# 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

## EESTI STANDARDI EESSÕNA

## NATIONAL FOREWORD

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| Standard on kinnitatud Eesti Standardikeskuse 30.09.2010 käskkirjaga ja jõustub sellekohase teate avaldamisel EVS Teatajas. | This standard is ratified with the order of Estonian Centre for Standardisation   dated 30.09.2010  and is endorsed with the notification published in the official bulletin of the Estonian national standardisation organisation. |
| Euroopa standardimisorganisatsioonide poolt rahvuslikele liikmetele Euroopa standardi teksti kättesaadavaks tegemise kuupäev on 15.06.2010. | Date of Availability of the European standard text 15.06.2010. |
| Standard on kättesaadav Eesti standardiorganisatsioonist. | The standard is available from Estonian standardisation organisation. |

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EUROPEAN STANDARD

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# EN ISO 286-2

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English Version

# 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 286-2:2010)

Spécification géométrique des produits (GPS) - Système de codification ISO pour les tolérances sur les tailles linéaires - Partie 2: Tableaux des classes de tolérance normalisées et des écarts limites des alésages et des arbres (ISO 286-2:2010)

Geometrische Produktspezifikation (GPS) - ISO-Toleranzsystem für Längenmaße - Teil 2: Tabellen der Grundtoleranzgrade und Grenzabmaße für Bohrungen und Wellen (ISO 286-2:2010)

This European Standard was approved by CEN on 15 May 2010.

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# Foreword

This document (EN ISO 286-2:2010) 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of an identical text or by endorsement, at the latest by December 2010, and conflicting national standards shall be withdrawn at the latest by December 2010.

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.

This document supersedes EN 20286-2:1993.

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## Endorsement notice

The text of ISO 286-2:2010 has been approved by CEN as a EN ISO 286-2:2010 without any modification.

# Contents

# Introduction

This part of ISO 286 is a geometrical product specification (GPS) standard and is to be regarded as a general GPS standard (see ISO/TR 14638). It influences chain links 1 and 2 of the chain of standards on size in the general GPS matrix.

For more detailed information on the relationship of this part of ISO 286 to the GPS matrix model, see Annex B.

The need for limits and fits for machined workpieces was brought about mainly by the requirement for interchangeability between mass-produced parts and the inherent inaccuracy of manufacturing methods, coupled with the fact that "exactness" of size was found to be unnecessary for most workpiece features. In order that the fit function could be satisfied, it was found sufficient to manufacture a given workpiece so that its size lay within two permissible limits, i.e. a tolerance, this being the variation in size acceptable in manufacture while ensuring the functional fit requirements of the product.

Similarly, where a specific fit condition is required between mating features of two different workpieces, it is necessary to ascribe an allowance, either positive or negative, to the nominal size to achieve the required clearance or interference. ISO 286 gives the internationally accepted code system for tolerances on linear sizes. It provides a system of tolerances and deviations suitable for two types of feature: "cylinder" and "two parallel opposite surfaces". The main intention of this code system is the fulfilment of the function fit.

The terms "hole", "shaft" and "diameter" are used to designate the types of feature of cylinders (e.g. for the tolerancing of the diameter of a hole or shaft). For simplicity, they are also used for two parallel opposite surfaces (e.g. for the tolerancing of the thickness of a key or the width of a slot).

The pre-condition for the application of the ISO code system for tolerances on linear sizes for the features forming a fit is that the nominal sizes of the hole and the shaft are identical.

The previous edition of ISO 286-2 (published in 1988) had the envelope criterion as the default association criterion for the size of a feature; however, ISO 14405-1 changes this default association criterion to the two-point size criterion. This means that form is no longer controlled by the default specification of size.

In many cases, the diameter tolerances specified in this part of ISO 286 are not sufficient for effective control of the intended function of the fit. The envelope criterion specified in ISO 14405-1 may be required. In addition, the use of geometrical form tolerances and surface texture requirements may improve the control of the intended function.

A general graphical representation of the relationship between the respective tolerance classes and their deviations is given in Annex A.

# 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

## 1 Scope

This part of ISO 286 gives values of the limit deviations for commonly used tolerance classes for holes and shafts calculated from the tables given in ISO 286-1. This part of ISO 286 covers values for the upper limit deviations $ES$ (for holes) and $es$ (for shafts), and the lower limit deviations $EI$ (for holes) and $ei$ (for shafts) (see Figures 1 and 2).

NOTE        In the tables of limit deviations, the values of the upper limit deviation $ES$ or $es$ are shown above the values of the lower limit deviation $EI$ or $ei$ except for tolerance classes JS and js which are symmetrical about the zero line.

The ISO system for tolerances on linear size provides a system of tolerances and deviations suitable for features of the following types:

a)   cylinders;

b)   two parallel opposite surfaces.

For simplicity, and also because of the importance of cylindrical workpieces of circular section, only these are referred to explicitly. It should be clearly understood, however, that the tolerances and deviations given in this part of ISO 286 equally apply to workpieces of other than circular sections.

In particular, the term "hole" or "shaft" is used to designate features of the cylinder type (e.g. for the tolerancing of the diameter of a hole or shaft) and, for simplicity, these terms are also used for two parallel opposite surfaces (e.g. for the tolerancing of the thickness of a key or the width of a slot).

For further information on terminology, symbols, the basis of the system, etc., see ISO 286-1.
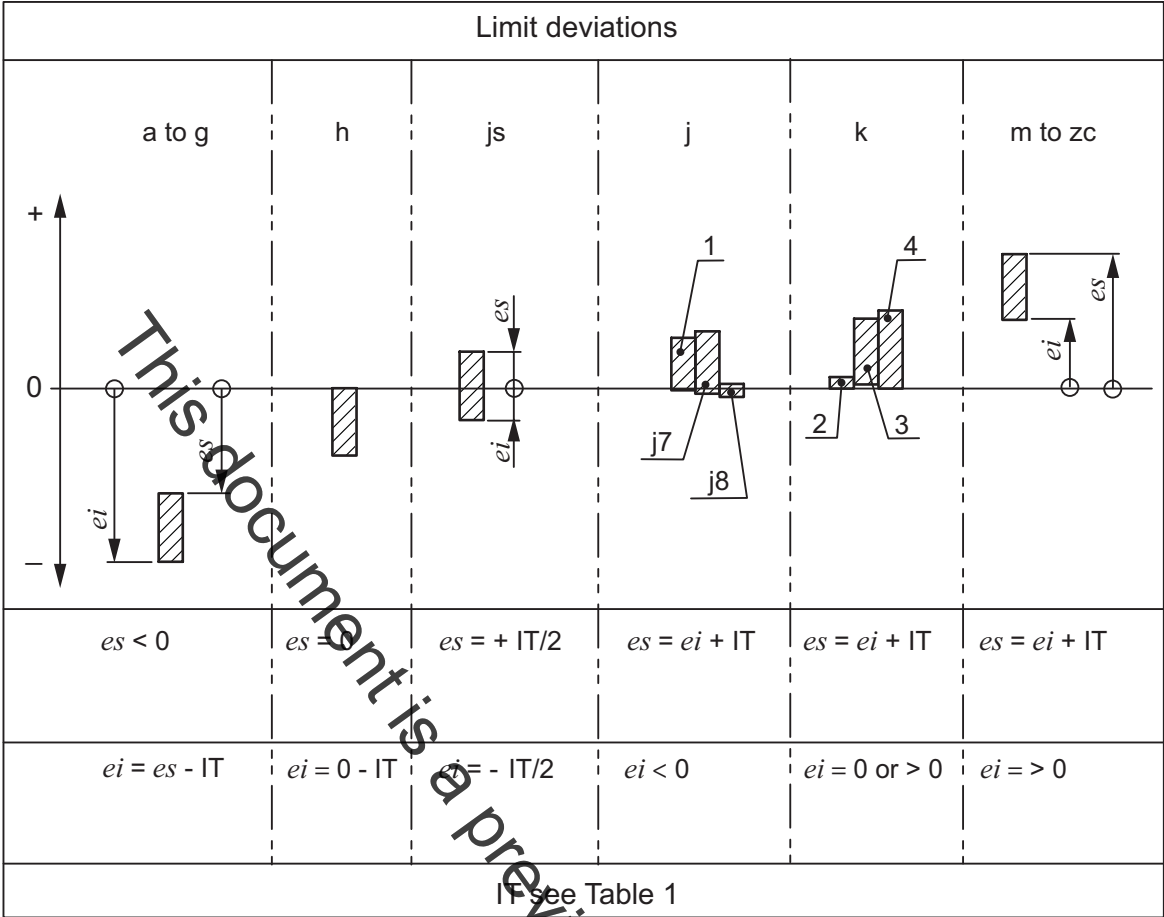
**Figure 1 — Upper and lower limit deviations for holes (internal features)**
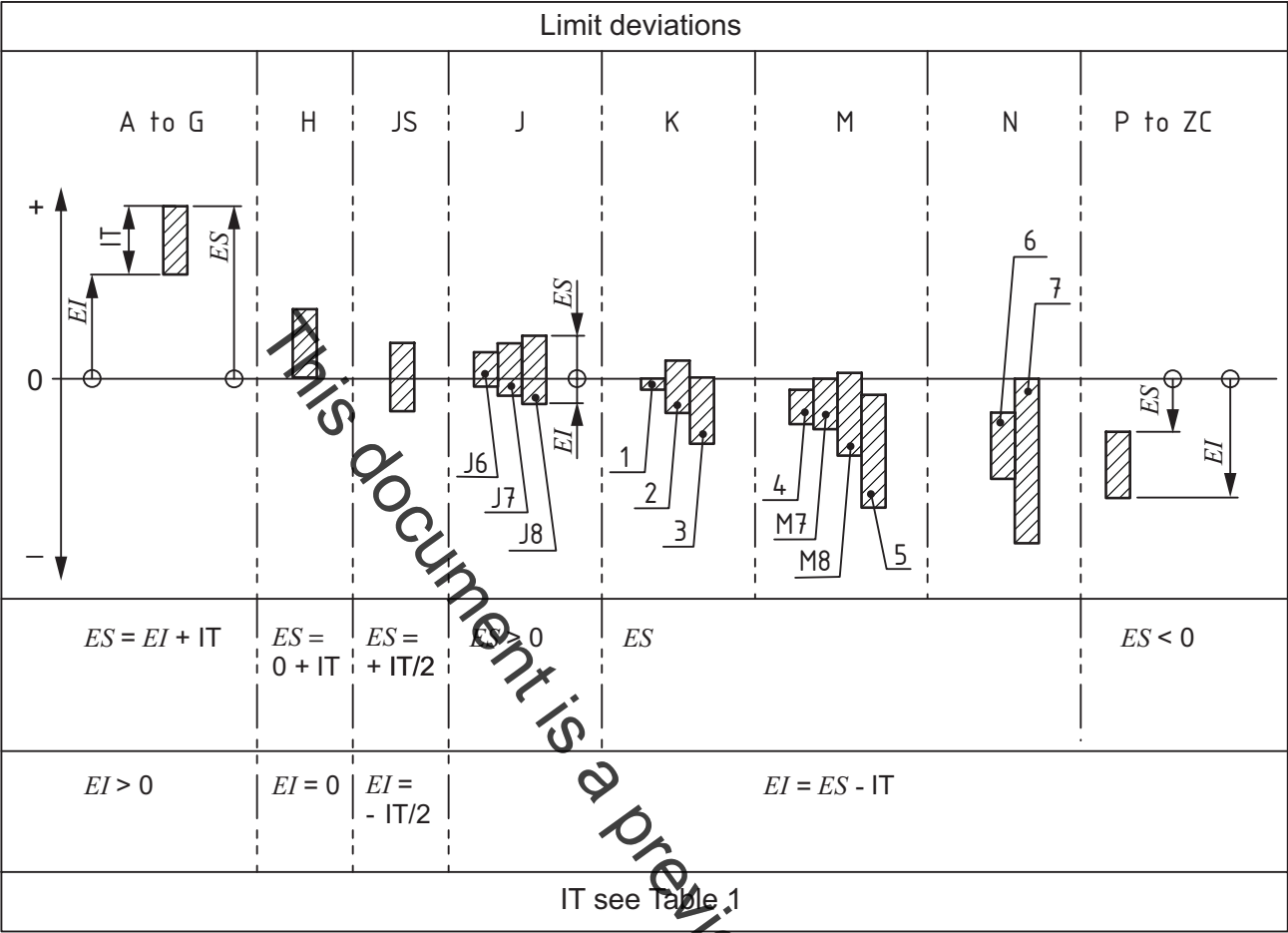
**Key**

1  K1 to K3, and also K4 to K8 for sizes for which — < nominal size ⩽ 3 mm (for the significance of the dash, see e.g. footnote "b" to Table 2)

2  K4 to K8 for sizes for which 3 mm < nominal size ⩽ 500 mm

3  K9 to K18

4  M1 to M6

5  M9 to M18

6  N1 to N8

7  N9 to N18

| Limit deviations | | | | | |
|---|---|---|---|---|---|
| a to g | h | js | j | k | m to zc |

1
4

$es$
1
$ei$

0
$es$
$ei$

j7
j8
2
3

| $es < 0$ | $es = 0$ | $es = +IT/2$ | $es = ei + IT$ | $es = ei + IT$ | $es = ei + IT$ |
| $ei = es - IT$ | $ei = 0 - IT$ | $ei = -IT/2$ | $ei < 0$ | $ei = 0$ or $> 0$ | $ei = > 0$ |

IT see Table 1

**Key**

1 j5, j6

2 k1 to k3, and k4 to k7 for sizes for which — $<$ nominal size $\leqslant$ 3 mm (for the significance of the dash, see e.g. footnote "b" to Table 2)

3 k4 to k7 for sizes for which 3 mm $<$ nominal size $\leqslant$ 500 mm

4 k8 to k18

**Figure 2 — Upper and lower limit deviations for shafts (external features)**

## 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 286-1:2010, *Geometrical product specifications (GPS) — ISO code system for tolerances of linear sizes — Part 1: Basis of tolerances, deviations and fits*

## 3 Standard tolerances

The values of standard tolerance grades IT01 to IT18, inclusive, are given in Table 1.