

Drain and sewer systems outside buildings —

Part 4: Hydraulic design and environmental considerations

The European Standard EN 752-4:1997 has the status of a
British Standard

ICS 93.030

National foreword

This British Standard is the official English language version of EN 752-4:1997. It supersedes the following standards, which have been declared obsolescent and which will be withdrawn in due course:

BS 8005-1:1987, BS 8005-2:1987, BS 8005-3:1989, BS 8005-4:1987, BS 8005-5:1990, BS 8301:1985.

The UK participation in its preparation was entrusted by Technical Committee B/505, Wastewater engineering, to Subcommittee B/505/22, Drain and sewer systems outside buildings, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

Guidance on aspects of UK practice, and additional information on hydraulic design, is given in National annex NA to National annex NI of this standard.

Cross-references

The British Standards which implement international publications referred to in this document may be found in the *BSI Catalogue* under the section entitled “International Standards Correspondence Index”, or by using the “Search” facility of the *BSI Electronic Catalogue* or of British Standards Online.

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Réseaux d'évacuation et d'assainissement à
l'extérieur des bâtiments —

Partie 4: Conception hydraulique et
considérations liées à l'environnement

Entwässerungssysteme außerhalb von
Gebäuden —

Teil 4: Hydraulische Berechnung und
Umweltschutzaspekte

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Foreword

This European Standard has been prepared by Technical Committee CEN/TC 165, Wastewater engineering, the secretariat of which is held by DIN.

This part is the fourth in a series relating to the functional requirements of drain and sewer systems outside buildings that operate essentially under gravity. There will be seven parts, as follows:

Drain and sewer systems outside buildings —

Part 1: Generalities and definitions;

Part 2: Performance requirements;

Part 3: Planning;

Part 4: Hydraulic design and environmental considerations;

Part 5: Rehabilitation;

Part 6: Pumping installations;

Part 7: Operations and maintenance.

In drafting this part of this European Standard, account has been taken of other available draft standards, in particular EN 476 *General requirements for components used in discharge pipes, drains and sewers for gravity systems*.

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 March 1998, and conflicting national standards shall be withdrawn at the latest by March 1998.

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

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1 Scope

This European Standard is applicable to drain and sewer systems, which operate essentially under gravity, from the point where the sewage leaves a building or roof drainage system, or enters a road gully, to the point where it is discharged into a treatment works or receiving water.

Drains and sewers below buildings are included provided that they do not form part of the drainage system of the building.

This part sets out the principles which shall be followed for both the hydraulic design and consideration of environmental impact of drain and sewer systems that operate essentially under gravity.

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 752-1, *Drain and sewer systems outside buildings — Part 1: Generalities and definitions*.

3 Definitions

For the purposes of this standard the following definitions, together with those given in EN 752-1, apply.

3.1

aerobic

conditions in which dissolved oxygen is present

3.2

aesthetic pollution

aspects of pollution sensed by sight or smell, e.g. floating solids, oil films or bankside litter

3.3

anaerobic

conditions in which free oxygen is not present

3.4

biochemical oxygen demand (BOD)

mass concentration of dissolved oxygen consumed under specific conditions by the biological oxidation of organic and/or inorganic matter in water

3.5

depression storage

precipitation retained in surface hollows which does not contribute to run-off

3.6

flow balancing

reduction in peak discharge by means of temporary storage of flow

3.7

hydrobiological stress

detrimental impact on aquatic flora and fauna, caused by high flow velocity and scour

3.8

rainfall intensity

depth of rain falling in unit time, i.e. volume of rain falling in unit time per unit area

3.9

roughness

the frictional resistance of the surface of a pipe or channel under turbulent flow

3.10

self-purifying capacity

ability of receiving waters to recover from pollution by natural processes

3.11

sub-critical flow

state of flow when the water velocity is less than the velocity of the small surface wave, water levels tending to be stable

3.12

super-critical flow

state of flow when the water velocity is greater than the velocity of the small surface wave, violent fluctuations in water level being possible

3.13

time of concentration

time taken for run-off to travel from the hydraulically most distant point of the catchment area to a defined point in the drain or sewer

3.14

vortex manhole

circular manhole within which a large difference in level is accommodated by the sewage entering tangentially and descending helically

4 Sources of additional information

This standard sets out the essential requirements for good practice in various engineering activities relating to the planning, design and operation of drain and sewer systems. For supplementary detail and guidance, reference should be made to national documents until such time as fully comprehensive European Standards are available.

The documents listed in Annex A contain details which may be used in the framework of this part, given approval by the relevant authority.

5 Protection from surcharge and flooding

Design shall provide protection against flooding and surcharge from storms of predetermined intensities and frequencies, taking into account backwater levels.

Surcharging is undesirable in wastewater drain and sewer systems.

6 Protection from pollution

The quality, quantity and frequency of any discharge to a receiving water from any sewer, including a surface water sewer, combined sewer overflow, pumping installation or treatment works, shall meet the requirements of the relevant authority. Design shall be such that the receiving water will be protected against overloading of its self-purifying capacity. It shall take account of physical, chemical, biochemical, bacteriological, aesthetic and any other relevant considerations.

7 Protection from septicity

Septicity within a drain or sewer system is undesirable and therefore shall be minimized. It will affect the sewage treatment process and can lead to the production of hydrogen sulfide (H_2S). Hydrogen sulfide is toxic and potentially lethal. Depending on its concentration, it is noxious, malodorous and, when oxidized to sulfuric acid, will tend to attack some materials in pipelines, treatment works and pumping installations. Parameters on which the concentration of hydrogen sulfide depends, and which shall be taken into account, include:

- temperature;
- biochemical oxygen demand (BOD);
- sulfate availability;
- retention time in the sewer system;
- velocity and turbulence conditions;
- pH;
- ventilation within the sewer system;
- existence of rising mains or particular trade effluent discharges upstream of the gravity sewer.

Predictive equations can be applied in order to quantify sulfide formation both in pressure and gravity sewers.

Sulfide production may be controlled by providing adequately high velocities, short enough retention times and sufficient ventilation to achieve aerobic conditions within the liquid. Other remedial measures may include air injection, oxygen injection or chemical addition (with chemicals such as hydrogen peroxide, nitrates, iron sulfate or other metal salts). The choice of chemicals shall take into account their potential environmental impact.

8 Self-cleansing velocities

The build-up of permanent deposits of solids in drains or sewers can significantly increase the risk of flooding and pollution. Drains and sewers shall be designed to provide sufficient shear stress to limit the build-up of solids to levels which do not significantly increase this risk.

For small diameter drains and sewers (less than DN 300), self-cleansing can generally be achieved by ensuring either that a velocity of at least 0,7 m/s occurs daily, or that a gradient of at least 1:DN is specified. In the case of drains, steeper gradients may be required by the relevant authority.

Where self-cleansing velocities cannot be achieved, provision should be made for adequate maintenance activities.

For larger diameter drains and sewers, higher velocities can be necessary, particularly if relatively coarse sediment is expected to be present.

Local guidance, in the form of tables or equations, may be available in national reference documents and should be used.

9 Hydraulic calculations

9.1 Velocity equations

9.1.1 General

Two equations are recommended for use in calculating turbulent flows in drains and sewers: .

Colebrook–White¹⁾ and Manning²⁾.

9.1.2 The Colebrook–White equation

For circular pipes flowing full, the velocity of flow, v , is given by the equation:

$$v = -2\sqrt{2gDJ_E} \times \log_{10} \left(\frac{k}{3,71D} + \frac{2,51\nu}{D\sqrt{2gDJ_E}} \right) \quad (1)$$

where

- v is the velocity averaged across the flow cross-section, in metres per second;
- g is the gravitational constant, in metres per second squared;
- D is the internal pipe diameter, in metres;
- J_E is the hydraulic gradient (energy loss per unit length), dimensionless;
- k is the hydraulic pipeline roughness, in metres;
- ν is the kinematic viscosity of fluid, in metres squared per second.

For partially full pipes or pipes with non-circular cross-sections, the velocity of flow is given by equation (1) by replacing D by $4R_h$, where R_h is the hydraulic radius (flow cross-sectional area divided by the wetted perimeter).

9.1.3 The Manning equation

For both circular and non-circular cross-sections, whether running full or partially full, the velocity of flow is given by the equation:

$$v = KR_h^{2/3} J_E^{1/2} \quad (2)$$

where

- K is the Manning coefficient, in metres raised to the power one third, per second;
- R_h is the hydraulic radius, in metres;
- J_E is the hydraulic gradient (energy loss per unit length), dimensionless.

¹⁾ This equation is named Colebrook in the French version and Prandtl–Colebrook in the German version.

²⁾ This equation is named Manning–Strickler in the French and German versions.

9.2 Headlosses

9.2.1 Pipeline headlosses

The hydraulic pipeline roughness (k) allows for headlosses due to pipe material, discontinuities at the joints and slime growth on the pipe surface below the water level.

9.2.2 Local headlosses

Headlosses, in addition to those mentioned in 9.2.1, occur at junctions, changes of cross-section, manholes, bends and other fittings. If direct calculations are to be made, the following equation shall be used:

$$h_L = \frac{k_L v^2}{2g} \quad (3)$$

where

- h_L is the local headloss, in metres;
- k_L is the headloss coefficient, dimensionless;
- v is the velocity of the liquid, in metres per second;
- g is the gravitational constant, in metres per second squared.

9.2.3 Total headlosses

Two methods of calculating total headlosses are:

- adding local headlosses (9.2.2) to the pipeline headlosses (9.2.1);
- accounting for local headlosses by assuming a higher value of hydraulic pipeline roughness in the calculation of pipeline headloss.

When using recommended hydraulic pipeline roughness values, it is necessary to establish whether allowance has been included for local headlosses. Values currently in use range from 0,03 mm to 3,0 mm for k , and $70 \text{ m}^{1/3} \cdot \text{s}^{-1}$ to $90 \text{ m}^{1/3} \cdot \text{s}^{-1}$ for K . More detailed advice is given in the documents referred to in Clause 4 and listed in Annex A.

In cases where deposits in the invert cannot be avoided, the reduced cross-section of the pipe shall be taken into account when calculating headlosses.

Approximate comparisons of velocity estimates obtained from equations (1) and (2) can be made using the following equation:

$$K = 4 \sqrt[4]{g \left(\frac{32}{D} \right)^{1/6}} \times \log_{10} \left(\frac{3,7D}{k} \right) \quad (4)$$

where

- K is the Manning coefficient, in metres raised to the power of one third, per second;
- g is the gravitational constant, in metres per second squared;
- D is the internal pipe diameter, in metres;
- k is the hydraulic pipeline roughness, in metres.

9.3 Sewers with steep gradients

Where sewers with steep gradients are required, consideration shall be given to consequences of high velocities such as:

- possible air entrainment and its effects;
- possible release of hydrogen sulfide;
- possible erosion;
- the need for energy conservation measures on super-critical flow to sub-critical flow;
- special safety measures for operatives.

Backdrop manholes, ramp manholes or vortex manholes may be installed in a sewer system to dissipate excessive static head in a controlled manner, thereby avoiding the installation of sewers with steep gradients and meeting any imposed velocity limitation.

10 Wastewater design flows

10.1 Water consumption statistics

Existing water supply statistics may be helpful for estimating future water supply consumption and hence wastewater flows. Flow patterns for daily consumption and anticipated variations between different types of development can also be established. Consumer water usage that does not enter the drain and sewer system, and distribution leakage, are of particular importance in assessing wastewater flows.

10.2 Sewer systems

Sewer systems shall be designed to convey wastewater discharges from domestic, commercial and industrial premises to the point of treatment without prejudice to health and safety. Such design should also include allowances for future growth and for extraneous discharges up to such flow that will justify rehabilitation.

For domestic wastewater sewers, flow rates are usually based on either population and a rate of flow per head or, for new developments where such data may not be available, on the planning criteria for the population or the type and number of dwellings. For a new development and for an upgrading scheme on an existing development, the estimates used shall be appropriate for the specified planning horizon.

The rate of flow per head may be based on local water supply statistics, allowing for consumption that does not result in discharge to the sewers and, where appropriate meters are not available, distribution losses. Typical discharge figures for developments similar to those under consideration may also be used. The flow per head, in the range from 120 l/d to 400 l/d, commonly used in various countries, is shown in Table B.1 of Annex B.

The peak design flow takes account of the diurnal variation in wastewater flow. The domestic peak design flow rates commonly used in various countries are shown in Table B.2 of Annex B. To these peak design flows shall be added commercial and industrial peak flows and, where appropriate, infiltration.

Where a scheme is to be developed in phases, consideration should be given to the likely flows following the initial stages of construction, so that either self-cleansing velocities are attained, at least at times of daily peak flow, or other cleansing arrangements are made.

10.3 Drain systems

The design of drains (and sewers) to serve individual or small groups of buildings where discharges from individual appliances will give relatively high flows of an intermittent and irregular nature shall use a peak rate of flow derived from the number and type of appliances connected.

Flow rates from the drains within the serviced buildings or premises shall be used in the design of downstream drain systems. Preferably, national standards transposing European Standards, as available, should be used for the calculation of flow rates.

Flow rates for individual appliances and factors to be applied may be specified by the relevant authority.

In the absence of such data, and of a national standard or European Standard, the empirical approach described in Annex C may be adopted.

Trade effluent flows shall be calculated separately.

On completion of the design for the drain system, the interaction between the drain and the sewer system shall be checked.

11 Surface water and combined drain and sewer design flows

11.1 General

Surface water and combined drains and sewers are designed to collect and convey run-off generated within a catchment area during rainfall, for safe discharge into a receiving water or treatment plant. The magnitude of peak flows depends on the intensity and duration of rainfall, the size and configuration of impermeable areas, and measures taken to reduce surface water. The topography, soil type and its permeability have also to be considered when estimating the flows emanating from other areas.

11.2 Rainfall — performance criteria

It is normally impracticable to avoid flooding from very severe storms. A balance therefore has to be drawn between cost and the level of protection provided. Attention is drawn to the performance criteria for protection against surcharge and flooding, wherever specified by a relevant authority. For small schemes, the “design storm frequency” for no surcharge criteria given in Table 1 should be used in the absence of any specified by a relevant authority.

Table 1 — Recommended design frequencies

Design storm frequency ¹⁾ 1 in <i>n</i> years	Location	Design flooding frequency 1 in <i>n</i> years
1 in 1	Rural areas	1 in 10
1 in 2	Residential areas	1 in 20
1 in 2	City centres/industrial/commercial areas: — with flooding check	1 in 30
	— without flooding check	—
1 in 10	Underground railway/underpasses	1 in 50
¹⁾ For these design storms, no surcharge shall occur.		

For larger schemes, design should be undertaken to limit frequency of surcharge using a sewer flow simulation model, following which the design should be checked to ensure that an adequate level of protection against flooding will be provided at specific sensitive locations. These design checks are particularly important on steeply sloping catchment areas. Any requirements from the relevant authority shall be followed. In the absence of specified design flooding frequency values, those given in Table 1 should be used.

11.3 Design flows

11.3.1 General

For separate systems, design flows for the surface water pipelines will be predominantly run-off. No allowance shall be made for any wastewater component other than that resulting from firefighting.

For combined and partially separate drains and sewers, the design flow rate is made up of run-off, which is by far the predominant component, plus an allowance for wastewater flows. The run-off component should therefore be estimated using the methods outlined in 11.3.2 or 11.3.3. The wastewater component is estimated as described in 10.2. As the wastewater flows are usually considerably lower than the design flow rates, particular consideration should be given to self-cleansing velocities during dry weather conditions.

11.3.2 Methods of calculating run-off from small development schemes

In the absence of a method specified by the relevant authority, a simple method of estimating the peak rate of discharge of surface water, applicable for areas of up to 200 ha or for times of concentration up to 15 min and assuming a uniform rate of rainfall intensity, may be used. The rainfall intensity to be adopted will depend on factors such as time of concentration of the contributing area and the analysis of local rainfall data. Peak flow rate is given by:

$$Q = \Psi i A$$

where

- Q is the peak flow rate, in litres per second;
- Ψ is the run-off coefficient (between 0,0 and 1,0), dimensionless;
- i is the rainfall intensity, in litres per second hectare;
- A is the area receiving rainfall (measured horizontally), in hectares.

Appropriate values for Ψ are given in Table 2.

Table 2 — Run-off coefficients

Nature of connected area	Run-off coefficient, Ψ	Comments
Impermeable areas and steeply sloping roofs ¹⁾	0,9 to 1,0	Depending on depression storage
Large flat roofs	0,5	Over 10 000 m ²
Small flat roofs	1,0	Less than 100 m ²
Permeable areas	0,0 to 0,3	Depending on ground slope and cover

¹⁾ Impermeable areas may be increased by 30 % for large vertical surfaces.

11.3.3 Flow simulation methods

For larger developments and for schemes which can have implications for the sewer system into which the outfall discharges or the receiving water, time-varying design rainstorms and computer-based flow simulation models are required. Any model used shall be chosen in cooperation with the relevant authority. For any application, it is necessary to select a method where the appropriate balance between cost, complexity and required accuracy is achieved. Guidance on when models should be used and the type of method to select is given in informative Annex D.

11.4 Flow balancing

It can be necessary to provide a means of flow detention to intercept and hold back temporary peak storm discharges in order to avoid flooding. The effects of flow balancing on the sewage treatment works shall be taken into consideration. Arrangements for maintenance and safety of these structures will be required.

12 Environmental considerations

12.1 Environmental impact of drain and sewer systems

Sources of environmental impact include:

- outfalls;
- combined sewer overflows;
- emergency overflows, for example from pumping installations or detention tanks;
- exfiltration to groundwater;
- infiltration of groundwater;
- disposal of residues produced during sewer cleaning.

Control of these sources shall be considered, as it can limit the environmental impact to levels acceptable to the relevant authority (see EN 752-3, EN 752-5, and prEN 752-7; see also Annex E).

To reduce the run-off entering the drain and sewer system, consideration shall be given to the use of soakaways and to minimizing the area of impermeable surfaces.

Consideration shall be given to the risk of spills of noxious substances within the catchment area, particularly on separate sewer systems. Where there is significant risk of spillage or discharge of significant quantities of firefighting water containing harmful substances, appropriate measures shall be taken to avoid entry into or exit from the sewer system of these substances by, for example, the provision of oil interceptors or retention tanks.

12.2 Control of pollution

12.2.1 General

There are two approaches to the control of pollution from drain and sewer systems, as follows.

- Uniform emission limits can be set by the relevant authority for general use with each of the different types of discharge.
- Site-specific emission limits can be set by the relevant authority for individual points of discharge, to satisfy requirements for receiving water quality.

In many cases a combination of the two approaches will be required.

12.2.2 Uniform emission limits

Uniform emission limits are generally set in relation to what is technically feasible for the different types of discharge. They form a baseline standard prior to the determination of site-specific limits, which will not put the self-purifying capacity of the receiving water at risk. They are unlikely to be applicable where discharge is to sensitive waters such as recreational areas, sources for water supply or lakes. Generally in such cases, more stringent site-specific emission limits will be necessary to satisfy the receiving water quality requirements.

12.2.3 Site-specific emission limits

The relevant authority for environmental regulation can classify receiving waters according to current or projected uses or interests, for example:

- abstraction for potable water supply;
- fishery;
- bathing or other water contact activities;
- special ecosystem.

The emission limits can then be set by the relevant authority using, where appropriate, water quality simulation models.

The site-specific emission limit approach is sensitive not just to the effects of an individual discharge, but also to the combined effects of the whole range of discharges to receiving waters. These discharges, including those from industry, treatment works and non-point sources, can demand an integrated approach to the identification of solutions.

Consideration of impacts shall pay due regard both to short-term and to cumulative long-term effects.

Short-term effects include fall in the concentration of dissolved oxygen, acute toxicity and hydrobiological stress. Cumulative long-term effects include the build-up, in aquatic biota and sediments, of persistent pollutants such as heavy metals and certain organic compounds.

12.3 Combined sewer overflows

The allowable discharges and impact of combined sewer overflows on receiving waters depend on local conditions. Requirements are generally specified by the relevant authority. The location of combined sewer overflows, pollution loads, duration and frequency of discharges, pollution concentrations and hydrobiological stress are factors to be considered. The impacts of combined sewer overflows on receiving waters occur only for short time periods. However, they can be many times higher than the impact and environmental loads from sewage treatment works. The main objective of combined sewer overflow design, therefore, is to protect the receiving water without causing hydraulic overload of the sewer or reduced treatment efficiency of downstream sewage treatment works.

Sewer flow simulation models (see 11.3.3) are needed to assess compliance with many of the specified emission limits (see 12.2).

Two relatively simple approaches are available. A combined sewer overflow may be designed to begin overflow discharge only after reaching a critical rainfall intensity, generally in a range of rates of 10 l/(s·ha) (impermeable area) to 30 l/(s·ha) (impermeable area), depending on the degree of protection required. Alternatively, when the self-purifying capacity is not at risk, a single criterion (commonly a dilution of 5 to 8 times dry weather flow before spill) may be used as an emission standard.

Associated storage in, for example, a detention tank, or length of tank sewer, can greatly reduce the environmental impact of stormwater overflows. Further reductions in environmental impact can be achieved by partial treatment (e.g. settling).

If the retained flow in a combined system exceeds the capacity of the treatment works, it will be necessary to incorporate storage or partial treatment of the retained flow. This may be sited at the treatment works or within the sewer system.

In the design of a combined sewer overflow, steps shall be taken to keep the discharge of floating solids and other unsightly material to acceptable levels. This can require the provision of baffles, screens or other means of control.

12.4 Outfall design requirements

Where surface water is to be discharged to a nearby ditch, stream, river, canal, pond or lake, the invert level of the outfall should be above the highest water level so as to provide free discharge conditions. Where periodic backflooding cannot be avoided, a non-return valve shall be fitted.

The outfall shall be so formed as to avoid, or provide protection against, local erosion. It can be necessary to provide additional protection to the outfall opening to prevent damage or interference. The visual impact of the outfall shall also be taken into account.

12.5 Groundwater protection

In order to protect groundwater, stringent performance and testing can be required in high-risk areas such as drinking water abstraction zones or aquifer protection zones and areas with high groundwater levels. In such areas, a number of zones with different levels of protection can be specified by the relevant authority, depending on risk.

12.6 Residues from maintenance

Residues from maintenance activities on drain and sewer systems shall be disposed of in accordance with the requirements of the relevant authority, in such a way as not to cause pollution. Care should be taken in the design of systems to keep such residues to a minimum.

Annex A (informative)

Sources of additional information

The titles of the documents are translated for information. Only these documents where the title is marked with an asterisk (*) are available in the language of the title.

A.1 Austria

A.1.1 Austrian Standards (ÖNORM)

No.	Title
B 2500	Abwassertechnik, Entstehung und Entsorgung von Abwasser, Begriffsbestimmungen und Zeichen* Wastewater management: formation and disposal of wastewater; definitions and symbols
B 2501	Entwässerungsanlagen für Gebäude und Grundstücke; Bestimmungen für Planung und Ausführung* Sewer systems for buildings and premises; rules for planning and installation
B 2503	Ortskanalanlagen (Straßenkanäle); Richtlinien der Ausführung* Sewer system; code of building practice
B2504	Schächte für Entwässerungsanlagen* Manhole shafts for sewerage
B 5012 Teil 1	Statische Berechnungen erdverlegter Rohrleitungen im Siedlungs- und Industriewasserbau, Grundlagen*
Part 1	Static calculation of buried pipelines for water supply and sewerage: principles
B 5012 Teil 2	Statische Berechnungen erdverlegter Rohrleitungen im Siedlungs- und Industriewasserbau, Lastannahmen, rechnerische Nachweise*
Part 2	Static calculation of buried pipelines as parts of water and sewerage conduits for housing and industry; assumptions of charge, calculating certificates
B 5013 Teil 1	Oberflächenschutz mit organischen Schutzmaterialien im Siedlungswasserbau; Abschätzung der Korrosionswahrscheinlichkeit und Schutz von unlegierten und niederlegierten Eisenwerkstoffen*
Part 1	Corrosion protection by organic coatings for water and wastewater engineering in residential areas, assessment of corrosion probability and protection of unalloyed and low-alloyed ferrous materials
B 5013 Teil 2	Oberflächenschutz mit organischen Schutzmaterialien im Siedlungswasserbau; Abschätzung der Korrosionswahrscheinlichkeit und Schutz von zementgebundenen Werkstoffen*

Part 2 Corrosion protection by organic coatings for water and wastewater engineering in residential areas, assessment of corrosion probability and protection of cement-bound materials

B 5016 Überprüfung von Erdarbeiten für Rohrleitungen des Siedlungs- und Industriewasserbaues; Verdichtungsgrade*
Examination of earthworks for pipelines of water and sewage conduits for housing and industry - Degrees of compaction

A.1.2 Austrian Water and Waste Management Association - Rules of Practice (ÖWAV - Österreichischer Wasser - und Abfallwirtschafts verband - Regelblätter)

No.	Title
Regelblatt 5 Rule 5	Richtlinien für die hydraulische Berechnung von Abwasserkanälen* Guidelines for the hydraulic calculation of sewerage pipelines
Regelblatt 9 Rule 9	Richtlinien für die Anwendung der Entwässerungsverfahren* Guidelines for the use of sewerage systems
Regelblatt 11 Rule 11	Richtlinien für die abwassertechnische Berechnung von Schmutz-, Regen- und Mischwasserkanälen* Guidelines for Technical calculation of foul water, stormwater and combined systems
Regelblatt 19 Rule 19	Richtlinien für die Bemessung und Gestaltung von Regenentlastungen in Mischwasserkanälen* Guidelines for the design of stormwater overflows in combined systems
Regelblatt 21 Rule 21	Kanalkataster* Documentation of sewerage systems
Regelblatt 22 Rule 22	Kanalwartung und Kanalerneuerung* Maintenance and renewal of sewerage systems

A.1.3 Other guidelines

No	Title
ZL.57.030/3-V-6/84	Technische Richtlinien für die Errichtung, Erweiterung und Verbesserung von mit Mitteln des Wasserwirtschaftsfonds geförderten Wasserversorgungs- und Abwasserbeseitigungsanlagen (Technische Richtlinien des Wasserwirtschaftsfonds). Bundesministerium für Umwelt, Jugend und Familie* Technical guidelines for the construction, extension and improvement of water supply and wastewater systems financially supported by the Water Management Fund (Technical Guidelines of the Water Management Fund). Federal Ministry for Environment, Youth and Family

A.2 Denmark**A.2.1 Danish Standards Association (DS)**

No.	Title
DS 421	Norm for tætte fleksible samlinger i ledninger af beton mv.* Code of practice for flexible watertight joints for pipelines of concrete, etc.
DS 430	Norm for lægning af fleksible ledninger af plast i jord* Code of practice for the laying of underground flexible pipelines of plastic.
DS 432	Norm for afløbsinstallationer* Code of practice for sanitary drainage/wastewater installations
DS 436	Norm for dræning af bygværker* Code of practice for the groundwater drainage of buildings
DS 437	Norm for lægning af stive ledninger af beton mv i jord* Code of practice for the laying of underground rigid pipelines of concrete, etc.
DS 440	Norm for mindre afløbsanlæg med nedsivning* Code of practice for smaller drainage disposal systems for percolation into the ground
DS 455	Norm for tæthed af afløbssystemer i jord* Code of practice for impenetrability of underground sewer systems

A.2.2 Nordic Committee on Building Regulations

No.	Title
NKB publ. No. 48	Retningslinier for bestemmelser vedrørende vand- og afløbsinstallationer*
NKB publ. No. 48E	Guidelines for building regulations for water supply and drainage systems*

A.2.3 The Danish Water Pollution Committee

No.	Title
Skrift nr. 18 Guide No. 18	Maksimalafstrømninger og bassinvoluminer fra historiske regnserier* Urban storm water runoff and storage tanks calculated with series of historical rain events
Skrift nr. 21 Guide No. 21	Recipientbelastning fra overløbssystemer* Calculation of combined sewer overflow on receiving waters
Skrift nr. 22 Guide No. 22	Forurening af vandløb fra overløbsbygværker* The impact of combined sewer overflows on small streams
Skrift nr. 24 Guide No. 24	Standardiserede data for afløbssystemer* Standardised data for sewer systems

ISBN 87-254-15-8	Huskelist for fornyelse af afløbssystemer* Check list for preparation of sewer rehabilitation plans
A.2.4	The National Agency of Environmental Protection
No.	Title
SPVF nr. 6	Kvalitetsstyring af afløbsprojekter* Quality control of sewer projects
SPVF nr. 13	Udarbejdelse af fornyelsesplaner for afløbssystemer* Preparation of Projects for the Renovation of Sewer Systems
SPVF nr. 22	Renovering af afløbssystemer; Belastning af PEH-rør ved dynamisk rørsproengning.* Renovation of sewer systems: HDPE pipes: stress by dynamic pipe cracking
SPVF nr. 33	Fornyelse af afløbssystemer; Behov og økonomi* Rehabilitation of sewer systems; Needs and finance
SPVF nr. 48	Uvedkommende vand i afløbssystemer* Intruding water in sewer systems
Projekt nr. 137 Project No. 137	Regulering af forurening fra afløbssystemer under regn* Control of Pollution from Sewer Systems during rain

A.3 Finland

A.3.1 Nordic Committee on Building Regulations

No.	Title
NKB publ. No. 48	(Not available in Finnish language)
NKB publ. No. 48E	Guidelines for building regulations for water supply and drainage systems*

A.3.2 Ministry of the Environment

No.	Title
ISBN 951-37-1134-X	Kiinteistöjen vesi-ja viemärlaitteistot* Water supply and drainage installations for buildings and recommendations

A.4 France

No.	Title
	Instruction technique relative aux réseaux d'assainissement des agglomérations (1977)*: Chapitre 1 Conception générale Chapitre 2 Calcul des débits d'eaux pluviales Chapitre 3 Calcul des débits d'eaux usées Chapitre 4 Calcul des sections des ouvrages Chapitre 5 Condition d'établissement des réseaux Chapitre 6 Ouvrages annexes Chapitre 7 Bassins de retenue d'eaux pluviales Technical Directive for Urban Drain and Sewer Systems: Chapter 1 General design data Chapter 2 Calculation of rainwater flow rates Chapter 3 Calculation of wastewater flow rates Chapter 4 Dimensioning of pipe diameters Chapter 5 Conditions for installation of systems Chapter 6 Ancillary works Chapter 7 Detention tanks for rainwater.
Fascicule 70	Cahier des clauses techniques générales applicables aux marchés publics de travaux (ouvrages d'assainissement): * Chapitre 1 Dispositions générales Chapitre 2 Nature et qualité des matériaux Chapitre 3 Règles de conception et de calcul des ouvrages Chapitre 4 Prestations préalables Chapitre 5 Exécution des travaux Chapitre 6 Conditions de réception.
Book No. 70	General technical requirements for public contracts dealing with installation of wastewater systems Chapter 1 General requirements Chapter 2 Type and quality requirements for materials Chapter 3 Design requirements including structural design Chapter 4 Preliminary work Chapter 5 Installation Chapter 6 Commissioning requirements

A.5 Germany

No.	Title
ATV-Merkblatt M 101	Planung von Entwässerungsanlagen, Neubau-, Sanierungs- und Erneuerungsmaßnahmen*
ATV Advisory leaflet M 101	Planning of Drain and Sewer Systems, New construction, Rehabilitation and Replacement*
ATV-Arbeitsblatt A 105	Hinweise für die Wahl des Entwässerungsverfahrens (Mischverfahren/Trennverfahren)*
ATV Standard A 105	Notes for the Selection of the Sewer System (combined system/ separate system)*

ATV-Arbeitsblatt A 110	Richtlinien für die hydraulische Dimensionierung und den Leistungsnachweis von Abwasserkanälen und -leitungen.*
ATV-Standard A 110	Standard for the Hydraulic Dimensioning and Performance Verification of Sewers and Drains.*
ATV-Arbeitsblatt A 111	Richtlinien für die hydraulische Dimensionierung und den Leistungsnachweis von Regenwasser-Entlastungsanlagen in Abwasserkanälen und -leitungen
ATV-Standard A 111	Standards for the Hydraulic Dimensioning and the Performance Verification of Stormwater Overflow Installations in Sewers and Drains
ATV-Arbeitsblatt A 112	Richtlinie für die hydraulische Dimensionierung und den Leistungsnachweis von Sonderbauwerken in Abwasserkanälen und -leitungen
ATV-Standard A 112	Standards for the Hydraulic Dimensioning and the Performance Verification of Special Structures in Sewers and Drains
ATV-Arbeitsblatt A 116	Besondere Entwässerungsverfahren: Unterdruckentwässerung, Druckentwässerung.*
ATV-Standard A 116	Special Sewer Systems: Vacuum Drainage Service, Pressure Drainage Service.*
ATV-Arbeitsblatt A 117	Richtlinien für die Bemessung, die Gestaltung und den Betrieb von Regenrückhaltebecken*
ATV Standard A 117	Standard for the Dimensioning, Design and Operation of Detention Tanks*
ATV-Arbeitsblatt A 118	Richtlinien für die hydraulische Berechnung von Schmutz-, Regen- und Mischwasserkanälen*
ATV Standard A 118	Standard for the Hydraulic Calculation of Wastewater, Stormwater and Combined Wastewater Sewers*
ATV-Arbeitsblatt A 119	Grundsätze für die Berechnung von Entwässerungsnetzen mit elektronischen Datenverarbeitungsanlagen*
ATV Standard A 119	Rules for the Calculation of Sewer Systems by Data Processing*
ATV-Arbeitsblatt A 127	Richtlinie für die statische Berechnung von Entwässerungskanälen und -leitungen.*
ATV-Standard A 127	Standards for the Structural Calibration of Drains and Sewers.*
ATV-Arbeitsblatt A 128	Richtlinien für die Bemessung und Gestaltung von Regenentlastungsanlagen in Mischwasserkanälen*
ATV-Standard A 128	Standard for the Dimensioning and Design of Stormwater Structures in Combined Sewers*
ATV-Arbeitsblatt A 138	Bau und Bemessung von Anlagen zur dezentralen Versickerung von nicht schädlich verunreinigtem Niederschlagswasser*
ATV-Standard A 138	Construction and Dimensioning of Facilities for Decentralized Percolation of non-harmful Polluted Surface water.*
ATV-Arbeitsblatt A 142	Abwasserkanäle und -leitungen in Wassergewinnungsgebieten.*
ATV-Standard A 142	Sewers and Drains in Water Catchment Areas.*
ATV-Arbeitsblatt A 161	Statische Berechnung von Vortriebsrohren.*