

Tolerancing by Dimensions

Linear size (the diameter of a cylinder or the distance between two parallel flat opposite surfaces). ISO 129, ISO 286-1 and ISO 14405-1.

Since the publication of ISO 14405-1 in 2010, all linear size tolerances have become unambiguous. The default size definition is 2-point size and applies to both \pm tolerances and ISO 286-1 tolerance codes:

- The smallest 2-point size shall be larger than the lower limit.
- The largest 2-point size shall be smaller than the upper limit.

\pm tolerance:

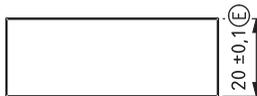


ISO 286-1 tolerance code:



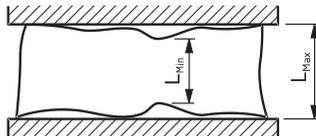
The two-point distance/diameter and the direction are defined in ISO 14660-2.

Envelope requirement: Used for features that participate in a fit. Indicated with the $\text{\textcircled{E}}$ symbol. Modifies the maximum material tolerance limit (upper limit for outside features, lower limit for inside features).



Explanation:

For an outside feature, $L \leq L_{\max}$, distance between two parallel tangential planes or the diameter of the minimum circumscribed cylinder. $L \geq L_{\min}$, two-point distance or diameter.



ISO 14405-1 includes a number of symbols (modifiers) in addition to $\text{\textcircled{E}}$, which can specify which diameter definition (specification operator) is required by the specification.

Tolerancing by Dimensions

Size modifiers - ISO 14405-1

Type	Symbol	Description	Symbol	Description
Local size	$\text{\textcircled{LP}}$	2-point size	$\text{\textcircled{LS}}$	Local sphere size
Global size	$\text{\textcircled{GG}}$	Least squares size	$\text{\textcircled{GN}}$	Minimum circumscribed size
	$\text{\textcircled{GC}}$	Minimax size*	$\text{\textcircled{GX}}$	Maximum inscribed size
Calculated size	$\text{\textcircled{CC}}$	Circumference diameter	$\text{\textcircled{CA}}$	Area diameter
	$\text{\textcircled{CV}}$	Volume diameter		
Rank order size	$\text{\textcircled{SX}}$	Maximum size	$\text{\textcircled{SN}}$	Minimum size
	$\text{\textcircled{SA}}$	Average size	$\text{\textcircled{SM}}$	Median size
	$\text{\textcircled{SD}}$	Mid-range size	$\text{\textcircled{SR}}$	Range of sizes
	$\text{\textcircled{SQ}}$	Standard deviation of sizes*		

* = Defined in $\text{\textcircled{E}}$ ISO 14405-1 2. Ed.

Examples:

Envelope requirement outside diameter (all 3 indications mean the same):

$$\phi 44 \text{ h7 } \text{\textcircled{E}} = \overset{0}{\phi 44 -0,025} \text{\textcircled{E}} = \overset{0}{\phi 44 -0,025} \text{\textcircled{LP}} \text{\textcircled{GN}}$$

Envelope requirement inside diameter (all 3 indications mean the same):

$$\phi 44 \text{ H7 } \text{\textcircled{E}} = \overset{+0,025}{\phi 44 0} \text{\textcircled{E}} = \overset{+0,025}{\phi 44 0} \text{\textcircled{LP}} \text{\textcircled{GX}}$$

Local sphere diameter:

$$\phi 11 \pm 0,1 \text{\textcircled{LS}}$$

Global least squares diameter:

$$\phi 22 \pm 0,2 \text{\textcircled{GG}}$$

Average 2-point diameter:

$$\phi 33 \pm 0,3 \text{\textcircled{LP}} \text{\textcircled{SA}}$$

Range of 2-point diameters:

$$0,4 \text{ max. } \text{\textcircled{LP}} \text{\textcircled{SR}}$$

Principles

Dim Tol 1

Geo Tol

Datums

TED



Edges Genrl.

IfGPS 8PP

Mod