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

Part 12:  
**Conditions of transport for optical  
instruments**

*Optique et instruments d'optique — Conditions d'environnement —  
Partie 12: Conditions de transport des instruments optiques*

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Published in Switzerland

## 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 2.

The main task of technical committees is to prepare International Standards. 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 document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 10109-12 was prepared by Technical Committee ISO/TC 172, *Optics and photonics*, 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*
- *Part 12: Conditions of transport for optical instruments*



# Optics and optical instruments — Environmental requirements —

## Part 12:

# Conditions of transport for optical instruments

## 1 Scope

This part of ISO 10109 details the general conditions of transport that are not under the control of the manufacturer, from manufacturers to customers for optical instruments and instruments with optical components.

It deals with the requirements to be met by commercial packaging of instruments during transport from manufacturers to customers in order that the optical, mechanical, chemical and electrical properties or the performance be unaffected. Transport from the manufacturer to the customer, as defined by this part of ISO 10109, comprises all steps and procedures the instrument may be subject to during transport from the moment it leaves the place of manufacture until it reaches its final destination (end user), including transport by parcel services, road, rail, sea or air etc. (all of which are beyond the control of the manufacturer) and including all intermediate steps such as e.g. loading, unloading, packing or unpacking.

It does not apply to the transport of instruments while they are in use by customers.

## 2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 9022-1:1994, *Optics and optical instruments — Environmental test methods — Part 1: Definitions, extent of testing*

ISO 9022-2:2002, *Optics and optical instruments — Environmental test methods — Part 2: Cold, heat and humidity*

ISO 9022-3:1998, *Optics and optical instruments — Environmental test methods — Part 3: Mechanical stress*

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

IEC 60068-2-6:1995, *Environmental testing — Part 2: Tests — Test Fc: Vibration (sinusoidal)*

IEC 60068-2-64:1993, *Environmental testing — Part 2: Test methods — Test Fh: Vibration, broad-band random (digital control) and guidance*

## 3 Terms and definitions

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

#### 4 Subdivision of the instrument group

The group number for the general conditions of transport for optical instruments is 12.

Group number 12 is subdivided into the standard and extreme climatic and/or mechanical conditions listed in Table 1.

**Table 1 — Subdivision of group 12**

Type number	Type of condition
01	<p><b>Exposure to standard conditions during transport:</b> Normal climatic and mechanical environmental conditions during transport with suitable means of transportation.</p>
02	<p><b>Exposure to extreme climatic and/or mechanical conditions during transport:</b> Extreme climatic and/or mechanical environmental conditions during transport, such as: transport of instruments across ground in a bad condition (road conditions or landing grounds) or with unsuitable means of transportation making it necessary to protect the instruments against the effects of extreme mechanical stress (higher degree of severity or additional conditioning method).</p>

#### 5 Designation of environmental requirements and of environmental tests

The relevant specification and other technical documents shall indicate the requirements defined by this part of ISO 10109 using the designation specified in ISO 10109-1.

EXAMPLE Instruments under standard conditions during transport, belonging to group 12, type of condition 01 are designated by:

**Environmental requirements ISO 10109-12-01**

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 environmental tests

Table 2 specifies the technical requirements for the conditioning methods as specified in ISO 9022-2 and ISO 9022-3.

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

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  $g = 10 \text{ m/s}^2$ .

#### 7 Procedure and function tests

Tests shall be performed as specified in ISO 9022 parts 1, 2 and 3.

The tests may be performed in any order, unless specified otherwise.

Unless the relevant part of ISO 9022 or the relevant specification gives no different indication of the test sequence, function tests shall be performed before and after the other tests in the series. Intermediate tests shall be performed in accordance with the relevant specification between selected tests.

Intermediate tests shall be performed after unpacking and after temperature conditioning to within 3 K of the test facility.

The specimen shall have passed the tests if all evaluation criteria laid down in the relevant specification have been met.

## 8 Additional tests

In order to verify whether a specific packaging complies with all performance requirements or to verify whether the packaging meets the technical requirements and environmental influences characteristic of it, further tests may be selected from the standards of the ISO 9022 series, e.g. ISO 9022-7 for dripping rain or steady rain.

The relevant specification shall indicate these tests in addition to the existing tests in the form of the environmental test code as specified in ISO 9022-1.

**Table 2 — Technical requirements and conditioning methods**

Serial No.	Part of ISO 9022		Type of condition		Exposure to standard conditions during transport	Exposure to extreme climatic and/or mechanical stress during transport
	Part	Conditioning method	Type number		01	02
			State of operation <sup>a</sup>		0	0
1	2	10 Cold	Technical requirements	Temperature °C	- 40	- 40 or - 55 <sup>c</sup> or - 65 <sup>c</sup>
			Degree of severity <sup>b</sup>		08	08 or 09 or 10
			Comment		Depending on instrument specifications a special packaging with appropriate isolation character may be used.	
2	2	11 Dry heat	Technical requirements	Temperature °C	70	70 or 85 <sup>c</sup>
			Degree of severity <sup>b</sup>		05	05 or 06
			Comment		After performing this test protection against mechanical stress must be effective.	
3	2	12 Damp heat	Technical requirements	Temperature °C Relative humidity %	40 92	40 or 55 92
			Degree of severity <sup>b</sup>		01	01 or 07 <sup>d</sup>
			Comment		Test not necessary if suitability of commercial packaging is qualified for damp heat effects.	
4	3	30 Shock	Technical requirements	Acceleration <sup>g</sup> Duration <sup>ms</sup>	30 6	30 or 50 6 or 3 or 11
			Degree of severity <sup>b</sup>		03 <sup>e</sup>	03 <sup>e</sup> or 05 <sup>e</sup> or 06 <sup>e</sup>
			Comment		Not necessary if conditioning method 33 is performed.	
5	3	31 Bump	Technical requirements	Acceleration <sup>g</sup> Duration <sup>ms</sup>	10 6	10 6
			Degree of severity <sup>b</sup>		01 <sup>f</sup>	01 <sup>f</sup> or 02
			Comment			

Table 2 (continued)

Serial No.	Part of ISO 9022		Type of condition			Exposure to standard conditions during transport	Exposure to extreme climatic and/or mechanical stress during transport
	Part	Conditioning method	Type number			01	02
			State of operation <sup>a</sup>			0	0
6	3	32 Drop and topple	Technical requirements			Toppling over	Toppling over
			Degree of severity <sup>b</sup>			04	04
			Comment			Test is only necessary if packaging has extreme differences in dimensions.	
7	3	33 Free fall	Technical requirements	Height of fall	mm	Mass-dependent	Mass-dependent
			Degree of severity <sup>b</sup>			g	g
			Comment				
8	3	34 Bounce <sup>h</sup>	Technical requirements	Frequency	Hz	4,75	4,75
				Acceleration	g	1,1 to 1,2	1,1 to 1,2
			Degree of severity <sup>b</sup>			02	03
Comment			Alternative test to conditioning method 37.				
9	3	36 Sinusoidal vibration <sup>i</sup>	Technical requirements	Frequency	Hz	10 to 150	10 to 150
				Acceleration	g	1	2
			Degree of severity <sup>b</sup>			02	03
Comment			Alternative test to conditioning method 37.				
10	3	37 Random vibration <sup>i</sup>	Technical requirements	Frequency	Hz	20 to 150	20 to 150
				Acceleration	g	1,6	1,6 or 2,6
			Degree of severity <sup>b</sup>			01	01 or 02
Comment			Performed test between conditioning methods 34, 36 and 37.				

<sup>a</sup> State of operation 0 as defined in ISO 9022-1 and in shipping packaging.

<sup>b</sup> See ISO 9022-1.

<sup>c</sup> Tests at these temperatures shall only be performed if the packaging protects instruments against such temperatures.

<sup>d</sup> For continuous storage in humid tropical climates or in non-weather-protected locations, additional tests are necessary.

<sup>e</sup> Number of shocks in each direction along each axis: 3 shocks.

<sup>f</sup> Test only offers protection on high-quality roads.

<sup>g</sup> Degree of severity according to mass of the instrument and packaging as specified in ISO 9022-3.

<sup>h</sup> A vertical shaker with suitable bounce platform and analogue or digital activated vibration control equipment can be used instead of a bounce tester. The test apparatus shall be capable of meeting the technical requirements.

<sup>i</sup> For other technical requirements, e.g. frequency range, see ISO 9022-3, IEC 60068-2-6 or IEC 60068-2-64.

Table 3 — Test summary

Environmental requirement ISO 10109-12-01	Environmental requirement ISO 10109-12-02	Part of ISO 9022
<b>Environmental test ISO 9022</b>		
10-08-0	10-08-0 or 09-0 or 10-0	2
11-05-0	11-05-0 or 06-0	
12-01-0	12-01-0 or 07-0	
30-03-0	30-03-0 or 05-0 or 06-0	3
31-01-0	31-01-0 or 02-0	
32-04-0	32-04-0	
33-xx-0	33-xx-0	
34-02-0	34-02-0	
36-02-0	36-03-0	
37-01-0	37-01-0 or 02-0	

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