

INTERNATIONAL
STANDARD

ISO
9022-12

First edition
1994-07-15

**Optics and optical instruments —
Environmental test methods —**

**Part 12:
Contamination**

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*Optique et instruments d'optique — Méthodes d'essais
d'environnement —*
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Partie 12: Contamination



Reference number
ISO 9022-12:1994(E)

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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 9022-12 was prepared by Technical Committee ISO/TC 172, *Optics and optical instruments*, Subcommittee SC 1, *Fundamental standards*.

ISO 9022-12:1994

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

- Part 1: *Definitions, extent of testing*
- Part 2: *Cold, heat, humidity*
- Part 3: *Mechanical stress*
- Part 4: *Salt mist*
- Part 5: *Combined cold, low air pressure*
- Part 6: *Dust*
- Part 7: *Drip, rain*
- Part 8: *High pressure, low pressure, immersion*
- Part 9: *Solar radiation*
- Part 10: *Combined sinusoidal vibration, dry heat or cold*

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International Organization for Standardization
Case Postale 56 • CH-1211 Genève 20 • Switzerland

Printed in Switzerland

- *Part 11: Mould growth*
- *Part 12: Contamination*
- *Part 13: Combined shock, bump or free fall, dry heat or cold*
- *Part 14: Dew, hoarfrost, ice*
- *Part 15: Combined random vibration wide band: reproducibility medium, in dry heat or cold*
- *Part 16: Combined bounce or steady-state acceleration, in dry heat or cold*
- *Part 17: Combined contamination, solar radiation*
- *Part 18: Combined damp heat and low internal pressure*
- *Part 19: Temperature cycles combined with sinusoidal or random vibration*
- *Part 20: Humid atmosphere containing sulfur dioxide or hydrogen sulfide*

Annex A forms an integral part of this part of ISO 9022.

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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.

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 the 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.

It should be noted that, 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 must 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 may arise where application of both ISO 9022 and other appropriate International Standards will be necessary.

Optics and optical instruments — Environmental test methods —

Part 12: Contamination

1 Scope

This part of ISO 9022 specifies methods for the testing of optical instruments and instruments containing optical components, under equivalent conditions, for their ability to resist contamination, i.e. contact with corrosive chemical substances (hereafter called test agents).¹⁾

However, complete instruments or assemblies are only tested as specified in this part of ISO 9022 in exceptional cases (see 5.3). Normally, representative samples such as material items or surface coatings on representative substrates are used for testing.

The tests described are designed for the selection of materials and components for instruments likely to suffer contamination during service life, rather than for regular production control.

The purpose of testing is to investigate the resistance of an instrument and, in particular, of instrument surfaces, coatings or synthetic materials, to a short exposure to the test agents.

2 Normative reference

The following standard contains provisions which, through reference in this text, constitute provisions of this part of ISO 9022. At the time of publication, the

edition indicated was valid. All standards are subject to revision, and parties to agreements based on this part of ISO 9022 are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 9022-1:1994²⁾, *Optics and optical instruments — Environmental test methods — Part 1: Definitions, extent of testing.*

3 General information and test conditions

The test shall be conducted under ambient atmospheric conditions in accordance with ISO 9022-1.

The test agents listed from each conditioning method (clause 4) represent different chemical groups.

3.1 Specimen

Unless the testing of complete instruments or assemblies is required in the relevant specification, representative samples shall be used for testing. Representative materials of at least 1 mm thickness and having dimensions as shown in figure 1 shall be used as substrates for the testing of non-metallic coatings.

1) Another possible source of service contamination to which optical instruments may be exposed is radioactive elements and isotopes, and hazardous chemical substances (e.g. 2,2-dichlorodiethylsulfide). However, as these materials may only be handled, used for testing, and stored by special, officially approved laboratories, they were not used as test reagents.

2) To be published.

NOTE 1 Sample sheets of $140 \text{ mm} \pm 2 \text{ mm}$ or $280 \text{ mm} \pm 2 \text{ mm}$ in length may also be specified in the relevant specification.

Coatings to be tested shall be of the same structure as the coating intended for the instrument or for parts of the instrument.

Prior to applying the coating, prepare the surface of the specimen in the same manner as required for the original instrument. The coating shall completely surround the specimen so as to cover particularly edges, corners and edges of holes. The coating shall not be degraded by identification marking; numbers, etc. shall be punched prior to applying the coating.

Particular care shall be taken to apply the coating in such a manner that the dry film will meet the thickness required for the instrument with a tolerance of $\pm 5 \mu\text{m}$. The specimens shall be protected from contamination until commencement of the tests.

If specimens as shown in figure 1 are not available, as level a surface as possible of representative in-

strument parts shall be used as test areas for testing synthetic materials. Where such surfaces are not sufficient in size to support the test pad (3.2), the specimen shall be half immersed in the test agent in order to permit testing under the required conditions.

3.2 Test pad

Felt pads having the following characteristics and drenched with test agent shall be used as test media:

colour: white

mass density: $0,25 \text{ g/cm}^3$ to $0,30 \text{ g/cm}^3$

pH: 5 to 8 (for measurement, see annex A)

thickness: 1 mm

diameter: 9 mm

The felt pads shall be used only once.

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Dimensions in millimetres

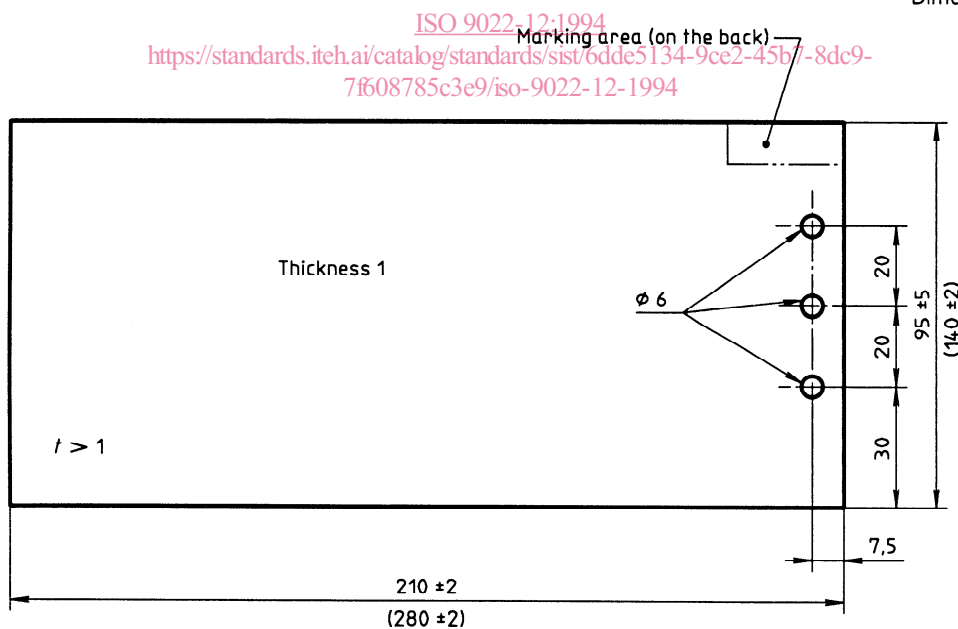


Figure 1 — Sample sheet

Normally, up to 21 test pads can be placed on a specimen with dimensions as shown in figure 1, provided that the pads are arranged in seven lines of three exposure areas each. Care shall however be taken to leave sufficient space between the exposure areas to prevent mutual contamination of the test agents. Each exposure area shall be appropriately identified by means of a pressure-sensitive label showing the test agent used and the degree of severity. Direct lettering in pencil or by similar means is unacceptable.

4 Conditioning

Each of the test agents listed for a conditioning method shall be included in the test performed in accordance with that conditioning method.

The exposure time begins as soon as the drenched test pad is placed upon the specimen.

4.1 Conditioning method 86: Basic cosmetic substances and artificial hand sweat

See table 1.

4.2 Conditioning method 87: Laboratory agents

See table 2.

4.3 Conditioning method 88: Production plant resources

See table 3.

4.4 Conditioning method 89: Fuels and resources for aircraft, naval vessels and land vehicles

See table 4.

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Table 1 — Degrees of severity for conditioning method 86: Basic cosmetic substances and artificial hand sweat

Degree of severity	01	02	03
Test agents	Paraffin oil, high purity Glycerine, high purity Vaseline, white ¹⁾ Lanoline (unguentum molle) ¹⁾ Cold cream (unguentum leniens) ¹⁾ Artificial hand sweat ²⁾		
Exposure time, days	1	7	30
State of operation	1 or 2		
1) Felt pad drenched in melted test agent. 2) Composition (high purity): 4,0 g sodium chloride (NaCl) 1,0 g urea [CO(NH ₂) ₂] 3,5 g ammonium chloride (NH ₄ Cl) 3 ml lactic acid [CH ₃ CH(OH)COOH] 0,5 ml acetic acid (CH ₃ COOH) 0,5 ml pyruvic acid (CH ₃ COCOOH) 1,7 ml butyric acid (C ₃ H ₇ COOH) Add sufficient distilled water to make 1 000 ml of solution.			

Table 2 — Degrees of severity for conditioning method 87: Laboratory agents

Degree of severity	01	02	03	04
Test agents	Sulfuric acid (H ₂ SO ₄), 95 % (m/m) to 97 % (m/m) Nitric acid (HNO ₃), 65 % (m/m) Hydrochloric acid (HCl), 25 % (m/m) Acetic acid (CH ₃ COOH), 96 % (m/m) Trichloroacetic acid (CCl ₃ COOH), 40 % (m/m) Potassium hydroxide (KOH) solution, 50 % (m/m) } high purity			
Mixture ratio of test agent/distilled water (m/m)	1 : 20	1 : 10	1 : 1	1 : 0
Exposure time min	120			10
Test agents	Ethanol (C ₂ H ₅ OH) Acetone (CH ₃ COCH ₃) Acetic acid ethyl ester (CH ₃ COOC ₂ H ₅) Dichloromethane (CH ₂ Cl ₂) Xylene [C ₆ H ₄ (CH ₃) ₂] } high purity			
Exposure time min	5	15	30	60
State of operation	1 or 2			

Table 3 — Degrees of severity for conditioning method 88: Production plant resources

Degree of severity	01	02	03
Test agents ¹⁾	Hydraulic oil (H-LP), kinematic viscosity: 46 mm ² /s at 40 °C Synthetic oil, ester-base (e.g. dioctylsebacate) Synthetic oil, polyglycol-base or polysilicone-base (e.g. dimethylpolysiloxane kinematic viscosity: 100 mm ² /s at 25 °C) Synthetic oil, phosphate-ester base Cooling lubricating emulsion, for machining purposes (cooling lubrication essence ²⁾ in water), mass fraction <i>w</i> (essence) = 0,04 Cooling lubricating solution for grinding purposes (free of mineral oils). Synthetic additives mass fraction <i>w</i> = 0,05 General-purpose detergent Perchlorethylene Trichlorethane Trichlorethylene } high purity Ethanol, mass fraction <i>w</i> (ethanol) = 0,96 (denaturated by means of methylethylketone)		
Exposure time h	2	6	16
State of operation	1 or 2		

1) The relevant specification specifies the commercial type, if not indicated in this table.

2) Composition of essence:

mineral oil, mass fraction $w_1 \leq 0,04$

EP additives, sulfur-, chlorine-, or phosphate-base, mass fraction $w_2 \leq 0,20$

Emulsifying agent in water, mass fraction $w_3 \geq 0,6$