SLOVENSKI STANDARD
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Sistemi za kontrolo tesnosti - 5 del: Manometri na rezervoarjih kot sistem za zaznavanje tesnosti

Leak detection systems - Part 5: Tank gauge leak detection systems

Leckanzeigesysteme - Teil 5: Tankinhalts-Leckanzeigesysteme

Systemes de détection de fuites - Partie 5: Systèmes de détection de fuites au moyen de jauges automatiques en citernes

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Systèmes de détection de fuites - Partie 5: Systèmes de détection de fuites au moyen de jauges automatiques en citernes

Leckanzeigesysteme - Teil 5: Tankinhalts-Leckanzeigesysteme

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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 Central Secretariat has the same status as the official versions.

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Foreword

This document (EN 13160-5:2004) has been prepared by Technical Committee CEN/TC 221 “Shop fabricated metallic 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of an identical text or by endorsement, at the latest by March 2005, and conflicting national standards shall be withdrawn at the latest by March 2005.

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, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

1 Scope

This document specifies the requirements for leak detection systems – class IV for use only with liquids as defined in the scope of EN 13352.

2 Normative references

The following referenced documents are indispensable for the application of this document. 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.*

EN 590, *Automotive fuels — Diesel – Requirements and test methods.*

EN 976-1, *Underground tanks of glass-reinforced plastics (GRP) — Horizontal cylindrical tanks for the non-pressure storage of liquid petroleum based fuels — Part 1: Requirements and test methods for single wall tanks.*

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

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

EN 13160-3, *Leak detection systems — Part 3: Liquid systems for tanks.*

EN 13160-4, *Leak detection systems — Part 4: Liquid and/or vapour sensor systems for use in leakage containments or interstitial spaces.*

EN 13160-6, *Leak detection systems — Part 6: Sensors in monitoring wells.*

EN 13352:2002, *Specification for the performance of automatic tank contents gauges.*

EN 28601, *Data elements and interchange formats — Information interchange — Representation of dates and times (ISO 8601:1988 and technical corrigendum 1:1991).*

3 Terms, definitions and abbreviated terms

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

3.1 Terms and definitions

3.1.1
quantitative output
numerical indication of the leak rate estimated for a given test

3.1.2
qualitative output
pass/fail indication for a given test with reference to a specified leak rate

3.2 Abbreviations

B	is the bias
LL	is the lower confidence bound for probability of detection
UL	is the upper confidence bound for probability of detection
MSE	is the mean squared error
PD	is the probability of detection
PFA	is the probability of false alarm
PI(all)	is the proportion of invalid records for all records
PI(leak)	is the proportion of invalid records for leaking tanks
PI(tight)	is the proportion of invalid records for tight tanks
R	is the simulated leak rate
C	is the criterion or threshold for indicating a leak
B	is the estimated bias of the system
SD	is the standard deviation
t_b	is the two-sample *t*-test bias

4 General

General principles shall be according to EN 13160-1.

Tank gauge leak detection systems shall be divided into two categories of operation:

— Category A: Systems providing leak detection for tanks and pipes, connected with the tank;

— Category B: Systems providing leak detection for tanks only.

The minimum operational performance requirements for each category are contained in Table 1.

Table 1 — Performance requirements for categories of leak detection

Category	Leak rate $l \cdot h^{-1}$	Maximum time of detection
A Dynamic leak detection	4,0	24 h
	2,0	7 days
	0,8	14 days
B(1) Statistical quiet period detection	4,0	24 h
	2,0	7 days
	0,8	14 days
B(2) Static leak detection	0,4	6 h

In addition to the performance requirements in terms of leak rates specified in Table 1 above, the tank gauge leak detection system shall be able to detect a large loss of 300 l or more in a maximum time of 30 min.

Any gauge system to be used for any category of leak detection shall have water detection capability according to EN 13352.

5 Dynamic leak detection (category A)

For this category, the system shall communicate with the metering system, associated with the withdrawal of product from the storage tank, in order to receive details of all volumes dispensed from the tank. At the specified leak rate according to Table 1, the system shall have a probability of detection of at least 95 % whilst a false alarm rate shall not exceed 5 %.

6 Statistical quiet period leak detection (category B (1))

For this category, the system shall be capable of detecting the specified leak rate according to Table 1 with a probability of at least 95 % whilst operating at a false alarm rate of 5 % or less.

7 Static tank gauge leak detection (category B (2))

For this classification, the system shall be capable, when no product is being dispensed from or delivered to the tank, of detecting the specified leak rate according to Table 1 with a probability of at least 95 % whilst operating at a false alarm rate of 5 % or less.

8 Leak indicating device

A leak indicating device shall be provided. In addition for categories A and *B*, the requirements of a gauge control device as defined in EN 13352 shall be met. An alarm shall be activated whenever a leak rate is detected at the specified rate or above, in accordance with Table 1.

Where performance in accordance with Table 1 is not achievable within the required levels of probability, the results shall be reported as inconclusive.

9 Type testing procedure for leak detection systems using tank gauge data, categories A and B (1)

9.1 Test objective

9.1.1 The aim of the test is to assess the suitability of a software leak detection system which uses tank gauge data for detecting the loss of stored product from:

In the case of Category A, a storage tank and/or draw-off pipework, or

in the case of Category B(1), a storage tank.

Tests are performed to determine:

9.1.1.1 that a leak rate of 4 $l \cdot h^{-1}$ is detected within 24 h with a probability of detection not less than 95 % and a probability of false alarms not greater than 5 %.

9.1.1.2 that a leak rate of 2 $l \cdot h^{-1}$ is detected within 7 days with a probability of detection not less than 95 % and a probability of false alarms not greater than 5 %.

9.1.1.3 that a leak rate of 0,8 $l \cdot h^{-1}$ is detected within 14 days with a probability of detection not less than 95 % and a probability of false alarms not greater than 5 %.

In each case, tests are performed following an initialisation period equivalent to a maximum of 28 days operation, during which the system under test processes normal operational data without induced leaks.

9.1.2 Data from a pre-recorded standard test database collected in accordance with annex A will be submitted to the system under test covering the ranges shown for each of the following (per tank):

9.1.2.1 Daily shade temperature: -5 °C to +30 °C;

9.1.2.2 Storage tank capacity: 10 000 l to 50 000 l;

9.1.2.3 Average daily throughput (per tank): 1 000 l to 12 000 l per day;

9.1.2.4 Delivery quantity per tank: 2 750 l to 9 500 l;

9.1.2.5 Delivery temperature: -5 °C to +25 °C;

9.1.2.6 Delivery frequency: 2 to 7 per week;

9.1.2.7 Individual dispenser accuracy: -0,3 % to +0,3 % of dispensed volume.

9.1.3 The system under test shall be qualified for use with database files representing at least one of 9.1.3.1 and 9.1.3.2 and, optionally, with 9.1.3.3, 9.1.3.4, 9.1.3.5 and/or 9.1.3.6:

9.1.3.1 Suction draw-off systems (where a hydraulic pumping device is incorporated into the dispenser);

9.1.3.2 Pressurised draw-off systems (where product is transferred from the tank to the dispenser by a remote pumping unit);

9.1.3.3 Blending dispenser systems (where product from two or more tanks is mixed at the dispenser);

9.1.3.4 Tank manifolding systems (where two or more tanks are connected together such that fuel may be drawn from the tanks independently);

9.1.3.5 Tank siphon systems (where two or more tanks are connected together such that fuel cannot be drawn from the tanks independently);

9.1.3.6 Multiple draw-off (minimum of 2 dispensers per tank, suction or pressure).

9.1.4 The system under test shall be qualified for use as a Category A or a Category B(1) leak detection system.

9.1.5 The system under test shall be qualified for use with data corresponding to each type of product in which it will detect leaks, such as unleaded gasoline according to EN 228, diesel fuel according to EN 590.

9.2 Test equipment

9.2.1 The following test equipment will be required:

9.2.1.1 A computer and associated data transfer peripherals.

9.2.1.2 Leak simulation and data analysis software, as necessary to process standard test database files in order to simulate leaks in the data as described in 9.3 and to submit data to the software of the tank gauge system under test

9.3 Test method

9.3.1 Objective

The objective of the test schedule is to verify that the system under test will return leak test results in accordance with the criteria of 9.1.1 when data from the standard test database are processed by the leak detection software following modifications to simulate leaks at various rates.

The manufacturer shall supply the system under test in the form of software loaded onto a computer which is capable of reading in and processing files from the standard test database. These files will be provided in a standard format (as defined in annex A) and shall be accepted without any pre-processing.

The manufacturer shall state the initialisation period required for the system under test, which shall not exceed 28 days.

9.3.2 File sorting and selection

A set of files shall be selected from the standard database, which includes data appropriate to those applications listed in 9.1.3, 9.1.4 and 9.1.5 for which the system under test is to be qualified.

For each type of draw-off system and fuel, the files selected shall meet the following conditions:

For each of the draw-off methods listed in 9.1.3, and each fuel listed in 9.1.5, between 25 % and 75 % of the data files selected should be taken from tanks where that type of draw-off system or fuel is in use. The same data file may cover two or more uses, for example a manifolded tank using pressurised draw-off via multiple dispensers.

Leak detection systems to be tested will provide a quantitative or a qualitative output. A qualitative output will indicate a pass/fail result in accordance with Table 1.

The minimum sample sizes for data files, which shall be collected for each of these types, are:

9.3.2.1 Systems with a Quantitative Output: ≥ 100 files (not more than 15 from the same tank);

9.3.2.2 Systems with a Qualitative Output: ≥ 240 files (not more than 36 from the same tank).

The database files shall be sorted to form an ordered data set which is divided into 5 equal groups according to the 20th, 40th, 60th and 80th percentiles of the recorded range of shade temperature. Each of the five groups shall be further divided into 3 equal sub-groups, according to the 33rd and 67th percentiles of the recorded range of tank sizes, such that sub-groupings are determined independently for each of the five groups.

For systems with a quantitative output, three files shall be selected at random from each of the 15 sub-sets, to provide a sample of 45 files for subsequent evaluation.

For systems with a qualitative output, eight files shall be selected at random from each of the 15 sub-sets, to provide a sample of 120 files for subsequent evaluation.

For example, for data collected over the ranges of shade temperature and tank capacity as defined in 9.1.2.2 and 9.1.2.3 the files would be sorted as shown in table 2, and *n* files selected from each sub-set as shown, where *n* = 3 for a quantitative system and *n* = 8 for a qualitative system:

Table 2 — Selection of data files according to tank capacity and shade temperature

Tank Capacity	Shade Temperature				
	-5 °C to 20th Percentile	**20th to 40th Percentile**	**40th to 60th Percentile**	**60th to 80th Percentile**	**80th Percentile to 30 °C**
10 000 l to 33rd Percentile	Select *n* files at random	Select *n* files at random	Select *n* files at random	Select *n* files at random	Select *n* files at random
33rd to 67th Percentile	Select *n* files at random	Select *n* files at random	Select *n* files at random	Select *n* files at random	Select *n* files at random
67th Percentile to 50 000 l	Select *n* files at random	Select *n* files at random	Select *n* files at random	Select *n* files at random	Select *n* files at random

9.3.3 Simulated tank leaks (constant)

Leaks from tanks are simulated as a continuous loss of product from the tank at a constant leak rate. The figure in a record representing the volume of stored product is reduced by a value equivalent to the quantity of product that would be lost at the specified rate during the time period between the record and its predecessor. The simulated losses for all previous time periods are accumulated and the total subtracted from the figure representing stored volume. These accumulated losses are also carried forward through each delivery event such that the subtracted figure increases monotonous.

Therefore, the volume figure, v_i, of the ith record is replaced by v_i', calculated according to equation (1):

$$v'_i = v_i - \sum_{j=1}^{i} \left(t_j - t_{j-1} \right) R \qquad (1)$$

where R = simulated leak rate;

t_j = time stamp of jth record;

t_j-1 = time stamp of predecessor to jth record.

Where tanks are connected via a siphon, the quantity of product corresponding to the leak over the specified time interval is divided by the number of tanks in the siphon arrangement and this quantity subtracted from the records for each of the tanks connected via the siphon.