

CARBO oxy<sup>CRP</sup>

# CARBO oxy<sup>CRP</sup> – PIPES FOR CLOSED HEATING AND COOLING CIRCUITS



UNIQUE CARBON TECHNOLOGY IN PP-R/PP-RCT SYSTEM  
INSTAPLAST NOW WITH OXYGEN BARRIER!

**PIPELIFE**   
always part of your life

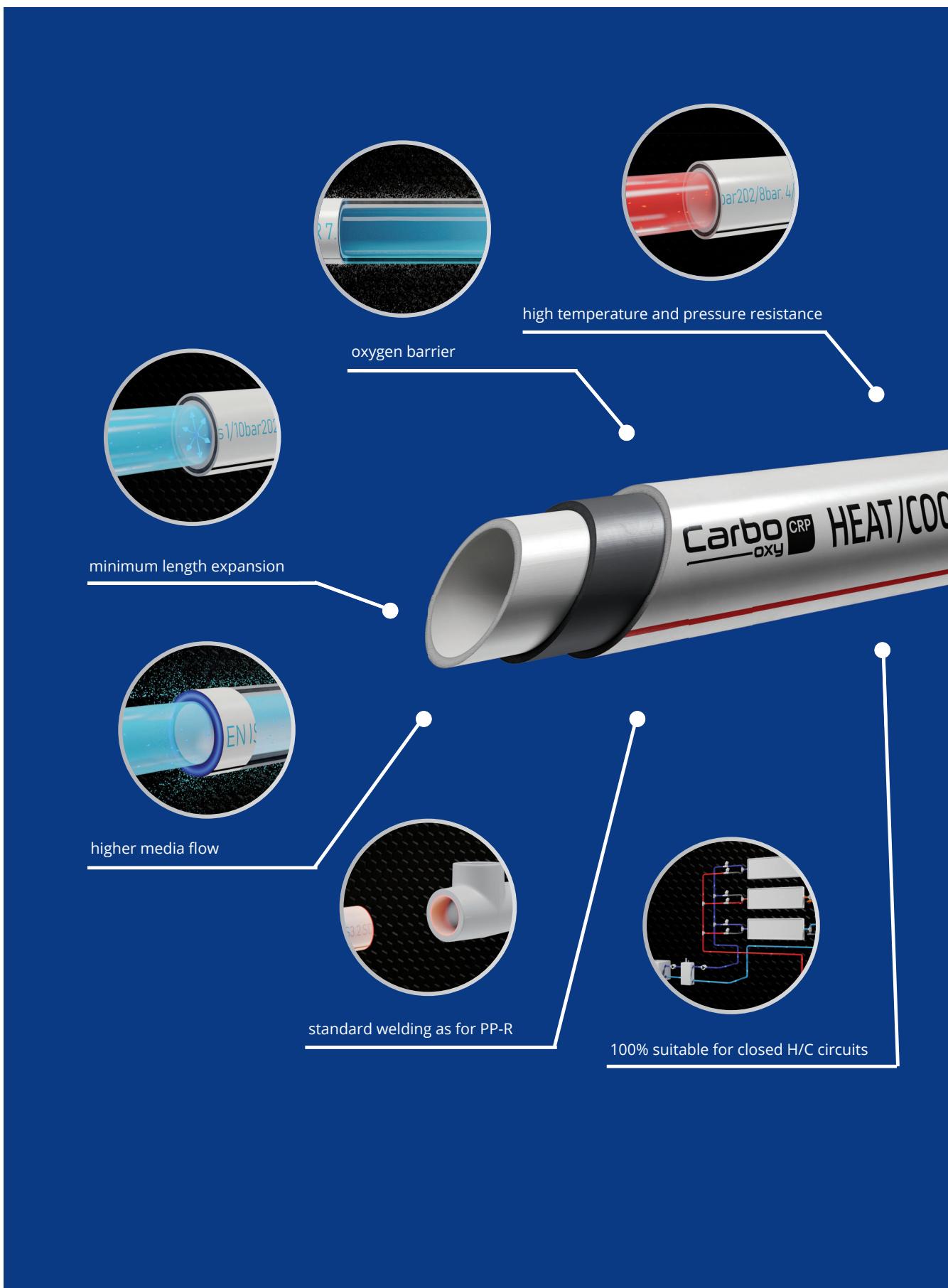
**we are wienerberger**



# CONTENT

<b>1.</b>	<b>Principle of “bulb” corrosion</b>	5
<b>2.</b>	<b>Myths and mistakes about reasonability of oxygen barrier</b>	6
<b>3.</b>	<b>CARBO oxy<sup>CRP</sup> pipes</b>	8
<b>4.</b>	<b>CARBO oxy<sup>CRP</sup> HEAT</b>	10
<b>5.</b>	<b>CARBO oxy<sup>CRP</sup> COOL</b>	11
<b>6.</b>	<b>DESCRIPTION PP-R/PP-RCT SYSTEM INSTAPLAST</b>	12
6.1.	Advantages of the PP-R/PP-RCT	12
6.2.	Pipes	12
6.3.	Fittings	13
6.4.	PP-R/PP-RCT INSTAPLAST system material	13
6.5.	Chemical resistance	13
6.6.	System disinfection	13
6.7.	Lifetime	14
6.8.	Economical aspects of use of the plastic pipes, generally	14
6.9.	Ecology – waste	14
6.10.	Usage for the other media	14
6.11.	Certification	14
6.12.	Table of interdependency of temperature, pressure and durability	15
<b>7.</b>	<b>Storage and handling, guarantee conditions</b>	16
7.1.	Storage and handling	16
7.2.	Guarantee conditions of PP-R/PP-RCT SYSTEM INSTAPLAST	16
<b>8.</b>	<b>Pressure losses</b>	17
8.1.	Pressure loss calculation	17
8.2.	Pressure loss in fitting (connecting fitting)	17
<b>9.</b>	<b>Distribution systems of cold and hot water</b>	23
9.1.	Piping mains	23
9.2.	Distance of supports	24
<b>10.</b>	<b>compensation of plastic piping</b>	25
<b>11.</b>	<b>Assembly and repairs of the system</b>	27
11.1.	Piping connection	27
11.2.	Weldability of materials	27
11.3.	Polyfusion welding	27
11.3.1.	Tools and accessories	27
11.3.2.	Principle of polyfusion welding	28
11.3.3.	Procedure for the polyfusion welding	28
11.4.	Piping repairs	30
11.5.	Additional installation of the weld in saddle	30
11.6.	Welding by electro-forming	30
11.7.	Working conditions	30
<b>12.</b>	<b>Pressure test</b>	31
<b>13.</b>	<b>Insulation of piping</b>	33
<b>14.</b>	<b>Products</b>	34
14.1.	CARBO oxy <sup>CRP</sup> pipes	34
14.2.	Fittings	35
14.3.	Tools and consumable materials	48

# ADVANTAGES OF CARBO oxy<sup>CRP</sup> PIPE



# 1. PRINCIPLE OF “BULB” CORROSION

## MYTHS AND MISTAKES ABOUT REASONABILITY OF OXYGEN BARRIER

Almost all materials are subject to corrosion, not just metals and their alloys.

It also occurs in other inorganic materials (glass, concrete, etc.), but also for organic materials (rubber, plastics, etc.). The method of material degradation can vary from an undesirable change in appearance to complete disintegration.

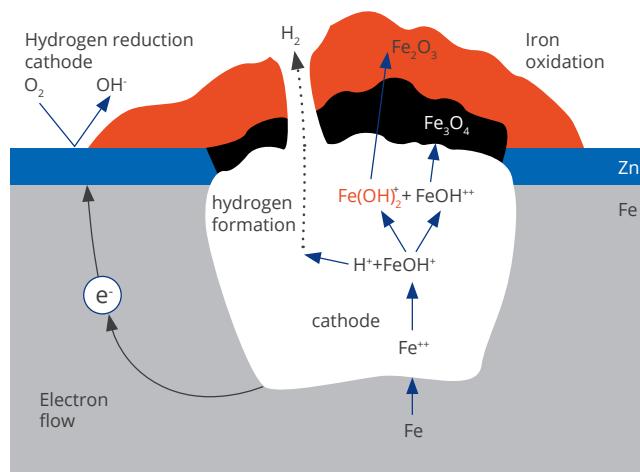
Corrosion represents significant economic losses. It is estimated that in the Czech Republic, corrosion will cause a loss of about CZK 25 billion per year. There are two groups of corrosion losses: direct and indirect. Direct losses include the costs of anti-corrosion measures, the costs of repairing damaged equipment and the costs associated with the complete decommissioning of equipment damaged by corrosion.

Indirect losses are losses caused by a reduction or cessation of production due to corrosion damage to equipment. In some cases, indirect losses can be many times greater than direct losses.

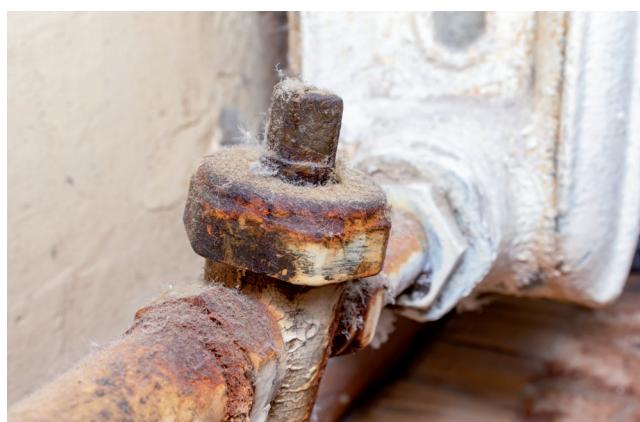
Corrosion of metals can basically be understood as a continuous process of electrolysis. 2 metals with different electro potential (iron + impurities and impurities) function as a cathode and anode, water

containing minerals acts as an electrolyte and everything else is just a matter of physical processes. At the cathode, water decomposes with subsequent reduction of oxygen and the formation of hydrogen gas, and at the anode of iron oxidation, first to a mixture of iron oxide and then only iron oxide (red-brown powder).

## PRINCIPLE OF “BULB” CORROSION



## CORROSION OF STEEL PIPE AFTER FEW YEARS OF WORKING



# 2. MYTHS AND MISTAKES ABOUT REASONABILITY OF OXYGEN BARRIER

## 6 MOST COMMON MISTAKES WITH EXPLANATION

### 1. ARGUMENT

**There is a pressure inside of pipe and O<sub>2</sub> molecules can't migrate in (inside pressure is much bigger than atmospheric one).**

#### Explanation

Migration (diffusion) of O<sub>2</sub> molecules from 1-st. to 2-nd. environs is not dependent on pressure but on difference of concentration of substance in both environs!

This explains the 1st Fick's law from Biomechanics of liquids. Driving force of diffusion is not pressure but difference of concentration in both environs. **Important: Time + Size of Surface**

#### Fick's law

Diffusion qty =  $j \times \text{time} \times \text{surface}$

$$J = -D \frac{\Delta c}{\Delta x}$$



J	diffusion flow density
$\Delta c$	diff. of concentration of 2 environs
$\Delta x$	dif. of distance of 2 environs
D	constant (permeability of diffusio



### 2. ARGUMENT

**The pipe for floor heating will be put into the concrete and no oxygen can go in.**

#### Explanation

Oxygen molecules are very small approx. 1 00 x smaller than the smallest concrete leeks (atomic radius of O<sub>2</sub> molecule is 6x10<sup>-8</sup> m vs. the smallest concrete leeks are 5x10<sup>-6</sup> m). Oxygen molecules can very easily go through of concrete.



### 3. ARGUMENT

**Our radiators don't corrode because of protective coating and radiator producer provides us 50 years warranty - we don't care about corrosion because radiator producer will give us new ones if necessary.**

#### Explanation

50 years is not warranty, it is estimated lifetime; 100% protection against corrosion doesn't exist (there are always small surface defects inside of radiators starting the corrosion process which is permanently consuming oxygen molecules and this way the oxygen concentration difference is increasing and speeding up the whole process thanks to migration of new oxygen molecules inside – see the 1<sup>st</sup>. Fick's law).

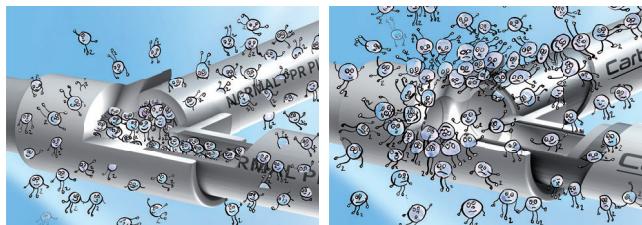


## 4. ARGUMENT

**The pipes are provided with oxygen barrier but fittings not, it makes no sense.**

### Explanation

The pipes surface (one of the most important parameter for diffusion process – see 1-st. Fick´s law) creates more than 99,5% from the whole surface; at fittings it´s less than 0,5% what is insignificant.



## 5. ARGUMENT

**The oxygen barrier is useless, because water contains a lot of oxygen.**

### Explanation

Yes, it's right, oxygen is dissolved in water in quite high amount and is very important for life of water animals (there is even more oxygen in water than in atmosphere) but it doesn't mean that the presence of oxygen in pipes is good. Oxygen is important and essential for growth of some bacterium and alga and creates biological films on inner surface of pipe (i.e., biological films covers approx. 25-40% inner surface of pipes and among other things creates insulation coat



## 6. ARGUMENT

**Nobody knows how to measure diffusion of oxygen molecules; it is not trustworthy; it is only marketing trick and „piece of paper you show us“.**

### Explanation

Diffusion of oxygen molecules is measured according of norm DIN 4726:2008 with refer. ISO 17455:2005 in accredited laboratory; in Czech Republic it is ITC Zlín (Institute for Testing and Certification, a.s.) and this company provides you with complete certificate and final protocol“.

Contact: <http://www.itczlin.cz/cz/>

**INSTITUT PRO TESTOVÁNÍ A CERTIFIKACI, a. s.**  
trída Tomáše Bati 299, Louky, 763 02 Zlín

**Zkušební laboratoř**

Zkušební laboratoř \* Kalibrační laboratoř \* Certifikační orgán pro výrobky \* Certifikační orgán systémů managementu  
Inspekční orgán \* Autorizovaná osoba \* Notifikovaná osoba

Počet stran : 4 Strana : 2 č. j. 412210158/01

**Popis a identifikace vzorků:**

**Tabulka I – Popis a identifikace vzorků**

Evidenční č. ITC	Označení vzorku zákazníkem	Popis předloženého vzorku
412210158/01	Plastová trubka DN20 - 25%	plastová trubka 20m ukončená přechodem na závit, viz obrázek č.1.

Obr. č. 1 – Zkušební vzorek 412210158/01

**Způsob odberu vzorků:**  
Výběr vzorku určeného ke zkouškám provedí objednatel. Laboratoř neručí za chyby vzniklé nesprávným odberem vzorku.

**Použití metody zkoušení:**  
Stanovení propustnosti kyslíku dle DIN 4726:2008 s odkazem na ISO 17455:2005 (dynamická zkušební metoda I)

**Podmínky zkoušky:**  
Zkušební teplota 80°C; tlak v systému 0,5 bar; doba měření 5h, počáteční hodnota koncentrace viz tabulka č. III

**Další informace, které jsou vyžadovány normou/normami a nejsou zde uvedené, jsou k dispozici na vyžádání v laboratoři.**

**Místo provedení zkoušek:**  
Zkoušky byly provedeny na Pracovišti č. 5, třída Tomáše Bati 5264, areál Svit, 113 budova, 760 01 Zlín

*Upozornění: Výsledky uvedené v tomto zkušebním protokolu se týkají jen vzorků náměřených.  
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# 3.



# CARBO oxy<sup>CRP</sup> PIPES

Another direction of development of the unique three-layer CARBOCRP pressure pipe application was to provide an oxygen barrier while retaining all the benefits original pipes.

This development was successfully completed by measuring "Determination oxygen barrier permeability" to DIN 4726 (paragraph 4.3) and ISO 17455 (dynamic test method) at independent ITC Zlin. The measured value is below the required value of 3.6 mg/m<sup>2</sup> per day.

## PP-RCT - polypropylene of the 4<sup>th</sup> generation

The special **nucleation process** modifies the crystalline structure of static copolymer PP-R. Thanks to this process the material gets much better **pressure and temperature properties**.

## Carbon fibre (CF)

The carbon fibre contains carbon in various modifications. It is a long thin strand of material with a diameter of 5 - 8 µm, comprised carbon atoms. The carbon atoms are bound together to form microscopic crystals which are oriented in parallel to the long axis of the fibre.

## Special Additives (SA)

Chemical compounds to prevent oxygen penetration through the wall of the tube into the heat transfer / cooling medium.

## Technical specification

Wall structure	PP-RCT/PP-RCT+CF+SA/PP-RCT
Wall description	multi-layer pipe, middle layer of carbon-containing composite and special additives
Temperature coefficient of expansion	0,045 mm/(m.K)
Diameters available	d (OD) 20 - 125 mm
Standard length available	4 m
Colours	20-110 grey, 125 green
Temperature resistance	up to 90 °C
Application	closed circles for heating or cooling water

## Wall structure CARBO oxy<sup>CRP</sup>

### 1. outer layer

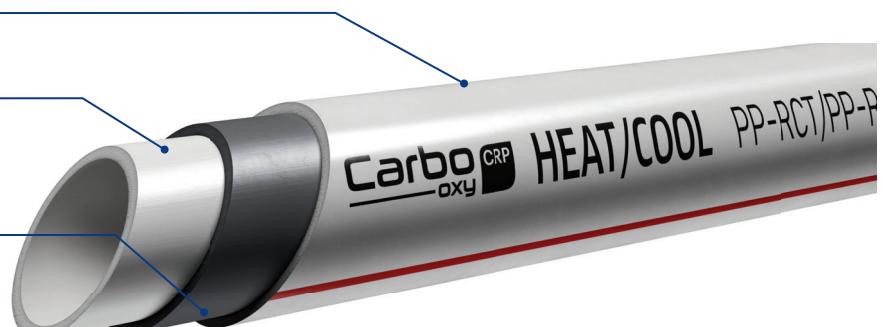
PP-RCT + polar reagent + stabilization

### 2. inner layer

PP-RCT + polar reagent + stabilization

### 3. middle layer

PP-RCT + carbon fibers + barrier agent + stabilization



## Pipe dilatation properties

Thanks to compound of PP-RCT and carbon fibres, the temperature coefficient of expansion (TCE) of the CARBO oxy<sup>CRP</sup> pipes is 0.045 mm/(m.K), which is less than one third of the value of the PP-R pipe's coefficient (0.15 mm/(m.K)).

This logically implies, that the linear expansion of the pipe with identical length and identical temperature difference will be more than 3.3 times lower in the case of the pipe with carbon fibres than in the case of the a conventional PP-R pipe.

### Linear temperature expansion formula

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

**ΔL** length of temperature expansion [mm]

**α** temperature coefficient of expansion  
(CARBO oxy<sup>CRP</sup> pipe = 0.045 mm/(m.K))

**L** length of installed pipe [m]

**ΔT** difference of temperature during of installation  
and working temperature [K]

### The CARBO oxy<sup>CRP</sup> pipe is primarily designed for these applications:

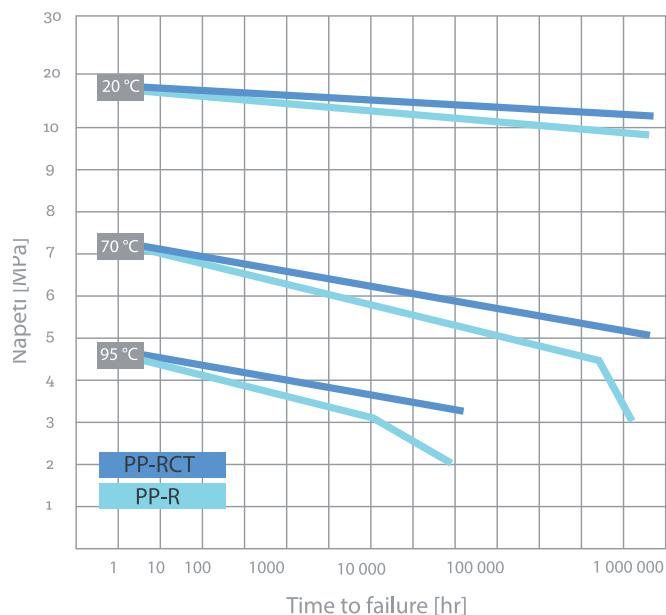
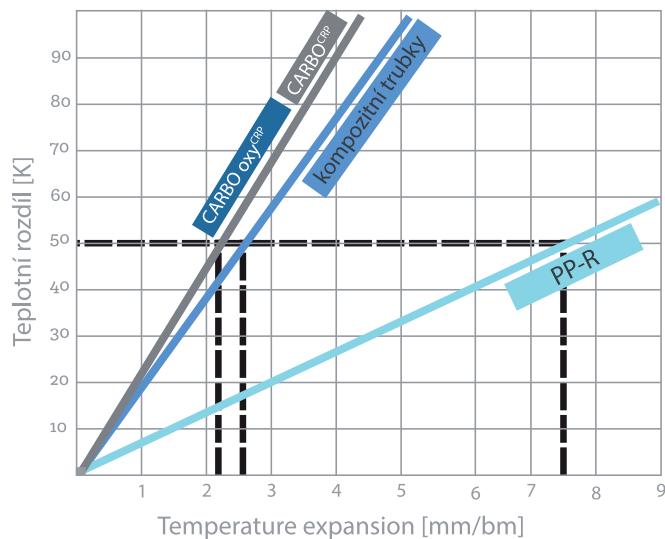
- distributions to distribution heating systems
- radiators
- coolant cooling system distributions
- hot water circulation with circulation
- chemical and industrial applications

### The CARBO<sup>CRP</sup> and CARBO oxy<sup>CRP</sup> pipes are the hi-tech elements of the PP-R/PP-RCT INSTAPLAST system

CARBO oxy<sup>CRP</sup> and HEAT/COOL pipes extend the PP-R/PP-RCT INSTAPLAST system and can be combined with another type for a given distribution pipes and fittings of this system. Pipes with fittings are connected by polyfusion welding at 260 °C. Before welding the pipe it only cleans like a standard PP-R pipe, it doesn't peel. Process welding, handling and other instructions are described in the technical instructions.

### Advantages of CARBO oxy<sup>CRP</sup> tubes

- oxygen barrier - protection of sensitive parts of heat / cooling-sources in the circuit
- minimum thermal coefficient of linear expansion – 0.045 mm/(m.K)
- higher temperature resistance up to 90 °C
- Higher pressure resistance at high temperatures up to 50 %
- a higher flow rate of up to 20 % due to the smaller wall thickness of the pipe
- standard welding as for PP-R (no further tube modifications),- compatibility
- 10 years warranty
- lower wear of cutting tools



# 4.

# CARBO oxy<sup>CRP</sup> HEAT

The CARBO oxy<sup>CRP</sup> HEAT pipe is suitable for heating water distribution or industrial distribution systems where circulating circuits with a medium temperature between 40 °C – 90 °C are closed.

This three - layer pipe is made of PP-RCT (polypropylene of 4th generation) wherein the middle layer of this pipe contains a mixture of PP-RCT material, carbon fibers and special additives.

Carbon fibers ensure minimal elongation /shrinkage due to temperature change.

Special additives provide an oxygen barrier - they prevent the penetration of oxygen into the heating medium and thus protect sensitive technological parts in the heating circuit.

Due to the higher temperature of the heat transfer medium, the pipe has a thicker wall than the pipe variant for cooling circuits. Due to the fact that it is made of PP-RCT material, the thickness is thinner than it would be in the case of a pipe made of PP-R material and this fact results in the advantages of the pipe such as: Favorable acquisition costs, standard installation, corrosion resistance, maintenance-free operation, long life. All this is provided by the CARBO oxy<sup>CRP</sup> HEAT pipe and is the optimal solution for closed heating systems.

Diameter d [mm]	Application	s	Wall thickness T [mm]
20	HEAT/COOL	3,2	2,8
25	HEAT/COOL	3,2	3,5
32	HEAT/COOL	3,2	4,4
40	HEAT	4	4,5
50	HEAT	4	5,6
63	HEAT	4	7,1
75	HEAT	4	8,4
90	HEAT	4	10,1
110	HEAT	4	12,3
125	HEAT	4	14,0



# 5.

# CARBO oxy<sup>CRP</sup> COOL

The CARBO oxy<sup>CRP</sup> COOL pipe is suitable for cooling water distribution, air conditioning or industrial distribution, ie systems where there are closed circulating circuits with a medium temperature not exceeding 40 °C.

This three - layer pipe is made of PP-RCT (polypropylene of 4th generation) wherein the middle layer of this pipe contains a mixture of PP-RCT material, carbon fibers and special additives.

Carbon fibers minimize elongation / shrinkage due to temperature changes.

Special additives provide an oxygen barrier - they prevent the penetration of oxygen into the cooling medium and thus protect sensitive technological parts in the cooling circuit.

The pipe is less thermally stressed, so it may have a weaker wall than the pipe variant for heating media. Larger inner diameter allows higher mass flow of coolant.

Favorable acquisition costs, standard installation, corrosion resistance, maintenance-free operation, long service life – all this is provided by the CARBO oxy<sup>CRP</sup> COOL pipe and is therefore the optimal solution for closed cooling systems.

Diameter d [mm]	Application	S	Wall thickness T [mm]
20	HEAT/COOL	3,2	2,8
25	HEAT/COOL	3,2	3,5
32	HEAT/COOL	3,2	4,4
40	COOL	5	3,7
50	COOL	5	4,6
63	COOL	5	5,8
75	COOL	5	6,8
90	COOL	5	8,2
110	COOL	5	10,0
125	COOL	5	11,4



# 6.

# DESCRIPTION PP-R/PP-RCT SYSTEM INSTAPLAST

## 6.1. ADVANTAGES OF THE PP-R/PP-RCT

- Wide range of fittings in the pressure range of S2.5
- Substitution of steel pipes by plastic ones results in considerably positive ecological and economical indicators
- Minimal service life in case of correct application: 50 years
- Hygienically harmless, it is not susceptible to corrosion
- Installation is simple, clean and quick
- Easy handling due to low weight
- Low noisiness
- The system complies with the standards for classification as "Environment friendly product"

Pipe type	Scope of application					
	Cold water	Hot water	Heating I (max. 70 °C)	Heating II (max. 90 °C)	Air	Cooling
CARBO oxy <sup>CRP</sup> HEAT/COOL	■	■	■	■	■	■
CARBO oxy <sup>CRP</sup> HEAT	■	■	■	■	■	■
CARBO oxy <sup>CRP</sup> COOL	■				■	■

Pipe type	Pressure range Dimension range	Material	Pressure resistance according to class 2 (hot water 70 °C)	Pressure resistance according to class 5 (heating water 90 °C)	Coefficient of thermal linear expansion	Lifetime	Guarantee
CARBO oxy <sup>CRP</sup> HEAT/COOL	S3.2 Ø 20 – 32	PP-RCT/PP-RCT +CF+SA/PP-RCT	10 bar	8 bar	0,045 mm/(m.K)	50 years	10 years
CARBO oxy <sup>CRP</sup> HEAT	S4 Ø 40 – 125	PP-RCT/PP-RCT +CF+SA/PP-RCT	10 bar	8 bar	0,045 mm/(m.K)	50 years	10 years
CARBO oxy <sup>CRP</sup> COOL	S5 Ø 40 – 125	PP-RCT/PP-RCT +CF+SA/PP-RCT	-	-	0,045 mm/(m.K)	50 years	10 years

## 6.2. PIPES

### CARBO oxy<sup>CRP</sup>

This is the highest range of pipes from the PP-R/PP-RCT system INSTAPLAST. The construction of the pipe is three-layered. The outer and inner layers are made of PP-RCT. The middle layer contains a compound of PP-RCT, carbon fibers (CF) and special additives (SA). This middle layer forms an oxygen barrier - it prevents the penetration of oxygen from the environment through the wall of the pipe into the heat transfer / cooling medium. This protects sensitive parts in a closed circuit (boiler, heat exchanger, pump) against corrosion.

### Advantages of CARBO oxy<sup>CRP</sup>:

- oxygen barrier inside the pipe wall!
- temperature resistance up to 90 °C
- higher pressure resistance at high temperatures
- higher flow rate up to 20 %
- low longitudinal expansion
- no need to peel before welding

## 6.3. FITTINGS

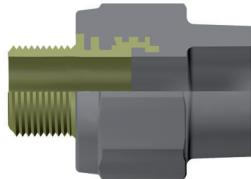
The fittings correspond to the dimension ranges of pipes. They are produced in the highest pressure range S 2.5 (PN 20) and therefore are suitable for all piping of PP-R/PP-RCT system INSTAPLAST.

Plastic fittings differ from each other depending on the application and function in the system. They may be simply divided to:

- Full plastic fittings which forms the basis of the system (T-pieces, elbows, pipe couplings, reductions, blenders, plugs etc.)
- Combined fittings for connecting threaded parts of pipes, fittings (DG transitions with metal plugs or with combined threads, bulkheads, flanged collars, etc.)
- Plastic shut-off valves - direct and, ball valves
- Additional elements (clips, crossings, dilatation loops)

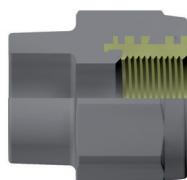
### DG-coupling MZV

Coupling with external brass thread. The brass thread is full nickel plated, new technology with internal transit injected with plastic material - possible to use for distribution of cold and hot water. There are manufactured also as elbows and T-pieces MZV.



### DG-coupling MZD

Coupling with internal brass nickel plated thread, possible to use for cold and hot water distribution. There are manufactured also as elbows and T-pieces MZD or wall-mounted pieces.



## 6.4. PP-R/PP-RCT SYSTEM INSTAPLAST MATERIAL

We use **PP-R** (PP-polypropylene Typee 3 random, gray) and **PP-R/PP-RCT SYSTEM INSTAPLAST MATERIAL** for the production of INSTAPLAST. It gets a much better **pressure and temperature properties** due to a special process of nucleation, which improves the crystalline structure of random copolymer PP-R.

System PP-R/PP-RCT INSTAPLAST is manufactured according to the standard EN ISO 15874.

Material properties	PP-R	PP-RCT	
<b>Density [kg/m<sup>3</sup>]</b>	900-910	905	
<b>The melt flow index MFI 230 / 2.16 [g/10min]</b>	0,30	0,30	
<b>Notched impact strength (Charpy) [kJ/m<sup>2</sup>]</b>	<b>23 °C</b>	31	40
	<b>-20 °C</b>	2,2	2,0
<b>Shear modulus [N/mm<sup>2</sup>]</b>	400	-	
<b>Tensile modulus [N/mm<sup>2</sup>]</b>	900	900	
<b>Elongation at yield [%]</b>	12	100	
<b>Tensibility [%]</b>	200	-	
<b>Yield strength [N/mm<sup>2</sup>]</b>	26	25	
<b>Absorbency [%/7 days]</b>	0,03	-	
<b>Coefficient of thermal linear expansion [mm/(m.K)]</b>	0,15	0,15	
<b>Coefficient of thermal conductivity W/(m.K)</b>	0,24	0,24	

## 6.5. CHEMICAL RESISTENCE

Pipes and fittings made of PP-R and PP-RCT are suitable for transporting all substances to it do not violate. It resists the action of radon. It is not resistant to long-term operation of a number of some concentrated petroleum products. Transported the medium may have a pH in the range of 2 to 12, i.e. water may show both acidic and basic reactions. The pipes can be used for a wide range of reaction fluids in various industries, they are not recommended for the transport of oxidizing media or for long-term use of pipelines for the transport of disinfectant solutions. To determine the suitability for the transport of chemicals other than water, we have a separate brochure - **Chemical resistance of plastic materials**.

When transporting media other than water, it must be remembered that the service life of the pipeline here can decrease much more significantly with increasing temperature.

## 6.6. SYSTEM DISINFECTION

### Thermal disinfection of the system

In the case of thermal disinfection to prevent legionella bacteria, we recommend disinfecting with a duration of min. 3 minutes and water at 70 °C throughout the system.

### Chemical disinfection of the system

Disinfection of the system must be applied only in case of proven contamination. In the case of impact disinfection, it is permitted to load plastic pipes twice a year with a free chlorine content of 50 mg/l for a period not exceeding 12 hours. Alternatively, 150 mg/l hydrogen peroxide ( $H_2O_2$ ) can be used for 24 hours. The temperature must not exceed 30 °C during the disinfection process. The use of a disinfection process, especially for chlorinated water, can have a direct impact on the life of the drinking water system.

## 6.7. LIFETIME

Molecular structure of plastic material, if it is exposed to permanent influence of tension, shows a slow flow of polymer chains and at the same time their orientation is changed. The first consequence of this effect is that Young's modulus for calculation differs in compliance with the assumed loading time. For a longer time of operation, it is lower than for a short-time operation – also the data result from this fact, as given in the below table of temperature dependability. These are the values taken during long-term laboratory tests which have been already verified by practical use and also are published in EN and ISO standards. Second consequence of the orientation polymer chains is called relaxation. After the mechanical loading (pressure tension etc.), a strain is developed in the pipe walls. If the force is not effecting permanently, the strain in pipe walls will decrease after some time (is relaxed) to zero, and the pipe behaves then as if it was without any loading. Its strength does not decrease and the pipe „does not grow old“.

The thickness of the pipe walls are determined so, that their strength at the end of the planned lifetime, and during the permanent operation at max. nominal pressure at 20 °C, reached the value which is necessary for the reliable function of the pressure order at maximum operation pressure, and with the determined safety coefficient (see bellow). If the pipe is not operated at max. pressure for the whole time, the lifetime is extended – see the table. The assumed lifetime of the system, when the selection of material, pressure range and the application is correct, is 50 years.

## 6.8. ECONOMICAL ASPECTS OF USE OF THE PLASTIC PIPES, GENERALLY

**The usage of the plastic pipes provides to the user many advantages:**

- High resistance against creation of incrustation (self-cleaning ability, permanent flow section).
- Flexibility of the pipes provide resistance to damage during the transport and installation.
- There is no risk of attack by microorganisms. Fungi or the corrosion caused by stray currents.
- Low weight, which allows for faster, more accurate and safer work, decreases the cost for transport and storage.

## 6.9. ECOLOGY – WASTE

All the materials used for packing of products of Pipelife Czech s.r.o. are classified for the „O“ category – other waste. Prisms, boxex, polyethylene foils and Raschel bags may be proposed for the use as secondary resources or may be stored or disposed without any problems in incineration plants. Steel binding strips may be used as an iron scrap.

## 6.10. USAGE FOR THE OTHER MEDIA

For the industrial distribution media or other liquid bulk and gaseous substances it is necessary to consult the use with us as a producer. It must take into account the chemical resistance of the material, physical characteristics and other circumstances of asseSPly technology.

## 6.11. CERTIFICATION

Plastic piping systems delivered by company Pipelife Czech s.r.o. are certified by authorized person according to Act No. 22/1997 Coll. about technical requirements to products, in compliance with the last valid regulation of the Goverment of the Czech Republic. The piping for drinking water complies with the hygienic requirements, in compliance with the valid regulation of Ministry of Health of the Czech Republic. The company Pipelife Czech s.r.o. has introduced, documented and certified the Quality Management System acc. to EN ISO 9001 and the Environmental Management System acc. to EN ISO 14001.

All valid documents are published on [www.pipelife.cz](http://www.pipelife.cz) or will be send upon request (please see the end of this document). System PP-R/PP-RCT INSTAPLAST is certified in the following countries: Czech Republic (Czech certificate is valid for all countries of European Union), Russia and Ukraine.

## 6.12. TABLE OF INTERDEPENDENCY OF TEMPERATURE, PRESSURE AND DURABILITY

Temperature (°C)	Lifetime (years)	CARBO oxy <sup>CRP</sup>	
		S4	S3.2
10	1	24,0	30,2
	5	23,2	29,3
	10	22,9	28,9
	25	22,5	28,4
	50	22,2	28,0
20	1	20,9	26,3
	5	20,2	25,4
	10	19,9	25,1
	25	19,6	24,6
	50	19,3	24,3
30	1	18,1	22,7
	5	17,4	22,0
	10	17,2	21,7
	25	16,9	21,2
	50	16,6	20,9
40	1	15,5	19,6
	5	15,0	18,9
	10	14,7	18,6
	25	14,4	18,2
	50	14,2	17,9
50	1	13,3	16,7
	5	12,8	16,1
	10	12,6	15,8
	25	12,3	15,5
	50	12,1	15,2
60	1	11,2	14,2
	5	10,8	13,6
	10	10,6	13,4
	25	10,4	13,1
	50	10,2	12,8
70	1	9,4	11,9
	5	9,1	11,4
	10	8,9	11,2
	25	8,7	10,9
	50	8,5	10,7
80	1	7,9	9,9
	5	7,5	9,5
	10	7,4	9,3
	25	7,2	9,1
95	1	5,9	7,4
	5	5,6	7,1
	cold water		
	hot water		
	hot & cold water		

Values in the table for pipes are determined using the safety coefficient SF = 1.5.

The table clearly shows that higher operating temperatures and operating pressures affect the mechanical properties of the pipeline and thus affect the length of its service life.

# 7. STORAGE AND HANDLING, GUARANTEE CONDITIONS

## 7.1. STORAGE AND HANDLING

The elements of PP-R/PP-RCT INSTAPLAST system are stored in accordance with ČSN 64 0090, from which some important parts are referred to further below together with the detailed conditions of company Pipelife Czech s.r.o.

- The elements of PP-R/PP-RCT INSTAPLAST system must not be stored outdoor.
- They must not be exposed to permanent direct solar radiation and climatic influences.
- They must be placed under a canopy in a dry and dust-free environment.
- They must not be stored together with organic solvents, products containing solvents and other chemicals for which the neutrality to the stored material is not assured (petrol, oil, sulphur etc.).
- They should not be exposed to emission of heat, the distance from heat source must be min. 1 meter.
- Temperature in stores must not exceed the value + 40 °C. Piping for drinking water must not be contaminated during storage.
- **Special care must be taken during manipulation at temperature below 0 °C.**
- The elements of PP-R/PP-RCT INSTAPLAST system must be stored separately, acc. to the Typee of plastic material, pressure range, shape and dimension.
- They must not be permanently unilateraly stressed, bent and leaned against sharp edges during storage and handling.
- The pipes produced in straight bars must be stored in horizontal position, min. 0.1 m above floors and in layers maximum up to 0.6 m.
- Maximal distance of supports for piping dimensions 16 – 32 mm is 0.25 m, for dimensions 40 – 100 mm it is 0.5 m.
- Supports on which the piping is laid must be so designed that it cannot damage the piping (flat supports). Minimal width of supports beams is 0.05 m.
- The pipes produced in the rolls must be stored in horizontal position, min. 0.1 m above the floor, max. 3 rolls in a pile.
- During the manipulation of elements PP-R/PP-RCT system INSTAPLAST, the packing should not be damaged.
- Individual elements should not be slide over floor or rubbed against sharp edges during handling. Strong shocks should be avoided during the manipulation with them.

## 7.2. GUARANTEE CONDITIONS OF PP-R/PP-RCT SYSTEM INSTAPLAST

During the assembly, the combinations with elements which are not suitable for the PP-R/PP-RCT INSTAPLAST system is unacceptable. For the assembly of formed pieces with metal injection, it is not allowed to use hemp, but PTFE tape of sealing mastic Siseal or sealing PTFE thread Loctite.

Storage of the material must comply with storage conditions as given above in this chapter.

Projecting, assembly and operation must be in compliance with this manual for PP-R/PP-RCT INSTAPLAST system. Aseemly of plastic piping may be performedonly by a worker who provable possess a valid certificate of welder D – U7, as the minimum, or certificate of welder for plastic materias Z – U/7, Z – U/V and C – U/V.

# 8.

# PRESSURE LOSSES

## 8.1. PRESSURE LOSS CALCULATION

Pressure losses in the pipeline  $\Delta p_{RF}$  [kPa] are determined by the following formula:

$$\Delta p_{RF} = \sum_{j=1}^n [l_j \cdot R_j + \Delta p_{Fj}]$$

$l$  length of the pipe section [m]

$R$  longitudinal pressure losses due to friction [kPa/m]

$\Delta p_{Fj}$  pressure loss due to local resistance in the respective section [kPa]

$n$  number of pipe sections

Longitudinal pressure losses due to friction  $R$  [kPa/m] were determined by the formula:

$$R = \frac{\lambda}{d_i} \cdot \frac{v^2}{2000} \cdot \rho$$

$d_i$  inner diameter of pipe [m]

$\lambda$  friction coefficient [-]

$v$  water velocity in the pipe [m/s]

$\rho$  water density [kg/m³] depending on the water temperature T [°C].

$\rho = 999,3$  [kg/m³] at T = 10 °C

$\rho = 987,9$  [kg/m³] at T = 50 °C

$\rho = 971,8$  [kg/m³] at T = 80 °C

The pressure loss due to local resistance (fittings and fixtures)  $\Delta p_F$  [kPa] is determined by:

$$\Delta p_F = \frac{v^2}{2000} \cdot \rho \cdot \sum_{i=1}^m \xi_i$$

$v$  water velocity in the duct [m/s],

$\rho$  water density [kg/m³] depending on the water temperature T [°C]

$\rho = 999,3$  [kg/m³] at T = 10 °C

$\rho = 987,9$  [kg/m³] at T = 50 °C

$\rho = 971,8$  [kg/m³] at T = 80 °C

$\xi$  resistance coefficient

Individual resistance coefficients are determined by the test. It is therefore a purely empirical values which may fluctuate significantly. The values in the table are "proven in practice" to be the best basis for calculation the pressure loss in the piping system.

To calculate the total piping head loss, it is necessary to count with great care all the individual parts. From our experience it is recommended recording various independent components into the table..

## 8.2. PRESSURE LOSS IN FITTING (CONNECTING FITTING)

Resistance coefficient (depending on geometry)

Pipe coupling	$\xi = 0,2$
Reduction	$\xi = 0,55$
Elbow 90°	$\xi = 1,5$
T-piece	$\xi = 1,1$
T-piece branch	$\xi = 1,5$
Reducing T-piece	$\xi = 1,1$
Reducing T-piece branch	$\xi = 4,3$
Metal - plastic coupling	$\xi = 0,4$
Metal - plastic reducing coupling	$\xi = 8,3$

# CARBO oxy<sup>CRP</sup> HEAT PIPES

water temperature = 10 °C

Q	20 × 2,8 mm		25 × 3,5 mm		32 × 4,4 mm		40 × 4,5 mm		50 × 5,6 mm		63 × 7,1 mm		75 × 8,4 mm		90 × 10,1 mm		110 × 12,3 mm		125 × 14,0 mm				
	R	v	R	v	R	v	R	v	R	v	R	v	R	v	R	v	R	v	R	v			
l/s	kPa/m	m/s	kPa/m	m/s	kPa/m	m/s	kPa/m	m/s	kPa/m	m/s	kPa/m	m/s											
0,02	0,027	0,1	0,009	0,1																			
0,04	0,093	0,2	0,032	0,2	0,01	0,1																	
0,06	0,189	0,4	0,065	0,2	0,02	0,1																	
0,08	0,313	0,5	0,108	0,3	0,034	0,2	0,006	0,1															
0,10	0,465	0,6	0,16	0,4	0,05	0,2	0,009	0,2															
0,12	0,641	0,7	0,221	0,5	0,069	0,3	0,016	0,2	0,004	0,1													
0,14	0,843	0,9	0,29	0,6	0,09	0,3	0,023	0,2	0,007	0,1													
0,16	1,068	1,0	0,367	0,6	0,114	0,4	0,027	0,2	0,01	0,2													
0,18	1,316	1,1	0,452	0,7	0,14	0,4	0,034	0,3	0,011	0,2	0,004	0,1											
0,20	1,588	1,2	0,544	0,8	0,168	0,5	0,039	0,3	0,014	0,2	0,005	0,1	0,002	0,1									
0,30	3,277	1,8	1,118	1,2	0,345	0,7	0,082	0,5	0,027	0,3	0,01	0,2	0,004	0,1									
0,40	5,499	2,5	1,868	1,6	0,574	1,0	0,134	0,6	0,047	0,4	0,015	0,2	0,01	0,2	0,003	0,1							
0,50	8,236	3,1	2,786	2,0	0,854	1,2	0,198	0,8	0,067	0,5	0,023	0,3	0,014	0,2	0,004	0,1							
0,60			3,869	2,4	1,183	1,4	0,272	0,9	0,095	0,6	0,031	0,4	0,017	0,3	0,006	0,2							
0,70			5,112	2,8	1,558	1,7	0,363	1,1	0,122	0,7	0,04	0,4	0,022	0,3	0,007	0,2	0,003	0,1					
0,80			6,513	3,1	1,98	1,9	0,458	1,2	0,157	0,8	0,053	0,5	0,028	0,3	0,01	0,2	0,004	0,1					
0,90			8,071	3,5	2,448	2,2	0,564	1,4	0,192	0,9	0,064	0,6	0,034	0,4	0,012	0,2	0,005	0,2					
1,00					2,96	2,4	0,678	1,5	0,234	1,0	0,076	0,6	0,046	0,5	0,014	0,3	0,005	0,2	0,003	0,1			
1,20					4,117	2,9	0,948	1,8	0,318	1,2	0,106	0,7	0,061	0,5	0,019	0,3	0,007	0,2	0,004	0,2			
1,40					5,449	3,4	1,246	2,1	0,42	1,4	0,141	0,9	0,076	0,6	0,026	0,4	0,009	0,2	0,005	0,2			
1,60							1,594	2,5	0,535	1,6	0,18	1,0	0,095	0,7	0,032	0,4	0,012	0,3	0,007	0,2			
1,80							1,967	2,8	0,662	1,7	0,219	1,1	0,113	0,8	0,039	0,5	0,015	0,3	0,008	0,2			
2,00							2,392	3,1	0,802	1,9	0,266	1,2	0,136	0,8	0,047	0,5	0,018	0,4	0,010	0,3			
2,20							2,838	3,4	0,954	2,1	0,314	1,3	0,157	0,9	0,055	0,6	0,021	0,4	0,012	0,3			
2,40									1,118	2,3	0,366	1,5	0,183	1,0	0,066	0,6	0,025	0,4	0,013	0,3			
2,60									1,294	2,5	0,425	1,6	0,207	1,1	0,076	0,7	0,028	0,5	0,016	0,4			
2,80									1,481	2,7	0,487	1,7	0,236	1,1	0,086	0,7	0,033	0,5	0,018	0,4			
3,00									1,681	2,9	0,548	1,8	0,263	1,2	0,097	0,8	0,037	0,5	0,021	0,4			
3,20									1,892	3,1	0,618	2,0	0,295	1,3	0,111	0,8	0,042	0,6	0,022	0,4			
3,40									2,115	3,3	0,692	2,1	0,325	1,4	0,123	0,9	0,046	0,6	0,025	0,5			
3,60									2,335	3,5	0,763	2,2	0,36	1,4	0,135	0,9	0,052	0,6	0,028	0,5			
3,80										0,844	2,3	0,393	1,5	0,149	1,0	0,056	0,7	0,03	0,5				
4,00										0,929	2,4	0,432	1,6	0,165	1,1	0,062	0,7	0,034	0,5				
4,20										1,018	2,6	0,467	1,7	0,18	1,1	0,067	0,7	0,037	0,6				
4,40											1,102	2,7	0,509	1,7	0,195	1,2	0,074	0,8	0,041	0,6			
4,60											1,198	2,8	0,547	1,8	0,21	1,2	0,079	0,8	0,043	0,6			
4,80											1,297	2,9	0,592	1,9	0,226	1,3	0,086	0,8	0,047	0,7			
5,00											1,391	3,1	0,632	2,0	0,246	1,3	0,092	0,9	0,051	0,7			
5,20												0,68	2,0	0,264	1,4	0,100	0,9	0,053	0,7				
5,40												0,73	2,1	0,281	1,4	0,106	0,9	0,058	0,7				
5,60												0,775	2,2	0,300	1,5	0,114	1,0	0,062	0,8				
5,80												0,828	2,3	0,322	1,5	0,120	1,0	0,065	0,8				
6,00												0,875	2,3	0,342	1,6	0,129	1,1	0,069	0,8				
6,50												0,952	2,4	0,395	1,7	0,147	1,1	0,08	0,9				
7,00												1,154	2,7	0,451	1,8	0,169	1,2	0,092	1,0				
7,50												1,241	2,9	0,512	2,0	0,193	1,3	0,010	1,0				
8,00												1,399	3,0	0,575	2,1	0,217	1,4	0,116	1,1				
8,50													0,642	2,2	0,240	1,5	0,130	1,2					
9,00													0,713	2,4	0,267	1,6	0,145	1,2					
9,50													0,786	2,5	0,296	1,7	0,160	1,3					
10,00													0,864	2,6	0,326	1,8	0,174	1,4					
10,50													0,944	2,7	0,353	1,8	0,191	1,4					
11,00													1,028	2,9	0,386	1,9	0,208	1,5					
11,50													1,122	3,0	0,419	2,0	0,226	1,6					
12,00														0,450	2,1	0,243	1,6						
12,50														0,486	2,2	0,262	1,7						
13,00														0,524	2,3	0,282	1,8						
13,50														0,563	2,4	0,303	1,8						
14,00														0,598	2,4	0,321	1,9						
14,50														0,639	2,5	0,342	2,0						
15,00														0,681	2,6	0,366	2,0						
15,50														0,725	2,7	0,389	2,1						
16,00														0,765	2,8	0,414	2,2						
16,50														0,811	2,9	0,435	2,2						
17,00														0,858	3,0	0,460	2,3						
17,50															0,486	2,4							
18,00															0,513	2,4							
18,50															0,536	2,5							
19,00															0,564	2,6							
19,50															0,593	2,6							
20,00															0,622	2,7							
20,50															0,647	2,8							
21,00															0,780	2,8							
21,50															0,709	2,9							
22,00															0,741	3,0							

# CARBO oxy<sup>CRP</sup> HEAT PIPES

water temperature = 50 °C

	20 × 2,8 mm		25 × 3,5 mm		32 × 4,4 mm		40 × 4,5 mm		50 × 5,6 mm		63 × 7,1 mm		75 × 8,4 mm		90 × 10,1 mm		110 × 12,3 mm		125 × 14,0 mm		
Q	R	v	R	v	R	v	R	v	R	v	R	v	R	v	R	v	R	v	R	v	
I/s	kPa/m	m/s	kPa/m	m/s	kPa/m	m/s	kPa/m	m/s	kPa/m	m/s	kPa/m	m/s	kPa/m	m/s	kPa/m	m/s	kPa/m	m/s	kPa/m	m/s	
0,02	0,022	0,1	0,008	0,1																	
0,04	0,075	0,2	0,026	0,2	0,008	0,1															
0,06	0,154	0,4	0,053	0,2	0,016	0,1	0,004	0,1	0,001	0,1											
0,08	0,257	0,5	0,088	0,3	0,027	0,2	0,007	0,1	0,002	0,1											
0,10	0,382	0,6	0,131	0,4	0,04	0,2	0,009	0,2	0,003	0,1	0,001	0,1									
0,12	0,53	0,7	0,181	0,5	0,056	0,3	0,013	0,2	0,004	0,1	0,001	0,1									
0,14	0,698	0,9	0,238	0,6	0,073	0,3	0,018	0,2	0,006	0,1	0,002	0,1									
0,16	0,888	1,0	0,302	0,6	0,093	0,4	0,021	0,2	0,008	0,2	0,002	0,1									
0,18	1,099	1,1	0,373	0,7	0,115	0,4	0,027	0,3	0,009	0,2	0,003	0,1	0,001	0,1							
0,20	1,33	1,2	0,45	0,8	0,138	0,5	0,031	0,3	0,011	0,2	0,004	0,1	0,002	0,1							
0,30	2,785	1,8	0,935	1,2	0,285	0,7	0,066	0,5	0,022	0,3	0,007	0,2	0,003	0,1	0,001	0,1					
0,40	4,731	2,5	1,578	1,6	0,478	1,0	0,109	0,6	0,037	0,4	0,012	0,2	0,005	0,2	0,002	0,1					
0,50	7,161	3,1	2,376	2,0	0,716	1,2	0,162	0,8	0,055	0,5	0,025	0,3	0,008	0,2	0,003	0,1					
0,60			3,325	2,4	0,997	1,4	0,224	0,9	0,077	0,6	0,035	0,4	0,011	0,3	0,005	0,2					
0,70			4,425	2,8	1,322	1,7	0,301	1,1	0,1	0,7	0,038	0,4	0,014	0,3	0,006	0,2	0,002	0,1			
0,80			5,675	3,1	1,689	1,9	0,382	1,2	0,129	0,8	0,043	0,5	0,018	0,3	0,008	0,2	0,003	0,1			
0,90			7,073	3,5	2,098	2,2	0,471	1,4	0,159	0,9	0,052	0,6	0,023	0,4	0,01	0,2	0,004	0,2			
1,00					2,549	2,4	0,570	1,5	0,194	1,0	0,062	0,6	0,028	0,5	0,011	0,3	0,004	0,2	0,002	0,1	
1,20					3,577	2,9	0,802	1,8	0,265	1,2	0,088	0,7	0,037	0,5	0,015	0,3	0,006	0,2	0,003	0,2	
1,40					4,770	3,4	1,062	2,1	0,352	1,4	0,117	0,9	0,050	0,6	0,021	0,4	0,008	0,2	0,004	0,2	
1,60							1,366	2,5	0,451	1,6	0,150	1,0	0,063	0,7	0,026	0,4	0,010	0,3	0,006	0,2	
1,80							1,694	2,8	0,561	1,7	0,183	1,1	0,079	0,8	0,032	0,5	0,012	0,3	0,007	0,2	
2,00							2,071	3,1	0,682	1,9	0,223	1,2	0,094	0,8	0,039	0,5	0,015	0,4	0,008	0,3	
2,20							2,467	3,4	0,815	2,1	0,266	1,3	0,113	0,9	0,046	0,6	0,017	0,4	0,010	0,3	
2,40								0,958	2,3	0,309	1,5	0,131	1,0	0,055	0,6	0,021	0,4	0,011	0,3		
2,60								1,113	2,5	0,360	1,6	0,153	1,1	0,063	0,7	0,023	0,5	0,013	0,4		
2,80								1,279	2,7	0,414	1,7	0,174	1,1	0,072	0,7	0,027	0,5	0,015	0,4		
3,00								1,455	2,9	0,467	1,8	0,199	1,2	0,081	0,8	0,030	0,5	0,017	0,4		
3,20								1,642	3,1	0,528	2,0	0,222	1,3	0,093	0,8	0,035	0,6	0,017	0,4		
3,40								1,841	3,3	0,592	2,1	0,250	1,4	0,103	0,9	0,038	0,6	0,021	0,5		
3,60								2,038	3,5	0,654	2,2	0,275	1,4	0,114	0,9	0,043	0,6	0,023	0,5		
3,80									0,725	2,3	0,306	1,5	0,125	1,0	0,047	0,7	0,025	0,5			
4,00									0,800	2,4	0,334	1,6	0,139	1,1	0,047	0,7	0,027	0,5			
4,20									0,878	2,6	0,368	1,7	0,152	1,1	0,056	0,7	0,031	0,6			
4,40										0,953	2,7	0,399	1,7	0,164	1,2	0,062	0,8	0,034	0,6		
4,60										1,038	2,8	0,435	1,8	0,178	1,2	0,066	0,8	0,036	0,6		
4,80										1,126	2,9	0,469	1,9	0,192	1,3	0,073	0,8	0,039	0,7		
5,00										1,210	3,1	0,508	2,0	0,209	1,3	0,077	0,9	0,042	0,7		
5,20											0,544	2,0	0,224	1,4	0,084	0,9	0,045	0,7			
5,40											0,586	2,1	0,239	1,4	0,089	0,9	0,048	0,7			
5,60											0,623	2,2	0,255	1,5	0,096	1,0	0,052	0,8			
5,80											0,669	2,3	0,275	1,5	0,102	1,0	0,054	0,8			
6,00											0,716	2,3	0,292	1,6	0,109	1,1	0,058	0,8			
6,50											0,826	2,4	0,338	1,7	0,125	1,1	0,067	0,9			
7,00											0,95	2,7	0,388	1,8	0,144	1,2	0,078	1,0			
7,50											1,083	2,9	0,441	2,0	0,164	1,3	0,087	1,0			
8,00											1,225	3,0	0,497	2,1	0,185	1,4	0,098	1,1			
8,50												0,556	2,2	0,205	1,5	0,111	1,2				
9,00												0,618	2,4	0,229	1,6	0,123	1,2				
9,50												0,684	2,5	0,254	1,7	0,137	1,3				
10,00												0,753	2,6	0,280	1,8	0,149	1,4				
10,50												0,824	2,7	0,304	1,8	0,163	1,4				
11,00												0,900	2,9	0,333	1,9	0,178	1,5				
11,50												0,984	3,0	0,362	2,0	0,194	1,6				
12,00													0,390	2,1	0,208	1,6					
12,50													0,422	2,2	0,225	1,7					
13,00													0,455	2,3	0,243	1,8					
13,50													0,489	2,4	0,261	1,8					
14,00													0,521	2,4	0,277	1,9					
14,50													0,557	2,5	0,297	2,0					
15,00													0,595	2,6	0,317	2,0					
15,50													0,634	2,7	0,337	2,1					
16,00													0,669	2,8	0,359	2,2					
16,50													0,711	2,9	0,378	2,2					
17,00													0,753	3,0	0,400	2,3					
17,50														0,423	2,4						
18,00														0,447	2,4						
18,50														0,468	2,5						
19,00														0,493	2,6						
19,50														0,518	2,6						
20,00														0,544	2,7						
20,50														0,567	2,8						
21,00														0,594	2,8						
21,50														0,622	2,9						
22,00														0,651	3,0						

# CARBO oxy<sup>CRP</sup> HEAT PIPES

water temperature = 80 °C

Water temperature 30 °C																				
20 × 2,8 mm		25 × 3,5 mm		32 × 4,4 mm		40 × 4,5 mm		50 × 5,6 mm		63 × 7,1 mm		75 × 8,4 mm		90 × 10,1 mm		110 × 12,3 mm		125 × 14,0 mm		
Q	R	v	R	v	R	v	R	v	R	v	R	v	R	v	R	v	R	v		
I/s	kPa/m	m/s	kPa/m	m/s	kPa/m	m/s														
0,02	0,019	0,1	0,007	0,1																
0,04	0,067	0,2	0,023	0,2	0,007	0,1	0,002	0,1												
0,06	0,134	0,4	0,047	0,2	0,013	0,1	0,005	0,1	0,002	0,1										
0,08	0,221	0,5	0,074	0,3	0,023	0,2	0,008	0,1	0,003	0,1										
0,10	0,328	0,6	0,111	0,4	0,034	0,2	0,011	0,2	0,004	0,1	0,001	0,1								
0,12	0,465	0,7	0,155	0,5	0,048	0,3	0,016	0,2	0,006	0,1	0,002	0,1								
0,14	0,612	0,9	0,206	0,6	0,064	0,3	0,021	0,2	0,008	0,1	0,003	0,1								
0,16	0,777	1,0	0,263	0,6	0,082	0,4	0,028	0,2	0,01	0,2	0,003	0,1								
0,18	0,976	1,1	0,327	0,7	0,097	0,4	0,034	0,3	0,011	0,2	0,004	0,1	0,001	0,1						
0,20	1,180	1,2	0,397	0,8	0,119	0,5	0,041	0,3	0,013	0,2	0,004	0,1	0,002	0,1						
0,30	2,492	1,8	0,828	1,2	0,247	0,7	0,083	0,5	0,027	0,3	0,009	0,2	0,003	0,1	0,001	0,1				
0,40	4,299	2,5	1,406	1,6	0,419	1,0	0,139	0,6	0,047	0,4	0,015	0,2	0,005	0,2	0,002	0,1				
0,50	6,536	3,1	2,129	2,0	0,631	1,2	0,212	0,8	0,700	0,5	0,023	0,3	0,007	0,2	0,003	0,1				
0,60			3,018	2,4	0,885	1,4	0,293	0,9	0,095	0,6	0,032	0,4	0,010	0,3	0,004	0,2				
0,70			4,030	2,8	1,180	1,7	0,388	1,1	0,127	0,7	0,042	0,4	0,013	0,3	0,005	0,2	0,002	0,1		
0,80			5,183	3,1	1,530	1,9	0,501	1,2	0,164	0,8	0,053	0,5	0,016	0,3	0,007	0,2	0,003	0,1		
0,90			6,513	3,5	1,907	2,2	0,621	1,4	0,200	0,9	0,065	0,6	0,020	0,4	0,009	0,2	0,003	0,2		
1,00					2,323	2,4	0,761	1,5	0,244	1,0	0,079	0,6	0,025	0,5	0,010	0,3	0,004	0,2	0,002	0,1
1,20					3,277	2,9	1,062	1,8	0,346	1,2	0,109	0,7	0,034	0,5	0,014	0,3	0,005	0,2	0,003	0,2
1,40					4,389	3,4	1,423	2,1	0,457	1,4	0,148	0,9	0,045	0,6	0,019	0,4	0,007	0,2	0,004	0,2
1,60							1,835	2,5	0,583	1,6	0,188	1,0	0,057	0,7	0,024	0,4	0,009	0,3	0,005	0,2
1,80							2,281	2,8	0,731	1,7	0,233	1,1	0,071	0,8	0,029	0,5	0,011	0,3	0,006	0,2
2,00							2,792	3,1	0,888	1,9	0,282	1,2	0,085	0,8	0,035	0,5	0,013	0,4	0,007	0,3
2,20							3,354	3,4	1,067	2,1	0,34	1,3	0,103	0,9	0,041	0,6	0,016	0,4	0,009	0,3
2,40								1,253	2,3	0,399	1,5	0,119	1,0	0,050	0,6	0,019	0,4	0,01	0,3	
2,60								1,465	2,5	0,462	1,6	0,140	1,1	0,057	0,7	0,021	0,5	0,011	0,4	
2,80								1,68	2,7	0,529	1,7	0,159	1,1	0,065	0,7	0,025	0,5	0,013	0,4	
3,00								1,91	2,9	0,607	1,8	0,182	1,2	0,074	0,8	0,027	0,5	0,015	0,4	
3,20								2,167	3,1	0,684	2	0,203	1,3	0,084	0,8	0,031	0,6	0,017	0,4	
3,40								2,426	3,3	0,765	2,1	0,229	1,4	0,094	0,9	0,035	0,6	0,019	0,5	
3,60								2,715	3,5	0,85	2,2	0,253	1,4	0,104	0,9	0,039	0,6	0,021	0,5	
3,80										0,947	2,3	0,282	1,5	0,114	1,0	0,042	0,7	0,023	0,5	
4,00										1,042	2,4	0,308	1,6	0,127	1,1	0,047	0,7	0,025	0,5	
4,20										1,14	2,6	0,34	1,7	0,139	1,1	0,051	0,7	0,028	0,6	
4,40										1,244	2,7	0,368	1,7	0,151	1,2	0,056	0,8	0,031	0,6	
4,60										1,36	2,8	0,403	1,8	0,163	1,2	0,060	0,8	0,032	0,6	
4,80										1,492	2,9	0,434	1,9	0,176	1,3	0,066	0,8	0,035	0,7	
5,00										1,589	3,1	0,471	2,0	0,192	1,3	0,071	0,9	0,038	0,7	
5,20												0,504	2,0	0,206	1,4	0,077	0,9	0,041	0,7	
5,40												0,544	2,1	0,221	1,4	0,081	0,9	0,044	0,7	
5,60												0,585	2,2	0,235	1,5	0,088	1,0	0,047	0,8	
5,80												0,622	2,3	0,254	1,5	0,093	1,0	0,05	0,8	
6,00												0,666	2,3	0,270	1,6	0,100	1,1	0,053	0,8	
6,50												0,77	2,4	0,313	1,7	0,115	1,1	0,062	0,9	
7,00												0,888	2,7	0,36	1,8	0,132	1,2	0,071	1,0	
7,50												1,013	2,9	0,409	2,0	0,151	1,3	0,080	1,0	
8,00												1,147	3,0	0,462	2,1	0,171	1,4	0,090	1,1	
8,50														0,517	2,2	0,189	1,5	0,102	1,2	
9,00														0,576	2,4	0,212	1,6	0,113	1,2	
9,50														0,638	2,5	0,235	1,7	0,126	1,3	
10,00														0,703	2,6	0,259	1,8	0,137	1,4	
10,50														0,771	2,7	0,282	1,8	0,151	1,4	
11,00														0,842	2,9	0,309	1,9	0,165	1,5	
11,50														0,922	3,0	0,337	2,0	0,180	1,6	
12,00																0,362	2,1	0,192	1,6	
12,50																0,393	2,2	0,209	1,7	
13,00																0,424	2,3	0,225	1,8	
13,50																0,456	2,4	0,242	1,8	
14,00																0,486	2,4	0,257	1,9	
14,50																0,52	2,5	0,276	2,0	
15,00																0,556	2,6	0,295	2,0	
15,50																0,593	2,7	0,314	2,1	
16,00																0,627	2,8	0,334	2,2	
16,50																0,666	2,9	0,352	2,2	
17,00																0,706	3,0	0,373	2,3	
17,50																		0,395	2,4	
18,00																		0,417	2,4	
18,50																		0,437	2,5	
19,00																		0,460	2,6	
19,50																		0,485	2,6	
20,00																		0,509	2,7	
20,50																		0,531	2,8	
21,00																		0,557	2,8	
21,50																		0,583	2,9	
22,00																		0,610	3,0	

# CARBO oxy<sup>CRP</sup> COOL PIPES

water temperature = 10 °C

	20 × 2,8 mm		25 × 3,5 mm		32 × 4,4 mm		40 × 3,7 mm		50 × 4,6 mm		63 × 5,8 mm		75 × 6,8 mm		90 × 8,2 mm		110 × 10,0 mm		125 × 11,4 mm		
Q l/s	R kPa/m	v m/s	R kPa/m	v m/s	R kPa/m	v m/s															
0,02	0,027	0,1	0,009	0,1																	
0,04	0,093	0,2	0,032	0,2	0,01	0,1															
0,06	0,189	0,4	0,065	0,2	0,02	0,1	0,004	0,1													
0,08	0,313	0,5	0,108	0,3	0,034	0,2	0,006	0,1	0,002	0,1											
0,10	0,465	0,6	0,16	0,4	0,05	0,2	0,009	0,1	0,003	0,1											
0,12	0,641	0,7	0,221	0,5	0,069	0,3	0,013	0,1	0,004	0,1	0,001	0,1									
0,14	0,843	0,9	0,29	0,6	0,09	0,3	0,017	0,2	0,006	0,1	0,002	0,1									
0,16	1,068	1,0	0,367	0,6	0,114	0,4	0,022	0,2	0,007	0,1	0,002	0,1	0,001	0,1							
0,18	1,316	1,1	0,452	0,7	0,14	0,4	0,027	0,2	0,009	0,1	0,003	0,1	0,001	0,1							
0,20	1,588	1,2	0,544	0,8	0,168	0,5	0,032	0,2	0,011	0,2	0,004	0,1	0,002	0,1							
0,30	3,277	1,8	1,118	1,2	0,345	0,7	0,065	0,4	0,022	0,2	0,007	0,1	0,003	0,1	0,001	0,1					
0,40	5,499	2,5	1,868	1,6	0,574	1,0	0,108	0,5	0,037	0,3	0,012	0,2	0,005	0,1	0,002	0,1	0,001	0,1			
0,50	8,236	3,1	2,786	2,0	0,854	1,2	0,160	0,6	0,055	0,4	0,018	0,2	0,008	0,2	0,003	0,1	0,001	0,1			
0,60			3,869	2,4	1,183	1,4	0,221	0,7	0,076	0,5	0,025	0,3	0,011	0,2	0,005	0,1	0,002	0,1			
0,70			5,112	2,8	1,558	1,7	0,291	0,8	0,099	0,5	0,033	0,3	0,014	0,2	0,006	0,2	0,002	0,1			
0,80			6,513	3,1	1,98	1,9	0,369	1,0	0,126	0,6	0,042	0,4	0,018	0,3	0,008	0,2	0,003	0,1	0,002	0,1	
0,90			8,071	3,5	2,448	2,2	0,455	1,1	0,155	0,7	0,051	0,4	0,022	0,3	0,009	0,2	0,004	0,1	0,002	0,1	
1,00					2,96	2,4	0,549	1,2	0,187	0,8	0,062	0,5	0,027	0,3	0,011	0,2	0,004	0,2	0,002	0,1	
1,20					4,117	2,9	0,760	1,4	0,258	0,9	0,085	0,6	0,037	0,4	0,015	0,3	0,006	0,2	0,003	0,1	
1,40					5,449	3,4	1,001	1,7	0,34	1,1	0,112	0,7	0,049	0,5	0,02	0,3	0,008	0,2	0,004	0,1	
1,60							1,273	1,9	0,431	1,2	0,142	0,8	0,062	0,5	0,026	0,4	0,01	0,3	0,005	0,2	
1,80							1,574	2,2	0,532	1,4	0,175	0,9	0,076	0,6	0,031	0,4	0,012	0,3	0,006	0,2	
2,00							1,903	2,4	0,642	1,5	0,211	1,0	0,092	0,7	0,038	0,5	0,014	0,3	0,008	0,2	
2,20							2,262	2,6	0,762	1,7	0,250	1,1	0,108	0,7	0,045	0,5	0,017	0,3	0,009	0,3	
2,40							2,649	2,9	0,891	1,8	0,292	1,2	0,126	0,8	0,052	0,6	0,02	0,4	0,01	0,3	
2,60							3,064	3,1	1,029	2,0	0,337	1,3	0,146	0,9	0,06	0,6	0,023	0,4	0,012	0,3	
2,80							3,507	3,4	1,176	2,1	0,385	1,3	0,166	1,0	0,069	0,7	0,026	0,4	0,014	0,3	
3,00									1,332	2,3	0,436	1,4	0,188	1,0	0,078	0,7	0,03	0,5	0,016	0,4	
3,20									1,497	2,4	0,489	1,5	0,211	1,1	0,087	0,8	0,033	0,5	0,018	0,4	
3,40									1,671	2,6	0,545	1,6	0,235	1,2	0,097	0,8	0,037	0,5	0,019	0,4	
3,60									1,854	2,8	0,604	1,7	0,260	1,2	0,107	0,8	0,041	0,6	0,022	0,4	
3,80									2,045	2,9	0,666	1,8	0,287	1,3	0,118	0,9	0,045	0,6	0,024	0,5	
4,00									2,246	3,1	0,731	1,9	0,314	1,4	0,129	0,9	0,049	0,6	0,026	0,5	
4,20									2,454	3,2	0,798	2,0	0,343	1,4	0,141	1,0	0,054	0,7	0,028	0,5	
4,40									2,672	3,4	0,868	2,1	0,373	1,5	0,153	1,0	0,058	0,7	0,031	0,5	
4,60									2,898	3,5	0,94	2,2	0,404	1,6	0,166	1,1	0,063	0,7	0,034	0,6	
4,80											1,016	2,3	0,436	1,6	0,179	1,1	0,068	0,8	0,037	0,6	
5,00											1,093	2,4	0,469	1,7	0,193	1,2	0,073	0,8	0,039	0,6	
5,20													0,492	1,8	0,203	1,2	0,078	0,8	0,041	0,6	
5,40													0,523	1,8	0,218	1,3	0,083	0,9	0,045	0,7	
5,60													0,560	2,0	0,234	1,3	0,088	0,9	0,048	0,7	
5,80													0,598	2,0	0,247	1,4	0,094	0,9	0,051	0,7	
6,00													0,637	2,0	0,264	1,4	0,099	0,9	0,054	0,7	
6,50													0,693	2,15	0,288	1,5	0,109	1,0	0,0595	0,8	
7,00													0,831	2,4	0,351	1,7	0,132	1,1	0,071	0,9	
7,50															0,394	1,8	0,15	1,2	0,081	0,9	
8,00															0,445	1,9	0,168	1,3	0,092	1,0	
8,50															0,498	2,0	0,188	1,3	0,102	1,0	
9,00															0,554	2,1	0,206	1,4	0,113	1,1	
9,50															0,607	2,2	0,228	1,5	0,124	1,2	
10,00															0,668	2,4	0,251	1,6	0,136	1,2	
10,50																	0,275	1,7	0,148	1,3	
11,00																	0,299	1,7	0,161	1,3	
11,50																	0,325	1,8	0,175	1,4	
12,00																	0,352	1,9	0,188	1,5	
12,50																	0,376	2,0	0,203	1,5	
13,00																	0,404	2,0	0,218	1,6	
13,50																	0,434	2,1	0,235	1,7	
14,00																	0,464	2,2	0,251	1,7	
14,50																	0,496	2,3	0,268	1,8	
15,00																	0,528	2,4	0,283	1,8	
15,50																		0,302	1,9		
16,00																		0,319	2,0		
16,50																		0,337	2,0		
17,00																		0,356	2,1		
17,50																		0,375	2,1		
18,00																		0,395	2,2		
18,50																		0,418	2,3		
19,00																		0,439	2,3		
19,50																					

## CARBO oxy<sup>CRP</sup> COOL PIPES

water temperature = 50 °C

	20 × 2,8 mm		25 × 3,5 mm		32 × 4,4 mm		40 × 3,7 mm		50 × 4,6 mm		63 × 5,8 mm		75 × 6,8 mm		90 × 8,2 mm		110 × 10,0 mm		125 × 11,4 mm		
Q l/s	R kPa/m	v m/s	R kPa/m	v m/s	R kPa/m	v m/s															
0,02	0,022	0,1	0,008	0,1																	
0,04	0,075	0,2	0,026	0,2	0,008	0,1															
0,06	0,154	0,4	0,053	0,2	0,016	0,1	0,003	0,1													
0,08	0,257	0,5	0,088	0,3	0,027	0,2	0,006	0,1	0,002	0,1											
0,10	0,382	0,6	0,131	0,4	0,04	0,2	0,008	0,1	0,003	0,1											
0,12	0,53	0,7	0,181	0,5	0,056	0,3	0,01	0,1	0,003	0,1											
0,14	0,698	0,9	0,238	0,6	0,073	0,3	0,014	0,2	0,005	0,1											
0,16	0,888	1,0	0,302	0,6	0,093	0,4	0,017	0,2	0,006	0,1	0,002	0,1									
0,18	1,099	1,1	0,373	0,7	0,115	0,4	0,022	0,2	0,007	0,1	0,003	0,1	0,001	0,1							
0,20	1,33	1,2	0,45	0,8	0,138	0,5	0,025	0,2	0,008	0,2	0,003	0,1	0,001	0,1							
0,30	2,785	1,8	0,935	1,2	0,285	0,7	0,051	0,4	0,018	0,2	0,006	0,1	0,002	0,1	0,001	0,1					
0,40	4,731	2,5	1,578	1,6	0,478	1,0	0,086	0,5	0,03	0,3	0,009	0,2	0,004	0,1	0,002	0,1					
0,50	7,161	3,1	2,376	2,0	0,716	1,2	0,128	0,6	0,043	0,4	0,014	0,2	0,006	0,2	0,003	0,1	0,001	0,1			
0,60			3,325	2,4	0,997	1,4	0,178	0,7	0,06	0,5	0,02	0,3	0,008	0,2	0,004	0,1	0,001	0,1			
0,70			4,425	2,8	1,322	1,7	0,235	0,8	0,08	0,5	0,026	0,3	0,011	0,2	0,004	0,2	0,002	0,1			
0,80			5,675	3,1	1,689	1,9	0,3	1,0	0,1	0,6	0,034	0,4	0,014	0,3	0,006	0,2	0,002	0,1	0,001	0,1	
0,90			7,073	3,5	2,098	2,2	0,371	1,1	0,125	0,7	0,04	0,4	0,017	0,3	0,007	0,2	0,003	0,1	0,002	0,1	
1,00					2,549	2,4	0,45	1,2	0,149	0,8	0,049	0,5	0,021	0,3	0,009	0,2	0,004	0,2	0,002	0,1	
1,20					3,577	2,9	0,629	1,4	0,21	0,9	0,069	0,6	0,03	0,4	0,012	0,3	0,005	0,2	0,003	0,2	
1,40					4,770	3,4	0,835	1,7	0,277	1,1	0,089	0,7	0,038	0,5	0,016	0,3	0,006	0,2	0,003	0,2	
1,60							1,069	1,9	0,352	1,2	0,115	0,8	0,049	0,5	0,021	0,4	0,008	0,3	0,004	0,2	
1,80							1,33	2,2	0,442	1,4	0,143	0,9	0,061	0,6	0,025	0,4	0,009	0,3	0,005	0,2	
2,00							1,618	2,4	0,534	1,5	0,171	1,0	0,074	0,7	0,03	0,5	0,011	0,3	0,006	0,2	
2,20							1,934	2,6	0,635	1,7	0,205	1,1	0,086	0,7	0,036	0,5	0,014	0,4	0,008	0,3	
2,40							2,276	2,9	0,751	1,8	0,242	1,2	0,101	0,8	0,042	0,6	0,016	0,4	0,009	0,3	
2,60							2,629	3,1	0,869	2,0	0,278	1,3	0,118	0,9	0,049	0,6	0,019	0,4	0,01	0,3	
2,80							3,024	3,4	0,994	2,1	0,32	1,4	0,135	1,0	0,056	0,7	0,021	0,4	0,011	0,3	
3,00								1,128	2,3	0,365	1,5	0,151	1,0	0,064	0,7	0,024	0,5	0,013	0,4		
3,20								1,28	2,5	0,408	1,6	0,171	1,1	0,071	0,8	0,027	0,5	0,015	0,4		
3,40								1,43	2,6	0,458	1,6	0,192	1,2	0,079	0,8	0,029	0,5	0,016	0,4		
3,60								1,589	2,8	0,506	1,7	0,214	1,2	0,089	0,9	0,034	0,6	0,018	0,4		
3,80								1,766	2,9	0,562	1,8	0,234	1,3	0,096	0,9	0,037	0,6	0,02	0,5		
4,00								1,941	3,1	0,62	1,9	0,258	1,4	0,107	1,0	0,04	0,6	0,022	0,5		
4,20								2,124	3,2	0,675	2,0	0,283	1,4	0,117	1,0	0,044	0,7	0,024	0,5		
4,40								2,328	3,4	0,738	2,1	0,31	1,5	0,126	1,0	0,048	0,7	0,026	0,6		
4,60								2,527	3,5	0,805	2,2	0,333	1,6	0,137	1,1	0,051	0,7	0,028	0,6		
4,80										0,866	2,3	0,361	1,6	0,149	1,1	0,055	0,8	0,031	0,6		
5,00										0,938	2,4	0,391	1,7	0,162	1,2	0,061	0,8	0,033	0,6		
5,20										1,012	2,5	0,421	1,8	0,172	1,2	0,065	0,8	0,035	0,6		
5,40										1,081	2,6	0,448	1,8	0,185	1,3	0,07	0,9	0,038	0,7		
5,60										1,16	2,7	0,481	1,9	0,199	1,3	0,074	0,9	0,04	0,7		
5,80										1,242	2,8	0,515	2,0	0,21	1,4	0,079	0,9	0,043	0,7		
6,00										1,318	2,9	0,349	2,0	0,225	1,4	0,084	0,9	0,045	0,7		
6,50										1,532	3,15	0,6355	2,2	0,2959	1,55	0,098	1,0	0,052	0,8		
7,00										1,76	3,4	0,727	2,4	0,3	1,7	0,111	1,1	0,06	0,9		
7,50														0,338	1,8	0,127	1,2	0,068	0,9		
8,00														0,383	1,9	0,143	1,3	0,077	1,0		
8,50														0,429	2,0	0,16	1,3	0,086	1,0		
9,00														0,479	2,1	0,176	1,4	0,096	1,1		
9,50														0,526	2,2	0,195	1,5	0,105	1,2		
10,00														0,58	2,4	0,215	1,6	0,116	1,2		
10,50																0,236	1,7	0,126	1,3		
11,00																0,257	1,7	0,138	1,3		
11,50																0,28	1,8	0,149	1,4		
12,00																0,303	1,9	0,161	1,5		
12,50																0,325	2,0	0,174	1,5		
13,00																0,35	2,0	0,187	1,6		
13,50																0,376	2,1	0,202	1,7		
14,00																0,403	2,2	0,216	1,7		
14,50																0,431	2,3	0,231	1,8		
15,00																0,459	2,4	0,245	1,8		
15,50																		0,26	1,9		
16,00																		0,276	2,0		
16,50																		0,292	2,0		
17,00																		0,309	2,1		
17,50																		0,326	2,1		
18,00																		0,343	2,2		
18,50																		0,364	2,3		
19,00																		0,382	2,3		
19,50																		0,401	2,4		

# 9.

# DISTRIBUTION SYSTEMS OF COLD AND HOT WATER

## 9.1. PIPING MAINS

- The assembly is performed, based on the project documentation which complies to the valid standards EN 806-1 – 3.
- Method of installation of piping and its protection should be designed properly so that no pressure is transferred to the piping from the construction structures.
- The piping should be as short and straight as possible.
- It is not possible to install in parallel the mains of drinking water and the piping of central heating in channels that are inaccessible for person.
- Water mains laid in constructional structures must be permanently secured against freezing, and the thermal characteristics of the object outside sheathing should not be impaired by the piping installation. The failure of the piping must not endanger the object.
- Water mains must not pass through chimney flues.
- Mains for drinking water must not pass through spaces with increased concentration of the vapours from oil products (fuel stores).

### Covered pipeline

- Concealed pipes stored in protective pipes or insulation must be conducted in an installation shaft or grooves in the walls, respectively in a properly conducted ducts in the floor.
- When the pipe is placed in protective tubes or in insulation into the building structure (e.g. in concrete floors or walls), it is necessary to ensure that there can be no deformation or displacement.
- Protective pipes in ceilings must be completed at least 30 mm higher than the finished floor level, to prevent any possible leak of liquid spills.
- Thermal expansion pipe is in plastic pipes maintained in protective pipes secured by suitable fastening but is water and the protective pipe at the point of exit from the wall or floor.

### Connecting piping

- The connecting piping should be oriented in places without any assumed mechanical damage by drilling or cutting during fixing of supports, brackets, mirrors, handrails etc.
- Each intake armature must be fixed firmly, either with use of a

wall-mounted structure in a classic masonry structure or with use of fixing elements for the attachment to walls of the service duct in flats.

- Attaching of pipes may be carried out using similar method as at attachment of cables by special clamps. It is necessary to insert a separation inserts from felt, foam, rubber, polyethylene etc. between pipes and clamps, which will prevent rubbing of pipes during dilatation movements, and protecting the pipe against mechanical damage in the place of attachment, or it is possible to use special metal clamps with rubber insert. It is necessary to use the separation insert of plastic clamps are used.
- For the fixing of the pipes, it is not recommended to use metal hooks as these may damage the pipes when the hooks are driven in the masonry.
- For the grooves in masonry, it is recommended to use pipes made with even shape, because a pipe from coil retains its shape memory. Fixing of pipes in grooves is made by plaster through a thermal insulation of protective part.
- Determination of places for laying of piping is carried out according to the projecting documentation and with observance of the specified pipe slopes. If the slope degree is not determined in the documentation, the piping is mounted with slope min 0,3 % towards the discharge or outlet armatures.

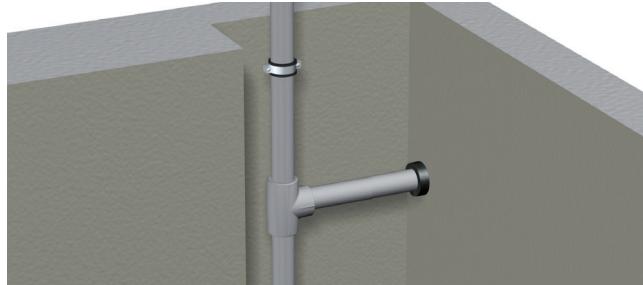
### Vertical piping

- A branch from vertical piping to the connection piping is made indirectly by an elbow creating a flexible bending arm between the vertical and the connecting piping. By this adjustment an efficient compensation of dilatation or plastic mains is reached (see pic. 3). In the pic. 1 and 2 are shown other possible alternatives, i.e. a long arm of free passing through the wall.
- The vertical piping must be equipped with compensation elements.
- The vertical piping must be equipped with a system of fixed and sliding gripping located in dependence on the applied compensation elements (see the project documentation, chapter 7 of this manual).
- Gripping of vertical piping may be performed by the existing clamps equipped with plastic protection or by plumber clamps with a rubber insert.
- Each passing through the constructional structure (ceiling spaces) must be equipped with suitable plastic bushing (polyethylene).

- lene pipe, PVC pipe etc.) so that the plastic piping is not in a direct contact with the constructional structure (pic. 4).
- From the point of view of fire, it is necessary to fill the space between the rising pipe and gland with a non-flammable mastic (prevention of chimney effect).
  - The vertical piping must be equipped with an independent closing armature.
  - The vertical piping must be connected to horizontal distribution system with elimination of influences caused by its own weight of vertical piping and influences caused by thermal changes.

## Horizontal distribution

- The horizontal distribution may be laid on benches under ceiling in grooves in masonry, in channels in floor, in gutters in soil or in plastic or metal sheets troughs. It is not recommended to fix the plastic pipes to the original steel mains.
- The horizontal distribution, as well as vertical piping, must be equipped with compensation elements of the fixed and sliding



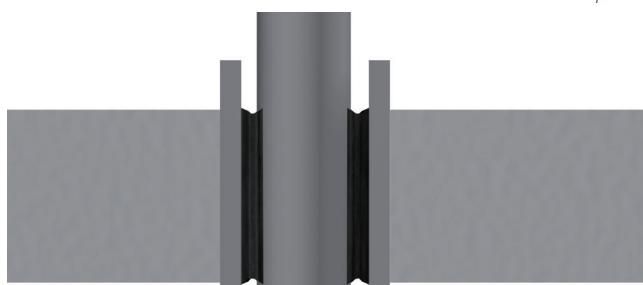
pic. 1



pic. 2



pic. 3



pic. 4

systems, which will assure the correct function of compensators.

- The closing armatures for the individual vertical piping (sections) must be oriented in accessible areas for the case of necessary quick closing.

## Piping slope

- Horizontal piping must be installed with slope min. 0,3 % towards the lowest point of possible drainage and towards the highest point for ventilation.
- It is recommended that the horizontal mains of cold water are with slope towards the water connection (to the water metering set with a discharge armature). The horizontal distribution systems of hot water and circulation piping should have the slope towards the hot water reservoir.
- Parts of horizontal piping which cannot be ventilated to the vertical piping must be equipped with an independent vent valve located at the highest point. Piping parts that cannot be drained by discharges must be equipped with an independent discharge armature.

## 9.2. DISTANCE OF SUPPORTS

In case of when the piping is laid on surface of walls or installed under ceilings, it is necessary to observe the correct pitch at the supports or attachments.

### CARBO oxy<sup>CRP</sup>

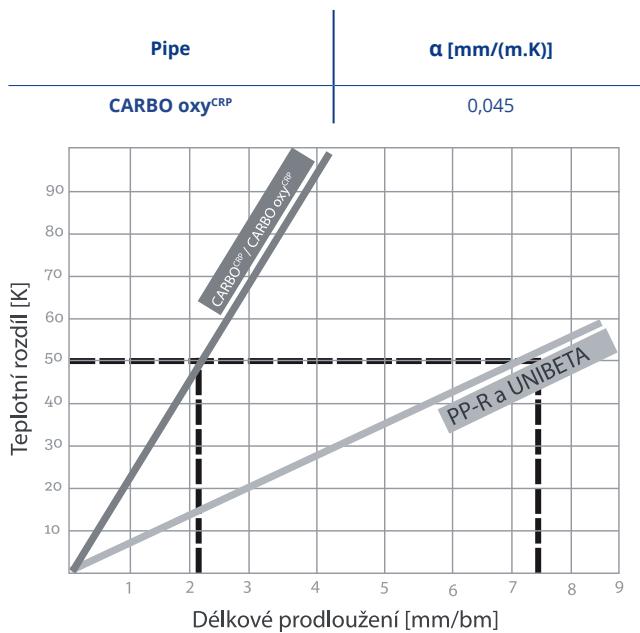
d [mm]	Supports distance [cm]	
	Independently of the water temperature	
20		80
25		100
32		110
40		120
50		130
63		145
75		150
90		155
110		160
125		165

Spacing supports for vertical pipes acc. to the above table may be multiplied by a factor of up to 1.3 m i.e. greater spacing than the horizontal piping. Here it is necessary to proceed from the disposition acc. to the facts and options location of fixed and sliding, as well as consultations with the designer.

# 10. COMPENSATION OF PLASTIC PIPING

Due to the differences in temperature during assembly of piping, and the respective operation, the expansion of piping may occur (or shrinkage). Magnitude of this longitudinal change depends on the length of piping, coefficient of linear expansion and the differences in temperature.

## Table for comparison of coefficients of linear expansion



## Linear expansion formula

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

- $\Delta L$  elongation [mm]
- $\alpha$  thermal coefficient of expansion
- $L$  length of pipe during installation [m]
- $\Delta T$  temperature difference when installing and operating temperatures [K]

## Examples

$$\text{PP-R: } \Delta L = 0,15 \cdot 6 \cdot 50 = 45 \text{ mm}$$

- $t_m$  installing temperature 15 °C
- $t_p$  operating temperature hot water 65 °C
- $L$  piping length 6 m
- $\alpha$  0,15 mm/(m.K)
- where  $\Delta t = t_p - t_m$

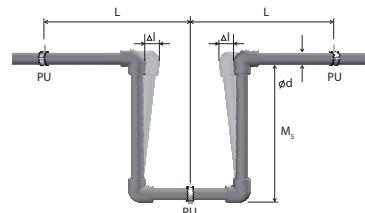
$$\text{CARBO oxy}^{\text{CRP}}: \Delta L = 0,045 \cdot 6 \cdot 50 = 13,5 \text{ mm}$$

- $t_m$  installing temperature 15 °C
- $t_p$  operating temperature hot water 65 °C
- $L$  piping length 6 m
- $\alpha$  0,045 mm/(m.K)

The calculated linear expansion may be compensated by a suitable compensator:

### a) U - compensator

- PU - fixed fit
- L - pipe length
- $\Delta l$  - elongation
- $\emptyset d$  - pipe diameter
- $M_s$  - extension



The length of the flexible arm MS depends on the expansion and the pipe diameter.

$$M_s = k \cdot \sqrt{\Delta l \cdot d}$$

- $k$  material constant (PP-R  $k = 20$ )
- $\Delta l$  elongation (mm)
- $d$  piping diameter (mm)

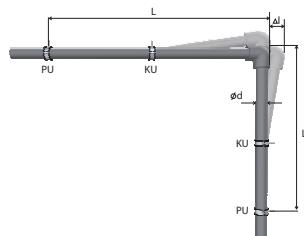
$$M_s = 20 \cdot \sqrt{45 \cdot 32} = 758 \text{ mm}$$

## Conclusion:

If PP-R piping with dimension 32 mm and length 6 meters is heated, it is extended by 45 mm. For the compensation of this expansion, a flexible arm must be used with minimum length 758 mm. Correct function of a compensator is dependant on the suitable location of fixed and sliding fits.

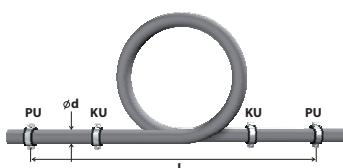
## b) L - compensator

PU - fixed fit  
KU - sliding fit  
L - pipe length  
 $\Delta l$  - elongation  
 $\varnothing d$  - pipe diameter



## c) Dilatation loop

PU - fixed fit  
KU - sliding fit  
L - pipe length  
 $\varnothing d$  - pipe diameter



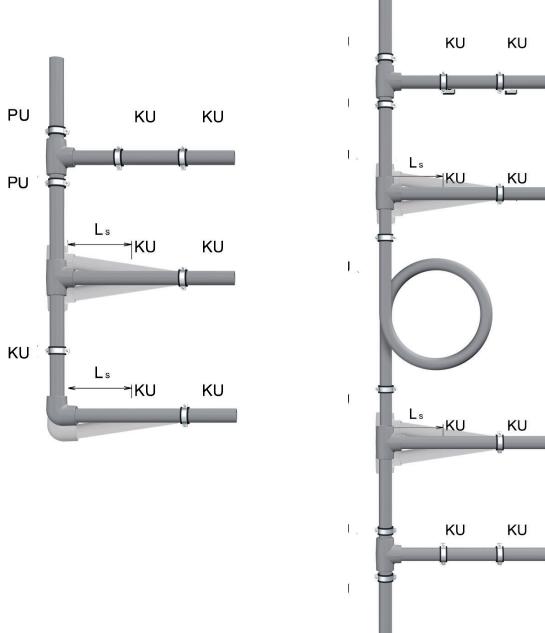
## Table of expansion transferred by the dilatation loop:

d [mm]	max. $\Delta l$ (mm)
20	80
25	70
32	55
40	45

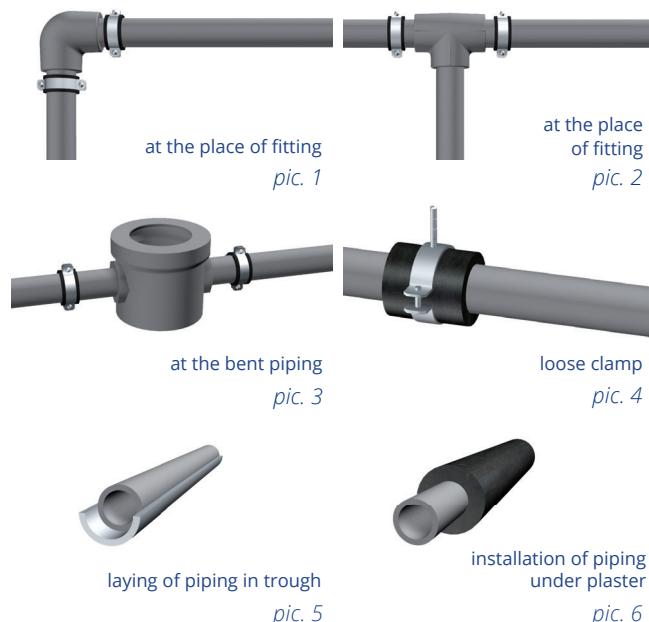
**Fixed fit** - gripping, where the piping cannot dilate. This may be carried out, e.g. at the bent piping (pic. 1), at a branch (pic. 2) or at a place of a fitting or water meter (pic. 3).

**Sliding fit** - method of fixing where the piping cannot move from the mains axis, however it can move and dilate axially inside a loose clamp (pic. 4), laying of piping in a trough (pic. 5) and installation under plaster with use of an insulation (pic. 6).

## Ascending pipe line



**Notice:** The above given compensators may be used either for horizontal or for vertical piping. However in case of installation of plastic pipes under plaster, it is not possible to use these compensators. Linear expansion is in this cases compensated by waving of piping. It is necessary to take in mind the dilation also at the connected mains. In the ascending shafts at branches of connecting piping, it must be assured that this piping can accommodate to the changes in length of the ascending pipe, i.e. that it can dilate sufficiently (see the picture in chapter Ascending piping). Compensation of linear expansion of piping is an important factor for the correct function of plastic mains. If the piping cannot extend and shrink, additional tensile or pressure strains are concentrated in the piping walls which shorten dramatically the piping lifetime.



**Conclusion:** When heating pipe PP-R in the dimension of 32 mm with a length of 6 m there is an expansion pipe of 45 mm. Compensation to this extension must be used flexible arm with a minimum length of 758 mm. Correct function of compensator depends on the proper placement of fixed and sliding fits. The expansion also covers the expansion loop.

# 11. ASSEMBLY AND REPAIRS OF THE SYSTEM

*Installation is based on TNI CEN / TR 12 108. Before installing the necessary control external and within the limits of possibility and the inner surface of the tube. For pressure application can be used only undamaged components can not use tubes with damage exceeding 1/10 of the wall thickness.*

## 11.1. PIPING CONNECTION

- The plastic piping from PP-R and PP-R system INSTAPLAST is connected by welding, it also possible to use mechanical method of connecting with use of flanged connections in specific cases, in transitions to metal piping with threaded transition pieces (DG-transition pieces). The piping cannot be glued.
- The plastic mechanical couplings which may be also used for transitions of various plastic materials; it is necessary to ask the manufacturer to provide the Declaration about suitability of use for cold or hot water and the allowed max. pressures of media.
- Reduction of piping is made strictly by formed pieces determined for this purpose, it is prohibited to modify or change the existing formed pieces with using of any method.
- For the connection and repairs of pipes, it is possible to use welding methods by electroforming, whereas the electro-formed piece must be weldable with the given piping.
- Use of plastic pipes for hot water downwards of a through-flow water heater or the reservoir water heater is possible only at regulated heating systems where the medium temperature does not exceed in a long term 60 °C at max. operation pressure 10,9 bar at tube S2,5 (PN20) and in a short term 70 °C at max. operation pressure 8,3 bar at tube S2,5 (PN20).

### Sealing of threaded transition pieces

- It is prohibited to use hemp with respect to the necessary high tightening torque and the possibility of tearing the metal injection out of the plastic material; at the internal injections, there exists the risk of metal cracking.
- It is allowed to use PTFE tape, special textile tapes (+GF± Paralig) or mastics based on PTFE which must be applied acc. to recommendations and manufacturer's instructions. The used sealing materials must be tested according to valid legislation.

## 11.2. WELDABILITY OF MATERIALS

Weldability of plastic materials is assessed according to the weldability class as determined by the index of melt flow of the respective material - IT (MFR).

**1) Guaranteed weldability:** The materials have the same weldability class and IT are overlapping.

**2) Conditional weldability:** The materials have the same weldability class and IT are not overlapping, whereas the manufacturer guarantees their reciprocal weldability.

**Warning:** The index values of flow which are given in chapter 1.6. are valid for polypropylene material. Other coSPinates of materials (e.g. polypropylene - polyethylene) are basically unweldable. In such cases, it is necessary to use other connecting method.

## 11.3. POLYFUSION WELDING

Similar procedure of preparation and polyfusion welding of pipes of plastic materials is involved in the program of professional training courses for welders organized in compliance with the valid standards, unified methodology of welding of plastic materials and the Technical rules of Czech welding association ANB.

**Course Z - u/7** – basic course for installers by polyfusion welding - 4 days

**Course Z - u/V** – basic course for welding of external and internal distribution systems from plastic materials by various methods, including gluing - 10 days

**Course C - u/V** – a course with certification test

### 11.3.1. TOOLS AND ACCESSORIES

The welding equipment for polyfusion welding is selected acc. to the diameter of welded piping and the character of welding works.

- up to diameter 40 mm (included) - Input 500 W Polys P - 1b
- up to diameter 63 mm (included) - Input 650 W Polys P - 1a, Polys P - 4/650 thorn-Typee

- up to diameter 75 mm (included) - Input 850 W Polys P - 4/850
- up to diameter 110 mm (included) - Input 1200 W Polys P - 4/1200 s

The individual polyfusion welding machines have (acc. to their design) the following options: the continuous analog regulation of temperature, continuous electronic regulation, or by steps by switching over to the required temperature. Also welding machines with one set temperature are manufactured.

**Welding machines and fixtures** are used from diameter 40 mm and higher:

- Fixture MP - 75 from Ø 40 mm to 75 mm (a corresponding welding machine must be used in compliance with the piping diameter used)
- Fixture MP - 110 from Ø 63 to 110 mm (welding machine 850 W and extensions in the fixture set)
- Welding machine ST - 160 from Ø 40 mm to 90 mm (welding machine 1200 W with extensions in the machine accessories -possibility of butt welding up to Ø 160 mm)

**Polyfusion adapters** are used by jaws or divided by type welding equipment, all are coated on the active surface Teflon (PTFE), which prevents the plastic from sticking to the heated melt areas..

**Cutters and cutting equipment for plastic piping** are manufactured in various sizes, acc. to the diameter of piping; cutters with cutting moment divided in to multiplied compression.

**Cleaning paper** for the surfaces on formed pieces and pipe should be without fibres and not coloured (it is possible to use toilet paper). Also special single-use cleaning tissues containing isopropyl alcohol are suitable, which are compressed in sealing foil against drying up.

**Cleaning agent** for pipes and formed pieces used for cleaning of welded surfaces from mechanical or chemical impurities before welding. Cleaning agent Tangit is suitable, or isopropyl alcohol, or 96 % alcohol, respectively. It is not allowed to use for cleaning the petrol based liquids, organic solvents, or cleaning agents containing traces of these chemicals, respectively. Scale, marker and knife - we recommend to use this tools for measuring and marking of length for inserting of pipe in the formed piece, and smoothing of burrs before welding.

## 11.3.2. PRINCIPLE AND PROCEDURE OF POLYFUSION WELDING

A polyfusion weld is created by the simultaneous heating of cone throat of formed piece and the tube end in highly plastic state, and pressing the pipe in the throat of the formed piece in plastic state, fixing and cooling down of the connection, through which a homogeneous connection is created with high stiffness.

In the cold state, the formed piece must not allow sliding on to the pipe of the same dimension. The harder the from piece goes on pipe, the better the resulting connection.

During the welding, it is necessary to maintain, additionally to others, the basic parameters of welding: **Temperature, Pressure, Time**. Maintaining of these parameters will influence the quality and longevity of the weld.

**Temperature of welding:** welding temperature for PP-R and PP-RCT (PP type 3 and 4) 260 °C. Note: *Ambient temperature and tempering of elements - see the chapter Working conditions.*

**Pressure:** conic design of the formed piece and polyfusion exten-

sions will ensure the pressure of heated up materials and complete bonding of macromolecular chains.

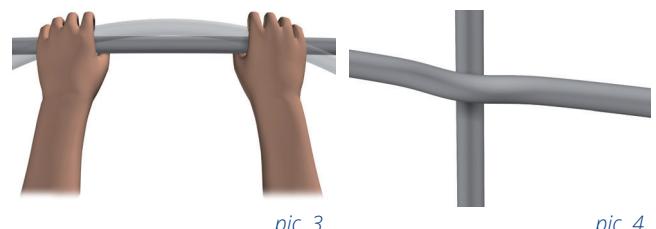
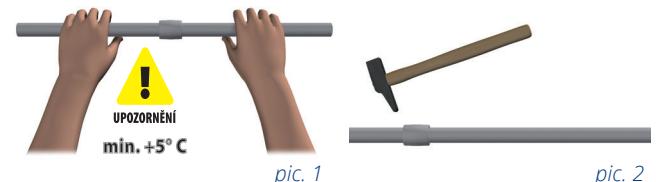
**Time:** time necessary for production of weld, divided in phases as given in the table for the individual diameters.

## 11.3.3. PROCEDURE FOR THE POLYFUSION WELDING

### 1) Generally

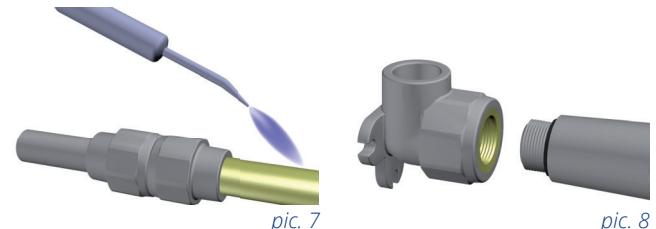
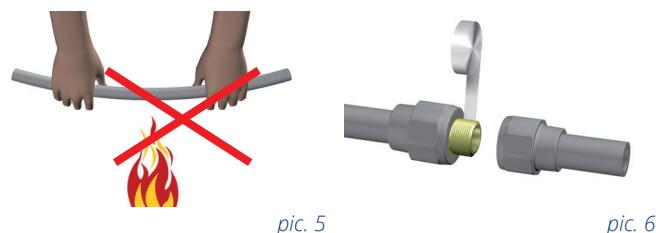
Connecting of plastic parts is done by polyfusion welding, butt welding and welding by electroforming. It is necessary to follow exact procedure and use the suitable tools.

- For the assembly, it is possible to use only elements that are not damaged or polluted.
- Welding of elements PP-R/PP-RCT system INSTAPLAST may be performed at temperature min +5 °C (pic. 1).
- The connected parts should be tempered at least 1 hour before the welding to the same temperature as it is specified in the work procedure.
- During the time of transport, handling and assembly, the system



elements PP-R/PP-RCT system INSTAPLAST should be protected against shocks and other possible mechanical damage (pic. 2).

- Bending of pipes is performed without heating up at temperature min. +15 °C (pic. 3).
- Crossing of pipes is performed with use of special elements (pic. 4) It is not allowed to bend the pipes with use of hot air of open flame!!! (pic. 5).
- Threaded formed pieces are used for threaded connections.



It is not admissible to cut threads directly on pipes!!! Sealing of threads is made by PTFE tape, sealing thread based on PTFE or by special sealing mastics (pic. 6). **It is prohibited to use hemp for sealing of threaded connections!!!**

- In cases where a metal pipe continues behind the formed piece, it is not possible to connect this piece by soldering or welding in the vicinity of the formed piece, with respect to the possible heat transfer in the formed piece!!! (pic. 7)
- During the pressure test, we recommend to use special mounting plastic plugs for closing of branches (wall-mounted structures, wall-mounted assemblies) (pic. 8).

## 2) Preparation

Fix the relevant welding extensions to the welding equipment, set the corresponding temperature by the regulator and plug in. In the heated state, using a cleaning cloth from non-synthetic textile material, clean the active surface from the rests of previous welding. The welding may be started after the welding equipment is heated up sufficiently.

Measure the necessary length of tube and cut it off (pic. 9).



pic. 9

Clean and degrease pipe active surface - throats of formed pieces and tube parts for sliding in the throat.

**WARNING:** The depth for sliding in is given in the table for welding of type A. The depth for sliding in the formed piece does not correspond with the throat depth of formed piece, this should be longer min. by 1 mm.

Welding up to the diameter 40 mm (included) may be performed manually; larger diameters are welded with use of welding fixtures to maintain the axial alignment at the piping, and assurance of required pressures.

## 3) Heating

At first, slide the formed piece on a heated extension and check for proper gripping at the extension. Formed piece which does not have the contact with the extension over the whole surface should be rejected because an uneven heating would cause a weld with poor quality. After the formed piece, slide the the pipe on the extension.

For the tightness of sliding in, the same is valid as for the formed piece (pic. 10, pic. 11).

Heat up both parts during the time specified in the table. The heating time is measured from the time when both, the formed piece



pic. 10



pic. 11

and the pipe, are slid on the welding extension over the whole length. During sliding in, it is allowed to rotate slightly both parts (max. by 10°), before complete sliding over the required length. During the heating up, any rotation with the pipe or the formed piece is not allowed, to avoid any deformations of material.

## Table of welding for PP-R (MRS 8) (with use of DVS 2207, part 1, for temperature 260 °C)

Diameter [mm]	Heating time [sec]	Displacement time [sec]	Time of setting the weld [min]
20	5	3	2
25	7	3	2
32	8	6	4
40	12	6	4
50	18	6	4
63	24	8	6
75	30	8	6
90	40	8	6
110	50	10	8
125	60	10	8

**DO NOT EXTEND THE HEATING TIME!**

## 4) Displacement, connection and cooling down (setting)

After the heating time remove pipe and formed piece from the heating extension and connect them. Slide the pipe by a slow even pressure without rotation in the throat of formed piece up to the measured length of sliding in (pic. 12, 13, 14 and 15). The table contains the maximum allowed time from removing from extension up to the sliding of pipe in the formed piece, i.e. time during which the fresh connection should be completed before it is cooled down partially, and the setting time of welds at the individual diameters.

**WARNING:** after the cooling phase is finished (setting), the equilibrium condition is not achieved in the connection. The connection must be cooled down naturally before the first filling with cold water (permanent mechanical load) within this specified minimum time from the last welding:

- diameters 20, 25 and 32 mm - 60 minutes
- diameters 40, 50, 63 and 75 mm - 90 minutes
- diameters 90, 110 and 125 mm - 120 minutes



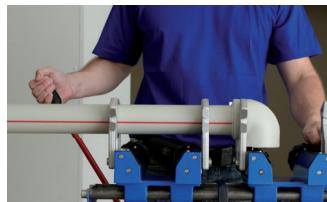
pic. 12



pic. 13



pic. 14



pic. 15

## 11.4. PIPING REPAIRS

When applying plastic materials, it is not possible to avoid damages caused by unprofessional assembly, unqualified performance of welding operations, damages caused by external influence during the lifetime of the mains, e.g. mechanical damage (drilling in, cutting through, piercing etc.), or unexpected change of operation conditions (increase in temperature and/or pressure of media in the distribution system). Due to this facts, a damage of piping can occur, which is manifested by cracking or other destruction of a part of mains. To restore the correct function, it is necessary to carry out professional repair of the distribution system. The scope of repairs depends on the rate of damage. In majority of cases, the damage of mains is of local nature, and because the connection is not demountable, it can be repaired by cutting off of the damaged part and its replacement. Repairs with use of gluing must be excluded for majority of polyolefin materials owing to limited ability for gluing and complexity of technology.

In praxis, the repair is made in the simplest way, i.e. by cutting out and welding on of a new part with use of suitable formed pieces. This method is used the most, but at the same time, it is also time consuming and requires extensive constructional works even by smaller damages. Up to date, the electroformed pieces are used for these kinds of repairs. This method is using basically the plastic formed pieces which have a resistance wire coiled inside and terminated by two contacts determined for the connection to welding machine.

The weld itself is performed inside the connection: pipe - formed piece. This connection has several advantages:

- Only small space is necessary to complete this connection which is decreasing the constructional works to minimum.
- For polypropylene, it is possible to create the connection at temperature up to -10 °C (provided that the manufacturer does not require different temperature range).
- The technology decreases the probability of failure caused by human factor

During the use of electroformed pieces, the differences in comparison to polyfusion welding should be noted. Each worker should be trained in DU/8 course, as the minimum, or should pass the courses ZUV, CUV. A closer explanation is given in the frame procedure of welding which in no case can replace the professional training.

## 11.5. ADDITIONAL INSTALLATION OF THE WELD IN SADDLE

A wide range of weld in saddles allows you to create a branch in diameter 20 - 63 mm or branch with internal and external thread (up to dim 2") for all types of PP-R/PP-RCT pipes of the INSTAPLAST system in diameters 63 - 200 mm.

By installing the saddle, the T-piece can be replaced and subsequently reduced to the required one branch dimension. Welding is polyfusion - type C. For each diameter of the branch pipe is a special welding tool attachment, it is universal for all type flat welders. Welding takes place at a temperature of 260 °C (with permitted tolerance ± 10 °C). Welding tools must be clean and should be cleaned before each welding process.

- 1) Drill a hole with a special drill for a given diameter of pipe and saddle.
- 2) Slide the weld in saddle onto the tool so that they follow each other lines on the seat and extension. Heat the hole and the welding saddle. Time warm-up for saddles: 90 x 32 mm is 8 s, for saddles 110 x 32 and 110 x 40 is 12 s, and for the other saddles 30 seconds.
- 3) Slide the heated saddle into the heated hole and fix for approx. 15 s. After one hour, it can be filled with water and subjected to pressure.

## 11.6. WELDING BY ELECTRO-FORMING

### 1) Preparation of material

- Adjust the pipe length using the cutter or wheel cutter.
- The pipe ends determined for sliding in the formed piece should be scraped, so that the oxidized layer is removed (approx. 0,1 mm). Then the formed piece and pipes are cleaned by cleaning agent.
- Select the piece for electroforming with a suitable diameter and from the identical material as the pipe. The pipe should be inserted easily in the formed piece (otherwise the tube must be scrapped more)..

### 2) Procedure of the welding

- Assemble both connected parts and fix (by special yoke or otherwise), so that the tube is not extruded from the formed piece due to internal stress during welding.
- For the welding process itself, use a suitable welding equipment (e.g. welding equipment DYTRON), and connect it to power source and wait until the required working mode is set. After setting of required parameters connect the adapters to the contacts on the formed piece and start the welding process. Completion of welding is signaled by the control lamp on the welding equipment.
- When the weld is made correctly, the control points are marked on the formed piece.
- The connection must not be stressed mechanically during 60 - 120 min. (depending on the formed piece) from the time of completion of weld.

## 11.7. WORKING CONDITIONS

The working place and working areas must comply with safety regulations. The working spaces must have sufficient lighting, be protected against wind, ideally with a roof against rain and solar radiation, with such manipulation and storage conditions which can prevent any mechanical damage of plastic materials. In winter period, the working place and the structure where the welding procedures of piping routes or the preparation of prefabricates will be performed, should be heated. Welding of elements of PP-R/PP-RCT system INSTAPLAST system (with exception of pieces made by electroforming) may be performed from ambient temperature + 5 °C; for the preparation of prefabricates, it is recommended to warm up the working space to min. + 10 °C. The connected parts should be tempered at least 1 hour before the welding to the same temperature in a heated working space.

#### Composition of working group:

- Installer - welder
- Installer - helper

# 12. PRESSURE TEST

## Leak test record

### Leak test certificate<sup>1)</sup>

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\_\_\_\_\_ date/signature of plumber

<sup>1)</sup>Water heating systems are tested with water to the maximum allowable overpressure specified in the project for the given part of the installation. The system fills with water, properly is vented and the entire equipment (all connections, radiators, fittings, etc.) is inspected without visible leaks. System it will remain fulfil for at least 6 hours, after which a new inspection will be carried out.

**The test is considered to have given a successful result if no leakage occurs during this inspection or if there is no appreciable drop in the level in the expansion tank.**

## Contact

### The assembly company that installed the heating system

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Phone \_\_\_\_\_

Address \_\_\_\_\_

Date of commissioning of the heating system \_\_\_\_\_

## Record of system flushing

## System flush confirmation<sup>1)</sup>

date/signature of plumber

<sup>1)</sup> Flushing is performed with disassembled orifices, water meters, heat meters and other devices where the accumulated dirt could lead to their damage.

## Contact

**The assembly company that installed the heating system**

**Phone** \_\_\_\_\_

Address \_\_\_\_\_

Date of commissioning of the heating system

# 13.

# INSULATION OF PIPING

- Internal water mains must not be installed in areas where the temperature during normal operation decreases under 5 °C, provided that the distribution system is not secured against the influences by temperature decrease (e.g. by insulation).
- Piping of cold water (installed loosely, laid in grooves in installation channels etc.) must be secured against condensation of moisture.
- Piping for cold water installed loosely in warm or heated environment, and installed in parallel with the heating system or the system of hot circulation water, must be protected against warming up and propagation of undesirable germs.
- Piping of hot water and circulation piping with forced circulation of water must be thermally insulated because of the thermal losses and linear expansion, in compliance with the requirements of valid standards.
- It is possible to use various materials for the insulation, e.g. foam, expanded polystyrene, mineral wool, or the insulation based on foam PE, PP or PUR, respectively. Minimum thickness of insulating layer is 5 mm for cold water. The minimum thickness of insulation layer for hot water is intended by Czech notice 193/2007. It depends on pipe diameter, wall thickness, insulation material and determining the heat transfer coefficient.
- Insulation pipes must be installed with pre-tension according to the instructions by the manufacturer because it is necessary to take in mind the natural shrinkage at the expanded materials - in longitudinal direction.

**Determining the heat transfer coefficient insulated pipeline interior wiring  $U_0$  ≤ minimum requirement for thermal heat transfer coefficient per unit length  $U$**

Diameter d [mm]	U W/(m.K)
DN 10 - DN 15	0,15
DN 20 - DN 32	0,18
DN 40 - DN 65	0,27
DN 80 - DN 125	0,34
DN 150 - DN 200	0,40

**E.g. for pressure range of PN 20 is the minimum insulation thickness internal distribution in mm:**

Diameter d [mm]	Stone wool (Thermal Conductivity $\lambda_{iz} = 0,041 \text{ W}/(\text{m.K})$ )	Mineral wool (Thermal Conductivity $\lambda_{iz} = 0,038 \text{ W}/(\text{m.K})$ )
16	30	18
20	25	22
25	32	28
32	42	37
40	25	22
50	32	28
63	40	36
75	35	30
90	40	36
110	50	45
125	61	55
160	63	57
200	80	73

# 14.

# PRODUCTS

## 14.1. CARBO oxy<sup>CRP</sup> PIPES

CARBO oxy<sup>CRP</sup> HEAT/COOL

d [mm]	S	T [mm]	Type	Code	SP	LP	kg/m
20	3,2	2,8	HEAT/COOL	3296450002	4	100	0,145
25	3,2	3,5	HEAT/COOL	3296451002	4	100	0,226
32	3,2	4,4	HEAT/COOL	3296451006	4	40	0,364



Pipes are available in rods 4 m length with red stripe.

CARBO oxy<sup>CRP</sup> HEAT

d [mm]	S	T [mm]	Type	Code	SP	LP	kg/m
40	4	4,5	HEAT	3296452002	4	40	0,466
50	4	5,6	HEAT	3296452006	4	16	0,736
63	4	7,1	HEAT	3296453002	4	8	1,176
75	4	8,4	HEAT	3296453006	4	8	1,654
90	4	10,1	HEAT	3296453010	4	4	2,386
110	4	12,3	HEAT	3296454002	4	4	3,548
GR 125	4	14,0	HEAT	3296454007	4	4	4,624



Pipes are available in rods 4 m length with red stripe.

GR – green color

CARBO oxy<sup>CRP</sup> COOL

d [mm]	S	T [mm]	Type	Code	SP	LP	kg/m
40	5	3,7	COOL	3296452009	4	40	0,398
50	5	4,6	COOL	3296452010	4	16	0,621
63	5	5,8	COOL	3296453013	4	8	0,977
75	5	6,8	COOL	3296453014	4	8	1,338
90	5	8,2	COOL	3296453015	4	4	1,958
110	5	10,0	COOL	3296454011	4	4	2,916
GR 125	5	11,4	COOL	3296454014	4	4	3,764



Pipes are available in rods 4 m length with blue stripe.

GR – green color

## 14.2. FITTINGS

Elbow 45°

	d [mm]	d1 [mm]	B [mm]	Z1 [mm]			Code	SP	LP	kg/pcs
GR	16	15,5	18,0	13,3			3297440203	50	200	0,008
GR	20	19,5	18,7	14,5			3297440210	50	500	0,019
GR	25	24,5	21,2	16,0			3297441205	50	300	0,023
GR	32	31,5	39,0	18,1			3297441214	20	100	0,036
GR	40	39,4	38,0	20,5			3297442203	5	25	0,060
GR	50	49,4	46,0	23,5			3297442210	5	20	0,101
GR	63	62,5	50,0	27,4			3297443203	5	20	0,208
GR	75	74,9	48,5	31,0			3297443210	2	8	0,402
GR	90	89,9	56,2	35,5			3297443216	1	6	0,685
GR	110	110,0	66,3	41,5			3297444202	1	5	1,025
GR	125	125,0	77,0	40,0			3295414201	1	1	1,410
GR	160	160,0		BUTT WELDED			3295414202	1	1	2,420
GR	200	200,0		BUTT WELDED			3295414005	1	1	4,400

GR – green color

Elbow 90°

	d [mm]	d1 [mm]	B [mm]	Z1 [mm]			Code	SP	LP	kg/pcs
GR	16	15,5	22,5	13,3			3297440204	50	250	0,008
GR	20	19,5	28,0	14,5			3297440211	50	400	0,015
GR	25	24,5	29,9	16,0			3297441206	50	300	0,028
GR	32	31,5	40,0	18,1			3297441215	20	100	0,050
GR	40	39,4	40,0	20,5			3297442204	10	70	0,084
GR	50	49,4	48,0	23,5			3297442211	10	40	0,141
GR	63	62,5	58,7	27,4			3297443204	5	20	0,258
GR	75	74,9	70,5	31,0			3297443211	2	6	0,455
GR	90	89,9	81,5	35,5			3297444217	1	4	0,788
GR	110	110,0	98,1	41,5			3297444203	1	4	1,376
GR	125	125,0	124,0	40,0			3295414203	1	1	2,056
GR	160	160,0		BUTT WELDED			3295414204	1	1	2,940
GR	200	200,0		BUTT WELDED			3295414205	1	1	5,610

GR – green color

Elbow 45° pin

	d [mm]	d1 [mm]	B [mm]	Z1 [mm]	D2 [mm]		Code	SP	LP	kg/pcs
	20	19,5	18,7	14,5	20,0		3297440213	20	200	0,011
	25	24,5	21,2	16,0	25,0		3297441219	20	200	0,019

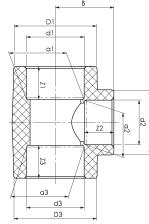
Elbow 90° pin

	d [mm]	d1 [mm]	B [mm]	Z1 [mm]	D2 [mm]	Z2 [mm]	Code	SP	LP	kg/pcs
	20	19,5	23,5	14,5	20,0	14,0	3297440212	50	300	0,014
	25	24,5	32,5	16,0	25,0	16,0	3297441207	50	250	0,026
	32	31,5	34,0	18,1	32,0	18,1	3297441220	20	100	0,057

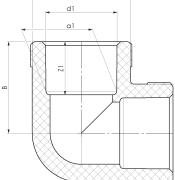
T-piece

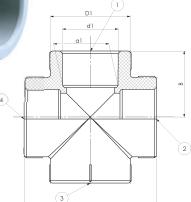
	d [mm]	d1 [mm]	B [mm]	Z1 [mm]	L [mm]		Code	SP	LP	kg/pcs
GR	16	15,5	22,0	13,3	44,0		3297440303	50	250	0,012
GR	20	19,5	26,0	14,5	54,0		3297440312	50	300	0,021
GR	25	24,5	27,0	16,0	65,0		3297441310	50	150	0,035
GR	32	31,5	36,0	18,1	78,0		3297441330	20	100	0,063
GR	40	39,4	42,0	20,5	94,0		3297442305	10	50	0,114
GR	50	49,4	50,0	23,5	114,0		3297442322	5	30	0,200
GR	63	62,5	70,0	27,4	140,0		3297443304	2	16	0,448
GR	75	74,9	70,0	31,0	142,0		3297443314	1	6	0,527
GR	90	89,9	81,3	35,5	162,6		3297443319	1	6	0,940
GR	110	110,0	97,5	41,5	195,0		3297444301	1	4	1,590
GR	125	125,0	124,0	41,5	248		3295414301	1	1	2,510
GR	160	160,0		BUTT WELDED			3295414302	1	1	4,060
GR	200	200,0		BUTT WELDED			3295414303	1	1	7,300

GR – green color

Reducing T-piece	d [mm]	d1 [mm]	d2 [mm]	Z1 [mm]	Z2 [mm]	B [mm]	L [mm]	Code	SP	LP	kg/pcs
	<b>20x16x20</b>	19,5	15,5	14,5	13,3	26,0	54,0	3297440313	50	300	0,026
	<b>20x25x20</b>	19,5	24,5	14,5	16,0	27,0	64,0	3297440314	50	150	0,033
	<b>25x20x25</b>	24,5	19,5	16,0	14,5	33,0	60,0	3297441311	50	200	0,036
	<b>25x25x20</b>	24,5	24,5	16,0	16,0	27,0	64,0	3297441312	50	150	0,038
	<b>25x32x25</b>	24,5	31,5	16,0	18,1	36,0	76,0	3297441313	20	120	0,049
	<b>25x20x20</b>	24,5	19,5	16,0	14,5	30,0	60,0	3297441314	20	100	0,035
	<b>32x20x32</b>	31,5	19,5	18,1	14,5	32,0	69,0	3297441331	20	100	0,045
	<b>32x20x25</b>	31,5	19,5	18,1	14,5	32,0	69,0	3297441332	20	100	0,047
	<b>32x25x32</b>	31,5	24,5	18,1	16,0	33,0	70,0	3297441333	20	100	0,049
	<b>32x32x25</b>	31,5	31,5	18,1	18,1	39,0	77,0	3297441334	20	100	0,061
	<b>32x40x32</b>	31,5	39,4	18,1	20,5	44,5	89,0	3297441335	10	50	0,081
	<b>40x20x40</b>	39,4	19,5	20,5	14,5	36,0	78,0	3297442306	10	60	0,083
	<b>40x25x40</b>	39,4	24,5	20,5	16,0	37,5	81,0	3297442307	10	60	0,104
	<b>40x32x40</b>	39,4	31,5	20,5	18,1	43,5	90,0	3297442308	10	50	0,103
	<b>50x25x50</b>	49,4	24,5	23,5	16,0	40,5	80,0	3297442323	5	30	0,142
	<b>50x32x50</b>	49,4	31,5	23,5	18,1	42,5	80,0	3297442324	5	30	0,146
	<b>50x40x50</b>	49,4	39,4	23,5	20,5	57,5	114,0	3297442325	5	15	0,223
	<b>63x32x63</b>	62,5	31,5	27,4	18,1	52,0	92,0	3297443306	5	20	0,259
	<b>63x40x63</b>	62,5	39,4	27,4	20,5	53,0	92,0	3297443305	5	20	0,260
	<b>63x50x63</b>	62,5	49,4	27,4	23,5	66,5	140,0	3297443307	5	16	0,414
	<b>75x50x75</b>	74,9	49,4	31,0	23,5	70,5	142,0	3297443315	2	12	0,496
	<b>75x63x75</b>	74,9	62,5	31,0	27,4	70,0	142,0	3297443316	2	8	0,531
	<b>90x63x90</b>	89,9	62,5	35,5	27,4	73,3	136,0	3297443320	2	6	0,727
	<b>90x75x90</b>	89,9	74,9	35,5	31,0	76,8	148,0	3297443321	2	6	0,805
	<b>110x63x110</b>	110,0	62,5	41,5	27,4	83,0	148,0	3297444302	1	5	1,076
	<b>110x75x110</b>	110,0	74,9	41,5	31,0	86,6	160,0	3297444303	1	4	1,170
	<b>110x90x110</b>	110,0	89,9	41,5	35,5	91,2	175,0	3297444304	1	4	1,270
GR	<b>125x75x125</b>	124,5	74,5		40,0	30,0	248,0	3295414304	1	1	2,320
GR	<b>125x90x125</b>	124,5	74,5		40,0	35,0	248,0	3295414305	1	1	2,330
GR	<b>125x110x125</b>	124,5	74,5		40,0	40,0	248,0	3295414306	1	1	2,400
GR	<b>160x90x160</b>						BUTT WELDED	3295414307	1	1	3,520
GR	<b>160x110x160</b>						BUTT WELDED	3295414308	1	1	3,650
GR	<b>200x90x200</b>						BUTT WELDED	3295414319	1	1	6,170
GR	<b>200x110x200</b>						BUTT WELDED	3295414320	1	1	6,280
GR	<b>200x125x200</b>						BUTT WELDED	3295414321	1	1	6,370
GR	<b>200x160x200</b>						BUTT WELDED	3295414322	1	1	6,700

GR – green color

Three way branch	d [mm]	d1 [mm]	Z1 [mm]	B [mm]				Code	SP	LP	kg/pcs
	<b>20x20x20</b>	19,5	14,5	25,0				3297440311	10	50	0,030
											

Cross	d [mm]	d1 [mm]	L [mm]	B [mm]				Code	SP	LP	kg/pcs
	<b>20</b>	19,5	51,0	25,5				3297440315	25	100	0,022
	<b>25</b>	24,5	58,0	29,0				3297441315	25	100	0,037
	<b>32</b>	31,5	69,0	34,5				3297441336	10	50	0,064
	<b>40/25</b>	39,4	67,0	33,5				3297442309	10	50	0,075

Pipe coupling	d [mm]	d1 [mm]	Z1 [mm]	L [mm]			Code	SP	LP	kg/pcs
GR	<b>16</b>	15,5	13,3	28,0			3297440402	50	250	0,006
	<b>20</b>	19,5	14,5	30,0			3297440407	50	600	0,011
	<b>25</b>	24,5	16,0	40,0			3297441406	50	400	0,019
	<b>32</b>	31,5	18,1	46,0			3297441420	20	200	0,024
	<b>40</b>	39,4	20,5	53,5			3297442406	20	100	0,053
	<b>50</b>	49,4	23,5	62,0			3297442419	10	70	0,095
	<b>63</b>	62,5	27,4	62,0			3297443405	5	30	0,120
	<b>75</b>	74,9	31,0	71,5			3297443417	1	30	0,260
	<b>90</b>	89,9	35,5	76,0			3297443424	1	16	0,436
	<b>110</b>	110,0	41,5	90,0			3297444402	1	10	0,614
	<b>125</b>	125,0	40,0	90,0			3295414414	1	1	0,76

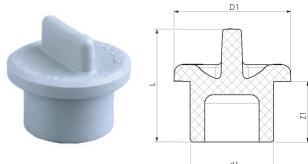
GR - green color

Reducing pipe coupling	d [mm]	d1 [mm]	d2 [mm]	Z1 [mm]	Z2 [mm]	L [mm]	Code	SP	LP	kg/pcs
	<b>20/16</b>	19,5	15,5	14,5	13,3	30,0	3297440409	50	200	0,010
	<b>25/20</b>	24,5	19,5	16,0	14,5	32,0	3297441408	50	450	0,012
	<b>32/20</b>	31,5	19,5	18,1	14,5	39,0	3297441424	50	250	0,025
	<b>32/25</b>	31,5	24,5	18,1	16,0	35,0	3297441423	50	250	0,017
	<b>40/32</b>	39,4	31,5	20,5	18,1	40,0	3297442410	10	100	0,031
	<b>50/40</b>	49,4	39,4	23,5	20,5	46,0	3297442422	10	100	0,054

Reduction	d [mm]	d1 [mm]	d2 [mm]	Z1 [mm]	Z2 [mm]	L [mm]	Code	SP	LP	kg/pcs
GR	<b>20/16</b>	20,0	15,5	32,0	13,3	32,0	3297440408	50	250	0,006
	<b>25/20</b>	25,0	19,5	16,5	14,5	32,0	3297441407	50	500	0,010
	<b>32/20</b>	32,0	19,5	18,0	14,5	32,5	3297441421	50	250	0,017
	<b>32/25</b>	32,0	24,5	18,0	16,0	38,0	3297441422	50	300	0,020
	<b>40/20</b>	40,0	19,5	20,5	14,5	34,0	3297442407	10	100	0,018
	<b>40/25</b>	40,0	24,5	20,5	16,0	35,5	3297442408	10	100	0,019
	<b>40/32</b>	40,0	31,5	18,5	18,1	39,0	3297442409	20	100	0,021
	<b>50/32</b>	50,0	31,5	29,5	18,1	62,0	3297442420	10	100	0,044
	<b>50/40</b>	50,0	39,4	29,5	20,5	66,0	3297442421	10	100	0,054
	<b>63/32</b>	63,0	31,5	35,0	18,1	75,5	3297443406	10	70	0,093
	<b>63/40</b>	63,0	39,4	28,5	20,5	65,0	3297443407	10	60	0,083
	<b>63/50</b>	63,0	49,4	28,0	23,5	62,5	3297443408	10	70	0,093
	<b>75/50</b>	75,0	49,4	30,0	23,5	57,5	3297443419	2	20	0,121
	<b>75/63</b>	75,0	62,5	30,0	27,4	65,0	3297443418	1	25	0,178
	<b>90/63</b>	90,0	63,0	33,4	27,5	64,5	3295413401	1	1	0,210
	<b>90/75</b>	90,0	75,0	34,0	30,0	78,0	3295413402	1	1	0,270
	<b>110/75</b>	110,0	75,0	39,4	30,0	60,0	3295413403	1	1	0,480
	<b>110/90</b>	110,0	80,0	39,4	30,0	87,0	3295414411	1	1	0,500
	<b>125/110</b>	125,0		BUTT WELDED			3295414402	1	1	1,050
	<b>160/110</b>	160,0		BUTT WELDED			3295414403	1	1	1,150
	<b>160/125</b>	160,0		BUTT WELDED			3295414404	1	1	1,160
	<b>200/110</b>	200,0		BUTT WELDED			3295414417	1	1	1,100
	<b>200/160</b>	200,0		BUTT WELDED			3295414418	1	1	2,610

GR - green color

Plug	d [mm]	L [mm]	H [mm]			Code	SP	LP	kg/pcs
	<b>16</b>	13,0	25,0			3297440604	50	200	0,003
	<b>20</b>	14,5	29,0			3297440612	50	250	0,006
	<b>25</b>	16,0	31,0			3297441606	50	200	0,009
	<b>32</b>	23,0	36,5			3297441613	10	100	0,013



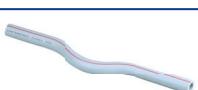
Blinder	d [mm]	d1 [mm]	Z1 [mm]	L [mm]		Code	SP	LP	kg/pcs
	<b>16</b>	15,5	13,3	16,0		3297440603	50	400	0,004
	<b>20</b>	19,5	14,5	24,0		3297440611	50	200	0,006
	<b>25</b>	24,5	16,0	25,0		3297441605	50	200	0,011
	<b>32</b>	31,5	18,1	26,2		3297441612	10	100	0,016
	<b>40</b>	39,4	20,5	30,8		3297442603	5	50	0,040
	<b>50</b>	49,4	23,5	35,4		3297442607	5	30	0,074
	<b>63</b>	62,5	27,4	44,0		3297443602	5	25	0,150
	<b>75</b>	74,9	31,0	58,2		3297443605	5	20	0,254
	<b>90</b>	89,9	35,5	66,0		3297443606	2	6	0,364
	<b>110</b>	110,0	41,5	79,0		3297444601	2	8	0,602
	<b>125</b>	125,0	40,0	87,0		3295414601	1	1	0,790
	<b>160</b>	160,0	BUTT WELDED			3295414602	1	1	0,890
	<b>200</b>	200,0	BUTT WELDED			3295414419	1	1	2,040

GR - green color

Plug with thread	Colour	Type	Z [mm]	L [mm]	Code	SP	LP	kg/pcs	
	CW	blue	1/2"	17,5	24,0	3297440613	50	250	0,006
		red	1/2"	17,5	24,0	3297440614	50	250	0,006
		grey	1/2"	17,5	24,0	3297440615	50	250	0,006
		grey	3/4"	18,0	24,0	3297441607	50	500	0,009

Plug for template with seal	Colour	Type	Z [mm]	L [mm]	Code	SP	LP	kg/pcs	
	CW	blue	1/2"	12,0	70,0	3297440617	10	250	0,020
		red	1/2"	12,0	70,0	3297440618	10	250	0,020
		grey	1/2"	12,0	70,0	3297440616	10	250	0,020

Dilatation loop	Type	d1 [mm]	L [mm]	d3 [mm]		Code	SP	LP	kg/pcs
	<b>20</b>	20,0	185,0	480,0		3295440208	1	100	0,181
	<b>25</b>	25,0	205,0	490,0		3295441206	1	80	0,280
	<b>32</b>	32,0	210,0	450,0		3295441212	1	60	0,478
	<b>40</b>	40,0	235,0	510,0		3295442202	1	40	0,738

Shifter	Type	d [mm]	L [mm]	H [mm]		Code	SP	LP	kg/pcs
	<b>20</b>	20,0	45,0	400,0		3295440207	10	50	0,069
	<b>25</b>	25,0	50,0	400,0		3295441205	10	50	0,106
	<b>32</b>	32,0	70,0	400,0		3295441211	5	20	0,173

Socket crossing	Type	d [mm]	L [mm]	B [mm]	B1 [mm]	Code	SP	LP	kg/pcs
	<b>20</b>	20,0	184,0	53,0	31,5	3297440327	10	50	0,040
	<b>25</b>	25,0	184,0	60,0	32,5	3297440328	10	50	0,060

DG coupling MZV (male)	Type	d1 [mm]	Z1 [mm]	L [mm]	Code	SP	LP	kg/pcs
GR	16x3/8"	15,5	13,3	29,5	3297450703	10	50	0,050
	16x1/2"	15,5	13,3	34,0	3297450704	10	50	0,063
	20x3/8"	19,5	14,5	32,5	3297450716	10	100	0,052
	20x1/2"	19,5	14,5	37,5	3297450714	10	150	0,065
	20x3/4"	19,5	14,5	41,0	3297450715	10	100	0,113
	25x1/2"	24,5	16,0	35,0	3297451710	10	50	0,069
	25x3/4"	24,5	16,0	42,5	3297451711	10	100	0,115
	32x3/4"	31,5	18,1	45,0	3297451729	5	50	0,129
	32x1"	31,5	18,1	45,0	3297451730	5	60	0,145
	40x5/4"	39,4	20,5	52,0	3297452702	4	40	0,365
	50x6/4"	49,4	23,5	55,0	3297452704	5	20	0,521
	63x2"	62,5	27,4	71,0	3297453702	2	14	0,750
	75x2 1/2"	74,9	31,0	80,0	3297453705	1	9	1,288
	90x3"	89,9	35,5	86,5	3297453707	1	6	1,715
	110x4"	108,9	40,0	161,0	3295414701	1	1	2,922
	125x5"	123,8	40,0	170,0	3295414702	1	1	4,380

GR - green color

DG coupling MZD (female)	Type	d1 [mm]	Z1 [mm]	L [mm]	Code	SP	LP	kg/pcs
GR	16x3/8"	15,5	13,3	30,0	3297450804	10	100	0,034
	16x1/2"	15,5	13,3	33,0	3297450824	10	50	0,050
	20x3/8"	19,5	14,5	32,5	3297450822	10	100	0,041
	20x1/2"	19,5	14,5	37,5	3297450823	10	200	0,042
	20x3/4"	19,5	14,5	41,0	3297451812	10	100	0,058
	25x1/2"	24,5	16,0	40,0	3297451813	10	50	0,043
	25x3/4"	24,5	16,0	42,5	3297451832	10	100	0,058
	32x3/4"	31,5	18,1	45,0	3297451833	5	40	0,075
	32x1"	31,5	18,1	45,0	3297452802	5	60	0,125
	40x5/4"	39,4	20,5	53,0	3297452805	4	40	0,359
	50x6/4"	49,4	23,5	69,0	3297453802	5	20	0,414
	63x2"	62,5	27,4	92,0	3297453804	2	14	0,662
	75x2 1/2"	74,9	31,0	106,0	3297453805	2	8	1,075
	90x3"	89,9	35,5	99,5	580414.01	1	6	1,623
	110x4"	108,9	40,0	121,0	3295414801	1	1	2,270
	125x5"	123,8	40,0	125,0	3295414703	1	1	3,510

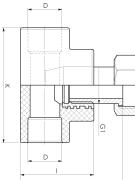
GR - green color

DG coupling with PM	Type	d [mm]	I [mm]	J [mm]	Code	SP	LP	kg/pcs
GR	16x1/2"	16,0	31,0	44,0	3295440804	10	100	0,085
	16x3/4"	16,0	33,5	49,0	3295440819	10	100	0,115
	20x1/2"	20,0	32,0	45,0	3295440817	10	100	0,097
	20x3/4"	20,0	40,0	60,0	3295440818	10	100	0,091
	20x1"	20,0	42,0	58,0	3295441809	10	50	0,173
	25x3/4"	25,0	40,5	53,5	3295441808	10	50	0,095
	25x1"	25,0	42,0	57,0	3295441823	10	40	0,168
	32x1"	32,0	45,0	60,0	3295441822	5	50	0,185
	32x5/4"	32,0	45,5	63,0	3295442802	5	50	0,292
	40x6/4"	40,0	63,0	84,0	580608.01	2	16	0,512

Elbow 90° MZV (male)	Type	d1 [mm]	Z1 [mm]	B [mm]	Code	SP	LP	kg/pcs
GR	16x1/2"	15,5	13,3	29,0	3297450705	10	100	0,064
	20x1/2"	19,5	14,5	30,0	3297450717	10	150	0,080
	20x3/4"	24,5	16,0	33,0	3297450718	10	50	0,126
	25x1/2"	19,5	14,5	35,0	3297451712	10	50	0,082
	25x3/4"	24,5	16,0	37,5	3297451713	10	100	0,129
	32x3/4"	31,5	18,1	41,5	3297451731	10	50	0,153
	32x1"	31,5	18,1	41,0	3297451732	5	50	0,145

Elbow 90° MZD (female)	Type	d1 [mm]	Z1 [mm]	B [mm]		Code	SP	LP	kg/pcs
	16x1/2"	15,5	13,3	28,5		3297450803	10	100	0,054
	20x1/2"	19,5	14,5	30,0		3297450817	10	150	0,064
	20x3/4"	19,5	14,5	30,0		3297450818	10	50	0,066
	25x1/2"	24,5	16,0	33,5		3297451808	10	50	0,065
	25x3/4"	24,5	16,0	32,0		3297451809	10	100	0,068
	32x3/4"	31,5	18,1	36,0		3297451827	5	50	0,073
	32x1"	31,5	18,1	41,0		3297451828	5	50	0,130
Elbow 90° MZD pin (female)	Type	d1 [mm]	Z1 [mm]	B1 [mm]	B2 [mm]	Code	SP	LP	kg/pcs
	20x1/2"	20,0	14,0	25,0	42,0	3297450816	10	100	0,060
Elbow 90° MZD with PM	Type	d [mm]	I [mm]	J [mm]		Code	SP	LP	kg/pcs
	16x3/4"	16,0	41,0	54,0		3295440805	10	100	0,115
	20x3/4"	20,0	48,0	63,0		3295440820	10	50	0,119
	20x1"	20,0	45,0	64,0		3295440821	10	50	0,168
	25x3/4"	25,0	51,0	65,0		3295441811	10	50	0,134
	32x1"	32,0	57,0	76,0		3295441825	5	50	0,179
	32x5/4"	32,0	61,0	83,0		3295441824	5	30	0,266
Wall piece MZD (female)	Type	B [mm]	B1 [mm]	Z1 [mm]		Code	SP	LP	kg/pcs
	16x3/8"	26,0	24,5	13,3		3297450601	10	50	0,047
	16x1/2"	26,0	24,5	13,3		3297450602	10	50	0,056
	20x1/2"	26,0	32,0	14,5		3297450610	10	150	0,069
	25x1/2"	26,5	32,0	16,0		3297451605	10	50	0,073
	25x3/4"	35,0	32,0	16,0		3297451606	10	100	0,084
Fixing plate for wall elbows	L(mm)	L1 (mm)	L2(mm)	Z(mm)	H2(mm)	Code	SP	LP	kg/pcs
	240,0	150,0	100,0	44,0	9,2	3297470006	5	100	0,047
Suitable for fixing wall elbows 20x1/2" and 25x1/2"									
Set - Fixing plate and wall elbows	Type	Item				Code	SP	BP	kg/set
	20x1/2"	2x wall elbows MZD + 1x fixing plate				3295440605	1	20	0,185
	25x1/2"	2x wall elbows MZD + 1x fixing plate				3295441603	1	20	0,193
Wall piece MZD for plaster	Type	B [mm]	B1 [mm]	Z1 [mm]		Code	SP	LP	kg/pcs
	20x1/2"	27,0	41,0	32,0		3295440601	2	20	0,0959

<b>Terminal wall piece MZD (female) right, left</b>	Type	d [mm]	Z1 [mm]	B [mm]		Code	SP	LP	kg/pcs
	<b>20x1/2" P</b>	29,0	34,0	14,5		3297450612	10	100	0,078
	<b>20x1/2" L</b>	29,0	34,0	14,5		3297450613	10	100	0,078
<b>Wall piece MZD pin (female)</b>	Type	d [mm]	B1 [mm]	B [mm]		Code	SP	LP	kg/pcs
	<b>20x1/2"</b>	28,0	34,0	14,5		3297450616	10	150	0,071
<b>Partition wall piece MZD (female)</b>	Type	d1 [mm]	Z1 [mm]	B1 [mm]		Code	SP	LP	kg/pcs
	<b>20x1/2"</b>	28,0	34,0	14,5		3297450615	10	100	0,065
<b>Through wall piece MZD (female)</b>	Type	d1 [mm]	t [mm]	B [mm]		Code	SP	LP	kg/pcs
	<b>20x1/2"</b>	19,5	68,0	35,0		3297450611	10	100	0,067
	<b>25x1/2"</b>	24,5	78,0	36,5		3297451604	5	50	0,085
<b>Wall set MZD (female)</b>	Type	d1 [mm]	Z1 [mm]	L1 [mm]	L [mm]	Code	SP	LP	kg/pcs
	<b>20x1/2"</b>	27,0	14,5	151,5	226,5	3297450614	1	10	0,192
<b>T-piece MZV (male)</b>	Type	d1 [mm]	Z1 [mm]	B [mm]	L [mm]	Code	SP	LP	kg/pcs
	<b>20x1/2"</b>	19,5	14,5	30,5	65,0	3297450713	10	100	0,084
	<b>25x1/2"</b>	24,5	16,0	32,5	68,0	3297451708	10	100	0,090
	<b>25x3/4"</b>	24,5	16,0	35,5	80,0	3297451709	5	20	0,148
	<b>32x1/2"</b>	31,5	18,1	36,0	68,0	3297451728	5	20	0,094
<b>T-piece MZD (female)</b>	Type	d1 [mm]	Z1 [mm]	B [mm]	L [mm]	Code	SP	LP	kg/pcs
	<b>20x1/2"</b>	19,5	14,5	30,0	66,0	3297450819	10	120	0,072
	<b>20x3/4"</b>	19,5	14,5	32,0	74,0	3297450820	5	30	0,084
	<b>25x1/2"</b>	24,5	16,0	32,5	76,0	3297451810	5	100	0,075
	<b>25x3/4"</b>	24,5	16,0	35,0	81,0	3297451811	5	25	0,100
	<b>32x1/2"</b>	31,5	18,1	38,0	68,0	3297451829	5	25	0,091
	<b>32x3/4"</b>	31,5	18,1	33,0	80,0	3297451830	5	25	0,100
	<b>32x1"</b>	31,5	18,1	38,0	86,0	3297451831	5	20	0,135

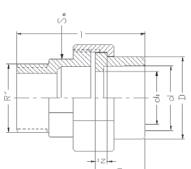
T-piece with PM	Type	d [mm]	J [mm]	K [mm]		Code	SP	LP	kg/pcs	
		<b>20x3/4"</b>	20,0	61,0	66,0		3295440815	10	100	0,141
		<b>20x1"</b>	20,0	67,0	74,0		3295440816	5	50	0,198
		<b>25x3/4"</b>	25,0	66,0	75,0		3295441806	5	50	0,141
		<b>25x1"</b>	25,0	69,0	80,0		3295441807	5	50	0,202
		<b>32x3/4"</b>	32,0	73,0	68,0		3295441819	5	40	0,157
		<b>32x1"</b>	32,0	71,0	79,0		3295441820	5	30	0,207
		<b>32x5/4"</b>	32,0	78,0	85,0		3295441821	5	25	0,290

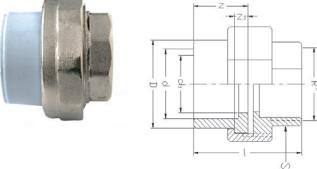
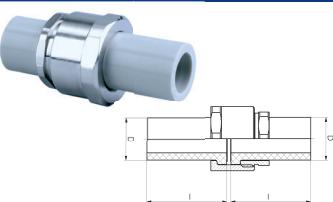
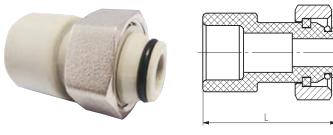
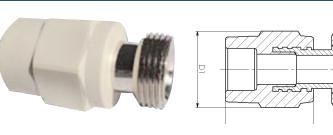
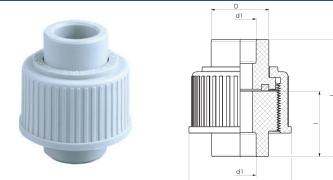
Elbow 90°BJ with PM	Type	d [mm]	J [mm]	K [mm]	Code	SP	LP	kg/pcs	
	<b>CW</b>	<b>16x1/2"</b>	16,0	34,0	57,0	3295440901	10	150	0,032
		<b>20x1/2"</b>	20,0	40,0	60,0	3295440908	10	100	0,048
		<b>20x3/4"</b>	20,0	40,0	60,0	3295440909	10	100	0,055
		<b>25x3/4"</b>	25,0	48,0	68,0	3295441904	10	100	0,060
		<b>25x1"</b>	25,0	48,0	70,0	3295441905	10	50	0,074

T-piece BJ with PM	Type	d [mm]	J [mm]	K [mm]	Code	SP	LP	kg/pcs	
	<b>CW</b>	<b>16x1/2"</b>	16,0	58,0	44,0	3295440902	10	40	0,006
		<b>16x3/4"</b>	16,0	59,0	46,0	590602.01	5	50	0,011
		<b>20x1/2"</b>	20,0	64,0	55,0	3295440910	10	40	0,019
		<b>20x3/4"</b>	20,0	62,0	52,0	3295440911	5	50	0,024
		<b>20x1"</b>	20,0	67,0	65,0	3295440912	5	50	0,053
		<b>25x3/4"</b>	25,0	73,0	60,0	3295441906	5	50	0,095
		<b>25x1"</b>	25,0	69,0	59,0	3295441907	5	25	0,120
		<b>32x3/4"</b>	32,0	77,0	59,0	3295441909	5	25	0,436
		<b>32x1"</b>	32,0	77,0	70,0	3295441910	5	25	0,614

DG coupling BJ with PM	Type	d [mm]	I [mm]	J [mm]	Code	SP	LP	kg/pcs	
	<b>CW</b>	<b>20x1/2"</b>	27,0	32,0	55,0	3295440905	10	100	0,040
		<b>20x3/4"</b>	28,0	38,0	61,0	3295440906	10	100	0,050
		<b>25x3/4"</b>	34,0	39,0	60,0	3295441901	10	100	0,060
		<b>25x1"</b>	34,0	38,0	60,0	3295441902	10	50	0,100
		<b>*20x3/4"</b>	28,0	38,0	61,0	3295440907	10	100	0,050
		<b>*25x3/4"</b>	34,0	39,0	60,0	3295441903	10	100	0,060

\*PM with a hole for the seal

Transition union (male)	Type	d [mm]	z [mm]	I [mm]	SW [mm]	Code	SP	LP	kg/pcs	
		<b>20x1/2"</b>	26,5	20,1	49,5	27,0	3295410005	25	100	0,111
		<b>20x3/4"</b>	26,5	20,1	53,0	32,0	3295410006	25	75	0,157
		<b>20x1"</b>	26,5	20,1	61,0	38,0	3295410012	25	50	0,209
		<b>25x3/4"</b>	34,5	22,5	55,5	32,0	3295411008	25	75	0,154
		<b>25x1"</b>	34,5	24,5	61,0	38,0	3295411010	25	50	0,180
		<b>32x1"</b>	40,0	24,5	61,0	38,0	3295411009	25	50	0,202
		<b>40x5/4"</b>	50,5	27,5	62,4	48	3295412003	25	25	0,293
		<b>50x6/4"</b>	64,0	27,7	65,7	53	3295412004	10	20	0,413
		<b>63x2"</b>	81,5	33,7	78,2	70	3295413005	5	10	0,881
		<b>75x2,5"</b>	97,0	43,0	80	88	3295413006	5	5	1,016

Transition union (female)	Type	d [mm]	z [mm]	I [mm]	SW [mm]	Code	SP	BP	kg/psc
	<b>20x1/2"</b>	26,5	20,1	37,0	27,0	3295410003	25	100	0,093
	<b>20x3/4"</b>	26,5	20,1	42,0	32,0	3295410004	25	75	0,150
	<b>20x1"</b>	26,5	20,1	46,5	38,0	3295410013	25	50	0,160
	<b>25x3/4"</b>	34,5	22,5	44,5	32,0	3295411005	25	75	0,147
	<b>25x1"</b>	34,5	24,5	46,5	38,0	3295411007	25	50	0,165
	<b>32x1"</b>	40,0	24,5	46,5	38,0	3295411006	25	50	0,189
	<b>40x5/4"</b>	50,5	27,5	49,8	48	3295412005	25	25	0,241
	<b>50x6/4"</b>	64,0	27,7	52	57	3295412006	10	20	0,388
	<b>63x2"</b>	81,5	33,7	60,6	70	3295413007	5	10	0,767
	<b>75x2,5"</b>	97,0	43,0	69	88	3295413008	5	5	0,980
Hollander	Type	d [mm]	I [mm]			Code	SP	LP	kg/psc
	<b>CW</b>	<b>16x1/2"</b>	16,0	35,0		3295440001	10	50	0,025
		<b>20x3/4"</b>	20,0	35,0		3295440002	10	100	0,040
		<b>25x1"</b>	25,0	35,0		3295441002	5	50	0,063
Detachable joint	Type	d [mm]	I [mm]			Code	SP	LP	kg/psc
	<b>20</b>	20,0	35,0			3295440003	10	100	0,098
	<b>25</b>	25,0	41,0			3295441001	10	50	0,124
	<b>32</b>	32,0	46,0			3295441003	10	30	0,190
	<b>40</b>	40,0	53,0			3295442001	5	15	0,301
	<b>50</b>	50,0	130,0			3295442002	2	8	0,805
Europlast PM	Type	L [mm]				Code	SP	LP	kg/psc
	<b>20x3/4"</b>	47,5				3295440507	10	100	0,045
Euroconus MZV	Type	d1 [mm]	L [mm]	I [mm]		Code	SP	LP	kg/pcs
	<b>20x3/4"</b>	35,5	60	41		3295410701	10	100	0,045
Euroconus MZD PM	Type	d1 [mm]	L [mm]	I [mm]		Code	SP	LP	kg/pcs
	<b>20x3/4"</b>	35,5	61,5	41		3295410801	10	100	0,095
Direct coupling	Type	d [mm]	I [mm]	J [mm]		Code	SP	LP	kg/pcs
	<b>CW</b>	<b>20</b>	44,1	40,0	71,0	3295440405	10	50	0,075
		<b>25</b>	34,4	40,0	71,0	3295441406	10	50	0,088
		<b>32</b>	34,4	45,0	87,0	3295441417	10	50	0,124

Weld in saddle	Type	d2 (mm)	di (mm)	H (mm)	SW (mm)	Code	SP	BP	kg/psc
	<b>40-50x20</b>	25,0	15,0	29,0	38,0	3295412302	1	1	0,001
	<b>63x32</b>	32,0	20,5	27,0	38,0	3295413301	1	1	0,040
	<b>75x32</b>	32,0	20,5	27,0	51,0	3295413801	1	1	0,040
	<b>90x32</b>	32,0	20,5	27,0	51,0	3295413302	1	1	0,040
	<b>110x32</b>	32,0	20,5	25,7	51,0	3295414310	1	1	0,047
	<b>110x40</b>	40,0	25,5	25,7	63,0	3295414311	1	1	0,052
GR	<b>63/125 x 20</b>	25,0	15,0	29,0	38,0	3295414312	1	1	0,025
GR	<b>63/125 x 25</b>	25,0	15,0	29,0	38,0	3295414323	1	1	0,022
GR	<b>63/125 x 32</b>	32,0	20,5	35,0	51,0	3295414324	1	1	0,035
GR	<b>75/125 x 40</b>	40,0	25,5	38,0	63,0	3295414325	1	1	0,083
GR	<b>90/125 x 50</b>	50,0	32,0	39,0	70,0	3295414326	1	1	0,098
GR	<b>110/125 x 63</b>	63,0	40,0	45,0	85,0	3295414327	1	1	0,163
GR	<b>160/250 x 20</b>	25,0	15,0	29,0	38,0	3295414328	1	1	0,027
GR	<b>160/250 x 25</b>	25,0	15,0	29,0	38,0	3295414313	1	1	0,020
GR	<b>160/250 x 32</b>	32,0	20,5	35,0	51,0	3295414314	1	1	0,050
GR	<b>160/250 x 40</b>	40,0	25,5	38,0	63,0	3295414315	1	1	0,090
GR	<b>160/250 x 50</b>	50,0	32,0	39,0	70,0	3295414316	1	1	0,100
GR	<b>160/250 x 63</b>	63,0	40,0	45,0	85,0	3295414317	1	1	0,160

GR – green color

Weld in saddle - MZV	Type	d2 (mm)	di (mm)	H (mm)	SW (mm)	Code	SP	BP	kg/psc
	<b>75x3/4"</b>	32,0	20,5	82,3	51,0	3295413303	1	1	0,135
	<b>90x3/4"</b>	32,0	20,5	89,8	51,0	3295413304	1	1	0,135
GR	<b>63-125x1/2"</b>	25,0	15,0	42,0	38,0	3295414340	1	1	0,090
GR	<b>63-125x3/4"</b>	32,0	20,5	49,0	51,0	3295414341	1	1	0,130
GR	<b>75-125x1"</b>	40,0	25,5	54,0	63,0	3295414342	1	1	0,210
GR	<b>90-125x5/4"</b>	50,0	32,0	59,0	70,0	3295414343	1	1	0,340
GR	<b>90-125x6/4"</b>	50,0	34,0	59,0	70,0	3295414344	1	1	0,350
GR	<b>110-125x2"</b>	63,0	40,0	68,0	85,0	3295414345	1	1	0,650
GR	<b>160-250x1/2"</b>	25,0	15,0	42,0	38,0	3295414346	1	1	0,090
GR	<b>160-250x3/4"</b>	32,0	20,5	49,0	51,0	3295414347	1	1	0,130
GR	<b>160-250x1"</b>	40,0	25,5	54,0	63,0	3295414348	1	1	0,220
GR	<b>160-250x5/4"</b>	50,0	32,0	59,0	70,0	3295414349	1	1	0,330
GR	<b>160-250x6/4"</b>	50,0	34,0	59,0	70,0	3295414350	1	1	0,350
GR	<b>160-250x2"</b>	63,0	40,0	68,0	85,0	3295414351	1	1	0,730

GR – green color

Weld in saddle - MZD	Type	d2 (mm)	di (mm)	H (mm)	SW (mm)	Code	SP	BP	kg/psc
	<b>75x3/4"</b>	32,0	20,5	64,5	51,0	3295413410	1	1	0,091
	<b>90x3/4"</b>	32,0	20,5	72,0	51,0	3295413802	1	1	0,130
GR	<b>63/125 x 1/2"</b>	25,0	15,0	29,0	38	3295414318	1	1	0,025
GR	<b>63-125x3/4"</b>	32,0	20,5	35,0	51	3295414329	1	1	0,110
GR	<b>75-125x1"</b>	40,0	25,5	38,0	63	3295414330	1	1	0,170
GR	<b>90-125x5/4"</b>	50,0	32,0	39,0	70	3295414331	1	1	0,250
GR	<b>90-125x6/4"</b>	50,0	34,0	39,0	70	3295414332	1	1	0,220
GR	<b>110-125x2"</b>	63,0	40,0	45,0	85	3295414333	1	1	0,460
GR	<b>160-250x1/2"</b>	25,0	15,0	29,0	38	3295414334	1	1	0,070
GR	<b>160-250x3/4"</b>	32,0	20,5	35,0	51	3295414335	1	1	0,110
GR	<b>160-250x1"</b>	40,0	25,5	38,0	63	3295414336	1	1	0,170
GR	<b>160-250x5/4"</b>	50,0	32,0	39,0	70	3295414337	1	1	0,240
GR	<b>160-250x6/4"</b>	50,0	34,0	39,0	70	3295414338	1	1	0,240
GR	<b>160-250x2"</b>	63,0	40,0	45,0	85	3295414339	1	1	0,490

GR – green color

Clip	Type	d [mm]	I [mm]	K [mm]		Code	SP	LP	kg/psc
	<b>16</b>	16,0	25,0	20,0		3295410507	50	250	0,002
	<b>20</b>	20,0	27,0	26,0		3295411509	50	1000	0,003

Double clip	Type	d [mm]	I [mm]	K [mm]		Code	SP	LP	kg/psc
	<b>16</b>	16,0	25,0	50,0		3295410506	20	500	0,006
	<b>20</b>	20,0	27,0	60,0		3295411508	20	500	0,007

Flange adaptor	Type	d [mm]	L [mm]	d1 [mm]	S [mm]	Code	SP	LP	kg/pcs
	<b>40</b>	40,0	58,0	80,0	12,5	3295412401	2	10	0,078
	<b>50</b>	50,0	60,0	90,0	12,5	3297442608	2	10	0,109
	<b>63</b>	63,0	62,0	105,0	13,5	3297443603	1	10	0,165
	<b>75</b>	75,0	73,0	123,0	14,7	3295413405	1	5	0,275
	<b>90</b>	90,0	92,0	140,0	17,0	3295413406	1	1	0,440
	<b>110</b>	110,0	103,0	160,0	19,0	3295414412	1	1	0,644
GR	<b>125</b>	125,0	53,0	162,0	25,0	3295414405	1	1	0,360
GR	<b>160</b>	BUTT WELDED			3295414406	1	1	1	1,610
GR	<b>200</b>	BUTT WELDED			3295414407	1	1	1	3,020

GR - green color

Flange	Type	d1 [mm]	d2 [mm]	d [mm]	Y [mm]	Code	SP	LP	kg/pcs
	<b>40/DN32</b>	100,0	140,0	46,0	4	3295412402	1	1	1,618
	<b>50/DN40</b>	110,0	150,0	54,0	4	3295412403	1	1	1,811
	<b>63/DN50</b>	125,0	165,0	66,0	4	3295413407	1	1	2,400
	<b>75/DN65</b>	145,0	185,0	83,0	8	3295413408	1	1	2,860
	<b>90/DN80</b>	160,0	200,0	94,0	8	3295413409	1	1	3,520
	<b>110/DN100</b>	180,0	220,0	114,0	8	3295414413	1	1	3,875
GR	<b>125/DN100</b>	180,0	220,0	109,0	8	3295414416	1	1	2,120
GR	<b>160/DN150</b>	240,0	285,0	160,0	8	3295414415	1	1	2,720
GR	<b>200/DN200</b>	295,0	340,0	221,0	8	3295414420	1	1	8,700
GR	<b>200/DN200/PN20</b>	295,0	340,0	221,0	12	3295414421	1	1	8,700

Y - number of the bores. GR - green color

Electrofusion socket	Type	d (mm)	L (mm)	H (mm)	Code	SP	BP	kg/psc
	<b>20</b>	20,0	70,0	52,0	3295410007	1	1	0,037
	<b>25</b>	25,0	70,0	57,0	3295410008	1	1	
	<b>32</b>	32,0	80,0	65,0	3295411011	1	1	0,050
	<b>40</b>	40,0	90,0	74,0	3295412001	1	1	0,060
	<b>50</b>	50,0	100,0	85,0	3295412002	1	1	0,080
	<b>63</b>	63,0	111,0	97,0	3295413001	1	1	0,110
	<b>75</b>	75,0	120,0	114,0	3295413002	1	1	0,160
	<b>90</b>	90,0	130,0	130,0	3295413003	1	1	0,350
GR	<b>110</b>	110,0	140,0	152,0	3295414003	1	1	0,393
GR	<b>125</b>	125,0	151,0	168,0	3295414001	1	1	1,110
GR	<b>160</b>	160,0	172,0	205,0	3295414002	1	1	1,610
GR	<b>200</b>	200,0	203,0	245,0	3295414004	1	1	1,900

GR - green color

Galvanized gutter	Type	L [mm]	Code	SP	BP	kg/psc
	<b>20</b>	2000	3295410101	1	25	0,331
	<b>25</b>	2000	3295411101	1	25	0,428
	<b>32</b>	2000	3295411102	1	25	0,596
	<b>40</b>	2000	3295412101	1	25	0,607
	<b>50</b>	2000	3295412102	1	25	0,732
	<b>63</b>	2000	3295413101	1	25	0,879
	<b>75</b>	2000	3295413102	1	25	0,995

## VALVES

Ball valve - lever	Type	d [mm]	I [mm]	L [mm]	H [mm]	Code	SP	LP	kg/pcs
	20	29,0	15,5	65,0	67,0	3295440408	10	50	0,117
	25	35,5	17,0	70,0	70,0	3295441409	10	40	0,130
	32	44,5	18,0	81,0	87,0	3295441422	10	30	0,231
	40	55,5	20,5	98,0	105,0	3295442402	2	16	0,384
	50	69,0	23,5	126,0	122,0	3295442409	1	6	0,611
	63	90,0	27,5	145,0	145,0	3295443402	1	5	0,961
	75	105,0	31,0	163,0	180,0	3295443406	1	4	1,607

Ball valve - bow tie	Type	d [mm]	Z1 [mm]	L [mm]	H [mm]	Code	SP	LP	kg/pcs
	20	29,0	15,5	65,0	67,0	3295440409	10	40	0,117
	25	35,5	17,0	70,0	70,0	3295441410	10	40	0,130
	32	44,5	18,0	81,0	87,0	3295441423	5	20	0,231
	40	55,5	20,5	98,0	105,0	3295442403	2	10	0,384

Ball valve - lever with outlet right	Type	d [mm]	Z1 [mm]	L [mm]	H [mm]	Code	SP	LP	kg/pcs
	20	29,0	15,5	65,0	67,0	3295440410	10	50	0,172
	25	35,5	17,0	70,0	70,0	3295441412	10	40	0,172
	32	44,5	18,0	81,0	87,0	3295441426	5	20	0,322
	40	55,5	20,5	98,0	105,0	3295442405	2	10	0,422
	50	69,0	23,5	126,0	122,0	3295442411	1	6	0,611
	63	90,0	27,5	145,0	145,0	3295443404	1	4	0,969
	75	105,0	31,0	163,0	180,0	3295443408	1	4	1,607

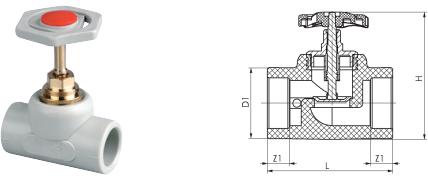
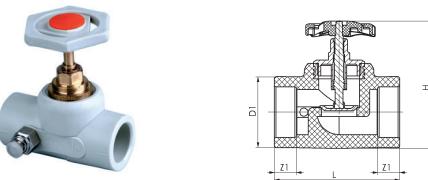
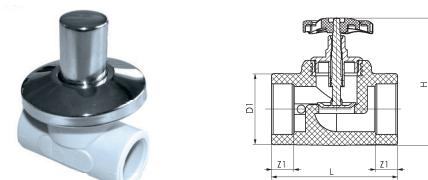
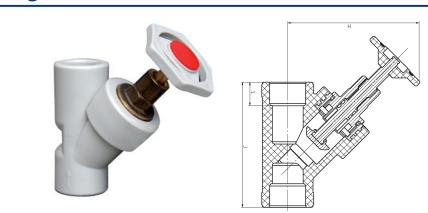
Ball valve - bow tie with outlet right	Type	d [mm]	Z1 [mm]	L [mm]	H [mm]	Code	SP	LP	kg/pcs
	20	29,0	15,5	65,0	67,0	3295440411	10	40	0,172

Ball valve - lever dismountable	Type	d [mm]	Z1 [mm]	L [mm]	H [mm]	Code	SP	LP	kg/pcs
	20	29,0	15,5	65,0	67,0	3295440406	10	50	0,180
	25	35,5	17,0	70,0	70,0	3295441407	10	40	0,191
	32	44,5	18,0	81,0	87,0	3295441420	5	20	0,313

Ball valve - bow tie dismountable	Type	d [mm]	Z1 [mm]	L [mm]	H [mm]	Code	SP	LP	kg/pcs
	20	29,0	15,5	65,0	67,0	3295440407	10	40	0,180
	25	35,5	17,0	70,0	70,0	3295441408	10	40	0,191
	32	44,5	18,0	81,0	87,0	3295441421	5	20	0,312

<b>Direct valve</b>		<table border="1"><thead><tr><th>Type</th><th>d [mm]</th><th>I [mm]</th><th>L [mm]</th><th>H [mm]</th><th>Code</th><th>SP</th><th>LP</th><th>kg/pcs</th></tr></thead><tbody><tr><td><b>20</b></td><td>29,0</td><td>14,5</td><td>65,0</td><td>73,0</td><td>3295440504</td><td>10</td><td>50</td><td>0,126</td></tr><tr><td><b>25</b></td><td>36,0</td><td>16,0</td><td>72,0</td><td>95,0</td><td>3295441505</td><td>10</td><td>40</td><td>0,243</td></tr><tr><td><b>32</b></td><td>45,5</td><td>18,0</td><td>104,0</td><td>84,0</td><td>3295441514</td><td>10</td><td>10</td><td>0,369</td></tr><tr><td><b>40</b></td><td>56,0</td><td>20,5</td><td>108,0</td><td>105,0</td><td>3295442502</td><td>2</td><td>8</td><td>0,423</td></tr><tr><td><b>50</b></td><td>69,0</td><td>23,5</td><td>115,0</td><td>126,0</td><td>3295442508</td><td>1</td><td>4</td><td>0,640</td></tr><tr><td><b>63</b></td><td>87,0</td><td>27,4</td><td>155,0</td><td>155,0</td><td>3295443501</td><td>1</td><td>4</td><td>1,125</td></tr></tbody></table>	Type	d [mm]	I [mm]	L [mm]	H [mm]	Code	SP	LP	kg/pcs	<b>20</b>	29,0	14,5	65,0	73,0	3295440504	10	50	0,126	<b>25</b>	36,0	16,0	72,0	95,0	3295441505	10	40	0,243	<b>32</b>	45,5	18,0	104,0	84,0	3295441514	10	10	0,369	<b>40</b>	56,0	20,5	108,0	105,0	3295442502	2	8	0,423	<b>50</b>	69,0	23,5	115,0	126,0	3295442508	1	4	0,640	<b>63</b>	87,0	27,4	155,0	155,0	3295443501	1	4	1,125
Type	d [mm]	I [mm]	L [mm]	H [mm]	Code	SP	LP	kg/pcs																																																									
<b>20</b>	29,0	14,5	65,0	73,0	3295440504	10	50	0,126																																																									
<b>25</b>	36,0	16,0	72,0	95,0	3295441505	10	40	0,243																																																									
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<b>63</b>	87,0	27,4	155,0	155,0	3295443501	1	4	1,125																																																									
<b>Direct valve with outlet left</b>		<table border="1"><thead><tr><th>Type</th><th>d [mm]</th><th>Z1 [mm]</th><th>L [mm]</th><th>H [mm]</th><th>Code</th><th>SP</th><th>LP</th><th>kg/pcs</th></tr></thead><tbody><tr><td><b>20</b></td><td>29,0</td><td>14,5</td><td>65,0</td><td>73,0</td><td>3295440505</td><td>5</td><td>30</td><td>0,170</td></tr><tr><td><b>25</b></td><td>36,0</td><td>16,0</td><td>72,0</td><td>95,0</td><td>3295441506</td><td>5</td><td>20</td><td>0,253</td></tr><tr><td><b>32</b></td><td>45,5</td><td>18,0</td><td>104,0</td><td>84,0</td><td>3295441515</td><td>5</td><td>10</td><td>0,396</td></tr><tr><td><b>40</b></td><td>56,0</td><td>20,5</td><td>108,0</td><td>105,0</td><td>3295442503</td><td>2</td><td>10</td><td>0,448</td></tr><tr><td><b>50</b></td><td>69,0</td><td>23,5</td><td>115,0</td><td>126,0</td><td>3295442509</td><td>2</td><td>12</td><td>0,655</td></tr><tr><td><b>63</b></td><td>87,0</td><td>27,4</td><td>155,0</td><td>155,0</td><td>3295443502</td><td>2</td><td>4</td><td>1,125</td></tr></tbody></table>	Type	d [mm]	Z1 [mm]	L [mm]	H [mm]	Code	SP	LP	kg/pcs	<b>20</b>	29,0	14,5	65,0	73,0	3295440505	5	30	0,170	<b>25</b>	36,0	16,0	72,0	95,0	3295441506	5	20	0,253	<b>32</b>	45,5	18,0	104,0	84,0	3295441515	5	10	0,396	<b>40</b>	56,0	20,5	108,0	105,0	3295442503	2	10	0,448	<b>50</b>	69,0	23,5	115,0	126,0	3295442509	2	12	0,655	<b>63</b>	87,0	27,4	155,0	155,0	3295443502	2	4	1,125
Type	d [mm]	Z1 [mm]	L [mm]	H [mm]	Code	SP	LP	kg/pcs																																																									
<b>20</b>	29,0	14,5	65,0	73,0	3295440505	5	30	0,170																																																									
<b>25</b>	36,0	16,0	72,0	95,0	3295441506	5	20	0,253																																																									
<b>32</b>	45,5	18,0	104,0	84,0	3295441515	5	10	0,396																																																									
<b>40</b>	56,0	20,5	108,0	105,0	3295442503	2	10	0,448																																																									
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<b>63</b>	87,0	27,4	155,0	155,0	3295443502	2	4	1,125																																																									
<b>Under plaster ball valve direct with chromium cover</b>		<table border="1"><thead><tr><th>Type</th><th>d [mm]</th><th>Z1 [mm]</th><th>L [mm]</th><th>H [mm]</th><th>Code</th><th>SP</th><th>LP</th><th>kg/pcs</th></tr></thead><tbody><tr><td><b>20</b></td><td>29,0</td><td>14,5</td><td>65,0</td><td>99,0</td><td>3295440506</td><td>5</td><td>20</td><td>0,200</td></tr><tr><td><b>25</b></td><td>36,0</td><td>16,0</td><td>72,0</td><td>99,0</td><td>3295441508</td><td>5</td><td>20</td><td>0,200</td></tr></tbody></table>	Type	d [mm]	Z1 [mm]	L [mm]	H [mm]	Code	SP	LP	kg/pcs	<b>20</b>	29,0	14,5	65,0	99,0	3295440506	5	20	0,200	<b>25</b>	36,0	16,0	72,0	99,0	3295441508	5	20	0,200																																				
Type	d [mm]	Z1 [mm]	L [mm]	H [mm]	Code	SP	LP	kg/pcs																																																									
<b>20</b>	29,0	14,5	65,0	99,0	3295440506	5	20	0,200																																																									
<b>25</b>	36,0	16,0	72,0	99,0	3295441508	5	20	0,200																																																									
<b>Angle valve</b>		<table border="1"><thead><tr><th>Type</th><th>d1 [mm]</th><th>Z1 [mm]</th><th>L [mm]</th><th>H [mm]</th><th>Code</th><th>SP</th><th>LP</th><th>kg/pcs</th></tr></thead><tbody><tr><td><b>22</b></td><td>35,0</td><td>16,0</td><td>117,0</td><td>107,0</td><td>3295441504</td><td>2</td><td>12</td><td>0,22</td></tr></tbody></table>	Type	d1 [mm]	Z1 [mm]	L [mm]	H [mm]	Code	SP	LP	kg/pcs	<b>22</b>	35,0	16,0	117,0	107,0	3295441504	2	12	0,22																																													
Type	d1 [mm]	Z1 [mm]	L [mm]	H [mm]	Code	SP	LP	kg/pcs																																																									
<b>22</b>	35,0	16,0	117,0	107,0	3295441504	2	12	0,22																																																									
<b>Filter</b>		<table border="1"><thead><tr><th>Type</th><th>d1 [mm]</th><th>Z1 [mm]</th><th>L [mm]</th><th>H [mm]</th><th>Code</th><th>SP</th><th>LP</th><th>kg/pcs</th></tr></thead><tbody><tr><td><b>25</b></td><td>34,4</td><td>16,0</td><td>85,0</td><td>55,4</td><td>3295441503</td><td>2</td><td>20</td><td>0,14</td></tr></tbody></table>	Type	d1 [mm]	Z1 [mm]	L [mm]	H [mm]	Code	SP	LP	kg/pcs	<b>25</b>	34,4	16,0	85,0	55,4	3295441503	2	20	0,14																																													
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<b>25</b>	34,4	16,0	85,0	55,4	3295441503	2	20	0,14																																																									

## 14.3. TOOLS AND CONSUMABLE MATERIALS

Teflon tape	Type	Code	Lenght [m]
	TEFLON	3295490098	12
			
Jaw adapters black/blue	Type	Code for black	Code for blue
	20	3295490005	3295490045
	25	3295490006	3295490040
	32	3295490007	3295490041
	40	3295490008	3295490042
	50	3295490009	3295490043
	63	3295490010	3295490044
Pair adapters black/blue	Type	Code for black	Code for blue
	20	3295490011	3295490032
	25	3295490012	3295490033
	32	3295490013	3295490034
	40	3295490014	3295490035
	50	3295490015	3295490036
	63	3295490016	3295490037
	75	3295490017	📞
	90	3295490018	3295490038
	110	3295490019	02340
	125	📞	📞
			2,658
Driller weld in saddle	Type	Code	kg/pcs
	25	3295490134	0,150
	32	3295490135	0,220
	40	3295490136	0,230
	50	3295490137	0,330
	63	3295490138	0,450
Welding tool weld in saddle	Type	Code	kg/pcs
	75-125 x 25	3295490139	0,280
	75-125 x 32	3295490140	0,410
	75-125 x 40	3295490141	0,360
	75-125 x 50	3295490142	0,650
	75-125 x 63	3295490143	1,050

<b>Hand welder POLYS P-1B 500 W with thermostat</b>	<b>Type</b>	<b>Code</b>	<b>kg/pcs</b>
	<b>500 W</b>	3295490002	1,300
<b>Hand welder POLYS P-1a 650 W with thermostat</b>	<b>Type</b>	<b>Code</b>	<b>kg/pcs</b>
	<b>650 W</b>	3295490028	1,300
<b>Hand welder POLYS P-1a 850 W with thermostat</b>	<b>Type</b>	<b>Code</b>	<b>kg/pcs</b>
	<b>650 W</b>	3295490028	1,600
<b>Hand welder POLYS P-4b 650 W TW Plus with electric control</b>	<b>Type</b>	<b>Code</b>	<b>kg/pcs</b>
 	<b>650 W</b>	01118	1,570
<b>Hand welder POLYS P-4c 650 W TW with electric control</b>	<b>Type</b>	<b>Code</b>	<b>kg/pcs</b>
 	<b>650 W</b>	04826	1,570
<b>Hand welder POLYS P-4c 650 W TW with electric control</b>	<b>Type</b>	<b>Code</b>	<b>kg/pcs</b>
 	<b>650 W</b>	01124	1,570
<b>Hand welder POLYS P-4a 850 W with electric control</b>	<b>Type</b>	<b>Code</b>	<b>kg/pcs</b>
 	<b>850 W</b>	3295490031	2,000
<b>Hand welder POLYS P-4a 1200 W with electric control</b>	<b>Type</b>	<b>Code</b>	<b>kg/pcs</b>
 	<b>1200 W</b>	01117	2,000

<b>Hand welder set POLYS P-1b 500 W</b>	<b>Type</b>	<b>Code</b>	<b>kg/pcs</b>
 	<b>HOBBY BLACK*</b>	00909	6,400
*Black jaw adapters Ø 20-40 mm, pipe cutter, clamp, imbus wrench, big metal case.			
<b>Hand welder set POLYS P-1a 650 W</b>	<b>Type</b>	<b>Code</b>	<b>kg/pcs</b>
 	<b>HOBBY BLACK*</b>	01924	6,400
	<b>MINI BLACK**</b>	3295490050	5,060
*Black jaw adapters Ø 16-32 mm, pipe cutter, clamp, imbus wrench, big metal case. **Black jaw adapters Ø 20-32 mm, clamp, imbus wrench, metal case MINI.			
<b>Hand welder set POLYS P-1a 850 W</b>	<b>Type</b>	<b>Code</b>	<b>kg/pcs</b>
 	<b>HOBBY BLACK*</b>	02196	6,400
*Black pair adapters Ø 16-32 mm, pipe cutter, clamp, stand, big metal case.			
<b>Hand welder set POLYS P-5a 650 W</b>	<b>Type</b>	<b>Code</b>	<b>kg/pcs</b>
 	<b>PROFI BLACK*</b>	3295490001	8,700
	<b>PROFI BLUE**</b>	3295490046	8,700
	<b>MINI BLACK***</b>	3295490051	5,100
	<b>MINI BLUE****</b>	3295490054	5,100
*Black jaw adapters Ø 16-63+110 mm, pipe cutter, clamp, foot stand, big metal case. **Blue jaw adapters Ø 16-63+110 mm, pipe cutter, clamp, foot stand, big metal case. ***Black jaw adapters Ø 20-32 mm, pipe cutter, clamp, foot stand, metal case MINI. ****Blue jaw adapters Ø 20-3 2mm, pipe cutter, clamp, foot stand, metal case MINI.			
<b>Hand welder set POLYS P-4a 850 W</b>	<b>Type</b>	<b>Code</b>	<b>kg/pcs</b>
 	<b>PROFI BLACK*</b>	3295490030	8,800
	<b>PROFI BLUE**</b>	02369	8,800
	<b>MINI BLACK***</b>	3295490052	5,200
*Black pair adapters Ø 16-63 mm, pipe cutter, clamp, foot stand, big metal case. **Blue pair adapters Ø 16-63 mm, pipe cutter, clamp, foot stand, big metal case. ***Black pair adapters Ø 20-32 mm, pipe cutter, clamp, foot stand, metal case MINI.			
<b>Hand welder set POLYS P-4a 1200 W</b>	<b>Type</b>	<b>Code</b>	<b>kg/pcs</b>
 	<b>BLACK 40-90*</b>	00911	9,600
	<b>BLUE 40-90**</b>	02366	9,600
*Black pair adapters Ø 40-90 mm, clamp, foot stand, big metal case. **Blue pair adapters Ø 40-90 mm, clamp, foot stand, big metal case.			
<b>Electrofusion machine for electrofusion socket</b>	<b>Type</b>	<b>Code</b>	<b>kg/pcs</b>
	<b>SVEL 950</b>	01989	9,500

Socket welding machine	Type	Code	kg/pcs
	MP - 75	01413	22,000

Socket welding machine	Type	Code	kg/pcs
	MP - 110 UM	3295490053	47,900

Pipe cutter	Type	D [mm]	Code	kg/pcs
	STANDARD PLAST 42	42	02595	0,350
	DYNO 42	42	3295490047	0,350
	75	75	38272	1,240

Pipe cutter SABAT	Type	D	kg/pcs
	SABAT	42	0,322

Tube cutter	Type	Code	kg/pcs
	50 - 140	3295490029	1,420
	100 - 160	02054	1,510

## SHORTCUTS

D - pipe diameter

SP - small package

R - red colour

t - pipe wall thickness

LP - large package

B - blue colour

Code - product catalogue number

CW - for cold water only

G - grey colour

At the end of the service life of the products, we recommend their material or energy recycling by a company with the appropriate authorization. Our technical advice consists of knowledge of standards, calculations and previous experience. We do not have the opportunity to influence the conditions of use of the products we offer, especially non-standard handling of products or use or installation, therefore all data stated in our catalog are non-binding.

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**Pipelife Czech s.r.o.**

Kučovaniny 1778  
765 02 Otrokovice  
tel.: +420 577 111 213

[www.pipelife.cz](http://www.pipelife.cz)

**Pipelife Slovakia s.r.o.**

Kuzmányho 13  
921 01 Piešťany  
tel.: +421 337 627 173

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