SIST

SLOVENSKI STANDARD
oSIST prEN 1518:2025

01-januar-2025

Neporušitveno preskušanje - Preskus tesnosti – Karakterizacija masno-spektrometričnih detektorjev puščanja

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

Zerstörungsfreie Prüfung - Dichtheitsprüfung - Charakterisierung von massenspektrometrischen Leckdetektoren

Essais non destructifs - Contrôle d’étanchéité - Caractérisation des détecteurs de fuite à spectrométrie de masse

Ta slovenski standard je istoveten z: **prEN 1518**

ICS:

19.100	Neporušitveno preskušanje	Non-destructive testing

oSIST prEN 1518:2025 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

DRAFT
prEN 1518

November 2024

ICS 19.100

Will supersede EN 1518:1998

English Version

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

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Zerstörungsfreie Prüfung - Dichtheitsprüfung - Charakterisierung von massenspektrometrischen Leckdetektoren

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COMITÉ EUROPÉEN DE NORMALISATION
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CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

Ref. No. prEN 1518:2024 E

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European foreword

This document (prEN 1518:2024) has been prepared by Technical Committee CEN/TC 138 “Non-destructive testing”, the secretariat of which is held by AFNOR.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 1518:1998.

prEN 1518:2024 includes the following significant technical changes with respect to EN 1518:1998:

a) normative references have been updated;

b) clause “Terms and definitions” has been revised;

c) new Subclause 4.1, General, has been added;

d) Clause 5.2 has been updated;

e) in Clause 6.1, the ambient temperature has been adapted;

f) Clause 7 and 8 have been revised;

g) the test report has been revised;

h) the figures have been integrated in the text.

1 Scope

This document 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.

The methods described in this document 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 leakage rates down to 10^{-12} Pa·m^3/s.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 ISO 20484:2017, *Non-destructive testing — Leak testing — Vocabulary (ISO 20484:2017)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 20484:2017 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

3.1 Terms

3.1.1 Terms related to the MSLD

3.1.1.1
compression ratio
ratio of partial pressure of tracer gas with zero flow at the exhaust of the counterflow stages of the high vacuum pump to the partial pressure at the inlet of the mass spectrometer (MS)

3.1.1.2
display
device which indicates visually the leakage rate measured

Note 1 to entry: The units in which the leakage rate is expressed can be selectable.

Note 2 to entry: The display can be analogue or quasi-analogue (continuous scale with definite divisions) or digital (numbers with a definite number of digits) or a combination of both.

3.1.1.3
inlet pumping speed
volume rate of flow at the test port of an MSLD when the instrument is operating with the MS below its maximum working pressure

Note 1 to entry: The inlet pumping speed can 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.

3.1.1.4
internal leak port
flange directly behind the inlet valve, used to connect a small leak for zero drift determination

3.1.1.5
intrinsic pumping speed
volume rate of flow of tracer gas at the inlet of the MS in a direct flow leak detector

3.1.1.6
ion collector
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

3.1.1.7
sensitivity control
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

3.1.1.8
sensitivity
ratio of the ion current at the output of the MS to the corresponding partial pressure of tracer gas inside the MS

3.1.1.9
zero control
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

3.1.2 Terms related to the operation of the MSLD

3.1.2.1
peak
<noun> trace showing a maximum when the leak detector is scanned with respect to mass with gas present, usually the tracer gas, to which the detector is tuned

3.1.2.2
peak
<verb> to set the scanning control (see 3.1.2.3) of a leak detector so that the output due to a given tracer gas input is maximized

Note 1 to entry: It is a form of tuning (see 3.1.2.4).

3.1.2.3
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

3.1.2.4
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

Note 1 to entry: Tuning by means of the scanning control only is called “peaking” (see 3.1.2.2).

3.1.3 Terms related to the specification of the MSLD

3.1.3.1
optimum working pressure
pressure in the MS, at which the minimum detectable concentration can be measured

3.1.3.2
maximum working pressure
pressure in the MS above which operation is no longer possible

3.1.3.3
maximum inlet pressure
maximum pressure at the test port at which the MSLD is able to detect leaks in a given mode of operation

Note 1 to entry: For an MSLD to be connected directly to a system under test, the total pressure in the system shall be less than the maximum inlet pressure of the MSLD.

3.1.3.4
maximum gas load
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 1 to entry: 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.

3.1.4 Terms relating to the tracer gas background signal

3.1.4.1
background signal drift
relatively slow change in background signal, given by the maximum change in a given period of time

3.1.4.2
background signal noise
relatively rapid change in background signal given by an average measure of scatter in a specified period of time

3.1.5 Terms relating to the detection limit

3.1.5.1
minimum detectable concentration ratio
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

3.1.5.2
resolving power
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)

3.1.6 Terms relating to the display resolution

3.1.6.1
display resolution
quantitative expression of the ability of the leakage rate-display device to distinguish meaningfully between closely adjacent values of the leakage rate indicated

3.1.6.2
linear display resolution
constant difference between adjacent scale intervals expressed in % full scale indication

3.1.6.3
logarithmic display resolution
constant ratio between two adjacent scale intervals expressed as a percentage of the indicated value

4 Description of an MSLD

4.1 General

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.

MSLD are commonly operated in either direct or counterflow configurations. These are both illustrated in Figure 2.

4.2 Main parts of an MSLD

An MSLD (see definition given in EN ISO 20484) consists basically of a mass spectrometer (MS) 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.

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

The leakage rate output can be displayed in a number of ways, for example an electrical meter, or digital displays of different types, such as with a logarithmic or linear display resolution. In addition, a digital and/or analogue output is usually available, which shall be used for the test procedures in this document.

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;