INTERNATIONAL STANDARD

ISO 9022-13

Second edition
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Optics and optical instruments — Environmental test methods —

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

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

Partie 13: Essai combiné choc, secousse ou chute libre et chaleur sèche ou froid

ISO 9022-13:1998(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 9022-13 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 9022-13:1994), 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*

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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 13:
Combined shock, bump or free fall 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 shock, bump or free fall, in dry heat or cold.

The purpose of the testing is to investigate to what extent the optical, thermal, mechanical, chemical and electrical performance characteristics of the specimen are affected by combined shock, bump or free fall, in 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*.

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 the tables 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 64: Combined shock, dry heat

See table 1.

When testing optical instruments, a half-sine shock pulse shall be applied. The specimen shall be subjected to three shocks in each direction along each axis.

Table 1 — Degrees of severity for conditioning method 64: Combined shock, dry heat

Degree of severity		01	02	03	04[1)]	05	06	07	08	09[1)]	10	11	12	13	14[1)]	15[1)]
Test chamber temperature	°C	40 ± 2				55 ± 2					63 ± 2					85 ± 2
Relative humidity	%	< 40														
Acceleration amplitude	m/s^2	150	300	500	5 000	150	300	500	500	5 000	150	300	500	500	5 000	5 000
	g_n multiples	15	30	50	500	15	30	50	50	500	15	30	50	50	500	500
Duration of nominal shock	ms	11	6	11	1	11	6	11	3	1	11	6	11	3	1	1
State of operation		0 or 1 or 2														

1) Applicable when testing components and assemblies. Shock of 500 g acceleration and 0,5 ms duration shall be applied when testing complete optical instrument.

4.3 Conditioning method 65: Combined bump, dry heat

See table 2.

Table 2 — Degrees of severity for conditioning method 65: Combined bump, dry heat

Degree of severity		01	02	03	04	05	06	07	08
Test chamber temperature	°C	40 ± 2		55 ± 2			63 ± 2		
Relative humidity	%	< 40							
Acceleration amplitude	m/s^2	100	100	100	100	250	100	100	250
	g_n multiples	10	10	10	10	25	10	10	25
Duration of nominal shock	ms	6	6	6	6	6	6	6	6
Number of shocks in each direction along each axis	± 10	1 000	4 000	1 000	4 000	1 000	1 000	4 000	1 000
State of operation		0 or 1 or 2							

4.4 Conditioning method 66: Combined shock, cold

See table 3.

When testing optical instruments, a half-sine shock pulse shall be applied. The specimen shall be subjected to three shocks in each direction along each axis.

Table 3 — Degrees of severity for conditioning method 66: Combined shock, cold

Degree of severity		01	02	03	04[1)]	05	06	07	08[1)]	09	10	11	12	13[1)]
Test chamber temperature	°C	− 10 ± 3				− 20 ± 3				− 25 ± 3				
Acceleration amplitude	m/s^2	150	300	500	5 000	150	300	500	5 000	150	300	500	500	5 000
	g_n multiples	15	30	50	500	15	30	50	500	15	30	50	50	500
State of operation		0 or 1 or 2			0 or 1	0 or 1 or 2			0 or 1	0 or 1 or 2				0 or 1

Degree of severity		14	15	16	17	18[1)]	19[2)]	20	21[1)]	22[2)]	23[2)]	24	25[1)]
Test chamber temperature	°C	− 35 ± 3					− 55 ± 3			− 65 ± 3			
Acceleration amplitude	m/s^2	150	300	500	500	5 000	150	500	5 000	150	500	500	5 000
	g_n multiples	15	30	50	50	500	15	50	500	15	50	50	500
Duration of nominal shock	ms	11	6	11	3	1	11	3	1	11	11	3	1
State of operation		0 or 1 or 2				0 or 1	0 or 1 or 2		0 or 1	0 or 1 or 2			0 or 1

1) Applicable when testing components and assemblies. Shocks of 500 g acceleration and 0,5 ms duration shall be applied when testing complete instrument.

2) Applicable only for the purpose of simulating arctic environment for ground and air transport.

4.5 Conditioning method 67: Combined bump, cold

See table 4.

Table 4 — Degrees of severity for conditioning method 67: Combined bump, cold

Degree of severity		01	02	03	04	05	06	07
Test chamber temperature	°C	− 10 ± 3		− 20 ± 3		− 25 ± 3		
Acceleration amplitude	m/s^2	100	100	100	100	100	100	250
	g_n multiples	10	10	10	10	10	10	25
Duration of nominal shock	ms	6	6	6	6	6	6	6
Number of shocks in each direction	± 10	1 000	4 000	1 000	4 000	1 000	4 000	1 000
State of operation		0 or 1 or 2						

Degree of severity		08	09	10	11	12	13	14
Test chamber temperature	°C	− 35 ± 3			− 55 ± 3		− 65 ± 3	
Acceleration amplitude	m/s^2	100	100	250	100	250	100	250
	g_n multiples	10	10	25	10	25	10	25
Duration of nominal shock	ms	6	6	6	6	6	6	6
Number of shocks in each direction	± 10	1 000	4 000	1 000	4 000	1 000	4 000	1 000
State of operation		0 or 1 or 2						

4.6 Conditioning method 68: Combined free fall, dry heat

See table 5.

Table 5 — Degrees of severity for conditioning method 68: Combined free fall, dry heat

Degree of severity			01	02	03	04	05	06	07	08	09	10	11	12
1)		°C	40 ± 2				63 ± 2				85 ± 2			
Relative humidity		%	< 40											
Height of fall	mm		100	250	500	1 000	100	250	500	1 000	100	250	500	1 000
	Acceptable deviation	mm	± 5		± 10		± 5		± 10		± 5		± 10	
Mass of specimen including packing2)		kg	⩽ 200	⩽ 100	⩽ 50	⩽ 20	⩽ 200	⩽ 100	⩽ 50	⩽ 20	⩽ 200	⩽ 100	⩽ 50	⩽ 20
State of operation			0 or 1											

1) Temperature of specimen is given to allow the free fall test being performed outside the heat chamber.

2) Recommendation for selection of degrees of severity. Storage containers shall not be considered as packing.

4.7 Conditioning method 69: Combined free fall, cold

See table 6.

Table 6 — Degrees of severity for conditioning method 69: Combined free fall, cold

Degree of severity	01	02	03	04	05	06	07	08	09	10	11	12
Temperature of specimen1) °C	− 25 ± 3				− 35 ± 3				− 40 ± 3			
Height of fall mm	100	250	500	1 000	100	250	500	1 000	100	250	500	1 000
Height of fall Acceptable deviation mm	± 5		± 10		± 5		± 10		± 5		± 10	
Mass of specimen including packing2) kg	⩽ 200	⩽ 100	⩽ 50	⩽ 20	⩽ 200	⩽ 100	⩽ 50	⩽ 20	⩽ 200	⩽ 100	⩽ 50	⩽ 20
State of operation	0 or 1											

1) Temperature of specimen is given to allow the free fall test being performed outside the cold chamber.

2) Recommendation for selection of degrees of severity. Storage containers shall not be considered as packing.

Degree of severity	13	14	15	16	17	18	19	20
Temperature of specimen1) °C	− 55 ± 3				− 65 ± 3			
Height of fall mm	100	250	500	1 000	100	250	500	1 000
Height of fall Acceptable deviation mm	± 5		± 10		± 5		± 10	
Mass of specimen including packing2) kg	⩽ 200	⩽ 100	⩽ 50	⩽ 20	⩽ 200	⩽ 100	⩽ 50	⩽ 20

1) Temperature of specimen is given to allow the free fall test being performed outside the cold chamber.

2) Recommendation for selection of degrees of severity. Storage containers shall not be considered as packing.

5 Procedure

5.1 General

The tests 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 procedure applicable when shock machine cannot be used within cold or heat chamber

Adequate measures shall be taken to prevent the specimen temperature from exceeding specified limits during exposure to shock or bump. Such measures are, for example, conditioning of the fixture beyond the specified test temperature, use of preconditioned insulating domes, or circulating air conditioning beneath the insulating dome.

A pre-test may be specified in the relevant specification, for the purpose of determining the time of temperature change of the heat-insulated specimen outside the test chamber. Thus, the time to mount and shock the specimen can be determined without the test temperature exceeding specified limits.