INTERNATIONAL STANDARD

# ISO 9022-8

Second edition
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# Optics and photonics — Environmental test methods —

## Part 8: High internal pressure, low internal pressure, immersion

*Optique et photonique — Méthodes d'essais d'environnement —*

*Partie 8: Pression interne élevée, pression interne faible, immersion*

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# Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 172, *Optics and photonics*, Subcommittee SC 1, *Fundamental standards*.

This second edition cancels and replaces the first edition (ISO 9022-8:1994), of which it constitutes a minor revision.

ISO 9022 consists of the following parts, under the general title *Optics and photonics — Environmental test methods*:

— *Part 1: Definitions, extent of testing*

— *Part 2: Cold, heat and humidity*

— *Part 3: Mechanical stress*

— *Part 4: Salt mist*

— *Part 6: Dust*

— *Part 7: Resistance to drip or rain*

— *Part 8: High internal pressure, low internal pressure, immersion*

— *Part 9: Solar radiation and weathering*

— *Part 11: Mould growth*

— *Part 12: Contamination*

— *Part 14: Dew, hoarfrost, ice*

— *Part 17: Combined contamination, solar radiation*

— *Part 20: Humid atmosphere containing sulfur dioxide or hydrogen sulfide*

— *Part 22: Combined cold, dry heat or temperature change with bump or random vibration*

— *Part 23: Low pressure combined with cold, ambient temperature and dry and damp heat*

# Introduction

Optical instruments are affected during their use by a number of different environmental parameters which they are required to resist without significant reduction in performance and to remain within defined specifications.

The type and severity of these parameters depend on the conditions of use of the instrument (for example, in the laboratory or workshop) and on its geographical location. The environmental effects on optical instrument performance in the tropics and subtropics are totally different from those found when they are used in arctic regions. Individual parameters cause a variety of different and overlapping effects on instrument performance.

The manufacturer attempts to ensure, and the user naturally expects, that instruments will resist the likely rigours of their environment throughout their life. This expectation can be assessed by exposure of the instrument to a range of simulated environmental parameters under controlled laboratory conditions. The severity of these conditions is often increased to obtain meaningful results in a relatively short period of time.

In order to allow assessment and comparison of the response of optical instruments to appropriate environmental conditions, ISO 9022 contains details of a number of laboratory tests which reliably simulate a variety of different environments. The tests are based largely on IEC standards, modified where necessary to take into account features special to optical instruments.

As a result of continuous progress in all fields, optical instruments are no longer only precision-engineered optical products, but, depending on their range of application, also contain additional assemblies from other fields. For this reason, the principal function of the instrument is to be assessed to determine which International Standard should be used for testing. If the optical function is of primary importance, then ISO 9022 is applicable, but if other functions take precedence, then the appropriate International Standard in the field concerned should be applied. Cases can arise where application of both ISO 9022 and other appropriate International Standards will be necessary.

# Optics and photonics — Environmental test methods —

# Part 8:
# High internal pressure, low internal pressure, immersion

## 1 Scope

This part of ISO 9022 specifies the methods relating to the environmental tests of optical instruments including additional assemblies from other fields (e.g. mechanical, chemical, and electronic devices), under equivalent conditions, for their ability to resist the influence of high pressure, low pressure, or immersion.

The purpose of testing is to investigate to what extent the optical, climatic, mechanical, chemical, and electrical performance characteristics of the specimen are affected by high pressure, low pressure, or immersion.

## 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 9022-1, *Optics and photonics — Environmental test methods — Part 1: Definitions, extent of testing*

## 3 General information and test conditions

The following are the three different test methods used to test the pressure-resistance of optical instruments:

— conditioning method 80: high internal pressure;

— conditioning method 81: low internal pressure;

— conditioning method 82: immersion.

Environmental conditions for conditioning method 80: clean dry air or dry nitrogen, relative humidity less than 30 %. Conditioning method 82 shall be used for instruments that might undergo immersion during service. The immersion test shall be carried out in an open water container or in a water pressure chamber using softened or demineralized water. The immersion depth specified relates to the uppermost point of the specimen. The water temperature shall be between 10 °C and 25 °C. During exposure, the temperature of the specimen shall not be lower than the water temperature nor shall it exceed that temperature by more than 10 K.

## 4 Conditioning

### 4.1 Conditioning method 80: High internal pressure

See Table 1.

### 4.2 Conditioning method 81: Low internal pressure

See Table 2.

### 4.3 Conditioning method 82: Immersion

See Table 3.

**Table 1 — Degrees of severity for conditioning method 80: High internal pressure**

| Degree of severity | | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Difference from ambient pressure | hPa | 100 ± 2 | | | | | | 400 ± 5 | | | | | | |
| Maximum pressure drop | hPa | 75 | 50 | 20 | 10 | 5 | 2 | 300 | 200 | 100 | 50 | 20 | 10 | 5 |
| Exposure time | min | 10 | | | | | | | | | | | | |
| State of operation | | 1 or 2[a] | | | | | | | | | | | | |

[a] See 5.4.

**Table 2 — Degrees of severity for conditioning method 81: Low internal pressure**

| Degree of severity | | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Difference from ambient pressure | hPa | 100 ± 2 | | | | | | 400 ± 5 | | | | | | |
| Maximum pressure drop | hPa | 75 | 50 | 20 | 10 | 5 | 2 | 300 | 200 | 100 | 50 | 20 | 10 | 5 |
| Exposure time | min | 10 | | | | | | | | | | | | |
| State of operation | | 1 or 2[a] | | | | | | | | | | | | |

[a] See 5.4.

**Table 3 — Degree of severity for conditioning method 82: Immersion**

| Degree of severity | | 01 | 02 | 03 | 04 | 05 | 06 |
|---|---|---|---|---|---|---|---|
| Immersion depths | m | 1 | 4 | 10 | 50 | 200 | 400 |
| | Allowable deviation | ±10 % | | | | | |
| Exposure time | h | 2 | | | | | |
| State of operation | | 1 or 2 | | | | | |

## 5 Procedure

### 5.1 General

The test shall be conducted in accordance with the requirements of the relevant specification and with ISO 9022-1.

### 5.2 Conditioning method 82: Preconditioning of specimen and initial test

Prior to exposure, the specimen shall be conditioned at a temperature of 40 °C ± 2 °C and a relative humidity of less than 40 % for a period of 4 h.

### 5.3 Conditioning methods 80 and 81: Pressure change curve

If required by the relevant specification, a graphical representation of the pressure change time history shall be recorded during testing. In the event that a suitable recorder is not available, the pressure change curve shall be plotted from not less than 10 values measured at equal intervals (see Annex A).

### 5.4 State of operation 2

If, in the relevant specification, state of operation 2 is required for conditioning methods 80 and 81, the following points shall be taken into consideration:

a) thermal changes within or on the specimen shall not exceed 1 K as, otherwise, the required measurement accuracy will be degraded;

b) mechanical motions may be initiated from the outside (e.g. manually) thus, replacing state of operation 2;

c) in the event that mechanical motion causes changes of volume with the specimen, the resulting discontinuities in the recording of the event shall be identified.

### 5.5 Conditioning method 82: Recovery and final test

After completion of exposure, the specimen shall be conditioned at a temperature of 40 °C ± 2 °C and a relative humidity of less than 40 % for a period of 4 h and then assessed in accordance with 5.6.

### 5.6 Conditioning method 82: Evaluation

Initial and final tests should not reveal moisture film on optical surfaces. Moisture film will be acceptable provided that it disappears during heating of the specimen and does not reappear within 24 h after completion of the test. The results of specimen evaluation shall be compared in accordance with 5.2 and 5.5. The relevant specification shall specify acceptable differences.

If, on account of the specimen design (e.g. closed casing), a visual inspection cannot reveal penetration of water, the relevant specification shall specify a method of detecting penetrated moisture.

## 6 Environmental test code

The environmental test code shall be as defined in ISO 9022-1, giving a reference to ISO 9022 and the codes for the conditioning method chosen, the degree of severity, and the state of operation.

EXAMPLE The environmental test of optical instruments for pressure-resistance in the event of internal low pressure, conditioning method 81, degree of severity 01, state of operation 1, is identified as:

**Environmental test** ISO 9022-81–01–1

## 7 Specification

The relevant specification shall contain the following details:

a) environmental test code;

b) number of specimens;

c) preconditioning (see 5.2);

d) type and scope of initial test (see 5.2);

e) conditioning methods 80 and 81: if recording of a pressure change curve in accordance with 5.3 is required, criteria for evaluation;

f) state of operation 2: period of operation;

g) state of operation 2: type and scope of intermediate test;

h) recovery (see 5.5);

i) type and scope of final test (see 5.5);

j) criteria for evaluation (see 5.6);

k) type and scope of test report.

# Annex A
(informative)

# Explanatory notes

For the sake of satisfactory functioning, it is essential that changes of temperature do not cause moisture films on internal surfaces since, otherwise, the optical performance would be considerably degraded and other effects such as corrosion or mould growth might be accelerated. This requirement can normally be satisfied by sealing the instrument before use with dry air or nitrogen and by defining the pressure-resistance of the instrument.

Therefore, in order to ensure proper functioning, it is necessary to investigate the pressure-resistance. Depending upon the air volume of the instrument and the number of enclosure interfaces or the functional bushings inserted into the enclosure wall (in other words, depending upon the number and type of enclosure sealings), reasonable pressure-resistance requirements need to be selected and defined choosing a mission-orientated environment and conditioning method.

Instruments used and transported and thus exposed to maximum stress in high-altitude environments therefore have to be pressure-tested at high internal pressure whereas instruments which are exposed to maximum stress in environments of low temperature or high external pressure have to be pressure-tested at low internal pressure (testing at low internal pressure also presents a higher degree of safety from contamination and increased internal humidity).

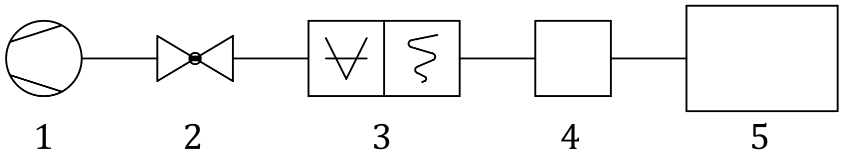
Skin diving or underwater instruments shall be immersion-tested.

Recording the pressure/time history from discrete data measured during testing at high internal pressure (conditioning method 80) or low internal pressure (conditioning method 81) permits an appropriate interpretation of the tightness measured and a reasonable determination of the expected service reliability.

The use of piezoelectric or piezoresistive pressure transducers, together with the associated measuring amplifiers, ensures a high degree of measurement accuracy. Wherever possible, the sensor should be installed within the test adapter in order to avoid air volumes outside the specimen. Moreover, this arrangement facilitates the connection of a recording unit (e.g. an X-T-recorder) thus, enabling immediate charting.

A schematic representation of a pressure test apparatus for test methods 80 and 81 is given in Figure A.1.

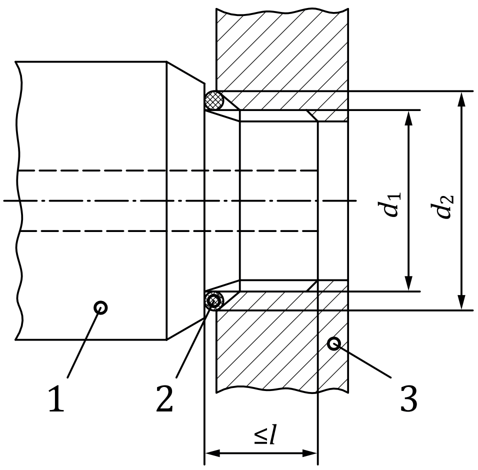
Figure A.2 shows a test connection for the pressure test.




**Key**

1 pump
2 valve
3 vacuum-sensor with read-out and charting
4 test adapter
5 specimen

**Figure A.1 — Schematic representation of pressure test apparatus suitable for test methods 80 and 81**




**Key**

1 test adapter
2 O-ring gasket
3 specimen

NOTE See Table A.1 for thread values.

**Figure A.2 — Test connection for pressure test**

**Table A.1 — Thread values of test connection for pressure test**

Dimensions in millimetres

| **Thread** $d_1$ | M3 | M6 | M10 | M16 × 1,5[a] | M24 × 1,5[a] | M36 × 1,5[a] |
|---|---|---|---|---|---|---|
| $d_2$ | 6 | 9 | 14 | 21 | 29 | 42 |
| $l$ | 5 | 8 | 12 | 15 | | |

[a] Desiccator cartridge connection.

ICS 37.020
Price based on 6 pages



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