SLOVENSKI STANDARD
SIST EN 1518:2000

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Neporuġitveno preskuġanje - Preskus tesnosti ï Karakterizacija masno-spektrometriļ nih detektorjev puġļ anja

Non-destructive testing - Leak testing - Characterization of mass spectrometer leak detectors

Zerstörungsfreie Prüfung - Dichtheitsprüfung - Charakterisierung von massenspektrometrischen Leckdetektoren

Essais non destructifs - Contrôles d'étanchéité - Caractérisation des détecteurs de fuite a spectrométrie de masse

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ICS

Descriptors: non-destructive tests, gas permeability tests, leak detection, leak detectors, mass spectrometry, characteristics, instrument sensitivity

English version

Non-destructive testing - Leak testing - Characterization of mass spectrometer leak detectors

Essais non destructifs - Contrôles d'étanchéité - Caractérisation des détecteurs de fuite à spectromètrie de masse

Zerstörungsfreie Prüfung - Dichtheitsprüfung - Charakterisierung von massenspektrometrischen Leckdetektoren

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

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Foreword

This European Standard has been prepared by Technical Committee CEN/TC 138 " Non-destructive testing", the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 1998, and conflicting national standards shall be withdrawn at the latest by October 1998.

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 terms and procedures for the characterization of mass spectrometer leak detectors (MSLD). It is not intended to give a complete set of specifications for an acceptance test but a description of procedures that can be used without particular calibration equipment.

An MSLD has an integral high vacuum system for maintaining the sensing element (mass spectrometer) at low operating pressure and for establishing a partial pressure related to the incoming gas flow. This pressure is measured quantitatively by the mass spectrometer. Such instruments are able to selectively measure the flow of a tracer gas. In most cases the tracer gas will be helium, flowing in/out of an object through a leak.

The methods described in this standard are applicable without restrictions to helium as the tracer gas. For other gases, additional precautions may be necessary.

These methods are applicable to commonly-available MSLD, based on the present level of technology, which may be able to measure leak rates down to 10^{-12} Pa.m^3/s.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

prEN 1330-8 Non-destructive testing - Terminology
Part 8: Terms used in testing for leak tightness

3 Definitions

For the purposes of this standard, the definitions given in prEN 1330-8 apply together with the following:

3.1 Terms

3.1.1 compression ratio of the counterflow stages of the high vacuum pump for tracer gas: With zero flow, the ratio of partial pressure of tracer gas at the exhaust of the counterflow stages of the high vacuum pump to the partial pressure at the inlet of the mass spectrometer (MS).

3.1.2 display: A device which indicates visually the leakage rate measured. The units in which the leakage rate is expressed may be selectable.

NOTE: The display may be analog or quasi-analog (continuous scale with definite divisions) or digital (numbers with a definite number of digits) or a combination of both.

3.1.3 inlet pumping speed: The volume rate of flow at the test port of a MSLD when the instrument is operating with the MS below its maximum working pressure.

NOTE: The inlet pumping speed may be different for different gases and different modes of operation. The inlet pumping speed for the tracer gas determines the response time for the volume under test.

3.1.4 internal leak port: A flange directly behind the inlet valve, used to connect a small leak for zero drift determination.

3.1.5 intrinsic pumping speed: In a direct flow leak detector, the volume rate of flow of tracer gas at the inlet of the MS.

3.1.6 ion collector: The part of the MS where ions are collected and neutralized producing a current in the collector which is a measure of the number of neutralized ions.

3.1.7 sensitivity control: An electrical hardware or software control which may be used to adjust the sensitivity of the instrument so that a calibrated leak is indicated with its true leakage rate.

3.1.8 sensitivity of the MS: The ratio of the ion current at the output of the MS to the corresponding partial pressure of tracer gas inside the MS.

3.1.9 zero control: An electrical hardware or software control which may be used to shift the output indication of the leak detector, to a determined point of the scale range in use, usually zero.

3.2 Terms related to the operation of the MSLD

3.2.1 peak (noun): The trace showing a maximum on the chart recorder when the leak detector is scanned with respect to mass with gas present, usually the tracer gas, to which the detector is tuned.

3.2.2 peak (verb): To set the scanning control (see 3.2.3) of a leak detector so that the output due to a given tracer gas input is maximized. It is a form of tuning (see 3.2.4).

3.2.3 scan (verb): To adjust the accelerating voltage (or other equivalent operating parameter) of a leak detector, particularly across that range of voltage which includes the voltage necessary to produce a tracer gas peak.

3.2.4 tune (verb): In leak detection, to adjust one or more of the controls of a leak detector so that its response to a tracer gas is maximized. Tuning by means of the scanning control only is called "peaking" (see 3.2.2).

3.3 Terms related to the specification of the MSLD

3.3.1 ***Operating conditions***

3.3.1.1 *General*

For the definition of operating conditions see prEN 1330-8.

NOTE: The operating conditions are normally given by the manufacturer.

3.3.1.2 optimum working pressure: The pressure in the MS, at which the minimum detectable concentration can be measured.

3.3.1.3 maximum working pressure: The pressure in the MS above which normal operation is no longer possible.

3.3.1.4 maximum inlet pressure: The maximum pressure at the test port at which the MSLD is able to detect leaks in a given mode of operation.

NOTE: For a MSLD to be connected directly to a system under test, the total pressure in the system has to be less than the maximum inlet pressure of the MSLD.

3.3.1.5 maximum gas load: The maximum pV-throughput of all gases emerging from the test specimen that the MSLD can pump during leak detection in a given mode of operation.

NOTE: For component testing, the MSLD is normally ready for measurement when the desorption of water vapour from the inner surfaces is less than the maximum gas load.

3.3.2 Tracer gas background signal

3.3.2.1 background signal drift: The relatively slow change in background signal, given by the maximum change in a given period of time.

3.3.2.2 background signal noise: The relatively rapid change in background signal given by an average measure of scatter in a specified period of time.

3.3.3 Detection limit

3.3.3.1 minimum detectable concentration ratio: The smallest concentration of a given tracer gas in an air mixture that can be detected unambiguously when the mixture is fed into the MSLD at such a rate as that is at its optimum working pressure.

3.3.4 resolving power: The ratio of a given mass number to the peak width measured at a specified (for example 10 %) height of the peak (in units of mass numbers).

3.3.5 Display resolution

3.3.5.1 general: A quantitative expression of the ability of the leakage rate-display device to distinguish meaningfully between closely adjacent values of the leakage rate indicated.

3.3.5.2 linear display resolution: The constant difference between adjacent scale intervals expressed in % full scale indication.

3.3.5.3 logarithmic display resolution: The constant ratio between two adjacent scale intervals expressed as a percentage of the indicated value.

4 Description of a MSLD

4.1 Main parts of a MSLD

A MSLD (see definition given prEN 1330-8) consists basically of a mass spectrometer and a high vacuum pumping system for:

- maintaining the MS under appropriate vacuum conditions;
- producing a definite partial pressure of tracer gas when a specific throughput of tracer gas enters the leak detector.

A MSLD includes also a number of valves and pressure gauges to ensure the appropriate vacuum conditions within the system.

The leakrate output can be displayed in a number of ways, for example an electrical meter, or digital displays of different types. In addition, a chart recorder output is usually available, which has to be used for the test procedures in this standard.

The general structure of an MSLD is described by the following list.

a) Mass spectrometer:

- ion source;
- separation system;
- ion collector.

b) Pumping system:

- inlet system;
- inlet line;
- inlet valve;
- pump valve;
- test port;
- vent valve;
- internal leak port.

c) Sensitivity zero control.

d) Display.

4.2 Operating principles of MSLD

4.2.1 *Direct flow leak detectors*

The leakage rate q_x is given by the equation:

$$q_x = p_x \times S_x$$

where

q_x is the pV-throughput of tracer gas;

S_x is the intrinsic pumping speed;

p_x is the partial pressure of tracer gas in the mass spectrometer (MS).

4.2.2 *Counterflow leak detectors*

The leakrate q_x is given by the equation:

$$q_x = p_x \times K_x \times S_{b,x}$$

where

q_x is the pV-throughput of tracer gas;

K_x is the compression ratio of the counterflow stages of the high vacuum pump for tracer gas (see 3.1.1);

$S_{b,x}$ is the speed of the pumping system, for tracer gas, backing the counterflow stages of the high vacuum pump;

p_x is the partial pressure of tracer gas in the MS.

4.3 MLSD specification

The MLSD specification is described by the following list:

a) Operating conditions:

- optimum working pressure;
- maximum working pressure;
- maximum inlet pressure;
- maximum gas load.

b) Tracer gas background signal:

- background signal drift;
- background signal noise.

c) Non linearity.

d) Detection limit:

- minimum detectable leakage rate;
- minimum detectable concentration ratio.

e) Resolving power.

f) Display discrimination.