TECHNICAL MANUAL

Hot & Cold Water Piping Systems

POLO-ECOSAN

poloplast

PIPE SYSTEMS

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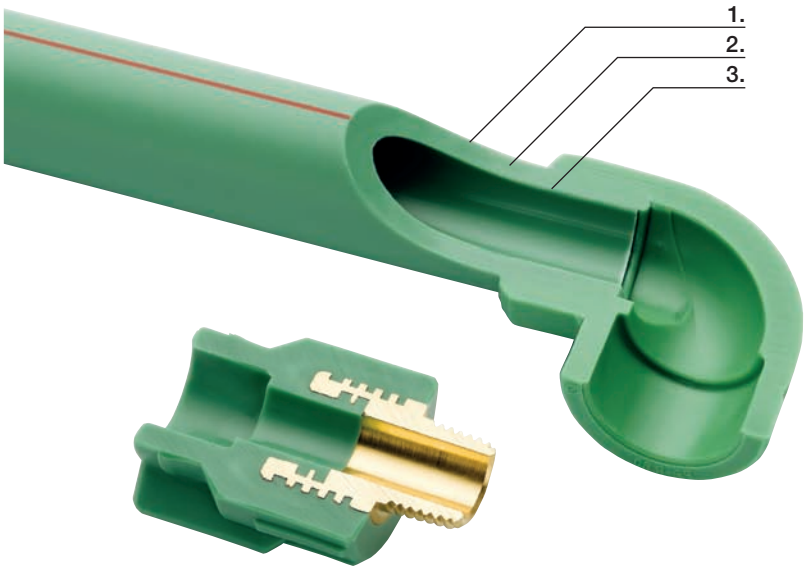
General Information

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

We are happy to provide further information – ask our technical field staff –
or contact us on +49 (0)8342 / 70 06-0, info@poloplast.com

1.1 Good Reasons at a Glance

Use anywhere – in new buildings, renovation and repair projects
(Never stuck for a solution) High product quality. Complete product assortment. Straightforward but extremely reliable and durable watertight joining technology. Low weight and troublefree. Time- and money-saving installation needing only a few lightweight tools. These are all things that make POLO-ECOSAN a "use-anywhere" indoor H+C water piping system.
Whether you're building from scratch, renovating or just doing a repair job – the flexibility of POLO-ECOSAN is one of many "watertight" arguments in this system's favour.



1. External layer made of PP-R 80
The outer layer made of high-grade polypropylene granulate protects the pipe from surface damage resulting from mechanical external forces.

2. Intermediate layer made of PP-glassfibre compound
The fibre reinforcement in the intermediate layer increases the stability and, in combination with the other two layers, provides low deflection, reduced linear expansion, a high load carrying capacity, increased robust-nessand resistance to pressure.

3. Internal layer made of PP-R 80
Used as material for the internal layer, high-grade polypropylene granulate not only provides for high tempera-ture resistance, but also ensures the pipe's resistance to corrosion, pitting, leaching and mechanical abrasion.

A watertight join.
Dependability for decades to come. The polypropylene-to-metal join created by POLO-ECOSAN's metal fittings is distinguished by watertightness. The PP-R / metal join effortlessly withstands decades of constant use.

Advantages of POLO-ECOSAN

- **High durability**
  thanks to high-quality materials and workmanship.
- **Watertight joins**
  ensure high operational reliability.
- **Meets the stringent hygienic requirements,**
  thus ensuring pristine water quality.
- **High abrasion resistance**
  means immaculate hygiene and safety.
- **Resistance to thermal stressing,**
  meaning high operational reliability.
- **Good chemical resistance**
  ensures long service life.
- **Smooth inner surfaces of pipes**
  prevent deposits and incrustation.
- **Water-flow noises are minimised**
  and so is the resultant acoustic nuisance in the home.
- **The system's high dimensional accuracy and low weight**
  save time and money when it is being installed.
- **The extensive range of different pipes and fittings**
  permits solutions for all areas of application.

1.2 Areas of Application

The POLO-ECOSAN System fulfils all requirements for drinking water installation technology.

The POLO-ECOSAN System, due to the special material properties of PP-R and our wide product range, offers a number of application possibilities:

- Drinking water pipeline networks
  for cold and warm water installations for new systems, or for systems to be renovated or to be repaired, e.g. for residential housing, hospitals, hotels, office buildings, schools, shipbuilding, etc.,

  - house connection stations
  - boiler connection
  - water distribution
  - ascending lines
  - floor level distribution
  - fittings connections

- Pipe networks for rainwater systems
- Pipelines for pneumatic systems
- Pipelines for agricultural and horticultural use
- Industrial pipeline networks, e.g. for the transport of aggressive media
  (acids, alkaline solutions, etc.) under consideration of chemical resistance.

1.3 Material Properties

POLO-ECOSAN pipes and fittings are made of polypropylene PP-R 80. This material is known for its special heat and extraction resistibility, among other features. The physical and chemical properties are specially adapted to the particular needs of drinking water.

Properties	Measuring technique	Unit	Value
Density	ISO / R 1183	g/cm^2	0,895
Yieldstress	ISO / R 527	N/mm^2	21
Tensile strength	Rate of feed D	N/mm^2	40
Tensile expansion	Specimen	%	800
Modulus of elasticity	ISO 178	N/mm^2	700
Modulus of shear	ISO / R 537, Method A		
- 10 °C		N/mm^2	1.100
0 °C		N/mm^2	770
10 °C		N/mm^2	500
20 °C		N/mm^2	370
30 °C		N/mm^2	300
40 °C		N/mm^2	240
50 °C		N/mm^2	180
60 °C		N/mm^2	140
Coefficient of elongation	VDE 0304 Sec. 1 § 4	K^{-1}	1,5 x 10^{-4}
Thermal conductivity at 20 °C	DIN 52612	W/mK	0,24
Specific heat at 20 °C	Adiabatic calorimeter	kJ/kg K	2,0

1.4 Quality Assurance

The manufacture of quality-controlled pipeline systems requires the supervision, control and inspection of all procedural steps. Furthermore, the results and procedures are to be documented.

The minimum requirements for independent company quality control diverges 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 toxological testing.

External control of the POLO-ECOSAN Pipe System in Germany is conducted by the

- Süddeutsche Kunststoffzentrum (Southern German Plastics Centre)
- Hygiene Institut (Hygiene Institute of) Karlsruhe/Gelsenkirchen, which are authorised as testing centres by DVGW (German Association of Gas and Water Facilities), among others.

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

Suitability for cold and warm drinking water has been established according to the Plastics and Drinking Water Guidelines by the Hygiene Institut Karlsruhe/Gelsenkirchen, and is a component of permanent external control.

The testing seal of the Institute documents that the POLO-ECOSAN Pipe System conforms to the Plastics and Drinking Water Recommendations of the Federal Department of Health for commodity goods.

1.5 Test Certificates

tested raw material for drinking water (according to DVGW-worksheet 270)

1.6 Standards Guidelines

The following laws, regulations, guidelines and standards are to be observed in the planning and execution of POLO-ECOSAN drinking water and heating installations:

This list does not include additional regional requirements and recommendations.

Planning and Execution:

- EnEV — Energy Conservation Regulation
- DIN 1988 — Technical Regulations for Drinking Water Installations (TRWI)
- DIN 4109 — Sound Insulation in Building Constructions
- DIN 18381 VOB Sec. C — Gas, Water and Sewage Installations within Buildings
- DIN 16928 — Pipe Connections, Fittings, Laying
- DVS 2207 — Welding of Thermoplastics
- DVS 2208 — Machines and Equipment for Welding Thermoplastics
- POLOPLAST — Technical Information

System-specific regulations: General quality specifications, dimensions

- DIN 8077 — Polypropylene Pipes, Dimensions
- DIN 8078 — Polypropylene Pipes, General Quality Requirements
- DIN 16962 — Pipe Connections and Pipeline Components for
- et sqq. — Polypropylene Pressure Pipes

- DVGW leaflets
- SKZ (Southern German Plastics Centre) Guidelines
- EN ISO 9000 et sqq.
- EN ISO 15874 1, 2, 3, 5, 7 — Plastic piping systems for hot and cold water installations-Polypropylene (PP)

System-specific regulations: Hygiene

- KTW recommendations from the Federal Department of Health
  Health-related evaluation of plastics and non-metal materials within the framework of the food and commodities law for drinking water.
- DVGW Leaflet W 270
  Reproduction of microorganisms on materials used for drinking water,- Test and evaluation.

Furthermore, all other declarations from water supply companies are to be observed. The same applies to regulations for the use of chemicals.

1.7 Chemical Resistance

Due to their special material properties, POLO-ECOSAN pipes and fittings are exemplary due to their special chemical resistance properties. The chemical resistance of POLO-ECOSAN adapters with their brass inserts is not comparable to the resistance of pure PP-R system elements.
The heat ageing resistance of polypropylene PP-R 80, is affected by copper, menganese and cabalt, particularly if the polymer melt comes with these metals. Details regarding contact with chemicals and other aggressive elements can be supplied on request.

Inquiry regarding the chemical restance oft the POLO-ECOSAN pipe system

Installation company:

Firm

Contact person

Street

Postal code/Place

Telephone

Telefax

Building Project

Street

Place

Place, date

Area of application:

Flow medium

°C Service temperature

mbar Service pressure

h/d Running time

Environment

°C Ambient temperature

mbar Ambient pressure

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

Send inquiry to: POLOPLAST GmbH
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1.8 Disinfection of POLOPLAST Piping Systems

1.8.1 Basic information about disinfection procedures

In proven cases of contamination, the disinfection of drinking water installations must only be carried out for a limited period of time. Prophylactic disinfection measures do not comply with the minimum quality requirements of the Drinking Water Ordinance. The disinfection of drinking water installations can only be successful, if all sources of contamination have been removed beforehand. The limit values for disinfectant concentration specified in the Drinking Water Ordinance represent maximum values, which were set in accordance with hygienic and toxicological standards. However, no conclusions should be drawn automatically from these values with regard to the resistance of product materials to the disinfectant agents. Only trained specialists may carry out the disinfection of drinking water installations. The disinfection measures must be recorded in writing.

Disinfection measures carried out incorrectly can damage the drinking water installation. A combined thermal-chemical disinfection procedure is not permitted.

The thermal disinfection of POLOPLAST pipe systems must be carried out as follows:
- The water heater and the entire circulation system must be heated to at least 70° C.
- Open all draw-off points in succession or line by line.
- Hot water at a temperature of 70° C must be allowed to run from all draw-off points for at least three minutes.
- Do not allow the temperature to drop during the disinfection process.
- Do not exceed the maximum temperature of 95° C.
- Take suitable measures to eliminate the risk of scalding.

The total thermal disinfection time for drinking water installations must not exceed 150 hours per year. Longer disinfection times or excessive temperatures can reduce the service life of the drinking water and can damage the system.

1.8.2 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 the subsequent flushing of the system with cold water.

Table 1 lists the concentration and contact times of chemicals on the basis of ÖNORM-Standard B 5019.

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

Table 1: Concentration and contact times of chemicals for chemical disinfection

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

1.8.3 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).

Table 2 lists the concentration and contact times of chemicals 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

Table 2: Concentration and contact times of chemicals for continuous metered addition

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

1.9 Long-term Durability and Strength

Long-term stress behaviour (PN 20) SDR 6
Max. service pressure [bar]
(security factor 1.25 acc. to DIN 8077)

Temperature [°C]	Years of operation					
	1	5	10	25	50	100
	max. service pressure					
10	42,0	39,8	38,5	37,3	36,3	35,4
20	36,0	33,8	32,8	31,8	30,9	29,9
30	30,6	28,7	27,7	26,8	26,1	25,5
40	25,8	24,2	23,6	22,6	22,0	21,3
50	22,0	20,4	19,7	19,1	18,5	17,8
60	18,5	17,2	16,6	15,9	15,3	-
70	15,6	14,3	14,0	12,1	10,2	-
80	13,1	11,5	9,6	7,6	-	-
95	9,2	6,1	5,1	-	-	-

Long-term stress behaviour (PN 10) SDR II
Max. service pressure [bar]
(security factor 1.25 acc. to DIN 8077)

Temperature [°C]	Years of operation					
	1	5	10	25	50	100
	max. service pressure					
10	21,1	20,0	19,3	18,7	18,2	17,7
20	18,0	16,9	16,4	16,0	15,5	15,0
30	15,3	14,4	13,9	13,4	13,1	12,8
40	12,9	12,1	11,8	11,3	11,0	10,7
50	11,0	10,2	9,9	9,6	9,3	8,9
60	9,3	8,6	8,3	8,0	7,7	-
70	7,8	7,2	7,0	6,1	5,1	-
80	6,5	5,7	4,8	3,8	-	-
95	4,6	3,0	2,6	-	-	-

1.10 Fire Protection

POLO-ECOSAN pipes and fittings are classified under Fire Classification B 2 according to DIN 4102, Section 4. Since all pipes and fittings are made of pure polypropylene, POLO-ECOSAN pipes do not exhibit an increased conflagration gas toxicity.

Generally, all pipe leadthroughs must possess the same classification as the penetrated elements. For example, in a wall with a fire resistance duration of 90 minutes (F 90), the pipe leadthroughs must also possess a fire resistance duration of 90 minutes (R 90). For POLO-ECOSAN pipes, all fire protection systems may be employed that have the corresponding test certificate.

Fire Load

The resulting POLO-ECOSAN combustion heat V (kWh/m) is dimension-specific. The basis of calculating the combustion heat V for POLO-ECOSAN pipes made from PP-R 80 is the lower heat value Hu = 12.2 kWh/kg (acc. to DIN 18230 Sec. 1), and the material mass m (kg/m).

Outside diameter mm	Pipe serics		Prostab
	SDR 11	SDR 6	SDR 7,4
	PN 10	PN 20	PN 16
16	-	1,34	1,62
20	1,31	2,1	2,04
25	2	3,25	3,18
32	3,25	5,3	5,04
40	5,03	8,19	7,57
50	7,78	12,81	11,06
63	12,32	20,13	17,27
75	17,32	28,55	24,8
90	24,77	41	36,84
110	36,72	61,49	58,75
125	47,54	77,84	-

Combustion heat values V (kWh/m) of POLO-ECOSAN pipes.

1.11 Sound Insulation

DIN 4109 “Sound insulation in building constructions” with supplementary tabe A1
DIN 4109 and supplementary table A1 regulate the minimum sound insulation requirements in buildings having various requirements and under consideration of the noise source. The following sound pressure levels in dB(A) are permitted.

Values for permissible sound pressure levels in rooms requiring sound insulation for noises from domestic technical building systems and businesses.

Column	1	2	3
Cell	Noise source	Type of rooms requiring sound insulation	
		Living rooms and bedrooms	Classrooms and office rooms
		Characteristic sound pressure level dB(A)	
1	Water installations (Water supply and sewage together)	≤ 30 ° [1) 2)]	≤ 35 ° [1) 2)]
2	Other domestic technical systems	≤ 30 ° [3)]	≤ 35 ° [3)]
3	Companies, daytime from 6 am to 10 pm	≤ 35 °	≤ 35 ° [3)]
4	Companies, at night from 10 pm to 6 am	≤ 25 °	≤ 35 ° [3)]

[1)] Individual, short-term peaks occurring when fixtures and equipment are operated according to Table 6 (opening, closing, adjusting, interrupting, etc.) are not included at this time.
[2)] Contractual plant requirements for fulfilment of permissible installation sound pressure level:
– Performance documentation must include sound insulation requirements, i.e. the necessary sound insulation documentation for the components must be available.
– In addition, the responsible construction manager(s) must be named and involved before closing or encasing the installation work. Further details are regulated by the ZVSHK instruction leaflet.*)
[3)] For ventilation systems, values of 5 dB(A) more are permitted if the noises in question are permanent but without noticeable individual tones.

DIN 4109 – RESIDENTIAL BUILDING
For noises from sanitary installations, a maximum sound pressure level L of ≤ 30 dB(A) is permissible if no augmented noise protection was stipulated in the contract. Assessed is the total sound level of the whole installation. A certificate of proof of sound insulation suitability is required.

Requirements of DIN 4109 do not automatically apply for freestanding, single-family homes. Conformity to the regulations is highly recommended, since, especially in single-family homes, a corresponding standard is expected.

1.12 Equipotential Bonding

VDE 0190 Sections 410 and 540 require an equipotential bonding between all types of earthed conductors and existing “conductive” water, sewage and heating pipes. Since the POLO-ECOSAN system is not a conductive pipe system, it cannot be used for equipotential bonding, and thus need not be earthed. Equipotential bonding is performed according to VDE guidelines from the components to be earthed directly to the equipotential busbar in the position stipulated on the corresponding plans. The plumber, heating technician or construction manager must inform the customer or the customer’s contractor that an authorised electrician must check the verification that the installation of the POLO-ECOSAN System does not inhibit the existing electrical protection and earthing measures (VOB, Sec. C, General Technical Contractual Obligations / ATV).

1.13 UV Protection

Uncovered POLO-ECOSAN pipe system without protective piping is to be protected from extended exposure to sunlight (several months) by a covering.

1.14 Transport and Storage

POLO-ECOSAN pipes may be stored at any outdoor temperature. The storage spot should be selected such that the pipes lie completely horizontally. Make sure the pipes are not bent while being stored or transported. In the case of temperatures below freezing, the pipes may become damaged if they are struck hard. Thus, the material is to be handled with care at low temperatures.
UV rays have a negative influence on all high-polymer plastics. Thus, do not store them outdoors for any length of time without sufficient cover.

1.15 Handling Tips

Recommendations for handling POLO-ECOSAN Pipe System

Avoid sharp impacts and strokes 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.

Shelter 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 immediately during jointing.

Protect pipes filled with water from freezing.

Drain lines in danger of freezing.

2.1 Fastening Techniques

The ideal fastening elements for the POLO-ECOSAN Pipe System are pipe clamps with rubber inserts.

Furthermore, when selecting fastening material, make sure that no mechanical damage of the pipe surface can occur.

Generally, during pipe assembly, we differentiate between installation as a fixed point or a loose point bearing.

2.2 Bearing Spans

Spans for POLO-ECOSAN standard pipe PN10 / PN20 in cm		
Pipe Ø in mm	cold T = 20° C	hot T = 70° C
16	75	50
20	80	50
25	85	70
32	100	80
40	110	90
50	125	100
63	140	120
75	155	130
90	165	145
110	185	160

Table for the determination of bearing spans of POLO-ECOSAN Pipe PN10 / PN20 depending on temperature and outside diameter.

Spans for POLO-ECOSAN Multi-Layer in cm		
Pipe Ø in mm	cold T = 20° C	hot T = 70° C
16	100	50
20	115	50
25	140	70
32	150	80
40	160	90
50	170	100
63	180	120
75	200	130
90	210	145
110	220	160

Table for the determination of bearing spans of POLO-ECOSAN Multi-Layer pipe depending on temperature and outside diameter.

Spans for POLO-ECOSAN standard pipe PN 10 / PN 20 with pipe supports in cm		
Pipe Ø in mm	cold T = 20° C	hot T = 70° C
16	170	150
20	170	150
25	200	180
32	220	200
40	230	210
50	230	230
63	230	230
75	230	230
90	230	230
110	230	230

Table for the determination of bearing spans of POLO-ECOSAN Pipe PN 10 / PN 20 with pipe supports depending on temperature and outside diameter.

2.3 Fixed Points

By arranging fixed points, pipelines can be divided into individual line segments. This prevents uncontrolled movement of the lines and ensures secure pipe guidance.

Fixed points are to be measured and executed taking into account the expansion forces of POLO-ECOSAN pipes.

When using threaded rods or studs, make sure there is a short ceiling distance.

Vertical pipes can generally be installed in a fixed manner. Expansion bends are not necessary when installing ascending pipes if a fixed point is mounted immediately in front of or behind a branching.

In order to absorb forces originating from length changes in the pipeline, the clamp and support must be fastened sufficiently and sturdily.

Pipe clamps with rubber inserts should be used in order to avoid damage to POLO-ECOSAN pipes.

2.4 Loose Points

Loose supports must enable movement of the pipeline in an axial direction without causing damage to the pipe.

When positioning the loose point, make sure that pipeline movement is not hindered by immediately adjacent fittings or valves. Also, make sure that pipe guidance is anchor-free.

2.5 Elongation

Elongation of pipes is dependent upon warming of the pipe material.

Thus, cold water lines cause virtually no elongation. Elongation during normal assembly and ambient temperature is not taken into consideration.

When installing warm-water and heating lines, elongation resulting from heat-induced expansion of the material must be taken into account. Treatment of elongation depends on whether a concealed or uncovered installation is performed.

2.5.1 Concealed Installation

When executing concealed installation, elongation of the POLO-ECOSAN pipes does not generally need to be taken into account.

The insulation measures stipulated in DIN 1988 and EnEV norms allow the pipe enough room for expansion. If expansion should exceed the space allowed by the insulation, the material will absorb any tension through permanent elongation.

The same is true for pipelines that do not need to be insulated in accordance with valid regulations. Temperature-related elongation is prevented by embedding the system in floor pavement, concrete or plaster. The resulting pressure and tensile stress are absorbed by the material, such that they are not critical.

2.5.2 Uncovered Installation

Particularly for uncovered installation (e.g. in basement areas), greater importance is placed on appearance and stability. POLO-ECOSAN Pipes for cold and warm water systems, with the support of pipe supports or POLO-ECOSAN multi-layer enable perfect installation with considerably less expansion.

2.5.3 Calculation of Elongation

The following calculation examples and diagrams will serve to aid in the practical determination of expansion in length. The difference between the service temperature and the maximum and minimum assembly temperature is fundamental to the calculation of elongation.

When calculating elongation, the following points must be observed:
- existing room and material temperature during assembly
- difference in temperature between the lowest and highest pipe wall temperature
- coefficient of elongation.

The formula for the calculation of elongation in mm is:

$$\Delta L = \alpha \cdot L \cdot \Delta T$$

Key:

ΔL	= elongation	
L	= pipe length in mm	
ΔT	= temperature difference in K	
α	= coefficient of elongation in K–1	
	POLO-ECOSAN standard pipe	$\alpha = 0.15$
	POLO-ECOSAN standard pipe with pipe support	$\alpha = 0.05$
	POLO-ECOSAN multi-layer pipe	$\alpha = 0.05$

Sample calculation:	
POLO-ECOSAN standard pipe	
pipe length: 6 m	
temperature ranges: medium temperature temperature at installation temperature difference	 60 °C 15 °C 45 K
ΔL = 0,15 · 6 · 45 = 40,5 mm	

2.5.4 Table of Elongation

POLO-ECOSAN standard pipes (PN 10 / PN 20)

pipe length in meter (m)	difference in temperature ΔT (K)							
	10	20	30	40	50	60	70	80
0,1	0,15	0,30	0,45	0,60	0,75	0,90	1,05	1,20
0,2	0,30	0,60	0,90	1,20	1,50	1,80	2,10	2,40
0,3	0,45	0,90	1,35	1,80	2,25	2,70	3,15	3,60
0,4	0,60	1,20	1,80	2,40	3,00	3,60	4,20	4,80
0,5	0,75	1,50	2,25	3,00	3,75	4,50	5,25	6,00
0,6	0,90	1,80	2,70	3,60	4,50	5,40	6,30	7,20
0,7	1,05	2,10	3,15	4,20	5,25	6,30	7,35	8,40
0,8	1,20	2,40	3,60	4,80	6,00	7,20	8,40	9,60
0,9	1,35	2,70	4,05	5,40	6,75	8,10	9,45	10,80
1,0	1,50	3,00	4,50	6,00	7,50	9,00	10,50	12,00
2,0	3,00	6,00	9,00	12,00	15,00	18,00	21,00	24,00
3,0	4,50	9,00	13,50	18,00	22,50	27,00	31,50	36,00
4,0	6,00	12,00	18,00	24,00	30,00	36,00	42,00	48,00
5,0	7,50	15,00	22,50	30,00	37,50	45,00	52,50	60,00
6,0	7,00	18,00	27,00	36,00	45,00	54,00	63,00	72,00
7,0	10,50	21,00	31,50	42,00	52,50	63,00	73,50	84,00
8,0	12,00	24,00	36,00	48,00	60,00	72,00	84,00	96,00
9,0	13,50	27,00	40,50	54,00	67,50	81,00	94,50	108,00
10,0	15,00	30,00	45,00	60,00	75,00	90,00	105,00	120,00

Elongation ΔL in mm

POLO-ECOSAN standard pipes PN 20 with pipe supports/POLO-ECOSAN multi-layer pipes

pipe length in meter (m)	difference in temperature ΔT (K)							
	10	20	30	40	50	60	70	80
0,1	0,05	0,10	0,15	0,20	0,25	0,30	0,35	0,40
0,2	0,10	0,20	0,30	0,40	0,50	0,60	0,70	0,80
0,3	0,15	0,30	0,45	0,60	0,75	0,90	1,05	1,20
0,4	0,20	0,40	0,60	0,80	1,00	1,20	1,40	1,60
0,5	0,25	0,50	0,75	1,00	1,25	1,50	1,75	2,00
0,6	0,30	0,60	0,90	1,20	1,50	1,80	2,10	2,40
0,7	0,35	0,70	1,05	1,40	1,75	2,10	2,45	2,80
0,8	0,40	0,80	1,20	1,60	2,00	2,40	2,80	3,20
0,9	0,45	0,90	1,35	1,80	2,25	2,70	3,15	3,60
1,0	0,50	1,00	1,50	2,00	2,50	3,00	3,50	4,00
2,0	1,00	2,00	3,00	4,00	5,00	6,00	7,00	8,00
3,0	1,50	3,00	4,50	6,00	7,50	9,00	10,50	12,00
4,0	2,00	4,00	6,00	8,00	10,00	12,00	14,00	16,00
5,0	2,50	5,00	7,50	10,00	12,50	15,00	17,50	20,00
6,0	3,00	6,00	9,00	12,00	15,00	18,00	21,00	24,00
7,0	3,50	7,00	10,50	14,00	17,50	21,00	24,50	28,00
8,0	4,00	8,00	12,00	16,00	20,00	24,00	28,00	32,00
9,0	4,50	9,00	13,50	18,00	22,50	27,00	31,50	36,00
10,0	5,00	10,00	15,00	20,00	25,00	30,00	35,00	40,00
11,0	5,50	11,00	16,50	22,00	27,50	33,00	38,50	44,00
12,0	6,00	12,00	18,00	24,00	30,00	36,00	42,00	48,00
13,0	6,50	13,00	19,50	26,00	32,50	39,00	45,50	52,00
14,0	7,00	14,00	21,00	28,00	35,00	42,00	49,00	56,00
15,0	7,50	15,00	22,50	30,00	37,50	45,00	52,50	60,00

Elongation ΔL in mm

2.6 Expansion Compensation

For uncovered POLO-ECOSAN installations, expansion in length ΔI must be taken into account in the planning stage. The pipeline must be planned and installed in such a way that the pipe can move freely within the limits of the calculated expansion.

In most cases, alterations in the direction of the pipeline can be used for the compensation of the expansion in length, via:
- bending legs
- expansion loops
- prestress.

2.6.1 Bending Leg

The length of a bending leg is calculated as follows:

Sample calculation: Bending Leg Length
Given and required values

Symbol	Meaning	Value	Unit
L_S	Length of bending leg	?	mm
K	Material-specific constant POLO-ECOSAN pipes	15	-
d	Outside diameter POLO-ECOSAN pipes	40.0	mm
ΔI	Elongation	30.0	mm

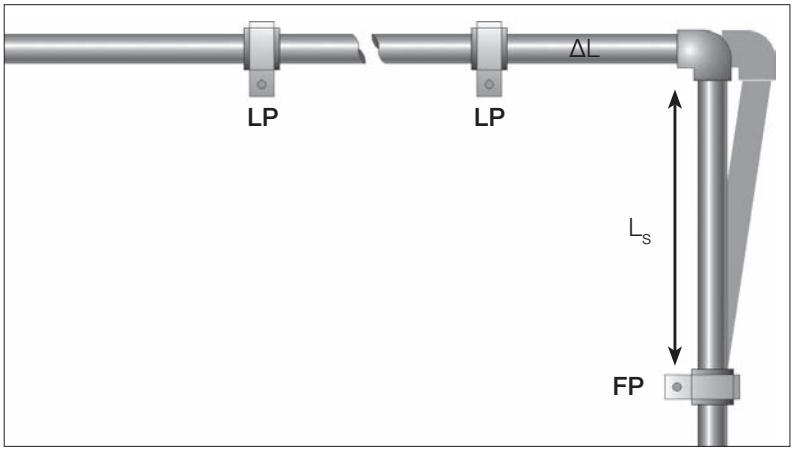
The following formula is used to calculate the length of the bending leg:

$$L_S = K \times \sqrt{d \times \Delta I}$$

$$L_S = 15 \times \sqrt{40{,}0\ mm \times 30{,}0\ mm}$$

$$L_S = 520{,}00\ mm$$

Based on the initial values above, the length of the bending leg L_S amounts to 520 mm.



LP = sliding bearing (loose point)
FP = fixed point

2.6.2 Expansion Loop

In addition to the length of the bending leg L_S, the width of pipe bend A_{min} must also be taken into account when calculating the expansion loop.

Sample calculation: Wide Expansion Loop

Given and required values

Symbol	Meaning	Value	Unit
A_{min}	Width of expansion loop	?	mm
Δl	Elongation	30.0	mm
SA	Safety margin	150.0	mm

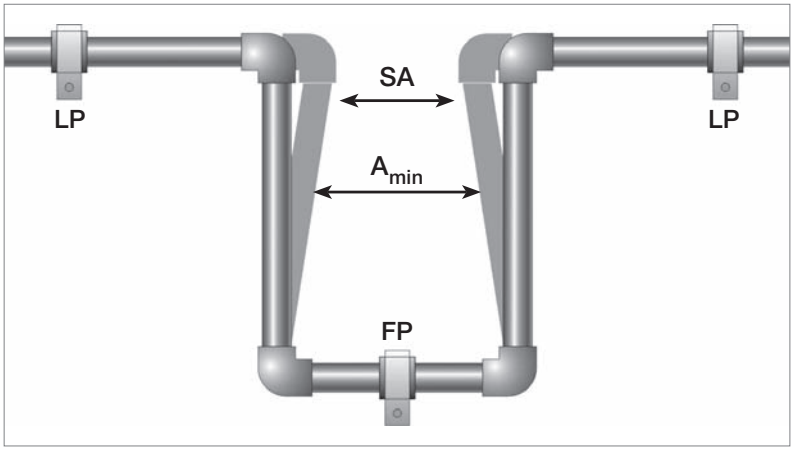
The following formula is used to determine pipe bend A_{min}:

$A_{min} = 2 \times \Delta l + SA$

$A_{min} = 2 \times 30{,}0\ mm + 150{,}0\ mm$

$A_{min} = 210{,}00$

The width of Expansion loop A_{min} should amount to at least 210 mm.



LP = sliding bearing (loose point)
FP = fixed point
ΔL = elongation

2.6.3 Prestress

By prestressing a bending leg, the length of the bending leg can be reduced if there is a lack of space. If calculated and installed precisely, prestressed installations render expansion movement virtually invisible and thus result in perfect pipeline appearance.

Leg length L_{SV} for prestressed bending legs is calculated as follows:

Sample calculation: Bending Leg Length with Prestressing
Given and required values

Symbol	Meaning	Value	Unit
L_{SV}	Length of prestressed bending leg	?	mm
K	Material-specific constant POLO-ECOSAN pipes	15	-
d	Outside diameter POLO-ECOSAN pipes	40.0	mm
Δl	Elongation	30.0	mm

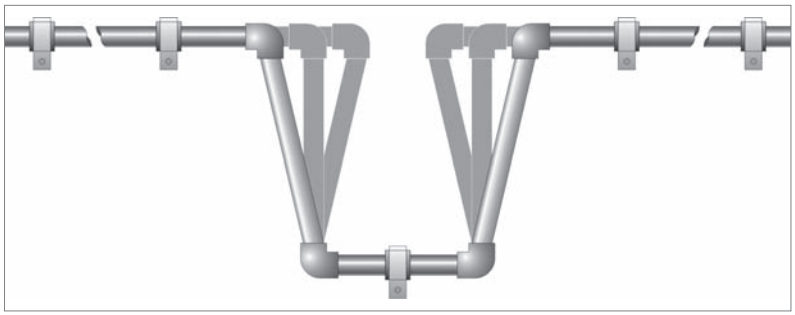
The following formula is used to determine the the bending leg length:

$$L_{SV} = K \times \sqrt{d \times \frac{\Delta l}{2}}$$

$$L_{SV} = 15 \times \sqrt{40{,}0\ mm \times \frac{30{,}0\ mm}{2}}$$

$$L_{SV} = 368{,}0\ mm$$

Using the initial values above, the length of the bending leg with prestressing amounts to 368 mm.

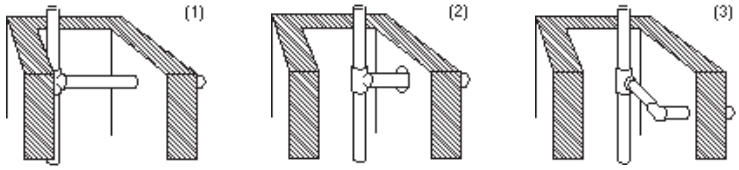


2.7 Installation in Shafts

If ascending pipes are installed in shafts, the floor branching has to be installed accordingly, i.e. the branching line has to have sufficient space for movement in accordance with the alteration in length of the ascending pipe.

This can be achieved by installing the ascending pipe in the appropriate spot in the shaft (1), by using a respectively large feeding pipe for the branching line (2) or by installing a spring leg (3).

When fixed and loose points are properly installed with respect to the bending legs, expansion compensation can also be easily achieved in basement ducts and ascending pipes.



2.8 Thermal Insulation

2.8.1 Hot Water Lines

EnEV norms regulate the thermal insulation of pipelines and fittings within the Federal Republic of Germany.

According to these regulations, POLO-ECOSAN pipes and fittings must also be thermally insulated.
The insulation thickness is dependent upon the individual installation circumstances.

Appendix 5 of the EnEV Norms
Requirements for Limiting Heat Emission in Heat Distribution and Hot-Water Pipelines as well as for Fittings (re: §12 Sec. 5)

1. Heat emission from heat distribution and hot-water pipelines and fittings is to be limited through heat insulation according to Table 1.

Line	Type of Pipe/Fitting	Minimum thickness of 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 over 22 to 35 mm	30 mm
3	Inner diameter over 35 to 100 mm	same as inner diameter
4	Inner diameter over 100 mm	100 mm
5	Pipes and fittings in Lines 1 - 4 in wall and ceiling passages, in cross sections of pipelines, at pipe connections, for central pipe net distributors	$^1/_2$ of the requirements for lines 1 - 4
6	Pipes of central heating systems from Lines 1 - 4 that have been installed in buildings between heated rooms of various users after these regulations went into effect.	$^1/_2$ of the requirements for lines 1 - 4
7	Pipes installed as in Line 6 in floor constructions.	6 mm

Table 1: Heat insulation of heat distribution and hot-water pipelines as well as for fittings

If central heating pipes corresponding to Lines 1 - 4 are installed in heated rooms or in buildings between heated rooms of a single user and their heat emission can be influenced by uncovered shut-off devices, no requirements apply to the minimum thickness of the insulation layer. This also applies for hot-water lines in residential housing having an inner diameter of up to 22 mm, which are neither connected to the flow circuit nor equipped with an electric auxiliary heater.

2. In the case of materials having thermal conductivity values other than 0.035 W/(mK), the minimum thicknesses of insulation layers are to be converted accordingly. The calculation procedures and values contained in the approved technical regulations are to be employed for the conversion of the thermal conductivity of the insulation material.

3. In the case of heat distribution and hot-water pipes, the minimum thicknesses of the insulation layers according to Table 1 may be reduced to the extent of the comparable limit of heat emission.

2.8.2 Cold Water Lines

Cold drinking water lines must be protected from condensation and heat in accordance with

* DIN 1988, Section 2.

Reference values for minimum insulation thickness are contained in the following table. The insulation thicknesses listed apply to all pipe materials and thus must also be used for POLO-ECOSAN pipes.

Reference Values for Minimum Thickness of Insulation Layers for the Insulation of Drinking Water Lines (Cold)	
Installation Situation	Insulation layer thickness at λ = 0,040 W/mK*
Pipelines in unheated rooms, uncovered installation (e.g. basement)	4 mm
Pipelines in heated rooms, uncovered installation	9 mm
Pipelines installed in sewers, no hot water lines next to them	4 mm
Pipelines installed in sewers, next to hot water lines	13 mm
Pipelines in wall slots, ascending	4 mm
Pipelines in wall recesses, next to hot water lines	13 mm
Pipelines on concrete floor	4 mm
*) If materials with different thermal conductivity coefficients are used, the insulation layer thickness must be converted accordingly in relation to a pipe diameter of d = 20 mm.	

2.9 Pressure Test

General Information
In accordance with DIN 1988, an internal pressure test is required for finished installation systems while pipelines are not yet covered, with a test pressure of 1.5 times the service pressure but at least 12 bar. Performance of the pressure test on POLO-ECOSAN sanitary pipes of 16 mm to 110 mm is based on pipe lengths of up to 100 m. In systems having over 100 m of pipeline, the pressure test must be performed in sections of fewer than 100 m. The pressure test may only be conducted one hour after termination of the last welding work, at the earliest.

Filling of the installation
- POLO-ECOSAN sanitary pipes are to be filled with pure water and deaired.
- The pressure pump should, if possible, be installed at the lowest part of the installation to be tested.
- The pressure gauge (manometer) used for pressure testing must easily enable readings of 0.1 bar in pressure alteration.

Warning!
Any increase in temperature on the pipe wall during the pressure test will cause a loss of pressure on the pressure gauge. Standard value: an alteration in temperature of 10 K causes a loss of pressure of approx. 0.5 to 1 bar.

Pre-test
Test pressure = 15 bar
Test duration = 1 hr.

For the pre-test, a pressure of 15 bar is built up, which may be repeated twice within 30 minutes. After a test duration of another 30 minutes, the pressure may not drop by more than 0.1 bar/5 minutes, and no leaks must occur.

Main test
Test pressure = 13 bar
Test duration = 2 hrs.

Immediately after successfully completing the pre-test, the main test is to be performed with a test pressure of 13 bar and a duration of 2 hours. During this period, the pressure may not drop more than 0.1 bar/hour. After completion of the pressure test, the service pressure of the installation must be set.

2.9.1 Pressure Test Report

1. Installations

Building owner: .....

Building: .....

Location: .....

Installation company: .....

Pipe lengths:

Ø 16 mm ( ) m, Ø 20 mm ( ) m, Ø 25 mm ( ) m

Ø 32 mm ( ) m, Ø 40 mm ( ) m, Ø 50 mm ( ) m

Ø 63 mm ( ) m, Ø 75 mm ( ) m, Ø 90 mm ( ) m

Ø 110 mm ( ) m, Ø 125 mm ( ) m.

Highest consumption point is locat m above pressure gauge. Total m

2. Pre-test

Test pressure = 15 bar

Pressure after 30 min = ... bar (start of pre-test)

Pressure after 60 min = ... bar

Pressure loss per 10 min = ... bar

Result of pre-test: .....

.....

3. Main test

Test pressure = 13 bar

Pressure after 30 min = ... bar (start of pre-test)

Pressure after 60 min = ... bar

Pressure loss per 10 min = ... bar

Result of main test: .....

.....

4. Time schedule of test

Start of test: ..... End of test: ..... Test duration: .....

Test company: .....

Plumber: .....

Location: ..... Date: .....

2.10 Flushing Pipe Systems

The Technical Regulations for Drinking Water Installations, TRWI

* DIN 1988, Sec. 2,

must be observed when flushing pipe systems. Flushing is performed with an air/water mixture intermittently under pressure.

DIN 1988 no longer completely conforms to the latest state of the art. The altered conditions have been summarised by the St. Augustin Central Association of Sanitary/Heat/Air Conditioning Systems in a leaflet on the problem entitled “Flushing Pipelines”. This leaflet is available from the Association or from the state guild associations.

Generally, all drinking water systems, regardless of materials used, should be thoroughly flushed after completion. The following requirements are necessary for optimal service readiness:

- securing of drinking water quality
- prevention of corrosion damage
- prevention of functional damage to fittings and equipment
- cleaning of interior pipe surfaces.

These requirements are achieved using two flushing procedures:
1. Flushing with water
2. Flushing with an air/water mixture.

The experience of the plumber, client requirements and manufacturer’s instructions are decisive in the type of flushing procedure used.

For drinking water systems in accordance with DIN 1988 assembled consisting exclusively of the POLO-ECOSAN pipe system, procedure 1, “Flushing with water”, is sufficient.

For thermal processing of POLO-ECOSAN pipe systems, no additional materials are needed such as adhesives, fluxing agents, etc. The bond is produced solely through fusion. The system materials are and remain pure during bonding.

Thus, simple flushing with water after system installation in accordance with procedure “1” is completely sufficient.

3.1 General Information

3.1.1 POLO-ECOSAN Welding Devices and Tools

Make sure that the welding tools lie flat against the heating element. Do not use pliers or other unsuitable tools so as not to damage the coating of the welding tools.
The required welding temperature for processing the POLO-ECOSAN system is 260°C.
Warning: The first welding should not be done until five minutes after welding temperature has been reached.

POLO-ECOSAN welding devices and tools are to be protected from impurities. Burned-on particles can lead to incorrect welding connections. Tools may be cleaned with non-fibrous, coarse paper towels. The welding tools must always be kept dry. If necessary, dry them with a clean, non-fibrous cloth.
Damaged and soiled welding tools must be replaced, since only clean, properly functioning tools can produce clean and proper connections.

Guidelines
General work protection and accident prevention guidelines are to be observed when using welding equipment.
The Guidelines of the Industrial Trade Associations of the Chemical Industry for Machines for the Processing and Employment of Plastics, Chapter: Welding Machines and Equipment, apply.
For the handling of POLO-ECOSAN welding equipment, machines and tools, the General Guidelines DVS 2208, Sec. 1 apply.
In accordance with DVS Guidelines, control of the necessary application temperature using quick-display surface temperature thermometers is permissible.

Suitable measuring devices must enable a temperature measurement of up to 350°C and exhibit a high degree of measurement accuracy.

3.1.2 Processing Information

Minimum times for socket welding of PP pipeline segments at an outdoor temperature of 20°C and moderate air movement (required time).
In the case of outdoor temperatures of under 5°C, heat-up times must be doubled.

1	2	3	4	5	DVS 2207
Outside pipe diameter mm	Insertion depths mm	Heating period s	Processing period s	Cooling period min	
16 20 25	13 14 15	6 6 9	4	2	With hand welding device
32 40 50	16,5 18 20	10 15 23	6	4	
63	24	28	8	6	With welding machine
75 90	26 32	35 46	10 10	8 8	
110	32,5	58	15	10	

3.1.3 Polyfusion Welding

Instructions for socket and sleeve welding can be found in DVS brochure no. 2207, Section 11, „Welding of thermoplastics – Heated tool welding of pipes, pipeline, components and sheets out of PP“. POLO-ECOSAN welding is performed according to those guidelines. In this process, pipes and fittings are welded overlapping. The end of the pipes and fittings are heated using a welding device and subsequently connected.

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 high-quality Teflon coating. In order to avoid damaging the Teflon coating, never use pliers or similar tools for assembly. Please use a screwdriver or hexagon socket wrench.)

2. Switch on the welding device.

3. Check welding temperature before starting to weld.
   Check the temperature once again before welding.

4. The ends of the pipes must be cut clean and even. Pipe, fittings and welding tools must be clean and checked before welding for impurities. If necessary, clean them with a non-fibrous paper towel or a clean cloth.

5. Fitting and pipe must be inserted quickly and axially, without twisting, into the corresponding welding tools (insertion depth acc. to the table on p. 25). The parts to be welded are then heated according to the table on p. 25, Column 3.

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 (max. processing time according to table on p. 25).
   A visual guide to determine the correct insertion depth is the double roll on the back of the fitting and pipe (see DVS brochure 2207, Sec. 11). The markings on the fittings, offset by 90°, enable easy removal at the proper angle when one marking is lined up with the solid line on the pipe.

7. The setting time of the joint corresponds to the heating period. Only after the cooling period (see the table on p. 25) may pressure be put on the welded connection.

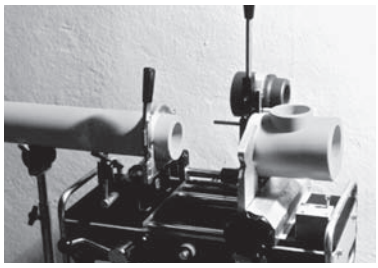
8. If necessary, clean the welding bushes and core rods after each use.

Fast
Cut pipe clean and even to desired length with pipe cutters.

Simple
Pipe and fittings are heated with the welding device.

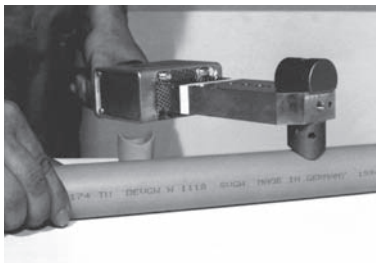
Safe
Join pipes and fittings. Finished!
100% secure polyfusion welding.

3.1.4 Welding Machine for Large Pipe Diameters



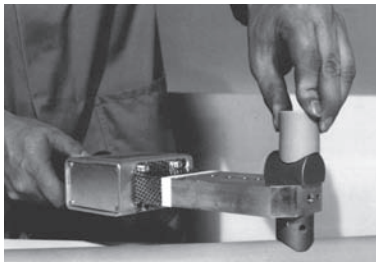
We recommend the use of a large welding machine for the welding of pipe diameters over 40 mm and for the pre-assembly of installation elements. Welding of thermoplastics – Heated tool welding of pipes, pipeline, components and sheets out of PP acc. to DVS 2207, Sec. 11 apply. Consult the instruction manual of the welding machine for detailed information on welding times and machine use.

3.1.5 Use of Welding Saddles



Areas of use:

- subsequent extension of existing pipe systems
- alternative use instead of tees
- direct branching of a service line to a supply line



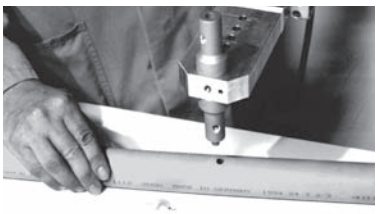
Procedure:

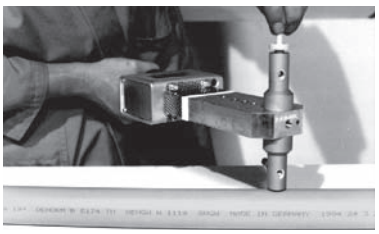
1. Remove the oxide film on the surfaces to be welded with the proper tools (sandpaper, scraper blade). For POLO-ECOSAN multi-layer pipes, the aluminium-PP sandwich layer must be completely mechanically removed in the area of the saddle to be welded.
2. Preheat the external surface of the pipe with the saddle welding tool for approx. 30 seconds until a roll forms on the edge of the tool.
3. Subsequently, heat the saddle along with the external surface of the pipe for another 20 seconds.
4. Remove the welding device and quickly place the saddle exactly over the pre-heated external surface of the pipe without twisting.
5. Hold pressure on the saddle for approx. 30 seconds.
6. After a cooling period of 10 minutes, the joint has reached full strength.
7. Subsequently, drill the wall of the pipe through with a conventional twist drill. When drilling, make sure that neither the wall of the saddle nor the opposite pipe wall are damaged. (Use drill depth gauge.)

3.1.6 Use of Repair Plugs

Use:
- repair of punctured (drilled) pipes

Procedure:
1. Drain pipes.
2. Uncover damaged pipe.
3. Drill damaged area of pipe out to a diameter of 8 mm square to the pipe.
4. Heat up drill hole and repair plug with POLO-ECOSAN 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 min.



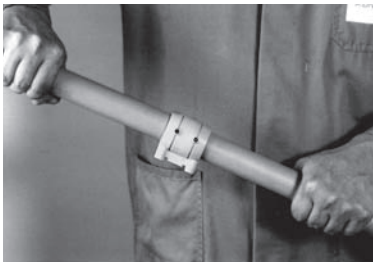


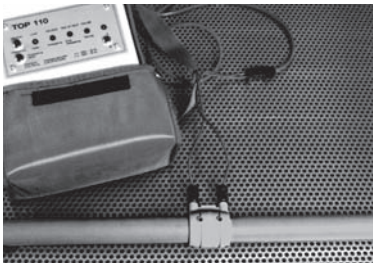
3.1.7 Use of Electric Welding Sockets

Areas of Use:

- welding in restricted space
- repair welding
- welding larger pipe dimensions without using a large welding machine.

Our POLO-ECOSAN Electric Socket Welder is the necessary tool for preparation of electric welding sockets.





Procedure:

1. Cut the pipe ends to be welded evenly and square to the pipe axis.
2. Using a scraper or sandpaper, remove the oxide film on the pipe surface along the length of the insertion depth.
3. When welding POLO-ECOSAN multi-layer pipes, the aluminium-PP sandwich layer must be removed on the surface to be welded. The peeling depth must be increased. To do so, reset the stop in the peeling device.
4. Insert pipe ends fully until stop into the electric welding socket. For a tight polyfusion connection, pipe and socket must fit snugly, without movement.
5. During the welding process, pipes are to be fixed so that they cannot slip out of or jam in the electric welding socket.
6. Switch on the electric welding device and start welding according to the instruction manual.
7. The cooling periods shown in the table to the right must be strictly observed.
8. Do not cool the welded connection with water!

Type of stress	Pressure stress	Minimum waiting period
Tension, deflection torsion of pipelines without pressure		20 minutes
Test or service pressure of pipelines under pressure	< 0,1 bar 0,1 - 1 bar > 1 bar	20 minutes 60 minutes 120 minutes
Repetition of a welding process		60 minutes

4.1 Basic Information

DIN 1988 defines a simplified and a differentiating calculation procedure (see next page).
In the differentiating procedure, all pipeline and individual resistances are included without exception.
This procedure offers what is likely the largest degree of accuracy and most exact approximation of the actual operating conditions.

For the calculation of the pipe diameter, the following data are required:

- minimum supply pressure or delivery-side pressure after a pressure-reducing valve or pressure increase
- geodetic height difference
- pressure loss from equipment such as water meters, filters, softening equipment, etc.
- minimum flow pressures of employed tap fittings
- pipe friction pressure difference of the employed pipe material
- loss correction value for the employed fittings and connections

The pipeline system must be dimensioned according to the following scheme of DIN 1988, sec. 3

Calculation step scheme

Determination of the calculated flow of tap fittings The calculated flow is an assumed tap fitting flow for which the reference values of standard fittings and valves can be obtained in Table 4.2.	
Determination of total flows and allocation of segments From the farthest tapping location to the supply line, the calculated flows are added, and the total flows are allocated to the corresponding line segments.	
Determination of peak flow from total flow To calculate the pipeline system, all taps are generally assigned to their respective calculated flows. Simultaneous water tapping depends on the type of use (e.g. residence or communal systems). Generally, one can assume that not all taps will be opened at the same time. For line systems in residential buildings, the corresponding peak flow can be determined using the formula / diagram in DIN 1988, Sec. 3.	
Determination of available pressure difference for pipe friction and individual resistances	
Differentiating Calculation Procedure	**Simplified Calculation Procedure**
Determine pressure loss from individual resistances via loss correction values	Calculate sum of pressure losses from pipe friction of all segments and compare to available pressure difference
Calculate total pressure loss from pipe friction and individual resistances and compare to available pressure difference	If necessary, re-calculate using altered pipe dimensions
If necessary, re-calculate using altered pipe dimensions	

4.2 Minimum Flow Pressures

Reference values for the minimum flow pressure and calculated flows for generally used drinking water service points

Minimum-flow pressure $P_{min\ Fl}$ bar	Type of drinking water service point		Calculated flow for outlet of		
			Mixed water		Either cold or hot water
			Volume flow cold l/s	Volume flow hot l/s	Volume flow l/s
	outlet valve				
0,5	without air whirler	DN 15	–	–	0,30
0,5		DN 20	–	–	0,50
0,5		DN 25	–	–	1,00
1,0	with air whirler	DN 10	–	–	0,15
1,0		DN 15	–	–	0,15
1,0	shower heads for clinsing showers	DN 15	0,10	0,10	0,20
1,2	pressure rinser acc. to DIN 3265 part 1	DN 15	–	–	0,70
1,2	pressure rinser acc. to DIN 3265 part 1	DN 20	–	–	1,00
0,4	pressure rinser acc. to DIN 3265 part 1	DN 25	–	–	1,00
1,0	pressure rinser for urinals	DN 15	–	–	0,30
0,5	corner valve for urinals	DN 15	–	–	0,30
1,0	household dishwasher	DN 15	–	–	0,15
1,0	household washing machine	DN 15			0,25
	mixer for				
1,0	showers	DN 15	0,15	0,15	–
1,0	bath tubs	DN 15	0,15	0,15	–
1,0	kitchen sinks	DN 15	0,07	0,07	–
1,0	wash-stands	DN 15	0,07	0,07	–
1,0	bidet	DN 15	0,07	0,07	–
1,0	mixer	DN 20	0, 30	0, 30	–
0,5	flushing box acc. to DIN 19542	DN 15	–	–	0,13
	heater for drinking water for supply of service point (incl. fitting for mixed outlet)				
1,0	electric water-boiler	DN 15	–	–	0,10*)
1,1**)	electric hot-water tank and boiler				
	with nominal contents 5 – 15 l	DN 15	–	–	0,10
1,2**)	with nominal contents 30 – 150 l	DN 15	–	–	0,20
	electric flow water heater with hydraulic test, without flow limitation				
1,5	nominal capacity				
1,9		12 kW	–	–	0,06
2,1		18 kW	–	–	0,08
2,4		21 kW	–	–	0,09
2,4		24 kW	–	–	0,10
1 ,0	gas flow water heater	12 kW	–	–	0,1

*) with fully opened throttle valve

**) values under unfavourable conditions (shower)

Note: Consumption points which are not included in the table as well as valves and fittings of similar kind with larger flow of fittings than indicated are to be taken into account to the recommendations of the producer as far as determination of pipe diameter is concerned.

4.3 Tables for pressure differences due to pipe friction

Pressure loss due to pipe friction R and calculated flow speed dependant on flow V

4.3.1 PN 10

d x s		16 x 1,8	20 x 1,9	25 x 2,3	32 x 2,9	40 x 3,7	50 x 4,6	63 x 5,8	75 x 6,8	90 x 8,2	110 x 10,0
V	di	12,4 mm	16,2 mm	20,4 mm	26,2 mm	32,6 mm	40,8 mm	51,4 mm	61,4 mm	73,6 mm	90,0 mm
0,01	R	0,20	0,06	0,02	0,01	0,00	0,00	0,00	0,00	0,00	0,00
	v	0,08	0,05	0,03	0,02	0,01	0,01	0,00	0,00	0,00	0,00
0,02	R	0,60	0,18	0,06	0,02	0,01	0,00	0,00	0,00	0,00	0,00
	v	0,17	0,10	0,06	0,04	0,02	0,02	0,01	0,01	0,00	0,00
0,03	R	1,16	0,34	0,12	0,04	0,01	0,00	0,00	0,00	0,00	0,00
	v	0,25	0,15	0,09	0,06	0,04	0,02	0,01	0,01	0,01	0,00
0,04	R	1,87	0,54	0,18	0,06	0,02	0,01	0,00	0,00	0,00	0,00
	v	0,33	0,19	0,12	0,07	0,05	0,03	0,02	0,01	0,01	0,01
0,05	R	2,71	0,77	0,27	0,08	0,03	0,01	0,00	0,00	0,00	0,00
	v	0,41	0,24	0,15	0,09	0,06	0,04	0,02	0,02	0,01	0,01
0,06	R	3,67	1,05	0,36	0,11	0,04	0,01	0,01	0,00	0,00	0,00
	v	0,50	0,29	0,18	0,11	0,07	0,05	0,03	0,02	0,01	0,01
0,07	R	4,77	1,36	0,46	0,14	0,05	0,02	0,01	0,00	0,00	0,00
	v	0,58	0,34	0,21	0,13	0,08	0,05	0,03	0,02	0,02	0,01
0,08	R	5,99	1,70	0,58	0,18	0,06	0,02	0,01	0,00	0,00	0,00
	v	0,66	0,39	0,24	0,15	0,10	0,06	0,04	0,03	0,02	0,01
0,09	R	7,32	2,07	0,70	0,22	0,08	0,03	0,01	0,00	0,00	0,00
	v	0,75	0,44	0,28	0,17	0,11	0,07	0,04	0,03	0,02	0,01
0,10	R	8,77	2,48	0,84	0,26	0,09	0,03	0,01	0,01	0,00	0,00
	v	0,83	0,49	0,31	0,19	0,12	0,08	0,05	0,03	0,02	0,02
0,12	R	12,02	3,38	1,14	0,35	0,13	0,04	0,02	0,01	0,00	0,00
	v	0,99	0,58	0,37	0,22	0,14	0,09	0,06	0,04	0,03	0,02
0,14	R	15,71	4,40	1,48	0,46	0,16	0,06	0,02	0,01	0,00	0,00
	v	1,16	0,68	0,43	0,26	0,17	0,11	0,07	0,05	0,03	0,02
0,16	R	19,83	5,54	1,86	0,57	0,20	0,07	0,02	0,01	0,00	0,00
	v	1,32	0,78	0,49	0,30	0,19	0,12	0,08	0,05	0,04	0,03
0,18	R	24,39	6,79	2,27	0,70	0,25	0,09	0,03	0,01	0,01	0,00
	v	1,49	0,87	0,55	0,33	0,22	0,14	0,09	0,06	0,04	0,03
0,20	R	29,37	8,15	2,72	0,83	0,30	0,10	0,04	0,02	0,01	0,00
	v	1,66	0,97	0,61	0,37	0,24	0,15	0,10	0,07	0,05	0,03
0,30	R	60,46	16,60	5,50	1,67	0,59	0,21	0,07	0,03	0,01	0,01
	v	2,48	1,46	0,92	0,56	0,36	0,23	0,14	0,10	0,07	0,05
0,40	R	101,63	27,68	9,11	2,75	0,97	0,34	0,11	0,05	0,02	0,01
	v	3,31	1,94	1,22	0,74	0,48	0,31	0,19	0,14	0,09	0,06
0,50	R	152,67	41,29	13,52	4,07	1,43	0,49	0,17	0,07	0,03	0,01
	v	4,14	2,43	1,53	0,93	0,60	0,38	0,24	0,17	0,12	0,08
0,60	R	213,47	57,40	18,72	5,61	1,97	0,68	0,23	0,10	0,04	0,02
	v	4,97	2,91	1,84	1,11	0,72	0,46	0,29	0,20	0,14	0,09
0,70	R	283,95	75,97	24,68	7,37	2,58	0,88	0,30	0,13	0,05	0,02
	v	5,80	3,40	2,14	1,30	0,84	0,54	0,34	0,24	0,16	0,11
0,80	R	364,05	96,98	31,40	9,34	3,27	1,12	0,37	0,16	0,07	0,03
	v	6,62	3,88	2,45	1,48	0,96	0,61	0,39	0,27	0,19	0,13
0,90	R	453,76	120,40	38,86	11,53	4,02	1,37	0,46	0,20	0,08	0,03
	v	7,45	4,37	2,75	1,67	1,08	0,69	0,43	0,30	0,21	0,14

V = l/s · R = mbar/m · v = m/s

d x s		16 x 1,8	20 x 1,9	25 x 2,3	32 x 2,9	40 x 3,7	50 x 4,6	63 x 5,8	75 x 6,8	90 x 8,2	110 x 10,0
V	di	12,4 mm	16,2 mm	20,4 mm	26,2 mm	32,6 mm	40,8 mm	51,4 mm	61,4 mm	73,6 mm	90,0 mm
1,00	R	553,02	146,24	47,07	13,92	4,85	1,65	0,55	0,24	0,10	0,04
	v	8,28	4,85	3,06	1,85	1,20	0,76	0,48	0,34	0,24	0,16
1,10	R	661,84	174,47	56,01	16,53	5,74	1,95	0,65	0,28	0,12	0,05
	v	9,11	5,34	3,37	2,04	1,32	0,84	0,53	0,37	0,26	0,17
1,20	R	780,20	205,08	65,68	19,34	6,71	2,28	0,76	0,32	0,14	0,05
	v	9,94	5,82	3,67	2,23	1,44	0,92	0,58	0,41	0,28	0,19
1,30	R	908,08	238,08	76,08	22,35	7,74	2,63	0,87	0,37	0,16	0,06
	v	10,76	6,31	3,98	2,41	1,56	0,99	0,63	0,44	0,31	0,20
1,40	R	1045,47	273,46	87,21	25,57	8,84	3,00	0,99	0,42	0,18	0,07
	v	11,59	6,79	4,28	2,60	1,68	1,07	0,67	0,47	0,33	0,22
1,60	R	1348,77	351,32	111,63	32,60	11,24	3,80	1,25	0,54	0,23	0,09
	v	13,25	7,76	4,90	2,97	1,92	1,22	0,77	0,54	0,38	0,25
1,80	R	1690,07	438,65	138,93	40,44	13,91	4,69	1,54	0,66	0,28	0,11
	v	14,91	8,73	5,51	3,34	2,16	1,38	0,87	0,61	0,42	0,28
2,00	R	2069,32	535,42	169,10	49,07	16,84	5,67	1,86	0,79	0,33	0,13
	v	16,56	9,70	6,12	3,71	2,40	1,53	0,96	0,68	0,47	0,31
2,20	R	2486,51	641,63	202,12	58,49	20,02	6,72	2,20	0,94	0,39	0,15
	v	18,22	10,67	6,73	4,08	2,64	1,68	1,06	0,74	0,52	0,35
2,40	R	2941,63	757,25	237,99	68,70	23,47	7,87	2,58	1,10	0,46	0,18
	v	19,87	11,64	7,34	4,45	2,88	1,84	1,16	0,81	0,56	0,38
2,60	R	3434,66	882,28	276,70	79,69	27,17	9,09	2,97	1,26	0,53	0,20
	v	21,53	12,61	7,95	4,82	3,11	1,99	1,25	0,88	0,61	0,41
2,80	R	3965,60	1016,71	318,26	91,46	31,13	10,40	3,39	1,44	0,60	0,23
	v	23,19	13,58	8,57	5,19	3,35	2,14	1,35	0,95	0,66	0,44
3,00	R	4534,44	1160,54	362,65	104,01	35,34	11,79	3,84	1,63	0,68	0,26
	v	24,84	14,55	9,18	5,56	3,59	2,29	1,45	1,01	0,71	0,47

4.3.2 PN 16

d x s		16 x 2,2	20 x 2,8	25 x 3,5	32 x 4,4	40 x 5,5	50 x 6,9	63 x 8,6	75 x 10,3	90 x 12,3	110 x 15,1
V	di	11,6 mm	14,4 mm	18,0 mm	23,2 mm	29,0 mm	36,2 mm	45,8 mm	54,4 mm	65,4 mm	79,8 mm
0,01	R	0,27	0,10	0,04	0,01	0,00	0,00	0,00	0,00	0,00	0,00
	v	0,09	0,06	0,04	0,02	0,02	0,01	0,01	0,00	0,00	0,00
0,02	R	0,82	0,30	0,11	0,03	0,01	0,00	0,00	0,00	0,00	0,00
	v	0,19	0,12	0,08	0,05	0,03	0,02	0,01	0,01	0,01	0,00
0,03	R	1,58	0,58	0,21	0,06	0,02	0,01	0,00	0,00	0,00	0,00
	v	0,28	0,18	0,12	0,07	0,05	0,03	0,02	0,01	0,01	0,01
0,04	R	2,55	0,93	0,33	0,10	0,04	0,01	0,00	0,00	0,00	0,00
	v	0,38	0,25	0,16	0,09	0,06	0,04	0,02	0,02	0,01	0,01
0,05	R	3,70	1,34	0,47	0,15	0,05	0,02	0,01	0,00	0,00	0,00
	v	0,47	0,31	0,20	0,12	0,08	0,05	0,03	0,02	0,01	0,01
0,06	R	5,03	1,82	0,64	0,20	0,07	0,03	0,01	0,00	0,00	0,00
	v	0,57	0,37	0,24	0,14	0,09	0,06	0,04	0,03	0,02	0,01
0,07	R	6,54	2,36	0,83	0,25	0,09	0,03	0,01	0,00	0,00	0,00
	v	0,66	0,43	0,28	0,17	0,11	0,07	0,04	0,03	0,02	0,01
0,08	R	8,21	2,95	1,04	0,32	0,11	0,04	0,01	0,01	0,00	0,00
	v	0,76	0,49	0,31	0,19	0,12	0,08	0,05	0,03	0,02	0,02
0,09	R	10,05	3,61	1,26	0,38	0,14	0,05	0,02	0,01	0,00	0,00
	v	0,85	0,55	0,35	0,21	0,14	0,09	0,05	0,04	0,03	0,02

V = l/s · R = mbar/m · v = m/s

d x s		16 x 2,2	20 x 2,8	25 x 3,5	32 x 4,4	40 x 5,5	50 x 6,9	63 x 8,6	75 x 10,3	90 x 12,3	110 x 15,1
V	di	11,6 mm	14,4 mm	18,0 mm	23,2 mm	29,0 mm	36,2 mm	45,8 mm	54,4 mm	65,4 mm	79,8 mm
0,10	R	12,05	4,32	1,51	0,46	0,16	0,06	0,02	0,01	0,00	0,00
	v	0,95	0,61	0,39	0,24	0,15	0,10	0,06	0,04	0,03	0,02
0,12	R	16,52	5,90	2,05	0,62	0,22	0,08	0,03	0,01	0,01	0,00
	v	1,14	0,74	0,47	0,28	0,18	0,12	0,07	0,05	0,04	0,02
0,14	R	21,61	7,70	2,67	0,81	0,28	0,10	0,03	0,02	0,01	0,00
	v	1,32	0,86	0,55	0,33	0,21	0,14	0,08	0,06	0,04	0,03
0,16	R	27,32	9,70	3,36	1,01	0,35	0,13	0,04	0,02	0,01	0,00
	v	1,51	0,98	0,63	0,38	0,24	0,16	0,10	0,07	0,05	0,03
0,18	R	33,62	11,91	4,11	1,24	0,43	0,15	0,05	0,02	0,01	0,00
	v	1,70	1,11	0,71	0,43	0,27	0,17	0,11	0,08	0,05	0,04
0,20	R	40,51	14,32	4,93	1,48	0,52	0,18	0,06	0,03	0,01	0,00
	v	1,89	1,23	0,79	0,47	0,30	0,19	0,12	0,09	0,06	0,04
0,30	R	83,65	29,29	10,01	2,98	1,03	0,36	0,12	0,05	0,02	0,01
	v	2,84	1,84	1,18	0,71	0,45	0,29	0,18	0,13	0,09	0,06
0,40	R	140,94	49,00	16,64	4,92	1,70	0,59	0,19	0,09	0,04	0,01
	v	3,78	2,46	1,57	0,95	0,61	0,39	0,24	0,17	0,12	0,08
0,50	R	212,11	73,32	24,76	7,28	2,50	0,87	0,29	0,13	0,05	0,02
	v	4,73	3,07	1,96	1,18	0,76	0,49	0,30	0,22	0,15	0,10
0,60	R	297,03	102,18	34,35	10,06	3,45	1,20	0,39	0,17	0,07	0,03
	v	5,68	3,68	2,36	1,42	0,91	0,58	0,36	0,26	0,18	0,12
0,70	R	395,61	135,53	45,38	13,24	4,52	1,56	0,51	0,23	0,09	0,04
	v	6,62	4,30	2,75	1,66	1,06	0,68	0,42	0,30	0,21	0,14
0,80	R	507,78	173,33	57,84	16,81	5,73	1,98	0,64	0,28	0,12	0,05
	v	7,57	4,91	3,14	1,89	1,21	0,78	0,49	0,34	0,24	0,16
0,90	R	633,52	215,57	71,71	20,78	7,06	2,43	0,79	0,35	0,15	0,06
	v	8,52	5,53	3,54	2,13	1,36	0,87	0,55	0,39	0,27	0,18
1,00	R	772,78	262,22	86,98	25,13	8,52	2,93	0,95	0,42	0,17	0,07
	v	9,46	6,14	3,93	2,37	1,51	0,97	0,61	0,43	0,30	0,20
1,10	R	925,54	313,27	103,64	29,86	10,10	3,47	1,12	0,49	0,21	0,08
	v	10,41	6,75	4,32	2,60	1,67	1,07	0,67	0,47	0,33	0,22
1,20	R	1091,80	368,71	121,69	34,98	11,81	4,05	1,31	0,58	0,24	0,09
	v	11,35	7,37	4,72	2,84	1,82	1,17	0,73	0,52	0,36	0,24
1,30	R	1271,53	428,53	141,13	40,47	13,64	4,67	1,51	0,66	0,28	0,11
	v	12,30	7,98	5,11	3,08	1,97	1,26	0,79	0,56	0,39	0,26
1,40	R	1464,74	492,72	161,95	46,34	15,59	5,33	1,72	0,75	0,31	0,12
	v	13,25	8,60	5,50	3,31	2,12	1,36	0,85	0,60	0,42	0,28
1,60	R	1891,51	634,21	207,71	59,20	19,86	6,77	2,18	0,95	0,40	0,15
	v	15,14	9,82	6,29	3,78	2,42	1,55	0,97	0,69	0,48	0,32
1,80	R	2372,08	793,13	258,96	73,54	24,60	8,36	2,69	1,18	0,49	0,19
	v	17,03	11,05	7,07	4,26	2,73	1,75	1,09	0,77	0,54	0,36
2,00	R	2906,42	969,48	315,68	89,37	29,82	10,12	3,24	1,42	0,59	0,23
	v	18,92	12,28	7,86	4,73	3,03	1,94	1,21	0,86	0,60	0,40
2,20	R	3494,49	1163,23	377,85	106,67	35,51	12,02	3,84	1,68	0,69	0,27
	v	20,82	13,51	8,65	5,20	3,33	2,14	1,34	0,95	0,65	0,44
2,40	R	4136,29	1374,36	445,48	125,43	41,66	14,07	4,49	1,96	0,81	0,31
	v	22,71	14,74	9,43	5,68	3,63	2,33	1,46	1,03	0,71	0,48
2,60	R	4831,80	1602,87	518,54	145,66	48,28	16,28	5,19	2,26	0,93	0,36
	v	24,60	15,96	10,22	6,15	3,94	2,53	1,58	1,12	0,77	0,52
2,80	R	5581,01	1848,75	597,05	167,36	55,37	18,64	5,93	2,58	1,06	0,41
	v	26,49	17,19	11,00	6,62	4,24	2,72	1,70	1,20	0,83	0,56
3,00	R	6383,92	2112,00	680,98	190,50	62,91	21,14	6,72	2,92	1,20	0,46
	v	28,39	18,42	11,79	7,10	4,54	2,91	1,82	1,29	0,89	0,60

V = l/s · R = mbar/m · v = m/s

4.3.3 PN 20

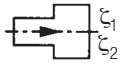
d x s		16 x 2,7	20 x 3,4	25 x 4,2	32 x 5,4	40 x 6,7	50 x 8,3	63 x 10,5	75 x 12,5	90 x 15,0	110 x 18,4
V	di	10,6 mm	13,2 mm	16,6 mm	21,2 mm	26,6 mm	33,2 mm	42,0 mm	50,0 mm	60,0 mm	73,2 mm
0,01	R	0,41	0,15	0,05	0,02	0,01	0,00	0,00	0,00	0,00	0,00
	v	0,11	0,07	0,05	0,03	0,02	0,01	0,01	0,01	0,00	0,00
0,02	R	1,24	0,45	0,16	0,05	0,02	0,01	0,00	0,00	0,00	0,00
	v	0,23	0,15	0,09	0,06	0,04	0,02	0,01	0,01	0,01	0,00
0,03	R	2,41	0,87	0,30	0,10	0,03	0,01	0,00	0,00	0,00	0,00
	v	0,34	0,22	0,14	0,08	0,05	0,03	0,02	0,02	0,01	0,01
0,04	R	3,89	1,39	0,48	0,15	0,05	0,02	0,01	0,00	0,00	0,00
	v	0,45	0,29	0,18	0,11	0,07	0,05	0,03	0,02	0,01	0,01
0,05	R	5,65	2,02	0,69	0,22	0,08	0,03	0,01	0,00	0,00	0,00
	v	0,57	0,37	0,23	0,14	0,09	0,06	0,04	0,03	0,02	0,01
0,06	R	7,70	2,74	0,94	0,30	0,10	0,04	0,01	0,01	0,00	0,00
	v	0,68	0,44	0,28	0,17	0,11	0,07	0,04	0,03	0,02	0,01
0,07	R	10,01	3,55	1,21	0,39	0,13	0,05	0,02	0,01	0,00	0,00
	v	0,79	0,51	0,32	0,20	0,13	0,08	0,05	0,04	0,02	0,02
0,08	R	12,59	4,45	1,51	0,48	0,17	0,06	0,02	0,01	0,00	0,00
	v	0,91	0,58	0,37	0,23	0,14	0,09	0,06	0,04	0,03	0,02
0,09	R	15,43	5,44	1,85	0,59	0,20	0,07	0,02	0,01	0,00	0,00
	v	1,02	0,66	0,42	0,25	0,16	0,10	0,06	0,05	0,03	0,02
0,10	R	18,51	6,52	2,21	0,70	0,24	0,09	0,03	0,01	0,01	0,00
	v	1,13	0,73	0,46	0,28	0,18	0,12	0,07	0,05	0,04	0,02
0,12	R	25,43	8,92	3,01	0,95	0,33	0,12	0,04	0,02	0,01	0,00
	v	1,36	0,88	0,55	0,34	0,22	0,14	0,09	0,06	0,04	0,03
0,14	R	33,32	11,65	3,92	1,23	0,42	0,15	0,05	0,02	0,01	0,00
	v	1,59	1,02	0,65	0,40	0,25	0,16	0,10	0,07	0,05	0,03
0,16	R	42,16	14,70	4,93	1,55	0,53	0,19	0,06	0,03	0,01	0,00
	v	1,81	1,17	0,74	0,45	0,29	0,18	0,12	0,08	0,06	0,04
0,18	R	51,95	18,07	6,04	1,89	0,65	0,23	0,08	0,03	0,01	0,01
	v	2,04	1,32	0,83	0,51	0,32	0,21	0,13	0,09	0,06	0,04
0,20	R	62,66	21,74	7,26	2,27	0,78	0,27	0,09	0,04	0,02	0,01
	v	2,27	1,46	0,92	0,57	0,36	0,23	0,14	0,10	0,07	0,05
0,30	R	129,94	44,63	14,76	4,58	1,55	0,54	0,18	0,08	0,03	0,01
	v	3,40	2,19	1,39	0,85	0,54	0,35	0,22	0,15	0,11	0,07
0,40	R	219,63	74,87	24,59	7,58	2,56	0,89	0,29	0,13	0,05	0,02
	v	4,53	2,92	1,85	1,13	0,72	0,46	0,29	0,20	0,14	0,10
0,50	R	331,39	112,28	36,67	11,24	3,78	1,31	0,43	0,19	0,08	0,03
	v	5,67	3,65	2,31	1,42	0,90	0,58	0,36	0,25	0,18	0,12
0,60	R	465,04	156,78	50,96	15,54	5,21	1,81	0,59	0,26	0,11	0,04
	v	6,80	4,38	2,77	1,70	1,08	0,69	0,43	0,31	0,21	0,14
0,70	R	620,47	208,28	67,41	20,48	6,85	2,37	0,77	0,34	0,14	0,06
	v	7,93	5,12	3,23	1,98	1,26	0,81	0,51	0,36	0,25	0,17
0,80	R	797,60	266,76	86,02	26,04	8,68	2,99	0,97	0,42	0,18	0,07
	v	9,07	5,85	3,70	2,27	1,44	0,92	0,58	0,41	0,28	0,19
0,90	R	996,40	332,19	106,77	32,22	10,71	3,68	1,20	0,52	0,22	0,09
	v	10,20	6,58	4,16	2,55	1,62	1,04	0,65	0,46	0,32	0,21
1,00	R	1216,81	404,53	129,63	39,00	12,94	4,44	1,44	0,63	0,26	0,10
	v	11,33	7,31	4,62	2,83	1,80	1,16	0,72	0,51	0,35	0,24

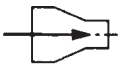
V = l/s · R = mbar/m · v = m/s

d x s		16 x 2,7	20 x 3,4	25 x 4,2	32 x 5,4	40 x 6,7	50 x 8,4	63 x 10,5	75 x 12,5	90 x 15,0	110 x 18,4
V	di	10,6 mm	13,2 mm	16,6 mm	21,2 mm	26,6 mm	33,2 mm	42,0 mm	50,0 mm	60,0 mm	73,2 mm
1,10	R	1458,83	483,78	154,61	46,39	15,36	5,26	1,70	0,74	0,31	0,12
	v	12,46	8,04	5,08	3,12	1,98	1,27	0,79	0,56	0,39	0,26
1,20	R	1722,42	569,92	181,70	54,38	17,96	6,14	1,98	0,86	0,36	0,14
	v	13,60	8,77	5,54	3,40	2,16	1,39	0,87	0,61	0,42	0,29
1,30	R	2007,58	662,94	210,89	62,97	20,76	7,09	2,29	0,99	0,42	0,16
	v	14,73	9,50	6,01	3,68	2,34	1,50	0,94	0,66	0,46	0,31
1,40	R	2314,29	762,83	242,17	72,16	23,74	8,09	2,61	1,13	0,47	0,18
	v	15,86	10,23	6,47	3,97	2,52	1,62	1,01	0,71	0,50	0,33
1,60	R	2992,34	983,21	311,00	92,31	30,27	10,29	3,30	1,43	0,60	0,23
	v	18,13	11,69	7,39	4,53	2,88	1,85	1,15	0,81	0,57	0,38
1,80	R	3756,52	1231,02	388,18	114,82	37,54	12,73	4,08	1,76	0,74	0,28
	v	20,40	13,15	8,32	5,10	3,24	2,08	1,30	0,92	0,64	0,43
2,00	R	4606,80	1506,23	473,67	139,68	45,55	15,41	4,92	2,13	0,89	0,34
	v	22,66	14,61	9,24	5,67	3,60	2,31	1,44	1,02	0,71	0,48
2,20	R	5543,15	1808,82	567,47	166,88	54,29	18,32	5,84	2,52	1,05	0,40
	v	24,93	16,08	10,17	6,23	3,96	2,54	1,59	1,12	0,78	0,52
2,40	R	6565,55	2138,78	669,57	196,42	63,75	21,47	6,84	2,94	1,22	0,47
	v	27,20	17,54	11,09	6,80	4,32	2,77	1,73	1,22	0,85	0,57
2,60	R	7674,00	2496,10	779,96	228,30	73,94	24,85	7,90	3,40	1,41	0,54
	v	29,46	19,00	12,01	7,37	4,68	3,00	1,88	1,32	0,92	0,62
2,80	R	8868,48	2880,76	898,63	262,50	84,85	28,47	9,03	3,88	1,61	0,62
	v	31,73	20,46	12,94	7,93	5,04	3,23	2,02	1,43	0,99	0,67
3,00	R	10148,99	3292,77	1025,58	299,02	96,48	32,31	10,24	4,39	1,82	0,70
	v	34,00	21,92	13,86	8,50	5,40	3,47	2,17	1,53	1,06	0,71

V = l/s · R = mbar/m · v = m/s

4.4 Single Resistors

No.	Designation	Graphic symbols	Loss-coefficient
1	branching, one-sided, dividing flow		1,3
2	branching, one-sided, merging flow		0,9
3	branching, one-sided, passage for dividing flow		0,3
4	branching, one-sided, passage for merging flow		0,6
5	branching, one-sided, counter-current for merging flow		3,0
6	branching, one-sided, counter-current for dividing flow		1,3
7	branching, one-sided, bow-shaped, dividing flow		0,9
8	branching, one-sided, bow-shaped, merging flow		0,4
9	branching, one-sided, bow-shaped, passage for dividing flow		0,3
10	branching, one-sided, bow-shaped, passage for merging flow		0,2
11	branching with 2 exit pipes (casing, reservoir)		0,5
12	branching with 2 entry pipes (casing, reservoir)		1,0
13	bow 90°, smooth R = d = 2 d = 4 d = 6 d = 10 d bow 90°, rough R = d = 2 d = 4 d = 6 d = 10 d		 0,21 0,14 0,11 0,09 0,11 0,51 0,30 0,23 0,18 0,20
14	elbow 90°, smooth elbow 90°, rough		1,13 1,27
15	expansion, steady β = 10° = 20° = 30° = 40° expansion, sudden expansion, free discharge	  	 0,20 0,45 0,60 0,75 $\left(\frac{F_1}{F_2} - 1\right)^2$ 1,0

No.	Designation	Graphic symbols	Loss-coefficient
16	narrow part steady reduction by 1 dimension by 2 dimensions by 3 dimensions by 4 dimensions by 5 dimensions by 6 dimensions		 0,40 0,50 0,60 0,70 0,80 0,90

Drag coefficients ζ of single resistors

No.	Designation	Graphic symbol	Loss-coefficient
17	smooth comp. tube bend quill comp. tube bend corrugated comp. tube bend		0,7 1,4 2
18	shut-off valves DN 15 DN 20 DN 25 DN 32 DN 40 to DN 100 slanted seat valves DN 15 DN 20 DN 25 to DN 50 DN 65		 10,0 8,5 7,0 6,0 5,0 3,5 2,5 2,0 0,7
19	full current valves DN 15 DN 20 to DN 25 DN 32 to DN 50 DN 65 to DN 80 over DN 100		 2 1,5 1 0,7 0,6
20	corner valves DN 15 DN 20 to DN 40 DN 50 to DN 100		 4,0 2,0 3,5
21	ball valves DN 10 to DN 15 DN 20 to DN 25 DN 32		 1,0 0,5 0,3
22	reflux valve without shut-off DN 25 to DN 40 DN 50 with shut-off DN 20 DN 25 to DN 50	 	 2,5 1,9 4,6 3,6
23	flap trap DN 50 DN 100 DN 200		 1,5 1,2 1,0
24	check valve DN 15 to DN 20 DN 25 to DN 50		 15 13
25	valve tapping clip DN 25 to DN 70		 5,0

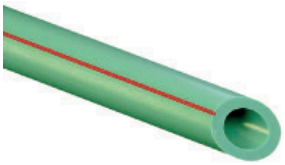
5.1 POLO-ECOSAN

Installation System made of PP-R 80 da 16 – 125

5.1.1 Pipes

ECOSAN Pipe PN 20 / SDR 6 / PP-R 80
for hot and cold water 67°/10 bar acc. to DIN 8078, color green DVGW DW-8501 AS2288 and AT2610

Range:
CW: 20°C / 20 bar
HW: 67°C / 10 bar
HT: 80°C / 5,5 bar
AP: 20°C / 20 bar



Item No.	Dimension in mm (Ø)	Packing unit parcel/bar	DG	
16001	16 x 2,7	100 m / 4 m	A	M 10.000
16002	20 x 3,4	100 m / 4 m	A	S
16003	25 x 4,2	60 m / 4 m	A	S
16004	32 x 5,4	40 m / 4 m	A	S
16005	40 x 6,7	20 m / 4 m	A	S
16006	50 x 8,3	20 m / 4 m	A	S
16007	63 x 10,5	12 m / 4 m	A	S
16008	75 x 12,5	8 m / 4 m	A	S
16009	90 x 15,0	4 m / 4 m	A	S
16010	110 x 18,3	4 m / 4 m	A	S
16011	125 x 20,8	4 m / 4 m	A	M 1.000

ECOSAN Pipe PN 16 / SDR 7,4 / PP-R 80
for hot and cold water 67°/10 bar acc. to DIN 8078, color green, DVGW DW-8501 AS2288 and AT2610

Range:
CW: 20°C / 15 bar
HW: 67°C / 8 bar
HT: 80°C / 4 bar
AP: 20°C / 15 bar

Item No.	Dimension in mm (Ø)	Packing unit parcel/bar	DG	
16302	20 x 2,8	100 m / 4 m	A	M 10.000
16303	25 x 3,5	60 m / 4 m	A	M 9.000
16304	32 x 4,4	40 m / 4 m	A	M 5.520
16305	40 x 5,5	20 m / 4 m	A	M 4.500
16306	50 x 6,9	20 m / 4 m	A	M 3.500
16307	63 x 8,6	12 m / 4 m	A	M 3.000
16308	75 x 10,3	8 m / 4 m	A	M 1.904
16309	90 x 12,3	4 m / 4 m	A	M 1.900
16310	110 x 15,1	4 m / 4 m	A	M 1.100
16311	125 x 17,1	4 m / 4 m	A	M 700

ECOSAN³ Glass-fibre-pipe PN 16 / SDR 7,4 / PP-R 80
for hot and cold water 67°/10 bar acc. to DIN 8078, color green, DVGW DW-8501 AS2288 and AT2610

Range:
CW: 20°C / 15 bar
HW: 67°C / 8 bar
HT: 80°C / 4 bar
AP: 20°C / 15 bar

Item No.	Dimension in mm (Ø)	Packing unit parcel/bar	DG	
16282	20 x 2,8	100 m / 4 m	A	S
16283	25 x 3,5	60 m / 4 m	A	S
16284	32 x 4,4	40 m / 4 m	A	S
16285	40 x 5,5	20 m / 4 m	A	S
16286	50 x 6,9	20 m / 4 m	A	S
16287	63 x 8,6	12 m / 4 m	A	S
16288	75 x 10,3	8 m / 4 m	A	S
16289	90 x 12,3	4 m / 4 m	A	S
16290	110 x 15,1	4 m / 4 m	A	S
16291	125 x 17,1	4 m / 4 m	A	M 1.000

S=Standard-Range, stored M x.xxx = Minimum order quantity in pieces or meter

ECOSAN Pipe PN 10 / SDR 11 / PP-R 80
for hot and cold water acc. to DIN 8078,
color green SKZ guideline HR 3.10,
Reg. Nr. A 193

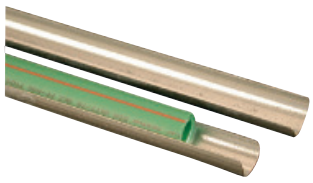
Range:
CW: 20°C / 10 bar
HW: 70°C / 4 bar
AP: 20°C / 15 bar

Item No.	Dimension in mm (Ø)	Packing unit parcel/bar	DG	
16102	20 x 1,9	100 m / 4 m	A	S
16103	25 x 2,3	60 m / 4 m	A	S
16104	32 x 2,9	40 m / 4 m	A	S
16105	40 x 3,7	20 m / 4 m	A	S
16106	50 x 4,6	20 m / 4 m	A	S
16107	63 x 5,8	12 m / 4 m	A	S
16108	75 x 6,8	8 m / 4 m	A	S
16109	90 x 8,2	4 m / 4 m	A	S
16110	110 x 10,0	4 m / 4 m	A	S
16111	125 x 11,4	4 m / 4 m	A	M 140

ECOSAN Prostab pipe alum.-reinforced PN 16 / SDR 7,4 / PP-R 80
for hot and cold water, colour green, anti-oxygene coating, acc. to SKZ guideline HR 3.10, Reg. Nr. A 234 and DVGW U538/U539

Item No.	Dimension in mm (Ø)	Packing unit parcel/bar	DG	
16182	20 x 2,8	60 m / 4 m	A	on request
16183	25 x 3,5	40 m / 4 m	A	on request
16184	32 x 4,4	40 m / 4 m	A	on request
16185	40 x 5,5	20 m / 4 m	A	on request
16186	50 x 6,9	20 m / 4 m	A	on request
16187	63 x 8,6	20 m / 4 m	A	on request
16188	75 x 10,3	16 m / 4 m	A	on request
16189	90 x 12,3	8 m / 4 m	A	on request
16190	110 x 15,1	8 m / 4 m	A	on request

Support for pipes, galvanized
(for horizontally installed pipes self-clamping up to Ø 75mm)

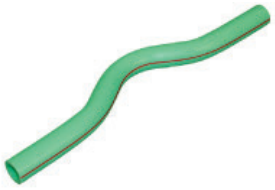


Item No.	Dimension in mm (Ø)	Packing unit parcel/bar	DG	
14901	16	75 / 3 m	A	S
14902	20	75 / 3 m	A	S
14903	25	75 / 3 m	A	S
14904	32	75 / 3 m	A	S
14905	40	15 / 3 m	A	S
14906	50	15 / 3 m	A	S
14907	63	15 / 3 m	A	S
14908	75	15 / 3 m	A	S
14909	90	15 / 3 m	A	S
14910	110	15 / 3 m	A	S

S=Standard-Range, stored M x.xxx = Minimum order quantity in pieces or meter

5.1.2 Fittings

ECOSAN Cross-over section PN 20 / SDR 6



Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
16501	16	120 / 10	A	M 120
16502	20	150 / 10	A	S
16503	25	100 / 10	A	S
16504	32	70 / 10	A	S
16506	40	60 / 5	A	M 20

ECOSAN Welding socket

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
17001	16	400 / 10	A	M 2.000
17002	20	600 / 10	A	S
17003	25	400 / 10	A	S
17004	32	300 / 10	A	S
17005	40	200 / 5	A	S
17006	50	100 / 5	A	S
17007	63	50 / 1	A	S
17008	75	40 / 1	A	S
17009	90	24 / 1	A	S
17010	110	15 / 1	A	S
17011	125	12 / 1	A	M 48

ECOSAN Reducer male / female

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
17601	20 / 16	500 / 10	A	M 500
17602	25 / 16	400 / 10 A	A	M 400
17603	25 / 20	300 / 10 A	A	S
17605	32 / 20	250 / 10 A	A	S
17606	32 / 25	200 / 10 A	A	S
17608	40 / 20	400 / 5	A	S
17609	40 / 25	400 / 5	A	S
17610	40 / 32	300 / 5	A	S
17612	50 / 20	250 / 5	A	S
17613	50 / 25	250 / 5	A	S
17614	50 / 32	200 / 5	A	S
17615	50 / 40	150 / 5	A	S
17618	63 / 25	150 / 1	A	S
17619	63 / 32	20 / 1	A	S
17620	63 / 40	100 / 1	A	S
17621	63 / 50	75 / 1	A	S
17627	75 / 50	50 / 1	A	S
17628	75 / 63	50 / 1	A	S
17634	90 / 50	40 / 1	A	S
17635	90 / 63	40 / 1	A	S
17636	90 / 75	30 / 1	A	S
17643	110 / 63	30 / 1	A	S
17644	110 / 75	25 / 1	A	S
17645	110 / 90	20 / 1	A	S
17646	125 / 110	15 / 1	A	M 45

S=Standard-Range, stored M x.xxx = Minimum order quantity in pieces or meter

PRODUCT RANGE

ECOSAN Welding elbow 90°

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
17041	16	250 / 10	A	M 2.000
17042	20	500 / 10	A	S
17043	25	350 / 10	A	S
17044	32	200 / 10	A	S
17045	40	100 / 5	A	S
17046	50	50 / 5	A	S
17047	63	25 / 1	A	S
17048	75	15 / 1	A	S
17049	90	12 / 1	A	S
17050	110	12 / 1	A	S
17051	125	8 / 1	A	M 56

ECOSAN Welding elbow 90° male /female

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
17061	16	400 / 10	A	M 2.000
17062	20	250 / 10	A	S
17063	25	150 / 10	A	S
17064	32	80 / 10	A	S
17065	40	40 / 5	A	S

ECOSAN Welding elbow 45°

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
17101	16	250 / 10	A	M 2.000
17102	20	200 / 10	A	S
17103	25	150 / 10	A	S
17104	32	100 / 10	A	S
17105	40	50 / 5	A	S
17106	50	25 / 5	A	S
17107	63	12 / 1	A	S
17108	75	20 / 1	A	S
17109	90	15 / 1	A	S
17110	110	8 / 1	A	S
17111	125	5 / 1	A	M 50

ECOSAN Welding elbow 90° male /female

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
17122	20	300 / 10	A	M 2.100
17123	25	200 / 10	A	M 2.000
17124	32	80 / 10	A	M 800
17125	40	60 / 5	A	M 720

ECOSAN Bend 90° welding socket on both sides

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
17082	20	120 / 5	A	S
17083	25	70 / 5	A	S
17084	32	40 / 5	A	S

S=Standard-Range, stored M x.xxx = Minimum order quantity in pieces or meter

ECOSAN Welding tee

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
17201	16	200 / 10	A	M 2.000
17202	20	400 / 10	A	S
17203	25	250 / 10	A	S
17204	32	100 / 10	A	S
17205	40	40 / 5	A	S
17206	50	20 / 5	A	S
17207	63	10 / 1	A	S
17208	75	15 / 1	A	S
17209	90	12 / 1	A	S
17210	110	6 / 1	A	S
17211	125	5 / 1	A	M 50

ECOSAN Reducing welding tee

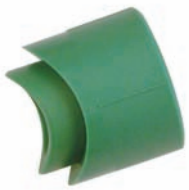
Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
17243	20 x 16 x 20	400 / 10	A	M 2.000
17250	25 x 20 x 20	250 / 10	A	S
17251	20 x 25 x 20	250 / 10	A	M 1.000
17252	25 x 16 x 25	250 / 10	A	M 1.000
17254	25 x 20 x 25	250 / 10	A	S
17256	25 x 25 x 20	250 / 10	A	M 1.000
17261	32 x 20 x 20	120 / 5	A	M 840
17266	32 x 25 x 20	120 / 5	A	M 840
17267	32 x 20 x 25	120 / 5	A	M 840
17269	32 x 25 x 25	120 / 5	A	M 840
17273	32 x 20 x 32	120 / 5	A	S
17275	32 x 25 x 32	120 / 5	A	S
17301	40 x 32 x 32	80 / 5	A	M 720
17305	40 x 20 x 40	80 / 5	A	S
17307	40 x 25 x 40	80 / 5	A	S
17309	40 x 32 x 40	80 / 5	A	S
17311	50 x 20 x 50	50 / 5	A	M 500
17334	50 x 25 x 50	50 / 5	A	S
17336	50 x 32 x 50	50 / 5	A	S
17338	50 x 40 x 50	40 / 5	A	S
17340	63 x 20 x 63	25 / 1	A	S
17352	63 x 25 x 63	25 / 1	A	S
17354	63 x 32 x 63	25 / 1	A	S
17356	63 x 40 x 63	25 / 1	A	S
17358	63 x 50 x 63	25 / 1	A	S
17360	75 x 20 x 75	15 / 1	A	M 150
17370	75 x 25 x 75	15 / 1	A	S
17372	75 x 32 x 75	15 / 1	A	S
17374	75 x 40 x 75	15 / 1	A	S
17376	75 x 50 x 75	15 / 1	A	S
17378	75 x 63 x 75	15 / 1	A	S
17394	90 x 50 x 90	12 / 1	A	M 120
17396	90 x 63 x 90	12 / 1	A	S
17398	90 x 75 x 90	8 / 1	A	S

S=Standard-Range, stored M x.xxx = Minimum order quantity in pieces or meter

ECOSAN Reducing welding tee

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
17400	110 x 50 x 110	8 / 1	A	S
17414	110 x 63 x 110	14 / 1	A	S
17416	110 x 75 x 110	6 / 1	A	S
17418	110 x 90 x 110	6 / 1	A	S
17420	125 x 110 x 125	6 / 1	A	M 48

ECOSAN Weld-in saddle with welding sleeve



Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
17741	40 / 20	250 / 5	A	S
17742	40 / 25	250 / 5	A	S
17744	50 / 20	250 / 5	A	S
17745	50 / 25	250 / 5	A	S
17747	63 / 20	200 / 5	A	S
17748	63 / 25	200 / 5	A	S
17749	63 / 32	150 / 5	A	S
17750	75 / 20	200 / 5	A	S
17751	75 / 25	200 / 5	A	S
17752	75 / 32	120 / 5	A	S
17754	90 / 20	200 / 5	A	S
17756	90 / 25	200 / 5	A	S
17758	90 / 32	150 / 5	A	S
17760	110 / 20	200 / 5	A	S
17761	110 / 25	150 / 5	A	S
17762	110 / 32	120 / 5	A	S
17765	125 / 20	200 / 5	A	S
17766	125 / 25	150 / 5	A	S
17767	125 / 32	100 / 5	A	S

ECOSAN Weld-in saddle with an internal screw thread for wrench - female

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
18352	40 x 1/2“	100 / 5	A	S
18353	40 x 3/4“	100 / 5	A	S
18354	50 x 1/2“	100 / 5	A	S
18355	50 x 3/4“	100 / 5	A	S
18356	63 x 1/2“	100 / 5	A	S
18357	63 x 3/4“	80 / 5	A	S
18358	63 x 1“	50 / 5	A	S
18359	75 x 1/2“	80 / 5	A	S
18360	75 x 3/4“	80 / 5	A	S
18361	75 x 1“	50 / 5	A	S
18362	90 x 1/2“	80 / 5	A	S
18363	90 x 3/4“	80 / 5	A	S
18364	90 x 1“	50 / 5	A	S
18366	110 x 1/2“	100 / 5	A	S
18367	110 x 3/4“	80 / 5	A	S
18368	110 x 1“	50 / 5	A	S
18370	125 x 1/2“	50 / 5	A	S
18371	125 x 3/4“	50 / 5	A	S
18372	125 x 1“	50 / 5	A	S

S=Standard-Range, stored M x.xxx = Minimum order quantity in pieces or meter

Plastic Drill see page 54. New saddle welding tolls see page 54

ECOSAN End cap

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
17701	16	500 / 10	A	M 2.000
17702	20	400 / 10	A	S
17703	25	250 / 10	A	S
17704	32	150 / 10	A	S
17705	40	100 / 5	A	S
17706	50	60 / 5	A	S
17707	63	30 / 1	A	S
17708	75	20 / 1	A	S
17709	90	30 / 1	A	S
17710	110	15 / 1	A	S
17711	125	12 / 1	A	M 48

ECOSAN Flange bushing with gasket

RETUSCHE LITHO
FREISTELLEN

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
17807	63	30 / 1 A S	A	M 2.000
17808	75	20 / 1 A S	A	S
17809	90	15 / 1 A S	A	S
17810	110	12 / 1 A S	A	S
17811	125	10 / 1 A S	A	S

ECOSAN PP-flange glass-fiber reinforced for flange bushing

RETUSCHE LITHO
FREISTELLEN

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
14207	63	1	A	S
14208	75	1	A	S
14209	90	1	A	S
14210	110	1	A	S
14211	125	1	A	S

ECOSAN Socket for electric welding

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
14802	20	35 / 1	A	S
14803	25	25 / 1	A	S
14804	32	20 / 1	A	S
14805	40	25 / 1	A	S
14806	50	20 / 1	A	S
14807	63	25 / 1	A	S
14808	75	36 / 1	A	S
14809	90	18 / 1	A	S
14810	110	15 / 1	A	S
14811	125	1 / 1	A	S

S=Standard-Range, stored M x.xxx = Minimum order quantity in pieces or meter

ECOSAN Wall union female

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
18002	16 x 1/2“	100 / 10	A	M 200
18004	20 x 1/2“	100 / 10	A	S
18005	20 x 3/4“	80 / 10	A	M 240
18006	25 x 1/2“	80 / 10	A	S
18007	25 x 3/4“	80 / 10	A	S

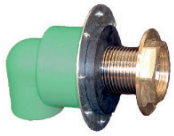
ECOSAN Wall union passage, female

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
18024	20 x 1/2“	70 / 10	A	S
18026	25 x 1/2“	50 / 10	A	S

ECOSAN Cistern adapter complete
with lock nut, gasket, and antitorsion device female and male

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
18056	16 x 1/2“ x 3/4“ 18 mm	50 / 1	A	M 150
18058	20 x 1/2“ x 3/4“ 18 mm	50 / 1	A	M 250

ECOSAN Extension elbow adapter
complete with lock nut, gasket, and anti-torsion device female and male

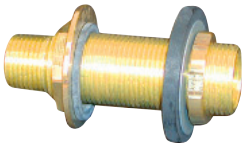


Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
18062	16 x 1/2“ x 3/4“ 25 mm	50 / 1	A	M 100
18064	20 x 1/2“ x 3/4“ 25 mm	50 / 1	A	M 250
18072	16 x 1/2“ x 3/4“ 33 mm	50 / 1	A	M 200
18074	20 x 1/2“ x 3/4“ 33 mm	50 / 1	A	M 200
18076	16 x 1/2“ x 3/4“ 65 mm	40 / 1	A	M 160
18078	20 x 1/2“ x 3/4“ 65 mm	40 / 1	A	M 120

S=Standard-Range, stored M x.xxx = Minimum order quantity in pieces or meter

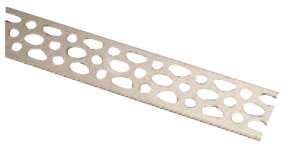
5.1.3 Fittings and Accessories

Extension for adapter
complete with nut, lock nut, gasket, and shim



Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
12042	1/2“ x 50	100 / 1	A	S
12044	1/2“ x 70	100 / 1	A	S

Assembly plate galvanized,
for all sanitary inside micrometers



Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
15480	2000 x 50 x 3	25 / 1	A	S

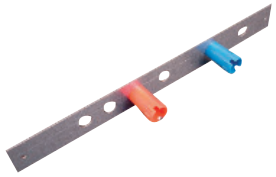
Tin plate for mounting for wall unions

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
15482		5	A	S

Assembly plug for gauge „Standard“
red = 15413
blue = 15414

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
15413	1/2“	200 / 10	A	S
15414	1/2“	200 / 10	A	S

Gauge „Standard“



Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
15400		50 / 1	A	S

S=Standard-Range, stored M x.xxx = Minimum order quantity in pieces or meter

5.1.4 Adapters

ECOSAN Adapter female not for wrench

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
18102	16 x 1/2“	150 / 10	A	M 300
18104	20 x 1/2“	150 / 10	A	S
18105	20 x 3/4“	100 / 10	A	M 200
18106	25 x 1/2“	150 / 10	A	S
18107	25 x 3/4“	100 / 10	A	S
18108	32 x 3/4“	100 / 10	A	S

ECOSAN Adapter female for wrench

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
18118	25 x 1“	50 / 5	A	S
18109	32 x 1“	50 / 5	A	S
18110	40 x 1“	50 / 5	A	M 100
18111	40 x 1 1/4“	30 / 5	A	S
18112	50 x 1 1/4“	30 / 5	A	M 90
18113	50 x 1 1/2“	25 / 5	A	S
18114	63 x 1 1/2“	10 / 1	A	S
18115	63 x 2“	10 / 1	A	S
18116	75 x 2“	8 / 1	A	M 48
18117	75 x 2 1/2“	8 / 1	A	S

Another size on request

ECOSAN Adapter male not for wrench

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
18152	16 x 1/2“	120 / 10	A	M 240
18154	20 x 1/2“	100 / 10	A	S
18155	20 x 3/4“	100 / 10	A	M 200
18156	25 x 1/2“	100 / 10	A	S
18157	25 x 3/4“	100 / 10	A	S
18158	32 x 3/4“	80 / 5	A	S

ECOSAN Adapter male for wrench

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
18159	32 x 1“	50 / 5	A	S
18160	40 x 1“	50 / 5	A	M 100
18161	40 x 1 1/4“	30 / 5	A	S
18162	50 x 1 1/4“	20 / 5	A	M 100
18163	50 x 1 1/2“	20 / 5	A	S
18165	63 x 2“	20 / 1	A	S
18167	75 x 2 1/2“	8 / 1	A	S
18169	90 x 3“	6 / 1	A	S
18171	110 x 2 1/2“	4 / 1	A	S

Another size on request

S=Standard-Range, stored M x.xxx = Minimum order quantity in pieces or meter

ECOSAN Elbow adapter female from 1“ for wrench

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
18202	16 x 1/2“	150 / 10	A	M 300
18204	20 x 1/2“	150 / 10	A	S
18205	20 x 3/4“	100 / 10	A	M 200
18206	25 x 1/2“	120 / 10	A	S
18207	25 x 3/4“	100 / 10	A	S
18208	32 x 3/4“	70 / 5	A	S
18209	32 x 1“	40 / 5	A	S

ECOSAN Elbow adapter male/female

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
18234	20 x 1/2“	150 / 10	A	S

ECOSAN Elbow adapter male from 1“ for wrench

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
18252	16 x 1/2“	100 / 10	A	M 200
18254	20 x 1/2“	100 / 10	A	S
18255	20 x 3/4“	100 / 10	A	M 200
18256	25 x 1/2“	100 / 10	A	S
18257	25 x 3/4“	70 / 10	A	S
18258	32 x 3/4“	70 / 5	A	M 140
18259	32 x 1“	40 / 5	A	S

ECOSAN Tee adapter female from 1“ for wrench

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
18302	16 x 1/2“ x 16	100 / 10	A	M 200
18304	20 x 1/2“ x 20	100 / 10	A	S
18305	20 x 3/4“ x 20	100 / 10	A	M 200
18306	25 x 1/2“ x 25	80 / 10	A	S
18307	25 x 3/4“ x 25	70 / 10	A	S
18311	32 x 1/2“ x 32	40 / 5	A	S
18310	32 x 3/4“ x 32	40 / 5	A	S
18309	32 x 1“ x 32	30 / 5	A	S
18312	40 x 3/4“ x 40	30 / 5	A	M 90
18313	40 x 1“ x 40	30 / 5	A	M 90
18314	50 x 1“ x 50	20 / 5	A	M 80

Plastic Drill see page 54. New saddle welding tolls see page 54.

S=Standard-Range, stored M x.xxx = Minimum order quantity in pieces or meter

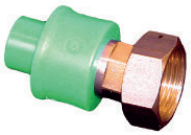
ECOSAN Tee adapter male

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
18300	20 x 1/2“ x 20	80 / 10	A	S
18301	20 x 3/4“ x 20	100 /100	A	S

ECOSAN Screwed union plastic/brass F with socket end

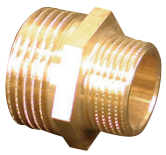
Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
20043	20 x 1/2“	100 / 1	A	S
20045	20 x 3/4“	100 / 1	A	M 200
20047	25 x 3/4“	100 / 1	A	S
20048	25 x 1“	70 / 1	A	M 140
20050	32 x 1“	70 / 1	A	S
20051	32 x 1 1/4“	50 / 1	A	M 200
20053	40 x 1 1/4“	50 / 1	A	S
20054	40 x 1 1/2“	40 / 1	A	M 80
20056	50 x 1 1/2“	30 / 1	A	S
20058	63 x 2“	20 / 1	A	S
20061	75 x 2 3/8“	10 / 1	A	M 30

ECOSAN Screwed union plastic/brass F with pipe end



Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
20075	20 x 3/4“	100 / 1	A	S
20077	25 x 3/4“	100 / 1	A	M 200
20078	25 x 1“	70 / 1	A	S
20080	32 x 1“	70 / 1	A	M 140
20081	32 x 1 1/4“	50 / 1	A	S
20083	40 x 1 1/4“	50 / 1	A	M 100
20084	40 x 1 1/2“	50 / 1	A	M 100
20086	50 x 1 1/2“	30 / 1	A	M 90

Reducing nipple male



Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
14102	3/4“ x 1/2“	260 / 1	A	S
14104	1“ x 3/4“	200 / 1	A	S
14106	1 1/4“ x 1“	140 / 1	A	S

Reducer male x female

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
14122	3/4“ x 1/2“	350 / 1	A	S
14124	1“ x 3/4“	240 / 1	A	S
14126	1 1/4“ x 1“	180 / 1	A	S

S=Standard-Range, stored M x.xxx = Minimum order quantity in pieces or meter

5.1.5 Shutt-Off Devices and Accessories

ECOSAN Slanted seat valve, body

without discharge screw

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
20504	20 x 3/4“	50 / 5	A	S
20505	25 x 3/4“	50 / 5	A	S
20508	32 x 1“	25 / 5	A	S
20510	40 x 1 1/4“	15 / 1	A	S
20512	50 x 1 1/2“	10 / 1	A	M 100

with discharge screw

20534	20 x 3/4“	40 / 5	A	S
20535	25 x 3/4“	40 / 5	A	S
20538	32 x 1“	25 / 5	A	S
20540	40 x 1 1/4“	15 / 5	A	S
20542	50 x 1 1/2“	8 / 1	A	M 96

Slanted seat valve, upper part

without backfl.prev. and non rising spindle

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
14642	3/4“	70 / 1	A	S
14643	1“	50 / 1	A	S
14644	1 1/4“	25 / 1	A	S
14645	1 1/2“	25 / 1	A	S

with backfl.prev. and non rising spindle

14662	3/4“	25 / 1	A	S
14663	1“	40 / 1	A	S
14664	1 1/4“	20 / 1	A	S
14665	1 1/2“	20 / 1	A	S

ECOSAN Shutt-off valve, body

without discharge screw

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
20304	20 x 3/4“	50 / 5	A	S
20306	25 x 3/4“	50 / 5	A	S
20308	32 x 1“	30 / 5	A	S
20310	40 x 1 1/4“	25 / 1	A	S

with discharge screw

20324	20 x 3/4“	50 / 5	A	M 200
20326	25 x 3/4“	50 / 5	A	M 200
20328	32 x 1“	20 / 5	A	M 100
20330	40 x 1 1/4“	15 / 1	A	M 90

Shutt-off valve, upper part

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
14602	3/4“	125 / 1	A	S
14604	1“	75 / 1	A	S
14606	1 1/4“	40 / 1	A	S

S=Standard-Range, stored M x.xxx = Minimum order quantity in pieces or meter

Concealed valve, upper part
(in flexible length 60 - 110 mm)

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
14612	3/4“	50 / 1	A	S
14614	1“	50 / 1	A	S

Concealed valve, upper part
simple model

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
14611	3/4“	40 / 1	A	S
14617	1“	40 / 1	A	S

Concealed valve,
only for authorised staff, simple model

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
14622	3/4“	60 / 1	A	S
14628	1“	40 / 1	A	S

Extension for upper parts
concealed valves, simple model

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
14638	92	100 / 1	A	S
14639	132	100 / 1	A	S

ECOSAN Ball valve

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
20402	20	50 / 5	A	S
20403	25	50 / 5	A	S
20404	32	30 / 1	A	S
20405	40	15 / 1	A	S
20412	50	12 / 1	A	S
20414	63	6 / 1	A	S

S=Standard-Range, stored M x.xxx = Minimum order quantity in pieces or meter

5.1.6 Weldingmachines, Tools and Accessories

Electronic welding device
without attachments, 1000 W up to Ø 63 mm

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
15016		1	C	S

Electronic welding device
without attachments, 550 W up to Ø 50 mm

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
15025		1	C	S

Electronic welding device,
large version without attachments, 1400 W up to Ø 125 mm

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
15015		1	C	S

Electronic welding machine
for pipes from 40 to 125mm, complete with tools and wooden box

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
15205		1	C	S

Electronic welding machine
for electric welding sockets

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
15255		1	C	S

S=Standard-Range, stored M x.xxx = Minimum order quantity in pieces or meter

Welding case incl. device 650 W,
bench mounting device, attachments Ø 20 – 63 mm

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
21310		1	C	S

Welding case incl. device 1000 W,
bench mounting device, attachments Ø 20 - 40 mm, pipe cutter

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
15311		1	C	S

Pipe cutter for pipes from Ø 16 to 40 mm

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
15001		1	C	S

Pipe cutter for pipes from Ø 16 to 63 mm

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
15003		1	C	S

Pipe cutter for pipes up to Ø 110 mm

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
15007		1	C	S

Welding attachment
acc. to DVS-Guideline

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
15041	16	1	C	S
15042	20	1	C	S
15043	25	1	C	S
15044	32	1	C	S
15045	40	1	C	S
15046	50	1	C	S
15047	63	1	C	S
15048	75	1	C	S
15049	90	1	C	S
15050	110	1	C	S
15051	125	1	C	S

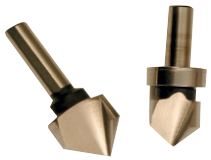
S=Standard-Range, stored M x.xxx = Minimum order quantity in pieces or meter

Saddle welding tools for weld-in saddles

Extra order (B25): Plastic Drill Art.-Nr.: 15095
Extra order (B32): Plastic Drill Art.-Nr.: 15096

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
15065	40 (B25)	1	C	S
15066	50 (B25)	1	C	S
15067	63 (B25)	1	C	S
15082	63 (B32)	1	C	S
15068	75 (B25)	1	C	S
15083	75 (B32)	1	C	S
15069	90 (B25)	1	C	S
15084	90 (B32)	1	C	S
15070	110 (B25)	1	C	S
15085	110 (B32)	1	C	S
15071	125 (B25)	1	C	S
15086	125 (B32)	1	C	S
15087	160 (B25)	1	C	S
15088	160 (B32)	1	C	S

Plastic Drill for weld-in saddles



32mm 25mm

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
15095	25 (B25)	1	C	S
15096	32 (B32)	1	C	S

Welding attachment
for repair holes up to Ø 8 mm

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
15080		1	C	S

ECOSAN Welding plug
for repair of holes up to Ø 8 mm

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
21090		1200 / 100	A	S

Peeling device
for Prostabalu-pipe

Item No.	Dimension in mm (Ø)	Packing unit carton/bag	DG	
15111	D16	1	C	S
15112	D20	1	C	S
15113	D25	1	C	S
15114	D32	1	C	S
15115	D40	1	C	S
15116	D50	1	C	S
15117	D63	1	C	S
15118	D75	1	C	S
15119	D90	1	C	S
15120	D110	1	C	S

S=Standard-Range, stored M x.xxx = Minimum order quantity in pieces or meter

NOTES

NOTES

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