TECHNICAL MANUAL

Pipe system for HVAC applications

POLO-KLIMA

PURE PROGRESS / poloplast

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General information

The information provided in this technical manual is intended to help you select our products for your application. Text and images were compiled with utmost care. Nevertheless, errors cannot be entirely excluded. POLOPLAST does not assume legal liability or any other form of liability for erroneous information and its consequences. POLOPLAST is grateful for any suggestions or comments.

We are happy to provide further information – please contact the POLOPLAST sales office on +49 (0)8342 / 70 06-0, info@poloplast.com

1.1 The company

POLOPLAST is an international supplier of plastic pipe systems, compounds and polymer engineering products. It focuses its activities on the field of plastic pipe systems for building engineering, water supply and sewage. In building engineering, special emphasis is given to pipe systems for modern domestic installation systems, energy-efficient building and drinking water. In the field of civil engineering, POLOPLAST is a partner of organisations that provide infrastructure, water supply and sewage, as well as pipe ducting. The compounding sector develops and manufactures innovative special compounds for the company‘s own needs, as well as for the plastics processing industry. POLOPLAST specialises in powerful, long-standing and recyclable pipe systems with a large innovative share, and is one of the leading manufacturers of high-quality plastic pipe systems using the multi-layer technology.

In its business activities in the course of more than 60 years, the company has acquired a great deal of experience and has established an international network of customers. POLOPLAST serves a well-balanced portfolio of established, as well as young, emerging markets and maintains long-standing and sustainable relationships with its customers.

Renowned reference projects, such as Frankfurt airport, spas, low-energy and passive houses, the luxurious Conference Palace Hotel in Abu Dhabi, or the Vatican Museums Palace were equipped with POLOPLAST products.

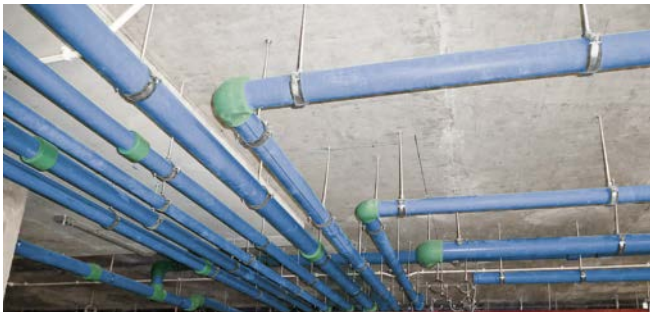
POLOPLAST Leonding

POLOPLAST Ebenhofen

2.1 POLO-KLIMA – pipe system made of PP-R

The POLO-KLIMA pipe system made of PP-R offers a non-corroding and long-standing solution for conveying water in enclosed cooling water systems for residential and commercial buildings, such as hotels and shopping centres, as well as for technological cooling purposes in industrial buildings.

The well-tried socket welding technology is used for connecting pipes of this system up to 125 mm. Pipes bigger than > 160 mm are connected using the butt welding technology. E-sockets can be applied with the entire product line and thus represent further connecting options.



Socket welding example:

When the pipe and the fitting are welded, their plastic materials fuse together to form a homogeneous, firmly bonded whole. Special tools are used to heat up pipe and fitting, which are then just joined together. This connection is reliable and lastingly leakproof.

Their excellent properties offer many advantages:

- Reliability
- Corrosion resistance
- Long service life of the entire system
- Homogeneous connection
- Low weight
- Simple handling and installation

2.2 Overview pipe system

The POLO-KLIMA pipe system consists of the POLO-KLIMA ML5 pipe and POLO-ECOSAN fittings. In addition elbows and tees made of segmented pipes are offered in large diameters > 160 mm.

The POLO-KLIMA system is available in the following design versions:

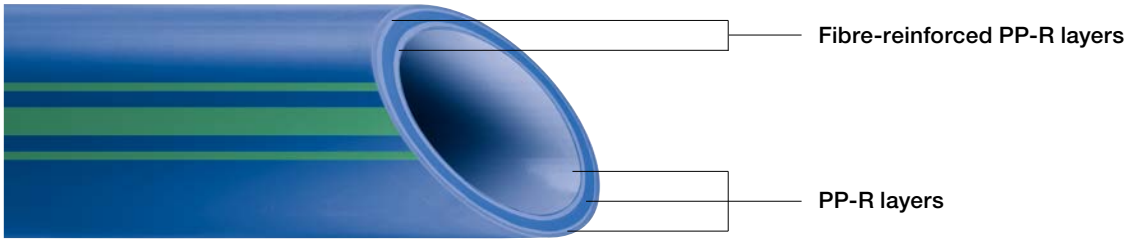
	Multi layer pipes fiber reinforced PP-R / PP-R GF		Corresponding fittings
			
			
da			
20	✓		POLO-ECOSAN socket welding fitting range
25	✓		
32		✓	
40		✓	
50		✓	
63		✓	
75		✓	
90		✓	
110		✓	
125		✓	
160		✓	Butt welding fittings, segment/injected fittings
200		✓	
250		✓	
Pipe series	S 3.2	S 5.0	
Working pressure	10 °C / 18 bar		
Thermal expansion factor	0.038 mm/mK		

The calculation of the working pressure assumed a safety factor SF 1.25 for a 50-year service life.

2.3 Pipe structure

The POLO-KLIMA ML5 pipe produced in the five-layer technology enhances the good assembly and processing properties. Higher stability due to the fibre reinforced middle layers is one of further benefits compared to standard PP pipes.

- **75 % less linear expansion compared to standard PP-R pipes**
  This reduces the demands placed upon the allowances for linear expansion
- **Excellent stability**
  It requires less fastening points which is why it can be assembled faster Approx. 30 % less fastening points compared to standard plastics
- **The linear expansion is nearly identical to metal pipes**
  This means the fastening intervalls can be enlarged compared to standard plastic pipes
- **Higher flow rate by thinner walls**
- **Lower weigth**
  compared to steel and copper

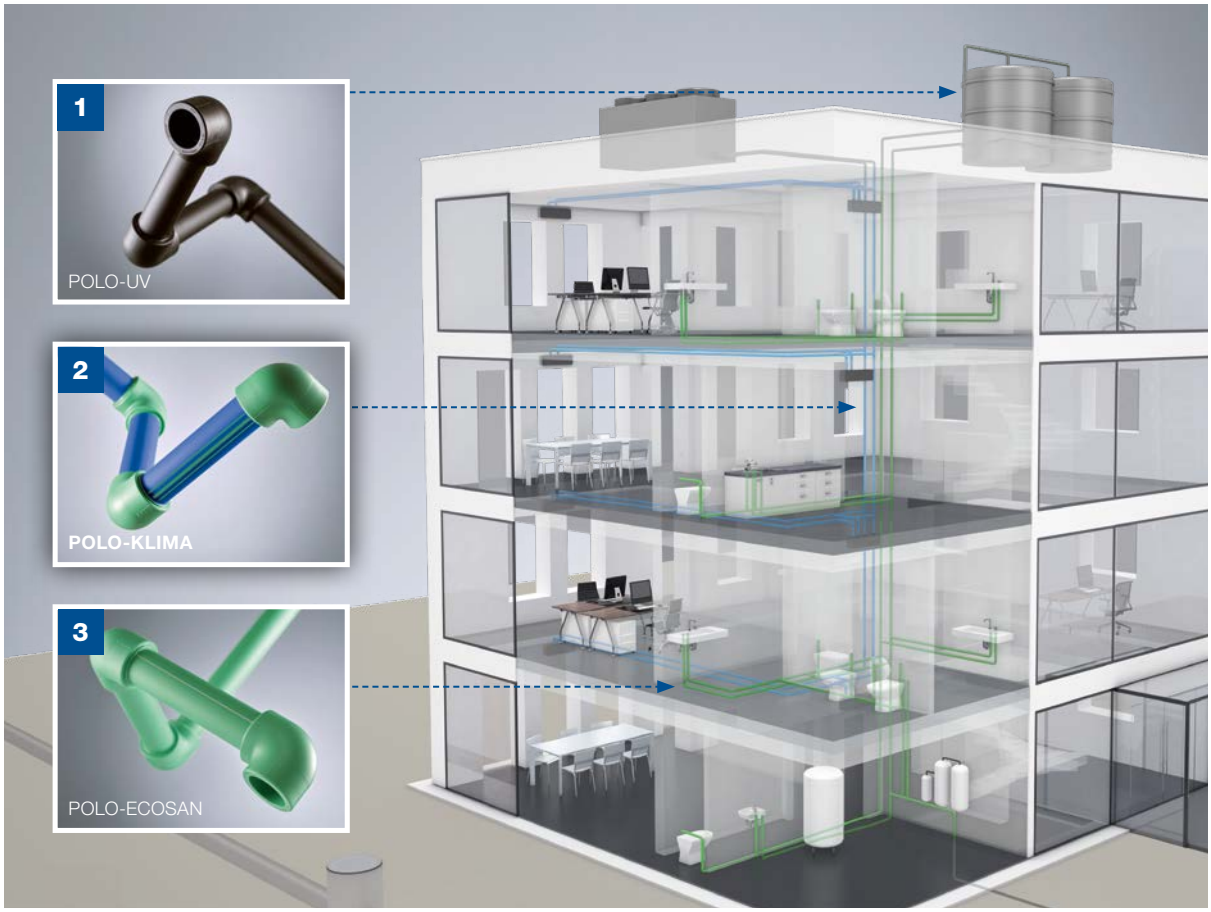


Material specification PP-R

Properties	Measuring method	Unit	Value
Density	ISO 1183	kg/m³	905
Melt flow rate 230 °C/2.16 kg	ISO 1133	g/10 min.	0.3
Modulus of elasticity in tension (1 mm/min.)	ISO 527	MPa	900
Tensile stress at yield (50 mm/min.)	ISO 527	MPa	25
Charpy impact strength, notched (+23 °C)	ISO 179	kJ/m²	40
Thermal conductivity	DIN 52612	W/mK	0.24
Pipe surface roughness k		mm	0.007
Specific heat at 20 °C	Calorimeter	KJ/kg K	2.0

2.4 Application

2.4.1 Example for the use of POLOPLAST systems



The unique interaction between POLO-KLIMA, POLO-ECOSAN and POLO-UV provides an extremely reliable and durable building installation.

1. POLO-UV system for outdoor application
- H&C potable water distribution
- Boiler and water tank connection
- Condenser lines from cooling towers
- Irrigation
- Dimension 20–63 mm

2. POLO-KLIMA system for HVAC applications
- Connection lines to AC vans
- Connection lines to chiller
- Process water cooling
- Connection to cooling towers
- Dimension 20–250 mm

3. POLO-ECOSAN system for H&C applications
- Potable water distribution
- Connection to boiler
- Manifold constructions
- Water tank connection
- Risers, single feeding lines
- Dimension 20–250 mm

SYSTEM DESCRIPTION

No corrosion problems in cooling water systems with POLO-KLIMA

Cooling water systems need insulation so that the energy can be used in the right place, and no condensed water collects on the outer pipe surfaces. Even minor weak spots, such as small holes in the insulating sheath, can cause the formation of condensed water and, as a consequence, corrosion. Corrosion-protective agents could be used to prevent the formation of rust on the pipe inner surfaces, however, this method is expensive and only partly environmentally friendly.

Apart from that, metal pipes need to be drained and cleaned every five years to prevent deposits that might block the control valves. This causes the spiral of costs to turn upwards, if metal pipes are used in cooling and air conditioning systems.

POLO-KLIMA is made from PP-R and is corrosion-resistant; the risk of encrustations and the risk of formation of deposits is extremely low. Thanks to these properties, it requires significantly less maintenance and guarantees the reliability and longevity of the installation.

Main advantages

- corrosion resistant
- increased lifetime
- fibre reinforcement and reduced linear expansion
- easy, fast and safe installation
- safe and homogenous connections
- no costs for corrosion protection

Further properties

- 75 % less linear expansion
- low weight
- higher flow rate due to thinner walls
- excellent sound and thermal insulation properties
- no problems with dew point and corrosion from outside

SYSTEM DESCRIPTION

2.4.2 Market segments

The POLO-KLIMA system can be used in the following areas:

Residential buildings
- Residential building by private and public developers

Commercial buildings
- Hotels, office buildings, hospitals, schools
- Shopping centres

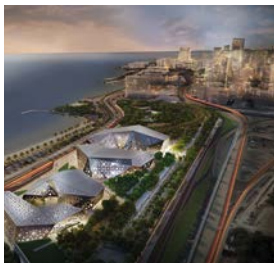
Industry
- Factories, research facilities, office

The recommended fields of application

Fields of application	POLO-ECOSAN	POLO-KLIMA	POLO-UV
Potable H&C water	✓		✓
Cooling technology		✓	
Heating technology	✓	✓	
Chilled water systems		✓	
District cooling system		✓	
Connection to cooling towers		✓	
Distribution lines exterior area			✓
Irrigation		✓	✓
Agricultural	✓	✓	✓
Geothermal	✓	✓	
Process water cooling		✓	
Chemical transport	✓	✓	
Compressed air systems	✓	✓	

INTERNATIONAL REFERENCES
POLOPLAST IN USE AROUND THE WORLD

Proscenium
Makati City, Philippines
Construction period:
2015–2018



Sheikh Jaber Al Ahmad Cultural Centre, Kuwait
Construction period:
2015–2016

Echelon Tower Singapore
Construction period:
2013–2016

Caprice Gold Hotel Istanbul, Turkey
Construction period:
2014–2015

3.1 Technical data

3.1.1 Working pressure values

Long term behaviour with a safety factor of 1.25

Temperature	Operating time	POLO-KLIMA ML5 pipe	
		Maximum working pressure	
		bar	psi
0–10 °C	1	21.1	306
	5	19.8	287
	10	19.3	280
	25	18.7	271
	50	18.2	264
20 °C	1	18.0	261
	5	16.9	245
	10	16.4	238
	25	15.9	232
	50	15.4	225
30 °C	1	15.3	222
	5	14.3	209
	10	13.9	202
	25	13.4	194
	50	13.0	190
40 °C	1	13.0	187
	5	12.1	176
	10	11.8	171
	25	11.3	164
	50	11.0	160
50 °C	1	11.0	160
	5	10.2	148
	10	9.9	144
	25	9.5	139
	50	9.2	135
60 °C	1	9.2	135
	5	8.6	125
	10	8.3	120
	25	8.0	116
	50	7.7	112
70 °C	1	7.8	113
	5	7.2	104
	10	7.0	102
	25	6.0	88
	50	5.1	74

SDR = Standard Dimension Ratio (diameter/wall thickness ratio)

SYSTEM REQUIREMENTS

This table enables you to select the suitable pipe for your application. You should know the requirements made on the system (temperature, pressure).

Example of how to select a pipe:

Field of application: cold water
Temperature of the medium: 10 °C
Maximum working pressure: 10 bar

Selection:
Step 1: select the applicable temperature range > 10 °C
Step 2: select the required service life > 50 years
Step 3: maximum working pressure within the system 10 bar > pressure according to the table > 18.2 bar >
Selection: **POLO-KLIMA ML5 pipe SDR 11**

Temperature	Operating time	POLO-KLIMA ML5 pipe	
		Maximum working pressure	
		bar	psi
0–10 °C	1	21.1	306
	5	19.8	287
	10	19.3	280
	25	18.7	271
	50	18.2	264
20 °C	1	18.0	261
	5	16.9	245
	10	16.4	238
	25	15.9	232
	50	15.4	225

3.2 Standards and regulations

The following standards and guidelines are relevant for planning, design and operating water installation systems in Germany and have to be observed.

EnEV	German Energy Saving Regulation
DIN 4109	Sound Protection in Structural Engineering
DIN 4102	Fire Prevention
POLOPLAST	Technical Manual
DVS 2207	Welding of Thermoplastics
DVS 2208	Machinery and Appliances for Welding Thermoplastics

3.2.1 System-specific standards

DIN 8077		Polypropylene Pipe Systems, Dimensions
DIN 8078		Polypropylene Pipe Systems General Quality Requirements, Testing
DIN EN ISO 15874	Parts 1–7	Plastic piping systems for hot and cold water installations – polypropylen
	Part 1	General information
	Part 2	Pipes
	Part 3	Fittings
	Part 5	Fitness for purpose of the system
	Part 7 / TS	Conformity Assessment
DIN EN ISO 21003	Parts 1–7	Multilayer Composite Pipe Systems for Hot and Cold Water Installations within Buildings

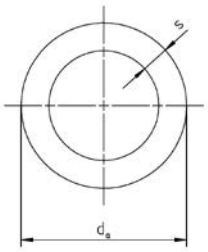
DIN standards are similar to ISO standards. The ISO standards are valid all over the world, while DIN standards only apply in Germany. ISO stands for the International Standardisation Organisation, which is an Association of Standards Organisations of more than 150 countries. Lately, no clear dividing line between standards seems to exist. For example, an ISO standard can be directly transferred to a DIN standard, or a German standard can be filed with the international committee as a pre-standard, which is why parallelisms exist between standards.

3.3 Terms used

3.3.1 Standard dimension ratio

SDR is an index in use for the classification of plastic pipes, which describes the ratio between a pipe's outer diameter and its wall thickness.

$$SDR = 2 \cdot S + 1 \qquad SDR \approx \frac{d_a}{s}$$



S = pipe series number
s = wall thickness
da = outer diameter

3.3.2 Pipe series number S

The nominal pipe series number is a dimensionless index, which is used for the calculation of the wall thickness of pipes.

The following equation is used for the calculation of the pipe series number S:

$$S = \frac{SDR - 1}{2}$$

Example: POLO-KLIMA ML5 pipe SDR 11 = S5

3.3.3 Nominal pressure (PN)

The abbreviation PN (nominal pressure) indicates a reference value that is representative for a pipe system. This reference value was used in the first plastic pipe standards (for example, DIN 8077 -1974/1989) and was based on a safety factor of 2.0. The maximum working pressure of 20 bar, 16 bar, 10 bar only refers to a service life of 50 years at a working temperature of 20 °C. However, at elevated temperatures the maximum operating pressure is lower.
This circumstance frequently leads to confusion.

For an exact pipe classification under various operating conditions, newer versions of the respective standards (DIN 8077 – 1999 or EN ISO 15874 – 2003) therefore only state the pipe series S or the diameter-wall thickness ratio SDR.

3.4 Chemical resistance

Thanks to the special properties of its materials, the POLO-KLIMA pipe system features excellent chemical resistance.
Chemical resistance of the POLO-ECOSAN fittings with brass inserts cannot be put on a level with the resistance of those system elements that are only made of PP-R.

Metallic copper, manganese or cobalt deteriorate the thermal ageing resistance of PP-R, above all, if the plasticized materials come into contact with these metals. Please contact POLOPLAST, if the pipe system is likely to come into contact with chemicals and other aggressive media.

Inquiry regarding the chemical resistance of the POLO-KLIMA pipe system

Installation company:

Firm

Contact person

Street

Postal code/Place

Telephone

Telefax

Building project

Street

Place

Place, date

Area of application:

Flow medium

°C Service temperature

mbar Service pressure

h/d Running time

Environment

°C Ambient temperature

mbar Ambient pressure

included	not included	**Data sheets**
☐	☐	flow medium
☐	☐	environment

Send inquiry to: POLOPLAST GmbH
Kirnachstrasse 17 . 87640 Ebenhofen . Germany
Tel. +49 (0) 8342 . 7006 . 0
Fax +49 (0) 8342 . 7006 . 66
info@poloplast.com . www.poloplast.com

3.4.1 Chemical disinfection – “shock disinfection”

During the process of chemical disinfection (“shock disinfection”) in accordance with Pt. 7.5.2 of the ÖNORM-Standard B 5019, the disinfecting agent can be fed into the cold water circulation or the warm water circulation, respectively. When the disinfecting agent is fed into the warm water circulation, the temperature must first be reduced to below 25 °C. Carrying out “shock disinfections” at higher temperatures is not permissible, as premature material damage cannot be ruled out. In relation to the service life of the installed system, the number of disinfecting procedures must not exceed 5 cycles. No drinking water may be drawn either during the disinfection process or during the subsequent flushing of the system with cold water.

This table lists the concentration and contact times of chemicals for chemical disinfection on the basis of ÖNORM-Standard B 5019.

Active component	Chemical formula	Max. concentration applied	Contact time	Max. water temp. in the system
Chlorine dioxide	ClO_2	6 mg/l as ClO_2	8 to 12 hrs	< 25 °C
Hypochlorite	ClO^-	50 mg/l as $Cl_{2\ (chlorine)}$	8 to 12 hrs	< 25 °C
Permanganate	MnO_4^-	15 mg/l	24 hrs	< 25 °C
Hydrogen peroxide	H_2O_2	150 mg/l	24 hrs	< 25 °C

During the application the applied concentration and application temperature may not be exceeded at any point within the pipe system.

3.4.2 Continuous metered addition of chemicals – “permanent disinfection”

The continuous metered addition of chemicals according to Pt. 9 of the ÖNORM-Standard B 5019 is only permissible in instances when repeated decontamination processes (thermal, chemical, according to section 7 of the ÖNORM-Standard) did not produce the desired results and where the systems in question have low levels of biofilm.
It must be stated that the continuous metered addition of chemicals can in no way replace the structural refurbishment of the pipe system and should be regarded merely as temporary supporting measure until such a time as the refurbishment takes place, and not as prophylactic measure against Legionella.

If the timeframe and the maximum water temperature are exceeded, damage to the component parts of the pipe systems (pipe, seals, o-rings, etc.) cannot be ruled out. This applies to all prevalent materials used in plumbing technology (types of metal, plastics and elastomers).

This table lists the concentration and contact times of chemicals for continuous metered addition on the basis of ÖNORM-Standard B 5019.

Active component	Chemical formula	Max. concentration applied	Max. period of application	Max. water temp. in the system
Chlorine dioxide**	ClO_2	0.4 mg/l als ClO_2	4 months	60 °C
Hypochlorite	ClO^-	0.3 mg/l als $Cl_{2\ (Chlor)}$	4 months	60 °C
Chlorine	Cl_2	0.3 mg/l als $Cl_{2\ (Chlor)}$	4 months	60 °C
Chlorine dioxide**	ClO_2	0.4 mg/l als ClO_2	18 months	< 25 °C
Hypochlorite	ClO^-	0.3 mg/l als $Cl_{2\ (Chlor)}$	18 months	< 25 °C
Chlorine	Cl_2	0.3 mg/l als $Cl_{2\ (Chlor)}$	18 months	< 25 °C

** For the disinfection process using chlorine dioxide (listed as ClO_2) the maximum amount that can be added into the pipe system is 0.4 mg/l ClO_2.

TRANSPORTATION AND STORAGE

4.1 Safety instructions and intended use

- Carefully read the technical manual and the operating instructions before starting work.
- POLOPLAST installation systems may only be planned, assembled and started up as described in the present manual.
- For any deviating fields of application, make sure to obtain POLOPLAST's advice.
- All national and international safety regulations and regulations on accident prevention have to be observed.
- Planning, installation and start-up have to be carried out pursuant to the current directives, standards and regulations, as intended and in accordance with the state of the art.
- Only POLOPLAST system components are allowed to be used. The use of other components entails loss of guarantee (refer to the letter of guarantee on page 64).
- Observe the general safety regulations when handling assembly tools. Danger of burn.

Handling instructions

- POLOPLAST PP-R pipes can generally be stored at any ambient temperature.
- Nevertheless, the material must never be subject to impacts or blows, particularly at temperatures below 5 °C.
- Do not drop the pipes when unloading them and protect them from falling objects.
- Select the place of storage so as to make sure that the pipes are always supported over their entire length.
- Before starting assembly, check the pipe and particularly the pipe ends for cracks or damage.
- Observe cleanliness when storing and laying the pipes and fittings. In order to protect the pipes and fittings against contamination, do not remove the packaging material before the material is used.
- Pipes (except UV pipes) and fittings must not be exposed to UV radiation over prolonged periods as this reduces the durability and the special properties of the pipes; provide protection of the pipes from the outside.
- At temperatures below zero, water supply pipes must be protected from frost, and drained, if necessary.
- Cut the pipes using only sharp tools.

Avoid sharp impacts and blows to the pipes, especially at low temperatures. Do not throw when unloading. Protect pipes from falling objects.

Put down pipes or pipe bundles carefully. Cover pipes in areas of falling rocks, etc.

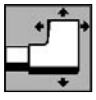
Do not use cracked or damaged pipes.

Only cut pipes with sharp cutters.

Do not expose pipes to UV-radiation for extended periods of time.

Protect stored pipes from sun and rain.

During polyfusion welding, do not twist the pipe or fitting; push the pipe and fitting joint together in a straight manner.



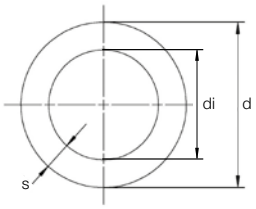
Minor corrections can only be made during joining.

Protect pipes filled with water from freezing.

Drain lines in danger of freezing.

5.1 Product range

5.1.1 Pipe



POLO-KLIMA ML 5 pipe SDR 7.4/11

Material: PP-R/ PP-R GF
Pipe structure: Multi-layer pipe, fibre-reinforced
Colour: Blue, with three green stripes
Pipe series: SDR 7.4/S 3.2, 11/S5
Standards: DIN 8077/78, EN ISO 15874
Product line: SDR 7.4; Ø 20–25 mm
SDR 11; Ø 32–250 mm

Available as: Pipes in 4 m length
On request: 160–250 mm in 5,8 m length

SDR	A. no.	Diameter (d) mm	Wall thickness (s) mm	Inner diameter (di) mm	DN	Water content l/m	Weight kg/m	Supply unit m	Availability
7.4	80322	20	2.8	14.4	15	0.16	0.15	100	S
7.4	80323	25	3.5	18.0	20	0.25	0.24	60	S
11	80324	32	2.9	26.2	25	0.53	0.26	40	S
11	80325	40	3.7	32.6	32	0.83	0.41	20	S
11	80326	50	4.6	40.8	40	1.31	0.64	20	S
11	80327	63	5.8	51.4	50	2.08	1.01	12	S
11	80328	75	6.8	61.4	65	2.94	1.41	8	S
11	80329	90	8.2	73.6	80	4.25	2.03	4	S
11	80330	110	10.0	90.0	80	6.36	3.01	4	S
11	80331	125	11.4	102.2	100	8.20	3.91	4	S
11	80333	160	14.6	130.8	125	13.44	6.38	4	S
11	80334	200	18.2	163.6	150	21.03	9.95	4	S
11	80335	250	22.7	204.6	200	32.87	15.50	4	S

5.1.2 Fittings

Long cross-over section
Material: PP-R
Colour: Green
Standards: EN ISO 15874
Product line: Ø 20–32 mm
Processing: Socket welding

A. no.	Diameter (d) mm	Weight kg/pc.	Packing unit carton/bag	Avail-ability
16502	20	0.057	150/10	S
16503	25	0.088	100/10	S
16504	32	0.146	70/10	S

Short cross-over section
Material: PP-R
Colour: Green
Standards: EN ISO 15874
Product line: Ø 20–25 mm
Processing: Socket welding

A. no.	Diameter (d) mm	Weight kg/pc.	Packing unit carton/bag	Avail-ability
17502	20	0.026	10	S
17503	25	0.044	10	S

Socket
Material: PP-R
Colour: Green
Standards: EN ISO 15874
Product line: Ø 20–125 mm
Processing: Socket welding

A. no.	Diameter (d) mm	Weight kg/pc.	Packing unit carton/bag	Avail-ability
17002	20	0.012	600/10	S
17003	25	0.017	400/10	S
17004	32	0.030	300/10	S
17005	40	0.043	200/5	S
17006	50	0.070	100/5	S
17007	63	0.160	50/1	S
17008	75	0.243	40/1	S
17009	90	0.391	24/1	S
17010	110	0.613	15/1	S
17011	125	0.755	12/1	MQ

S = Standard range stored, MQ = Minimum order quantity in pieces or meter

PLANNING AND DESIGN

Reducer male/female
Material: PP-R
Colour: Green
Standards: EN ISO 15874
Product line: Ø 20–125 mm
Processing: Socket welding

A. no.	Diameter (d) mm	Weight kg/pc.	Packing unit carton/bag	Availability
17603	25/20	0.017	300/10	S
17605	32/20	0.017	250/10	S
17606	32/25	0.019	200/10	S
17608	40/20	0.022	400/5	S
17609	40/25	0.025	400/5	S
17610	40/32	0.030	300/5	S
17612	50/20	0.037	250/5	S
17613	50/25	0.039	250/5	S
17614	50/32	0.048	200/5	S
17615	50/40	0.050	150/5	S
17618	63/25	0.066	150/1	S
17619	63/32	0.072	120/1	S
17620	63/40	0.079	100/1	S
17621	63/50	0.103	75/1	S
17627	75/50	0.122	50/1	S
17628	75/63	0.156	50/1	S
17634	90/50	0.168	40/1	S
17635	90/63	0.196	40/1	S
17636	90/75	0.239	30/1	S
17643	110/63	0.327	30/1	S
17644	110/75	0.312	25/1	S
17645	110/90	0.473	20/1	S
17646	125/110	0.755	15/1	MQ

Reducer male/male
Material: PP-R
Colour: Green
Standards: EN ISO 15874
Product line: SDR 11 Ø 160–250 mm
Processing: Socket and butt welding

d d1

SDR	A. no.	Diameter d	Diameter d1	Weight kg/pc.	Packing unit carton/bag	Availability
Butt welding						
11	17647/2	160	110	1.141	10/1	S
11	17648/2	160	125	1.163	10/1	S
11	17650/2	200	160	2.607	1	S
11	17651/2	250	160	3.948	1	S
11	17652/2	250	200	4.454	1	S

S = Standard range stored, MQ = Minimum order quantity in pieces or meter

Elbow 90° for socket welding and butt welding
Material: PP-R
Colour: Green
Standards: EN ISO 15874, DIN 16962
Product line: Ø 20–250 mm
Processing: Type A: Socket welding
Type C: Butt welding/Fitting made of pipe segments

Type A

Type C

SDR	A. no.	Diameter (d) mm	Type	Weight kg/pc.	Packing unit carton/bag	Availability
	17042	20	A	0.018	500/10	S
	17043	25	A	0.026	300/10	S
	17044	32	A	0.049	150/10	S
	17045	40	A	0.075	100/5	S
	17046	50	A	0.170	50/5	S
	17047	63	A	0.279	25/1	S
	17048	75	A	0.464	15/1	S
	17049	90	A	0.783	12/1	S
	17050	110	A	1.087	12/1	S
	17051	125	A	2.185	8/1	MQ
11	9017054 *	160	C	4.772	1/1	S
11	9017056 *	200	C	7.907	1/1	S
11	9017058 *	250	C	17.289	1/1	S

* A. no. has been changed

Elbow 45° for socket welding and butt welding
Material: PP-R
Colour: Green
Standards: EN ISO 15874, DIN 16962
Product line: Ø 20–250 mm
Processing: Type A: Socket welding
Type C: Butt welding/Fitting made of pipe segments

Type A

Type C

SDR	A. no.	Diameter (d) mm	Type	Weight kg/pc.	Packing unit carton/bag	Availability
	17102	20	A	0.017	200/10	S
	17103	25	A	0.024	150/10	S
	17104	32	A	0.042	100/10	S
	17105	40	A	0.059	50/5	S
	17106	50	A	0.133	25/5	S
	17107	63	A	0.236	12/1	S
	17108	75	A	0.359	20/1	S
	17109	90	A	0.645	15/1	S
	17110	110	A	0.787	8/1	S
	17111	125	A	1.190	5/1	MQ
11	9017114 *	160	C	3.815	1/1	S
11	9017116 *	200	C	5.819	1/1	S
11	9017118 *	250	C	12.642	1/1	S

* A. no. has been changed

Tee for socket welding and butt welding
Material: PP-R
Colour: Green
Standards: EN ISO 15874, DIN 16962
Product line: Ø 20–250 mm
Processing: Type A: Socket welding
Type C: Butt welding/Fitting made of pipe segments

Type A

Type C

SDR	A. no.	Diameter (d) mm	Type	Weight kg/pc.	Packing unit carton/bag	Availability
	17202	20	A	0.024	300/10	S
	17203	25	A	0.033	200/10	S
	17204	32	A	0.068	100/10	S
	17205	40	A	0.108	30/5	S
	17206	50	A	0.213	30/2	S
	17207	63	A	0.369	10/1	S
	17208	75	A	0.621	15/1	S
	17209	90	A	1.046	12/1	S
	17210	110	A	1.321	6/1	S
	17211	125	A	2.710	5/1	S
11	9017214 *	160	C	3.910	1/1	S
11	9017216 *	200	C	6.495	1/1	S
11	9017218 *	250	C	15.626	1/1	S

* A. no. has been changed

S = Standard range stored, MQ = Minimum order quantity in pieces or meter

PLANNING AND DESIGN

Tee reduced for socket welding and butt welding
Material: PP-R
Colour: Green
Standards: EN ISO 15874, DIN 16962
Product line: Ø 20–250 mm
Processing: Type A: Socket welding
Type C: Butt welding/Fitting made of pipe segments

Type A

Type C

SDR	A. no.	Diameter (d) mm	Type	Weight kg/pc.	Packing unit carton/bag	Availability
	17250	25 × 20 × 20	A	0.037	250/10	S
	17254	25 × 20 × 25	A	0.034	250/10	S
	17269	32 × 25 × 25	A	0.073	120/5	MQ
	17273	32 × 20 × 32	A	0.064	120/5	S
	17275	32 × 25 × 32	A	0.066	120/5	S
	17305	40 × 20 × 40	A	0.079	80/5	S
	17307	40 × 25 × 40	A	0.080	80/5	S
	17309	40 × 32 × 40	A	0.103	80/5	S
	17311	50 × 20 × 50	A	0.183	40/2	MQ
	17334	50 × 25 × 50	A	0.187	40/2	S
	17336	50 × 32 × 50	A	0.191	40/2	S
	17338	50 × 40 × 50	A	0.195	40/2	S
	17352	63 × 25 × 63	A	0.371	25/1	S
	17354	63 × 32 × 63	A	0.324	25/1	S
	17356	63 × 40 × 63	A	0.366	25/1	S
	17358	63 × 50 × 63	A	0.433	25/1	S
	17370	75 × 25 × 75	A	0.589	15/1	S
	17372	75 × 32 × 75	A	0.595	15/1	S
	17374	75 × 40 × 75	A	0.520	15/1	S
	17376	75 × 50 × 75	A	0.594	15/1	S
	17378	75 × 63 × 75	A	0.572	15/1	S
	17394	90 × 50 × 90	A	0.949	12/1	MQ
	17396	90 × 63 × 90	A	0.907	12/1	S
	17398	90 × 75 × 90	A	1.001	8/1	S
	17414	110 × 63 × 110	A	1.206	6/1	S
	17416	110 × 75 × 110	A	1.228	6/1	S
	17418	110 × 90 × 110	A	1.217	6/1	S
	17420	125 × 110 × 125	A	2.560	6/1	MQ
11	9017423 *	160 × 110 × 160	C	4.318	1/1	S
11	9017438 *	160 × 125 × 160	C	4.295	1/1	S
11	9017442 *	200 × 160 × 200	C	7.891	1/1	S
11	9017446 *	250 × 160 × 250	C	16.720	1/1	S
11	9017450 *	250 × 200 × 250	C	17.810	1/1	S

* A. no. has been changed

S = Standard range stored, MQ = Minimum order quantity in pieces or meter

Weld-in saddle
Material: PP-R
Colour: Green
Standards: EN ISO 15874
Product line: Ø 40–250 mm
Processing: Socket welding

A. no.	Diameter (d) Pipe/outlet mm	Drill diameter mm	Weight kg/pc.	Packing unit carton/bag	Availability
17741	40/20	25	0.014	250/5	S
17742	40/25	25	0.016	250/5	S
17744	50/20	25	0.014	250/5	S
17745	50/25	25	0.016	250/5	S
17747	63/20	25	0.014	200/5	S
17748	63/25	25	0.016	200/5	S
17749	63/32	32	0.027	150/5	S
17750	75/20	25	0.014	200/5	S
17751	75/25	25	0.016	200/5	S
17752	75/32	32	0.027	120/5	S
17754	90/20	25	0.014	200/5	S
17756	90/25	25	0.017	200/5	S
17758	90/32	32	0.028	150/5	S
17760	110/20	25	0.015	200/5	S
17761	110/25	25	0.017	150/5	S
17762	110/32	32	0.028	100/5	S
17765	125/20	25	0.015	200/5	S
17766	125/25	25	0.017	150/5	S
17767	125/32	32	0.028	100/5	S
17770	160–250/20	25	0.015	200/5	S
17771	160–250/25	25	0.017	200/5	S
17772	160–250/32	32	0.028	100/5	S
17773	160–250/40	40	0.037	200/5	S
17774	160–250/50	50	0.048	100/5	S
17775	160–250/63	63	0.071	50/1	S

Weld-in saddle female thread
Material: PP-R/brass
Colour: Green
Standards: EN ISO 15874
Product line: Ø 40–250 mm
Processing: Socket welding

A. no.	Diameter (d) Pipe/outlet mm	Drill diameter mm	Weight kg/pc.	Packing unit carton/bag	Availability
18352	40 × 1/2"	25	0.113	100/5	S
18353	40 × 3/4"	25	0.138	100/5	S
18354	50 × 1/2"	25	0.028	100/5	S
18355	50 × 3/4"	25	0.137	100/5	S
18356	63 × 1/2"	25	0.113	100/5	S
18357	63 × 3/4"	25	0.138	50/5	S
18358	63 × 1"	32	0.218	50/5	S
18359	75 × 1/2"	25	0.113	80/5	S
18360	75 × 3/4"	25	0.034	80/5	S
18361	75 × 1"	32	0.219	50/5	S
18362	90 × 1/2"	25	0.114	80/5	S
18363	90 × 3/4"	25	0.139	80/5	S
18364	90 × 1"	32	0.219	50/5	S
18366	110 × 1/2"	25	0.114	100/5	S
18367	110 × 3/4"	25	0.139	80/5	S
18368	110 × 1"	32	0.221	50/5	S
18370	125 × 1/2"	25	0.113	50/5	S
18371	125 × 3/4"	25	0.139	50/5	S
18372	125 × 1"	32	0.218	50/5	S
18375	160–250 × 1/2"	25	0.113	100/5	S
18376	160–250 × 3/4"	25	0.140	50/5	S
18377	160–250 × 1"	32	0.220	50/5	S

Saddle welding tools and hole saw are on page 35, 36

S = Standard range stored, MQ = Minimum order quantity in pieces or meter

PLANNING AND DESIGN

Adapter female thread
Material: PP-R/brass
Colour: Green
Standards: EN ISO 15874
Product line: Ø 20–75 mm
Processing: Socket welding

Type A Type B

A. no.	Diameter (d) mm	Type	Weight kg/pc.	Packing unit carton/bag	Availability
18104	20 × 1/2"	A	0.071	130/10	S
18105	20 × 3/4"	A	0.101	100/10	MQ
18106	25 × 1/2"	A	0.072	130/10	S
18107	25 × 3/4"	A	0.101	100/10	S
18108	32 × 3/4"	A	0.141	100/10	S
18109	32 × 1"	B	0.224	50/5	S
18110	40 × 1"	B	0.211	50/5	MQ
18111	40 × 1 1/4"	B	0.392	30/5	S
18113	50 × 1 1/2"	B	0.483	25/5	S
18115	63 × 2"	B	0.705	10/1	S
18116	75 × 2"	B	0.764	8/1	MQ
18117	75 × 2 1/2"	B	1.195	8/1	S

Adapter male thread
Material: PP-R/brass
Colour: Green
Standards: EN ISO 15874
Product line: Ø 20–110 mm
Processing: Socket welding

Type A Type B

A. no.	Diameter (d) mm	Type	Weight kg/pc.	Packing unit carton/bag	Availability
18154	20 × 1/2"	A	0.101	100/10	S
18155	20 × 3/4"	A	0.138	100/10	MQ
18156	25 × 1/2"	A	0.098	100/10	S
18157	25 × 3/4"	A	0.147	100/10	S
18158	32 × 3/4"	A	0.151	80/5	S
18159	32 × 1"	B	0.254	50/5	S
18160	40 × 1"	B	0.259	50/5	MQ
18161	40 × 1 1/4"	B	0.326	30/5	S
18162	50 × 1 1/4"	B	0.439	20/5	MQ
18163	50 × 1 1/2"	B	0.436	20/5	S
18165	63 × 2"	B	0.752	20/1	S
18167	75 × 2 1/2"	B	0.998	8/1	S
18169	90 × 3"	B	1.622	6/1	S
18171	110 × 2 1/2"	B	1.061	4/1	S

Wall union, female
Material: PP-R/brass
Colour: Green
Standards: EN ISO 15874
Product line: Ø 20–25 mm
Processing: Socket welding

A. no.	Diameter (d) mm	Weight kg/pc.	Packing unit carton/bag	Availability
18004	20 × 1/2"	0.464	100/10	S
18006	25 × 1/2"	1.087	80/10	S
18007	25 × 3/4"	2.185	80/10	S

S = Standard range stored, MQ = Minimum order quantity in pieces or meter

PLANNING AND DESIGN

Elbow adapter with female thread
Material: PP-R/brass
Colour: Green
Standards: EN ISO 15874
Product line: Ø 20–32 mm
Processing: Socket welding

A. no.	Diameter (d) mm	Weight kg/pc.	Packing unit carton/bag	Avail-ability
18204	20 × 1/2"	0.075	150/10	S
18206	25 × 1/2"	0.083	120/10	S
18207	25 × 3/4"	0.103	100/10	S
18208	32 × 3/4"	0.114	70/5	S
18209	32 × 1"	0.242	40/10	S

Elbow adapter with male thread
Material: PP-R/brass
Colour: Green
Standards: EN ISO 15874
Product line: Ø 20–32 mm
Processing: Socket welding

A. no.	Diameter (d) mm	Weight kg/pc.	Packing unit carton/bag	Avail-ability
18254	20 × 1/2"	0.093	100/10	S
18256	25 × 1/2"	0.120	100/10	S
18257	25 × 3/4"	0.169	70/10	S
18259	32 × 1"	0.269	40/10	S

Tee with female thread
Material: PP-R/brass
Colour: Green
Standards: EN ISO 15874
Product line: Ø 20–32 mm
Processing: Socket welding

A. no.	Diameter (d) mm	Weight kg/pc.	Packing unit carton/bag	Avail-ability
18304	20 × 1/2" × 20	0.092	100/10	S
18306	25 × 1/2" × 25	0.103	80/10	S
18307	25 × 3/4" × 25	0.090	70/10	S
18311	32 × 1/2" × 32	0.113	40/5	S
18310	32 × 3/4" × 32	0.133	40/5	S
18309	32 × 1" × 32	0.268	30/5	S

Screw union male/male
Material: PP-R/brass
Colour: Green
Standards: EN ISO 15874
Product line: Ø 20–63 mm
Processing: Socket welding

A. no.	Diameter (d) mm	Weight kg/pc.	Packing unit carton/bag	Avail-ability
24182	20	0.170	80/1	MQ
24183	25	0.255	50/1	MQ
24184	32	0.325	50/1	MQ
24185	40	0.478	25/1	MQ
24186	50	0.620	20/1	MQ
24187	63	0.910	15/1	MQ

S = Standard range stored, MQ = Minimum order quantity in pieces or meter

PLANNING AND DESIGN

Screw union male/male thread
Material: PP-R/brass
Colour: Green
Standards: EN ISO 15874
Product line: Ø 20–63 mm
Processing: Socket welding

A. no.	Diameter (d) mm	Weight kg/pc.	Packing unit carton/bag	Availability
24172	20 × 1/2"	0.167	80/1	MQ
24173	25 × 3/4"	0.220	50/1	MQ
24174	32 × 1"	0.400	50/1	MQ
24175	40 × 11/4"	0.680	25/1	MQ
24176	50 × 11/2"	0.780	20/1	MQ
24177	63 × 2"	1.130	15/1	MQ

Water meter nut adapter with gasket female/female thread
Material: PP-R/brass
Colour: Green
Standards: EN ISO 15874
Product line: Ø 20–63 mm
Processing: Socket welding

A. no.	Diameter (d) mm	Weight kg/pc.	Packing unit carton/bag	Availability
20043	20 × 1/2"	0.064	100/1	S
20045	20 × 3/4"	0.122	100/1	S
20047	25 × 3/4"	0.094	100/1	S
20050	32 × 1"	0.171	70/1	S
20053	40 × 1 1/4"	0.287	50/1	S
20056	50 × 1 1/2"	0.360	30/1	S
20058	63 × 2"	0.650	20/1	S

Shut-off valve body
Material: PP-R/brass
Colour: Green
Standards: EN ISO 15874
Product line: Ø 20–40 mm
Processing: Socket welding

A. no.	Diameter (d) mm	Weight kg/pc.	Packing unit carton/bag	Availability
20304	20 × 3/4"	0.105	50/5	S
20306	25 × 3/4"	0.107	50/5	S
20308	32 × 1"	0.159	30/5	S
20310	40 × 1 1/4"	0.305	25/1	S

Shut-off valve, upper part
Material: Brass
Product line: Ø 3/4"–1 1/4"

A. no.	Diameter (d) mm	Weight kg/pc.	Packing unit carton/bag	Availability
14602	3/4"	0.091	125/1	S
14604	1"	0.170	75/1	S
14606	1 1/4"	0.265	40/1	S

S = Standard range stored, MQ = Minimum order quantity in pieces or meter

Concealed valve, upper part (in flexible length 60–110 mm)
Material: Brass
Product line: Ø 3/4"–1"

A. no.	Diameter (d) mm	Weight kg/pc.	Packing unit carton/bag	Avail-ability
14612	3/4"	0.317	50/1	S
14614	1"	0.337	50/1	S

Concealed valve, upper part simple model
Material: Brass
Product line: Ø 3/4"–1"

A. no.	Diameter (d) mm	Weight kg/pc.	Packing unit carton/bag	Avail-ability
14611	3/4"	0.310	40/1	S
14617	1"	0.300	40/1	S

Ball valve
Material: PP-R
Handle: Polyamide, GF reinforced
Ball: Brass
PTFE seats: NBR O-Ring
Colour: Green
Product line: Ø 20–75 mm
Processing: Socket welding

A. no.	Diameter (d) mm	Weight kg/pc.	Packing unit carton/bag	Avail-ability
20402	20	0.114	50/5	S
20403	25	0.131	25/5	S
20404	32	0.182	15/1	S
20405	40	0.346	10/1	S
20412	50	0.503	6/1	S
20414	63	0.980	5/1	S
20416	75	1.200	5/1	S

PP ball valve with screw connection
Material: PP ball valve with screw connection PN 10
Colour: Green
Product line: Ø 20–63 mm
Processing: Socket welding
Size up to 110 mm on request

A. no.	Diameter (d) mm	Weight kg/pc.	Packing unit carton/bag	Avail-ability
20422	20	0.16	1/1	S
20423	25	0.34	1/1	S
20424	32	0.35	1/1	S
20425	40	0.65	1/1	S
20426	50	0.70	1/1	S
20427	63	1.14	1/1	S

S = Standard range stored, MQ = Minimum order quantity in pieces or meter

PLANNING AND DESIGN

End cap
Material: PP-R
Colour: Green
Standards: EN ISO 15874
Product line: Ø 20–250 mm
Processing: Type A: Socket welding
Type B: Butt welding

Type A

Type B

SDR	A. no.	Diameter (d) mm	Type	Weight kg/pc.	Packing unit carton/bag	Availability
Socket welding						
	17702	20	A	0.009	400/10	S
	17703	25	A	0.014	250/10	S
	17704	32	A	0.024	150/10	S
	17705	40	A	0.038	100/5	S
	17706	50	A	0.081	60/5	S
	17707	63	A	0.180	30/1	S
	17708	75	A	0.255	20/1	S
	17709	90	A	0.410	30/1	S
	17710	110	A	0.636	15/1	S
	17711	125	A	0.532	12/1	S
Butt welding						
11	17712/2	160	B	0.900	1/1	S
11	17713/2	200	B	2.030	1/1	S
11	17714/2	250	B	3.171	1/1	S

Flange adapter with gasket
Material: PP-R
Seal material: EPDM
Colour: Green
Standards: EN ISO 15874
Product line: Ø 20–250 mm
Processing: Type A: Socket welding
Type B: Butt welding

Type A

Type B

SDR	A. no.	Diameter (d) mm	Type	Weight kg/pc.	Packing unit carton/bag	Availability
Socket welding						
	17807	63	A	0.125	30/1	S
	17808	75	A	0.184	20/1	S
	17809	90	A	0.239	15/1	S
	17810	110	A	0.327	12/1	S
	17811	125*	A	0.890	10/1	S
Butt welding						
11	17812/2	160*	B	1.800	1/1	S
11	17814/2	200*	B	3.395	1/1	S
11	17816/2	250*	B	5.022	1/1	S

*125–250, can be used for butterfly valves

PP flange fibre reinforced
Material: PP fibre-reinforced with steel insert
Colour: Black
Standards: EN 1092
Product line: Ø 63–250 mm
PN 16

A. no.	Diameter (d) mm	DN	Weight kg/pc.	Packing unit carton/bag	Availability
14207	63	50	0.760	1	S
14208	75	65	1.130	1	S
14209	90	80	1.180	1	S
14210	110	100	1.630	1	S
14211	125	100	1.190	1	S
14212	160	150	2.760	1	S
14214	200	200	3.810	1	S
14216	250	250	5.990	1	S

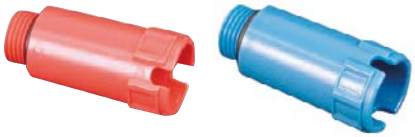
S = Standard range stored, MQ = Minimum order quantity in pieces or meter

PLANNING AND DESIGN

Socket for electric welding
Material: PP-RCT
Colour: Green
Standards: EN ISO 15874
Product line: Ø 20–250 mm
SDR 7.4
Welding voltage: 8–48 V
Pin size: 4 mm
With bar code
Suitable welding tool A. no. 15270

A. no.	Diameter (d) mm	Weight kg/pc.	Packing unit carton/bag	Availability
14802	20	0.045	35/1	S
14803	25	0.055	25/1	S
14804	32	0.075	20/1	S
14805	40	0.110	25/1	S
14806	50	0.155	20/1	S
14807	63	0.225	25/1	S
14808	75	0.330	36/1	S
14809	90	0.490	18/1	S
14810	110	0.800	15/1	S
14811	125	1.060	1/1	S
14812	160	1.855	1/1	S
14814	200	4.100	1/1	S
14816	250	6.550	1/1	S

Assembly plug
Material: PP-R
Colour: Blue, Red
Product line: Ø 1/2"



A. no.	Diameter (d) mm	Colour	Weight kg/pc.	Packing unit carton/bag	Availability
15413	1/2"	Red	0.022	200/10	S
15414	1/2"	Blue	0.022	200/10	S

Socket welding machine up to Ø 63 mm “professional”
Working range: max. Ø 20–63 mm
Power supply: 230 V–50/60 Hz
Absorbed power: 800 W
Working temperature: TFE 260 °C ± 10 °C
Without welding tools

A. no.	Diameter (d) mm	Weight kg/pc.	Packing unit carton/bag	Availability
15016	20–63	1.820	1	S

Socket welding machine up to Ø 63 mm “basic”
Working range: max. Ø 20–63 mm
Power supply: 230 V–50/60 Hz
Absorbed power: 500 W
Working temperature: TFE 260 °C ± 10 °C
Without welding tools

A. no.	Diameter (d) mm	Weight kg/pc.	Packing unit carton/bag	Availability
15025	20–63	1.440	1	S

S = Standard range stored, MQ = Minimum order quantity in pieces or meter

PLANNING AND DESIGN

Socket welding machine up to Ø 125 mm
Working range: max. Ø 20–125 mm
Power supply: 230 V–50/60 Hz
Absorbed power: 1,400 W
Working temperature: TFE 260 °C ± 10 °C
Without welding tools

A. no.	Diameter (d) mm	Weight kg/pc.	Packing unit carton/bag	Avail-ability
15015	20–125	3.160	1	S

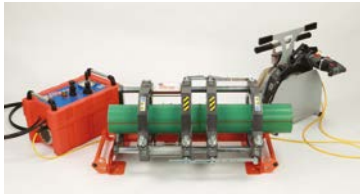
Socket welding machine for pipes from 40 to 125 mm
Product line: Ø 40–125 mm
Processing: Socket welding

A. no.	Weight kg/pc.	Packing unit carton/bag	Avail-ability
15205	50	1	S

Welding gauge
Material: PP-R
Colour: Green
Product line: Ø 20–125 mm
For marking the welding depth on the pipe

A. no.	Weight kg/pc.	Packing unit carton/bag	Avail-ability
15030	0.0056	700/50	S

Butt welding machine for pipes up to 250 mm
Working range: max. Ø 75–250 mm
Power supply: 230 VAC 50/60 Hz
Absorbed power: 3,500 W
Working temperature: 210 °C ± 10 °C



A. no.	Weight kg/pc.	Packing unit carton/bag	Avail-ability
15207	63	1	S

S = Standard range stored, MQ = Minimum order quantity in pieces or meter

PLANNING AND DESIGN

Welding machine for electric fittings
Working range: 20–315 mm
Power supply: 230 V single phase 50/60 Hz
Universal adapter: 4.0–4.7 mm
Laser scanner
For fittings from 8–48 V

A. no.	Weight kg/pc.	Packing unit carton/bag	Avail-ability
15270	25.0	1	S

Rotational pipe scraper
Professional rotary scrapers, essential to prepare the plastic pipes and fittings before electro-fusion welding

Peeling depth: 0.2 mm (0.15–0.25 mm)

A. no.	Working range	Weight kg/pc.	Packing unit carton/bag	Avail-ability
15167	20–125	1.100	1	S

Pipe scraper
Professional rotary scrapers, essential to prepare the plastic pipes and fittings before electro-fusion welding

Peeling depth: 0.3 mm (0.25–0.35 mm)

A. no.	Working range	Weight kg/pc.	Packing unit carton/bag	Avail-ability
15169	90 (SDR 11)–315 (SDR 17.6)	6.500	1	S

Cleaning towels for welded plastic joints
1 can = 100 towels
Ingredient: Ethanol

A. no.	Weight kg/pc.	Packing unit carton/bag	Avail-ability
15163	–	1	S

S = Standard range stored, MQ = Minimum order quantity in pieces or meter

PLANNING AND DESIGN

Welding set “BASIC 40” with metal case
Working range: max. Ø 20–63 mm
Power supply: 230 V–50/60 Hz
Absorbed power: 500 W
With welding tools 20–40 mm

A. no.	Diameter (d) mm	Weight kg/pc.	Packing unit carton/bag	Avail-ability
21310	20–63	–	1	S

Welding set “Professional 63” with metal case
Working range: max. Ø 20–63 mm
Power supply: 230 V–50/60 Hz
Absorbed power: 800 W
With welding tools 20–63 mm and pipe cutter

A. no.	Diameter (d) mm	Weight kg/pc.	Packing unit carton/bag	Avail-ability
15311	20–63	–	1	S

Assembly tool “Spider”
Universal-purpose welding aid
for socket welding from 63–125 mm

A. no.	Diameter (d) mm	Weight kg/pc.	Packing unit carton/bag	Avail-ability
15212	63–125	6.800	1	S

Pipe cutter for pipes from Ø 20 to 40 mm
Material: Metal
Colour: Yellow

A. no.	Diameter (d) mm	Weight kg/pc.	Packing unit carton/bag	Avail-ability
15001	20–40	0.460	1	S

Pipe cutter for pipes from Ø 20 to 63 mm
Material: Metal
Colour: Yellow

A. no.	Diameter (d) mm	Weight kg/pc.	Packing unit carton/bag	Avail-ability
15003	20–63	1.240	1	S

S = Standard range stored, MQ = Minimum order quantity in pieces or meter

PLANNING AND DESIGN

Pipe cutter for pipes from Ø 50 to 110 mm
Material: Metal
Range of application: for pipes SDR 6/7.4/11

A. no.	Diameter (d) mm	Weight kg/pc.	Packing unit carton/bag	Availability
15007	50–110	2.0	1	S

Welding attachment
Material: Aluminium, teflon-coated
Standards: according to DVS, type A
Product line: Ø 20–125 mm
Processing: Socket welding

A. no.	Diameter (d) mm	Weight kg/pc.	Packing unit carton/bag	Availability
15042	20	0.100	1	S
15043	25	0.166	1	S
15044	32	0.213	1	S
15045	40	0.268	1	S
15046	50	0.268	1	S
15047	63	0.430	1	S
15048	75	0.668	1	S
15049	90	0.880	1	S
15050	110	1.230	1	S
15051	125	1.520	1	S

Welding tools for weld-in saddle
Material: Aluminium, teflon-coated
Product line: Ø 40–250 mm
Processing: Socket welding

A. no.	Diameter (d) Pipe/outlet mm	Bore diameter mm	Weight kg/pc.	Packing unit carton/bag	Availability
15065	40	25	0.225	1	S
15066	50	25	0.240	1	S
15067	63	25	0.240	1	S
15082	63	32	0.240	1	S
15068	75	25	0.275	1	S
15083	75	32	0.280	1	S
15069	90	25	0.280	1	S
15084	90	32	0.370	1	S
15070	110	25	0.300	1	S
15085	110	32	0.400	1	S
15071	125	25	0.405	1	S
15086	125	32	0.405	1	S
15087	160	25	0.285	1	S
15088	160	32	0.305	1	S
15106	160–250	40	0.350	1	S
15107	160–250	50	0.652	1	S
15108	160–250	63	1.048	1	S

S = Standard range stored, MQ = Minimum order quantity in pieces or meter

PLANNING AND DESIGN

Hole saw for weld-in saddles
Material: Metal

For installation holes and continuous drilling
A. no. 15094 necessary

A. no.	Diameter (d) mm	Weight kg/pc.	Packing unit carton/bag	Availability
15095	25	–	1	S
15096	32	–	1	S
15097	40	–	1	S
15098	50	–	1	S
15099	63	–	1	S

Quick change system
With pilot drill for hole saw, bayonet catch, quick change between hole saws of different diameters

A. no.	for A. no.
15094	15095–15099

Welding attachment
for repair of holes up to Ø 8 mm
Material: Aluminium, Teflon-coated

A. no.	Diameter (d) mm	Weight kg/pc.	Packing unit carton/bag	Availability
15080	8	0.169	1	S

Welding plug
for repair of holes up to Ø 8 mm

A. no.	Diameter (d) mm	Weight kg/pc.	Packing unit carton/bag	Availability
21090	8	0.003	1200/100	S

S = Standard range stored, MQ = Minimum order quantity in pieces or meter

5.1.3 BIM planing with POLOPLAST

All our POLO-ECOSAN and POLO-KLIMA products are available as dwg. files and BIM files.

What is BIM?

BIM stands for "**B**uilding **I**nformation **M**odelling". It describes a holistic method of optimized planning and designing of buildings. Starting from the first draft and up to the facility management, all persons involved in the planning process use an integrated virtual 3D model of the building,

If planning is carried out in compliance with BIM, all relevant information on the individual structural elements is contained in the corresponding elements of the 3D building model. These "smart structural elements" can be used, for example, for energy calculation or structural analysis without any loss of information. The 3D building model recognises possible collisions at an early stage, thus avoiding errors from the very beginning. All persons involved in the planning procedure have access to all data at any time. The classical processes of drafting, planning and implementing are united in a single building model that grows dynamically.

3D planning using BIM

Real installation situation

THE ADVANTAGES OF BIM

- One central 3D model of the building
- Up-to-date information is available at any time
- A consistent flow of information without any gaps is guaranteed
- Possible collisions between trades show immediately
- Planning errors are reduced, which in turn saves costs
- The entire useful life of the building can be represented, spanning from draft over facility management to demolition

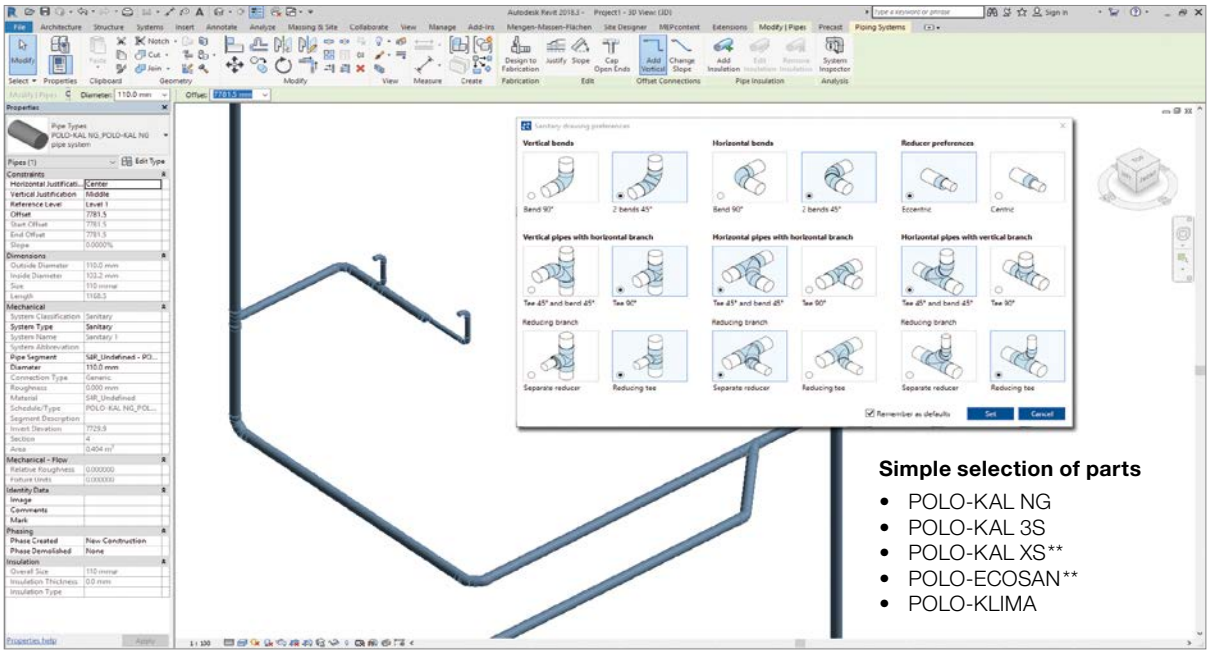
PLANNING AND DESIGN

POLOPLAST-Product-Line-Placer app for autodesk revit

The POLOPLAST-**P**roduct-**Li**ne-**P**lacer*, "**PLiP**" for short, helps design any POLO-KAL® and POLO-ECOSAN and POLO-KLIMA pipe systems** in a matter of seconds.

Revit has been developed by Autodesk particularly to be able to plan in conformity with BIM. As PLiP is an integrated application of Revit, the pipe systems can be used in any new project, easily and fast. During the designing phase of the pipe network, the **auto-routing function** automatically places all required elbows, branches and transitions. The **optimisation function** perfects the whole pipe network at one mouse click. Connecting parts, flow direction, and orientation of fittings are automatically adapted and modified. In return, different versions of branches and redirections can be pre-defined individually. Once the pipe network design has been finished, a clear list of all POLOPLAST articles used can be drawn up.

In a nutshell: POLOPLAST-PLiP makes work easier and faster than simple Revit family packs. This App for Autodesk Revit is free of charge and makes it significantly easier to work in conformity with BIM.



Simple selection of parts

- POLO-KAL NG
- POLO-KAL 3S
- POLO-KAL XS**
- POLO-ECOSAN**
- POLO-KLIMA

THE ADVANTAGES
POLOPLAST-PRODUCT-LINE-PLACER FOR REVIT

- Updated, country-specific product information
- Fast and easy designing thanks to the auto-routing feature
- Fittings are placed automatically
- Optimisation feature
- Material lists can be drawn up

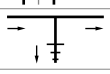
www.poloplast.com

* **System requirements:** Windows 7 or higher (x64 only); Autodesk Revit 2016–2018 (x64 only)

** Country-specific option, depends on the availability in market

5.2 Single resistance values and pressure loss tables

Coefficient of resistance values for fittings made of PP-R

Fitting individual resistance	Graphic symbol	Remark	Resistance coefficient value ζ
Tee		branching, dividing flow	1.3
		passage for dividing flow	0.3
		counter current for dividing flow	1.4
		branching, merging flow	1.3
		passage for merging flow	2.5
		counter current for merging flow	3.0
Elbow 90°			1.2
Elbow 45°			0.7
Socket			0.25
Reducer		by 1 dimension	0.4
		by 2 dimensions	0.6
		by 3 dimensions	0.7
		more than 4 dimensions	0.9
Wall union			1.7
Double wall union			1.5
Short cross over			1.9
Transition with internal thread			0.5
Transition with internal thread, reduced			0.8
Transition with external thread			0.4
Transition with external thread, reduced			0.8
Transition elbow with thread			1.7
Tee with transition, dividing flow			1.6
Slanted seat valve			3.0
Slanted seat valve with back-flow prevention			3.8
Shut off valve			7.0
Ball valve			0.4

PLANNING AND DESIGN

Pressure loss due to pipe resistance R and flow speed v depending on flow V

Pipes SDR 7.4/20–25 mm; SDR 11/32–250 mm

Temperature 20 °C Roughness: 0.007 mm Density: 998.29 kg/m³ Kin. viscosity: 1.004E-06 m²/s

		Dimension	20 mm	25 mm	32 mm	40 mm	50 mm	63 mm	75 mm	90 mm	110 mm	125 mm	160 mm	200 mm	250 mm
		Wall thickness	2.8 mm	3.5 mm	2.9 mm	3.7 mm	4.6 mm	5.8 mm	6.8 mm	8.2 mm	10.0 mm	11.4 mm	14.6 mm	18.2 mm	22.7 mm
l/s	m³/h														
0.01	0.04	R in mbar/m	0.10	0.04	0.01										
		v in m/s	0.06	0.04	0.02										
0.02	0.07	R	0.30	0.11	0.02	0.01									
		v	0.12	0.08	0.04	0.02									
0.03	0.11	R	0.58	0.21	0.04	0.01									
		v	0.18	0.12	0.06	0.04									
0.04	0.14	R	0.93	0.33	0.06	0.02	0.01								
		v	0.25	0.16	0.07	0.05	0.03								
0.05	0.18	R	1.34	0.47	0.08	0.03	0.01								
		v	0.31	0.20	0.09	0.06	0.04								
0.06	0.22	R	1.82	0.64	0.11	0.04	0.01	0.01							
		v	0.37	0.24	0.11	0.07	0.05	0.03							
0.07	0.25	R	2.36	0.83	0.14	0.05	0.02	0.01							
		v	0.43	0.28	0.13	0.08	0.05	0.03							
0.08	0.29	R	2.96	1.04	0.18	0.06	0.02	0.01							
		v	0.49	0.31	0.15	0.10	0.06	0.04							
0.09	0.32	R	3.61	1.26	0.22	0.08	0.03	0.01							
		v	0.55	0.35	0.17	0.11	0.07	0.04							
0.10	0.36	R	4.32	1.51	0.26	0.09	0.03	0.01	0.01						
		v	0.61	0.39	0.19	0.12	0.08	0.05	0.03						
0.12	0.43	R	5.90	2.05	0.35	0.13	0.04	0.02	0.01						
		v	0.74	0.47	0.22	0.14	0.09	0.06	0.04						
0.14	0.50	R	7.70	2.67	0.46	0.16	0.06	0.02	0.01						
		v	0.86	0.55	0.26	0.17	0.11	0.07	0.05						
0.16	0.58	R	9.70	3.36	0.57	0.20	0.07	0.02	0.01						
		v	0.98	0.63	0.30	0.19	0.12	0.08	0.05						
0.18	0.65	R	11.91	4.11	0.70	0.25	0.09	0.03	0.01	0.01					
		v	1.11	0.71	0.33	0.22	0.14	0.09	0.06	0.04					
0.20	0.72	R	14.32	4.94	0.83	0.30	0.10	0.04	0.02	0.01					
		v	1.23	0.79	0.37	0.24	0.15	0.10	0.07	0.05					
0.30	1.08	R	29.30	10.01	1.67	0.59	0.21	0.07	0.03	0.01	0.01				
		v	1.84	1.18	0.56	0.36	0.23	0.14	0.10	0.07	0.05				
0.40	1.44	R	49.02	16.64	2.75	0.97	0.34	0.11	0.05	0.02	0.01				
		v	2.46	1.57	0.74	0.48	0.31	0.19	0.14	0.09	0.06				
0.50	1.80	R	73.35	24.77	4.07	1.43	0.49	0.17	0.07	0.03	0.01	0.01			
		v	3.07	1.96	0.93	0.60	0.38	0.24	0.17	0.12	0.08	0.06			
0.60	2.16	R	102.21	34.36	5.61	1.97	0.68	0.23	0.10	0.04	0.02	0.01			
		v	3.68	2.36	1.11	0.72	0.46	0.29	0.20	0.14	0.09	0.07			
0.70	2.52	R	135.57	45.40	7.37	2.58	0.89	0.30	0.13	0.05	0.02	0.01			
		v	4.30	2.75	1.30	0.84	0.54	0.34	0.24	0.16	0.11	0.09			
0.80	2.88	R	173.38	57.86	9.34	3.27	1.12	0.37	0.16	0.07	0.03	0.01			
		v	4.91	3.14	1.48	0.96	0.61	0.39	0.27	0.19	0.13	0.10			
0.90	3.24	R	215.63	71.73	11.53	4.02	1.37	0.46	0.20	0.08	0.03	0.02	0.01		
		v	5.53	3.54	1.67	1.08	0.69	0.43	0.30	0.21	0.14	0.11	0.07		
1.00	3.60	R	262.30	87.00	13.93	4.85	1.65	0.55	0.24	0.10	0.04	0.02	0.01		
		v	6.14	3.93	1.85	1.20	0.76	0.48	0.34	0.24	0.16	0.12	0.07		
1.10	3.96	R	313.36	103.67	16.53	5.74	1.96	0.65	0.28	0.12	0.05	0.02	0.01		
		v	6.75	4.32	2.04	1.32	0.84	0.53	0.37	0.26	0.17	0.13	0.08		
1.20	4.32	R	368.81	121.73	19.34	6.71	2.28	0.76	0.32	0.14	0.05	0.03	0.01		
		v	7.37	4.72	2.23	1.44	0.92	0.58	0.41	0.28	0.19	0.15	0.09		
1.30	4.68	R	428.65	141.17	22.36	7.74	2.63	0.87	0.37	0.16	0.06	0.03	0.01		
		v	7.98	5.11	2.41	1.56	0.99	0.63	0.44	0.31	0.20	0.16	0.10		
1.40	5.04	R	492.86	162.00	25.57	8.84	3.00	0.99	0.42	0.18	0.07	0.04	0.01		
		v	8.60	5.50	2.60	1.68	1.07	0.67	0.47	0.33	0.22	0.17	0.10		
1.60	5.76	R	634.39	207.77	32.61	11.25	3.80	1.25	0.54	0.23	0.09	0.05	0.01		
		v	9.82	6.29	2.97	1.92	1.22	0.77	0.54	0.38	0.25	0.20	0.12		
1.80	6.48	R	793.36	259.03	40.45	13.91	4.69	1.54	0.66	0.28	0.11	0.06	0.02	0.01	
		v	11.05	7.07	3.34	2.16	1.38	0.87	0.61	0.42	0.28	0.22	0.13	0.09	
2.00	7.20	R		315.77	49.09	16.84	5.67	1.86	0.79	0.33	0.13	0.07	0.02	0.01	
		v		7.86	3.71	2.40	1.53	0.96	0.68	0.47	0.31	0.24	0.15	0.10	
2.20	7.92	R		377.96	58.51	20.03	6.73	2.21	0.94	0.39	0.15	0.08	0.03	0.01	
		v		8.65	4.08	2.64	1.68	1.06	0.74	0.52	0.35	0.27	0.16	0.10	
2.40	8.64	R		445.60	68.72	23.48	7.87	2.58	1.10	0.46	0.18	0.10	0.03	0.01	
		v		9.43	4.45	2.88	1.84	1.16	0.81	0.56	0.38	0.29	0.18	0.11	
2.60	9.36	R		518.69	79.71	27.18	9.10	2.97	1.26	0.53	0.20	0.11	0.03	0.01	
		v		10.22	4.82	3.11	1.99	1.25	0.88	0.61	0.41	0.32	0.19	0.12	

		Dimension	32 mm	40 mm	50 mm	63 mm	75 mm	90 mm	110 mm	125 mm	160 mm	200 mm	250 mm
		Wall thickness	2.9 mm	3.7 mm	4.6 mm	5.8 mm	6.8 mm	8.2 mm	10.0 mm	11.4 mm	14.6 mm	18.2 mm	22.7 mm
l/s	m³/h												
2.80	10.08	R	91.49	31.14	10.40	3.40	1.44	0.60	0.23	0.13	0.04	0.01	
		v	5.19	3.35	2.14	1.35	0.95	0.66	0.44	0.34	0.21	0.13	
3.00	10.80	R	104.04	35.35	11.79	3.84	1.63	0.68	0.26	0.14	0.04	0.02	0.01
		v	5.56	3.59	2.29	1.45	1.01	0.71	0.47	0.37	0.22	0.14	0.09
3.50	12.60	R	138.82	47.00	15.62	5.07	2.15	0.90	0.34	0.19	0.06	0.02	0.01
		v	6.49	4.19	2.68	1.69	1.18	0.82	0.55	0.43	0.26	0.17	0.11
4.00	14.40	R	178.44	60.21	19.95	6.46	2.73	1.14	0.43	0.24	0.07	0.03	0.01
		v	7.42	4.79	3.06	1.93	1.35	0.94	0.63	0.49	0.30	0.19	0.12
4.50	16.20	R	222.89	74.99	24.77	8.01	3.38	1.41	0.53	0.29	0.09	0.03	0.01
		v	8.35	5.39	3.44	2.17	1.52	1.06	0.71	0.55	0.33	0.21	0.14
5.00	18.00	R	272.15	91.32	30.09	9.70	4.08	1.70	0.64	0.35	0.11	0.04	0.01
		v	9.27	5.99	3.82	2.41	1.69	1.18	0.79	0.61	0.37	0.24	0.15
5.50	19.80	R	326.21	109.21	35.90	11.55	4.85	2.02	0.76	0.41	0.13	0.04	0.02
		v	10.20	6.59	4.21	2.65	1.86	1.29	0.86	0.67	0.41	0.26	0.17
6.00	21.60	R		128.65	42.20	13.55	5.69	2.36	0.89	0.48	0.15	0.05	0.02
		v		7.19	4.59	2.89	2.03	1.41	0.94	0.73	0.45	0.29	0.18
6.50	23.40	R		149.64	48.99	15.70	6.58	2.73	1.03	0.56	0.17	0.06	0.02
		v		7.79	4.97	3.13	2.20	1.53	1.02	0.79	0.48	0.31	0.20
7.00	25.20	R		172.17	56.26	17.99	7.53	3.12	1.18	0.64	0.20	0.07	0.02
		v		8.39	5.35	3.37	2.36	1.65	1.10	0.85	0.52	0.33	0.21
7.50	27.00	R		196.24	64.02	20.44	8.55	3.53	1.33	0.72	0.22	0.08	0.03
		v		8.99	5.74	3.61	2.53	1.76	1.18	0.91	0.56	0.36	0.23
8.00	28.80	R		221.85	72.27	23.03	9.62	3.97	1.50	0.81	0.25	0.08	0.03
		v		9.58	6.12	3.86	2.70	1.88	1.26	0.98	0.60	0.38	0.24
8.50	30.60	R		249.01	80.99	25.78	10.76	4.44	1.67	0.90	0.28	0.09	0.03
		v		10.18	6.50	4.10	2.87	2.00	1.34	1.04	0.63	0.40	0.26
9.00	32.40	R			90.20	28.67	11.95	4.93	1.85	1.00	0.31	0.10	0.04
		v			6.88	4.34	3.04	2.12	1.41	1.10	0.67	0.43	0.27
9.50	34.20	R			99.89	31.70	13.20	5.44	2.04	1.10	0.34	0.11	0.04
		v			7.27	4.58	3.21	2.23	1.49	1.16	0.71	0.45	0.29
10.00	36.00	R			110.06	34.89	14.52	5.97	2.24	1.21	0.37	0.13	0.04
		v			7.65	4.82	3.38	2.35	1.57	1.22	0.74	0.48	0.30
10.50	37.80	R			120.71	38.22	15.89	6.53	2.45	1.32	0.40	0.14	0.05
		v			8.03	5.06	3.55	2.47	1.65	1.28	0.78	0.50	0.32
11.00	39.60	R			131.84	41.69	17.32	7.12	2.67	1.44	0.44	0.15	0.05
		v			8.41	5.30	3.72	2.59	1.73	1.34	0.82	0.52	0.33
11.50	41.40	R			143.45	45.32	18.81	7.72	2.89	1.56	0.47	0.16	0.06
		v			8.80	5.54	3.88	2.70	1.81	1.40	0.86	0.55	0.35
12.00	43.20	R			155.54	49.08	20.36	8.35	3.13	1.69	0.51	0.17	0.06
		v			9.18	5.78	4.05	2.82	1.89	1.46	0.89	0.57	0.36
12.50	45.00	R			168.11	53.00	21.96	9.00	3.37	1.82	0.55	0.19	0.06
		v			9.56	6.02	4.22	2.94	1.96	1.52	0.93	0.59	0.38
13.00	46.80	R			181.16	57.06	23.63	9.68	3.62	1.95	0.59	0.20	0.07
		v			9.94	6.27	4.39	3.06	2.04	1.58	0.97	0.62	0.40
13.50	48.60	R			194.69	61.26	25.35	10.38	3.88	2.09	0.63	0.22	0.07
		v			10.33	6.51	4.56	3.17	2.12	1.65	1.00	0.64	0.41
14.00	50.40	R				65.61	27.13	11.10	4.14	2.23	0.68	0.23	0.08
		v				6.75	4.73	3.29	2.20	1.71	1.04	0.67	0.43
14.50	52.20	R				70.10	28.97	11.84	4.42	2.38	0.72	0.24	0.08
		v				6.99	4.90	3.41	2.28	1.77	1.08	0.69	0.44
15.00	54.00	R				74.74	30.87	12.61	4.70	2.53	0.76	0.26	0.09
		v				7.23	5.07	3.53	2.36	1.83	1.12	0.71	0.46
16.00	57.60	R				84.46	34.84	14.22	5.30	2.85	0.86	0.29	0.10
		v				7.71	5.40	3.76	2.52	1.95	1.19	0.76	0.49
17.00	61.20	R				94.75	39.04	15.91	5.92	3.18	0.96	0.33	0.11
		v				8.19	5.74	4.00	2.67	2.07	1.27	0.81	0.52
18.00	64.80	R				105.62	43.47	17.70	6.58	3.53	1.06	0.36	0.12
		v				8.67	6.08	4.23	2.83	2.19	1.34	0.86	0.55
19.00	68.40	R				117.06	48.13	19.58	7.27	3.90	1.17	0.40	0.14
		v				9.16	6.42	4.47	2.99	2.32	1.41	0.90	0.58
20.00	72.00	R				129.09	53.03	21.55	7.99	4.29	1.29	0.44	0.15
		v				9.64	6.75	4.70	3.14	2.44	1.49	0.95	0.61
21.00	75.60	R				141.69	58.15	23.61	8.75	4.69	1.41	0.48	0.16
		v				10.12	7.09	4.94	3.30	2.56	1.56	1.00	0.64
22.00	79.20	R					63.51	25.77	9.54	5.11	1.53	0.52	0.18
		v					7.43	5.17	3.46	2.68	1.64	1.05	0.67
23.00	82.80	R					69.09	28.01	10.36	5.55	1.66	0.56	0.19
		v					7.77	5.41	3.62	2.80	1.71	1.09	0.70
24.00	86.40	R					74.90	30.34	11.21	6.00	1.80	0.61	0.21
		v					8.11	5.64	3.77	2.93	1.79	1.14	0.73
25.00	90.00	R					80.95	32.76	12.10	6.47	1.94	0.65	0.22
		v					8.44	5.88	3.93	3.05	1.86	1.19	0.76
26.00	93.60	R					87.22	35.28	13.02	6.96	2.08	0.70	0.24
		v					8.78	6.11	4.09	3.17	1.93	1.24	0.79

		Dimension	32 mm	40 mm	50 mm	63 mm	75 mm	90 mm	110 mm	125 mm	160 mm	200 mm	250 mm
		Wall thickness	2.9 mm	3.7 mm	4.6 mm	5.8 mm	6.8 mm	8.2 mm	10.0 mm	11.4 mm	14.6 mm	18.2 mm	22.7 mm
l/s	m³/h												
27.00	97.20	R					93.72	37.88	13.97	7.46	2.23	0.75	0.25
		v					9.12	6.35	4.24	3.29	2.01	1.28	0.82
28.00	100.80	R					100.46	40.57	14.95	7.99	2.38	0.80	0.27
		v					9.46	6.58	4.40	3.41	2.08	1.33	0.85
29.00	104.40	R					107.42	43.36	15.96	8.52	2.54	0.86	0.29
		v					9.79	6.82	4.56	3.54	2.16	1.38	0.88
30.00	108.00	R					114.61	46.23	17.01	9.08	2.71	0.91	0.31
		v					10.13	7.05	4.72	3.66	2.23	1.43	0.91
32.00	115.20	R						52.25	19.20	10.24	3.05	1.02	0.35
		v						7.52	5.03	3.90	2.38	1.52	0.97
34.00	122.40	R						58.62	21.51	11.46	3.41	1.14	0.39
		v						7.99	5.34	4.14	2.53	1.62	1.03
36.00	129.60	R						65.36	23.96	12.76	3.79	1.27	0.43
		v						8.46	5.66	4.39	2.68	1.71	1.09
38.00	136.80	R						72.45	26.53	14.12	4.19	1.40	0.47
		v						8.93	5.97	4.63	2.83	1.81	1.16
40.00	144.00	R						79.90	29.22	15.54	4.60	1.54	0.52
		v						9.40	6.29	4.88	2.98	1.90	1.22
42.00	151.20	R						87.71	32.05	17.03	5.04	1.68	0.57
		v						9.87	6.60	5.12	3.13	2.00	1.28
44.00	158.40	R						95.87	35.00	18.59	5.49	1.84	0.62
		v						10.34	6.92	5.36	3.27	2.09	1.34
46.00	165.60	R							38.08	20.21	5.97	1.99	0.67
		v							7.23	5.61	3.42	2.19	1.40
48.00	172.80	R							41.28	21.90	6.46	2.15	0.72
		v							7.55	5.85	3.57	2.28	1.46
50.00	180.00	R							44.61	23.66	6.97	2.32	0.78
		v							7.86	6.10	3.72	2.38	1.52
52.00	187.20	R							48.07	25.48	7.50	2.50	0.84
		v							8.17	6.34	3.87	2.47	1.58
54.00	194.40	R							51.65	27.37	8.05	2.68	0.90
		v							8.49	6.58	4.02	2.57	1.64
56.00	201.60	R							55.36	29.32	8.61	2.86	0.96
		v							8.80	6.83	4.17	2.66	1.70
58.00	208.80	R							59.20	31.34	9.20	3.06	1.02
		v							9.12	7.07	4.32	2.76	1.76
60.00	216.00	R							63.16	33.42	9.80	3.25	1.09
		v							9.43	7.31	4.47	2.85	1.82
62.00	223.20	R							67.24	35.57	10.42	3.46	1.16
		v							9.75	7.56	4.61	2.95	1.89
64.00	230.40	R							71.46	37.78	11.06	3.67	1.23
		v							10.06	7.80	4.76	3.04	1.95
66.00	237.60	R								40.06	11.72	3.88	1.30
		v								8.05	4.91	3.14	2.01
68.00	244.80	R								42.40	12.40	4.11	1.37
		v								8.29	5.06	3.23	2.07
70.00	252.00	R								44.81	13.10	4.33	1.45
		v								8.53	5.21	3.33	2.13
75.00	270.00	R								51.12	14.91	4.93	1.64
		v								9.14	5.58	3.57	2.28
80.00	288.00	R								57.84	16.85	5.56	1.85
		v								9.75	5.95	3.81	2.43
85.00	306.00	R								64.96	18.90	6.23	2.07
		v								10.36	6.33	4.04	2.59
90.00	324.00	R									21.06	6.93	2.30
		v									6.70	4.28	2.74
95.00	342.00	R									23.33	7.67	2.55
		v									7.07	4.52	2.89
100.00	360.00	R									25.72	8.45	2.80
		v									7.44	4.76	3.04
110.00	396.00	R									30.85	10.11	3.35
		v									8.19	5.23	3.35
120.00	432.00	R									36.42	11.92	3.94
		v									8.93	5.71	3.65
130.00	468.00	R									42.45	13.87	4.58
		v									9.67	6.18	3.95
140.00	504.00	R									48.94	15.96	5.26
		v									10.42	6.66	4.26
150.00	540.00	R									55.87	18.20	5.99
		v									11.16	7.14	4.56
160.00	576.00	R									63.26	20.58	6.76
		v									11.91	7.61	4.87
170.00	612.00	R									71.10	23.10	7.58
		v									12.65	8.09	5.17

6.1 Basic information

6.1.1 Socket welding using a heated tool

Before starting the work, make sure that the welding tools lie flat against the heated rod. Do not use pliers or other unsuitable tools for the assembly, to avoid damage to the coating of the welding tools.

The required welding temperature for processing the POLO-KLIMA installation system is 250–270 °C.

Warning:
- Danger of burns from hot welding equipment
- The first welding should not be carried out until five minutes after the welding temperature has been reached!

POLO-KLIMA welding equipment and welding tools must be protected against impurities. Burned-on particles can lead to faulty welding connections. Tools may be cleaned with non-fibrous, coarse paper towels. The welding tools must be kept dry at all times.

Damaged and soiled welding tools must be replaced, since only impeccable processing tools can ensure impeccable connections.

Connect the components during the welding process without twisting the parts. Minor corrections can only be made immediately after the parts are connected.

6.1.2 Guidelines

General work protection and accident prevention guidelines are to be observed when using welding equipment.

The Guidelines of the Industrial Trade Associations of the Chemical Industry for Machines for the Processing and Employment of Plastics, Chapter: Welding Machines and Equipment, apply.

For the handling of POLO-KLIMA welding equipment, machines and tools, the General Guidelines DVS 2208, Section 1 apply. In order to establish a connection between the POLO-KLIMA ML5 pipe and the fitted part, the welding tools used must correspond to the measurements as stipulated by procedure A.

In accordance with DVS Guidelines, control of the necessary application temperature using quick-display surface temperature thermometers is permissible.

6.2 Processing information for welding

Parameters for socket welding with a heated tool

Outer pipe diameter	Insertion depth	Heating period for SDR 11, SDR 7.4	Processing period (maximum period)	Cooling period	
				fixed	total
mm	mm		s	s	min
20	14	5	4	6	2
25	15	7	4	10	2
32	16.5	8	6	10	4
40	18	12	6	20	4
50	20	18	6	20	4
63	24	24	8	30	6
75	26	30	8	30	6
90	29	40	8	40	6
110	32.5	50	10	50	8
125	35	60	10	60	8

Note: heating element temperature 250 to 270 °C

Instructions for socket welding can be found in DVS brochure no. 2207, Section 11, “Socket welding with a heated tool – welding of thermoplastic plastics and pipelines made of polypropylene (PP)”. POLO-KLIMA socket welding is performed according to these guidelines.
In this process, pipes and fittings are welded overlapping. The end of the pipes and fittings are heated using a welding device and are subsequently connected.

6.2.1 Socket welding with a hand-held welding device, from 20 mm

The following points should be observed:

1. The welding device should be equipped with the appropriate welding tools. Welding bushes and core rods have a Teflon coating. In order to avoid damaging the Teflon coating, never use pliers or similar tools for assembly. Please use a suitable hexagon socket wrench.

2. Switch on the welding device.

3. Using a thermometer or a temperature control pin, check welding temperature before starting to weld.

4. The ends of the pipes must be cut straight. Use appropriate pipe scissors or cutters. Pipe, fittings and welding tools must be clean. If necessary, clean them with a lint-free cloth.

5. Fitting and pipe must be inserted quickly and axially, without twisting, into the corresponding welding tools. The parts to be welded are then heated without pressure according to the table.

6. After the required heating time, fitting and pipe are to be removed quickly from the heating element and connected immediately by pushing together without twisting until insertion depth or markings have been reached. A double roll provides a visual guide to determine the correct welding (see DVS brochure 2207, Section 11). The line markings on the fittings and the pipe ensure the proper alignment of the pipes.

7. Pressure due to subsequent installation works must not be exerted upon the welded connection until after the end of the cooling period.

8. If necessary, clean the welding tools after each use.

6.2.2 Socket welding with a stationary welding machine, from 40 mm

6.2.2.1 Area of use

We recommend the use of a stationary welding machine for the welding of larger pipe diameters and for the pre-assembly of installation elements. The general guidelines provided by DVS brochure no. 2207, Section 11, “Socket welding with a heated tool. Detailed information on welding times.” apply here.

6.2.2.2 Processing steps

1. Check the machine: Establish welding insertion depth by setting the dimension; make sure the welding temperature is reached.

2. Fix the moulded part with the clamp, taking care not to wind it too tightly, as this can lead to ovality, with a negative impact on the resulting weld. Make sure the moulded part is correctly positioned; use counter-tension to prevent the possibility of slipping.

3. Place the pipe loosely into the jaw chuck.

4. Adjust the dimension using the rotary button, which sets the precise welding insertion depth.

5. Push both tools together until they reach the stop.

6. Push the pipe as far as the fitting, then tighten. Make sure that the welding partners are accurately aligned. Open the welding tool.

7. Insert the welding device. Using the crank, gradually push the fitting and the pipe into the tool until the stop is reached. Pay attention to the welding time.

8. The welding period begins when the pipe and the fitting have been fitted together closely. Allow them to heat up without exerting any further pressure. Once the heating time has elapsed, move the tools apart, remove the welding device, and fit together the fitting and the pipe.

9. Observe the required cooling time.

6.2.3 Welding saddle for 40–250 mm

6.2.3.1 Area of use

- Subsequent extension of existing pipe systems
- Alternative use instead of tees
- Direct branching of a service line to a supply line
- Simple assembly of sensor sleeves

6.2.3.2 Processing steps

1. Before you start the work, prepare material and tools. Ensure that the welding saddle, the drill and the welding tool have the same diameters.

2. Uncover the pipe at the exact location where the welding saddle is supposed to be welded, and mark the welding area. Drain existing pipes and vent the pressure.

3. Prepare the welding device and the saddle welding tools for the polyfusion welding and heat to operating temperature (250–270 °C).

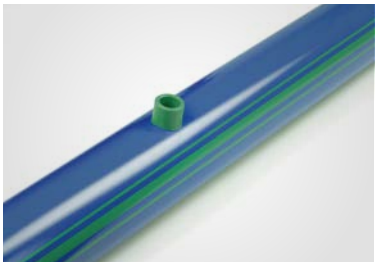
4. Drill through the marked pipe wall with the POLOPLAST plastic drill and clear any cuttings from the drill hole.

5. The parts and areas to be welded must be clean and dry.

6. Push the welding plate into the hole in the wall of the pipe using a suitable and aligned saddle tool, until the tool reaches its stop position. At the same time the weld-in saddle must be pushed in, until the saddle surface reaches the camber of the tool.

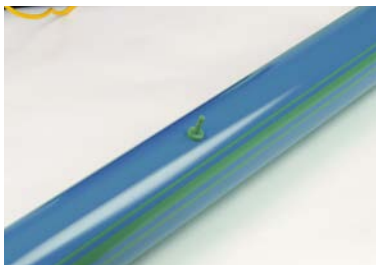
7. The heating time for the pipe and fittings for the drilled hole 25 mm up to 63 mm is 25 seconds for all dimensions.

8. Once the heating time has elapsed, remove the welding device, push the heated weld-in saddle straight into the heated hole as far as it will go without turning it, and hold the pipe in position for at least 20 seconds applying the necessary pressure.



9. After a cooling period of at least 10 minutes, the connection can withstand a full load.

6.2.4 Repair plugs



6.2.4.1 Area of use

- the repair of damaged pipes up to hoile size of 8 mm pipes

6.2.4.2 Processing steps

1. Drain pipes.
2. Uncover damaged pipe.
3. Drill damaged area of pipe out to a diameter of 8 mm at a right angle to the pipe.
4. Heat up drill hole and repair plug with POLO-KLIMA hole welding tool for 15 seconds.
5. Insert repair plug immediately.
6. Cut off protruding end of repair plug.
7. The repaired area of pipe has reached full strength after approx. 5 minutes.

6.2.5 Use of electric welding sockets

6.2.5.1 Area of use

- Welding in constrained positions and in areas with restricted space
- Repair welding
- Alternative processing option for large pipe dimensions

6.2.5.2 Preparation

1. General information and controls

Cleanliness – besides the correct operation – is the most important requirement for achieving good welding results! For the sockets to stay thoroughly clean, they need to be left in the original packaging until they are used. Furthermore, the surface of the pipe must be clean and undamaged. Incorrectly collapsed pipe ends must be cut off. We recommend PP-cleaner or cloths with ethyl alcohol for cleaning.

The pipe elements to be welded as well as the electric socket and the welding equipment must show precisely the same temperature level within the permitted temperature range (i.e. +5 °C to 40 °C according to DVS 2207). (UV radiation or improper storage, to name two examples, can cause significant differences in temperature, which will result in faulty welding.)

2. Preparatory work

It is absolutely mandatory to maintain the order of the working steps!

1. Cut pipe ends at a right angle and burr them (control carved ends).
2. Remove any dirt from the pipe ends at the required length and dry them.
3. Mark the insertion depth of the electro-welded sockets at the pipe end.
4. Remove the oxide film with a pipe scraper on the pipe surface along the length of the insertion depth. Use the peeler intended for the respective diameter of the pipe.
5. Clean thoroughly using ethyl alcohol. A homogeneous and impermeable welded connection can only be established, if the surface in the welding range is peeled and cleaned comprehensively.

Do not touch peeled pipe ends again and protect them from new contamination – e.g. put a clean plastic bag over them. Weld within 30 minutes after the peeling process.

3. Assembly of the electric welding socket

1. Carefully clean the inner surface of the socket using lint-free cloth. Mount the socket within 30 minutes after opening the packaging.
2. Slide the electric welding socket onto the clean and dry pipe end until you reach the marked insertion depth.
3. Completely remove the protective foil and slide the peeled and clean second pipe end into the electric welding socket.

WELDING TECHNOLOGY

Contaminations are to be avoided diligently and all parts must be securely fastened. Pipes must be free of flexural strain or self-weight when they are inserted into the electric welding socket. The socket should still be able move on the pipe ends after the mounting process. The air gap must be evenly distributed around the circumference. A joint that is not free of tension or that has shifted can result in undesired molten mass or in an inadequate connection. The pipe ends and welded sockets must be dry when mounted.

4. Welding process

1. Position the socket so that the air gap is evenly distributed around the circumference.
2. Set the welding equipment to the diameter of the welding socket.
3. Compare the data on the welding equipment's display screen with the details on the label and enter the requested code by scanner or manual (see barcode label on the electric welding socket).
4. Start the welding process and monitor it closely.

The joint must not be moved or put under external pressure during the entire welding process, until it has completely cooled off!
Once the welded connection has been successfully established, two pins remain visible as an outward sign (see picture).

5. Cooling-off time and pressure test

The welded pipe joint may only be put under pressure or moved, and the fastening may only be loosened once the cooling-off period has elapsed!
The minimum required cooling-off time is marked on the electric welding sockets. In case of ambient temperatures above 25 °C or when there is strong solar radiation, the cooling-off time must be extended accordingly!

In order to achieve an ideal and stable welding result, both pipe ends must be plane-parallel within the electric welding socket! It is imperative to mark the socket insertion depth on the pipe, and to adhere to it!

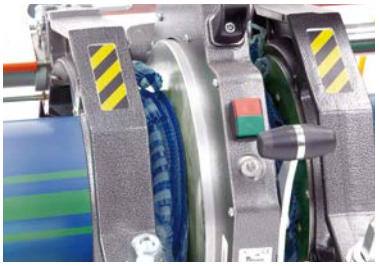
Type of strain	Compression strain	Minimum waiting period
Tension, bending, torsion of unpressurised pipelines		20 minutes
Testing or working pressure of pressurised pipelines	up to 0.1 bar	20 minutes
	0.1 bar to 1 bar	60 minutes
	over 1 bar	120 minutes
Repetition of welding process		60 minutes

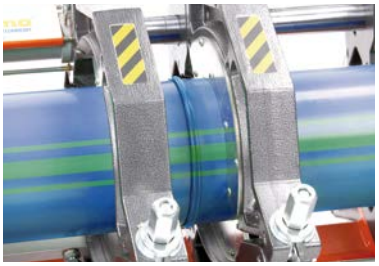
6.2.6 Butt welding process for 160 mm and above

Please also refer to the operating instructions for your welding equipment, which will provide the precise welding parameters.

6.2.6.1 Processing steps

1. Protect the workplace against the effects of weather and against contamination by dirt.
2. Heat up the welding machine and check for proper function.
3. Cut the pipes at a right angle to the required length.
4. Align the pipes and tighten the clamping elements.
5. Using a milling machine, plane the front of the pipes at a uniform level and evenly.
6. Remove shavings and clean the front side with ethyl alcohol.
7. Maintain pipe offset (at most 0.1 × wall thickness).
8. Combine the pipes and check for a seamless connection (maximum tolerance 0.5 mm).
9. Set the joining pressure (refer to relevant table in the operating instructions of the welding machine).
10. Check welding temperature (210 °C).
11. Examine cleanliness of heated element before every operation.
12. Initiate welding process by swivelling the heated element and press the pipes onto the heating element using joining pressure.
13. After reaching the bead height, the pressure is reduced. This is the start of the warm-up time, which brings the pipe ends to the required welding temperature.
14. Once the warm-up time has elapsed, remove the heated element swiftly, and combine the pipes using the necessary pressure.
15. The pipes are now welded and will cool down under pressure.
16. Do not release or remove the welded joint from the clamps until the stipulated cooling-off period has elapsed.





7.1 Fastening techniques

A pipe fastening system that complies with regulations is subject to the following requirements:

- The fastening system must absorb any forces that may occur.
- The external impact upon pipes and fittings, caused e.g. by sagging, changes in length, mechanical load, must be prevented by applying appropriate fastening techniques.
- The pipework must be held firmly in the intended position.

The fastening mechanism must be selected in accordance with the outside diameter of the pipe due to be fixed into position. Take appropriate measures to ensure that the pipe surface cannot be damaged by any of the pipe fastening elements.

Experience has shown that pipe clamps with rubber inserts represent the ideal fastening mechanism for POLOPLAST installation systems. In the selection of suitable fastening materials, we generally differentiate between fixed bearings and slide or guide bearings.

7.1.1 Fixed bearings

- Fixed points are determined to divide the pipe line into individual sections, which helps to avoid uncontrolled pipe movement.
- These fixed points need to be designed so as to compensate for the expansion forces arising from the pipe and possibly existing additional loads.
- Short distances in the ceiling should be chosen as the clamp and the fastening element need to be fastened tightly because of the forces that arise here.

7.1.2 Slide bearings

- They have to compensate for the axial pipe movement without causing any damage.
- When positioning the slide bearings, care must be taken that no fittings or fixtures obstruct the pipeline movement.

7.2 Mounting distances

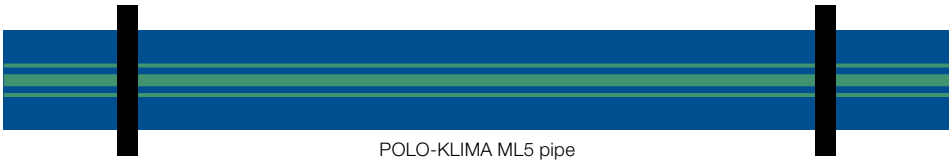
Tables for the determination of the distance between clamps, depending on temperature and outside diameter. The values specified are POLOPLAST recommendations, and are valid for horizontal and vertical installations.

POLO-KLIMA ML5 pipes SDR 7.4, SDR 11

Dimension in mm	Media temperature [°C]						
	10	20	30	40	50	60	70
	Mounting distances [cm]						
20	110	95	90	85	85	80	70
25	120	105	105	95	95	90	80
32	140	120	120	110	110	105	95
40	160	140	135	125	125	120	110
50	185	155	155	145	145	135	130
63	200	175	175	165	165	155	145
75	215	190	190	175	175	165	155
90	230	210	210	195	195	180	180
110	250	220	220	210	200	200	190
125	250	240	225	215	195	185	170
160	280	270	245	235	205	195	180
200	285	275	250	240	210	205	185
250	290	280	255	245	215	200	190

With POLO-KLIMA ML5 pipes you need around 30 % less clamps compared to an installation with standard plastics without fibre reinforcment.

Example:
POLO-KLIMA ML5 pipe 50 mm, medium temperature 10 °C
mounting distance = 1,85 m



POLO-KLIMA ML5 pipe

Standard plastic pipes 50 mm, medium temperature 10 °C
mounting distance = 1,2 m

Standard plastic pipe

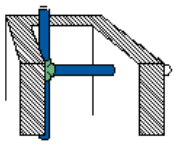
7.3 Laying the pipes

In the case of pipes laid in walls and ceilings, the friction forces that occur prevent the expansion of the pipes, and therefore no compensation is necessary. The resulting tension is absorbed by the pipe materials.

Due to the low expansion forces, the masonry or the plaster are not damaged.

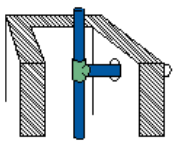
Installing pipes in a shaft

- Changes in length can be disregarded if pipes are laid in a vertical shaft.
- It will be sufficient to mount a fixed-point clamp ahead of every branching; in a rising pipe, all clamps are fixed points.
- Rising pipes can be laid without expansion elbows.
- The distance between two fixed points must not be greater than 3 m.



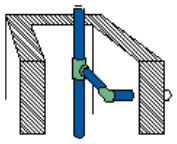
Open laying of pipes

- Such pipes need to be laid using fixed and slide bearings. This will ensure sufficient space for the pipe to expand.
- If the line length equals or exceeds 40 m, expansion must be compensated for using bending legs and angles.



Concealed laying

- No precautions required.



7.4 Length variation

Changes in the length of pipes are dependent on the increasing temperature of the pipe material. This temperature change can be caused by different installation and operating temperatures, as well as varying media temperatures. The potential variation in length must be taken into account at the time of installation.

If the operating temperature is higher than the installation temperature, the pipe will elongate. If the media temperature (e.g. cold water) is lower than the installation temperature, the calculation will result in a reduction in length.

The following factors must be considered in the calculation of the variation in length:
- Installation temperature
- Operating temperatures (media temperatures)
- Temperature difference between installation and operating temperatures
- Coefficient of linear expansion
- Pipe length

The coefficient of linear expansion α are:
- POLO-ECOSAN pipe α = 0.15 mm/mK
- POLO-KLIMA ML5 pipe α = 0.038 mm/mK

The formula for the calculation of the variation in length is:

$$\Delta L = \alpha \times l_0 \times \Delta T$$

ΔL	variation in length	mm
l_0	pipe length prior to temperature change	m
α	length variation coefficient	$\frac{mm}{m \times K}$
ΔT	maximum occurring temperature difference between installation and operating temperature	K

Example:
POLO-KLIMA ML5 pipe
Length = 10 m
Assembly temperature: 20 °C
Working temperature: 40 °C

Calculation:
ΔL = 0.038 mm/mK × 10 m × 20 K
ΔL = 7.6 mm

POLO-KLIMA ML5 pipe								
Pipe length in meters (m)	Difference in temperature ΔT (K)							
	10	20	30	40	50	60	70	80
1.0	0.4	0.8	1.1	1.5	1.9	2.3	2.7	3.0
2.0	0.8	1.5	2.3	3.0	3.8	4.6	5.3	6.1
3.0	1.1	2.3	3.4	4.6	5.7	6.8	8.0	9.1
4.0	1.5	3.0	4.6	6.1	7.6	9.1	10.6	12.2
5.0	1.9	3.8	5.7	7.6	9.5	11.4	13.3	15.2
6.0	2.3	4.6	6.8	9.1	11.4	13.7	16.0	18.2
7.0	2.7	5.3	8.0	10.6	13.3	16.0	18.6	21.3
8.0	3.0	6.1	9.1	12.2	15.2	18.2	21.3	24.3
9.0	3.4	6.8	10.3	13.7	17.1	20.5	23.9	27.4
10.0	3.8	7.6	11.4	15.2	19.0	22.8	26.6	30.4
15.0	5.7	11.4	17.1	22.8	28.5	34.2	39.9	45.6
20.0	7.6	15.2	22.8	30.4	38.0	45.6	53.2	60.8
25.0	9.5	19.0	28.5	38.0	47.5	57.0	66.5	76.0
30.0	11.4	22.8	34.2	45.6	57.0	68.4	79.8	91.2
35.0	13.3	26.6	39.9	53.2	66.5	79.8	93.1	106.4
40.0	15.2	30.4	45.6	60.8	76.0	91.2	106.4	121.6
45.0	17.1	34.2	51.3	68.4	85.5	102.6	119.7	136.8
50.0	19.0	38.0	57.0	76.0	95.0	114.0	133.0	152.0
	Linear expansion ΔL in mm							

7.5 Thermal expansion force

The following formula can be used to calculate the thermal expansion force:

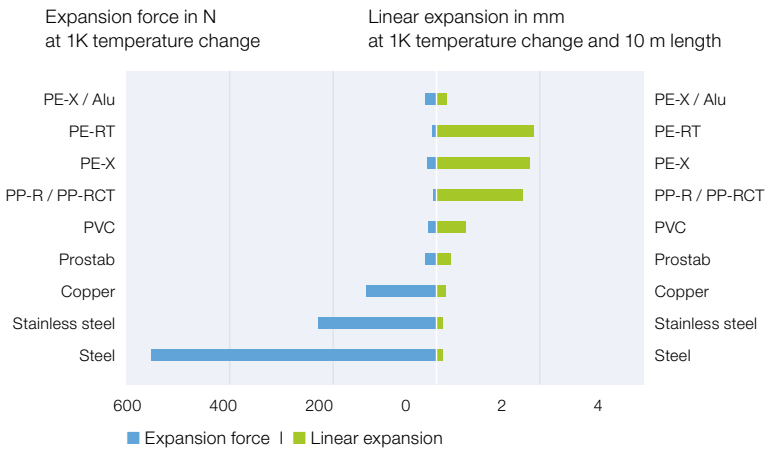
$$F_t = \frac{E \times A \times \alpha \times \Delta T}{1000}$$

F_t = thermal expansion force [N]
E = modulus of elasticity (modulus of rigidity) [MPa = N/mm²]
A = cross-sectional area of the pipe in [mm²]
α = specific thermal expansion coefficient [mm/(mK)]
ΔT = temperature difference resulting from media temperature minus laying temperature [K]

Material	Pipe dimension	Modulus of elasticity	Coefficient of linear expansion	Thermal expansion force
Steel	26.9 × 2.65	220,000	0.012	533
High-grade steel	22.0 × 1.2	200,000	0.015	235
Copper	22.0 × 1.0	130,000	0.016	137
Prostab	25.0 × 3.5	3,500	0.035	29
PVC	25.0 × 3.2	1,100	0.08	19
PP-R / PP RCT	25.0 × 4.2	900	0.150	12
PE-X	25.0 × 3.5	540	0.175	22
PE-RT	25.0 × 3.5	250	0.180	10
PE-X / Alu	26.0 × 3.0	3,500	0.030	22

This comparison shows that the thermal expansion forces occurring in plastic pipes are extremely low, compared to pipes made of metallic materials

If the thermal expansion force is countered by a corresponding retention force, the expansion can be neutralised effectively.



7.6 Expansion compensation

Variations in length caused by temperature differences must be taken into account during the planning stage to prevent subsequent damage to pipelines, fastening elements and the building structure. In order to keep the occurring stress impacts within acceptable ranges, the variation in length must be compensated appropriately. There are two options available to achieve this compensation:

- Expansion compensation using bending legs and a U-pipe bends (“natural” expansion compensation)
- Expansion compensation using compensators (“artificial” expansion compensation)

In most cases, directional changes in the pipe routeing can be utilised to absorb the variation in length. Should the directional changes not be sufficient, a U-pipe bend must be used.

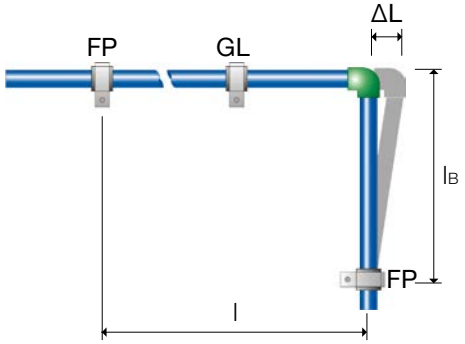
It is important to bear in mind that the outlets distributed throughout the line system can also influence the variation in length, or may be negatively affected themselves by the variation in length.

Please refer to the manufacturers of the compensators for more information on the expansion compensation provided by compensators.

7.6.1 Bending legs

In order to determine the specific direction in which the expansion compensation is steered, the directional change is installed between two fixed points. Generally, the pipes are arranged in right angles at the points where the direction changes. A variation in the length of one leg produces bending in the other leg. Provided that all legs are of a sufficient length to prevent the resulting flexural strain from becoming too great, the system can flexibly absorb the variation in length.

$l_B = K \times \sqrt{d} \times \Delta L$		
l_B	length of the bending leg	mm
K	material-dependent constant (15.0 for PP)	
d	outside pipe diameter	mm
ΔL	variation in length	mm



Sample calculation:
Pipe outside diameter 75 mm
Variation in length 84 mm

$l_B = 15 \times \sqrt{75\ mm\ 84\ mm}$
$l_B = 1191\ mm$

7.6.2 Expansion loop

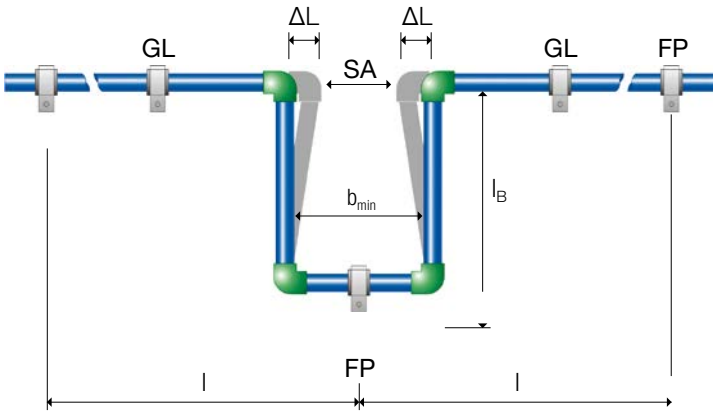
If it is not possible to compensate for the variation in length by introducing directional changes into the pipe routeing, an expansion loop must be used instead.
For the implementation of the expansion bend, the length l_B of the bending leg and the width b_{min} of the expansion bend must be considered. It is advisable to position the expansion bend in such a way that the lengths l_1 and l_2 are equal.

$$b_{min} = 2 \times \Delta L + SA$$

b_{min}	minimum width of the expansion	mm
ΔL	variation in length	mm
SA	safety clearance = 150	mm

Sample calculation:
Variation in length ΔL = 84 mm

$b_{min} = 2 \times 84 \text{ mm} + 150 \text{ mm}$
$b_{min} = 318 \text{ mm}$



7.6.3 Pre-tensioning

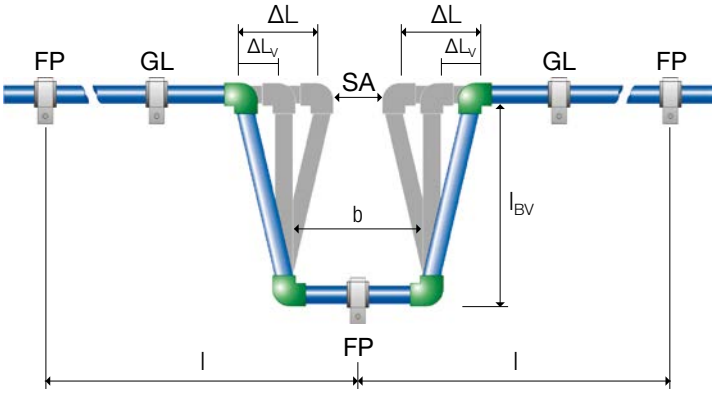
If, during installation, an expansion loop is already pre-stretched by the length ΔL_V against the subsequent length variation and is thus “pre-tensioned”, the length of the bending leg l_{BV} can be reduced.

$$l_{BV} = l_B \times \sqrt{1 - \frac{\Delta L_V}{\Delta L}}$$

ΔL_V	variation in length with pre-tensioning	mm
ΔL	variation in length	mm
l_{BV}	length of bending leg with pre-tensioning	mm
l_B	length of bending leg	mm

Sample calculation:
Variation in length ΔL = 84 mm
Pre-tensioning ΔL_V = 42 mm

$l_{BV} = 1191 \text{ mm} \sqrt{\times 1 - \frac{42}{84}} \text{ mm}$
$l_{BV} = 842 \text{ mm}$



7.7 Insulation

The EnEV (German Energy Saving Regulation) standard regulates the thermal insulation of pipelines and fittings within the Federal Republic of Germany. The tasks of a pipe insulation are:

- Protect the pipes against condensation
- Protect the cold water pipes against exposure to heat
- Minimize heat losses
- Reduce the transfer of heat to structural components
- Reduce sound transmission
- Protect against UV radiation
- Absorb variations in length caused by temperature
- Protect against mechanical stresses
- Protect against corrosion

Requirements according to EnEV
Thermal insulation of heat distribution and hot water pipelines as well as fittings:

Line	Type of pipeline / valves and fittings	Minimum thickness of the insulation layer, based on a thermal conductivity of 0.035 W/(m k)
1	inner diameter up to 22 mm	20 mm
2	inner diameter above 22 mm up to 35 mm	30 mm
3	inner diameter above 35 mm up to 100 mm	equal to inner diameter
4	inner diameter above 100 mm	100 mm
5	pipes, valves and fittings acc. to lines 1 to 4 in wall and ceiling breaks, at the intersection of lines, at line connection points, at central mains system switches	½ of the requirements listed in lines 1 to 4
6	central heating pipes acc. to lines 1 to 4, that have been installed in buildings between heated rooms of various users since January 31, 2002	½ of the requirements listed in lines 1 to 4
7	pipes acc. to line 6 installed in floor constructions	6 mm
8	cold distribution and cold water pipes as well fittings for ventilation and cooling systems	6 mm

When using materials with thermal conductivity values other than 0.035 W/(m K), the minimum thickness values of the insulation layers must be converted accordingly. The calculation methods and values contained within accepted engineering standards must be employed for the conversion and the thermal conductivity of the insulation material.

In the case of heat distribution and hot water pipes, as well as cold distribution and cold water pipes, the minimum thickness values of the insulation layers listed in the table above may be reduced to the extent of the equivalent limitation of heat absorption or loss, and the insulating effect of the pipe walls must be taken into account.

POLO-KLIMA system: Thermal Insulation from heat and cool distribution, hot and cold water lines acc. to EnEV2009

Minimum thickness of the insulating layer related to a thermal conductivity of 0.035 W/mK

Pipe diameter	50 % acc. EnEV	100 % acc. EnEV
20 mm	10 mm	20 mm
25 mm	10 mm	20 mm
32 mm	15 mm	30 mm
40 mm	15 mm	30 mm
50 mm	20 mm	40 mm
63 mm	25 mm	50 mm
75 mm	30 mm	60 mm
90 mm	35 mm	70 mm
110 mm	45 mm	90 mm
125 mm	50 mm	100 mm
160 mm	50 mm	100 mm
200 mm	50 mm	100 mm
250 mm	50 mm	100 mm

7.7.1 Dew point

Condensation occurs when the temperature of a surface falls below the saturation temperature of the surrounding air.
The saturation temperature of the air is determined from the current temperature and the relative humidity. The temperature of the surface is determined by the heat transfer from the material to the pipe surface, from the air to the pipe surface, and the heat transfer through the pipe wall.

Data required in order to determine the dew point:

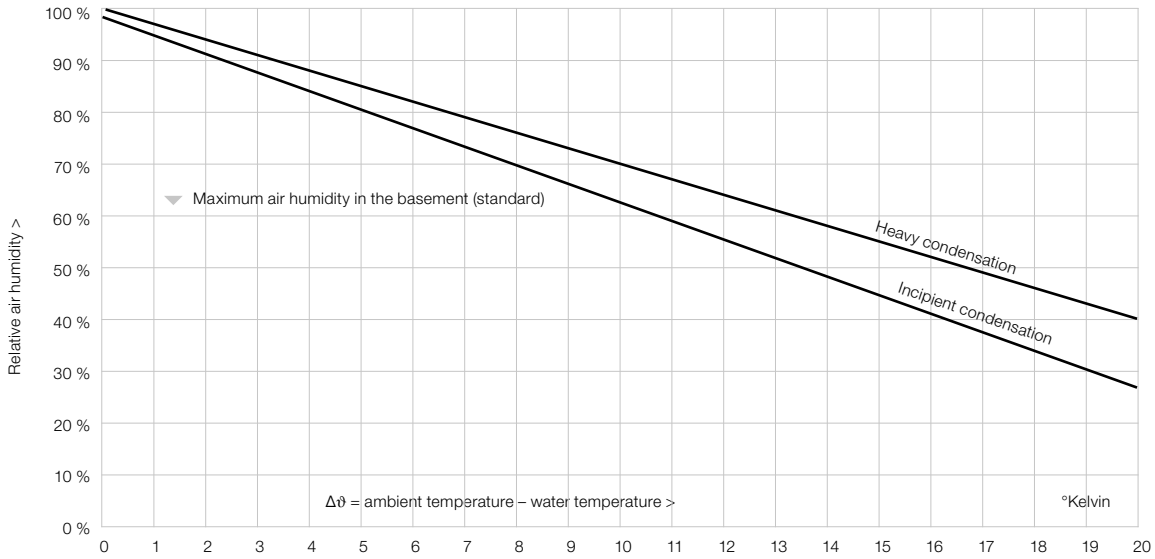
- Relative air humidity
- Room temperature
- Water temperature
- Temperature difference $\Delta\vartheta$ in K (room temperature – water temperature)

Sample calculation:

At a room temperature of 27 °C, 60 % relative humidity and 12 °C water temperature the pipe begins to sweat.

- For SDR 11 pipes the maximum temperature difference is 11 K.

Diagram for the determination of the dew point for POLO-KLIMA ML5 pipe SDR 11



7.8 Fire protection

The POLO-KLIMA pipe system is classified as follows:

Standard	Classification
EN 13501	E
DIN 4102	B2

EN 13501 and DIN 4102
These standards define the classification of those materials, which are used as products or as product components in building construction. The fire behaviour of the products used is tested and classified by testing the behaviour in the case of fire, e.g. the development and spread of fire and smoke.

The behaviour of PP-R in the case of fire
Pipes and fittings made of PP-R, PP-RCT and with fibres, do not exhibit an increased conflagration gas toxicity. In construction objects with a greater need for fire protection measures, pipe ducts through walls and ceilings must be protected against fire in such a way that, as a general principle, all pipe ducts have the same classification as the structural components through which the ducts lead.

For example: In the case of a wall, which features a fire resistance period of 90 minutes (F90), the pipe ducting must also have a fire resistance period of 90 minutes (R 90).

One possible solution is the fire protection measure using fire protection collars or special mineral insulation with a melting temperature of > 1,000 °C.

Fire load

The resulting combustion heat V(kWh/m) of POLO-KLIMA ML5 pipes is dependent on the pipe dimension. The basis for the calculation of the combustion heat V for POLO-KLIMA ML5 pipes made of PP-R is given by the lower calorific value Hu = 12.2 kWh/kg (acc. to DIN 18230 Section 1), as well as the material mass m (kg/m).

Combustion values V (kWh/m) of POLO-KLIMA ML5 pipes.

Outer diameter mm	SDR 7.4 kWh/m	SDR 11 kWh/m
20	1.82	-
25	2.88	-
32	-	3.18
40	-	5.03
50	-	7.78
63	-	12.32
75	-	17.20
90	-	24.77
110	-	36.72
125	-	47.70
160	-	77.84
200	-	121.93
250	-	189.10

8.1 Pressure tests

Upon completion of the installation work, water installations inside buildings must be subjected to hydraulic pressure testing. This must be carried out while the pipe system is fully accessible. In accordance with DIN EN 806, the test can be carried out using water or, if national regulations permit, with oil-free clean air at low pressure or inert gases.
The choice of method to be applied must take into account the factors relating to hygiene and corrosion, and must be determined in relation to the design of the system and the time schedule of the construction project.

In order to pressure test using water, the completed pipelines must be gradually filled with drinking water that does not contain particles ≥ 150 µm, and must then be vented. The drinking water system must be put into operation immediately after the pressure test with water and the subsequent flushing of the system. If this is not possible, the flushing process must be repeated regularly, with no more than 7 days between repetitions. If the system is due to be put into operation at a later stage, in the interest of hygiene, the pressure test should be conducted with air or inert gas as a testing medium.

Due to the characteristic properties of the materials used, plastic pipes expand for a limited period of time when they are subjected to pressure. This has an impact on the test result. A change in the temperature in a pipe system can lead to a change in pressure in the case of pipes made of plastic.
Consequently, pressure testing should follow the protocols provided below (page 61 and following).

Once the pressure tests have been completed, the responsible technician must produce a formal record, which includes an assessment of the test. The impermeability of the system must be evident, and must be confirmed in writing.

Pressure testing with water

DIN EN 806-4 stipulates that there are three possible pressure tests, depending on the different material properties. Due to issues concerning the practical feasibility on site, and following practical experiments, a modified method was selected, which is suitable for all materials and all material combinations.
The duration of the test was extended beyond the period stipulated in the standard, to ensure that even the smallest possible leaks can be detected during the leak test.

Pressure testing protocol, testing media: water

Construction project: .....

Construction stage: .....

Client represented by: .....

Contractor represented by: .....

Admissible operating pressure = 10 bar ..... bar (if higher)

Water temperature ..... °C Ambient temperature ..... °C

System inspection as ☐ complete system ☐ in ..... sections

Preliminary arrangements:

☐ The pipe system is made of PP, and, if applicable, with combined installations made of metal and multi-layer composite pipelines.
☐ All pipes have been sealed by metal plugs, caps, blanking plates or blank flanges.
☐ Equipment and valves that do not meet the required test pressure, have been separated from the lines.
☐ Expert laying of the piping.
☐ Filling water has been filtered. Filter mesh < 150µm
☐ The system has been filled, flushed and de-aerated.

Leak test

	Testing method	Results	Note
☐	Preliminary test Test pressure 15 bar Test duration 30 min	A maximum pressure drop of 0.5 bar Test pressure after 30 min _____ bar	
☐	Main test Test pressure 10 bar Test duration 30 min	A maximum pressure drop of 0.2 bar Test pressure after 30 min _____ bar	
☐	Final test Test pressure 10 bar Test duration 60 min	No pressure drop Test pressure after 60 min _____ bar	

☐ Visual inspection of pipe system has been carried out
☐ No leaks were determined during the testing period
☐ The pipe system is leak-proof

Place ..... Date .....

Client ..... Contractor .....

1) The pressure gauges used must allow a precise reading of a 0.1 bar change in pressure.

9.1 Quality assurance

All incoming goods that are intended for use as raw and auxiliary materials for further processing, are checked for their suitability by POLOPLAST quality assurance.

The manufacture of quality-controlled pipeline systems requires all necessary procedural steps:
- Monitoring
- Control
- Inspection

Furthermore, all results and procedures are documented.

The minimum requirements for independent company quality control are derived from the corresponding regulations for the quality control of sanitary pipeline systems, in that compliance must also include inspection by a neutral testing institution within the framework of external control.

External control, in addition to external testing of products, includes
- testing of the manufacturer's own required control measures
- examination of the technical equipment requirements
- hygienic and toxicological testing

External control of the POLOPLAST pipe systems in Germany is conducted by the
- Süddeutsches Kunststoffzentrum (Southern German Plastics Centre) (SKZ)
- Hygiene Institut (Hygiene Institute of) Karlsruhe (TZW),

which are authorised as testing centres by DVGW (German Association of Gas and Water Facilities), among others.

External control of approvals for foreign usage is conducted in a similar manner.

The suitability of the POLOPLAST pipe systems for drinking water has been established by the Technology Water Centre (TWZ) according to the "Guideline for Hygienic Assessment of Organic Materials in Contact with Drinking Water" (KTW Guideline) provided by the German Federal Environmental Agency, and is subject to permanent external control.

Summary of key points:
- The entire production process is defined, monitored, documented
- Quality management according to DIN EN ISO 9001
- Complies with all applicable standards, laws and regulations
- Monitoring by external institutes
- Certified system
- Energy management according to DIN EN ISO 50001

QUALITY MANAGEMENT

Quality assurance

The entire production process for POLOPLAST pipe systems and fittings is monitored and controlled by POLOPLAST quality assurance. All results and procedures are documented. The monitoring is carried out by external institutes and by self-monitoring.

Self-monitoring

↓

Tasks

↓

- Comply with all applicable standards, laws and regulations
- Laboratory testing of pipes and fittings
- Inspection of incoming goods
- Quality assurance in production processes

External monitoring

↓

By authorised testing institutes of the DVGW:
- Süddeutsches Kunststoffzentrum (Southern German Plastics Centre) (SKZ)
- Technologiezentrum Wasser (Technology Centre Water) in Karlsruhe

↓

Tasks

↓

- Testing of the manufacturer's self-monitoring
- Product testing
- Examination of the technical equipment requirements
- Hygienic and toxicological testing acc. to KTW guidelines

Our organisation is certified in accordance with ISO 9001 and ISO 50001


qualityaustria
Succeed with Quality

CERTIFICATE

poloplast

POLOPLAST GmbH & Co KG
POLOPLAST GmbH

QUALITY MANAGEMENT SYSTEM
complying with the requirements of standard
ISO 9001:2008

Signatures removed for security reasons


qualityaustria
Succeed with Quality

CERTIFICATE

poloplast

POLOPLAST GmbH

ENERGY MANAGEMENT SYSTEM
complying with the requirements of standard
ISO 50001:2011

Signatures removed for security reasons


IQNet
THE INTERNATIONAL CERTIFICATION NETWORK

CERTIFICATE

POLOPLAST GmbH
DE-87640 Ebenhofen, Kirnachstraße 17

for following field of activities
International supplier of plastic pipe systems for hot and cold water

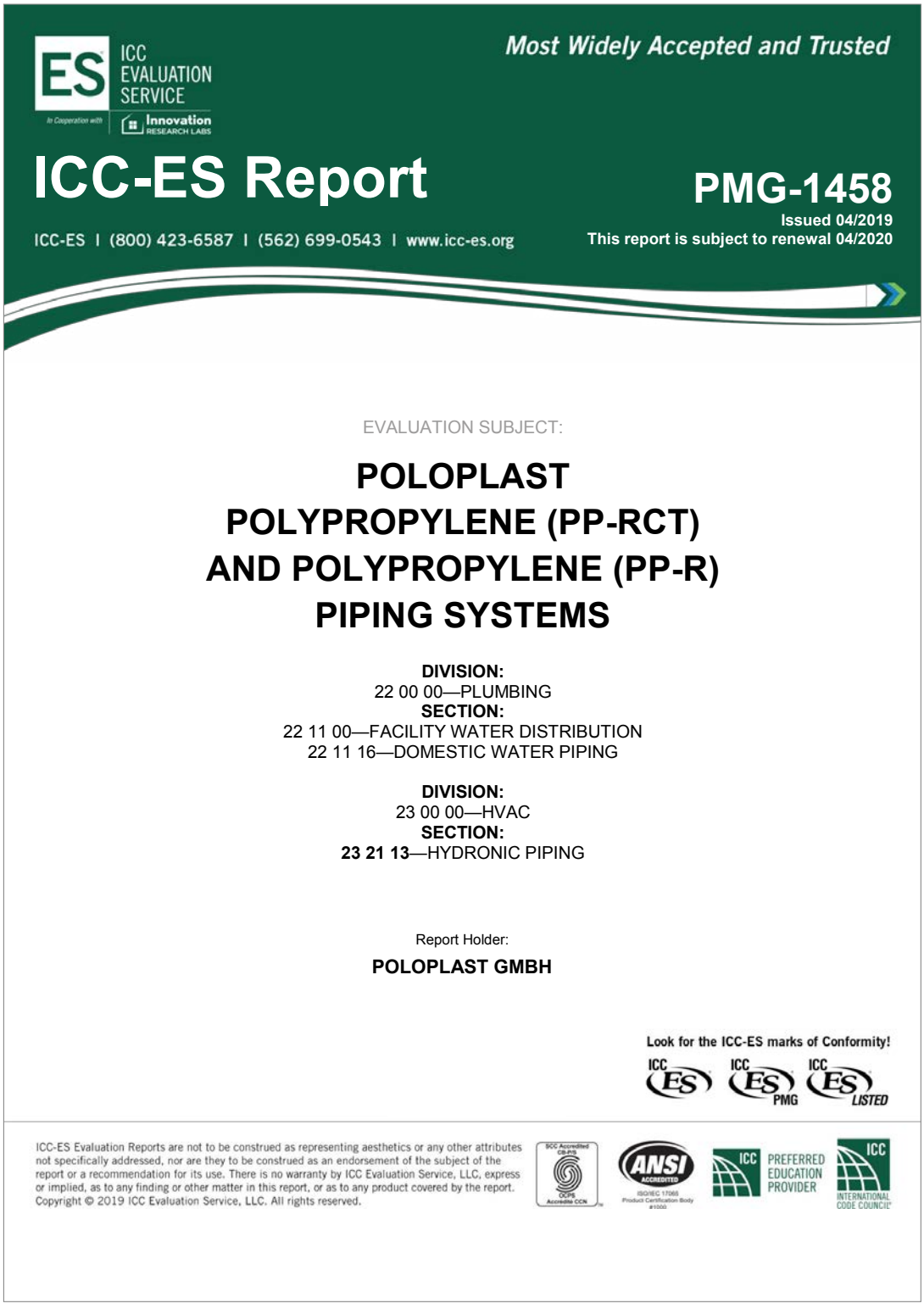
has implemented and maintains an
ENERGY MANAGEMENT SYSTEM
which fulfils the requirements of the following standard
ISO 50001:2011

Registration Number: AT-00087/0

Signatures removed for security reasons

9.1.1 Approvals

- Compliance with standards according to EN ISO 15874, ASTM F 2389, NSF14
- Tested by the accredited testing service institute ICC



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Issued 04/2019
This report is subject to renewal 04/2020

EVALUATION SUBJECT:

POLOPLAST
POLYPROPYLENE (PP-RCT)
AND POLYPROPYLENE (PP-R)
PIPING SYSTEMS

DIVISION:
22 00 00—PLUMBING
SECTION:
22 11 00—FACILITY WATER DISTRIBUTION
22 11 16—DOMESTIC WATER PIPING

DIVISION:
23 00 00—HVAC
SECTION:
23 21 13—HYDRONIC PIPING

Report Holder:
POLOPLAST GMBH

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ICC PREFERRED EDUCATION PROVIDER

9.2 POLO-KLIMA pipe system letter of guarantee

POLOPLAST FOR PARTNERS

POLO-KLIMA
GUARANTEE DECLARATION

In line with our corporate philosophy, top tube and moulding quality includes the subsequent guarantee for in-company manufactured products from POLOPLAST's POLO-KLIMA programme. In addition to any legal warranty and damage claims, upon the agreement of POLOPLAST's general terms of business, the company undertakes the following

GUARANTEE

POLOPLAST assumes worldwide (with the exception of the USA and Canada) liability for damages, resulting from manufacturing errors, deficiencies caused by incorrect storage, laying and installation instructions, the lack of the characteristics expressly guaranteed by POLOPLAST, or damages caused by POLOPLAST through the use of products covered by this guarantee. This liability shall be valid for a period of **10 years** from the date of manufacture and encompass:

1. the free delivery to the place of employment of the replacement parts required for the repair of the damage, as well as
2. the necessary removal and installation costs, including the expenses incurred for the restoration of the object to its original condition, up to a sum of € 2,000,000 per occurrence of damage.

Pursuant to this declaration POLOPLAST provides this guarantee to its contractual partners when

1. laying was completed by trained personnel from a licensed sanitary plumping company in connection with installation as contractually intended and all the technical regulations valid at the time of completion were observed;
2. the contractual partner proves that only POLOPLAST original parts were employed and that these were not combined with products of any other origin;
3. the contractual partner proves that the cause of damage did not relate to parts subject to natural wear and tear, to external mechanical damage, or other external influences on the product;
4. it can be proven that at the time of laying all the current storage, laying, installation and application stipulations were observed in full;
5. all the measures necessary for damage minimisation were initiated immediately;
6. the occurrence of damage was reported to POLOPAST without delay and under all circumstances within seven days of the identification of the damage, complete with information concerning the related facts and circumstances;
7. prior to repair work, POLOPLAST is given an opportunity to determine and appraise the damage itself or through a third party;
8. all the parts relating to the claim are kept for the investigation of the damage occurrence and are provided to POLOPLAST upon request;
9. the date of production and installation are evidenced in suitable form (pressure test report);
10. the related delivery documents are presented to POLOPLAST.

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POLOPLAST GmbH
Ebenhofen, October 1st, 2017

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9.3 Sustainability

In the development of its products and their production, POLOPLAST places emphasis on the sustainable, environmentally friendly and resource-conserving implementation. The raw material polypropylene PP-R can be recycled to 100 %. Any residues from the production can be reused.

Thanks to this advantage it can be processed further for the industry in many different ways. Compared to other materials, the energy expenditure required for the production of POLOPLAST products is significantly lower. Furthermore, the process does not produce any environmentally hazardous substances, leading to an excellent environmental performance evaluation overall.

Advantages PP-R:

- Can be recycled
- Free of halogen
- Free of plasticisers
- Hygienically safe
- Environmentally friendly

NOTES

NOTES

POLOPLAST. A company of Wietersdorfer

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