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**Optics and photonics — Environmental requirements —**

Part 1:

**General overview, terms and definitions, climatic zones and their parameters**

*Optique et photonique — Exigences environnementales —*

*Partie 1: Vue d'ensemble générale, termes et définitions, zones climatiques et leurs paramètres*

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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 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 10109-1 was prepared by Technical Committee ISO/TC 172, *Optics and photonics*, Subcommittee SC 1, *Fundamental standards*.

This second edition cancels and replaces the first edition (ISO 10109-1:1994), to which a new Clause 6, *Classification of instruments*, has been added and the former Clause 6 (now Clause 7), *Environmental requirement designation*, has been substantially revised.

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

- *Part 1: General overview, terms and definitions, climatic zones and their parameters*
- *Part 4: Test requirements for telescopic systems*
- *Part 6: Test requirements for medical optical instruments*
- *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 photonics — Environmental requirements —

## Part 1:

## General overview, terms and definitions, climatic zones and their parameters

### 1 Scope

This part of ISO 10109 is applicable 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 characteristics (see Note) 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 (all parts), 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.

NOTE 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 standard.

### 2 Terms and definitions

For the purposes of this document, the following terms and 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 are to be operable

#### 2.2

##### **technical requirement**

defined limiting value for the natural and technical environmental influences occurring in the envisaged area of application

NOTE In order to verify whether an instrument fulfils a technical requirement, conditioning methods can 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

NOTE 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

NOTE 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

NOTE 1 Sampling procedures can be used.

NOTE 2 Series testing is designated by the code letter S in other parts of ISO 10109.

**2.4**

**severity of testing**

number of specimens per production batch/series or sample production to be subjected to a specific test

NOTE 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 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 60721-2-1 and IEC 60721-3-4.

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	Comment
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 $\geq 95$ %, 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 <sup>2</sup>	Intensity of global radiation on earth's surface.
Amount of precipitation (rain, snow or hail)	$\leq 15$ mm/min	
Dew or ice build-up	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	Comment
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 $\geq 95$ %, 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 <sup>2</sup>	Intensity of global radiation on earth's surface.
Amount of precipitation (rain, snow or hail)	$\leq 15$ mm/min	
Dew or ice build-up	yes	

### 3.3 Standard Climate 3

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

Environmental influence	Value	Comment
Temperature	−20 °C to +35 °C	Along coasts with icing, temperatures 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 over 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 $\geq 95$ %, 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 <sup>2</sup>	Intensity of global radiation on earth's surface.
Amount of precipitation (rain, snow or hail)	$\leq 15$ mm/min	
Dew or ice build-up	yes	

### 3.4 Standard Climate 4

**Table 4 — High altitudes of up to 30 000 m**

Environmental influence	Value	Comment
Temperature	−65 °C to +55 °C	Above polar zones, temperatures below −65 °C have to be expected. With temporary or permanent storage in enclosed vehicles, sheds, hangars or attics, temperatures 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 $\geq 95$ %, the highest temperature occurring is 35 °C.
Air pressure	1 kPa to 106 kPa	
Solar radiation	up to 1,4 kW/m <sup>2</sup>	Intensity of radiation at altitude of 30 000 m.
Amount of precipitation (rain, snow or hail)	$\leq 15$ mm/min	
Dew or ice build-up	yes	

3.5 Standard Climate 5

Table 5 — Technical climate in weather-protected locations

Environmental influence	Value	Comment
Temperature	+15 °C to +35 °C	In unfavourable conditions, temperatures below 15 °C and over 35 °C may occur.
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 <sup>2</sup>	Without protection from sunshine.

3.6 Standard Climate 6

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

Environmental influence	Value	Comment
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 $\geq 95$ %, 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 <sup>2</sup>	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)	$\leq 6$ mm/min	
Dew or ice build-up	yes	

4 State of operation

Table 7 gives states of operation in accordance with ISO 9022 (all parts).

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

The suitability of an instrument within the standard climates shall be given in the form of a suitability index.

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 $-25\text{ }^{\circ}\text{C}$ ).
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.

## 6 Classification of instruments

Different parts of ISO 10109 have been prepared for different instruments, e.g. telescopes, optical measuring instruments. Table 9 provides an overview of ISO 10109 parts and respective instruments. Table 9 also includes previously used group numbers.

**Table 9 — Summary of groups of instruments**

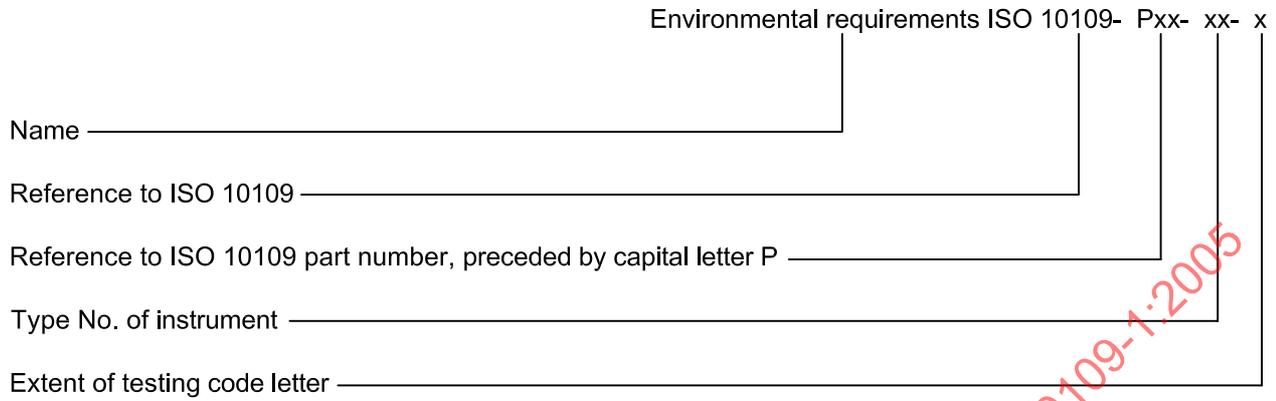
Group of instruments	ISO 10109 part number	Group number <sup>a</sup>
Telescopic instruments	4	03
Medical optical instruments	6	05
Optical measuring instruments	7	06
Optical instruments for extreme conditions of use	8	07
Optical instruments for outdoor conditions of use	11	11
General conditions of transport for optical instruments	12	12

<sup>a</sup> Group numbers have previously been specified by the various ISO 10109 parts, but for future use of ISO 10109, the use of part numbers is preferred.

In the ISO 10109 series of standards, the groups of instruments are divided into types of instruments depending on their conditions of use.

## 7 Environmental requirement designation

The designation for environmental requirements shall be formed as follows:



NOTE Previously, environmental requirements designation used a group number which did not correspond to the part number, thus causing confusion. The “P” in the designation stands for Part number.

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- [6] ISO 9022-6:1994, *Optics and optical instruments — Environmental test methods — Part 6: Dust*
- [7] ISO 9022-7:2005, *Optics and photonics — Environmental test methods — Part 7: Resistance to drip or 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 9022-10:1998, *Optics and optical instruments — Environmental test methods — Part 10: Combined sinusoidal vibration and 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 9022-13:1998, *Optics and optical instruments — Environmental test methods — Part 13: Combined shock, bump or free fall and dry heat or cold*
- [14] ISO 9022-14:1994, *Optics and optical instruments — Environmental test methods — Part 14: Dew, hoarfrost, ice*
- [15] ISO 9022-15:1998, *Optics and optical instruments — Environmental test methods — Part 15: Combined digitally controlled broad-band random vibration and dry heat or cold*
- [16] ISO 9022-16:1998, *Optics and optical instruments — Environmental test methods — Part 16: Combined bounce or steady-state acceleration and 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*