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

Part 1:

General information, definitions, climatic
zones and their parameters

ISO 10109-1:1994

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

Partie 1: Informations générales, définitions, zones climatiques et leurs paramètres



Reference number
ISO 10109-1:1994(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 10109-1 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 6: *Test requirements for medical optical devices*
- Part 8: *Test requirements for extreme conditions of use*

Annex A of this part of ISO 10109 is for information only.

Optics and optical instruments — Environmental requirements —

Part 1:

General information, definitions, climatic zones and their parameters

1 Scope

This part of ISO 10109 specifies the types of testing required to establish the suitability of an instrument for its particular intended conditions of use.

This part of ISO 10109 applies to optical instruments and instruments with optical components. It specifies the requirements to be met with regard to the reliability of the optical, mechanical, chemical and electrical properties or performance characteristics¹⁾ of the instruments when exposed to environmental influences. Hence it also determines 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 the respective area of application.

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

2 Definitions

For the purposes of this part of ISO 10109, the following definitions apply.

2.1 environmental requirements: Specific natural and technical environmental influences, between the

limiting values of which optical instruments and instruments with optical components must be operable.

2.2 technical requirement: Defined limiting value for the natural and technical environmental influences occurring in the envisaged area of application.

NOTE 1 In order to verify whether an instrument fulfils a technical requirement, conditioning methods may be stipulated with degrees of severity whose limiting values are either higher or lower than those specified.

2.3 extent of testing: Sum of all required tests with which the operability of an instrument is ascertained under environmental influence.

The extent of testing is subdivided into type (or sample) testing and series testing.

2.3.1 type testing; sample testing: Extent of testing required of initial or qualification samples sufficient to ascertain reliably whether the instrument complies with all the environmental requirements of the relevant specification.

Type (or sample) testing is designated by the code letter T in other parts of ISO 10109.

2.3.2 series testing: Extent of testing required to ensure constant production quality.

Series testing is designated by the code letter S in other parts of ISO 10109.

1) For the purposes of this part of ISO 10109, nominal values for properties or performance characteristics are understood to be the technical data provided by the manufacturer, technical conditions of delivery or instrument standards.

2.4 severity of testing: Number of specimens per production batch/series or sample production to be subjected to a specific test.

NOTE 2 The severity of testing is stipulated in the relevant specification or in the instrument standard.

2.5 suitability index: Classification of the operability of an instrument within a standard climate.

NOTE 3 The values given in the comments of tables 1 to 6 are not taken into account.

3 Climatic environmental influences

This clause classifies and describes six standard climates (see tables 1 to 6) which constitute a summary

of the various major climatic environmental influences which are of significance for the use of optical instruments.

The values for standard climates 1 and 2 have been compiled from excerpts of IEC 721-2-1 and IEC 721-3-4.

Technical standard climate 5 is defined for use in weather-protected locations.

Standard climate 6 is defined as an open-air climate with restricted limiting values for optical precision measurements and for the use of optical consumer products in the open air.

3.1 Standard climate 1

Table 1 — Non-weather-protected locations with cold or extremely cold climates (arctic or antarctic climate)

Environmental influence	Value	Comments
Temperature	– 65 °C to + 35 °C	In extreme geographical conditions, temperatures as low as – 75 °C and as high as 40 °C can occur in the location of use. With temporary or permanent storage in enclosed vehicles, sheds, hangars or attics, temperatures of over 35 °C can be experienced in strong sunshine, and over 70 °C in extreme cases.
Relative humidity	up to 100 %	At a relative humidity of ≥ 95 %, the maximum temperature occurring is 20 °C
Air pressure	70 kPa to 106 kPa	50 kPa to 110 kPa in unfavourable conditions.
Solar radiation	up to 1,1 kW/m ²	Intensity of global radiation on earth's surface.
Amount of precipitation (rain, snow or hail)	≤ 15 mm/min	
Dew or ice buildup	yes	

3.2 Standard climate 2

Table 2 — Global locations, non-weather-protected, with the exception of cold and extremely cold climates

Environmental influence	Value	Comments
Temperature	– 33 °C to + 55 °C	In extreme geographical conditions, temperatures as low as – 45 °C and over 60 °C can be experienced in the location of use. With temporary or permanent storage in enclosed vehicles, sheds, hangars or attics, temperatures of over 55 °C can occur in strong sunshine, and over 85 °C in extreme cases.
Relative humidity	up to 100 %	At a relative humidity of ≥ 95 %, the highest temperature occurring is 33 °C , and 37 °C in extreme conditions.
Air pressure	70 kPa to 106 kPa	50 kPa to 110 kPa in unfavourable conditions.
Solar radiation	up to 1,1 kW/m ²	Intensity of global radiation on the earth's surface.
Amount of precipitation (rain, snow or hail)	≤ 15 mm/min	
Dew or ice buildup	yes	

3.3 Standard climate 3

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Table 3 — Global locations, non-weather-protected, with maritime and/or coastal climate

Environmental influence	Value	Comments
Temperature	– 20 °C to + 35 °C	Along coasts with icing, temperatures of below – 20 °C can be experienced, and above 35 °C along tropical coasts. With temporary or permanent storage in enclosed vehicles, sheds, hangars or attics, temperatures of above 35 °C can be experienced in strong sunshine, and over 85 °C in extreme cases.
Relative humidity	up to 100 %	At a relative humidity of ≥ 95 %, the highest temperature occurring is 30 °C.
Air pressure	90 kPa to 106 kPa	50 kPa to 110 kPa in unfavourable conditions.
Solar radiation	up to 1,1 kW/m ²	Intensity of global radiation on the earth's surface.
Amount of precipitation (rain, snow or hail)	≤ 15 mm/min	
Dew or ice buildup	yes	

3.4 Standard climate 4

Table 4 — High altitudes of up to 30 000 m

Environmental influence	Value	Comments
Temperature	– 65 °C to + 55 °C	Above polar zones, temperatures of below – 65 °C must be expected. With temporary or permanent storage in enclosed vehicles, sheds, hangars or attics, temperatures of over 55 °C can be experienced in strong sunshine, and over 85 °C in extreme cases.
Relative humidity	up to 100 %	At a relative humidity of ≥ 95 %, the highest temperature occurring is 35 °C.
Air pressure	1 kPa to 106 kPa	
Solar radiation	up to 1,4 kW/m ²	Intensity of radiation at altitude of 30 000 m.
Amount of precipitation (rain, snow or hail)	≤ 15 mm/min	
Dew or ice buildup	yes	

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3.5 Standard climate 5

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Table 5 — Technical climate in weather-protected locations

Environmental influence	Value	Comments
Temperature	15 °C to 35 °C	In unfavourable conditions, temperatures of under 15 °C and over 35 °C may occur (cellars or attics).
Relative humidity	up to 85 %	In unfavourable conditions, relative humidities of up to 95 % can be experienced.
Air pressure	70 kPa to 106 kPa	50 kPa to 110 kPa in unfavourable conditions.
Solar radiation	up to 0,9 kW/m ²	Without protection from sunshine.

3.6 Standard climate 6

Table 6 — Non-weather-protected locations with restricted limiting values

Environmental influence	Value	Comments
Temperature	– 20 °C to + 50 °C	The restricted temperature range applies for state of operation 2. The values of standard climate 2 apply for the states of operation 0 and 1.
Relative humidity	up to 100 %	At a relative humidity of ≥ 95 %, the highest temperature occurring is 25 °C.
Air pressure	70 kPa to 106 kPa	50 kPa to 110 kPa in unfavourable conditions.
Solar radiation	up to 1,1 kW/m ²	With simultaneous high exposure to heat and solar radiation, the critical limiting values for temperature in and on the instrument shall not be exceeded.
Amount of precipitation (rain, snow or hail)	≤ 6 mm/min	
Dew or ice buildup	yes	

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4 States of operation

Table 7 gives states of operation in accordance with ISO 9022.

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Table 7 — States of operation

State of operation	Comment
0	Specimen in its normal transport and/or storage container as provided by the manufacturer.
1	Specimen unprotected, ready for operation, power supply not connected.
2	Specimen is in operation during conditioning for a period to be specified in the relevant specification. The mode of the operating status shall be specified in the relevant specification. During operation a check shall be performed to establish if the specimen is functioning as required.

5 Suitability index

climates shall be given in the form of a suitability index.

The suitability of an instrument within the standard

Table 8 defines the meaning of the letters used for this index.

Table 8 — Key to suitability index letters

Index	State of operation	
	0 and 1	2
A	Suitable	Specifications met in full.
B	Generally suitable	Instrument fully operable. In extreme climatic conditions, the specifications need not be met in full (e.g. at temperatures below - 25 °C).
C	Suitable to a limited extent	Reduced function; specifications not fully met.
D	Generally unsuitable	Pronounced reduction in function; specifications not met.
E	Unsuitable; damage is possible	Instrument can become inoperable. Damage is also possible.

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6 Environmental requirement designation

Environmental requirements ISO . . . XX-XX-X

The designation for environmental requirements shall be formed as follows:

Name _____
 Reference to ISO 10109 _____
 Group N° of instrument _____
 Type N° of instrument _____
 Extent of testing code letter _____

Annex A (informative)

Bibliography

- [1] ISO 9022-1:1994, *Optics and optical instruments — Environmental test methods — Part 1: Definitions, extent of testing.*
- [2] ISO 9022-2:1994, *Optics and optical instruments — Environmental test methods — Part 2: Cold, heat, humidity.*
- [3] ISO 9022-3:1994, *Optics and optical instruments — Environmental test methods — Part 3: Mechanical stress.*
- [4] ISO 9022-4:1994, *Optics and optical instruments — Environmental test methods — Part 4: Salt mist.*
- [5] ISO 9022-5:1994, *Optics and optical instruments — Environmental test methods — Part 5: Combined cold, low air pressure.*
- [6] ISO 9022-6:1994, *Optics and optical instruments — Environmental test methods — Part 6: Dust.*
- [7] ISO 9022-7:1994, *Optics and optical instruments — Environmental test methods — Part 7: Drip, rain.*
- [8] ISO 9022-8:1994, *Optics and optical instruments — Environmental test methods — Part 8: High pressure, low pressure, immersion.*
- [9] ISO 9022-9:1994, *Optics and optical instruments — Environmental test methods — Part 9: Solar radiation.*
- [10] ISO 9022-10:1994, *Optics and optical instruments — Environmental test methods — Part 10: Combined sinusoidal vibration, dry heat or cold.*
- [11] ISO 9022-11:1994, *Optics and optical instruments — Environmental test methods — Part 11: Mould growth.*
- [12] ISO 9022-12:1994, *Optics and optical instruments — Environmental test methods — Part 12: Contamination.*
- [13] ISO 9022-13:1994, *Optics and optical instruments — Environmental test methods — Part 13: Combined shock, bump or free fall, dry heat or cold.*
- [14] ISO 9022-14:1994, *Optics and optical instruments — Environmental test methods — Part 14: Dew, hoarfrost, ice.*
- [15] ISO 9022-15:1994, *Optics and optical instruments — Environmental test methods — Part 15: Combined random vibration wide band: reproducibility medium, in dry heat or cold.*
- [16] ISO 9022-16:1994, *Optics and optical instruments — Environmental test methods — Part 16: Combined bounce or steady-state acceleration, in dry heat or cold.*
- [17] ISO 9022-17:1994, *Optics and optical instruments — Environmental test methods — Part 17: Combined contamination, solar radiation.*
- [18] ISO 9022-18:1994, *Optics and optical instruments — Environmental test methods — Part 18: Combined damp heat and low internal pressure.*
- [19] ISO 9022-19:1994, *Optics and optical instruments — Environmental test methods — Part 19: Temperature cycles combined with sinusoidal or random vibration.*
- [20] IEC 721-2-1:1982, *Classification of environmental conditions — Part 2: Environmental conditions appearing in nature. Temperature and humidity.*
- [21] IEC 721-3-4:1987, *Classification of environmental conditions — Part 3: Classification of groups of environmental parameters and their severities. Stationary use at non-weather protected locations.*