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Optics and optical instruments — Environmental requirements —

Part 11: Optical instruments for outdoor conditions of use

Optique et instruments d'optique — Conditions d'environnement —

Partie 11: Instruments optiques pour conditions d'utilisation en extérieur

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

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.

Attention is drawn to the possibility that some of the elements of this part of ISO 10109 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 10109-11 was prepared by Technical Committee ISO/TC 172, *Optics and optical instruments*, Subcommittee SC 1, *Fundamental standards*.

ISO 10109 consists of the following parts, under the general title *Optics and optical instruments — Environmental requirements*:

— *Part 1: General information, definitions, climatic zones and their parameters*

— *Part 4: Test requirements for telescopic systems*

— *Part 6: Test requirements for medical optical devices*

— *Part 7: Test requirements for optical measuring instruments*

— *Part 8: Test requirements for extreme conditions of use*

— *Part 11: Optical instruments for outdoor conditions of use*

Optics and optical instruments — Environmental requirements —

Part 11:
Optical instruments for outdoor conditions of use

1 Scope

This part of ISO 10109 specifies requirements to be met with regard to the resistance of the properties or performance data of instruments to environmental influences and hence determines geographical and technical areas of application. It applies to optical instruments and instruments with optical components in the field of outdoor use.

Environmental test methods as specified in ISO 9022 are assigned to the various areas of application for the purpose of ascertaining the suitability of the instruments in their respective area of application.

This part of ISO 10109 is the basis for the specification of environmental requirements and environmental tests in instrument standards. If necessary, these requirements and tests may be amended in the instrument standards.

This part of ISO 10109 does not deal with the requirements to be met by the packaging of the instrument during transport from the manufacturer to the user.

The transportation requirements in this part of ISO 10109 shall apply to the transport of the instrument while it is being used by the customer.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 10109. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 10109 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC 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*

ISO 9022-7:1994, *Optics and optical instruments — Environmental test methods — Part 7: Drip, rain*

ISO 9022-9:1994, *Optics and optical instruments — Environmental test methods — Part 9: Solar radiation*

ISO 9022-14:1994, *Optics and optical instruments — Environmental test methods — Part 14: Dew, hoarfrost, ice*

ISO 10109-1:1994, *Optics and optical instruments — Environmental requirements — Part 1: General information, definitions, climatic zones and their parameters*

3 Terms and definitions

For the purposes of this part of ISO 10109, the terms and definitions given in ISO 9022-1 and ISO 10109-1 apply.

4 Subdivision of the instrument group

The group number of optical instruments for outdoor conditions of use is 11.

Group number 11 is subdivided into instrument types with the type numbers given in Table 1.

Table 1 — Subdivision of group 11

Type number	Instrument type
01	**Sensitive outdoor instruments:** Instruments requiring careful handling, i.e. needing restricted using conditions. In general, the climatic requirements of the standard climate 3 are met. At low temperatures (below –10°C), however, caution is required. Here, the nominal values of the predetermined performance characteristics (functioning) can be reduced. In addition, careful handling of these instruments must ensure that they are protected against the action of rain, snow and ice and longlasting direct exposure to sunlight and against special mechanical stress. Continual use of this instrument type in tropical climates makes it necessary to protect it against the effect of high relative humidity (higher degree of severity).
02	**Standard outdoor instruments:** The climatic requirements of the standard climate 2 are met. The manufacturer may, however, specify restrictions with regard to the effect of rain, snow or ice. In general, the instrument remains fully operable even in the conditions of the climatic class 4, as the use of this instrument type at temperatures below –20 °C is relatively rare. This instrument type withstands normal mechanic stress occurring during handling and transportation. Continual use of this instrument type in tropical climates makes it necessary to protect it against the effect of high relative humidity (higher degree of severity).
03	**Sturdy outdoor instruments:** Unrestricted use of the instrument in the climatic influences specified in the standard climates 2 and 4 is guaranteed if the instrument is equipped by the manufacturer for use at low temperatures; the same applies to rough handling and unfavourable transportation conditions (transport in cold and hot weather conditions). In extreme cold, a reduction in the performance characteristics and reversible malfunctions are to be expected. Continual use of this instrument type in tropical climates makes it necessary to protect it against the effect of high relative humidity (higher degree of severity).

5 Designation of environmental requirements and of environmental tests

The relevant specification and other technical documents shall indicate the environmental requirements required by this part of ISO 10109 using the designation as per ISO 10109-1.

An example of the designation for the environmental requirements for optical instruments for outdoor conditions of use, belonging to group 11, of instrument type 02, and extent of testing “T” is:

Environmental requirements ISO 10109-11-02-T

In relevant specifications and other technical documentation, tests carried out in accordance with the environmental requirements given in this part of ISO 10109 shall be designated by the environmental test code as specified in ISO 9022-1.

6 Specification of suitability indices on the basis of technical requirements

The technical requirements and the conditioning methods for the different types of instruments are defined in Table 2 and Table 4.

Also given in Table 2 and Table 4 are the suitability indices which, on the basis of the technical requirements, describe the suitability of the instruments for use in the different standard climates using the key specified in ISO 10109-1.

The standard climates are defined in ISO 10109-1.

NOTE For the purposes of this part of ISO 10109, the value of g_n is rounded up to the next highest integer, that is 10 m/s^2.

6.1 Type or sample test (extent of testing T)

Table 2 specifies the technical requirements and conditioning methods for the extent of testing T.

Table 3 shows a summary of the tests given in Table 2, as specified in ISO 9022.

6.2 Series test (extent of testing S)

Table 4 specifies the technical requirements and the conditioning methods for the extent of testing S.

Table 5 shows a summary of the tests given in Table 4, as specified in ISO 9022.

7 Procedure

Tests shall be performed in accordance with ISO 9022.

The tests may be performed in any order, if not specified otherwise.

8 Additional tests

In order to verify whether a specific specimen meets all performance requirements or to verify whether the instrument meets the technical requirements and environmental influences characteristic of it, further tests may be selected from Parts 1 to 21 of ISO 9022.

Instruments for continued use under extreme conditions shall be tested in accordance with ISO 10109-8.

The relevant specification shall indicate these tests in addition to the extent of testing T or S in the form of the environmental test code as specified in ISO 9022-1.

Table 2 — Technical requirements and conditioning methods for extent of testing T

Serial No.	ISO 9022 Part	ISO 9022 Conditioning method	Instrument type			Sensitive outdoor instruments			Standard outdoor instruments			Sturdy outdoor instruments		
			Type number			01			02			03		
			State of operation [a]			0	1	2	0	1	2	0	1	2
1	2	10 Cold	Technical requirements	Temperature	°C	–30	–25	–10 or –20 [b]	–40	–30	20 or –25 [b]	–40	–40	–25 or –35 [b]
			Degree of severity [a]			06	05	02 or 04 [b]	08	06	04 or 05 [b]	08	06	05 or 07 [b]
			Suitability index for standard climate		1	E	E	E	E	E	E	E	E	E
					2	B	D	E	A	B	C	A	A	A
					3	A	A	B	A	A	A	A	A	A
					4	E	E	E	E	E	E	E	E	E
					6	A	A	B	A	A	A	A	A	A
2	2	11 Dry heat	Technical requirements	Temperature	°C	70	55	40	70	63	55	70	63	55
			Degree of severity [a]			05	03	02	05	04	03	05	04	03
			Suitability index for standard climate		1	A	A	A	A	A	A	A	A	A
					2	A	A	D	A	A	A	A	A	A
					3	A	A	A	A	A	A	A	A	A
					4	A	A	A	A	A	A	A	A	A
					6	A	A	C	A	A	A	A	A	A
3	2	12 Damp heat	Technical requirements	Temperature	°C	—	40	40	—	40	40	—	55	40
				Rel. humidity	%	—	95	95	—	95	95	—	95	95
			Degree of severity [a]			—	01 [c]	01 [c]	—	02 [c]	01	—	06 [c]	01
			Suitability			The instrument is only suitable for the technical requirement if it is operative without restriction after conditioning.								

Table 2 *(continued)*

Serial No.	ISO 9022 Part	ISO 9022 Conditioning method	Instrument type		Sensitive outdoor instruments			Standard outdoor instruments			Sturdy outdoor instruments		
			Type number		01			02			03		
			State of operation [a]		0	1	2	0	1	2	0	1	2
4	2	15 Temperature shock	Technical requirements	Temperatures °C t_1	—	20	—	—	40	—	—	40	—
				t_2	—	–10	—	—	–25	—	—	–25	—
			Degree of severity [a]		—	01	—	—	02	—	—	02	—
			Suitability		The instrument is only suitable for the technical requirement if it is operative without restriction after conditioning.								
5	2	16 Damp heat cyclic	Technical requirements	Climate/ rel. humidity °C/%	—	40/92	—	—	40/92	—	—	40/92	—
					—	23/83	—	—	23/83	—	—	23/83	—
			Degree of severity [a]		—	01	—	—	01	—	—	01	—
			Suitability		The instrument is only suitable for the technical requirement if it is operative without restriction after conditioning.								
6	9	20 Solar radiation [d]	Technical requirement	Irradiance kW/m²	up to 1,1								
			Degree of severity [a]		—	02	—	—	02	—	—	02	—
			Suitability		The instrument is only suitable for the technical requirement if it is operative without restriction after conditioning.								
7	3	30 Shock	Technical requirements	Acceleration g	—	10	—	—	50	—	—	100	—
				Duration ms	—	6	—	—	3	—	—	6	—
			Degree of severity [a]		—	01 [e]	—	—	05 [e]	—	—	07 [e]	—
			Suitability		The instrument is only suitable for the technical requirement if it is operative without restriction after conditioning.								

Table 2 *(continued)*

Serial No.	ISO 9022 Part	ISO 9022 Conditioning method	Instrument type		Sensitive outdoor instruments			Standard outdoor instruments			Sturdy outdoor instruments		
			Type number		01			02			03		
			State of operation [a]		0	1	2	0	1	2	0	1	2
8	3	31 Bump	Technical requirements	Acceleration g	—	10	—	—	10	—	—	25	—
				Duration ms	—	6	—	—	6	—	—	6	—
			Degree of severity [a]		—	01 [f]	—	—	02 [f]	—	—	05	—
			Suitability		The instrument is only suitable for the technical requirement if it is operative without restriction after conditioning.								
9	3	32 Drop and topple	Technical requirement	Toppling over	—	—	—	—	—	—	—	—	—
			Degree of severity [a]		—	—	—	—	04	—	—	04	—
			Suitability		The instrument is only suitable for the technical requirement if it is operative without restriction after conditioning.								
10	3	33 Free fall	Technical requirement	Height of fall	Depending on the mass of the specimen: Mass > 500 kg: Height 25 mm Mass ⩽ 500 kg: Height 50 mm Mass ⩽ 200 kg: Height 100 mm Mass ⩽ 100 kg: Height 250 mm Mass ⩽ 50 kg: Heigth 500 mm Mass ⩽ 20 kg: Height 1 000 mm								
			Degree of severity [a]		g	—	—	g	—	—	g	g [h]	—
			Suitability		The instrument is only suitable for the technical requirement if it is operative without restriction after conditioning.								

Table 2 *(continued)*

Serial No.	ISO 9022 Part	ISO 9022 Conditioning method	Instrument type		Sensitive outdoor instruments			Standard outdoor instruments			Sturdy outdoor instruments		
			Type number		01			02			03		
			State of operation [a]		0	1	2	0	1	2	0	1	2
11	3	36 Sinusoidal vibration	Technical requirements	Acceleration *g*	0,5	—	—	0,5	—	—	0,5	—	—
				Frequency range Hz	10 to 500	—	—	10 to 500	—	—	10 to 500	—	—
			Degree of severity [a]		01	—	—	01	—	—	01	—	—
			Suitability		The instrument is only suitable for the technical requirement if it is operative without restriction after conditioning.								
12	7	72 Drip	Technical requirement	Drip rate mm/min	—	—	—	—	1,5	—	—	1,5	1,5
			Degree of severity [a]		—	—	—	—	01 [i]	—	—	01 [i]	01 [i]
			Suitability		The instrument is only suitable for the technical requirement if it is operative without restriction during or after conditioning.								
13	7	73 Steady rain	Technical requirement	Rain rate mm/min	—	—	—	—	5	—	—	20	—
			Degree of severity [a]		—	—	—	—	01 [i]	—	—	02 [i]	—
			Suitability		The instrument is only suitable for the technical requirement if it is operative without restriction after conditioning.								

Table 2 *(continued)*

Serial No.	ISO 9022 Part	ISO 9022 Conditioning method	Instrument type		Sensitive outdoor instruments			Standard outdoor instruments			Sturdy outdoor instruments		
			Type number		01			02			03		
			State of operation [a]		0	1	2	0	1	2	0	1	2
14	14	76 Hoarfrost followed by the process of thawing	Technical requirement	Test chamber temperature °C	—	—	—	—	–10 and 30	—	—	–25 and 30	—
			Degree of severity [a]		—	—	—	—	01	—	—	02	—
			Suitability		The instrument is only suitable for the technical requirement if it is operative without restriction after drying of dew or hoarfrost.								

a See ISO 9022.

b The test at this temperature shall only be performed if this temperature is given in the performance data of the instrument.

c For continued use in humid tropical climates, an additional test is necessary, e.g. degree of severity 07.

d Wavelengths in the atmospheric window below 280 nm which are not covered by this part of ISO 10109 will result in long-term damage to polymer optics and polymer surfaces. Even if the test in compliance with this part of ISO 10109 is passed, degradation of the materials must be expected outdoors.

e The degrees of severity also cover the possible stress of the instrument caused by single shocks in transport containers in normal transport conditions.

f Test only offers protection for high-quality roads.

g Degree of severity according to mass of the instrument as specified in ISO 9022-3.

h Test is only performed on instruments which feature protection against damage caused by free fall.

i Test only performed on instruments which are specified accordingly by the manufacturer.

Table 3 — Test summary

Environmental requirement ISO 10109-11-01-T	Environmental requirement ISO 10109-11-02-T	Environmental requirement ISO 10109-11-03-T	Part of ISO 9022
Environmental test ISO 9022			
10-06-0	10-08-0	10-08-0	
10-05-1	10-06-1	10-06-1	
10-02-2 or 10-04-2	10-04-2 or 10-05-2	10-05-2 or 10-07-2	
11-05-0	11-05-0	11-05-0	
11-03-1	11-04-1	11-04-1	
11-02-2	11-03-2	11-03-2	2
12-01-1	12-02-1	12-06-1	
12-01-2	12-01-2	12-01-2	
15-01-1	15-02-1	15-02-1	
16-01-0	16-02-0	16-03-0	
—	16-01-1	16-01-1	
—	—	16-01-2	
30-01-1	30-05-1	30-07-1	
31-01-1	31-02-1	31-05-1	
—	32-04-1	32-04-1	
33-x-0	33-x-0	33-x-0	3
—	—	33-x-1	
36-01-0	36-01-0	36-01-0	
—	72-01-1	72-01-1	
—	—	72-01-2	7
—	73-01-1	73-02-1	
20-02-1	20-02-1	20-02-1	9
—	76-01-1	76-02-1	14

Table 4 — Technical requirements and conditioning methods for extent of testing S

Serial No.	ISO 9022 Part	ISO 9022 Conditioning method	Instrument type		Sensitive outdoor instruments			Standard outdoor instruments			Sturdy outdoor instruments		
			Type number		01			02			03		
			State of operation [a]		0	1	2	0	1	2	0	1	2
1	2	10 Cold	Technical requirement	Temperature °C	—	—	–10 or –20 [b]	—	—	20 or –25 [b]	—	—	–25 or –35 [b]
			Degree of severity [a]		—	—	02 or 04 [b]	—	—	04 or 05 [b]	—	—	05 or 07 [b]
			Suitability index for standard climate	1	—	—	E	—	—	E	—	—	E
				2	—	—	E	—	—	C	—	—	A
				3	—	—	B	—	—	A	—	—	A
				4	—	—	E	—	—	E	—	—	E
				6	—	—	B	—	—	—	—	—	A
2	2	11 Dry heat	Technical requirement	Temperature °C	—	—	40	—	—	55	—	—	55
			Degree of severity [a]		—	—	02	—	—	03	—	—	03
			Suitability index for standard climate	1	—	—	A	—	—	A	—	—	A
				2	—	—	D	—	—	A	—	—	A
				3	—	—	B	—	—	A	—	—	A
				4	—	—	D	—	—	A	—	—	A
				6	—	—	C	—	—	A	—	—	A
3	2	12 Damp heat	Technical requirements	Temperature °C	—	—	—	—	—	40	—	—	40
				Rel. humidity %	—	—	—	—	—	95	—	—	95
			Degree of severity [a]		—	—	—	—	—	01	—	—	01
			Suitability		The instrument is only suitable for the technical requirement if it is operative without restriction during or after conditioning.								
4	3	31 Bump	Technical requirements	Acceleration *g*	10	—	—	10	—	—	25	—	—
				Duration ms	6	—	—	6	—	—	6	—	—
			Degree of severity [a]		01	—	—	02	—	—	05	—	—
			Suitability		The instrument is only suitable for the technical requirement if it is operative without restriction after conditioning.								

[a] See ISO 9022.

[b] The test at this temperature shall only be performed if this temperature is given in the performance data of the instrument.

Table 5 — Test summary

Environmental requirement ISO 10109-11-01-S	Environmental requirement ISO 10109-11-02-S	Environmental requirement ISO 10109-11-03-S	Part of ISO 9022
Environmental test ISO 9022			
10-02-2 or 10-04-2	10-04-2 or 10-05-2	10-05-2 or 10-07-2	
11-02-2	11-03-2	11-03-2	2
—	12-01-2	12-01-2	
31-01-0	31-02-0	31-05-0	3

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