6 Engineering

6.1 Hydraulic parameters

6.1.1 Delivery capacity

The delivery capacity is determined by the number and size of the delivery and tapping points. Values minimum flow pressure and flow rates according the German standard DIN 1988 and EN 805 are given in tables 6.1 and 6.2. Ensure to apply the values according the national standards.

Minimum flow pressures and calculation flow rates for commonly available fittings and items of apparatus (guideline values)

Minimum flow pressure P min Fl bar	Extract DIN 1988 E Type of drinking water removal point		Calculation flow rate with the removal of: Mixed water QR cold l/s	QR hot l/s	Only cold or only hot water QR l/s
0,5	Outlet valves without aeration	DN 15	-	-	0,30
0,5	....	DN 20	-	-	0,50
0,5	....	DN 25	-	-	1,00
1,0	Outlet valves with aeration	DN 10	-	-	0,15
1,0	....	DN 15	-	-	0,15
1,0	Showerheads for cleaning showers	DN 15	-	-	0,20
1,2	Flushing valves to DIN 3265 Part 1	DN 15	-	-	0,70
1,2	Flushing valves to DIN 3265 Part 1	DN 20	-	-	1,00
0,4	Flushing valves to DIN 3265 Part 1	DN 25	-	-	1,00
1,0	Flushing valves to urinal basins	DN 15	-	-	0,30
0,5	Corner valves for urinal basins	DN 15	-	-	0,30
1,0	Domestic dishwashing machine	DN 15	-	-	0,15
1,0	Domestic washing machine	DN 15	-	-	0,25
	Mixing battery for				
1,0	shower tubs	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	bidets	DN 15	0,07	0,07	-
1,0	Mixing battery	DN 20	0,30	0,30	-
0,5	Flushing boxes to DIN 19542	DN 15	-	-	0,13
	Drinking water heaters for supplying a tap (incl. mixed removal fitting)				
1,0	Electric water boiling device	DN 15	-	-	0,10 *)
	Electric hot-water tank and boiler				
1,1 **)	with nominal volume 5 to 15 l	DN 15	-	-	0,10
1,2 **)	with nominal volume 30 to 150 l	DN 15	-	-	0,20
	Electric continuous-flow water heater, hydraulically controlled, without flow limiter				
1,5	Rated power	12 kW	-	-	0,06
1,9	....	18 kW	-	-	0,08
2,1	....	21 kW	-	-	0,09
2,4	....	24 kW	-	-	0,10
1,0	Gas continuous-flow water heater	12 kW	-	-	0,10

**) With throttle screw, fully opened*

***) Values with unfavourable conditions (shower)*

Note: Water removal points not listed in the table as well as items of apparatus as listed in the table, but with greater flow rates, are to be taken into account in accordance with the manufacturer's statements when calculating pipe diameters

Table 6.1 Values according DIN 1988

Engineering

6.1.2 Flow speed

Flow speeds must be selected in such a way that flow noise and water hammer are avoided as far as possible. When the pipe diameters are selected correctly, the flow speeds given in table 6.2 will not be exceeded.

Pipework section	Max. computed flow speed at flow duration of	
	≤ 15 min.	>15 min.
	m/s	m/s
Connection lines	2	2
Consumer lines, part sections for low pressure loss fitting pressure (<2,5) *)	5	2
Part sections with through fittings	2,5	2
Recirculating hot water systems	0,9	0,9

**) e.g. ball valve, valve DIN 3500/3502*

***) e.g. straight seat valve DIN 3512*

Table 6.2 Flow speeds

6.1.3 Resistance coefficients

Resistance coefficients of the individual components of the Wefatherm system are given in table 6.4.

6.1.4 Pressure losses from individual resistance

Pressure losses from individual resistances Z as a function of the flow speed.

Computed flow speed v m/s	Pressure loss Z for ζ = 1 mbar	Computed flow speed v m/s	Pressure loss Z for ζ = 1 mbar
0,1	0,1	**2,6**	33,8
0,2	0,2	**2,7**	36,5
0,3	0,5	**2,8**	39,2
0,4	0,8	**2,9**	42,1
0,5	1,3	**3,0**	45
0,6	1,8	**3,1**	48
0,7	2,5	**3,2**	51
0,8	3,2	**3,3**	55
0,9	4,1	**3,4**	58
1,0	5,0	**3,5**	61
1,1	6,1	**3,6**	65
1,2	7,2	**3,7**	68
1,3	8,5	**3,8**	72
1,4	9,8	**3,9**	76
1,5	11,3	**4,0**	80
1,6	12,8	**4,1**	84
1,7	14,5	**4,2**	88
1,8	16,2	**4,3**	92
1,9	18,1	**4,4**	97
2,0	20,0	**4,5**	101
2,1	22,1	**4,6**	106
2,2	24,2	**4,7**	110
2,3	26,5	**4,8**	115
2,4	28,8	**4,9**	120
2,5	31,3	**5,0**	125

Table 6.3 Pressure loss from individual resistance for resistance coefficient ζ =1 (at ϑ = 10°C and Q = 999,7 kg/m³) and flow speed ($z = 5v^2 \cdot \sum \zeta$)

The total pressure loss of the line is the sum of the pressure losses from the pipe friction and from the individual resistances: $\Delta p_{loss} = \Sigma (l \cdot R + Z)$. Please see table 6.3 for the guideline values for the individual resistances.

6.1.5 Maximum flow rate

Maximum flow rates are given in appendix B.

6.1.6 Pipe friction gradients

Pipe friction gradient R and calculated flow speed in dependence of circulation are given in appendix B.

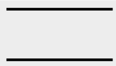
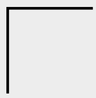
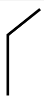
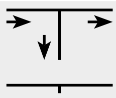
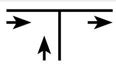
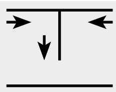
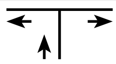
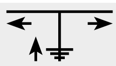
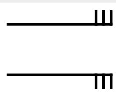
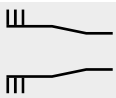
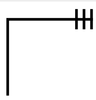
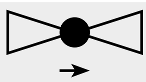
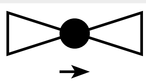
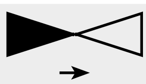
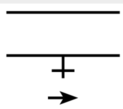
Nr.	Individual resistance		Graphical symbol	Resistance coefficient
1	Socket			0,25
2 2a	Reduction up to 2 dimensions Reduction from 3 dimensions			0,55 0,85
3 3a	Elbow 90° Elbow 90° i./a.			2,0 1,2
4 4a	Elbow 45° Elbow 45° i./a.			0,6 0,5
5 5a	Tee (separation) Tee (reduced)			1,8 3,6
6 6a	Tee (combination) Tee (reduced)			1,3 2,6
7 7a	Tee (counter-flow) Tee (reduced)			4,2 9,0
8 8a	Tee (counter-flow) Tee (reduced)			2,2 5,0
9	Tee with transition			0,8
10	Transition with outside thread, without counterpart			0,4
11	Transition with outside thread, reduced, without counterpart			0,85
12	Transition angle piece with outside thread, without counterpart			2,2
13	Transition angle piece with outside thread, reduced, without counterpart			3,5
14	Straight seat valve	20 mm 25 mm 32 mm 40 mm		9,5 8,5 7,6 5,7
15	Inclined seat valve	20 mm 25 mm 32 mm 40 mm		5,0 4,4 3,8 3,2
16	KFR valve	20 mm 25 mm 32 mm 40 mm		5,0 4,4 3,8 3,2
17	Drain nozzle			0,25

Table 6.4

Engineering

6.2 Mechanical parameters

6.2.1 Longitudinal expansion

Polypropylene pipe systems extend when subjected to heat in accordance with their material characteristics. The longitudinal expansion of the Wefatherm stabi pipe or Wefatherm fiber pipe is considerably less than 100% plastic pipe experiences. The method of calculating the longitudinal expansion theoretically can be found in an example. For practical use the longitudinal expansion to be expected with the three different materials is shown in tables. In these tables you will find the longitudinal expansion to be expected for a particular free length of pipe. Critical for the determination of the longitudinal expansion is the difference between the temperature at which the pipework is installed and the maximum operating temperature to be expected. After the expected longitudinal expansion has been determined, a decision can be made if any of the possible measures should be taken to compensate it.

Definition of free pipe length

The free pipe length is the length of the pipe between two points at which the pipe is secured or clamped in a fixed manner.

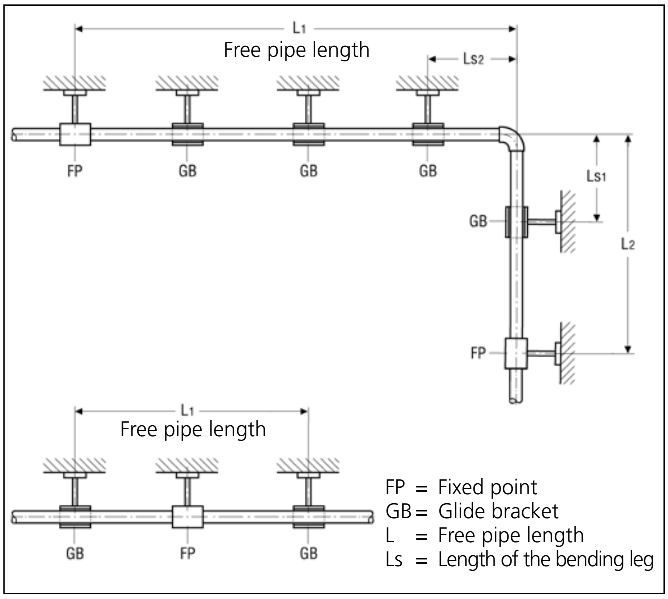


Illustration 6.1 Longitudinal expansion

Type of laying	Longitudinal expansion compensation yes/no	Comments
Laying in shafts Rising mains	no	Free length less than 3 m
Buried laying in plaster Laying in floor topping Laying in concrete	no	Expansion is absorbed by the insulation or by the pipe material
Exposed laying	yes	Take expansion compensation measure

Table 6.5

Calculation example of longitudinal expansion:

$$\Delta t = \alpha \times L \times \Delta t$$

Δt = Longitudinal expansion in mm
α = linear expansion factor
for Wefatherm standard pipe 0,150 mm/m . K
for Wefatherm stabi pipe 0,030 mm/m . K
for Wefatherm fiber pipe 0,035 mm/m . K
L = Length of pipe in m
Δt = temperature difference between assembly temperature and operation temperature

Equation 6.1

Calculation example of longitudinal expansion of Wefatherm pipe:

$$\alpha = 0{,}15 \text{ mm/m . K}$$

Equation 6.2

Pipe length	Longitudinal expansion Temperature difference Δ_t (K)							
(m)	10	20	30	40	50	60	70	80
0,1	0,15	0,30	0,45	0,60	0,75	0,90	1,05	1,10
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	9,00	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

Table 6.6

$$\alpha = 0{,}03 \text{ mm/m . K}$$

Equation 6.3

Pipe length	Longitudinal expansion Temperature difference Δ_t (K)							
(m)	10	20	30	40	50	60	70	80
0,1	0,03	0,06	0,09	0,12	0,15	0,18	0,21	0,24
0,2	0,06	0,12	0,18	0,24	0,30	0,36	0,42	0,48
0,3	0,09	0,18	0,27	0,36	0,45	0,54	0,63	0,72
0,4	0,12	0,24	0,36	0,48	0,60	0,72	0,84	0,96
0,5	0,15	0,30	0,45	0,60	0,75	0,90	1,05	1,20
0,6	0,18	0,36	0,54	0,72	0,90	1,08	1,26	1,44
0,7	0,21	0,42	0,63	0,84	1,05	1,26	1,47	1,68
0,8	0,24	0,48	0,72	0,96	1,20	1,44	1,68	1,92
0,9	0,27	0,54	0,81	1,08	1,35	1,62	1,89	2,16
1,0	0,30	0,60	0,90	1,20	1,50	1,80	2,10	2,40
2,0	0,60	1,20	1,80	2,40	3,00	3,60	4,20	4,80
3,0	0,90	1,80	2,70	3,60	4,50	5,40	6,30	7,20
4,0	1,20	2,40	3,60	4,80	6,00	7,20	8,40	9,60
5,0	1,50	3,00	4,50	6,00	7,50	9,00	10,50	12,00
6,0	1,80	3,60	5,40	7,20	9,00	10,80	12,60	14,40
7,0	2,10	4,20	6,30	8,40	10,50	12,60	14,70	16,80
8,0	2,40	4,80	7,20	9,60	12,00	14,40	16,80	19,20
9,0	2,70	5,40	8,10	10,80	13,50	16,20	18,90	21,60
10,0	3,00	6,00	9,00	12,00	15,00	18,00	21,00	24,00

Table 6.7

α **= 0,035 mm/m . K**

Equation 6.3

Pipe length	Longitudinal expansion Temperature difference Δ_t (K)							
(m)	10	20	30	40	50	60	70	80
0,1	0,04	0,07	0,11	0,14	0,18	0,21	0,25	0,28
0,2	0,07	0,14	0,21	0,28	0,35	0,42	0,49	0,56
0,3	0,11	0,21	0,32	0,42	0,53	0,63	0,74	0,84
0,4	0,14	0,28	0,42	0,56	0,70	0,84	0,98	1,12
0,5	0,18	0,35	0,53	0,70	0,88	1,05	1,23	1,40
0,6	0,21	0,42	0,63	0,84	1,05	1,26	1,47	1,68
0,7	0,25	0,49	0,74	0,98	1,23	1,47	1,72	1,96
0,8	0,28	0,56	0,84	1,12	1,40	1,68	1,96	2,24
0,9	0,32	0,63	0,95	1,26	1,58	1,89	2,21	2,52
1,0	0,35	0,70	1,05	1,40	1,75	2,10	2,45	2,80
2,0	0,70	1,40	2,10	2,80	3,50	4,20	4,90	5,60
3,0	1,05	2,10	3,15	4,20	5,25	6,30	7,35	8,40
4,0	1,40	2,80	4,20	5,60	7,00	8,40	9,80	11,20
5,0	1,75	3,50	5,25	7,00	8,75	10,50	12,25	14,00
6,0	2,10	4,20	6,30	8,40	10,50	12,60	14,70	16,80
7,0	2,45	4,90	7,35	9,80	12,25	14,70	17,15	19,60
8,0	2,80	5,60	8,40	11,20	14,00	16,80	19,60	22,40
9,0	3,15	6,30	9,45	12,60	15,75	18,90	22,05	25,20
10,0	3,50	7,00	10,50	14,00	17,50	21,00	24,50	28,00

Table 6.8

6.2.2 Expansion compensation constructions

Bending legs

Frequent changes in the direction of a pipe, which are in any case necessary, will enable bending legs to be planned, which can compensate for the previously determined longitudinal expansion.

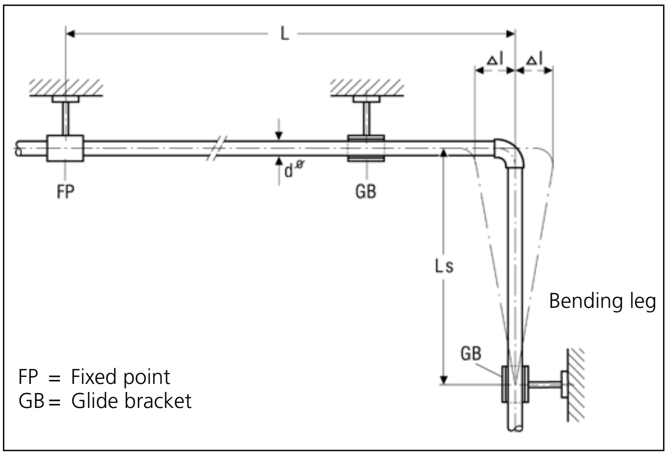


Illustration 6.2

Calculation example of the minimum length L_s of the bending leg:

The minimum length L_s of the bending leg can be calculated with the following formula:

$$L_s = K \times \sqrt{d \cdot \frac{\Delta l}{2}}$$

1. Calculation of the longitudinal expansion Δl
   For a temperature difference of Δt 40 K between the hot water temperature and the ambient temperature.
   α = 0,15 mm/m . K
   L = 10,0 m
   Δt = 40 K (°C)

   To be calculated: Δl
   $\alpha \times L \times \Delta t = \Delta l$
   0,15 x 10,0 x 40 = 60 mm

2. Calculation of the minimum length of L_s of the bending leg
   d = 40 mm
   Δl = 60 mm
   K = 15 mm

   To be calculated: L_s

   $$K \times \sqrt{d \times \Delta l}$$

   $$15 \times \sqrt{40 \times 60}$$

Equation 6.5

L_s = length of the bending leg in mm
d = external diameter Wefatherm pipe in mm
Δl = longitudinal expansion in mm
K = constant for the material, for Wefatherm pipes = 15

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Expansion bow

If the installation requires a 'U-shape', this can be used to provide compensation for longitudinal expansion. Here the width of the pipe bow A_{min} and the lengths of the two bending legs must be calculated.

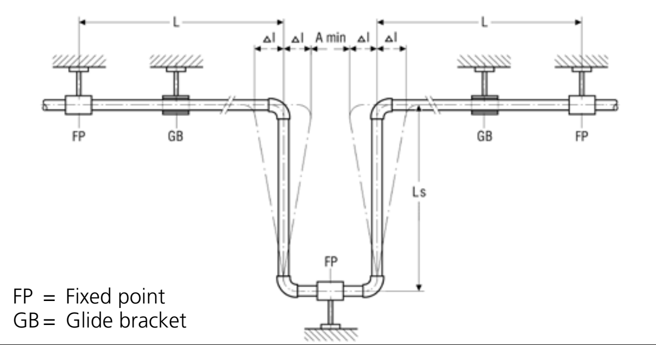


Illustration 6.3

Calculation example of expansion bow width Amin:

The width of the expansion bow A_{min} is calculated with the following formula:

$$2 \times \Delta l + SA = A_{min}$$
$$2 \times 60{,}0\ \text{mm} + 150\ \text{mm} = 270\ \text{mm}$$

Equation 6.6

Designation	Significance	Value	Unit
A_{min}	Width of expansion bow	?	mm
Δl	Longitudinal expansion	60,0	mm
SA	Safety distance	150,0	mm

Table 6.9 Given values and values to be calculated

Pre-stressing

By pre-stressing of a bending leg the length of the leg might be shortened with narrow space. When exactly planned and carried out, preload assemblies offer an optically perfect image as expansion movement is not visible. The calculated Δl is negatively pre-stressed when being installed. After initial operation of a pipe system a correct 90° angle will arise.

Calculation example of length of bending legs with pre-stressing:

The length of the bending leg with pre-stressing is calculated in accordance with the following formula (U-shape):

$$K \times \sqrt{d \cdot \frac{\Delta l}{2}} = L_s$$

$$15 \times \sqrt{40\ \text{mm} \cdot \frac{60\ \text{mm}}{2}} = 520\ \text{mm}$$

Equation 6.7

Designation	Significance	Value	Unit
L_{SV}	Length of the bending leg with pre-stressing	?	mm
K	Material-specific constant for Wefatherm pipes	15	
d	External diameter Wefatherm pipes	40,0	mm
Δl	Longitudinal expansion	60,0	mm

Table 6.9 Given values and values to be calculated

In accordance with the above stated starting values the length of bending leg is 520 mm.

6.3 Mounting and bracketing

6.3.1 Techniques for mounting pipework

When considering the techniques for mounting pipe work, one must differentiate fundamentally between fixed point mountings (hereafter fixed points) and loose or sliding point mountings (hereafter sliding points). By definition the fixed point or fixed clamp holds the pipe in a fixed manner, in which in contrast a sliding point will permit the pipe to move in the axial direction of the pipe. An optimally satisfactory installation can be ensured by appropriate selection of these two different methods of mounting. Rubber clamp inserts for plastic pipe prevent the pipe surface from being damaged at the clamp and ensure the required guiding and holding of the pipe.

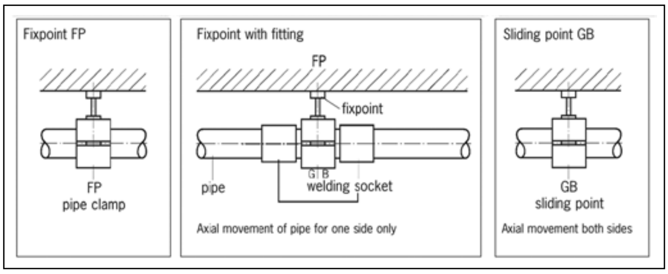


Illustration 6.4

6.3.2 Fix points

Fix points (fixed point mountings) divide a pipe network into sections. The free lengths from a fixed point must be measured and the possible longitudinal expansion that can take place in this free length must be calculated. Fixed point mountings with a long distance between the part of the clamp, holding the pipe and the ceiling or wall to which the clamp is mounted, should be avoided, since in these cases the clamps can act in a self-aligning manner and will not provide a fixed point. Sliding point clamps positioned on each side of the fittings, will act as fixed points! Vertical distribution lines (shaft mounting) and pipework laid beneath plaster or in concrete or floor topping, can also be laid in a rigid manner. Branch points, where the pipe branching off passes through a wall, must be mounted in a fixed manner since otherwise the pipe branching off could be cut off.

6.3.3 Loose or sliding mounting points

Axial movement of a pipe produced by longitudinal expansion should not be influenced by loose or sliding point mountings. The clamps should have suitable inserts (e.g. rubber) to prevent the pipe surface from being damaged and allow movement. Fittings must be at a sufficient distance from the sliding point clamps since otherwise these will act as fixed points.

6.3.4 Principles for the layout and construction of fixed points

- Fixed points are to be arranged so that direction changes in the pipe route can be used to absorb length changes.
- They are also to be designed in considering all the loads that might arise. In addition to reaction forces from friction at bracket contact points and deformation of bends, large forces are produced by fixed restraints of pipe lengths.
- The pipe must have the appropriate retainer rings to transfer the forces to the construction of the fixed point. Insufficient consideration of the restraint of the pipe in the bracket alone will, in many cases, cause deformation of the pipe cross section or damage to the pipe surface.
- Fixing pipe systems at fixed points should, if possible, be done at low ambient temperatures, giving rise to predominantly compressive stresses when heated (operating state).
- If flange connections occur in pipe lengths between fixed points, tensile stresses can cause the joint pre-tension forces to decrease, resulting in leakage at the flange connections.
- In inclining pipe segments, fixed points are employed to absorb dead weight and dynamic loads. The design has to ensure that vertical length changes do not produce any unacceptable tensile loads on the horizontal connections.

6.3.5 Valve mounting

Locations in which valves or other heavy equipment encumber the pipe system have to be provided with an additional support structure. Supporting valves not only serves to bear weight but also prevents the transfer of large actuating forces to the pipe system.

The design features must be arranged to enable replacement of the valves without simultaneous disassembly of the entire fixing. If the valve mount corresponds to a fixed point, consideration must be given to the consequences of the restricted length change.

6.3.6 Recommended spans LA at pipe wall temperature T_R

Wefatherm PP-R pipe

Pipe wall temp.	Pipe diameter (mm)										
TR (°C)	16	20	25	32	40	50	63	75	90	110	125
	Recommended spans L_A (cm) (Montage distance)										
0	70	85	105	125	140	165	190	205	220	250	250
20	50	60	75	90	100	120	140	150	160	180	190
30	50	60	75	90	100	120	140	150	160	180	190
40	50	60	70	80	90	110	130	140	150	170	180
50	50	60	70	80	90	110	130	140	150	170	180
60	50	55	65	75	85	100	115	125	140	160	170
70	50	50	60	70	80	95	105	105	125	140	150

Table 6.11

Wefatherm stabi pipes

Pipe wall temp.	Pipe diameter (mm)										
TR (°C)	16	20	25	32	40	50	63	75	90	110	125
	Recommended spans L_A (cm) (Montage distance)										
0	130	155	170	195	220	245	270	285	300	325	340
20	100	120	130	150	170	190	210	220	230	250	265
30	100	120	130	150	170	190	210	220	230	240	255
40	100	110	120	140	160	180	200	210	220	230	245
50	100	110	120	140	160	180	200	210	220	210	225
60	80	100	110	130	150	170	190	200	210	200	210
70	70	90	100	120	140	160	180	190	200	200	210

Table 6.12

Wefatherm stabi pipes

Pipe wall temp.	Pipe diameter (mm)										
TR (°C)	16	20	25	32	40	50	63	75	90	110	125
	Recommended spans L_A (cm) (Montage distance)										
0	120	140	160	180	205	230	245	260	290	320	340
20	90	105	120	135	155	175	185	195	215	240	265
30	90	105	120	135	155	175	185	195	210	230	255
40	85	95	110	125	145	165	175	185	200	220	245
50	85	95	110	125	145	165	175	185	190	205	225
60	80	90	105	120	135	155	165	175	180	190	210
70	70	80	95	110	130	145	155	165	170	180	210

Table 6.13

For vertical pipelines increase the relevant distances by 20% (factor 1.2).

6.4 Insulation

6.4.1 Protective measures

Protective measures for above ground pipe systems outside buildings (e.g. on pipe bridges) include insulation against loss of heat or cooling, concomitant heating and UV light blinding. Protected pipes are no longer exposed to extreme ambient temperatures that can result in such effects as a reduction in length change. In establishing the bracket distances it should be noted that the dead weight of the insulation will cause increased deflection. Protective measures can also be used to limit maximum pipe wall temperatures and therefore broaden the range of internal pressure loads for which the pipes are suitable.

! Energy-saving is environmental protection. The legal regulation of the specific countries have to be taken into consideration.

6.4.2 Insulation warm water lines

In spite of the high level of insulation of PP-R pipe systems, warm and hot water lines must be insulated. Insulation protects against physical contact with the hot surface, it reduces noise discomfort and reduces the heat loss of the water. In hot water circulation systems the temperature loss needs to be reduced to assure conditions which are unfavourable for legionella. The return flow temperature needs to maintain a minimum temperature of 60°C. To compensate the heat loss the boiler temperature is raised. A raised boiler temperature requires additional energy and is often an additional attack on the applied (plastic) pipe work. At water temperatures above 70°C reduction of the life time expectancy of PP needs to be considered. Depending the operating conditions the life time can be reduced significantly. With proper insulation the boiler temperature setting can be limited and the PP-R's material properties exploited fully.

Mounting situation	Insulating layer thickness at λ = 0,040 W (mK)
Pipework laid exposed in unheated room (e.g. basement)	4 mm
Pipework laid exposed in heated room	9 mm
Pipework laid in channel with additional heated pipe lines	4 mm
Pipework laid in channel next to heated pipe lines	13 mm
Pipework laid in masonry slit rising main	
Pipework laid in wall recess next to heated pipe lines	13 mm
Pipework laid on cement floor 4 mm	4 mm

Table 6.14 Guideline values for minimum thicknesses of insulation for insulating drinking water systems (cold)

Engineering

6.4.3 Insulation cold water lines

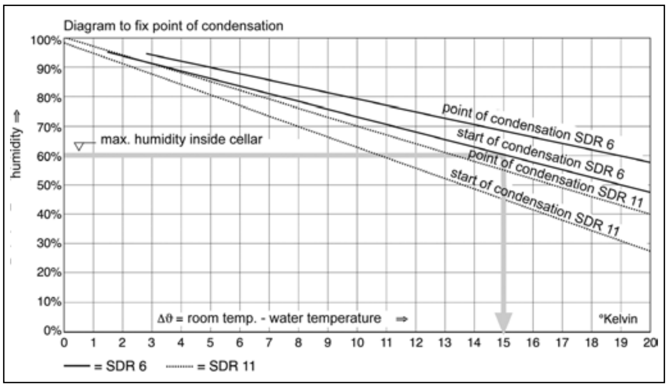
Condensation is the precipitation of water vapour on a surface that is cooler than its environment. Condensation arises when the humidity in the air is higher than the maximum quantity water vapour that the air can contain at that temperature. If water valour condenses to water depends on the insulation and humidity.

Illustration 6.5 Condensation on cold water lines

6.4.4 Condensation point

- The normal case is a cellar submerged to two thirds of the wall height in the earth, that has no continuously opened doors and windows.
- Such a 'normal case' stays even in summer after strong rain below a room temperature of 25°C and 60% moisture.
- With 25°C and 60% moisture and 10°C water temperature the pipe begins to sweat.
- For southern regions is important that these temperatures are sometimes exceeded and the water temperature is often higher than 10°C.
- With all rooms not according to a standard cellar, it has to be determined from case to case, whether the maximum room temperature may be 15°C higher than the water temperature.
- For pipes SDR 11 the permissible temperature difference is at 11°C.

Result: Cold water systems consisting of pipe SDR 6 normally do not show condensation water.



Graphic 6.1 Condensation on cold water lines

6.5 Construction of concealed pipe systems

Plastic pipes encased in concrete after installation represent a special case. Their handling in connection with the technical application guidelines for pressure pipes in this manual is therefore limited to important or critical details. The instructions may be applied to other similar circumstances.

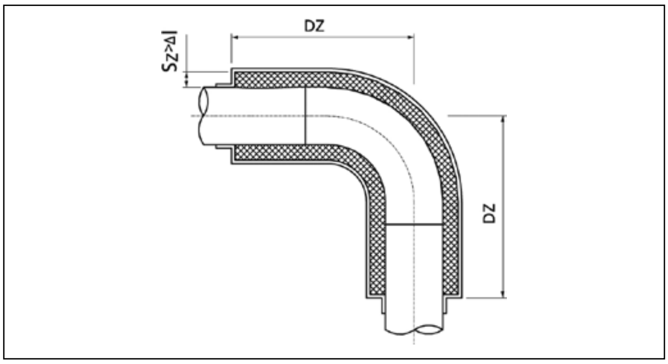


Illustration 6.6 Expansion zones in pipe bends

6.5.1 Behaviour of pipe systems under temperature loads

Once a pipe system is encased in concrete, no movement can any longer occur. A pipe system without linear compensation is created, meaning that increased heat stresses have to be taken into account. Since no friction-lock connection is formed between the straight pipe and surrounding concrete, the fittings constitute fixed points and are correspondingly subjected to stress. In installing pipe systems, measures need to be taken to limit the load on the fittings. Examples of such practices are described below.

6.5.2 Load on a pipe bend

If extreme temperature differences can arise, pipe bends have to be protected against overstress. For this purpose, an expansion zone using deformable material is incorporated. The chosen thickness of the expansion cushions must be at least as large as Δl.

6.5.3 Load on a tee

Due to varying temperatures, fittings are subject to surface pressure. This adverse load concentrates on tee sections, as additional shear forces are created at outgoing connections. If a load limiting element is placed directly beside the fitting, an electrofusion coupler is the most suitable connection piece. The longitudinal force (force on a fixed point) remains equally large, but the deformation due to the significantly smaller Δl is clearly less. Another option for protection against overload is the incorporation of an expansion zone (expansion cushion).

6.5.4 Fixing pipe systems

In comparison with brackets, the installation of a concrete-encased pipe system does not require any special measures. The fixing during installation only serves as float protection and is to be regarded as provisional attachment prior to encasement with concrete.

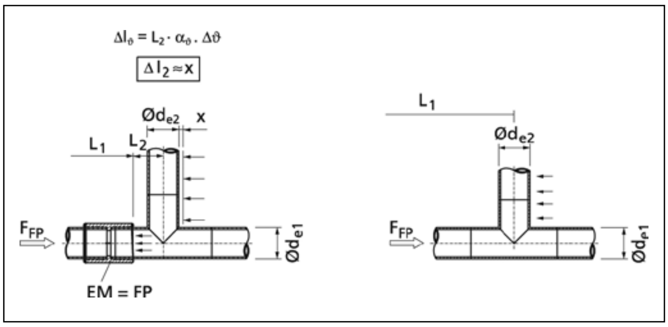


Illustration 6.7 Shear and fixed point forces on tees and 45° branches

6.6 Putting in use

6.6.1 Pressure test

After a drinking water system has been installed but before it is commissioned, it must be tested for tightness. This should be done while the system is still visible. Polypropylene expands under the influence of heat and pressure. For this reason it is necessary that the test medium (as a rule water) and the pipe work material are at the same temperature. Attention should therefore be paid to the fact that the test medium has a temperature that is as constant as possible. The pressure test is divided into three parts, namely the initial, the main and the final test.

Initial test

The highest possible operating pressure is increased by a factor of 1,5. This test pressure must be restored twice at intervals of in each case 10 minutes within a period of 30 minutes. After the pressure has been restored again a second time, the test pressure may not fall by more than 0,6 bar within the next 30 minutes. In addition no leakage may occur.

Main test

The main test commences immediately after the completion of the initial test and lasts two hours. During this period the pressure may not fall by more than 0,2 bar relative to the pressure at the end of the initial test.

Final test

Test pressures of 10 bar and 1 bar are applied alternately at intervals of at least 5 minutes. After each application of pressure, the pipe network is to be depressurized. Leakage may not occur at any point in the network being tested.

Measuring devices

The pressure measuring device used, must permit accurate readings to the nearest 0,1 bar. Where possible, the pressure is to be determined at the lowest point of the network.

Test memorandum

The test as carried out is to be documented in a memorandum which must be signed by the client and contractor with statement of the place and date of signing. See illustration 6.8 on the next page for a test memorandum form.

6.6.2 Flushing out of pipe work systems

The purpose of flushing out pipe work systems is ensuring the quality of drinking water, avoidance of corrosion damage, avoidance of damage to fittings and equipment and cleaning of the inner surface of the pipes. Regardless of the material of the pipes, all pipe work systems carrying drinking water are to be flushed out.

Suitable processes are:

1. Flushing out with water
2. Flushing out with a mixture of air and water

Flushing out process 1, namely flushing out with water, is sufficient in the case of drinking water systems which are composed exclusively of Wefatherm pipes and fittings. The appropriate flushing out process should be selected on the basis of the experience of the installing firm and of the client.

6.6.3 Balancing

After the flushing procedure has been performed, the flow in the pipe system segments are balanced by setting and adjusting valves.

Engineering

Name of project:

Client represented by:

Contractor/responsible expert

represented by:

☐ Filling water was filtered and the pipeline system was fully vented.

Permissible operating pressure totals P_{perm} = 10 bar/ _____ bar (if greater)

Water temperature ϑw = ______________ °C

Ambient temperature ϑu = ______________ °C

$\Delta\vartheta = \vartheta u - \vartheta w$ = ______________ K

Minimum duration for testing is 30min.
Minimum pressure for testing is 11bar.
Temperature differences of more than 10K might cause pressure changes.
A waiting time of minimum 30min has to be respected.

Description of the installation:

The WEFATHERM installation system was integrated in the above-mentioned construction project.

☐ Wefatherm ☐ Wefaklim

Pressure test/Date:

Pressure test/Start: Pressure (min. 11 bar): **bar**

Pressure test/End:

Pressure drop: ☐ Yes ☐ No

☐ **The pipelines are tight.**

Place/Date: **Place/Date:**

(Client representative) **(Contractor representative)**

Illustration 6.8 Test memorandum form