BRITISH STANDARD

BS EN
13280:2001

Specification for glass fibre reinforced cisterns of one-piece and sectional construction, for the storage, above ground, of cold water

The European Standard EN 13280:2001 has the status of a British Standard

ICS 23.020.10; 91.140.60

National foreword

This British Standard is the official English language version of EN 13280:2001. It supersedes BS 7491-1:1991, -2:1992 and -3:1994 which are withdrawn.

The UK participation in its preparation was entrusted by Technical Committee PRI/5, UK steering committee for CEN/TC 210, to Subcommittee PRI/5/2, GRP tanks for water cisterns, 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.

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EUROPEAN STANDARD

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EN 13280

August 2001

ICS 23.020.10

English version

Specification for glass fibre reinforced cisterns of one-piece and sectional construction, for the storage, above ground, of cold water

Spécification pour citernes monoblocs et réservoirs compartimentés en PRV pour le stockage hors sol d'eau froide

Spezifikation für textilglasverstärkte Einkammer- oder Mehrkammertanks für die oberirdische Lagerung von Kaltwasser

This European Standard was approved by CEN on 9 June 2001.

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 Management Centre 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 Management Centre 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.

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Foreword

This European Standard has been prepared by Technical Committee CEN/TC 210, GRP tanks and vessels, the Secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by February 2002, and conflicting national standards shall be withdrawn at the latest by February 2002.

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.

1 Scope

This European Standard specifies the requirements for rectangular and vertical cylindrical glass reinforced plastics (GRP) one-piece cisterns and rectangular sectional tanks for the storage of water above ground for both domestic and industrial use within the following capacity ranges;

a) one-piece cistern 500 l to 100 000 l;

b) sectional tank 500 l and larger.

Particular requirements for additional components for cisterns for domestic use are also included.

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 (including amendments).

EN 59, *Glass reinforced plastics — Measurement of hardness by means of a Barcol impresser.*

EN 578, *Plastics piping systems — Plastics pipes and fittings — Determination of the opacity.*

EN 10025:1993, *Hot rolled products of non-alloy structural steels — Technical delivery conditions.*

EN 10088-3:1995, *Stainless steels — Part 3: Technical delivery for semi finished products, bar, rod and sections for general purposes.*

prEN 13121-1:1998, *GRP tanks and vessels for use above ground — Part 1: Raw materials — Acceptance conditions and usage conditions.*

EN ISO 2078, *Textile glass — Yarns — Designation.*

ISO 75-3:1993, *Plastics — Determination of temperature of deflection under load — Part 3: High strength thermosetting laminates and long-fibre-reinforced plastics.*

ISO 472, *Polyester resin systems — Designation.*

ISO 1461, *Metallic coatings — Hot dip galvanized coatings on fabricated ferrous products — Requirements.*

ISO 4759-1, *Tolerances for fasteners — Part 1: Bolts, screws, studs and nuts — Product grades A, B and C.*

ISO 8605, *Textile glass reinforced plastics; sheet moulding compound (SMC); basis for a specification.*

3 Terms and definitions

For the purposes of this European Standard the following terms and definitions apply.

3.1
cistern

3.1.1
one-piece cistern
rectangular or vertical cylindrical fixed container for holding water at atmospheric pressure at a maximum temperature of 39 °C

3.1.2
sectional tank
rectangular fixed container assembled from panels for the storage of water at atmospheric pressure at a maximum temperature of 39 °C. This temperature is higher than is acceptable for drinking water that has a maximum upper limit 25 °C as defined within the Drinking Water Directive, 80/778/EEC

3.2
water for domestic purposes
water supplied for drinking, washing, cooking and sanitary purposes

3.3
feed and expansion cistern
cistern for supplying cold water to and receiving expansion water from a hot water system

3.4
primary expansion cistern
cistern connected to a primary circuit of space heating or hot water heating system which accommodates the increase in volume of water in that system when it is heated from cold

3.5
secondary water heating system
part of the hot water system comprising the cold feed pipe, any storage cistern, the water heater and flow and return pipework from which hot water for use is conveyed to all points of draw off

3.6
nominal capacity
volume contained in the cistern, measured up to the top edge of the side walls

3.7
actual capacity
volume contained in the cistern up to the maximum working level

3.8
top edge of tank
top edge of the upper side panels or the lowest point of the cover, whichever is the lower

3.9
raised level inlet chamber
enclosed chamber above the level of the cover incorporating an access lid or panel, permitting the level control mechanism or piped inlet to be mounted at a higher level than would otherwise be possible

3.10
maximum working depth
depth of water to the lower edge of the overflow pipe or warning pipe, whichever is the lower

3.11
jointing sealant
material used to effect a watertight seal between the modular panels of a sectional tank construction

3.12
vent pipe
pipe open to the atmosphere and used in connection with a hot water system for the escape of air and/or steam

3.13
vent
fitting on the cistern cover providing a protected opening to atmosphere to allow for the movement of air resulting from changes in the water level so that the water always remains at atmospheric pressure

3.14
warning pipe
pipe so fixed that its outlet, whether inside or outside a building, is in a conspicuous position where the discharge of water can be readily seen

3.15
overflow pipe
pipe connected to the cistern to discharge any overflow therefrom

3.16
bracing system
internal or external structure which provides support to the side walls, divisions, weirs and baffles of the cistern or tank

3.17
baffle
internal wall within a cistern or tank, which partially subdivides the cistern or tank in order to increase the length of the flowpath between the inlet and the outlet of the cistern or tank

3.18
weir
internal wall within a cistern or tank, which divides the cistern or tank but to less than its full depth such that the contents can spill over from one side of the weir to the other

3.19
division
internal wall within a cistern or tank which divides the tank into watertight compartments

3.20
tank base
panel or panels, principally in the horizontal plane, which form the bottom of the sectional tank

3.21
foundation
structure upon which the cistern or tank is constructed

3.22
rupture
complete or catastrophic structural failure

3.23
cover
rigid close-fitting cover secured to cistern or tank sides which excludes light and the ingress of particles and/or insects from the cistern or tank

3.24
test water line
line at 100 mm below the top edge of the side walls of a one-piece cistern

4 Designation

Each one-piece cistern or sectional tank shall be designated by a code with the following components, in the order presented.

a) The number and date of this European Standard i.e. EN 13280: 2001.

b) The capital letters GRP.

c) The capital letters and numbers "A1", "A2" or "B" where:

"A1" and "A2" indicates class A one-piece cisterns or sectional tanks, which are for use in potable water storage as one of the following:

1) a cold water storage one-piece cistern or sectional tank;

2) a feed one-piece cistern or sectional tank or a combined feed and expansion one-piece cistern or sectional tank, supplying a secondary water heating system;

3) a combination of these.

"A1" indicates a class A one-piece cistern or sectional tank, which is for use in potable water storage, and is supplied for use with the additional fittings specified in clause 9.

"A2" indicates a class A one-piece cistern or sectional tank, which is for use in potable water storage and is supplied for use without the additional fittings specified in clause 9.

NOTE These fittings are required for use in potable water storage but in that case are supplied and fitted by other parties.

"B" indicates a class B one-piece cistern or sectional tank which is for use in the storing of cold non-potable water as one of the following:

1) a cold non-potable water one-piece cistern or sectional tank;

2) a combined feed and expansion one-piece cistern or sectional tank to a primary circuit;

3) an expansion one-piece cistern or sectional tank.

d) A number representing the nominal capacity in litres.

For example, a sectional tank of nominal capacity 20 000 l intended for use in potable water storage and supplied without the additional fittings specified in clause 9 would be designated as EN 13280 :2001/GRP/A2/2000.

5 Materials

5.1 Resins

Polyester resin systems, where used, shall conform to ISO 472 and be selected from the resin types specified in prEN 13121-1:1998.

5.2 Fibrous reinforcement

The glass fibre reinforcement used shall be of type "E" glass.

A type "E" glass, comprising either an alumino-borosilicate glass or an alumino-calco-silicate glass, with or without other oxides, comprising mainly aluminium trioxide for enhanced corrosion resistance.

NOTE The description for "E" glass is consistent with, but more specific than that given in EN ISO 2078.

The reinforcement shall be made from continuously drawn filaments of a glass conforming to the above description, and the filaments shall have a sizing compatible with the resin to be used. It may be used in any form free from longitudinal splitting, e.g. as continuous or chopped filaments, strands or rovings, mat or fabric.

5.3 Sheet moulding compound

5.3.1 General

Sheet moulding compound (SMC) shall conform to the requirements of ISO 8605.

5.3.2 Reinforcement

The glass fibre reinforcement in the SMC shall contain 25 mm and/or 50 mm long "E" glass strands, cut from glass fibre rovings conforming to the requirements given in EN ISO 2078.

Where required, additional glass reinforcement shall be used in the moulded part consisting of glass fibre woven fabrics or continuous filament mat conforming to EN ISO 2078.

5.4 Other materials

5.4.1 Aggregates

Where required, inert granular materials of particle size between 5 mm and 0,05 mm shall be used as a design part of the structure, e.g. graded silica sands.

5.4.2 Inert fillers

Where required, an inert filler shall be used with a maximum partical size of 60 μm.

5.4.3 Additives

Where required, release agents, shrinkage control agents, pigment, curing agents, wetting agents, etc. shall be used as necessary to control those characteristics of the sheet-moulding compound necessary to achieve the requirements of the moulded panels.

5.5 Metal bracing

Where a metal brace is supplied with the cistern or tank, it shall be corrosion resistant and free from sharp edges, sharp corners and surface projections.

6 Appearance and configuration

6.1 Appearance and quality of finish of cisterns

The internal surfaces of one-piece cisterns and sectional tanks and their covers shall be free from such imperfections that may inhibit the cleaning of these internal surfaces.

6.2 Configuration of one-piece cisterns and sectional tanks

6.2.1 One-piece cisterns

When a change in the direction of the cistern wall is necessary this shall be accomplished by the use of a radius of not less than 10 mm. Where the walls of the cistern are tapered, this taper shall not exceed 7 degrees from the vertical.

6.2.2 Sectional tanks

The tank shall consist of base and side plates, all constructed from flanged GRP panels with a jointing sealant between. The flanges of all panels may be internal or external as required.

6.2.2.1 Corners

The corners of a tank shall be formed by either:

a) bolting side panels to each other; or

b) bolting each side panel to a corner angle member.

In each case a jointing sealant shall be used.

6.3 Division plates

Where required, one-piece cisterns and sectional tanks shall be subdivided into two or more compartments by the inclusion of a division plate constructed from GRP sheet or panels. Division plates shall be sealed leak tight and be capable of supporting water on either side to the maximum working depth.

6.4 Baffle and weir plates

One-piece cisterns and sectional tanks shall be fitted with baffle plates and/or weir plates if required. They shall be constructed to withstand only the additional forces created by the water movement they are designed to induce, and in the case of weir plates, to withstand any additional force due to any imbalance in water pressure created by their use.

6.5 Access ladders

Where requested by the purchaser (see annex L), one-piece cistern and sectional tanks of depths 1,5 m or more shall be provided with internal and external access ladders. Consideration for the requirements of external ladders shall take into account the height of the tank above floor level. All internal ladders shall be protected against corrosion.

NOTE There may be difficulties with the provision of safety hoops, should they be considered necessary, because of space limitations.

6.6 Manholes or access hatches

A manhole or access hatch of at least 600 mm diameter or side dimension shall be provided in one-piece cisterns and sectional tanks of capacities greater than 1 000 l and so designed to prevent the ingress of rain water, dust and vermin.

6.7 One-piece cistern and sectional tank covers

Covers shall be fitted on all class "A1" and "A2" one-piece cisterns and sectional tanks. Class "B" one-piece cisterns and sectional tanks shall be fitted with a cover when required by the purchaser (see 8.2).

In any event covers for class "A1" and class "A2" cisterns and tanks covers shall be rigid and close fitting, having a gap of less than 0,65 mm and be secured or mechanically fixed with an effective seal to ensure the exclusion of light and the ingress of particles and/or insects and where connections pass through the cover they shall be sealed.

All covers of greater plan area than 2 m^2 shall be capable of sustaining an imposed load of 0,6 kN/m^2 or 0,9 kN concentrated load, whichever produces the maximum deflection.

6.8 Raised level control valve chambers

Raised level control valve chambers shall be fitted when required by the purchaser and shall be designed so as to:

a) withstand the forces imposed by the weight and operation of the valve;

b) permit free and unrestrained movement of the float and arm where the valve is of this type;

c) provide a seal at the junction of the cover to chamber.

NOTE It is recommended that an adequate means of access for control valve maintenance is provided (see 6.6) but of a size compatible with the raised level control valve chamber selected.

6.9 Venting

One-piece cisterns and sectional tanks shall be fitted with either an air inlet or a breather (see 9.1).

NOTE The size of the vent is determined from the information provided by the purchaser (see annex L).

6.10 Fasteners

Fasteners used inside a cistern or tank shall be made from stainless steel in accordance with grade 1.4401 in EN 10088-3:1995.

The fasteners shall have dimensions in accordance with ISO 4759-1.

Fasteners used outside a tank shall be made from grade A, B and C bolts and nuts in accordance with ISO 4759-1 and protected from corrosion by galvanising in accordance with ISO 1461 or from stainless steel. Where the tank is situated within a building, external fasteners may be zinc plated.

6.11 Bracing system

Internal metallic bracing system members shall be manufactured from stainless steel in accordance with grade 1.4401 or other appropriate steel selected from Table 3 of EN 10088-3:1995. External structural supports shall be manufactured either from mild steel in accordance with S275JO of EN 10025:1993 encapsulated in GRP laminate or suitably protected from corrosion or galvanized in accordance with ISO 1461 or from stainless steel.

NOTE The design of bracing systems should minimize the possibility of bimetallic corrosion, e.g. where internal and external fittings are connected.

7 Requirements for one-piece cisterns and sectional tanks

7.1 General performance requirements

7.1.1 Opacity

The one-piece cistern or sectional tank structure shall not transmit more than 0,2 % of the visible light incident on it, when tested by the method given in EN 578.

7.1.2 Water absorption

The water absorption shall not exceed 0,5 % by mass when the GRP material of construction of the one-piece cistern or sectional tank is tested in accordance with annex A.

7.1.3 Heat distortion temperature

The temperature of deflection of the GRP material of construction under a bending stress shall be not less than 70 °C when tested in accordance with ISO 75-3:1993.

7.1.4 Barcol hardness

The Barcol hardness of the GRP material of construction shall be determined in accordance with EN 59 and the result shall be declared to the purchaser on request.

7.2 One-piece cisterns

7.2.1 Resistance to deformation

7.2.1.1 Cylindrical cisterns

The maximum percentage deformation shall not be greater than 0,2 %, when measured in accordance with B.1.

7.2.1.2 Rectangular cisterns

The maximum deformation of any strengthening rib or flange shall not exceed the lesser of 10 mm or 1 % of the length, when measured in accordance with B.2.

The maximum deformation of the cistern wall between any strengthening ribs, shall not exceed 1,5 % when measured in accordance with B.2.

NOTE Care should be taken that the positioning and fixing of strengthening ribs does not create unacceptable strains on the cistern laminate.

7.2.2 Resistance to impact

There shall be no visible leaks resulting from any impact damage, when the cistern is tested in accordance with annex C.

7.2.3 Leakage test

There shall be no visible leaks, when the cistern is tested in accordance with annex E.

7.2.4 Type testing

At least one sample of cistern shall be subjected to the type tests listed in Table 1 to ensure satisfactory type performance of cisterns. Samples shall be retested in the following circumstances:

a) when the method of production is altered or when the manufacturer changes the formulation of the raw material used;

b) when a change in wall thickness exceeds ± 10 %;

c) when a change in length, width or diameter exceeds ± 10 %;

d) when a change in height exceeds 300 mm.

Table 1 — Type tests; one-piece cisterns

Type test	Requirement in subclause	Test method
Deformation	7.2.1	Annex B
Opacity	7.1.1	EN 578
Impact resistance	7.2.2	Annex C
Leakage	7.2.3	Annex E
Water absorption	7.1.2	Annex A
Heat distortion	7.1.3	ISO 75-3:1993
Barcol hardness	7.1.4	EN 59

7.3 Sectional tanks

7.3.1 Panels

Sectional tank panels can be made of any size. Preferred panel sizes are based either on a 1 000 mm or 1 220 mm square modules. Derivatives of these panel sizes shall be based on the basic panel size, e.g. a quarter, a half, one, one and a half, and double panels. Moulded panels may be pre-insulated. Any insulation should be applied to the outer surface of the panel, not to a surface in contact with the tank contents.

7.3.2 Tolerances

Panels shall have nominal dimensions declared by the manufacturer, subject to the tolerances given in Tables 2 and 3.

Table 2 — Tolerances of panel dimensions

Measurement	Tolerance
Panel size: Overall length Overall breadth	 ± 1,0 mm ± 1,0 mm
Flange thickness:	As Table 3
Flange height:	± 1,0 mm
Diaphragm thickness:	As Table 3
Squareness of panel:	

(measured as difference of overall lengths across the two diagonals of the panel)	1,5 mm
Flange angle: (measured as angle of flange relative to the plane of the panel)	± 1°
Flange bolt-holes: Diameter Pitch (centre-to-centre) Line of bolt-hole centres (measured as from the flat face of the flange at the two corners of the panel)	 ± 0,5 mm ± 0,5 mm ± 0,5 mm

Table 3 — Tolerances for flange and diaphragm thickness

Nominal thickness mm	**Moulding from open mould** mm	**Moulding from closed mould** mm	**Matched metal moulds** mm
up to but not including 1,5	+ 0,50 - 0,25	± 0,20	± 0,18
1,5 up to but not including 3	± 0,75	± 0,30	± 0,20
3 up to but not including 6	± 1,1	± 0,50	± 0,30
6 up to but not including 12	± 1,5	± 0,75	± 0,40
12 up to but not including 25	± 2,0	± 1,40	± 0,50
25 and over	± 3,0	± 1,90	± 0,65

7.3.3 Appearance and quality of finish

The internal surfaces of panels shall be smooth, of even texture, and free from imperfections that may detract from the performance of the tank in use. All cut edges of panels in contact with the water in the tank shall be sealed by coating with resin of a similar composition to that used on the inside surface of the tank panels.

7.3.4 Panel drilling

Panel assembly bolt-holes shall be drilled at the manufacturer's premises.

7.4 Requirements for all sectional tanks

7.4.1 Performance of panels

7.4.1.1 Impact resistance

An uninsulated panel (see 7.3.1) shall not show any cracking when tested in accordance with C.2.

7.4.1.2 Pressure test

A panel shall not rupture when tested in accordance with annex D.

7.4.1.3 Testing of panels

At least one panel shall be subjected to the type tests listed in Table 4 to ensure satisfactory type performance of panels. Samples shall be retested in the following circumstances:

a) when the method of production is altered or the manufacturer changes the formulation of raw material used;

b) when a change in diaphragm thickness exceeds ± 10 %;

c) when a change in length or width exceeds ± 20 %;

d) when there is a change in the depth of use for which the panel is designed.

Table 4 — Type tests for sectional tank panels

Property	Requirement in subclause	Test method
Opacity	7.1.1	EN 578
Impact resistance	7.4.1.1	C.2
Water absorption	7.1.2	Annex A
Pressure test	7.4.1.2	Annex D
Heat distortion temperature	7.1.3	ISO 75
Barcol hardness	7.1.4	EN 59

7.5 Performance of sectional tanks

7.5.1 Leakage test

When erected, a tank shall not show any visible leakage after filling in accordance with the manufacturer's instructions. The duration of the test shall be for a minimum of 24 h, commencing at least 2 h after the tank has been filled. The test shall be carried out within 10 days of erection unless the manufacturer agrees to a longer period after erection.

7.5.2 Resistance to deformation

The maximum deformation for the tank panel flanges between support points shall not exceed the lesser of 10 mm or 1 %, when measured in accordance with B.3.

8 Requirements for class A1 and A2 one-piece cisterns and sectional tanks only

8.1 Effect on water quality

When used under the conditions for which they are designed, products in contact with or likely to come into contact with potable water shall not so affect the potable water that it ceases to comply with the relevant EU Directives or Regulations or national legislation in the country of use from time to time in force, it having first been certified that the potable water supplied did so comply.

8.2 Covers

Class A1 and A2 one-piece cisterns and sectional tanks shall be fitted with covers (see 6.7). These covers shall be rigid, close fitting or sealed with a resilient elastomeric sealing compound or gasket, so as to exclude light, ingress of particles, insects or rainwater. The material shall be such that covers shall be opaque, resist impact and do not contaminate any moisture condensing or splashing on them.

Where provided at external locations, frames for covers and access doors shall incorporate an upstand of not less than 20 mm, in order to prevent the entry of rainwater when the cover is removed or the door opened for maintenance. When connections pass through the cover panels, a means of permanent seal shall be provided.

8.2.1 Performance requirements of covers

8.2.1.1 Opacity for covers

The cover shall not transmit more than 0,2 % of the visible light incident upon it, when tested in accordance with EN 578.

8.2.1.2 Resistance to impact for covers

The cover shall not be punctured, when tested in accordance with annex F.

8.2.1.3 Rigidity of one-piece cistern and sectional tank covers

The cover shall at no point be depressed below the top plane of the cistern by more than 10 mm when tested in accordance with annex J.

8.2.1.4 Materials

The materials shall conform to 8.1.

8.2.2 Sampling and testing

One specimen cover shall be subjected to the type tests listed in Table 5, to ensure satisfactory performance of covers.

Table 5 — Type tests: covers

Type test	Requirements of subclause	Test Method
Opacity	8.2.1.1	EN 578
Impact resistance	8.2.1.2	Annex F
Rigidity	8.2.1.3	Annex J

When the method of production is altered, or when the manufacturer changes the formulation of raw material used new specimens shall be retested.

9 Requirements for class A1 one-piece cisterns and sectional tanks only

9.1 Screened air inlet (breather)

Class A1 one-piece cisterns and sectional tanks shall be provided with a screened air inlet to allow the escape of air and to preserve the integrity of the stored water. The air inlet shall have a screen with apertures not exceeding 0,65 mm × 0,65 mm intended to prevent the ingress of insects and particles.

The inlet shall be shrouded to alleviate the entry of dust and light, and prevent the entry of rainwater. The screens shall be non-corrosive material and easily removable for inspection and cleaning.

9.2 Vent pipe entry device for the cover

A fixing, connection provision or other device shall be provided to allow entry of a vent pipe through the cover. Such a device shall prevent any displacement or distortion of the cistern or tank or associated cover due to expansion or other movement of the vent pipe.

9.3 Screened warning and overflow pipes

Warning pipes and/or overflow pipes shall be provided with a termination assembly for fitting through the side wall of the one-piece cistern or sectional tank which incorporates a free draining external watertight housing containing a screen for fitting to the warning pipe. The screen shall have apertures not exceeding 0,65 mm × 0,65 mm, shall not restrict the full flow and shall be easily removable for inspection and cleaning.

Additionally the warning pipe shall incorporate a turn down inside the one-piece cistern or sectional tank with its inlet 50 mm ± 10 mm below the shut off water level. A warning pipe may not necessarily be required for larger sizes of one-piece cisterns or sectional tanks for use in domestic water storage, provided that other arrangements are made for warning, but a separate overflow is required. One-piece cisterns or sectional tanks used for purposes other than domestic water storage may not be subject to the same requirements. Requirements demanded for domestic water storage may however be equally appropriate for many commercial applications.

9.4 Particle ingress limitation between a one-piece cistern or sectional tank, cover and fittings

When the assembled installation is tested in accordance the annex G, all particles retained by the filter paper or bag in the air extraction line shall have at least two dimensions of 0,65 mm or less.

The screened air inlet, vent pipe entry device, warning pipe termination assembly and cistern or tank cover seal shall be tested on one size of cistern or tank only.

10 Requirements for class B one-piece cisterns

When class B cisterns are tested in accordance with annex H, the following shall apply:

a) there shall be no overflow from the top edge of the cistern or any other visible signs of leakage;

b) the function and operation of the float operated valve shall not be impaired due to distortion of the cistern;

c) after the conclusion of the heating cycle and when water has been left to cool for 120 $^{+15}_{0}$ min, the cover recommended by the manufacturer shall be replaceable.

NOTE Deflecting the sides of the cistern in order to replace the cover and contact between the turn down edges of the cover and cistern wall are permissible, provided that the cover remains in position with its edges overlapping the cistern at all points.

This test shall be carried out as a type test in the circumstances specified in 7.2.4.

11 Marking

All one-piece cisterns and tanks shall be clearly and durably marked by a waterproof adhesive label with the following information:

11.1 One-piece cisterns

a) the manufacturer's name or trade mark;

b) the cistern designation (see clause 4);

11.2 Sectional tanks

a) the manufacturer's name or trade mark;

b) the tank designation (see clause 4);

c) date of installation.

11.3 Additional component kit.

For class A one-piece cisterns and sectional tanks where additional components are not fitted to the cistern during manufacture, the additional component kit shall be clearly labelled with the following:

a) a statement "This additional component kit complies with EN 13280";

b) the cistern or tank manufacturer's name or trade mark;

c) instructions as to which of the components are only suitable for a specific size of cistern or tank.

NOTE Marking EN 13280 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is therefore solely the claimant's responsibility. Such a declaration is not to be confused with third party certification of conformity, which may also be desirable.

Annex A
(normative)
Method of test for water absorption

A.1 Test specimens

Three specimens shall be used. Each specimen shall be nominally 50 mm ± 1 mm square, and shall have smooth edges. The thickness of the specimen shall be the thickness of a test sheet of the material of construction of the one-piece cistern or sectional tank panel. The cut edges and the outside face shall be coated with resin of similar composition to that used in the inside surface of the cistern or tank panel.

The surface of all specimens shall be free from dust, oil or other matter that might interfere with the absorption of water.

A.2 Procedure

Measure the thickness of the test specimen. Determine the mass of the specimen m_1 and immerse it for (24 ± 1) h in distilled water at (23 ± 0,5) °C. Take precautions to prevent specimens from making contact over any substantial area with one another or with the container. Dry the specimen with a clean cloth or filter paper and, not more than 2 min after removal from the water, redetermine the mass (m_2).

Express the water absorption (E) of the specimen as a percentage and calculate as follows:

$$E = \frac{(m_2 - m_1) \text{ x } 100}{m_1}$$

Report the percentage water absorption of the material under test as the mean of the percentage water absorptions of the two test specimens.

A.3 Test report

The test report shall state:

a) the water absorption of the material;

b) the individual test results;

c) the thickness of the specimens;

d) the temperature of immersion.

Annex B
(normative)
Method of test for deformation

B.1 Circular one-piece cisterns

B.1.1 Procedure

Place the cistern on a flat level base. Make a circumferential measurement, parallel to the base at a distance from the base of one third of the height measured between the base and the test water line. The cover shall not be placed in position unless it is an integral part of the cistern.

Fill the cistern to the test water line with water at a temperature in the range 5 °C to 25 °C at a minimum rate of 23 l/min.

Float a continuous film of polyethylene over the whole of the surface of the water in the cistern to prevent evaporation.

After 7 days make a circumferential measurement at the previously determined level.

Express the difference between the two measurements as a percentage of the original circumferential measurement.

Report the percentage deformation (circumferential).

B.1.2 Test report

The test report shall state the percentage deformation (circumferential).

B.2 Rectangular one-piece cisterns

B.2.1 Procedure

Place the cistern on a flat, level base. Erect a measuring system capable of detecting deflections of strengthening ribs, flanges, as well as the deflection of the walls of the cistern, with an accuracy of ±1 mm.

Measure the length of each strengthening rib or supporting flange and record each measurement. Fill the cistern to the test water line with water at a temperature in the range 5 °C to 25 °C at a minimum rate of 23 l/min and leave for 7 days.

Measure the deflection of each strengthening rib or supporting flange and record as a percentage of the length. Observe where the deformation of cistern walls is the greatest and measure the deflection of these cistern walls between the strengthening ribs or corners.

Record the deformation as a percentage of the distance between the ribs and/or the corners.

B.2.2 Test report

The test report shall include the individual deflections of each strengthening rib and the deflection of cistern walls tested.

B.3 Rectangular sectional tanks

B.3.1 Procedure

Place the tank on a flat level base. Erect a measuring system capable of measuring movements of tank panel flanges at their extremities and at the position of maximum deflection under load, with an accuracy of ±1 mm. Measure the initial positions of the extremities of a panel flange and the point of maximum deflection under load.

Fill the tank to the actual capacity with water at a temperature between 5 °C and 25 °C at a minimum rate of 23 l/min. Wait for two days, and then remeasure the positions of the flange extremities and the point of maximum deflection under load.

From the measurements made, calculate the deflection of the panel flanges.

B.3.2 Test Report

Report the maximum deflection measured.

Annex C
(normative)
Method of test for impact resistance

C.1 Procedure for testing one-piece cisterns

Maintain the cistern, supported and inverted on a flat, level base, for a period of not less than 1 h prior to the commencement of the test.

Strike the base of the cistern with a 25 mm diameter hemispherically ended striker of mass 1,0 kg falling freely from a height of 0,5 m.

The striker shall be so arranged as to hit the base at its mid-point.

Turn the cistern on its side and make another impact on a side, as close to the base or corner as is practical. Repeat this procedure for two other sides. The shape of the striker shall be such that only the surface of the specified hemisphere comes into contact with the cistern.

Observe whether the cistern is punctured. If this is unclear, place it upright on a flat, level base and fill with water at a temperature in the range 5 °C to 25 °C to the test water line. Determine after 1 h whether there is any visible leakage.

NOTE The method requires rectangular cisterns to be impacted close to the corners and base. At the corners, the rigidity of the material and the shape allow the least energy absorption by the material: consequently, the corners have lower impact resistance.

C.1.1 Test report

The test report shall state whether the cistern was punctured and if there were any visible leaks.

C.2 Procedure for testing rectangular sectional tanks

NOTE This test is not suitable for insulated panels (7.3.1).

C.2.1 Principle

The impact force required to damage a panel supported horizontally at its periphery is determined by dropping a weight on to the panel.

C.2.2 Apparatus

C.2.2.1 An impacting mass of 1 kg, with a hemispherical lower surface of diameter 50 mm.

C.2.2.2 A horizontal support, to enable the periphery of the panel to be supported.

C.2.3 Test specimens

Three panels shall be tested.

C.2.4 Procedure

Bolt the panel horizontally on to its panel support.

NOTE The panel may be restrained where appropriate in a manner simulative of the method of installation.

Drop the impacting mass vertically from a height of 2 m into the centre of the panel. Observe by unaided vision and record if the panel suffers any cracking. Repeat with two further panels.

If no cracking is observed on any of the three panels, repeat the test, impacting on the opposite face.

C.2.5 Report

Report the number of panels that have cracking on either face.

Annex D
(normative)
Sectional tank panel pressure test

D.1 Principle

A panel restrained at its periphery has a uniformly distributed load applied to its diaphragm at a rate and to a maximum value that is specified.

Where a panel in use is additionally supported at any intermediate position within its perimeter, that support is simulated in the test.

D.2 Apparatus

D.2.1 A rigid test framework, capable of restraining the panel at its periphery in a manner analogous to the manufacturer's method of installation where appropriate.

D.2.2 A mechanism, for applying uniformly a force to the panel at a specified rate (see D.4).

NOTE This is often achieved by using a restrained water-filled bag.

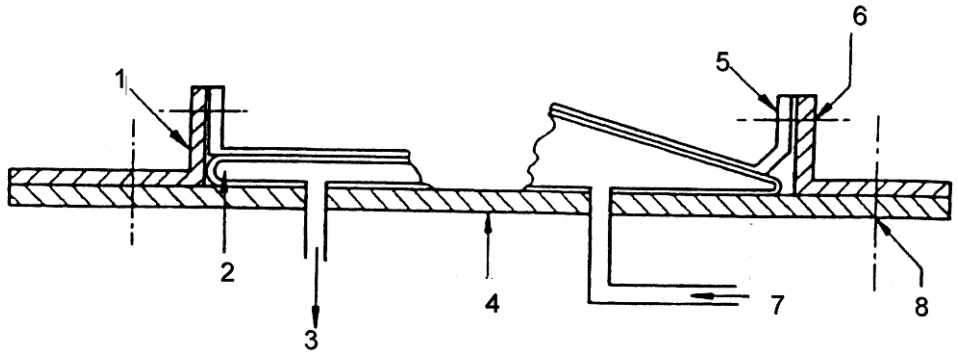
D.3 Test specimen

Three panels of the same dimensions shall be tested.

D.4 Procedure

Ensure that the ambient temperature is between 5 °C and 25 °C. Fix the panel into its test rig (D.2.1).

NOTE An example is shown in Figure D.1.



Key
1 Side member
2 Water bag
3 Pressure gauge
4 Base
5 Panel
6 Fixings
7 Water pressure
8 Fixings

Figure D.1 — Example of panel assembled into test rig for pressure test

Apply the uniform force via the mechanism (D.2.2) at a rate of 5 kN/m² per min, over the full area of the panel. Continue loading until a load is reached that is equal to six times the load anticipated in service, the load anticipated in service being that produced by filling the tank to 250 mm below the top edge.

D.5 Report

Report rupture of any of the panels tested.

Annex E
(normative)
Method of test for leaks in a one-piece cistern

E.1 Procedure

Mount the cistern on a flat, level base and fill with water at a temperature in the range 5 °C to 25 °C to the test water line. After leaving the cistern to stand for 48 h, observe whether there are any visible signs of leaks.

E.2 Test report

The test report shall state whether there were any visible signs of leaks.

Annex F
(normative)
Method of test for impact resistance of one-piece cistern covers

F.1 Procedure

Support the cover on a cistern of the appropriate dimensions, placed on a flat, level base.

Strike the cover with a 25 mm diameter hemispherically ended striker of mass 2,0 kg falling freely from a height of 0,5 m. The striker shall be so arranged as to hit the cover at its midpoint. Make three other impacts as close to the edges or corners as is practical.

The shape of the striker shall be such that only the surface of the specified hemisphere comes in to contact with the cover.

Observe whether cover is punctured.

F.2 Test report

The test report shall state whether the cover is punctured.

Annex G
(normative)
Method of test for the assessment of ingress of particles and insects

G.1 Apparatus

NOTE A typical installation is shown in Figure G.1.

Test box with a removable lid, fitted with an inlet to allow entry of an air line with a connection for the vacuum pump at the top. The test box dimensions shall be such that there is a gap of at least 150 mm between the box and cistern to permit a free flow of air when installed.

Polyethylene particles, measuring 0,5 mm to 1,0 mm.

Vacuum pump and connection, fitted with a filter bag or bag capable of retaining the polyethylene particles. The vacuum pump shall be capable of maintaining a partial vacuum of 50 mm ± 10 mm water gauge. A relief valve vented to atmosphere shall be fitted for control of the vacuum.

U-tube manometer, to measure partial vacuum applied to the cistern.

G.2 Procedure

Carry out the test as follows:

a) remove the lid from the test box;

b) install the cistern, cover and fittings to be evaluated in the test box and place the cistern on the raised support base;

NOTE The vent pipe should be sealed.

c) partly fill the test box with polyethylene particles to a height not less than 75 mm above the test box base;

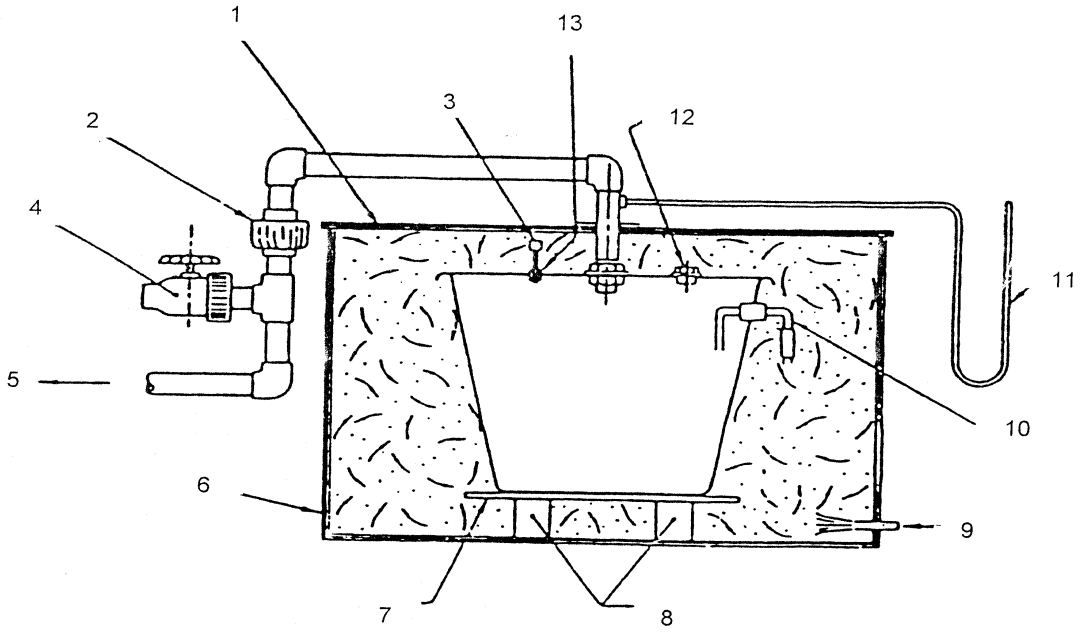
d) fit the cover to the cistern in accordance with the manufacturer's instructions;

e) replace the lid on the test box and ensure that it is airtight;

f) activate the air supply so that the particles remain airborne;

g) activate the vacuum pump leaving the relief valve fully open to atmosphere. Gradually close the relief valve until the manometer indicated that a partial vacuum of 50 mm ± 10 mm H_2O is being applied to the potable water cistern. Maintain this partial vacuum for 5 min ± 10 s;

h) at the end of the test, shut off the equipment, examine the filter paper or bag in the vacuum pump line and measure any particles found.



Key

1 Screened venting aperture in lid
2 Filter paper or bag
3 Vent pipe sealed
4 Valve to control vacuum
5 To vacuum pump
6 Test box
7 Raised support
8 Bearers (150 min. height)
9 Air supply to keep particles airborne
10 Screened warning pipe
11 U-tube manometer
12 Screened air inlet (breather)
13 Vent pipe entry device

Figure G.1 — Typical installation for particle ingress test

Annex H
(normative)
Method for the hot water test for one-piece cisterns

H.1 Procedure

The test installation shall be as shown in Figures H.1 and H.2 incorporating a float operated ball valve of metal construction with copper float and a copper hot water storage cylinder. The test shall be conducted in a controlled environment where the air temperature at the cistern test water line, 100 mm from the side of the cistern, shall be 38 °C ± 3 °C.

Install the cistern in accordance with the manufacturer's instructions.

No insulation shall be applied to the copper cylinder, the cistern or any of the pipework.

The heat input shall be provided by a 3 kW heater immersion of 760 mm length. No thermostat or cut-off device shall be provided in order that runaway conditions can prevail.

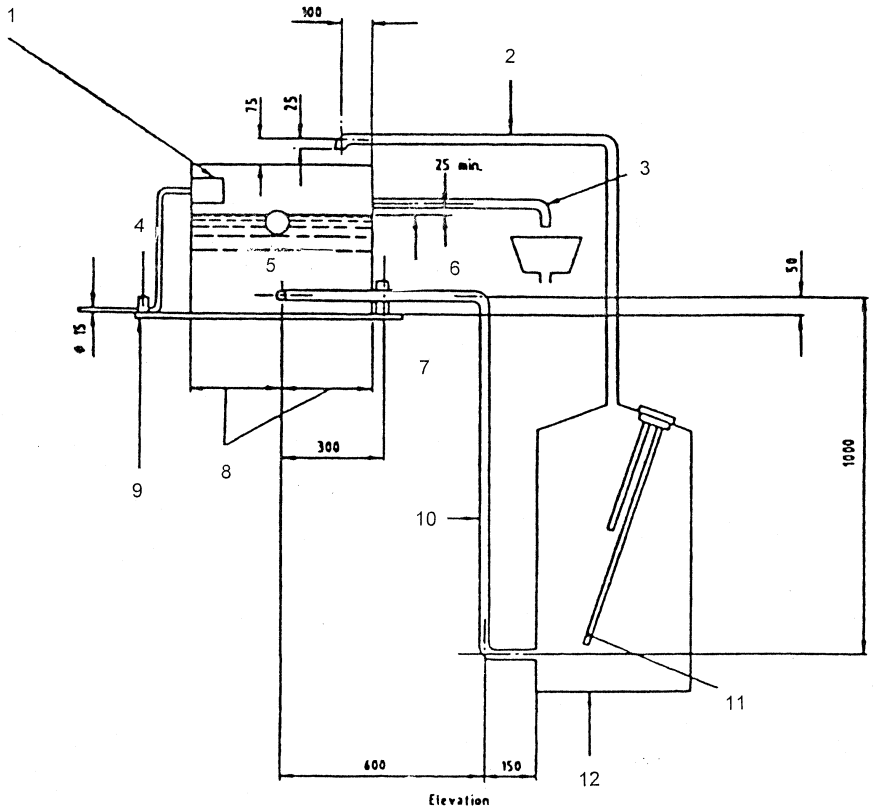
Fill the installation with cold water, to the test water line and switch on the heater for a continuous period of $500\ ^{+1}_{0}$ h.

At the end of this time, switch off the electrical supply to the immersion heater and allow a period of $120\ \text{min}\ ^{+15}_{0}$ to elapse to permit cooling of the installation. Examine the cistern for conformance to clause 10.

NOTE 1 It is recommended that provision is made for a means of containing any spillage from a ruptured cistern and,in that event, for the stopping of both the supply of cold water and the power.

NOTE 2 All pipework should be supported in accordance with good plumbing practice and with the cistern manufacturer's instructions.

Dimensions in millimetres.

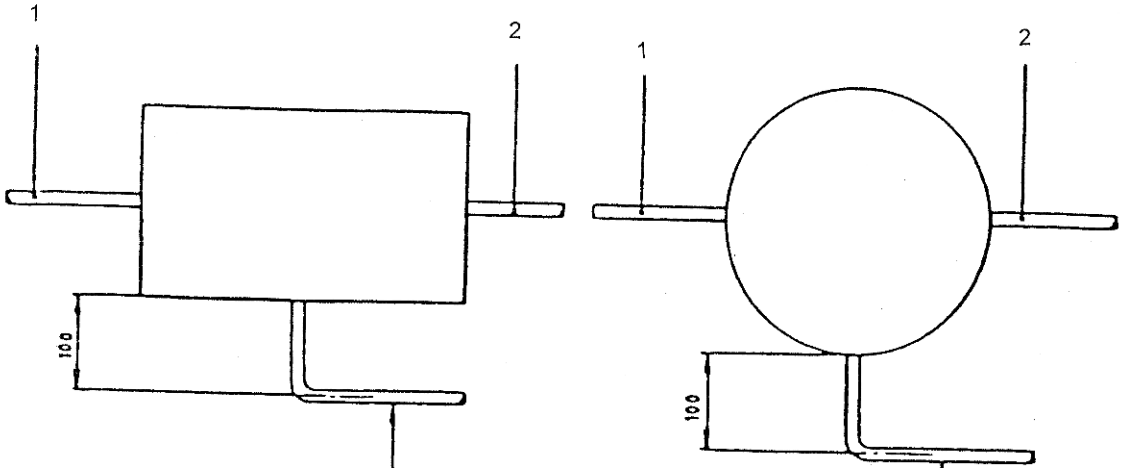


Key

1 Float operated valve as metal construction
2 ϕ 22 vent pipe
3 ϕ 22 warning pipe (supported so that lateral movement is not restrained)
4 Clamp
5 Test cistern
6 Water line
7 Clamp
8 Equally spaced
9 Base support to be 15 mm min. chipboard to prevent deflection in addition to necessary support
10 ϕ 22 cold feet
11 3 kW immersion heater
12 Copper cylinder

Figure H.1 — Typical installation for hot water test: elevation

Dimensions in millimetres.



Key
1 Cold water supply pipe
2 Warning pipe
3 ϕ cold feed

a) rectangular cisterns

b) Cylindrical cisterns

NOTE 22 mm connections to cistern are to be supported by suitable flange/plate 1 900 mm^2 (minimum) support area.

Figure H.2 — Typical installation for hot water test: plan view

NOTE 3 It is recommended that a means of restricting the dispersal of steam is used. This may be effected by fitting a suitable covering, provided it does not restrain the sides of the cistern during the test, covering the surface of the water by plastics balls or other suitable means.

NOTE 4 The actual positions of the connections to the cisterns may be varied slightly from those indicated in Figures H.1 and H.2 in order to accommodate design features of the cisterns.

NOTE 5 The test is for class B cisterns only (see clause 10).

H.2 Test report

The test report shall state whether the cistern conforms to clause 10.

Annex J
(normative)
Method of test for the assessment of rigidity of one-piece cistern and sectional tank covers

J.1 Procedure

Apply a mass of 2,5 kg over a maximum area of 200 mm × 200 mm above the centre point of the cover or for large cisterns and tanks, at the centre point of the largest cover area between cover support positions, for a period of 7 days. Determine the extent of which the cover is depressed below the top plane of the cistern or tank.

J.2 Test Report

The test report shall state the extent to which the cover is depressed (in mm).

Annex K
(informative)
Recommendations for thermal insulation

K.1 Introduction

The provision of thermal insulation for tanks may be required by the purchasers or may be specified by regulatory bodies.

NOTE It is recommended that a cistern or tank is protected:
a) against freezing;
b) against heat gain which would cause the content to rise to a temperature of 20 °C or greater.

K.2 Minimum insulation

Where thermal insulation is agreed to be necessary (see K.1), the purchaser should specify the thermal transmittance value (U) required, taking into consideration the period of protection considered necessary, the location of the tank and the surrounding conditions. The thermal transmittance is calculated as follows:

$$U = \frac{1}{R} \quad \text{and}$$

$$R = L_1/\lambda_1 + L_2/\lambda_2 \ldots + L_n/\lambda_n + R_i + R_e$$

where:

R is the total thermal resistance in $m^2 \cdot K/W$;

L is the thickness of the component of the total tank wall thickness (in m);

λ is the respective thermal conductivity [$W/(m \cdot K)$];

R_i is the internal surface resistance ($m^2 \cdot K/W$);

R_e is the external surface resistance ($m^2 \cdot K/W$);

NOTE Guidance may be found in ISO 12241.

K.3 Additional insulation

In certain circumstances, additional insulation to that calculated by the method shown in K.2 will be required. This can occur, for example:

a) where the tank is exposed to outside elements or solar gain, cold air or wind chill;

b) where the tank is exposed to inside locations with extremes of temperatures such as a boiler room.

The thickness of additional insulation should be calculated by taking into account:

1) the location of the tank, either indoors, outdoors but protected from the weather or outdoors exposed to the weather;

2) the water temperatures, including the normal operating water temperature, any fluctuating temperatures and the duration of any extreme or fluctuating temperatures;

3) the surrounding atmospheric conditions, including abnormally high or low temperatures or abnormally high humidity.

K.4 Materials and construction

K.4.1 Insulation materials should be incorporated in such a manner as to protect them from the ingress of moisture, insects or vermin, including those points where connections are made. Where connections are to be made by other than the manufacturer, attention is drawn to the need to preserve the integrity of the insulation and its protective finish.

K.4.2 The materials should not contain substances that will support pests or encourage the growth of fungi.

K.4.3 The materials should be free from objectionable odour at the temperature at which they are to be used.

NOTE Transient effects during the initial period of use may generally be ignored.

K.4.4 The materials should not suffer permanent structural deterioration as a result of contact with moisture. If subsequent drying is practicable, the material after drying should recover its physical form and thermal properties.

K.4.5 Any materials liable to be in contact with the insulated surface should not cause corrosion or degradation under normal site conditions.

K.4.6 The materials should not cause a known hazard to health at the time of application or while in use.

Annex L
(informative)
Information to be supplied by the purchaser

The following information should be supplied.

a) Either the capacity required, in litres, or the dimensions in metres, in multiples of 1,0 m or 1,22 m. Provision for any future extension, if applicable.

b) Type of cover, if required (see 6.7) Number and position and type of manholes (see 6.6).

c) Number and position of division plates, baffles, and weir plates if required (see 6.4).

d) Limiting conditions, if any, as to space and accessibility for erection, whether the tank will be erected in a building or exposed to weather, and the height above ground level at which the tank is to be installed.

e) Type of water for which the tank is required; if potable water this should be stated. The maximum rate of filling and emptying the tank, head fluctuations and cycles per day.

f) Maximum and minimum quantities of water to be stored, and the ambient temperatures.

g) Particulars of connections and their precise location on the tank with dimensional sketches, including any blanked connections required for future use, and any standards to which they should conform, e.g. ISO 7005-3.

h) Details of any existing or proposed supporting structure and height of bottom of tank above ground level, so that the necessary scaffolding arrangements can be made. Attention is drawn to statutory safety regulations.

i) The type of foundation on which the tank is to be mounted.

j) Whether inspection will be made by the representative of the purchaser at the works of the manufacturer.

k) Whether erection is to be carried out by the manufacturer at site, if so information as to site conditions and required accessibility.

l) Wind loading as required.

m) Snow loading as required in ISO 4355.

n) The type and weight of the float operated valve to be used (if any).

o) Provision of ladders, including the number and whether they are to be internal or external access ladders (see 6.5).

p) Positioning of connections, taking into account relevant regulations or national legislation and restrictions that may be caused by individual tank designs. Consideration should also be given to the support of pipe fittings and valves to prevent excessive strain being imposed upon the cistern.

q) Any special venting requirements.

r) Any other special requirements or conditions, e.g. level switches, alarm facilities and temperature probes.

Annex M
(informative)
One-piece cistern and sectional tank foundation and installation

M.1 General

All tanks should be supported on a foundation provided by the purchaser.

M.2 Foundations

The top surface of the foundation, whether it is flat screed concrete, steelwork, support walls or pillars, should be flat, level and free from any local irregularities. It should not vary more than 2 mm in any 1 m, or a total of 6 mm in any 6 m, measured laterally or diagonally. Intermittent supports should be spaced in accordance with the manufacturer's instructions and should be continuous in one direction.

If foundations are to be provided by suspended floors or beams, then the foundation should be constructed so that when the tank is full, the combined deflections should not exceed 1/500th of the span.

M.3 Additional manufacturer's requirements

Both continuous and discontinuous foundations should conform to any additional requirements provided by the manufacturer arising from the design of the cistern or tank.

M.4 Assembly

The sectional tank should be assembled in accordance with the manufacturer's instructions.

Bibliography

ISO 7005-3, *Metallic flanges — Part 3: Copper alloy and composite flanges.*

ISO 12241, *Thermal insulation for building equipment and industrial installations — Calculation rules.*

ISO 4355, *Bases for design of structures — Design of snow loads on roofs.*

Drinking Water Directive 80/778/EEC.

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