

# **SLOVENSKI STANDARD**

## **SIST EN 13160-2:2016**

**01-november-2016**

**Nadomešča:**  
**SIST EN 13160-2:2003**

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**Sistemi za kontrolo tesnosti - 2. del: Zahteve in metode za preskušanje in ocenjevanje tlačnih in vakuumskih sistemov**

Leak detection systems - Part 2: Requirements and test/assessment methods for pressure and vacuum systems

Leckanzeigesysteme - Teil 2: Anforderungen und Prüf-/Bewertungsverfahren für Über- und Unterdrucksysteme

Systèmes de détection de fuites - Partie 2: Exigences et méthodes d'essai/d'évaluation des kits en pression et en dépression

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**Ta slovenski standard je istoveten z: EN 13160-2:2016**

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**ICS:**

23.020.01	Vsebniki za shranjevanje tekočin na splošno	Fluid storage devices in general
23.160	Vakumska tehnologija	Vacuum technology

**SIST EN 13160-2:2016**

**en,fr,de**

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EUROPEAN STANDARD  
NORME EUROPÉENNE  
EUROPÄISCHE NORM

**EN 13160-2**

July 2016

ICS 23.020.01; 23.040.99; 29.260.20

Supersedes EN 13160-2:2003

English Version

**Leak detection systems - Part 2: Requirements and  
test/assessment methods for pressure and vacuum  
systems**

Systèmes de détection de fuites - Partie 2: Exigences et  
méthodes d'essai/d'évaluation des systèmes sous  
pression et à dépression

Leckanzeigesysteme - Teil 2: Anforderungen und Prüf-  
/Bewertungsverfahren für Über- und  
Unterdrucksysteme

This European Standard was approved by CEN on 8 April 2016.

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 CEN-CENELEC Management Centre or to any CEN member.

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EUROPEAN COMMITTEE FOR STANDARDIZATION  
COMITÉ EUROPÉEN DE NORMALISATION  
EUROPÄISCHES KOMITEE FÜR NORMUNG

**CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels**

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## EN 13160-2:2016 (E)

## European foreword

This document (EN 13160-2:2016) has been prepared by Technical Committee CEN/TC 393 “Equipment for tanks and filling 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 January 2017, and conflicting national standards shall be withdrawn at the latest by April 2018.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 13160-2:2003.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative Annex ZA, which is an integral part of this document.

According to edition 2003 the following fundamental changes are given:

- requirements from EN 13160-1:2003 included, which are no longer contained in EN 13160-1:2016;
- new structure - technical requirements for the components divided; (pressure device, evaluation device, alarm device;
- technical requirements revised.

This European Standard *Leak detection systems* consists of 7 parts:

- *Part 1: General principles*
- *Part 2: Requirements and test/assessment methods for pressure and vacuum systems*
- *Part 3: Requirements and test/assessment methods for liquid systems for tanks*
- *Part 4: Requirements and test/assessment methods for sensor based leak detection systems*
- *Part 5: Requirements and test/assessment methods for in-tank gauge systems and pressurized pipework systems*
- *Part 6: Sensors in monitoring wells*
- *Part 7: Requirements and test/assessment methods for interstitial spaces, leak detection linings and leak detection 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, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta,

Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

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## 1 Scope

This European Standard gives requirements and the corresponding test/assessment methods applicable to leak detection kits (leak detector) based on the measurement of pressure change. Leak detection kits are intended to be used with double skin, underground or above ground, pressurized or non-pressurized, tanks or pipework designed for water polluting liquids/fluids. The kits are usually composed of:

- measuring device;
- evaluation device;
- alarm device;
- pressure generator;
- pressure relief device;
- liquid stop device;
- condensate trap.

## 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 228, *Automotive fuels — Unleaded petrol — Requirements and test methods*

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EN 981:1996+A1:2008, *Safety of machinery — System of auditory and visual danger and information signals*

EN 12285-1, *Workshop fabricated steel tanks — Part 1: Horizontal cylindrical single skin and double skin tanks for the underground storage of flammable and non-flammable water polluting liquids*

EN 12285-2, *Workshop fabricated steel tanks — Part 2: Horizontal cylindrical single skin and double skin tanks for the aboveground storage of flammable and non-flammable water polluting liquids*

EN 13160-1:2016, *Leak detection systems — Part 1: General principles*

EN 13160-7, *Leak detection systems — Part 7: Requirements and test/assessment methods for interstitial spaces, leak detection linings and leak detection jackets*

EN 14879-4:2007, *Organic coating systems and linings for protection of industrial apparatus and plants against corrosion caused by aggressive media — Part 4: Linings on metallic components*

EN 61672-1, *Electroacoustic — Sound level meters — Part 1: Specifications (IEC 61672-1)*



### 3 Terms, definitions, symbols and abbreviated terms

#### 3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 13160-1:2016 and the following apply.

##### 3.1.1

##### **design pressure**

maximum pressure expected to be applied to a system component

##### 3.1.2

##### **pressure full scale**

full scale pressure value of the measuring device

##### 3.1.3

##### **working pressure**

maximum pressure which is generated by a pressure/vacuum generator in the interstitial space under normal operating conditions

#### 3.2 Symbols and abbreviated terms

$F_e$	is the exhaust flow rate of the pressure relief valve at $p_e$ , in litres per hour
$g$	is the force of gravity, in metres per second squared
$h$	is the maximum filling height of the tank, in metres
$h_G$	is the maximum height of the groundwater related to the lowest point of the tank, in metres
$h_1$	is the filling height of the interstitial space due to alarm pressure $p_{AE}$ , in metres
$l$	is the length of the interconnecting line, in metres
$m_1$	is the mass of air at $T_1$ and $p_4$
$m_2$	is the mass of air at $T_2$ and $p_4$
$m_a$	is the mass of the absorbed water per kg dry pearls, in kilograms per kilogram
$m_{sch}$	is the bulk weight of the dry pearls, in kilograms per cubic metre
$\Delta m$	is the difference between $m_1$ and $m_2$
$p_a$	is the set pressure of the pressure relief valve, in Pascal
$p_{am}$	is the measured set pressure of the pressure relief valve, in Pascal
$p_{AA}$	is the relative pressure at control point "alarm off", in Pascal
$p_{AE}$	is the relative pressure at control point "alarm on", in Pascal
$p_e$	is the pressure of $p_{am} + 5\%$ of the pressure relief valve, in Pascal
$p_{PA}$	is the working pressure of the leak detection kit and corresponds to the relative pressure at control point "pump off", in Pascal
$p_{PE}$	is the pressure of the leak detection kit and corresponds to the relative pressure at control point "pump on", in Pascal

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$p_{t2}$	pressure to which the interstitial space between the skins is subjected for testing, in Pascal
$p_z$	is the closing pressure of the pressure relief valve, in Pascal
$p_{zm}$	is the measured closing pressure of the pressure relief valve, in Pascal
$p_0$	is the operating pressure of the tanks and pipes, in Pascal
$p_1$	is $p_{PA} + 100\,000$ , in Pascal
$p_2$	is $p_{PE} + 100\,000$ , in Pascal
$p_3$	is $p_{AE} + 100\,000$ , in Pascal
$p_4$	is $p_a + 100\,000$ , in Pascal
$\Delta p$	is the difference between $p_{AE}$ and $p_{PA}$ , in Pascal
$Q_L$	is the flow rate of air due to leaks, in cubic metres per year
$Q_S$	is the flow rate of air due to temperature variation exceeding opening pressure of the over pressure device, in cubic metres per year
$Q_{gas}$	is the entire flow rate of air ( $Q_S + Q_L$ ), in cubic metres per year
$R$	is the general gas constant (here for air) = 287 J/(kgK)
$T_0$	is 15 °C = 288 K
$T_1$	is $T_0 + \Delta T_2$
$T_2$	is $T_1 + 7,5$ K
$\Delta T_1$	is the temperature increase according to Formula (A.1), in Kelvins
$\Delta T_2$	is the temperature increase according to Formula (A.2), in Kelvins
$V$	is the proportional reduction of the interstitial space caused by ingress of liquid for assurance of the alarm, in per cent
$V_A$	is the deflated air volume (by the pressure relief valve) in the leak detector), in cubic metres
$V_k$	is the volume of interstitial space = 1 m <sup>3</sup>
$V_{max}$	is the max. volume of interstitial space, intended for this leak detector, in cubic metres
$V_{TF}$	is the contents (volume) of the dry filter, in litres
$V_0$	is the entire volume of the interstitial space, in cubic metres
$V_1$	is the volume of the interstitial space at filling height $h_1$ , in cubic metres
$p_m$	is $(p_1 + p_2)/2$ average working pressure (absolute), in Pascal
$\rho_G$	is the density of the groundwater, in kilograms per cubic metre
$\rho_P$	is the density of the stored product in the tank, in kilograms per cubic metre

## 4 Requirements

### 4.1 Effectiveness

#### 4.1.1 General

This type of leak detection kit is classified according to EN 13160-1:2016 as class I.

The general requirements on leak detection systems according to Clause 5 of EN 13160-1:2016 shall be met.

The interstitial space shall fulfil the requirements according to EN 13160-7, EN 12285-1 or EN 12285-2. The leak detection kit is not effective with an interstitial space volume exceeding 10 m<sup>3</sup>.

**NOTE** To ensure the effectiveness of the system a vacuum leak detection kit can only serve one tank. Whereby a pipework may consist of several sections where the interstitial spaces are connected.

A complete documentation shall be provided by the manufacturer. The documentation shall contain the technical values according to 4.1.2 to 4.1.5, 4.2 and 4.3 as well as a statement about the reaction of the leak detection kit by over and under voltage and current.

The leak detection kit shall be equipped with an integrated test device for simulating a leak which shall result in an alarm.

#### 4.1.2 Measure the pressure change

##### 4.1.2.1 Measuring device for over pressure

Leak detection kit comprises of measuring device for over pressure to be connected to the interstitial space. The measuring device for over pressure shall fulfil the following requirements:

- pressure measuring range: given by the manufacturer;
- repeatability of the measurement according to manufacturer data;
- overload protection: at least 1,5 times of the working pressure ( $p_{PA}$ );
- overpressure protection: at least 1,5 times of the pressure full scale.

The measuring device shall be connected to the interstitial space by a measuring line of the following minimum inside diameter:

- 6 mm for air based systems;
- 4 mm for inert gas based systems.

The colour of this measuring line shall be red or marked in red for indication.

##### 4.1.2.2 Evaluation device for over pressure

The operating condition of the evaluation device shall be clearly indicated, i.e. by a “green” light.

The evaluation device shall be designed to be connected to an alarm device.

For leak detection kits with permanent connected pressure generator, the evaluation device shall provide a signal to the pressure generator that the pressure in the interstitial space does not exceed more than 90 % of  $p_{t2}$  and that a shut-off of the pressure generator is triggered.

- **For tanks**

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The evaluation device shall evaluate the measuring device values. In case of a pressure drop in the interstitial space to the level before or at the value calculated in Formula (1) or Formula (2) a signal shall be sent to the alarm device.

$$p_{AE} = 3\,000 \text{ Pa} + \rho_P \cdot h \cdot g + p_0 \quad (1)$$

$$p_{AE} = 3\,000 \text{ Pa} + \rho_G \cdot h_G \cdot g \quad (2)$$

— **For pipes**

The evaluation device shall evaluate the measuring device values. In case of a pressure drop in the interstitial space to the level before or at the value calculated in Formula (3) a signal shall be sent to the alarm device.

$$p_{AE} = 0,1 \text{ MPa} + p_0 \quad (3)$$

#### **4.1.2.3 Alarm device for over pressure**

The alarm device shall generate an audible and visible alarm. The audible alarm shall have a sound level of  $\geq 70 \text{ dB (A)}$  in a distance of minimum 1 m with a signal according to Table 1 of EN 981:1996+A1:2008 which shall be maintained for a minimum period of 36 h. The audible alarm may be able to be switched off, but the status off should be visible.

The visible alarm shall be clearly indicated i.e. by a “red” light. The visible alarm shall have no switch off option.

The alarm device should be designed for connecting an additional alarm device, e.g. signal horn. The output parameter shall be stated.

A test possibility shall be provided to test the functionality of the audible and visible alarm.

#### **4.1.2.4 Measuring device for vacuum**

Leak detection kit comprises of measuring device for vacuum to be connected to the interstitial space. The measuring device for vacuum shall fulfil the following requirements:

- vacuum measuring range: given by the manufacturer;
- repeatability of the measurement: according to manufacturer data;
- overload protection against vacuum: minimum 1,1 times of the working vacuum ( $p_{PA}$ ), at least however 60 kPa (600 mbar);
- if the measuring device is designed to be used on pressurized tanks or pipes, the measuring device shall withstand an overpressure of at least 1,1 times of the design pressure given by the manufacturer.

A condensate trap shall be provided for all lowest points of the measuring line.

The measuring device shall be connected to the interstitial space by a measuring line of 6 mm minimum diameter. The colour of this measuring line shall be red or marked in red.

#### **4.1.2.5 Evaluation device for vacuum**

##### **4.1.2.5.1 General**

The operating condition of the evaluation device shall be clearly indicated, i.e. by a “green” light.

The evaluation device shall be designed to be connected to an alarm device.

For assurance of the alarm the volume of the interstitial space has to be reduced by increasing liquid, see Formula (4):

$$V = \left(1 - \frac{100000 \text{ Pa} - p_{\text{PA}}}{100000 \text{ Pa} - p_{\text{AE}}}\right) \cdot 100 \text{ in } \% \quad (4)$$

Due to the alarm pressure  $p_{\text{AE}}$  the interstitial space is filled (in the case of a leak) up to the height  $h_1$  compared with the lowest point of the tank, see Formula (5):

$$h_1 = \frac{p_{\text{AE}}}{g \cdot \rho_{\text{P}}} \text{ or } h_1 = \frac{p_{\text{AE}}}{g \cdot \rho_{\text{G}}} \quad (5)$$

Under consideration of tank geometry or geodetic differences in the levels of the double wall pipe systems the volume of the interstitial space  $V_1$  at filling height  $h_1$  has to be determined by calculation (or by measurement in litres), see EN 13160-7.

The alarm is considered reliable, if the following condition is fulfilled, see Formula (6):

$$V < \frac{V_1}{V_0} \quad (6)$$

**NOTE** The above mentioned calculation would be carried out for tanks with a suction line down to the lowest point of the interstitial space. An analogue application is required for tanks without a suction line or for pipework, i.e. the line of reference for the height  $h_1$  is the horizontal line through the lowest point, at which the suction line is connected with or ends in the interstitial space. For tanks with a suction line down to the lowest point of the interstitial space it is the end of the suction line on the lowest point and for tanks without a suction line down to the lowest point of the interstitial space it is the suction nozzle at the top of the tank.

#### 4.1.2.5.2 Without integrated vacuum generator

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For the application of these systems the following conditions shall be fulfilled:

- a suction line (for the vacuum pump to be installed outside) which shall be led down to the lowest point of the interstitial space;
- or
- at above-ground tanks, as an alternative, a control nozzle may be installed at the lowest point of the interstitial space.

The vacuum pressure (relative value) at  $p_{\text{AE}}$  shall be at least 35 kPa.

The vacuum pressure (relative value) of the working pressure shall be at least 70 kPa.

#### 4.1.2.5.3 With integrated vacuum generator

The evaluation device with integrated vacuum generator for tanks and pipes shall evaluate the measuring device values. In case of a pressure rise in the interstitial space to the level before or at the value:

- a) as high as the pressure calculated according to Formula (7)

$$p_{\text{AE}} = 3\,000 \text{ Pa} + \rho \cdot g \cdot h \quad (7)$$

or

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b) of 3 kPa, if the suction line in the interstitial space is led down to the lowest point

or

c) of 25 kPa for flat-bottom tanks with double bottom

an appropriate signal shall be sent to the alarm device.

For leak detection kits with permanent connected vacuum generator, the evaluation device shall provide a signal to the vacuum generator that the vacuum in the interstitial space does not exceed more than 90 % of  $p_{t2}$  and that a shut-off of the vacuum generator is triggered.

#### 4.1.2.6 Alarm device for vacuum

The alarm device shall generate an audible and visible alarm. The audible alarm shall have a sound level of  $\geq 70$  dB (A) in a distance of minimum 1 m with a signal according to Table 1 of EN 981:1996+A1:2008 which shall be maintained for a minimum period of 36 h. The audible alarm may be able to be switched off but the status off should be visible.

The alarm device should be designed for connecting an additional alarm device, e.g. signal horn. The output parameter shall be stated.

The visible alarm shall be clearly indicated i.e. by a “red” light. The visible alarm shall have no switch off option.

A test possibility shall be provided to test the functionality of the audible and visible alarm.

#### 4.1.3 Replenishment rate of the medium (only if provided)

##### 4.1.3.1 Vacuum and pressure generators with regulated flow rate

The volume flow at the alarm pressure shall be  $(85 \pm 15) \text{ l} \cdot \text{h}^{-1}$  if a pressure/vacuum generator is used.

The pressure/vacuum generator shall be connected to the interstitial space by an interconnecting line of the following minimum inside diameter:

- 6 mm for air based systems;
- 4 mm for inert gas based systems.

The colour of this interconnecting line shall be white or clear or marked in white for indication.

The total flow resistance of the interconnecting line between the pressure generator and the double skin tank or pipe may be not more than 1 kPa (10 mbar) at  $(85 \pm 15) \text{ l} \cdot \text{h}^{-1}$ .

NOTE This requirement is fulfilled for air-based systems, when the length of the interconnecting line is  $\leq 50$  m for an inner diameter of the interconnecting line of 6 mm.

##### 4.1.3.2 Pressure / vacuum generator with time regulated flow

The average volume flow (measured over a refill and a control period) at the alarm pressure shall be  $(85 \pm 15) \text{ l} \cdot \text{h}^{-1}$  if a pressure/vacuum generator is used.

The pressure/vacuum generator shall be connected to the interstitial space by an interconnecting line of the following minimum inside diameter:

- 6 mm for air based systems;
- 4 mm for inert gas based systems.

The colour of this interconnecting line shall be white or clear or marked in white for indication.

The total flow resistance of the interconnecting line between the pressure generator and the double skin tank or pipe may be not more than 1 kPa (10 mbar) at  $(85 \pm 15) \text{ l} \cdot \text{h}^{-1}$ .

NOTE This requirement is fulfilled for air-based systems, when the length of the interconnecting line is  $\leq 50 \text{ m}$  for an inner diameter of the interconnecting line of 6 mm.

#### 4.1.4 Software (only if provided)

The software, where provided, shall have a facility for self-checking by fulfilling the following requirements:

- a self-diagnostic mode to test the integrity of the system at start up and periodically during use. A negative result of self-diagnostic mode shall result in an alarm condition;
- a facility to check the consistency of the input and output data, malfunction shall result in an alarm condition.

#### 4.1.5 Function and tightness of leak detection kit

All leak detection kits shall

- be equipped with a device for simulating a leak which shall result in an alarm;
- withstand the operation pressure/vacuum as well as the pressure of tanks or pipes or the hydrostatic pressure of tanks and shall be tight under these conditions;
- have an opening and closing pressure of the pressure relief device in the range given by the manufacturer.

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The devices for simulating a leak shall have clearly identified operating position.

### 4.2 Durability of effectiveness

#### 4.2.1 Durability of effectiveness against temperature

The temperature ranges for leak detection kits shall be as follows:

- Type 1:  $-20^\circ\text{C}$  to  $+60^\circ\text{C}$ ;
- Type 2:  $0^\circ\text{C}$  to  $+40^\circ\text{C}$ ;
- Type 3:  $-40^\circ\text{C}$  to  $+40^\circ\text{C}$ .

#### 4.2.2 Durability of effectiveness against chemical attack

Parts of leak detection kits which may come into contact with the liquid of the stored/conveyed product or its vapour shall be resistant.

#### 4.2.3 Durability of effectiveness against fatigue through cycling of pressure

Leak detection kits shall withstand 10 000 cycles of pressure changes.

#### 4.2.4 Humidity measurement of the leak detection medium (only if provided)

A dry filter shall be sized so that it has not to be exchanged within one year, provided a tight system.

A device shall indicate proper function.