INTERNATIONAL STANDARD

ISO 9022-19

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Optics and optical instruments — Environmental test methods —

Part 19: Temperature cycles combined with sinusoidal or random vibration

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

Partie 19: Essai combiné cycles de températures-vibrations sinusoïdales ou aléatoires

Reference number
ISO 9022-19:1994(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 9022-19 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 19:
Temperature cycles combined with sinusoidal or random vibration

1 Scope

This part of ISO 9022 specifies the method of testing of optical instruments and instruments containing optical components under equivalent conditions, to assess their resistance to temperature cycles combined with sinusoidal or random vibration.

The purpose of testing is to investigate on a number of specimens to be arranged to what extent the optical, thermal, mechanical, chemical or electrical performance characteristics of the specimens are affected by the combined effect of temperature cycles and mechanical vibrations using specific variations of the operating condition.

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

IEC 68-2-6:1982, *Environmental testing — Part 2: Tests — Test Fc and guidance: Vibration (sinusoidal).*

IEC 68-2-36:1973, *Environmental testing — Part 2: Tests — Test Fdb: Random vibration wide band — Reproducibility: medium.*

IEC 68-2-37:1973, *Environmental testing — Part 2: Tests — Test Fde: Random vibration wide band — Reproducibility: low.*

IEC 68-2-47:1982, *Environmental testing — Part 2: Tests — Mounting of components, equipment and other articles for tests including shock (Ea), bump (Eb), vibration (Fe and Fd) and steady-state-acceleration (Ga) and guidance.*

3 General information and test conditions

The size of the test chamber and the arrangement of the specimens shall be selected in such a way that a uniform temperature of all specimens contained therein is guaranteed. If condensation occurs, the specimens shall be protected from falling drops.

The test fixture for the specimens shall conform to the requirements of IEC 68-2-47.

For the purposes of this International Standard, the acceleration of free fall shall be taken as $g = 9{,}81\ \mathrm{m \cdot s^{-2}}$.

1) To be published.

4 Conditioning

If mechanical or other uncontrolled vibration generators are used, the peak value for the acceleration in conditioning method 53 or for the rms acceleration in conditioning method 55 are set by means of a pretest using specimens or dummies. This setting shall be maintained for the duration of the test and for all tests regardless of any acceleration value which may be displayed.

The rms acceleration in conditioning method 54 shall be set in accordance with the specifications of IEC 68-2-36 (reproducibility medium).

If controlled vibration generators are used in conditioning method 55, the specifications of IEC 68-2-37 shall apply (reproducibility low).

The specifications of IEC 68-2-6 shall apply for conditioning method 53 and a controlled vibration generator.

4.1 Conditioning method 53: Combination of temperature cycles with sinusoidal vibration

See table 1.

4.2 Conditioning method 54: Combination of temperature cycles with random vibration: narrow band

See tables 2 to 4.

4.3 Conditioning method 55: Combination of temperature cycles with random vibration: wide band

See tables 5 to 7.

Table 1 — Degrees of severity for conditioning method 53: Combination of temperature cycles with sinusoidal vibration

Degree of severity	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20
Test chamber temperature °C t_2	40 ± 2				55 ± 2				63 ± 2				70 ± 2				85 ± 2			
Test chamber temperature °C t_1	− 10 ± 3				− 25 ± 3				− 35 ± 3				− 40 ± 3				− 65 ± 3			
Mean heating or cooling rate of test chamber	2 K to 10 K per min																			
Number of temperature cycles 1)	⩾ 3																			
Acceleration g multiples ± 10 %	0,5	1	2	5	0,5	1	2	5	0,5	1	2	5	0,5	1	2	5	0,5	1	2	5
Frequency 2)	Between 20 Hz and 100 Hz																			
Duration of vibration conditioning per cycle	30 min per hot or cold phase																			
State of operation	2																			

1) The number of temperature cycles (⩾ 3) shall be specified in the relevant specification.

2) A constant frequency shall be selected below the first resonance frequency of the specimen and stipulated in the relevant specification.

Table 2 — Degrees of severity for conditioning method 54: Combination of temperature cycles with random vibration, narrow band, mean frequency range: 30 Hz **to** 150 Hz

Degree of severity	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
Test chamber temperature °C t_2	40 ± 2			55 ± 2			63 ± 2			70 ± 2			85 ± 2		
Test chamber temperature °C t_1	− 10 ± 3			− 25 ± 3			− 35 ± 3			− 40 ± 3			− 65 ± 3		
Mean heating or cooling rate of test chamber	2 K to 10 K per min														
Number of temperature cycles 1)	⩾ 3														
Rms acceleration *g* multiples	0,5	1	2	0,5	1	2	0,5	1	2	0,5	1	2	0,5	1	2
Mean frequency range	30 Hz to 150 Hz														
Band width	31,6 Hz														
Frequency change rate	1 octave per min														
Duration of vibration conditioning per cycle	60 min per hot or cold phase														
State of operation	2														

1) The number of temperature cycles (⩾ 3) shall be specified in the relevant specification.

Table 3 — Degrees of severity for conditioning method 54: Combination of temperature cycles with random vibration, narrow band, mean frequency range: 60 Hz **to** 500 Hz

Degree of severity	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Test chamber temperature °C t_2	40 ± 2			55 ± 2			63 ± 2			70 ± 2			85 ± 2		
Test chamber temperature °C t_1	− 10 ± 3			− 25 ± 3			− 35 ± 3			− 40 ± 3			− 65 ± 3		
Mean heating or cooling rate of test chamber	2 K to 10 K per min														
Number of temperature cycles 1)	⩾ 3														
Rms acceleration *g* multiples	0,5	1	2	0,5	1	2	0,5	1	2	0,5	1	2	0,5	1	2
Mean frequency range	60 Hz to 500 Hz														
Band width	100 Hz														
Frequency change rate	1 octave per min														
Duration of vibration conditioning per cycle	60 min per hot or cold phase														
State of operation	2														

1) The number of temperature cycles (⩾ 3) shall be specified in the relevant specification.

Table 4 — Degrees of severity for conditioning method 54: Combination of temperature cycles with random vibration, narrow band, mean frequency range: 60 Hz to 2 000 Hz

Degree of severity		41	42	43	44	45	46	47	48	49	50	51	52	53	54	55
Test chamber temperature °C	t_2	40 ± 2			55 ± 2			63 ± 2			70 ± 2			85 ± 2		
	t_1	− 10 ± 3			− 25 ± 3			− 35 ± 3			− 40 ± 3			− 65 ± 3		
Mean heating or cooling rate of test chamber		2 K to 10 K per min														
Number of temperature cycles 1)		⩾ 3														
Rms acceleration	*g* multiples	0,5	1	2	0,5	1	2	0,5	1	2	0,5	1	2	0,5	1	2
Mean frequency rate		60 Hz to 2 000 Hz														
Band width		100 Hz														
Frequency change rate		1 octave per min														
Duration of vibration conditioning per cycle		60 min per hot or cold phase														
State of operation		2														

1) The number of temperature cycles (⩾ 3) shall be specified in the relevant specification.

Table 5 — Degrees of severity for conditioning method 55: Combination of temperature cycles with random vibration, wide band, mean frequency range: 20 Hz to 150 Hz

Degree of severity		01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
Test chamber temperature °C	t_2	40 ± 2			55 ± 2			63 ± 2			70 ± 2			85 ± 2		
	t_1	− 10 ± 3			− 25 ± 3			− 35 ± 3			− 40 ± 3			− 65 ± 3		
Mean heating or cooling rate of test chamber		2 K to 10 K per min														
Number of temperature cycles 1)		⩾ 3														
Rms acceleration	*g* multiples 2)	1	2	5	1	2	5	1	2	5	1	2	5	1	2	5
Frequency range		20 Hz to 150 Hz														
Duration of vibration conditioning per cycle		30 min per hot or cold phase														
State of operation		2														

1) The number of temperature cycles (⩾ 3) shall be specified in the relevant specification.

2) The rise or fall of the conditioning outside the test frequency range shall be ⩾ 24 dB/oct.

Table 6 — Degrees of severity for conditioning method 55: Combination of temperature cycles with random vibration, wide band, mean frequency range: 20 Hz to 500 Hz

Degree of severity		21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Test chamber temperature °C	t_2	40 ± 2			55 ± 2			63 ± 2			70 ± 2			85 ± 2		
	t_1	− 10 ± 3			− 25 ± 3			− 35 ± 3			− 40 ± 3			− 65 ± 3		
Mean heating or cooling rate of test chamber		2 K to 10 K per min														
Number of temperature cycles 1)		⩾ 3														
Rms acceleration 2)	*g* multiples	1	2	5	1	2	5	1	2	5	1	2	5	1	2	5
Frequency range		20 Hz to 500 Hz														
Duration of vibration conditioning per cycle		30 min per hot or cold phase														
State of operation		2														

1) The number of temperature cycles (⩾ 3) shall be specified in the relevant specification.

2) The rise or fall of the conditioning outside the test frequency range shall be ⩾ 24 dB/oct.

Table 7 — Degrees of severity for conditioning method 55: Combination of temperature cycles with random vibration, wide band, mean frequency range: 20 Hz **to** 2 000 Hz

Degree of severity		41	42	43	44	45	46	47	48	49	50	51	52	53	54	55
Test chamber temperature °C	t_2	40 ± 2			55 ± 2			63 ± 2			70 ± 2			85 ± 2		
	t_1	− 10 ± 3			− 25 ± 3			− 35 ± 3			− 40 ± 3			− 65 ± 3		
Means heating or cooling rate of test chamber		2 K to 10 K per min														
Number of temperature cycles 1)		⩾ 3														
Rms acceleration 2)	*g* multiples	1	2	5	1	2	5	1	2	5	1	2	5	1	2	5
Frequency range		20 Hz to 2 000 Hz														
Duration of vibration conditioning per cycle		30 min per hot or cold phase														
State of operation		2														

1) The number of temperature cycles (⩾ 3) shall be specified in the relevant specification.

2) The rise or fall of the conditioning outside the test frequency range shall be ⩾ 24 dB/oct.

5 Procedure

5.1 General

The test shall be performed as specified in the relevant specification and as described below in accordance with ISO 9022-1.

5.2 Course of temperature cycle

The first temperature cycle commences at ambient atmospheric conditions. The duration of a cycle is between 7 h and 8 h, regardless of temperature differences within the cycles depending on the required severity. The changeover to the required limit temperatures shall be performed in such a way that the durations for the hot and cold phases are approximately equal (see figure 1). The mean heating and cooling rate of the test chamber shall be stipulated in the relevant specification in the range between 0,5 K and 10 K per minute.

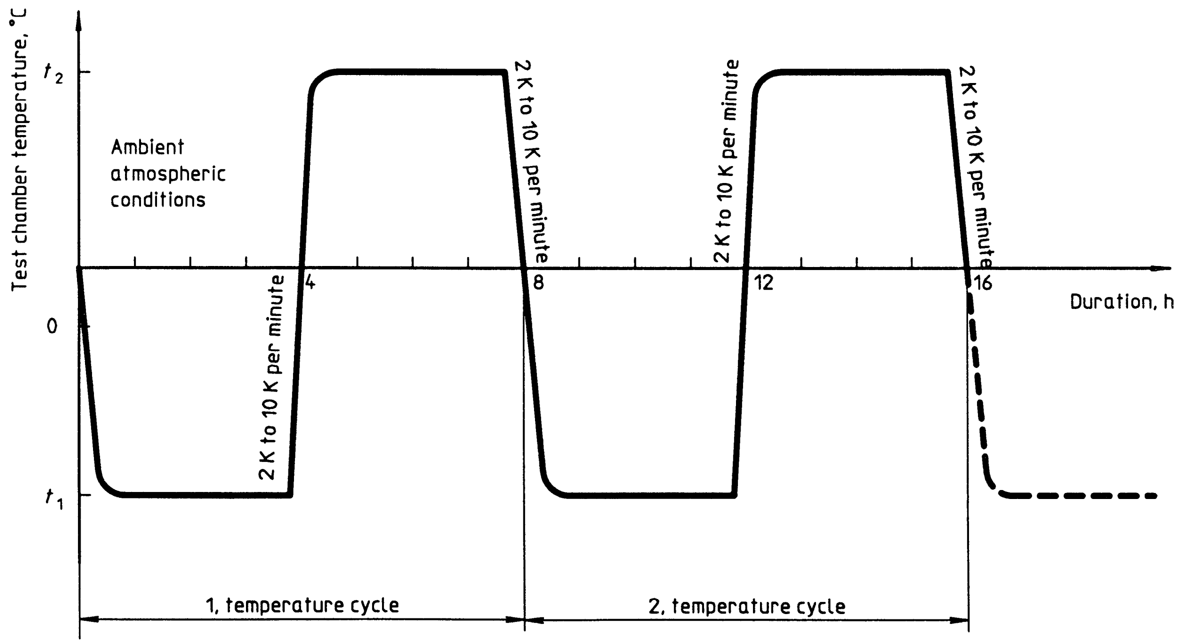

Figure 1 — Schematic representation of course of first two temperature cycles for conditioning methods 53, 54 and 55 with duration of 8 h **per cycle**