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PREIS® SML - TECHNICAL SPECIFICATIONS

PREIS®

DRAINAGE SYSTEMS

Technical Specifications

for Gravity Flow Pipes in Buildings

Technical manual for gravity flow pipes in buildings

This documentation is intended to give an overview about the most important regulations for planning and design as of EN 12056:2000 including installation instructions. This documentation shall provide information and does not claim to be complete. For detailed information about assembling and design, please, refer to the corresponding national standards and regulations.

Table of Contents

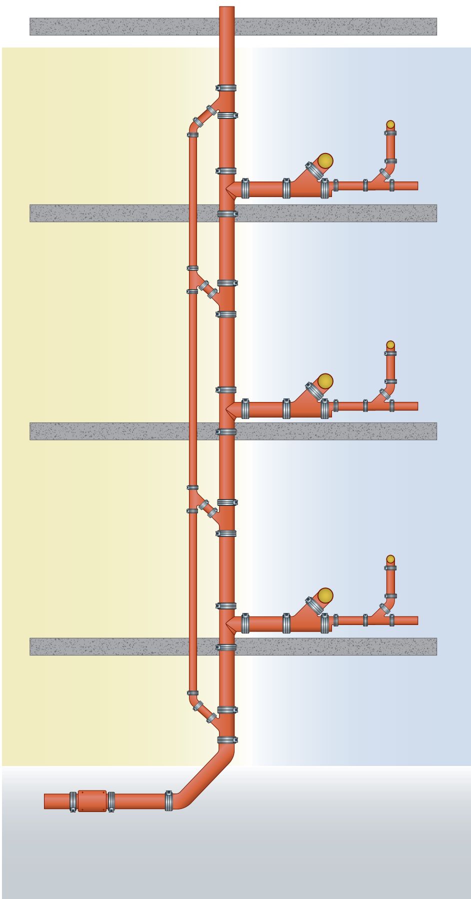
1 General requirements

For proper functioning of drainage systems the following general requirements have to be fulfilled:

1. Wastewater has to be discharged providing quiet operation.
2. Self-cleansing properties of the drainage system have to be ensured.
3. Evacuation of the maximum wastewater volume to be expected has to be guaranteed.
4. Pressure fluctuations have to be inhibited as they could cause seal water to be drawn out from the traps or cause backflow into the tubes of sanitary equipment to be drained.
5. The required venting capacity of the drainage system has to be ensured by taking proper venting measures and by partial filling of the tubes.
6. Resistance of the tubes and fittings against effects of the sewage.
7. Drainage systems have to provide sufficient measures to be water tight and gas-tight under working pressure. It has to be guaranteed that pipe systems in buildings do not allow foul air or bad odours to spread in the building.

As a basic condition, conventional drainage using gravity flow lines requires a sufficient filling level and a mid-range flow rate in order to ensure suspended particles and deposited matter to be properly transported and flushed out.
The proper hydraulic functioning is given if the flow in partially filled tubes is unchanging and steady.

Picture 01 **Types of pipes**



Basically, it can be differentiated between:

single pipe connections
collective connection pipes

downpipes / venting pipes

base pipes
collective pipes

1.1 Drainage systems classified in accordance with EN 12056

General remarks

There is a widespread range of drainage systems; this is due to the different kinds of applications and the varying sanitary facilities in the respective countries and due to most various technical layouts.

Types of systems

As a general rule, drainage systems may be divided into **4 different groups**, although there are slight variations within each type (therefore, it is necessary to refer to the requirements given by national and regional regulations and to the technical specifications). **As in practice system I and system II types are the most common ones, the following details refer only to these types.**

System I - single downpipe system with partially filled connection pipes
Sanitary facilities to be drained are connected to partially filled connection pipes.
The partially filled connection pipes are designed for a filling level of 0.5 (50%) and they are connected to a single wastewater downpipe.

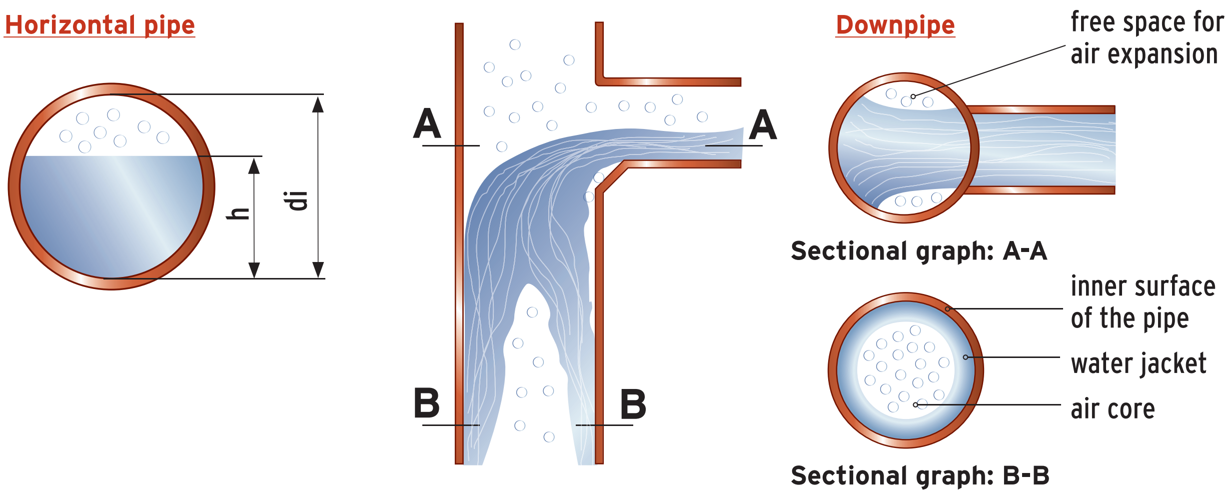
System II - single downpipe with connection pipes of smaller diameters.
Sanitary facilities are connected to connection pipes with a smaller diameter.
The connection pipes with a smaller diameter dispose of a filling level of 0.7 (70%) and they are connected to a single wastewater downpipe.

In general in both systems has to be observed that the cross section of the piping system in flow direction may never be reduced.

1.2 Filling level

Filling level in horizontal wastewater pipes refers to the ratio of depth of water to the inner diameter. In the case of downpipes the filling level refers to the ratio between the cross section of the pipe filled with water and the total cross section.

Picture 02 **Formation of water jackets and air cores in downpipes behind a branch**



2 Connection pipes

2.1 Calculation of the wastewater drain (Q_{WW})

Q_{WW} refers to the expected drain of wastewater in these parts of the whole drainage system, where only sanitary facilities are connected to the system.

$$Q_{WW} = K\sqrt{\sum DU}$$

Q_{WW} = wastewater drain (l per sec.)
K = runoff coefficient
$\sum DU$ = sum of the design units

2.2 Runoff coefficient (K)

Table 01 shows typical values for the runoff coefficient in association with the frequency of use of the sanitary facilities.

Table 01 TYPICAL VALUES FOR RUNOFF COEFFICIENT (K)

Type of building	K
Irregular use. e.g. in residential buildings. boarding houses. offices	0.5
Regular use, e.g. in hospitals, schools, restaurants, hotels	0.7
Frequent use, e.g. in public restrooms and / or showers	1.0
Special use, e.g. laboratories	1.2

2.3 Design units (DU)

Table 02 shows the values for various sanitary facilities to be drained. The values shown are only valid for calculation of the system and do not relate to design units of sanitary facilities as included in product standards.

Table 02 DESIGN UNITS (DU)

Facility to drain	System I	System II	Facility to drain	System I	System II
	DU (l/s)	DU (l/s)		DU (l/s)	DU (l/s)
Hand basin. bidet	0.5	0.3	Washing machine. capacity ≥ 6 kg	0.8	0.6
Shower without plug	0.6	0.4	Washing machine, capacity ≥ 12 kg	1.5	1.2
Shower with plug	0.8	0.5	Toilet with cistern, volume 4.0 l	**	1.8
Individual urinal with cistern	0.8	0.5	Toilet with cistern, volume 6.0 l	2.0	1.8
Urinal pressurized flush	0.5	0.3	Toilet with cistern, volume 7.5 l	2.0	1.8
Floor stand urinal	0.2*	0.2*	Toilet with cistern, volume 9.0 l	2.5	2.0
Bathtub	0.8	0.6	Floor drain DN 50	0.8	0.9
Kitchen sink	0.8	0.6	Floor drain DN 70	1.5	0.9
Dishwasher (household)	0.8	0.6	Floor drain DN 100	2.0	1.2

* per person ** not approved

2.4 Calculation table for wastewater evacuation

The values have been calculated with the following equation: $Q_{WW} = K\sqrt{\sum DU}$

Table 03	WASTEWATER EVACUATION (Q_{WW})								
Total of the design units	K 0.5	K 0.7	K 1.0	K 1.2	Total of the design units	K 0,5	K 0,7	K 1,0	K 1,2
$\sum$DU	Q_{WW} (l/s)	Q_{WW} (l/s)	Q_{WW} (l/s)	Q_{WW} (l/s)	$\sum$DU	Q_{WW} (l/s)	Q_{WW} (l/s)	Q_{WW} (l/s)	Q_{WW} (l/s)
10	1.6	2.2	3.2	3.8	130	5.7	8.0	11.4	13.7
12	1.7	2.4	3.5	4.3	140	5.9	8.3	11.8	14.2
14	1.9	2.6	3.7	4.5	150	6.1	8.6	12.2	14.7
16	2.0	2.8	4.0	4.8	160	6.3	8.9	12.6	15.2
18	2.1	3.0	4.2	5.1	170	6.5	9.1	13.0	15.6
20	2.2	3.1	4.5	5.4	180	6.7	9.4	13.4	16.1
25	2.5	3.5	5.0	6.0	190	6.9	9.6	13.8	16.5
30	2.7	3.8	5.5	6.6	200	7.4	9.9	14.1	17.0
35	3.0	4.1	5.9	7.1	220	7.6	10.4	14.8	17.8
40	3.2	4.4	6.3	7.6	240	7.7	10.8	15.5	18.6
45	3.4	4.7	6.7	8.0	260	8.1	11.3	16.1	19.3
50	3.5	4.9	7.1	8.5	280	8.4	11.7	16.7	20.1
60	3.9	5.4	7.7	9.3	300	8.7	12.1	17.3	20.8
70	4.2	5.9	8.4	10.0	320	8.9	12.5	17.9	21.5
80	4.5	6.6	8.9	10.7	340	9.2	12.9	18.4	22.1
90	4.7	6.6	9.5	11.4	360	9.5	13.3	19.0	22.8
100	5.0	7.0	10.0	12.0	380	9.7	13.6	19.5	23.4
110	5.2	7.3	10.5	12.6	400	10.0	14.0	20.0	24.0
120	5.5	7.7	11.0	13.1	420	10.2	14.3	20.5	24.6

2.5 Connection pipes

2.5.1 Vented Connection Pipes

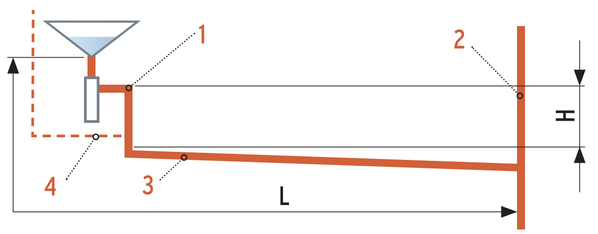
Nominal width and restrictions of their application can be seen in tables 04 and 05. Restrictions of application as referred to in table 05 are simplifications; for further information, please, refer to national and regional regulations.

Table 04 ADMISSIBLE WASTEWATER DRAIN AND NOMINAL WIDTH		
Q_{max} (l/s)	System I	System II
	DN	DN
	Connection / Venting	Connection / Venting
0.60	*	30/30
0.75	50/40	40/30
1.50	60/40	50/30
2.25	70/50	60/30
3.00	80/50**	70/40
3.40	90/60***	80/40**
3.75	100/60	90/50

* not permitted ** no toilets *** maximum 2 toilets and vertical turn of 90° not allowed

Table 05 RESTRICTIONS OF APPLICATION		
Restrictions of Application	System I	System II
max. pipe length (L)	10.0m	no limit
max. number of bends 90°	no limit	no limit
max. flow distance (H) with a bend of 45° or more	3.0m	3.0m
minimum gradient	0.5%	0.5%

* bend connection not included



1 connection bend 2 downpipe 3 connection pipe 4 venting pipe

Picture 03 **Application restrictions of vented connection pipes in system I and II types**

2.5.2 Non-vented connection pipes

Tables 06 and 07 show nominal width and application restrictions of non-vented connection pipes. Wherever application restrictions cannot be kept, non-vented connection pipes have to be vented, unless otherwise specified in national or regional regulations, thus, allowing bigger nominal widths or installation of venting valves. The restrictions of application as referred to in table 07 are simplifications; for further information, please, refer to national and regional regulations.

Table 06 ADMISSIBLE WASTEWATER DRAIN AND NOMINAL WIDTH

Q_{max} (l/s)	System I	System II
	DN	DN
	Connection	Connection
0.40	*	30
0.50	40	40
0.80	50	*
1.00	60	50
1.50	70	60
2.00	80**	70**
2.25	90***	80****
2.50	100	90

* not permitted ** no toilets *** maximum 2 toilets and vertical turning of 90° not allowed **** maximum 1 toilet

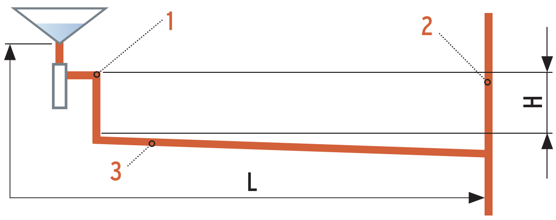
Table 07 RESTRICTIONS OF APPLICATION

Restrictions of Application	System I	System II
max. pipe length (L)	4.0m	10.0m
max. number of bends 90°	3*	1*
max. flow distance (H) with a bend of 45° or more	1.0m	**6.0m DN ›70 **3.0m DN =70
minimum gradient	1%	1.5%

* bend connection not included
** If DN is smaller than 100 mm and a toilet is connected to a non-vented connection pipe, connection to a vented system of another facility to be drained within a distance of 1 m is not allowed.

Picture 04 **Application restrictions of vented connection pipes, systems I and II**

1 connection bend
2 downpipe
3 connection pipe

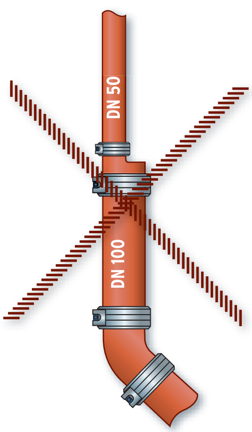


3 Downpipes

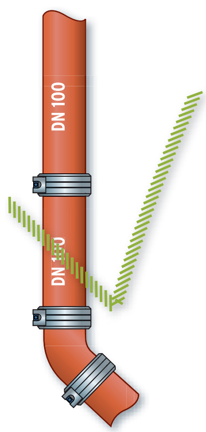
3.1 General remarks

A downpipe is to be understood as a vertical pipe, leading through one or more storeys, with venting carried out via the roof.

Tip: In order to guarantee proper ventilation of the downpipe, the pipe has to be dimensioned according to the amount of water gathering at the lowest point. Hence, the whole downpipe has to be dimensioned according to this value and it must not be reduced towards the top.



Picture 05



Picture 06

3.1.1 Reaction forces

Reaction forces at turns

At the transition from a downpipe to a horizontal pipe notable reaction forces might occur due to the deviation of flow. Hence, special attention has to be paid to rain water downpipes and downpipes with a high water column. When selecting couplings, it has to be observed that the expected pressure load does not exceed the values stipulated in the manufacturer's specifications.

The following example illustrates the reaction forces set free in a turn of 90°.

$$F_x = F_y = p * A_x * v_x^2 + p_x * A_x$$

whereas

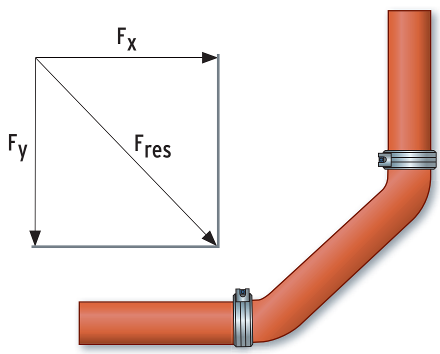
p = refers to the density of water [kg/m³]

A_x = refers to the area of cross section of stream [m²]

v_x = refers to the flow velocity of the stream [m/s]

p_x = refers to the static interior pressure of the stream surface [pascal]

Picture 07 Forces active in a turn of 90° (downpipe into horizontal pipe) under high pressure (gravity flow drainage)



The resulting force, therefore, is as follows:

$$F_{res} = \sqrt{F_x^2 + F_y^2}$$

whereas

F_{res} = refers to the resulting force from F_x plus F_y

(this is the force that acts in pipe connections)

Examples of calculations for DN 100 and DN 150 with p_x = 0,5 bar und v_x = 7,0 m/s.

Example 1: F_{res} DN 100 = 1,098.80 N = 112 kg

Example 2: F_{res} DN 150 = 2,472.29 N = 252 kg

Calculations for example 2:

$F_x = F_y =$ 998.50 * 0,02 * 49.00 + 50,000.00 * 0,02 = 1,748.18

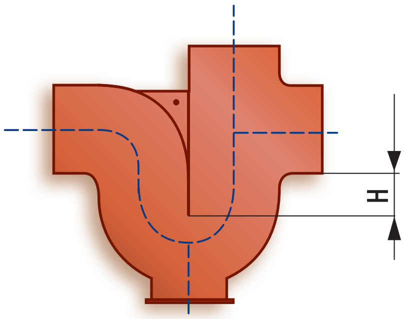
$F_{res} = \sqrt{1{,}748.18^2 + 1{,}748.18^2}$ = 2,472.29 N (corresponds approx. to 252 kg)

Findings: Forces acting at constant internal pressure and identical velocity increase disproportionate to the diameter of the pipe. For measures against slipping of the couplings (axial restraint) see chapter "Couplings", page 23.

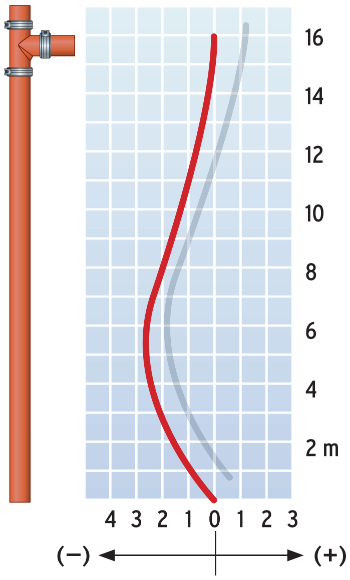
3.1.2 Pressure flow in downpipes

Downpipes have to take over ventilation tasks, as horizontal wastewater pipes do. Downpipes in operation are only partially filled, but we have to assume that the areas filled with air or water cannot be defined as clearly as this can be done in horizontal lines (see picture 02). In order to ensure an unhindered air circulation, at least one main ventilation has to be planned in downpipes. A steady flow is hard to reach due to the interactions of wastewater and air; as a result, pressure fluctuations in downpipes may occur. These fluctuations have a critical impact on odour traps. It has to be observed that the height of the odour trap / seal water (H) must remain over 50 mm, even when seal water is drawn out of the traps due to pressure fluctuations.

Picture 08 Odour trap



Picture 09 Pressure fluctuation in a wastewater downpipe



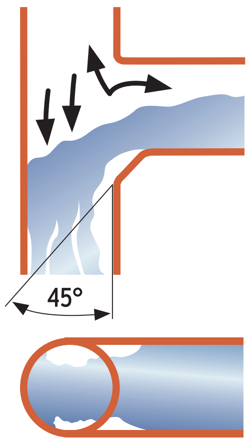
The connection selected has a substantial influence on pressure fluctuations in downpipes and therefore on the hydraulic load. **ATTENTION:** Beside the volume of wastewater, the cross section of the pipe and the axial restraint, above all the branch layout in the downpipe is of critical importance. At the connection pipe air has to circulate above the water to be drained (see picture 10). In the downpipe the inflowing water should not cover the whole cross section of the pipe. Otherwise, there would be a hydraulic closure accompanied by a high pressure drop (see picture 11).

It is recommended to use branches with 88.5° when connecting them to downpipes, as branches with 45° could cause a hydraulic closure, which, as a consequence, could lead to a self-suction of the connected odour trap.

Optimum discharge is reached with a branch of 88.5° and an access angle of 45°. These types of branches, best for optimum hydraulic conditions according to EN 12056, allow 30% more load than common branches.

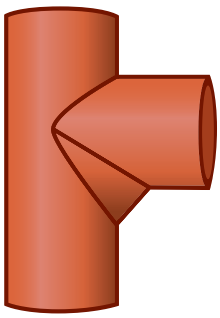
As a standard, all PREIS® SML branches are designed with the optimum access angle of 45°.

Picture 10



Picture 11

It was found that for proper operation of a downpipe considerable air volume streams are necessary. To give an example, in a downpipe size DN 100 carrying a wastewater volume of 100 l per minute, a total of 2,340 l per minute passes through.
Due to the great number of different variables the possible load of downpipes can only be calculated in a very rough way. To optimize the functions, we recommend the following layout:



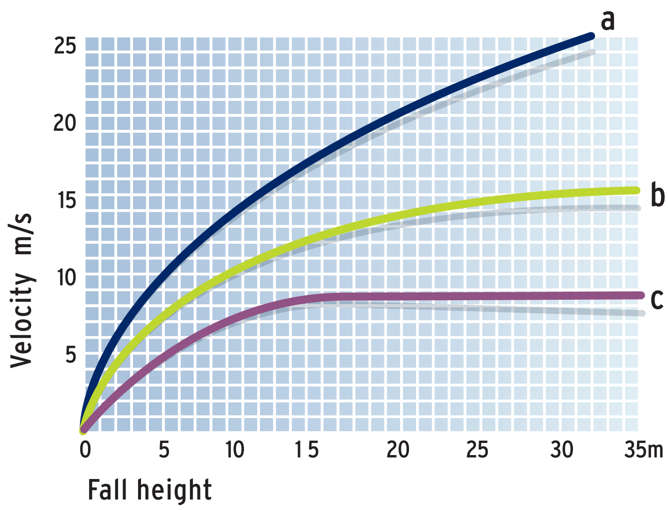
- Connection of branches with an access angle of 45°
- As a best case scenario nominal width of the connection pipe should be smaller than the nominal width of the downpipe
- To keep the loss of flow as low as possible, the venting pipes should be kept as short and straight as possible

3.1.3 Flow velocity

Flow velocity of wastewater in downpipes

Evacuation in downpipes occurs as shown in picture 02; after a short free fall the water forms a water jacket along the wall of the pipe and in the middle of the pipe an air core is formed. The flow is slowed down by the resistance of the air column in the pipe and the friction at the pipe walls. In vacuum, the flow velocity of the wastewater would be speeded up with the fall height accelerated by the acceleration of the fall V=9.81 m/s2. The following equation applies: $V=\sqrt{2gh}$ (= m per sec.). Measurements have shown that flow acceleration and decelerating by the air column and pipe friction neutralize at a distance of about 15 metres, so that a maximum flow velocity of 10 m per second is reached to remain stable at this value.
Hence, an additional slow down of the flow in downpipes of multi-storey-buildings in the form of additional pipe deflections is not necessary.

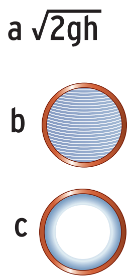
Picture 12 Theoretical and actual flow velocity in downpipes



a) free fall in vacuum

b) fully filled pipe

c) with water jacket and air core



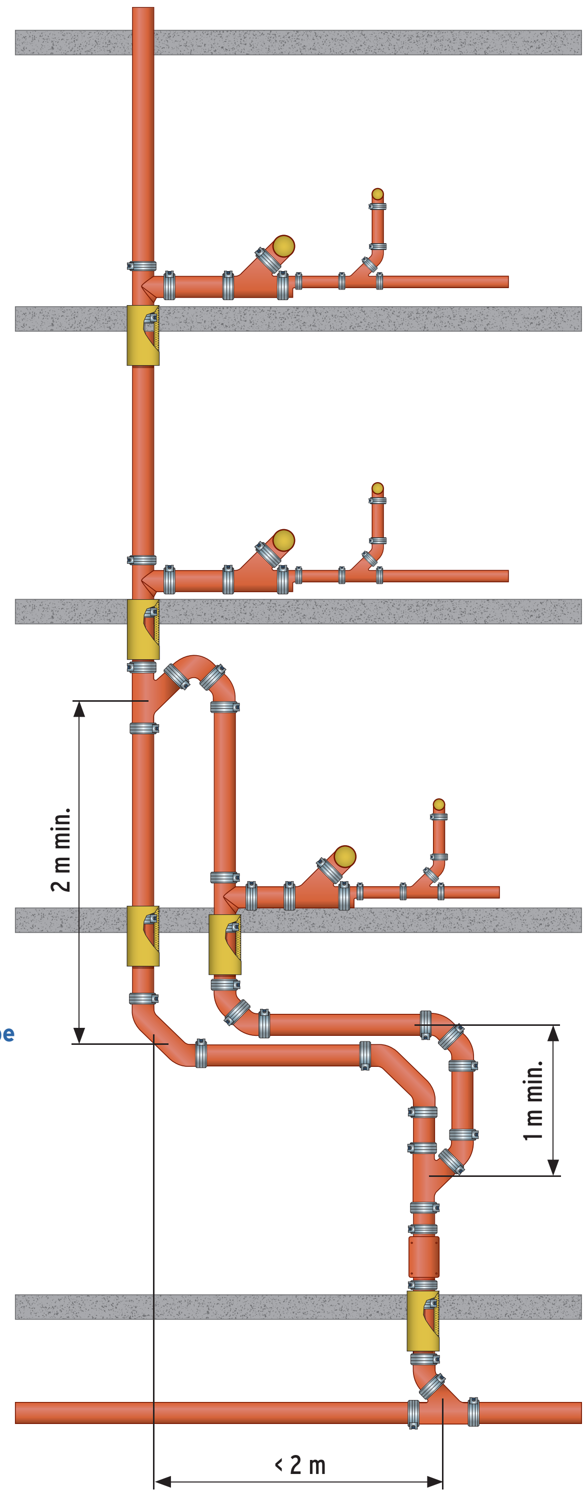
3.1.4 Deflection of downpipes in multi-storey-buildings

The following two influencing factors have a decisive impact on the pressure load in downpipes:

- Inflow conditions at the connection pipes
- Deflection of wastewater flow

Every downpipe disposes of at least one deflection in the area of transition into the collective pipe or the base pipes. As a general rule, deflections of downpipes should be avoided, unless structural conditions do not allow a fully vertical pipe. Dynamic pressure develops when the water jacket and the air core of the wastewater to drain arrive at a deflection.
Flow velocity will slow down, the volume of the water in the pipe will increase and the air volume is compressed, provided that the air cannot escape.
This leads to a pressure increase in this section of the tube; hence, it is not possible to directly connect a facility to drain in this section of overpressure.

In order to be able to still connect facilities to be drained in this area, a bypass pipe has to be built. In the area where overpressure develops, an additional pipe is installed which runs parallel to the deflection.



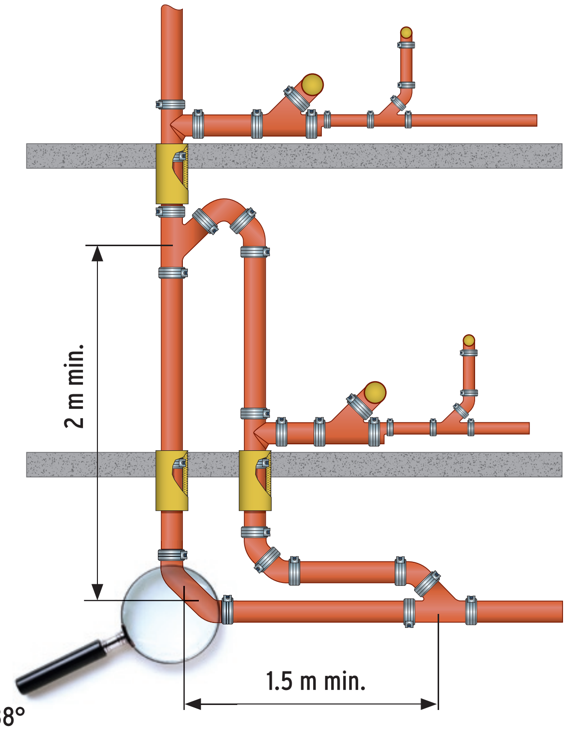
Picture 13 Deflection of downpipes < 2m with bypass pipe

In case of a deflection or the transition of a downpipe into a horizontal pipe a bypass pipe has to be installed if downpipes are longer than 22 m. If the deflection of the pipe is less than 2 m, picture 13 applies, if it is more than 2 m or there is a transition into a horizontal pipe, refer to picture 14 for layout.

Picture 14 **Deflection of the pipe ≥ 2 m with bypass pipe or bypass for the transition of a downpipe into the collection or base pipe**

To reduce the noise level caused by the impact of the flow of wastewater when arriving at the deflection, the pipe layout for downpipes longer than 22 m has to be carried out with two bends of 45° and a separator of 250 mm, or, as an alternative, the PREIS® SML branch 88° may be used.

To improve pressure compensation, we recommend to install venting pipes and bypass pipes with the same nominal width.

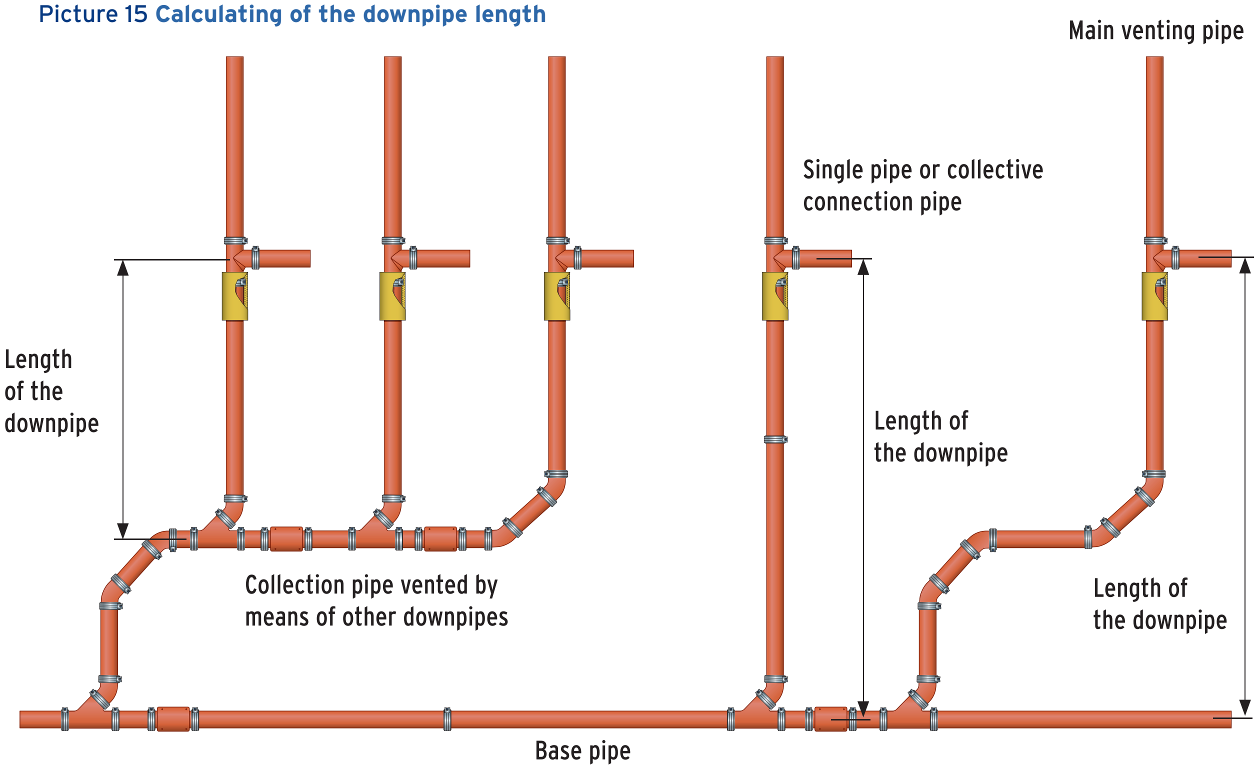


3.2 Downpipes wastewater

3.2.1 Determination of the downpipe length

The length of the downpipe has to be understood as the distance between the highest positioned connection branch and the deflection of the downpipe leading into a horizontal base pipe or collection pipe. Hence, when determining the length of the downpipe, only the vertical gravity flow parts of the pipe are to be considered. A possible deflection is not considered to be a reduction of the length of a downpipe.

Picture 15 **Calculating of the downpipe length**



3.2.2 Choosing a venting system

Venting pipes are designed to control and limit pressure fluctuations within the drainage system.
As a general rule the following venting systems are applied:

- main ventilation
- direct secondary ventilation
- indirect secondary ventilation

3.2.2.1 Wastewater gravity flow pipe with main ventilation

A main ventilation pipe is a pipe where one or more downpipes are integrated having a ventilation opening at the roof. Wastewater downpipes with main ventilation have to be designed according to table 08.

Table 08 MAX. WASTEWATER EVACUATION ADMISSIBLE (Q_{max}) AND NOMINAL WIDTH (DN)

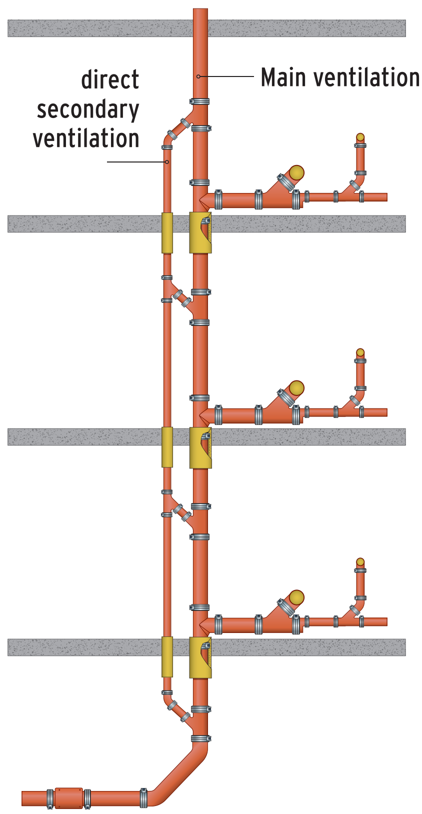
Wastewater gravity flow pipe with main ventilation	System I. II Qmax (l/s)	
DN	Branches	Branches with access angle 45°
70	1.5	2.0
80*	2.0	2.6
100**	4.0	5.2
125	5.8	7.6
150	9.5	12.4
200	16.0	21.0

*minimum nominal width for connections of toilets to system II **minimum nominal width for connections of toilets to system I

3.2.2.2 Wastewater gravity flow pipe with direct secondary ventilation

In a secondary ventilation system the strain of ventilation of the downpipe is reduced by a parallel ventilation pipe which is connected to the downpipe at every storey. This system leads to a notable increase of wastewater evacuation compared to the system with main ventilation.

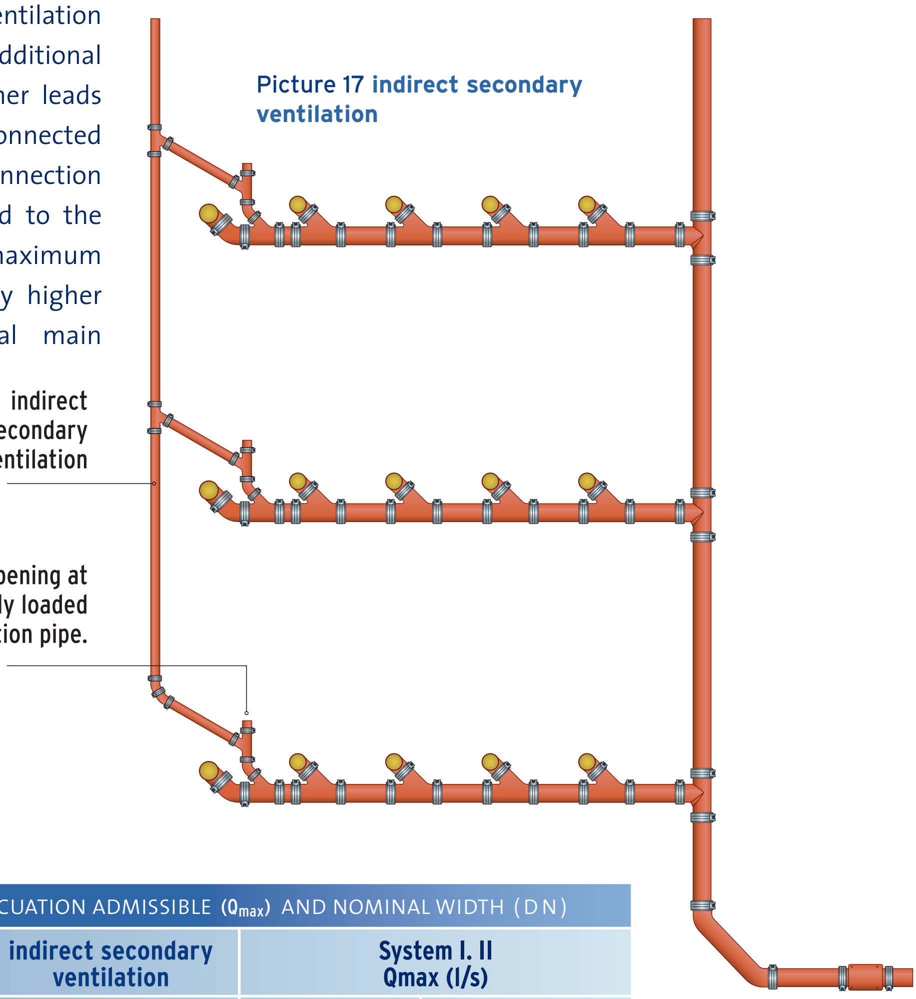
This ventilation system is especially suitable for gravity flow lines with short individual evacuation pipes or collection pipes.



Picture 16 **direct secondary ventilation**

3.2.2.3 Wastewater gravity flow pipes with indirect secondary ventilation

Indirect secondary ventilation is carried out by an additional ventilation pipe which either leads directly to the roof, being connected to the upper end of a connection pipe or which is connected to the main ventilation pipe. The maximum evacuation, thus, is notably higher than in the conventional main ventilation system.



Picture 17 **indirect secondary ventilation**

Table 09 MAX. WASTEWATER EVACUATION ADMISSIBLE (Q_{max}) AND NOMINAL WIDTH (DN)

Wastewater gravity flow pipe with main ventilation	indirect secondary ventilation	System I. II Qmax (l/s)	
DN	DN	Branches	Branches with access angle 45°
70	50	2.0	2.6
80*	50	2.6	3.4
100**	50	5.6	7.3
125	70	8.4	10.9
150	80	14.1	18.3
200	100	21.0	27.3

*minimum nominal width for connections of toilets to system II
**minimum nominal width for connections of toilets to system I

3.3 Gravity drainage pipes for rainwater

Item 6.1 of EN 12056-3 contains the following: “The maximum discharge of rainwater in vertical gravity flow pipes with circular cross section should not surpass the value indicated in table 10. The value for the filling level of 0.33 has to be applied, unless otherwise stated in national, regional or technical regulations, setting a value between 0.20 and 0.33.
Moreover, internal rainwater pipes shall be able to withstand the head of water likely to occur in case of clogging.

Tip: Condensate may develop due to high temperature differences between the liquids to be discharged and the material of the pipes. At all sections where condensate in rainwater drainage pipes might form, internal pipes of buildings are to be insulated in an appropriate way.

Due to the predefined filling level of 0.20 to 0.33, adequate ventilation is given, so that pressure compensation is always possible and, thus, it is not necessary to install additional venting pipes.

Table 10 RAINWATER EVACUATION WITH GRAVITY DRAINAGE PIPES MADE BY PREIS® SML

DN	Minimum external diameter in mm	Wall thickness in mm	Minimum inner diameter in mm	Filling level	
				0.20	0.33
50	57.0	3.50	50.0	0,7 l/s	1,7 l/s
70	77.0	3.50	70.0	1,8 l/s	4,2 l/s
80	82.0	3.50	75.0	2,2 l/s	5,1 l/s
100	109.0	3.50	102.0	4,9 l/s	11,5 l/s
125	133.0	4.00	125.0	8,4 l/s	19,8 l/s
150	158.0	4.00	150.0	13,7 l/s	32,1 l/s
200	207.5	5.00	197.5	28,5 l/s	66,9 l/s
250	271.5	5.50	260.5	59,7 l/s	140,0 l/s
300	323.5	6.00	311.5	96,2 l/s	225,5 l/s

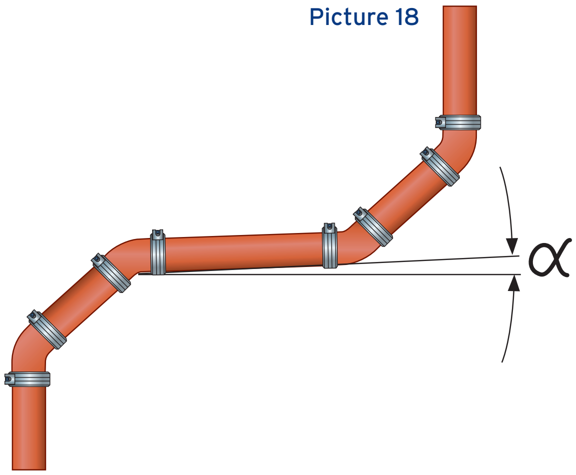
* as a calculation basis the minimum inner diameter according to EN 877 has been chosen. Maximum sized pipes have an accordingly higher drainage performance, which can be calculated applying the WYLY EATON equation.

If it is necessary to integrate a deflection, 2 different versions may be designed, according to the measures of the angle:

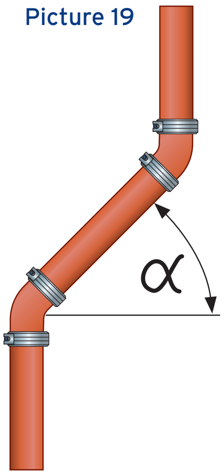
- If the angle is < 10° to the horizontal, the pipe has to be dimensioned like a base pipe or a collective pipe (see picture 18).
- If the angle is > 10° to the horizontal, the pipe has to be dimensioned like a gravity drainage rainwater pipe (see picture 19).

Influence of a deflection of the gravity drainage rainwater pipe

Picture 18

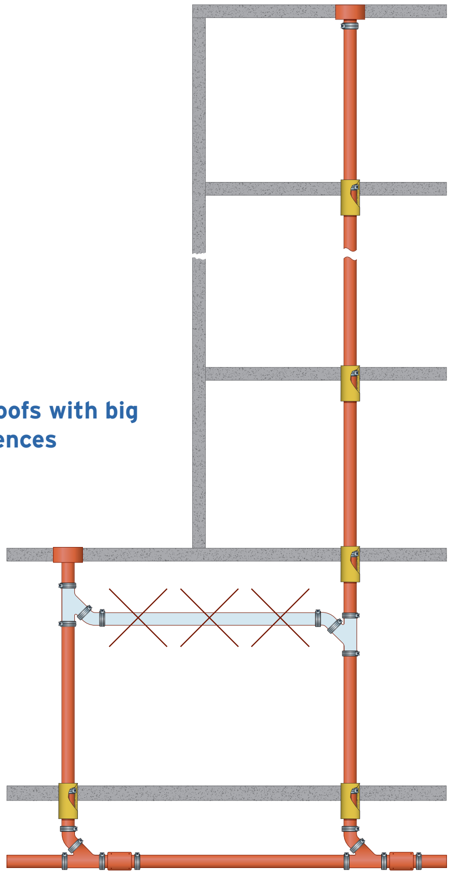


Picture 19



3.3.1 Roof surfaces with big differences in height

It is recommended, to drain roofs with big differences in height by means of separate downpipes, as a collective pipe may lead to flooding of the base surface of the roof in case of heavy rainfalls or clogging.



Picture 20 **Roofs with big height differences**

4 Base pipes and collective pipes

In general, we can decide between two kinds of pipes:

Base pipe

→ Drainage pipes within the building, embedded in foundations or laid below foundations (e.g. embedded in concrete), or sanitary facilities directly connected to downpipes or connected at the basement.

Collective pipe

→ Horizontal pipe, in general laid below the basement ceiling, to receive wastewater from downpipes and connection pipes.

For inspection or cleaning of the pipes and easier modernization of the system, the preferred option should be to install collective pipes.
In both types of pipes special attention should be paid to providing them with sufficient cleaning facilities.
Base pipes and collective pipes are calculated applying the Prandtl-Colebrook equation. The layout may be calculated according to the following tables:

System I

Table 11 MAXIMUM WASTEWATER EVACUATION ADMISSIBLE, FILLING LEVEL 50% (h/d = 0,5)

Gradient	DN 100		DN 125		DN 150		DN 200		DN 250		DN 300	
i	Q_{max}	V	Q_{max}	V	Q_{max}	V	Q_{max}	V	Q_{max}	V	Q_{max}	V
cm/m	l/s	m/s	l/s	m/s	l/s	m/s	l/s	m/s	l/s	m/s	l/s	m/s
0.50	1.8	0.5	2.8	0.5	5.4	0.6	10.0	0.8	18.9	0.9	34.1	1.0
1.00	2.5	0.7	4.1	0.8	7.7	0.9	14.2	1.1	26.9	1.2	48.3	1.4
1.50	3.1	0.8	5.0	1.0	9.4	1.1	17.4	1.3	32.9	1.5	59.2	1.8
2.00	3.5	1.0	5.7	1.1	10.9	1.3	20.1	1.5	38.1	1.8	68.4	2.0
2.50	4.0	1.1	6.4	1.2	12.2	1.5	22.5	1.7	42.6	2.0	76.6	2.3
3.00	4.4	1.2	7.1	1.4	13.3	1.6	24.7	1.9	46.7	2.2	83.9	2.5
3.50	4.7	1.3	7.6	1.5	14.4	1.7	26.6	2.0	50.4	2.3	90.7	2.7
4.00	5.0	1.4	8.2	1.6	15.4	1.8	28.5	2.1	53.9	2.5	96.9	2.9
4.50	5.3	1.5	8.7	1.7	16.3	2.0	30.2	2.3	57.3	2.7	102.8	3.1
5.00	5.6	1.6	9.1	1.8	17.2	2.1	31.9	2.4	60.3	2.8	108.4	3.2

System II

Table 12 MAXIMUM WASTEWATER EVACUATION ADMISSIBLE, FILLING LEVEL 70% (h/d = 0,7)

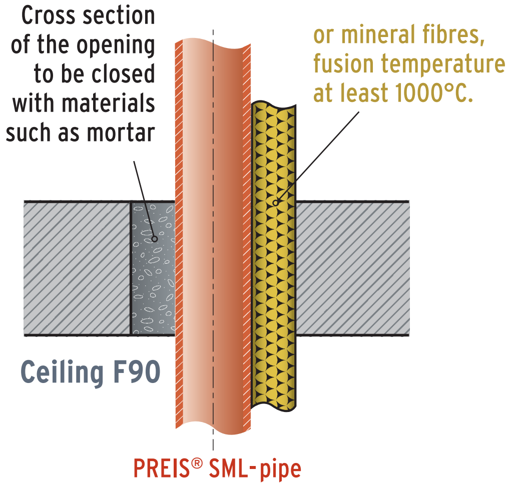
Gradient	DN 100		DN 125		DN 150		DN 200		DN 250		DN 300	
i	Q_{max}	V	Q_{max}	V	Q_{max}	V	Q_{max}	V	Q_{max}	V	Q_{max}	V
cm/m	l/s	m/s	l/s	m/s	l/s	m/s	l/s	m/s	l/s	m/s	l/s	m/s
0.50	2.9	0.5	4.8	0.6	9.0	0.7	16.7	0.8	31.6	1.0	56.8	1.1
1.00	4.2	0.8	6.8	0.9	12.8	1.0	23.7	1.2	44.9	1.4	80.6	1.6
1.50	5.1	1.0	8.3	1.1	15.7	1.3	29.1	1.5	55.0	1.7	98.8	2.0
2.00	5.9	1.1	9.6	1.2	18.2	1.5	33.6	1.7	63.6	2.0	114.2	2.3
2.50	6.7	1.2	10.8	1.4	20.3	1.6	37.6	1.9	71.1	2.2	127.7	2.6
3.00	7.3	1.3	11.8	1.5	22.3	1.8	41.2	2.1	77.9	2.4	140.0	2.9
3.50	7.9	1.5	12.8	1.6	24.1	1.9	44.5	2.2	84.2	2.6	151.2	3.0
4.00	8.4	1.6	13.7	1.8	25.8	2.1	47.6	2.4	90.0	2.8	161.7	3.2
4.50	8.9	1.7	14.5	1.9	27.3	2.2	50.5	2.5	95.5	3.0	171.5	3.4
5.00	9.4	1.7	15.3	2.0	28.8	2.3	53.3	2.7	100.7	3.1	180.8	3.6

Qmax = maximum amount of wastewater evacuation admissible in l per second
V= flow velocity in m per second

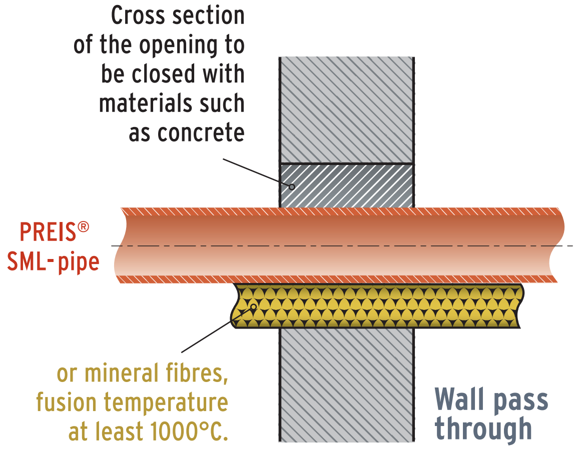
5 Wall and ceiling pass-throughs

Where pipes have to pass through walls and ceilings, being subject to particular requirements with regard to fire resistance, special measures have to be taken in accordance with national and regional requirements (see EN 12056-1:2000, 5.4.1).
In general, any openings must be kept as small as possible. The opening remaining after installation of the pipe must be closed with non-flammable building material.

We recommend to use mineral fibres (with a fusion temperature of > 1000° C). The remaining opening could also be closed with cement mortar or concrete, however, this could cause noise to be transmitted to the wall or ceiling and, therefore, is not recommendable.



Picture 21 **Requirements to fire resistance of ceiling pass-throughs of pipes**



Picture 22 **Requirements to fire resistance of wall pass-throughs (fire protection) of pipes**

6 Wastewater lifting systems

EN 12056-4 defines wastewater lifting systems as follows:

„A facility for building and terrain drainage to collect and automatically lift wastewater, whether containing sewer or not, as well as lifting of rainwater to the backwater level to be drained within or outside of buildings with connection to sewage systems.“

Pressure lines of wastewater lifting systems

Cast iron pipes and fittings are the best solution for wastewater lifting systems at wastewater pumps, due to the high quality of the material and its robustness. The system mainly consists of pipes of the nominal width DN 80 and DN 100. They are connected with Rapid-Couplings and the corresponding clamps. The clamps have to resist a maximum internal pressure of up to 10 bar, as while switching on or off the pump, pressure peaks are to be expected.

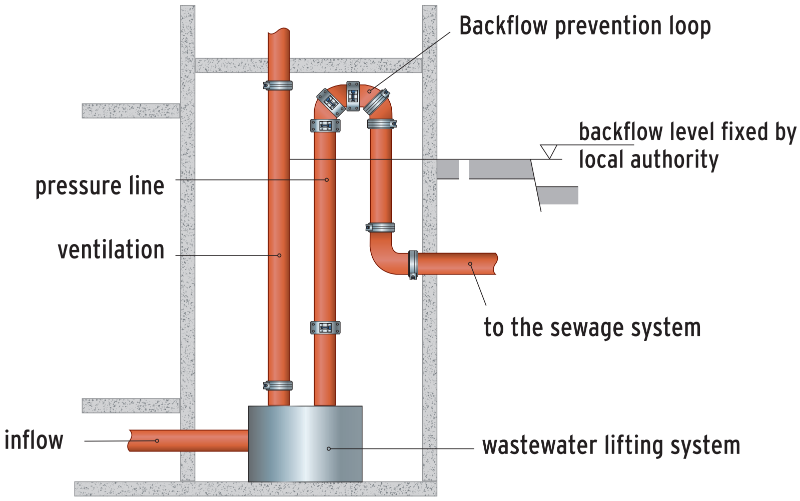
For detailed technical specifications and layout for pressure pumps, please, refer to the manufacturer.

Backwater level

Backwater level refers to the highest admissible level of water in a drainage system that may be reached. In general, this means that the backwater level equals the street level, unless otherwise provided by local authorities.

Backflow prevention loop

Prevention from backflow can be reached using a backflow prevention loop. The loop has to be 250 mm above the backflow level.



Picture 23 **Wastewater lifting system**

Planning and layout of the pressure line

Minimum nominal width of the pressure line as defined in table 2, DIN EN 12056, part 4. For lifting systems for faecal matters without grinding, pipes with a nominal width of DN 80 have to be used.
Wastewater lifting systems have to be vented via the roof, though there is also the option to integrate the ventilation in an existing main or secondary ventilation system.

It has to be observed that no other connections may be integrated into the pressure line, nor is it permitted to install ventilation valves.

Pressure lines of wastewater lifting systems must not lead into wastewater gravity flow pipes, but instead have to be connected to vented base pipes or collective pipes. Connections of the pressure pipe to the base pipe or collective pipes are to be carried out in the same way as non-pressurized pipes.
Evacuation pipes have to have a frictionless connection to the lifting system. The weight of the pipelines has to be held by means of corresponding fixing methods.
The pressure pipe has to withstand a minimum of 1.5 times the maximum pressure of the pump.

Sound insulation

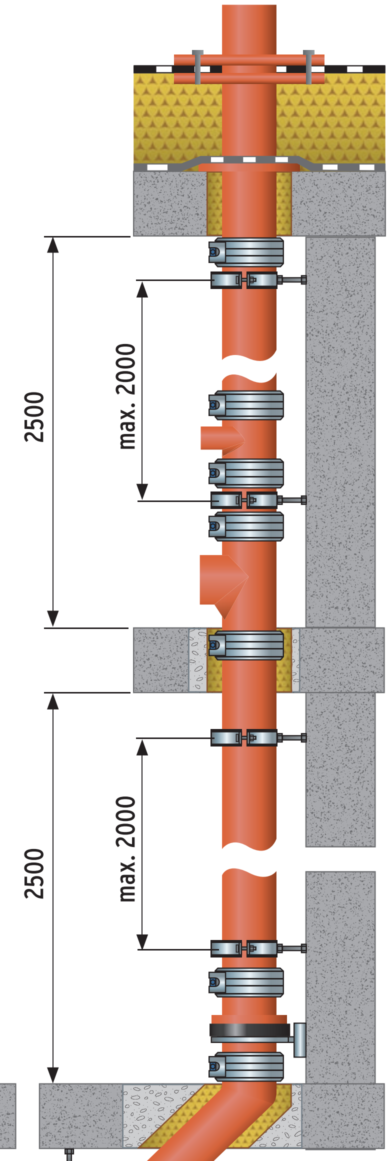
To avoid direct transmission of noise from the pump, all connections to the wastewater lifting system have to be carried out in a flexible way using special noise damping clamps.

Layout and calculation of pressure pipes

Layout and calculation of wastewater lifting systems have to be carried out according to the specific needs. Hence, for layout of wastewater lifting systems we recommend to refer to EN 12056-4, from chapter 6 onwards.

7 Fixings

Picture 24 Fixings



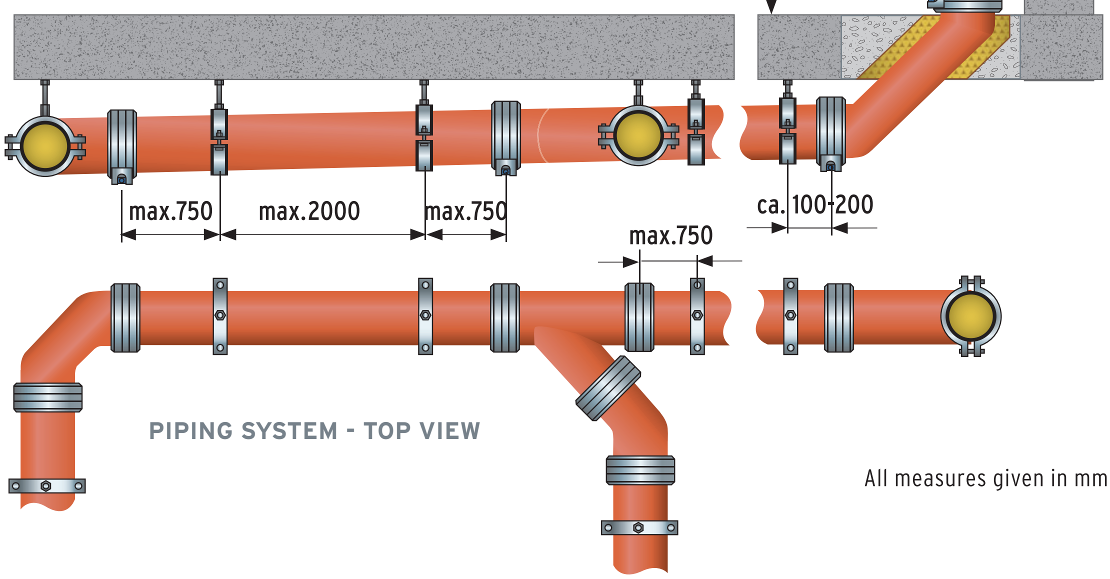
General rules

Pipes that exceed a length of 2 m should be fixed twice, whereas the maximum distance between 2 clamps should be 2 m.

Shorter pipes should be fixed once or twice according to the nominal width. As a general rule, fixings before or after each coupling should not be further away than 0.75 m and not be closer than 0.10 m. In buildings with 5 floors or more, the downpipes of DN100 or larger should be secured against sinking by means of a downpipe support. Additionally, for higher buildings a downpipe support should be fitted at every subsequent fifth storey.

Horizontal pipes have to be fastened adequately at all turns and branches. Special fixed-point-holding devices are necessary if pipes are pendant-fixed and longer than 10 m. The fixed-point holding devices have to be installed every 10 to 15 m.

PIPING SYSTEM - LAYOUT



PIPING SYSTEM - TOP VIEW

All measures given in mm

Downpipes mounted at the wall or in slits have to be fixed with a clamp every 2 m. If a storey is 2.50 m high, fastening is needed twice per storey, but at least once close to possible branches.

Downpipe supports have to hold the weight of the downpipe and should be fixed at the deepest point possible. Downpipes from size DN 100 upwards in buildings with more than 5 storeys should be mounted on downpipe supports. Additionally, for higher buildings a downpipe support should be fitted at every subsequent fifth storey.

Brackets: Use common brackets available on the market with the corresponding fastening elements and supports.

Fixing of SML-pipes

For SML pipes DN 50 to 150 we recommend using brackets with threads M 12. Rain water pipes and wastewater pipes under pressure (e.g. for wastewater lifting systems) should be fastened with brackets with threaded rods M 16. (see product information of the supplier of the brackets).

SML pipes under pressure need a special securing of the clamps with the corresponding claws (see connections, page 23)

8 Cutting

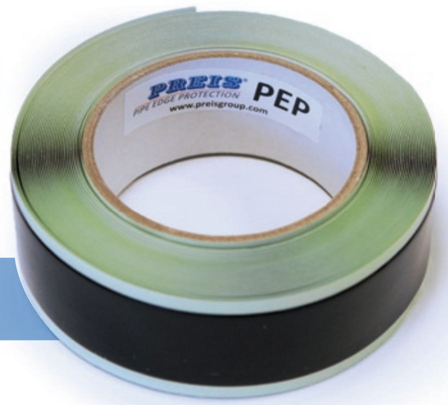
PREIS® SML socketless cast iron pipes are delivered with a length of 3m to be cut at any length directly from the personnel working with the material.
The cuts must be carried out bearing in mind the function of the joint that will be made. The cut must be perpendicular to the pipe length, smooth, clean and even. If necessary the cut face should be deburred to ensure a perfect seal for the connector.

Some form of clamping jig will be needed to ensure that the cut is truly perpendicular. This will establish the positioning and clamping of the pipe. The following tools are suggestions of common cutting methods:

- **Bandsaw/circular saw/mechanical hacksaw:** Transportable electrical saws with clamping jig ensure a nearly perfect perpendicular cut.
- **Angle grinder:** An angle grinder with a cutting disc for cast iron should only be used in conjunction with a suitable clamping jig.
- **Pipe cutter:** The pipe cutter has the clamping jig integrated in the tool and allows a fast, clean and perpendicular cut. The tool needs no electrical connection, but there is the risk of damage to the pipe due to high pressures caused by worn cutting discs and excessive feed rates.

NOTE:

- Appropriate protective clothing must be worn whilst working!
- The relevant safety regulations must be obeyed!
- Saw blades and cutting wheels must be changed regularly!
- The appropriate assembly instructions must be considered (e.g. protection of the cut edges).



9 PREIS®PEP (Pipe Edge Protection)

Fields of application:

cut edge protection for PREIS® cast iron drainage pipe system, during tests for PREIS® KML according DIN EN877 and RAL-GZ 698 successful practice-tested.

Advantages:

- liner release with finger-lift for quick and
- easy removal of the backing paper
- quick and easy application to the cut edge
- no drying time, therefore quick installation without delays

Materials:

- butyl rubber with special polyethylene foil
- parts separated by silicone foil with finger tabs for easy use

Characteristics:

- largely resistant to chemicals
- good adhesion
- permanently flexible
- impermeable
- aging resistant

Warehousing:

- cool (+5°C to +25°C), dry and protected from UV light
- minimum storage life 24 months (+5°C to +25°C)

Temperature for use:

applicable at +5 ° C to +40 ° C

Instructions for use:

- first read and follow installation instructions
- use PREIS®PEP according application instructions (page 22)

9.1 Installation instructions

Note:

- PREIS®PEP is not resistant to oils and organic solvents (e.g. fuel).
- If necessary, loosen the clamping screw of the connector before application.
- PREIS®PEP must always be used for cut edges in KML pipes.
- PREIS®PEP is also recommended as cut edge protection for SML pipes.
- Keep out of reach of children!

More information on proper handling of PREIS® drainage system can be found in our technical documentation under ***www.preisgroup.com.***

Table **cut length**

DN	cut length PREIS®PEP [mm]	yield PREIS®PEP [edges/tape]
50	170	58
70	230	43
75	220	45
80	250	40
100	330	30
125	410	24
150	490	20
200	640	15
250	840	11
300	1000	10

PREIS®PEP application instructions:

1. After cutting the pipe chamfer the edges.



2.

Clean the pipe surface inside and outside 3 cm wide until it is dry and free from grease and dust.

3.


Roll up **PREIS®PEP** and cut the length according to the DN in table 1 (page 23).

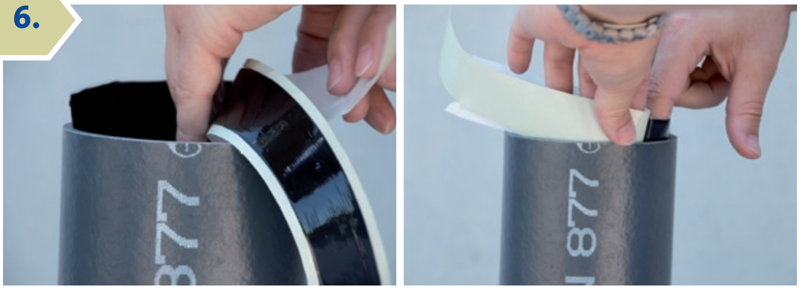
4.

Expose half of the adhesive side of the tape.

5.

Apply **PREIS®PEP** to the inside of the cut pipe, taking care that the application is straight, so half the width (about 15 mm) extends beyond the pipe edge.

6.



Taking care to avoid creases, press **PREIS®PEP** firmly to the inner surface and remove remaining protection.

7.

Firmly press **PREIS®PEP** on to full internal pipe circumference taking care to avoid creases or tension.
Attention: PREIS®PEP must not be stretched – avoid any tension!

8.

The ends of **PREIS®PEP** should overlap about 10 mm, an open gap is not allowed.

9.

Fold **PREIS®PEP** from the inside out and firmly press to the whole circumference of the outside of the tube until the cut edge is completely covered by **PREIS®PEP**.

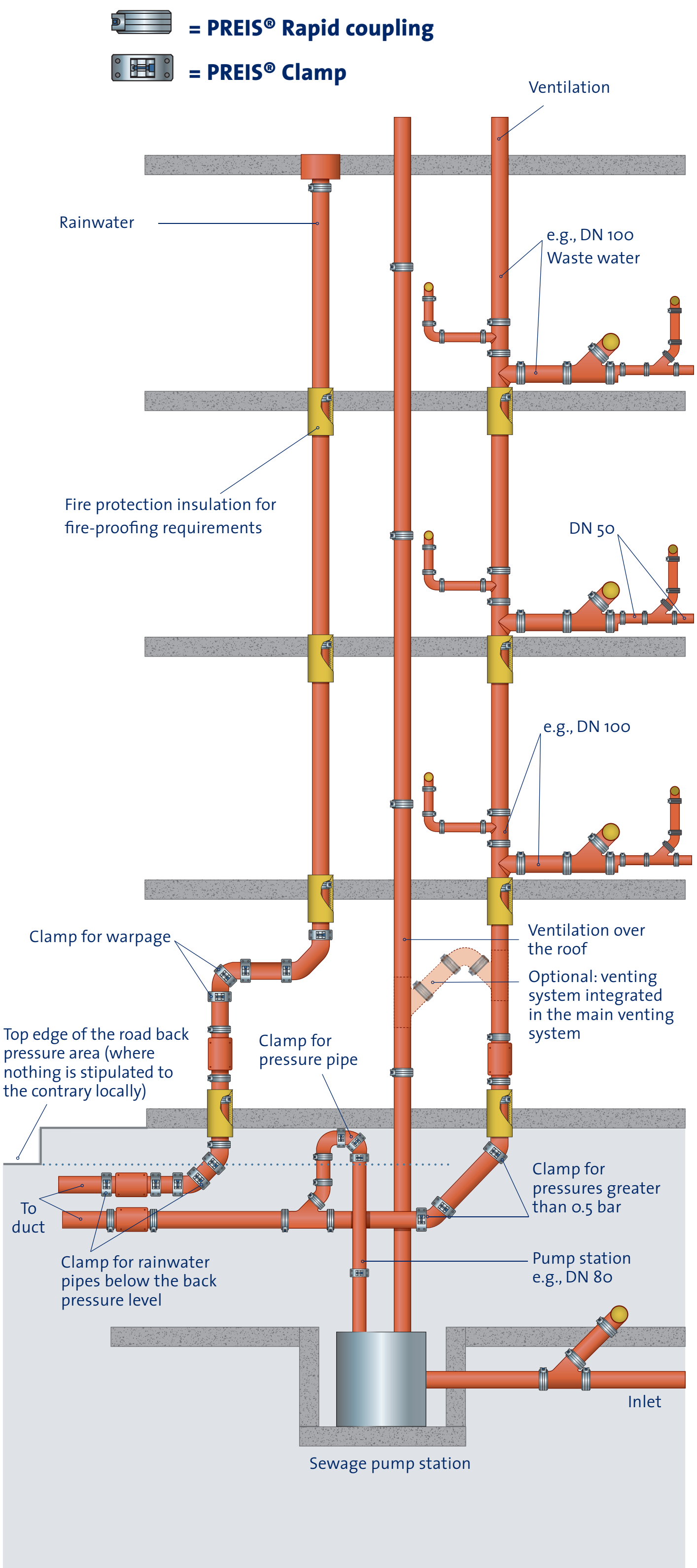
10.

If necessary loosen the clamping screw, apply the coupling on the pipe end and tighten the screw.

Technical modifications and printing errors excepted.

10 Assembly and installation instructions

PREIS® SML pipes, fittings and coupling systems are produced and inspected according to EN 877. The SML pipes are cut to the required length directly from the personnel working with the material. Pipes and fittings are joined with suitable pipe clamps.



Horizontal pipes have to be adequately fastened at all turns and branches. Downpipes have to be fastened at a maximum distance of 2 m. In buildings with 5 floors or more, the downpipes of DN 100 or larger should be secured against sinking by means of a downpipe support. Additionally, for higher buildings a downpipe support should be fitted at every subsequent fifth storey.

Drainage pipes are planned as unpressurized gravity flow lines. However, this does not exclude the pipe to be under pressure if certain operating conditions occur. As drainage and ventilation pipes are subject to possible interactions between the pipes and their environment, they have to be permanently leak-tight against internal and external pressure of between 0 and 0.5 bar. To sustain this pressure, those pipe parts subject to longitudinal movement must be fitted along the longitudinal axis, properly supported and secured.

This kind of fitting has to be used whenever interior pressure exceeding 0.5 bar may arise in the drainage pipes, such as in the following cases:

- **Rainwater pipes**
- **Pipes in the backwater area**
- **Wastewater pipes which run through more than one basement without further outlet**
- **Pressure pipes at wastewater pumps.**

Non-friction-fitted pipelines subject to possible internal pressure or pressure developing during operation. These pipes must be provided with a suitable fixture, above all along the turns, to secure the axes from slipping apart and separating.

The required resistance of the pipe and fitting connections to longitudinal forces is achieved by installing additional clamps (internal pressure load up to 10 bar possible) at the joints.

Further information on technical issues can be found in our brochure for technical specifications and details.

11 Couplings

PREIS® Rapid Couplings
Couplings with axial restraint

PREIS® Rapid Clamps
To secure couplings of pipes with internal pressure loads of more than 0.5 bar.

Konfix
For connecting other materials to SML pipes

11.1 Installation instructions

To connect socketless pipes and fittings, clamps and couplings have to be used. Special attention has to be paid to their resistance to axial restraint caused by internal pressure loads and to special measures to be taken to compensate for axial forces (see table 13).

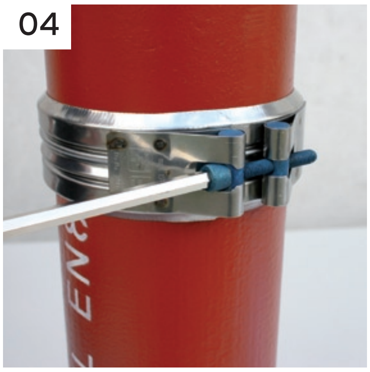
Table 13

Type	DN	Axial restraint up to .... bar	Torque Nm	No of segments	Screw size	Type of screw	Material
 PREIS® Rapid Clamps	50	10	27-29	2	M8	cylinder head bolt with hexagon socket SW 6mm**	galvanized steel
	70/80*	10	27-29	2	M8		
	100	7	27-29	2	M8		
	125	6	27-29	2	M8		
	150	4	27-29	3	M8		
	Other DN upon request	*one coupling for 3 dimensions	**same screw used as with PREIS® Rapid Couplings				
 CV Clamps	50	10	12-14	2	M8	cylinder head bolt with hexagon socket	steel electroplated
	70/75-S	10	12-14	2	M8		
	80	10	12-14	2	M8		
	100	10	32-35	3	M10		
	125	5	32-35	3	M10		
	150	5	45-49	3	M10		
	200	3	40-50	3	M10		
 Universal Clamps * in connection with Rapid ** in connection with CV	200	5* 5**	Block tightening	1	M12	cylinder head bolt with hexagon socket	Casing: 1.4510/11 locking unit: steel surface protected claw ring: 1.4310
	250	3* 3**	Block tightening	1	M12		
	300	3* 3**	Block tightening	1	M12		

01


02


03


04


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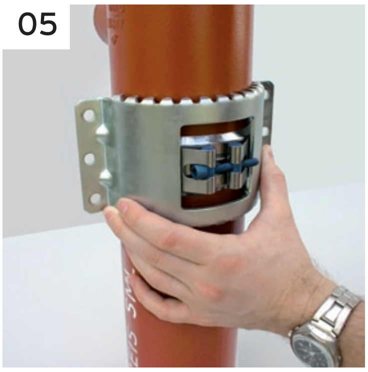


06


Both, **PREIS® Rapid Coupling** and **PREIS® Rapid clamps** have a 6 mm hexagon socket head screw which allows fastening of both elements with one single tool. For tightening, use a common powered screw driver, a hexagon socket spanner or a ratchet. In any case, the indicated torque has to be observed.

07


08


09


Picture 08 Attention! Remove the rubber stopper only by using a blunt tool, e.g. pliers and avoid using a knife, as the rubber sealing could be damaged.
Picture 09 Apply a lubricant to the plastic pipe and push it in until the stop. If required, the connection pipe must be fixed in order to prevent from slipping due to internal pressure.

11.2 Regulations for pipe laying and maximum pressure admissible for couplings

General remarks

In general, drainage systems are planned as non-pressurized gravity flow pipes. However, certain circumstances may lead to negative pressure or overpressure, as this is the case in:

1. pipes in the backflow area
2. rainwater pipes in buildings
3. wastewater pipes which run through more than one basement without further outlets
4. pressure pipes of wastewater lifting systems.

In pipes below the backwater area, working pressure may develop which may cause pipe connections to slip (e.g. due to backwater from the sewer system). Hence, the following measures have to be taken for cast iron pipes below the backflow area:

• For wastewater pipes with a pressure up to 0.5 bar in the backwater area
using Rapid Coupling until DN 200, no additional measures are required,
when using Rapid Couplings from DN 250 upwards, they have to be secured at turns with the corresponding grip collars.

• For wastewater pipes with a higher pressure than 0.5 bar in the backwater area
all couplings are to be secured with the corresponding grip collars (see table 13)

11.3 Securing of rainwater pipes

DIN EN 12056-3, item 7.6.4 requires that rainwater pipes inside the building have to withstand the pressure caused by clogging.
In vertical gravity flow pipes for rainwater drainage that are open at the top, the water column cannot exert axial forces as long as the pipes are secured against possible sideway movements.
Therefore, the common Rapid Coupling may be used. However, deflections or turns must be secured with grip collars. As a backflow until the upper building edge due to clogging is very unlikely, grip collars to secure pipes are to be used only below the backwater level.

12 Pipes embedded in concrete

As cast iron pipes and fittings have nearly the same expansion coefficient than concrete, these pipes can be embedded in concrete without any problems.
Before embedding the pipelines, they have to be sufficiently secured against slipping and floating on the surface. This may be achieved by trestles and common brackets in combination with Rapid Couplings and clamps. In order to prevent pipes from floating on the surface, they should be filled with water before being embedded in concrete.

13 Calculation example

Residential building and building for offices

Downpipes: 3 (connection branches with access angle 45°)
Storeys: 6 **Basement:** 1 **Connections:** System 1
Runoff coefficient: 0,5 bzw. 0,7 (siehe Skizze)
Collective pipe: 1 (Gefälle 2%, Füllungsgrad 0,5)
Wastewater lifting system: 12m³ per hour in the basement (3 washing machines / 5 showers / 7 toilets / 10 hand basins)

Downpipe A
6 storeys
2 flats per storey

Downpipe B
6 storeys
2 flats per storey

Downpipe C
2 flats each in storeys 4 to 6
2 flats each in storeys 1 to 3

Each flat consists of: Table 14

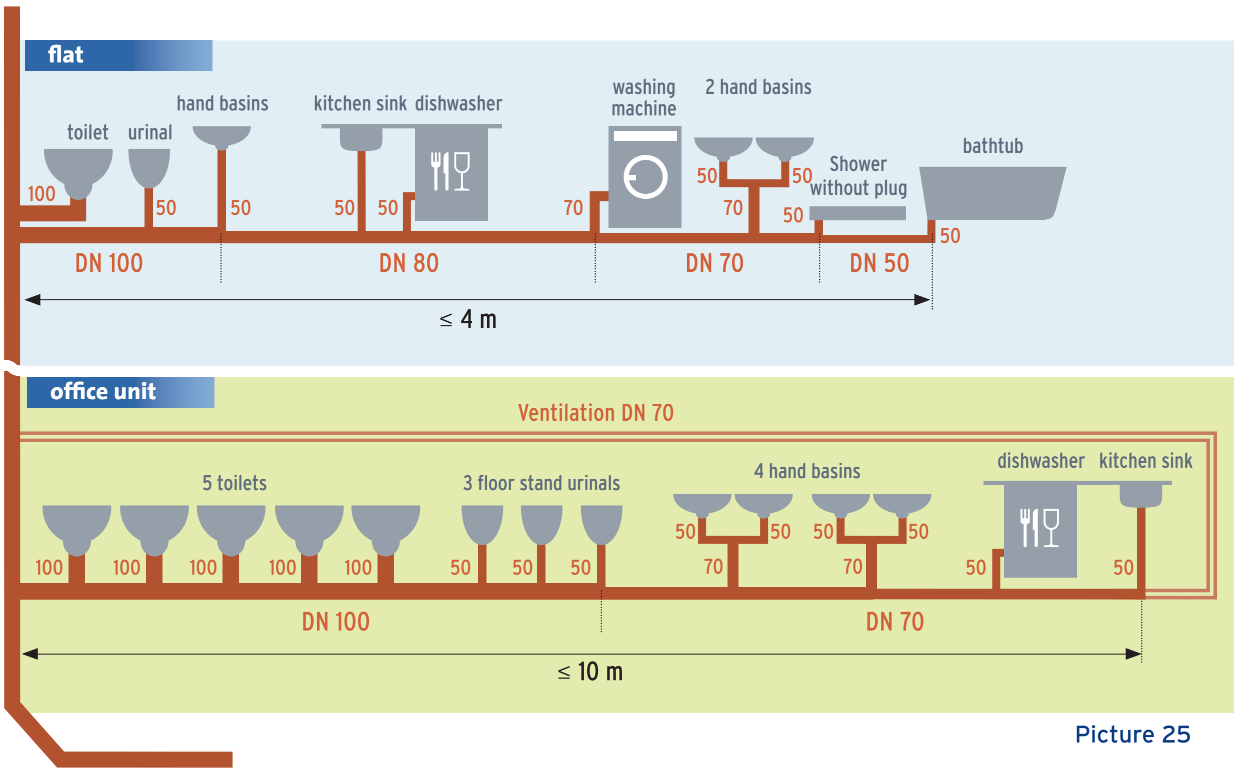
	DU l/s	∑ l/s
1 toilet	2.0	2.0
1 washing machine (< 12 kg)	1.5	1.5
1 Shower without plug	0.6	0.6
1 bathtub	0.8	0.8
3 hand basins	0.5	1.5
1 kitchen sink	0.8	0.8
1 dishwasher	0.8	0.8
1 individual urinal with cistern	0.5	0.5
TOTAL		**8.5**

The office unit consists of: Table 15

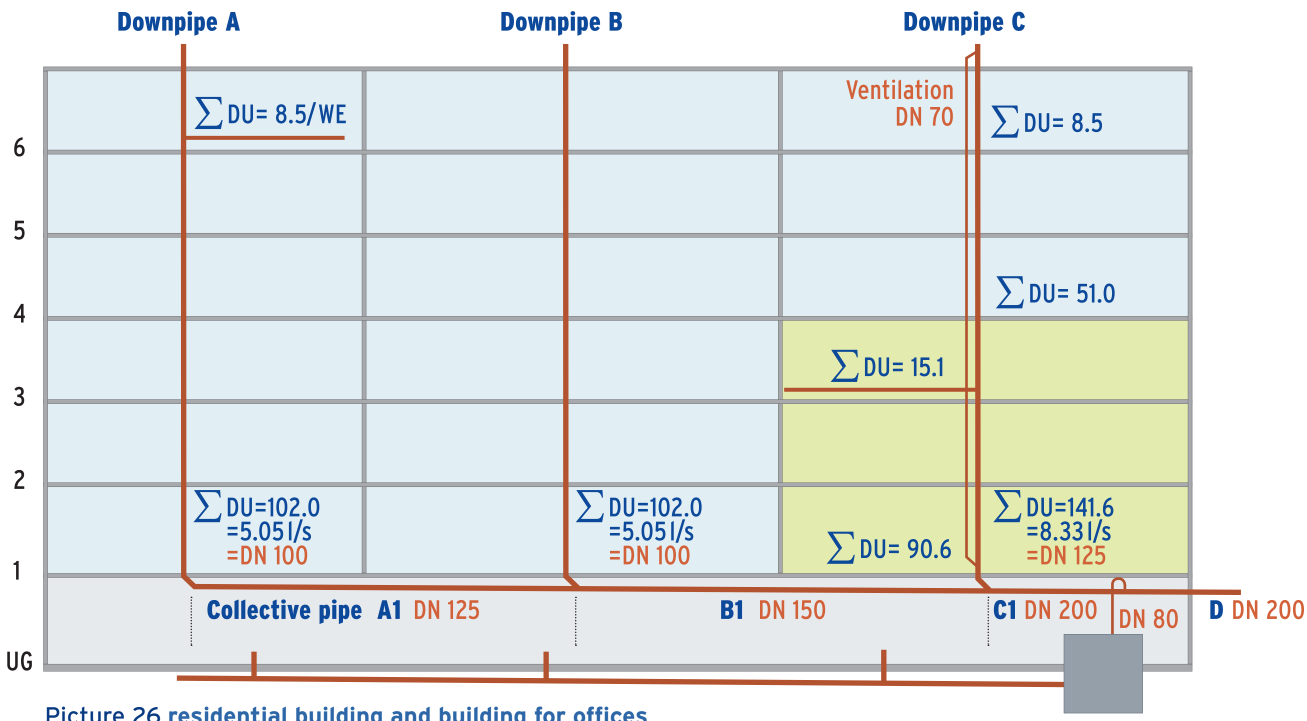
	DU l/s	∑ l/s
5 toilets	2.0	10.0
3 floor stand urinals	0.5	1.5
4 hand basins	0.5	2.0
1 kitchen sink	0.8	0.8
1 dishwasher	0.8	0.8
TOTAL		**15.1**

Dimensioning of connection pipes according to ÖNORM B2501

For dimensioning of the connection pipes, please, refer to national standards and regulations.



Picture 25



Picture 26 **residential building and building for offices**

Downpipe A
1 Unit = 8.5 DU
2 Units per storey = 17.0 DU
6 storeys (= 17.0 * 6 = 102.0 DU)
$Q_{ww} = 0.5 * \sqrt{102.0} = 5.05$ l/s
→ DN 100 (acc. to table 08)

Collective pipe A1
5.05 l per sec. gradient 2% at filling level 0.5
→ DN 125 (acc. to table 08)

Downpipe B
See downpipe A

Collective pipe B1
$Q_{ww} = 0.5 * \sqrt{\Sigma \text{DU of downpipe A + B}}$
$Q_{ww} = 0.5 * \sqrt{102.0 + 102.0} = 7.14$ l/s → DN 150

Downpipe C
3 storeys with living units (3 * 17.0= 51.0)
3 storeys with offices (3 * 30.2 = 90.6)
$Q_{ww} = 0.7 * \sqrt{51.0 + 90.6} = 8.33$ l/s → DN 125
Ventilation dimensioned in DN 70 (acc. to table 09)

Collective pipe C1
$Q_{ww} = 0.7 * \sqrt{\Sigma \text{ DU of downpipe A + B + C}}$
$Q_{ww} = 0.7 * \sqrt{102.0 + 102.0 + 141.6} = 13.01$ l/s → DN 200

Attention! Use in this office is frequently, therefore k = 0.7. As the residential units have a value of k = 0.5, however, the offices below show a value 0.7, the whole downpipe has to be calculated with a value k = 0.7.

Inflow pump lifting system from basement
Capacity of 12 m³ per hour -> corresponds to a constant inflow of 3.33 l per second.
Attention! The pump lifting inflow has to be included in the system with the full inflow capacity.

Collective pipe D
$Q_{tot} = Q_{ww} + Q_p$ $\quad Q_{tot} = 13.01$ l/s + 3.33 l/s = 16.34 l/s → DN 200
Total of the downpipes + pump lifting inflow = total evacuation

Q_{tot}
The total evacuation of wastewater equals the sum of wastewater Q_{ww}, the possible continuous evacuation of Q_c and the pump lifting inflow Q_p in litres per second.

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