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МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ

ISO system of limits and fits —

Part 1:
Bases of tolerances, deviations and fits

Système ISO de tolérances et d'ajustements —

Partie 1: Base des tolérances, écarts et ajustements

Reference number
ISO 286-1 : 1988 (E)

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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

This part of ISO 286 has been prepared by ISO/TC 3, *Limits and fits*, and, together with ISO 286-2, completes the revision of ISO/R 286, *ISO system of limits and fits*. ISO/R 286 was first published in 1962 and subsequently confirmed in November 1964; it was based on ISA Bulletin 25 first published in 1940.

The major changes incorporated in this part of ISO 286 are as follows:

a) The presentation of the information has been modified so that ISO 286 can be used directly in both the design office and the workshop. This has been achieved by separating the material dealing with the bases of the system, and the calculated values of standard tolerances and fundamental deviations, from the tables giving specific limits of the most commonly used tolerances and deviations.

b) The new symbols js and JS replace the former symbols j_s and J_S (i.e. s and S are no longer placed as subscripts) to facilitate the use of the symbols on equipment with limited character sets, e.g. computer graphics. The letters "s" and "S" stand for "symmetrical deviation".

c) Standard tolerances and fundamental deviations have been included for basic sizes from 500 to 3 150 mm as standard requirements (these were previously included on an experimental basis only).

d) Two additional standard tolerance grades, IT17 and IT18, have been included.

e) Standard tolerance grades IT01 and IT0 have been deleted from the main body of this part of ISO 286, although information on these grades is given in annex A for users who may have a requirement for such grades.

f) Inch values have been deleted.

g) The principles, terminology and symbols have been aligned with those required by contemporary technology.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

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Part 1:
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0 Introduction

The need for limits and fits for machined workpieces was brought about mainly by the inherent inaccuracy of manufacturing methods, coupled with the fact that "exactness" of size was found to be unnecessary for most workpieces. In order that 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.

Similarly, where a specific fit condition is required between mating workpieces, it is necessary to ascribe an allowance, either positive or negative, to the basic size to achieve the required clearance or interference, i.e. a "deviation".

With developments in industry and international trade, it became necessary to develop formal systems of limits and fits, firstly at the industrial level, then at the national level and later at the international level.

This International Standard therefore gives the internationally accepted system of limits and fits.

Annexes A and B give the basic formulae and rules necessary for establishing the system, and examples in the use of the standard are to be regarded as an integral part of the standard.

Annex C gives a list of equivalent terms used in ISO 286 and other International Standards on tolerances.

1 Scope

This part of ISO 286 gives the bases of the ISO system of limits and fits together with the calculated values of the standard tolerances and fundamental deviations. These values shall be taken as authoritative for the application of the system (see also clause A.1).

This part of ISO 286 also gives terms and definitions together with associated symbols.

2 Field of application

The ISO system of limits and fits provides a system of tolerances and deviations suitable for plain workpieces.

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 International Standard equally apply to workpieces of other than circular section.

In particular, the general term "hole" or "shaft" can be taken as referring to the space contained by (or containing) the two parallel faces (or tangent planes) of any workpiece, such as the width of a slot or the thickness of a key.

The system also provides for fits between mating cylindrical features or fits between workpieces having features with parallel faces, such as the fit between a key and keyway, etc.

NOTE — It should be noted that the system is not intended to provide fits for workpieces with features having other than simple geometric forms.

For the purposes of this part of ISO 286, a simple geometric form consists of a cylindrical surface area or two parallel planes.

3 References

NOTE — See also clause 10.

ISO 1, *Standard reference temperature for industrial length measurements.*

ISO 286-2, *ISO system of limits and fits — Part 2: Tables of standard tolerance grades and limit deviations for holes and shafts.*

ISO/R 1938, *ISO system of limits and fits — Inspection of plain workpieces.* [1)]

ISO 8015, *Technical drawings — Fundamental tolerancing principle.*

1) At present under revision.

4 Terms and definitions

For the purposes of this International Standard, the following terms and definitions apply. It should be noted, however, that some of the terms are defined in a more restricted sense than in common usage.

4.1 shaft: A term used, according to convention, to describe an external feature of a workpiece, including features which are not cylindrical (see also clause 2).

4.1.1 basic shaft: Shaft chosen as a basis for a shaft-basis system of fits (see also 4.11.1).

For the purposes of the ISO system of limits and fits, a shaft the upper deviation of which is zero.

4.2 hole: A term used, according to convention, to describe an internal feature of a workpiece, including features which are not cylindrical (see also clause 2).

4.2.1 basic hole: Hole chosen as a basis for a hole-basis system of fits (see also 4.11.2).

For the purposes of the ISO system of limits and fits, a hole the lower deviation of which is zero.

4.3 size: A number expressing, in a particular unit, the numerical value of a linear dimension.

4.3.1 basic size; nominal size: The size from which the limits of size are derived by the application of the upper and lower deviations (see figure 1).

NOTE — The basic size can be a whole number or a decimal number, e.g. 32; 15; 8,75; 0,5; etc.

4.3.2 actual size: The size of a feature, obtained by measurement.

4.3.2.1 actual local size: Any individual distance at any cross-section of a feature, i.e. any size measured between any two opposite points.

4.3.3 limits of size: The two extreme permissible sizes of a feature, between which the actual size should lie, the limits of size being included.

4.3.3.1 maximum limit of size: The greatest permissible size of a feature (see figure 1).

4.3.3.2 minimum limit of size: The smallest permissible size of a feature (see figure 1).

4.4 limit system: A system of standardized tolerances and deviations.

4.5 zero line: In a graphical representation of limits and fits, the straight line, representing the basic size, to which the deviations and tolerances are referred (see figure 1).

According to convention, the zero line is drawn horizontally, with positive deviations shown above and negative deviations below (see figure 2).

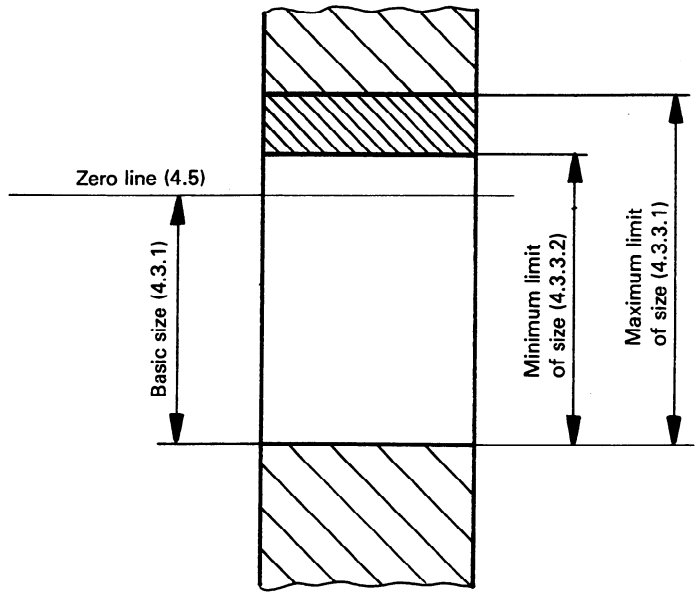

Figure 1 — Basic size, and maximum and minimum limits of size

4.6 deviation: The algebraic difference between a size (actual size, limit of size, etc.) and the corresponding basic size.

NOTE — Symbols for shaft deviations are lower case letters (*es*, *ei*) and symbols for hole deviations are upper case letters (*ES*, *EI*) (see figure 2).

4.6.1 limit deviations: Upper deviation and lower deviation.

4.6.1.1 upper deviation (*ES*, *es*): The algebraic difference between the maximum limit of size and the corresponding basic size (see figure 2).

4.6.1.2 lower deviation (*EI*, *ei*): The algebraic difference between the minimum limit of size and the corresponding basic size (see figure 2).

4.6.2 fundamental deviation: For the purposes of the ISO system of limits and fits, that deviation which defines the position of the tolerance zone in relation to the zero line (see figure 2).

NOTE — This may be either the upper or lower deviation, but, according to convention, the fundamental deviation is the one nearest the zero line.

4.7 size tolerance: The difference between the maximum limit of size and the minimum limit of size, i.e. the difference between the upper deviation and the lower deviation.

NOTE — The tolerance is an absolute value without sign.

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