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

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

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*Optique et photonique — Préparation des dessins pour éléments et
systèmes optiques —*

Partie 19: Description générale des surfaces et des composants

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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*.

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 19: General description of surfaces and components

1 Scope

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

This part of ISO 10110 provides a general method of describing surfaces and components. This part of ISO 10110 applies to continuous and discontinuous surfaces. It does not apply to diffractive surfaces, Fresnel surfaces, ophthalmic glasses, and micro-optical surfaces.

This part of ISO 10110 applies to any general surface or component, even including spherical or rotationally symmetric surfaces if it is necessary, i.e. when NURBS, splines, point clouds, etc. are used.

This part of ISO 10110 does not specify the method by which compliance with the specifications is to be tested.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 10110-5, *Optics and photonics — Preparation of drawings for optical elements and systems — Part 5: Surface form tolerances*

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

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

ISO 10110-8, *Optics and photonics — Preparation of drawings for optical elements and systems — Part 8: Surface texture; roughness and waviness*

ISO 10110-14, *Optics and photonics — Preparation of drawings for optical elements and systems — Part 14: Wavefront deformation tolerance*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1

general surface

any surface including those free from constraints of symmetry and/or form

Note 1 to entry: A general surface can be both a continuous as well as a discontinuous surface. It can contain local regular geometrical properties. In principle, any surface (e.g. conic sections, including the sphere) can be described by this part of ISO 10110 as a general surface. ISO 10110-12 offers a formalized and specific mathematical approach that is a more direct approach. The simplest description that fulfils the given requirements shall be used.

3.2

reference axis

theoretical axis given by the optical designer which does not depend on symmetries of the surface and which usually represents the centre of the optical path for the main function

Note 1 to entry: It should ensure a minimum of tolerance influence and enhance the flexibility for production. The reference axis cannot be changed and is defined once. The position and orientation of the reference axis is defined by measurable references at and/or on the general surface/component or by an approximation of the nominal surface.

3.3

transport formats

file formats for transfer of data between software systems and processing and measuring machines

EXAMPLE Typical transport formats are XML and STEP.

4 Referencing

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4.1 General

The general surface is referenced with the coordinate systems used in the process chain, e.g. to define centring tolerances according to ISO 5459. A general surface can have 3 essential coordinate systems as shown in [Figure 1](#):

- the origin of the mathematical description;
- the reference coordinate system at the intersection of reference axis and surface;
- the component reference points.

NOTE If the origin of the mathematical surface description is out of the used surface area, it can be useful to provide two separated reference axes; one reference axis for the production (e.g. fast tool servo machining axis) and one reference coordinate system for measuring. Although both coordinate systems have geometric meaning, they are not physical and thus useful to be referenced by the component reference points. The referencing establishes a clear reference of the general surface, both to coordinate systems of processing machines and measuring devices as well as higher-level assemblies.

For referencing, specifications shall be available for the clear orientation of the general surface according to its position and direction (6 degrees of freedom) relative to component reference points. For referencing planes, cylinders, cones, or spheres shall be included. Reference marks in the form of crosses, circles, or lines and combinations of the specified structures can also be used. The references may be in any position on the work piece. An example is illustrated in [Figure 1](#).

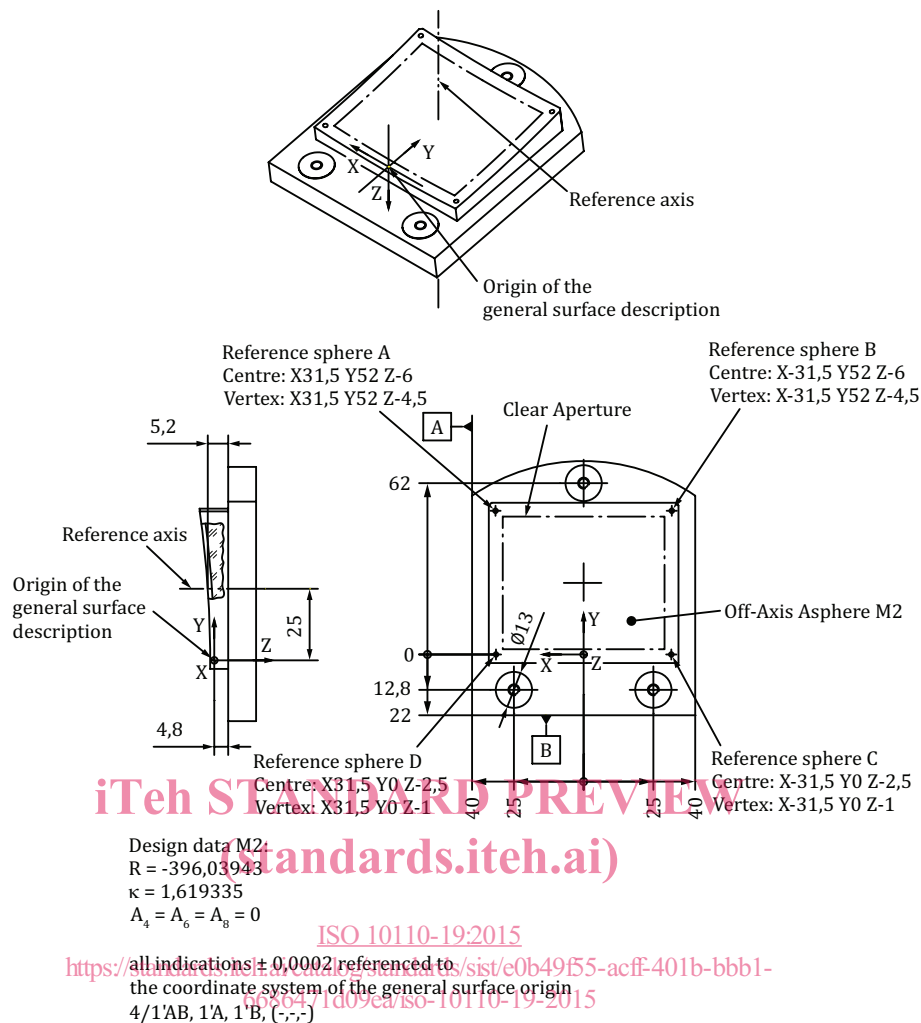


Figure 1 — Off-axis asphere drawn as general component with reference structures

4.2 Coordinate system

The coordinate system is in three axes (X, Y, Z) orthogonal to each other and follows the right hand rule (right-handed system). The coordinate origin should be on the reference axis and the general surface (see Figure 2). In this case, the Z-axis of the coordinate system will represent the reference axis. Once defined, the position and orientation of the coordinate system shall not be changed.

Unless otherwise specified, the Z-axis is in the plane of the drawing and runs from left to right. If only one cross-section is drawn, the Y-axis is in the plane of drawing and is oriented upwards.

If two cross-sections are drawn, the XZ cross-section shall appear below the YZ cross-section. For clarity, the X and Y axes can be shown on the drawing.

4.3 Sign convention

As laid down in later clauses of this part of ISO 10110, the various general surfaces are specified by mathematical equations or vectors. To achieve clear surface specifications, the following sign conventions for the constants, vectors, and coefficients shall be used.

The sagitta of a point on the general surface is positive if it lies in the positive Z direction from the XY plane and negative if it lies in the negative Z direction from the XY plane.

5 Drawing specifications

5.1 General

A general surface shall be represented in the same manner as a spherical component (see ISO 10110-1). The specification of the radius of curvature shall be replaced by the abbreviation “GS” (for “General Surface”).

The origin of the general surface shall be specified on the drawing.

The component references shall be marked and dimensioned to the coordinate system of the general surface.

The general surface may be represented in an exaggerated manner on the drawing to illustrate these factors. The part shall be marked accordingly. In addition, the drawing shall contain a sagitta table (see Table 1). It shall allow the point-by-point testing of the transferred surface form on the basis of Cartesian coordinates or Polar coordinates for Z , the sagitta, and S , the surface slope. The required accuracy and uniformly complete distribution shall be ensured in the point-by-point testing method. In addition to the sagitta, the slope is specified as a control value.

Table 1 — Example of a sagitta table

X	Y	Z	S	I	ΔS_x , 1-dim	ΔS_z , 2-dim
0,0	0,0	0,000 000	7,023 15°	—	—	—
5,0	0,0	7,231 564	1,213 64°	—	—	—
0,0	5,0	3,201 487	5,812 36°	—	—	—
5,0	5,0	3,024 566	2,847 48°	0,000 5	0,3'	0,1'
-5,0	5,0	4,558 790	1,834 70°	0,000 7	0,5'	0,3'
..
15	-10	12,345 300	668,2455 34°	0,001 0	0,9'	0,4'
					(1/0,1)	(4/0,2)

A note shall be added to the drawing indicating the selected form of mathematical description or a corresponding data file with the corresponding constants, vectors, and coefficients.

If there is no data file for exchanging data between CAD and other systems, the mathematical description shall be specified on the drawing. If there is a data file for exchanging data between CAD and other systems, it shall be specified on the 2D drawing of the individual part near the general surface. An unambiguous file name (e.g. date stamp, version number) including data file extension shall be given.

An example of the representation is shown in Figure 2.

5.2 Specification of surface form tolerances

Surface form tolerances shall be specified in one of the following ways:

- according to ISO 1101;
- according to ISO 10110-5 (code number 3/) or ISO 10110-14 (code number 13/);

NOTE According to ISO 10110-14, it is possible to specify only one tolerance for the deformation of the wavefront without any need to specify tolerances for individual surfaces.

- in a table that indicates the permissible form and slope deviations as well as sampling interval and integration length. The specification can be made in addition to the sagitta table.

In each of the three cases, the permissible slope deviation shall also be indicated as an absolute quantity in (X,Y) or (ρ, φ) . The local slope deviation is the local angle deviation of the normal of the real surface from the normal of the theoretical surface.

5.3 Specification of centring tolerances

Centring tolerances shall be specified according to ISO 1101 or ISO 10110-6.

5.4 Tolerance specifications for surface imperfections and surface texture

Tolerance specifications for surface imperfections and surface texture shall be made in accordance with ISO 10110-7 and ISO 10110-8.

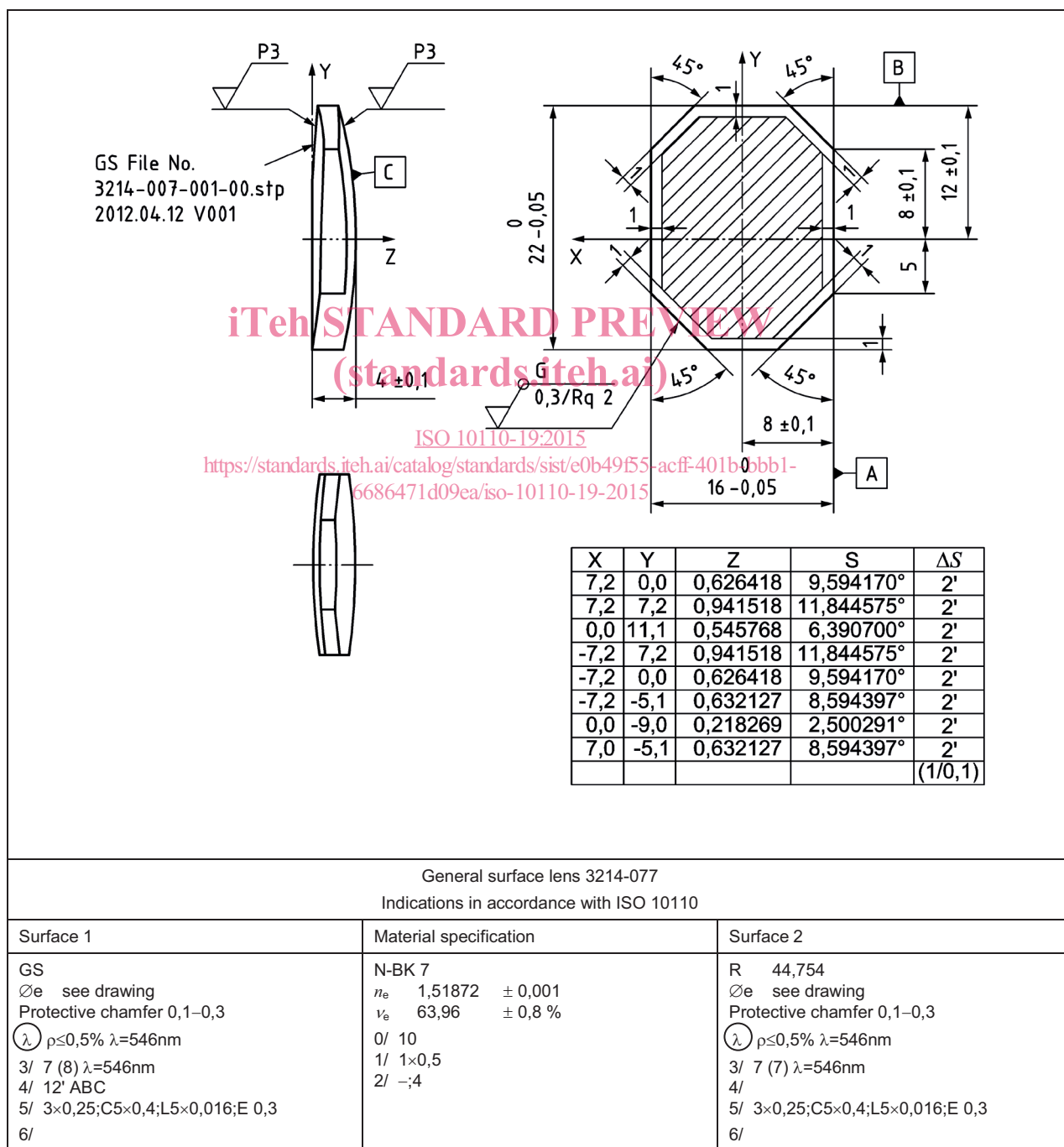


Figure 2 — Example of drawing of a general surface part including the specification of the data file on the drawing (alternatively in the labelling field for the relevant surface)