SLOVENSKI STANDARD
SIST EN ISO 2692:2015

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Nadomešča:
SIST EN ISO 2692:2007

Specifikacija geometrijskih veličin izdelka (GPS) - Toleriranje geometrijskih veličin - Zahteva po maksimalnem materialu, zahteva po minimalnem materialu in zahteva po usklajenosti materialov (ISO 2692:2014)

Geometrical product specifications (GPS) - Geometrical tolerancing - Maximum material requirement (MMR), least material requirement (LMR) and reciprocity requirement (RPR) (ISO 2692:2014)

Geometrische Produktspezifikation (GPS) - Form- und Lagetolerierung - Maximum-Material-Bedingung (MMR), Minimum-Material-Bedingung (LMR) und Reziprozitätsbedingung (ISO 2692:2014)

Spécification géométrique des produits (GPS) - Tolérancement géométrique - Exigence du maximum de matière (MMR), exigence du minimum de matière (LMR) et exigence de réciprocité (RPR) (ISO 2692:2014)

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17.040.30	Merila	Measuring instruments

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English Version

Geometrical product specifications (GPS) - Geometrical tolerancing - Maximum material requirement (MMR), least material requirement (LMR) and reciprocity requirement (RPR) (ISO 2692:2014)

Spécification géométrique des produits (GPS) - Tolérancement géométrique - Exigence du maximum de matière (MMR), exigence du minimum de matière (LMR) et exigence de réciprocité (RPR) (ISO 2692:2014)

Geometrische Produktspezifikation (GPS) - Geometrische Tolerierung - Maximum-Material-Bedingung (MMR), Minimum-Material-Bedingung (LMR) und Reziprozitätsbedingung (RPR) (ISO 2692:2014)

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COMITÉ EUROPÉEN DE NORMALISATION
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Foreword

This document (EN ISO 2692:2014) has been prepared by Technical Committee ISO/TC 213 "Dimensional and geometrical product specifications and verification" in collaboration with Technical Committee CEN/TC 290 “Dimensional and geometrical product specification and verification” the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2015, and conflicting national standards shall be withdrawn at the latest by June 2015.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

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Endorsement notice

The text of ISO 2692:2014 has been approved by CEN as EN ISO 2692:2014 without any modification.

INTERNATIONAL STANDARD

ISO 2692

Third edition
2014-12-15

Geometrical product specifications (GPS) — Geometrical tolerancing — Maximum material requirement (MMR), least material requirement (LMR) and reciprocity requirement (RPR)

Spécification géométrique des produits (GPS) — Tolérancement géométrique — Exigence du maximum de matière (MMR), exigence du minimum de matière (LMR) et exigence de réciprocité (RPR)

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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).

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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 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 213, *Dimensional and geometrical product specifications and verification*.

This third edition cancels and replaces the second edition (ISO 2692:2006), of which subclauses 3.10, 4.1, 4.2.1 (rule D), 4.2.2 (rule G), 4.3.1 (rule K), 4.3.2 (rule N) and Annex A have been revised.

Introduction

0.1. General

This International Standard is a geometrical product specification (GPS) standard and is to be regarded as a general GPS standard (see ISO/TR 14638). It influences the chain links 1, 2 and 3 of the chain of standards on size of linear "features of size" and form of a line (independent/dependent of a datum), form of a surface (independent/dependent of a datum), orientation and location of derived features based on "features of size" and datums also based on "features of size".

The ISO GPS Masterplan given in ISO/TR 14638 gives an overview of the ISO GPS system of which this document is a part. The fundamental rules of ISO GPS given in ISO 8015 apply to this document and the default decision rules given in ISO 14253-1 apply to specifications made in accordance with this document, unless otherwise indicated.

For more detailed information on the relation of this International Standard to the GPS matrix model, see Annex C.

This International Standard covers some frequently occurring workpiece functional cases in design and tolerancing. The "maximum material requirement", MMR, covers "assembleability" and the "least material requirement", LMR, covers, for example, "minimum wall thickness" of a part. Each requirement (MMR and LMR) combines two independent requirements into one collective requirement, which more accurately simulates the intended function of the workpiece. In some cases of both MMR and LMR, the "reciprocity requirement", RPR, can be added.

NOTE In ISO GPS standards, threaded features are often considered as features of size of type cylinder. However, no rules are defined in this International Standard for how to apply MMR, LMR and RPR to threaded features. Consequently, the tools defined in this International Standard cannot be used for threaded features.

0.2 Information about maximum material requirement, MMR

The assembly of parts depends on the combined effect of

a) the size (of one or more extracted features of size), and

b) the geometrical deviation of the (extracted) features and their derived features, such as the pattern of bolt holes in two flanges and the bolts securing them.

The minimum assembly clearance occurs when each of the mating features of size is at its maximum material size (e.g. the largest bolt size and the smallest hole size) and when the geometrical deviations (e.g. the form, orientation and location deviations) of the features of size and their derived features (median line or median surface) are also at their maximum. Assembly clearance increases to a maximum when the sizes of the assembled features of size are furthest from their maximum material sizes (e.g. the smallest shaft size and the largest hole size) and when the geometrical deviations (e.g. the form, orientation and location deviations) of the features of size and their derived features are zero. It therefore follows that if the sizes of one mating part do not reach their maximum material size, the indicated geometrical tolerance of the features of size and their derived features may be increased without endangering the assembly to the other part.

This assembly function is controlled by the maximum material requirement. This collective requirement is indicated on drawings by the symbol Ⓜ.

0.3 Information about least material requirement, LMR

The least material requirement is designed to control, for example, the minimum wall thickness, thereby preventing breakout (due to pressure in a tube), the maximum width of a series of slots, etc. It is indicated on drawings by the symbol Ⓛ. The least material requirement is also characterized by a collective requirement for the size of a feature of size, the geometrical deviation of the feature of size (form deviations) and the location of its derived feature.

0.4 Information about reciprocity requirement, RPR

The reciprocity requirement is an additional requirement, which may be used together with the maximum material requirement and the least material requirement in cases where it is permitted — taking into account the function of the toleranced feature(s) — to enlarge the size tolerance when the geometrical deviation on the actual workpiece does not take full advantage of, respectively, the maximum material virtual condition or the least material virtual condition.

The reciprocity requirement is indicated on the drawing by the symbol Ⓡ.

0.5 General information about terminology and figures

The terminology and tolerancing concepts in this International Standard have been updated to conform to GPS terminology, notably that in ISO 286-1, ISO 14405-1, ISO 14660-2:1999 and ISO 17450-1:2011.

Geometrical product specifications (GPS) — Geometrical tolerancing — Maximum material requirement (MMR), least material requirement (LMR) and reciprocity requirement (RPR)

1 Scope

This International Standard defines the maximum material requirement, the least material requirement and the reciprocity requirement. These requirements can only be applied to features of size.

These requirements are used to control specific functions of workpieces where size and geometry are interdependent, e.g. to fulfil the functions "assembly of parts" (for maximum material requirement) or "minimum wall thickness" (for least material requirement). However, the maximum material requirement and least material requirement are also used to fulfil other functional design requirements.

Considering this interdependence between size and geometry, the *principle of independency* defined in ISO 8015 does not apply when the maximum material requirement, least material requirement, or reciprocity requirement, are used.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 1101:2012, *Geometrical product specifications (GPS) — Geometrical tolerancing — Tolerances of form, orientation, location and run-out*

ISO 5459:2011, *Geometrical product specifications (GPS) — Geometrical tolerancing — Datums and datum systems*

ISO 14405-1:2010, *Geometrical product specifications (GPS) — Dimensional tolerancing — Part 1: Linear sizes*

ISO 14660-2:1999, *Geometrical Product Specifications (GPS) — Geometrical features — Part 2: Extracted median line of a cylinder and a cone, extracted median surface, local size of an extracted feature*

ISO 17450-1:2011, *Geometrical product specifications (GPS) — General concepts — Part 1: Model for geometrical specification and verification*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5459:2011, ISO 14405-1:2010, ISO 14660-2:1999, ISO 17450-1:2011 and the following apply.

3.1
integral feature
geometrical feature belonging to the real surface of the workpiece or to a surface model

Note 1 to entry: An integral feature is intrinsically defined, e.g. skin of the workpiece.

Note 2 to entry: Adapted from ISO 17450-1:2011, definition 3.3.5.

3.2
feature of size
feature of linear size
geometrical feature, having one or more intrinsic characteristics, only one of which may be considered as variable parameter, that additionally is a member of a "one parameter family", and obeys the monotonic containment property for that parameter

Note 1 to entry: Adapted from ISO 17450-1:2011, definition 3.3.1.5.1. See also ISO 22432:2011, definitions 3.2.5.1.1.1 and 3.2.5.1.1.2 for "one parameter family" and "monotonic containment property".

EXAMPLE 1 A single cylindrical hole or shaft is a feature of linear size. Its linear size is its diameter.

EXAMPLE 2 Two opposite parallel plane surfaces are a feature of linear size. Its linear size is the distance between the two parallel planes.

3.3
derived feature
geometrical feature, which does not exist physically on the real surface of the workpiece and which is not natively a nominal integral feature

Note 1 to entry: A derived feature can be established from a nominal feature, an associated feature, or an extracted feature. It is qualified respectively as a nominal derived feature, an associated derived feature, or an extracted derived feature.

Note 2 to entry: The centre point, the median line and the median surface defined from one or more integral features are types of derived features.

Note 3 to entry: Adapted from ISO 17450-1:2011, definition 3.3.6.

EXAMPLE 1 The median line of a cylinder is a derived feature obtained from the cylinder surface, which is an integral feature. The axis of the nominal cylinder is a nominal derived feature.

EXAMPLE 2 The median surface of two opposite parallel plane surfaces is a derived feature obtained from the two parallel plane surfaces, which constitute an integral feature. The median plane of the nominal two opposite parallel planes is a nominal derived feature.

3.4
maximum material condition
MMC
state of the considered extracted feature, where the feature of size is at that limit of size where the material of the feature is at its maximum everywhere, e.g. minimum hole diameter and maximum shaft diameter

Note 1 to entry: The term maximum material condition, MMC, is used in this International Standard to indicate, at ideal or nominal feature level (see ISO 17450-1), which limit of the requirement (upper or lower) is concerned.

Note 2 to entry: The size of the extracted feature at maximum material condition, MMC, can be defined by default, or by several special definitions of the size of the extracted feature (see ISO 14405-1).

Note 3 to entry: The maximum material condition, MMC, as defined in this International Standard, can be used unambiguously with any definition of size of the extracted feature.

3.5
maximum material size
MMS
l_{MMS}
dimension defining the maximum material condition of a feature

Note 1 to entry: Maximum material size, MMS, can be defined by default or by one of several special definitions of the size of the extracted feature (see ISO 14405-1 and ISO 14660-2).

Note 2 to entry: In this International Standard, maximum material size, MMS is used as a numerical value, therefore no specific definition of the extracted size is needed to permit unambiguous use of maximum material size, MMS.

Note 3 to entry: See Annex A.

3.6
least material condition
LMC
state of the considered extracted feature, where the feature of size is at that limit of size where the material of the feature is at its minimum everywhere, e.g. maximum hole diameter and minimum shaft diameter

Note 1 to entry: The term least material condition, LMC, is used in this International Standard to indicate, at the ideal or nominal feature level (see ISO 17450-1), which limit of the requirement (upper or lower) is concerned.

Note 2 to entry: The size at least material condition, LMC, can be defined by default or by several special definitions of the size of extracted feature (see ISO 14405-1 and ISO 14660-2).

Note 3 to entry: The least material condition, LMC, as defined in this International Standard, can be used unambiguously with any definition of size of the extracted feature.

3.7
least material size
LMS
l_{LMS}
dimension defining the least material condition of a feature

Note 1 to entry: Least material size, LMS, can be defined by default or by one of several special definitions of the size of the extracted feature (see ISO 14405-1 and ISO 14660-2).

Note 2 to entry: In this International Standard, least material size, LMS, is used as a numerical value, therefore no specific definition of the extracted size is needed to permit unambiguous use of least material size, LMS.

Note 3 to entry: See Annex A.

3.8
maximum material virtual size
MMVS
l_{MMVS}
size generated by the collective effect of the maximum material size, MMS, of a feature of size and the geometrical tolerance (form, orientation or location) given for the derived feature of the same feature of size

Note 1 to entry: Maximum material virtual size, MMVS, is a parameter for size used as a numerical value connected to maximum material virtual condition, MMVC.

Note 2 to entry: For external features, MMVS is the sum of MMS and the geometrical tolerance, whereas for internal features, it is the difference between MMS and the geometrical tolerance.

Note 3 to entry: The MMVS for external features of size, $l_{MMVS,e}$, is given by Formula (1):

$$l_{MMVS,e} = l_{MMS} + \delta \quad (1)$$

and the MMVS for internal features of size, $l_{MMVS,i}$, is given by Formula (2):

$$l_{MMVS,i} = l_{MMS} - \delta \quad (2)$$

where

l_{MMS} is the maximum material size;

δ is the geometrical tolerance.