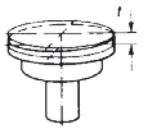
Tolerances for Form and Position

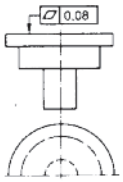
General Notes on Tolerances for Form and Position
A tolerance for a form and position of an element (area, axis, point or centre axis) defines the zone within which every point of this element has to lie.
Depending on the quality to be toleranced and its typical dimensions the tolerance zone falls within one of the following:

- the area within a circle
- the area between two concentric circles
- the area between two parallel straight lines
- the area between two equidistant lines
- the space between two parallel planes
- the space between two equidistant planes
- the space between a cylinder
- the space between two coaxial cylinders
- the space within a square

FLATNESS
DIN ISO 1101



Definition
The tolerance zone is limited by two parallel planes a distance *t* apart.



Example:
The surface is to be contained between to parallel planes 0.08 apart.

GENERAL TOLERANCES [mm]
for tools produced in clamped position (DIN/ISO 2768)

Tolerance class H

Range	…10	> 10 …30	> 30 …100	> 100 …300	> 300 …1000	> 1000 …3000
⏥	0,02	0,05	0,1	0,2	0,3	0,4
⊥	0,2			0,3	0,4	0,5
≡	0,5					
⁄	0,1					

Tolerance class L

Range	…10	> 10 …30	> 30 …100	> 100 …300	> 300 …1000	> 1000 …3000
⏥	0,1	0,2	0,4	0,8	1,2	1,6
⊥	0,6			1	1,5	2
≡	0,6			1	1,5	2
⁄	0,5					

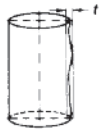
Tolerance class K

Range	…10	> 10 …30	> 30 …100	> 100 …300	> 300 …1000	> 1000 …3000
⏥	0,05	0,1	0,2	0,4	0,6	0,8
⊥	0,4			0,6	0,8	1
≡	0,6				0,8	1
⁄	0,2					

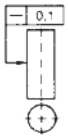
Circularity
The general tolerance for circularity is the **Minimum** of the diameter tolerance and the general running tolerance.

Parallelism
The general tolerance for parallelism is the **Maximum** of the measuring tolerance and the general tolerance for straightness and flatness.

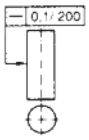
STRAIGHTNESS
DIN ISO 1101



Definition
When projected on a plane the tolerance zone is limited by two parallel straight lines at a distance *t* apart.



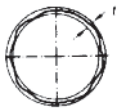
Example
Any line on the upper surface parallel to the plane of projection in which the indication is shown is to be contained between to parallel straight lines 0.1 apart.



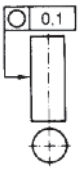
Any portion of length 200 of any generator of the cylindrical surface indicated by the arrow is to be contained between to parallel straight lines 0.1 apart in a plane containing the axis.

Note:
Further information on Straightness Tolerances see DIN ISO 1101.

CIRCULARITY
DIN ISO 1101



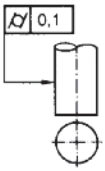
Definition
The tolerance zone in the considered plane is limited by two concentric circles at a distance *t* apart.



Example
The circumference of each cross-section is to be contained between two co-planar concentric circles 0.1 apart.

CILINDERCITY
DIN ISO 1101

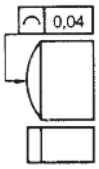
Definition
The tolerance zone is limited by two coaxial cylinders a distance *t* apart.



Example
The concidered surface is to be contained between two coaxial cylinders 0.1 apart.

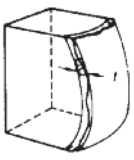
PROFIL OF ANY LINE DIN ISO 1101

Definition
The tolerance zone is limited by two lines enveloping circles of diameter t_1 on the centres of which are situated on a line having the theoretically exact geometrical form.

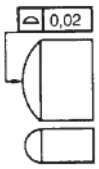


Example
In each section parallel to the plane of projection the considered profile is to be contained between two lines enveloping circles of diameter 0.04, the centres of which are situated on a line of theoretically exact geometrical profile.

PROFIL OF ANY SURFACE DIN ISO 1101

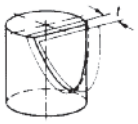


Definition
The tolerance zone is limited by two surfaces enveloping spheres of diameter t_1 the centres of which are situated on a surface having the theoretically exact geometrical form.

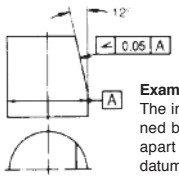


Example
The concidered surface is to be contained between to surfaces enveloping spheres of diameter 0.02, the centres of which are situated on a surface of theoretically exact geometrical form.

ANGULARITY
DIN ISO 1101



Definition
The tolerance zone, when projected on a plane is limited by two parallel straight lines a distance *t* apart and inclined at the specified angle to the datum surface.

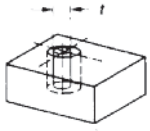


Example
The inclined surface is to be contained between to parallel planes 0.1 apart which are inclined at 12° to datum axis A.

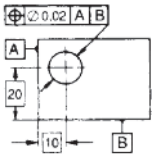
Tolerances for Form and Position

For position tolerances a reference point is required which gives the precise position of the tolerance zone. A reference point is a theoretically precise geometrical element (i.e. axis, plane straight line, etc). Reference points can be based on one or several reference elements.
Within a tolerance zone the element to be toleranced can be in any form, any position or direction, bar any additional limiting factors.
For the tolerance value "*t*" the identical value as for length measurements is applicable. If nothing else is specified the tolerance applies to the total length or area of the element to be toleranced.

POSITION
DIN ISO 1101



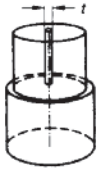
Definition
When the tolerance value is preceded by the diameter symbol the tolerance zone is limited by a cylinder of diameter *t* the axis of which is in the theoretically exact position of the considered line.



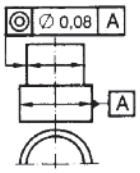
Example
The axis of the hole is to be contained within a cylindrical zone of diameter 0.08 the axis of which is in the theoretically exact position of the considered line with reference to the datum surface A and B.

Note
For the positional tolerance of a point or a plane see DIN ISO 1101.

CONCENTRICITY AND COAXIALITY
DIN ISO 1101



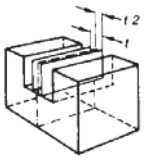
Definition
When the tolerance value is preceded by the diameter symbol the tolerance zone is limited by a cylinder of diameter t_1 the axis of which coincides with the datum axis.



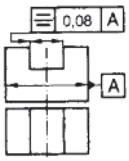
Example coaxiality
The axis of the cylinder is to be contained within a cylindrical zone of diameter 0.08 coaxial with the datum axis A.

Note
Concentricity tolerance see DIN ISO 1101.

SYMMETRY
DIN ISO 1101



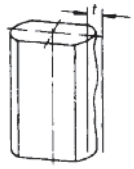
Definition
The tolerance zone is limited by two parallel planes a distance *t* apart and disposed symmetrically about the datum axis or datum median plane.



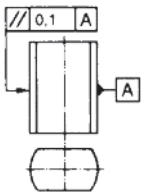
Example
The median plane of a slot is to be contained contained between two parallel planes which are 0.08 apart and symetrically disposed about the median plane of the datum feature A.

Note
For the symmetrical tolerance of a line or an axis see DIN ISO 1101.

PARALLELISM
DIN ISO 1101



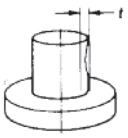
Definition
When the tolerance is specified in one direction only, the tolerance zone when projected on a plane is limited by two parallel straight lines a distance *t* apart and parallel to the datum line.



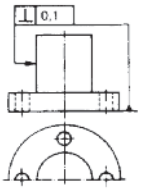
Example
The tolerance axis is to be contained between two straight lines 0.1 apart, which are parallel to the datum axis A and lie in the vertical directions.

Note
For further parallelistic tolerancing see DIN ISO 1101.

PERPENDICULARITY
DIN ISO 1101



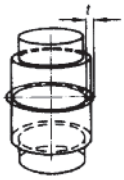
Definition
The tolerance zone when projected on a plane is limited by two parallel straight lines a distance *t* apart and perpendicular to the datum line.



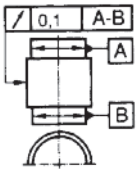
Example
The axis of the cylinder is to be contained between two parallel planes 0.1 apart, perpendicular to the datum surface.

Note
For further perpendicular tolerancing see DIN ISO 1101.

CIRCULAR RUN-OUT
DIN ISO 1101



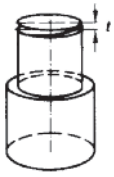
Definition
Within any plane of measurement perpendicular to the axis the tolerance zone is limited by two concentric circles a distance *t* apart, the centre of which coincides with the datum axis.



Example
The radial run-out is to be not greater than 0.1 in any plane of measurement during one revolution about the axis A–B.

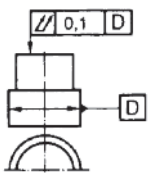
Notes
When checking the measurement the work piece has to be rotated on its reference axis.
For the plane run-out and radial run-out tolerance in any direction or to specifieddirectionseeDIN ISO 1101.

TOTAL RUN-OUT
DIN ISO 1101



Definition (Total Run-out)
The tolerance zone is limited by two parallel planes a distance *t* apart and perpendicular to the datum axis.

Example (Total Run-out)
The total run-out is to be no greater than 0.1 at any point on the specified surface whilst revolving about the datum axis D and with relative radial movement between the measuring instrument and the workpiece. With relative movement the measuringinstrumentoftheworkpiece is to be guided along a line having the theoretically exact form of the contour and being in its correct position relative to the datum axis.



Note:
When measuring, the work piece has to be turned several times on its reference axis. Work piece and gauge have to be moved radially in relation to each other.
For Total Run-Out tolerance see DIN ISO 1101.