INTERNATIONAL STANDARD

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Optics and photonics — Preparation of drawings for optical elements and systems —

Part 1: General

Optique et photonique — Indications sur les dessins pour éléments et systèmes optiques —

Partie 1: Généralités

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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 10110-1 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 10110-1:1996) which has been technically revised.

ISO 10110 consists of the following parts, under the general title *Optics and photonics — Preparation of drawings for optical elements and systems*:

- *Part 1: General*
- *Part 2: Material imperfections — Stress birefringence*
- *Part 3: Material imperfections — Bubbles and inclusions*
- *Part 4: Material imperfections — Inhomogeneity and striae*
- *Part 5: Surface form tolerances*
- *Part 6: Centring tolerances*
- *Part 7: Surface imperfection tolerances*
- *Part 8: Surface texture*
- *Part 9: Surface treatment and coating*
- *Part 10: Table representing data of optical elements and cemented assemblies*
- *Part 11: Non-toleranced data*
- *Part 12: Aspheric surfaces*
- *Part 14: Wavefront deformation tolerance*
- *Part 17: Laser irradiation damage threshold*

Optics and photonics — Preparation of drawings for optical elements and systems —

Part 1: General

1 Scope

ISO 10110 specifies the presentation of design and functional requirements for optical elements and systems in technical drawings used for manufacturing and inspection.

This part of ISO 10110 specifies the presentation in drawings of the characteristics, especially the tolerances, of optical elements and systems.

Rules for preparation of technical drawings as well as for dimensioning and tolerancing are given in various International Standards. These general standards apply to optical elements and systems only if the necessary rules are not given in the various parts of ISO 10110.

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 128-24, *Technical drawings — General principles of presentation — Part 24: Lines on mechanical engineering drawings*

ISO 406, *Technical drawings — Tolerancing of linear and angular dimensions*

ISO 7944, *Optics and optical instruments — Reference wavelengths*

ISO 8015, *Technical drawings — Fundamental tolerancing principle*

ISO 10110-2, *Optics and optical instruments — Preparation of drawings for optical elements and systems — Part 2: Material imperfections — Stress birefringence*

ISO 10110-3, *Optics and optical instruments — Preparation of drawings for optical elements and systems — Part 3: Material imperfections — Bubbles and inclusions*

ISO 10110-4, *Optics and optical instruments — Preparation of drawings for optical elements and systems — Part 4: Material imperfections — Inhomogeneity and striae*

ISO 10110-5:1996, *Optics and optical instruments — Preparation of drawings for optical elements and systems — Part 5: Surface form tolerances*

ISO 10110-6:1996, *Optics and optical instruments — Preparation of drawings for optical elements and systems — Part 6: Centring tolerances*

ISO 10110-7, *Optics and optical instruments — Preparation of drawings for optical elements and systems — Part 7: Surface imperfection tolerances*

ISO 10110-10:2004, *Optics and optical instruments — Preparation of drawings for optical elements and systems — Part 10: Table representing data of optical elements and cemented assemblies*

ISO 10110-11, *Optics and optical instruments — Preparation of drawings for optical elements and systems — Part 11: Non-toleranced data*

ISO 10110-12, *Optics and optical instruments — Preparation of drawings for optical elements and systems — Part 12: Aspheric surfaces*

ISO 13715, *Technical drawings — Edges of undefined shape — Vocabulary and indications*

3 Fundamental stipulations

All indications in drawings for optical elements and systems shall apply to the finished product, i.e., to its final form, except where other parts of ISO 10110 stipulate otherwise, as for example in ISO 10110-8.

Whenever details or symbols specified in this International Standard are found to be inadequate to clearly define the requirement, the information should be supplemented by a note or special instruction.

All linear dimensions are in millimetres, unless otherwise stated.

All optical data refer to the reference wavelength given in ISO 7944, and to the reference temperature of 20 °C [1], unless specified otherwise.

Unless specified elsewhere, the omission of a requirement from the drawing shall indicate that the provisions of ISO 10110-11 apply.

Because of the existence of older (national) standards for optical drawings, a possibility of incorrect interpretation of data may exist. For this reason, a reference to ISO 10110 shall appear on each drawing in the form

“Indications in accordance with ISO 10110”

or

“Ind. acc. ISO 10110”

These indications should preferably be associated with the title of the drawing (see Annex A and ISO 10110-10:2004, Figures 1 to 7).

4 Presentation and dimensioning

4.1 Views

Optical elements shall be shown with incident light entering from the left and the optical axis horizontal, unless otherwise specified.

The preferred method is that components be drawn in cross-section and hatched with short-long-short strokes. Back edges and hidden lines should normally be omitted (see Figure 1). However, for the sake of clarity, it may be necessary to include such lines in the case of non-rotationally symmetric elements.

1) 20 °C is the reference temperature in accordance with ISO 1. In the 1996 edition of ISO 10110-1, the default value for the reference temperature was 22 °C.

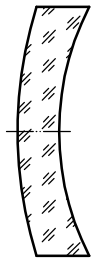


Figure 1 — Hatching

Components of sub-assemblies, such as cemented components, shall be hatched in alternate directions.

For the purpose of simplification, optical parts may be drawn without hatching (see Figure 2). Mixing of hatched and unhatched parts in one drawing shall not be used.

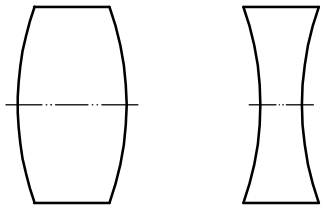


Figure 2 — Simplified drawings of lens elements

Lens elements with surfaces having two meridians of symmetry, such as cylindrical and toric surfaces, shall be drawn in two cross-sections corresponding to these meridians (see Figures 3 and 4). For the presentation of toric surfaces see ISO 10110-12.

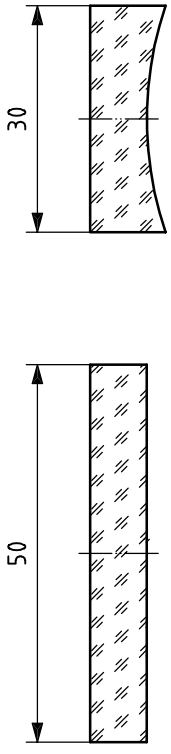


Figure 3 — Rectangular cylindrical lens element

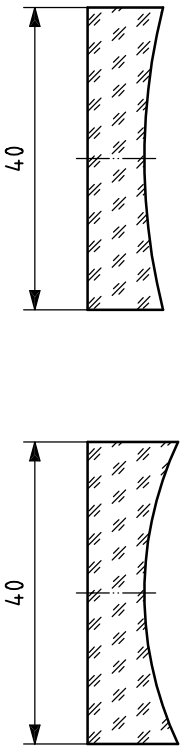


Figure 4 — Square toric lens element

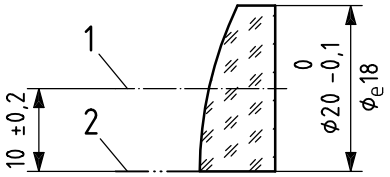
4.2 Axes

Axes shall be drawn as follows:

Rotation axes and centre lines: Line type 04.1, ISO 128-24

Optical axes: Line type 05.1, ISO 128-24

If an optical axis coincides with a rotation axis or centre line, the optical axis shall be drawn. An intentional displacement or tilt of axes (e.g. of the centre line of an element with respect to the optical axis) shall be indicated and dimensioned (see Figure 5). Very small shifts shall be drawn out of scale to exaggerate the displacement.



Key

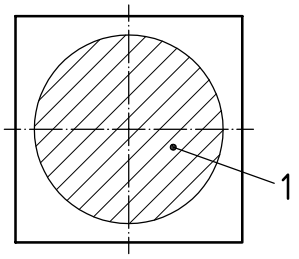
1 centre line

2 optical axis

Figure 5 — Axes

4.3 Leader lines

Leader lines shall have a dot at the end for leaders terminating within the outline of a part (see Figure 6), and an arrowhead for leaders terminating on the outline (see Figure 7).



Key

1 test region

Figure 6 — Leader line to an area

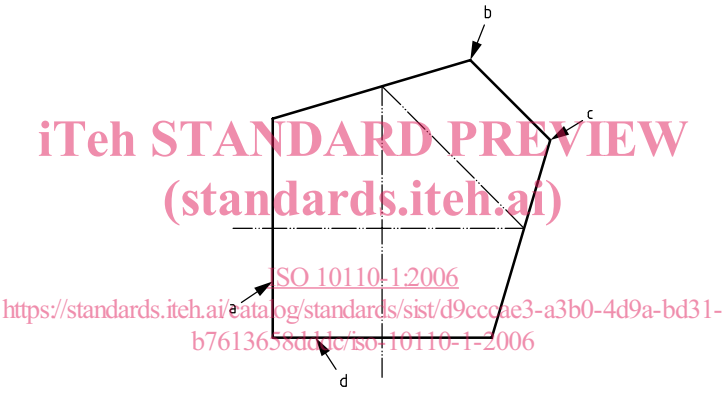


Figure 7 — Leader lines to edges and surfaces

4.4 Test regions

If testing of a complete surface or space is not required, the test regions or optically effective surfaces shall be shown on the drawings. The diameter of circular test regions, the "effective diameter", shall be indicated by "$\varnothing_e$" (see Figures 8, 18, A.1 and A.2). It defines the region of the component surface which has optical significance.[2)]

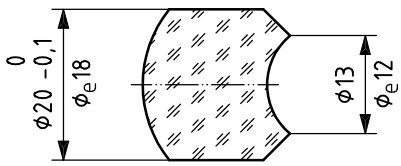


Figure 8 — Test regions

2) Former practice (and specification of the 1996 edition of ISO 10110-1) has been to assign the effective diameter to a surface by a leader line. This is no longer recommended, because it could be misinterpreted as an indication for the radius of curvature.

The boundaries of test regions shall be drawn in continuous narrow lines (line type 01.1, ISO 128-24) and the regions themselves shall be hatched in continuous lines of the same type. They may be subdivided into zones to which different tolerances apply, if required. In such cases, the zones shall be numbered to clarify their relationship. The zone number shall be indicated by a leader to the appropriate area (see Figure 9).

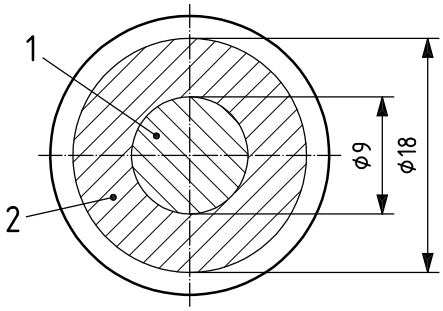


Figure 9 — View showing test regions

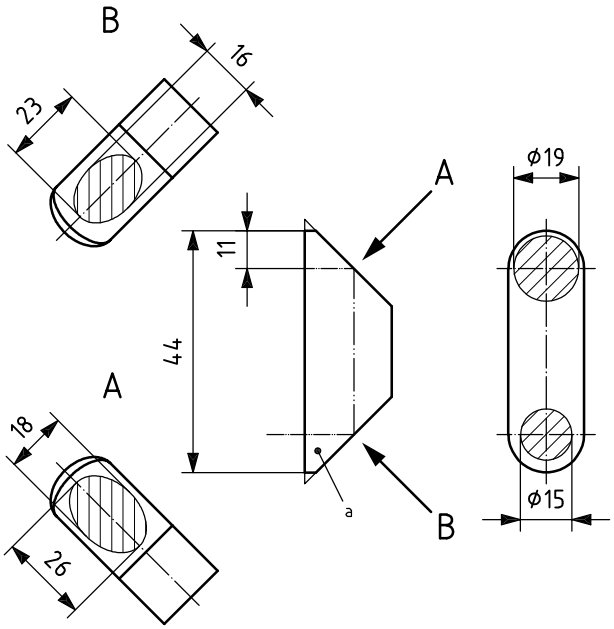
Where necessary, special views entitled “test regions” shall be added showing optically effective regions and provided with appropriate dimensional data. If symmetrical components have different test regions (e.g. due to the path of the rays being divergent or convergent) then the regions in question shall be suitably identified to prevent wrong assembly. The same requirement applies if dissimilar test specifications are to be applied to similar test areas. The method of identification should be explained in the drawing (see Figure 10).

If the test regions are not shown, the surfaces count in their full extent as test regions.

A circular test field may be shown in any position within the test region as a dimensioned area bounded by a thin continuous line. Appropriate requirements indicated by a leader to this test field shall apply to all possible positions of the test field within the test region. In this case the diameter of the test field shall be appended to the appropriate tolerance indication as follows: “... (all ∅ ...)” (see Figure 11).

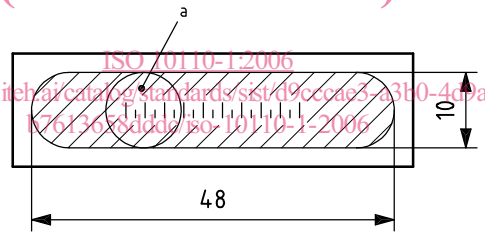
4.5 Test volumes

A test volume shall be indicated if a volume of defined extent must fulfil higher requirements than the rest of the optical element (see Figure 12).



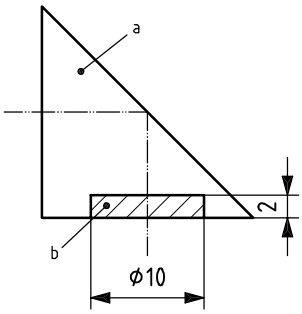
a Mark for identification.

Figure 10 — Different test regions for a prism



a Tolerance (all ∅ 10 mm).

Figure 11 — Test field within a test region



a Normal tolerance for bubbles.

b Special tolerance for bubbles.

Figure 12 — Test volume

4.6 Dimensioning

4.6.1 General

Fundamentally, the dimensions for optical elements relate to the finished state and therefore include surface treatment such as painting and/or coating. However, in certain cases the dimensions of a part before the application of surface treatments are important. In such cases it shall be explicitly indicated in the drawing that these dimensions refer to the untreated part.

4.6.2 Radius of curvature

Spherical surfaces are defined by stating the radius of curvature with a dimensional tolerance (see Figures 13 to 15).

This tolerance shall indicate the range within which the actual surface shall be contained.

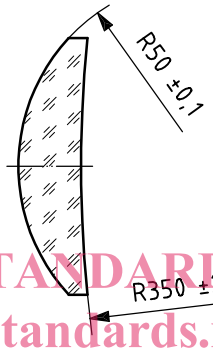


Figure 13 — Radii for a meniscus lens element

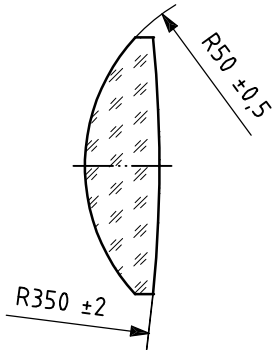


Figure 14 — Radii for a biconvex lens element

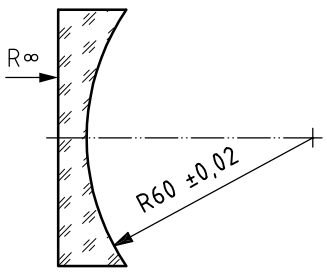


Figure 15 — Radii for a plano-concave lens element