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EAST AFRICAN STANDARD

Water supply — Requirements for systems and components for the storage of water

EAST AFRICAN COMMUNITY

First Edition 2010

Foreword

Development of the East African Standards has been necessitated by the need for harmonizing requirements governing quality of products and services in East Africa. It is envisaged that through harmonized standardization, trade barriers which are encountered when goods and services are exchanged within the Community will be removed.

In order to meet the above objectives, the EAC Partner States have enacted an East African Standardization, Quality Assurance, Metrology and Test Act, 2006 (EAC SQMT Act, 2006) to make provisions for ensuring standardization, quality assurance, metrology and testing of products produced or originating in a third country and traded in the Community in order to facilitate industrial development and trade as well as helping to protect the health and safety of society and the environment in the Community.

East African Standards are formulated in accordance with the procedures established by the East African Standards Committee. The East African Standards Committee is established under the provisions of Article 4 of the EAC SQMT Act, 2006. The Committee is composed of representatives of the National Standards Bodies in Partner States, together with the representatives from the private sectors and consumer organizations. Draft East African Standards are circulated to stakeholders through the National Standards Bodies in the Partner States. The comments received are discussed and incorporated before finalization of standards, in accordance with the procedures of the Community.

Article 15(1) of the EAC SQMT Act, 2006 provides that "Within six months of the declaration of an East African Standard, the Partner States shall adopt, without deviation from the approved text of the standard, the East African Standard as a national standard and withdraw any existing national standard with similar scope and purpose".

East African Standards are subject to review, to keep pace with technological advances. Users of the East African Standards are therefore expected to ensure that they always have the latest versions of the standards they are implementing.

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Introduction

In specifying the requirements of this standard, due regard has been taken of the importance of a reliable and safe supply of water for human consumption as well as for the purposes of trade, industry, agriculture and fire fighting.

In the preparation of this East African Standard, the following source was consulted extensively:

BS EN 1508:1999, *Water supply — Requirements for systems and components for the storage of water*

Assistance derived from this source and others inadvertently not mentioned is hereby acknowledged.

BRITISH STANDARD

BS EN
1508:1999

Water supply — Requirements for systems and components for the storage of water

The European Standard EN 1508:1998 has the status of a British Standard

ICS 13.060.20

National foreword

This British Standard is the English language version of EN 1508:1998.

The UK participation in its preparation was entrusted by Technical Committee B/504, Water supply, to Subcommittee B/504/1, Water supply — External systems and components, 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 17 and a back cover.

This British Standard, having been prepared under the direction of the Sector Committee for Building and Civil Engineering, was published under the authority of the Standards Committee and comes into effect on 15 March 1999

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EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 1508

September 1998

ICS 13.160.20

Descriptors: water distribution, water supply, storage, storage tanks, exterior, buildings, specifications, design, leaktightness, inspection, tests, safety, operating requirements, repairs

English version

Water supply — Requirements for systems and components for the storage of water

Alimentation en eau — Prescriptions pour les systèmes et les composants pour le stockage de l'eau

Wasserversorgung — Anforderungen an Systeme und Bestandteile der Wasserspeicherung

This European Standard was approved by CEN on 24 July 1998.

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. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CEN

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

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

Ref. No. EN 1508:1998 E

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 164, Water supply, the Secretariat of which is held by AFNOR.

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 1999, and conflicting national standards shall be withdrawn at the latest by March 1999.

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.

Contents

Introduction

In specifying the requirements of this standard, due regard has been taken of the importance of a reliable and safe supply of water for human consumption as well as for the purposes of trade, industry, agriculture and fire fighting.

The widely varying water supply legislative requirements, populations, social and climatic conditions across Europe have also been taken into account.

1 Scope

This standard specifies and gives guidance on:

— general requirements for storage of water outside consumers' buildings, including service reservoirs for potable water and reservoirs containing water not for human consumption at intake works or within treatment works, excluding those that are part of the treatment process;

— design;

— general requirements for product standards;

— requirements for checks, testing and commissioning;

— operational requirements;

— requirements for rehabilitation and repair.

The requirements of this standard are applicable to:

— the design and construction of new reservoirs;

— the extension and modification of existing reservoirs;

— significant rehabilitation of existing reservoirs.

NOTE 1 It is not intended that existing reservoirs are to be altered to comply with this standard, provided that there are no significant detrimental effects on water quality.

NOTE 2 This standard does not apply to reservoirs formed by the building of dams or the use of lakes for water storage purposes.

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.

prEN 805:1996, *Water supply — Requirements for systems and components outside buildings.*

3 Definitions

For the purposes of this standard, the following definitions apply.

3.1
capacity
the total volume of the compartment(s) which can be used for the operation of a reservoir

3.2
compartment
self-contained part of a reservoir which has separate inlet, outlet, overflow and washout arrangements, and can be operated independently from other compartments of the same reservoir
(see Figures 1 and 2)

3.3
control building
self-contained part of a reservoir used to accommodate the main valves, pumps, controls and monitoring equipment and which can provide the means of access to the water compartment(s)

3.4
designer
the person responsible for establishing, with the purchaser or water company, the basic criteria to be used for the design, construction, commissioning and operation of the reservoir

3.5
elevated reservoir
a reservoir constructed with the compartment(s) at ground level, but at an elevation sufficient to provide water by gravity to the supply area

3.6
rehabilitation
work necessary to upgrade or improve a reservoir to comply with this standard

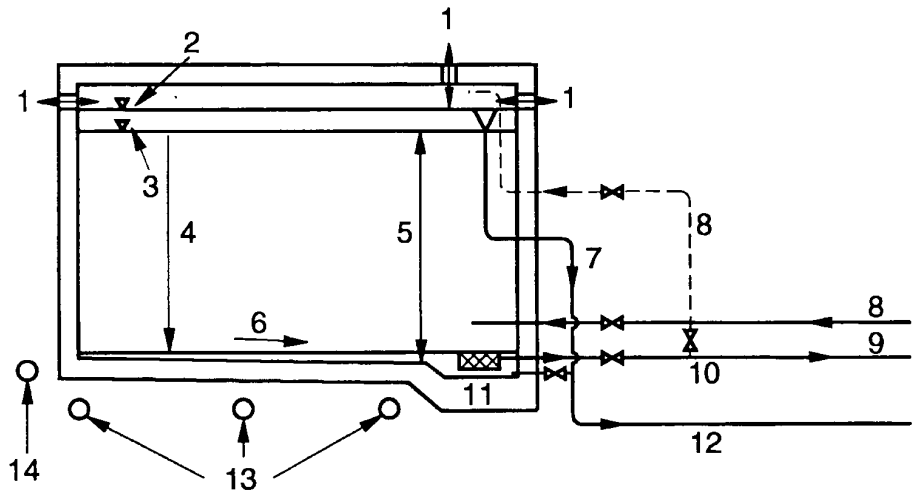
3.7
repair
work necessary to remedy a defect and restore a reservoir to satisfactory operation

3.8
reservoir
storage facility for water

3.9
service reservoir
covered storage facility for potable water which includes water compartment(s), control building, operation equipment and access arrangements, providing reserve supplies and pressure stability, and balancing demand fluctuations (see Figure 1)

3.10
water demand
estimated quantity of water required per unit of time

3.11
watertightness
the characteristic quality of the structure that prevents the passage of water through the structure in excess of any permitted quantity



1 ventilation
2 max. water level
3 max. operational water level
4 capacity
5 max. water depth
6 sloping floor
7 overflow
8 inlet
9 outlet
10 by-pass valve
11 sump
12 washout/overflow
13 underfloor drains (if required)
14 perimeter drain (if required)

Figure 1 — Simplified section through a service reservoir

4 Application of standards and regulations

In all aspects, including health and safety, the national standards, transposing European Standards as available shall apply as well as the regulations valid at the place where the system is being constructed and/or operated.

5 General requirements

5.1 General

This standard is written principally for application to service reservoirs. In the case of other reservoirs the designer or operator will determine which parts of the standard shall apply e.g. disinfection may not be required for reservoirs containing water not for human consumption.

5.1.1 *Functions*

(See also **A.1**.)

The purpose of service reservoirs is to store the necessary amount of water required for water supply in the area concerned. To achieve this their functions include:

— to equalize the difference between water intake and output and to cover peaks in demand;

— to maintain the required pressure in the water distribution systems;

— to keep stocks in reserve in case of plant malfunctions and interruptions in the water distribution systems;

— to provide water for fire fighting in accordance with local requirements.

5.1.2 ***Decision criteria and system configuration***

(See also **A.2**.)

Important decision criteria are:

— security of supply and water quality;

— overall cost of construction, operation and maintenance;

— integration into the water supply system;

— town and landscape planning.

The above-mentioned criteria can be achieved by elevated service reservoirs, water towers or by low level service reservoirs with pumping systems. Service reservoirs may be designed as buried, partially buried or above ground structures.

The construction of an elevated service reservoir is advisable if suitable high ground is available.

The construction of a water tower may be considered where the necessary ground elevation at a suitable point near the supply area is not available for an elevated service reservoir.

A pumping station with a low level service reservoir is a viable option if measures have been taken to ensure continuity of power supply.

Service reservoirs are mainly constructed from reinforced or pre-stressed concrete. They may also be constructed using steel, glass fibre reinforced plastics or other appropriate materials.

5.2 Functional requirements

5.2.1 ***Functional requirements — Water quality***

5.2.1.1 *General*

Service reservoirs shall be designed, constructed and operated to prevent contamination or other chemical, physical and biological changes that are detrimental to the water quality. (Refer to water quality regulations.)

5.2.1.2 *Materials*

Materials which meet appropriate test requirements and which will not cause the stored water to fail to comply with the requirements of appropriate EU Directives or EFTA Regulations shall be used in the structure of the water compartments and in the surfaces in contact with the stored water. Concrete and cement mortars generally satisfy this requirement but special care shall be taken if additives are used. In order to facilitate subsequent cleaning and to avoid bacterial growth, internal surfaces shall be as smooth and pore-free as possible. This can be achieved by high quality concrete finishes or by the application of suitable coatings or linings.

All metallic parts vulnerable to corrosion shall be protected.

5.2.1.3 *Water circulation*

Stagnant zones shall be minimized. This can be achieved by suitable design of the physical shape of the water compartments and the arrangement of inlet and outlet pipework for the particular storage capacity.

5.2.1.4 *Ventilation*

Ventilation facilities are required in the water compartments in order to permit air movement caused by changing water levels. This may be achieved by natural or forced ventilation. If specified by the designer measures shall be taken to safeguard and control the quality of the air entering or leaving the service reservoir.

5.2.1.5 *Prevention of contamination*

Service reservoirs shall be designed to prevent the ingress of external water or other contaminants either through the structure or any opening, entrance or pipework. Permanent exposure of the water to daylight shall be avoided.

Entrances and ventilation equipment shall also be designed so that the water cannot be contaminated (e.g. by polluted air, dust, insects and other animals).

Design may specify that openings shall not be positioned directly above the free water surface. Wherever positioned they shall be arranged in such a way that no extraneous matter is able to enter the compartment and that all external interference is impeded.

5.2.1.6 *Temperature effects*

There shall be no unacceptable alteration to the stored water caused by heat or cold. Thermal insulation measures may need to be taken to avoid adverse effects on the stored water, the structure and the associated equipment. The thermal insulation measures for service reservoirs shall be appropriate for the local climatic conditions, the operating requirements and in order to minimize condensation within the water compartments.

5.2.1.7 *Maintaining water quality*

Prior to commissioning, the service reservoir and the associated equipment shall be carefully checked, cleaned and disinfected.

Inspections shall be carried out before initial commissioning, during operation and as part of regular maintenance.

Facilities to allow the sampling of water, without entry by personnel, shall be provided for each compartment, and if specified by the designer for the inlet and outlet pipes.

5.2.2 ***Functional requirements — Operation***

5.2.2.1 *Access and security*

(See also **A.3**.)

Service reservoir sites shall be provided with access for routine visits and repair work. Facilities shall be provided to permit cleaning of each compartment independently.

Access to the water compartments, control buildings and all functional equipment shall be designed for safety, including that of personnel, and for ease of operation. Openings shall be dimensioned so as to permit entry for materials and equipment for cleaning, maintenance and repair.

Access to the reservoirs shall always be restricted and controlled. Arrangements shall be such that the minimum number of openings are provided into the water compartments. The compartments may be accessed from the control building or, subject to suitable safeguards, from the roof.

Due regard shall be paid to the security of service reservoirs with respect to acts of terrorism, vandalism and other unlawful activity. Measures shall be taken to deter, detect and delay intruders.

5.2.2.2 *General arrangement*

Service reservoirs shall normally comprise at least two compartments (see Figure 2).

Inlet, outlet, overflow and washout pipework, the necessary valves, and if specified by the designer, flow meters and level measuring devices, shall be provided for each water compartment. A bypass pipework arrangement to connect inlet and outlet pipework shall be provided for all reservoirs. The type and arrangement of the valves will depend upon the configuration of the water distribution system. If necessary, underfloor and perimeter drains shall be provided.

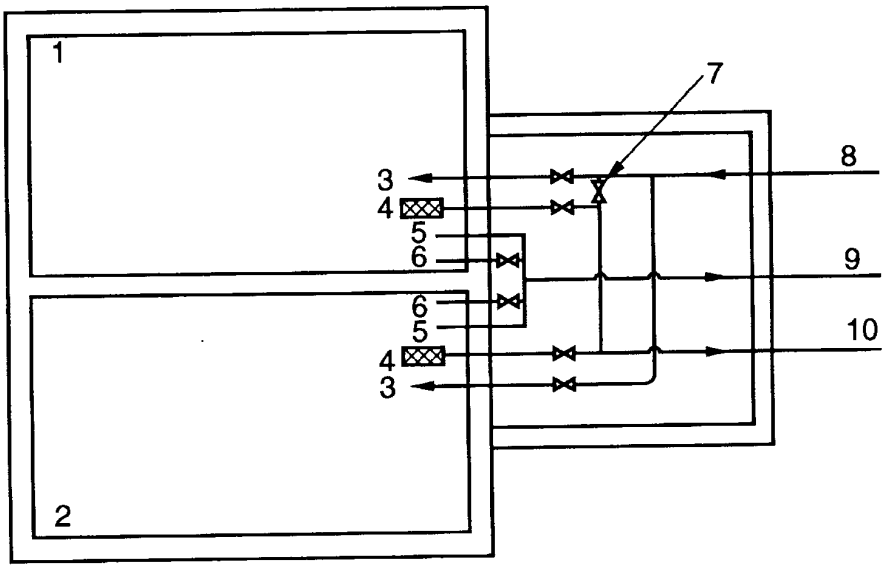
5.2.2.3 *Overflow*

The overflow of each compartment shall be of adequate dimensions to permit the free escape of excess water and shall normally allow for the discharge of the maximum inflow capable of being delivered to the service reservoir. There shall be no isolation valves on the overflow system. In certain cases where overflow pipe capacity cannot be provided for maximum inflow, emergency inlet control measures shall be provided. The overflow arrangements shall not permit the contamination of the stored water. The overflow should not be permanently connected to a sewer except where this is unavoidable, in which case special attention shall be given to checking the capacity of the sewer, and preventing the backflow of foul water and gases from the sewer.

5.2.2.4 *Monitoring*

(See also **A.4.**)

Service reservoirs shall be monitored and controlled. All necessary operational data shall be recorded. The designer shall specify if visual inspection facilities are required to observe the water in each compartment.



1 compartment 1
2 compartment 2
3 inlet
4 outlet
5 overflow
6 washout
7 by-pass valve
8 from treatment works or source
9 washout/overflow
10 to supply area

Figure 2 — Simplified arrangement of a service reservoir

5.2.2.5 *Power supplies*

Consideration shall be given to providing permanent and emergency power supplies to service reservoir sites.

5.2.2.6 *Lightning protection*

Lightning protection arrangements shall be provided for all water towers, and shall be considered for all service reservoirs.

6 Design requirements

6.1 Watertightness

Reservoirs shall be designed to be watertight. This can be achieved using various methods, either singly or in various combinations as described below:

— structures where watertightness is obtained by the nature of the structure itself, which is typically achieved by reinforced or prestressed concrete structures. In addition it is possible to improve the impermeability of the concrete by the inclusion of additives or the application of surface treatments;

— structures where watertightness is achieved by the structure itself, to which a coating has been added;

— structures where watertightness is achieved by the addition of a waterproof coating, or lining which may either be bonded to, or independent from, the supporting structure.

For structures using prefabricated component parts, watertightness may be achieved using the above techniques.

Special attention shall be paid to construction and movement joints, pipes or ducts passing through structural elements and other features subject to water pressure. This shall include the use of appropriate waterstops and sealants.

6.2 Structural design

6.2.1 ***General***

In all aspects, including health and safety, the valid national design and construction standards and requirements at the place where the reservoir is proposed to be constructed shall apply until such time as the implementation of the relevant structural Eurocode[1]). These shall be based on the acceptable probability that the structure will remain fit for the use for which it is intended throughout its design life. This involves calculation at limit states.

6.2.2 ***Limit states***

Ultimate limit states which may require consideration include:

— loss of equilibrium of the structure or any part of it, considered as a rigid body;

— failure by excessive deformation, rupture, or loss of stability of the structure or any part of it, including supports and foundations.

Serviceability limit states which may require consideration include:

— deformations or deflections which affect the appearance or effective use of the structure (including the malfunction of machines or services) or cause damage to finishes or non-structural elements;

— cracking which is likely to affect adversely the appearance, durability or watertightness of the structure;

— vibration which causes discomfort to people, damage to the service reservoir or to its components, or which limits its functional effectiveness;

— excessive stress which is likely to lead to loss of durability.

6.2.3 ***Actions***

6.2.3.1 *General*

The structural design shall take into account the effects of permanent, variable and accidental actions. The reservoir and its compartments shall be designed for both the full and empty conditions.

6.2.3.2 *Permanent actions*

These include:

— the dead load of the structure;

— the load of the operational equipment and plant (e.g. pumps and pipework);

— the load of any additional installations;

and, where applicable:

— the prestressing load;

— the earth load and earth pressure;

— the load and pressure of the groundwater at its lowest assumed level;

— any imposed displacement;

— shrinkage;

— creep.

[1]) Eurocodes 1 to 9 (ENV 1991 to 1999) in preparation by CEN/TC 250.

6.2.3.3 *Variable actions*

These include:

— the load and pressure of the water in the reservoir;

— the snow and wind loads;

— the loads due to operation of the reservoir;

— the loads due to maintenance;

and, where applicable:

— the load and pressure of the groundwater at its highest assumed level;

— transient loads in the vicinity of the structure;

— the loads at the time of construction;

— temperature variations both inside and outside the reservoir, taking into account climatic extremes and seasonal or operational variations in the temperature of the stored water;

— the thermal gradient between parts of the structure exposed to differing climatic conditions.

Variable actions not defined by this standard shall be specified by the designer.

6.2.3.4 *Accidental actions*

These include, where applicable, earthquakes and other accidental actions such as avalanches, forest fires, vehicle and aircraft impact etc. The technical data to be taken into account shall be defined by the designer.

6.3 Further provisions

6.3.1 ***Stress analysis***

The stresses shall be calculated under the relevant load combinations using appropriate structural design methods. For those parts of the structure designed to retain water and for serviceability limit state verifications the calculations are normally carried out using the assumption of linear elastic behaviour of materials.

Where necessary shell and plate effects and the interaction of the reservoir with the subsoil shall be taken into account.

6.3.2 ***Stress analysis — Construction***

When the execution methods include construction phases, during which the stability and resistance conditions can be different from those of the completed structure, the appropriate limit states shall be checked.

6.3.3 ***Stress analysis — Water towers***

For water towers, the effects of deformation of the supporting structure shall be considered. For tall, slender towers, and for calculating dynamic stresses due to wind or earthquakes, the transitional and rotational inertia of the structure shall be considered. The effect of the movement of the stored water on the structure, if significant, shall also be considered.

6.3.4 ***Crack width***

To ensure durability and watertightness of concrete the crack width shall be limited to the extent required by local conditions and its location in the structure, and through suitable selection of reinforcement content, steel stress and bar diameter.

7 General requirements for product standards

Service reservoirs, their components and all materials used in their manufacture shall comply with the relevant requirements of prEN 805:1996, **8.1** and **8.2**.

8 Checks, testing and commissioning

8.1 General considerations

8.1.1 ***General***

The stages leading to the commissioning of new service reservoirs are the satisfactory completion of the following:

— checks for movement;

— watertightness tests;

— cleaning and disinfection;

— putting into service.

8.1.2 ***Hygiene***

(See also **A.5**.)

Entering a compartment of a service reservoir can constitute direct contact with water intended for human consumption. All personnel engaged on work described in this standard shall be instructed on the need for the maintenance of a high standard of cleanliness, hygiene and safety. Attention shall be drawn to the dangers of contamination of the water supply, e.g. at entry to a service reservoir personnel shall be required to clean footwear in a tray of strong disinfectant solution.

It shall be established that all personnel meet appropriate health requirements, particularly with regard to water-borne diseases.

8.1.3 ***Safety of personnel***

(See also **A.5**.)

Prior to commencement of operations a check shall be made that appropriate safety equipment is available and that all personnel wear the correct protective clothing.

Consideration shall be given to the use of appropriate permit to work or safe working procedure systems.

A safe means of access and egress shall be provided.

8.2 Checks for movement

In appropriate cases the designer shall require checks for movement (e.g. settlement, rotation or displacement) during the commissioning process.

8.3 Watertightness tests

8.3.1 *Principles*

Before commissioning of the service reservoir watertightness tests of each compartment are required in accordance with the design requirements, as given in **6.1**. These watertightness tests shall take place while the walls and roof are freely accessible prior to backfilling. The procedure for testing the walls and floors and any permitted drop in water level shall be specified by the designer. The roof of the service reservoir shall be watertight. The designer may specify the testing of the roof by either continuous wetting or flooding with water. In either case the test shall be considered satisfactory if no leaks are evident on the underside of the roof. Any moisture evident at joints or through the structure shall be assessed to determine whether a long term risk of water loss exists. If either test fails, remedial work shall be carried out following which the relevant test shall be repeated.

8.3.2 *Walls and floors*

The test procedure shall, as a minimum, include the following steps.

8.3.2.1 *Preparation*

On completion of construction:

— ensure that adequate discharge arrangements are available;

— thoroughly clean all internal surfaces;

— isolate and secure all inlet and outlet pipework;

— slowly fill the compartment with water up to the overflow level, which can require temporary filling arrangements. For service reservoirs, potable water should be used;

— allow a soaking period, where appropriate, to achieve saturation of the wetted surfaces and if necessary top up with water at the end of the period.

8.3.2.2 *Test procedure*

— Measure by reference to a fixed datum point and record the water level at the start of the test.

— Observe and if necessary measure the flow in the underfloor drains.

— At intervals monitor the water level during the test period.

— Monitor the condition of external surfaces, including dividing walls, for signs of leakage.

— At the end of the test period measure the final water level.

— Calculate water loss.

— Complete test report.

8.3.3 *Roofs*

The test procedure shall include, as a minimum, the following steps.

8.3.3.1 *Preparation*

— Ensure the compartment is empty of water.

— In the case of a flat roof make temporary provision to seal any roof drainage.

— Where necessary make any temporary arrangements to achieve the depth of water on the roof specified by the designer.

8.3.3.2 *Procedure*

— Flood or wet the roof as specified by the designer.

— Where wetting is specified spray the roof continuously with water over the entire area.

— Observe the soffit of the roof for signs of leakage.

— Complete the test report.

8.3.4 *Test report*

The test report shall be recorded and retained in a suitable format (see **A.6**).

8.4 Cleaning and disinfection

Before putting into service, the empty reservoir shall be cleaned in all cases and disinfected unless otherwise specified.

8.4.1 *Cleaning*

Before putting into service, the empty reservoir shall be cleaned. In the course of basic cleaning all inner surfaces of the reservoir shall be sprayed copiously with water, which for service reservoirs should be potable water, under adequate pressure. All pipelines shall be flushed. The conditions of cleaning shall be such that no damage is caused to the service reservoir surfaces.

The use of chemical cleaning agents shall be minimized, but, when employed, the designer shall specify the use of appropriate products, taking account of local legislation or other mandatory requirements. Any effluent or material resulting from the cleaning process shall be disposed of safely after use, and in an environmentally suitable manner.

8.4.2 *Disinfection*

8.4.2.1 *Selection of disinfectant*

The use of disinfectants shall be in accordance with the relevant EU directives or EFTA regulations where applicable and national and local regulations shall be complied with.

The choice shall be made in accordance with the contact time required and water quality considerations e.g. pH, and in the case of calcium hypochlorite, the hardness of the water. Moreover, the choice of the disinfectants shall be made according to factors such as shelf life, ease of handling, and the likelihood of accidents to personnel or to the environment.

Recommendations for suitable disinfectants, maximum concentrations, limitations of use and neutralising agents are given in prEN 805.

8.4.2.2 *Disinfection procedure*

All internal surfaces of the reservoir and associated pipework shall be washed (generally by spraying) with a disinfectant and subsequently rinsed with potable water. The designer or operator shall specify the concentration of the disinfectant solution and the minimum and any maximum contact time. The disinfectant shall be drained from the reservoir and disposed of carefully, using an appropriate neutralizing agent where necessary, to avoid harm to the environment or personnel. The method of disinfection shall be such that no damage is caused to the reservoir surfaces.

The reservoir shall then be filled to the specified water level with potable water having a disinfectant residual of less than or equal to that normally encountered in the potable water supplying the reservoir.

All associated pipework and components shall be disinfected as specified in prEN 805.

8.4.3 ***Water quality clearance***

Following completion of filling, and after a period specified by the designer, samples shall be taken for bacteriological analysis.

Microbiological clearance is achieved if the sample results received comply with national requirements. If any sample fails to comply, the designer or operator shall specify the remedial actions to be taken in order to obtain microbiological clearance.

Samples shall also satisfy national requirements in all other water quality aspects.

8.4.4 ***Records***

(See also **A.6**.)

The results of the disinfection procedure shall be recorded and retained in a suitable format for a period of time specified by the operator.

8.5 Commissioning

The reservoir shall not be taken into service until the following conditions have been fulfilled.

8.5.1 ***Water quality***

Immediately prior to putting the reservoir into service it shall be confirmed that the water quality in the reservoir, and the associated pipework and components, is satisfactory in accordance with **8.4.3**.

8.5.2 ***Operations***

All apparatus and equipment of the reservoir shall be checked for correct operation, and operating instructions shall be written down in an operating manual.

9 Operational requirements

9.1 Introduction

9.1.1 ***General***

In order to secure a regular water supply and to avoid adverse public health and environmental effects, service reservoirs shall be systematically monitored, inspected, maintained and cleaned during their operational life. All personnel involved with these tasks shall comply with **8.1.2** and **8.1.3** of this standard.

9.1.2 ***Monitoring***

The monitoring of service reservoirs shall include the analysis of water samples in compliance with all relevant health requirements (e.g. frequency and numbers of samples, parameters checked and methods to be followed). The operator may also require the regular collection and verification of data such as reservoir levels, inflow, outflow, pressures and under-drain flows.

9.1.3 ***Inspection***

The inspection of service reservoirs shall, as a minimum, include:

— periodic checking to confirm the satisfactory operation of all parts and equipment while in service;

— periodic and scheduled removal from service to check the internal condition of the water compartments, parts and equipment.

If any defect becomes apparent at any time, consideration shall be given to removing the reservoir from service for inspection.

9.1.4 ***Operating manual***

(See also **A.7**.)

An operating manual shall be provided for each service reservoir, which shall include all instructions and procedures to be followed. All instructions and procedures given in the operating manual for each service reservoir shall be followed. Records of inspections of all maintenance work shall be kept for a period of time specified by the operator.

In the event of significant alterations during the working life of the reservoir the operating manual shall be updated.

9.2 Maintenance

Routine and preventive maintenance programmes shall be considered for each service reservoir, including all components such as pumps, valves, and electrical equipment.

Defects identified as a result of routine or other inspections, in accordance with **9.1.3**, shall be repaired as necessary.

9.3 Cleaning and disinfection

Cleaning, disinfection and the return to service of reservoirs emptied for inspection or maintenance shall comply with **8.4** and **8.5** of this standard.

10 Rehabilitation and repair requirements

10.1 Introduction

If a reservoir becomes unfit for its purpose, measures shall be taken to restore it to an acceptable condition or to take the reservoir out of use, including the disconnection of all pipework from the distribution system.

Consideration shall be given to upgrading the reservoir to meet the requirements for a new reservoir as far as economically and technically possible. The future of the reservoir within the overall distribution system shall be taken into account.

10.2 Survey

Prior to carrying out repair or rehabilitation work, a survey of the reservoir shall be carried out to identify any problems and to compare the condition of the reservoir with the requirements set out in this standard for a new reservoir. Where possible the cause of any defects shall be identified.

10.3 Prevention of contamination

(See also **A.2**.)

If it is necessary for a service reservoir to be kept in operation while repair or rehabilitation work is carried out, special attention shall be paid to ensure that no contamination of the water takes place. In addition to the measures specified in clause **8** of this standard other appropriate protection measures shall be taken. These may include more frequent sampling of the water or additional precautionary disinfection. The methods and a programme of work shall both be agreed with the operator; see **A.2**.

10.4 Return to service

Prior to returning a reservoir to service the water compartments that have been taken out of use to enable the repair and rehabilitation work to be carried out shall be cleaned, disinfected and then put into service as set out in clause **8** of this standard.

Annex A (informative)
Guidance to EN 1508

A.1 ad 5.1.1 Functions

The capacity of the service reservoir and the time the water is stored in the reservoir depends upon the functions the service reservoir is required to fulfil and its operating regime within the water distribution system.

The capacity is based around the normal equalization (balancing) volume plus a safety reserve. The operation of a reservoir is normally based on the equalization of the water inflow and outflow over a set period of time.

Storage based on equalization over a twenty four hour period is typical but longer periods of time can be required. In order to ensure that the water quality does not deteriorate, storage periods should be the minimum consistent with providing adequate continuity of supplies.

Safety reserves are based on the assessment of the risk and likely duration of operating malfunctions of the inlet main, the supply source works, pumping stations and control systems, and the consequences of such failures.

For a service reservoir supplied by a single source through a long inlet main with minimal standby plant it is recommended to provide a larger safety reserve than for a service reservoir supplied by several inlet mains within an inter-connected system with full standby plant.

Safety reserves should be increased if the water distribution system is used to provide water for fire fighting. Such reserves may not be appropriate when there is already a large storage capacity. Temporary arrangements can often be made to meet emergency demands for fire fighting.

A.2 ad 5.1.2 Decision criteria and system configuration

A service reservoir comprises one or more water compartments, a control building and an external area.

One water compartment can suffice where another service reservoir is available for the same supply area or where the water supply can be maintained by other operational measures (e.g. pumping and/or temporary supply from a different area) to enable the service reservoir to be taken out of use for cleaning or maintenance work. Full height separation walls are preferable between compartments to prevent deterioration and contamination of the water in the operational compartment whilst cleaning or repair is carried out in the other compartment.

The control building should be sized to house all necessary operating equipment such as control valves, washout valves, control panels, sampling and monitoring equipment, switch gear etc. It may also contain forced ventilation equipment, disinfection plant, booster pumps and personnel facilities.

The ventilation of the water compartments should be separate from the ventilation of the control building.

The external area, which is normally enclosed, to a service reservoir can comprise valves, pumping stations, access roads, aerials etc.

The service reservoir should be integrated into the landscape. Consideration should be given to embankments, the roof covering, tree and shrub planting and other landscaping measures but care should be exercised in the selection of species (root intrusion, irrigation requirements, maintenance). Maintenance requirements to the external areas should be kept to a minimum.

Consideration should be given to the phased extension of the reservoir as the water demand increases as an alternative to its initial construction at its ultimate capacity.

Service reservoirs are often positioned as near as possible to the area of water demand as this will provide greater safeguards against interruptions to supplies and reduce head losses.

The elevation of the service reservoir will be determined by the topographical conditions and the hydraulics of the water distribution system.

An adequate flow and pressure should be provided to all buildings within the supply area to be served. The head losses in the distribution system for peak demands and the lowest normal operating level in the service reservoir should be considered.

For illustrations see Figures A.1 to A.4.

A.3 ad 5.2.2.1 Access and security

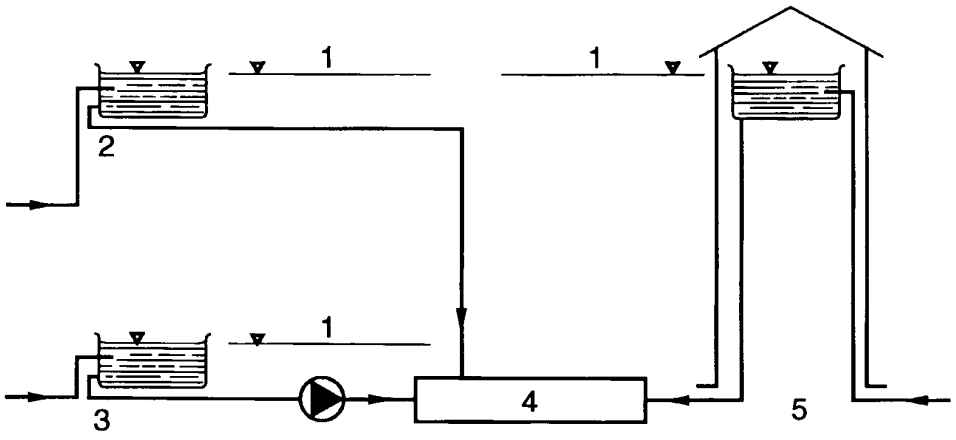
Demarcating fencing around the service reservoir will deter entry in low risk areas. Where risks are high the provision of security fencing and monitoring systems should be considered.

Unmanned service reservoirs should be visited frequently and consideration should be given to intruder detection systems, camera surveillance, audible alarms and high intensity lighting.

The joint use of service reservoir sites with third parties and/or the general public should only be considered in exceptional circumstances.

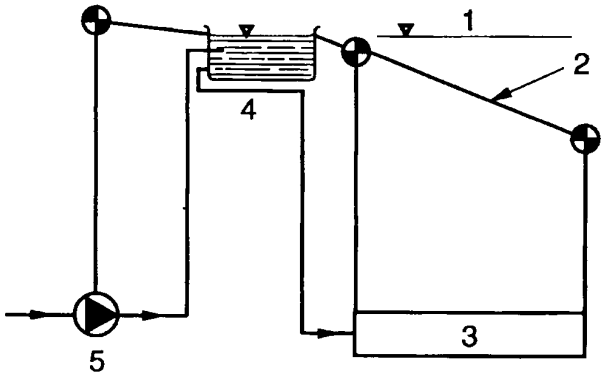
A.4 ad 5.2.2.4 Monitoring

The water level of every compartment should be measured with appropriate instruments, displayed and if possible transmitted to a central location. Other data such as flow, pressure and quality parameters can also be transmitted. These data links can provide remote control facilities.



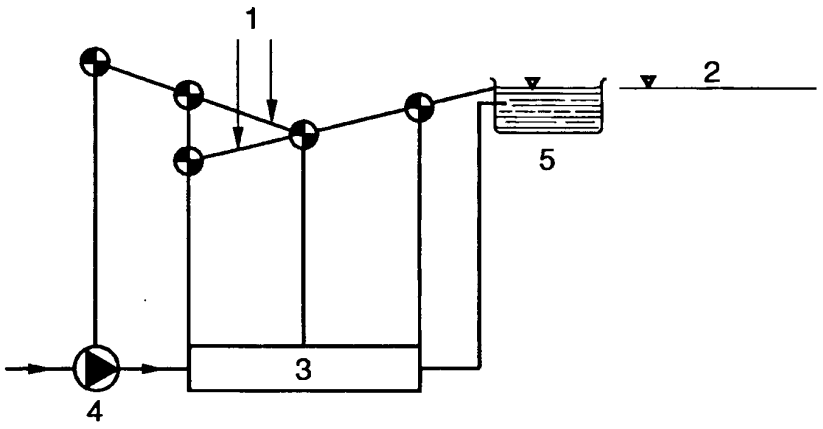
1 water level
2 elevated service reservoir
3 service reservoir with pumping station
4 water supply area
5 water tower

Figure A.1 — Illustrative hydraulic arrangement



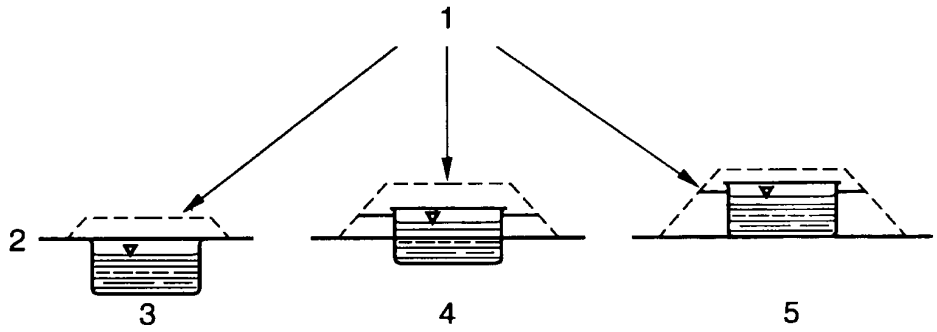
1 water level
2 example of operating pressure
3 water supply area
4 service reservoir
5 pumping station

Figure A.2 — Illustrative siting of a service reservoir in the distribution system — Service reservoir between pumping station and water supply area



1 example of operating pressure
2 water level
3 water supply area
4 pumping station
5 service reservoir

Figure A.3 — Illustrative siting of a service reservoir in the distribution system — Water supply area between pumping station and service resevoir



1 optional embankment/roof coverings
2 ground level
3 buried reservoir
4 partially buried reservoir
5 above ground reservoir

Figure A.4 — Illustrative topographical arrangement

A.5 ad 8.1.2 Hygiene and 8.1.3 Safety of personnel

Care should be taken to ensure that plant, tools, instrumentation and other equipment are free from contamination before use. Such items should be stored separately from equipment used for other purposes and preferably colour coded.

Protective clothing to be used in service reservoirs should be clean. It should be stored apart from the other protective clothing, kept free from contamination and its purpose clearly identified. Colour coding or alternative marking is recommended.

Service reservoirs should be considered as spaces where entry is only permitted in accordance with an appropriate permit to work or safe working procedure.

Emergency procedures should be laid down and all personnel should be properly trained.

Appropriate telemetry, control systems, pumps and control valves should be isolated and locked off to prevent an unplanned inflow of water whilst personnel can be inside the compartment.

Compartments should be adequately ventilated by natural or assisted means. Internal combustion engines should never be operated within a service reservoir or adjacent to any access or ventilation openings. Care should be exercised with the use of temporary electrical equipment inside reservoir compartments.

The atmosphere in each compartment should be checked for oxygen deficiency, explosive or toxic conditions and certified safe before entry and continuously monitored while occupied. Devices for indicating and measuring gases should be tested and calibrated before use in accordance with the manufacturer's requirements.

The attention of operators should be drawn to the need for emergency evacuation. Where necessary a manhole winch should be erected at one access point for emergency use.

A.6 ad 8.3.4 Test report and 8.4.4 Records — Example of a test procedure report

Reservoir: .....

1 - Client: ..... Contractor: .....

2 - Construction period - from: ..... to: .....

3 - Number of compartments: .....

4 - Technical details to be given for each compartment

Storage volume:	m^3
Capacity:	m^3
Maximum water depth:	m
Water surface area:	m^2
Wetted surface area:	m^2

Pipe diameter:

Inlet:	DN .....
Outlet:	DN .....
Washout:	DN .....
Overflow:	DN .....
Others:	DN .....

Surface type and condition at time of leakage test:

Walls: .....

Floor: .....

Soffit: .....

Supports: .....

5 - Water loss test:

Security against unauthorized operation

Component	Closed	Sealed	Blank flanged
Access			
Inlet valves DN			
Outlet valves DN			
Washout valves DN			
Others			

Measurements: Maximum and minimum temperatures during test:

external atmosphere:.....

internal atmosphere:.....

water: .....

Test record							
	start date	start time	end date	end time	Duration		Signature
Initial filling					days		
Reading on scale or		mm		mm	difference	mm	
Gauging from fixed point		mm		mm	difference	mm	

6 - Result of visual inspection: .....

.....

.....

Notes:

(e.g. locations, cause, elimination of leaks, repeated test)

.....

.....

7 - Evaluation:

The water loss test has/has not been passed.

.....	.....
Client	Contractor
....	....
Place Date	Place Date
.....	.....
Signature	Signature

.....

Project Manager

....

Place Date

.....

Signature

A.7 ad 9.1.4 Operating manual

Examples of the requirements of an operating manual are:

— general arrangement drawings and loading limitations;

— special measures for operational events and/or major fires in the supply area;

— procedures for taking the reservoir out of service;

— instructions for cleaning and disinfection prior to return to service;

— instructions for the operation of valves and their maintenance;

— instructions for the maintenance of all other components of the reservoir including electrical and hydraulic equipment and transmission devices;

— details of materials used in joints, linings, coatings etc.;

— reports on inspections, maintenance, and any unusual events.

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