

WASTE WATER HYDRAULICS COMPETENCY BROCHURE

PLANNING, DIMENSIONING AND DESIGN

**KNOW
HOW**
INSTALLED

Table of contents

1	About this document	4
1.1	Foreword.....	4
2	Standards and regulations	5
2.1	Areas of application	5
2.2	Drainage system I.....	6
3	Principles	7
3.1	Sanitary appliances	7
3.1.1	Domestic sanitary appliances	7
3.1.2	Measures against the loss of sealing water.....	7
3.2	Principles for dimensioning	8
3.2.1	Maximum total waste water discharge rate of underground and collector pipes	8
3.2.2	Discharge value K.....	9
3.3	Principles for installing	9
3.3.1	Access pipes.....	9
4	Dimensioning and installing	11
4.1	Branch discharge pipes	11
4.1.1	Branch discharge pipe types	11
4.1.2	Dimensioning single branch discharge pipes	11
4.1.3	Installing single branch discharge pipes	12
4.1.4	Dimensioning and installing collector branch discharge pipes	14
4.1.5	Connection pipes	16
4.1.6	Connection to the stack	16
4.1.7	Geberit branch fittings for connecting to branch discharge pipes with WCs.....	19
4.2	Stack.....	20
4.2.1	Dimensioning stacks.....	20
4.2.2	Installing stacks	21
4.3	Collector pipes	24
4.3.1	Dimensioning collector pipes	24
4.3.2	Dimensioning example	24
4.3.3	Installing collector pipes.....	25
4.4	Underground pipes	26
4.4.1	Dimensioning underground pipes	26
4.4.2	Installing underground pipes.....	26
4.5	Ventilation pipes	28
4.5.1	Dimensioning ventilation pipes	28
4.5.2	Geberit pipe cross-sections	30
4.5.3	Dimensioning example	31
4.5.4	Installing ventilation pipes.....	32
4.6	Sewage water pipes	34
4.6.1	Dimensioning sewage water pipes	34
4.6.2	Installing sewage water pipes.....	34

1 About this document

1.1 Foreword

This Geberit waste water hydraulics competence brochure provides you with application-related knowledge for planning, dimensioning and installing building drainage systems. Based on the most important standards and regulations, it describes the individual pipe areas and provides rules and recommendations for designing a building drainage system. Thanks to our long-standing experience in sanitary technology, we offer a training and reference guide based on practical expertise which is intended for practical work.

1.2 Disclaimer

All information contained in this document, which is based on standards, ordinances or regulations etc., has been thoroughly researched and compiled with the greatest possible care. However, we cannot guarantee that such information is correct, complete or up to date. Geberit is not liable for damage resulting from the use of this information.

1.3 Copyright

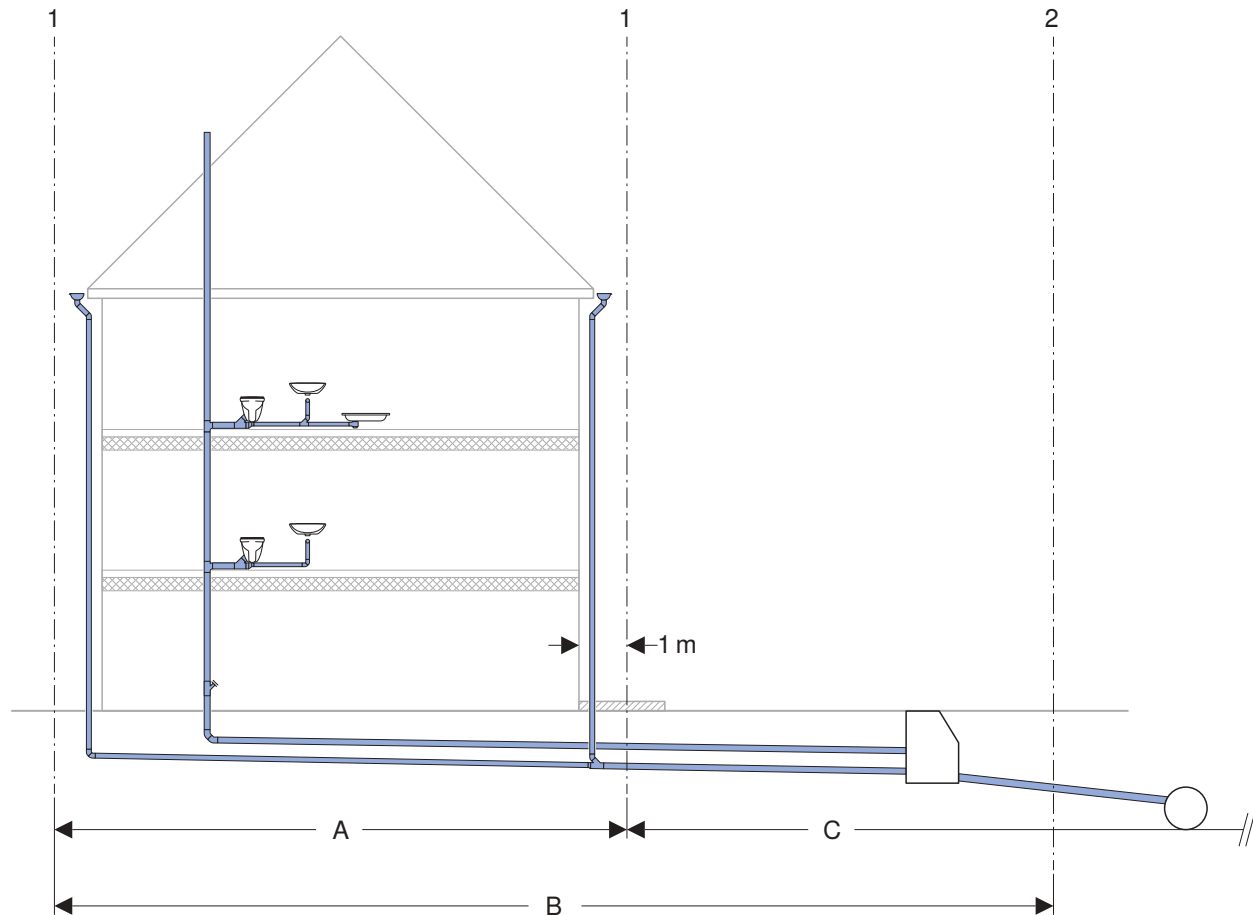
Geberit International Sales AG

All rights reserved. The text, images and graphics as well as their arrangement are subject to copyright protection.

2 Standards and regulations

2.1 Areas of application

Basic standards and regulations which refer to the building, property or both areas must be observed in building drainage. The following figure provides an overview.



- 1 Building boundary
- 2 Property boundary
- A DIN EN 12056-2:2001-01
- B DIN 1986-100:2016-12, DIN EN 12056-4:2001-01
- C DIN EN 752:2017-07, DIN EN 1610:2015-12

2.2 Drainage system I

Drainage system I is a single discharge stack system with partially filled branch discharge pipes and one of 4 drainage systems that are defined and described in DIN EN 12056-2:2001-01.

The 4 drainage systems were included in the standard for reasons of different drainage traditions. However, there are also variations within the different systems, which are reflected in national and regional provisions. These provisions are listed in Appendix A of DIN EN 12056-1:2001-01.

Drainage system I is used in Germany. Note that when using water-saving WCs with a flush volume of 4–6 l, the additional requirements of DIN 1986-100:2016-12 must be taken into account for dimensioning and installing branch discharge pipes, stacks, collector pipes and underground pipes.

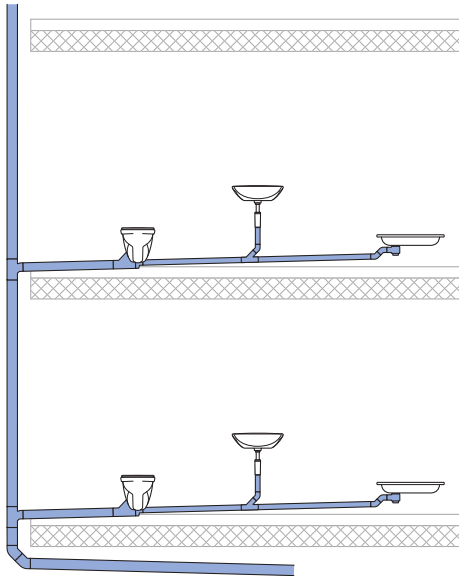


Figure 1: Drainage system I: single discharge stack system with partially filled branch discharge pipes with a filling level of $h/d_i = 0.5$

3 Principles

3.1 Sanitary appliances

Sanitary appliances collect the waste water and discharge it into the drainage system. They can be divided according to the type and source of the waste water to be discharged.

- Domestic waste water: domestic sanitary appliances
- Rainwater: roof outlets

3.1.1 Domestic sanitary appliances

In buildings, each drinking water abstraction point must be connected to a sanitary appliance which, in turn, must be connected to the building drainage systems. Such sanitary appliances include:

- washbasins, bidets and urinals
- dammable and non-dammable shower trays
- Bathtubs
- kitchen sinks and cleaner sinks
- dishwashers and washing machines
- WC facilities
- floor drains

Domestic sanitary appliances must be equipped with a trap to prevent the release of sewer gases into the building. The following are exceptions to this rule:

- floor drains in garages that are connected in the combined system and where the trap is located in a frost-free area in the pipe
- floor drains that are located in the direction of flow and upstream of separators for light liquids
- overflows in other drainage points

3.1.2 Measures against the loss of sealing water

The water in the trap must have a depth of water seal H of at least 50 mm. The admissible loss of sealing water during a draining process is 25 mm. The admissible amount of evaporation is 1 mm per day.

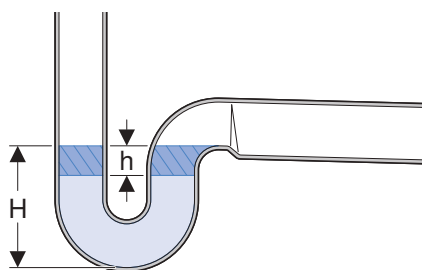


Figure 2: Admissible loss of sealing water

H Depth of water seal

h Loss of sealing water height

In rooms with overpressure and negative pressure, the depth of water seal must be adapted to the pressure conditions. The sealing water must not be pushed out by overpressure or drawn in by negative pressure.

If sanitary appliances such as floor drains are not used regularly, there is a risk that the trap will dry out. In this case, the sealing water must be refreshed.

Floor drains in cellars, bathrooms or rooms with underfloor heating must be planned in such a way that another sanitary appliance that is used regularly – such as washbasin – is also connected to the floor drain. However, it must be ensured that the traps of the floor drain and sanitary appliance are not connected in series.

3.2 Principles for dimensioning

3.2.1 Maximum total waste water discharge rate of underground and collector pipes

DIN EN 12056-2:2001-01 specifies the maximum total waste water discharge rate of underground and collector pipes as a function of the filling level and slope. The following tables list the values for filling levels of 50 % and 70 %.

Table 1: Maximum total waste water discharge rate in l/s for underground or collector pipes with a filling level of 50 % according to DIN EN 12056-2:2001-01

Slope J										Pipe dimension ø [mm]/DN
0.5 % (1 : 200)	1 % (1 : 100)	1.5 % (1 : 66)	2 % (1 : 50)	2.5 % (1 : 40)	3 % (1 : 33)	3.5 % (1 : 28)	4 % (1 : 25)	4.5 % (1 : 22)	5 % (1 : 20)	
0.3	0.4	0.5	0.6	0.6	0.7	0.8	0.8	0.9	0.9	56/56
0.4	0.6	0.7	0.8	0.9	1.0	1.2	1.2	1.3	1.3	63/60
0.6	0.9	1.2	1.4	1.5	1.7	1.9	1.9	2.1	2.2	75/70
1.0	1.4	1.8	2.1	2.3	2.5	2.9	2.9	3.1	3.1	110/100
1.8	2.5	3.1	3.5	4.0	4.4	4.7	5.0	5.3	5.6	110/100
3.4	4.1	5.0	5.7	6.4	7.1	7.6	8.2	8.7	9.1	125/125
5.3	7.7	9.4	10.9	12.2	13.3	14.4	15.4	16.3	17.2	160/150
10.5	14.2	17.4	20.1	22.5	24.7	26.6	28.5	30.2	31.9	200/200
19.0	26.9	32.9	38.1	42.6	46.7	50.4	53.9	57.2	60.3	250/250
35.1	48.3	59.2	68.4	76.6	83.9	90.7	96.6	102.8	108.4	315/300

Table 2: Maximum total waste water discharge rate in l/s for underground or collector pipes with a filling level of 70 % according to DIN EN 12056-2:2001-01

Slope J										Pipe dimension ø [mm]/DN
0.5 % (1 : 200)	1 % (1 : 100)	1.5 % (1 : 66)	2 % (1 : 50)	2.5 % (1 : 40)	3 % (1 : 33)	3.5 % (1 : 28)	4 % (1 : 25)	4.5 % (1 : 22)	5 % (1 : 20)	
3.1	4.2	5.1	5.9	6.7	7.3	7.9	8.4	8.9	9.4	110/100
5.7	6.8	8.3	9.6	10.8	11.8	12.8	13.7	14.5	15.3	125/125
9.0	12.8	15.7	18.2	20.3	22.3	24.1	25.8	27.3	28.8	160/150
17.5	23.7	29.1	33.6	37.6	41.2	44.5	47.6	50.5	53.3	200/200
31.7	44.9	55.0	63.6	71.1	77.9	84.2	90.0	95.5	100.7	250/250
58.6	80.6	98.8	114.2	127.7	140.0	151.2	161.7	171.5	180.8	315/300

3.2.2 Discharge value K

Discharge value K is a dimension for the simultaneous drainage of sanitary appliances that are connected to a stack. A factor of 0.5, e.g. for apartments or offices, takes into account that water does not flow simultaneously via all of the branch discharge pipes into the stack.

DIN EN 12056-2:2001-01 recommends the following K discharge values:

Table 3: Discharge values according to DIN EN 12056-2:2001-01

Utilisation frequency and building type	K
Irregular use: e.g. residential buildings, guest houses/inns, offices	0.5
Regular use: e.g. hospitals, schools, restaurants, hotels	0.7
Frequent use: e.g. public toilets, shower rooms	1.0
Special use: e.g. laboratories	1.2

3.3 Principles for installing

3.3.1 Access pipes

Access pipes are used for inspecting, cleaning and repairing building drainage systems.

Access pipes can be designed as:

- pipe end seals
- cleaning seals
- access pipes with round opening
- access pipes with rectangular or oval opening
- access pipes as sliding pipes
- open pipe feed-throughs in ducts

Access pipes must be installed as follows:

- as cleaning seals in underground and collector pipes, at least every 20 m
- as cleaning and pipe end seals in collector pipes
- as access pipes directly at the transition of the stack into a horizontal pipe
- as access pipes in stacks or as pipe end seals at accessible points at the transition from a vertical pipe to a collector pipe

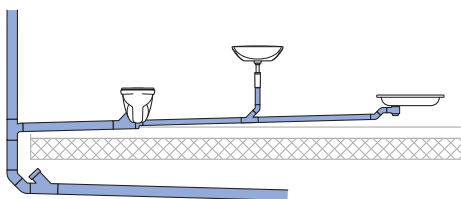


Figure 3: pipe end seal directly at branch fitting 45°

The following rules must be observed when planning access pipes:

- access pipes must be planned separately for each building drainage system
- access pipes must be placed as close as possible to the property boundary
- access pipes must not be installed further than 15 m from the public sewage system
- access pipes must not be installed in rooms in which food is prepared, processed or stored
- manholes must be accessible at all times for vehicles and devices

If there is a boundary development, an access pipe can be placed directly in front of the wall feed-through instead of a duct on the property.

The following rules must be observed when installing access pipes:

- access pipes with a rectangular or oval opening may be used in all pipe areas
- access pipes with a round opening must only be used in branch discharge pipes, stacks and collector pipes
- if an access pipe cannot be installed directly at the transition of the stack into the collector pipe – e.g. because it is then located in an apartment – the access pipe may be installed immediately after the transition into the collector pipe

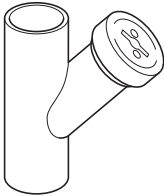
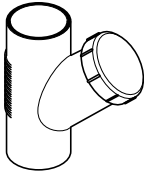
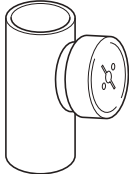
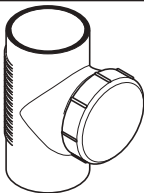
The distances between access pipes in underground pipes without changes in direction are:

- 40 m up to DN 150
- 60 m from DN 200 for ducts with an open through-flow

The distances also apply to changes in direction of underground pipes $> 30^\circ$ if inspection chambers are provided as close as possible to the change in direction between the access pipes. Axial offsets with 2 bends 30° are excluded.

Geberit access pipes

Geberit offers suitable access pipes for each Geberit pipe system.

Designation	Geberit HDPE	Geberit Silent-db20
Access pipe 45° with round opening		
Access pipe 90° with round opening		
Access pipe 90° with oval opening		—

4 Dimensioning and installing

4.1 Branch discharge pipes

4.1.1 Branch discharge pipe types

Branch discharge pipes can be divided into the following types:

- single branch discharge pipes
- collector branch discharge pipes

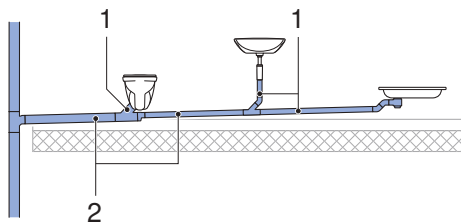


Figure 4: Single and collector branch discharge pipes

- 1 Single branch discharge pipe
2 Collector branch discharge pipe

4.1.2 Dimensioning single branch discharge pipes

A single branch discharge pipe collects the waste water from precisely one sanitary appliance. The nominal width DN of a single branch discharge pipe depends on the connection value DU of the sanitary appliance.

Table 4: Dimensioning of single branch discharge pipes as a function of the connection value DU

Sanitary appliance	DU [l/s]	DN	
		According to DIN 1986	Geberit recommendation
Washbasin, bidet	0.5	40	56
Shower without waste plug	0.6	50	60
Shower with waste plug	0.8	50	60
Urinal with cistern	0.8	50	60
Urinal with pressure flushing valve	0.5	50	56
Stall urinal	0.2	50	56
Urinal without flush	0.1	50	56
Bathtub	0.8	50	60
Kitchen sink and dishwasher with common trap	0.8	50	60
Kitchen sink, cleaner sink	0.8	50	60
Dishwasher	0.8	50	60
Washing machine, capacity up to 8 kg	0.8	50	60
Washing machine, capacity up to 12 kg	1.5	56	70
WC with cistern 4.0/4.5 l	1.8	90	
WC with cistern/pressure flushing valve 6.0 l	2.0	90	
WC with cistern/pressure flushing valve 7.5 l	2.0	90	
WC with cistern/pressure flushing valve 9.0 l	2.5	100	
Floor drain DN 50	0.8	50	56
Floor drain DN 70	1.5	70	
Floor drain DN 100	2.0	100	

4.1.3 Installing single branch discharge pipes

Single branch discharge pipes can be divided into the following types:

- non-ventilated single branch discharge pipes
- ventilated single branch discharge pipes

Non-ventilated single branch discharge pipes

Non-ventilated single branch discharge pipes are subject to the following application limits:

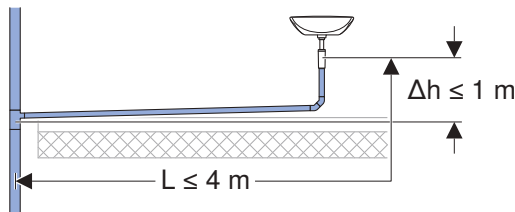


Figure 5: Application limits for a non-ventilated single branch discharge pipe

Maximum pipe length L	4 m
Maximum height difference $\Delta h^{1)}$	1 m
Maximum number of direction changes 90° ^{2), 3)}	3
Minimum slope J	1 %

¹⁾ The height difference Δh describes the dimension between the connection of a sanitary appliance and the pipe bottom of the branch discharge pipe at the transition to the stack.

²⁾ The connection bend for retaining the trap at the end of the single branch discharge pipe does not count as a direction change.

³⁾ The standard only regulates direction changes 90° . If direction changes with an angle $< 90^\circ$ (e.g. 45°) are used, the sum of angles must not exceed 270° (e.g. $6 \cdot 45^\circ = 270^\circ$).

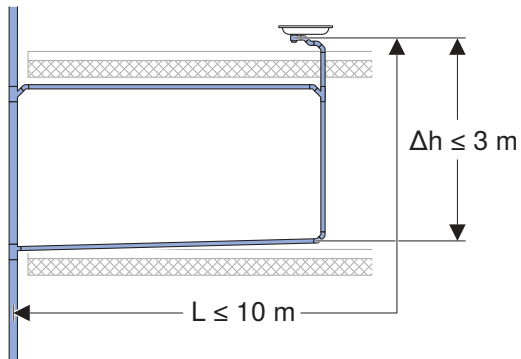
If one of the application limits cannot be complied with, the single branch discharge pipe must be ventilated. The nominal width of the single branch discharge pipe remains unchanged.

Ventilation can be provided via the following types:

- branch ventilation
- secondary ventilation
- air admittance valves approved by the construction supervisor

Ventilated single branch discharge pipes

Ventilated single branch discharge pipes are subject to the following application limits:



Maximum pipe length L	10 m
Maximum height difference Δh ¹⁾	3 m
Maximum number of direction changes 90°	Unlimited
Minimum slope J	0.5 %

¹⁾ The height difference Δh describes the dimension between the connection of a sanitary appliance and the pipe bottom of the branch discharge pipe at the transition to the stack.

The application limits also apply to a ventilated single branch discharge pipe that is connected to a collector branch discharge pipe.

4.1.4 Dimensioning and installing collector branch discharge pipes

A collector branch discharge pipe collects the waste water from at least two sanitary appliances.

Collector branch discharge pipes can be divided into the following types:

- non-ventilated collector branch discharge pipes
- ventilated collector branch discharge pipes

Non-ventilated collector branch discharge pipes

Non-ventilated collector branch discharge pipes are subject to the following application limits:

DN		Σ DU [l/s]			Maximum pipe length L [m]	Maximum height difference Δh ³⁾ [m]	Maximum number of direction changes 90°	Minimum slope J [%]
According to DIN 1986	Geberit recommen- dation	K = 0.5	K = 0.7	K = 1.0				
50	56	1.0	1.0	0.8	4	1	3	1
56	60	2.0	2.0	1.0				
70 ¹⁾		9.0	4.6	2.2				
90 ²⁾		13.0	10.0	5.0	10			
100		16.0	12.0	6.4				

1) No WCs

2) Maximum 2 WCs

3) The height difference Δh describes the dimension between the connection of a sanitary appliance and the pipe bottom of the branch discharge pipe at the transition to the stack.

If one of the application limits cannot be complied with, the collector branch discharge pipe must be ventilated.

The following figures show examples of non-ventilated collector branch discharge pipes with the corresponding application limits.

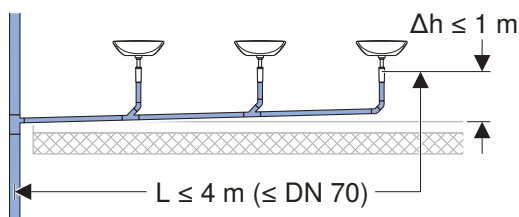


Figure 6: Application limits for a non-ventilated collector branch discharge pipe with nominal width $\leq$ DN 70

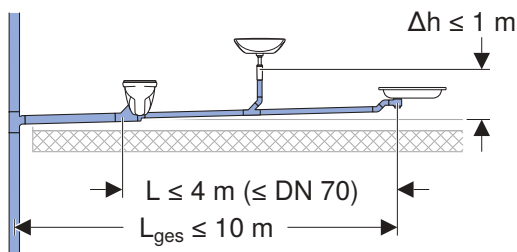


Figure 7: Application limits for a non-ventilated collector branch discharge pipe with nominal width $\geq$ DN 90 connected to a non-ventilated collector branch discharge pipe with nominal width $\leq$ DN 70

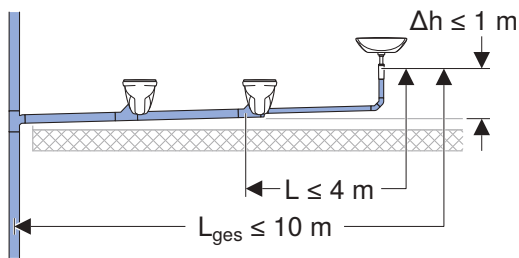


Figure 8: Application limits for a non-ventilated collector branch discharge pipe with nominal width $\geq$ DN 90 connected to a non-ventilated single branch discharge pipe with nominal width $\leq$ DN 70

Ventilated collector branch discharge pipes

The ventilated collector branch discharge pipe is generally dimensioned according to the underground and collector pipe. However, if the ventilated collector branch discharge pipe fulfils one of the following conditions, it must have the same dimensions as the non-ventilated collector branch discharge pipe:

- use in residential constructions ($K = 0.5$)
- $\Sigma DU < 2.0$

Ventilated collector branch discharge pipes are subject to the following application limits:

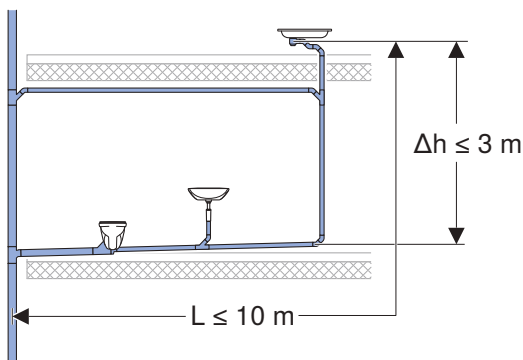


Figure 9: Application limits for a ventilated collector branch discharge pipe

Maximum pipe length L	10 m
Maximum height difference $\Delta h^{1)}$	3 m
Maximum number of direction changes 90°	Unlimited
Minimum slope J	0.5 %

¹⁾ The height difference Δh describes the dimension between the connection of a sanitary appliance and the pipe bottom of the branch discharge pipe at the transition to the stack.

4.1.5 Connection pipes

A connection pipe drains several sanitary appliances of the same type via a common trap.

Connection pipes are subject to the following rules and application limits:

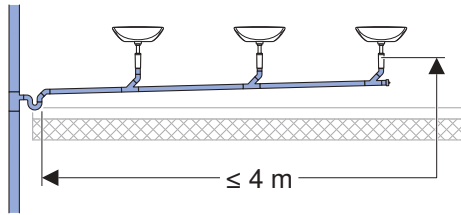


Figure 10: Application limits for a connection pipe

- the maximum pipe length L is 4 m
- an access pipe must be provided at one end of the connection pipe
- dimensioning must be carried out in accordance with the specifications for single and collector branch discharge pipes

The connection pipe is not suitable for preventing odour nuisances from the discharge pipe.

4.1.6 Connection to the stack

The following rules must be observed when connecting stack connectors:

- the height difference Δh between the connection of a sanitary appliance and the pipe bottom of the branch discharge pipe at the transition to the stack must be greater by at least one nominal width than the nominal width of the branch discharge pipe
- outside backing up into the branch discharge pipe must be prevented by:
 - height offset of the stack connector
 - no opposite branch discharge pipe if there is no height offset
 - use of double branch fitting, swept-entry for opposite connection of WCs
- branch discharge pipes $\geq \text{DN } 70$ must be connected with branch fittings $88 \pm 2^\circ$ to the stack

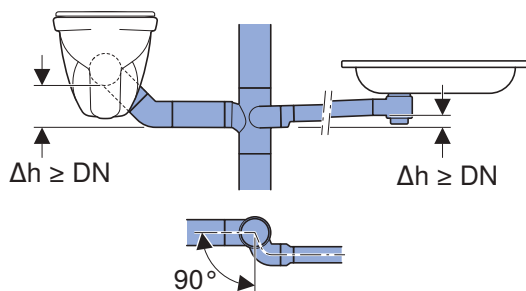


Figure 11: Height difference Δh for stack connector with Geberit duct branch fitting, swept entry

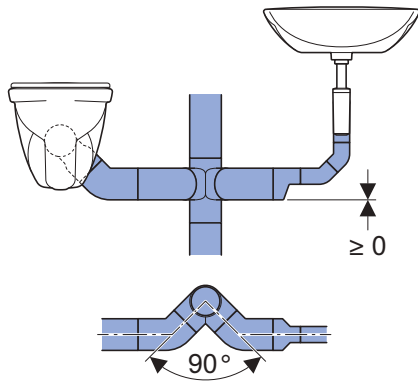
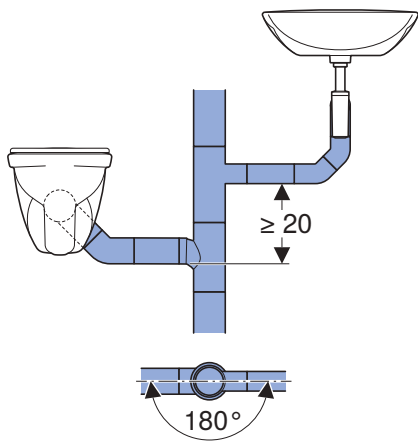
Figure 12: Height difference Δh for stack connector with Geberit corner branch fitting

Figure 13: Stack connector with height offset

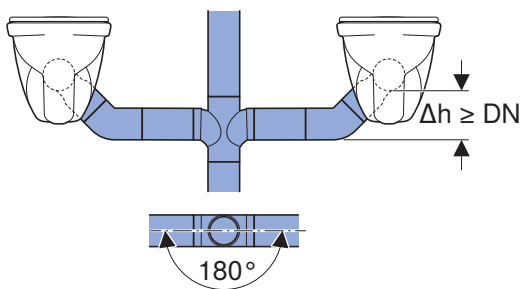


Figure 14: Stack connector with double branch fitting, swept-entry, for opposite connection of WCs

If double branch fittings 87.5° or 88.5°, swept-entry, with a swept-entry of $D/2$ are used for the stack connector, the opposite connection (spread angle = 180°) for faecal-free branch discharge pipes and branch discharge pipes containing faecal matter can be installed on the same pipe bottom and with the same nominal width of the branch discharge pipe.

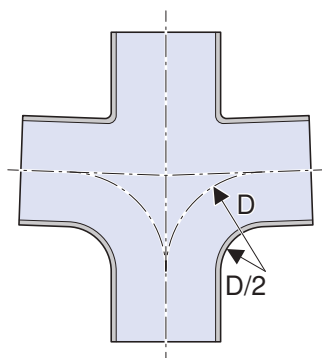


Figure 15: Double branch fitting 87.5° or 88.5°, swept-entry, with a swept-entry of $D/2$

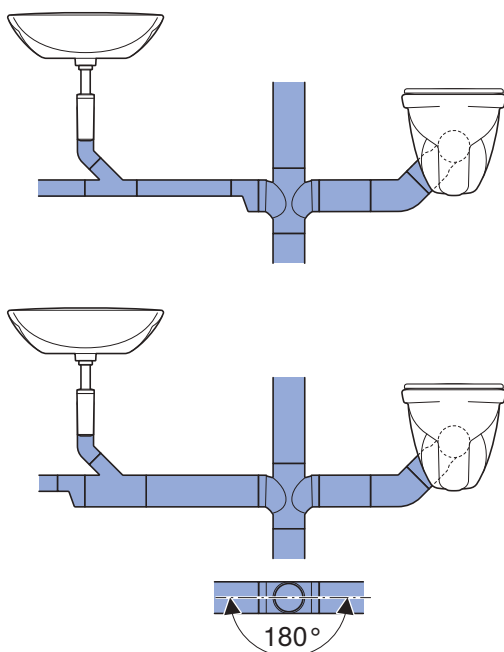
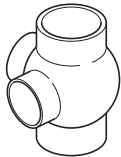
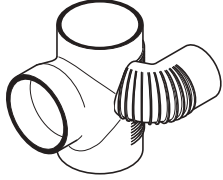
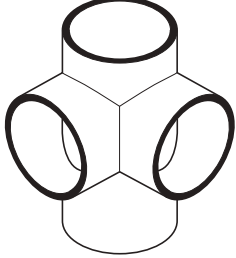
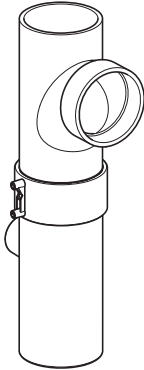
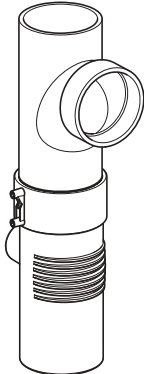
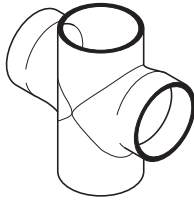


Figure 16: Connection of faecal-free stack connector and stack connector containing faecal matter with double branch fitting, swept-entry, with swept-entry $D/2$

In contrast to a double branch fitting without swept-entry, where only one WC may be connected to each connection, the double branch fitting, swept-entry, can be loaded according to the sum of discharge units DU for single or collector branch discharge pipes or according to the total waste water discharge rate Q_{tot} for collector pipes.

4.1.7 Geberit branch fittings for connecting to branch discharge pipes with WCs

The following table lists the Geberit drainage system branch fittings which can be used to connect branch discharge pipes with WCs. The branch fittings are divided according to the arrangement of their branches.

Branch arrangement	Geberit HDPE	Geberit Silent-db20
90°	 Double branchball 88.5°, connection 90° offset	 Duct branch (swept entry) 88.5°/180° parallel  Corner branch 88.5°/90°
Height offset	 Branch fitting combination	 Branch fitting combination
Specific shape	 Double branchball 88.5°, connection 180° offset	 Double branch fitting 88.5°, swept-entry

4.2 Stack

4.2.1 Dimensioning stacks

Depending on the branch fittings used and the type of ventilation, stacks can be subjected to different loads. Stacks equipped with branch fittings $88^\circ \pm 2^\circ$, swept entry, can be subjected to higher loads than stacks with branch fittings without swept-entry. For the same nominal width and branch fitting types, stacks with secondary ventilation can collect a larger quantity of waste water than stacks with stack vent.

Waste water discharge rate in stacks

The relevant key figure for dimensioning stacks is the waste water discharge rate Q_{ww} in the stack which is determined with the following calculation formula:

$$Q_{ww} = K \cdot \sqrt{\Sigma DU}$$

Q_{ww} Waste water discharge rate

K Discharge value

ΣDU Sum of discharge units DU

Stack with stack vent

Depending on the type of branch fitting, the following maximum waste water discharge rates $Q_{ww \max}$ result for a stack with stack vent:

DN	$Q_{ww \max}$ [l/s]	
	Branch fitting without swept-entry	Branch fitting swept entry
70	1.5	2.0
90 ¹⁾	2.7	3.5
100	4.0	5.2
125	5.8	7.6
150	9.5	12.4
200	16.0	21.0

¹⁾ Minimum nominal width for connecting WCs

Stack with secondary ventilation

Depending on the type of branch fitting, the following maximum waste water discharge rates $Q_{ww \max}$ result for a stack with secondary ventilation:

DN	$Q_{ww \max}$ [l/s]	
	Branch fitting without swept-entry	Branch fitting swept entry
70	2.0	2.6
90 ¹⁾	3.5	4.6
100	5.6	7.3
125	7.6	10.0
150	12.4	18.3
200	21.0	27.3

¹⁾ Minimum nominal width for connecting WCs

Kitchen stack

To prevent grease deposits from clogging the stack, a maximum of four kitchen sanitary appliances may be connected to a DN 70 stack. If there are more than four kitchen sanitary appliances, the waste water discharge rate Q_{ww} must be determined and the stack must be increased by at least one nominal width.

4.2.2 Installing stacks

The following rules must be observed when installing stacks:

- the nominal width must remain the same over the entire stack
- stacks must be ventilated via the roof
- stacks must be laid as straight as possible
- stack offsets must be executed with bends $\leq 45^\circ$

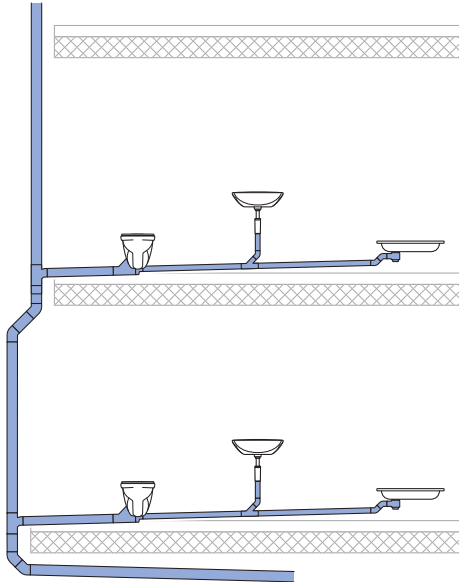


Figure 17: Stack offset with bend $\leq 45^\circ$

If the stack offset is ≥ 1 m and the direction change angle is $\geq 45^\circ$, the following rules must also be observed for the stack offset:

- if the stack offset consists of 2 bends 45° and a transition piece of 250 mm, sanitary appliances must not be connected in the transition piece area
- due to unfavourable pressure conditions in the stack offset area, sanitary appliances must be connected at a distance of at least 50 cm below a stack offset

Adjacent apartments must only be connected to a common stack if sound-absorbing properties and fire protection are taken into account.

Stacks ≤ 10 m

Due to improved hydraulic and acoustic properties, it is recommended to execute the direction change from the stack into the horizontal pipe section with 2 bends 45° . The following distances from the direction changes must be observed for the stack connectors.

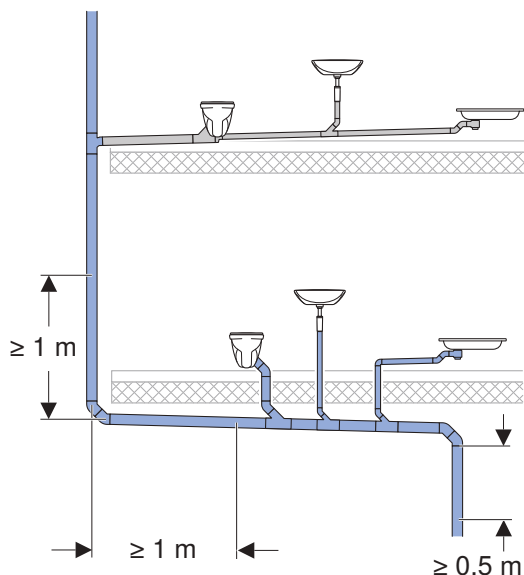


Figure 18: Recommended design for a direction change with 2 bends 45°

Stacks over 10 m

For stacks over 10 m, sanitary appliances in the stack offset area must be connected to the stack via relief stacks.

For stack offsets under 2 m, the direction changes can be executed with 2 bends 45° . The relief stack must be connected to the stack by observing the following distances from the direction changes:

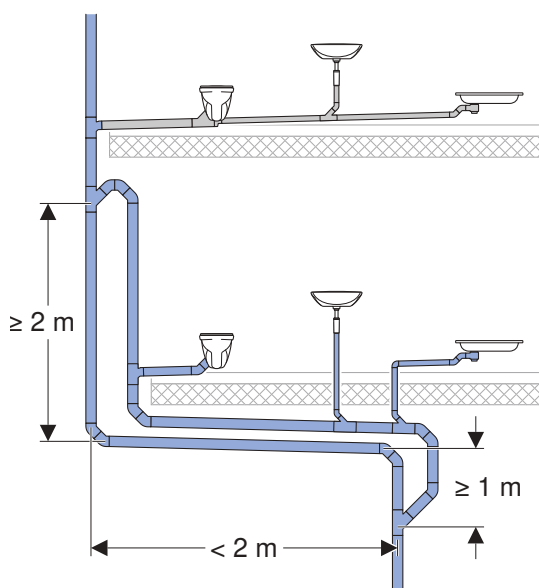


Figure 19: Stack offset less than 2 m

For stack offsets ≥ 2 m, the standard direction change from the stack into the horizontal pipe section is executed with 2 bends 45° and a transition piece with a length of 25 cm.

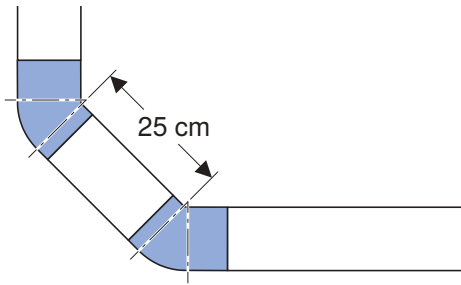


Figure 20: Stack offset ≥ 2 m: standard direction change with 2 bends 45° and a transition piece with a length of 25 cm

The relief stack must be connected to the stack by observing the following distances from the direction changes:

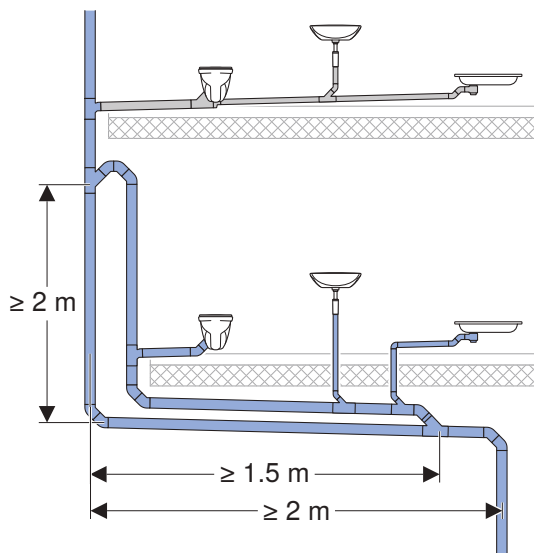


Figure 21: Stack offset ≥ 2 m

4.3 Collector pipes

In buildings, collector pipes should be used instead of underground pipes. In contrast to underground pipes, they are freely accessible and are therefore easier to inspect and maintain.

4.3.1 Dimensioning collector pipes

The following values apply when dimensioning collector pipes:

Filling level h/d_i	0.5 ¹⁾
Minimum slope J	0.5 ‰
Minimum flow velocity	0.5 m/s

¹⁾ If the volumetric flow rate of a faeces lifting system is introduced, a filling level h/d_i of 0.7 can be applied downstream of the faeces lifting system.

Dimensioning depends on the total waste water discharge rate Q_{tot} and the largest single discharge unit DU. The larger of the two values is decisive for dimensioning. Based on the determined value, collector pipes are dimensioned according to DIN EN 12056-2:2001-01.

The total waste water discharge rate Q_{tot} is calculated using the following calculation formula:

$$Q_{tot} = Q_{ww} + Q_C + Q_P$$

Q_{tot} Total waste water discharge rate [l/s]

Q_{ww} Waste water discharge rate [l/s]

Q_C Continuous discharge [l/s]

Q_P Pump discharge volume [l/s]

If the total waste water discharge rate Q_{tot} is < 2.0 l/s, the collector pipe can be dimensioned according to the criteria for non-ventilated collector branch discharge pipes.

4.3.2 Dimensioning example

The following example shows how to determine the decisive value for dimensioning a collector pipe.

Given:

- 1 WC suite 6 l: DU = 2.0 l/s
- 1 floor drain DN 70: DU = 1.5 l/s

Required:

Volumetric flow rate for dimensioning

Solution:

Determine the total waste water discharge rate Q_{tot}

$$Q_{tot} = Q_{ww} + Q_C + Q_P$$

$$Q_{tot} = 0.5 \cdot \sqrt{(2.0 + 1.5)} + 0 + 0 = 0.94 \text{ l/s}$$

Determine the largest single discharge unit DU:

$$DU = 2.0 \text{ l/s}$$

Compare Q_{tot} with DU:

$$DU (2.0 \text{ l/s}) > Q_{tot} (0.94 \text{ l/s})$$

Result:

The collector pipe must be dimensioned for 2.0 l/s.

4.3.3 Installing collector pipes

The following rules must be observed when installing collector pipes:

- changes in direction must be executed with bends 45°
- branch fittings in horizontal pipes must be executed with bends 45°. The lateral connection can have an angle of inclination of 15° to 45°
- double branch fittings must not be used
- collector pipes that are not connected to a stack must be fitted with at least one DN 70 ventilation pipe that is routed over the roof
- access pipes must be provided at least every 20 m

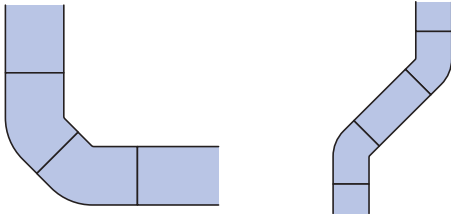


Figure 22: Changes in direction with bends 45°

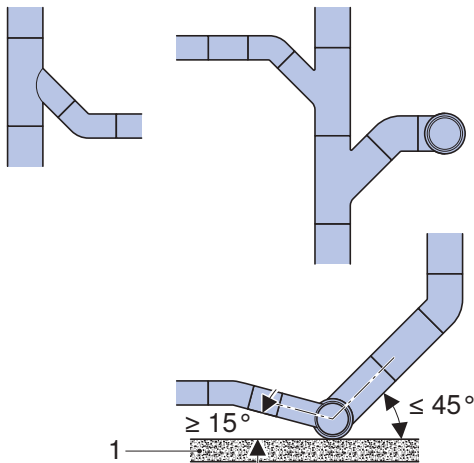


Figure 23: Branch fittings with branches 45°

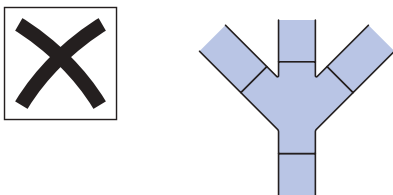


Figure 24: Not permitted: branch fittings with double branches 45°

4.4 Underground pipes

4.4.1 Dimensioning underground pipes

Underground pipes can be laid inside and outside buildings. The following values apply for dimensioning:

	Inside buildings	Outside buildings
Filling level h/d_i	0.5 ¹⁾	0.7 ²⁾
Minimum slope J	0.5 ‰	1 : DN
Minimum flow velocity	0.5 m/s	0.7 m/s
Maximum flow velocity	—	2.5 m/s

¹⁾ If the volumetric flow rate of a faeces lifting system is introduced, a filling level h/d_i of 0.7 can be applied downstream of the faeces lifting system.

²⁾ If the volumetric flow rate of a faeces lifting system is introduced, a filling level h/d_i of 1.0 can be applied downstream of a duct with an open through-flow.

Underground pipes are dimensioned according to the same technique as collector pipes.

If it is possible based on the hydraulic calculation, the underground pipe can be dimensioned up to the nearest duct with a nominal width DN 90 outside the building.

If underground pipes are laid in the ground, a static calculation according to ATV-DVWK-A 127:2000-08 must be determined in the following situations:

- burial depth of the underground pipe ≥ 6 m
- presence of groundwater, imposed loads or other influencing variables

4.4.2 Installing underground pipes

The following rules must be observed when installing underground pipes:

- changes in direction must be executed with bends $\leq 45^\circ$
- changes in direction outside buildings in open or closed ducts must be executed with bends 45°
- branch fittings in horizontal pipes must be executed with bends 45° . The lateral connection can have an angle of inclination of 15° to 45°
- double branch fittings must not be used

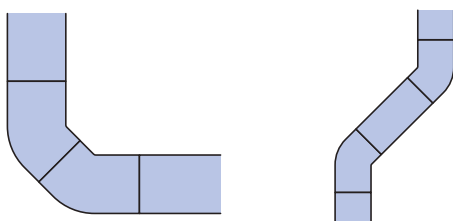


Figure 25: Changes in direction with bends 45°

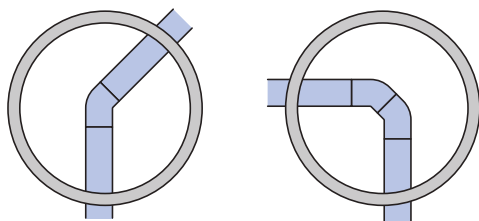


Figure 26: Changes in direction with bends 45° in ducts

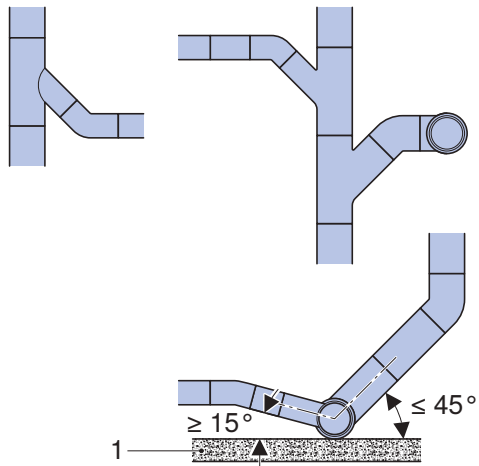


Figure 27: Branch fittings with branches 45°

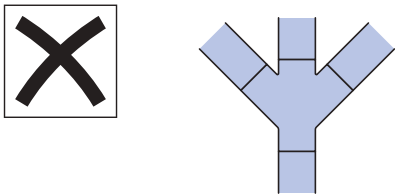


Figure 28: Not permitted: branch fittings with double branches 45°

4.5 Ventilation pipes

4.5.1 Dimensioning ventilation pipes

The open end pipes of the ventilation pipes routed over the roof must have the same cross-section as the ventilation pipe. The openings must not be covered.

Amount of water and air in stacks

The waste water flows along the pipe wall as a water jacket in stacks, creating an air core in the middle. Stacks require a very large amount of air in order to work perfectly hydraulically. The volumetric flow rate of air can be up to 35 times greater than that of waste water. The following table shows the ratio of the volumetric flow rates as a function of the nominal width.

DN	Q_{Water} [l/s]	Q_{Air} [l/s]	$Q_{\text{Air}} : Q_{\text{Water}}$
70	1.0	10.2	10.2
	1.7	10.5	6.3
100	0.8	29.2	35.2
	1.7	39.0	23.4
	3.3	43.0	13.0
	5.0	45.0	9.0
125	0.8	28.8	34.7
	1.7	49.3	29.5
	3.3	64.2	19.5
	5.0	75.0	15.0

Individual ventilation

The following rules must be observed when dimensioning the individual ventilation:

- the nominal width of the individual ventilation must correspond to the nominal width of the stack

Collective ventilation

The following rules must be observed when dimensioning the collective ventilation:

- the pipe cross-section of the collective ventilation must be at least as large as half the sum of the pipe cross-sections of the stacks
- the nominal width of the collective ventilation must be greater by at least one nominal width than the nominal width of the largest individual ventilation. This does not apply to collective ventilation systems in single-family houses

Direct secondary ventilation

The dimensions of the direct secondary ventilation system depend on the nominal width of the stack.

DN Stack	DN Direct secondary ventilation
70	50
90 ¹⁾	50
100	50
125	70
150	90
200	100

¹⁾ Minimum nominal width for connecting WCs

Indirect secondary ventilation

The dimensions of the indirect secondary ventilation system depend on the nominal width of the stack.

DN Stack	DN Indirect secondary ventilation
70	50
90 ¹⁾	50
100	50
125	70
150	90
200	100

¹⁾ Minimum nominal width for connecting WCs

Branch ventilation

The dimensions of the indirect secondary ventilation system depend on the nominal width of the collector branch discharge pipe.

DN Collector branch discharge pipe	DN Branch ventilation
≤ 70	= DN collector branch discharge pipe
> 70	70

Air admittance valves

In ventilation pipes with air admittance valves, the nominal width of the air admittance valve corresponds to the nominal width of the ventilation pipe.

Air admittance valve design:

- $Q_a \geq Q_{tot}$ for single and collector branch discharge pipes
- $Q_a \geq 8 \cdot Q_{tot}$ for stacks

Q_a Atmospheric air [l/s]

Q_{tot} Total waste water discharge rate [l/s]

Air admittance valve	d [mm]	Q_a at 250 Pa [l/s]	Q_{tot} Single and collector branch discharge pipes [l/s]	Q_{tot} Stack [l/s]
GRB50	32/40 / 50	7.5	7.5	—
GRB90	75/90 / 110	32.0	32.0	4.0

4.5.2 Geberit pipe cross-sections

Geberit HDPE pipe cross-sections

DN	d [mm]	A [cm ²]
30	32	5.3
40	40	9
50	50	15.2
56	56	19.6
60	63	25.4
70	75	37.3
90	90	54.1
100	110	80.7
125	125	104.5
150	160	171.1
200	200	276.4
250	250	431.5
300	315	685.3

Geberit HDPE pipe PN4 cross-sections

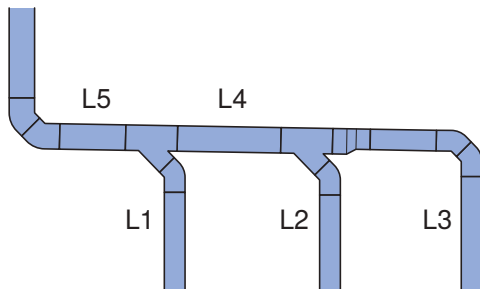
DN	d [mm]	A [cm ²]
200	200	268.4
250	250	418.2
300	315	663.8

Geberit Silent-db20 pipe cross-sections

DN	d [mm]	A [cm ²]
56	56	19.3
60	63	25.1
70	75	36.1
90	90	49
100	110	75.4
125	135	118.7
150	160	167.4

4.5.3 Dimensioning example

The following example shows how to determine the nominal width of a collective ventilation with Geberit Silent-db20.



Given:

- nominal width L1–L3 = DN 100
- pipe cross-section L1–L3 = 75.4 cm²

Required:

Nominal widths of L4 and L5

Solution:

Determine the nominal width of L4:

$$A_{L4} = (A_{L2} + A_{L3}) / 2$$

$$A_{L4} = (75.4 \text{ cm}^2 + 75.4 \text{ cm}^2) / 2$$

$$A_{L4} = 75.4 \text{ cm}^2$$

Nominal width of L4 for a single-family house = DN 100

Nominal width of L4 for all other buildings = DN 125

Determine the nominal width of L5:

$$A_{L5} = (A_{L1} + A_{L2} + A_{L3}) / 2$$

$$A_{L5} = (75.4 \text{ cm}^2 + 75.4 \text{ cm}^2 + 75.4 \text{ cm}^2) / 2$$

$$A_{L5} = 113.1 \text{ cm}^2$$

Nominal width of L5 = DN 125

Result:

The collective ventilation must be dimensioned with DN 125.

4.5.4 Installing ventilation pipes

The following rules must be observed when installing ventilation pipes:

- ventilation pipes must be laid as straight and with as few direction changes as possible
- ventilation pipes must be routed vertically over the roof
- offsets must have a slope and be as short as possible
- direction changes must be executed with bends $\leq 45^\circ$
- the length of a telescopic connection to the air vent must not exceed 1 m
- when the ventilation pipe emerges from the roof, it must be positioned at least 2 m away from windows or supply air openings. If the distance is < 2 m, the ventilation pipe must be routed at least 1 m over windows or supply air openings

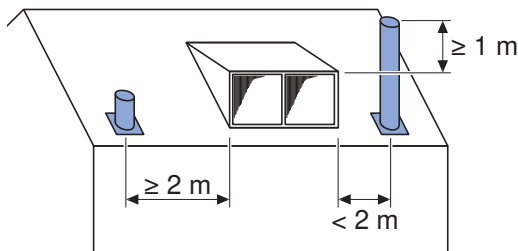
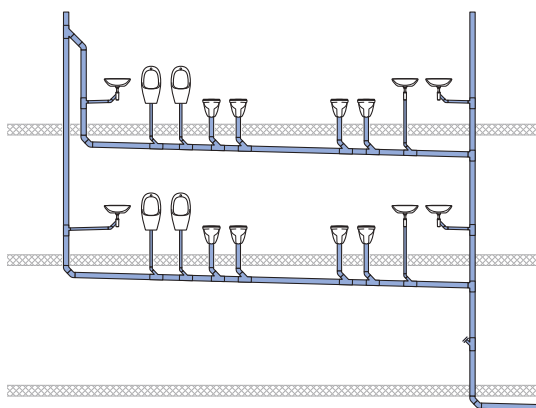


Figure 29: Distance between ventilation pipe and windows and supply air openings

Indirect secondary ventilation

The following rules must be observed when installing indirect secondary ventilation systems:

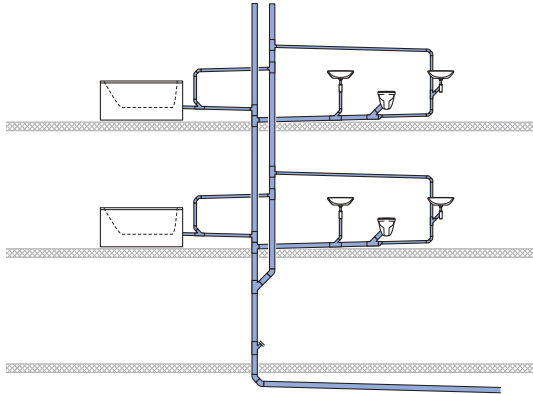
- the indirect secondary ventilation system must be connected upstream of the last sanitary appliance in the collector branch discharge pipe



Branch ventilation

The following rules must be observed when installing branch ventilation systems:

- the branch ventilation system must be connected upstream of the last sanitary appliance in the collector branch discharge pipe



Air admittance valves

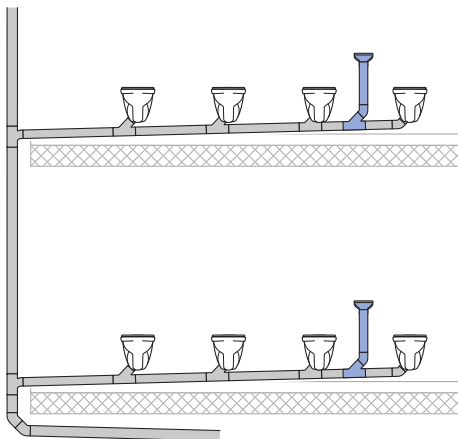
If a stack vent is routed via the roof in single-family or two-family houses, all other stack vents can be replaced by air admittance valves. The air admittance valves must be installed in such a way to ensure a sufficient air supply and that they can easily be reached, for example, for maintenance purposes.

Air admittance valves must not be used in the following cases:

- in areas at risk of backpressure below the highest possible waste water level
- as ventilation systems for separation or faeces lifting systems

The following rules must be observed when installing ventilation pipes with air admittance valves:

- the ventilation pipe with the air admittance valve must be connected upstream of the last sanitary appliance in the collector branch discharge pipe



4.6 Sewage water pipes

4.6.1 Dimensioning sewage water pipes

The minimum nominal width for sewage water pipes is DN 100. The following values must be observed for dimensioning:

Filling level h/d_i	0.7 ¹⁾
Minimum slope J	1 : DN
Minimum flow velocity	0.7 m/s
Maximum flow velocity	2.5 m/s

¹⁾ If the volumetric flow rate of a faeces lifting system is introduced and the nominal width of the sewage water installation is $\geq$ DN 150, a filling level h/d_i of 1.0 can be applied downstream of a duct with an open through-flow.

Sewage water pipes are dimensioned according to the same technique as underground pipes.

The sewage system discharge rate Q_m is calculated using the following calculation formula:

$$Q_m = Q_{ww} + Q_r$$

Q_m Sewage system discharge rate [l/s]

Q_{ww} Waste water discharge rate [l/s]

Q_r Rainwater outflow [l/s]

If sewage water pipes are laid in the ground, a static calculation according to ATV-DVWK-A 127:2000-08 must be determined in the following situations:

- burial depth of the sewage water pipe $\geq$ 6 m
- presence of groundwater, imposed loads or other influencing variables

4.6.2 Installing sewage water pipes

Sewage water pipes drain waste water and rainwater in a common pipe.

In a mixed water system, the discharge and rainwater pipes should be routed separately inside the building and connected in a duct with an open through-flow outside the building.

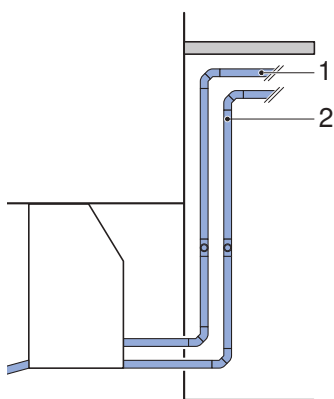


Figure 30: Connecting rainwater and discharge pipes outside the building

- 1 Rainwater pipe
- 2 Discharge pipe

Geberit International Sales AG

CH-8640 Rapperswil
Switzerland

sales@geberit.com

www.international.geberit.com