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Plastics moulded parts — Tolerances and acceptance conditions

Moulages plastiques — Tolérances et conditions de réception

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— Term 3.1 on design documentation has been replaced by a new term on product definition data set and its definition has been reformulated;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

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