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

Part 6: Centring tolerances

Optique et photonique — Indications sur les dessins pour éléments et systèmes optiques —
Partie 6: Tolérances de centrage

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ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information.

The committee responsible for this document is ISO/TC 172, *Optics and photonics*, Subcommittee SC 1, *Fundamental standards*.

This second edition cancels and replaces the first edition (ISO 10110-6:1996), which has been technically revised. It also incorporates ISO 10110-6:1996/Cor.1:1999.

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; roughness and waviness*

— *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*

— *Part 19: General description of surfaces and components*

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

Part 6: Centring tolerances

1 Scope

This International Standard 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 rules for indicating centring tolerances for optical elements, subassemblies, and assemblies.

This part of ISO 10110 applies to plano surfaces, rotationally invariant surfaces, circular cylindrical, non-circular cylindrical, and non-symmetrical surfaces (general surfaces). General surfaces are described using ISO 10110-19.

2 Normative references

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

ISO 1101, *Geometrical product specifications (GPS) — Geometrical tolerancing — Tolerances of form, orientation, location and run-out*

ISO 5459, *Geometrical product specifications (GPS) — Geometrical tolerancing — Datums and datum systems*

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

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5459 and the following apply.

3.1
optical surface
optically effective surface which deflects the incident light by reflection or refraction

Note 1 to entry: Optical surfaces can be of different degrees of complexity. Correspondingly, the number of the degrees of freedom needed for describing the orientation and location of the surface increases with complexity.

3.2
optical element
part with one or more *optical surfaces* (3.1) providing an optical function and which has a mechanical interface to the superior system

EXAMPLE One optical surface (e.g. parabolic mirror), two optical surfaces (e.g. lens element), or more than two optical surfaces (e.g. cube corner prism).

3.3
subassembly
combination of one or more *optical elements* (3.2) or of an optical element and a mechanical element including a mechanical interface to the superior system

EXAMPLE Doublets, triplets, cube or colour beamsplitters, or a lens element fixed in a barrel.

3.4
assembly
combination of *optical elements* (3.2), *subassemblies* (3.3), and/or mechanical parts

3.5
optical system
complete system providing a function with defined optical performance

3.6
optical axis
<optical system> theoretical axis which is given by the optical design and represents the central path for the main function of the *optical system* (3.5)

3.7
axis of symmetry
axis that connects the nominal centres of curvature of a series of *optical elements* (3.2)

Note 1 to entry: In a typical symmetrical optical system, the axis of symmetry and the *optical axis* (3.6) are the same.

Note 2 to entry: A symmetrical optical system which is used off axis has an optical axis which is not the axis of symmetry.

3.8
datum feature
real (non-ideal) integral feature used for establishing a *datum* (3.9)

Note 1 to entry: A datum feature should be accessible and of sufficient size to permit its use (such as the outer edge of the lens cylinder or a spherical surface).

Note 2 to entry: As datum features are subject to manufacturing imperfections and variations, it could be necessary, where appropriate, to specify tolerances of form to them (see ISO 5459).

[SOURCE: ISO 5459:2011, 3.2, modified — Note 1 and Note 2 from ISO 5459:2011, 3.2, are irrelevant for the purposes of this part of ISO 10110 and potentially confusing and therefore, have been omitted. For the purposes of this part of ISO 10110, instead, Note 1 to entry and Note 2 to entry have been added.]

3.9
datum
theoretically exact geometric reference (such as points, axes, planes, straight lines, etc.) to which toleranced features are related

Note 1 to entry: Datums can be based on one or more *datum features* (3.8) of a part.

3.10
common datum
datum (3.9) established from two or more *datum features* (3.8) considered simultaneously

Note 1 to entry: The two or more features are of equal order of priority (see ISO 5459).

[SOURCE: ISO 5459:2011, 3.9, modified — The Note from ISO 5459:2011, 3.9 is irrelevant for the purposes of this part of ISO 10110 and potentially confusing and therefore, has been omitted. For the purposes of this part of ISO 10110, instead, Note 1 to entry has been added.]

3.11
datum system
group of two or more separate *datums* (3.9) used as a combined reference for a toleranced feature

Note 1 to entry: The sequence of the indicated datums is of considerable influence on the resulting reference (see ISO 5459).

3.12
datum axis
theoretically exact axis based on one or more *datums* (3.9)

3.13
datum point
specified point on the *datum axis* (3.12)

Note 1 to entry: A datum point serves as an additional reference to the location of an *optical system* (3.5). The indication of the datum point is described in 5.2.

3.14
cylindrical datum feature
smallest circumscribed cylinder that contacts the edge of an *optical element* (3.2)

3.15
cylindrical datum
axis of the *cylindrical datum feature* (3.14)

3.16
spherical surface datum feature
best fit sphere of the *optical surface* (3.1) over the defined useable aperture

3.17
spherical datum
point defined by the *spherical surface datum feature's* (3.16) centre of curvature

3.18
tilt angle
<spherical surface> angle between the *datum axis* (3.12) and the normal to the surface at its intersection point with the datum axis

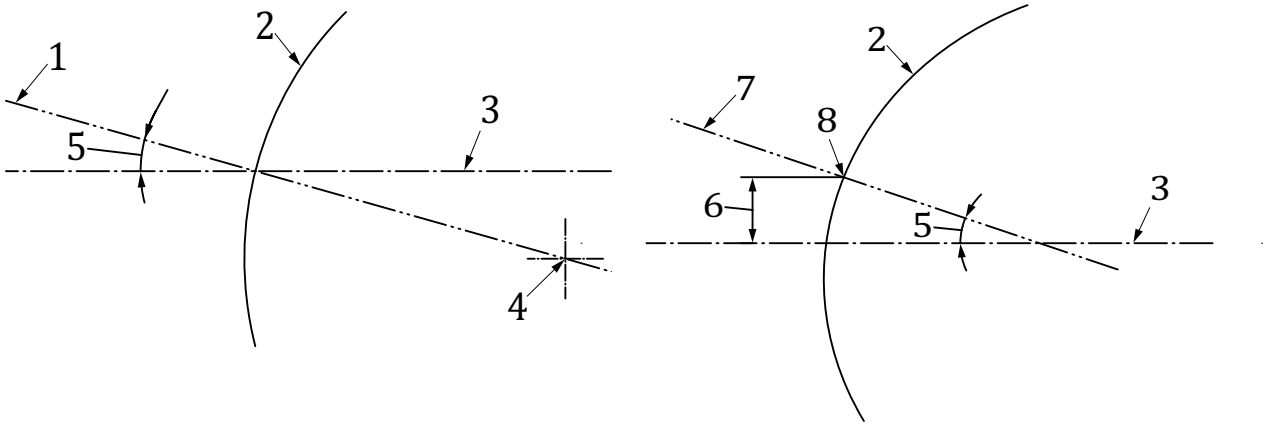
Note 1 to entry: See Figure 1a).

3.19
aspheric surface datum feature
best fit asphere to the *optical surface* (3.1)

3.20
aspheric datum system
combination of an axis defined by the *aspheric surface datum feature* (3.19) and the point of rotational symmetry which is the intersection of this axis with the best fit surface

Note 1 to entry: Depending on the grade of asphericity, it can be difficult to clearly differentiate between decentre and surface deviation (see Reference [3]).

3.21
tilt angle
<aspheric surface> angle between the rotation axis of the aspheric surface and the *datum axis* (3.12) of the part, *subassembly* (3.3), or system to which the aspheric surface belongs



a) Spherical surface **b) Aspheric surface**

Key

1 normal to the surface
2 surface
3 datum axis
4 centre of curvature
5 surface tilt angle
6 lateral displacement
7 aspheric datum axis
8 point of rotational symmetry

Figure 1 — Centring tolerances of a single spherical and aspheric surface

3.22
lateral displacement
<aspheric surface> distance from the point of rotational symmetry of the aspheric surface to the *datum axis* (3.12)

Note 1 to entry: See Figure 1b).

3.23
circular cylindrical surface datum feature
best fit circular cylinder to the *optical surface* (3.1)

Note 1 to entry: A circular cylindrical surface is a cylindrical surface whose cross-section perpendicular to its axis is a portion of a circle.

3.24
circular cylindrical datum
axis defined by the centre of curvature of the *circular cylindrical surface datum feature* (3.23)

3.25
tilt angle
<circular cylindrical surface> angle between the *datum system* (3.11) and the best fit circular cylinder to the surface at its intersection point with the datum axis

Note 1 to entry: Circular cylindrical surfaces typically require two tilt angles.

3.26
non-circular cylindrical surface datum feature
best fit non-circular cylinder to the *optical surface* (3.1)

Note 1 to entry: A non-circular cylindrical surface is a surface formed by the translation of a non-circular curve along a linear axis.

Note 2 to entry: The best fit defines the symmetry plane of the non-circular cylinder.

3.27
non-circular cylindrical datum system
combination of the plane of symmetry defined by the *non-circular cylindrical surface datum feature* (3.26) and the line of intersection of this plane and the best fit surface

3.28
tilt angles
<non-circular cylindrical surface> angles between the *non-circular cylindrical datum system* (3.27) and the *datum system* (3.11) of the part, *subassembly* (3.3), or system to which the surface belongs

Note 1 to entry: Non-circular cylindrical surfaces typically require three tilt angles.

3.29
lateral displacement
<non-circular cylindrical surface> distances from the *non-circular cylindrical datum system* (3.27) to the *datum system* (3.11) of the part, *subassembly* (3.3), or system to which the surface belongs

Note 1 to entry: Non-circular cylindrical surfaces typically require one lateral displacement value.

3.30
non-symmetrical surface
generalized surface defined by a function

3.31
non-symmetrical surface datum feature
best fit of the defining function to the *optical surface* (3.1)

Note 1 to entry: Depending on the defining function of the surface, it can be difficult to clearly differentiate between decentre and surface deviation.

3.32
non-symmetrical datum system
combination of three axes defined by the *non-symmetrical surface datum feature* (3.31)