BRITISH STANDARD

BS EN
752-6:1998

Drain and sewer systems outside buildings —

Part 6: Pumping installations

The European Standard EN 752-6:1998 has the status of a British Standard

ICS 13.060.30

BSI
British Standards

National foreword

This British Standard is the English language version of EN 752-6:1998.

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.

Cross-references

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

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 19 and a back cover.

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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 European Standard sets out principles for planning and design of pumping installations for drain and sewer systems which otherwise operate essentially under gravity.

For pumping installations for pressurized drainage systems EN 1671 applies.

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.*

EN 752-2:1996, *Drain and sewer systems outside buildings — Part 2: Performance requirements.*

EN 752-3, *Drain and sewer systems outside buildings — Part 3: Planning.*

EN 752-4:1997, *Drain and sewer systems outside buildings — Part 4: Hydraulic design and environmental considerations.*

EN 752-7, *Drain and sewer systems outside buildings — Part 7: Maintenance and operation.*

EN 1671, *Pressure sewerage systems.*

3 Definitions

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

3.1

air valve

valve used to allow air to escape from or enter into a rising main

3.2

dry well

dry chamber forming part of a pumping station and containing pumping equipment, normally used in conjunction with a wet well

3.3

duty point

rate of flow and the corresponding total head for which a pump is designed or selected

3.4

explosion proof

protected from causing ignition of flammable gases

3.5

pumping installation

pumping station together with any associated rising main(s)

3.6

pumping station

building, structures and equipment used to transfer sewage through a rising main or otherwise to raise the sewage

3.7

retention time

time during which sewage is held within the pumping installation

3.8

wet well

chamber forming a part of a sewage pumping station into which sewage discharges prior to pumping. It can include submersible pumping equipment and pipework

4 Sources of additional information

This European 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 General

Pumping installations are occasionally required in gravity drain and sewer systems in order to avoid excessive depths, or to drain low lying areas. They may also be required at combined sewer overflows or outfalls to discharge flows into treatment works or receiving waters.

Installations shall be planned and designed taking into account:

a) total cost;

b) energy usage;

c) operations and maintenance requirements;

d) risk and consequences of failure;

e) health and safety of public and operating staff;

f) environmental impact;

g) the nature of sewage which can:

— be aggressive, corrosive and/or erosive;

— have a high solid content increasing the potential for blockage;

— be toxic;

— lead to potentially explosive conditions.

Clauses **7**, **8** and **9** deal separately with the design of pumping stations, rising mains and components. However these shall not be considered in isolation as there is interaction between them.

6 Planning of pumping installations

6.1 Preliminary considerations

Where part of a system cannot be effectively drained using a gravity system then consideration should be given to the use of one or more pumping installations. The optimum number of installations shall first be determined having regard to the total cost (see also EN 752-3). The preliminary considerations for each pumping installation shall include:

— the general location in relation to such features as flood plains, rivers, railways, major roads and over all topography;

— the relation to existing sewer systems;

— environmental considerations including the potential impact on any environmentally sensitive areas and the siting of combined sewer overflows;

— access requirements;

— land ownership;

— availability of power supply, water supply and telecommunications;

— risk of explosion;

— risk of flooding;

— risk of flotation;

— risk of saline infiltration;

— the suitability of geotechnical conditions.

Once these have been established consideration can be given to more detailed planning.

6.2 Planning

The requirements for the pumping installation shall be determined in accordance with EN 752-2:1996, clause **6**, with particular reference to:

— the nature and quantity of flows including the range of flow rates (diurnal, dry/wet weather, etc.) and the range of heads to be pumped;

— the effect of the flows on the downstream sewer system and treatment works;

— measures to limit the impact of failure, which may include the use of standby pumps, generators, duplicate rising mains, emergency overflows, screens, overpumping arrangements, detention tanks, all including the requirements of the relevant authority;

— the requirements of the relevant authority with regard to combined sewer overflows;

— limiting noise and odour;

— limiting retention time in order to avoid septicity and/or sedimentation;

— provision of facilities and equipment for operation and maintenance;

— requirements for future expansion;

— consideration of special conditions (e.g. aquifer protection zones).

Once the requirements for the pumping installation have been determined, consideration can be given to the requirements for the site and the location taking into account:

— the estimated size of the pumping station, relating to the number, size and type of duty and stand-by pumps, whether there is to be a wet well/dry well, wet well only arrangement, or duplicated wet wells;

— space for detention tanks, screens or grit chambers if required;

— space for future expansion of the pumping station;

— access to the site in all weather conditions;

— space for maintenance vehicles and ancillary equipment;

— the route and levels of the incoming and outgoing sewers;

— environmental impact including odour, noise, visual impact, impact of discharge to receiving waters;

— location of receiving waters for overflows if required;

— the risk of vandalism, site security and the need for fencing.

7 Design of pumping stations

7.1 Internal design

Design requirements shall be determined for:

— pumps;

— drive units;

— controls and electrical equipment;

— instrumentation and telemetry;

— alarms;

— pipework and valves.

These shall take account of the basic requirements (see clause **6**). Consideration shall be given to:

— maximum and minimum predicted flow rates to determine the duty points of the pumps and the size of mechanical and electrical equipment;

— type and number of pumps being used (in general at least two pumps are required);

— fixed speed, multi-speed or variable speed drive units;

— provision of screens, grit chambers or, where permitted, macerators at the inlet to minimize the risk of clogging of, or damage to the pump impellers and downstream components;

— removal of screenings and grit;

— odour control;

— physical size of the various items of plant such as pumps;

— provision of access to, and sufficient working space around, all components which may require maintenance or replacement;

— means of lifting for removal or dismantling of equipment;

— size of the wet well(s) and, where applicable, the dry well;

— inlet configuration;

— welfare facilities for staff where required;

— power source for drive units (e.g. electricity or diesel) and if necessary, standby power source;

— fuel storage capacity, where appropriate;

— overpumping facilities;

— susceptibility to vandalism.

The layout shall also:

— allow pumps to be installed so they can be primed;

— keep the suction pipelines substantially horizontal, as short as possible and with no areas for air to become trapped;

— ensure that non-immersible electrical and mechanical equipment is protected from flooding;

Control equipment should be grouped together where possible.

The hydraulic design of the pumping station and rising main shall be considered together.

Buildings and chambers shall be adequately ventilated to avoid build-up of toxic or explosive gases. Wet wells shall be provided with forced ventilation where necessary. Gas testing facilities shall be made available (either portable or permanently installed).

7.2 Wet well design

The design of the wet well shall take into account the need:

— for the sump to extend below the level of incoming sewers;

— to be able to isolate, empty and clean the wet well (e.g. by partitioning or duplicating the wet well);

— to avoid "dead zones" where sedimentation can build up (in some cases model testing may be useful);

— to design the intake configuration to ensure stable flow conditions to the pump, particularly avoiding air entrainment (in some cases model testing may be useful);

— to allow adequate clearance between the base and sides of the wet well and the pump inlet;

— to protect against septicity (see EN 752-4:1997, clause **7**);

— to take any necessary measures to guard against explosion.

The size of the wet well and its detailed design shall be determined from the maximum and minimum flow rates. The capacity between start and cut out shall be set to limit the frequency of switching to within the drive unit manufacturer's recommendations. Start levels shall take into account the need to prime pumps.

7.3 External layout and access

Access and appropriate parking shall be provided at all times for emergency vehicles, maintenance vehicles and ancillary equipment. Adverse weather conditions shall be considered. The site shall be designed to deter unauthorized access.

Adequate protection against lightning shall be provided.

7.4 Environmental impact

The design of the pumping station shall take into account its effect on the environment including:

— consequences of discharges from combined sewer overflows;

— noise, vibration and odour inside and outside the pumping station;

— consequences of failure;

— visual impact.

The relevant authority can lay down requirements pertaining to the quality, quantity and frequency of discharges to receiving waters (see EN 752-4:1997, clause **12**).

Where emergency overflows are provided they shall be designed to ensure maximum retention of solids.

7.5 Structural design

The structural design of chambers and buildings shall take account of:

a) structural integrity (taking into account loads from lifting equipment and seismic loadings where appropriate);

b) watertightness;

c) prevention of flotation;

d) bearing capacity and chemical nature of the soil;

e) aggressive, corrosive and/or erosive effluents;

f) possible differential settlement between the structure and all incoming sewers and outgoing rising mains and other services;

g) requirements of the relevant authority.

7.6 Maintenance considerations

Mechanical and electrical equipment shall be selected which is robust and reliable and shall require minimal maintenance. Consideration should also be given to the availability of spare parts.

The provision of appropriate lifting hoists and beams, and of lifting eyes or similar features on heavy equipment, shall be considered.

Complete sets of current general arrangement and sectional drawings, operational, maintenance and service manuals, circuit diagrams and parts lists shall be supplied and be available at all times.

8 Design of rising mains

8.1 Principal considerations

The principal considerations for the design of rising mains for sewers, in the context of total cost, shall include:

— choice of a route;

— choice of diameter;

— positive and negative pressures and external loads;

— choice of materials;

— thrust;

— discharge points;

— control of septicity;

— valve chambers.

The hydraulic design of the rising main and pumping station shall be considered together. Methods for calculation of head losses and flows in pipes are described in EN 752-4:1997, clause **9**.

The location of rising mains shall take account of the requirements for access for maintenance and operations. Flushing or rodding connections may be incorporated.

8.2 Choice of route

Where possible the route should avoid pipeline summits and valleys.

8.3 Choice of diameter

The diameter of the rising mains shall be selected by considering:

— design flow rates and associated velocities and pumping costs;

— capital cost;

— minimum velocities to limit sedimentation;

— minimum diameter to limit clogging;

— septicity implications of retention time.

8.4 Pressures and external loads

Pipelines shall be designed for pressure resulting from maximum flow, no flow and transient pressures (positive or negative), also taking account of external loads. In the case of transient conditions, the amplitude and frequency shall be estimated.

Surge analysis shall be carried out taking into account all possible operating conditions. Numerous methods to reduce or suppress surge are available.

8.5 Choice of materials

The material for the rising main shall be selected having regard to prevention of leaks, pressures, effluent and ground/soil conditions. Particular care shall be taken:

— where wastewater contains aggressive substances;

— in contaminated or aggressive soil conditions;

— in adverse ground conditions;

— in difficult terrain;

— in aquifer protection zones.

8.6 Thrust

Thrust forces occur at valves, changes in direction and diameter, branches and blank ends and shall be contained. The methods available include:

— restrained joints over an adequate length of pipeline;

— thrust or anchor blocks;

— cradles and clamps, generally for non-buried pipelines.

Anchorages should be designed to avoid transmitting vibration.

Where thrust or anchor blocks are to bear against the soil, the safe bearing pressures shall be determined. The possibility of shear failure, sliding, and potential disturbance of the block by subsequent excavation shall be considered.

8.7 Discharge points

Discharge points shall be designed to minimize splashing and noise. Manholes into which rising mains discharge shall be well ventilated having regard to the need for odour control.

Receiving manholes shall be protected against chemical attack and erosion where appropriate.

8.8 Control of septicity

Septicity should be limited (see EN 752-4:1997, clause **7**).

8.9 Valve chambers

Valve chambers shall be provided where necessary to allow maintenance of valves. The design of valve chambers shall include for:

— removal and replacement of valves;

— safe access for personnel into the chamber;

— vehicle access to the site of the chamber.

Arrangements shall be made for removing standing water from the valve chambers.

Air valve chambers shall be adequately ventilated.

9 Components and appliances

9.1 Pumps

Each pump and its drive unit shall be suitable for the nature and composition of the sewage to be pumped and for duty throughout the specified range of station requirements such as flow rates, heads, duty points.

In some cases it may be necessary to modify the pumping station design to find an acceptable combination of pump and pumping station to avoid:

— instability of pumping units, particularly when two or more pumps are operating in parallel;

— overloading of pumps, leading to abnormal increase in power consumption;

— cavitation throughout the permissible range of operating speeds, flows and available suction level;

— negative suction head.

In addition to any testing carried out before delivery, pumps shall be tested after installation for compliance with user requirements. Performance tests for acceptance shall be agreed with the pump supplier.

Further factors to be considered shall include:

— optimization of efficiency;

— anticipated future flows taking into consideration the design life of the pump;

— pump speed (fixed speed, multi-speed or variable speed);

— materials used in pump construction, including susceptibility to corrosion and erosion;

— ability to pass permitted solids without clogging.

9.2 Prime movers and drives

Prime movers and drives shall be suitable for the types of pump selected and rated for all the operational conditions. They shall be designed to be energy efficient.

Where electric motors are to be in contact with potentially explosive atmospheres, they shall be explosion proof.

All non-submersible plant shall be located in a machinery room which is protected from flooding.

Types of prime movers which may be used include:

— electric motors;

— internal combustion engines.

These may be multiple or variable speed prime movers.

Types of drive which may be used are:

— direct;

— geared;

— belt;

— close coupled;

— intermediate shafting.

Vibration shall be kept at a minimum. Any requirements of the relevant authority to limit vibration shall be adhered to.

9.3 Valves

Valves of varying types may be required as follows:

— isolating valves to allow sections of pipework, pumps, valves etc. to be removed without emptying the whole rising main;

— washout valves at low or intermediate points to allow sections of the rising main to be emptied;

— non-return valves at pumps to prevent backflow from the rising main;

— air valves at summits and other points indicated by the surge analysis. When a single valve is used this shall be double acting.

When fully open valves should not disturb the flow distribution. Consideration shall be given to the surge effects of valve operation.

To minimize surge pressures in the rising mains, valves on rising mains may be arranged to close before pumps are stopped, and to open after they have reached full speed, both at controlled rates.

All valves shall be suitable for use with wastewater and shall be designed to prevent retention of solids.

All valves shall be identified by durable tags.

9.4 Controls and electrical equipment

All electrical installations shall meet the requirements of the relevant authority and, where appropriate, shall be protected by suitable enclosures (e.g. drip proof, explosion proof). High voltage equipment shall be secure from access by unauthorized personnel. All electrical equipment shall be properly earthed and protected from lightning damage.

Switchboards and motor control centres should be of modular construction. Each circuit should be totally segregated. Each pump set shall be provided with a separate starter. Safeguards shall be incorporated in pump controls to stop units in the event of loss of suction pressure or unacceptable flow conditions. Control systems shall ensure that unnecessary repeated stopping and starting or speed changes are avoided.

Controls may use various devices to activate the closing of the electrical circuit e.g. floats, electrodes, ultrasonics, pressure transducers, time controls. Control systems should allow for the switching sequences to be varied, where two or more pumps are used in parallel or to change from a normal duty pump to the standby pump.

A separate connection point for a temporary power generator, with switching arrangements, may be required.

9.5 Instrumentation

Suitable instrumentation shall be provided. This may include:

— monitoring equipment (e.g. level, flow, pressure, speed, voltage, current, power factor, gas content, hours run etc.);

— indication of operation of duty/standby pumps.

Information, alarms, and instructions may be relayed by telemetry to or from a remote location. The design of telemetry systems shall consider present and future data requirements and the means of data transmission.

9.6 Alarms

Provision of alarms shall be considered, these may include:

— flammable gas;

— fire;

— high water level;

— bearing temperature;

— motor temperature;

— pump failure;

— power failure;

— vandalism.

An alarm system should have an emergency power source capable of operating for at least 24 h in the event of failure of the main power supply.

Alarms should be relayed by telemetry to a central location.

10 Health and safety

The relevant authority may lay down requirements in respect of the health, safety and welfare of the public and/or operational personnel (see also EN 752-7). Examples are:

— alarm systems (see **9.6**);

— guards to protect operators from falling or injury by machinery;

— adequate lighting;

— first aid equipment;

— fire protection;

— gas detection;

— potable water supply;

— hand washing facilities;

— insulation to reduce excessive noise;

— forced ventilation to exclude toxic, noxious, or flammable gases;

— warning signs to indicate hazardous areas;

— procedures to assess potential risks;

— provision of safety equipment including personal protection equipment;

— safe systems of work.