Surface Roughness by Different Processing Methods

	Arithmetical mean roughness Ra	0.025	0.05	0.1	0.2	0.4	0.8	1.6	3.2	6.3	12.5	25	50	100
Former designations of surface roughness	Maximum peak Ry Rmax.	0.1 −S	0.2 −S	0.4 −S	0.8 −S	1.6 −S	3.2 −S	6.3 −S	12.5 −S	25 −S	50 −S	100 −S	200 −S	400 −S
	Standard values of standard length (mm)	0.25				0.8			2.5		8		25	
	Triangular indication	▽▽▽▽				▽▽▽			▽▽		▽		–	
Working method	Forging								Precision					
	Casting								Precision					
	Die casting													
	Hot rolling													
	Cold rolling													
	Drawing													
	Extruding													
	Tumbling													
	Sandblasting													
	Rolling													
	Face cutter grinding						Precision							
	Planing													
	Carving (Slotting)													
	Cutter grinding						Precision							
	Precision boring													
	Filing						Precision							
	Round grinding			Precision			Fine		Medium		Rough			
	Boring						Precision							
	Drilling													
	Reaming					Precision								
	Broach grinding					Precision								
	Shaving													
	Grinding			Precision	Fine		Medium			Rough				
	Hone finishing			Precision										
	Super finishing	Precision												
	Buffing			Precision										
	Paper finishing			Precision										
	Lapping	Precision												
	Liquid honing			Precision										
	Burnishing													
	Surface rolling													
	Electric discharge carving													
	Wire cut electric spark													
	Chemical polishing						Precision							
	Electrolytic abrasion		Precision											

Indications of Geometrical Tolerance on Drawings

Excerpt from JIS B 0021(1984)

Kinds and Symbols of Geometrical Tolerances

Kind of tolerance		Symbol	Definition of tolerance zone	Examples of diagrammatical indication and its interpretation
Form tolerance	Straightness tolerance	—	Where symbol φ is attached before the numerical value indicating a tolerance zone, this tolerance zone is a zone in a cylinder of diameter t.	Φ0.08 — Where a tolerance frame is connected to the dimension showing the diameter of a cylinder, the axis of the cylinder shall be contained a cylinder of 0.08mm diameter.
	Flatness tolerance	▱	The tolerance zone is a zone held between two parallel planes a distance t apart.	0.08 — This surface shall be contained between two parallel planes 0.08mm apart.
	Circularity tolerance	○	The tolerance zone in the considered plane is a zone between two concentric circles a distance t apart.	0.1 — The circumference in any section normal to the axis shall be contained between two concentric circles 0.1mm apart on the same plane.
	Cylindricity tolerance	⌭	The tolerance zone is a zone contained between two coaxial cylinder surfaces a distance t apart.	0.1 — The considered surface shall be contained between two coaxial cylinder surfaces 0.1mm apart.
	Profile tolerance of line	⌒	The tolerance zone is a zone held between two lines enveloping circles of diameter t, the centers of which are situated on a theoretically exact profile line.	0.04 — In any cross-section parallel to the projection plane the considered profile shall be contained between two lines enveloping circles of 0.04mm in diameter, the centers of which are situated on a line having the theoretically exact profile.
	Profile tolerance of surface	⌓	The tolerance zone is a zone held between the two surfaces enveloping the spheres of diameter t, the centers of which are situated on a theoretically exact profile surface.	0.02 — The considered surface shall be contained between two surfaces enveloping the spheres of diameter 0.02mm, the centers of which are situated on a surface having the theoretically exact profile.
Orientation tolerance	Parallelism tolerance	//	The tolerance zone is a zone held between two parallel planes parallel to the datum plane and a distance t apart from each other.	0.01 A — The surface shown by the arrow of the leader line shall be contained between two planes parallel to the datum plane A and 0.01mm apart from each other in the direction of the arrow of the leader line.
	Perpendicularity tolerance	⊥	Where symbol φis attached before the numerical value indicating the tolerance, the tolerance zone is a zone within a cylinder of diameter t perpendicular to the datum plane.	Φ — Φ0.01 A — The axis of the cylinder shown by the arrow of the leader line shall be contained within a cylinder of diameter 0.01mm perpendicular to the datum plane A.
	Angularity tolerance	∠	The tolerance zone is a zone held between two parallel planes inclined at the specified angle to the datum plane and a distance t apart from each other.	0.08 A, 40°, A — The surface shown by the arrow of the leader line shall be contained between two parallel planes which are inclined at 40 ° with theoretical exactness to the datum plane A and which are 0.08mm apart from each other in the direction of the arrow of the leader line.
Location tolerance	Positional tolerance	⌖	The tolerance zone is a zone within a circle or sphere of diameter t having its center at the theoretically exact location, hereinafter referred to as the " true location ".	B, Φ0.03 AB, 60, 100, A — The point shown by the arrow of the leader line shall be contained within a circle of 0.03mm diameter having its center at the true location 60mm and 100mm apart, respectively,from the datum straight line A and from the datum straight line B.
	Coaxiality tolerance or concentricity tolerance	◎	Where symbol φ is attached before the numerical value indicating the tolerance, the tolerance zone is a zone within a cylinder of diameter t whose axis agrees with the datum axial straight line.	A, Φ0.01 A — The axis shown by the arrow of the leader line shall be contained within a cylinder of 0.01mm diameter whose axis agrees with the datum axial straight line A.
	Symmetry tolerance	⌯	The tolerance zone is a zone held between two parallel planes a distance t apart from each other and arranged symmetrically about the datum median plane.	A, 0.08 A — The median surface shown by the arrow of the leader line shall be contained between two parallel planes 0.08mm apart from each other and arranged symmetrically about the datum median plane A.
Run-out tolerance	Circular run-out tolerance	↗	Measuring plane, Toleranced surface — The tolerance is a zone between two concentric circles whose centers agree with the datum axial straight line on any measuring plane normal to the datum axial straight line and which are a distance t apart from each other in the radial direction.	0.1 A–B, A, B — The run-out in the radial direction of the cylinder surface shown by the arrow of the leader line shall not exceed 0.1mm on any measuring plane normal to the datum axial straight line when the cylinder is rotated by one rotation about the datum axial straight line A-B.
	Total run-out tolerance	⌰	The tolerance zone is a zone between two coaxial cylinders having axes agreeing with the datum axial straight line and a distance t apart from each other in the radial direction.	0.1 A–B, A, B — The total radial run-out of the cylinder surface shown by the arrow of the leader line shall not exceed 0.1mm at any point on the cylinder surface when the cylinder part is rotated about the datum axial straight line A-B with a relative movement in the axial direction.

Lines used in the drawings in the column of " definition of tolerance zone " indicate the following meanings :
Thick solid line or broken line: Feature
Thick alternate long and short dash line: Datum
Thin solid line or broken line: Tolerance zone
Thin alternate long and short dash line: Center line
Thin alternate long and two short dashes line: Supplementary projection plane or sectional plane
Thick alternate long and two short dashes line: Projection of a feature to supplementary Projection plane or sectional plane