

Environmental testing —

Part 2: Tests —

Test Q: Sealing

The European Standard EN 60068-2-17:1994 has the status of a British Standard

This Part should be read on conjunction with BS 2011-1.1:1989 General and guidance

UDC 621.3:620.193:620.162.4

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Committees responsible for this British Standard

The United Kingdom participation in the preparation in this British Standard was entrusted to Technical Committee GEL/50, Environmental testing of electrotechnical products, upon which the following bodies were represented:

- Federation of the Electronics Industry
- GAMBICA (BEAMA Ltd.)
- Ministry of Defence
- Society of Environmental Engineers
- Society of Motor Manufacturers and Traders Limited

This British Standard, having been prepared under the direction of the Electrotechnical Sector Board, was published under the authority of the Standards Board and comes into effect on 15 May 1995

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The following BSI references relate to the work on this standard:
Committee reference GEL/50
Draft for comment 92/21483 DC

ISBN 0 580 23580 7

Amendments issued since publication

Amd. No.	Date	Comments

Contents

	Page
Committees responsible	Inside front cover
National foreword	ii
Foreword	2
Text of EN 60068-2-17	5

National foreword

This British Standard has been prepared by Technical Committee GEL/50 and is the English Language version of EN 60068-2-17:1994 *Environmental testing, Part 2: Tests, Test Q. Sealing*, published by the European Committee for Electrotechnical Standardization (CENELEC). It is identical with IEC 68-2-17:1994 published by the International Electrotechnical Commission (IEC).

This British Standard supersedes BS 2011-2.1Q:1981 which is withdrawn.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 38 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

UDC 621.3:620.193:620.162.4

Descriptors: Electricity, components, equipment, mechanical test, definitions, sealing test, procedures, components specifications writing, equipment specifications writing

English version

Environmental testing Part 2: Tests Test Q: Sealing

(IEC 68-2-17:1994)

Essais d'environnement
Partie 2: Essais
Essai Q: Étanchéité
(CEI 68-2-17:1994)

Umweltprüfungen
Teil 2: Prüfungen
Prüfung Q: Dichteheit
(IEC 68-2-17:1994)

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B-1050 Brussels

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Foreword

At the request of CENELEC Reporting Secretariat SR 50, the International Standard IEC 68-2-17:1978 and its amendment 4:1991 (incorporating amendments 1:1985, 2:1987 and 3:1989) was submitted to the CENELEC Unique Acceptance Procedure (UAP) in May 1993 for acceptance as a European Standard.

The text of document 50 (CO)261, as prepared by IEC Technical Committee 50, Environmental testing, was submitted to the IEC-CENELEC parallel vote in May 1993.

The combined text of the International Standard with its four amendments and 50(CO)261 was approved by CENELEC as EN 60068-2-17 on 1994-03-08.

This European Standard replaces HD 323.2.17 S4:1990.

The following dates were fixed:

- latest date of publication of an identical national standard (dop) 1995-04-01
- latest date of withdrawal of conflicting national standards (dow) 1995-04-01

Annexes designated “normative” are part of the body of the standard. In this standard, Annex A to Annex H are all normative.

IEC 529:1989, *Degrees of protection provided by enclosures (IP Code)*, which is quoted in this standard, has been harmonized by CENELEC as EN 60529:1991.

Contents

	Page
Foreword	2
1 Definitions	8
2 Test Qa: Sealing of bushes, spindles and gaskets	9
2.1 Object	9
2.2 Scope	9
2.3 General description of the test	9
2.4 Initial measurements	9
2.5 Conditioning	9
2.6 Final measurements	9
2.7 Information to be given in the relevant specification	9
3 Test Qc: Container sealing, gas leakage	9
3.1 Object	9
3.2 Scope	9
3.3 General description of the test	10
3.4 Test Method 1	10
3.5 Test Method 2	10
3.6 Test Method 3	10
3.7 Information to be given in the relevant specification	11
4 Test Qd: Container sealing, seepage of filling liquid	11
4.1 Object	11
4.2 Scope	11
4.3 General description of the test	11
4.4 Severities	11
4.5 Preconditioning	12
4.6 Initial measurements	12
4.7 Conditioning	12
4.8 Final measurements	12
4.9 Information to be given in the relevant specification	12
5 Test Qf: Immersion	12
5.1 Object	12
5.2 General description of the test	12
5.3 Initial measurements	12
5.4 Preconditioning	12
5.5 Conditioning	12
5.6 Recovery	13
5.7 Final measurements	13
5.8 Information to be given in the relevant specification	13
6 Test Qk: Sealing tracer gas method with mass spectrometer	13

	Page		Page
6.1 Object	13	Annex F (normative) Guidance for Test Ql	35
6.2 Scope	14	Annex G (normative) Guidance for Test Qm	35
6.3 General description of the test	14	Annex H (normative) Guidance for Test Qy	37
6.4 Test method 1 (for specimens not filled with helium during manufacturing)	14	Figure 1	6
6.5 Test Method 2 (for specimens filled with helium during manufacturing or for the requirements of this test)	15	Figure 2 — Typical installation for sealing test using the pressure rise test procedure	23
6.6 Test Method 3 (applicable to specimens to be mounted on bulkheads or panels)	16	Figure 3 — Pressure of volume of measurement versus time during the sealing test using the pressure rise test procedure	24
6.7 Information to be given in the relevant specification	17	Figure 4 — Limiting cases of the pressure of volume of measurement versus test time, provided that the dimensions of the test device, the volume of measurement and the evacuation time are constant	25
7 Test Ql: Bomb pressure test	19	Figure A.1 — (Test Qa) Chamber for sealing test	27
7.1 Object	19	Figure A.2 — (Test Qa) Apparatus for sealing test	28
7.2 Scope	19	Figure D.1 — Nomogram for determination of test parameters	32
7.3 General description of the test	19	Table 1 — Degrees of protection indicated by the first characteristic numeral	7
7.4 Initial measurements	19	Table 2 — Degrees of protection indicated by the second characteristic numeral	7
7.5 Conditioning	19	Table 3	13
7.6 Recovery	19	Table 4 — Severities and test conditions (and corresponding equivalent standard leak rates)	18
7.7 Final measurements	19		
7.8 Information to be given in the relevant specification	20		
8 Test Qm: Tracer gas sealing test with internal pressurization	20		
8.1 Object	20		
8.2 Scope	20		
8.3 General description of the test	20		
8.4 Pre-conditioning	20		
8.5 Conditioning	21		
8.6 Information to be given in the relevant specification	22		
9 Test Qy: Pressure rise sealing test	22		
9.1 Object	22		
9.2 Scope	22		
9.3 General description of the test	22		
9.4 Calibration of the test equipment	23		
9.5 Information to be given in the relevant specification	23		
Annex A (normative) Example of a test chamber for Test Qa	26		
Annex B (normative) Guidance for Test Qc	28		
Annex C (normative) Guidance for Test Qd	30		
Annex D (normative) Interrelation of test parameters for Test Qk	30		
Annex E (normative) Guidance for Test Qk	33		

General

This survey indicates the interrelation between the various tests for sealing in Test Q of IEC 68. 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 529.

Tests in IEC 68-2-17

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

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

Test Q may be subdivided in the following two sub-groups, distinguished by their detection methods, viz:

- 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 air tightness 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 $1 \text{ Pa cm}^3/\text{s}$ ($10^{-5} \text{ bar cm}^3/\text{s}$)].

Test Qk and Qm are the most sensitive of this series. Their sensitivity ranges from $1 \text{ Pa.cm}^3/\text{s}$ ($10^{-5} \text{ bar cm}^3/\text{s}$) to about $10^{-6} \text{ Pa cm}^3/\text{s}$ ($10^{-11} \text{ bar cm}^3/\text{s}$). 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 in IEC 529

In IEC 529, degrees of protection are established by tests and identified by numerals as follows:

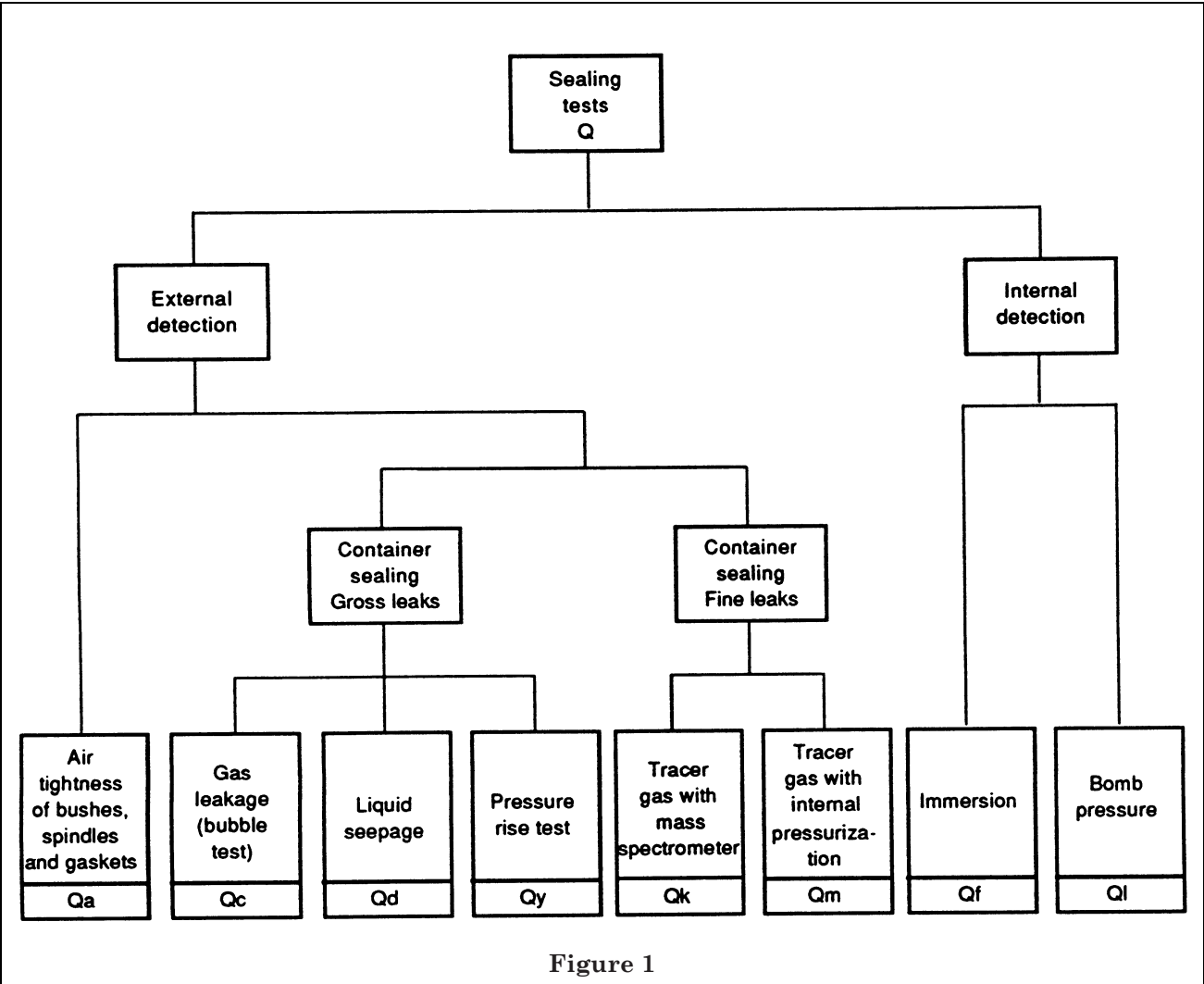


Table 1 — Degrees of protection indicated by the first characteristic numeral

First characteristic 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 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 1,0 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

Table 2 — Degrees of protection indicated by the second characteristic 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

1 Definitions

For the purpose of this standard the following definitions apply:

1.1

leak rate

the 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

NOTE The basic SI unit for leak rate is “pascal cubic metre per second ($\text{Pa} \cdot \text{m}^3/\text{s}$)”. The derived units “ $\text{Pa} \cdot \text{cm}^3/\text{s}$ ” and “ $\text{bar} \cdot \text{cm}^3/\text{s}$ ” are used in this standard as they better conform with the orders of magnitude used in common industrial practice. It is recalled that: $1 \text{ Pa} \cdot \text{m}^3/\text{s} = 10^6 \text{ Pa} \cdot \text{cm}^3/\text{s} = 10 \text{ bar} \cdot \text{cm}^3/\text{s}$.

1.2

standard leak rate

the leak rate under standard conditions of temperature and pressure difference

for the purpose of this test, the standard conditions are 25°C and 10^5 Pa (1 bar)

1.3

measured leak rate (R)

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

NOTE 1 Measured leak rates are often determined with helium employed as the test gas under a pressure difference of 10^5 Pa (1 bar) at 25°C .

NOTE 2 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.

1.4

equivalent standard leak rate (L)

the standard leak rate of a given device, with air as the test gas

1.5

time constant (of leakage) (θ)

the time required for equalization of partial pressure difference across a leak if the initial rate of change of that pressure difference were maintained. 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

1.6

gross leak

any leak the equivalent standard leak rate of which is greater than $1 \text{ Pa} \cdot \text{cm}^3/\text{s}$ ($10^{-5} \text{ bar} \cdot \text{cm}^3/\text{s}$)

1.7

fine leak

any leak the equivalent standard leak rate of which is smaller than $1 \text{ Pa} \cdot \text{cm}^3/\text{s}$ ($10^{-5} \text{ bar} \cdot \text{cm}^3/\text{s}$)

1.8

virtual leak

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

1.9

leakage meter ($\text{Test } Q_m$)

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

1.10

volume of measurement [V_m]/($\text{Test } Q_m$)

volume contained between the gastight sheath collecting the leakage and the specimen

NOTE The tracer gas concentration being small in that volume, the sealing of its sheath does not generally need to be perfect.

1.11

leak detector ($\text{Test } Q_m$)

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 preset threshold level

1.12**probing [sniffing: deprecated term] (Test Q_m)**

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

2 Test Qa: Sealing of bushes, spindles and gaskets**2.1 Object**

To determine the effectiveness of seals of bushes, spindles and similar features.

NOTE For the purpose of this test, two types of seals shall be considered:

- Type A: 100 kPa (10 N/cm²) to 110 kPa (11 N/cm²) in the direction specified in the relevant specification.
- Type B: 100 kPa (10 N/cm²) to 110 kPa (11 N/cm²) in each direction.

2.2 Scope

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

2.3 General description of the test

The specimen is mounted on the lid of 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 unit time is a measure of the air leakage. A suitable test apparatus is described in Annex A.

2.4 Initial measurements

Not required.

2.5 Conditioning

2.5.1 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/cm²) to 110 kPa (11 N/cm²) in the direction specified in the relevant specification.

Type B: 100 kPa (10 N/cm²) to 110 kPa (11 N/cm²) in each direction.

Where a higher pressure is required, it shall be 340 kPa (34 N/cm²) to 360 kPa (36 N/cm²).

NOTE The test apparatus described in Annex A may not be suitable for these higher pressures.

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

2.6 Final measurements

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

2.7 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:

	Sub-clause
a) Requirements for pressure	2.5.1
b) Direction of application of pressure difference	2.5.1
c) Mechanical operation during conditioning	2.5.2
d) Requirements for leakage rate	2.6

3 Test Qc: Container sealing, gas leakage**3.1 Object**

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

3.2 Scope

This test can be used for the detection of leak rates greater than 100, 10 or 1 Pa · cm³/s (10⁻³, 10⁻⁴ or 10⁻⁵ bar · cm³/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 (see **3.3.3**) without suffering distortion or permanent physical damage (see Annex B, clauses **B.1**, **B.2** and **B.3**).

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.

3.3 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 (see Annex B, clause **B.5**).

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

3.3.1 Test Method 1

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

3.3.2 Test Method 2

Through immersion in a test liquid maintained at an elevated temperature (see Annex B, clause **B.10**).

3.3.3 Test Method 3

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

3.4 Test Method 1

3.4.1 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 (see Annex B, clause **B.8**) 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.

3.4.2 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 (10 mbar) or as otherwise prescribed in the relevant specification. If no failure has been observed (**3.4.4**) maintain this pressure for a further minute or another duration prescribed in the relevant specification (see Annex B, clause **B.9**).

3.4.3 Specimens possessing seals on more than one surface shall be tested in accordance with **3.4.2** with each surface in the uppermost position (see Annex B, clause **B.4**).

3.4.4 Failure criteria for this test shall be the observance at any time during the test of a definite stream of bubbles, or more than two large bubbles, or an attached bubble that grows in size (see Annex B, clauses **B.6** and **B.7**).

3.5 Test Method 2

3.5.1 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.

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

3.5.3 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 (see Annex B, clause **B.11**) for a period of at least 10 min, or as prescribed in the relevant specification (see Annex B, clause **B.3**).

3.5.4 Specimens possessing seals on more than one surface shall be tested in accordance with **3.5.3** with each surface in the uppermost position (see Annex B, clause **B.4**).

3.5.5 Failure criteria for this test shall be the observance at any time during the test of a definite stream of bubbles, or more than two large bubbles, or an attached bubble that grows in size (see Annex B, clauses **B.6** and **B.7**).

3.6 Test Method 3

This method consists of two steps:

3.6.1 Step 1

Step 1 shall be performed at ambient temperature.