INTERNATIONAL STANDARD

ISO 9022-5

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Optics and optical instruments — Environmental test methods —

Part 5:
Combined cold, low air pressure

Optique et instruments d'optique — Méthodes d'essais d'environnement —

Partie 5: Essais combinés froid-basse pression

Reference number
ISO 9022-5:1994(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 9022-5 was prepared by Technical Committee ISO/TC 172, *Optics and optical instruments*, Subcommittee SC 1, *Fundamental standards.*

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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— *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 of this part of ISO 9022 is for information only.

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 5:
Combined cold, low air pressure

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 the combined influence of cold and low air pressure, including the potential condensation and freezing of water, simultaneously acting on the instrument under test.

This part of ISO 9022 is applicable to optical instruments, and instruments containing optical components, designed for operation and/or transport in high mountainous areas or on board aircraft or missiles.

The purpose of testing is to investigate to what extent the optical, thermal, mechanical, chemical and electrical performance characteristics of the specimen (e.g. of instruments installed in unheated aircraft or missiles providing no pressure balance) are affected by low temperature and low air pressure. Furthermore, the additional effects of water condensing and freezing on the instrument or components externally mounted on aircraft or missiles can be determined.

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 9022-1:1994[1], *Optics and optical instruments — Environmental test methods — Part 1: Definitions, extent of testing.*

3 General information and test conditions

Low air pressure or altitude chambers or cabinets, providing air circulation, are used for the exposure of the specimen. The test chamber may be a combined low air pressure/low temperature chamber, or a low air pressure chamber may be installed in a low air temperature chamber.

The size of the test chamber and the location of the specimens shall be chosen so as to ensure an even conditioning of all specimens.

Lowering of the temperature shall be started prior to the commencement of pressure reduction. The specimen shall have reached the specified test temperature before the test pressure is adjusted.

When applying conditioning method 51, there shall be no condensation or freezing of water on the specimen during air pressure rise. Ways of preventing this are either the use of repurified nitrogen or radiant heating of the specimen.

1) To be published.

Changes in temperature shall be effected sufficiently slowly not to cause any damage to the specimen. Shock-type air pressure changes shall be avoided unless they are likely to be encountered in the natural environment.

The exposure period specified shall start at that point in time at which all parts of the specimen have reached a temperature within 3 K of the test chamber temperature and the specified air pressure is reached. Heat-dissipating specimens shall be cooled down to the test temperature and left to soak until their temperature, at constant test chamber temperature, does not change more than 1 K in 1 h. Then air pressure reduction shall be started. Inherent heating of the specimen during pressure reduction is acceptable. The exposure time shall not commence until the specified test pressure is reached. After exposure, pressure and temperature rise are initiated simultaneously. The temperature of both chamber air and specimen shall be measured. The location of the temperature sensor on the specimen shall be specified in the relevant specification. The location of the temperature sensor for measuring the chamber air temperature shall be noted in the test report.

When the specimen is exposed in accordance with conditioning method 50, condensed or freezing moisture shall form on the specimen during pressure rise, as specified in the relevant specification. There are two methods of generating the formation of condensed or freezing moisture on the specimen. One of the two methods described below shall be specified in the relevant specification.

a) Generation of freezing moisture under low air pressure conditions. Within the temperature range − 20 °C to − 10 °C and in the low air pressure range from 40 kPa, water vapour is injected into the test chamber while heating is in process.

b) Generation of freezing moisture under standard ambient pressure conditions.

During heating, the pressure within the test chamber is adjusted to standard ambient pressure while the temperature is maintained between − 20 °C and − 10 °C. Moisture will condense and freeze on the specimen because of its low temperature. When hoarfrost is present, specimens that do not develop inherent heating shall be prevented from drying out during the final test.

4 Conditioning

4.1 Conditioning method 50: Combined cold, low air pressure including hoarfrost and dew

Degrees of severity 01 to 08 shall be applicable, as specified in table 1.

4.2 Conditioning method 51: Combined cold, low air pressure without hoarfrost and dew

Degrees of severity 01 to 04, 06 and 07 shall be applicable, as specified in table 1.

5 Procedure

5.1 General

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

See annex A for an example of conditioning method 50.

6 Environmental test code

The environmental test code shall be as defined in ISO 9022-1.

EXAMPLE

The environmental test of optical instruments for resistance to combined cold and low air pressure without condensation and freezing of moisture, conditioning method 51, degree of severity 01, state of operation 1, shall be identified as:

Environmental test ISO 9022-51-01-1

7 Specification

The relevant specification shall contain the following details:

a) environmental test code;

b) number of specimens to be tested;

c) conditioning method 50: time of first hoarfrost formation and method of generation;

d) location of the temperature sensors on the specimen;

e) preconditioning;

f) type and scope of initial test;

g) period of operation for state of operation 2;

h) type and scope of intermediate test for state of operation 2;

i) recovery;

j) type and scope of final test;

k) criteria for evaluation;

l) type and scope of test report.

Table 1 — Degrees of severity for conditioning methods 50 and 51: Combined cold, low air pressure

Degree of severity		01	02	03	04	05	06	07	08
Test chamber temperature	°C	− 25 ± 3	− 40 ± 3	− 25 ± 3	− 40 ± 3	− 65 ± 3	− 25 ± 3	− 40 ± 3	− 65 ± 3
Air pressure	kPa	60 ± 3		8,5 ± 1			1 ± 0,5		
	Equivalent altitude[1] m	3 500		16 000			31 000		
Time needed for air pressure reduction or air pressure rise	min	max. 5		max. 20			max. 40		
Mean temperature change rate during heating or cooling respectively	K/min	In the range from 0,2 to 2							
Exposure time	h	4							
State of operation		1 or 2							

1) The data are based on bad weather conditions.

Annex A
(informative)

Explanatory notes

A.1 General

This part of ISO 9022 describes two methods of exposure characterized by different environmental influences. Both methods employ cold and low air pressure as acting factors. Whereas conditioning method 51 requires only low temperature and low air pressure, conditioning method 50 also includes exposure to hoarfrost and condensed moisture.

Conditioning method 51 simulates the operation and transport of optical instruments in high mountainous areas where temperature and humidity change slowly without noticeably affecting the instrument. Similar conditions are encountered in unheated internal compartments of aircraft where there is little or no pressure balance e.g. in cargo space. Hoarfrost and moisture condensation may be excluded in such surroundings. However, optical instruments, or parts of them that are externally mounted on aircraft, are exposed not only to cold and low air pressure but also to air humidity in the form of condensed moisture or hoarfrost.

Condensation or freezing of moisture on instrument surfaces, or even within leaky instruments, occurs when descending aircraft or missiles penetrate regions where, with rising temperature and pressure, humid air or rain are encountered, the temperature of which exceeds the temperature of the instrument surfaces. The melting hoarfrost or the condensed moisture is likely to penetrate into externally mounted instruments or components. As a consequence of leakages or inadequately ventilated parts, condensed moisture may accumulate within the instrument and cause malfunctions.

Exposure conditions as required for conditioning method 51 may be simulated in standard low air pressure cabinets or chambers providing means of cooling and air circulation. If, for conditioning method 50, the formation of hoarfrost in the low air pressure range is additionally required, the test apparatus should include a device for injecting, at low temperature and low air pressure, water vapour and spray into the chamber; the injection inlet should be located near the specimen. One of several methods of performing the test in accordance with conditioning method 50, using chamber as described above, is given in A.2.

A.2 Example of conditioning method 50

At the end of the exposure time and while heating up is in process, adjust the test chamber temperature to between − 20 °C and − 10 °C. Let specimen temperatures stabilize within this temperature range.

Adjust the pressure within the test chamber to between 40 kPa and 60 kPa. Inject, in the immediate neighbourhood of the specimen, water vapour or spray through a well-insulated hose and funnel into the chamber until hoarfrost becomes clearly visible on the specimen. Then, as rapidly as possible, raise the chamber temperature to approximately 2 °C, at constant pressure, and dwell at this temperature until the wet bulb indicates a positive temperature value. This dwell time, which depends upon the type of humidifier used in the test chamber, is required because, normally, the humidity control will not work until the mantle humidifier installed within the test chamber has defrosted. The relative humidity within the test chamber is to be maintained at a level of more than 95 % in order to prevent the condensed moisture from drying while heating up continues.

As soon as the mositure control has started working and the relative humidity has reached a level of more than 95 %, adjust the test chamber temperature, as rapidly as possible, and at constant pressure and constant relative humidity, to ambient atmospheric conditions until the hoarfrost on the specimen has completely changed into condensed moisture.

After ambient atmospheric conditions have been reached, gradually adjust the test chamber air pressure to ambient air pressure. The relative humidity within the test chamber should continue to be maintained at more than 95 %.

Care should be taken that the condensed moisture on specimens other than heat-active components does not dry up during the subsequent intermediate test.

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