



SLOVENSKI STANDARD SIST EN ISO 2692:2007

01-april-2007

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NU HJ Udc`a U_g]a UbYa `a UYf]Ui žnU HJ Udc`a]b]a UbYa `a UYf]Ui]b`nU HJ U
dc`a UYf]Ub]i g_`UYbcgh]fGC`&* - &\$\$*Ł

Geometrical product specifications (GPS) - Geometrical tolerancing - Maximum material requirement (MMR), least material requirement (LMR) and reciprocity requirement (RPR) (ISO 2692:2006)

Geometrische Produktspezifikation (GPS) - Form- und Lagetolerierung - Maximum-Material-Bedingung (MMR), Minimum-Material-Bedingung (LMR) und Reziprozitätsbedingung (RPR) (ISO 2692:2006)

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 2692:2006)

Ta slovenski standard je istoveten z: EN ISO 2692:2006

ICS:

01.100.20 Konstrukcijske risbe Mechanical engineering drawings

SIST EN ISO 2692:2007 en

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ICS 01.100.20

English Version

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tolerancing - Maximum material requirement (MMR), least
material requirement (LMR) and reciprocity requirement (RPR)
(ISO 2692:2006)

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Lagetolerierung - Maximum-Material-Bedingung (MMR),
Minimum-Material-Bedingung (LMR) und
Reziprozitätsbedingung (RPR) (ISO 2692:2006)

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Foreword

This document (EN ISO 2692:2006) 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of an identical text or by endorsement, at the latest by June 2007, and conflicting national standards shall be withdrawn at the latest by June 2007.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

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The text of ISO 2692:2006 has been approved by CEN as EN ISO 2692:2006 without any modifications.

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**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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Published in Switzerland

Contents

Page

Foreword.....	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms and definitions.....	2
4 Maximum material requirement, MMR and least material requirement, LMR.....	5
4.1 General.....	5
4.2 Maximum material requirement, MMR.....	5
4.3 Least material requirement, LMR.....	7
5 Reciprocity requirement, RPR.....	9
5.1 General.....	9
5.2 Reciprocity requirement and maximum material requirement	9
5.3 Reciprocity requirement and least material requirement.....	9
Annex A (informative) Examples of tolerancing with M , L and R	10
Annex B (informative) Concept diagram.....	29
Annex C (informative) Relation to the GPS matrix model.....	30
Bibliography	31

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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

ISO 2692 was prepared by Technical Committee ISO/TC 213, *Dimensional and geometrical product specifications and verification*.

This second edition cancels and replaces the first edition (ISO 2692:1988), which has been technically revised. It also incorporates the Amendment ISO 2692:1988/Amd.1:1992.

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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, orientation or location of derived features based on “features of size”.

For more detailed information of 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 tolerance 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.

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. The collective requirement is indicated on drawings by the symbol M .

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 L . The least material requirement is also characterised 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 286-1:1998, ISO 14405:—, ISO 14660-1:1999, ISO 14660-2:1999 and ISO/TS 17450-1:2005.

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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, and specifies their applications.

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) and “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.

2 Normative references

The following referenced documents are indispensable for the application 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.

- [SIST EN ISO 2692:2007](#)
[https://standards.itec.ai/standards/iso-2692-2006/iso-2692-2007/01bcd38b286/sist-en-iso-2692-2007](#)
- ISO 286-1:1988, *ISO system of limits and fits — Part 1: Bases of tolerances, deviations and fits*
- ISO 1101:2004, *Geometrical Product Specifications (GPS) — Geometrical tolerancing — Tolerances of form, orientation, location and run-out*
- ISO 5459:—¹, *Geometrical product specifications (GPS) — Geometrical tolerancing — Datums and datum-systems*
- ISO 14405:—², *Geometrical Product Specifications (GPS) — Dimensional tolerancing — Linear sizes*
- ISO 14660-1:1999, *Geometrical Product Specifications (GPS) — Geometrical features — Part 1: General terms and definitions*
- 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/TS 17450-1:2005, *Geometrical Product Specifications (GPS) — General concepts — Part 1: Model for geometrical specification and verification*

1) To be published. (Revision of ISO 5459:1981)

2) To be published.

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 286-1:1998, ISO 14405:—, ISO 14660-1:1999, ISO 14660-2:1999, ISO/TS 17450-1:2005 and the following apply.

3.1 feature of size

geometrical shape defined by a linear or angular dimension which is a size

[ISO 14660-1:1999]

3.2 derived feature

centrepoint, median line or median surface from one or more integral features

[ISO 14660-1:1999]

3.3 integral feature

surface or line on a surface

NOTE An integral feature is intrinsically defined.

[ISO 14660-1:1999]

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 The term maximum material condition, MMC, is used in this International Standard to indicate, at ideal or nominal feature level (see ISO/TS 17450-1 and ISO 14660-1 respectively), which upper or lower limit of the requirement is concerned.

NOTE 2 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 and ISO 14660-2).

NOTE 3 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

See Annex A.

NOTE 1 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 and ISO 14660-2).

NOTE 2 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.

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 The term least material condition, LMC, is used in this International Standard to indicate, at the ideal or nominal feature level (see ISO/TS 17450-1 and ISO 14660-1 respectively), which end (upper or lower) of the requirement is concerned.

NOTE 2 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 and ISO 14660-2).

NOTE 3 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

See Annex A.

NOTE 1 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 and ISO 14660-2).

NOTE 2 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.

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

NOTE 2 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 The MMVS for external features of size, $l_{MMVS,e}$, is given by Equation (1):

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

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

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

where

l_{MMS} is the maximum material size

δ is the geometrical tolerance.

3.9

maximum material virtual condition

MMVC

state of associated feature of maximum material virtual size, MMVS

See Annex A.

NOTE 1 Maximum material virtual condition, MMVC, is a perfect form condition of the feature.