SLOVENSKI STANDARD
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Vakuumski kanalizacijski sistemi zunaj stavb

Vacuum sewerage systems outside buildings

Unterdruckentwässerungssysteme ausserhalb von Gebäuden

Réseaux d'assainissement sous vide a l'extérieur des bâtiments

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93.030	Zunanji sistemi za odpadno vodo	External sewage systems

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Réseaux d'assainissement sous vide à l'extérieur des bâtiments

Unterdruckentwässerungssystеme außerhalb von Gebäuden

This European Standard was approved by CEN on 1996-11-30. CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart,36 B-1050 Brussels

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FOREWORD

This European Standard has been prepared by Technical Committee CEN/TC 165 "Waste Water Engineering", the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 1997, and conflicting national standards shall be withdrawn at the latest by June 1997.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

INTRODUCTION

This European Standard has been prepared for specifiers, designers, constructors and operators of vacuum sewerage systems. This European Standard covers vacuum sewerage systems transporting domestic sewage but not rainwater.

1 SCOPE

This European Standard specifies the performance requirements of negative pressure driven sewerage systems carrying domestic waste water independent of their material. It also covers additional performance characteristics that are of importance to the specifiers, designers, constructors and operators of vacuum sewerage systems.

It does not provide for the evaluation of conformity of systems.

This European Standard gives guidance on the design and construction of vacuum sewerage systems which convey domestic waste water but not rainwater. It does not deal with internal vacuum drainage systems. The components of the system should be evaluated by reference to the appropriate product standard. In the absence of a product standard, this standard may be used as a reference for drawing up a product specification.

The design requirements of this European Standard are minimum requirements and do not constitute in themselves a comprehensive design guide sufficient to ensure a correctly functioning system. Every system must be individually designed, based on the design parameters of the system employed; where proprietary systems are employed, account should be taken of the advice of the system suppliers.

2 NORMATIVE REFERENCES

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 752-2	Drain and sewer systems outside buildings - Requirements
prEN 805	Water supply - Requirements for systems and components outside buildings
prEN 1293	General requirements for components used in pneumatically pressurised discharge pipes, drains and sewers

3 DEFINITIONS

For the purpose of this standard the following definitions apply.

3.1 batch volume

Volume of the sump up to the level at which the level sensor activates the controller.

3.2 collection chamber

Collection sump and interface valve pit.

3.3 collection sump
Sump provided to store flows of domestic waste water until sufficient has been accumulated to activate the interface valve.

3.4 controller
Device which, when activated by the level sensor, opens the interface valve and, after the passage of sewage and air, closes the valve.

3.5 forwarding pumps
Devices, installed at the vacuum station to deliver the sewage from the vacuum system.

3.6 interface valve
Valve which admits the flow of sewage and air into the vacuum sewer via the service connection.

3.7 level sensor
Device which senses the presence of sewage in the collection sump and activates the valve controller when a batch volume has collected in the sump.

3.8 lift
Section of vacuum pipeline with an increase in invert level in the direction of flow.

3.9 pipeline profile
Vertical alignment of the vacuum pipeline.

3.10 service connection
Part of the vacuum pipeline which connects a single collection chamber to the vacuum sewer.

3.11 vacuum generator
Equipment installed at the vacuum station to generate a vacuum in the sewer.

3.12 vacuum pipeline
Pipeline under negative pressure.

3.13 vacuum recovery time
Time taken, after the operation of an interface valve, for the negative pressure at the valve to be restored to a value sufficient to operate the valve again.

3.14 vacuum sewer
Part of the vacuum pipeline into which the service connections feed.

3.15 vacuum station
Installation comprising the vacuum generators, vacuum vessel (or sewage sump), means of discharge and control equipment.

3.16 vacuum vessel
Negative pressure vessel connected to the vacuum generator and vacuum sewer.

3.17 water-logging
Accumulation of wastewater at low points which fills the cross section of the vacuum pipeline.

4 DESCRIPTION OF THE SYSTEM

4.1 Collection Chamber and Vacuum Pipeline

When the volume of domestic waste water draining into a collection chamber reaches a predetermined level in the sump the normally closed interface valve opens. The differential pressure between the vacuum sewer and atmosphere forces the waste water from the collection chamber into the sewer. After the sump is emptied the valve closes. Air is admitted simultaneously with, or after, the admittance of the waste water. The waste water is driven along the sewer until frictional and gravitational forces eventually bring it to rest in the lower section of the pipe profiles. The characteristics of the vacuum sewerage system ensure that peak discharges into the sewer are rapidly attenuated. The vacuum sewer discharges into the vacuum vessel or sewage sump at the vacuum station. The vacuum is maintained, by a vacuum generator, at a predetermined level. The waste water is generally pumped from the vacuum station by forwarding pumps.

4.2 Vacuum Station

The vacuum station is similar to a conventional sewage lift station with the addition of vacuum generators and a closed vacuum vessel or sewage sump. Vacuum sewers discharge into the vacuum vessel which is held under vacuum if vacuum pumps are employed, or into a sewage sump if the vacuum is generated by an ejector pump. The level of the sewage in the vacuum vessel is monitored by a level controller which activates the forwarding pumps or discharge valves. If the sewage rises too high in the vessel then a high level sensor stops and locks out the vacuum pumps to prevent the flow of sewage into the vacuum pump. The vacuum in the vacuum vessel is maintained within the operational range by pressure switches.

5 REQUIREMENTS

5.1 General Requirements

The system shall convey domestic sewage from the household drainage system to the vacuum station and forward it downstream and meet the following performance requirements:

a) the interface valve and pipework shall operate without blocking;

b) flooding shall not occur or shall be limited to identifiable circumstances and prescribed frequencies;

c) surcharging of collection chambers and sewers shall be limited to identifiable circumstances and prescribed frequencies;

d) the system shall not endanger existing adjacent structures and services;

e) the system shall be water and air tight as tested;

f) odour,or other nuisance, shall not be generated;

g) provision shall be made for maintenance.

5.2 Performance and Quantitative Requirements

5.2.1 Gravity Drains

New gravity drains discharging to collection chamber sumps shall be in accordance with EN 752-2. Where air inlet valves are installed on new gravity drains they shall be designed to suit the vacuum sewerage system.

5.2.2 Flows from Interceptor Sewers and Commercial Developments

Where vacuum pipelines are used to intercept sewerage systems or accept domestic sewage from commercial developments the design performance criteria including the peak flow shall be specified.

5.2.3 Collection Chambers

NOTE: One or more properties may be connected to a collection chamber in accordance with local or national regulations.

The chamber shall resist external forces and internal water pressure. The chamber shall be watertight. Frames and/or covers shall prevent the ingress of surface water. Separate chambers shall be provided to serve properties at different elevations where there is a risk of sewage from one property flooding another property. Thermal conductivity calculations or recorded past performance shall demonstrate that the valve mechanism will function during the anticipated extremes of temperature.

5.2.4 Collection Sumps

Collection sumps shall be watertight. Collection sumps serving domestic properties shall provide capacity to store a minimum of 25% of average daily flow in the event of a power failure or similar emergency; account may be taken of the storage in the gravity system.

The sump shall be constructed of material which is corrosion resistant and unaffected by contact with sewage. The internal surface of the sump shall be smooth and the sump shall have benching to maintain self cleansing flows.

Where the interface valve is situated over the collection sump a working platform shall be provided if needed for health or safety reasons.

The sump shall be sufficiently vented to allow the intake of air without causing a noise nuisance and to ensure that the operation of the vacuum system does not unseal the water traps on the gravity drainage system.

NOTE: National or local regulations may require additional measures to prevent backflooding from sumps into houses. These measures may include the provision of an overflow from the sump to define a backflood level below which no sanitary apparatus may be fitted.

5.2.5 Interface Valve

The interface valve shall fail safe in the closed position and shall prevent backflows from the service connection to the collection sump.

The sewer vacuum shall ensure positive valve seating. When the valve is open the flow path shall not be obstructed by the valve mechanism.The valve shall evacuate at least the batch volume each time it cycles.

Valves installed in the sump shall be capable of operating when submerged provided that the breather pipe is not also submerged.

The fixing arrangements shall enable the interface valve and/or control system to be readily replaced in not more than 30 min.

5.2.6 Level Sensor

The valve shall be equipped with a sensor to determine the level of sewage in the collection sump; this sensor shall be designed to be fouling resistant. Level sensor pipes shall not be less than DN/ID 45.

5.2.7 Interface Valve Controller

The controller shall open the valve only if there is a minimum partial vacuum of 15 kPa below atmospheric available and shall maintain the valve fully open until at least the batch volume has been evacuated. If the design provides for the introduction of air after the sewage has been evacuated the controller shall maintain the valve open for a further period. The controller shall be adjustable so that a range of air to sewage ratios can be obtained. Controllers installed in sumps shall be capable of operating when submerged

5.2.8 Explosion Proof

The valve mechanism and controller shall be explosion proof if exposed to potentially explosive atmosphere. Until a European Standard is produced the standards in the country of installation shall be met.

NOTE: National and local regulations can prescribe explosive proof electrical equipment.

5.2.9 Life of Membranes and Seals

The manufacturer shall on request state the operating life of valve membranes and other seals employed.

5.2.10 Vacuum Pipeline Components

The vacuum pipeline components, including pipes, fittings, joints and sealing materials shall comply with prEN 1293.

NOTE: Sharp bends should be avoided.

5.2.11 Pipe Size

The suction pipe DN/ID shall not be greater than the DN/ID of the interface valve. The minimum diameter of service connections shall be DN/ID 50 and shall be greater than the DN/ID of the suction pipe.

Vacuum sewers shall have a minimum diameter of DN/ID 65 where national or local regulations control the discharge of gross solids to sewers. Vacuum sewers shall have a minimum diameter of DN/ID 80 where there are no such controls over the discharge of gross solids to sewers or where national or local regulations require larger diameters.

NOTE: The maximum lengths of service connections and vacuum sewers

corresponding to a particular DN/ID may be specified.

5.2.12 Service Connections

Service connections shall initially fall away from the interface valve and shall connect into the top sector of the vacuum sewer contained within the angle of ± 60° about the vertical axis.

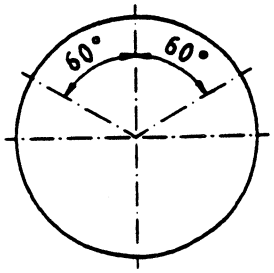
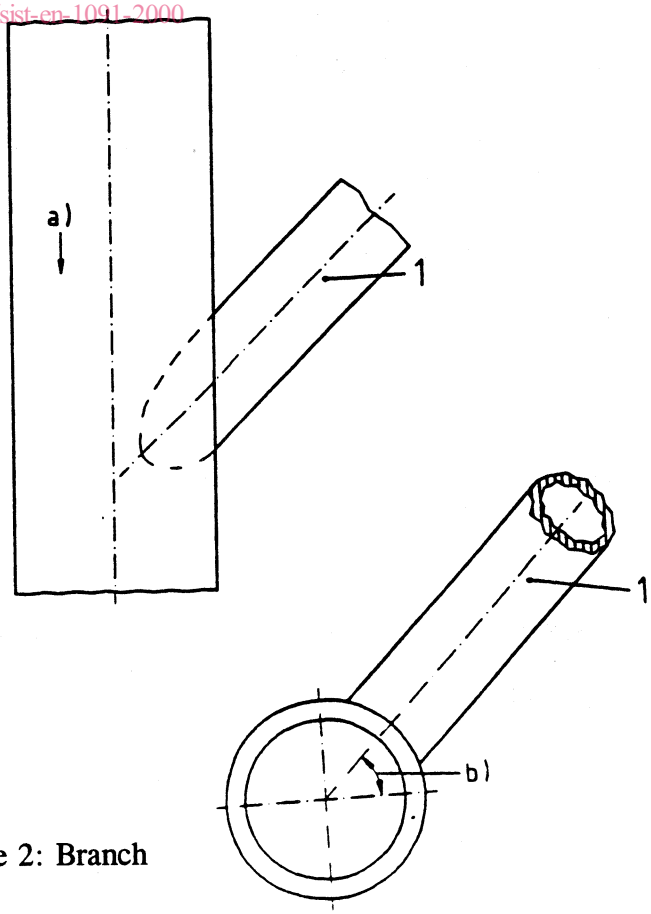


Figure 1: Service Connection

5.2.13 Branch connections

All branch connections to vacuum sewers shall be by a junction connected to the sewer above the horizontal axis. In plan, the angle of the junction shall ensure that flow towards the vacuum station is generated and backflows are minimised. No connection shall be made within 2 m of a lift.



1 branch
a) direction of flow
b) vertical angle

Figure 2: Branch

5.2.14 Isolation Measures

Means of isolating lengths of vacuum sewer to permit repairs or to locate faults shall be provided at distances of not more than 450m and on branch sewers longer than 200m.

Buried valves shall have extension spindles and surface boxes. The valve clear opening shall be not less than the DN/ID of the pipe.

NOTE: Isolation valves or other means of isolation such as inspection pipes which allow the introduction of inflatable balls may be employed. Isolation valves should be suitable for service in sewage under both vacuum and pressure and should be capable of sustaining a differential vacuum of 80 kPa below atmospheric.

5.2.15 Vacuum Vessel/Sewage Sump

Each vessel shall be furnished with the required number of correctly sized sewage inlet and outlet pipes which shall be integral with the vessel. No inlet pipes shall be connected below the system emergency stop level. The inlet and outlet pipes shall be sited to encourage flow through the vessel and thus prevent the build up of solids.It shall be possible to inspect the vessel internally. Each vessel shall be furnished with access openings to allow for internal inspection and cleaning. Each vessel shall be fitted with a level control system which is suitable for operation in a vacuum and is easily removed for adjustment or replacement When the sewage sump is used in conjunction with ejector pumps it shall have a minimum liquid capacity of 400 l per installed duty ejector.

5.2.16 Vacuum Station Control

The controls shall permit the selection of duty, duty assist (where provided) and standby vacuum generators and forwarding pumps and shall provide for the automatic introduction of the standby units in the event of failure.The vacuum generators shall be controlled by monitoring the vacuum in the vacuum vessel via adjustable pressure switches set to the desired operating range.

5.2.17 Level Control

The level control system shall respond to the following sewage levels in the vacuum vessel or the sewage sump;

Emergency stop level	- stops vacuum generation - forwarding pump(s) operate
Start level	- starts forwarding pump(s)
Normal stop level	- stops forwarding pump(s)