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## Optics and optical instruments — Environmental requirements — Part 4: Test requirements for telescopic systems

*Optique et instruments d'optique — Prescriptions d'environnement —  
Partie 4: Prescriptions d'essai pour les systèmes télescopiques*



Reference number  
ISO 10109-4:2001(E)

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## 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.

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 10109-4 was prepared by Technical Committee ISO/TC 172, *Optics and optical instruments*, Subcommittee SC 4, *Telescopic systems*.

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*

This corrected version of ISO 10109-4:2001 incorporates corrections in Table 4, Serial No.13, Instrument type 05, State of operation I.

# Optics and optical instruments — Environmental requirements —

## Part 4: Test requirements for telescopic systems

### 1 Scope

This part of ISO 10109 specifies requirements to be met with regard to resistance of the optical, mechanical, chemical and electrical 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, including accessories, in the field of telescopic systems.

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.

NOTE Nominal values of properties and performance characteristics as understood by this International Standard are predetermined by specifications provided by the manufacturer, technical terms of delivery and instrument standards.

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

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*

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

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

ISO 14133-1:—<sup>1)</sup>, *Optics and optical instruments — Specifications for binoculars, monoculars and spotting scopes — Part 1: General purpose instruments*

ISO 14133-2:—<sup>1)</sup>, *Optics and optical instruments — Specifications for binoculars, monoculars and spotting scopes — Part 2: High performance instruments*

ISO 14134:—<sup>1)</sup>, *Optics and optical instruments — Specifications for astronomical telescopes*

ISO 14135-1:—<sup>1)</sup>, *Optics and optical instruments — Part 1: General-purpose telescopic sights*

ISO 14135-2:—<sup>1)</sup>, *Optics and optical instruments — Part 2: High-performance telescopic sights*

### 3 Terms and 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 telescopic systems is 03.

Group number 03 is subdivided into instrument types with the type numbers given in Table 1.

**Table 1 — Subdivision of group 03**

Type number	Instrument type
01	<b>Binoculars, monoculars and spotting scopes</b> which are designed for occasional use in moderate environments by users such as tourists and spectators of sporting events, etc.
02	<b>Binoculars, monoculars and spotting scopes</b> which are designed for continuous use in moderately harsh environments by professional users as, for example, emergency personnel, ship's captains and forest rangers, etc.
03	<b>Telescopic sights for airguns</b> which are designed for mounting on airguns and for use in moderate environments, mainly in sports.
04	<b>Telescopic sights for rifles and handguns</b> which are designed for mounting on rifles and handguns and for hunting.
05	<b>Telescopic sights for extreme conditions of use</b> which are designed for mounting on rifles and handguns and for use in severe environmental conditions.
06	<b>Amateur astronomical telescopes</b> which are designed for occasional use in moderate environments.
07	<b>Amateur astronomical telescopes</b> which are designed for continuous use in moderately harsh environments.

1) To be published.

## 5 Designation of environmental requirements and environmental tests

The relevant specification and other technical documents shall indicate the environmental requirements applicable to this part of ISO 10109 using the designation given in ISO 10109-1.

EXAMPLE:

Environmental requirement designation for telescopic systems, Group 03, type number of the instrument type 02 and the extent of testing T:

### **Environmental requirements ISO 10109-03-02-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 technical requirements and appropriate environmental tests

### 6.1 Acceleration of free fall

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

### 6.2 Binoculars, monoculars and spotting scopes (instrument type 01 and 02)

Table 2 specifies technical requirements and corresponding environmental tests for extent of testing T (type or sample test).

After testing in accordance with Table 2, the instrument shall meet the specifications of either ISO 14133-1 or ISO 14133-2.

Series tests (extent of testing S) shall be stipulated in the relevant specification.

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

Table 2 — Environmental requirements for binoculars, monoculars and spotting scopes for extent of testing T

Serial No.	ISO 9022		Type No.		01			02			
	Part	Conditioning method			0	1	2	0	1	2	
			State of operation		0	1	2	0	1	2	
1	2	10 Cold	Technical requirements	Temperature °C	-40	—	-10	-40	—	-25	
			Degree of severity		08	—	02	08	—	05	
			Comment								
2	2	11 Dry heat	Technical requirements	Temperature °C	55	—	55	70	—	55	
			Degree of severity		03	—	03	05	—	03	
			Comment								
3	2	12 Damp heat	Technical requirements	Temperature °C	—	40	—	—	55	—	
				Relative humidity %	—	92	—	—	92	—	
			Degree of severity		—	01	—	—	07	—	
		Comment									
4	2	15 Temperature shock	Technical requirements	Temperature °C	$t_2$	—	20	—	—	40	—
					$t_1$	—	-10	—	—	-25	—
			Degree of severity		—	01	—	—	02	—	
		Comment									
5	9	20 Solar radiation	Technical requirements	Irradiance kW/m <sup>2</sup>	—	up to 1,1	—	—	up to 1,1	—	
			Degree of severity		—	02	—	—	02	—	
			Comment								
6	3	30 Shock	Technical requirements	Acceleration	g	—	30	—	—	100	—
				Duration	ms	—	6	—	—	6	—
			Degree of severity		—	03	—	—	07	—	
		Comment									
7	3	31 Bump	Technical requirements	Acceleration	g	—	10	—	—	25	—
				Duration	ms	—	6	—	—	6	—
			Degree of severity		—	01	—	—	05	—	
		Comment									
8	3	32 Drop and topple	Technical requirements	Height of overturn	mm	—	Toppling over	—	—	Toppling over	—
			Degree of severity		—	04	—	—	04	—	
			Comment								
9	3	33 Free fall	Technical requirements	Height of fall	mm	—	—	—	250	—	—
			Degree of severity		—	—	—	04	—	—	
			Comment								



Table 2 (continued)

Serial No.	ISO 9022		Type No.			01			02		
	Part	Conditioning method	State of operation			0	1	2	0	1	2
10	3	36 Sinusoidal vibration (sweep frequencies)	Technical requirements	Frequency Acceleration	Hz g	— —	10 to 150 2	— —	— —	10 to 150 2	— —
			Degree of severity			—	03	—	—	03	—
			Comment								
11	4	40 Salt mist	Technical requirements	Corrosion resistance		Ability to be operated for $\geq 5$ years in compliance with stipulated instructions regarding maintenance and care.					
			Degree of severity			—	01	—	—	03	—
			Comment			Parts (materials) are tested					
12	7	73 Steady rain	Technical requirements	Rain rate	mm/min	—	5	—	—	20	—
			Degree of severity			—	01	—	—	02	—
			Comment			This requirement applies to instruments that are declared waterproof.					
13	8	80 High internal pressure	Technical requirements	Difference from ambient pressure	hPa	—	—	—	—	100	—
			Degree of severity			—	—	—	—	02	—
			Comment			This requirement applies to instruments that are declared waterproof.					
14	8	81 Low internal pressure	Technical requirements	Difference from ambient pressure	hPa	—	—	—	—	100	—
			Degree of severity			—	—	—	—	04	—
			Comment			This requirement applies to instruments that are declared waterproof.					
15	8	82 Immersion	Technical requirements	Immersion depth	m	—	—	—	—	4	—
			Degree of severity			—	—	—	—	02	—
			Comment			This requirement applies to instruments that are declared waterproof.					
16	12	86 Basic cosmetic substances and artificial hand sweat	Technical requirements	Ability to be operated for $\geq 5$ years in compliance with stipulated instructions regarding maintenance and care.							
			Degree of severity			—	03	—	—	03	—
			Comment								

Table 3 — Test summary for binoculars, monoculars and spotting scopes

Environmental requirement ISO 10109-03-01-T	Environmental requirement ISO 10109-03-02-T	Part of ISO 9022
Environmental test ISO 9022		
10-08-0	10-08-0	2
10-02-2	10-05-2	
11-03-0	11-05-0	
11-03-2	11-03-2	
12-01-1	12-07-1	
15-01-1	15-02-1	
20-02-1	20-02-1	9
30-03-1	30-07-1	3
31-01-1	31-05-1	
32-04-1	32-04-1	
36-03-1	33-04-0	
40-01-1	36-03-1	4
73-01-1	40-03-1	7
	73-02-1	8
	80-02-1	
	81-04-1	
	82-02-1	12
86-03-1	86-03-1	

### 6.3 Telescopic sights (instrument type 03, 04 and 05)

Table 4 specifies technical requirements and corresponding environmental tests for extent of testing T (type or sample test).

After testing in accordance with Table 4, the instrument shall meet the specifications of either ISO 14135-1 or ISO 14135-2.

Series tests (extent of testing S) shall be stipulated in the relevant specification.

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

Table 4 — Environmental requirements for telescopic sights

Serial No.	ISO 9022		Type No.	03			04			05					
	Part	Conditioning method		State of operation			0	1	2	0	1	2			
1	2	10 Cold <sup>1)</sup>	Technical requirements	Temperature °C	-40	—	0	-40	—	-10	-40	—	-25		
			Degree of severity			08	—	01	08	—	02	08	—	05	
			Comment												
2	2	11 Dry heat <sup>1)</sup>	Technical requirements	Temperature °C	55	—	40	55	—	55	70	—	55		
			Degree of severity			03	—	02	03	—	03	05	—	03	
			Comment												
3	2	12 Damp heat <sup>1)</sup>	Technical requirements	Temperature °C Relative humidity %	—	40 92	—	—	40 92	—	—	55 92	—		
			Degree of severity			—	01	—	—	01	—	—	07	—	
			Comment												
4	2	15 Temperature shock <sup>1)</sup>	Technical requirements	Temperature °C $t_2$ $t_1$	—	20 -10	—	—	40 -25	—	—	55 -40	—		
			Degree of severity			—	01	—	—	02	—	—	03	—	
			Comment												
5	2	16 Damp heat cyclic <sup>1)</sup>	Technical requirements	Climate relative humidity °C %	—	—	—	—	—	—	—	40 92	—		
				Climate relative humidity °C %	—	—	—	—	—	—	—	—	23 83	—	
			Degree of severity			—	—	—	—	—	—	—	—	02	—
			Comment												
6	3	30 Shock <sup>2)</sup>	Technical requirements	Acceleration Duration	g ms	— —	10 6	— —	— —	25 6	— —	500 1	— —	500 <sup>4)</sup> 1	
			Degree of severity			—	—	03	—	—	08	—	—	08	
			Comment			Application in the direction of the firearm shock only. Number of shocks: 2000									
7	3	31 Bump <sup>3)</sup>	Technical requirements	Acceleration Duration	g ms	— —	10 6	— —	— —	25 6	— —	— —	40 6	— —	
			Degree of severity			—	01	—	—	05	—	—	07	—	
			Comment												
8	3	36 Sinusoidal vibration (sweep frequencies) <sup>3)</sup>	Technical requirements	Frequency Acceleration	Hz g	— —	— —	— —	— —	10-150 2	— —	— —	10-500 2	— —	
			Degree of severity			—	—	—	—	03	—	—	04	—	
			Comment												

Table 4 (continued)

Serial No.	ISO 9022		Type No.	03			04			05					
	Part	Conditioning method		State of operation			0	1	2	0	1	2			
9	4	40  Salt mist <sup>3)</sup>	Technical requirements	Corrosion resistance	—	—	—	—	—	—	Ability to be operated ≥ 5 years in compliance with stipulated instructions regarding maintenance and care.				
			Degree of severity		—	—	—	—	—	—				04	
			Comment		Parts (material) are tested.										
10	7	73 Steady rain <sup>3)</sup>	Technical requirements	Rain rate mm/min	—	—	—	—	5	—	—	20	—		
			Degree of severity		—	—	—	—	01	—	—	02	—		
			Comment												
11	8	80 High internal pressure <sup>1)</sup>	Technical requirements	Difference from ambient pressure hPa	—	—	—	—	100	—	—	100	—		
			Degree of severity		—	—	—	—	04	—	—	04	—		
			Comment												
12	8	81 Low internal pressure <sup>1)</sup>	Technical requirements	Difference from ambient pressure hPa	—	—	—	—	100	—	—	100	—		
			Degree of severity		—	—	—	—	04	—	—	04	—		
			Comment												
13	8	82 Immersion <sup>1)</sup>	Technical requirements	Immersion depth m	—	—	—	—	—	—	—	4	—		
			Degree of severity		—	—	—	—	—	—	—	02	—		
			Comment												
14	9	20 Solar radiation <sup>3)</sup>	Technical requirements	Irradiance kW/m <sup>2</sup>	—	—	—	—	up to 1,1	—	—	up to 1,1	—		
			Degree of severity		—	—	—	—	01	—	—	02	—		
			Comment												
15	12	86 Basic cosmetic substances and artificial hand sweat <sup>3)</sup>	Technical requirements		Ability to be operated for ≥ 5 years in compliance with stipulated instructions regarding maintenance and care.										
			Degree of severity		—	03	—	—	01	—	—	03	—		
			Comment		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 conditioning.										

1) Type or sample test and series test.  
 2) Type or sample test or series test.  
 3) Type or sample test only.  
 4) Up to 1 000 g according to the relevant specification of the manufacturer.

Table 5 — Test summary for telescopic sights

Environmental requirement ISO 10109-03-03-T/S	Environmental requirement ISO 10109-03-04-T/S	Environmental requirement ISO 10109-03-05-T/S	Part of ISO 9022
Environmental test ISO 9022			
10-08-0 <sup>1)</sup>	10-08-0 <sup>1)</sup>	10-08-0 <sup>1)</sup>	2
10-01-2 <sup>1)</sup>	10-02-2 <sup>1)</sup>	10-05-2 <sup>1)</sup>	
11-03-0 <sup>1)</sup>	11-03-0 <sup>1)</sup>	11-05-0 <sup>1)</sup>	
11-02-2 <sup>1)</sup>	11-03-2 <sup>1)</sup>	11-03-2 <sup>1)</sup>	
12-01-1 <sup>1)</sup>	12-01-1 <sup>1)</sup>	12-07-1 <sup>1)</sup>	
15-01-1 <sup>1)</sup>	15-02-1 <sup>1)</sup>	15-03-1 <sup>1)</sup> 16-02-1 <sup>1)</sup>	
	20-01-1 <sup>3)</sup>	20-02-1 <sup>3)</sup>	9
30-03-2 <sup>2)</sup>	30-08-2 <sup>2)</sup>	30-08-2 <sup>2)</sup>	3
31-01-1 <sup>3)</sup>	31-05-1 <sup>3)</sup>	31-07-1 <sup>3)</sup>	
	36-03-1 <sup>3)</sup>	36-04-1 <sup>3)</sup>	
		40-04-1 <sup>3)</sup>	4
	73-01-1 <sup>3)</sup>	73-02-1 <sup>3)</sup>	7
	80-04-1 <sup>1)</sup> 81-04-1 <sup>1)</sup>	80-04-1 <sup>1)</sup> 81-04-1 <sup>1)</sup> 82-02-1 <sup>1)</sup>	8
86-03-1 <sup>3)</sup>	86-01-1 <sup>3)</sup>	86-03-1 <sup>3)</sup>	12
<sup>1)</sup> Type or sample test and series test. <sup>2)</sup> Type or sample test or series test. <sup>3)</sup> Type or sample test only.			

#### 6.4 Astronomical telescopes (instrument type 06 and 07)

Table 6 specifies technical requirements and corresponding environmental tests for extent of testing T (type or sample test).

After testing in accordance with Table 6 the instrument shall meet the specifications of ISO 14134.

Series tests (extent of testing S) shall be stipulated in the relevant specification.

Table 7 shows a summary of the tests given in Table 6 as specified in ISO 9022.

Table 6 — Environmental requirements for astronomical telescopes for extent of testing T

Serial No.	ISO 9022		Type No.	06			07				
	Part	Conditioning method		State of operation			0	1	2		
1	2	10 Cold	Technical requirements	Temperature °C	- 25	—	- 10	- 40	—	- 25	
			Degree of severity			05	—	02	08	—	05
			Comment								
2	2	11 Dry heat	Technical requirements	Temperature °C	55	—	55	70	—	55	
			Degree of severity			03	—	03	05	—	03
			Comment								
3	2	12 Damp heat	Technical requirements	Temperature °C Relative humidity %	— —	40 92	— —	— —	55 92	— —	
			Degree of severity			—	01	—	—	07	—
			Comment								
4	2	15 Temperature shock	Technical requirements	Temperature °C $t_2$ $t_1$	— —	— —	— —	— —	20 - 10	— —	
			Degree of severity			—	—	—	—	01	—
			Comment								
5	9	20 Solar radiation	Technical requirements	Irradiance kW/m <sup>2</sup>	—	up to 1,1	—	—	up to 1,1	—	
			Degree of severity			—	02	—	—	02	—
			Comment								
10	3	36 Sinusoidal vibration (sweep frequencies)	Technical requirements	Frequency Hz Acceleration g	— —	10 to 150 2	— —	— —	10 to 150 2	— —	
			Degree of severity			—	03	—	—	03	—
			Comment								

Table 7 — Test summary for astronomical telescopes

Environmental requirement ISO 10109-03-06-T	Environmental requirement ISO 10109-03-07-T	Part of ISO 9022
Environmental test ISO 9022		
10-05-0	10-08-0	2
10-02-2	10-05-2	
11-03-0	11-05-0	
11-03-2	11-03-2	
12-01-1	12-07-1	
	15-01-1	
20-02-1	20-02-1	9
36-03-1	36-03-1	3

## 7 Procedure

Tests shall be performed as specified in ISO 9022.

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

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