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Edition 5.0 2023-06

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Environmental testing – Part 2-17: Tests – Test Q: Sealing

Essais d'environnement – Partie 2-17: Essais – Essai Q: Etanchéité

IEC 60068-2-17:2023-06(en-fr)

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Environmental testing – Part 2-17: Tests – Test Q: Sealing

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FOREWORD

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IEC 60068-2-17 has been prepared by IEC technical committee 104: Environmental conditions, classification and methods of test. It is an International Standard.

This fifth edition cancels and replaces the fourth edition published in 1994. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) "Survey of sealing tests" has been deleted and the relevant content moved to a new Clause 4 "General";
b) the Scope has been revised;
c) the figures have been updated for clarification purposes;
d) all non-SI units have been removed;
e) the information to be given in the relevant specification has been revised.

The text of this International Standard is based on the following documents:

Draft	Report on voting
104/984/FDIS	104/1000/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 60068 series, published under the general title *Environmental testing*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

ENVIRONMENTAL TESTING –

Part 2-17: Tests – Test Q: Sealing

1 Scope

This part of IEC 60068 deals with seal tests applicable to the external and internal detection in container sealing of gross leaks and fine leaks to determine the effectiveness of seals of specimens. For further tests to verify the ability of enclosures, covers and seals to maintain components and equipment in good working order, IEC 60068-2-18 can be helpful.

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 terminology 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
leak rate
quantity of a dry gas at a given temperature that flows through a leak per unit of time and for a known difference of pressure across the leak

3.2
standard leak rate
leak rate under standard conditions of temperature and pressure difference of 25 °C and 10^5 Pa

3.3
measured leak rate
R
leak rate of a given device as measured under specified conditions and employing a specified test gas

Note 1 to entry: Measured leak rates are often determined with helium employed as the test gas under a pressure difference of 10^5 Pa at 25 °C. For the purpose of comparison with leak rates determined by other methods of testing, the leak rates should be converted to equivalent standard leak rates.

3.4
equivalent standard leak rate
L
standard leak rate of a given device with air as the test gas

Note 1 to entry: The equivalent standard leak rate is expressed in Pa · cm^3/s.

3.5
time constant
θ
<of leak> time required for equalization of the partial pressure difference across a leak if the initial rate of change of that pressure difference were maintained

Note 1 to entry: For the purpose of Test Q, the time constant is equal to the quotient of the internal volume of the specimen and the equivalent standard leak rate.

3.6
gross leak
any leak with an equivalent standard leak rate greater than 1 Pa · cm^3/s

3.7
fine leak
any leak with an equivalent standard leak rate smaller than 1 Pa · cm^3/s

3.8
virtual leak
semblance of a leak caused by slow release of absorbed, adsorbed or occluded gas

3.9
leak meter
<in Test Qm> apparatus consisting of a hand probe for taking a sample of gas mixture and a meter providing a graduated display of the concentration of a predetermined type of gas in the sample

3.10
volume of measurement
V_m
<in Test Qm> volume contained between the gastight sheath collecting the leak and the specimen

3.11
leak detector
<in Test Qm> apparatus consisting of a hand probe for taking a sample of gas mixture and a device sensitive to the presence of a predetermined type of gas and emitting a signal, either acoustic or visual, when the concentration of a predetermined type of gas reaches a pre-set threshold level

3.12
probing
DEPRECATED: sniffing
<in Test Qm> action of slowly moving the probe of a leak detector along a specimen to locate the leaks

4 General

Test Q: Sealing includes several tests which use different conditioning procedures appropriate for different applications.

NOTE Other tests of this category are rain and water tests which are described in IEC 60068-2-18.

The family tree of all sealing tests is shown in Figure 1.

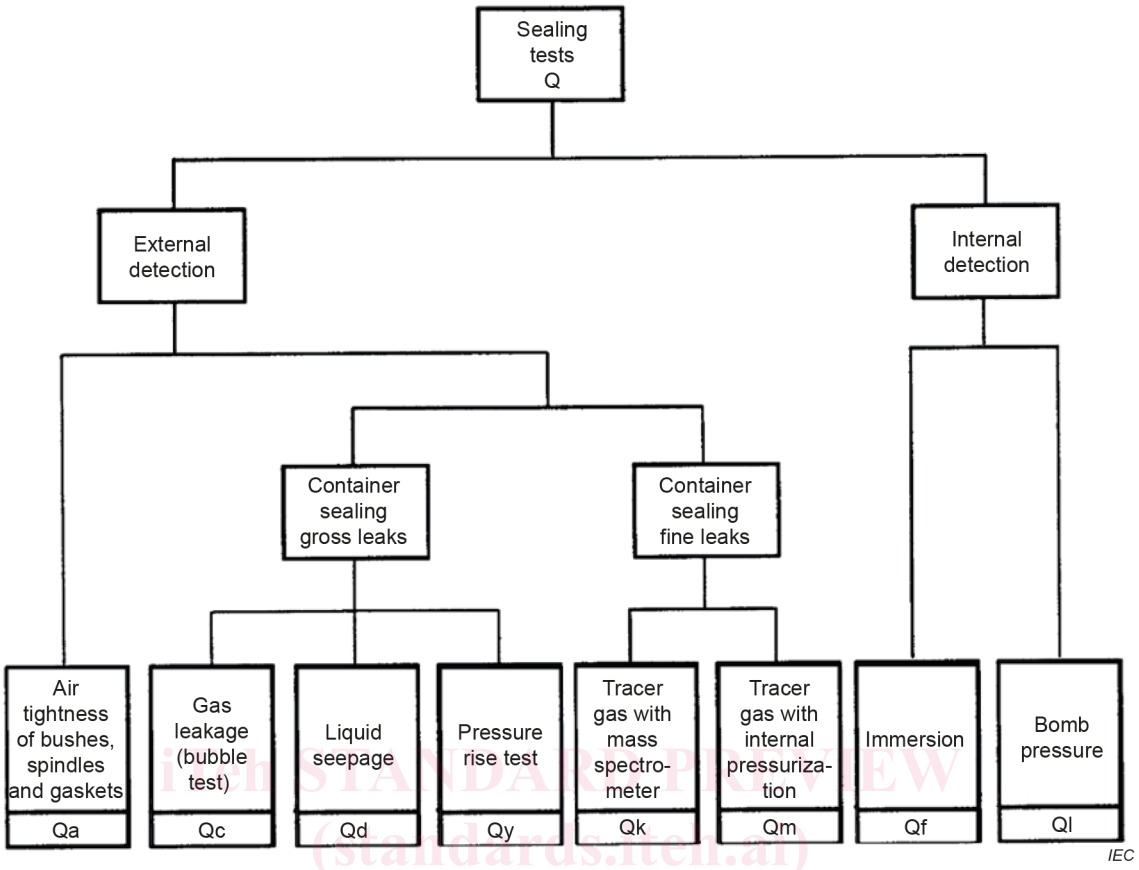

Figure 1 – Family tree of all sealing tests

Test Q can be subdivided in the following two subgroups, distinguished by their detection methods:

– internal detection, which measures changes of electrical characteristics produced by the test medium (liquid or gas) introduced into the specimens through the leak;

– external detection, whereby the escape of the test medium through the leak is observed.

The two tests for internal detection Qf and Ql are very similar. They are very effective for certain components, for example plastic-foil capacitors; they are not recommended, however, for components in which electrical changes become effective only after a long time (for instance, after the test is terminated).

The tests for external detection are further subdivided according to their application. Test Qa is a bubble test which is used to determine the airtightness of bushes, spindles and gaskets. The other tests, Qc, Qd, Qk and Qm, are used to determine leaks in containers (metallic cases, housings, etc.).

Test Qc is a bubble test again including three methods with different sensitivities (leaks not less than 1 Pa · cm^3/s). Test Qd is a liquid seepage test which may be applied to specimens filled during manufacture with a liquid or a product becoming liquid at the test temperature.

Tests Qk and Qm are the most sensitive of this series. Their sensitivity ranges from 1 Pa · cm^3/s to about 10^{-6} Pa · cm^3/s.

5 Test Qa: Sealing of bushes, spindles and gaskets

5.1 Object

To determine the effectiveness of seals of bushes, spindles and similar features. For this test, two types of seals shall be considered:

– Type A: 100 kPa (10 N/cm^2) to 110 kPa (11 N/cm^2) in the direction specified in the relevant specification.

– Type B: 100 kPa (10 N/cm^2) to 110 kPa (11 N/cm^2) in each direction.

5.2 Scope of Test Qa

This test can be used for the detection of gross leaks.

5.3 General description of the test

The specimen is mounted on the lid at a pressurized test chamber which is submerged in a liquid. If the specimen leaks, the air escaping is collected. The amount of air collected per time is a measure of the air leak. A suitable test apparatus is described in Annex A.

5.4 Initial measurements

There are no initial measurements required for Test Qa.

5.5 Conditioning

An air pressure difference, as specified below, shall be applied across each seal or simultaneously across a group of seals forming an assembly, if not specified otherwise.

– Type A: 100 kPa (10 N/cm^2) to 110 kPa (11 N/cm^2) in the direction specified in the relevant specification.

– Type B: 100 kPa (10 N/cm^2) to 110 kPa (11 N/cm^2) in each direction.

Where a higher pressure is required, it shall be 340 kPa (34 N/cm^2) to 360 kPa (36 N/cm^2).

NOTE It is possible that the test apparatus described in Annex A will not be suitable for these higher pressures.

Type B seals shall be tested both in a static condition and while being mechanically operated as required by the relevant specification.

5.6 Final measurements

The rate of leak shall be measured. The limit shall be specified in the relevant specification.

5.7 Information to be given in the relevant specification

When Test Qa is included in the relevant specification, the following details shall be given as far as they are applicable:

	Subclause
a) Requirements for pressure	5.5
b) Direction of application of pressure difference	5.5
c) Mechanical operation during conditioning	5.5
d) Requirements for leak rate	5.6

6 Test Qc: Container sealing, gas leak

6.1 Object

To determine the effectiveness of seals of specimens having an included gas-filled space (e.g. specimens not completely filled with impregnant).

6.2 Scope of Test Qc

This test can be used for the detection of leak rates greater than (100, 10 or 1) Pa · cm^3/s according to the method chosen.

Test Methods 1 and 3 are applicable only to specimens that are able to withstand full decompression and the compression necessary for the impregnation without suffering distortion or permanent physical damage.

Test Method 2 is applicable to all specimens subject to a significant thermally generated pressure differential being achieved at the maximum ambient temperature of operation of the specimen.

Guidance on Test Qc is given in Annex B.

6.3 General description of the test

The detection of gross leaks is achieved by submerging the test specimen in a suitable liquid, under controlled conditions and by observing bubbles emanating from the specimen surface.

A positive internal pressure within the test specimen is generated by one of the following test methods:

a) Test Method 1

   Conducting the test in a vacuum environment, thereby increasing the pressure differential across the seals of the test specimen.

b) Test Method 2

   Through immersion in a test liquid maintained at an elevated temperature.

c) Test Method 3

   Through immersion in a test liquid, following impregnation with another liquid having a boiling point below the test temperature.

6.4 Test Method 1

The test chamber containing the bath required for this test shall be capable of being evacuated, and the bath shall contain sufficient liquid to enable the specimens to be immersed so that the uppermost surface of the specimen enclosure or seal to be tested is at a depth of not less than 10 mm below the surface. The test liquid shall be maintained at a temperature between 15 °C and 35 °C. The bath should be capable of being drained of the liquid or having the specimen removed from the liquid before breaking the vacuum.

Specimens shall be immersed in the test liquid with their seals uppermost. The pressure within the test chamber shall then be reduced within 1 min to a value of 1 kPa or as otherwise specified in the relevant specification. If no failure has been observed this pressure shall be maintained for another minute or any duration specified in the relevant specification.

Specimens possessing seals on more than one surface shall be tested with each surface in the uppermost position.

Failure criteria for this test shall be the observance of a definite stream of bubbles, or more than two large bubbles, or an attached bubble that grows at any time during the test.

6.5 Test Method 2

The bath required for this test shall contain sufficient liquid to enable the test specimens to be completely immersed to a depth of not less than 10 mm above the uppermost part of the enclosure or seal to be tested.

The liquid shall be maintained at a temperature of 1 K to 5 K above the maximum ambient temperature of operation for the specimen under test or at the temperature required in the relevant specification.

The specimens, which shall be at a temperature between 15 °C and 35 °C, shall be immersed in the test liquid with their seals uppermost for a period of at least 10 min, or as specified in the relevant specification.

Specimens possessing seals on more than one surface shall be tested with each surface in the uppermost position.

Failure criteria for this test shall be the observance of a definite stream of bubbles, or more than two large bubbles, or an attached bubble that grows at any time during the test.

6.6 Test Method 3

Test Method 3 consists of two steps.

a) Step 1

Step 1 shall be performed at ambient temperature.

The specimens shall be enclosed in a vacuum/pressure vessel and the pressure reduced to about 100 Pa for 1 h. After that time, and without breaking the vacuum, an impregnation liquid shall be drawn into the vessel until the specimens are covered by it.

The specimens shall then be pressurized under conditions as shown in Table 1.

Table 1 – Test conditions for Test Method 3, Step 1

Internal cavity volume	Minimum pressure (absolute)	Minimum duration
< 0,1 cm^3	600 kPa	1 h
> 0,1 cm^3	300 kPa	2 h

At the end of this impregnation time, the pressure shall be removed. The specimens shall be removed from the liquid and allowed to dry in air at ambient temperature for (3 ± 1) min or another duration specified in the relevant specification before performing Step 2.

b) Step 2

Test Method 2 shall apply, using a test temperature of (125 ± 5) °C, if not specified otherwise. The specimen shall be observed from the instant of immersion until 30 s after immersion, if not specified otherwise.

WARNING – The use of Test Method 3 can bear the risk of explosion, when a large specimen is likely to be filled with the impregnation liquid, that tends to vaporize rapidly during Step 2.

WARNING – The impregnation liquid can form toxic gases when boiled dry. Any direct contact with heating elements shall be prevented.