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

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**EESTI STANDARDI EESSÕNA** **NATIONAL FOREWORD**

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| Käesolev Eesti standard EVS-EN ISO 2692:2007 sisaldab Euroopa standardi EN ISO 2692:2006 ingliskeelset teksti.<br><br>Käesolev dokument on jõustatud 29.01.2007 ja selle kohta on avaldatud teade Eesti standardiorganisatsiooni ametlikus väljaandes.<br><br>Standard on kättesaadav Eesti standardiorganisatsioonist. | This Estonian standard EVS-EN ISO 2692:2007 consists of the English text of the European standard EN ISO 2692:2006.<br><br>This document is endorsed on 29.01.2007 with the notification being published in the official publication of the Estonian national standardisation organisation.<br><br>The standard is available from Estonian standardisation organisation. |

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|---|---|
| **Käsitlusala:**<br>This International Standard defines the maximum material requirement, the least material requirement, the reciprocity requirement and specifies their applications. The use of these requirements is to control specific functions of workpieces where there is a mutual dependence of size and geometry, for fulfilling the function assembly of parts (for maximum material requirement) and e.g. for fulfilling the function minimum wall thickness (for least material requirement). However the maximum material requirement and least material requirement may be used to fulfill other functional design requirements. | **Scope:**<br>This International Standard defines the maximum material requirement, the least material requirement, the reciprocity requirement and specifies their applications. The use of these requirements is to control specific functions of workpieces where there is a mutual dependence of size and geometry, for fulfilling the function assembly of parts (for maximum material requirement) and e.g. for fulfilling the function minimum wall thickness (for least material requirement). However the maximum material requirement and least material requirement may be used to fulfill other functional design requirements. |

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

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

This European Standard was approved by CEN on 25 November 2006.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

**Management Centre: rue de Stassart, 36 B-1050 Brussels**



Ref. No. EN ISO 2692:2006: E

## 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.

### Endorsement notice

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

INTERNATIONAL STANDARD

**ISO 2692**

Second edition
2006-12-15

# 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.

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.



 

# 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 Ⓜ.

## 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 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.

# 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.

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.