

# Project Tolerance Learning

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When working on making a shaft and hole fit, unless you are machining both parts yourself check on the tolerance of the purchased parts so that you can get the correct fit.

One location that this was important for our project was machining custom shafts that will fit in the bearings.

We wanted a fit that was +0 microns to -0.9 microns which is a h6 fit if the hole was exactly 8mm large.

## Radial Bearing(Class 0)Tolerances and Allowances. (JIS Class 0 is equivalent to ABEC-1)

### (1) Inner Wheel

Unit  $\mu\text{m}$

Nominal Inner Diameter of Bearing		$\Delta dmp$		Diameter Series			$V_{dmp}$	$K_{ia}$	Single Bearing		Bearings in Combinations		$V_{Bs}$
				9	0,1	2,3,4			Above	Below	Above	Below	
More	or Less	Above	Below	$V_{dp}$			Max.	Max.	Above	Below	Above	Below	Max.
0.6(1)	2.5	0	-8	10	8	6	6	10	0	-40	-	-	12
2.5	10	0	-8	10	8	6	6	10	0	-120	0	-250	15
10	18	0	-8	10	8	6	6	10	0	-120	0	-250	20
18	30	0	-10	13	10	8	8	13	0	-120	0	-250	20
30	50	0	-12	15	12	9	9	15	0	-120	0	-250	20
50	80	0	-15	19	19	11	11	20	0	-150	0	-380	25
80	120	0	-20	25	25	15	15	25	0	-200	0	-380	25
120	180	0	-25	31	31	19	19	30	0	-250	0	-500	30
180	250	0	-30	38	38	23	23	40	0	-300	0	-500	30
250	315	0	-35	44	44	26	26	50	0	-350	0	-500	35
315	400	0	-40	50	50	30	30	60	0	-400	0	-630	40
400	500	0	-45	56	56	34	34	65	0	-450	-	-	50
500	630	0	-50	63	63	38	38	70	0	-500	-	-	60
630	800	0	-75	-	-	-	-	80	0	-750	-	-	70
800	1000	0	-100	-	-	-	-	90	0	-1000	-	-	80
1000	1250	0	-125	-	-	-	-	100	0	-1250	-	-	100
1250	1600	0	-160	-	-	-	-	120	0	-1600	-	-	120
1600	2000	0	-200	-	-	-	-	140	0	-2000	-	-	140

(1) 0.6mm is included in this class. (2) Applies to each orbit ring made for bearing combination.

This document was found that maps out the tolerances of the bearings that Misumi creates. We made the mistake of assuming the bearings were minimum of 8mm large, but as seen above the bearing inner hole is a maximum of 8mm and a minimum of 7.992mm

This combined with an h6 shaft fit almost always led to a force fit, when we were looking for a clearance/contact fit.

### Dimension Tolerance of Shaft, Regularly Used Fitting

Reference Dimension (mm)	Class of Tolerance Range for Shafts																								Unit $\mu\text{m}$									
	More than	or Less	b9	c9	d8	d9	e7	e8	e9	f6	f7	f8	g5	g6	h5	h6	h7	h8	h9	js5	js6	js7	k5	k6		m5	m6	n5*	n6	p6	r6	s6	t6	u6
-	3	-140	-60	-20	-20	-14	-14	-14	-6	-6	-6	-2	-2	0	0	0	0	0	0	$\pm 2$	$\pm 3$	$\pm 5$	+4	+6	+6	+8	+8	+10	+12	+16	+20	-	+24	+26
		-165	-85	-34	-45	-24	-28	-39	-12	-16	-20	-6	-8	-4	-6	-10	-14	-25				$\pm 3$	0	0	+2	+2	+4	+4	+6	+10	+14	-	+18	+20
3	6	-140	-70	-30	-30	-20	-20	-10	-10	-10	-4	-4	0	0	0	0	0	0	0	$\pm 2.5$	$\pm 4$	$\pm 6$	+6	+9	+9	+12	+13	+16	+20	+23	+27	-	+31	+36
		-170	-100	-48	-60	-32	-38	-50	-18	-22	-28	-9	-12	-5	-8	-12	-18	-30				$\pm 2.5$	+1	+1	+4	+4	+8	+8	+12	+15	+19	-	+23	+28
6	10	-150	-80	-40	-40	-25	-25	-13	-13	-13	-5	-5	0	0	0	0	0	0	0	$\pm 3$	$\pm 4.5$	$\pm 7.5$	+7	+10	+12	+15	+16	+19	+24	+28	+32	-	+37	+43
		-186	-116	-62	-76	-40	-47	-61	-22	-28	-35	-11	-14	-6	-9	-15	-22	-36				$\pm 3$	+1	+1	+6	+6	+10	+10	+15	+19	+23	-	+28	+34
10	14	-150	-95	-50	-50	-32	-32	-16	-16	-16	-6	-6	0	0	0	0	0	0	0	$\pm 4$	$\pm 5.5$	$\pm 9$	+9	+12	+15	+18	+20	+23	+29	+34	+39	-	+44	+40
		-186	-126	-72	-86	-44	-51	-65	-24	-30	-37	-13	-16	-8	-11	-17	-24	-36				$\pm 4$	+1	+1	+7	+7	+11	+11	+16	+20	+24	-	+29	+35

We ended up going with a g5 shaft fit because at most it will be a slight force fit, but majority of the time it will be a clearance fit or a contact fit.

Steps for choosing a shaft or hole fit:

- 1) Determine the application and if you want a force fit, clearance fit, or contact fit
- 2) Find specifications for purchased part/parts and find tolerances for the shaft or hole
- 3) Choose correct Tolerance Range for either the shaft or hole that will provide the type of fit up you are looking for