Bearing Mounting and Fitting

Mounting & Fitting

After a bearing selection has been made, the product or system designer should pay careful attention to details of bearing mounting and fitting.

Bearing seats on shafts and housings must be accurately machined, and should match the bearing ring width to provide maximum seating surface.

Recommendations for geometry and surface finish of bearing seats and shoulders are shown in Table 3. Dimensional accuracy recommendations for shafts and housings can be found in Tables 1 and 2.

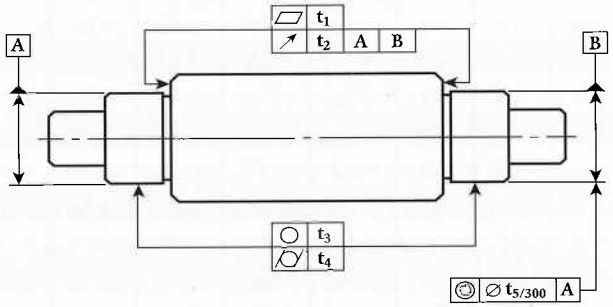

Table 1: Dimensional accuracy recommendations for shafts.

Characteristic	OUTSIDE DIAMETER OF SHAFT BEARING SEAT, mm							
	<6	6-10	11-18	19-30	31-50	51-80	81-120	121-180
▱ Flatness, t_1	30	60	80	100	100	120	150	200
↗ Runout, t_2	40	100	120	150	150	200	250	300
○ Roundness, t_3	25	50	60	75	75	100	125	150
⌭ Taper, t_4	25	50	60	75	75	100	125	150
◎ Concentricity, t_5	40	100	120	150	150	200	250	300

Values in microinches.

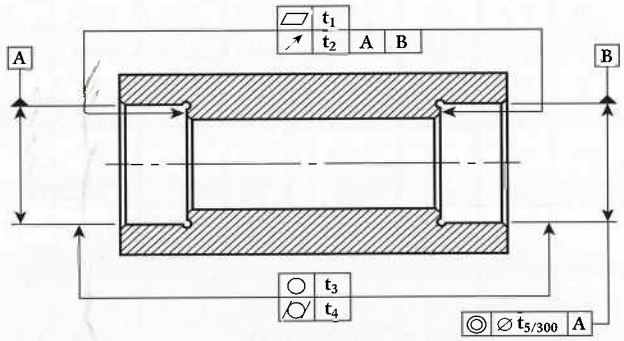

Table 2: Dimensional accuracy recommendations for housings.

Characteristic	BORE DIAMETER OF BEARING HOUSING, mm							
	<10	10-18	19-30	31-50	51-80	81-120	121-180	181-250
▱ Flatness, t_1	65	80	100	100	120	150	200	300
↗ Runout, t_2	100	120	150	150	200	250	300	400
○ Roundness, t_3	60	75	100	125	150	150	200	250
⌭ Taper, t_4	50	60	75	75	100	125	150	200
◎ Concentricity, t_5	100	120	150	150	200	250	300	400

Values in microinches.

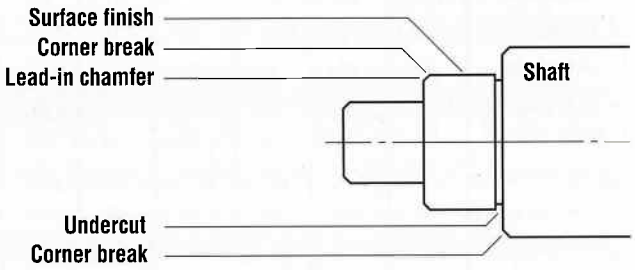

Table 3: Recommended finish of bearing seats and shoulders.

Detail or Characteristic	Specification
Lead-in chamfer	Required
Undercut	Preferred
All corners	Burr-free at 5x magnification
Surface finish	16 microinch AA maximum
Bearing seats	Clean at 5x magnification

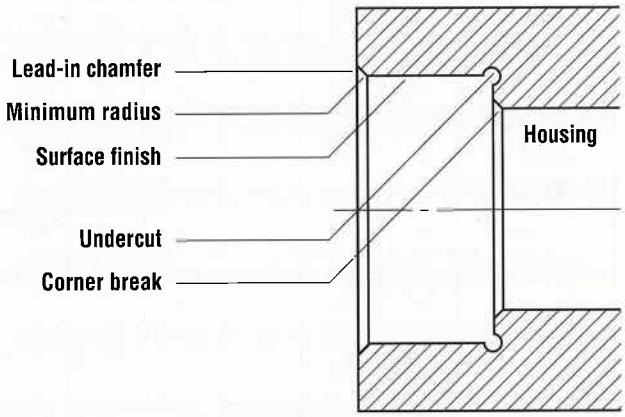

Table 4: Recommended geometry of corners.

Detail \ Bearing	NOMINAL BORE DIAMETER, mm			
	<6	6-50	51-120	121-180
Corner break, min.	.001	.002	.003	.004
Minimum radius	.003	.003	.003	.004

Values in inches.

Bearing Mounting and Fitting

Shaft & Housing Fits

The ideal mounting for a precision bearing has a line-to-line fit, both on the shaft and in the housing. Such an idealized fit has no interference or looseness.

As a practical matter, many influencing factors have to be considered:

- Operating conditions such as load, speed, temperature.
- Provision for axial expansion.
- Ease of assembly and disassembly.
- Requirements for rigidity and rotational accuracy.
- Machining tolerances.

Thus, the appropriate fit may have moderate interference, moderate looseness or even a transitional nature, as governed by operating requirements and the mounting design. Tables 5 and 6 provide general guidelines for typical applications, according to dominant requirements.

Fitting Practice

Interference fits (press fits) may be required when there is:

- A need to avoid mass center shifts.
- Heavy radial loading.
- Vibration that could cause fretting and wear.
- A need for heat transfer.
- A lack of axial clamping.
- To compensate for centrifugal growth of inner ring.

Interference fits should be used cautiously, as they can distort the raceway and reduce radial play. In preloaded pairs, reduction of radial play increases the preload. If excessive, this can result in markedly reduced speed capability, higher operating temperature and premature failure.

Loose fits may be advisable when:

- There are axial clamping forces.
- Ease of assembly is important.
- There must be axial movement to accommodate spring loading or thermal movements.

Table 5: *Shaft/housing fits for miniature & instrument bearings.*

	Dominant Requirements*		Fit Extremes, inches**	
			Random Fitting	Selective Fitting
Shaft Fits	Inner ring clamped	Normal accuracy.	.0000 – .0004	– .0001 – .0003
		Very low runout, high radial rigidity.	+ .0001 – .0003	.0000 – .0002
	Inner ring not clamped	Normal accuracy.	+ .0001 – .0003	.0000 – .0002
		Very low runout, high radial rigidity.	+ .0003 – .0001	+ .0002 .0000
		Very high speed service.	+ .0002 – .0002	+ .0001 – .0001
		Inner ring must float to allow for expansion.	.0000 – .0004	– .0001 – .0003
		Inner ring must hold fast to rotating shaft.	+ .0003 – .0001	+ .0002 .0000
Housing Fits	Normal accuracy, low to high speeds. Outer ring can move readily in housing for expansion.		.0000 – .0004	– .0001 – .0003
	Very low runout, high radial rigidity. Outer ring need not move readily to allow for expansion.		+ .0001 – .0003	.0000 – .0002
	Heavy radial load. Outer ring rotates.		+ .0001 – .0003	.0000 – .0002
	Outer ring must hold fast to rotating housing. Outer ring not clamped.		+ .0004 .0000	+ .0003 + .0001

*Radial loads are assumed to be stationary with respect to rotating ring.
**Interference fits are positive (+) and loose fits negative (–) for use in shaft and housing size determination, page 35.

Bearing Mounting and Fitting

Loose fits for stationary rings can be a problem if there is a dominant rotating radial load (usually unbalanced). While axial clamping, tighter fits and anti-rotation devices can help, a better solution is good dynamic balancing of rotating mass.

The appropriate fit may also vary, as governed by operating requirements and mounting design. To ensure a proper fit, assemble only clean, burr-free parts. Even small amounts of dirt on the shaft or housing can cause severe bearing misalignment problems.

When press fitting bearings onto a shaft, force should be applied evenly and only to the ring being fitted or internal damage to the bearing — such as brinelling — could result. If mounting of bearings remains difficult, selective fitting practices should be considered. Selective fitting — utilizing a system of bearing calibration — allows better matching of bearing, shaft and housing tolerances, and can provide more control over assembly.

Fitting Notes:

1. Before establishing tight interference fits, consider their effect on radial internal clearance and bearing preloads (if present). Also realize that inaccuracies in shaft or housing geometry may be transferred to the bearings through interference fits.

***Table 6:** Shaft and housing fits for spindle and turbine bearings.*

	Dominant Requirements*			Fit Extremes, inches** Nominal Bore Diameter, mm 7–30	31–80	81–180
Shaft Fits	Inner ring clamped	Very low runout, high radial rigidity.		+ .0002 – .0001	+ .0003 – .0001	+ .0004 – .0002
		Low to high speeds, low to moderate radial loads.		+ .00015 – .00015	+ .0002 – .0002	+ .0003 – .0003
		Heavy radial load	Inner ring rotates	+ .0003 .0000	+ .0004 .0000	+ .0006 .0000
			Outer ring rotates	.0000 – .0003	+ .0001 – .0003	+ .0001 – .0005
	Inner ring not clamped	Very low runout, high radial rigidity, light to moderate radial loads.		+ .0003 .0000	+ .0004 .0000	+ .0006 .0000
		Heavy radial load	Inner ring rotates	+ .0004 + .0001	+ .0005 + .0001	+ .0007 + .0001
			Outer ring rotates	.0000 – .0003	+ .0001 – .0003	+ .0001 – .0005
		Inner ring must float to allow for expansion, low speed only.		.0000 – .0003	– .0001 – .0005	– .0008 – .0002
				Nominal Outside Diameter, mm 18–80	81–120	121–250
Housing Fits	Normal accuracy, low to high speeds, moderate temperature.			.0000 – .0004	+ .0001 – .0005	+ .0002 – .0006
	Very low runout, high radial rigidity. Outer ring need not move readily to allow for expansion.			+ .0001 – .0003	+ .0002 – .0004	+ .0002 – .0006
	High temperature, moderate to high speed. Outer ring can move readily to allow for expansion.			– .0001 – .0005	– .0001 – .0007	– .0002 – .0010
	Heavy radial load, outer ring rotates.			+ .0004 .0000	+ .0006 .0000	+ .0008 .0000

*Radial loads are assumed to be stationary with respect to rotating ring.
**Interference fits are positive (+) and loose fits negative (–) for use in shaft and housing size determination, page 35.