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Non-destructive testing — Leak testing — Vocabulary

Essais non-destructifs — Contrôle d'étanchéité — Vocabulaire

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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ISO 20484 was prepared by the European Committee Standardization (CEN) Technical Committee CEN/TC 138, *Leak testing*, in collaboration with ISO Technical Committee TC 135, *Non-destructive testing*, Subcommittee SC 6, *Leak testing*, in accordance with the agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This document is based on and replaces the European standard EN 1330-8:1998, *Non-destructive testing — Terminology — Part 8: Terms used in leak tightness testing*.

Introduction

The series of European standards, EN 1330, comprises 10 parts prepared separately by groups of experts, each group consisting of experts in a given NDT (non-destructive testing) method (for EN 1330-3 to EN 1330-10).

A comparative examination of these parts has shown the existence of common terms that are often defined differently. These terms have been taken from EN 1330-3 to EN 1330-10 and then split into two categories:

— general terms corresponding to other fields such as physics, electricity, metrology, etc. and already defined in international documents; these terms are the subject of EN 1330-1;

— common terms specific to NDT; these terms, the definitions of which have been harmonized in an Ad Hoc group, are the subject of EN 1330-2.

In view of the nature of the approach taken, the list of terms in EN 1330-1 and EN 1330-2 are in no way exhaustive.

EN 1330 consists of the following parts:

— *Part 1: General terms*

— *Part 2: Terms common to the non-destructive testing methods*

— *Part 3: Terms used in industrial radiographic testing*

— *Part 4: Terms used in ultrasonic testing*

— *Part 7: Terms used in magnetic particle testing*

— *Part 9: Terms used in acoustic emission*

— *Part 10: Terms used in visual examination*

NOTE 1 ISO 12718 replaced EN 1330–5.

NOTE 2 ISO 12706 was published formerly as the draft European standard prEN 1330–6.

Non-destructive testing — Leak testing — Vocabulary

1 Scope

This document defines the terms used in leak testing.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

— ISO Online browsing platform: available at http://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1 Atomic/molecular structure

3.1.1
concentration
c
ratio of the number of atoms or molecules of a given constituent in a gas mixture to the total number of atoms or molecules in the mixture

Note 1 to entry: For ideal gases, this is equivalent to the ratio of the partial pressure to the total pressure.

Note 2 to entry: In other cases, the concentration is considered as mole fraction and the symbol used is n_B.

3.1.2
ionization potential
minimum energy, expressed in electronvolts, required to remove an electron from an atom or molecule or ion to form a positive ion

3.2 Pressure and vacuum

3.2.1
atmospheric pressure
pressure of the atmosphere at a specified place and time

3.2.2
partial pressure
p_A, p_B
pressure that would be exerted by a gas or vapour if it alone was present in an enclosure

3.3 Gas-solid interaction

3.3.1
gettering
removal of a gas by permanent binding in or on a solid, usually involving chemical reaction

3.3.2
occlusion of gas
trapping of undissolved gas in a solid during solidification

3.3.3
permeation
mechanism of adsorption/solution/diffusion/desorption in a solid material that allows a substance to pass through under a partial pressure difference

3.3.4
permeability coefficient
P_{perm}
coefficient, dependent on temperature, characterizing the *conductance* (4.2.1) of a material for the *permeation* (3.3.3) of a given substance

4 Terms relating to gas

4.1 Properties of gases

4.1.1
ideal gas
perfect gas
gas obeying the relationship $pV = nRT$, where $n = m/M$

where

p is the pressure;

V is the volume;

m is the mass of the gas;

M is the molecular mass;

R is the ideal gas constant;

T is the absolute temperature.

4.2 Flow of gas

4.2.1
conductance
C
throughput divided by the difference in mean pressures prevailing at two specified cross-sections or at either sides of the duct or orifice, assuming isothermal conditions

Note 1 to entry: Applies to fluid flow in a duct, or part of a duct, or a constriction.

4.2.2
flow rate
q_M, q_N, q_V
rate at which an amount of mass, a number of particles or moles pass through a given cross section of the system

Note 1 to entry: Mass: q_M, Particles: q_N, Molar: q_V.

Note 2 to entry: For gases, the volume flow rate (Volume: symbol q_V) is a measure of quantity only at specified conditions.

4.2.3
pV-throughput
q_G
rate at which a volume of gas at specified pressure passes a given cross section of the system

Note 1 to entry: In leak detection, pV-throughput is used to express the flow rate of gas. The temperature and molar weight or density are given additionally so that the flow rate can be calculated using the gas equation.

4.2.4
resistance to flow
w
reciprocal of conductance (flow)

4.2.5
dynamic viscosity coefficient
η
coefficient, dependent on temperature, that defines the resistance of a specified fluid to the motion, due to the molecular interactions

4.3 Gas leakage

4.3.1
leak
<non-destructive testing (NDT)> hole, porosity, permeable element or other structure in the wall of an object allowing gas to pass from one side of the wall to the other by the effect of pressure- or concentration-difference across the wall

4.3.2
conductance leak
leak which consists of one or more discrete passages, including porous areas, through which a fluid may flow

4.3.3
orifice leak
conductance leak (4.3.2) having a diameter much greater than the leakage path length

Note 1 to entry: It may also be considered as an opening in a very thin wall.

4.3.4
capillary leak
conductance leak (4.3.2) in which the diameter is small compared to the length

4.3.5
leakage rate
pV-throughput of a specific fluid which passes through a leak under specific conditions

4.3.6
leaktight object
object with a leakage rate lower than that stated in a specification

4.3.7
molecular leak
leak of such geometric configuration and under such pressure conditions that gas flowing through it obeys the laws of molecular flow

4.3.8
standard leakage rate
leakage rate of a leak with stated standard temperature and pressure at one end and, at the other end, a pressure low enough to have a negligible effect on the leakage rate

Note 1 to entry: Different standard pressure- and temperature conditions are used [e.g. standard temperature and pressure (STP), standard ambient temperature and pressure (SATP)].

4.3.9
permeation leak
leak which permits a gas to flow through a non-porous wall

4.3.10
total leakage rate
integral leakage rate
sum of all leakage rates from all leaks of an object, expressed as a pV-throughput

4.3.11
virtual leak
apparent (not real) leak, caused by mechanisms generating a signal equivalent to a leakage rate signal

Note 1 to entry: Such mechanisms can be due to, for example, temperature and volume effects or slow release of sorbed or occluded gases from surfaces or from the bulk of the material.

4.3.12
viscous leak
leak of such geometric configuration and under such pressure conditions that gas flowing through it obeys the laws of viscous flow

5 Terms relating to test techniques

5.1 Test techniques

5.1.1
accumulation test
leakage test where a tracer gas is collected in a known volume over a specified period of time and the *partial pressure* (3.2.2) increase of the tracer gas is measured

Note 1 to entry: The leakage rate can be obtained by calibrating the partial pressure rise with that due to a known leak or comparing the measured *concentration* (3.1.1) with a known concentration.

5.1.2
carrier gas test
flushing test
leakage test in which a viscous gas flow is created along the outer surface of the test object in a chamber to carry escaping tracer gas to the sensor

5.1.3
vacuum tracer gas test
leakage test in which tracer gas is detected in a space where the tracer gas atoms move freely to the sensor

Note 1 to entry: Each tracer gas species moves with its specific thermal velocity.

5.1.4
bombing test
back-pressurising test
leakage test in which sealed objects are subjected to pressurization with tracer gas prior to testing them in a vacuum chamber

5.1.5
bubble test
leakage test used to detect leaks by the immersion of the object in a test fluid or covering its outer surface with a surfactant (foaming) solution

Note 1 to entry: The pressure difference across the walls of the object is high enough that leaks are shown by bubble formation.

5.1.6
hood test
over-all leakage test in which the object is placed in a soft enclosure at *atmospheric pressure* (3.2.1)

Note 1 to entry: If the object is evacuated, the enclosure is filled with tracer gas and the leak detector is connected to the inner volume of the object.

Note 2 to entry: If the object is pressurized with the tracer gas, the test is performed with the sampling probe inserted in the hood.

5.1.7
pressure change test
leakage test in which the rate of the total pressure change (decay or rise) in an object is measured over a period of time

5.1.8
flow measurement test
leakage test in which the flow is measured necessary to maintain a pressure difference across the object boundary

Note 1 to entry: The upstream pressure may be controlled by pressure regulator or an auxiliary volume.

5.1.9
pressure dye test
leakage test in which a liquid containing a dye or fluorescent oil is driven by a pressure differential into the leak in the wall of the object to be tested and is then detected by a visual inspection on the other side

5.1.10
chemical reaction test
leakage test in which the outside of the test object is probed with a reactive substance showing a reaction when in contact with escaping fluid

Note 1 to entry: A typical example for the reaction may involve the colour change of an indicator.

5.1.11
radionuclide leakage test
leakage test which uses a radioactive tracer fluid and a detector for measuring the radiation emitted by the tracer fluid

5.2 Test equipment

5.2.1
tracer gas leak detector
instrument capable of detecting and measuring *pV-throughputs* (4.2.3) of a specific tracer gas with acceptable response time

Note 1 to entry: A gas sensor is too slow and a flow meter is not sensitive enough to be a tracer gas leak detector.

5.2.2
counterflow helium leak detector
mass spectrometer leak detector in which the tracer gas (helium or hydrogen) enters through the backing line into the outlet port of the high vacuum pump and the partial pressure of the tracer gas is measured on the high vacuum side of this pump

5.2.3
direct flow leak detector
mass spectrometer leak detector in which the tracer gas enters the high vacuum side of the pump system where the partial pressure of tracer gas is measured

5.2.4
differential Pirani gauge
leak detector, in which the gas coming from the test object or a sampling probe enters one of two similar Pirani tubes (thermal conductivity gauges) being arms in a Wheatstone bridge

5.2.5
discharge tube leak indicator
glass tube, linked to the vacuum system to be tested, in which the gas present in the system is exposed to a high frequency electrical discharge

Note 1 to entry: Shape and colours of the discharge are related to the nature and pressure of the gas present in the system.

5.2.6
halogen leak detector
leak detector that is sensitive to halogen tracer gas

Note 1 to entry: Examples are alkali-ion diode-, infrared-, flame-ionization- and electron-capture detector.

5.2.7
helium leak detector
leak detector that is sensitive to helium (^{4}He) tracer gas

5.2.8
mass spectrometer leak detector
MSLD
leak detector in which the sensing element is a mass spectrometer, tuned to respond only to the tracer gas

5.2.9
spark coil leak tester
high frequency discharge coil of the Tesla type which indicates pin holes in a glass vacuum system by a spark jumping between the core of the coil and the pin hole

5.2.10
ultrasonic leak tester
sensor that detects ultrasonic sound produced by the flow of a gas or liquid through a *conductance leak* (4.3.2) and which converts this to a usable signal

5.3 Test equipment components

5.3.1
sampling probe
device used to collect tracer gas from an area of the test object and transfer it to the leak detector at the reduced pressure required

5.3.2
spray gun
device for directing a fine jet of tracer gas on an object under vacuum testing

5.3.3
test seal
temporary seal only used for the test, e.g. plugs or gaskets, other than operating seals

5.3.4
tight chamber
<non-destructive testing (NDT)> tight enclosure that can completely contain the object to be tested and that can be pressurized or evacuated to create a pressure differential across the object wall

5.3.5
tracer fluid
fluid (gas, liquid) which can be detected by a specific detector and thus discloses the presence of a leak

5.3.6
vacuum box
container, open at one side, which can be tightly fitted to the wall to be tested and used as a local vacuum chamber for partial tests

Note 1 to entry: For the performance of a bubble test, the container walls are transparent.

6 Terms relating to test procedure

6.1 Preparation/calibration

6.1.1
calibrated leak
leak device which provides a known mass rate of flow for a specific gas under specific conditions, traceable to national metrological standards

6.1.2
reference leak
calibrated leak (6.1.1) intended to be used as a reference for the calibration of other leak devices by comparison

6.1.3
adjustment of leak detector
set of operations carried out on a leak detector so that it provides prescribed indications corresponding to given values of a leakage rate to be measured

6.1.4
operating conditions
specified values (under reference conditions) dependent on the system and on the gases involved, which shall be maintained in the system to perform the test with a given instrument

6.1.5
pump-down time
time required to reduce the pressure in a system from *atmospheric pressure* (3.2.1) to the desired value

6.1.6
response factor
relative sensitivity of a leak detector for a given gas, compared to a reference gas

6.1.7
response time
time from the beginning of application of tracer gas until the signal reaches 90 % of the equilibrium signal, obtained when the tracer gas is continuously applied

Note 1 to entry: Exponential signals can be described by a time constant (see ISO 3530).

6.1.8
test conditions
actual conditions of ambient temperature and pressure under which the leakage test is performed

6.1.9
zero adjustment
adjustment of the zero control so that the output indication of the leak detector is at the zero of the indicating scale or at some other reference point

6.2 Test techniques

6.2.1
backing-line port technique
method of testing in which the leak detector is connected to a port in the backing, line of the system under test

6.2.2
bombing
action of subjecting sealed test objects to a high pressure of test gas (usually helium)

6.2.3
dynamic leakage rate measurement
leakage test where the leakage rate is determined by measuring the equilibrium (steady-state) *partial pressure* (3.2.2) of the tracer gas while the system is being pumped

6.2.4
isolated pressure test
pressure test where the object is isolated from the pumping or pressurizing system so that the pressure changes in the test object if a leak exists

6.2.5
masking
covering of part of a test object to prevent tracer gas entering leaks that may exist in that part

6.2.6
sniffing test
leakage test in which the object under test is pressurized with tracer gas and the escaping tracer gas through leaks is detected by a sampling (sniffer) probe

6.2.7
vacuum test
test used to detect leakage from an evacuated object connected to a mass spectrometer leak detector by placing it in a tight chamber filled or pressurized with tracer gas

6.3 Performance limits

6.3.1
clean up time
time, from the end of application of tracer gas, until the signal falls to 10 % of the equilibrium signal, obtained when the tracer gas was continuously applied

Note 1 to entry: Exponential signals can be described by a time constant (see ISO 3530).

6.3.2
detection limit of leakage test
smallest leakage rate that can be repeatably detected under specified conditions

6.3.3
instrument signal drift
gradual change of an instrument output signal due to changes in the ambient conditions or in the electronics

6.3.4
tracer gas drift
gradual change of the output signal of the leak detector, due to changes in tracer gas partial pressure at the sensor

6.3.5
minimum detectable leakage rate
smallest leakage rate that can be detected unambiguously by a leak detection system under test conditions

6.3.6
minimum detectable signal
output signal, due to the incoming tracer gas which is equal to the sum of the noise and the drift per specified time of the signal

Note 1 to entry: The minimum detectable signal is given in units of the instrument output, e.g. scale divisions, voltage.

6.3.7
background signal
total spurious indication given by the leak detection system at the starting point of the test (without injecting tracer gas)

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