

Technical manual

PP-R Pipe system for HVAC application

MECHANICAL



TABLE OF CONTENTS

System description

1.1	MECHANICAL – pipe system made of PP-R.....	6
1.2	Overview pipe system.....	7
1.3	Pipe structure	8
1.4	Application	9
1.4.1	Example for the use of POLYMELT systems	9
1.4.2	POLYMELT Pre-insulated pipes	10
1.5.2	Market segments.....	12

System requirements

2.1	Technical data	13
2.1.1	Working pressure values	13
2.2	Standards and regulations.....	15
2.2.1	System-specific standards	15
2.3	Terms used.....	16
2.3.1	Standard dimension ratio.....	16
2.3.2	Pipe series number S	16
2.3.3	Nominal pressure (PN).....	16
2.4	Chemical resistance	17
2.4.1	Chemical disinfection – “shock disinfection”	18
2.4.2	Continuous metered addition of chemicals – “permanent disinfection” ...	18

Transportation and storage

3.1	Safety instructions and intended use	19
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Product range

4.1	Product range.....	20
4.1.1	Pipe	20
4.1.2	Fittings.....	21
4.1.3	Fitting Adapters	31
4.1.4	Valves	33

Planning and design

5.1	Single resistance values and pressure loss tables	40
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Welding technology

6.1	Basic information.....	52
6.1.1	Socket welding using a heated tool	52
6.1.2	Guidelines.....	52
6.2	Processing information for welding	53
6.2.1	Socket welding with a hand-held welding device, from 20 mm.....	54
6.2.2	Socket welding with a stationary welding machine, from 40 mm.....	55
6.2.3	Welding saddle for 40–250 mm.....	56
6.2.4	Repair plugs	57
6.2.5	Use of electric welding sockets.....	58
6.2.6	Butt welding process for 160 mm and above	60

TABLE OF CONTENTS

Assembly guidelines

7.1	Fastening techniques.....	61
7.1.1	Fixed bearings	61
7.1.2	Slide bearings.....	61
7.2	Mounting distances	62
7.3	Laying the pipes	63
7.4	Length variation	64
7.5	Thermal expansion force	65
7.6	Expansion compensation	66
7.6.1	Bending legs	66
7.6.2	Expansion loop.....	67
7.6.3	Pre-tensioning	67
7.7	Insulation	68
7.7.1	Dew point	69
7.8	Fire protection.....	70

Initial operation

8.1	Pressure tests.....	71
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Quality management

9.1	Quality assurance.....	73
9.3	Sustainability	75

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. POLYMELT does not assume legal liability or any other form of liability for erroneous information and its consequences. POLYMELT is grateful for any suggestions or comments.

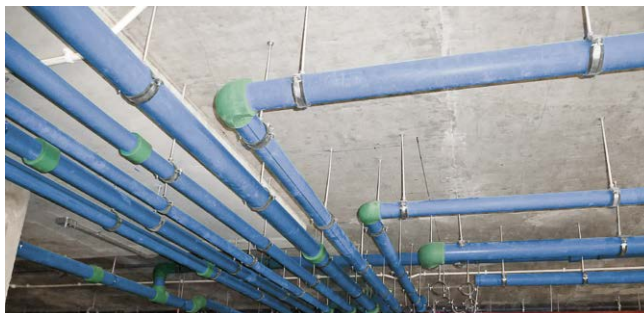
We are happy to provide further information – please contact the POLYMELT sales office on +49 8342 70060, mail@polymelt.com

SYSTEM DESCRIPTION

1.1 MECHANICAL – pipe system made of PP-R

The MECHANICAL 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.



POLO-KLIMA is
now **MECHANICAL**

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

SYSTEM DESCRIPTION

1.2 Overview pipe system

The MECHANICAL pipe system consists of the MECHANICAL ML5 pipe and ECOSAN fittings.

The MECHANICAL system is available in the following design versions:

	MECHANICAL Fiber pipe			Fusion technology
				
				
Outside diameter in mm				
20	✓			Socket fusion
25	✓			
32		✓		
40		✓		
50		✓		
63		✓		
75		✓		
90		✓		
110		✓		
125		✓	✓	
160		✓	✓	Butt fusion
200		✓	✓	
250		✓	✓	
315		✓	✓	
355		✓	✓	
400		✓	✓	
450		✓	✓	
500			✓	
Pipe series	S 3.2	S 5.0	S 8.3	
Working pressure @50 years *for elevated working pressures see our table on page 13	10 °C / 18 bar		10°C / 11bar	
Thermal expansion factor	0.038 mm/mK			

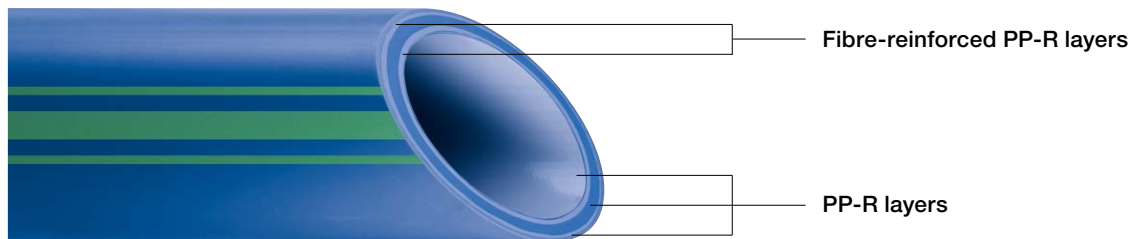
The calculation of the working pressure assumed a safety factor SF 1.25 for a 50-year service life.

SYSTEM DESCRIPTION

1.3 Pipe structure

The MECHANICAL 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 weight**
compared to steel and copper



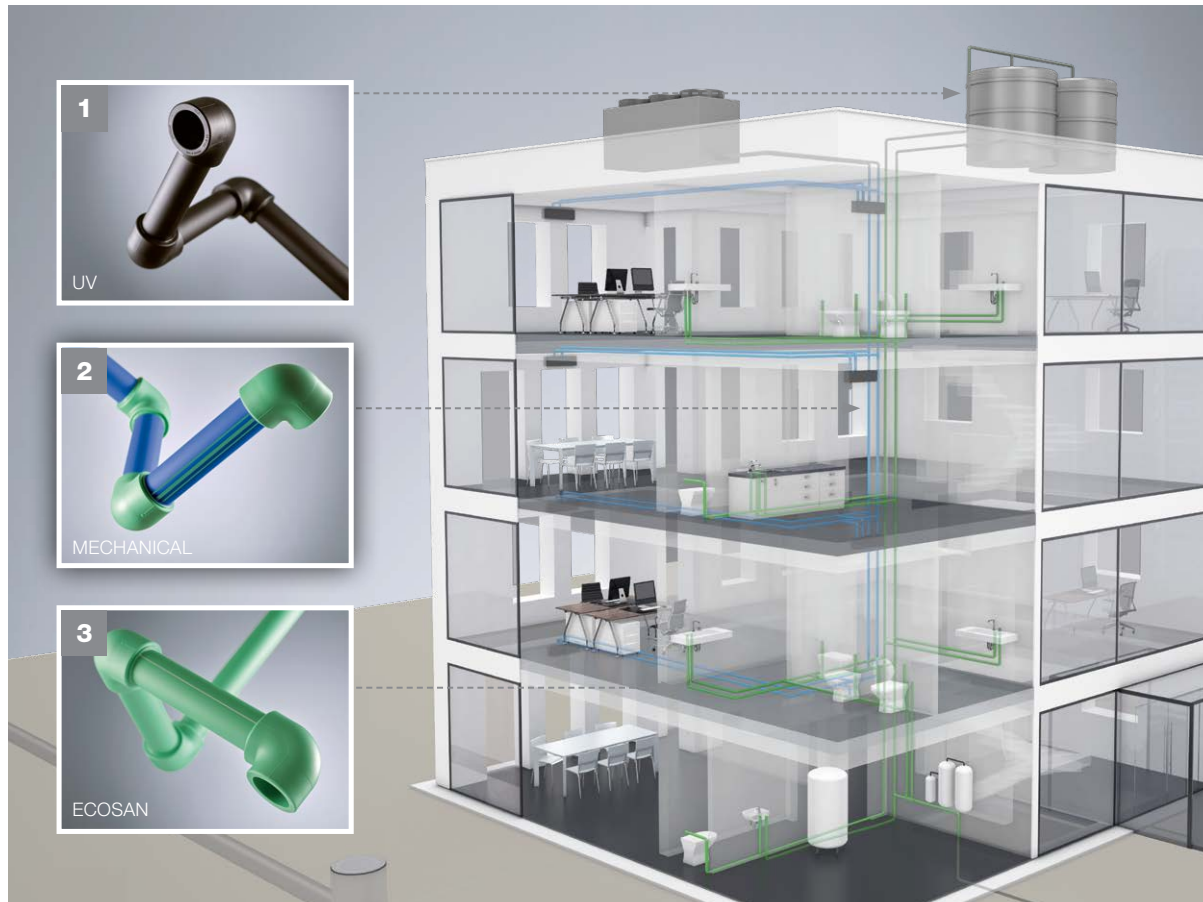
Material specification PP-R

Properties	Measuring method	Unit	Value
Density	ISO 1183	kg/m ³	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/m ²	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

SYSTEM DESCRIPTION

1.4 Application

1.4.1 Example for the use of POLYMELT systems



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

1. 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. MECHANICAL system for HVAC applications

- Connection lines to AC vans
- Connection lines to chiller
- Process water cooling
- Connection to cooling towers
- Dimension 20–500 mm

3. ECOSAN system for Hot & Cold applications

- Potable water distribution
- Connection to boiler
- Manifold constructions
- Water tank connection
- Risers, single feeding lines
- Dimension 20–250 mm

SYSTEM DESCRIPTION

1.4.2 POLYMELT Pre-insulated pipes

Lightweight, pre-insulated pipes are easy to connect and install. They help minimize energy losses and reduce long-term operating costs. These pipelines are pre-insulated with high efficiency foam and are suitable for both new construction and retrofits of district heating and cooling systems.

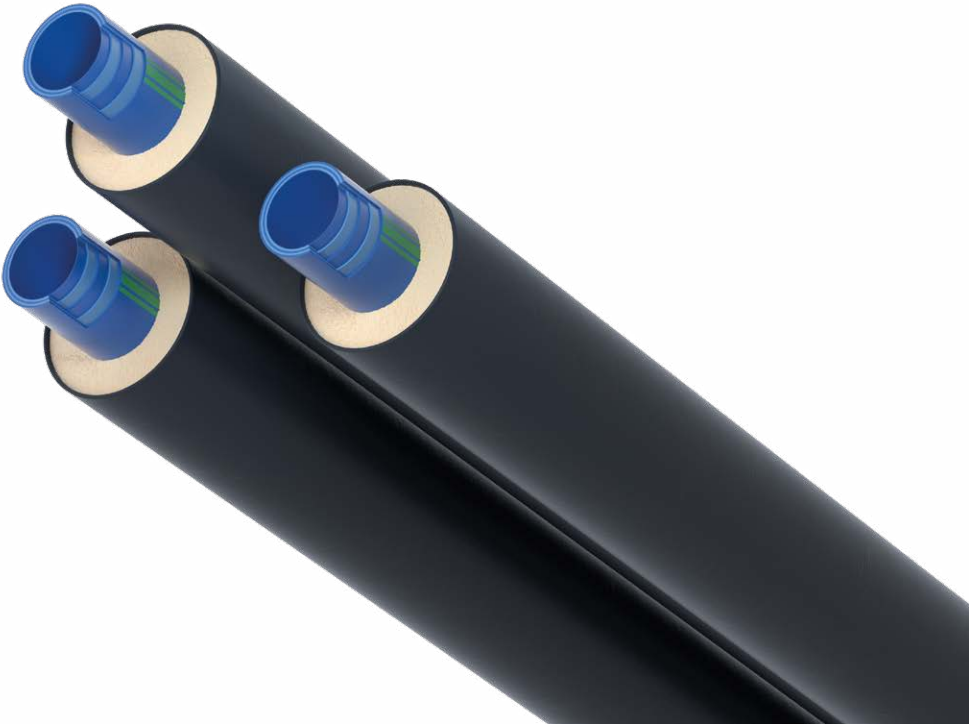
POLYMELT pipes are also in Pre-insulated version available. Upon request we can offer you based on your individual demand and application.

Pre insulated construction:

- Pressure pipe made of ECOSAN or MECHANICAL fiber pipe
- Insulation PUR foam
- Outer layer made of PE

Application

- Potable hot and cold water
- District heating and cooling
- Thermal water systems



SYSTEM DESCRIPTION

No corrosion problems in cooling water systems with MECHANICAL

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.

MECHANICAL 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

1.5.2 Market segments

The POLYMELT Mechanical system can be used in the following areas:

Residential

- Custom single-family
- Commercial multi-family
- Private developments
- Public developments

Commercial

- Hotels
- Office buildings
- Hospitals
- Universities
- Government/D.O.D.
- Municipal schools
- Stadiums
- Shopping centers

Industrial

- Food processing
- Manufacturing
- Data centers
- Agricultural
- Chemical
- Laboratories
- Pharmaceutical
- Utility
- Landfill
- Mining

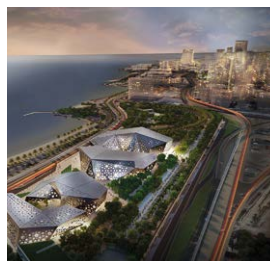
The recommended fields of application

Fields of application	POLYMELT MECHANICAL
Cooling technology	✓
Heating technology	✓
Chilled water systems	✓
District cooling system	✓
Connection to cooling towers	✓
Irrigation	✓
Agricultural	✓
Geothermal	✓
Process water cooling	✓
Chemical transport	✓
Compressed air systems	✓

INTERNATIONAL REFERENCES POLYMELT 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

SYSTEM REQUIREMENTS

2.1 Technical data

2.1.1 Working pressure values

Long term behaviour with a safety factor of 1.25

Temperature	Operating time	MECHANICAL ML5 pipe			
		SDR11		SDR17,6	
		maximum working pressure			
		bar	(psi)	bar	(psi)
0-10 °C	1	21,1	306	12,6	183
	5	19,8	287	11,9	173
	10	19,3	280	11,6	168
	25	18,7	271	11,2	162
	50	18,2	264	10,9	158
15 °C	1	19,8	287	11,8	171
	5	18,6	270	11,1	161
	10	18,1	263	10,8	157
	25	17,5	254	10,4	151
	50	17,0	247	10,1	146
20 °C	1	18,0	261	10,5	152
	5	16,9	245	10,1	146
	10	16,4	238	9,9	144
	25	15,9	232	9,5	138
	50	15,4	225	9,3	135
30 °C	1	15,3	222	9,2	133
	5	14,3	209	5,6	81
	10	13,9	202	5,4	78
	25	13,4	194	5,1	74
	50	13,0	190	7,5	109
40 °C	1	13,0	187	7,5	109
	5	12,1	176	7,3	106
	10	11,8	171	7,1	103
	25	11,3	164	6,8	99
	50	11,0	160	6,6	96
50 °C	1	11,0	160	6,6	96
	5	10,2	148	6,1	88
	10	9,9	144	5,9	86
	25	9,5	139	5,7	83
	50	9,2	135	5,5	80
60 °C	1	9,2	135	5,5	80
	5	8,6	125	5,1	74
	10	8,3	120	5,0	73
	25	8,0	116	4,8	70
	50	7,7	112	4,6	67
70 °C	1	7,8	113	4,6	67
	5	7,2	104	4,3	62
	10	7,0	102	4,2	61
	25	6,0	88	3,6	52
	50	5,1	74	3,0	44
75 °C	1	7,3	106	4,3	62
	5	6,7	97	4,1	59
	10	6,2	90	3,7	54
	25	4,9	71	2,9	42
	50	4,1	59	2,5	36
80 °C	1	6,5	94	3,9	57
	5	5,7	83	3,4	49
	10	4,8	70	2,9	42
	25	3,9	57	2,3	33
90 °C	1	5,5	80	3,3	48
	5	3,9	57	2,3	33
	10	3,2	46	1,9	28

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: **MECHANICAL ML5 pipe SDR 11**

Temperature	Operating time	MECHANICAL 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

SYSTEM REQUIREMENTS

2.2 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 1988	Technical Regulations on Drinking Water Installations
DIN EN 806	Technical Regulations on Drinking Water Installations
DIN 2000	Guidelines on the Requirements on Drinking Water, Planning, Laying, Operation and Maintenance of Supply Systems
DIN 4109	Sound Protection in Structural Engineering
DIN 4102	Fire Prevention
DVGW W 551	Technical Measures for the Reduction of Legionella Growth in Drinking Water Installations
VDI 6023	Hygiene-conscious planning, laying, operation and maintenance of drinking water plants
POLYMELT	Technical Manual
DVS 2207	Welding of Thermoplastics
DVS 2208	Machinery and Appliances for Welding Thermoplastics

2.2.1 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
ASTM F2389-2017A	Pressure-rated Polypropylene (PP) Piping System
NSF/ANSI 14-2018	Plastic Piping Systems Components and Related Materials
ICC-ES LC1004	PMG Listing Criteria for PP Piping and Fittings Used in Water Supply Systems

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.

SYSTEM REQUIREMENTS

2.3 Terms used

2.3.1 Standard dimension ratio

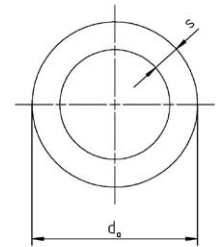
SDR is an index in use for the classification of plastic pipes, which describes the ratio between a pipe's outer diameter and its wall thickness.

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

S = pipe series number

s = wall thickness

da = outer diameter



2.3.2 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:

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

Example: MECHANICAL ML5 pipe SDR 11 = S5

2.3.3 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.

SYSTEM REQUIREMENTS

2.4 Chemical resistance

Thanks to the special properties of its materials, the MECHANICAL pipe system features excellent chemical resistance.

Chemical resistance of the 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 POLYMELT, if the pipe system is likely to come into contact with chemicals and other aggressive media.

Inquiry regarding the chemical resistance of the MECHANICAL 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: POLYMELT GmbH
Kirnachstraße 17, 87640 Ebenhofen, Germany
Tel. +49 8342 70060
Fax +49 8342 700666
mail@polymelt.com, www.polymelt.com

SYSTEM REQUIREMENTS

2.4.1 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 ₂ O 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.

2.4.2 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 ClO₂) the maximum amount that can be added into the pipe system is 0.4 mg/l ClO₂.

TRANSPORTATION AND STORAGE

3.1 Safety instructions and intended use

- Carefully read the technical manual and the operating instructions before starting work.
- POLYMELT 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 POLYMELT'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 POLYMELT 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

- POLYMELT 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.

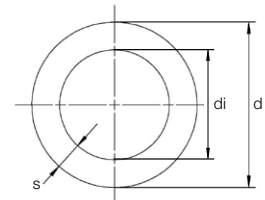
PRODUCT RANGE

4.1 Product range

4.1.1 Pipe

MECHANICAL ML 5 pipe SDR 7.4/11/17.6

Material: PP-R/ PP-R GF
 Pipe structure: Multi-layer pipe, fibre-reinforced
 Colour: Blue with green stripes
 Standards: DIN 8077/78, EN ISO 15874, ASTM 2389, NSF14
 Approval: ICC ES product certification
 Available sizes: 20-500mm
 Pipe lenght : 20-125mm in 4.0m length
 160-500mm in 5.8m length
 Special length on request



SDR	A. no.	Inch N.D.	Outer Diameter (d) mm	Wall thickness (s) mm	Inner diameter (di) mm	Water content l/m	Weight kg/m	Supply unit m	Availability
7.4	80322	1/2"	20	2,8	14,4	0,16	0,15	100,0	S
7.4	80323	3/4"	25	3,5	18,0	0,25	0,24	60,0	S
11	80324	1"	32	2,9	26,2	0,53	0,26	40,0	S
11	80325	1 1/4"	40	3,7	32,6	0,83	0,41	20,0	S
11	80326	1 1/2"	50	4,6	40,8	1,31	0,64	20,0	S
11	80327	2"	63	5,8	51,4	2,08	1,01	12,0	S
11	80328	2 1/2"	75	6,8	61,4	2,94	1,41	8,0	S
11	80329	3"	90	8,2	73,6	4,25	2,03	4,0	S
11	80330	3 1/2"	110	10,0	90,0	6,36	3,01	4,0	S
11	80331	4"	125	11,4	102,2	8,20	3,91	4,0	S
11	80333	6"	160	14,6	130,8	13,44	6,41	4,0	S
11	80334	8"	200	18,2	163,6	21,03	10,00	4,0	S
11	80335	10"	250	22,7	204,6	32,87	15,60	4,0	S
11	80346	12"	315	28,6	257,8	52,20	24,60	5,8	MQ
11	80347	14"	355	32,2	290,6	66,33	31,20	5,8	MQ
11	80348	16"	400	36,3	327,4	84,18	39,60	5,8	MQ
11	80349	18"	450	40,9	368,2	106,47	50,10	5,8	MQ
17.6	80351	4"	125	7,1	110,8	9,64	2,55	4,0	S
17.6	80353	6"	160	9,1	141,8	15,79	4,17	5,8	S
17.6	80354	8"	200	11,4	177,2	24,66	6,50	5,8	S
17.6	80355	10"	250	14,2	221,6	38,57	10,10	5,8	S
17.6	80366	12"	315	17,9	279,2	61,22	16,00	5,8	MQ
17.6	80367	14"	355	20,1	314,8	77,83	20,30	5,8	MQ
17.6	80368	16"	400	22,7	354,6	98,75	25,70	5,8	MQ
17.6	80369	18"	450	25,5	399,0	125,03	32,50	5,8	MQ
17.6	80370	20"	500	28,4	443,2	154,27	40,20	5,8	MQ

MQ: Minimum Quantity required upon request

S: Stocked

PRODUCT RANGE

4.1.2 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	Availability
	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	Availability
	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	Availability
	17002	20	0.012	600 / 10	S
	17003	25	0.017	400 / 10	S
	17004	32	0.030	250 / 10	S
	17005	40	0.043	170 / 10	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	S
					

PRODUCT RANGE

SYSTEM DESCRIPTION	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			
PRODUCT RANGE		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			
PLANNING AND DESIGN	Reducer male/male Material: PP-R Colour: Green Standards: EN ISO 15874 Product line: Ø 160–500 mm Processing: Socket and butt welding  d d1	SDR	A. no.	Diameter		Weight kg/pc.	Supply unit cardboard box/package	Availability
				d	d1			
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	
11		9017655	315	250	7,97	1	S	
11		9017657	355	250		1	S	
11		9017658	355	315	11,9	1	S	
11		9017659	400	315		1	S	
11		9017660	400	355		1	S	
11		9017663	450	355		1	S	
11		9017664	450	400		1	S	
ASSEMBLY GUIDELINES		17.6	8017648	160	110		1	S
		17.6	8017647	160	125	1,12	1	S
		17.6	8017650	200	160	2,61	1	S
		17.6	8017651	250	160	3,95	1	S
		17.6	8017652	250	200	4,45	1	S
	17.6	8017655	315	250	7,85	1	S	
INITIAL OPERATION	17.6	8017658	355	315	9,5	1	S	
	17.6	8017660	400	355		1	S	
	17.6	8017664	450	400		1	S	
	17.6	8017663	450	355		1	S	
	17.6	8017666	500	400		1	S	
	17.6	8017667	500	450		1	S	
QUALITY MANAGEMENT								

22

.

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

PRODUCT RANGE

Elbow 90° for socket welding and butt welding

Material: 20-125mm: PP-R

160-500mm: PP-RCT

Colour: Green

Standards: EN ISO 15874, DIN 16962

Processing: Type A: Socket welding,

Type B: Butt welding/molded,

Type C: Butt welding/segmented

Type A



Type B



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	S
11	17053/2	160	B	2.96	1 / 1	S
11	17055/2	200	B	5.44	1 / 1	S
11	17057/2	250	B	9.62	1 / 1	S
11	17059/2	315	B	17.07	1 / 1	S
11	17061/2	355	B	28,45	1 / 1	S
11	17063/2	400	B	39,58	1 / 1	MQ
11	17065/2	450	B	57,1	1 / 1	MQ
17.6	8717054	160	B	2,33	1 / 1	S
17.6	8717056	200	B	4,4	1 / 1	S
17.6	8717058	250	B	7,7	1 / 1	S
17.6	8717070	315	B	14,1	1 / 1	S
17.6	8717072	355	B	23,1	1 / 1	MQ
17.6	8717074	400	B	30,9	1 / 1	MQ
17.6	8717076	450	B	43,8	1 / 1	MQ
17.6	8717078	500	B	60,5	1 / 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
11	9017070	315	C		1 / 1	S
17.6	8017054	160	C		1 / 1	S
17.6	8017056	200	C		1 / 1	S
17.6	8017058	250	C		1 / 1	S
17.6	8017070	315	C		1 / 1	S

SYSTEM DESCRIPTION

SYSTEM REQUIREMENTS

TRANSPORTATION AND STORAGE

PRODUCT RANGE

PLANNING AND DESIGN

WELDING TECHNOLOGY

ASSEMBLY GUIDELINES

INITIAL OPERATION

QUALITY MANAGEMENT

PRODUCT RANGE

SYSTEM DESCRIPTION	Elbow 45° for socket welding and butt welding Material: 20-125mm: PP-R 160-500mm: PP-RCT Colour: Green Standards: EN ISO 15874, DIN 16962 Processing: Type A: Socket welding, Type B: Butt welding/molded, Type C: Butt welding/segmented						
SYSTEM REQUIREMENTS	Type A  Type B  Type C 						
TRANSPORTATION AND STORAGE							
PRODUCT RANGE							
PLANNING AND DESIGN							
WELDING TECHNOLOGY							
ASSEMBLY GUIDELINES							
INITIAL OPERATION							
QUALITY MANAGEMENT							
	SDR	A. no.	Diameter (d) mm	Type	Weight kg/pc.	Packing unit carton/bag	Avail-ability
		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	S
11		17113/2	160	B	2.40	1 / 1	S
11		17115/2	200	B	4.450	1 / 1	S
11		17117/2	250	B	8.00	1 / 1	S
11		17118/2	315	B		1 / 1	S
11		17119/2	355	B		1 / 1	S
11		17120/2	400	B		1 / 1	MQ
11		17121/2	450	B		1 / 1	MQ
17.6		8717114	160	B		1 / 1	S
17.6		8717116	200	B		1 / 1	S
17.6		8717118	250	B		1 / 1	S
17.6		8717120	315	B		1 / 1	S
17.6		8717122	355	B		1 / 1	MQ
17.6		8717124	400	B		1 / 1	MQ
17.6		8717126	450	B		1 / 1	MQ
17.6		8717128	500	B		1 / 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
11		9017120	315	C		1 / 1	S
17.6		8017114	160	C		1 / 1	S
17.6		8017116	200	C		1 / 1	S
17.6		8017118	250	C		1 / 1	S
17.6		8017120	315	C		1 / 1	S

PRODUCT RANGE

Tee for socket welding and butt welding

Material: 20-125 mm: PP-R

160-500 mm: PP-RCT

Colour: Green

Standards: EN ISO 15874, DIN 16962

Processing: Type A: Socket welding,

Type B: Butt welding/molded,

Type C: Butt welding/segmented of pipe segments

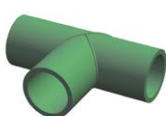
Type A



Type B



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	17213/2	160	B	4.020	1 / 1	S
11	17215/2	200	B	7.360	1 / 1	S
11	17217/2	250	B	13.800	1 / 1	S
11	17219/2	315	B		1 / 1	S
11	17221/2	355	B		1 / 1	S
11	17223/2	400	B		1 / 1	MQ
11	17225/2	450	B		1 / 1	MQ
17.6	8717214	160	B		1 / 1	S
17.6	8717216	200	B		1 / 1	S
17.6	8717218	250	B		1 / 1	S
17.6	8717220	315	B		1 / 1	S
17.6	8717222	355	B		1 / 1	S
17.6	8717224	400	B		1 / 1	MQ
17.6	8717226	450	B		1 / 1	MQ
17.6	8717228	500	B		1 / 1	MQ
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
11	9017220	315	C		1 / 1	S
17.6	8017214	160	C		1 / 1	S
17.6	8017216	200	C		1 / 1	S
17.6	8017218	250	C		1 / 1	S
17.6	8017220	315	C		1 / 1	S

PRODUCT RANGE

SYSTEM DESCRIPTION	Tee reduced for socket welding and butt welding Material: 20-125 mm: PP-R 160-500 mm: PP-RCT Colour: Green Standards: EN ISO 15874, DIN 16962 Product line: Ø 20–500 mm Processing: Type A: Socket welding, Type B: Butt welding/molded, Type C: Butt welding/segmented						
SYSTEM REQUIREMENTS	SDR	A. no.	Diameter (d) mm	Type	Weight kg/pc.	Packing unit carton/bag	Availability
TRANSPORTATION AND STORAGE		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
PRODUCT RANGE		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
PLANNING AND DESIGN		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	17422/2	160 × 90 × 160	B	3.40	1 / 1	S
	11	17423/2	160 × 110 × 160	B	3.50	1 / 1	S
WELDING TECHNOLOGY	11	17425/2	200 × 160 × 200	B	7.1	1 / 1	S
	11	17441/2	200 × 125 × 200	B	6.800	1 / 1	S
	11	17444/2	250 × 110 × 250	B	10.500	1 / 1	S
	11	17446/2	250 × 160 × 250	B	10.900	1 / 1	S
	11	17456/2	315 × 250 × 315	B	21.000	1 / 1	S
	11	17455/2	315 × 160 × 315	B	19.700	1 / 1	S
	11	17464/2	355 × 315 × 355	B	43.900	1 / 1	MQ
	11	17466/2	355 × 250 × 355	B	43.100	1 / 1	MQ
	11	17467/2	400 × 315 × 400	B	58.100	1 / 1	MQ
	11	17468/2	400 × 355 × 400	B	59.100	1 / 1	MQ
ASSEMBLY GUIDELINES	17.6	8717434	160 × 90	B	2.950	1 / 1	S
	17.6	8717423	160 × 110	B	3.000	1 / 1	S
	17.6	8717442	200 × 160	B	5.700	1 / 1	S
	17.6	8717441	200 × 125	B	5.450	1 / 1	S
	17.6	8717444	250 × 110	B	7.400	1 / 1	S
	17.6	8717446	250 × 160	B	7.700	1 / 1	S
	17.6	8717456	315 × 250	B	15.250	1 / 1	S
	17.6	8717455	315 × 160	B	14.700	1 / 1	S
	17.6	8717464	355 × 315	B	31.540	1 / 1	MQ
	17.6	8717466	355 × 250	B	30.250	1 / 1	MQ
INITIAL OPERATION							
QUALITY MANAGEMENT							

PRODUCT RANGE

SDR	A. no.	Diameter (d) mm	Type	Weight kg/pc.	Packing unit carton/bag	Avail- ability
17.6	8717467	400 × 315	B	40.540	1 / 1	MQ
17.6	8717468	400 × 355	B	41.900	1 / 1	MQ
17.6	8717472	500 × 400	B	72.800	1 / 1	MQ
17.6	8717473	500 × 450	B	74.890	1 / 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
11	9017456	315 × 250 × 315	C		1 / 1	S
11	9017458	315 × 200 × 315	C		1 / 1	S
17.6	8017423	160 × 110	C		1 / 1	S
17.6	8017438	160 × 125	C		1 / 1	S
17.6	8017442	200 × 160	C		1 / 1	S
17.6	8017446	250 × 160	C		1 / 1	S
17.6	8017450	250 × 200	C		1 / 1	S
17.6	8017456	315 × 250	C		1 / 1	S
17.6	8017458	315 × 200	C		1 / 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 dia- meter mm	Weight kg/pc.	Packing unit carton/bag	Avail- ability
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

PRODUCT RANGE

SYSTEM DESCRIPTION	Weld-in saddle Material: PP-R Colour: Green Standards: EN ISO 15874 Product line: Ø 40–355 mm Processing: Socket welding	A. no.	Diameter (d) Pipe/outlet mm	Drill dia- meter mm	Weight kg/pc.	Packing unit carton/bag	Avail- ability
SYSTEM REQUIREMENTS		17741	40 / 20	25	0.014	250 / 5	S
		17742	40 / 25	25	0.016	250 / 5	S
TRANSPORTATION AND STORAGE		17744	50 / 20	25	0.014	250 / 5	S
		17745	50 / 25	25	0.016	250 / 5	S
PRODUCT RANGE		17747	63 / 20	25	0.014	200 / 5	S
		17748	63 / 25	25	0.016	200 / 5	S
PLANNING AND DESIGN		17749	63 / 32	32	0.027	150 / 5	S
		17750	75 / 20	25	0.014	200 / 5	S
WELDING TECHNOLOGY		17751	75 / 25	25	0.016	200 / 5	S
		17752	75 / 32	32	0.027	120 / 5	S
ASSEMBLY GUIDELINES		17753	75 / 40	40			
		17754	90 / 20	25	0.014	200 / 5	S
INITIAL OPERATION		17756	90 / 25	25	0.017	20 / 5	S
		17758	90 / 32	32	0.028	150 / 5	S
QUALITY MANAGEMENT		17759	90 / 40	40			
		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
		17768	125 / 40	40			
		17769	125 / 50	50			
		17780	125 / 63	63			
		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
		17786	160 / 75	75			
		17787	160 / 90	90			
		17796	200 / 75	75			
		17797	200 / 90	90			
		17866	250 / 75	75			
		17867	250 / 90	90			
		17877	315-355/90	90			

PRODUCT RANGE

End cap Material: 20-125 mm: PP-R 160-500 mm: PP-RCT Colour: Green Standards: EN ISO 15874 Product line: Ø 20–500 mm Processing: Type A: Socket welding Type B: Butt welding	SDR	A. no.	Diameter (d) mm	Type	Weight kg/pc.	Packing unit carton/bag	Avail- ability
		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
	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
	11	17715/2	315	B		1 / 1	S
	11	17716/2	355	B		1 / 1	S
	11	9017724	400	B		1 / 1	S
	11	9017726	450	B		1 / 1	S
	17.6	8017714	160	B		1 / 1	S
	17.6	8017716	200	B		1 / 1	S
	17.6	8017718	250	B		1 / 1	S
	17.6	8017720	315	B		1 / 1	S
	17.6	8017722	355	B		1 / 1	S
	17.6	8017724	400	B		1 / 1	S
	17.6	8017726	450	B		1 / 1	S
	17.6	8017728	500	B		1 / 1	S
Flange adapter with gasket Material: PP-R Seal material: EPDM Colour: Green Standards: EN ISO 15874 Product line: Ø 20–500 mm Processing: Type A: Socket welding Type B: Butt welding * for use with Butterfly valves	SDR	A. no.	Diameter (d) mm	Type	Weight kg/pc.	Packing unit carton/bag	Avail- ability
		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
	11	9017811	125*	B	1.125	1 / 1	S
	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
	11	17818/2	315	B		1 / 1	S
	11	17820/2	355	B		1 / 1	S
	11	9017822	400	B		1 / 1	S
	11	9017824	450	B		1 / 1	S
	17.6	8017812	160	B		1 / 1	S
	17.6	8017814	200	B		1 / 1	S
	17.6	8017816	250	B		1 / 1	S
	17.6	8017818	315	B		1 / 1	S
	17.6	8017820	355	B		1 / 1	S
	17.6	8017822	400	B		1 / 1	S
	17.6	8017824	450	B		1 / 1	S
	17.6	8017826	500	B		1 / 1	S

PRODUCT RANGE

SYSTEM DESCRIPTION	PP Flange fibre reinforced Material: PP fibre-reinforced with steel insert Colour: Black Standards: EN 1092 Product line: Ø 63–500 mm 63-160mm: PN 16 / 200-500mm: PN10 	A. no.	Diameter (d) mm	DN	Weight kg/pc.	Packing unit carton/bag	Avail- ability
SYSTEM REQUIREMENTS		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
		14218	315	300		1	S
		14220	355	350		1	S
		14222	400	400		1	S
		14224	450	500		1	S
		14226	500	500		1	S
TRANSPORTATION AND STORAGE							
PRODUCT RANGE	Socket for electric welding Material: PP-RCT Colour: Green 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.	Supply unit card- board box/package	Avail- ability	
PLANNING AND DESIGN		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	
WELDING TECHNOLOGY							
ASSEMBLY GUIDELINES							
INITIAL OPERATION							
QUALITY MANAGEMENT							

30

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

PRODUCT RANGE

4.1.3 Fitting Adapters

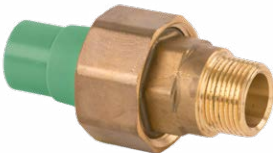
Adapter female thread Material: PP-R/brass Colour: Green Standards: EN ISO 15874 Product line: Ø 20–75 mm Processing: Socket welding Type A Type B	A. no.	Diameter (d) mm	Type	Weight kg/pc.	Packing unit carton/bag	Availability
	18104	20 × 1/2"	A	0.071	130 / 10	S
	18105	20 × 3/4"	A	0.101	100 / 10	MQ
	18106	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
						

Elbow adapter female from 1" for wrench 	A. no.	Diameter (d) mm	Supply unit cardboard box/ package	Availability
	18204	20 × 1/2"	150 / 10	S
	18205	20 × 3/4"	100 / 10	MQ
	18206	25 × 1/2"	120 / 10	S
	18207	25 × 3/4"	100 / 10	S
	18208	32 × 3/4"	70 / 5	S
	18209	32 × 1"	40 / 10	S

Elbow adapter male from 1" for wrench 	A. no.	Diameter (d) mm	Supply unit cardboard box/ package	Availability
	18254	20 × 1/2"	100 / 10	S
	18256	25 × 1/2"	100 / 10	S
	18257	25 × 3/4"	70 / 10	S
	18258	32 × 3/4"	70 / 5	S
	18259	32 × 1"	40 / 5	S

PRODUCT RANGE

SYSTEM DESCRIPTION	SYSTEM REQUIREMENTS	TRANSPORTATION AND STORAGE	PRODUCT RANGE	PLANNING AND DESIGN	WELDING TECHNOLOGY	ASSEMBLY GUIDELINES	INITIAL OPERATION	QUALITY MANAGEMENT
Tee adapter female from 1" for wrench 	A. no. Diameter (d) mm Supply unit card-board box/package Avail-ability							
Screw adapter pipe end/pipe end 	A. no. Diameter (d) mm Supply unit card-board box/package Avail-ability							
Screw adapter, male, thread/pipe end 	A. no. Diameter (d) mm Supply unit card-board box/package Avail-ability							
Screwed union plastic/brass F with socket end 	A. no. Diameter (d) mm Supply unit card-board box/package Avail-ability							
Wall union, female 	A. no. Diameter (d) mm Supply unit card-board box/package Avail-ability							

PRODUCT RANGE

4.1.4 Valves

Shut-off valve, body without discharge screw 	A. no.	Diameter (d) mm	Supply unit card-board box/package	Availability
	20304	20 × 3/4"	50 / 5	S
	20306	25 × 3/4"	50 / 5	S
	20308	32 × 1"	30 / 5	S
	20310	40 × 1 1/4"	25 / 1	S

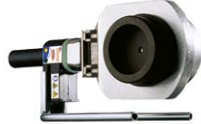
Shut-off valve, upper part 	A. no.	Diameter (d) mm	Supply unit card-board box/package	Availability
	14602	3/4"	125 / 1	S
	14604	1"	75 / 1	S
	14606	1 1/4"	40 / 1	S

Concealed valve, upper part in flexible length 60–110 mm 	A. no.	Diameter (d) mm	Supply unit card-board box/package	Availability
	14612	3/4"	50 / 1	S
	14614	1"	50 / 1	S

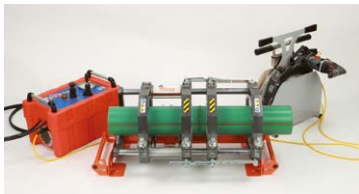
Concealed valve, upper part 	A. no.	Diameter (d) mm	Supply unit card-board box/package	Availability
	14611	3/4"	40 / 1	S
	14617	1"	40 / 1	S

Ball valve Handle: glass fibre reinforced polyamide, ball and stem: brass PTFE seats, NBR O-ring 	A. no.	Diameter (d) mm	Supply unit card-board box/package	Availability
	20402	20	50 / 5	S
	20403	25	25 / 5	S
	20404	32	15 / 1	S
	20405	40	10 / 1	S
	20412	50	6 / 1	S
	20414	63	5 / 1	S
	20416	75	5 / 1	S

PRODUCT RANGE

SYSTEM DESCRIPTION	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 in request 	A. no.	Diameter (d) mm	Weight kg/pc.	Packing unit carton/bag	Availability
SYSTEM REQUIREMENTS		20422	20	0.16	1 / 1	S
TRANSPORTATION AND STORAGE		20423	25	0.34	1 / 1	S
PRODUCT RANGE		20424	32	0.35	1 / 1	S
PLANNING AND DESIGN		20425	40	0.65	1 / 1	S
WELDING TECHNOLOGY		20426	50	0.70	1 / 1	S
ASSEMBLY GUIDELINES		20427	63	1.14	1 / 1	S
INITIAL OPERATION						
QUALITY MANAGEMENT						
	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.	Supply unit card-board box/package	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.	Supply unit card-board box/package	Availability
		15025	20–63	1.440	1	S
	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.	Supply unit card-board box/package	Availability
		15015	20–125	3.160	1	S

PRODUCT RANGE

Socket welding machine for pipes from 40 to 125 mm Product line: Ø 40–125 mm Processing: Socket welding	A. no.	Weight kg/pc.	Supply unit card-board box/package	Availability
	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.	Supply unit card-board box/package	Availability
	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.	Supply unit card-board box/package	Availability
	15207	63	1	S
				
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.	Supply unit card-board box/package	Availability
	15270	25.0	1	S
				

PRODUCT RANGE

SYSTEM DESCRIPTION	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.	Supply unit card-board box/package	Availability
		15167	20–125	1.100	1	S
SYSTEM REQUIREMENTS						
TRANSPORTATION AND STORAGE						
PRODUCT RANGE	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.	Supply unit card-board box/package	Availability
		15169	90 (SDR 11)–315 (SDR 17.6)	6.500	1	S
PLANNING AND DESIGN						
WELDING TECHNOLOGY	Cleaning towels for welded plastic joints 1 can = 100 towels Ingredient: Ethanol 	A. no.	Weight kg/pc.	Supply unit card-board box/package	Availability	
		15163	-	1	S	
ASSEMBLY GUIDELINES						
INITIAL OPERATION						
QUALITY MANAGEMENT						

36

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

PRODUCT RANGE

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
					

PRODUCT RANGE

SYSTEM DESCRIPTION	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.	Supply unit card- board box/package	Avail- ability	
		15007	50–110	2.0	1	S	
SYSTEM REQUIREMENTS							
TRANSPORTATION AND STORAGE	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.	Supply unit card- board box/package	Avail- ability	
PRODUCT RANGE		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			
PLANNING AND DESIGN	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 dia- meter mm	Weight kg/pc.	Supply unit card- board box/package	Avail- ability
WELDING TECHNOLOGY		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
		15102	75	40	0.330	1	S
		15069	90	25	0.280	1	S
		15084	90	32	0.370	1	S
	15180	90	40	0.485	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	
	15186	125	40	0.475	1	S	
	15187	125	50	0.54	1	S	
	15188	125	63	0.58	1	S	
	15087	160	25	0.285	1	S	
	15088	160	32	0.305	1	S	
INITIAL OPERATION	15106	160–250	40	0.350	1	S	
	15107	160–250	50	0.652	1	S	
	15108	160–250	63	1.048	1	S	
QUALITY MANAGEMENT	15189	160	75	1.105	1	S	
	15191	160	90	1.185	1	S	
	15192	200	75	1.354	1	S	

38

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

PRODUCT RANGE

A. no.	Diameter (d) Pipe/outlet mm	Bore dia- meter mm	Weight kg/pc.	Supply unit card- board box/package	Avail- ability
15193	200	90	1.41	1	S
15195	250	75	1.546	1	S
15196	250	90	1.598	1	S
15221	315–355	90	1.745	1	S

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.	Supply unit card- board box/package	Avail- ability
15095	25	-	1	S
15096	32	-	1	S
15097	40	-	1	S
15098	50	-	1	S
15099	63	-	1	S
15100	75	-	1	S
15175	90	-	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	15095–15175



Welding attachment

for repair of holes up to Ø 8 mm

Material: Aluminium, Teflon-coated



A. no.	Diameter (d) mm	Weight kg/pc.	Supply unit card- board box/package	Avail- ability
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.	Supply unit card- board box/package	Avail- ability
21090	8	0.003	1200/100	S

PLANNING AND DESIGN

5.1 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	m ³ /h														
0.01	0.04	R in mbar/m v in m/s	0.10 0.06	0.04 0.04	0.01 0.02										
0.02	0.07	R v	0.30 0.12	0.11 0.08	0.02 0.04	0.01 0.02									
0.03	0.11	R v	0.58 0.18	0.21 0.12	0.04 0.06	0.01 0.04									
0.04	0.14	R v	0.93 0.25	0.33 0.16	0.06 0.07	0.02 0.05	0.01 0.03								
0.05	0.18	R v	1.34 0.31	0.47 0.20	0.08 0.09	0.03 0.06	0.01 0.04								
0.06	0.22	R v	1.82 0.37	0.64 0.24	0.11 0.11	0.04 0.07	0.01 0.05	0.01 0.03							
0.07	0.25	R v	2.36 0.43	0.83 0.28	0.14 0.13	0.05 0.08	0.02 0.05	0.01 0.03							
0.08	0.29	R v	2.96 0.49	1.04 0.31	0.18 0.15	0.06 0.10	0.02 0.06	0.01 0.04							
0.09	0.32	R v	3.61 0.55	1.26 0.35	0.22 0.17	0.08 0.11	0.03 0.07	0.01 0.04							
0.10	0.36	R v	4.32 0.61	1.51 0.39	0.26 0.19	0.09 0.12	0.03 0.08	0.01 0.05	0.01 0.03						
0.12	0.43	R v	5.90 0.74	2.05 0.47	0.35 0.22	0.13 0.14	0.04 0.09	0.02 0.06	0.01 0.04						
0.14	0.50	R v	7.70 0.86	2.67 0.55	0.46 0.26	0.16 0.17	0.06 0.11	0.02 0.07	0.01 0.05						
0.16	0.58	R v	9.70 0.98	3.36 0.63	0.57 0.30	0.20 0.19	0.07 0.12	0.02 0.08	0.01 0.05						
0.18	0.65	R v	11.91 1.11	4.11 0.71	0.70 0.33	0.25 0.22	0.09 0.14	0.03 0.09	0.01 0.06	0.01 0.04					
0.20	0.72	R v	14.32 1.23	4.94 0.79	0.83 0.37	0.30 0.24	0.10 0.15	0.04 0.10	0.02 0.07	0.01 0.05					
0.30	1.08	R v	29.30 1.84	10.01 1.18	1.67 0.56	0.59 0.36	0.21 0.23	0.07 0.14	0.03 0.10	0.01 0.07	0.01 0.05				
0.40	1.44	R v	49.02 2.46	16.64 1.57	2.75 0.74	0.97 0.48	0.34 0.31	0.11 0.19	0.05 0.14	0.02 0.09	0.01 0.06				
0.50	1.80	R v	73.35 3.07	24.77 1.96	4.07 0.93	1.43 0.60	0.49 0.38	0.17 0.24	0.07 0.17	0.03 0.12	0.01 0.08	0.01 0.06			
0.60	2.16	R v	102.21 3.68	34.36 2.36	5.61 1.11	1.97 0.72	0.68 0.46	0.23 0.29	0.10 0.20	0.04 0.14	0.02 0.09	0.01 0.07			
0.70	2.52	R v	135.57 4.30	45.40 2.75	7.37 1.30	2.58 0.84	0.89 0.54	0.30 0.34	0.13 0.24	0.05 0.16	0.02 0.11	0.01 0.09			
0.80	2.88	R v	173.38 4.91	57.86 3.14	9.34 1.48	3.27 0.96	1.12 0.61	0.37 0.39	0.16 0.27	0.07 0.19	0.03 0.13	0.01 0.10			
0.90	3.24	R v	215.63 5.53	71.73 3.54	11.53 1.67	4.02 1.08	1.37 0.69	0.46 0.43	0.20 0.30	0.08 0.21	0.03 0.14	0.02 0.11	0.01 0.07		
1.00	3.60	R v	262.30 6.14	87.00 3.93	13.93 1.85	4.85 1.20	1.65 0.76	0.55 0.48	0.24 0.34	0.10 0.24	0.04 0.16	0.02 0.12	0.01 0.07		
1.10	3.96	R v	313.36 6.75	103.67 4.32	16.53 2.04	5.74 1.32	1.96 0.84	0.65 0.53	0.28 0.37	0.12 0.26	0.05 0.17	0.02 0.13	0.01 0.08		
1.20	4.32	R v	368.81 7.37	121.73 4.72	19.34 2.23	6.71 1.44	2.28 0.92	0.76 0.58	0.32 0.41	0.14 0.28	0.05 0.19	0.03 0.15	0.01 0.09		
1.30	4.68	R v	428.65 7.98	141.17 5.11	22.36 2.41	7.74 1.56	2.63 0.99	0.87 0.63	0.37 0.44	0.16 0.31	0.06 0.20	0.03 0.16	0.01 0.10		
1.40	5.04	R v	492.86 8.60	162.00 5.50	25.57 2.60	8.84 1.68	3.00 1.07	0.99 0.67	0.42 0.47	0.18 0.33	0.07 0.22	0.04 0.17	0.01 0.10		
1.60	5.76	R v	634.39 9.82	207.77 6.29	32.61 2.97	11.25 1.92	3.80 1.22	1.25 0.77	0.54 0.54	0.23 0.38	0.09 0.25	0.05 0.20	0.01 0.12		
1.80	6.48	R v	793.36 11.05	259.03 7.07	40.45 3.34	13.91 2.16	4.69 1.38	1.54 0.87	0.66 0.61	0.28 0.42	0.11 0.28	0.06 0.22	0.02 0.13	0.01 0.09	
2.00	7.20	R v		315.77 7.86	49.09 3.71	16.84 2.40	5.67 1.53	1.86 0.96	0.79 0.68	0.33 0.47	0.13 0.31	0.07 0.24	0.02 0.15	0.01 0.10	
2.20	7.92	R v		377.96 8.65	58.51 4.08	20.03 2.64	6.73 1.68	2.21 1.06	0.94 0.74	0.39 0.52	0.15 0.35	0.08 0.27	0.03 0.16	0.01 0.10	
2.40	8.64	R v		445.60 9.43	68.72 4.45	23.48 2.88	7.87 1.84	2.58 1.16	1.10 0.81	0.46 0.56	0.18 0.38	0.10 0.29	0.03 0.18	0.01 0.11	
2.60	9.36	R v		518.69 10.22	79.71 4.82	27.18 3.11	9.10 1.99	2.97 1.25	1.26 0.88	0.53 0.61	0.20 0.41	0.11 0.32	0.03 0.19	0.01 0.12	

PLANNING AND DESIGN

SYSTEM DESCRIPTION			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												
SYSTEM REQUIREMENTS	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
TRANSPORTATION AND STORAGE	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
PRODUCT RANGE	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
PLANNING AND DESIGN	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
WELDING TECHNOLOGY	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
ASSEMBLY GUIDELINES	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
INITIAL OPERATION	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
QUALITY MANAGEMENT	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

PLANNING AND DESIGN

		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

PLANNING AND DESIGN

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

SDR 11/315–450 mm

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

		Dimension	315 mm	355 mm	400 mm	450 mm
		Wall thickness	28.6 mm	32.2 mm	36.3 mm	40.9 mm
	l/s	m ³ /h				
	6,50	23,40	R in mbar/m v in m/s	0,00 0,12		
	7,00	25,20	R v	0,00 0,13		
	7,50	27,00	R v	0,00 0,14		
	8,00	28,80	R v	0,00 0,15		
	8,50	30,60	R v	0,01 0,16		
	9,00	32,40	R v	0,01 0,17		
	9,50	34,20	R v	0,01 0,18		
	10,00	36,00	R v	0,01 0,19		
	10,50	37,80	R v	0,01 0,20		
	11,00	39,60	R v	0,01 0,21	0,00 0,17	
	11,50	41,40	R v	0,01 0,22	0,01 0,17	
	12,00	43,20	R v	0,01 0,23	0,01 0,18	
	12,50	45,00	R v	0,01 0,24	0,01 0,19	
	13,00	46,80	R v	0,01 0,25	0,01 0,20	
	13,50	48,60	R v	0,01 0,26	0,01 0,20	
	14,00	50,40	R v	0,01 0,27	0,01 0,21	
	14,50	52,20	R v	0,01 0,28	0,01 0,22	
	15,00	54,00	R v	0,02 0,29	0,01 0,23	0,00 0,18
	16,00	57,60	R v	0,02 0,31	0,01 0,24	0,01 0,19
	17,00	61,20	R v	0,02 0,33	0,01 0,26	0,01 0,20
	18,00	64,80	R v	0,02 0,34	0,01 0,27	0,01 0,21
	19,00	68,40	R v	0,03 0,36	0,01 0,29	0,01 0,23
	20,00	72,00	R v	0,03 0,38	0,02 0,30	0,01 0,24
	21,00	75,60	R v	0,03 0,40	0,02 0,32	0,01 0,25
	22,00	79,20	R v	0,03 0,42	0,02 0,33	0,01 0,26
	23,00	82,80	R v	0,04 0,44	0,02 0,35	0,01 0,27
	24,00	86,40	R v	0,04 0,46	0,02 0,36	0,01 0,29
	25,00	90,00	R v	0,04 0,48	0,02 0,38	0,01 0,30
	26,00	93,60	R v	0,05 0,50	0,03 0,39	0,01 0,31
	27,00	97,20	R v	0,05 0,52	0,03 0,41	0,01 0,32
	28,00	100,80	R v	0,05 0,54	0,03 0,42	0,02 0,33
	29,00	104,40	R v	0,06 0,56	0,03 0,44	0,02 0,34
	30,00	108,00	R v	0,06 0,57	0,03 0,45	0,02 0,36
						0,01 0,28

PLANNING AND DESIGN

		Dimension	315 mm	355 mm	400 mm	450 mm
		Wall thickness	28.6 mm	32.2 mm	36.3 mm	40.9 mm
l/s	m³/h					
32,00	115,20	R in mbar/m v in m/s	0,07 0,61	0,04 0,48	0,02 0,38	0,01 0,30
34,00	122,40	R v	0,08 0,65	0,04 0,51	0,02 0,40	0,01 0,32
36,00	129,60	R v	0,09 0,69	0,05 0,54	0,03 0,43	0,01 0,34
38,00	136,80	R v	0,10 0,73	0,05 0,57	0,03 0,45	0,02 0,36
40,00	144,00	R v	0,11 0,77	0,06 0,60	0,03 0,48	0,02 0,38
42,00	151,20	R v	0,12 0,80	0,07 0,63	0,04 0,50	0,02 0,39
44,00	158,40	R v	0,13 0,84	0,07 0,66	0,04 0,52	0,02 0,41
46,00	165,60	R v	0,14 0,88	0,08 0,69	0,04 0,55	0,02 0,43
48,00	172,80	R v	0,16 0,92	0,08 0,72	0,05 0,57	0,03 0,45
50,00	180,00	R v	0,17 0,96	0,09 0,75	0,05 0,59	0,03 0,47
52,00	187,20	R v	0,18 1,00	0,10 0,78	0,05 0,62	0,03 0,49
54,00	194,40	R v	0,20 1,03	0,11 0,81	0,06 0,64	0,03 0,51
56,00	201,60	R v	0,21 1,07	0,12 0,84	0,06 0,67	0,03 0,53
58,00	208,80	R v	0,23 1,11	0,12 0,87	0,07 0,69	0,04 0,54
60,00	216,00	R v	0,25 1,15	0,13 0,90	0,07 0,71	0,04 0,56
62,00	223,20	R v	0,26 1,19	0,14 0,93	0,08 0,74	0,04 0,58
64,00	230,40	R v	0,28 1,23	0,15 0,96	0,08 0,76	0,04 0,60
66,00	237,60	R v	0,30 1,26	0,16 1,00	0,09 0,78	0,05 0,62
68,00	244,80	R v	0,31 1,30	0,17 1,03	0,09 0,81	0,05 0,64
70,00	252,00	R v	0,33 1,34	0,18 1,06	0,10 0,83	0,05 0,66
75,00	270,00	R v	0,38 1,44	0,21 1,13	0,11 0,89	0,06 0,70
80,00	288,00	R v	0,43 1,53	0,23 1,21	0,13 0,95	0,07 0,75
85,00	306,00	R v	0,49 1,63	0,26 1,28	0,14 1,01	0,08 0,80
90,00	324,00	R v	0,55 1,72	0,30 1,36	0,16 1,07	0,09 0,85
95,00	342,00	R v	0,61 1,82	0,33 1,43	0,18 1,13	0,10 0,89
100,000	360,00	R v	0,68 1,92	0,37 1,51	0,20 1,19	0,11 0,94
110,00	396,00	R v	0,82 2,11	0,44 1,66	0,24 1,31	0,13 1,03
120,00	432,00	R v	0,98 2,30	0,53 1,81	0,28 1,43	0,16 1,13
130,00	468,00	R v	1,14 2,49	0,62 1,96	0,33 1,54	0,18 1,22
140,00	504,00	R v	1,33 2,68	0,72 2,11	0,39 1,66	0,21 1,31
150,00	540,00	R v	1,52 2,87	0,82 2,26	0,44 1,78	0,24 1,41
160,00	576,00	R v	1,73 3,07	0,93 2,41	0,50 1,90	0,28 1,50
170,00	612,00	R v	1,95 3,26	1,05 2,56	0,57 2,02	0,31 1,60
180,00	648,00	R v	2,19 3,45	1,18 2,71	0,64 2,14	0,35 1,69
190,00	684,00	R v	2,44 3,64	1,32 2,86	0,71 2,26	0,39 1,78
200,00	720,00	R v	2,70 3,83	1,46 3,02	0,79 2,38	0,43 1,88
210,00	756,00	R v	2,98 4,02	1,61 3,17	0,87 2,49	0,47 1,97

PLANNING AND DESIGN

SYSTEM DESCRIPTION			Dimension	315 mm	355 mm	400 mm	450 mm
			Wall thickness	28.6 mm	32.2 mm	36.3 mm	40.9 mm
	l/s	m³/h					
	220,00	792,00	R in mbar/m v in m/s	3,27 4,21	1,76 3,32	0,95 2,61	0,52 2,07
	230,00	828,00	R v	3,57 4,41	1,93 3,47	1,04 2,73	0,57 2,16
	240,00	864,00	R v	3,89 4,60	2,10 3,62	1,13 2,85	0,62 2,25
	250,00	900,00	R v	4,22 4,79	2,27 3,77	1,23 2,97	0,67 2,35
SYSTEM REQUIREMENTS	260,00	936,00	R v	4,56 4,98	2,46 3,92	1,33 3,09	0,73 2,44
	270,00	972,00	R v	4,92 5,17	2,65 4,07	1,43 3,21	0,78 2,54
	280,00	1008,00	R v	5,29 5,36	2,85 4,22	1,54 3,33	0,84 2,63
	290,00	1044,00	R v	5,68 5,56	3,06 4,37	1,65 3,44	0,90 2,72
TRANSPORTATION AND STORAGE	300,00	1080,00	R v	6,08 5,75	3,27 4,52	1,77 3,56	0,97 2,82
	310,00	1116,00	R v	6,49 5,94	3,49 4,67	1,89 3,68	1,03 2,91
	320,00	1152,00	R v	6,91 6,13	3,72 4,82	2,01 3,80	1,10 3,01
	330,00	1188,00	R v	7,35 6,32	3,96 4,98	2,14 3,92	1,17 3,10
PRODUCT RANGE	340,00	1224,00	R v	7,80 6,51	4,20 5,13	2,27 4,04	1,24 3,19
	350,00	1260,00	R v	8,27 6,71	4,45 5,28	2,41 4,16	1,31 3,29
	360,00	1296,00	R v	8,75 6,90	4,71 5,43	2,55 4,28	1,39 3,38
	370,00	1332,00	R v	9,24 7,09	4,98 5,58	2,69 4,39	1,47 3,47
PLANNING AND DESIGN	380,00	1368,00	R v	9,74 7,28	5,25 5,73	2,84 4,51	1,55 3,57
	390,00	1404,00	R v	10,26 7,47	5,53 5,88	2,99 4,63	1,63 3,66
	400,00	1440,00	R v	10,79 7,66	5,82 6,03	3,14 4,75	1,71 3,76
	410,00	1476,00	R v	6,11 6,18	6,11 6,18	3,30 4,87	1,80 3,85
WELDING TECHNOLOGY	420,00	1512,00	R v	6,41 6,33	6,41 6,33	3,46 4,99	1,89 3,94
	430,00	1548,00	R v	6,72 6,48	6,72 6,48	3,63 5,11	1,98 4,04
	440,00	1584,00	R v	7,04 6,63	7,04 6,63	3,80 5,23	2,07 4,13
	450,00	1620,00	R v	7,36 6,78	7,36 6,78	3,98 5,35	2,17 4,23
ASSEMBLY GUIDELINES	460,00	1656,00	R v	7,69 6,94	7,69 6,94	4,15 5,46	2,27 4,32
	470,00	1692,00	R v	8,03 7,09	8,03 7,09	4,34 5,58	2,37 4,41
	480,00	1728,00	R v	8,37 7,24	8,37 7,24	4,52 5,70	2,47 4,51
	490,00	1764,00	R v	8,72 7,39	8,72 7,39	4,71 5,82	2,57 4,60
INITIAL OPERATION	500,00	1800,00	R v	9,08 7,54	9,08 7,54	4,91 5,94	2,68 4,70
	510,00	1836,00	R v	9,45 7,69	9,45 7,69	5,11 6,06	2,79 4,79
	520,00	1872,00	R v	9,82 7,84	9,82 7,84	5,31 6,18	2,90 4,88
	530,00	1908,00	R v	10,20 7,99	10,20 7,99	5,51 6,30	3,01 4,98
QUALITY MANAGEMENT	540,00	1944,00	R v	6,41 6,41	6,41 6,41	5,72 6,41	3,12 5,07
	550,00	1980,00	R v	6,53 6,53	6,53 6,53	5,94 6,53	3,24 5,17
	600,00	2160,00	R v	7,06 7,13	7,06 7,13	6,36 7,13	3,85 5,63
	650,00	2340,00	R v	7,72 7,72	7,72 7,72	7,29 7,72	4,52 6,10
	700,00	2520,00	R v	9,61 8,31	9,61 8,31	9,61 8,31	5,24 6,57

PLANNING AND DESIGN

		Dimension	315 mm	355 mm	400 mm	450 mm
		Wall thickness	28.6 mm	32.2 mm	36.3 mm	40.9 mm
l/s	m³/h					
750,00	2700,00				11,03 8,91	6,02 7,04
800,00	2880,00				12,55 9,50	6,85 7,51
850,00	3060,00				14,17 10,10	7,73 7,98
900,00	3240,00				15,89 10,69	8,66 8,45
950,00	3420,00					9,65 8,92
1000,00	3600,00					10,69 9,39

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

SDR 17.6/125–500 mm

Temperature 20 °C

Roughness: 0.007 mm

Density: 998.29 kg/m³

Kin. viscosity: 1.004E-06 m²/s

		Dimension	125 mm	160 mm	200 mm	250 mm	315 mm	355 mm	400 mm	450 mm	500 mm
		Wall thickness	7.1 mm	9.1 mm	11.4 mm	14.2 mm	17.9 mm	20.1 mm	22.7 mm	25.5 mm	28.4 mm
l/s	m³/h										
0,50	1,80	R	0,00								
		v	0,05								
0,60	2,16	R	0,01								
		v	0,06								
0,70	2,52	R	0,01								
		v	0,07								
0,80	2,88	R	0,01								
		v	0,08								
0,90	3,24	R	0,01	0,00							
		v	0,09	0,06							
1,00	3,60	R	0,01	0,00							
		v	0,10	0,06							
1,10	3,96	R	0,02	0,01							
		v	0,11	0,07							
1,20	4,32	R	0,02	0,01							
		v	0,12	0,08							
1,30	4,68	R	0,02	0,01							
		v	0,13	0,08							
1,40	5,04	R	0,03	0,01							
		v	0,15	0,09							
1,60	5,76	R	0,03	0,01	0,00						
		v	0,17	0,10	0,06						
1,80	6,48	R	0,04	0,01	0,00						
		v	0,19	0,11	0,07						
2,00	7,20	R	0,05	0,01	0,01						
		v	0,21	0,13	0,08						
2,20	7,92	R	0,06	0,02	0,01						
		v	0,23	0,14	0,09						
2,40	8,64	R	0,07	0,02	0,01						
		v	0,25	0,15	0,10						
2,60	9,36	R	0,08	0,02	0,01	0,00					
		v	0,27	0,16	0,11	0,07					
2,80	10,08	R	0,09	0,03	0,01	0,00					
		v	0,29	0,18	0,11	0,07					
3,00	10,80	R	0,10	0,03	0,01	0,00					
		v	0,31	0,19	0,12	0,08					
3,50	12,60	R	0,13	0,04	0,01	0,00					
		v	0,36	0,22	0,14	0,09					
4,00	14,40	R	0,16	0,05	0,02	0,01					
		v	0,41	0,25	0,16	0,10					
4,50	16,20	R	0,20	0,06	0,02	0,01	0,00				
		v	0,47	0,28	0,18	0,12	0,07				
5,00	18,00	R	0,24	0,07	0,03	0,01	0,00				
		v	0,52	0,32	0,20	0,13	0,08				
5,50	19,80	R	0,28	0,09	0,03	0,01	0,00				
		v	0,57	0,35	0,22	0,14	0,09				

PLANNING AND DESIGN

SYSTEM DESCRIPTION			Dimension	125 mm	160 mm	200 mm	250 mm	315 mm	355 mm	400 mm	450 mm	500 mm
			Wall thickness	7.1 mm	9.1 mm	11.4 mm	14.2 mm	17.9 mm	20.1 mm	22.7 mm	25.5 mm	28.4 mm
		l/s	m³/h									
SYSTEM REQUIREMENTS	6,00	21,60	R	0,33	0,10	0,03	0,01	0,00				
			v	0,62	0,38	0,24	0,16	0,10				
	6,50	23,40	R	0,38	0,12	0,04	0,01	0,00				
			v	0,67	0,41	0,26	0,17	0,11				
	7,00	25,20	R	0,43	0,13	0,05	0,02	0,01				
			v	0,73	0,44	0,28	0,18	0,11				
TRANSPORTATION AND STORAGE	7,50	27,00	R	0,49	0,15	0,05	0,02	0,01	0,00			
			v	0,78	0,47	0,30	0,19	0,12	0,10			
	8,00	28,80	R	0,55	0,17	0,06	0,02	0,01	0,00			
			v	0,83	0,51	0,32	0,21	0,13	0,10			
	8,50	30,60	R	0,61	0,19	0,06	0,02	0,01	0,00			
			v	0,88	0,54	0,34	0,22	0,14	0,11			
PRODUCT RANGE	9,00	32,40	R	0,68	0,21	0,07	0,02	0,01	0,00			
			v	0,93	0,57	0,36	0,23	0,15	0,12			
	9,50	34,20	R	0,75	0,23	0,08	0,03	0,01	0,01			
			v	0,99	0,60	0,39	0,25	0,16	0,12			
	10,00	36,00	R	0,82	0,25	0,09	0,03	0,01	0,01			
			v	1,04	0,63	0,41	0,26	0,16	0,13			
PLANNING AND DESIGN	10,50	37,80	R	0,90	0,27	0,09	0,03	0,01	0,01	0,00		
			v	1,09	0,66	0,43	0,27	0,17	0,13	0,11		
	11,00	39,60	R	0,97	0,30	0,10	0,03	0,01	0,01	0,00		
			v	1,14	0,70	0,45	0,29	0,18	0,14	0,11		
	11,50	41,40	R	1,06	0,32	0,11	0,04	0,01	0,01	0,00		
			v	1,19	0,73	0,47	0,30	0,19	0,15	0,12		
WELDING TECHNOLOGY	12,00	43,20	R	1,14	0,35	0,12	0,04	0,01	0,01	0,00		
			v	1,24	0,76	0,49	0,31	0,20	0,15	0,12		
	12,50	45,00	R	1,23	0,37	0,13	0,04	0,01	0,01	0,00		
			v	1,30	0,79	0,51	0,32	0,20	0,16	0,13		
	13,00	46,80	R	1,32	0,40	0,14	0,05	0,02	0,01	0,00		
			v	1,35	0,82	0,53	0,34	0,21	0,17	0,13		
ASSEMBLY GUIDELINES	13,50	48,60	R	1,41	0,43	0,15	0,05	0,02	0,01	0,01		
			v	1,40	0,85	0,55	0,35	0,22	0,17	0,14		
	14,00	50,40	R	1,51	0,46	0,16	0,05	0,02	0,01	0,01	0,00	
			v	1,45	0,89	0,57	0,36	0,23	0,18	0,14	0,11	
	14,50	52,20	R	1,61	0,49	0,17	0,06	0,02	0,01	0,01	0,00	
			v	1,50	0,92	0,59	0,38	0,24	0,19	0,15	0,12	
INITIAL OPERATION	15,00	54,00	R	1,71	0,52	0,18	0,06	0,02	0,01	0,01	0,00	
			v	1,56	0,95	0,61	0,39	0,25	0,19	0,15	0,12	
	16,00	57,60	R	1,92	0,58	0,20	0,07	0,02	0,01	0,01	0,00	
			v	1,66	1,01	0,65	0,41	0,26	0,21	0,16	0,13	
	17,00	61,20	R	2,15	0,65	0,22	0,08	0,03	0,01	0,01	0,00	
			v	1,76	1,08	0,69	0,44	0,28	0,22	0,17	0,14	
Y EMENT	18,00	64,80	R	2,38	0,72	0,25	0,08	0,03	0,02	0,01	0,01	
			v	1,87	1,14	0,73	0,47	0,29	0,23	0,18	0,14	
	19,00	68,40	R	2,63	0,79	0,27	0,09	0,03	0,02	0,01	0,01	
			v	1,97	1,20	0,77	0,49	0,31	0,24	0,19	0,15	
	20,00	72,00	R	2,89	0,87	0,30	0,10	0,03	0,02	0,01	0,01	
			v	2,07	1,27	0,81	0,52	0,33	0,26	0,20	0,16	
SYSTEM REQUIREMENTS	21,00	75,60	R	3,16	0,95	0,32	0,11	0,04	0,02	0,01	0,01	
			v	2,18	1,33	0,85	0,54	0,34	0,27	0,21	0,17	
	22,00	79,20	R	3,44	1,04	0,35	0,12	0,04	0,02	0,01	0,01	0,00
			v	2,28	1,39	0,89	0,57	0,36	0,28	0,22	0,18	0,14
	23,00	82,80	R	3,73	1,12	0,38	0,13	0,04	0,02	0,01	0,01	0,00
			v	2,39	1,46	0,93	0,60	0,38	0,30	0,23	0,18	0,15
TRANSPORTATION AND STORAGE	24,00	86,40	R	4,04	1,21	0,41	0,14	0,05	0,03	0,01	0,01	0,01
			v	2,49	1,52	0,97	0,62	0,39	0,31	0,24	0,19	0,16
	25,00	90,00	R	4,35	1,31	0,44	0,15	0,05	0,03	0,02	0,01	0,01
			v	2,59	1,58	1,01	0,65	0,41	0,32	0,25	0,20	0,16
	26,00	93,60	R	4,68	1,40	0,48	0,16	0,05	0,03	0,02	0,01	0,01
			v	2,70	1,65	1,05	0,67	0,42	0,33	0,26	0,21	0,17
PRODUCT RANGE	27,00	97,20	R	5,02	1,50	0,51	0,17	0,06	0,03	0,02	0,01	0,01
			v	2,80	1,71	1,09	0,70	0,44	0,35	0,27	0,22	0,18
	28,00	100,80	R	5,37	1,61	0,55	0,19	0,06	0,03	0,02	0,01	0,01
			v	2,90	1,77	1,14	0,73	0,46	0,36	0,28	0,22	0,18
	29,00	104,40	R	5,73	1,71	0,58	0,20	0,06	0,04	0,02	0,01	0,01
			v	3,01	1,84	1,18	0,75	0,47	0,37	0,29	0,23	0,19
PLANNING AND DESIGN	30,00	108,00	R	6,10	1,82	0,62	0,21	0,07	0,04	0,02	0,01	0,01
			v	3,11	1,90	1,22	0,78	0,49	0,39	0,30	0,24	0,19
	32,00	115,20	R	6,88	2,05	0,69	0,24	0,08	0,04	0,02	0,01	0,01
			v	3,32	2,03	1,30	0,83	0,52	0,41	0,32	0,26	0,21
	34,00	122,40	R	7,70	2,30	0,78	0,26	0,09	0,05	0,03	0,02	0,01
			v	3,53	2,15	1,38	0,88	0,56	0,44	0,34	0,27	0,22
WELDING TECHNOLOGY	36,00	129,60	R	8,56	2,55	0,86	0,29	0,10	0,05	0,03	0,02	0,01
			v	3,73	2,28	1,46	0,93	0,59	0,46	0,36	0,29	0,23

PLANNING AND DESIGN

		Dimension	125 mm	160 mm	200 mm	250 mm	315 mm	355 mm	400 mm	450 mm	500 mm
		Wall thickness	7.1 mm	9.1 mm	11.4 mm	14.2 mm	17.9 mm	20.1 mm	22.7 mm	25.5 mm	28.4 mm
l/s	m³/h										
38,00	136,80	R	9,47	2,82	0,95	0,32	0,11	0,06	0,03	0,02	0,01
		v	3,94	2,41	1,54	0,99	0,62	0,49	0,38	0,30	0,25
40,00	144,00	R	10,42	3,10	1,04	0,35	0,12	0,06	0,04	0,02	0,01
		v	4,15	2,53	1,62	1,04	0,65	0,51	0,41	0,32	0,26
42,00	151,20	R	11,42	3,39	1,14	0,39	0,13	0,07	0,04	0,02	0,01
		v	4,36	2,66	1,70	1,09	0,69	0,54	0,43	0,34	0,27
44,00	158,40	R	12,46	3,69	1,24	0,42	0,14	0,08	0,04	0,02	0,01
		v	4,56	2,79	1,78	1,14	0,72	0,57	0,45	0,35	0,29
46,00	165,60	R	13,54	4,01	1,35	0,45	0,15	0,08	0,05	0,03	0,02
		v	4,77	2,91	1,87	1,19	0,75	0,59	0,47	0,37	0,30
48,00	172,80	R	14,67	4,34	1,46	0,49	0,16	0,09	0,05	0,03	0,02
		v	4,98	3,04	1,95	1,24	0,78	0,62	0,49	0,38	0,31
50,00	180,00	R	15,84	4,68	1,57	0,53	0,17	0,10	0,05	0,03	0,02
		v	5,19	3,17	2,03	1,30	0,82	0,64	0,51	0,40	0,32
52,00	187,20	R	17,05	5,04	1,69	0,57	0,19	0,10	0,06	0,03	0,02
		v	5,39	3,29	2,11	1,35	0,85	0,67	0,53	0,42	0,34
54,00	194,40	R	18,31	5,40	1,81	0,61	0,20	0,11	0,06	0,04	0,02
		v	5,60	3,42	2,19	1,40	0,88	0,69	0,55	0,43	0,35
56,00	201,60	R	19,61	5,78	1,94	0,65	0,21	0,12	0,07	0,04	0,02
		v	5,81	3,55	2,27	1,45	0,91	0,72	0,57	0,45	0,36
58,00	208,80	R	20,95	6,17	2,07	0,69	0,23	0,13	0,07	0,04	0,02
		v	6,02	3,67	2,35	1,50	0,95	0,75	0,59	0,46	0,38
60,00	216,00	R	22,34	6,58	2,20	0,74	0,24	0,13	0,08	0,04	0,03
		v	6,22	3,80	2,43	1,56	0,98	0,77	0,61	0,48	0,39
62,00	223,20	R	23,77	6,99	2,34	0,78	0,26	0,14	0,08	0,05	0,03
		v	6,43	3,93	2,51	1,61	1,01	0,80	0,63	0,50	0,40
64,00	230,40	R	25,24	7,42	2,48	0,83	0,27	0,15	0,09	0,05	0,03
		v	6,64	4,05	2,60	1,66	1,05	0,82	0,65	0,51	0,41
66,00	237,60	R	26,75	7,86	2,62	0,88	0,29	0,16	0,09	0,05	0,03
		v	6,85	4,18	2,68	1,71	1,08	0,85	0,67	0,53	0,43
68,00	244,80	R	28,31	8,31	2,77	0,93	0,30	0,17	0,10	0,05	0,03
		v	7,05	4,31	2,76	1,76	1,11	0,87	0,69	0,54	0,44
70,00	252,00	R	29,91	8,78	2,93	0,98	0,32	0,18	0,10	0,06	0,03
		v	7,26	4,43	2,84	1,81	1,14	0,90	0,71	0,56	0,45
75,00	270,00	R	34,11	9,99	3,33	1,11	0,36	0,20	0,11	0,06	0,04
		v	7,78	4,75	3,04	1,94	1,23	0,96	0,76	0,60	0,49
80,00	288,00	R	38,57	11,28	3,75	1,25	0,41	0,23	0,13	0,07	0,04
		v	8,30	5,07	3,24	2,07	1,31	1,03	0,81	0,64	0,52
85,00	306,00	R	43,30	12,65	4,20	1,40	0,45	0,25	0,14	0,08	0,05
		v	8,82	5,38	3,45	2,20	1,39	1,09	0,86	0,68	0,55
90,00	324,00	R	48,30	14,09	4,67	1,56	0,50	0,28	0,16	0,09	0,05
		v	9,33	5,70	3,65	2,33	1,47	1,16	0,91	0,72	0,58
95,00	342,00	R	53,57	15,60	5,17	1,72	0,56	0,31	0,17	0,10	0,06
		v	9,85	6,02	3,85	2,46	1,55	1,22	0,96	0,76	0,62
100,00	360,00	R	59,10	17,20	5,69	1,89	0,61	0,34	0,19	0,11	0,07
		v	10,37	6,33	4,05	2,59	1,63	1,28	1,01	0,80	0,65
110,00	396,00	R		20,60	6,81	2,26	0,73	0,41	0,23	0,13	0,08
		v		6,97	4,46	2,85	1,80	1,41	1,11	0,88	0,71
120,00	432,00	R		24,31	8,02	2,66	0,86	0,48	0,27	0,15	0,09
		v		7,60	4,87	3,11	1,96	1,54	1,22	0,96	0,78
130,00	468,00	R		28,32	9,32	3,09	0,99	0,55	0,31	0,17	0,10
		v		8,23	5,27	3,37	2,12	1,67	1,32	1,04	0,84
140,00	504,00	R		32,63	10,72	3,54	1,14	0,63	0,35	0,20	0,12
		v		8,87	5,68	3,63	2,29	1,80	1,42	1,12	0,91
150,00	540,00	R		37,23	12,22	4,03	1,29	0,72	0,40	0,23	0,14
		v		9,50	6,08	3,89	2,45	1,93	1,52	1,20	0,97
160,00	576,00	R		42,14	13,81	4,55	1,46	0,81	0,45	0,26	0,15
		v		10,13	6,49	4,15	2,61	2,06	1,62	1,28	1,04
170,00	612,00	R		47,34	15,50	5,10	1,63	0,91	0,51	0,29	0,17
		v		10,76	6,89	4,41	2,78	2,18	1,72	1,36	1,10
180,00	648,00	R			17,28	5,68	1,82	1,01	0,56	0,32	0,19
		v			7,30	4,67	2,94	2,31	1,82	1,44	1,17
190,00	684,00	R			19,15	6,29	2,01	1,11	0,62	0,35	0,21
		v			7,70	4,93	3,10	2,44	1,92	1,52	1,23
200,00	720,00	R			21,12	6,93	2,21	1,23	0,68	0,38	0,23
		v			8,11	5,19	3,27	2,57	2,03	1,60	1,30
210,00	756,00	R			23,19	7,60	2,42	1,34	0,75	0,42	0,25
		v			8,52	5,44	3,43	2,70	2,13	1,68	1,36
220,00	792,00	R			25,35	8,30	2,64	1,46	0,82	0,46	0,27
		v			8,92	5,70	3,59	2,83	2,23	1,76	1,43
230,00	828,00	R			27,60	9,03	2,87	1,59	0,89	0,50	0,30
		v			9,33	5,96	3,76	2,96	2,33	1,84	1,49
240,00	864,00	R			29,95	9,79	3,11	1,72	0,96	0,54	0,32
		v			9,73	6,22	3,92	3,08	2,43	1,92	1,56

PLANNING AND DESIGN

SYSTEM DESCRIPTION			Dimension	125 mm	160 mm	200 mm	250 mm	315 mm	355 mm	400 mm	450 mm	500 mm
			Wall thickness	7.1 mm	9.1 mm	11.4 mm	14.2 mm	17.9 mm	20.1 mm	22.7 mm	25.5 mm	28.4 mm
	l/s	m³/h										
SYSTEM REQUIREMENTS	250,00	900,00	R			32,39	10,58	3,36	1,86	1,04	0,58	0,35
			v			10,14	6,48	4,08	3,21	2,53	2,00	1,62
	260,00	936,00	R			34,92	11,40	3,62	2,00	1,11	0,62	0,37
			v			10,54	6,74	4,25	3,34	2,63	2,08	1,69
	270,00	972,00	R			37,55	12,25	3,88	2,15	1,19	0,67	0,40
			v			10,95	7,00	4,41	3,47	2,73	2,16	1,75
TRANSPORTATION AND STORAGE	280,00	1008,00	R				13,12	4,16	2,30	1,28	0,72	0,43
			v				7,26	4,57	3,60	2,84	2,24	1,81
	290,00	1044,00	R				14,03	4,44	2,45	1,37	0,77	0,46
			v				7,52	4,74	3,73	2,94	2,32	1,88
	300,00	1080,00	R				14,97	4,74	2,62	1,45	0,81	0,49
			v				7,78	4,90	3,85	3,04	2,40	1,94
PRODUCT RANGE	310,00	1116,00	R				15,94	5,04	2,78	1,55	0,87	0,52
			v				8,04	5,06	3,98	3,14	2,48	2,01
	320,00	1152,00	R				16,93	5,35	2,95	1,64	0,92	0,55
			v				8,30	5,23	4,11	3,24	2,56	2,07
	330,00	1188,00	R				17,96	5,67	3,13	1,74	0,97	0,58
			v				8,56	5,39	4,24	3,34	2,64	2,14
PLANNING AND DESIGN	340,00	1224,00	R				19,02	6,00	3,31	1,84	1,03	0,61
			v				8,82	5,55	4,37	3,44	2,72	2,20
	350,00	1260,00	R				20,10	6,34	3,50	1,94	1,09	0,65
			v				9,07	5,72	4,50	3,54	2,80	2,27
	360,00	1296,00	R				21,22	6,69	3,69	2,05	1,14	0,68
			v				9,33	5,88	4,63	3,65	2,88	2,33
WELDING TECHNOLOGY	370,00	1332,00	R				22,37	7,05	3,88	2,15	1,20	0,72
			v				9,59	6,04	4,75	3,75	2,96	2,40
	380,00	1368,00	R				23,54	7,41	4,08	2,26	1,27	0,76
			v				9,85	6,21	4,88	3,85	3,04	2,46
	390,00	1404,00	R				24,75	7,79	4,29	2,38	1,33	0,79
			v				10,11	6,37	5,01	3,95	3,12	2,53
ASSEMBLY GUIDELINES	400,00	1440,00	R				25,98	8,17	4,50	2,49	1,39	0,83
			v				10,37	6,53	5,14	4,05	3,20	2,59
	410,00	1476,00	R				27,24	8,57	4,71	2,61	1,46	0,87
			v				10,63	6,70	5,27	4,15	3,28	2,66
	420,00	1512,00	R				28,54	8,97	4,93	2,73	1,53	0,91
			v				10,89	6,86	5,40	4,25	3,36	2,72
INITIAL OPERATION	430,00	1548,00	R					9,38	5,16	2,86	1,60	0,95
			v					7,02	5,52	4,35	3,44	2,79
	440,00	1584,00	R					9,80	5,39	2,98	1,67	0,99
			v					7,19	5,65	4,46	3,52	2,85
	450,00	1620,00	R					10,23	5,62	3,11	1,74	1,04
			v					7,35	5,78	4,56	3,60	2,92
QUALITY MANAGEMENT	460,00	1656,00	R					10,67	5,86	3,25	1,81	1,08
			v					7,51	5,91	4,66	3,68	2,98
	470,00	1692,00	R					11,11	6,11	3,38	1,89	1,12
			v					7,68	6,04	4,76	3,76	3,05
	480,00	1728,00	R					11,57	6,36	3,52	1,96	1,17
			v					7,84	6,17	4,86	3,84	3,11
	490,00	1764,00	R					12,04	6,61	3,66	2,04	1,21
			v					8,00	6,30	4,96	3,92	3,18
	500,00	1800,00	R					12,51	6,87	3,80	2,12	1,26
			v					8,17	6,42	5,06	4,00	3,24
	510,00	1836,00	R					12,99	7,13	3,95	2,20	1,31
			v					8,33	6,55	5,16	4,08	3,31
	520,00	1872,00	R					13,49	7,40	4,09	2,28	1,36
			v					8,49	6,68	5,27	4,16	3,37
	530,00	1908,00	R					13,99	7,68	4,24	2,36	1,41
			v					8,66	6,81	5,37	4,24	3,44
	540,00	1944,00	R					14,50	7,95	4,40	2,45	1,46
			v					8,82	6,94	5,47	4,32	3,50
	550,00	1980,00	R					15,02	8,24	4,55	2,54	1,51
			v					8,98	7,07	5,57	4,40	3,57
	560,00	2016,00	R					15,54	8,53	4,71	2,62	1,56
			v					9,15	7,19	5,67	4,48	3,63
	570,00	2052,00	R					16,08	8,82	4,87	2,71	1,61
			v					9,31	7,32	5,77	4,56	3,69
	580,00	2088,00	R					16,63	9,12	5,04	2,80	1,67
			v					9,47	7,45	5,87	4,64	3,76
	590,00	2124,00	R					17,18	9,42	5,20	2,89	1,72
			v					9,64	7,58	5,97	4,72	3,82
	600,00	2160,00	R					17,75	9,73	5,37	2,99	1,78
			v					9,80	7,71	6,08	4,80	3,89
	610,00	2196,00	R					18,32	10,04	5,54	3,08	1,83
			v					9,96	7,84	6,18	4,88	3,95

PLANNING AND DESIGN

		Dimension	125 mm	160 mm	200 mm	250 mm	315 mm	355 mm	400 mm	450 mm	500 mm
		Wall thickness	7.1 mm	9.1 mm	11.4 mm	14.2 mm	17.9 mm	20.1 mm	22.7 mm	25.5 mm	28.4 mm
l/s	m³/h										
620,00	2232,00	R					18,90	10,36	5,72	3,18	1,89
		v					10,13	7,97	6,28	4,96	4,02
630,00	2268,00	R					19,49	10,68	5,89	3,28	1,95
		v					10,29	8,09	6,38	5,04	4,08
640,00	2304,00	R					20,09	11,01	6,07	3,38	2,01
		v					10,45	8,22	6,48	5,12	4,15
650,00	2340,00	R					20,70	11,34	6,25	3,48	2,07
		v					10,62	8,35	6,58	5,20	4,21
660,00	2376,00	R					21,32	11,67	6,44	3,58	2,13
		v					10,78	8,48	6,68	5,28	4,28
670,00	2412,00	R					21,95	12,01	6,63	3,68	2,19
		v					10,94	8,61	6,78	5,36	4,34
680,00	2448,00	R						12,36	6,82	3,79	2,25
		v						8,74	6,89	5,44	4,41
690,00	2484,00	R						12,71	7,01	3,89	2,31
		v						8,87	6,99	5,52	4,47
700,00	2520,00	R						13,07	7,20	4,00	2,38
		v						8,99	7,09	5,60	4,54
710,00	2556,00	R						13,43	7,40	4,11	2,44
		v						9,12	7,19	5,68	4,60
720,00	2592,00	R						13,79	7,60	4,22	2,51
		v						9,25	7,29	5,76	4,67
730,00	2628,00	R						14,16	7,80	4,33	2,57
		v						9,38	7,39	5,84	4,73
740,00	2664,00	R						14,54	8,01	4,45	2,64
		v						9,51	7,49	5,92	4,80
750,00	2700,00	R						14,92	8,22	4,56	2,71
		v						9,64	7,59	6,00	4,86
760,00	2736,00	R						15,30	8,43	4,68	2,78
		v						9,76	7,70	6,08	4,93
770,00	2772,00	R						15,69	8,64	4,80	2,85
		v						9,89	7,80	6,16	4,99
780,00	2808,00	R						16,09	8,86	4,92	2,92
		v						10,02	7,90	6,24	5,06
790,00	2844,00	R						16,49	9,08	5,04	2,99
		v						10,15	8,00	6,32	5,12
800,00	2880,00	R						16,89	9,30	5,16	3,06
		v						10,28	8,10	6,40	5,19
850,00	3060,00	R						18,98	10,44	5,79	3,43
		v						10,92	8,61	6,80	5,51
860,00	3096,00	R						19,42	10,68	5,92	3,51
		v						11,05	8,71	6,88	5,57
870,00	3132,00	R							10,92	6,05	3,59
		v							8,81	6,96	5,64
880,00	3168,00	R							11,16	6,19	3,67
		v							8,91	7,04	5,70
890,00	3204,00	R							11,41	6,32	3,74
		v							9,01	7,12	5,77
900,00	3240,00	R							11,65	6,46	3,83
		v							9,11	7,20	5,83
950,00	3420,00	R							12,93	7,16	4,24
		v							9,62	7,60	6,16
1000,00	3600,00	R							14,27	7,90	4,67
		v							10,13	8,00	6,48
1050,00	3780,00	R							15,68	8,67	5,13
		v							10,63	8,40	6,81
1100,00	3960,00	R								9,48	5,61
		v								8,80	7,13
1150,00	4140,00	R								10,33	6,10
		v								9,20	7,45
1200,00	4320,00	R								11,21	6,62
		v								9,60	7,78
1250,00	4500,00	R								12,13	7,16
		v								10,00	8,10
1300,00	4680,00	R								13,08	7,72
		v								10,40	8,43
1400,00	5040,00	R									8,90
		v									9,07
1500,00	5400,00	R									10,16
		v									9,72
1600,00	5760,00	R									11,51
		v									10,37

SYSTEM
DESCRIPTION

SYSTEM
REQUIREMENTS

TRANSPORTATION
AND STORAGE

PRODUCT
RANGE

PLANNING AND
DESIGN

WELDING
TECHNOLOGY

ASSEMBLY
GUIDELINES

INITIAL
OPERATION

QUALITY
MANAGEMENT

WELDING TECHNOLOGY

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 MECHANICAL 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!

MECHANICAL 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 MECHANICAL welding equipment, machines and tools, the General Guidelines DVS 2208, Section 1 apply. In order to establish a connection between the MECHANICAL 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.

SYSTEM
DESCRIPTION

SYSTEM
REQUIREMENTS

TRANSPORTATION
AND STORAGE

PRODUCT
RANGE

PLANNING AND
DESIGN

WELDING
TECHNOLOGY

ASSEMBLY
GUIDELINES

INITIAL
OPERATION

QUALITY
MANAGEMENT

6.2 Processing information for welding

Parameters for socket welding with a heated tool

Outer pipe diameter mm	Insertion depth mm	Heating period for SDR 11, SDR 7.4 at 20°	Processing period (maximum period) s	Cooling period	
				fixed s	total 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)". MECHANICAL 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.

WELDING TECHNOLOGY

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.



WELDING TECHNOLOGY

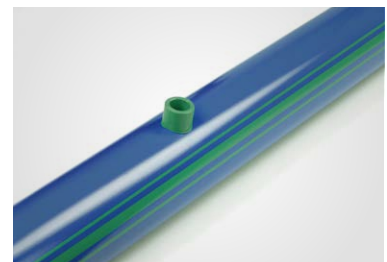
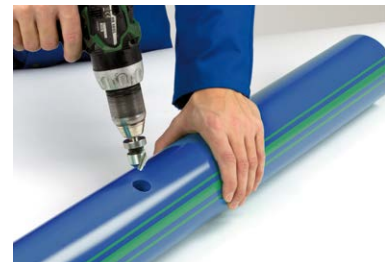
6.2.3 Welding saddle for 40–250 mm

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 POLYMELT 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.



WELDING TECHNOLOGY

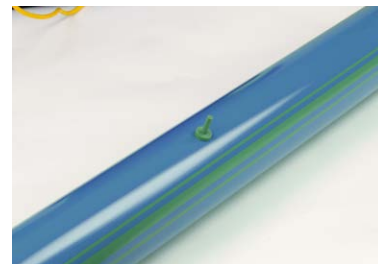
6.2.4 Repair plugs

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 MECHANICAL 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.



SYSTEM
DESCRIPTION

SYSTEM
REQUIREMENTS

TRANSPORTATION
AND STORAGE

PRODUCT
RANGE

PLANNING AND
DESIGN

WELDING
TECHNOLOGY

ASSEMBLY
GUIDELINES

INITIAL
OPERATION

QUALITY
MANAGEMENT

WELDING TECHNOLOGY

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

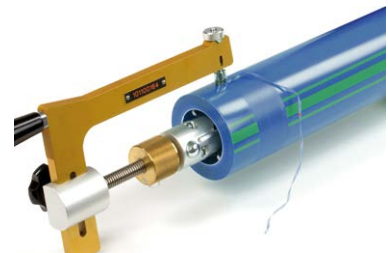
It is absolutely mandatory to maintain the order of the working steps!

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.



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

WELDING TECHNOLOGY

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 $0.1 \times \text{wall thickness}$).
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.



ASSEMBLY GUIDELINES

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 POLYMELT 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.

SYSTEM
DESCRIPTION

SYSTEM
REQUIREMENTS

TRANSPORTATION
AND STORAGE

PRODUCT
RANGE

PLANNING AND
DESIGN

WELDING
TECHNOLOGY

ASSEMBLY
GUIDELINES

INITIAL
OPERATION

QUALITY
MANAGEMENT

ASSEMBLY GUIDELINES

7.2 Mounting distances

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

MECHANICAL 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
315	300	290	270	260	230	220	200
355	310	300	290	270	250	240	220
400	320	310	300	280	260	250	230
450	330	320	310	300	280	270	250

With MECHANICAL ML5 pipes you need around 30 % less clamps compared to an installation with standard plastics without fibre reinforcement.

MECHANICAL ML5 pipes SDR 17.6

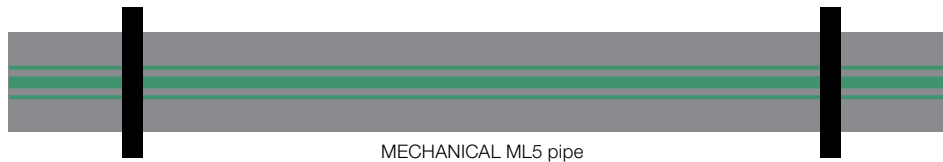
Dimension in mm	Media temperature [°C]						
	10	20	30	40	50	60	70
	Mounting distances [cm]						
125	200	190	180	170	160	150	140
160	220	215	200	190	170	160	150
200	230	220	210	200	170	170	160
250	240	230	220	200	180	170	160
315	240	240	220	210	190	180	160
355	250	240	230	220	200	190	170
400	260	250	240	230	210	200	190
450	270	260	250	240	230	220	200
500	280	270	260	250	240	230	220

ASSEMBLY GUIDELINES

Example:

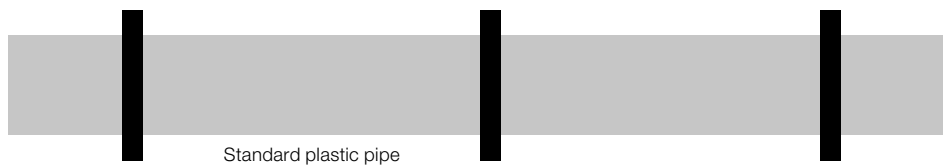
MECHANICAL ML5 pipe 50 mm, medium temperature 10 °C

mounting distance = 1,85 m



Standard plastic pipes 50 mm, medium temperature 10 °C

mounting distance = 1,2 m



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

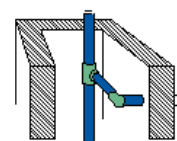
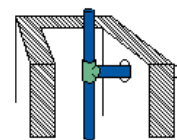
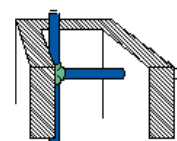
- Changes in length can be disregarded if pipes are laid in a vertical shaft.
- It will be sufficient to mount a fixed-point clamp ahead of every branching; in a rising pipe, all clamps are fixed points.
- Rising pipes can be laid without expansion elbows.
- The distance between two fixed points must 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.



ASSEMBLY GUIDELINES

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 $\alpha = 0.15 \text{ mm/mK}$
- MECHANICAL ML5 pipe $\alpha = 0.038 \text{ mm/mK}$

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	$\frac{\text{mm}}{\text{m} \times \text{K}}$
ΔT	maximum occurring temperature difference between installation and operating temperature	K

Example:

MECHANICAL ML5 pipe

Length = 10 m

Assembly temperature: 20 °C

Working temperature: 40 °C

Calculation:

$$\Delta L = 0.038 \text{ mm/mK} \times 10 \text{ m} \times 20 \text{ K}$$

$$\Delta L = 7.6 \text{ mm}$$

ASSEMBLY GUIDELINES

MECHANICAL 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)]

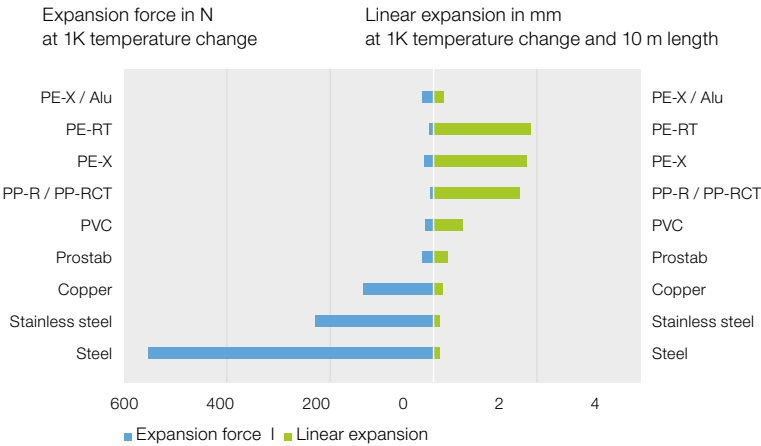
ΔT = temperature difference resulting from media temperature minus laying temperature [K]

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

ASSEMBLY GUIDELINES

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 routing 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.

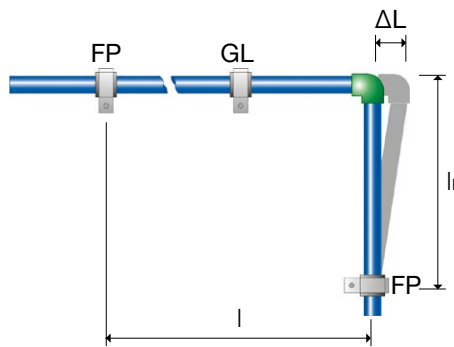
7.6.1 Bending legs

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.

$I_B = K \times \sqrt{d \times \Delta L}$		
I_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
66 .

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



ASSEMBLY GUIDELINES

7.6.2 Expansion loop

If it is not possible to compensate for the variation in length by introducing directional changes into the pipe routing, an expansion loop must be used instead.

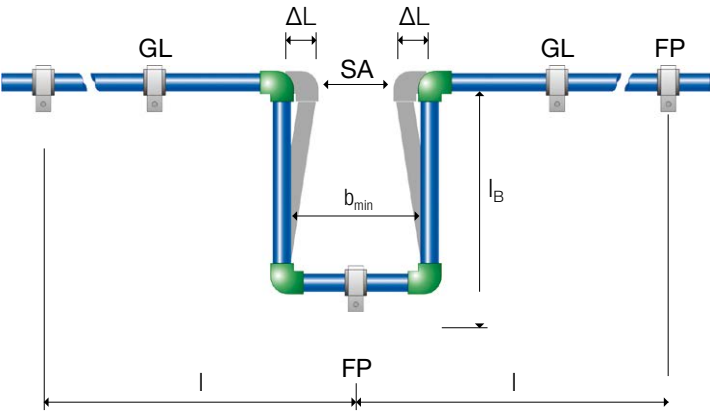
For the implementation of the expansion bend, the length l_B of the bending leg and the width b_{min} of the expansion bend must be considered. It is advisable to position the expansion bend in such a way that the lengths l_1 and l_2 are equal.

$b_{min} = 2 \times \Delta L + SA$		
b_{min}	minimum width of the expansion	mm
ΔL	variation in length	mm
SA	safety clearance = 150	mm

Sample calculation:
Variation in length $\Delta L = 84$ mm

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

$$b_{min} = 318 \text{ mm}$$



7.6.3 Pre-tensioning

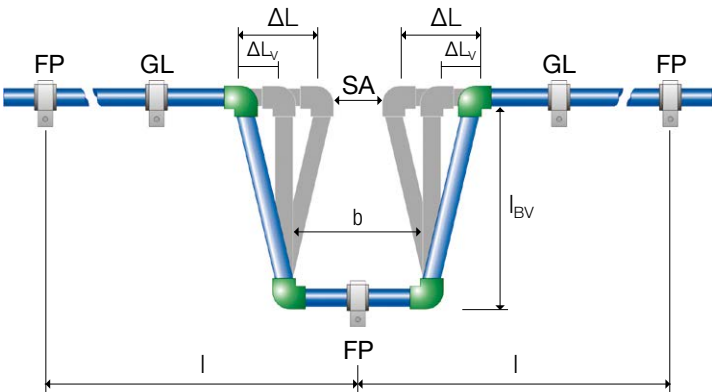
If, during installation, an expansion loop is already pre-stretched by the length ΔL_v against the subsequent length variation and is thus “pre-tensioned”, the length of the bending leg l_{BV} can be reduced.

$l_{BV} = l_B \times \sqrt{1 - \frac{\Delta L_v}{\Delta L}}$		
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 $\Delta L = 84$ mm
Pre-tensioning $\Delta L_v = 42$ mm

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

$$l_{BV} = 842 \text{ mm}$$



ASSEMBLY GUIDELINES

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.

ASSEMBLY GUIDELINES

MECHANICAL 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 $\Delta\theta$ in K (room temperature – water temperature)

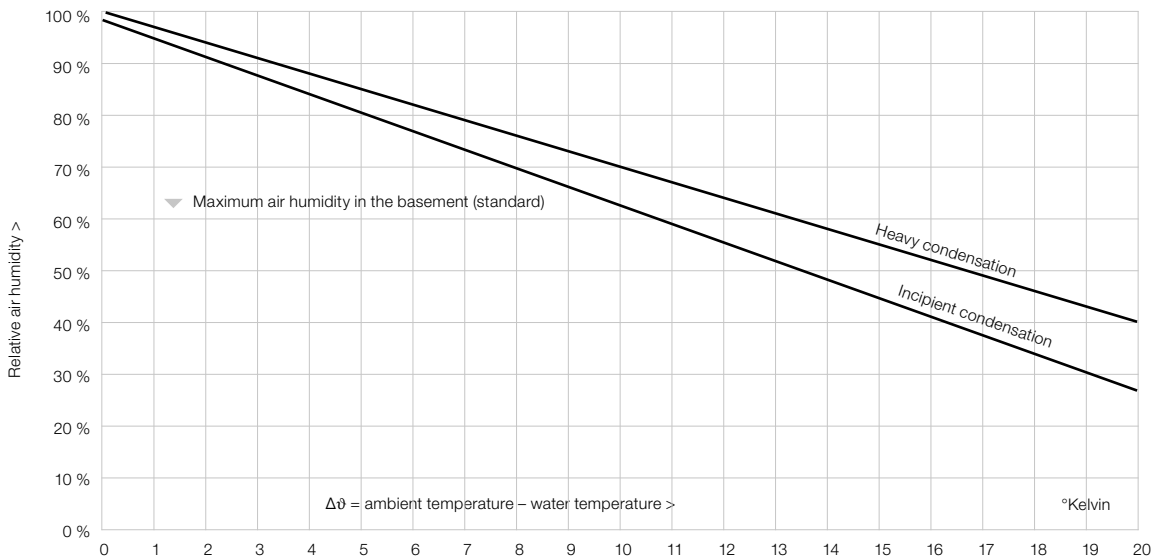
Sample calculation:

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.

ASSEMBLY GUIDELINES

Diagram for the determination of the dew point for MECHANICAL ML5 pipe SDR 11



7.8 Fire protection

The MECHANICAL 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.

INITIAL OPERATION

Fire load

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

Combustion values V (kWh/m) of MECHANICAL 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 $\geq 150 \mu\text{m}$, 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.

INITIAL OPERATION

SYSTEM
DESCRIPTION

SYSTEM
REQUIREMENTS

TRANSPORTATION
AND STORAGE

PRODUCT
RANGE

PLANNING AND
DESIGN

WELDING
TECHNOLOGY

ASSEMBLY
GUIDELINES

INITIAL
OPERATION

QUALITY
MANAGEMENT

Pressure Testing Protocol – Water

Construction project:

Construction stage:

Client represented by:

Contractor represented by:

Admissible operating pressure = bar

Test pressure = bar (Corresponds to 1.1 times the system operating pressure)

Water temperature °C Ambient temperature °C

System inspection as ☐ complete system ☐ in sections

Preliminary arrangements:

- ☐ The pipe system is made of PP-R
- ☐ The pipe system is made of PP-R and/or with combined installations made of metal and multi-layer composite pipelines.
- ☐ All pipes have been sealed with metal plugs, caps, blanking plates or blank flanges
- ☐ Equipment, pressure tanks or drinking water heaters have been disconnected from the system.
- ☐ A visual inspection ensuring the professional execution of all pipe connections has been carried out.
- ☐ Filling water has been filtered. Filter size < 150 µm
- ☐ The drinking water system has been filled, flushed and de-aerated.

Leak Test

1. Establish testing pressure bar ¹⁾ (minimum 1.1 x admissible operating pressure)
2. In the case of large temperature differences (> 10 °) between ambient temperature and the filling water, a 30-minute waiting period must be observed after testing pressure has been reached in order to achieve temperature equalization.
3. Testing period: 30 minutes
4. Use visual inspection of all connections and pressure gauge to check for obvious leaks.
5. Reduce pressure to 0.5 of testing pressure (e.g. from 15 bar to 7.5 bar)
6. Additional testing period: 30 minutes
7. Assessment:
No drop in pressure (= 0) occurred during this period.

- ☐ 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.

QUALITY MANAGEMENT

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 POLYMELT 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 POLYMELT 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 POLYMELT 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

SYSTEM
DESCRIPTION

SYSTEM
REQUIREMENTS

TRANSPORTATION
AND STORAGE

PRODUCT
RANGE

PLANNING AND
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TECHNOLOGY

ASSEMBLY
GUIDELINES

INITIAL
OPERATION

QUALITY
MANAGEMENT

SYSTEM DESCRIPTION

SYSTEM REQUIREMENTS

TRANSPORTATION AND STORAGE

PRODUCT RANGE

PLANNING AND DESIGN

WELDING
TECHNOLOGY

ASSEMBLY GUIDELINES

INITIAL OPERATION

QUALITY MANAGEMENT

Tasks

-

Tasks

- Das Kunststoff-Zentrum



The SKZ-Cert GmbH Zertifizierungen certifies to the company



POLYMELT GmbH
Kirnachstraße 17
87640 Ebenhofen

the introduction and application of a management system according to
ISO 9001:2015

Scope:
Development, production and sales of plastic pipe systems and components.

The proof has been furnished by an audit.

This certificate is valid from: **05.08.2021** to: **04.08.2024**
Certificate No.: **000482 Q/21-N**

Würzburg, 05.08.2021

Dipl.-Ing. Robert Schmitt
Certification Body



SKZ - Cert Gesellschaft mbH Zertifizierungen
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ICC-ES PMG Product Certificate

PMG-1458

Effective Date: April 2021

This listing is subject to re-examination in one year.

www.icc-es-pmq.org | (800) 423-6587 | (562) 699-0543 A Subsidiary of the International Code Council®

CSI: Division: 22 00 00 — PLUMBING
Section: 22 11 00—Facility Water Distribution
Section: 22 11 16—Domestic Water Piping

Division: 23 00 00 — HVAC
Section: 23 21 13—Hydronic Piping

Product certification system:

The ICC-ES product certification system includes testing samples taken from the market or supplier's stock, or a combination of both, to verify compliance with applicable codes and standards. The system also involves factory inspections, and assessment and surveillance of the supplier's quality system.

Products: POLYMELT Polypropylene (PP-RCT) and Polypropylene (PP-R) Piping Systems

Listee: POLYMELT GmbH
Kirnachstr. 17
87640 Ebenhofen, Germany
www.poloplast.com

Compliance with the following codes:

2021, 2018, 2015, 2012 and 2008 *International Plumbing Code®* (IPC)
2021, 2018, 2015, 2012 and 2008 *International Residential Code®* (IRC)
2021, 2018, 2015, 2012 and 2008 *International Mechanical Code®* (IMC)
2021, 2018, 2015, 2012 and 2008 *Uniform Plumbing Code®* (UPC)
2021, 2018, 2015, 2012 and 2008 *Uniform Mechanical Code®* (UMC)
2017 *Uniform Illustrated Plumbing Code-India (UIPC-India)*
2017 *Uniform Illustrated and 2010 California Plumbing Code®* (CPC)
2019, 2016, 2013 and 2010 *California Mechanical Code®* (CMC)
2020 and 2017 *City of Los Angeles Plumbing Code*
2020 and 2017 *City of Los Angeles Mechanical Code*
2017 and 2007 *Code of Massachusetts Regulation 248 CMR 10.00: Uniform State Plumbing Code of Massachusetts State Board of Building and Fire Under Chapter 29B*
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Compliance with the following standards:

ASTM F 2389-2019, Pressure-rated Polypropylene (PP) Piping Systems
NSF/ANSI 14-2020 Plastic Piping Systems Components and Related Materials
NSF/ANSI/CAN 61-2020, Drinking Water System Components – Health Effects
CSA B137.11-2020, Polypropylene (PP-R) pipe and fittings for pressure applications

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Page 1 of 1

9.2 Sustainability

In the development of its products and their production, POLYMELT 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 POLYMELT 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



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