INTERNATIONAL STANDARD

ISO 11151-2

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Lasers and laser-related equipment — Standard optical components —

Part 2: Components for the infrared spectral range

Lasers et équipements associés aux lasers — Composants optiques standards —

Partie 2: Composants pour la plage spectrale infrarouge

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.ch
Web www.iso.ch

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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 11151 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 11151-2 was prepared by Technical Committee ISO/TC 172, *Optics and optical instruments*, Subcommittee SC 9, *Electro-optical systems*.

ISO 11151 consists of the following parts, under the general title *Lasers and laser-related equipment — Standard optical components*:

— *Part 1: Components for UV, visible and near-infrared spectral ranges*

— *Part 2: Components for the infrared spectral range*

Annexes A and B of this part of ISO 11151 are for information only.

Introduction

Lasers are used in a wide variety of applications, including medicine, materials processing, information technology and metrology. Most lasers contain optical windows and mirrors (intracavity) and most laser systems use a variety of windows, beamsplitters, deflectors, mirrors and lenses. Those components used in high power laser applications must withstand high peak power and/or energy densities to avoid laser-induced damage, thus their component specifications are more demanding than those used in low power applications.

Lasers and laser-related equipment — Standard optical components —

Part 2: Components for the infrared spectral range

1 Scope

This part of ISO 11151 specifies requirements for laser components used in the infrared spectral range, from wavelengths 2,10 µm to 15,0 µm, and facilitates the supply of spare parts:

— by specifying preferred dimensions and tolerances, thereby reducing the variety of types;

— by standardizing the specifications and removing barriers to trade;

— by establishing an agreed designation for item orders.

This part of ISO 11151 covers planar, plano-spherical and spherical substrates, lenses and optical components that are designed specifically as standardized optical components normally offered via catalogue from suppliers and intended for use with lasers.

This part of ISO 11151 includes component descriptions, materials employed, physical dimensions and manufacturing tolerances (including surface finish, figure and parallelism). Although most, but not all of these components will be coated (fully reflecting, partially reflecting or anti-reflecting) before incorporation into the laser system, this part of ISO 11151 does not include recommendations for the specification of coatings.

NOTE For optical components used in the ultra-violet, visible and near infrared spectral ranges (190 nm to 2 100 nm), refer to ISO 11151-1. For the specification and testing of optical coatings, refer to the ISO 9211 series.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 11151. 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 11151 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 9211-1:1994, *Optics and optical instruments — Optical coatings — Part 1: Definitions.*

ISO 9211-2:1994, *Optics and optical instruments — Optical coatings — Part 2: Optical properties.*

ISO 10110-1:1996, *Optics and optical instruments — Preparation of drawings for optical elements and systems — Part 1: General.*

3 Code for components covered

Table 1 specifies codes for the components to which this part of ISO 11151 is applicable.

Table 1 — Component codes

Component form	Code
Optical flats	IOF
Circular windows — flat	IWC
Elliptical windows — flat	IWE
Rectangular windows — flat	IWR
Output couplers — flat	IOC
Mirrors — flat	IMF
Mirrors — convex	IMX
Mirrors — concave	IMV
Plano-convex lenses	IPX
Plano-concave lenses	IPV
Symmetric biconvex lenses	IBX
Symmetric biconcave lenses	IBV

4 Materials

This part of ISO 11151 covers components employed in the infrared wavelength region from 2,10 µm to 15 µm. A wide range of materials may be used, such as:

— zinc selenide, ZnSe;

— potassium chloride, KCl;

— germanium, Ge;

— gallium arsenide, GaAs;

— silicon, Si;

— copper, Cu.

In view of the wide variety of materials available, the use of specific code numbers for each material has not been formalized. Manufacturers and designers shall therefore specifiy the exact materials used/required. The material specification shall be given as stated in subclause 4.7 of ISO 10110-1:1996. If birefringent materials are used/specified, the orientation of the optical axis relative to the geometric axes of the components shall be stated.

5 Requirements for quality

Preferred specifications and classes for material and surface quality are set out in Tables 2 to 6, using terminology in accordance with parts 1 to 7 of ISO 10110. The same quality standards apply to all components of a given diameter, except that the material tolerances are inapplicable in the case of total reflector substrates.

The requirement of quality for components to be used with infrared lasers is in general high, therefore this part of ISO 11151 only promulgates one class of quality[1)] .

For this reason there is no difference between a flat circular window, IWC, specification and an output coupler, IOC, specification in this waveband. It should be noted that the surface dig and pit critical dimensions for laser-induced damage are $\lambda/10$ to 10λ, where λ is the wavelength of operation of the laser.

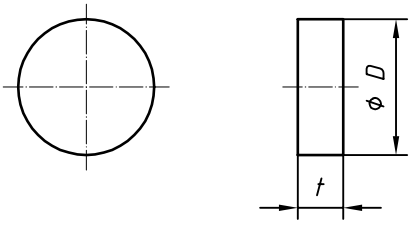
Table 2 — Material and surface fabrication tolerances for lenses, windows and beamsplitters

Diameter mm	Stress birefringence 0/...	Bubbles and inclusions 1/...	Inhomogeneity and striae 2/...	Surface form 3/...	Centring 4/...	Surface imperfection 5/...
5 to 15	15	3 × 0,063	0;2	–(0,4/0,4)	3′	2 × 0,025
>15 to 30	15	4 × 0,063	0;2	–(0,6/0,6)	3′	3 × 0,040
>30 to 51	15	4 × 0,100	0;2	–(1,0/1,0)	3′	4 × 0,063
>51 to 102	15	5 × 0,100	0;2	–(1,0/1,0)	3′	5 × 0,100

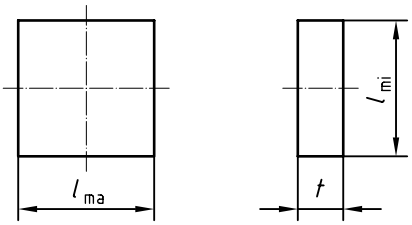
Table 3 — Material and surface fabrication tolerances for total reflector substrates

Diameter mm	Stress birefringence 0/...	Bubbles and inclusions 1/...	Inhomogeneity and striae 2/...	Surface form 3/...	Centring 4/...	Surface imperfection 5/...
5 to 15	NA	NA	NA	–(0,4/0,4)	5′	2 × 0,025
>15 to 30	NA	NA	NA	–(0,6/0,6)	5′	3 × 0,040
>30 to 51	NA	NA	NA	–(1,0/1,0)	5′	4 × 0,063
>51 to 102	NA	NA	NA	–(1,0/1,0)	5′	5 × 0,100
NA: not applicable.						

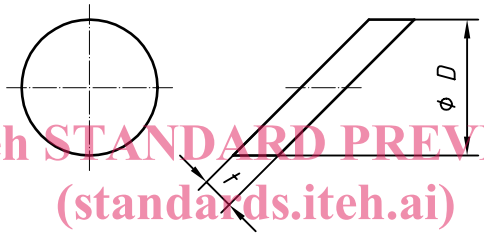
1) The quoted grade values assume that most of the incident radiation is scattered out of the beam by the imperfection. This is the case where the radiometric obscuration equals the area obscuration. If the imperfection is partially transmitting, its actual area could be larger than is suggested by these values. A method for measuring the surface imperfections is described in ISO 14997.



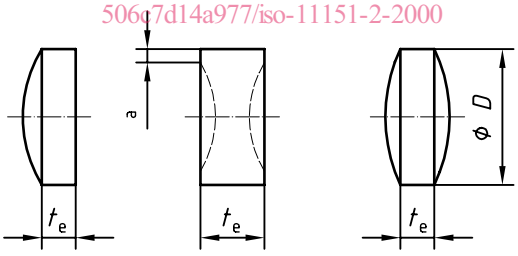
a) Form IWC (i.e. circular window, flat)



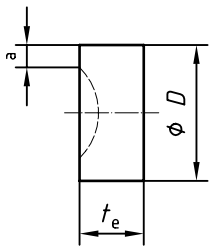
b) Form IWR (i.e. rectangular window, flat)



c) Form IWE (i.e. elliptical window, flat)



d) Forms IPX, IBV and IBX



e) Form IMV

Key

D	Diameter
t	Thickness
l_{mi}	Minor edge length
l_{ma}	Major edge length
t_e	Edge thickness

[a] Annulus width may be specified.

Figure 1 — Schematic presentation of different component types

6 Dimensional tolerances

6.1 Preferred dimensions

It is strongly recommended that all dimensions for components be specified in metric units. However it is recognized that, at least for the time being, there is also a market for components whose dimensions are specified in imperial units. Preferred dimensions for this latter class are given in annex A.

It should be noted that while the nomenclature (see clause 8) has been designed so that non-preferred dimensions can be included if strictly necessary, it is strongly recommended that both designers and manufacturers adopt preferred dimensions. The preferred (metric) dimensions and dimensional tolerances are listed in Table 4 using reference terminology as defined in Figure 1.

6.2 Diameter of circular optical components

These include circular windows, mirrors and lenses. The preferred diameters are given in Table 4.

6.3 Mirror and output coupler curvature

Although many laser mirrors and windows are optically flat, it is also recognized that there may be a requirement for both plano-convex and plano-concave components. These should be specified using the radius of curvature (half the equivalent lens focal length). The radius of curvature is the 'second dimension' as specified in clause 8. There are no basic limits on the radius of curvature except it cannot be smaller than the substrate radius. The standard tolerance for the radius of curvature is ± 2 %.

6.4 Rectangular and elliptical windows

The preferred dimensions and tolerances are listed in Table 4 using terminology specified in Figure 1. The minor dimension is specified together with the diameter of circular components and the major dimension is specified as the second dimension. In the case of elliptical windows, this second dimension is the angle at which the component is to be used. The tolerances for all linear dimensions is 0,00/–0,20 mm.

Table 4 — Standardized dimensions for the diameter of circular components and edge length of rectangular components

Dimensions in millimetres

Diameter or minor edge length	Major edge length	Edge thickness	Tolerance of diameter or edge length
12,5	20	a	–0,20
25	40	a	–0,20
30	48	a	–0,20
40	63	a	–0,20
50	80	a	–0,20
75	120	a	–0,20
100	160	a	–0,20

[a] Shall be specified separately depending on the material (see 6.6).

6.5 Focal length

The manufacturer shall specify the effective focal length as an element of the designation. The effective focal length shall be specified, in millimetres, at 10,6 µm. The standard tolerance is ± 2 %. Preferred values for the effective focal lengths of lenses are given in Table 5, and for the radii of curvature of total reflector substrates in Table 6. The edge thickness is standardized for plano-convex and plano-concave lenses only. For other lenses the edge thickness may be specified differently.