SLOVENSKI STANDARD
oSIST prEN IEC 60068-2-17:2022

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Okoljsko preskušanje - 2-17. del: Preskusi - Preskus Q: Tesnjenje

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

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

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COMMITTEE DRAFT FOR VOTE (CDV)

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IEC TC 104 : ENVIRONMENTAL CONDITIONS, CLASSIFICATION AND METHODS OF TEST	
SECRETARIAT: Sweden	SECRETARY: Mr Henrik Lagerström
OF INTEREST TO THE FOLLOWING COMMITTEES:	PROPOSED HORIZONTAL STANDARD: ☐ Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary.
FUNCTIONS CONCERNED: ☐ EMC ☐ ENVIRONMENT ☐ QUALITY ASSURANCE ☐ SAFETY	
☒ SUBMITTED FOR CENELEC PARALLEL VOTING	☐ NOT SUBMITTED FOR CENELEC PARALLEL VOTING
Attention IEC-CENELEC parallel voting The attention of IEC National Committees, members of CENELEC, is drawn to the fact that this Committee Draft for Vote (CDV) is submitted for parallel voting. The CENELEC members are invited to vote through the CENELEC online voting system.	

This document is still under study and subject to change. It should not be used for reference purposes.

Recipients of this document are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

TITLE:

Basic environmental testing procedures - Part 2-17: Tests - Test Q: Sealing

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NOTE FROM TC/SC OFFICERS:

CONTENTS

Page

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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ENVIRONMENTAL TESTING –

Part 2-17: Tests – Test Q: Sealing

FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.

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International Standard IEC 60068-2-17 has been prepared by IEC Technical Committee 104: Environmental conditions, classification and methods of test.

The present edition supersedes the fourth edition (1997) and the amendments 1 (1985), 2 (1987), 3 (1989) and 4 (1991).

The text of this standard is based on the third edition (1978) and amendments 1 (1985), 2 (1987), 3 (1989), 4 (1991) and on the following documents:

DIS	Report on voting
50(CO)261	50(CO)264

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

Annexes A to H form an integral part of this standard.

The committee has decided that the contents of this publication will remain unchanged until 2026. At this date, the publication will be

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

SURVEY OF SEALING TESTS

General

This survey indicates the interrelation between the various tests for sealing in Test Q of IEC 60068. Other tests of this category are rain and water tests which are to be included as Tests R. At the same time the opportunity has been taken to make reference to similar tests in IEC 60529.

Tests in IEC 60068-2-17

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

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

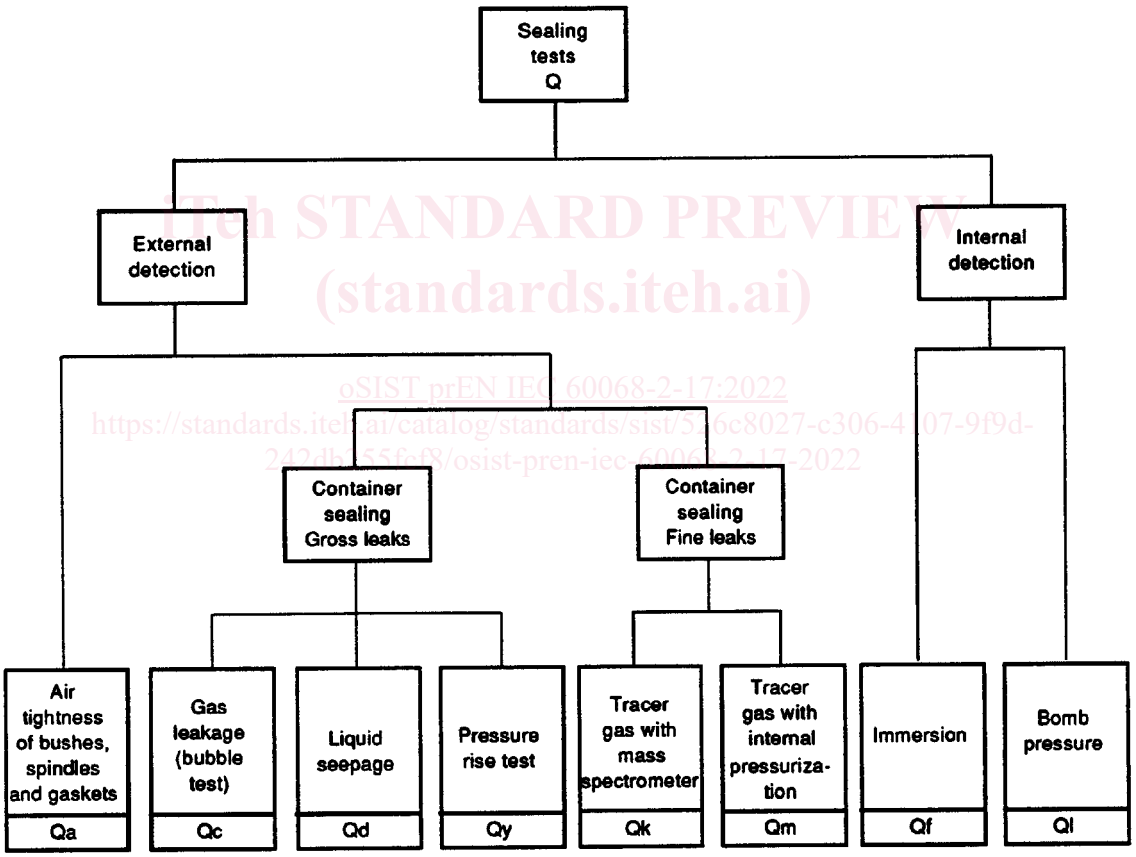

Figure 1 – Family tree of all sealing tests

Test Q may 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.

Test 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.

Tests in IEC 60529

In IEC 60529, degrees of protection are established by tests and identified by numerals as follows:

Table 1 – Degree of protection against access to hazardous parts and against solid foreign objects indicated by the first characteristic numeral

First charac-teristic numeral	Degree of protection	
	Short description	Definition
0	Non-protected	No special protection
1	Protected against solid objects greater than 50 mm	A large surface of the body, such as a hand (but no protection against deliberate access). Solid objects exceeding 50 mm in diameter
2	Protected against solid objects greater than 12 mm	Fingers or similar objects not exceeding 80 mm in length. Solid objects exceeding 12 mm in diameter
3	Protected against solid objects greater than 2,5 mm	Tools, wires, etc., of diameter or thickness greater than 2,5 mm. Solid objects exceeding 2,5 mm in diameter
4	Protected against solid objects greater than 1,0 mm	Wires or strips of thickness greater than 2,5 mm. Solid objects exceeding 1,0 mm in diameter
5	Dust-protected	Ingress of dust is not totally prevented but dust does not enter in sufficient quantity to interfere with satisfactory operation of the equipment
6	Dust-tight	No ingress of dust

177 **Table 2 – Degrees of protection against ingress of water indicated by the second characteristic**
178 **numeral**

Second characteristic numeral	Degree of protection	
	Short description	Definition
0	Non-protected	No special protection
1	Protected against dripping water	Dripping water (vertically falling drops) shall have no harmful effect
2	Protected against dripping water when tilted up to 15°	Vertically dripping water shall have no harmful effect when the enclosure is tilted at any angle up to 15° from its normal position
3	Protected against spraying water	Water falling as a spray at an angle up to 60° from the vertical shall have no harmful effect
4	Protected against splashing water	Water splashed against the enclosure from any direction shall have no harmful effect
5	Protected against water jets	Water projected by a nozzle against the enclosure from any direction shall have no harmful effect
6	Protected against heavy seas	Water from heavy seas or water projected in powerful jets shall not enter the enclosure in harmful quantities
7	Protected against the effects of immersion	Ingress of water in a harmful quantity shall not be possible when the enclosure is immersed in water under defined conditions of pressure and time
8	Protected against submersion	The equipment is suitable for continuous submersion in water under conditions which shall be specified by the manufacturer NOTE Normally, this will mean that the equipment is hermetically sealed. However, with certain types of equipment it can mean that water can enter but only in such a manner that it produces no harmful effects

179

BASIC ENVIRONMENTAL TESTING PROCEDURES –

Part 2: Tests – Test Q: Sealing

1 Scope

This part of IEC 60068 deals with seal tests applicable to external and internal detection in container sealing 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, IEC 60068-2-18 may be helpful.

2 Normative references

The following documents are referred to in text in such a way that some or all their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of referenced document (including any amendment) applies.

IEC 60068-1, *Environmental testing – Part 1: General and guidance*

3 Terms and definitions

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

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

For the purpose of this part of IEC 60068 the following definitions apply.

3.1

Leak rate

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

3.2

Standard leak rate

leak rate under standard conditions of temperature and pressure difference. For this test, the standard conditions are 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 must be converted to equivalent standard leak rates.

3.4

Equivalent standard leak rate
L

standard leak rate of a given device in Pa · cm^3/s, with air as the test gas.

3.5

Time constant, <of leakage>
θ

time required for equalization of 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 this test, 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

Leakage 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, <in Test Qm>
Vm

volume contained between the gaslight sheath collecting the leakage 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, <in Test Qm>
DEPRECATED: sniffing

action of slowly moving the probe of a leak detector along a specimen to locate the leaks.

4 Test Qa: Sealing of bushes, spindles and gaskets

4.1 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.

4.2 Scope

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

4.3 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 leakage. A suitable test apparatus is described in Annex A.

4.4 Initial measurements

There are no initial measurements required for Test Qa.

4.5 Conditioning

Unless otherwise specified, an air pressure difference, as specified below, shall be applied across each seal or simultaneously across a group of seals forming an assembly.

– 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 The test apparatus described in Annex A may 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.

4.6 Final measurements

The rate of leakage shall be measured. The limit shall be prescribed in the relevant specification.

4.7 Information to be given in the relevant specification

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

	Subclause
a) Requirements for pressure	4.5
b) Direction of application of pressure difference	4.5
c) Mechanical operation during conditioning	4.5
d) Requirements for leakage rate	4.6

5 Test Qc: Container sealing, gas leakage

5.1 Object

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

5.2 Scope

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.

A guidance for test Qc is given an Annex B.

5.3 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:

5.3.1 Test Method 1

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

5.3.2 Test Method 2

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

5.3.3 Test Method 3

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

5.4 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 prescribed in the relevant specification. If no failure has been observed this pressure shall be maintained for another minute or any duration prescribed 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.

5.5 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 prescribed 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.

5.6 Test Method 3

Test method 3 consists of two steps:

5.6.1 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 3.

Table 3 – 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 prescribed in the relevant specification before performing step 2.

5.6.2 Step 2

Test Method 2 shall apply, using a test temperature of (125 ± 5) °C, unless otherwise specified. The specimen shall be observed from the instant of immersion until 30 s after immersion unless otherwise specified in the relevant specification.

5.7 Information to be given in the relevant specification

When this test is included in a relevant specification, the following details shall be given, as far as they are applicable:

	Clause or subclause
a) The method	5.3, 5.4, 5.5, 5.6
b) Recommended liquid(s)	B.8, B.11, 5.6.1
c) Test Method 1: pressure and time, if different from 3.4.2	5.4.2
d) Test Method 2: liquid temperature, if different from 3.5.2	5.5.2
e) Test Method 2: immersion duration, if different from 3.5.3	5.5.3
f) Drying time if different from 3 min	5.6.1
g) Test Method 3: Step 2 temperature	5.6.2

6 Test Qd: Container sealing, seepage of filling liquid

6.1 Object

To determine the effectiveness of seals of specimens filled with liquid.

NOTE This test may also be used for specimens having a filling which is solid at room temperature, but which is liquid at the testing temperature.

6.2 Scope

This test can be used for the detection of leak rates corresponding to an air leak rate greater than about 1 Pa · cm^3/s. The sensitivity of the method depends on the kinematic viscosity of the liquid at testing temperature and the technique employed to detect seepage.

6.3 General description of the test

The specimen is examined for seepage of liquid likely to occur when it is brought up to a temperature slightly higher than its maximum ambient temperature of operation.

6.4 Severities

A severity is defined as the period of time at which the specimen is maintained at the testing temperature. The relevant specification shall state the applicable severity chosen from the following list:

10 min	1 h	4 h	24 h	48 h

6.5 Preconditioning

The specimen shall be so cleaned (degreased) that possible seepage of liquid is clearly contrasted with all other materials.

6.6 Initial measurements

There are no initial measurements required for Test Qd.

6.7 Conditioning

The specimens shall be placed in an air circulating oven, in which the air is heated until the temperature of the surface of the specimens is 1 K to 5 K above its maximum ambient temperature of operation. The specimens should occupy an attitude most favourable to reveal leakage.