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Plastics moulded parts — Tolerances and acceptance conditions

Moulages plastiques — Tolérances et conditions de réception

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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 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).

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

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 61, *Plastics*.

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

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 should always be defined in the design documentation.

c) The functionally required tolerances should always be defined in the design documentation 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 cost. After order placement, calculated values with respect to the moulding shrinkage should 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.

The acceptance of non-conformance requires appropriate documentations including drawing corrections, production deviation documentations or updated reference parts.

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 possible manufacturing tolerances for plastic moulded parts.

This document specifies all integral features with general tolerances with surface profile tolerance within a specified datum system. It allows for additional specifications in case of functional needs and requirements using the ISO-GPS-tools for dimensional and geometrical tolerating.

This document addresses injection moulding, injection compression moulding, transfer moulding, compression moulding and rotational moulding of non-porous moulded parts made from thermoplastics, thermoplastic elastomers and thermosets of thermoplastics. 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.

This document is not intended to supplant, replace or in any way interfere with requirements for tolerances found in product standards.

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 286-1, *Geometrical product specifications (GPS) — ISO code system for tolerances on linear sizes — Part 1: Basis of tolerances, deviations and fits*

ISO 286-2, *Geometrical product specifications (GPS) — ISO code system for tolerances on linear sizes — Part 2: Tables of standard tolerance classes and limit deviations for holes and shafts*

ISO 291:2008, *Plastics — Standard atmospheres for conditioning and testing*

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

ISO 10135, *Geometrical product specifications (GPS) — Drawing indications for moulded parts in technical product documentation (TPD)*

ISO 14405-1, *Geometrical product specifications (GPS) — Dimensional tolerancing — Part 1: Linear sizes*

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 terminological databases for use in standardization at the following addresses:

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