-1	
Impact strength	ISO 179	
Impact strength with a notch (Charpy)	Test method	Value unit
-20 °C		2,00 kJ/m ²
0 °C		4,00 kJ/m ²
23 °C		40,00 kJ/m ²
Thermal Conductivity (20 °C)	DIN 52612	0,24 W/mK
Linear expansion coefficient	DIN 53752	1,5·10 ⁻⁴ K ⁻¹

Table no. 2: Basic properties of PP-R material

2.1.3 Sensitivity to chlorinated disinfectant in water

Polypropylene is naturally sensitive to strong oxidation agents and chlorine. Its chemical resistance at a high concentration of chlorine in the form of chlorine dioxide and sodium hypochlorite is not satisfactory. However, in reality, these chlorine substances are dosed in water at very low

concentrations, thereby reducing the impact on polypropylene as material. In the example below, the effect of degradation can be seen observed on the lateral side of PP-R and PP-RCT tubes that are exposed to high concentrations of chlorine dioxide and sodium hypochloride.



Picture no. 2: Example of degradation of PP-R material due to the high concentration of chlorine dioxide

2.2 Basic information about Peštan PP-R and PP-RCT pipes

Peštan's strict rules on quality control require to use only premium materials that are manufactured by world-renowned manufacturers as what is Borealis. Material formulation itself and parameters production is constantly monitored due to conformity and consistency in production, and thus providing a lifetime of 50 years when the pipes are used for approved applications. Program PP-R and PPR- Pestan CT pipes are manufactured from PPR and PP-RCT materials (polypropylene and polypropylene random copolymer crystalline temperature) by the latest tube extrusion technology and are foreseen for the transport of fluid under made as standard

pipes of (PP-R), as well as with the middle layer of the special mixture of PP-R with glass fibers (PPR-FG) or medium with a layer of aluminum (PPR-AL-PPR). Too pipes produced from PP-RCT materials can be made as one-layer or as a pipe with a central one a layer of special PP-RCT with a glass fibers. PP-R pipes with central layer with glass fibers and aluminum are intended increased or reduced temperatures of exploitation, while pipes produced from PP-RCT materials with the central layer with glass fibers has increased long lasting temperature resistance, at of this technical manual. Connect the pipe is made by means of connecting elements



(fittings) while waterproofing The joint ensures that the pipe is welded and fittings. Pipes made of PP-R and PPR-CT they have very little roughness, which results in good hydraulic characteristics, and the amount of light which passes through PP-R and PPR-CT tubes is less than 0.2% therefore algae and other biofilm pathogens can not to develop inside the tube. This advantage makes them ideal for pipe systems for residential buildings, health care and in the areas of food preparation. Unlike metal pipe systems, whose inner ones the diameter can be narrowed due to corrosion, the advantage of PP-R and PPR-CT system is that they do not corrode, and they do not change their inner diameter During the lifetime, this means a long-term flow, lower cost of costs while pumping the fluid through pipes and better water quality.

Pipes and fittings have exceptional thermal properties stability and resistant to:

- Short thermal load up to 90 °C
- Continuous thermal load up to 60 °C

In terms of chemical resistance PP-R and PPR-CT pipes are resistant to: salty water, alcohol, acids, bases, sulfates, aggressive gases and all kinds of detergents. Because of its non-polar characteristics, polypropylene (PP-R) systems are suitable for the distribution of most chemicals. For detailed chemical resistance of the pipeline from PP-R and PPR-CT material see the table chemical resistance that is an integral part of this technical catalog.

The basic characteristics of PP-R and PPR-CT pipes are:

- Made of very light material with excellent mechanical properties,
- Simple and easy mode of transport and handling,
- Fast and cheap mounting, by connecting the fitting by welding at the ends pipes
- Resistant to hydrolysis
- Good electrical insulator,
- Resistant to mechanical influences,
- A lifetime of 50 years,
- Without maintenance of the pipeline,
- Natural sound insulation

2.2.1 Basic concepts

When marking the pipe as well as the pipe classification several basic terms are used. In the following text of this technical catalog will be used related to the pipe class, working pressure, thickness walls...

In order to better understand the technical catalog in this chapter we will explain the basic concepts for marking and the classification of PP-R and PP-RCT pipes.

SDR – Standard Dimension Ratio

SDR or Standard Dimension Ratio refers to geometry pipes and is defined as the ratio of the nominal one external diameter and wall thickness and is used as method for determining the required pressure in the pipe system.

PN - Nominal operating pressure pipe

iNominal value [PN] for pipeline systems under Pressure is a guideline that depends on the material and the fluid temperature indicates an approximate resistance pressure pipes. Nominal value [PN] which is located on the pipes itself indicates the value of the pressure which tube can handle when transporting the fluid at 20 °C. The [PN] value is expressed in bar.

S – Pipe class

Depending on the desired temperature, the demanding lifetime and necessary working temperatures there are four classes of application of PP-R or PP-RCT pipes in hot and cold water systems. A detailed explanation for pipe classes is in the chapter 2.2.3.

Material	<ul style="list-style-type: none"> • PP-R (Polypropylene) • PPR-CT (Polypropylene random copolymer) • crystalline temperature)
Pipe structure	<ul style="list-style-type: none"> • Single layer made of PP-R and PP-RCT materials • PP-R three layers with a central layer of glass fibers FG and aluminum AL • PP-RCT three-layer with a central layer of glass fibers FG
Color	<ul style="list-style-type: none"> • PP-R pipes: Green, white, gray • PP-RCT pipes: Green
Temperature resistance	<ul style="list-style-type: none"> • Short term up to 90 °C • Long lasting up to 60 °C
Production diameters in standard production for PP-R and PP - RCT pipes	<ul style="list-style-type: none"> • Ø20, Ø25, Ø32, Ø40, Ø50, Ø63, Ø75, Ø90, Ø110, Ø125, Ø160, Ø200, Ø250, Ø315, Ø355, Ø400
Production diameters that can be made according to the project	<ul style="list-style-type: none"> • Ø500, Ø630
Pressure and Application field for PP-R pipes	<ul style="list-style-type: none"> • [PN 25] SDR 6 – internal plumbing • [PN 20] SDR 7,4 – internal plumbing • [PN 16] SDR 9 – internal plumbing • [PN 10] SDR 11 – internal plumbing • [PN 12,5] SDR 11 – internal plumbing • [PN 6] SDR 17,6 – internal plumbing
Pressure and Application field for PP-RCT pipes	<ul style="list-style-type: none"> • [PN 25] SDR 6 – internal plumbing • [PN 20] SDR 7,4 – internal plumbing • [PN 16] SDR 9 – internal plumbing • [PN 10] SDR 11 – internal plumbing • [PN 12,5] SDR 11 – internal plumbing • [PN 8] SDR 17,6 – internal plumbing
Pipe length for PP-R and PP-RCT pipes	<ul style="list-style-type: none"> • 4m for all dimensions
Method of connecting PP-R and PP-RCT pipes	<ul style="list-style-type: none"> • Welding with manual fusing machine • Welding with a front welding machine • Welding with electro-coupling joints
Compliance with standards	<ul style="list-style-type: none"> • EN 15874 • DIN 8077
Classification flammability of PP-R and PP-RCT pipes	<ul style="list-style-type: none"> • B2 – normal flammability

Table no. 3: Basic information on PP-R and PP-RCT pipes



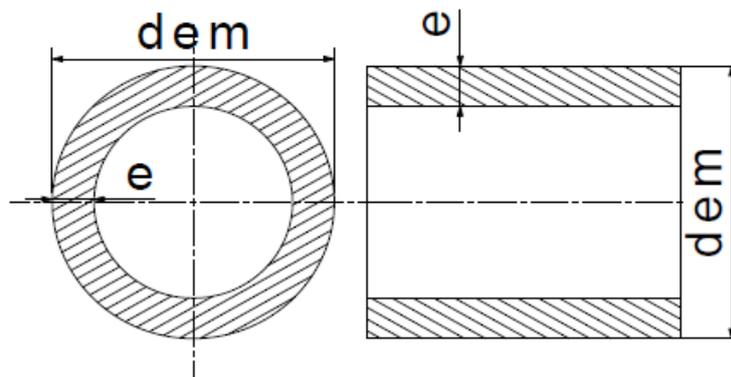
2.2.2 Marking PP-R and PP-RCT pipes

All Peštan PP-R and PPR-CT pipes must be labeled without any magnification.

Minimum requirements for marking PP-R and PPR-CT pipes for supplying hot and cold water according to ISO 15874 - 3 are:



- | | |
|--|----------------------------|
| 1. Bar code | 8. Working pressure |
| 2. Peštan logo | 9. Application class |
| 3. Company name | 10. Pipe series |
| 4. Extrusion machine marking | 11. Site |
| 5. Production standard | 12. Date of manufacture |
| 6. Material | 13. Number of certificates |
| 7. Nominal diameter and minimum wall thickness | 14. Worker code |



dem - external pipe diameter

e - wall thickness of the pipe

2.2.3 Class of pipe

For each special class of working conditions, nominal pressure and size, minimum wall thickness, e_{min} , need to be selected in such a way that the corresponding S series or the Scalc value is equal to or less than the value Scalc, max given in Tables 3 and 4.

For the applicable dimension class of pipe, wall thickness e_{min} and one person should agree with the tables 4 and 5, relative to the corresponding series of tubes S and values Scalc. However, pipes intended for welding should have a minimum wall thickness of 2 mm.

pD	Application			
	Class 1	Class 2	Class 4	Class 5
bar	$S_{calc, max}$ - values ^a			
4	6,9	5,3	6,9	4,7
6	5,0	3,5	5,5	3,2
8	3,8	2,6	4,1	2,4
10	3,0	2,1	3,3	1,9
The values are rounded to the first place of decimals.				

Table no. 4: S values for PP-R

pD	Application			
	Class 1	Class 2	Class 4	Class 5
bar	$S_{calc, max}$ - values ^a			
4	8,2	8,2	8,2	7,3
6	6,1	5,7	6,1	4,9
8	4,5	4,3	4,6	3,7
10	3,6	3,4	3,7	2,9
The values are rounded to the first place of decimals.				

Table no. 5: S values for PP-RCT

By the given temperature, lifetime and the necessary application, there are 4 classes of pipes. From the attached table they can take all the necessary parameters for determining.

The class applications	Designed temperature T_d , [°C]	Designed temperature T_d , [°C]	Designed temperature T_d , [°C]	Duration at T_{max}	Temperature pipe failure T_{mal} [°C]	Duration of T_{mal} necessary for glitch [hours]	Typical area applications
1	60	49	80	1	95	100	Supply hot water (60 °C)
2	70	49	80	1	95	100	Supply hot water (70 °C)
4	20	2,5	70	2,5	100	100	Floor heating i low temperature radiators
	40	20					
	60	25					
5	20	14	90	1	100	100	High temperature radiators
	60	25					
	80	10					

Table no. 6: Class of pipe



2.2.4 Table of tube geometry

The table below contains all the necessary dimensions and allowed deviations for standard PP-R pipes.

CLASS TUBES													
		SDR 6		SDR 7,4		SDR 9		SDR 11		SDR 13,6		SDR 17	
		S 2,5		S 3,2		S 4 ^a		S 5		S 6,3 ^a		S 8 ^a	
Wall thickness													
Main external diameter		e _{min}	e _{min}	e _{min}	e _{max}	e _{min}	e _{max}	e _{min}	e _{max}	e _{min}	e _{max}	e _{min}	e _{max}
d _{em, min}	d _{em, max}												
12,0	12,3	2,0	2,3	1,8	2,1	1,8	2,1	1,8	2,1	1,8	2,1	1,8	2,1
16,0	16,3	2,7	3	2,2	2,6	1,8	2,1	1,8	2,1	1,8	2,1	1,8	2,1
20,0	20,3	3,4	3,9	2,8	3,2	2,3	2,7	1,9	2,2	1,8	2,1	1,8	2,1
25,0	25,3	4,2	4,8	3,5	3,9	2,8	3,2	2,3	2,7	1,9	2,2	1,8	2,1
32,0	32,3	5,4	6,1	4,4	5,0	3,6	4,1	2,9	3,3	2,4	2,8	1,9	2,2
40,0	40,4	6,7	7,5	5,5	6,2	4,5	5,1	3,7	4,2	3,0	3,4	2,4	2,8
50,0	50,4	8,3	9,3	6,9	7,7	5,6	6,3	4,6	5,2	3,7	4,2	3,0	3,4
63,0	63,6	10,5	11,7	8,6	9,6	7,1	8,0	5,8	6,5	4,7	5,3	3,8	4,3
75,0	75,7	12,5	13,9	10,3	11,5	8,4	9,4	6,8	7,6	5,6	6,3	4,5	5,1
90,0	90,9	15,0	16,6	12,3	13,7	10,1	11,3	8,2	9,2	6,7	7,5	5,4	6,1
110,0	111,0	18,3	20,3	15,1	16,8	12,3	13,7	10,0	11,1	8,1	9,1	6,6	7,4
125,0	126,2	20,8	23,0	17,1	19,0	14,0	15,5	11,4	12,7	9,2	10,3	7,4	8,3
140,0	141,3	23,3	25,8	19,2	21,3	15,7	17,4	12,7	14,1	10,3	11,5	8,3	9,3
160,0	161,5	26,6	29,4	21,9	24,2	17,9	19,8	14,6	16,2	11,8	13,1	9,5	10,6

Table no. 7: Dimensions and permitted deviations in the production of PP-R pipes

KLASE CEVI													
		SDR 6		SDR 7,4		SDR 9		SDR 11		SDR 17			
		S 2,5		S 3,2		S 4 ^a		S 5		S 8 ^a			
Debljina zida													
Glavni spoljašnji prečnik		e _{min}	e _{min}	e _{min}	e _{max}								
d _{em, min}	d _{em, max}												
12,0	12,3	2,0	2,3	1,8	2,1	1,8	2,1	1,8	2,1	1,8	2,1	1,8	2,1
16,0	16,3	2,7	3	2,2	2,6	1,8	2,1	1,8	2,1	1,8	2,1	1,8	2,1
20,0	20,3	3,4	3,9	2,8	3,2	2,3	2,7	1,9	2,2	1,8	2,1	1,8	2,1
25,0	25,3	4,2	4,8	3,5	3,9	2,8	3,2	2,3	2,7	1,8	2,1	1,8	2,1
32,0	32,3	5,4	6,1	4,4	5,0	3,6	4,1	2,9	3,3	1,9	2,2	1,8	2,1
40,0	40,4	6,7	7,5	5,5	6,2	4,5	5,1	3,7	4,2	2,4	2,8	1,8	2,1
50,0	50,4	8,3	9,3	6,9	7,7	5,6	6,3	4,6	5,2	3,0	3,4	2,4	2,8
63,0	63,6	10,5	11,7	8,6	9,6	7,1	8,0	5,8	6,5	3,8	4,3	2,4	2,8
75,0	75,7	12,5	13,9	10,3	11,5	8,4	9,4	6,8	7,6	4,5	5,1	2,4	2,8
90,0	90,9	15,0	16,6	12,3	13,7	10,1	11,3	8,2	9,2	5,4	6,1	2,4	2,8
110,0	111,0	18,3	20,3	15,1	16,8	12,3	13,7	10,0	11,1	6,6	7,4	2,4	2,8
125,0	126,2	20,8	23,0	17,1	19,0	14,0	15,5	11,4	12,7	7,4	8,3	2,4	2,8
140,0	141,3	23,3	25,8	19,2	21,3	15,7	17,4	12,7	14,1	8,3	9,3	2,4	2,8
160,0	161,5	26,6	29,4	21,9	24,2	17,9	19,8	14,6	16,2	9,5	10,6	2,4	2,8

Table no. 8: Dimensions and permitted deviations in the production of PP-RCT pipes

2.2.5 Calculation SDR and required PN for pipes

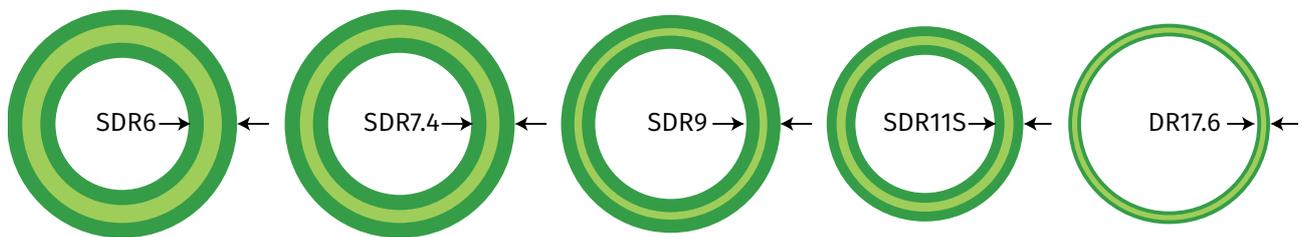
Pipes made of PP-R and PPR-CT materials can be made in different SDRs, each of which SDR contributes to the desired product characteristics.

Budget for SDR pipes:

$$\text{SDR} = 2S + 1 \approx d/e$$

$$e = d / (2S + 1)$$

Where: d = outside pipe diameter, e = wall thickness



Historically, the pipe classification according to the nominal one pressure (PN) based on security Factor 1.5 for industrial application, results well known classifications such as PN20, PN16, and PN10. Maximum operating pressure of 20 bar, 16 bar and 10 bar are only possible at a temperature of 20 °C over a lifetime of 50 years. While on the elevated The maximum operating pressures are significant

lower. All this leads to confusion, and one of the the main reasons why the classification was dropped PN pipes. PN classification has been replaced SDR values that define the maximum necessary working pressures during different applications. The table below shows the differences in the maximum working pressures expressed in bar for PP-R pipes depending on the SDR and the safety factor.

SDR values	PP-R Maximum permissible working pressure (bar)		
	DIN 8077:1989 SF = 2,0	ISO 15874:2010 SF = 1,5	DIN 8077:2008 SF = 1,25
SDR 6	20,0 (PN 20)	27,7	30,9
SDR 7,4	15,6 (PN 16)	20,4	24,5
SDR 11	10,0 (PN 10)	12,9	15,4

Table no. 9: Maximum permissible operating pressures

*Note: Pestan PP-R i PP-RCT pipes are manufactured with safety factor SF=1,5.



2.2.6 Maximum allowed work pressures for PP-R and PP-RCT pipes

When designing installations made from PP-R materials should be considered safety factor, time of exploitation (number of years), average temperature to determine the required SDR tube.

PP-R					
SF = 1,5					
T, °C	LIFESPAN, YEARS	S			
		5	4	3,2	2,5
		SDR			
		11	9	7,4	6
20	1	15,0	18,8	23,8	29,9
	5	14,1	17,8	22,3	28,1
	10	13,7	17,3	21,8	27,3
	25	13,3	16,7	21,0	26,4
	50	12,8	16,3	20,4	25,8
	100	12,5	15,8	19,9	25,1
40	1	10,8	13,6	17,2	21,6
	5	10,1	12,8	16,0	20,2
	10	9,8	12,3	15,6	19,6
	25	9,4	11,9	15,0	18,8
	50	9,2	11,6	14,5	18,3
	100	8,9	11,3	14,1	17,8
60	1	7,7	9,7	12,3	15,4
	5	7,2	9,0	11,3	14,3
	10	6,9	8,8	11,0	13,8
	25	6,7	8,4	10,6	13,3
	50	6,4	8,1	10,3	12,9
70	1	6,5	8,2	10,3	12,9
	5	6,0	7,6	9,5	12,0
	10	5,8	7,3	9,3	11,6
	25	5,0	6,3	8,0	10,1
	50	4,3	5,3	6,8	8,5
80	1	5,4	6,8	8,6	10,8
	5	4,8	6,0	7,6	9,6
	10	4,0	5,1	6,4	8,1
	25	3,3	4,1	5,2	6,5
95	1	3,8	4,8	6,1	7,7
	5	2,6	3,3	4,1	5,2

Table no. 10: The lifetime of PP-R pipe in relation to the temperature and pressure

TEMPERATURE °C	LIFESPAN, YEARS	PERMISSIBLE WORKING PRESSURE, BAR (SF=1,5)			
		S			
		5	4	3,2	2,5
		SDR			
		11	9	7,4	6
10	1	19,0	24,0	30,2	38,0
	5	18,4	23,3	29,3	36,8
	10	18,3	22,9	28,9	36,4
	25	17,9	22,6	28,4	35,8
	50	17,7	22,3	28,0	35,3
	100	17,4	21,9	27,7	34,8
20	1	16,6	20,8	26,3	33,1
	5	16,1	20,2	25,4	32,1
	10	15,8	19,9	25,1	31,6
	25	15,5	19,6	24,7	31,0
	50	15,3	19,3	24,3	30,6
30	1	14,3	18,1	22,8	28,7
	5	13,8	17,4	22,0	27,7
	10	13,7	17,2	21,7	27,3
	25	13,4	16,8	21,3	26,8
	50	13,2	16,6	20,9	26,3
40	1	12,3	15,5	19,6	24,7
	5	11,9	15,0	18,8	23,8
	10	11,8	14,8	18,6	23,4
	25	11,5	14,4	18,2	22,9
	50	11,3	14,3	17,9	22,6
50	1	10,5	13,3	16,8	21,1
	5	10,2	12,8	16,1	20,3
	10	10,0	12,6	15,8	19,9
	25	9,8	12,3	15,5	19,5
	50	9,6	12,1	15,3	19,2
60	1	8,9	11,3	14,2	17,8
	5	8,6	10,8	13,6	17,2
	10	8,4	10,6	13,3	16,8
	25	8,3	10,3	13,1	16,5
	50	8,1	10,2	12,8	16,2
70	1	7,5	9,4	11,9	15,0
	5	7,2	9,1	11,4	14,4
	10	7,1	8,9	11,3	14,1
	25	6,9	8,7	10,9	13,8
	50	6,8	8,5	10,8	13,5
80	1	6,3	7,9	9,9	12,5
	5	6,0	7,5	9,5	12,0
	10	5,8	7,4	9,3	11,8
	25	5,8	7,2	9,1	11,4
95	1	4,7	5,9	7,4	9,3
	5	4,4	5,6	7,1	8,9
	10	4,3	5,5	6,9	8,8

Table no. 11: The lifetime of PP-RCT pipe in relation to the temperature and pressure

2.3 Basic information on Peštan PP-R i PP-RCT fitting

As with pipes and fittings, strict control rules quality requires that only premium materials can be used, produced by world-recognized manufacturers. During production due to compliance and consistency parameters are constantly monitored. PP-R and PP-RCT fittings program of Peštan is produced with the latest injection technology thus

ensuring longevity and quality. PP-R and PP-RCT fitting company Peštan products in all necessary sizes from $\varnothing 16$ to $\varnothing 630$ as injected or welded. PP-R and PP-RCT fitting can be with brass insert with external or internal threaded, and manufactured in the pressing class PN 25.

2.3.1 Basic characteristics of PP-R and PP-RCT fittings

Fittings material	<ul style="list-style-type: none"> • PP-R (Polypropylene) i • PPR-CT (Polypropylene random copolymer crystalline temperature)
Pressure and field of application	<ul style="list-style-type: none"> • The complete PP-R fitting is made in the class [PN 25] and is intended in-stallation for indoor plumbing • Complete PP-RCT fitting made in class [PN 25] and intended installation for indoor plumbing
Color	<ul style="list-style-type: none"> • Green, white, gray for PP-R • Green for PP-RCT
Types of fittings	<ul style="list-style-type: none"> • Fittings made entirely from PP-R • Fittings made of PP-R with brass insert • Fittings completely made of PP-RCT • Fittings made of PP-RCT with brass insert
Connection mode	<ul style="list-style-type: none"> • Handheld welding fusion • Welding with a front welding machine • Connection via brass thread
Material of brass insert PP-R	<ul style="list-style-type: none"> • CW602N
PP-R Thread	<ul style="list-style-type: none"> • According to EN 10226 RP
Material of brass insert PP-RCT	<ul style="list-style-type: none"> • CW511N
PP-RCT Thread	<ul style="list-style-type: none"> • According to EN 10226 RP

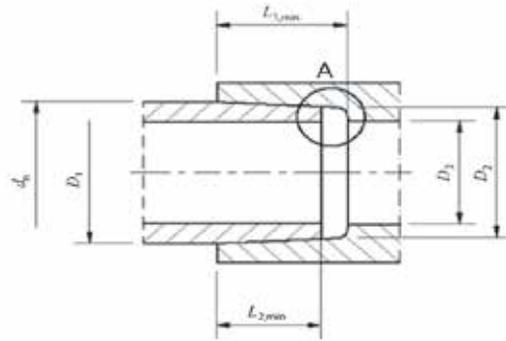
Table no. 12: Basic information on PP - R and PP - RCT fittings

2.3.2 Marking of PP-R and PP-RCT fittings

The symbol size should be such that the marking is read without enlargement. Minimum demanding labeling PP-R and PP-RCT fittings for the supply of hot and cold water according to ISO 15874-3:

- Manufacturer's mark - Peštan*
- Nominal diameter - d_n^*
- Material - PPR*
- Production period - month and year*
- Standard - ISO 15874
- Application class combined with working pressure - Class 1/10 bar

**This is mandatory, other labels can be written on the sticker on the product packaging.*



Picture no. 3: Universal drawing of PP-R and PP-RCT fittings

dn - nominal diameter

d1 - input internal diameter

d2 - end (end) inner diameter

d3 - minimum flowrate

L1 - welding depth

L2 - length of the heated part of the pipe entering the fitting

2.3.3 Production program PP-R and PP-RCT fittings

Within the PESTAN PP-R and PP-RCT production program, there is a complete fitting program (as injected, welded - handmade), made in all diameters and all the strengths:

- Elbows
- Reduced Elbows
- Couplings
- Cores
- T - pieces
- Crossed T - pieces
- Reductions
- Valve body, end caps, test caps, saddle after grip, etc.



Picture no. 4: PP-R pipes

3 PACKAGING

PACKAGING, TRANSPORT AND STORAGE

3.1 Packing of pipes and fittings

Peštan PP-R and PP-RCT pipes and fittings are packaged in transport packages (unit and pallet) in a way favorable to customers. The way packaging provides the customer with safety when storing as well as easy handling with the same.

3.1.1 Pipe packing

Standard PP-R and PP-RCT pipes are in packages (rebellions). Each package is marked the paper declaration on which it is located:

- Company logo
- Company address
- Product key
- The norm according to which the product is produced
- Description of the product itself (diameter, nominal pressure, color)
- The number of pieces in the package
- Bar code



Picture no. 5: Declaration Form

Pipes of all diameters in the length of 4m are packed in packages (UV protective foil) in itself, in dependence of diameter, contain a certain number of pieces as in unit packaging and whole packages. Every the package contains a number of unit packages which are packed to a certain number of wooden ones billets represent the ultimate transport packaging ready for further distribution to the end customer.



Picture no. 6: Appearance of unit packages in transport package

NOTE: For accurate information about packaging dimensions, number of pieces on unit and transport Packages contact Peštan on mail office@pestan.net

3.1.2 Fittings package

Standard packages of fittings (fittings) are in the cardboard packaging of certain dimensions, which represent unit packages, and which in particular number consists of transport packaging.

The procedure for packaging PP-R and PP-RCT fittings is next:

- Depending on the dimensions of the fitting, the bag is packed with a certain number of pieces.



Picture no. 7: Pack items in a bag

Each bag is marked by its declaration bonding in the middle of the bag itself.



Picture no. 8: Declaration Form On the Bag



When forming a transport package for fitting, the box is used as the basis dimension. When stacking bags in a box Take care that the bags are well aligned.



Picture no. 9: Packaged fittings in the box

This packed and closed box is marked the declaration by its gluing in the upper right corner, on the side of the box that will be found when packaging to the side of the pallet.



Izgled Jediničnog pakovanja (kutija)

Picture no. 10: Appearance of unit packaging



Figure 11: Appearance of the declaration on the box

Boxes are adapted to the EURO 800 x 1200 pallet mm, which is first set to nylon. When they boxes stacked on a pallet, the palette is strewn.



Izgled transportnog pakovanja (paleta)

Picture no. 12: Appearance transport packaging (pallets)

Depending on the dimensions of the bag, the number of bags, dimensions boxes and pallet collars, transport The packaging may visually look different.

3.2 Transport and manipulation

Peštan PP-R and PP-RCT pipes and all fittings should be transported with appropriate transport vehicles. The loading area of the transport vehicle must be clean, flat, without sharp jaws and without any waste, (both on the floor of the vehicle and on all sides of the inner part of the transport vehicle). Gather pallets and packages are of such dimensions that it is vehicle loading space maximum filled.

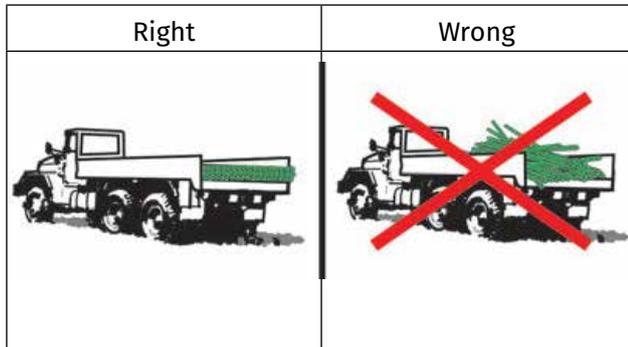
When it comes to loading transport packages (both pipes and coupling elements) with cardboard By packaging, the packages are so defined in the vehicle a height of 2.9 meters of car space can stand two packs to one another.



Picture no. 13: Transport packages in a truck



When it comes to loading pipes outside the transport package (bulk), pipes are all their length they must rely on a flat surface so as not to come to deformation of the same. This is what primarily needs take care of it, because it can handle incorrect handling get bending at their ends.



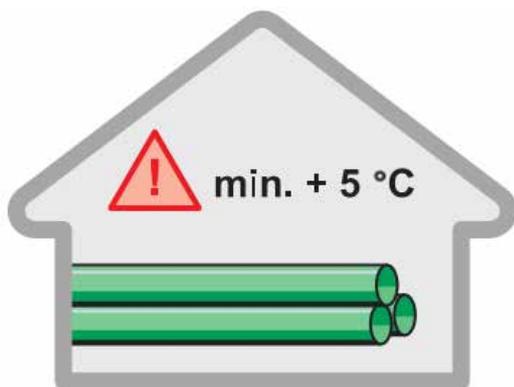
Picture no. 14: Correct and wrong transport of PP-R pipes

At the request of the customer, the pipes can be packed in wooden positions that can be packed in the truck three in height so that it is ram on the shoulder. During loading and unloading, the pipes must be handled carefully with them, they should not be thrown, hit, dragged, push, especially for concrete and other rough ones surfaces.



Picture no. 15: Increased attention when using

NOTE: When manipulating and transporting to temperatures lower than 5 ° C, especially turn Attention, to avoid shock strikes, not to be mechanical damage to the pipes and fittings.



Slika br. 16: Minimalna temperatura

3.3 Storage

Peštan PP-R and PP-RCT pipes and fittings that are packed in cardboard boxes are stored exclusively indoors (preferably shelf, one pallet-one pallet place).



Picture no. 17: The appearance of shelf storage

If there is no regal warehouse, the recommendation is to such a transport packing warehouse indoors on a flat surface and in one level (do not put a palette on the palette). When there is no transport packaging, there is already a commodity arrived at the end customer in a unit package, It should be packaged on a particular pallet that must Be clean and dry. Boxes (unit packages) fold one on the other by the edge principle on the edge. Boxes can not be out of the pallet, nor be relieved on the pallet ("in the air"). For storage of transport packages of pipes and joints elements, the warehouse needs to be met certain conditions.

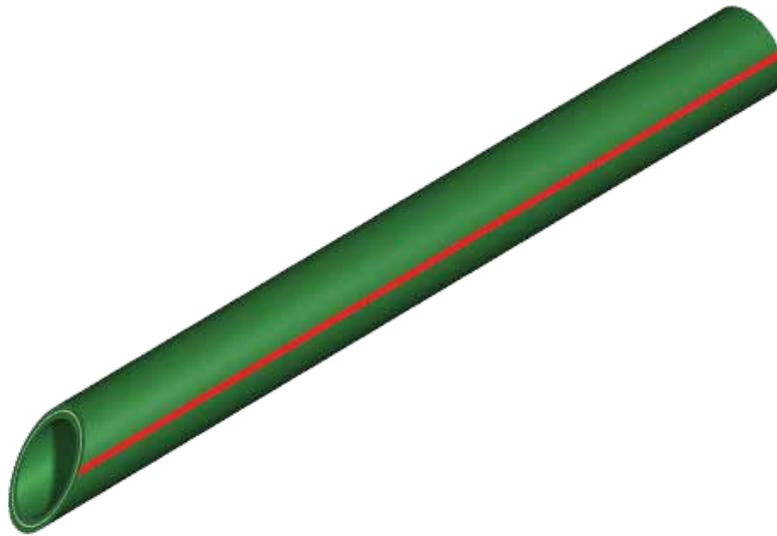
3.3.1 Recommended storage conditions

Transport packaging stored dry, clean and closed space, with temperatures between 10 and 30 °C, and relative humidity between 50 and 60%.

Packages should be protected from direct the influence of sunlight, moisture and heat, and especially They should be protected from high temperature oscillations as this can lead to the occurrence of condensation and loss of functional properties of transport packaging (cardboard boxes).

Peštan PP-R and PP-RCT pipes with a length of 4 meters can be stored both indoors and outdoors space provided that they are protected from direct UV impact, the pipes should protect UV stable foil or eaves. It is recommended that i these transport packages are stored indoors space, or space that is shaded.

No matter where it is stored, whether in closed or open space, PP-R and PP-RCT pipes should not be accommodated at higher levels than prescribed.



Picture no. 18: PP-R and PP-RCT pipes

WARNING: When storing, the pipes must not be stored near the heated surfaces, and care should be taken not to come into contact with fuels, solvents, etc.

4 INSTALLING

INSTALLING AND CONNECTING

 Pestan PP-R and PP-RCT pipes and fittings are installed in accordance with norms valid for the internal installation of the pipeline under the relevant INFORMATION, all in accordance with DVS 2208-1.

 If there is a specific regulation within certain countries and which deviates from the mentioned norm, a LEGAL .

4.1 Types of installation of pipe systems

Pestan recommends that when designing and planning thermoplastic installations, the PP-R and PP-RCT material is always considered. Application of PP-R and PP-RCT materials in the fields of water supply and heating is possible under the condition that the material meets the necessary parameters for the given application. Because of its physical and mechanical properties, Pestan pipe systems from PP-R and PP-RCT allow designers and contractors to choose way of installation of the pipe system itself. Also, the possibility of prefabrication and transportation is another of the great advantages of PESTAN PP-R and PP-RCT pipe systems.

All components of the Pestan piping system are approved and certified for use in the fields of water supply. The system as such is suitable for various methods of installation in these areas. Because it is suitable for different installation methods, the PP-R and PP-RCT system allows designers and contractors to choose how the installation will perform. Below this technical catalog will be described the two most common ways of installing pipe systems made of PP-R and PP-RCT materials.

4.1.1 Installation of pipes inside the wall

When installing the pipe system in the wall, it is longitudinally elongation must not necessarily be taken into account, in the case that the pipe system must be insulated with certain regulations, isolation will in that case prevent longitudinal elongation without any problems, when planning place (channels) in which the pipe system will be installed, the thickness of the insulation itself should be taken into account. The piping system

of PP-R and PP-RT does not have to be isolated and can be directly placed in the floor, concrete or under the plaster because the material itself will accept and compensate for the elongation in case of longitudinal elongation. In installations where the pipe system is fitted In this case, they will accept longitudinal elongation. The elongation of the system itself results from the heat of fluid flow through the pipe system, but only the elongation is not critical because the material surrounding the pipe system also absorbs the resulting outgrowth.

4.1.2 Open pipe installation

In cases where an open pipe installation is performed, the pipe system itself has to satisfy a number of criteria in order to be able to apply it. For the criteria to be met, the length of the pipe itself must be taken into account, as well as the correct arrangement of the supports. Regular installation and proper arrangement of the supports, expansion arches, the open pipe installation will retain its uniform appearance and after installation.

4.2 Calculation of the pipeline

There are many methods for the calculation and dimensioning of internal water distribution, but the most common method is by the engineer Briks. According to the Briks method, the determination of consumption is made to the load units, hereinafter referred to as JO, which are later converted to flow, and finally, on the basis of the flow, the selection of the diameter of the pipe is carried out, taking into account the height, pressure and speed of the water in the pipe system.

4.2.1 Calculation of indoor plumbing by engineer

Briks As mentioned earlier in the text, the budget is based on JO in such a way that all points of the site are categorized according to their function and accordingly assigned to them the value in JO. The number of load units for spot points is given in the following table.



Type of armature	Brix unit loads JO
Propellers (valves)	-
Propellers (valves) with drain	-
Ordinary tap (sink or fountain) 1/2"	0,5
Spigot flange at the pump 1/2" (3/4")	2,5 (16)
The faucet on the sink 1/2" (5/8")	1 (0,5)
Faucet above urinal 1/2"	0,25
Tin on the bidet 1/2" 0.25"	0,25
Faucet with flange for washing machine 1/2" 0.5	0,5
Dishwashing flush for dishwasher 1/2" 0.5	0,5
Drip tray (triangular) 1/2" 1	1
Flooring bowl with tap 1/2" 0,25	0,25
Automatic toilet bowl 3/4" (1") 16 (36)	16 (36)
Shower bath bath 1/2" (3/4") 1 (16)	1 (16)
Shower cushion 1/2" 1	1
Fire hydrant 2" 100	100
Courtyard 1/2" (3/4") 2,5 (16)	2,5 (16)
Electric boiler in bathroom 1/2"	-
Water meter with flow and discharge valve	-
Street water pipe with necklace for home connection	-

Table no. 13: Brix unit load for fittings in domestic installations

A calculation is carried out in a manner that is at the inner-conduit isometric patterns at each tapping point is entered by the corresponding value A briks (JO according briks are given in the table above). The entry of JO is done from the highest one, and downwardly downwards on the verticals, and on the verticals, the collections of all the downstream branches, down the floors, to the

point of connection of the main pipe with the city water pipeline are recorded. When each branch has assigned the corresponding total value of JO, we assign each water to the applicable flow. The flow in line with Briks' JO and speed, as well as the loss of pressure in meters per meter of pipe length are given in the following table

Tables of hydraulic values for pipes press the class PN10 SDR 11/S5

Number JO according to Briks	Q [l/sec]	DN16		DN20		DN25		DN32		DN40	
		v[m/s]	Δh [m/m1]								
0,5	0,177	1,466	0,269	0,859	0,075	0,542	0,025				
1	0,250	2,071	0,498	1,214	0,137	0,765	0,046				
1,5	0,306			1,485	0,197	0,937	0,065	0,568	0,020		
2	0,354			1,718	0,255	1,084	0,084	0,657	0,025		
2,5	0,395			1,917	0,310	1,209	0,102	0,733	0,031		
3	0,433			2,102	0,366	1,325	0,121	0,804	0,036		
3,5	0,468					1,433	0,138	0,869	0,042		
4	0,500					1,531	0,156	0,928	0,047	0,599	0,016
4,5	0,530					1,622	0,173	0,984	0,052	0,635	0,018

Number JO according to Briks	Q [l/sec]	DN16		DN20		DN25		DN32		DN40	
		v[m/s]	Δh [m/m1]								
5	0,559					1,711	0,190	1,037	0,057	0,670	0,020
5,5	0,586					1,794	0,207	1,087	0,062	0,702	0,022
6	0,612					1,873	0,223	1,136	0,067	0,734	0,024
6,5	0,637					1,950	0,240	1,182	0,072	0,764	0,025
7	0,661					2,023	0,256	1,227	0,077	0,792	0,027
7,5	0,685							1,271	0,082	0,821	0,029
8	0,707							1,312	0,087	0,847	0,030
8,5	0,729							1,353	0,091	0,874	0,032
9	0,750							1,392	0,096	0,899	0,034
9,5	0,771							1,431	0,101	0,924	0,035
10	0,791							1,468	0,106	0,948	0,037
11	0,829							1,538	0,115	0,994	0,040
12	0,866							1,607	0,124	1,038	0,043
13	0,901							1,672	0,133	1,080	0,047
14	0,935							1,735	0,142	1,121	0,050
15	0,968							1,796	0,151	1,160	0,053
16	1,000							1,856	0,161	1,199	0,056
17	1,031							1,913	0,170	1,236	0,059
18	1,061							1,969	0,178	1,272	0,062
19	1,090							2,023	0,187	1,307	0,065
20	1,118									1,340	0,068
22	1,173									1,406	0,074
24	1,225									1,468	0,080
26	1,275									1,528	0,086
28	1,323									1,586	0,092
30	1,369									1,641	0,098
32	1,414									1,695	0,104
34	1,458									1,748	0,110
36	1,500									1,798	0,115
38	1,541									1,847	0,121
40	1,581									1,895	0,127
42	1,620									1,942	0,132
44	1,658									1,987	0,138
46	1,696									2,033	0,144

Table no. 14: Indication of the relevant flows according to JO according to Briks and the velocity display in the pipes as well as the pressure losses in meters per meter of the length pipe for the coefficient of roughness $k=0.007$ mm and the water temperature of 20 °C for pipes PN10 in diameter DN16 to DN40 mm



Number JO according to Briks	Q [l/sec]	DN50		DN63		DN75		DN90		DN110	
		v[m/s]	Δh[m/m1]								
9,5	0,771	0,590	0,012								
10	0,791	0,605	0,013								
11	0,829	0,634	0,014								
12	0,866	0,663	0,015								
13	0,901	0,690	0,016								
14	0,935	0,716	0,017								
15	0,968	0,741	0,018								
16	1,000	0,765	0,019								
17	1,031	0,789	0,020								
18	1,061	0,812	0,021								
19	1,090	0,834	0,022								
20	1,118	0,856	0,023								
22	1,173	0,898	0,025								
24	1,225	0,937	0,027	0,591	0,009						
26	1,275	0,976	0,029	0,615	0,010						
28	1,323	1,012	0,031	0,638	0,010						
30	1,369	1,048	0,033	0,660	0,011						
32	1,414	1,082	0,035	0,682	0,012						
34	1,458	1,116	0,037	0,703	0,012						
36	1,500	1,148	0,039	0,723	0,013						
38	1,541	1,179	0,041	0,743	0,014						
40	1,581	1,210	0,043	0,762	0,014						
42	1,620	1,240	0,045	0,781	0,015						
44	1,658	1,269	0,047	0,799	0,016						
46	1,696	1,298	0,049	0,818	0,016						
48	1,732	1,325	0,051	0,835	0,017						
50	1,768	1,353	0,053	0,852	0,017	0,597	0,007				
55	1,854	1,419	0,057	0,894	0,019	0,626	0,008				
60	1,937	1,482	0,062	0,934	0,020	0,655	0,009				
65	2,016	1,543	0,066	0,972	0,022	0,681	0,009				
70	2,092	1,601	0,071	1,009	0,023	0,707	0,010				
75	2,165	1,657	0,075	1,044	0,025	0,732	0,011				
80	2,236	1,711	0,080	1,078	0,026	0,756	0,011				
85	2,305	1,764	0,084	1,111	0,028	0,779	0,012				
90	2,372	1,815	0,089	1,144	0,029	0,802	0,012				
95	2,437	1,865	0,093	1,175	0,031	0,823	0,013				
100	2,500	1,913	0,097	1,205	0,032	0,845	0,014	0,588	0,006		
11	2,622	2,007	0,106	1,264	0,035	0,886	0,015	0,617	0,006		
120	2,739			1,321	0,038	0,926	0,016	0,644	0,007		
130	2,850			1,374	0,040	0,963	0,017	0,670	0,007		

Number JO according to Briks	Q [l/sec]	DN50		DN63		DN75		DN90		DN110	
		v[m/s]	Δh [m/m1]								
140	2,958			1,426	0,043	1,000	0,018	0,696	0,008		
150	3,062			1,476	0,046	1,035	0,020	0,720	0,008		
160	3,162			1,525	0,049	1,068	0,021	0,744	0,009		
170	3,260			1,572	0,051	1,102	0,022	0,767	0,009		
180	3,354			1,617	0,054	1,133	0,023	0,789	0,010		
190	3,446			1,662	0,057	1,164	0,024	0,810	0,010		
200	3,536			1,705	0,059	1,195	0,025	0,832	0,011		
225	3,750			1,808	0,066	1,267	0,028	0,882	0,012	0,590	0,005
250	3,953			1,906	0,073	1,336	0,031	0,930	0,013	0,622	0,005
275	4,146			1,999	0,079	1,401	0,034	0,975	0,014	0,652	0,005
300	4,331			2,088	0,085	1,463	0,036	1,019	0,015	0,681	0,006
350	4,677					1,580	0,042	1,100	0,017	0,736	0,007
400	5,000					1,690	0,047	1,176	0,020	0,786	0,007
450	5,303					1,792	0,052	1,247	0,022	0,834	0,008
500	5,590					1,889	0,057	1,315	0,024	0,879	0,009
600	6,124					2,069	0,067	1,440	0,028	0,963	0,011
700	6,614							1,555	0,032	1,040	0,012
800	7,071							1,663	0,036	1,112	0,014
900	7,500							1,764	0,040	1,180	0,015
1000	7,906							1,859	0,044	1,243	0,017

Table no. 15: Indication of relevant flows according to JO according to Briks and velocity display in pipes, as well as pressure losses in meters per meter of pipe length for coefficient of roughness $k = 0,007$ mm and water temperature of 20°C for pipes PN10 in diameter DN50 to DN110 mm

Tables of hydraulic values for pipes press the class PN16 SDR9 / S4^a

Number JO according to Briks	Q [l/sec]	DN16		DN20		DN25		DN32		DN40	
		v[m/s]	Δh [m/m1]								
0,5	0,177	1,676	0,370	1,087	0,131	0,696	0,045				
1	0,250	2,367	0,687	1,536	0,242	0,983	0,083	0,592	0,025		
1,5	0,306			1,880	0,347	1,203	0,119	0,724	0,035		
2	0,354			2,175	0,450	1,392	0,154	0,838	0,046		
2,5	0,395					1,553	0,187	0,935	0,055	0,598	0,019
3	0,433					1,702	0,220	1,025	0,065	0,656	0,022
3,5	0,468					1,840	0,253	1,108	0,075	0,709	0,026
4	0,500					1,966	0,284	1,183	0,084	0,757	0,029
4,5	0,530					2,084	0,316	1,254	0,093	0,803	0,032
5	0,559							1,323	0,102	0,847	0,035
5,5	0,586							1,387	0,111	0,888	0,038
6	0,612							1,448	0,120	0,927	0,041
6,5	0,637							1,508	0,129	0,965	0,044
7	0,661							1,564	0,138	1,001	0,047



Number JO according to Briks	Q [l/sec]	DN16		DN20		DN25		DN32		DN40	
		v[m/s]	Δh [m/m1]								
7,5	0,685							1,621	0,147	1,038	0,050
8	0,707							1,673	0,155	1,071	0,053
8,5	0,729							1,725	0,164	1,104	0,056
9	0,750							1,775	0,173	1,136	0,059
9,5	0,771							1,825	0,181	1,168	0,062
10	0,791							1,872	0,190	1,198	0,065
11	0,829							1,962	0,206	1,256	0,071
12	0,866							2,050	0,223	1,312	0,076
13	0,901									1,365	0,082
14	0,935									1,416	0,087
15	0,968									1,466	0,093
16	1,000									1,515	0,098
17	1,031									1,562	0,104
18	1,061									1,607	0,109
19	1,090									1,651	0,115
20	1,118									1,693	0,120
22	1,173									1,777	0,131
24	1,225									1,856	0,141
26	1,275									1,931	0,152
28	1,323									2,004	0,162

Table no. 16: A summary of the relevant flows according to JO according to Briks and the velocity display in the pipes as well as the pressure losses in meters per meter of the length pipe for the roughness coefficient $k = 0,007$ mm and the water temperature of 20 °C for pipes PN16 in diameter DN16 to DN40 mm

Number JO according to Briks	Q [l/sec]	DN50		DN63		DN75		DN90		DN110	
		v[m/s]	Δh [m/m1]								
6	0,612	0,595	0,014								
6,5	0,637	0,619	0,015								
7	0,661	0,643	0,016								
7,5	0,685	0,666	0,017								
8	0,707	0,687	0,018								
8,5	0,729	0,709	0,019								
9	0,750	0,729	0,020								
9,5	0,771	0,749	0,021								
10	0,791	0,769	0,022								
11	0,829	0,806	0,024								
12	0,866	0,842	0,026								
13	0,901	0,876	0,028								
14	0,935	0,909	0,030								
15	0,968	0,941	0,032	0,588	0,010						

Number JO according to Briks	Q [l/sec]	DN50		DN63		DN75		DN90		DN110	
		v[m/s]	Δh [m/m1]								
16	1,000	0,972	0,034	0,607	0,011						
17	1,031	1,002	0,036	0,626	0,012						
18	1,061	1,031	0,038	0,644	0,012						
19	1,090	1,060	0,040	0,662	0,013						
20	1,118	1,087	0,041	0,679	0,013						
22	1,173	1,140	0,045	0,712	0,015						
24	1,225	1,191	0,049	0,744	0,016						
26	1,275	1,239	0,052	0,774	0,017						
28	1,323	1,286	0,056	0,803	0,018						
30	1,369	1,331	0,059	0,831	0,019	0,589	0,008				
32	1,414	1,375	0,063	0,859	0,020	0,609	0,009				
34	1,458	1,417	0,066	0,885	0,021	0,628	0,009				
36	1,500	1,458	0,070	0,911	0,023	0,646	0,010				
38	1,541	1,498	0,073	0,936	0,024	0,663	0,010				
40	1,581	1,537	0,077	0,960	0,025	0,681	0,011				
42	1,620	1,575	0,080	0,984	0,026	0,697	0,011				
44	1,658	1,612	0,083	1,007	0,027	0,714	0,012				
46	1,696	1,649	0,087	1,030	0,028	0,730	0,012				
48	1,732	1,684	0,090	1,052	0,029	0,746	0,013				
50	1,768	1,719	0,093	1,074	0,030	0,761	0,013				
55	1,854	1,802	0,102	1,126	0,033	0,798	0,014				
60	1,937	1,883	0,110	1,176	0,035	0,834	0,016				
65	2,016	1,960	0,118	1,224	0,038	0,868	0,017	0,600	0,007		
70	2,092	2,034	0,126	1,270	0,041	0,901	0,018	0,623	0,007		
75	2,165			1,315	0,043	0,932	0,019	0,645	0,008		
80	2,236			1,358	0,046	0,963	0,020	0,666	0,008		
85	2,305			1,400	0,048	0,992	0,021	0,687	0,009		
90	2,372			1,441	0,051	1,021	0,022	0,706	0,009		
95	2,437			1,480	0,053	1,049	0,023	0,726	0,010		
100	2,500			1,518	0,056	1,076	0,024	0,745	0,010		
11	2,622			1,592	0,061	1,129	0,027	0,781	0,011		
120	2,739			1,663	0,066	1,179	0,029	0,816	0,012		
130	2,850			1,731	0,071	1,227	0,031	0,849	0,013		
140	2,958			1,796	0,075	1,273	0,033	0,881	0,014	0,592	0,005
150	3,062			1,860	0,080	1,318	0,035	0,912	0,014	0,613	0,006
160	3,162			1,920	0,085	1,361	0,037	0,942	0,015	0,633	0,006
170	3,260			1,980	0,090	1,403	0,039	0,971	0,016	0,652	0,006
180	3,354			2,037	0,094	1,444	0,041	0,999	0,017	0,671	0,007
190	3,446					1,483	0,043	1,026	0,018	0,689	0,007
200	3,536					1,522	0,045	1,053	0,019	0,707	0,007
225	3,750					1,614	0,050	1,117	0,021	0,750	0,008



Number JO according to Briks	Q [l/sec]	DN50		DN63		DN75		DN90		DN110	
		v[m/s]	Δh [m/m1]								
250	3,953					1,702	0,055	1,177	0,023	0,791	0,009
275	4,146					1,785	0,060	1,235	0,025	0,829	0,010
300	4,331					1,864	0,065	1,290	0,027	0,866	0,010
350	4,677					2,013	0,074	1,393	0,031	0,936	0,012
400	5,000							1,489	0,035	1,000	0,013
450	5,303							1,579	0,038	1,061	0,015
500	5,590							1,665	0,042	1,118	0,016
600	6,124							1,824	0,050	1,225	0,019
700	6,614							1,970	0,057	1,323	0,022
800	7,071							2,106	0,064	1,415	0,025
900	7,500									1,500	0,027
1000	7,906									1,582	0,030

Table no. 17: Indication of the relevant flows according to JO according to Briks and the velocity display in pipes as well as pressure losses in meters per meter of pipe length for roughness coefficient $k = 0,007$ mm and water temperature of 20°C for pipes PN16 in diameter DN50 to DN110 mm

Tables of hydraulic values for pipes press PN20 SDR 7,4 / S3,2

Number JO according to Briks	Q [l/sec]	DN20		DN25		DN32		DN40	
		v[m/s]	Δh [m/m']						
0,5	0,177	1,294	0,199	0,818	0,066	0,502	0,021		
1	0,250	1,828	0,368	1,156	0,122	0,709	0,038		
1,5	0,306	2,237	0,528	1,415	0,175	0,867	0,054	0,551	0,018
2	0,354			1,637	0,227	1,003	0,070	0,637	0,024
2,5	0,395			1,826	0,276	1,120	0,085	0,711	0,029
3	0,433			2,002	0,325	1,227	0,100	0,780	0,034
3,5	0,468					1,326	0,115	0,843	0,039
4	0,500					1,417	0,129	0,900	0,044
4,5	0,530					1,502	0,144	0,954	0,048
5	0,559					1,584	0,158	1,006	0,053
5,5	0,586					1,661	0,172	1,055	0,058
6	0,612					1,735	0,185	1,102	0,062
6,5	0,637					1,806	0,199	1,147	0,067
7	0,661					1,874	0,213	1,190	0,071
7,5	0,685					1,942	0,227	1,233	0,076
8	0,707					2,004	0,240	1,273	0,080
8,5	0,729							1,312	0,085
9	0,750							1,350	0,089
9,5	0,771							1,388	0,094
10	0,791							1,424	0,098
11	0,829							1,493	0,107
12	0,866							1,559	0,115
13	0,901							1,622	0,124
14	0,935							1,683	0,132

Number JO according to Briks	Q [l/sec]	DN20		DN25		DN32		DN40	
		v[m/s]	Δh [m/m ¹]						
15	0,968							1,743	0,141
16	1,000							1,800	0,149
17	1,031							1,856	0,158
18	1,061							1,910	0,166
19	1,090							1,962	0,174
20	1,118							2,013	0,182

Table no. 18: List of relevant flows according to JO according to Briks and velocity display in pipes, as well as pressure losses in meters per meter bound pipe for roughness coefficient $k = 0.007$ mm and water temperature of 20 °C for pipes PN20 of diameter DN20 to DN40 mm

Number JO according to Briks	Q [l/sec]	DN50		DN63		DN75		DN90		DN110	
		v[m/s]	Δh [m/m ¹]								
4	0,500	0,571	0,015								
4,5	0,530	0,605	0,016								
5	0,559	0,638	0,018								
5,5	0,586	0,669	0,019								
6	0,612	0,699	0,021								
6,5	0,637	0,727	0,022								
7	0,661	0,755	0,024								
7,5	0,685	0,782	0,026								
8	0,707	0,807	0,027								
8,5	0,729	0,832	0,029								
9	0,750	0,856	0,030								
9,5	0,771	0,880	0,032								
10	0,791	0,903	0,033								
11	0,829	0,947	0,036	0,599	0,012						
12	0,866	0,989	0,039	0,625	0,013						
13	0,901	1,029	0,042	0,651	0,014						
14	0,935	1,068	0,044	0,675	0,015						
15	0,968	1,105	0,047	0,699	0,016						
16	1,000	1,142	0,050	0,722	0,017						
17	1,031	1,177	0,053	0,745	0,018						
18	1,061	1,212	0,055	0,766	0,019						
19	1,090	1,245	0,058	0,787	0,019						
20	1,118	1,277	0,061	0,807	0,020						
22	1,173	1,339	0,066	0,847	0,022	0,598	0,010				
24	1,225	1,399	0,072	0,885	0,024	0,624	0,010				
26	1,275	1,456	0,077	0,921	0,026	0,650	0,011				
28	1,323	1,511	0,082	0,955	0,027	0,674	0,012				
30	1,369	1,563	0,087	0,989	0,029	0,698	0,013				
32	1,414	1,615	0,092	1,021	0,031	0,721	0,013				
34	1,458	1,665	0,098	1,053	0,032	0,743	0,014				



Number JO according to Briks	Q [l/sec]	DN50		DN63		DN75		DN90		DN110	
		v[m/s]	Δh [m/m']								
36	1,500	1,713	0,103	1,083	0,034	0,764	0,015				
38	1,541	1,760	0,108	1,113	0,036	0,785	0,016				
40	1,581	1,805	0,113	1,142	0,038	0,806	0,016				
42	1,620	1,850	0,118	1,170	0,039	0,825	0,017				
44	1,658	1,893	0,123	1,197	0,041	0,845	0,018				
46	1,696	1,937	0,128	1,225	0,042	0,864	0,018	0,600	0,008		
48	1,732	1,978	0,133	1,251	0,044	0,883	0,019	0,613	0,008		
50	1,768	2,019	0,138	1,277	0,046	0,901	0,020	0,626	0,008		
55	1,854			1,339	0,050	0,945	0,022	0,656	0,009		
60	1,937			1,399	0,054	0,987	0,023	0,685	0,010		
65	2,016			1,456	0,058	1,027	0,025	0,713	0,010		
70	2,092			1,511	0,062	1,066	0,027	0,740	0,011		
75	2,165			1,563	0,066	1,103	0,028	0,766	0,012		
80	2,236			1,615	0,069	1,139	0,030	0,791	0,013		
85	2,305			1,665	0,073	1,175	0,032	0,816	0,013		
90	2,372			1,713	0,077	1,209	0,033	0,839	0,014		
95	2,437			1,760	0,081	1,242	0,035	0,862	0,015		
100	2,500			1,805	0,085	1,274	0,037	0,885	0,015	0,591	0,006
11	2,622			1,893	0,092	1,336	0,040	0,928	0,017	0,620	0,006
120	2,739			1,978	0,100	1,396	0,043	0,969	0,018	0,648	0,007
130	2,850			2,058	0,107	1,452	0,046	1,008	0,019	0,674	0,007
140	2,958					1,507	0,049	1,047	0,021	0,699	0,008
150	3,062					1,560	0,053	1,084	0,022	0,724	0,008
160	3,162					1,611	0,056	1,119	0,023	0,748	0,009
170	3,260					1,661	0,059	1,154	0,024	0,771	0,009
180	3,354					1,709	0,062	1,187	0,026	0,793	0,010
190	3,446					1,756	0,065	1,219	0,027	0,815	0,010
200	3,536					1,802	0,068	1,251	0,028	0,836	0,011
225	3,750					1,911	0,075	1,327	0,031	0,887	0,012
250	3,953					2,014	0,083	1,399	0,034	0,935	0,013
275	4,146							1,467	0,037	0,980	0,014
300	4,331							1,533	0,041	1,024	0,015
350	4,677							1,655	0,046	1,106	0,018
400	5,000							1,769	0,052	1,182	0,020
450	5,303							1,877	0,058	1,254	0,022
500	5,590							1,978	0,064	1,322	0,024
600	6,124							2,167	0,075	1,448	0,028
700	6,614									1,564	0,033
800	7,071									1,672	0,037
900	7,500									1,773	0,041
1000	7,906									1,869	0,045

Table no. 19: Display of relevant flows according to JO according to Briks and the velocity display in pipes, as well as pressure losses in meters per meter length pipe for roughness coefficient $k = 0.007$ mm and water temperature of 20°C for pipes PN20 of diameter DN50 to DN110 mm

After determining the flow through the sections, the pipes are selected according to the above tables. Select the diameter of the pipes so that the water velocity in the pipelines is within the limits of 0.8-1.2 m/s. It must not be crossed a lower limit of 0.6 m/s and an upper limit of 2.0 m/s. Pressure in the network should not exceed 5 bar, since higher pressures are badly affecting the tapes and metal joints, if any, and they also create hydraulic bumps (water wave, water stroke). Of course, it is necessary to check the maximum allowed pressure pressures of all devices connected to the water supply network, fittings and fixtures and to take the smallest maximum permissible pressure level as relevant and to ensure that it does not exceeds.

NOTE: Determination of the flow rate by sections based on the above tables applies exclusively to cold water at a temperature of 20 °C

When pipe diameters are selected, the required pressures are calculated. First, the critical path is determined, ie the longest and highest part, and in the end, along the route from the connection, to the highest point of the pit, losses are accumulated. The calculation is best done in a spreadsheet, for which the following is an example of the layout of the boxes in the table. no. 20.

- In the first column, segments of the route from nodes to nodes are written, according to the isometric scheme of the water supply
- In the second column, the previously mentioned JOs are listed
- In the third column, account is taken of the share flows, which are taken from the table of applicable flows, if your number JO is between the two values in the table, taken higher.
- In the fourth column, the adopted tube diameters are entered, the pipe fitting criterion is already mentioned above
- In the fifth column, the length of each route is entered

- In the sixth column, unit losses are entered, which for each diameter, depending on the JO are in the table of relevant flows (unit loss is a drop in the pressure in meters per meter of meter)

NOTE: It is mandatory to include a local pressure loss on the meter and other major local losses, if any, in the total loss of pressure. Finally, under the column of total losses per share, the losses of all sections of the route are collected. Now that we have lost the relevant route (critical path), we need to determine the required pressure level. The necessary height of the pressure is determined by the fact that at the end of the critical path, a minimum height of overpressure of 0.5 bar for the drainage site or 1.5 bar for the boiler. If the building has a common boiler, located on the lower floors or if the supply of the facility with hot water is carried out from the city heating plant, then we need the height of the overpressure in the most contaminated outlet from the connection to the city water pipeline 0.5 bar (5 m), and In case every apartment has a boiler, then the height of the overpressure for the last boiler on the critical path is 1.5 bar (15 m). After that, the total losses on the route of the critical road with the previously selected value (0.5 or 1.5 bar) and the geodetic difference are collected, so we need the pressure height of the connection.

NOTE: In case you are not sure which route has the biggest losses, you need to take several critical paths at the start and calculate them in parallel, so that's the route, which shows the highest required value of the overpressure, your critical path. In case of need of pressure on the connection greater than the actual height of the pressure on the connection, it is necessary to provide for a substation for increasing the pressure. In the case of high residential buildings, water supply is carried out in zones. objects, water supply is done by zones.

Route (from-to)	Number JO	Water quantities Q[l/s]	Nominal pipe diameter [mm]	Route length [m]	Loss of pressure in the pipe [at 1 m in m]	Total loss per share [m]

Table no. 20: Calculation of the necessary pressures for each diameter, depending on the JO, in the table of relevant flows (unit loss is the drop in the pressure in meters per meter of meter)

4.2.2 Loss of pressure on the coupling elements - on the fitting

When designing a pipeline, the designer must take into account the loss of pressure through the fittings. The hydraulic resistance of the fitting can be calculated through the following formula:

$$H=5\Sigma V^2\Sigma k$$

wherein:

- H – loss of pressure
- V – flow rate of the fluid
- k – loss of effectiveness



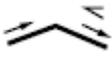
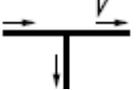
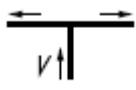
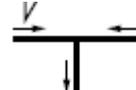
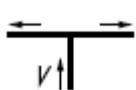
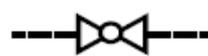
Type of fitting		Loss of pressure	
ELBOW 90°		1,2	
ELBOW 45°		0,7	
ELBOW UN/SN		1,7	
COUPLING		0,25	
COUPLING UN		0,5	
COUPLING SN		0,8	
COUPLING UN reduced		0,4	
COUPLING SN reduced		0,8	
REDUCER	For one dimension		0,4
	For two dimension		0,6
	For three dimensions		0,7
	For more than four dimensions		0,9
CROSS OVER		1,9	
T – piece reduced		0,3	
T – piece reduced		1,4	
T – piece reduced		3,0	
T – piece reduced		1,4	
VALVE		7,0	
Ball Valve		0,4	

Table no. 21: Table of pressure loss through the fitting

4.2.3 Determination of the pipe dimension according to the flow

As mentioned earlier, Pestane's pipe systems are highly resistant to abrasion and leakage because they are made of PP-R and PP-RCT materials. Most Pestana pipes are designed to operate at speeds

up to 2.0 m/s. The diameter of the pipe and the thickness of the wall decide on the flow (l/s). The table below shows an approximate flow rate based on a speed of 2.0 m/s.

Determination of the pipe dimension according to the flow rate based on a flow rate of 2.0 m/s			
Diameters: O.D (mm)	SDR 7,4; [PN20]	SDR 9; [PN16]	SDR 11; [PN10]
16 mm	/	0,250	0,250
20 mm	0,306	0,354	0,432
25 mm	0,433	0,530	0,661
32 mm	0,707	0,866	1,090
40 mm	1,118	1,323	1,696
50 mm	1,768	2,092	2,622
63 mm	2,850	3,354	4,331
75 mm	3,953	4,677	6,124
90 mm	6,124	7,071	7,906
110 mm	7,906	7,906	7,906

Table no. 22: Determination of pipe dimension according to PP-R and PP-RCT flow

4.3 Connecting pipes and fittings



When preparing for the pipe and fitting process, pay attention to the following steps: Safety, Power, Tool Preparation, Preparation and marking of pipes.

As previously mentioned, PP-R and PP-RCT material from which Pestan's tubes are made are thermoplastic materials, so the connection of the Fluidterm tube is done by welding. Welding Pesto Fluidterm pipes can be:

- welt with fittings,
- Suction pipe on the pipe (mainly used for larger diameters) and
- Electrofusion, using electrofusion fittings.

When installing installations in high-rise buildings for the distribution of hot and cold water, in practice, the most commonly used method is suction welding with fittings for smaller diameters. The method of welding the pipe on the pipe is carried out at larger diameters and from the hydraulic aspect is somewhat less appreciable compared to the other two methods of joining, since the casing appears on the inner wall of the pipe during welding. Welding of pipes through electrofusion fittings is much safer with regard to the endurance of the joint, due to reduced error possibility. Due to the higher price of connection through electrofusion fittings and at the same time the higher safety of joints, this method is applied in the transport of viscous materials, in the repair of existing pipelines where

due to the lack of space for manipulation of heaters it is not possible to come. In the continuation of this technical catalog, there will be guidelines for connecting the pipe through fittings, welding with fittings and electrofusion fittings (couplings), as well as connecting PP-R and PP-RCT pipes with other tubular materials and fittings.

NOTE: Peštan does not assume any responsibility when connections are poor due to the use of defective or inadequate equipment.

4.3.1. Security

When working with a hand tool that performs tube and fitting welding, it is very important that the safety measures are applied:

- The digestion process should be carried out by certified and trained persons for this.
- Personal use of HTZ equipment is required, which includes: safety glasses, long sleeves, gloves, shoes and helmet.
- The installation site itself should be safe to use a welding tool that reaches 260 °C during operation.
- Before starting the welding process, check that the welding tool is in the correct state.
- Do not leave the welding tool unattended.
- When the welding process is complete, the tool should be switched off and safely disposed.



4.3.2 Power supply

The necessary power supply for the power tool must be secured so that it is available without interruption or power reduction. When using extension cords, make sure it is a cable itself answering and can transfer the required amount of electricity. Inadequate power supply can cause cold welding and thus jeopardize the integrity of the compounds.

4.3.3 Preparation of the Welding Process Tool

The tool should be unpacked and placed on the provided stand. While the tool is in cold condition, it is necessary to assemble the heater of the appropriate teflon nozzle for the desired pipe diameter. Before the heater is switched on, check the following items as well:

1. Ensure that the plate and the welding head are clean and free of impurities. In case of drowsiness, clean them with soft cloth and alcohol, when cleaning, be careful not to damage the Teflon heads.
2. Check that the Teflon nozzles are correctly mounted, ensuring good contact between the extensions and the heater's plate.

After performing the check, turn on the tool and wait for the tool to warm up to the required $260\text{ }^{\circ}\text{C} / \pm 5\text{ }^{\circ}\text{C}$ in order to start the digestion process.

4.3.4 Preparation and marking of pipes

Pipes visually inspect and make sure that there is no damage, if they have to be removed remotely on the axis of the pipe and cut with the appropriate equipment. After inspecting the pipe, cut the tube to the desired length. To cut the tubes, use only the appropriate shears intended for this purpose, in order not to cause the endurance and the oval end of the tube.



Picture no. 19: Cutting PP-R and PP-RCT pipes



Picture no. 20: Cutting Scissors PP-R and PP-RCT pipes

NOTE: For cutting large diameter pipe there are handheld circular pipe cutters.

After executing the cutting of the pipe to the desired length, check the purity of the end of the pipe to be welded and the purity of the fitting, also check the internal purity of the pipe and fittings, and if necessary clean. After cleaning with a pen, mark the depth of the weld with the template, or use the meter to measure the depth of pipe insertion in the fitting.



Picture no. 21: Marking the required depth of cheeses. The required welding depths along pipe diameters can be taken from the following table:

Outer pipe diameter (mm)	20	25	32	40	50	63	75	90	110
Depth of welding (mm)	12	13	14,5	16	18	24	26	29	32,5

Table no. 23: Welding depth of pipes and fittings depending on diameter

4.4 WELDING

4.4.1 Preparation of the tools for process of welding

The tool should be unpacked and placed on the appropriate stand. While the tool in cold condition should be installed on the heater of the corresponding Teflon attachment for desired pipe diameter. Before the heater is switched on the following things should be checked in electricity:

1. Ensure that the plate and the welding head are clean and free of impurities. In case of drowsiness clean them with soft cloth and alcohol, when cleaning, be careful not to damage Teflon heads..
2. Check that the Teflon plugs are correctly mounted, ensuring good contact between the extensions and the heater board itself.

After executing the check tool turn on and wait for the tool is heated to the required $260\text{ }^{\circ}\text{C}/\pm 5\text{ }^{\circ}\text{C}$ to start the welding process.

4.4.2 Heating the fusion apparatus

After assembly and preparation of the welding tool to turn on the power tool. Depending on the outside temperature, a welding tool may be required between 10 and 30 minutes to reach operating temperature from $260\text{ }^{\circ}\text{C}/\pm 5\text{ }^{\circ}\text{C}$. Before the process begins welding to determine that the tool has reached the necessary temperature. Measurement of the temperature reached is performed by a digital contact thermometer, or at indicator on the tool itself. Also another way in which it is possible to determine the achievement of the necessary temperature is a thermal pencil. When a heater has achieved the desired temperature with a thermal pen mark the mark on the heater, the marked mark will change color after 1 - 2 seconds, if the color change will occur later, the heater is not warm enough.



Picture no. 22: Control heater temperature through thermal pen

NOTE: Minimum 5 minutes must be started with the welding after the suitable welding temperature ($260\text{ }^{\circ}\text{C}$)

4.4.3 Preparation and marking of pipes

Pipes are to be visually inspected and make sure they are not damaged, if they are -have them

removed straightly on The axis of the pipes and cutting should be carried out with appropriate equipment. After inspecting the pipe, cut the tube to the desired length. Use only the appropriate cutting tools scissors designed for this purpose, how there would be no resilience and an oval end of the tube.

4.4.4 Heating of pipes and fittings

After the previous steps the process of heating pipes and fittings can be started. During heating the installer heats the outer diameter of the pipe and the inner one fitting diameter. The end of the tube is intended for welding is slowly, it retracts into the heating ring until previously indicated the depth of the welding, while the fitting reaches the heating throat until the boundary in the fitting. The pipe and fittings are simultaneously pushed (without twisting) the welding heads. When pushing, the installer will be able to deepen them pushes into the welding head when the fitting and the tube soften. When the installer comes to the digestion base and the marked part of the pipe, the heating time begins only then.



Picture no. 23: Heat pipe and fittings (pay attention to positioning the pipes and fittings on the heating plate)

4.4.5 Heating time

When the tube and fittings are inserted on the welding heads, the welding time - melting begins. Depending on the diameter and ambient temperature at which the welding is done performed, there are recommended heating times. The tables below provide the recommended heating times of pipes and fittings.

Outer pipe diameter (mm)	20	25	32	40	50	63	75	90	110
heating time	5	7	8	12	18	24	30	40	50

Table no. 24: Required heating times for pipes and fittings depending on diameter (heating time starts only after the insertion depth is reached)

NOTE: The actual heating times may vary in dependence on ambient conditions, continuity and the power etc. Pestan recommends to perform a welding test to determine optimally heating time.



4.4.6 Connecting pipes and fittings

When the heating time is reached, the hose and fittings are removed from tools (ironing), without screwing, just straight pull out. Quickly inspect melt material at pipes and fittings in case there is a defect that is not observed before the start of the welding itself. The tube and fittings need to align and insert so that the ring itself is on the pipe does not touch the end of the fitting, the fitting and the pipe during merging should not be twisted because it can lead to uneven moving the melted material and that can affect the integrity of the compound itself.



Picture no. 24: Connecting the pipe with the fitting

4.4.7 Correction time

After inserting the pipe into the fitting, the installer has a couple of seconds during the merger time to adjust insertion angle max. 10 °C to make it correct settled the pipe with the fitting.

Outer pipe diameter (mm)	20	25	32	40	50	63	75	90	110
Correc-tion time (sec)	3	3	6	6	6	8	8	8	10

Table no. 25: Correction times between pipe and fittings depending on diameter

4.4.8 Connection time

After inserting the pipe into the fitting, the hose and fittings should be kept in the final position. Depending on the pipe wiper the connection time is different, the table below shows the minimum required connection times for the pipe and fittings.



Picture no. 25: Connecting pipes and fittings

Spoljni prečnik cevi (mm)	20	25	32	40	50	63	75	90	110
Time Reten-tion (sec)	5	7	8	12	18	30	30	30	50

Table no. 26: Connection time

4.4.9 Cooling time of the joint

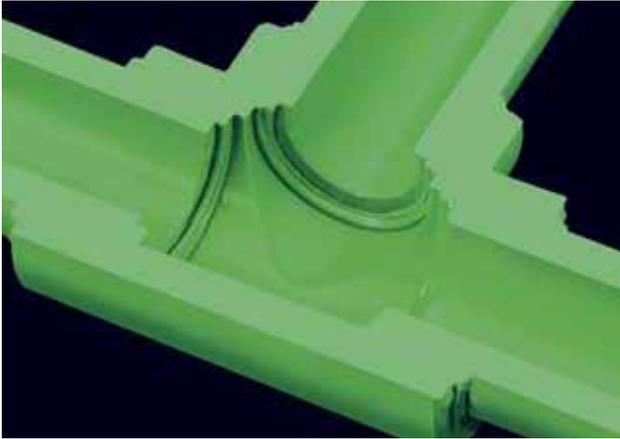
After completing the connection of the pipe and fittings, the connection should be left to cool for some time. In the given table below, the recommended times are given for cooling depending on diameter.

Outer pipe di- ameter (mm)	20	25	32	40	50	63	75	90	110
Cooling time (min)	2	2	4	4	4	6	6	6	8

Table no. 27: The minimum cooling time

NOTE: During the cooling time of the joints do not accelerate the process using water or any other way.

After the required cooling time of the compounds has elapsed, the pipe system is ready for exploitation. When use of fusion welding techniques, a homogeneous connection between the pipe and the fitting is obtained without leakage possibilities.



Picture no. 26: Cross section of a compound achieved butt welding

4.5 Successive welding of the Saddle couplings (using a manual fusion tool)

Unlike welding of pipes and fittings, for welding saddle joints welding occurs on the wall of the pipe, on the very curved surface of the pipe. By using the saddle attachments get the ideal solution at adding additional lines to verticals, or adding measuring instruments and etc. Advantage of saddle coupling is that these compounds can be made at the end of the main lines, also saddle couplings cause much less pressure drop compared to classic T - piece. When preparing for the process of the saddle welding process pay attention to the following steps as for welding pipes and fittings:

- Security,
- Power supply,
- Tool preparation,
- Preparation and marking of pipes

NOTE: As for Safety, Power, Tool Preparation, these procedures are completely identical to the procedures as well as for welding pipes and fittings.

4.5.1 Preparation of the Tools for process of welding

The tool should be unpacked and placed on the appropriate stand. While the tool in cold condition should be installed on the heater of the corresponding Teflon attachment for desired pipe diameter. Before the heater is switched on the following things should be checked in electricity:

1. Ensure that the plate and the welding head are clean and free of impurities. In case of drowsiness clean them with soft cloth and alcohol, When cleaning, be careful not to damage Teflon heads.
2. Check that the Teflon plugs are correctly mounted, ensuring good contact between the extensions and the heater board itself.

After executing the check tool turn on and wait for the tool is heated to the required $260\text{ }^{\circ}\text{C}/\pm 5\text{ }^{\circ}\text{C}$ to start the welding process.

4.5.2 Preparation of pipes and saddle welding joints

It is necessary to mark the place on the very wall of the pipe drilling where the saddle will come. Before starting with drilling of the wall itself, the tube is visually checked and made sure there is no damage. When drilling it is very important that the tube breaks down precisely and straight on the axis of the pipe. Drilling needs to be done by appropriate equipment, using suitable drills. Make sure when drilling shrubs that are formed not to fall into the pipe itself and thus ensure safety that clogging will not occur nor a bad connection. Upon completion of the preparation of the place where saddle will be put make sure it is safe that no surplus or shards remained inside the tube or that the shards were not attached to the wall of the pipe.



Picture no. 27: A method of drilling pipe



Picture no. 28: Auger for drilling holes in the pipes



4.5.3 Welding of a saddle attachment - heating process

As with the welding of pipes and fittings, before the the process of heating and welding the saddle coupling, should be determined whether the Teflon head itself has reached the necessary temperature, the process of checking can be viewed in already described in Section 4.4.1. When the fusion machine has achieved the required temperature you can access heating process. In a previously drilled hole insert the welding head so that the head is completely inserted into the drill uses a wooden plug or another tool that is heat resistant to make the head pressed and installed correctly. When the head is inserted into the borehole, attach the saddle joint and press the other part of the head on the fusion apparatus. After the coupling is fully inserted Keep the head of the fusion machine, and wait until it is no uniform melting of the material occurs. Depending on the diameter of the pipe, the heating time varies. The table below shows the time:

Outer pipe diameter (mm)	20	25	32	40	50	63	75	90	110
Heating time	5	7	8	12	18	24	30	40	50

Table no. 28: Time required, depending on the diameter of the holes for the holes in the pipe and the seal joints (the warm-up time starts only after the digesting depth has been reached)

NOTE: During the heating process, taken as a valid time, the time for one diameter is greater than the one that is changing.

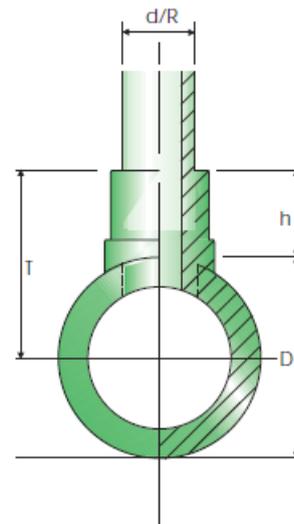
4.5.4 Connecting the saddle pipe fittings

When the heating time is reached, draw the fusion head from a well, a saddle joint without twisting separate from the iron, and insert it straightly on the axle boreholes without twisting. Pay attentio to the position and tension on the part of the saddle joint which is welded. Screwing the coupling can lead to displacing the dissolved material and thereby affecting integrity of the compound itself. After placing the saddle couplings check to see if the coupling and the pipe are properly merged.

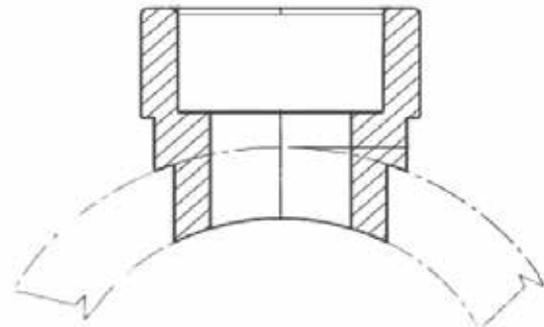


Picture no. 29: Insert the saddle coupling on the wall of the pipe

When the coupling was correctly coupled with The pipe itself the integrator of the joint is solid and safe for further handling. In the picture below you can see the transverse cross-section of welded saddle couplings from pipes. The painting.



Picture no. 30: Cross-section of the pipe through the saddle coupling, where the said position of the groove is visible when placing the coupling



Picture no. 31: Cross-section of the pipe through the saddle coupling, where the said position of the groove is visible when placing the coupling

NOTE: The correction times and the cooling times are taken by one diameter greater than the one used. The tables below provide the time needed:

Outer pipe diameter (mm)	20	25	32	40	50	63	75	90	110
Correction time	3	3	6	6	6	8	8	8	10

Table no. 29: Correction times between pipe and fittings in dependence on diameter

Outer pipe diameter (mm)	20	25	32	40	50	63	75	90	110
Cooling time (min)	2	2	4	4	4	6	6	6	8

Table no. 30: Minimum required period of cooling

4.6 Welding the pipe through electrofusion fittings

As with standard welding of pipes and fittings, welding tubes by electrofusion joints is also divided into three essential phases:

- Preparation, Welding, Cooling

4.6.1 Preparation of the electrofusion tool

As part of the preparation procedure, the appliance is required to be connected to the appropriate power source.



Picture no. 32: Electrofusion device

4.6.2 Preparation of electro-tube tubes welding

Pipes as in the previous procedures, should be visually inspect, and if damage or any kind is detected remove the defect. Cut the tube to the required length, at right angles using the appropriate tool. In the event that the tool is not sharp it can make the same pipe oval and thus the bad welding..



Picture no. 33: Displays the cutting of the pipe with scissors

NOTE: After cutting the pipe to the correct length, clean the ends of the pipes with a soft cloth that does not leave the fibers behind.

4.6.3 Electrical fusion welding

Once the tube is ready, remove electro-coupling joint from the protective packaging directly before starting welding, in order to prevent contamination of compound and thus obtain a quality compound. In case of the coupling was removed earlier, checked and if necessary clean. When inserting the ends of the tubes in the electro fusion clamp, be sure to mark the insertion depth and take care that the welding tubes are axial directed.

The insertion depth of pipes in coupling is given in the table below.

Outer pipe diameter (mm)	20	25	32	40	50	63	75	90	110
Depth of entry (mm)	26,5	26,5	25,0	25,0	25,0	30,0	33,0	36,0	41,0

Table no. 31: Displays the depth of pipe entry in the EF (electro-coupling) coupling

After inserting the tube into the electrofusion coupling, fix the coupling together with the pipes so that it can get linear or axial shifting. In order for the electrofusion welding process to be possible It is necessary to connect the electrodes of the appliance to predicted locations in electro-coupling. When everything is connected in a proper way, the apparatus for electrofusion turns on. Welding by electrofusion is in fully automated and when used the apparatus itself recognizes the diameter of the tube and the type of electrofusion couplings..



Picture no. 34: Indicates the power of the EF device connected to the EF connector in the correct way

4.6.4 Cooling process with electrofusion welding

Electrofusion apparatus after completing the welding process gives a signal that the process has been completed and from that moment on cooling of the compound begins. Depending on the manufacturer electrofusion apparatus read the instructions in order to know how the apparatus signals that the process is welding finished.

NOTE: During the cooling period, do not remove electrodes from the coupling, otherwise it can get to deformation of the joint or you can get burns. The cooling time of the compound is equal to the time process fusion. When cooling the use of means for cooling is not allowed.

IMPORTANT: During the electrofusion process, don't touch the coupling and do not move the pipe, otherwise deformation of pipes and exterior can occur. When The duration of the electrofusion process of the coupling reaches the temperature and up to 200 °C, caution is advised due to possible burns caused by touching without protective equipment.

4.7 Welding of large diameter pipes

When welding pipes with a diameter of $\phi 63$ mm and more, It is advisable to use manual or hydraulic stationary welding machines (welders with stand, welders with hydraulics, welders with feet). By using a welding machine whether it is with stand, hydraulics or with feet, helps the installer to make connections faster and more precisely.

4.7.1 Welding of pipes using a elding machine with stand and teflon

The scraper with the stand is used for joining (welding) compounds of $\phi 63$ and more. When using It is very important that the server for the machine for welding adheres to all safety measures as there would be no injuries to the worker himself. When welding with a welding machine with a stand, all preparation processes for welding are the same as for the use of manual welding tools.



Picture no. 35: Appearance stationary welding machines



Picture no. 36: Welding machine with stand

The area around the welding machine where it will be installed should be neat and clean. Before start welding inspect the machine visually, and in the event of any defects detected must be removed. After checking, on his own tool mount appropriate teflon bits for the corresponding pipe and fitting diameter. Fit pipe and fittings in suitable holders (jaws). By turning the main handle, the hose and fittings are aligned before starting the welding, space it out and insert the iron for welding.



Picture no. 37: Pipe and fitting alignment procedure

By turning the main handle again, move the tube and fitting so that pipe and fittings are inserted into the Teflon heads..



Picture no. 38: The installation of pipes and fittings in the teflon head

Heating times are given in table no. 24. After completion of the heating time required, remove the pipe and fittings from the Teflon heads so as not to damage the dissolved material. Re-turning the main handle makes the insertion of the pipe in the fitting. After inserting the tube and fittings leave them in this position until the connection cools off.



Picture no. 39: Welding and cooling of pipes and fittings

The required cooling times are given in **table no. 27**.

IMPORTANT: Make sure you do not get reinsertion and do not get narrowing of the flow or deformed joint.

4.7.2 Butt welding

When connecting tubes and fittings are larger than $\varnothing 125$ for the welding process, a front welding method is used, for connecting the pipes and fittings of a larger diameter hydraulic machine shown in the picture below is used.



Picture no. 40: The appearance of a hydraulic front-welding machine

The basic principles of preparation for welding are the same as for welding pipes and fittings. Before machine worker start the process of welding pipes and fittings, it is necessary to check and if necessary to remind all safety measures when using the machine. Before the front welding of the pipes and fittings, fix the elements with the holders (jaws) in order not to move during the welding process..



Picture no. 41: Fixing the pipe with jaws

All the elements of the machine must be dusted and cleaned during welding. In front end welding ends of pipes and fittings must be processed using a special extension for processing. After processing check and remove the shaving occurrences during process.



Picture no. 42: A method of processing the ends of the tube

After finishing with the pipes and fittings, the elements are to be aligned and is needed to insert a heating plate between them the process of welding.



Picture no. 43: Insertion of the heating plate

During the welding process, control the formation rings of dissolved material. Heating time given in the table No 31. When the heating time is achieved space out the elements and eliminate heating plate. Carefully control the formed rings of dissolved material, in case there are anomalies noticed stop the welding process. After executed control of dissolved material in which no irregularities are detected welding process can continue to attract elements, in a way that there is a connection of dissolved rings.



Picture no. 44: Butt Welding

IMPORTANT: When the rings are connected, leave the elements in that position until it is necessary to achieve cooling time of the circuit itself.

NOTE: Do not pour water into the junction to accelerate cooling time.

Required times of heating and cooling at the front welding			
Dimensions		Heating time (sec)	Cooling time (sec)
SDR	Diameter		
9	160mm	315	28
11	160mm	277	24
17,6	160mm	204	15
9	200mm	364	35
11	200mm	320	29
17,6	200mm	237	19
9	250mm	415	43
11	250mm	367	35
17,6	250mm	272	23
9	315mm	471	53
11	315mm	412	44
17,6	315mm	317	28

Table no. 31: Heating and cooling time for PP-R and PP-RCT

4.8 Pipe repair technique (repellent plug)

In case of using the system PP-R and PP-RCT materials have been damaged (holes), the system can be repaired using reparation plugs for smaller diameters, while for larger diameters is used reparation saddle extension.



Picture no. 45: Repairing cap



Picture no. 46: Reparation saddle extension

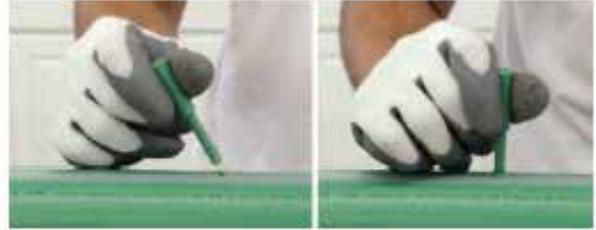
Repair process:

1. Mount the tool on the repair welding head tool
2. Empty the system from the fluid
3. If it is left on the pipe itself the object that caused the damage, it should be removed.
4. Measure the hole diameter and, if necessary, opening expand to the corresponding reparation diameter plug. When expanding the opening, drill at right angle
5. Clean the place where the damage occurred that during the welding process it does not come to the defect of the joint itself.
6. Mark the repellent plug to the required depth insertion, which gives the diameter and the wall thickness the element on which the repair is performed.
7. Heat the reparation tool at 260 °C
8. After reaching the temperature, in Teflon part on the tool insert a repellent plug, Insert the other part of the tool into the opening on the reparation element.



Picture no. 47: Inserting reparation tools

9. After heating, remove the repellent head from the tube and insert the repacking plug, which is previously marked to the required depth inserting. Keep reparation plug after insertion until the joint cools down.



Picture no. 48: Inserting the repacking plug

10. When the repellent plug is set, the rest part of the repacking plug should be carefully removed by scalpel.

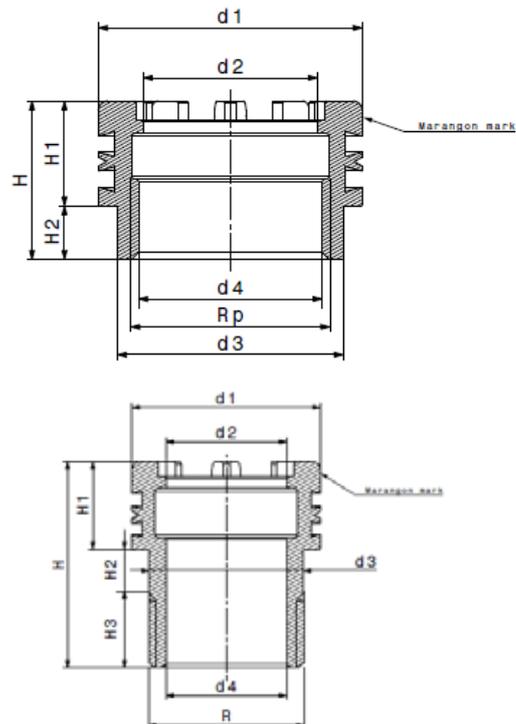


Picture no. 49: Cutting off of the reparation plug

4.9 Connection of PP-R and PP-RCT pipes with other tubular materials

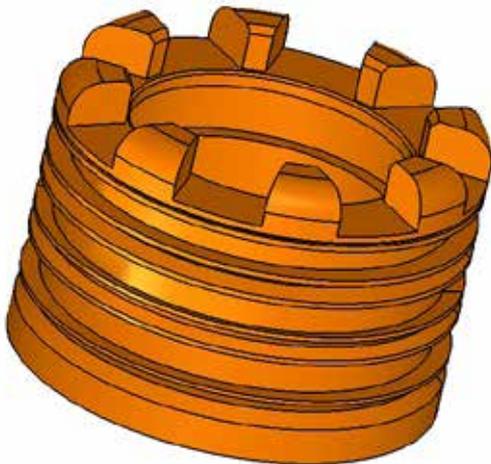
Connection of PP-R and PP-RCT pipes with other tubular materials and outlets, as well as with connection fittings made of other materials, are made over brass inserts. When sealing joints The pipe system should use a teflon thread or tape.

4.9.1. Brass inserts (PP-R)



Picture no. 50: Technical drawings of UN/SN inserts

Pestan transverse brass inserts for PP-R pipes and fittings, are made according to EN 10226 Rp norms, and are approved for use in water supply. Brass as a material is a mixture of copper and zinc, due to the low content of copper the risk of brass oxidation is reduced. During the production of the fittings, special additives are added to the PP-R mixture to compensate for the smallest influence of free ions in mesh.

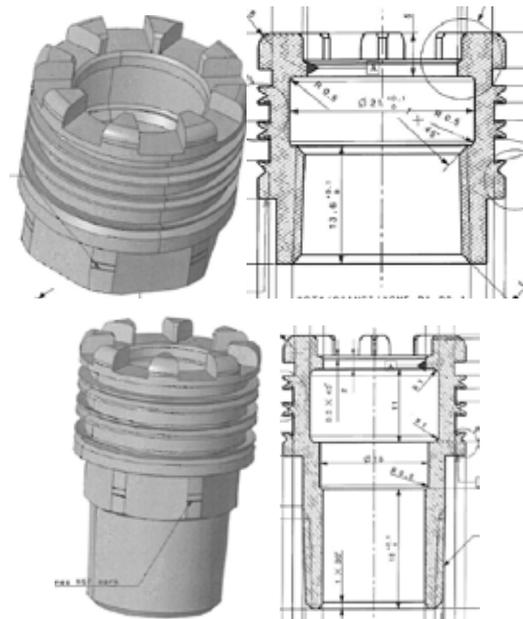


Picture no. 51: Brass insert

MATERIAL	CW602N DIEHL GERMANY
HARDWARE	110+-10 HB
INSERT WEIGHT	37g
DESIGN DESCRIPTION	Inability to leak liquid between the insert and the plastic
MOMENT	The maximum permissible torque that the brass insert can withstand without turning inside the fitting is 70N/m
SUPPLIER CONTROL	Each insert has a logo of the supplier
SAFETY	Increased tensile strength by more than 30% (min. Wall thickness 2mm).
NOW	according to EN 10226 Rp

Table no. 33: Properties of brass insert HEX

4.9.2 Brass inserts (PP-RCT)



Picture no. 52: Technical drawings HEX UN/SN inserts

Pestan transient brass inserts for PP-RCT pipes and fittings, are made according to EN 10226 Rp norms, and are approved for use in water supply.

MATERIAL	CW511L DIEHL GERMANY
HARDWARE	110+-10 HB
INSERT WEIGHT	63g
DESIGN DESCRIPTION	Inability to leak liquid between the insert and the plastic
MOMENT	The maximum permissible torque that the brass insert can withstand without turning inside the fitting is 70N/m
SUPPLIER CONTROL	Each insert has a logo of the supplier
SAFETY	Increased tensile strength by more than 30% (min. Wall thickness 2mm).
NOW	according to EN 10226 Rp

Table no. 33: Properties of brass insert HEX

4.9.3 Mixed pipe system PP-R, PP-RCT/Copper

Copper is a known catalyst for the oxidation process in polypropylene. Due to the increased concentration of chlorine, pH water values, water quality and temperature, the copper is released into the negative ion ions and the process oxidation of polypropylene begins. In cases of elevated water temperature in the system, the oxidation process drastically accelerates.



In order to avoid the erosion of PP-R and PP-RCT pipe systems for hot water distribution and provide long - term use in systems where PP-R and PP-RCT pipe systems are used in combination with copper pipes, it is recommended to avoid large length of copper tubes. The amount of copper that is considered optimal for combination with PP-R and PP-RCT is the amount found in the heating or water pumps themselves.



Picture no. 53: The appearance of degraded PP-R and PP-RCT tubes due to the action of negative copper ions

NOTE: In order to ensure the long-term use of the mixed PP-R and PP-RCT / Copper system, for hot water systems, Pestan recommends that these limitations be respected.

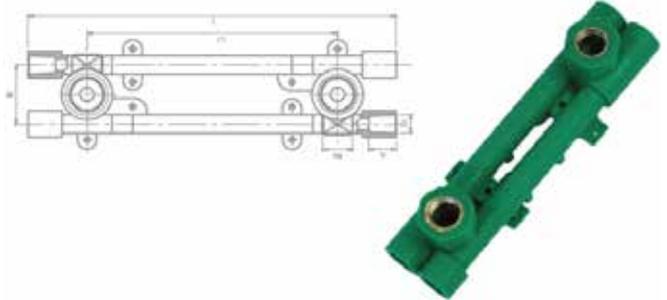
4.9.4 Connection of PP-R and PP-RCT tubes at the outflow points

When connecting (welding) the PP-R and PP-RCT pipes in the outflow points, the intended fitting with brass inserts (SN/UN) can be used).



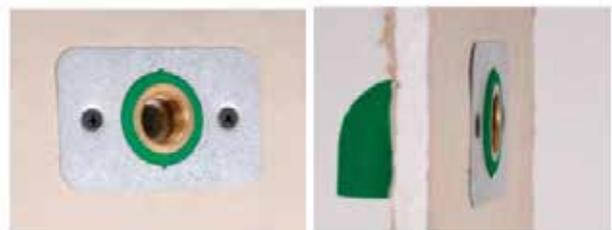
Picture no. 54: PP-R and PP-RCT end elbow with brass inserts

Also, in certain cases, the drainage points can be made with the help of a mounting group which, like the fitting, is welded, the picture below shows the picture of the assembly group. The mounting group has the possibility of counting on the required space for reinforcements such as water heater, sink, etc.



Picture no. 55: Schematic view and appearance of the installer, for which PP-R pipes are directly welded

When it comes to the connection of PP-R and PP-RCT pipes in buildings where walls or partition walls are made of plasterboard boards, special rigips knees are used for the outflow points. Rigips - elbow also it protects according to the same principle as the classic fingers, with special fixing plates.



Picture no. 56: Appearance rigips elbow

NOTE: Instructions for fixing outflow points can be found in the catalog in section 4.11.3. Installation of outflow points.

4.10 TYPES OF PIPELINE

4.10.1 Cold water pipelines

To install the Peštan PP-R and PP-RCT system, the installation and use guidelines according to DVS 2208-1 should be complied with. When designing and installing a cold water pipeline system, attention should be paid to the following parameters that must be controlled.

Temperature, pressure and fluid velocity in the system:

- Pressure in cold water systems for the temperature of the fluid (max 20 °C) can be as declared on the pipe itself and depends on the SDR (see table No. 34).
- The recommended fluid flow rate in cold water systems for the fluid temperature (max 20 °C) is 2.0 m/s.

TEMPERATURE C°	LIFESPAN, YEAR	PERMISSIBLE WORKING PRESSURE (SF=1,5)			
		S			
		5	4	3,2	2,5
		SDR			
		11	9	7,4	6
10	1	19,0	24,0	30,2	38,0
	5	18,4	23,3	29,3	36,8
	10	18,3	22,9	28,9	36,4
	25	17,9	22,6	28,4	35,8
	50	17,7	22,3	28,0	35,3
	100	17,4	21,9	27,7	34,8
20	1	16,6	20,8	26,3	33,1
	5	16,1	20,2	25,4	32,1
	10	15,8	19,9	25,1	31,6
	25	15,5	19,6	24,7	31,0
	50	15,3	19,3	24,3	30,6
	100	15,1	19,0	24,0	30,2
30	1	14,3	18,1	22,8	28,7
	5	13,8	17,4	22,0	27,7
	10	13,7	17,2	21,7	27,3
	25	13,4	16,8	21,3	26,8
	50	13,2	16,6	20,9	26,3
	100	13,0	16,4	20,7	26,0
40	1	12,3	15,5	19,6	24,7
	5	11,9	15,0	18,8	23,8
	10	11,8	14,8	18,6	23,4
	25	11,5	14,4	18,2	22,9
	50	11,3	14,3	17,9	22,6
	100	11,1	14,0	17,7	22,3
50	1	10,5	13,3	16,8	21,1
	5	10,2	12,8	16,1	20,3
	10	10,0	12,6	15,8	19,9
	25	9,8	12,3	15,5	19,5
	50	9,6	12,1	15,3	19,2
	100	9,4	11,9	15,0	18,8
60	1	8,9	11,3	14,2	17,8
	5	8,6	10,8	13,6	17,2
	10	8,4	10,6	13,3	16,8
	25	8,3	10,3	13,1	16,5
	50	8,1	10,2	12,8	16,2
	100	7,9	10,0	12,6	15,9
70	1	7,5	9,4	11,9	15,0
	5	7,2	9,1	11,4	14,4
	10	7,1	8,9	11,3	14,1
	25	6,9	8,7	10,9	13,8
	50	6,8	8,5	10,8	13,5
	100	6,6	8,3	10,6	13,3
80	1	6,3	7,9	9,9	12,5
	5	6,0	7,5	9,5	12,0
	10	5,8	7,4	9,3	11,8
	25	5,8	7,2	9,1	11,4
	50	5,7	7,1	9,0	11,3
	100	5,6	7,0	8,9	11,2
95	1	4,7	5,9	7,4	9,3
	5	4,4	5,6	7,1	8,9
	10	4,3	5,5	6,9	8,8

Table no. 34: Permissible operating pressure depending on temperature and the expected life span of the pipe-

4.10.2 Hot water pipelines

As with the installation of a cold water system, when installing a hot water system, the installation and use guidelines for DVS 2208-1 should be followed. In the DHW system, be careful when designing and using the following parameters:

- Pressure in DHW systems (max. 60 °C constant temperature) depends on pipe SDR (see table No. 34)
- Avoid constant temperatures above 60 °C in hot water systems.
- The flow rate of the fluid in hot water systems should be limited according to the recommendation of the German Institute and the Guidelines DIN 1988 and the Dutch
- KIWA fluid temperature institute (max. 60 °C constant temperature) to 0.5 - 0.75 m/s.

4.10.3 Piping systems for recirculation systems

In the hot water recirculation system, special measures should be taken to ensure that the conditions of use do not lead to corrosion or erosion of the system. The use of chlorine (chlorine dioxide) or similar disinfectants in the system must be fully in line with the applicable national regulations. Pestan recommends that such chemicals be completely avoided in recirculation systems.

The parameters to be considered when designing and using are the following:

- The pressure in the recirculation systems for the temperature of the fluid (max 45 °C constant temperature) must not exceed 5.5 bar.
- The maximum permissible fluid velocity in the recirculation system (max. 45 °C constant temperature) is 0.5 m/s.
- In recirculation systems, it is recommended to avoid the long length of copper pipes in combination with PP-R and PP-RCT pipes. Conditions for the use of copper tubes in recirculation systems (elevated temperature, flow rate, chemicals, etc.) can lead to corrosion, erosion and copper corrosion, resulting in an increase in the concentration of ions of copper in water. Increased amount of copper ions in water can damage the internal surfaces of PP-R and PP-RCT pipes in systems.
- The amount of copper that is considered optimal for combination with PP-R and PP-RCT in recirculation systems is that quantity found in the water heating device itself or water pumps.

NOTE: Following manufacturer's recommendations regarding temperature, pressure and fluid velocity in recirculation systems, you prevent these appearance.



4.11 Reliance pipelines

When relying on the piping, the rules for positioning the pipe support are applied both to fixed and sliding support. The maximum distance between the pipes depends on the type of pipe (with fiber or without fiber layers), and from the outer diameter of the pipe and the expected temperature difference between the ambient and the working fluid temperature.

The suspension of the pipeline can be continuous or in points. When placing the pipe in the wall, the reliance is continuous, while the time is right visual or channel reliance in points. Continuous emptying means that the pipe system is fully supported by its entire length, while when relying on points, as the name implies, the system relies on certain points. When relying on points in pipes, they can be supported on fixed or sliding supports. When selecting the reliance of the pipeline itself, it is very important to select a product that has been proven safe to use in the installation. In cases where the metal clips (clips) are bristles, the part coming into contact with the tubes must be linearly secured with rubber.

WARNING: Condensation can occur if the metal holders are placed directly on cold pipes. All holders should be linearly coated with rubber to prevent condensation.

NOTE TO INSTALLERS: Before determining the spacing between the holder, release the first boiling water through the pipe to simulate the active pipe system.

4.11.1 Determination of sizes of clips and clamps for PP-R and PP-RCT pipes

The recommended spacing between the PP-R and PP-RT tubes is based on the outside diameter of the pipe. In case the pipes are insulated, the total sum of the pipe diameter and the insulation thickness are taken as the relevant measure, in determining the size and distance of the holders themselves.

4.11.2 Positioning of the tube supports in the visual direction and direction of the pipe through the dedicated channels

The positioning of the fixed supports determines the positioning of the compensation elements on the pipeline, and when mounting the supports, the sliding supports for which there are also installation rules are also to be considered. The principles for setting the supports, ie spacings, depending on the type of pipe, diameter, and the predicted temperature changes, are given in the tables below.

IMPORTANT: When installing vertical lines, particular attention should be paid to the positioning of the fixed supports and avoid using sliding supports, since in this case they are not worn in the vertical direction and can overload and pierce the pipeline due to its own weight and weight of the fluid transported.

NOTE: Spacings given in the previous tables refer to the positioning of horizontal lines, while for vertical lines the position of the paddles is calculated.

Temperature change	Pipe diameter									
	16	20	25	32	40	50	63	75	90	110
	Spaces supports									
0	70	85	105	125	140	165	190	205	220	250
20	50	60	75	90	100	120	140	150	160	180
30	50	60	75	90	100	120	140	150	160	180
40	50	60	70	80	90	110	130	140	150	170
50	50	60	70	80	90	110	130	140	150	170
60	50	55	65	75	85	100	115	125	140	160
70	50	50	60	75	80	95	105	115	125	140

Table no. 35: Supports of supports for different expected temperature changes of PP-R and PP-RCT pipes for SDR 6 and SDR 7.4

TEMPERATURE	Pipe Diameter								
	20	25	32	40	50	63	75	90	110
	Spaces supports								
20	60	75	90	100	120	140	150	160	180

Table no. 36: Required substrate spacing for PP-R and PP-RCT pipes for SDR 11, when transporting water temperature from 20 °C

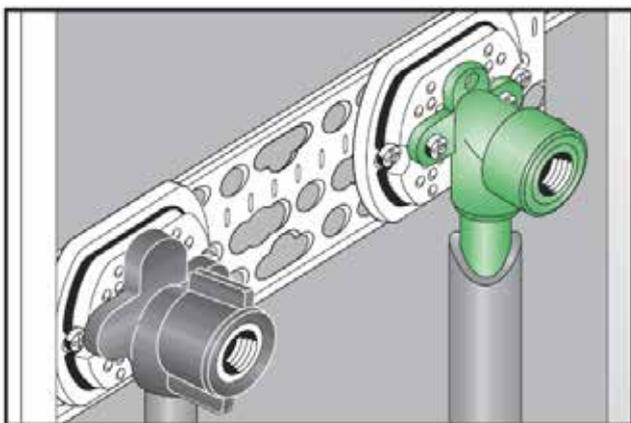
Temperature change	Pipe Diameter								
	20	25	32	40	50	63	75	90	110
	Spaces supports								
0	120	140	160	180	205	230	245	260	290
20	90	105	120	135	155	175	185	195	215
30	90	105	120	135	155	175	185	195	210
40	85	95	110	125	145	165	175	185	200
50	85	95	110	125	145	165	175	185	190
60	80	90	105	120	135	155	165	175	180
70	70	80	95	110	130	145	155	165	170

Table no. 37: Spacings in different expected temperature changes for PP-R and PP-RCT Fiber Glass pipes SDR 7,4

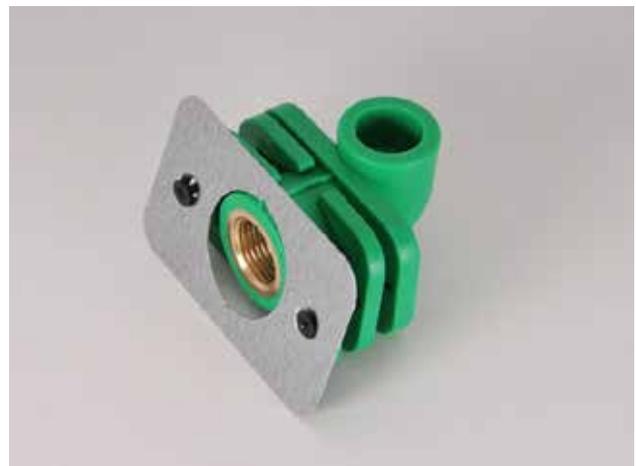


4.11.3 Installation of outlet points

The end points of the water supply installation are drinking water. The drainage points are finishing pieces with internal or external thread to which the fittings are mounted. The drainage points must be secured to avoid the breakage of the pressure pipes and the weight of the fittings. In the example below, there is an example of one of the ways of filling the outlet.



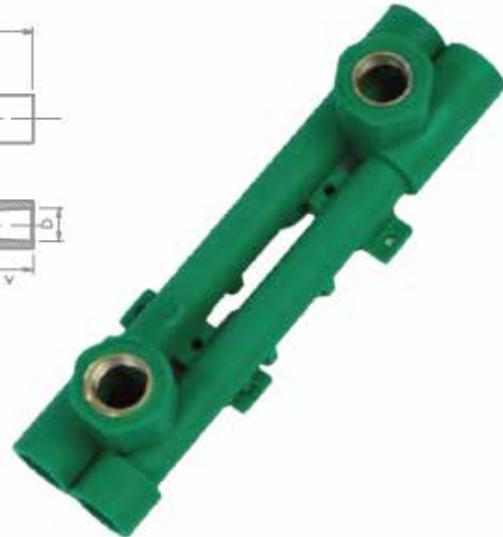
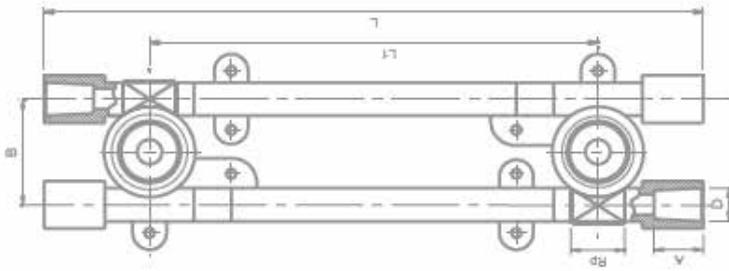
Sika br. 57: Installation of the outlet, knee 90° UN with eyelets, galvanized stand



Picture no. 58: Galvanized spacer with mounted knees with inserted threads and washers with eyelets. The spacer is screwed into the wall, and the knees are fastened by the spacers with the eyelets.

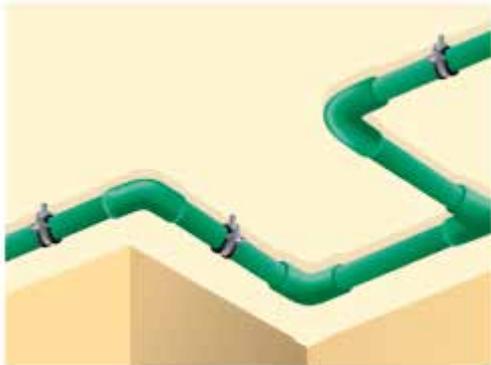
Also, one of the ways of fastening the outlet site is the rope of wall mounts.

When installing outflow points on gypsum wallboard, use special rigips of the knees, which in special way (with special screws) fasten to plasterboard panels in order to provide a drainage place and not to move the fitting itself during the final fitting of the fittings.



Picture no. 59: Schematic view and layout of the installer, for which PP-R pipes are directly welded and screwed onto the wall, and after that, a tapping point is mounted on it.

4.12 Linear Scrolls, Spreads and Collections



Based on application and environment, the designer should calculate the linear expansion and collection of the pipe system that may occur. By selecting the correct positioning of the Pipe System, linear expansion and shrinkage can be compensated. With a closed type of installation, installers should leave sufficient length of the pipe and thus compensate for the expansion and collection of the pipe system itself. While in an open installation, it is very important to retain the visual effect itself, therefore they are used in some cases by expansive arches or sliding knees.

4.12.1 Linear Expansion and Collection

In the design, linear expansion and shrinkage is an important factor for each pipe system. The expansion and collection of pipes is based on the difference in ambient temperature and the maximum operating temperature of the fluid in the pipe.

$$\Delta T = T_{\text{Operating Temperature}} - T_{\text{Temperature installation}}$$

When transporting cold fluid through the pipe system, the value of ΔT is minimal and the collection of cold-fluid pipes will not affect the welded connections. When transporting boiling fluids, the effect of heat on the pipe system is such that it is expanding, and thus the value of ΔT increases. Due to changes in temperature, the pipe system requires accessories such as expansion arches or liras to prevent deformation of the pipes themselves. The linear spread calculation can be calculated according to the following formulas:

where are they:

- required elongation of the pipe or longitudinal temperature dilation
- coefficient of temperature dilation
- pipe length
- temperature increase.

4.12.1.1 Coefficient of linear expansion and shrinkage - temperature dilatation coefficient

PE-R and PP-RCT pipes have a very high level of stability and stability. Linear elongation Peštan PP-R and PP-RCT pipes, with standard coefficient of linear thermal shrinkage and expansion, is given in the table below.

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

Difference in temperature ΔT						
Pipe length (m)	10	20	30	40	50	60
	Linear elongation ΔL (mm)					
10	15	30	45	60	75	90
20	30	60	90	120	150	180
30	45	90	135	180	225	270
40	60	120	180	240	300	360
50	75	150	225	300	375	450
60	90	180	270	360	450	540
70	105	210	315	420	525	630
80	120	240	360	480	600	720
90	135	270	405	540	675	810
100	150	300	450	600	750	900
150	225	450	675	900	1125	1350
200	300	600	900	1200	1500	1800

Table no. 38: Linear thermal shrinkage and expansion of PP-R pipes

When it comes to collecting and expanding the glass fiber tubes in the central layer, it should be noted that the coefficient depends on several factors, and therefore the size of the collected and expandable can be varied. The coefficient of linear thermal shrinkage and expansion is influenced by temperature, line length, pipe diameter, SDR tube, amount of glass fiber in the central layer, etc.

Minimum Coefficient of Linear Thermal Shrinking and Spreading Fiberglass pipes with PP (RF-RFG and PP-RCT-FG) is $\alpha = 0.035 \text{ mm/m } ^\circ\text{C}$
 Linear elongation Peštan PP-RFG and PP-RCT-FG pipes, with a minimum coefficient of linear thermal shrinkage and expansion, is given in the table below.

$\alpha=0.035 \text{ mm/m } ^\circ\text{C}$

Difference in temperature ΔT						
Pipe length (m)	10	20	30	40	50	60
	Linear elongation ΔL (mm)					
10	3.5	7	10.5	14	17.5	21
20	7	14	21	28	35	42
30	10.5	21	31.5	42	52.5	63
40	14	28	42	56	70	84
50	17.5	35	52.5	70	87.5	105
60	21	42	63	84	105	126
70	24.5	49	73.5	98	122.5	147
80	28	56	84	112	140	168
90	31.5	63	94.5	126	157.5	189
100	35	70	105	140	175	210
150	52.5	105	157.5	210	262.5	315
200	70	140	210	280	350	420

Table no. 39: Linear thermal shrinkage and expansion of PP-RCT pipes



As said, to linear collecting and expanding influenced by several factors. The table below shows the values given linear elongation Peřtan PP-R-FG and PP-RCT-G pipe diameter DN 25x3.4, tested in lab, in

length of 1m, with 10% glass fiber in the central layer at different ΔT .

$$\alpha = 0.085 \text{ mm/m } ^\circ\text{C}$$

Pipe length (m)	Temperature difference ΔT					
	10	20	30	40	50	60
	Linear elongation ΔL (mm)					
10	8.5	17	25.5	34	42.5	51
20	17	34	51	68	85	102
30	25.5	51	76.5	102	127.5	153
40	34	68	102	136	170	204
50	42.5	85	127.5	170	212.5	255
60	51	102	153	204	255	306
70	59.5	119	178.5	238	297.5	357
80	68	136	204	272	340	408
90	76.5	153	229.5	306	382.5	459
100	85	170	255	340	425	510
150	127.5	255	382.5	510	637.5	765
200	170	340	510	680	850	1020

Table no. 39: Linear thermal shrinkage at temperature change

4.12.2 Acceptance of tube elongation by changing the direction

Extension of pipes at temperature dilatations, can be compensated by changing directions from 90°. The required length of the piece of pipes that will be administrative to the tube direction and which will serve for acceptance Expansion is calculated as follows:

$L_s = K \times \sqrt{d \times \Delta l}$ - expression for calculating the required length changes in direction, where:

L_s is the length of the required direction change, if followed instructions for other values that are entered in the formula, this value is obtained in millimeters [mm],

- specific material constant (for Fuidtherm pipes it is 15) and this value is a dysfunctional,
- The outer diameter of the pipeline, the unit is millimeter [mm],
- Pre-calculated longitudinal dilatation of the pipeline, unit is millimeter.



Picture no. 60: Display of the correct acceptance of longitudinal dilatations by changing the direction, where GL is a plain bearing (support), and FP fixed bearing (fixed support), while L_s is required length of change direction.

4.12.3 Acceptance of tube elongation

Through lyre acceptance of the elongation of the tube through the lyre (compensation port), is performed in case of compensation stretching in length can not be performed by a change direction. In order to accept acceptance elongation through The lyre need an additional 4 ports at 90°. Width expansion port should be taken into account when calculating the budget independent of the length of the compensation angle L_s and width of the A_{\min} tube port. Required parameters for Compensation ports are calculated in the following way:

$LS = K \times \sqrt{d \times \Delta l}$ - an expression for calculating the required length of change the direction of the lira, where:

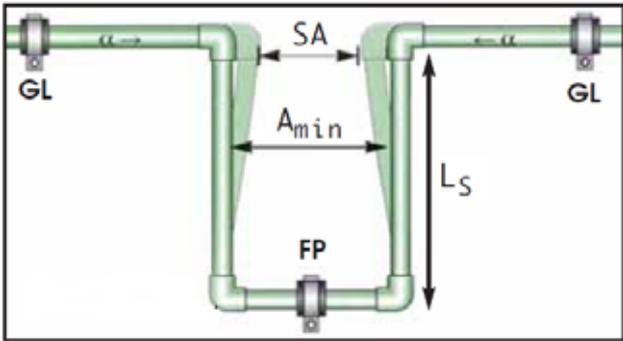
- the length of the required direction change, if any follow the instructions for the other values that are entries in the formula, this value is obtained in millimeters,
- specific material constant (for Fuidtherm pipes it is 15) and this value is a dysfunctional,
- The outer diameter of the pipeline, the unit is a millimeter
- previously calculated longitudinal dilation pipeline, unit is millimeter.

Previously calculated longitudinal dilation pipeline, unit is millimeter. As mentioned earlier, the importance of the lyre is important determine the width of the tube port A_{\min} , and this is done on the following way:

$A_{\min} = 2 \times \Delta l + SA$ - the expression for calculating the width of the pipe port of the lira, where are:

A_{\min} - The width of the hose port is followed by

instructions for other values that are entered in the formula,
 ΔL - previously calculated longitudinal dilation pipeline, unit is millimeter,
 SA - safety clearance, the value of which is 150 mm.



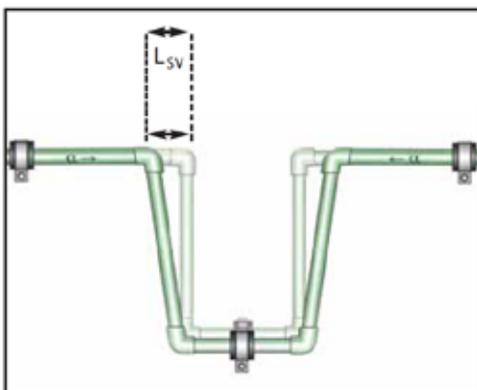
Picture no. 61: Display of the correct acceptance of longitudinal dilations through the lever, where the GL is a plain bearing (support), FP-fixed bearing (support), L_S - required direction change direction, A_{min} - width of tube port lire, SA - safety clearance

IMPORTANT: Alter the direction of the course at an angle from 90 ° as shown in the figure.

When installing compensatory elements of the type changes in direction and lira in sloped areas can reduce the required space for moving (work of elements) by preloading. Length for which is "elongated" (prestigious) compensation element with prestressing is obtained as follows:

$L_{sv} = K \times \sqrt{d \times \Delta L / 2}$ - an expression for obtaining the pre-stress length, where:

L_{sv} - the required pre-delay length, if any follow the instructions for the other values that are entries in the formula, this value is obtained in millimeters,
 K - specific material constant (for Fuidtherm pipes it is 15) and this value is a dysfunctional,
 d - the outer diameter of the pipeline, the unit is a millimeter,
 ΔL - previously calculated longitudinal dilation pipeline, unit is millimeter.



Picture no. 62: Display of pre-stressed lira, with marked length prestressing L_{sv}

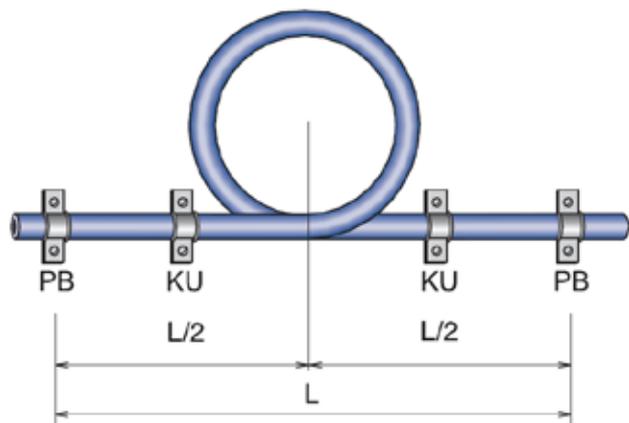
Note: When using preloaded lyre or change directions, take care of the order welding the elements, ie to form a lyre, weld piping the pipes on it, and then mount it, stretch and fix with fixed supports, after continue to further link the pipeline to avoid it deformation of compounds.

4.12.4 Acceptance of tube elongation

through the compensator in addition to the method of accepting the elongation through lyres and compensation angles, can be more use and compensators. They're compensators prefabricated element and their maximum the elongation values they accept are given tabular. As with previous ones the technique of accepting dilatations, the sea make sure there is enough space for compensating elements yes they work (to move).

Pipe diameter [mm]	The distance between the fixed supports L (m)
	PP-R
16	8
20	9
25	10
32	12
40	14

Table no. 40: Length covered by one compensator



Picture no. 63: Correctly mounted compensator, where L is the distance between fixed supports, PB-fixed bearing (support), KU-sliding bed (support)



4.13 Pipe insulation

In order to prevent thermal loss of heat through the pipes, and that there would be no condensation on the tubes, pipes should be insulated. PP-R pipes as thermoplastic materials have a low coefficient thermal conductivity (0.24 W/mK), which is significant lower compared to steel tubes, which allows significant energy savings. According to the thermal coefficient conductivity, are prescribed and required minimum thickness of insulation. Required minimum thickness Insulation in dependence on diameter is given in the table below, and applies only to the transport of hot fluids through the pipe system.

When transporting cold liquids, it can come to the irrigation ("sweating of the tube"), therefore, it is desirable and these tubes to isolate. It's coming down due to oiling differences in the temperature of the transported liquid and external temperatures. The following table is located display of limit values of temperature difference between the transported fluid and the outside. If temperature differences are predicted higher than shown, Insulation should be installed if there is less insulation not needed.

Thermal coefficient conductivity [W/mK]	0,25	0,30	0,35	0,40
Pipe diameter [mm]	Minimum insulation thickness [mm]			
16	12,0	14,1	16,7	19,6
20	13,6	15,7	18,1	20,9
25	18,6	21,8	25,6	30,1
32	21,4	24,6	28,2	32,5
40	27,7	32,1	37,1	43,0
50	34,8	40,3	46,8	54,2
63	44,3	51,4	59,7	69,3
75	52,9	61,5	71,5	83,1
90	63,8	74,2	86,3	100,4

Table no. 41: Required minimum thickness of insulation when transporting warm fluids

Pipe diameter [mm]	Temperature difference Δt [°C]
16	7,0
20	7,2
25	7,4
32	8,0
40	8,2
50	10,0
63	10,2
75	10,4
90	10,6

Table no. 42: Display of limit values of temperature difference depending on pipe diameter

5 USING THE PIPELINE

i

After the installation is complete, the piping system must be subject to pressure control, where the test pressure must be 1.5 times higher from working pressure..

When testing of the pipe is performing system must be being easy to access, allowing it access to system segments in case of need.

5.1 INSTALLATION TESTING

Properties of materials FLUIDTERM - pipelines leads to when the hydrostatic pressure is tested pressure comes to a certain expansion of the pipe. It affects on the test results. Including thermal coefficient the expansion of the pipeline leads to additional changes of the value of the pipeline test. Differences in temperature pipes and test fluids leads to a difference in pressure. The difference in the temperature of 10 °C corresponds pressing the pressure of 0.5-1 bar. For these reasons, it should Tend to ensure a constant temperature test fluid. The pressure test should be carried out in three phases:

- reconsideration
- main examination and
- final examination.

It is necessary to provide for the re-examination test pressure corresponding to the values in the table:

SDR	TEST PRESSURE (bar)
SDR 6 (S=2.5)	15
SDR 7.4 (S=3.2)	12

Table no. 43: Test pressure

This test pressure must be established twice within 30 minutes, with a break of 10 minutes. After wait for an additional 30 minutes and read the pressure. The test pressure must not decrease by more than 0.6 bar. There must be no fluid leak. Immediately after completing the pre-examination, you need to come to the stage of the main test. Duration of the main test is two hours. Drop of pressure after the main one the test must not be greater than 0.2 bar in relative to the pressure value read out after completion of pre-examination. After completion of the examination and the main examination a final test should be done. It must be carried out with an alternate test pressure of 15 and 1.5 bar for SDR 6, also 12 and 1.2 bar for SDR 7.4, which switch on two minutes one by one (three trials are being done), with the final examination that they are carried out with an alternate test pressure of 15 and 1.5 bar, also 12 and 1.2 bar, pressure switches five minutes one after the other (it's one testing). Between each of the four above-mentioned pressures must be zero. No leakage may occur at any point in the installation.

5.1.2 Measurement of pressure

To measure the pressure, be sure to use a pressure gauge (manometer) that allows reading accuracy from a minimum of 0.1 bar. Manometer set by possibility at the lowest point of the network.

5.1.3 Test protocol

The test results should be compiled on the test results of a protocol that should be certified by the investor or supervisory authority and contractor.



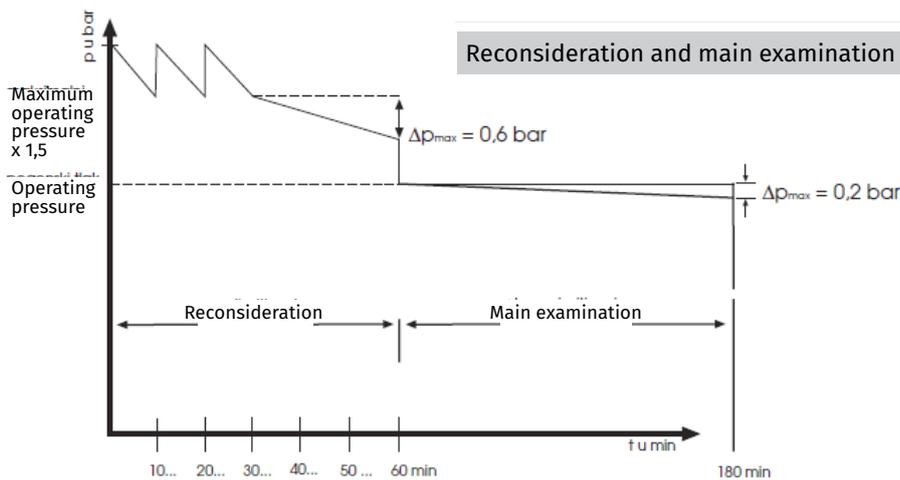
5.2 EXAMPLES OF THE SYSTEM OF PP-R I PP-RCT TUBE

5.2.1 Pre-examination and main testing

The pre-treatment is carried out with a pressure of 1.5 times greater than the nominal pressure of the pipeline (for PN 10 is 15 bar, for PN 16 is 24 bar, for PN 20 it is 30 bar). Pre-examination It takes 60 minutes. When it begins to re-examine, the first 30 minutes the test pressure is envisaged. Because physical - mechanical properties PP-R and PP-RCT as a material, after achieving the test pressure, it will come to release and pressure dropping. After reaching exhaust pressure should be performed within 10 minutes correction of the pressure on the value of the test pressure. Achieving the test pressure and its correction must be within the first 30 minutes of the pre-trial. After adjusting the pressure, the remaining 30 minutes must not pressure drops to more than 0.6 bar. If there is a pressure drop of more than 0.6 bar, pipeline should

be checked, because somewhere there is leakage in the system.

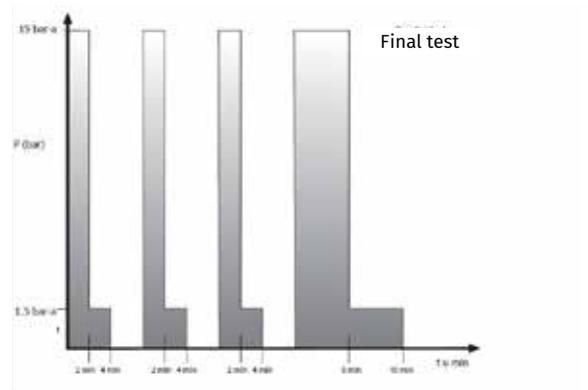
1. Apply system pressure to 15 bar.
2. Wait for 10 minutes, then check the pressure, and if there is a decrease in pressure.
3. Repeat step 2.
4. Wait for 30 minutes and read the pressure. Pressure must not fall below 14.4 bars.
5. Wait 120 minutes (2 hours) and read the pressure. The pressure must not fall below 14.2 bar.
6. If the system has satisfied the steps 4 and 5 go to the final examination..



Graph no. 1: Displays the pressure change during the time of re-examination and main test

5.2.2 Final examination

1. Bring system pressure to 15 bar and wait 2 minutes.
2. Reduce pressure to 1.5 bar and wait 2 minutes.
3. Bring system pressure to 15 bar and wait 2 minutes.
4. Reduce pressure to 1.5 bar and wait 2 minutes.
5. Bring system pressure to 15 bar and wait 2 minutes.
6. Lower the pressure to 1.5 bar and wait 2 minutes.
7. Bring system pressure to 15 bar and wait 2 minutes.
8. Reduce pressure to 1.5 bar and wait 2 minutes.



Graph no. 2: Final examination

NOTE: No leak may occur in any one installation points

5.3 Test protocol record form

DESCRIPTION OF THE INSTALLATION

Place: _____

Building: _____

Pipe length: $\varnothing 20$ _____ m
 $\varnothing 25$ _____ m
 $\varnothing 32$ _____ m
 $\varnothing 40$ _____ m
 $\varnothing 50$ _____ m
 $\varnothing 63$ _____ m
 $\varnothing 75$ _____ m

Highest point of highlighting: _____ m
(above pressure gauge)

Testing start: _____

End of test: _____

Duration of test: _____

Investitor:

Contractor:

Place: _____

Date: _____

(M.P.) / SIGNATURE

PRE-EXAMINATION

Test Pressure: _____

Pressure after 1st rehearsal: _____ bar
(start of rehearsal)

Pressure after 2nd rehearsal: _____ bar

Pressure drop after 30 minutes: _____ bar
(max. 0.6 bar)

Test result: _____

MAIN EXAMINATION

Working pressure: _____ bar
(the result of the pre-examination)

Pressure after 1 hour: _____ bar
(start of testing)

Pressure after 2 hours: _____ bar

Pressure drop: _____ bar
(max. 0.2 bar)

Result of the main test:

FINAL EXAMINATION*

1. Working pressure 15 (10) bar: _____ bar
at least 2 minutes, then
Working pressure 1,5 (1,2) bar: _____ bar
at least 2 min.

2. Working pressure 15 (10) bar: _____ bar
at least 2 minutes, then
Working pressure 1,5 (1,2) bar: _____ bar
at least 2 min.

3. Working pressure 15 (10) bar: _____ bar
at least 2 minutes, then
Working pressure 1,5 (1,2) bar: _____ bar
at least 2 min.

4. Working pressure 15 (10) bar: _____ bar
at least 5 minutes, then
Working pressure 1,5 (1,2) bar: _____ bar
at least 5 min.

* There is no pressure between each cycle of networks.



5.4 Flushing the pipeline

After completion of the pipeline installation according to the guidelines DIN 1988, the piping must be flushed. Flushing the pipeline is done with water to make a complete pipeline washed out of mineral and organic particles left behind piping when installing it.

Note: Strictly forbidden piping of the pipeline using a concentrated chlorine dioxide solution (ClO₂).

5.5 Shooting on the pressure

When using and using PP-R or PP-RCT Pipes can break into pipes themselves, if pipes not used in accordance with the regulations and defined parameters for using them, ie due to improper use or improper maintenance pipeline.

There are three basic factors, when using a pipeline, which affect the lifespan of the tube system and his eventual cancellation due to overload.

- The first factor is the increased operational pressure which is greater than the nominal pressure for which the tube is foreseen [PN].
- The second factor is the elevated temperature itself fluid flowing through the tube itself.
- The third factor is the excessive duration pipe load.

When the values of one of these factors are greater than of the allowed values, whether it is only elevated pressure, or elevated pressure and elevated temperature all in combination with longer time the period of action of one or a combination of factors can break pipe!

When breaking pipes made of pure PP-R material Due to increased pressure, the tube itself is deformed in such a way that the location of the punch looks, ie, reminiscent of a fish mouth. In the picture below you can see what does it look like.



Slika br. 64: Primer pucanja cevi od čistog PP-R materijala

For three-layer PP-R pipes that are made of anterior layer of PP-R material, the middle layer of glass fibers (GF) and the inner layer of PP-R, when shooting due to increased pressure or combination factor, the place of the strike does not necessarily have to It reminds you of a fish mouth, but the shooting can occur in different ways (longitudinal, transversal, etc.). One from the example of a crack PP-R-FG tube you can see in picture below.



Slika br. 65: Primer pucanja PP-R-FG cevi

6 OBSTRUCTIONS

OBSTRUCTION REMOVAL

During exploitation, with each pipe system there are possible disruptions. Faults are possible on their own piping and fittings, and for this reason should predict sectional closures and detachable joints on the pipeline itself, so that it can be closed and for dismantling of certain parts of pipelines and fittings for repair or cleaning. If damage occurs on the pipeline itself, which consist of Fluiderm pipes,

it is necessary to close the smallest possible section within the damaged pipeline, remove the damaged part and remove the damaged pipe material and replaces with the new ones. During exploitation, with each pipe system possible interference. Connecting new pipeline with existing, is done by welding or connecting with detachable joints, as explained in chapter 4. Installing and connecting.

7 MAINTENANCE

When using pipes regularly, it is not necessary additional special maintenance.

8 DISASSEMBLING AND REMOVAL

It is recommended that the work on the dismantling of the pipeline should be done by professional contractors specialized in this field.

9 POST USAGE

PP-R and PP-RCT material from which pipes are made according to the list Waste categories (Q list) is marked with Q1, and is not hazardous and can be recycled. When recycling PP-R, the material does not lose its physical-chemical properties. Pestan use for production only original materials from renowned world manufacturers. Plastic masses are sorted according to the material code when recycling, and the code for polypropylene is:



Picture no. 66: Code for polypropylene



10 ADDITION

NOTES: The document uses a metric unit of measurement units (SI), e.g. Force Force Newton (N) instead of a pound (p) and a Watt (W) power unit instead of kcal/h..

Conversion:

1 kp = 9.80665 N or 1 kp \approx 10 N
1 Mp = 9806.65 N or 1 Mp \approx 10 kN i 1 Mp/m = 10 kN/m
1 kp/cm² = 9.80665 N/cm² = 0.0980665 N/mm² = 0.0980665 Mpa or 1 kp/cm² \approx 0.1 N/mm²
1 m water column = 0.0980665 bar or 1 m water column \approx 0.1 bar
1 kcal/m h degrees = 1.16 W/mK (Thermal conductivity) or 1 kcal/mh degrees \approx 1.2 W/mK

Thermal conductivity is given in W/mK. It's the same for K and °C, since the difference is only the beginning of the scale. In that the meaning is 1 W/m °C identical to 1 W/mK. K (Kelvin) is SI unit for temperature. Temperature in Celsius (t) differs from temperature in Kelvin (T) by 273.15 K.

t (°C) = T - To = T - 273.15 K.

In this document, 10 m/s was adopted for g, a mistake of approximately 2% is neglected DN denotes nominal diameter, PN is the nominal pressure.

Dimensions and units

Dimensions are expressed in mm and/or inches and are specified as nominal and standard sizes.

d, d1, d2, d3, d4 Diameter
DN Nominal diameter
SC Size of hexagonal screws
AL Number of holes for screws
s Width of hexagon head screw
g Weight in grams
SP Quantity in standard package
GP Quantity in a large package
e The wall thickness of the pipe
PN Nominal pressure
Rp Parallel internal threaded thread according to ISO 7-1
R Conical outer tube thread to ISO 7-1 ppm parts per million
1 bar = 0.1 N/mm² = 0.1 Mpa (Megapaskal) = 14.504 psi
C Project factor
S Series of pipes
SDR Standard dimensional relationship
MFR Solubility coefficient according to ISO 4440

System dimensions for pressure

DN = Nominal diameter

OD = Outside diameter

Table

Explanation of abbreviations

PB Polibitulen

PE Polyethylene

PE-X Cross-linked polyethylene

PP Polypropylene

PVC Polyvinyl chloride

PVC-C Re-chlorinated polyvinyl chloride (increased content chlorine)

PVC-U Unglazed polyvinyl chloride

PVC-O Oriented Polyvinyl Chloride

SDR

SDR Standard dimension ratio:

OD / SDR WT

OD / WT SDR

OD Outside diameter

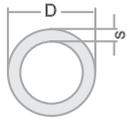
WT Wall thickness

11 PRODUCT CATALOGUE



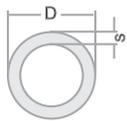
ITEM DESCRIPTION	PICTURE	SDR	CODE			OD, MM	S, MM	DINN, MM
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MECHANICAL FIBER PIPE (PP-RCT/PPR-RCT-FG)



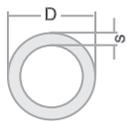
SDR 9	10000660					32	3,6	24,8
	10000661					40	4,5	31
	10000662					50	5,6	38,8
	10000663					63	7,1	48,8
	10000664					75	8,4	58,2
	10000665					90	10,1	69,8
	10000666					110	12,3	85,4
	10000667					125	14	97

FIBER PIPE PP-R/P-PR-FG/PP-R



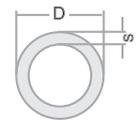
		GREEN	WHITE	GRAY					
SDR 6 [PN25]	10000720	10010720	10020720	20	3,4	13,2			
	10000721	10010721	10020721	25	4,2	16,6			
	10000722	10010722	10020722	32	5,4	21,2			
	10000723	10010723	10020723	40	6,7	26,6			
	10000724	10010724	10020724	50	8,3	33,4			
	10000725	10010725	10020725	63	10,5	42			
	10000726	10010726	10020726	75	12,5	50			
	10000727	10010727	10020727	90	15	60			
	10000728	10010728	10020728	110	18,3	73,4			
	10000729	10010729	10020729	125	20,8	83,4			
	SDR 7.4 [PN20]	10000700	10010710	10020700	20	2,8	14,4		
		10000701	10010711	10020701	25	3,5	18		
10000702		10010712	10020702	32	4,4	23,2			
10000703		10010703	10020703	40	5,5	29			
10000704		10010704	10020704	50	6,9	36,2			
10000705		10010705	10020705	63	8,6	45,8			
10000706		10010706	10020706	75	10,3	54,4			
10000707		10010707	10020707	90	12,3	65,4			
10000708		10010708	10020708	110	15,1	79,8			
10000709		10010709	10020809	125	17,1	90,8			
SDR11 [PN10]	10000690	10010690	10020690	20	1,9	16,2			
	10000691	10010691	10020691	25	2,3	20,4			
	10000692	10010692	10020692	32	2,9	26,2			
	10000693	10010693	10020693	40	3,7	32,6			
	10000694	10010694	10020694	50	4,6	40,8			
	10000695	10010695	10020695	63	5,8	51,4			
	10000696	10010696	10020696	75	6,8	61,4			
	10000697	10010697	10020697	90	8,2	73,6			
	10000698	10010698	10020698	110	10	90			
	10000699	10010699	10020699	125	11,4	102,2			

PURPLE PIPE PP-R



SDR 7.4	10000740			20	2,8	14,4		
	10000741			25	3,5	18		
SDR 11	10000750			32	2,9	26,2		
	10000751			40	3,7	32,6		
	10000752			50	4,6	40,8		
	10000753			63	5,8	51,4		
	10000754			75	6,8	61,4		
	10000755			90	8,2	73,6		
	10000756			110	10	90		
	10000757			125	11,4	102,2		

ITEM DESCRIPTION	PICTURE	SDR	CODE	OD, MM	S, MM	DINN, MM
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FLUIDTHERM PPR PIPE [PP-R]							
SDR 6 [PN20]	10000220	16	2,7	10,6			
	10000230	20	3,4	13,2			
	10000240	25	4,2	16,6			
	10000250	32	5,4	21,2			
	10000260	40	6,7	26,6			
	10000270	50	8,3	33,4			
	10000280	63	10,5	42			
	10000290	75	12,5	50			
	10000300	90	15	60			
	10000310	110	18,3	73,4			
	10000315	125	20,8	83,4			
	SDR 7.4 [PN16]	10000120	16	2,2	11,6		
		10000130	20	2,8	14,4		
		10000140	25	3,5	18		
		10000150	32	4,4	23,2		
		10000160	40	5,5	29		
		10000170	50	6,9	36,2		
		10000180	63	8,6	45,8		
		10000190	75	10,3	54,4		
		10000200	90	12,3	65,4		
		10000210	110	15,1	79,8		
10000215	125	17,1	90,8				
SDR 11 [PN10]	10000020	16	1,8	12,4			
	10000030	20	1,9	16,2			
	10000040	25	2,3	20,4			
	10000050	32	2,9	26,2			
	10000060	40	3,7	32,6			
	10000070	50	4,6	40,8			
	10000080	63	5,8	51,4			
	10000090	75	6,8	61,4			
	10000100	90	8,2	73,6			
	10000110	110	10	90			
10000115	125	11,4	102,2				

PIPE W. ALUMINIUM PPR/AL/PPR



SDR 6	10000540	20	3,4	13,2		
	10000550	25	4,2	16,6		
	10000560	32	5,4	21,2		
	10000570	40	6,7	26,6		
	10000580	50	8,3	33,4		
	10000590	63	10,5	42		



ITEM DESCRIPTION	PICTURE	CODE	ND-OD
COUPLING			
	10001601	1/2"-20 mm	
	10001602	3/4" -25 mm	
	10001603	1"-32 mm	
	10001604	1 1/4"-40 mm	
	10001605	1 1/2"-50 mm	
	10001606	2"-63 mm	
	10001607	2 1/2"-75 mm	
	10001608	3"-90 mm	
	10001610	4" - 125 mm	
	REDUCER		
	10002200	3/4" to 1/2"-25 to 20 mm	
	10002205	1" to 1/2"-32 to 20 mm	
	10002206	1" to 3/4"-32 to 25 mm	
	10002210	1 1/4" to 1/2"-40 to 20 mm	
	10002211	1 1/4" to 3/4"-40 to 25 mm	
	10002212	1 1/4" to 1"-40 to 32 mm	
	10002221	1 1/2" to 3/4"-50 to 25 mm	
	10002222	1 1/2" to 1"-50 to 32 mm	
	10002223	1 1/2" to 1 1/4"-50 to 40 mm	
	10002240	2" to 1 1/2"-63 to 20 mm	
	10002241	2" to 3/4"-63 to 25 mm	
	10002242	2" to 1"-63 to 32 mm	
	10002243	2" to 1 1/4"-63 to 40 mm	
	10002244	2" to 1 1/2"-63 to 50 mm	
	10002260	2 1/2" to 1 1/4"-75 to 40 mm	
	10002261	2 1/2" to 1 1/2"-75 to 50 mm	
	10002262	2 1/2" to 2"-75 to 63 mm	
	10002263	2 1/2" to 1 1/2"-75 to 20 mm	
	10002264	2 1/2" to 3/4"-75 to 25 mm	
	10002265	2 1/2" to 1"-75 to 32 mm	
10002280	3" to 1 1/2"-90 to 50 mm		
10002281	3" to 2"-90 to 63 mm		
10002282	3" to 2 1/2"-90 to 75 mm		
10002320	4" to 2 1/2"-125 to 75 mm		
10002291	3 1/2" to 2"-110 to 63 mm		
10002293	3 1/2" to 3"-110 to 90 mm		
10002321	4" to 3"-125 to 90 mm		
ELBOW 90°			
	10001020	1/2"-20 mm	
	10001021	3/4" -25 mm	
	10001022	1"-32 mm	
	10001023	1 1/4"-40 mm	
	10001024	1 1/2"-50 mm	
	10001025	2"-63 mm	
	10001026	2 1/2"-75 mm	
	10001027	3"-90 mm	
	10001028	3 1/2" - 110mm	
	10001029	4"-125 mm	
ELBOW 45°			
	10001000	1/2"-20 mm	
	10001001	3/4" -25 mm	
	10001002	1"-32 mm	
	10001003	1 1/4"-40 mm	
	10001004	1 1/2"-50 mm	
	10001005	2"-63 mm	
	10001006	2 1/2"-75 mm	
	10001007	3"-90 mm	
	10001009	4"-125 mm	
	TEE		
	10001900	1/2"-20 mm	
	10001901	3/4" -25 mm	
	10001902	1"-32 mm	
	10001903	1 1/4"-40 mm	
	10001904	1 1/2"-50 mm	
	10001905	2"-63 mm	
	10001906	2 1/2"-75 mm	
	10001907	3"-90 mm	
	10001908	3 1/2" - 110mm	
	10001909	4"-125 mm	

ITEM DESCRIPTION	PICTURE	CODE	ND-OD
REDUCING TEE			
	10002160	1/2" x 1/2" x 3/4" - 20 x 20 x 25 mm	
	10002161	3/4" x 3/4" x 1/2" - 25 x 25 x 20 mm	
	10002162	1" x 1/2" x 1/2" -- 32 x 20 x 20 mm	
	10002167	1" x 1" x 1/2"-32 x 32 x 20 mm	
	10002163	1" x 3/4" x 3/4" - 32 x 25 x 25 mm	
	10002168	1" x 1" x 3/4"-32 x 32 x 25 mm	
	10002169	1 1/4" x 1 1/4" x 1/2"-40 x 40 x 20 mm	
	10002170	1 1/4" x 1 1/4" x 3/4"-40 x 40 x 25 mm	
	10002171	1 1/4" x 1 1/4" x 1"-40 x 40 x 32 mm	
	10002172	1 1/2" x 1 1/2" x 3/4"-50 x 50 x 25 mm	
	10002173	1 1/2" x 1 1/2" x 1"-50 x 50 x 32 mm	
	10002174	1 1/2" x 1 1/2" x 1 1/4"-50 x 50 x 40 mm	
	10002175	2" x 2" x 3/4"- 63 x 63 x 25 mm	
	10002176	2" x 2" x 1"-63 x 63 x 32 mm	
	10002177	2" x 2" x 1 1/4"-63 x 63 x 40 mm	
	10002178	2" x 2" x 1 1/2"-63 x 63 x 50 mm	
	10002330	2 1/2" x 2 1/2" x 3/4"-75 x 75 x 25mm	
	10002331	2 1/2" x 2 1/2" x 1"-75 x 75 x 32 mm	
	10002332	2 1/2" x 2 1/2" x 1 1/4"-75 x 75 x 40 mm	
	10002333	2 1/2" x 2 1/2" x 1 1/2"-75 x 75 x 50 mm	
	10002334	2 1/2" x 2 1/2" x 2"-75 x 75 x 63 mm	
	10002335	3" x 3" x 1"-90 x 90 x 32 mm	
	10002336	3" x 3" x 1 1/4"-90 x 90 x 40 mm	
	10002337	3" x 3" x 1 1/2"- 90 x 90 x 50 mm	
	10002338	3" x 3" x 2"-90 x 90 x 63 mm	
	10002339	3" x 3" x 2 1/2"-90 x 90 x 75 mm	
	10002345	4" x 4" x 2 1/2"-125 x 125 x 75 mm	
	10002346	4" x 4" x 3"-125 x 125 x 90 mm	
STREET 90° (FEMALE/MALE)			
	10001550	1/2" - 20 mm	
END CAP			
	10002400	1/2"-20 mm	
	10002401	3/4" -25 mm	
	10002402	1"-32 mm	
	10002403	1 1/4"-40 mm	
	10002404	1 1/2"-50 mm	
	10002405	2"-63 mm	
	10002406	2 1/2"-75 mm	
	10002407	3"-90 mm	
	10002409	4"-125 mm	
	SADDLE		
	10002500	1 1/4" x 1/2" - 40 x 20 mm	
	10002501	1 1/4" x 3/4" - 40 x 25 mm	
	10002502	1 1/2" x 1/2" - 50 x 20 mm	
	10002503	1 1/2" x 3/4" - 50 x 25 mm	
	10002504	2" x 1/2" - 63 x 20 mm	
	10002505	2" x 3/4" - 63 x 25 mm	
	10002506	2" x 1" - 63 x 32 mm	
	10002507	2 1/2" x 1/2" - 75 x 20 mm	
	10002508	2 1/2" x 3/4" - 75 x 25 mm	
	10002509	2 1/2" x 1" - 75 x 32 mm	
	10002510	2 1/2" x 1 1/4" - 75 x 40 mm	
	10002511	3" x 1/2" - 90 x 20 mm	
	10002512	3" x 3/4" - 90 x 25 mm	
	10002513	3" x 1" - 90 x 32 mm	
	10002514	3" x 1 1/4" - 90 x 40 mm	
	10002515	4" x 1/2" - 125 x 20 mm	
	10002516	4" x 3/4" - 125 x 25 mm	
	10002517	4" x 1" - 125 x 32 mm	
	10002518	4" x 1 1/4" - 125 x 40 mm	
	10002519	4" x 1 1/2" - 125 x 50 mm	
10002520	4" x 2" - 125 x 63 mm		
CROSS TEE			
	10002150	(1/2" - 20 mm) x (1/2" - 20 mm) x (1/2" - 20 mm) x (1/2" - 20 mm)	
	10002151	(3/4" - 25 mm) x (3/4" - 25 mm) x (3/4" - 25 mm) x (3/4" - 25 mm)	



ITEM DESCRIPTION	PICTURE	CODE	ND-OD
3 WAY ELBOW		10001050	(1/2" - 20 mm) x (1/2" - 20 mm) x (1/2" - 20 mm)
		10001051	(3/4" - 25 mm) x (3/4" - 25 mm) x (3/4" - 25 mm)
CROSS OVER (INJECTED)		10003050	(1/2" - 20 mm) x (1/2" - 20 mm)
		10003051	(3/4" - 25 mm) x (3/4" - 25 mm)
		10003052	(1" - 32 mm) x (1" - 32 mm)
CROSS OVER		10003000	1/2" - 20mm
		10003001	3/4" - 25mm
		10003002	1"-32mm
CROSS OVER SHORT		10003053	1/2" - 20mm
		10003054	3/4" - 25mm
ADJUSTER		10003100	1/2" - 20mm
DRAINING VRANCH		10003730	1/2" - 20 mm
		10003731	3/4" - 25 mm
SCREW DOWN STOP GLOBE VALVE		10003300	1/2" - 20mm
		10003301	3/4" - 25mm
		10003302	1" - 32 mm
CONCEALED VALVE (CHROMIUM PLATED)		10003200	1/2" - 20mm
		10003201	3/4" - 25mm
		10003202	1" - 32 mm
VALVE WITH FIXING SCREW (CAP)		10005400	1/2"-20mm
		10005401	3/4"-25mm
		10005402	1" - 32 mm
HAND KNOB		10003800	1/2"-20mm
		10003801	3/4"-25mm
FLANGE ADAPTER		10004002	1 1/2" - 50 mm
		10004003	2" - 63 mm
		10004004	2 1/2" - 75 mm
		10004005	3" - 90 mm
		10004007	4" - 125 mm (nije za kugla ventil)

ITEM DESCRIPTION	PICTURE	CODE	ND-OD
FLANGE RINGS			
		TBA	ANSI metalna priрубnica 1½" - 50 mm
		TBA	ANSI metalna priрубnica 2" - 63 mm
		TBA	ANSI metalna priрубnica 2½" - 75 mm
		TBA	ANSI metalna priрубnica 3" - 90 mm
		TBA	ANSI metalna priрубnica 4" - 125 mm (nije za kugla ventil)
METAL PIPE CLAMP WITH RUBBER RING			
		10005050	½"-20 mm
		10005051	¾" -25 mm
		10005052	1"-32 mm
		10005053	1¼"-40 mm
		10005054	1½"-50 mm
		10005055	2"-63 mm
		10005056	2½"-75 mm
		10005057	3"-90 mm
		10005059	4" - 125 mm
MARKING GUIDE			
		10005001	
REPAIR PLUG			
		10005000	
PAD			
			
LONG PLUG FOR PRESSURE			
		10003600	1/2" - 20 mm
		10003601	3/4" - 25 mm
SHORT PLUG FOR PRESSURE			
		10002450	1/2" - 20 mm
		10002451	3/4" - 25 mm
CLAMP			
		10002900	1/2" - 20mm
		10002901	3/4" - 25mm
		10002902	1"-32mm
		10002903	1¼"- 40 mm
ELBOW MASK			
		10001350	
PLASTIC - PLASTIC NUT CONNECTOR			
		10002600	1/2" - 20mm
		10002601	3/4" - 25 mm



ITEM DESCRIPTION	PICTURE	CODE	ND-OD
ADAPTOR METAL PLASTIC MALE			
		10002650	1/2" - 20mm
		10002651	3/4" - 25 mm
ADAPTOR METAL PLASTIC FEMALE			
		10002630	1/2" - 20mm
		10002631	3/4" - 25 mm
"UNIVERSAL" ADAPTOR METAL-PLASTIC MALE			
		10002690	1/2" - 20mm
"UNIVERSAL" ADAPTOR METAL-PLASTIC FEMALE			
		10002670	1/2" - 20mm

ITEM DESCRIPTION	PICTURE	CODE	ND-OD	ND-OD
TRANSITION PIECE (ROUND FEMALE THREAD)				
		10001651	18000450	(1/2" - 20 mm) x 1/2"Female
		10001800	18000451	(1/2" - 20 mm) x 3/4"Female
		10001801	18000452	(3/4" - 25 mm) x 1/2"Female
		10001652	18000453	(3/4" - 25 mm) x 3/4"Female
		10001802	18000454	(1" - 32 mm) x 3/4"Female
TRANSITION PIECE (W/ROUND MALE THREAD)				
		10001701	18000530	(1/2" - 20 mm) x 1/2" Male
		10001851	18000531	(3/4" - 25 mm) x 1/2" Male
		10001702	18000532	(3/4" - 25 mm) x 3/4" Male
		10001852	18000533	(1" - 32 mm) x 3/4" Male
TRANSITION PIECE (W/HEX FEMALE THREAD)				
		10001660	18000500	(1/2" - 20 mm) x 1/2"Female HEX
		10001803	18000501	(3/4" - 25 mm) x 1/2"Female HEX
		10001661	18000502	(3/4" - 25 mm) x 3/4"Female HEX
		10001804	18000503	(1" - 32 mm) x 3/4"Female HEX
		10001662	18000504	(1" - 32 mm) x 1" Female HEX
		10001805	18000505	(1 1/4" - 40 mm) x 1" Female HEX
		10001663	18000506	(1 1/4" - 40 mm) x 1 1/4"Female HEX
		10001664	18000507	(1 1/2" - 50 mm) x 1 1/2"Female HEX
	10001665	18000508	(2" - 63 mm) x 2" Female HEX	
TRANSITION PIECE (W/ HEX MALE THREAD)				
		10001710	18000550	(1/2" - 20 mm) x 1/2" Male HEX
		10001711	18000551	(3/4" - 25 mm) x 3/4" Male HEX
		10001712	18000552	(1"-32 mm) x 1" Male HEX
		10001713	18000554	(1 1/4"- 40 mm) x 1 1/4" Male HEX
		10001714	18000555	(1 1/2"- 50 mm) x 1 1/2" Male HEX
		10001715	18000556	(2" - 63 mm) x 2" Male HEX
TRANSITION ELBOW (W/FEMALE THREAD)				
		10001100	18000570	(1/2" - 20 mm) x 1/2" Female
		10001101	18000571	(3/4" - 25 mm) x 3/4" Female
		10001451	18000572	(3/4" - 25 mm) x 1/2" Female
		10001102	18000574	(1" - 32 mm) x 1" Female
TRANSITION ELBOW (W/MALE THREAD)				
		10001150	18000590	(1/2" - 20 mm) x 1/2" Male
		10001151	18000591	(3/4" - 25 mm) x 3/4" Male
		10001152	18000592	(1" - 32 mm) x 1" Male
TRANSITION TEE (W/FEMALE TREAD)				
		10001930	18000630	(1/2" - 20 mm) x (1/2" - 20 mm) x 1/2"Female
		10002091	18000631	(3/4" - 25 mm) x (3/4" - 25 mm) x 1/2"Female
		10001931	18000632	(3/4" - 25 mm) x (3/4" - 25 mm) x 3/4"Female
SADDLE TRANSITION PIECE (W/FEMALE THREAD)				
		10002552	18000650	(1 1/2" / 3/4" - 50 / 25 mm) x 1/2"Female
		10002554	18000651	(2" / 3/4" - 63 / 25 mm) x 1/2"Female
		10002556	18000652	(2 1/2" / 3/4" - 75 / 25 mm) x 1/2"Female
		10002559	18000653	(3" / 3/4" - 90 / 25 mm) x 1/2"Female
		10002562	18000654	(4" / 3/4" - 125 / 25 mm) x 1/2"Female
		10002553	18000655	(1 1/2" / 3/4" - 50 / 25 mm) x 3/4"Female
		10002555	18000656	(2" / 3/4" - 63 / 25 mm) x 3/4"Female
		10002557	18000657	(2 1/2" / 3/4" - 75 / 25 mm) x 3/4"Female
		10002560	18000658	(3" / 3/4" - 90 / 25 mm) x 3/4"Female
		10002563	18000659	(4" / 3/4" - 125 / 25 mm) x 3/4"Female
SADDLE TRANSITION PIECE (W/MALE THREAD)				
		10002586	18000692	(2 1/2" / 3/4" - 75 / 25 mm) x 1/2"Male HEX
		10002589	18000693	(3" / 3/4" - 90 / 25 mm) x 1/2"Male HEX
		10002592	18000694	(4" / 3/4" - 125 / 25 mm) x 1/2"Male HEX
		10002587	18000697	(2 1/2" / 3/4" - 75 / 25 mm) x 3/4"Male HEX
		10002590	18000698	(3" / 3/4" - 90 / 25 mm) x 3/4"Male HEX
		10002593	18000699	(4" / 3/4" - 125 / 25 mm) x 3/4"Male HEX
BACK PLATE TRANSITION ELBOW (W/FEMALE THREAD)				
		10001202	18000400	(1/2" - 20 mm) x 1/2" Female



ITEM DESCRIPTION	PICTURE	CODE	ND-OD	ND-OD
BACK PLATE TRANSITION ELBOW (FEMALE THREAD)				
		10001200	18000970	(1/2" - 20 mm) x 1/2" Female
		10001201	18000971	(1/2" - 20 mm) x 3/4" Female
BACK PLATE TRANSITION ELBOW (MALE THREAD)				
		10001250	18000990	(1/2" - 20 mm) x 1/2" Male NPT
		10001251	18000991	(1/2" - 20 mm) x 3/4" Male
TRANSITION ELBOW 90° FOR GYPSUM WALL MOUNTING				
		10001070	18000890	(1/2" - 20 mm) x 1/2" Female
BACK PLATE TRANSITION TEE				
		10002180	18000830	(1/2" - 20 mm) x (1/2" - 20 mm) x 1/2"
		10002190	18000831	(3/4" - 25 mm) x (3/4" - 25 mm) x 1/2"
BALL VALVE				
		10003700	18000730	1/2" - 20 mm
		10003701	18000731	3/4" - 25 mm
		10003702	18000732	1" - 32 mm
		10003703	18000733	1 1/4" - 40 mm
		10003704	18000734	1 1/2" - 50 mm
		10003705	18000735	2" - 63 mm
VALVE WITH TWO OUTLETS				
		10003750		1/2" - 20 mm
		10003751		3/4" - 25 mm
STOP VALVE BODY				
		10002350	18001030	(1/2"-20mm) x 1/2"
		10002351	18001031	(3/4"-25mm) x 3/4"
		10002352	18001032	(1"-32mm) x 1"
TRANSITION MOUNTAGER				
		10003500	18000770	1/2" - 20 mm

