

# Geometrical Tolerancing

Excerpt from JIS B 0021:1998 Tolerancing of form, orientation, location and run-out

Types of tolerancing	Symbol	Definition	
Form tolerance	Straightness tolerance	—	Tolerance for deviation of straight object from the geometric straightness
	Flatness tolerance		Tolerance for deviation of flat object from the geometric flatness
	Roundness tolerance	○	Tolerance for deviation of round object from the geometric roundness
	Cylindricity tolerance		Tolerance for deviation of cylindrical object from the geometric cylindricity
	Profile tolerance for line		Tolerance of deviation of a line profile from the geometrical profile defined by the theoretically accurate dimensions
	Profile tolerance for plane		Tolerance of deviation of a plane profile from the geometrical profile defined by the theoretically accurate dimensions.
Orientation tolerance	Parallelism tolerance	//	Tolerance for deviation of straight line object or plane object that are assumed to be parallel to the geometrical straight line or geometrical plane that are parallel to datum straight line or datum plane.
	Squareness tolerance		Tolerance for deviation of straight line object or plane object that are assumed to be right angle to the geometrical straight line or geometrical plane that are right angle to datum straight line or datum plane.
	Angularity tolerance		Tolerance for deviation of straight line object or plane object that are assumed to have an accurate angle to the geometrical straight line or geometrical plane that have the accurate angle to datum straight line or datum plane.
Position tolerance	Positional tolerance		Tolerance for the deviation of a point, straight line object or plane object from the accurate position defined in relation to datum or other geometric feature.
	Coaxiality tolerance or concentricity tolerance		Coaxiality tolerance is tolerance of the deviation for the axis line that is assumed to be on the same straight line with datum axis line, from the datum axis line. On the other hand, concentricity tolerance is tolerance for the position deviation from the center of datum circle to the center of other circular geometric feature.
	Symmetry tolerance		Tolerance for the deviation of actual body that is assumed to be symmetrical to each other against the datum axis straight line or datum central plane, from the symmetrical position.
Run-out tolerance	Radial run-out tolerance		When a rotating body whose axis is datum axis straight line rotates around the datum axis straight line, the tolerance represents the permissible displacement of its surface from the specified position or at an arbitrary position along the specified direction.
	Total run-out tolerance		When a rotating body whose axis is datum axis straight line rotates around the datum axis straight line, the tolerance represents the permissible displacement of its surface along the specified direction.

Property symbol	Definition of tolerance zone	Example and explanation of instruction method
<b>Straightness tolerance</b>		
—		When adding the symbol $\phi$ before the tolerance value, the geometric tolerance zone is restricted by the cylinder whose diameter is t.
		The actual (reproduced) shaft line of cylinder to which tolerance is applied must be within a cylindrical tolerance zone of 0.08 in diameter.
<b>Flatness tolerance</b>		
		The tolerance zone is restricted by parallel two planes apart by distance t.
		The actual (reproduced) surface must be within the parallel two planes apart by distance 0.08.
<b>Roundness tolerance</b>		
○		In the symmetric cross section, the tolerance zone is restricted by two circles with the common axis.
		In an arbitrary cross section of a cylinder or a circular cone, the actual (or reproduced) line along the radius direction must be between the two circles on the common plane with the common axis that are 0.03 apart in radius distance.
<b>Cylindricity tolerance</b>		
		The tolerance zone is restricted by two cylinders with the common axis apart by distance t.
		The actual (reproduced) cylindrical surface must be within the two cylinders with the common axis apart by radius distance 0.1.
<b>Profile tolerance of a line: Profile tolerance of a line that is not related to datum (ISO 1660)</b>		
		Tolerance zone is restricted by two envelope curves of each circle with diameter t, and the centers of these circles are positioned on a line that has the theoretically accurate geometrical configuration.
		In each cross sections that are parallel to project plane along the specified direction, the actual (or reproduced) profile line must be between the two envelope lines of circles which have the diameter 0.04 and whose centers are positioned on an idealistic geometrical line.
<b>Profile tolerance of a plane: Profile tolerance of a plane that is not related to datum (ISO 1660)</b>		
		Tolerance zone is restricted by two envelope curves of each sphere with diameter t, and the centers of these spheres are positioned on a line that has the theoretically accurate geometrical configuration.
		The actual (or reproduced) surface must be between the enveloping surfaces of each spheres whose diameter is 0.02 and whose centers are positioned on a theoretically accurate geometrical surface.