tech.info

SIMODRAIN® Drainage Pipe Systems

GLOBAL THERMOPLASTIC SOLUTIONS

Contents

1 General

In this tech.info you will find detailed laying information, full filling tables and an example of a calculation for the hydraulic discharge data of our SIMODRAIN® drainage pipe systems.

1.1 Properties

SIMODRAIN® pipes are extruded smooth-wall solid pipes made of PE. Owing to their high static and dynamic load capacity and their excellent material properties, they are used in all line categories and zones of railways (inner and outer pressure zones as well as outside the pressure zone) and for heavy-load traffic.

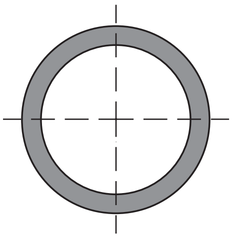
Tasks of drainage systems
- Fast interception, collection and discharge of inflowing water
- Absorption and discharge of unbound gravitational water
- Prevention of surface water penetration into the earth structure and supporting medium
- Elimination of further water flow from the supporting medium in order to prevent damage due to frost

Benefits of PE piping systems in traffic route engineering
- Fracture-resistant pipe owing to high flexibility
- Can be rinsed out at high pressure in accordance with DIN 19523, Procedure 1
- Ring stiffness in accordance with DIN EN ISO 9969 and DIN EN 12666
- Suitable for very high static and dynamic loads
- Resistant to all substances normally contained in the ground
- Favourable hydraulic conditions due to smooth interior pipe surfaces ($k \leq 0.01$ mm)
- Trouble-free open-air storage due to UV and frost resistance
- Fast laying due to socket connection and long overall lengths
- Slot pattern based on DIN 4266 and 4262; DBS 918 064
- Easy handling due to light weight

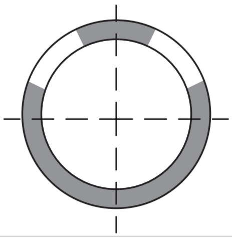
SIMODRAIN® slot types

Depending on what demands are placed on the drainage of track beds and road beds, there are SIMODRAIN® drainage pipes available with four different types of slot. The slot geometry of SIMODRAIN® pipes enables optimal rinsability.

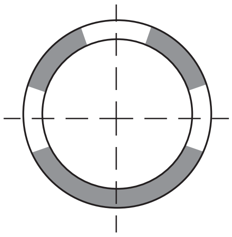
As opposed to the side-milling cutter method there are no undercuts, pockets or notch stress-sensitive radii in which iron ochre deposits and incrustations can develop and accumulate.



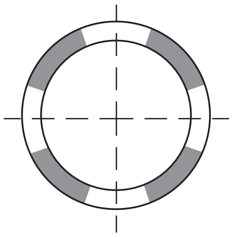
SIMODRAIN® multi-purpose pipes, unslotted (UP)*
Unslotted SIMODRAIN® pipes are used for the discharge of large flows of water. They are used as collecting drains and they convey water to the receiving water course via shafts. As opposed to the other types of slot they do not have the function of water absorption.



SIMODRAIN® multi-purpose pipes, 1/3 slotted (MP)*
On the one hand, multi-purpose pipes act not only as partial leachate pipes (drainage of the soil material) but also act as collecting drains for relatively long distances in the area of the closed cross section at the bottom.



SIMODRAIN® partial leachate pipes, 2/3 slotted (LP)*
Partial leachate pipes are embedded in a pipe bottom inclined towards the partial leachate pipe and they absorb leachate water, artesian water and surface water through the slots at the top, conveying it to the next receiving water course in the enclosed bottom area.



SIMODRAIN® full leachate pipes, 3/3 slotted (TP)*
For sections with a supporting medium capable of seepage full leachate pipes are most effective. Owing to their slots distributed around the circumference of the pipe and a bedding course made of filter material not only leachate water and artesian water but also water pressing from below (unbound gravitational water) can be absorbed and taken to the nearest collecting drain.

* Designation based on DIN 4262-1

1.2 Stability and operational reliability

The stability and operational reliability of railway structures depend on the mutual influences exerted by the components being used, for example, pipes, fittings, shafts, embedding materials and backfill materials in the trench.

The works to be performed at the construction site, such as the laying of pipes and shafts in the trench, the making of pipe and shaft connections, embedding, as well as the side and main backfills, are key factors determining safe operation of the railway structure as intended. These works may only be performed by experienced, specially trained personnel.

To make sure a railway line remains operational in the long term, it is essential to have a drainage system that is continuously effective. SIMODRAIN® piping systems ensure controlled discharge of leachate water, surface water and artesian water and provide maximum reliability to ensure the long-term stability of traffic routes, even if there is heavy rainfall.

To be able to use permanent ways safely and without any operating restrictions in the long term, drainage systems have to be not only capable of bearing static and dynamic loads but also resistant to fracture.

Static and dynamic live loads and soil loads are the highest mechanical forces acting on drainage pipes. The system is also exposed to hydraulic loads due to the influx of water above and below ground.

For the long-term drainage of traffic route structures water under pressure and in situ water in the structure has to be discharged directly. That is the only way to avoid water infiltration into the pipe bedding and prevent associated damage and instabilities in the rail network.

1.3 Areas of use

According to approvals by the German Federal Railways Office (EBA) and manufacturer-related product qualification (HPQ) in accordance with DBS 918 064, the SIMODRAIN® system can be used for railway construction.

Other fields of application:
- Tunnel construction
- Road construction
- General supporting soil drainage
- Landfill drainage
- Rehabilitation

1.4 Range of products

For detailed information on the current range of SIMODRAIN® drainage pipes and matching fittings and shafts, please refer to our brochure "SIMODRAIN® Drainage Pipe Systems for Traffic Route Construction". You will also find information on other SIMONA products at www.simona.de.

Our staff in Sales will be pleased to advise you:
Phone +49 (0) 67 52 14-327
Fax +49 (0) 67 52 14-211
sales@simona.de

The SIMODRAIN® Drainage Pipe Systems brochure

2 Transport and storage

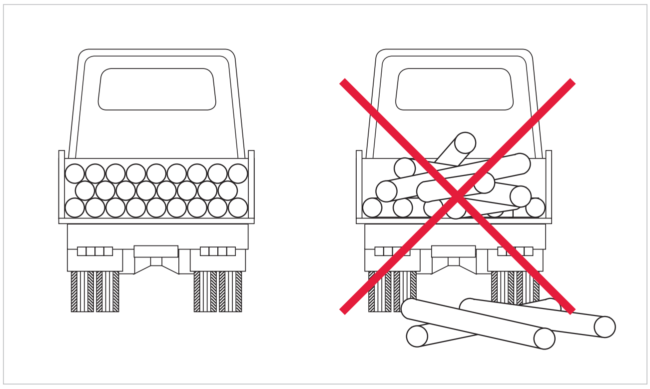
The delivery of components, on-site transport, processing and installation have to be monitored by the client. Suitable precautions must be taken to ensure intended use for the construction of a good-quality structure. That is the only way to ensure long-term, permanently safe use.

During construction work it is essential to comply with the following: the applicable accident prevention regulations issued by the employer's liability insurance associations, the road traffic regulations and the guidelines for safeguarding work zones in traffic route construction.

Pipes and fittings must be loaded onto vehicles and unloaded with due care. They must not be dragged over a load sill. During storage and when in transit the pipes should preferably make contact with the supporting surface over their entire length and must be secured in such a way that transport does not cause any dents or other damage.

When loading and unloading unpackaged bundles of pipes, fabric straps must be used (no chains, wire cables, etc.). The loading of very long pipes should be performed using spreaders. It is not permitted to drag the pipes or fittings over the ground, across sills or over rough surfaces. Scores and scratches on the pipe surface exceeding 10 % of pipe wall thickness are not allowed. At the insertion ends – especially in the welding/insertion zone – there must be no irregularities on the surface.

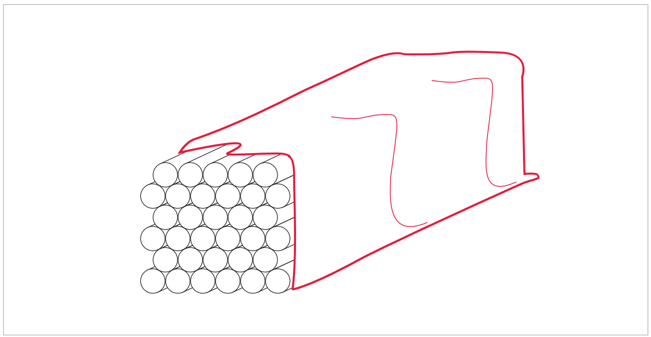
Pipes and pipeline parts must be checked with regard to their condition (i.e. checked for damage). The material, dimensions and unit quantity must agree with the information on the delivery note.



Transporting plastic pipes

In storage, care must be taken to prevent contact with substances that damage materials (e.g. solvents, petrol, oil, bitumen, etc.). The area of support must be flat and devoid of stones and sharp-edged objects.

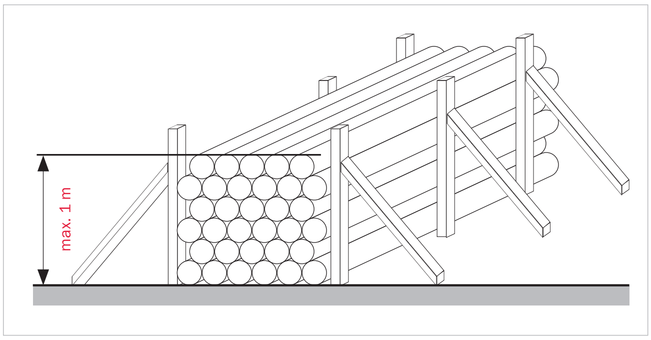
Pipes and fittings can be stored in the open air. Owing to the thermoplasticity of plastic pipes, any unilateral exposure to heat may lead to deformation, thus making correct laying more difficult, especially if the gradient is minimal. Protection against direct sunlight prevents the pipes from becoming distorted by a unilateral change in length. This can be achieved by covering them with light-coloured plastic sheets. Good ventilation should be provided in order to prevent heat from building up. Avoid any exposure to intense sunlight that lasts over a month.



On-site storage in wooden frame under a light-coloured plastic sheet.

Stacks of PE 100 pipes must not exceed a height of 1.0 m in order to prevent the lower part of the stack from being subjected to excessive loading. If, when stacking, pieces of wood are placed in between, they must be at least 100 mm wide.

They must be supported with shims and side posts of sufficient width at intervals of 1 m max. so that storage does not cause any permanent bends, dents or other damage.



Storing plastic pipes

3 Processing

On railway construction sites with services still running the time windows available are very limited. Therefore, the focus is on pipelaying methods that can be performed quickly but nevertheless ensure permanently watertight pipe connections.

The system solution developed by SIMONA is the integral socket connection WIMU. It is characterised by extremely easy handling. We also offer our know-how with regard to traditional pipelaying methods, such as the push-on connection using a double socket, or welded joints.

3.1 Integral socket connection WIMU

This joining method produces particularly cost-effective pipe connections and high pipelaying rates. The integral socket connection, WIMU, where the tapered end and socket end are directly affixed to the pipe section at the factory, allows a secure, permanently watertight joint.

The tapered and socket ends and the sealing rings of the pipelines have to be checked for clean surfaces and serviceability. Soiling due to gravel, sand, chippings and any other objects that could damage the material are not allowed in the insertion zone. If necessary, the surfaces to be joined must be cleaned by suitable means. Sealing rings have to be checked for any signs of damage. Damaged sealing rings must not be used. For the socket connection use lubricants that are standard for plastic pipes. Oils and greases are not allowed.

Insertion of the pipes should be performed with consistent force being applied. For perforated SIMODRAIN® pipes we recommend using our manual insertion tool.

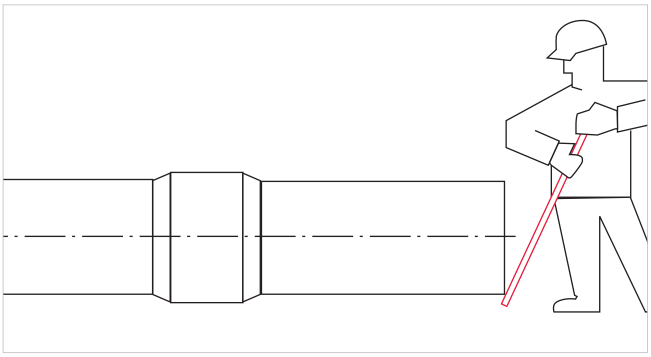
Manual insertion tool from SIMONA (see page 18)

If the pipes have to be pushed together by leverage, squared timber should be placed crosswise in front of the pipe being inserted in order to improve force distribution. In doing so, the pipe ends should be protected against damage. The pipe must be inserted until it comes to a stop.

3.2 Push-on connection using double socket

When making pipe connections (socket/push-on connection) the socket insertion depth must be checked and marked on the pipe. Check the sockets and sealing rings for clean surfaces and serviceability. Soiling due to gravel, sand, chippings and any other objects that could damage the material are not allowed in the insertion zone. If necessary, the surfaces to be joined must be cleaned by suitable means. Sealing rings have to be checked for any signs of damage. Damaged sealing rings must not be used. For the socket connection use lubricants that are standard for plastic pipes. Oils and greases are not allowed.

To join the connection points the pipes must be chamfered at the ends. Insertion of the pipes should be performed with consistent force being applied.



Pipe insertion by leverage

If the pipes have to be pushed together by leverage, squared timber should be placed crosswise in front of the pipe being inserted in order to improve force distribution. In doing so, the pipe ends should be protected against damage. The pipe must be inserted up to the insertion depth marked previously.

If pipes have to be shortened by the client, use appropriate tools such as pipe cutters and suitable saws (as used in wood processing, for example). The cut must be made at right angles to the axis of the pipe. After shortening, chamfer the ends of the pipes again and remove any flash or unevenness using scrapers.

3.3 Welding

The methods of heated-tool butt welding and electrofusion welding are generally regulated in DVS 2207-1. The guideline constitutes the basis of processing and it is assumed to be known. When installing the pipes with electrofusion welding sockets it is also essential to follow the pipelaying instructions issued by the respective socket manufacturers.

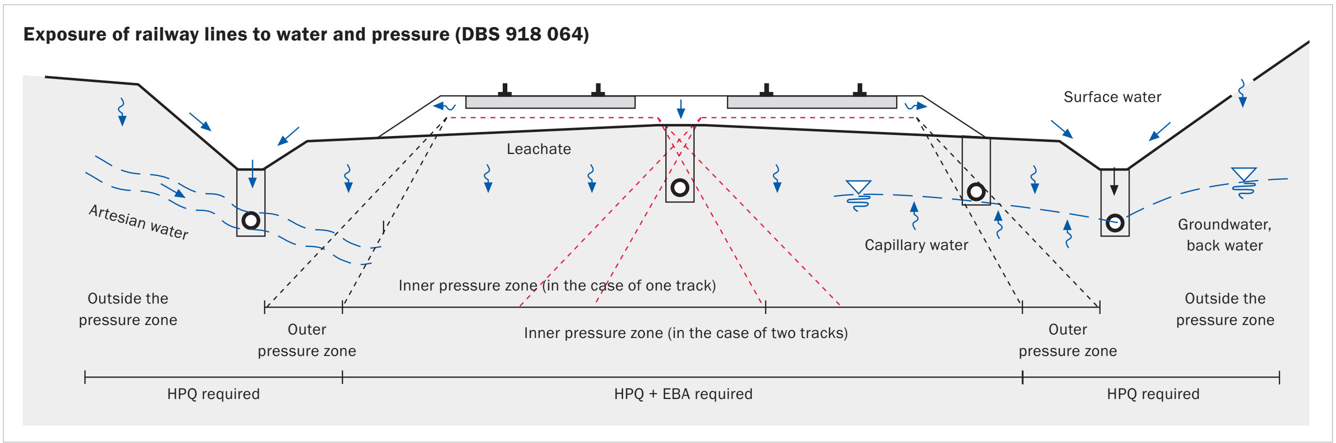
The quality of a welded joint depends not only on the suitability of the materials and jigs but also on the qualifications of the welders. Well-trained welders are absolutely essential. For documentation purposes a welding record based on the DVS specimen templates is recommended.

If assembly is not possible despite the descriptions concerning welding procedures, please contact SIMONA's technical advisory service before conducting a welding test.

Our staff from the Applications Technology unit (Pipes and Fittings division) will be only too pleased to advise you:
Phone +49 (0) 6752 14-315
pipingsystems@simona.de

4 Placement

SIMODRAIN® pipes can be used in all railway line categories and zones (inner and outer pressure zones as well as outside the pressure zone) and for heavy-load traffic.



Pressure zones of railway lines

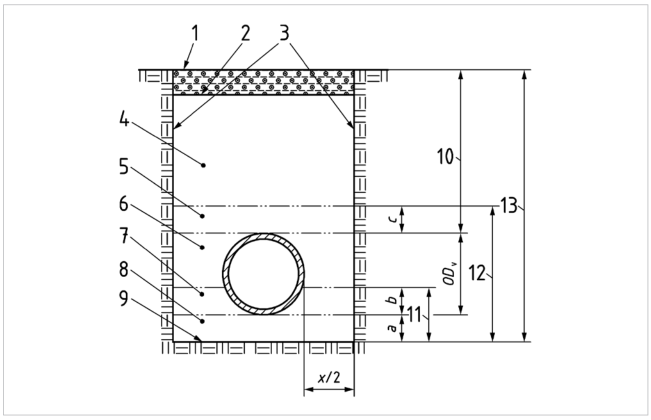
4.1 Outer pressure zone and outside the pressure zone

SIMODRAIN® pipes and shafts are laid in accordance with the valid rules of pipeline construction, e.g. DIN EN 1610 (Laying and Testing of Waste-water Pipes and Sewers), DIN 4124 (Building Pits and Trenches – Slopes, Sheeting, Working Space Widths) and the requirements of DB Netz AG (Ril 836, TM and DBS 918 064).

Below you will find key extracts from the codes of practice. The use of extracts does not relieve the laying contractor of its obligation to heed the entire content of the codes of practice referred to above.

4.1.1 Trench sheeting

Structure for stabilising the trench and protecting persons inside the trench.



1 Surface
2 Bottom edge of the road or track structure
3 Trench walls
4 Main backfill
5 Covering
6 Side backfill
7 Upper bedding course, b
8 Lower bedding course, a
9 Trench floor
10 Cover height
11 Thickness of bedding
12 Thickness of the pipe zone
13 Trench depth
a Thickness of the lower bedding course
b Thickness of the upper bedding course
c Thickness of the covering
ODv Vertical outside diameter
x/2 Minimum working space between pipe and trench wall or trench sheeting

4.1.2 Minimum trench width

Minimum trench width must ensure a minimum working space equal in total to the higher value in Tables 1 and 2. Compliance with national regulations should be checked.

Table 1: Minimum trench width in relation to nominal diameter (DN) of the pipe

DIN	Minimum trench width (OD_h + x) mm		
	Sheeted trench	Unsheeted trench	
		β > 60°	β ≤ 60°
≤ 225	OD_h + 0.40	OD_h + 0.40	OD_h + 0.40
> 225 to ≤ 350	OD_h + 0.50	OD_h + 0.50	OD_h + 0.40
> 350 to ≤ 700	OD_h + 0.70	OD_h + 0.70	OD_h + 0.40
> 700 to ≤ 1200	OD_h + 0.85	OD_h + 0.85	OD_h + 0.40
> 1200	OD_h + 1.00	OD_h + 1.00	OD_h + 0.40

In the formula OD_h + x, x/2 equals the minimum working space between the pipe and the trench wall or the trench sheeting (if any). In this case:
OD_h is the horizontal outside diameter in m
β is the angle of slope of the unsheeted trench, measured in relation to the horizontal

Under the following conditions it is necessary to specify a smaller width than required:

- if staff are not allowed to access the trench
- if staff never require access to the trench or the space between the pipeline and the trench wall, e.g. if using automated methods of placement
- at inevitable fixed points, e.g. due to awkward local conditions in parts of zones
- if self-compacting backfill materials are used

In each of these isolated cases special measures are required in planning and construction work, including safety precautions, in order to ensure the protection of workers in the trench. National regulations should be checked. If there are any deviations from the trench widths used in the structural pipe analysis, structural sizing has to be reviewed or revised.

Table 2: Minimum trench width in relation to trench depth

Trench depth m	Minimum trench width m
< 1.00	No information
≥ 1.00 ≤ 1.75	0.80
> 1.75 ≤ 4.00	0.90
> 4.00	1.00

4.1.3 Bedding and supports

The gradient of the trench floor and the material of the trench floor must agree with the specifications in the planning requirements.

In the event of frost it may be necessary to protect the trench floor so that no frozen layers remain below or around the pipeline.

If pipes are placed directly on the trench floor, it must be prepared according to the required gradient and the necessary shape in order to enable the pipe barrel to be supported.

Where the trench floor is unstable or the soil has a low load capacity, suitable precautions must be taken. The original load capacity of the in situ soil is the minimum required for the trench floor.

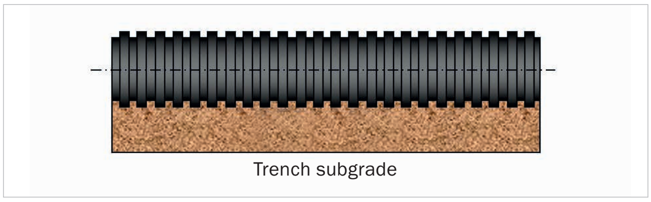
Trenches should be kept free of water during placement work. Precautions must be taken to prevent fines from being washed out during the predraining process.

The influence of predraining operations on groundwater movement and the stability of the surrounding area must be taken into account.

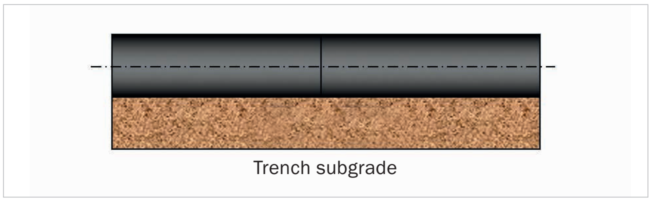
The bedding of pipes is placed in accordance with the requirements of DIN EN 1610 Type 1 to Type 3 and the requirements of the relevant codes of practice. It must ensure uniform pressure distribution under the pipe in the supporting zone. The same type of bedding must be provided over at least one pipe length.

In the case of smooth-walled, extruded SIMODRAIN® pipes no special measures are required in the subgrade along the straight pipe section (e.g. profiling). Around the socket connection a recess must be made in the subgrade in order to prevent undue stress peaks occurring in that area owing to different supports.

If pipes with the integral socket connection WIMU are laid, no further work is necessary afterwards in the trench subgrade. The pipes lie flat on the trench floor. The pipe zone can be homogeneously compacted accordingly.



More elaborate configuration of trench subgrade for profiled pipes



Making the trench subgrade is simple with a WIMU integral socket connection

4.1.4 Concrete supports and concrete jacket

Direct placement of plastic pipes on concrete is not permitted according to the engineering rules applicable (e.g. DWA-A127).

A concrete subgrade may be necessary for structural reasons (e.g. realisation of slight gradients or ground waterproofing). In this case, it will be necessary to make an intermediate layer of suitable soil between the pipe and the concrete subgrade, approx. 150 mm below the pipe bottom and approx. 100 mm below the socket.

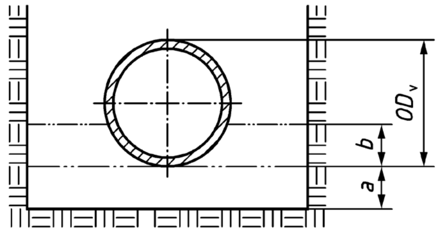
If ground waterproofing is necessary, a suitable bedding material (e.g. aggregate 1 (grain size 1) as per DBS 918 062) must be used so that the static and hydraulic requirements are met.

If static or structural conditions (e.g. in tunnel construction) call for a complete concrete jacket, it must be designed in such a way that the entire static load can be absorbed by the concrete jacket.

Bedding type 1

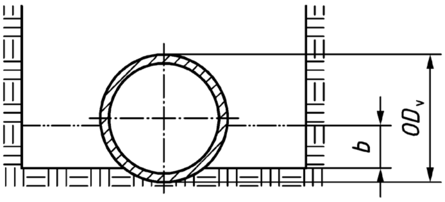
The thickness of the lower bedding course (a) must not be less than the following figures:

- 100 mm for normal soil conditions
- 150 mm for rock or solidified soils



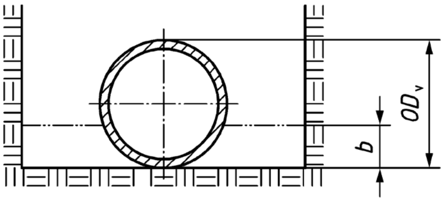
Bedding type 2

Bedding type 2 may be used in homogeneous, relatively loose, fine-grained soil, which makes it possible to support the pipes over their entire length. Pipes may be placed directly on the pre-shaped, prepared trench floor. The thickness (b) of the upper bedding course must conform to the structural analysis.



Bedding type 3

Bedding type 3 may be used in homogeneous, relatively loose, fine-grained soil, which makes it possible to support the pipes over their entire length. Pipes may be placed directly on the prepared trench floor. The thickness (b) of the upper bedding course must conform to the structural analysis.



4.1.5 Pipe zone

Placement of the side backfill in the pipe zone can only take place when the pipes have been laid on the bedding according to specifications, the pipe joints have been made properly and the load capacity and load absorption by the roadbed are guaranteed.

Penetration by in situ soil and displacement of material must be prevented – using a nonwoven if necessary.

In the pipe zone, work should be performed with lightweight compacting equipment (e.g. a hand tamper or a lightweight vibratory tamper). The bedding course must be placed in such a way that the wedges under the pipe are backfilled and compacted in accordance with the structural requirements and DIN EN 1610.

The construction materials being used must be in conformity with the planning requirements. Such construction materials must not have any detrimental effect on the pipe material or the groundwater. The material used must act as a stable filter vis-à-vis the soil being drained and the in situ soil.

In the pipe zone it is preferable to use stone-free, compactable soils in soil class BK3 as per DIN 18300 or G1, G2 and G3 as per DWA-A127. The use of prepared excavated trench soil or other soils (e.g. barrier courses) is permissible if they meet the requirements in terms of structural specifications and the pipe/soil system.

4.1.6 Placement of pipes

SIMODRAIN® pipes must be inspected for damage before placement. The pipes should be laid in such a way that their marking (labelling) is visible at the crown of the pipes when they are in place. Care must be taken to ensure that in the case of partially perforated (1/3 and 2/3 slotted) pipes the run-off channel rests on the pipe support. The pipes have to be placed in the trench with suitable lifting gear. Damage to pipes during placement must be avoided.

SIMODRAIN® pipes and shafts can, if soil conditions permit, also be laid under adverse weather conditions, e.g. rain and/or temperatures below 0 °C. Tests conforming to DIN EN 1411 and DIN EN 1852 have proved that SIMODRAIN® pipes slotted all round withstand a drop weight of 10 kg / 12.5 kg at a temperature of –20 °C and a drop height of 2.0 m without sustaining any failure in the material or in perforation geometry. Thus, they surpass the requirements of DBS 918 064.

When joining up to structures the thermoplastic material properties of PE pipes mean it may be necessary to take into account a potential thermal change in length because of a different temperature during pipelaying operations. The mean coefficient of linear thermal expansion of polyethylene to be taken into account in this case is 1.8×10^{-4} m/(m x K).

The main backfilling operation must be performed in accordance with the planning requirements and after the completion of trench backfilling work the surface of the terrain has to be made according to the client's requirements.

If during the construction phase the minimum pipe covers specified in code of procedure DWA-A127 cannot be maintained, appropriate measures must be taken to prevent the pipelines from being driven over.

4.1.7 Laying pipes in curves

Owing to the high flexibility of SIMODRAIN® pipes, it is possible to also lay the pipes in radii to match the laying route of the tracks. For the permissible bending radii refer to Table 3. Local kinks in the socket connections are permissible up to 0.5°.

Table 3:
Permissible bending radii for SIMODRAIN® pipes SDR 17 / 17.6 / 11; for SDR class 21 the figures must be multiplied by 1.5

Material	Laying temperature		
	≥ 0 °C	~ 10 °C	~ 20 °C
PE	50 x d	35 x d	20 x d

4.1.8 Structural analysis

The structural analysis of SIMODRAIN® pipes and shafts should be based on code of procedure DWA-A127. For the preparation of a verifiable structural analysis the client must state the necessary local soil and placement conditions as indicated in our questionnaires.

The manufacturer's calculations conducted for the pipes and shafts are chargeable verifiable structural analyses. Prior to placement of the pipes and shafts the latter have to be checked by an independent test institute appointed by the owner or client.

4.2 Inner pressure zone

In addition to the specifications for the outer pressure zone and outside the pressure zone, the requirements of the valid EBA approval, including annex and appendices, have to be complied with for the laying of PE 100 pipes in the inner pressure zone. This code of practice can be requested from SIMONA AG's technical advisory service.

Please address your enquiry to our staff at the Applications Technology unit (Pipes and Fittings division):
Phone +49 (0) 6752 14-254
pipingsystems@simona.de

You will find key extracts from the approval (cover heights and minimum trench widths) in the tables below. However, the latter do not apply to placement in systems with a slab track (FF). The use of extracts from the above-mentioned EBA approval does not relieve the processing contractor of its obligation to heed the entire content of the approval.

Direction changes in the inner pressure zone using PE 100 pipe bends in compliance with the DB codes of practice can only be implemented up to 15° max. per bend if there are no separate structural proofs available.

For track crossings only unperforated drainage pipes are allowed.

Trenchless pipelaying by means of the HDD method (horizontal directional drilling – a wash boring method) and the use at times of flowable, self-compacting and cohesive, frictionally restabilising backfill material (so-called liquefied soil as per RAL quality mark 507) are permissible under certain circumstances. For more details, please refer to the EBA approval.

If placement deviates from the EBA approval (e.g. inadequate cover height), an "Internal Company Permit ('U. i. G.')" from DB AG and "Consent in an Individual Case ('Z. i. E.')" from the German Federal Railways Office ('EBA') will be required. For this purpose the EBA has a code of practice available on its website at www.eba.bund.de , from which details can be taken.

Cover heights and minimum trench widths for SIMODRAIN® pipes in SDR classes 17 and 17.6

	SDR 17 made of PE 100		SDR 17.6 made of PE 100	
Outside diameter	G1 in E1 + E2 with 95 % Proctor		G1 in E1 + E2 with 95 % Proctor	
	Cover min/max	Min. trench width with sheeting	Cover min/max	Min. trench width with sheeting
d mm	$h_ü$ mm	b mm	$h_ü$ mm	b mm
160 TP	1,100	**1,000**	1,400	**1,000**
	6,000	**1,000**	6,000	**1,000**
160 UP, MP, LP	1,100	**1,000**	1,100	**1,000**
	6,000	**1,000**	6,000	**1,000**
180 TP	1,100	**1,000**	1,400	**1,000**
	6,000	**1,000**	6,000	**1,000**
180 UP, MP, LP	1,100	**1,000**	1,100	**1,000**
	6,000	**1,000**	6,000	**1,000**
200 TP	1,100	**1,000**	1,400	**1,000**
	6,000	**1,000**	6,000	**1,000**
200 UP, MP, LP	1,100	**1,000**	1,100	**1,000**
	6,000	**1,000**	6,000	**1,000**
225 TP	1,100	**1,000**	1,400	**1,000**
	6,000	**1,000**	6,000	**1,000**
225 UP, MP, LP	1,100	**1,000**	1,100	**1,000**
	6,000	**1,000**	6,000	**1,000**
250 TP	1,200	**1,000**	1,500	**1,000**
	6,000	**1,000**	6,000	**1,000**
250 UP, MP, LP	1,100	**1,000**	1,100	**1,000**
	6,000	**1,000**	6,000	**1,000**
280 TP	1,300	**1,100**	1,500	**1,100**
	6,000	**1,100**	5,900	**1,100**
280 UP, MP, LP	1,100	**1,100**	1,100	**1,100**
	6,000	**1,100**	6,000	**1,100**
315 TP	1,400	**1,200**	1,500	**1,200**
	6,000	**1,200**	5,600	**1,200**
315 UP, MP, LP	1,100	**1,200**	1,100	**1,200**
	6,000	**1,200**	6,000	**1,200**
355 TP	1,300	**1,400**	1,500	**1,400**
	6,000	**1,400**	5,700	**1,400**
355 UP, MP, LP	1,100	**1,400**	1,100	**1,400**
	6,000	**1,400**	6,000	**1,400**
400 TP	1,500	**1,500**	1,500	**1,500**
	6,000	**1,500**	5,300	**1,500**
400 UP, MP, LP	1,100	**1,500**	1,200	**1,500**
	6,000	**1,500**	6,000	**1,500**
450 TP	1,500	**1,600**	1,500	**1,600**
	5,600	**1,600**	4,700	**1,600**
450 UP, MP, LP	1,100	**1,600**	1,300	**1,600**
	6,000	**1,600**	6,000	**1,600**
500 TP	1,500	**1,700**	1,500	**1,700**
	4,900	**1,700**	3,900	**1,700**
500 UP, MP, LP	1,500	**1,700**	1,300	**1,700**
	6,000	**1,700**	6,000	**1,700**
560 TP	Use only with individual proof			
560 UP, MP, LP	2.000	**1.800**	1.700	**1.800**
	4.800	**1.800**	3.500	**1.800**
630 TP	Use only with individual proof			
630 UP, MP, LP				

Trench width figures in **boldface** indicate an increase in size compared to the minimum trench width specified in DIN EN 1610.
The use of G2 for trench backfilling is only permissible with individual proof.

Cover heights and minimum trench widths for SIMODRAIN® pipes in SDR class 11

	SDR 11 made of PE 100	
Outside diameter	G1 in E1 + E2 with 95 % Proctor	
	Cover min/max	Min. trench width with sheeting
d mm	$h_{ü}$ mm	b mm
160 TP	1,100	800
	6000	1,000
160 UP, MP, LP	1,100	800
	6,000	1,000
180 TP	1,100	800
	6,000	1,000
180 UP, MP, LP	1,100	800
	6,000	1,000
200 TP	1,100	800
	6,000	1,000
200 UP, MP, LP	1,100	800
	6,000	1,000
225 TP	1,100	800
	6,000	1,000
225 UP, MP, LP	1,100	800
	6,000	1,000
250 TP	1,100	800
	6,000	1,000
250 UP, MP, LP	1,100	800
	6,000	1,000
280 TP	1,100	800
	6,000	1,000
280 UP, MP, LP	1,100	800
	6,000	1,000
315 TP	1,100	850
	6,000	1,000
315 UP, MP, LP	1,100	850
	6,000	1,000
355 TP	1,100	900
	6,000	1,000
355 UP, MP, LP	1,100	900
	6,000	1,000
400 TP	1,100	1,100
	6,000	1,100
400 UP, MP, LP	1,100	1,100
	6,000	1,100
450 TP	1,100	1,150
	6,000	1,150
450 UP, MP, LP	1,100	1,150
	6,000	1,150
500 TP	1,100	1,200
	6,000	1,200
500 UP, MP, LP	1,100	1,200
	6,000	1,200
560 TP	1,100	1,250
	5,900	1,250
560 UP, MP, LP	1,100	1,250
	6,000	1,250
630 TP	1,100	1,330
	4,400	1,330
630 UP, MP, LP	1,100	1,330
	5,600	1,330

The use of G2 for trench backfilling is only permissible with individual proof.
For pipes with diameters > 250 the regulation in Ril 836.4502 ($h_{ü} \geq 20\,d + 600$) must be complied with in those cases in which only the minimum cover is placed. If necessary, an Internal Company Permit ('U. i. G.') will be required.

5 Services

Accessories service

Manual insertion tool for slotted SIMODRAIN® pipes with WIMU socket connection
For professional processing of SIMODRAIN® pipes we also offer you appropriate accessories and machines.

The pipelaying aid specially developed for on-site installation makes it easy for you to join slotted SIMODRAIN® pipe modules with a WIMU socket connection. Thanks to a hand crank, the manual insertion tool pulls the two pipe modules into one another easily and effortlessly.

We will be glad to advise you before purchasing the manual insertion tool.

Our members of staff will be only too pleased to enable you to benefit from their experience and the necessary technical expertise.

Phone +49 (0) 67 52 14-268
pipingsystems@simona.de

Fitting the manual insertion tool

Manual insertion tool ready for use

6 Legal information and advice

Legal information

These laying instructions do not contain any warranty commitments. They provide technical information that was state of the art on the date of issue (errors and misprints excepted). They are non-committal and do not exempt the buyer or processing contractor from their obligation to take necessary precautions, take due care and observe applicable standards, guidelines and regulations issued by authorities.

Upon publication of a new edition all previous editions become void. For the applicable version of this publication, please refer to our website at www.simona.de.

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We accept liability only for intent or gross negligence, and under no circumstances for the accuracy and completeness of the information you provide or the results of our advice based on it. The information we provide does not relieve you of your duty to conduct your own testing.

We reserve the right to make changes on account of new findings and evaluations.

Our staff in Applications Technology and Customer Service will be pleased to advise you on the processing and use of plastic piping systems as well as the availability of our products.

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7 Appendix

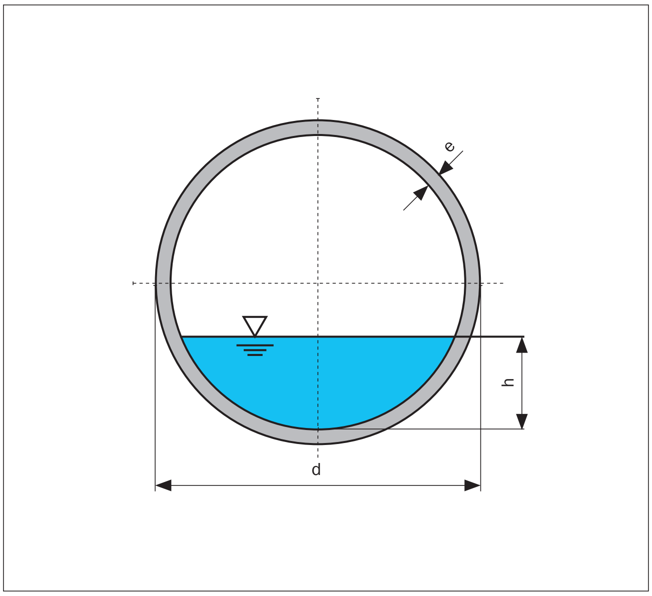
7.1 Pipe hydraulics

Excellent discharge figures are achieved owing to the very smooth interior wall surfaces of SIMODRAIN® pipes. The calculation of discharge figures for full pipes is conducted according to the DWA (German Association for Water Management) Code of Procedure A110 at a water temperature of 10 °C.

Based on that Code of Procedure, the coefficient of roughness, k, of the pipes is assumed to be 0.1 mm. The tables below can be used to determine the discharge flow in relation to nominal diameter and flow velocity.

Consequently, for a SIMODRAIN® pipe measuring 315 mm x 18.7 mm, a flow velocity of 1.788 m/s and a floor gradient of 1 % (equivalent to an incline of 1:100) the discharge flow listed in the table is 108.20 l/s.

This example, the calculation method of which is explained in section 7.2, is marked in red in the DWA-A110 full filling table for SIMODRAIN® pipes in SDR class 17 and on the partial filling diagram for circular cross sections.



DWA-A110 full filling table for SIMODRAIN® pipes in SDR class 11

d	Incline	1:2000	1:1000	1:500	1:400	1:333.3	1:250	1:200	1:166.7	1:133.3	1:125	1:100	1:66.7	1:50	1:20	1:10
e	**Gradient**	**0.05%**	**0.1%**	**0.2%**	**0.25%**	**0.3%**	**0.4%**	**0.5%**	**0.6%**	**0.75%**	**0.8%**	**1%**	**1.5%**	**2%**	**5%**	**10%**
160	v in m/s	0.218	0.320	0.466	0.526	0.580	0.677	0.763	0.841	0.947	0.980	1.102	1.364	1.585	2.550	3.640
14.6	Q in l/s	2.93	4.29	6.27	7.07	7.80	9.10	10.25	11.30	12.72	13.16	14.81	18.33	21.30	34.26	48.91
180	v in m/s	0.237	0.346	0.505	0.569	0.628	0.733	0.825	0.909	1.023	1.058	1.190	1.472	1.711	2.748	3.921
16.4	Q in l/s	4.03	5.89	8.59	9.69	10.69	12.47	14.04	15.47	17.41	18.01	20.26	25.06	29.11	46.77	66.73
200	v in m/s	0.254	0.372	0.542	0.611	0.674	0.785	0.884	0.974	1.096	1.134	1.275	1.576	1.831	2.939	4.191
18.2	Q in l/s	5.35	7.82	11.39	12.84	14.16	16.51	18.59	20.47	23.03	23.83	26.80	33.13	38.48	61.77	88.09
225	v in m/s	0.276	0.403	0.586	0.660	0.728	0.848	0.955	1.051	1.183	1.223	1.375	1.699	1.973	3.165	4.511
20.5	Q in l/s	7.33	10.71	15.58	17.56	19.36	22.56	25.39	27.96	31.44	32.53	36.57	45.18	52.47	84.15	119.95
250	v in m/s	0.297	0.433	0.628	0.708	0.780	0.909	1.023	1.126	1.266	1.310	1.472	1.818	2.111	3.383	4.820
22.7	Q in l/s	9.75	14.22	20.66	23.28	25.66	29.89	33.63	37.03	41.63	43.07	48.40	59.78	69.40	111.23	158.47
280	v in m/s	0.320	0.467	0.677	0.763	0.840	0.979	1.101	1.212	1.362	1.409	1.583	1.954	2.268	3.632	5.173
25.4	Q in l/s	13.21	19.25	27.94	31.47	34.67	40.38	45.42	49.99	56.20	58.13	65.31	80.63	93.58	149.87	213.43
315	v in m/s	0.347	0.505	0.731	0.823	0.907	1.056	1.187	1.307	1.468	1.519	1.706	2.105	2.442	3.909	5.564
28.6	Q in l/s	18.09	26.33	38.18	42.98	47.35	55.12	61.98	68.20	76.65	79.27	89.04	109.89	127.49	204.03	290.45
355	v in m/s	0.375	0.546	0.791	0.890	0.980	1.140	1.282	1.410	1.585	1.639	1.840	2.270	2.633	4.211	5.992
32.2	Q in l/s	24.90	36.21	52.44	59.02	65.00	75.63	85.03	93.54	105.10	108.69	122.06	150.57	174.64	279.29	397.41
400	v in m/s	0.406	0.590	0.854	0.961	1.058	1.231	1.383	1.521	1.709	1.767	1.984	2.446	2.837	4.534	6.449
36.3	Q in l/s	34.22	49.70	71.89	80.90	89.07	103.60	116.45	128.08	143.86	148.76	167.02	205.95	238.82	381.67	542.88
450	v in m/s	0.439	0.637	0.921	1.036	1.140	1.326	1.490	1.639	1.840	1.903	2.136	2.633	3.052	4.874	6.931
40.9	Q in l/s	46.77	67.86	98.07	110.32	121.43	141.20	158.66	174.47	195.92	202.59	227.40	280.30	324.96	519.01	737.98
500	v in m/s	0.471	0.682	0.985	1.108	1.220	1.418	1.593	1.751	1.966	2.033	2.281	2.811	3.259	5.201	7.394
45.4	Q in l/s	61.91	89.75	129.60	145.76	160.40	186.46	209.46	230.30	258.56	267.34	300.03	369.71	428.53	684.05	972.35
560	v in m/s	0.507	0.734	1.059	1.191	1.311	1.523	1.711	1.880	2.111	2.182	2.449	3.016	3.495	5.577	7.925
50.8	Q in l/s	83.68	121.19	174.85	196.59	216.30	251.36	282.31	310.33	348.34	360.15	404.11	497.80	576.87	920.35	1307.8
630	v in m/s	0.547	0.792	1.142	1.283	1.411	1.640	1.841	2.024	2.271	2.348	2.634	3.244	3.758	5.992	8.513
57.2	Q in l/s	114.28	165.34	238.35	267.92	294.71	342.37	384.44	422.52	474.17	490.23	549.95	677.24	784.66	1251.2	1777.4

DWA-A110 full filling table for SIMODRAIN® pipes in SDR class 17

d	Incline	1:2000	1:1000	1:500	1:400	1:333,3	1:250	1:200	1:166,7	1:133,3	1:125	1:100	1:66,7	1:50	1:20	1:10
e	**Gradient**	**0.05%**	**0.1%**	**0.2%**	**0.25%**	**0.3%**	**0.4%**	**0.5%**	**0.6%**	**0.75%**	**0.8%**	**1%**	**1.5%**	**2%**	**5%**	**10%**
160	v in m/s	0.230	0.336	0.490	0.553	0.610	0.712	0.802	0.884	0.995	1.029	1.158	1.432	1.664	2.674	3.816
9.5	Q in l/s	3.59	5.25	7.66	8.64	9.53	11.12	12.52	13.80	15.53	16.07	18.07	22.36	25.98	41.76	59.59
180	v in m/s	0.249	0.364	0.531	0.598	0.660	0.770	0.867	0.954	1.074	1.111	1.249	1.545	1.795	2.882	4.110
10.7	Q in l/s	4.92	7.20	10.48	11.82	13.04	15.20	17.12	18.86	21.22	21.95	24.68	30.52	35.45	56.93	81.19
200	v in m/s	0.268	0.391	0.569	0.642	0.707	0.825	0.928	1.022	1.150	1.190	1.337	1.653	1.919	3.080	4.390
11.9	Q in l/s	6.53	9.54	13.88	15.65	17.25	20.11	22.64	24.93	28.04	29.01	32.61	40.30	46.80	75.09	107.05
225	v in m/s	0.290	0.424	0.615	0.693	0.764	0.891	1.002	1.103	1.241	1.283	1.442	1.782	2.069	3.316	4.725
13.4	Q in l/s	8.95	13.07	18.99	21.40	23.58	27.48	30.92	34.04	38.28	39.60	44.50	54.98	63.82	102.32	145.79
250	v in m/s	0.312	0.455	0.660	0.744	0.819	0.954	1.073	1.182	1.328	1.374	1.544	1.906	2.213	3.545	5.049
14.8	Q in l/s	11.90	17.35	25.18	28.37	31.26	36.40	40.95	45.08	50.68	52.42	58.90	72.73	84.41	135.23	192.61
280	v in m/s	0.337	0.490	0.711	0.800	0.882	1.027	1.155	1.271	1.428	1.477	1.659	2.048	2.376	3.804	5.416
16.6	Q in l/s	16.10	23.45	34.00	38.29	42.18	49.11	55.24	60.79	68.32	70.66	79.38	97.97	113.68	181.98	259.09
315	v in m/s	0.364	0.530	0.767	0.864	0.951	1.107	1.245	1.370	1.539	1.592	1.788	2.206	2.559	4.093	5.825
18.7	Q in l/s	22.04	32.06	46.45	52.29	57.59	67.02	75.36	82.91	93.16	96.34	108.20	133.50	154.86	247.72	352.54
355	v in m/s	0.394	0.573	0.829	0.933	1.027	1.195	1.344	1.478	1.660	1.717	1.928	2.377	2.757	4.407	6.270
21.1	Q in l/s	30.30	44.03	63.72	71.71	78.96	91.86	103.25	113.57	127.58	131.93	148.14	182.70	211.88	338.69	481.83
400	v in m/s	0.427	0.620	0.896	1.008	1.109	1.290	1.450	1.594	1.791	1.852	2.078	2.562	2.971	4.746	6.749
23.7	Q in l/s	41.68	60.50	87.47	98.41	108.32	125.98	141.57	155.68	174.84	180.80	202.96	250.21	290.10	463.43	659.03
450	v in m/s	0.461	0.669	0.966	1.086	1.196	1.390	1.562	1.717	1.928	1.993	2.237	2.757	3.196	5.102	7.254
26.7	Q in l/s	56.98	82.62	119.33	134.22	147.71	171.72	192.92	212.12	238.16	246.26	276.39	340.61	394.82	630.34	896.08
500	v in m/s	0.494	0.716	1.033	1.162	1.278	1.486	1.669	1.834	2.059	2.129	2.389	2.943	3.411	5.443	7.735
29.7	Q in l/s	75.33	109.14	157.51	177.12	194.88	226.49	254.40	279.67	313.95	324.61	364.25	448.75	520.07	829.88	1179.4
560	v in m/s	0.532	0.770	1.110	1.248	1.373	1.596	1.792	1.969	2.210	2.285	2.564	3.157	3.659	5.835	8.290
33.2	Q in l/s	101.81	147.36	212.49	238.87	262.78	305.31	342.86	376.85	422.95	437.28	490.58	604.20	700.08	1116.5	1586.3
630	v in m/s	0.574	0.830	1.196	1.344	1.479	1.717	1.928	2.119	2.378	2.458	2.757	3.395	3.933	6.269	8.904
37.4	Q in l/s	139.01	201.01	289.60	325.48	357.98	415.80	466.83	513.01	575.65	595.12	667.55	821.89	952.13	1517.7	2155.7

(The red mark refers to the calculation example in section 7.2)

DWA-A110 full filling table for SIMODRAIN® pipes in SDR class 17.6

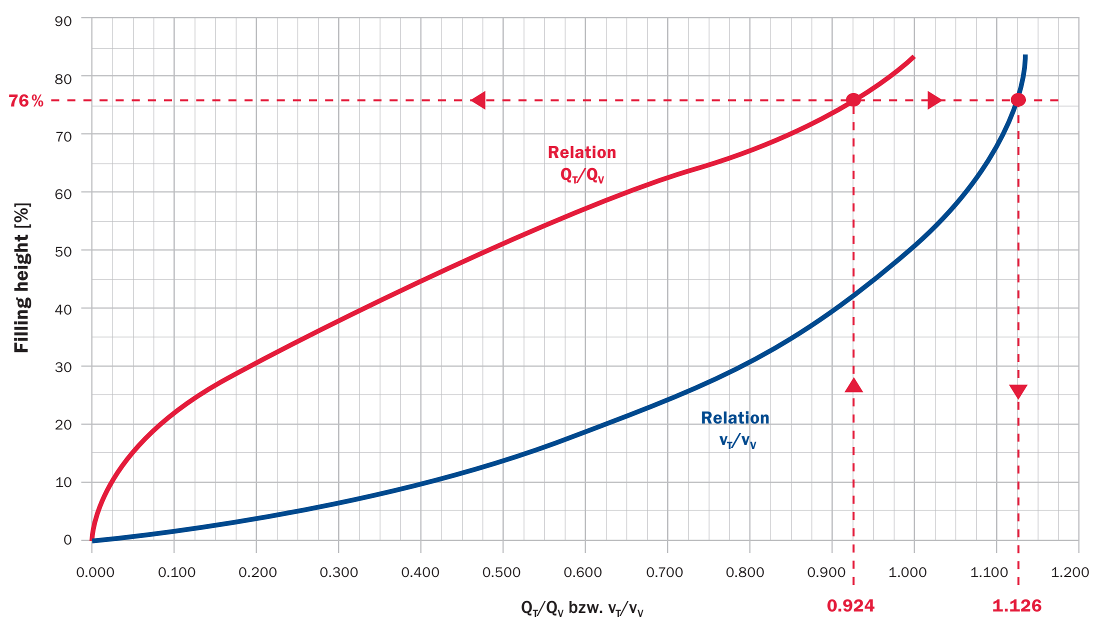
d	Incline	1:2000	1:1000	1:500	1:400	1:333,3	1:250	1:200	1:166,7	1:133,3	1:125	1:100	1:66,7	1:50	1:20	1:10
e	**Gradient**	**0.05%**	**0.1%**	**0.2%**	**0.25%**	**0.3%**	**0.4%**	**0.5%**	**0.6%**	**0.75%**	**0.8%**	**1%**	**1.5%**	**2%**	**5%**	**10%**
160	v in m/s	0.231	0.338	0.492	0.555	0.613	0.715	0.805	0.887	0.998	1.033	1.162	1.437	1.670	2.684	3.830
9.1	Q in l/s	3.64	5.33	7.78	8.77	9.67	11.29	12.71	14.01	15.76	16.31	18.35	22.70	26.37	42.39	60.49
180	v in m/s	0.250	0.366	0.533	0.601	0.663	0.773	0.870	0.958	1.078	1.116	1.255	1.551	1.802	2.893	4.126
10.2	Q in l/s	5.01	7.32	10.66	12.02	13.26	15.46	17.41	19.17	21.57	22.32	25.10	31.03	36.05	57.88	82.55
200	v in m/s	0.269	0.393	0.571	0.644	0.710	0.828	0.932	1.026	1.154	1.194	1.342	1.659	1.926	3.091	4.406
11.4	Q in l/s	6.63	9.69	14.09	15.88	17.51	20.41	22.98	25.30	28.46	29.44	33.10	40.91	47.51	76.22	108.66
225	v in m/s	0.291	0.425	0.618	0.696	0.767	0.894	1.006	1.108	1.245	1.288	1.448	1.789	2.077	3.329	4.743
12.8	Q in l/s	9.10	13.28	19.30	21.74	23.96	27.92	31.42	34.59	38.89	40.23	45.22	55.86	64.85	103.95	148.12
250	v in m/s	0.313	0.456	0.662	0.746	0.822	0.958	1.077	1.186	1.333	1.379	1.549	1.913	2.220	3.557	5.066
14.2	Q in l/s	12.07	17.60	25.55	28.78	31.71	36.93	41.55	45.73	51.41	53.18	59.75	73.78	85.63	137.17	195.37
280	v in m/s	0.338	0.492	0.713	0.803	0.885	1.030	1.159	1.275	1.433	1.482	1.665	2.055	2.385	3.817	5.435
15.9	Q in l/s	16.35	23.80	34.52	38.87	42.82	49.85	56.07	61.70	69.34	71.72	80.57	99.44	115.39	184.70	262.96
315	v in m/s	0.366	0.532	0.770	0.867	0.955	1.111	1.250	1.375	1.545	1.598	1.794	2.214	2.568	4.108	5.846
17.9	Q in l/s	22.38	32.56	47.16	53.09	58.47	68.05	76.51	84.17	94.58	97.81	109.85	135.53	157.22	251.48	357.89
355	v in m/s	0.396	0.575	0.833	0.937	1.032	1.200	1.349	1.484	1.667	1.724	1.935	2.387	2.768	4.425	6.295
20.1	Q in l/s	30.82	44.78	64.80	72.93	80.30	93.41	105.00	115.50	129.74	134.17	150.64	185.78	215.45	344.40	489.93
400	v in m/s	0.428	0.622	0.899	1.011	1.113	1.295	1.455	1.600	1.797	1.858	2.086	2.571	2.981	4.763	6.773
22.7	Q in l/s	42.31	61.41	88.78	99.89	109.95	127.87	143.69	158.02	177.46	183.51	205.99	253.95	294.43	470.34	668.84
450	v in m/s	0.463	0.671	0.970	1.091	1.200	1.395	1.568	1.724	1.935	2.001	2.246	2.767	3.208	5.121	7.280
25.5	Q in l/s	57.90	83.95	121.25	136.37	150.08	174.47	196.01	215.51	241.97	250.20	280.80	346.04	401.11	640.36	910.32
500	v in m/s	0.496	0.719	1.037	1.166	1.283	1.491	1.675	1.841	2.067	2.137	2.398	2.954	3.423	5.463	7.763
28.4	Q in l/s	76.52	110.85	159.97	179.88	197.92	230.03	258.37	284.03	318.84	329.66	369.91	455.72	528.14	842.73	1197.7
560	v in m/s	0.534	0.773	1.115	1.253	1.379	1.602	1.799	1.977	2.219	2.294	2.573	3.169	3.672	5.857	8.321
31.7	Q in l/s	103.46	149.73	215.90	242.71	267.00	310.21	348.36	382.89	429.72	444.28	498.43	613.86	711.27	1134.4	1611.6
630	v in m/s	0.576	0.834	1.201	1.350	1.484	1.724	1.936	2.127	2.387	2.468	2.768	3.408	3.948	6.293	8.938
35.7	Q in l/s	141.27	204.27	294.29	330.75	363.77	422.52	474.36	521.29	584.94	604.72	678.30	835.12	967.45	1542.1	2190.3

DWA-A110 full filling table for SIMODRAIN® pipes in SDR class 21

d	Incline	1:2000	1:1000	1:500	1:400	1:333.3	1:250	1:200	1:166.7	1:133.3	1:125	1:100	1:66.7	1:50	1:20	1:10
e	Gradient	0.05 %	0.1 %	0.2 %	0.25 %	0.3 %	0.4 %	0.5 %	0.6 %	0.75 %	0.8 %	1 %	1.5 %	2 %	5 %	10 %
160	v in m/s	0.234	0.342	0.499	0.563	0.621	0.724	0.815	0.898	1.011	1.046	1.177	1.455	1.691	2.718	3.878
7.7	Q in l/s	3.84	5.62	8.19	9.24	10.19	11.89	13.39	14.75	16.60	17.18	19.32	23.90	27.77	44.63	63.68
180	v in m/s	0.254	0.371	0.540	0.609	0.671	0.783	0.881	0.971	1.092	1.130	1.271	1.571	1.825	2.930	4.178
8.6	Q in l/s	5.28	7.72	11.24	12.68	13.98	16.30	18.35	20.21	22.74	23.52	26.45	32.70	37.99	60.98	86.97
200	v in m/s	0.273	0.398	0.579	0.653	0.720	0.839	0.944	1.040	1.169	1.210	1.360	1.680	1.951	3.130	4.462
9.6	Q in l/s	7.00	10.22	14.87	16.76	18.47	21.53	24.24	26.69	30.02	31.05	34.91	43.14	50.10	80.36	114.55
225	v in m/s	0.295	0.431	0.626	0.705	0.777	0.905	1.018	1.121	1.261	1.304	1.466	1.810	2.102	3.369	4.799
10.9	Q in l/s	9.57	13.97	20.29	22.86	25.19	29.35	33.03	36.36	40.88	42.29	47.53	58.71	68.15	109.24	155.64
250	v in m/s	0.317	0.463	0.671	0.756	0.833	0.970	1.092	1.201	1.351	1.397	1.570	1.938	2.249	3.603	5.131
11.9	Q in l/s	12.75	18.59	26.98	30.39	33.48	39.00	43.87	48.28	54.28	56.14	63.08	77.88	90.39	144.77	206.18
280	v in m/s	0.342	0.499	0.723	0.814	0.897	1.044	1.174	1.292	1.452	1.501	1.686	2.081	2.415	3.865	5.503
13.4	Q in l/s	17.24	25.10	36.39	40.98	45.14	52.55	59.10	65.04	73.09	75.60	84.92	104.80	121.60	194.62	277.07
315	v in m/s	0.371	0.539	0.781	0.879	0.968	1.126	1.266	1.393	1.565	1.619	1.818	2.243	2.601	4.160	5.920
15	Q in l/s	23.64	34.39	49.80	56.06	61.74	71.85	80.78	88.87	99.84	103.26	115.96	143.06	165.94	265.40	377.68
355	v in m/s	0.401	0.583	0.844	0.949	1.045	1.216	1.366	1.503	1.688	1.746	1.960	2.417	2.803	4.480	6.373
16.9	Q in l/s	32.52	47.24	68.35	76.92	84.68	98.51	110.72	121.79	136.80	141.46	158.83	195.87	227.14	363.03	516.41
400	v in m/s	0.434	0.630	0.911	1.025	1.128	1.311	1.474	1.621	1.820	1.882	2.112	2.604	3.019	4.822	6.857
19.1	Q in l/s	44.64	64.77	93.63	105.33	115.94	134.82	151.50	166.60	187.09	193.46	217.16	267.70	310.36	495.74	704.92
450	v in m/s	0.469	0.680	0.982	1.105	1.215	1.413	1.587	1.745	1.959	2.026	2.274	2.802	3.248	5.184	7.369
21.5	Q in l/s	61.03	88.48	127.77	143.70	158.14	183.83	206.51	227.06	254.92	263.58	295.81	364.52	422.52	674.48	958.76
500	v in m/s	0.503	0.728	1.050	1.181	1.299	1.510	1.696	1.864	2.093	2.164	2.428	2.991	3.466	5.530	7.859
23.9	Q in l/s	80.71	116.90	168.68	189.67	208.68	242.52	272.39	299.43	336.11	347.51	389.93	480.36	556.67	888.18	1262.2
560	v in m/s	0.541	0.783	1.129	1.269	1.396	1.622	1.821	2.002	2.246	2.322	2.605	3.209	3.718	5.928	8.422
26.7	Q in l/s	109.07	157.83	227.54	255.79	281.37	326.89	367.08	403.45	452.78	468.12	525.16	646.74	749.34	1195.0	1697.6
630	v in m/s	0.584	0.844	1.216	1.367	1.503	1.746	1.960	2.154	2.417	2.499	2.803	3.450	3.997	6.370	9.048
30	Q in l/s	149.03	215.46	310.36	348.79	383.60	445.52	500.18	549.64	616.73	637.58	715.14	880.43	1019.9	1625.6	2308.8

Partial filling diagram for circular cross sections

(The red mark refers to the calculation example in section 7.2)



7.2 Example of a calculation

Hydraulic performance:
Excellent discharge figures are achieved owing to the very smooth interior surfaces of SIMODRAIN® pipes. The calculation of discharge figures for a full pipe was based on the generalised concept in DWA Code of Procedure A110. Accordingly, the viscosity of water was assumed for a water temperature of 10 °C. Service roughness k was assumed to be 0.1 mm. The sample calculation below shows the procedure to determine the discharge figures for a partial pipe filling.

Given:
Leachate flow to be discharged: Q = 100 l/s
Floor gradient: J = 1 %

Sought:
SIMODRAIN® PE 100 drainage pipe SDR 17 with appropriate discharge capacity, filling height and flow velocity at which the leachate flow will be discharged.

Solution:
Identified in the DWA-A110 full filling table for SIMODRAIN® pipes in SDR class 17 (see page 22, red mark):
d x e = 315 x 18.7 mm, J = 1 %

- Velocity with full filling v_V = 1.788 m/s
- Volumetric flow with full filling Q_V = 108.20 l/s.

Determination of ratio Q_T/Q_V = 100/108.20 = 0.924

Read off the partial filling diagram (see red marks):
$v_T/v_V \approx 1.126$, hence v_T = 2.01 m/s
Filling height h approx. 76 % or 277.6 mm x 0.76 → h = 211 mm

Result:
SIMODRAIN® PE 100 drainage pipe SDR 17 with dimensions 315 x 18.7 mm conveys at a filling height h of approx. 76 % (h = 211 mm) a volumetric flow of 100 l/s at a flow velocity of 2.01 m/s over a gradient J of 1 % / incline of 1:100.

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01/2019 - GB