INTERNATIONAL STANDARD

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Optics and optical instruments — Environmental test methods —

Part 10:
Combined sinusoidal vibration and dry heat or cold

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

Partie 10: Essai combiné de vibrations sinusoïdales et chaleur sèche ou froid

ISO 9022-10:1998(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 9022-10 was prepared by Technical Committee ISO/TC 172, *Optics and optical instruments*, Subcommittee SC 1, *Fundamental standards.*

This second edition cancels and replaces the first edition (ISO 9022-10:1994), which has been technically revised.

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*

International Organization for Standardization
Case postale 56 • CH-1211 Genève 20 • Switzerland
Internet iso@iso.ch

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— *Part 9: Solar radiation*

— *Part 10: Combined sinusoidal vibration and dry heat or cold*

— *Part 11: Mould growth*

— *Part 12: Contamination*

— *Part 13: Combined shock, bump or free fall and dry heat or cold*

— *Part 14: Dew, hoarfrost, ice*

— *Part 15: Combined digitally controlled broad-band random vibration and dry heat or cold*

— *Part 16: Combined bounce or steady-state acceleration and 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*

— *Part 21: Combined low pressure and ambient temperature or dry 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.

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.

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 10:
Combined sinusoidal vibration and dry heat or cold

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 combined sinusoidal vibration and dry heat or cold.

The purpose of the testing is to investigate to what extent the optical, thermal, chemical and electrical performance characteristics of the specimen are affected by combined sinusoidal vibration and dry heat or cold.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 9022. At the time of publication, the editions indicated were 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 editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

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

ISO 9022-2:1994, *Optics and optical instruments — Environmental test methods — Part 2: Cold, heat, humidity*.

ISO 9022-3:1998, *Optics and optical instruments — Environmental test methods — Part 3: Mechanical stress*.

IEC 60068-2-47:1982, *Environmental testing — Part 2: Tests — Mounting of components, equipment and other articles for dynamic tests including shock (Ea), bump (Eb), vibration (Fc and Fd) and steady-state acceleration (Ga) and guidance*.

IEC 60068-2-50:1983, *Environmental testing — Part 2: Tests — Tests Z/AFc: Combined cold/vibration (sinusoidal) tests for both heat-dissipating and non-heat-dissipating specimens*.

IEC 60068-2-51:1983, *Environmental testing — Part 2: Tests — Tests Z/BFc: Combined dry heat/vibration (sinusoidal) tests for both heat-dissipating and non-heat-dissipating specimens*.

IEC 60068-2-53:1984, *Environmental testing — Part 2: Tests — Guidance to tests Z/AFc and Z/BFc: Combined temperature (cold and dry heat) and vibration (sinusoidal) tests*.

3 General information and test conditions

Exposure of the specimen to combined stress conditions renders the test much more severe than seperate exposure to any one of the environmental conditions alone.

The values of temperature specified in tables 1 and 3 are selected from ISO 9022-2, conditioning methods 10 and 11.

The test shall be conducted in accordance with the requirements of ISO 9022-3.

The fixture for the specimen shall meet the requirements of IEC 60068-2-47 and shall be thermally insulated, if appropriate.

In the event that the specimen is mounted on shock absorbers, time shall be allowed for temperature stabilization of the absorber elements.

4 Conditioning

4.1 General

The required exposure time shall not commence until all parts of the specimen have reached a temperature within 3 K of the test chamber temperature. For heat-dissipating specimens, the period of exposure shall not begin until the temperature of the specimens changes by not more than 1 K within 1 h at the stabilized test chamber temperature.

The last hour of the temperature soaking time shall be considered to be the first hour of the exposure period.

4.2 Conditioning method 61: Combined sinusoidal vibration, dry heat

See tables 1 and 2.

Table 1 — Degrees of severity for conditioning method 61: Combined sinusoidal vibration, dry heat, applying frequency sweep

Degree of severity		01	02	03	04	05	06	07	08	09	10	11	12	13
Test chamber temperature	°C	40 ± 2		55 ± 2						63 ± 2				
Relative humidity	%	< 40												
Displacement	mm	0,035	0,15	0,075	0,15	0,15	0,15	0,35	0,35	0,15	0,15	0,35	0,35	1,0
Acceleration	m/s^2	5	20	10	20	—	20	50	50	20	20	50	50	—
	g_n multiples	0,5	2	1	2	—	2	5	5	2	2	5	5	—
Number of frequency cycles[1)] for each bands	10 Hz to 55 Hz	—	—	—	—	5	—	—	—	2	2	7	—	— — 20
	10 Hz to 150 Hz	—	20	—	—	—	—	5	—	20	—	5	—	—
	10 Hz to 2000 Hz	—	—	2	—	—	10	—	10	—	10	—	10	—
State of operation		0 or 1 or 2												

1) The sweep rate for the specified number of frequency cycles shall be one octave per minute.

Table 2 — Degrees of severity for conditioning method 61: Combined sinusoidal vibration, dry heat, applying characteristic frequencies

Degree of severity	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46
Degree of severity as in table 1	01	01	02	02	03	03	04	04	05	05	06	06	07	07	08	08	09	09	10	10	11	11	12	12	13	13
Exposure time of characteristic frequency min	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30
State of operation	0 or 1 or 2																									

4.3 Conditioning method 62: Combined sinusoidal vibration, cold

See tables 3 and 4.

Table 3 — Degrees of severity for conditioning method 62: Combined sinusoidal vibration, cold, applying frequency sweep

Degree of severity		01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17
Test chamber temperature °C		− 10 ± 3		− 20 ± 3		− 25 ± 3				− 35 ± 3				− 55 ± 3				− 65 ± 3
Relative humidity %		< 40																
Displacement mm		0,035	0,15	0,035	0,15	0,075	0,15	0,15	0,35	0,075	0,15	0,15	0,35	0,15	0,15	0,35	1,0	0,15
Acceleration	m/s	5	20	5	20	10	20	—	50	10	20	20	50	20	20	50	—	20
	g_n multiples	0,5	2	0,5	2	1	2	—	5	1	2	2	5	2	2	5	—	2
Number of frequency cycles[1)] for each axis, for frequency bands	10 Hz to 55 Hz	—	—	—	2	2	7	—	—	5	—	— —	——	—	—	•	20	—
	10 Hz to 150 Hz	—	20	—	20	—	20	—	5	—	—	—	—	20	—	—	—	—
	10 Hz to 500 Hz	2	—	2	—	—	—	—	—	—	10	—	—	—	—	—	—	—
	10 Hz to 2000 Hz	—	—	—	—	2	—	—	—	2	—	10	10	—	10	10	—	10
State of operation		0 or 1 or 2																

1) The sweep rate for the specified number of frequency cycles shall be one octave per minute.

Table 4 — Degrees of severity for conditioning method 62: Combined sinusoidal vibration, cold, applying characteristic frequencies

Degree of severity	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
Degree of severity as in table 3	01	01	02	02	03	03	04	04	05	05	06	06	07	07	08	08	09
Exposure time of characteristic frequency min	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10
State of operation	0 or 1 or 2																

Degree of severity	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
Degree of severity as in table 3	09	10	10	11	11	12	12	13	13	14	14	15	15	16	16	17	17
Exposure time of characteristic frequency min	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30	10	30
State of operation	0 or 1 or 2																

4.4 Examples

Typical examples of application of conditioning methods 61 and 62 are shown in table 5.

Table 5 — Typical examples of application

Conditioning method	Degree of severity	Instruments
61 62	01 01	Astronomical instruments
61 62	03 03	Instruments for general industrial requirements
61 62	04 10	Instruments for general industrial requirements and for use in ground vehicles
61 61 62 62	08 12 12 15	Instruments for use in aircraft and missiles as well as in special vehicles such as hovercraft
61 62	21 to 46 21 to 54	Instruments the characteristic frequencies of which tend to respond during operation

5 Procedure

5.1 General

The test shall be conducted in accordance with the requirements of the relevant specification and with the relevant parts of ISO 9022 and IEC 60068 listed in clause 2.

5.2 Test sequence

The time of exposure to test temperatures depends on the thermal behaviour of the specimen and on the specified time of exposure to vibration.

Specimens may be repositioned, for vibration along another axis, at any temperature between ambient and test temperature, provided that there is no formation of condensation, hoarfrost or ice.

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 resistance to combined sinusoidal vibration, cold, conditioning method 62, degree of severity 03, state of operation 1, is identified as:

Environmental test ISO 9022-62-03-1

7 Specification

The relevant specification shall contain the following details:

a) environmental test code;

b) number of specimens;

c) axes along which mechanical vibration is to be applied;

d) location and number of temperature measuring points;

e) preconditioning;

f) type and scope of initial test;

g) state of operation 2: period of operation;

h) state of operation 2: method and extent of intermediate test;

i) recovery;

j) type and scope of final test;

k) criteria for evaluation;

l) type and scope of test report.