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Täthetsprovning –
Del 7: Allmänna krav och testmetoder för mellanrum, beklädnad och mantel för skydd mot läckage

Leak detection systems –
Part 7: General requirements and test methods for interstitial spaces, leak protecting linings and leak protecting jackets

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English version

Leak detection systems - Part 7: General requirements and test methods for interstitial spaces, leak protecting linings and leak protecting jackets

Systèmes de détection de fuites - Partie 7: Exigences générales et méthodes d'essais pour les espaces interstitiels, pour revêements intérieurs et revêtements extérieurs protecteurs de fuites

Leckanzeigesysteme - Teil 7: Allgemeine Anforderungen und Prüfverfahren für Überwachungsräume, Leckschutzauskleidung und Leckschutzummantelungen

This European Standard was approved by CEN on 11 March 2003.

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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.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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EUROPÄISCHES KOMITEE FÜR NORMUNG

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Contents

Foreword

This document (EN 13160-7:2003) has been prepared by Technical Committee CEN /TC 221, "Shop fabricated tanks and equipment for storage tanks and for service stations", 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of an identical text or by endorsement, at the latest by November 2003, and conflicting national standards shall be withdrawn at the latest by November 2003.

This European Standard consists of 7 parts:

Leak detection systems;

Part 1: General principles

Part 2: Pressure and vacuum systems

Part 3: Liquid systems for tanks

Part 4: Liquid and/or vapour sensor systems for use in leakage containments or interstitial spaces

Part 5: Tank gauge leak detection systems

Part 6: Sensors in monitoring wells

Part 7: General requirements and test methods for interstitial spaces, leak protecting linings and leak protecting jackets

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, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This European Standard specifies the type test of the interstitial space and the general requirements and test methods for leak protecting linings and leak protecting jackets which are parts of leak detection systems.

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 431, *Resilient floor coverings — Determination of peel resistance.*

EN 495–5, *Flexible sheets for waterproofing - Determination of foldability at low temperature - Part 5: Plastic and rubber sheets for roof waterproofing.*

EN 976–2, *Underground tanks of glass-reinforced plastics (GRP) —Horizontal cylindrical tanks for non-pressure storage of liquid petroleum based fuels — Part 2: Transport, handling, storage and installation of single wall tanks.*

EN 1107-2:2001, *Flexible sheets for waterproofing - Determination of dimensional stability - Part 2: Plastic and rubber sheets for roof waterproofing.*

EN 13160–1:2003, *Leak detection systems — Part 1: General principles.*

EN 13160–2:2003, *Leak detection systems — Part 2: Pressure and vacuum systems.*

EN ISO 62, *Plastics - Determination of water absorption (ISO 62:1999).*

EN ISO 75–1, *Plastics - Determination of temperature of deflection under load - Part 1: General test method (ISO 75-1:1993).*

EN ISO 75–2, *Plastics - Determination of temperature of deflection under load - Part 2: Plastics and ebonite (ISO 75-2:1993).*

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

EN ISO 175, *Plastics - Methods of test for the determination of the effects of immersion in liquid chemicals (ISO 175:1999).*

EN ISO 178, *Plastics - Determination of flexural properties (ISO 178:2001).*

EN ISO 179-1, *Plastics - Determination of Charpy impact properties - Part 1: Non-instrumented impact test (ISO 179-1:2000).*

EN ISO 179-2, *Plastics - Determination of Charpy impact properties - Part 2: Instrumented impact test (ISO 179-2:1997).*

EN ISO 527–1, *Plastics - Determination of tensile properties - Part 1: General principles (ISO 527-1:1993 including Corr 1:1994).*

EN ISO 527–3, *Plastics - Determination of tensile properties - Part 3: Test conditions for films and sheets (ISO 527-3:1995).*

EN ISO 604, *Plastics - Determination of compressive properties (ISO 604:1993).*

EN ISO 8501–1, *Preparation of steel substrates before application of paints and related products - Visual assessment of surface cleanliness - Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings (ISO 8501-1:1988).*

ISO 554, *Standard atmospheres for conditioning and/or testing — Specifications.*

ISO 2528, *Sheet materials - Determination of water vapour transmission rate - Gravimetric (dish) method.*

ISO 4593, *Plastics; film and sheeting; determination of thickness by mechanical scanning.*

ISO 6133, *Rubber and plastics - Analysis of multi-peak traces obtained in determinations of tear strength and adhesion strength.*

3 Terms and definitions

For the purposes of this European Standard, the terms and definitions given in EN 13160-1:2003 apply.

4 Material

For leak protecting linings:

— polyvinyl chloride (PVC) and polyurethane (PUR) according to 6.3;

— glass reinforced plastics (GRP) according to 6.4.

For leak protecting jackets according to 7.2.

5 Type test of the interstitial space

5.1 General

The construction of the interstitial space and the free passage of liquid shall be tested with the aid of a construction drawing and a sample of a tank or pipe.

5.2 Abbreviations and symbols

g is the force of gravity, in metres per second squared

h is the maximum filling height of the tank, in metres

p_{MS} is the maximum possible surface pressure, in Pascal

p_0 is the ambient pressure, in Pascal

p_{PA} is relative pressure at control point "pump off", in Pascal

p_1 is the relative vacuum pressure, in Pascal

p_2 is the relative pressure in the interstitial space after the admission test, in Pascal

p_{2abs} is the pressure in the interstitial space after the admission test ($p_0 + p_2$), in Pascal

Δp is the differential pressure between the pressure before and after the admission of the air, in Pascal

s_1 is the initial thickness of the intermediate layer, in millimetres

s_2 is the residual thickness of the intermediate layer after loading with 50 kPa, in millimetres

s_3 is the half of the residual thickness s_2, in millimetres

V_G is the volume of the water filled vessel and the volume of the connection hose, in litres

V_w is the volume of the flowed in water, in litres

V_z is the volume of the receiver tank, in litres

V_1 is the volume of the interstitial space, in litres

ρ is the density of the stored material in the tank, in kilograms per cubic metre.

5.3 Test equipment

receiver tank, volume 50 l to 80 l. The receiver tank shall have two ball valves in the top surface for connection with the interstitial space and the vacuum pump and a drain cock with a connected hose assembly at the lowest point;

vessel with a graduation, volume at least 10 l;

measuring device for pressure (eg manometer), accuracy 0,6 % of the maximum graduated value;

measuring device for the volume flow, accuracy 2 % of the measured value;

pressure pump;

vacuum pump.

5.4 Proof of the tightness and the strength of the interstitial space

5.4.1 Test objective

The test objective is to ensure that the integrity of the interstitial space is maintained under all operating pressures.

5.4.2 Evaluation

The test shall be deemed to have been passed if the following condition is fulfilled:

$$10 \geq \frac{(p_B - p_E) \cdot V_1}{t} \text{ in Pa l s}^{-1}$$

where

p_B is the pressure at the beginning of the test, in Pascal

p_E is the pressure at the end of the test, in Pascal

t is the test time, in seconds

V_1 is the volume of the interstitial space, in litres

5.4.3 Test method

The test shall be carried out at a temperature above the freezing point of water but not exceeding + 40 °C.

The tightness and the strength of the interstitial space shall be proved by a pressure test on a sample of a tank or pipework at ambient pressure in the tank or pipework.

The difference of the ambient temperature shall be within a range of 1 K at the beginning and at the end of the test.

The following minimum test pressures shall be used:

— for interstitial spaces, which are part of a leak detection system working on the basis of liquid or pressure at 1,1 times of the set pressure of the pressure relief valve, but at least at 60 kPa (0,6 bar) pressure;

— for the interstitial spaces, which are part of a leak detection system working on the basis of vacuum at 1,1 times of the negative operating pressure of the leak detector and at 1,1 times of the internal operating pressure of the pipework or the tank at pressurisation of the pipework or tank at the same time.

5.5 Test of the free passage of liquid (only for vacuum systems)

5.5.1 Preparation

For the test the vacuum leak detector shall be connected to either

— the actual interstitial space for the tank or pipe or

— a representative sample of the interstitial space of at least 1600 mm × 900 mm.

The test sample shall include any seams/welds and intermediate layer and shall have at least two test nozzles at a distance of 1500 mm apart.

5.5.2 Evaluation

The test is deemed to have been passed if the leak detector triggers an alarm, after the quantity of liquid, calculated according to EN 13160–2:2003, Equation (3), has entered the interstitial space.

5.5.3 Test method

The test shall be carried out at a temperature above the freezing point of water.

The admission of the test medium shall be made through that test nozzle, where the distance to the connection piece of the leak detector is the greatest, until the alarm at the leak detector is released. The passage for the stored product shall be checked by direct admission of water. If the viscosity of the stored product exceeds the viscosity of water, the test shall be carried out directly with the stored product or with a comparable liquid. The pressure in the interstitial space shall be recorded by a manometer fitted at a test nozzle of the interstitial space and the switching points of the connected leak detector have to be controlled.

5.6 Test of the free passage of air

5.6.1 Evaluation

The test shall be deemed to have been passed, if after opening of the interstitial space due to drilling a 2 mm hole air is deflated in the interstitial space at the pressure system and the pressure in the interstitial space falls or at the vacuum system air is sucked into the interstitial space due to drilling a 2 mm hole, so that the pressure in the interstitial space increases immediately.

5.6.2 Preparation

A manometer shall be connected to a nozzle for the leak detector at the interstitial space. Further nozzles shall be tightly shut by a stop valve. The interstitial space shall be evacuated by an externally connected vacuum pump to a vacuum of -60 kPa for vacuum systems. For pressure systems the interstitial space shall be pressurized by an externally pressure pump to a pressure of + 60 kPa.

5.6.3 Test method

The test shall be carried out at a temperature above the freezing point of water.

The free passage of the interstitial space of the sample of the tank or pipework shall be tested by sampling by means of borings with a drill (2 mm) at positions determined by the person during the test. The pressure or vacuum reached before the test is carried out shall be reduced within a short time according to the capacity of the interstitial space by charging and discharging and shall be visible at the manometer.

5.7 Flow rate test of the intermediate layer

5.7.1 Test objective

The test objective is to ensure a suitable passage for air, stored product and/or water.

5.7.2 Test equipment

Thickness tester, with an accuracy of 0,01 mm;

two quadratic steel retaining plates 100 mm × 100 mm, thickness 10 mm;

two quadratic steel pressure plates 150 mm × 150 mm, thickness 10 mm, with a hole of 10 mm each in the corner sphere. One steel plate has a hole in the middle of the plate with a diameter of 6 mm and a fitting with a diameter of 6 mm is also welded on in the middle of the plate;

four locking screws, 8 mm;

compression device, with an accuracy of 1 %;

air impermeable foil, e. g. PE 0,75 mm thickness;

environmental chamber;

vacuum pump;

measuring device for the volume flow.

5.7.3 Preparation

The tests shall be carried out at least at three quadratic test samples with the dimensions of 100 mm × 100 mm.

5.7.4 Evaluation

The test shall be deemed to have been passed, if the air current back pressure emanating from the intermediate layer is not less than - 1 kPa (10 mbar) at a volume flow of (85 ± 15) l/h of air.

For protecting the lining the intermediate layer shall be tested at 1,3 times the maximum possible surface pressure (p_{MS}) – but a minimum of 50 kPa (0,5 bar).

For protecting the jacket the intermediate layer shall be tested at 1,3 times the maximum possible surface pressure (p_{MS}) – but a minimum of 100 MPa (1000 bar).

Maximum possible surface pressure according to Equation (1):

$$p_{MS} = \rho \cdot g \cdot h + p_{PA} \quad (1)$$

5.7.5 Test method

The test shall be carried out at a temperature of (20 ± 5) °C. First the initial thickness of the intermediate layers (s_1) shall be measured with the thickness tester. After the measurement the intermediate layers shall be laid between the two test plates. Through the upper test plate the test samples shall be charged with the help of the compression device:

— for linings with the calculated maximum possible surface pressure (p_{MS}), but a minimum of 50 kPa;

— for jackets with 1,3 times the maximum possible surface pressure (p_{MS}), but a minimum of 100 MPa.

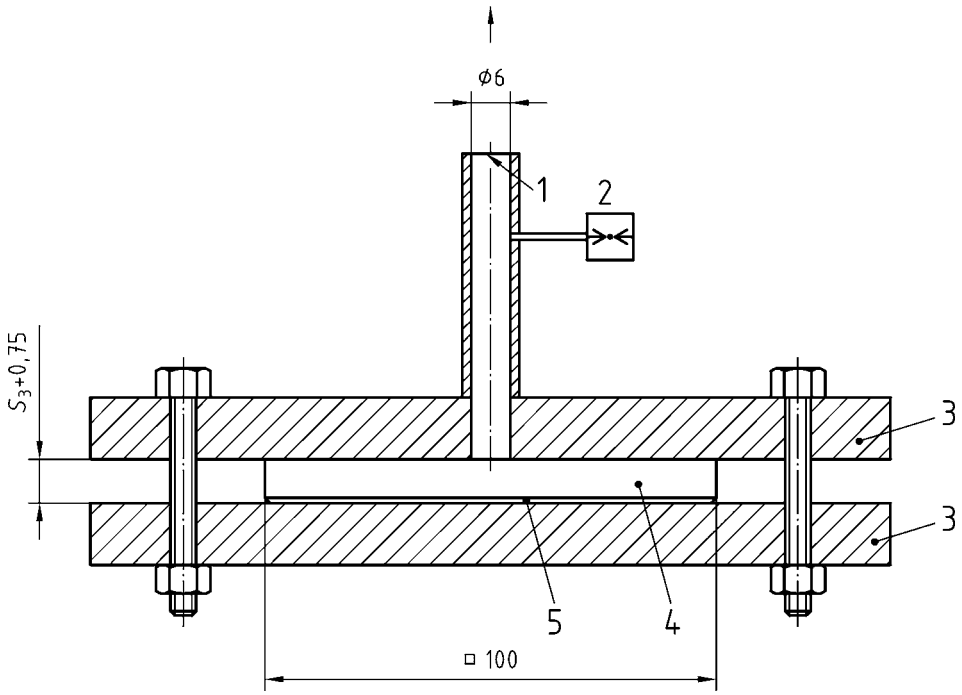
After reaching the steady state condition but not before a minimum period of 14 days has elapsed the residual thickness (s_2) shall be measured and the test equipment shall be installed in the environmental chamber. The test samples shall be charged further with the maximum possible surface pressure (p_{MS}) and the measurement of the thickness shall be repeated at the limiting temperatures of the given operating conditions as mentioned in 5.1 of EN 13160-1:2003. The steady state condition has been reached, if two measurements of the residual thickness (s_2) made at intervals of 24 h do not differ by more than 1 % from the thickness (s_1). If after 90 days the steady state condition has not been achieved the test has failed. Following this test the intermediate layers shall be pressed with the help of the pressure plates and the locking screws until half of the residual thickness of the intermediate layers (s_3) has been achieved or the pressure exceeds $2 \cdot p_{MS}$.

At the fittings, located in the middle of the plate, a vacuum pump with an inserted measuring device for pressure, eg u-tube, shall be connected. At the exit of the vacuum pump a valve for throttling the volume flow shall be installed, so that the volume flow can be adjusted to the given value of 85 l/h through the secondary measuring device for the volume flow. The length of the connecting line of the manometer to the fittings of the interstitial space shall be 250 mm. The flexible connecting lines at the connection of the vacuum pump and the measuring device for the volume flow shall be realized with an internal diameter of 6 mm.

The total length of the connecting line from the fittings to the vacuum pump shall be max. 1 m for the measurements.

After installation of the test equipment as mentioned above and in Figure 1 the flow resistance shall be taken from the measuring device for pressure after turning-on the vacuum pump and adjusting the volume flow to 85 l/h. The measurement shall be repeated at each test sample. The mean of the measured values shall be compared with the limiting value of -1 kPa.

Dimensions in millimetres



Key

1 Connection for vacuum pump with 85 l/h air
2 Measuring device for pressure
3 Test plate
4 Intermediate layer
5 Air impermeable foil

Test sample	Initial thickness s_1 Mm	Res. thickness at p_{MS} after loading s_2 mm	1/2 residual thickness s_2 s_3 mm	flow back pressure at a flow of 85 l/h air (set-up as shown) kPa

Figure 1 — Flow rate test set-up

5.8 Determination of the flow resistance

5.8.1 General

The flow resistance for the interstitial space shall be determined by means of the test arrangement in Figure 4 to 6.

5.8.2 Evaluation

The test shall be deemed to have been passed, if the flow resistance shown at the u-tube does not exceed the value of - 1 kPa when sucked with an air volume flow of 85 l/h is applied through a vacuum pump fitted at the interstitial space.

Before the test is carried out according to 5.1 to 5.7 the suitability of the type of the interstitial space shall be proved as described below.