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Plastics moulded parts — Tolerances and acceptance conditions

Moulages plastiques — Tolérances et conditions de réception

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Contents

Page

Foreword ... **iv**

Introduction ... **v**

1 Scope ... **1**

2 Normative references ... **1**

3 Terms and definitions ... **1**

4 Symbols and abbreviated terms ... **2**
4.1 General ... 2
4.2 Symbols ... 2
4.3 Abbreviated terms ... 3

5 Tolerancing of plastic moulded parts ... **3**
5.1 General ... 3
5.2 Composition of tolerance ... 6
5.3 Default settings ... 7
5.4 Direct tolerancing (individual tolerancing) ... 7
5.5 Draft angles ... 7
5.6 Dimensioning, tolerancing and measuring of radii ... 8
5.7 Specification of freeform surfaces ... 8

6 Description of the technically possible accuracy ... **8**
6.1 Moulding compound properties ... 8
6.1.1 General ... 8
6.1.2 Moulding shrinkage and shrinkage anisotropies ... 8
6.2 Moulded material stiffness or hardness ... 9

7 Dimensional and geometrical tolerancing ... **10**
7.1 Dimensional tolerancing ... 10
7.1.1 Tolerance grades for features of sizes ... 10
7.1.2 Determination of the tolerance grades ... 13
7.2 Geometrical tolerancing ... 16
7.3 Parting line/Tool offset ... 19
7.4 Tolerancing of angular dimensions ... 19

8 General tolerances ... **20**
8.1 General ... 20
8.2 Entry of the specification in the technical product documentation ... 20

9 Acceptance conditions for moulded part production (ABF) ... **21**

Annex A (informative) **Dimensional reference levels for application and production of the moulded parts** ... **22**

Annex B (informative) **Causes and influential factors on the moulding shrinkage of non-porous plastics** ... **24**

Annex C (informative) **Evaluation of the production expense** ... **25**

Annex D (informative) **Validation of machine, process and measuring instrumentation capability** ... **28**

Annex E (informative) **Main causes for dimension, form and location deviations in moulded part production** ... **29**

Annex F (informative) **Example for determining the D_P dimension for application of Table 9** ... **30**

Annex G (informative) **Feasible acceptance parameters** ... **32**

Bibliography ... **33**

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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 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.

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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.

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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.

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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/

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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

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