Technical drawings — Geometrical tolerancing — Toleranced characteristics and symbols — Examples of indication and interpretation

Extract from International Standard ISO **1101**

This document forms an extract of ISO 1101, suitable for everyday use.

Form tolerances limit the deviations of an individual feature from its ideal geometrical form.

Orientation, location and run-out tolerances limit the deviations of the mutual orientation and/or location of two or more features. For functional reasons one or more features may be indicated as a datum. If necessary, a geometrical tolerance should be specified to the datum feature in order to ensure that the datum feature is sufficiently exact for its purpose.

The geometrical tolerance applies always to the whole extent of the toleranced feature unless otherwise specified, for example 0,02/50 indicates that a tolerance of 0,02 is permitted for an extent of 50 at any place on the toleranced feature.

When a geometrical tolerance applies to an axis or a median plane, then the arrow of the leader line terminates at the dimension line (figure 4).

When a geometrical tolerance applies to a line or surface itself, then the leader line with its arrow terminating on the contour of the feature has to be clearly separated from the dimension line (figure 5).

The same method of indication is used for the datum triangle.

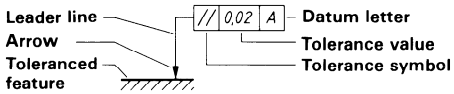


Figure 1

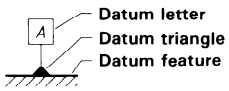


Figure 2

Theoretically exact dimension

Figure 3

Refers to the axis or the median plane


Figure 4

Refers to the generating line or the surface


Figure 5

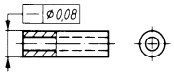
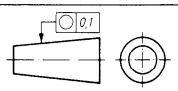
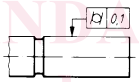
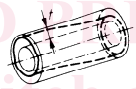
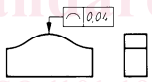
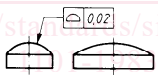
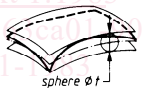
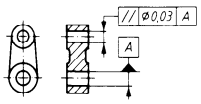
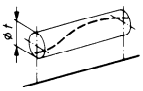
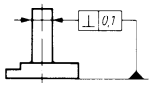
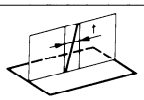
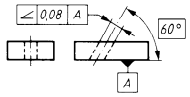
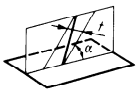
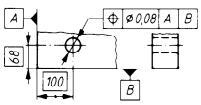
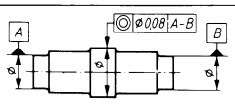
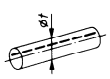
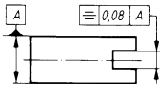
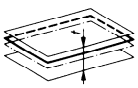
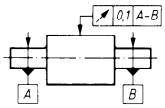
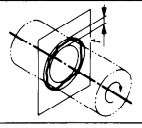
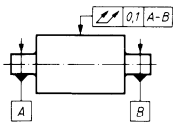
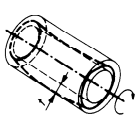
Figure 6 Ⓜ Maximum material condition (MMC)

Figure 7 Ⓟ Projected tolerance zone

Figure 8 

Datum target (see ISO 5459)

Values in millimetres

Symbols and toleranced characteristics				Examples of indication and interpretation		
				Indication on the drawing	Tolerance zone	Interpretation
Single features	Form tolerances	—	**Straightness**			The axis of the cylinder, to which the tolerance frame is connected, shall be contained in a cylindrical zone of diameter 0,08.
		▱	**Flatness**			The surface shall be contained between two parallel planes 0,08 apart.
		○	**Circularity**			The circumference of each cross-section shall be contained between two co-planar concentric circles 0,1 apart.
		⌭	**Cylindricity**			The considered surface shall be contained between two coaxial cylinders 0,1 apart.
Single or related features		⌒	**Profile of any line**			In each section parallel to the plane of projection, the considered profile shall be contained between two lines enveloping circles of diameter 0,04, the centres of which are situated on a line having the true geometrical profile.
		⌓	**Profile of any surface**			The considered surface shall be contained between two surfaces enveloping spheres of diameter 0,02, the centres of which are situated on a surface having the true geometrical form.
Related features	Orientation tolerances	//	**Parallelism** of a line (axis) with reference to a datum line			The toleranced axis shall be contained in a cylindrical zone of diameter 0,03, parallel to the datum axis **A** (datum line).
		⊥	**Perpendicularity** of a line (axis) with reference to a datum surface			The axis of the cylinder, to which the tolerance frame is connected, shall be contained between two parallel planes 0,1 apart, perpendicular to the datum surface.
		∠	**Angularity** of a line (axis) with reference to a datum surface			The axis of the hole shall be contained between two parallel planes 0,08 apart which are inclined at 60° to the surface **A** (datum surface).
	Location tolerances	⌖	**Position** of a line			The axis of the hole shall be contained within a cylindrical zone of diameter 0,08, the axis of which is in the theoretically exact position of the considered line, with reference to the surfaces **A** and **B** (datum planes).
		◎	**Coaxiality** of an axis			The axis of the cylinder, to which the tolerance frame is connected, shall be contained in a cylindrical zone of diameter 0,08 coaxial with the datum axis **A-B**.
		⌯	**Symmetry** of a median plane			The median plane of the slot shall be contained between two parallel planes, which are 0,08 apart and symmetrically disposed about the median plane with respect to the datum feature **A**.
	Run-out tolerances	↗	**Circular run-out** radial			The radial run-out shall not be greater than 0,1 in any plane of measurement during one revolution about the datum axis **A-B**.
		⌰	**Total run-out** radial			The total radial run-out shall not be greater than 0,1 at any point on the specified surface during several revolutions about the datum axis **A-B**, and with relative axial movement between part and measuring instrument. The movement shall be guided along a line having a theoretically perfect form of the contour and being in correct position to the datum axis.

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