International Standard

ISO 20457

Plastics moulded parts — Tolerances and acceptance conditions

Moulages plastiques — Tolérances et conditions de réception

Second edition
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Foreword

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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 document 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).

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This document was prepared by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 11, *Products*.

This second edition cancels and replaces the first edition (ISO 20457:2018), which has been technically revised.

The main changes are as follows:

— Clause 1 has been formulated more precisely;

— Term 3.1 on design documentation has been replaced by a new term on product definition data set and its definition has been reformulated;

— Term 3.2, size, has been changed to "linear size";

— Clause 5 has been reworked including adding of new figures for a better understanding and improved user-friendliness;

— Clause 6, “Moulding compound properties” has been renamed as “Description of the technically possible accuracy”;

— Annex F has been reworked, Figure F.1 has been replaced, and a new Figure F.2 has been added.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document has two intentions. One intention is to give the part designer a guideline for producible tolerances. The other is to serve as a standard for general tolerances for all geometrical features as well as for direct tolerances (individual tolerances).

In comparison to metal materials, significantly larger deviations with respect to dimension, form and location are expected when manufacturing moulded parts. Based on particular properties, such as high deformability and low stiffness, the functional accuracy requirements in order to economically manufacture moulded parts are much lower for plastics than for metals.

The physical and chemical properties as well as the material modification options of plastics are vastly different from those of metals. Properties of plastics relevant to dimensional accuracy in the moulding application and during processing by the original mould method (injection moulding, compression moulding, rotational moulding) require a different evaluation and quantification of geometrical tolerances in comparison to metal materials. The tolerance standards applicable for metal parts, therefore, cannot be adopted for plastic structures or can only be applied to a very limited extent which led to the development of this document.

The unique properties of plastics mean that three different dimensional reference levels defined in Annex A and characterized in respect to the main influential factors are taken into consideration.

The following is the preferred sequence of steps to ensure effective cooperation in the effective design and development of moulded parts.

a) The part designer specifies the functionally required tolerances based on the application requirements including, part functionality, use environment, and any assembly requirements.

b) The moulded part manufacturer confirms that the functionally required tolerance is greater than or equal to the tolerance capability of the manufacturing technology to be used. This is to avoid impractical tolerances which cannot be achieved without incurring adverse economic or productivity effects. The functionally required tolerances is always defined in the product definition data set.

c) The functionally required tolerances shall always be defined in the product definition data set in order to establish the basis for determining the moulding shrinkage. This is to prevent situations in which the functionally required tolerances cannot be achieved, if at all, without excessive scrap generation and excessive costs. After order placement, calculated values with respect to the moulding shrinkage shall be agreed between the part manufacturer and toolmaker or tool designer, with consultation with the material supplier as necessary.

Dimensional control of the moulded part is primarily affected by the material specified, the part design and tool layout, and the processing conditions.

In addition to the factors affecting dimensional control, there are other factors which influence dimensions, part integrity and mechanical properties. These factors include anisotropic behaviour, warpage and distortion due to non-uniform thicknesses and resulting non-uniform cooling rates, and fill profiles. These factors and the basic complexity of polymer systems make standardization much more difficult in comparison to conventional materials such as metals.

Because of the unavoidable process-induced factors, deviations are therefore expected in the moulded part. The procedure in case of deviations depends on the function of the moulded part and is subject to mandatory contractual agreement:

— eliminate deviation by design measures (strengthening ribs, optimized material thickness, optimized fill profiles, etc.);

— correct deviation by specified retention in the tool, i.e. extended cooling cycles;

— acceptance of non-conformance.

NOTE 1 Process-induced deviations can be reduced both by effective design of the moulded part and by optimization of the production process.

NOTE 2 The conventional tolerance chain calculation presupposes rigid bodies and is therefore primarily unsuitable for plastic parts.

Plastics moulded parts — Tolerances and acceptance conditions

1 Scope

This document specifies geometrical and dimensional tolerances for plastic moulded parts including:

— limits of technical manufacturability according to the manufacturing effort for direct tolerances;

— general tolerances of plastic moulded parts;

— acceptance conditions of plastic moulded parts;

— modification of the drawing default according to ISO 8015, in accordance to the environmental conditions common in the plastics industry.

This document is applicable to non-porous moulded parts made from thermoplastics, thermoplastic elastomers and thermosets of thermoplastics, made by injection moulding, injection compression moulding, transfer moulding, compression moulding and rotational moulding. This document is applicable to other plastic processes, if agreed to by the contractual parties.

Moulded part surface imperfections such as sink marks, undesired flow structures and roughness, as well as joint lines are not addressed in this document.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 294-4, *Plastics — Injection moulding of test specimens of thermoplastic materials — Part 4: Determination of moulding shrinkage*

ISO 2577, *Plastics — Thermosetting moulding materials — Determination of shrinkage*

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

ISO 8015, *Geometrical product specifications (GPS) — Fundamentals — Concepts, principles and rules*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 8015 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
product definition data set
collection of one or more computer file(s) that discloses (directly or by reference), by means of graphic or textual presentations, or combinations of both, the physical and functional requirements of a product

Note 1 to entry: These are initially 3D data records and drawings as well as part lists. They might be supplemented by measuring and test specifications. 3D data records or drawings alone only fully describe plastic moulded parts in rare exceptional cases.

Note 2 to entry: The aim of a specification is to describe the function completely with GPS characteristics (ISO 8015). This is done by means of references, direct tolerancing and general tolerances.

[SOURCE: ISO 10209:2022, 3.1.70, modified — Notes 1 and 2 to entry have been added]

3.2
linear size
dimensional parameter considered variable for a feature of size that can be defined on a nominal feature or on an associated feature

Note 1 to entry: A linear size is e.g. the diameter of a cylinder or the distance between two parallel opposite planes, two opposing lines, and two concentric circles. Depending on the type of linear feature of size, the terms "diameter", "width", and "thickness" are synonyms for size. Distances in the sense of step dimensions are not size dimensions

[SOURCE: ISO 14405-1:2025, 3.2, modified — Term changed from "size" to "linear size", in Note 1 to entry the introductory phrase changed]

3.3
general tolerance
tolerance on geometrical elements used as default, if the element has no direct tolerance (individual tolerance)

4 Symbols and abbreviated terms

4.1 General

The symbols and abbreviated terms according to the ISO 1043 series, ISO 18064 and the following symbols and abbreviated terms apply for the application of this document.

4.2 Symbols

C	tolerance mean dimension
C_A	tolerance mean dimension for moulded part application
C_F	tolerance mean dimension for moulded part production
C_W	tolerance mean dimension for tool contour production
D_P	furthest distance in the space between the element to be toleranced and the origin of the datum system used for this positional tolerancing
L_F	moulded part dimension
L_W	tool contour dimension
N_F	nominal dimension for moulded part drawings
NW	non-tool-specific dimensions
P_g	total number of points

P_i	point evaluation of the individual influences
T	tolerance
t	form and location tolerance
T_A	moulded part application tolerance
T_F	moulded part production tolerance
T_W	tool contour production tolerance
S_M	moulding shrinkage
$S_{M\perp}$	moulding shrinkage transverse to the melt flow direction
S_{MII}	moulding shrinkage parallel to the melt flow direction
S_{Mmax}	maximum moulding shrinkage
S_{Mmin}	minimum moulding shrinkage
S_{MR}	average calculated value for the moulding shrinkage
W	tool-specific dimensions
ΔL	dimensional shift
ΔL_A	application-induced dimensional shift
ΔL_V	moulding-induced dimensional shift
ΔS	distribution of the moulding shrinkage
ΔS_M	difference between $S_{M\perp}$ and S_{MII}

4.3 Abbreviated terms

ABF	acceptance conditions for moulded part production
ABW	acceptance conditions for tool production
GA	maximum permissible deviation
IRHD	International Rubber Hardness Degree
ISIR	Initial Sample Inspection Report
IT	standard tolerance
TG	tolerance grade

5 Tolerancing of plastic moulded parts

5.1 General

Relevant functions of the part shall be toleranced directly in order to enable the part manufacturer to optimize his manufacturing process accordingly. Secondary functions can be toleranced by means of the general tolerance.

Due to the special properties of plastic moulded parts, the following entries shall be made, where appropriate, in or on the title block in the product definition data set (drawing) in addition to the direct tolerancing, the specification of the general tolerance class and the reference system for general tolerances:

— for non-rigid parts: ISO 10579 - NR, including additional restrained condition;

— if envelope principle is desired for linear size: Linear size ISO 14405Ⓔ.

Moulded part drawings or CAD data records correspond to the nominal geometry. The tolerances are symmetrical to the nominal geometry.

The procedure for the verification of tolerances shall be unambiguously defined and shall be a part of the contract. It is recommended to separate between Initial Sample Inspection Report (ISIR) and running production report (requalification). This may include or exclude the individual tolerances and general tolerances or specified functional tests (e.g. tightness, dielectric strength). If nothing has been stated in the contract, only individually indicated tolerances are subject for verification. The verification obligation of all toleranced surfaces for the initial sample approval refers to the measurement within the scope of the initial sample approval. This is to be stored as documented information.

Certain moulded parts, when removed from their manufacturing environment, can deform significantly from their defined limits owing to their weight, flexibility or the release of internal stresses resulting from the manufacturing processes.

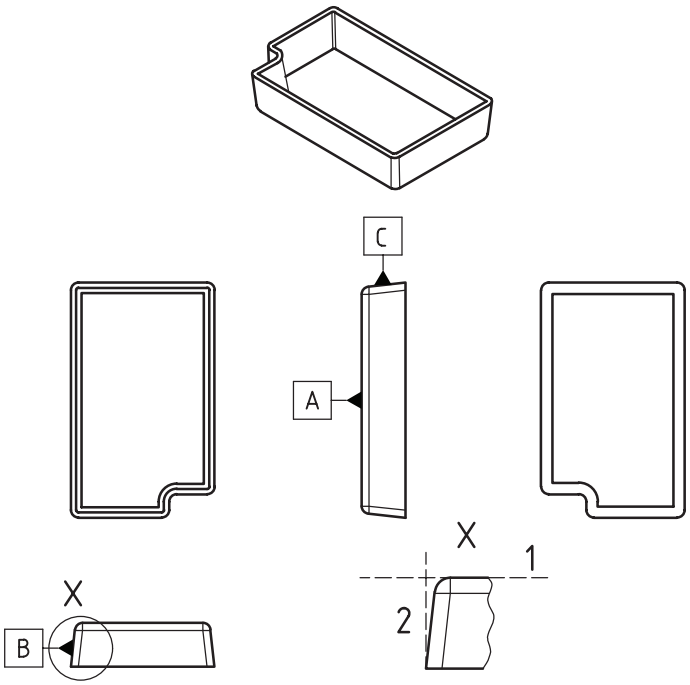
Functionally reasonable references with adequate form stiffness shall be specified.

In the case of non-rigid parts, the measuring concept is of special importance (functional orientation, datum system and overdetermination, gravitational influence, pretension, etc.). See also ISO 10579.

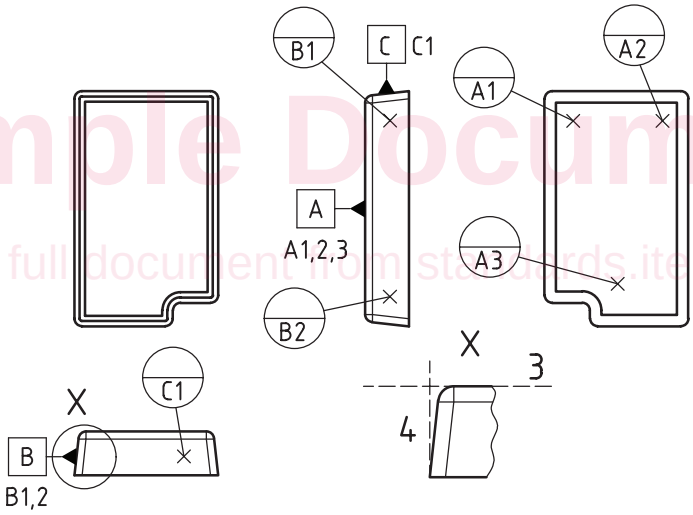
For the orientation of the part, datum target points or small datum target areas shall be used instead of datum features (e.g. complete planes).

Due to accuracy, integral references shall be created from reference points or as common references from small geometry elements.

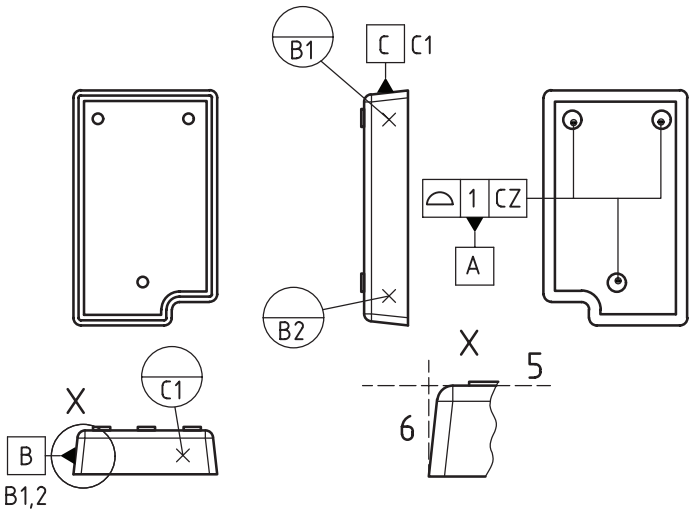
Figure 1 a) shows a reference system of reference elements. This is not optimal for moulded parts due to the draft angles, since the references are perpendicular to each other and thus only the edge is used for slanted secondary or tertiary references. In Figure 1 b), the reference system is formed from reference points. Since the moulded part is only aligned at points, the draft angles do not play a role. The design in Figure 1 c) also takes into account potential distortion of the surface at the primary reference (A-A) and reduces the reference to three small raised surfaces.



a) Inadequat reference system from reference elements



b) Reference system from reference points



c) Reference system from reference points suitable for plastics

Key

1	datum A
2	datum B
3	datum A
4	datum B
5	common datum A – A
6	datum B

Figure 1 — Datum systems

It is important that the datum system is stable.

NOTE 1 The datum system reflects the orientation of the part in the assembly.

NOTE 2 Reference elements or reference points on mould partition lines, ejector surfaces and inserts are critical regarding the reproducibility of the reference system.

In the case of parts moulded from dissimilar materials (e.g. over-moulding) or assemblies using multiple component parts moulded from different materials, a separate tolerance grade shall be specified for each material used. In the case of cross-material size dimensions, the more inaccurate material is the basis for determining the tolerance.

5.2 Composition of tolerance

Figure 2 gives an overview about the intentions and about the composition of tolerance.