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10109-8

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**Optics and optical instruments —
Environmental requirements —**

Part 8:

Test requirements for extreme conditions of
use

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ISO 10109-8:1994
*Optique et instruments d'optique — Conditions d'environnement —
Partie 8: Spécifications d'essai pour conditions d'utilisation extrêmes*



Reference number
ISO 10109-8:1994(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 10109-8 was prepared by Technical Committee ISO/TC 172, *Optics and optical instruments*, Subcommittee SC 1, *Fundamental standards*.

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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 6: *Test requirements for medical optical devices*
- Part 8: *Test requirements for extreme conditions of use*

Optics and optical instruments — Environmental requirements —

Part 8:

Test requirements for extreme conditions of use

1 Scope

This part of ISO 10109 applies to optical instruments and instruments with optical assemblies in extreme conditions of use. It specifies requirements to be met with regard to the resistance of the optical, mechanical, chemical and electrical properties or performance data of the instruments influences and hence stipulates geographical and technical areas of application. 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.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 10109. 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 10109 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 9022-3:1994, *Optics and optical instruments — Environmental test methods — Part 3: Mechanical stress.*

ISO 9022-4:1994, *Optics and optical instruments — Environmental test methods — Part 4: Salt mist.*

ISO 9022-5:1994, *Optics and optical instruments — Environmental test methods — Part 5: Combined cold, low air pressure.*

ISO 9022-6:1994, *Optics and optical instruments — Environmental test methods — Part 6: Dust.*

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

ISO 9022-8:1994, *Optics and optical instruments — Environmental test methods — Part 8: High pressure, low pressure, immersion.*

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

ISO 9022-10:1994, *Optics and optical instruments — Environmental test methods — Part 10: Combined sinusoidal vibration, dry heat or cold.*

ISO 9022-11:1994, *Optics and optical instruments — Environmental test methods — Part 11: Mould growth.*

ISO 9022-12:1994, *Optics and optical instruments — Environmental test methods — Part 12: Contamination.*

ISO 9022-13:1994, *Optics and optical instruments — Environmental test methods — Part 13: Combined shock, bump or free fall, dry heat or cold.*

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

ISO 9022-16:1994, *Optics and optical instruments — Environmental test methods — Part 16: Combined bounce or steady-state acceleration, in dry heat or cold.*

ISO 9022-17:1994, *Optics and optical instruments — Environmental test methods — Part 17: Combined contamination, solar radiation.*

ISO 9022-18:1994, *Optics and optical instruments — Environmental test methods — Part 18: Combined damp heat and low internal pressure.*

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

3 Definitions

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

4 Subdivision of the instrument group

The group number of optical instruments for extreme conditions of use is 07.

Group number 07 is subdivided into instrument types with the type numbers given in table 1.

Table 1 — Subdivision of group 07

Type number	Instrument type
01	Mainly instruments for ground use, except when used in extreme polar conditions
02	Mainly instruments exposed to maritime climatic conditions
03	Mainly instruments for use in aircraft and instruments in global use

5 Designation of environmental tests

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 the environmental test code as specified in ISO 9022.

6 Specification of suitability indices on the basis of selected environmental tests

For the purposes of this part of ISO 10109, the acceleration of free fall shall be taken as $g = 9,81 \text{ m/s}^2$.

Standard climates are specified in ISO 10109-1.

6.1 Type or sample testing (extent of testing T)

Table 2 specifies suitability indices on the basis of selected environmental tests for 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 suitability indices on the basis of selected environmental tests for extent of testing S.

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

6.3 Special requirements

Further technical requirements to be met by instruments for extreme conditions of use which are not contained in tables 2 and 4 may be selected from table 6, if required, and shall be agreed separately between the customer and manufacturer.

7 Procedure

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

Tests shall be performed as specified in ISO 9022.

Table 2 — Suitability indices for extent of testing T

Serial No.	ISO 9022		Instrument type		Mainly instruments for ground use, except when used in extreme polar conditions			Mainly instruments exposed to maritime climatic conditions			Mainly instruments for use in aircraft and instruments in global use			
	Part	Conditioning method	Type No.		01			02			03			
			State of operation ¹⁾		0	1	2	0	1	2	0	1	2	
1	2	10 Cold	Technical requirements	Temperature °C	-55	-40	-35	-35	-25	-25	-65	-65 ²⁾ -40	-65 ²⁾ -40	
					Degree of severity ¹⁾		09	08	07	07	05	05	10	10 ²⁾ 08
			Suitability index for standard climate		1	B	C	D	C	—	—	A	A	A
					2	A	A	A	A	—	—	A	A	A
					3	A	A	A	A	A	A	A	A	A
4	B	C	D	C	—	—	A	A	A					
2	2	11 Dry heat	Technical requirements	Temperature °C	70	63	63	70	55	55	70	63	63	
					Degree of severity ¹⁾		09	08	07	07	05	05	10	10 ²⁾ 08
			Suitability index for standard climate		1	A	A	A	A	—	—	A	A	A
					2	A	A	A	A	—	—	A	A	A
					3	A	A	A	A	A	A	A	A	A
4	A	A	A	A	—	—	A	A	A					
3	2	14 Slow temperature change	Technical requirements	Temperatures °C	t ₂	—	63	55	—	55	40	—	70	70
					t ₁	—	-35	-25	—	-25	-10	—	-65 ²⁾	-65 ²⁾
			Degree of severity ¹⁾		—	05	02	—	02	01	—	08 ²⁾	08 ²⁾	
			Suitability index for standard climate		1	—	C	D	—	—	—	—	A	A
					2	—	A	A	—	—	—	—	A	A
3	—	A			A	—	A	A	—	A	A			
4	—	C	D	—	—	—	—	A	A					
4	2	15 Rapid temperature change	Technical requirements	Temperatures °C	t ₂	—	40	—	—	40	—	—	55	55
					t ₁	—	-25	—	—	-25	—	—	-40	-40
			Degree of severity ¹⁾		—	02	—	—	02	—	—	03	03	
			Suitability index for standard climate		1	—	A	—	—	—	—	—	A	A
					2	—	A	—	—	—	—	—	A	A
3	—	A			—	—	A	—	—	A	A			
4	—	A	—	—	—	—	—	A	A					

Serial No.	ISO 9022		Instrument type			Mainly instruments for ground use, except when used in extreme polar conditions			Mainly instruments exposed to maritime climatic conditions			Mainly instruments for use in aircraft and instruments in global use			
	Part	Con- ditioning method	Type No.			01			02			03			
			State of operation ¹⁾			0	1	2	0	1	2	0	1	2	
5	2	16 Damp heat cyclic	Technical require- ments	Climate rel. hu- midity	°C	—	40/92	40/92	—	40/92	40/92	—	40/92	40/92	
					%	—	23/83	23/83	—	23/83	23/83	—	23/83	23/83	
			Degree of severity ¹⁾			—	02	01	—	02	01	—	02	01	
			Suitability index for stan- dard climate			1	—	A	A	—	—	—	—	A	A
						2	—	A	A	—	—	—	—	A	A
			3	—	A	A	—	A	A	—	A	A			
			4	—	A	A	—	—	—	—	A	A			
6	3	30 Shock	Technical require- ments	Acceler- ation Duration	g	—	500	30	—	30	15	—	500	50	
					ms	—	1	6	—	18	11	—	1	3	
			Degree of severity ¹⁾			—	08 ³⁾	03	—	04	02	—	08 ³⁾⁴⁾	05	
Suitability			The instrument is only suitable for the technical requirement if it is operative without restriction after conditioning.												
7	3	31 Bump	Technical require- ments	Acceler- ation Duration	g	—	10	10	—	10	10	—	10	10	
					ms	—	6	6	—	6	6	—	6	6	
			Degree of severity ¹⁾			—	01	01	—	01	01	—	01	01	
Suitability			The instrument is only suitable for the technical requirement if it is operative without restriction after conditioning.												
8	3	32 Drop and topple	Technical requirement	Height of over- turn	—	100	—	—	100	—	—	100	—		
					Degree of severity ¹⁾			—	03 ⁵⁾	—	—	03 ⁵⁾	—	—	03 ⁵⁾
			Suitability			The instrument is only suitable for the technical requirement if it is operative without restriction after conditioning.									
9	3	33 Free fall	Technical requirement	Height of fall	Mass-dependent										
					Degree of severity ¹⁾			6)	6)7)	—	6)	6)7)	—	6)	6)7)
			Suitability			The instrument is only suitable for the technical requirement if it is operative without restriction after conditioning.									
10	3	34 Bounce	Technical requirement			Mechanical stresses during transport									
			Degree of severity ¹⁾			03	—	—	03	—	—	03	—	—	
			Suitability			The instrument is only suitable for the technical requirement if it is operative without restriction after conditioning.									

Serial No.	ISO 9022		Instrument type		Mainly instruments for ground use, except when used in extreme polar conditions			Mainly instruments exposed to maritime climatic conditions			Mainly instruments for use in aircraft and instruments in global use			
	Part	Con- ditioning method	Type No.		01			02			03			
			State of operation ¹⁾		0	1	2	0	1	2	0	1	2	
11	3	36 Sinusoidal vibration	Technical require- ments	Displace- ment	mm	—	—	—	—	1	1	—	—	—
				Acceler- ation	g	—	1	1	—	—	—	—	5	2
				Fre- quency range	Hz	—	10 to 2 000	10 to 2 000	—	10 to 55	10 to 55	—	10 to 2 000	10 to 2 000
			Degree of severity ¹⁾		—	02	02	—	10 ⁸⁾	10 ⁸⁾	—	09	09	
			Suitability		The instrument is only suitable for the technical requirement if it is operative without restriction after conditioning.									
12	4	40 Salt mist	Technical requirement		Corrosion resistance ⁹⁾									
			Degree of severity ¹⁾		—	05	—	—	06	—	—	05	—	
			Suitability		The instrument is only suitable for the technical requirement if it is operative without restriction after conditioning.									
13	7	74 Driving rain	Technical require- ments	Wind velocity	m/s	up to 21								
				Rain rate	mm/min	up to 10								
			Degree of severity ¹⁾		—	02	02	—	02	02	—	02	02	
			Suitability index for stan- dard climate	1	—	A	A	—	—	—	—	A	A	
				2	—	A	A	—	—	—	—	A	A	
3	—	A		A	—	A	A	—	A	A				
4	—	A	A	—	—	—	—	A	A					
14	8	80 High internal pressure	Technical requirement	Difference from ambient pressure, hPa	—	—	—	—	—	—	—	400	—	
				Degree of severity ¹⁾		—	—	—	—	—	—	—	10	—
			Suitability		The instrument is only suitable for the technical requirement if it is operative without restriction after conditioning.									
15	8	81 Low internal pressure	Technical requirement	Difference from ambient pressure, hPa	—	—	—	—	—	—	—	400	—	
				Degree of severity ¹⁾		—	—	—	—	—	—	—	10	—
			Suitability		The instrument is only suitable for the technical requirement if it is operative without restriction after conditioning.									

Serial No.	ISO 9022		Instrument type	Mainly instruments for ground use, except when used in extreme polar conditions			Mainly instruments exposed to maritime climatic conditions			Mainly instruments for use in aircraft and instruments in global use					
	Part	Con- ditioning method		Type No.			01			02			03		
			State of operation ¹⁾			0	1	2	0	1	2	0	1	2	
16	11	85 10) Mould growth	Technical requirement		Ability to be operated for > 3 years in humid tropical locations in compliance with stipulated instructions regarding maintenance and care.										
			Degree of severity ¹⁾		—	02	—	—	—	02	—	—	—	02	—
			Suitability index for stan- dard climate	1	—	B	—	—	—	—	—	—	—	B	—
				2	—	B	—	—	—	—	—	—	—	B	—
				3	—	B	—	—	B	—	—	—	—	B	—
4	—	B	—	—	—	—	—	—	—	B	—				
17	12	86 11) Basic cos- metic sub- stances and arti- ficial hand sweat	Technical requirement		Ability to be operated for ≥5 years in compliance with stipulated instructions regarding maintenance and care.										
			Degree of severity ¹⁾		—	02	—	—	—	02	—	—	—	02	—
			Suitability		The instrument is only suitable for the technical requirement if it is operative without restriction after conditioning.										

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- 1) See ISO 9022.
- 2) Only for aerotechnical equipment mounted outside the aircraft and for instruments in global use.
- 3) Applies to the testing of components and assemblies; complete optical instruments are tested with acceleration of 500 g and a shock duration of 0,5 ms.
- 4) Aerotechnical equipment shall be tested with degree of severity 03.
- 5) Degree of severity 04 drop and topple shall be used for specimens at risk of toppling.
- 6) The degree of severity shall be taken from ISO 9022-3 according to the mass of the specimen.
- 7) For specially armoured instruments constructed for free fall.
- 8) For use on ships only, otherwise degree of severity 02.
- 9) To be performed primarily on representative samples.
- 10) Testing of representative samples and components only. The test is not required if tests of identical materials and/or the structure of identical finish coatings have been performed on other instrument types using the same conditioning or if the fungus-resistant properties have been verified.

Long-term storage in high relative humidity (> 75 %) and in packaging which is not humidity-proof can also lead to mould contamination in fungus-resistant materials (caused by minor contamination, e.g. fingerprints, on the surface of the material which serves as a culture-medium for fungus spores).

- 11) Testing of representative samples only. The test is not required if tests of identical materials and/or the structure of identical finish coatings have been performed on other instrument types using the same or more severe conditioning.

Table 3 — Test summary

Environmental requirement ISO 10109-07-01-T	Environmental requirement ISO 10109-07-02-T	Environmental requirement ISO 10109-07-03-T	Part of ISO 9022
Environmental test ISO 9022			
10-09-0 10-08-1 10-07-2 11-05-0 11-04-1 11-04-2 14-05-1 14-02-2 15-02-1 16-02-1 16-01-2	10-07-0 10-05-1 10-05-2 11-05-0 11-03-1 11-03-2 14-02-1 14-01-2 15-02-1 16-02-1 16-01-2	10-10-0 10-10-1 10-10-2 11-05-0 11-04-1 11-04-2 14-08-1 14-08-2 15-03-1 15-03-2 16-02-1 16-01-2	2
30-08-1 30-03-2 31-01-1 31-01-2 32-03-1 33-x-0 33-x-1 34-03-0 36-02-1 36-02-2	30-04-1 30-02-2 31-01-1 31-01-2 32-03-1 33-x-0 33-x-1 34-03-0 36-10-1 36-10-2	30-08-1 30-05-2 31-01-1 31-01-2 32-03-1 33-x-0 33-x-1 34-03-0 36-09-1 36-06-2	3
40-05-1	40-06-1	40-05-1	4
74-02-1 74-02-2	74-02-1 74-02-2	74-02-1 74-02-2	7
—	—	80-10-1 81-10-1	8
85-02-1	85-02-1	85-02-1	11
86-02-1	86-02-1	86-02-1	12

Table 4 — Suitability indices for extent for testing S

Serial No.	ISO 9022		Instrument type		Mainly instruments for ground use, except when used in extreme polar conditions			Mainly instruments exposed to maritime climatic conditions			Mainly instruments for use in aircraft and instruments in global use			
	Part	Conditioning method	Type No.		01			02			03			
			State of operation ¹⁾		0	1	2	0	1	2	0	1	2	
1	2	10 Cold	Technical requirement	Temperature °C	-55	-40	-35	-35	-25	-25	-65	-65 ²⁾ -40	-65 ²⁾ -40	
			Degree of severity ¹⁾		09	08	07	07	05	05	10	10 ²⁾ 08	10 ²⁾ 08	
			Suitability index for standard climate		1	B	C	D	C	—	—	A	A	A
					2	A	A	A	A	—	—	A	A	A
					3	A	A	A	A	A	A	A	A	A
4	B	C			D	C	—	—	A	A	A			
2	2	11 Dry heat	Technical requirement	Temperature °C	70	63	63	70	55	55	70	63	63	
			Degree of severity ¹⁾		05	04	04	05	03	03	05	04	04	
			Suitability index for standard climate		1	A	A	A	A	—	—	A	A	A
					2	A	A	A	A	—	—	A	A	A
					3	A	A	A	A	A	A	A	A	A
4	A	A			A	A	—	—	A	A	A			
3	3	30 Shock	Technical requirements	Acceleration Duration	g ms	500 —	305 1	153 6	30 18	15 11	—	500 1	50 3	
			Degree of severity ¹⁾		—	08 ³⁾	03	—	04	02	08	08 ³⁾⁴⁾	05	
			Suitability		The instrument is only suitable for the technical requirement if it is operative without restriction after conditioning.									
4	3	31 Bump	Technical requirements	Acceleration Duration	g ms	— —	10 6	10 6	— —	10 6	10 6	— —	10 6	10 6
			Degree of severity ¹⁾		—	01	01	—	01	01	—	01	01	
			Suitability		The instrument is only suitable for the technical requirement if it is operative without restriction after conditioning.									
5	3	36 Sinusoidal vibration	Technical requirements	Displacement	mm	—	—	—	—	1	1	—	—	—
				Acceleration	g	—	1	1	—	—	—	—	5	2
				Frequency range	Hz	—	10 to 2 000	10 to 2 000	—	10 to 55	10 to 55	—	10 to 2 000	10 to 2 000
			Degree of severity ¹⁾		—	02	02	—	10 ⁵⁾	10 ⁵⁾	—	09	06	
			Suitability		The instrument is only suitable for the technical requirement if it is operative without restriction after conditioning.									

Serial No.	ISO 9022		Instrument type		Mainly instruments for ground use, except when used in extreme polar conditions			Mainly instruments exposed to maritime climatic conditions			Mainly instruments for use in aircraft and instruments in global use			
	Part	Conditioning method	Type No.		01			02			03			
			State of operation ¹⁾		0	1	2	0	1	2	0	1	2	
6	8	80 High internal pressure	Technical requirement	Difference from ambient pressure, hPa								400		
			Degree of severity ¹⁾		—	—	—	—	—	—	—	—	—	—
			Suitability		The instrument is only suitable for the technical requirement if it is operative without restriction after conditioning.									
7	8	81 Low internal pressure	Technical requirement	Difference from ambient pressure, hPa								400		
			Degree of severity ¹⁾		—	—	—	—	—	—	—	—	—	—
			Suitability		The instrument is only suitable for the technical requirement if it is operative without restriction after conditioning.									

1) See ISO 9022.

2) Only for aerotechnical equipment mounted outside the aircraft and for instruments in global use.

3) Applies to specimens of components and assemblies; complete optical instruments shall be tested with an acceleration of 500 g and a shock duration of 0,5 ms.

4) Aerotechnical equipment shall be tested with degree of severity 03.

5) For use on ships only, otherwise degree of severity 02.

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Table 5 — Test summary

Environmental requirement ISO 10109-07-01-S	Environmental requirement ISO 10109-07-02-S	Environmental requirement ISO 10109-07-03-S	Part of ISO 9022
Environmental test ISO 9022			
10-09-0 10-08-1 10-07-2 11-05-0 11-05-1 11-04-2	10-07-0 10-05-1 10-05-2 11-05-0 11-03-1 11-03-2	10-10-0 10-10-1 10-10-2 11-05-0 11-04-1 11-04-2	2
30-08-1 30-03-2 31-01-1 31-01-2 36-02-1 36-02-2	30-04-1 30-02-2 31-01-1 31-01-2 36-10-1 36-10-2	30-08-1 30-05-2 31-01-1 31-01-2 36-09-1 36-06-2	3
—	—	80-10-1 81-10-1	8