

TAPERED ROLLING BEARING – BASIC DESIGN

Considering the performance demands placed on tapered roller bearings, it's rather amazing how simple the basic design really is. Timken tapered roller bearings minimize friction because of the interrelationship of the bearing's four basic parts:

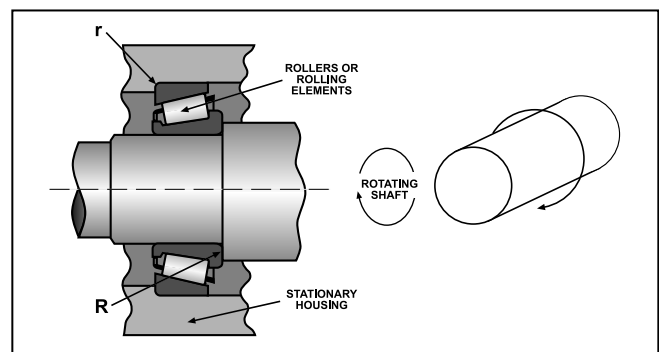
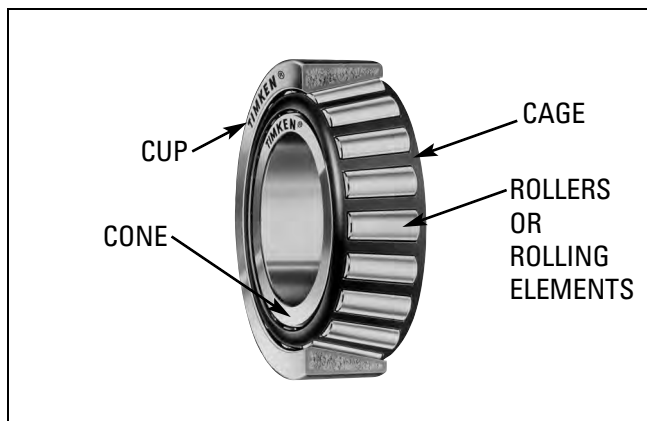
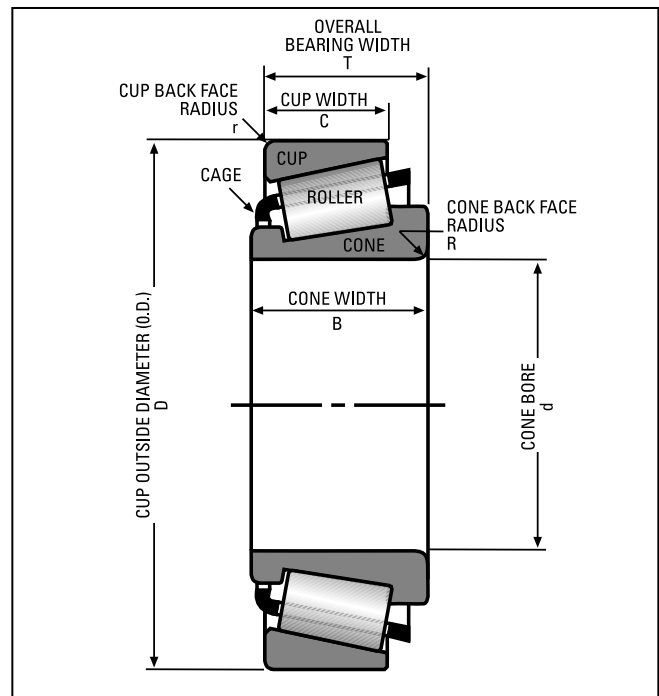
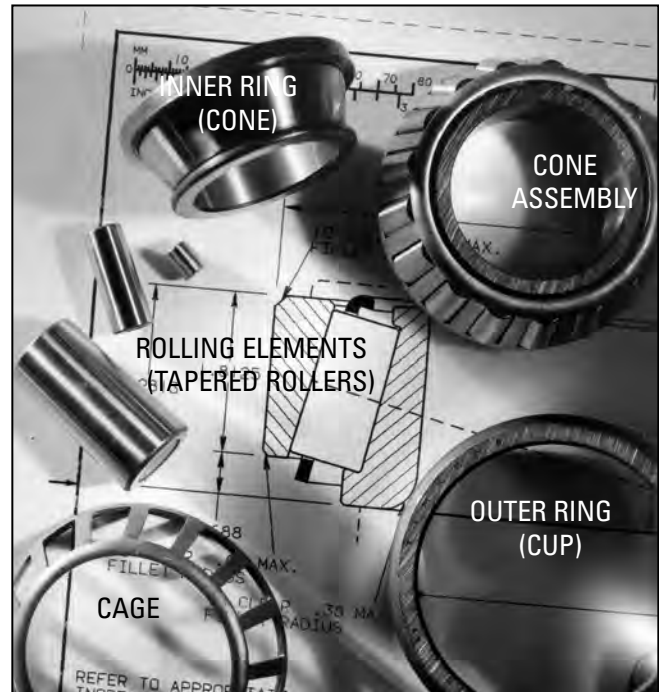
- The inner ring, or cone, is mounted onto the shaft.
- The outer ring, or cup, sits in the housing (hub).
- The tapered rollers, or rolling elements, allow relative motion between the cone and cup thus minimizing friction between the two.
- The cage, or separator, spaces and holds the rolling elements in the proper position.
- The races are the surfaces on the cup and cone where the rolling elements make contact.

The tapered roller bearing's most important dimensions are:

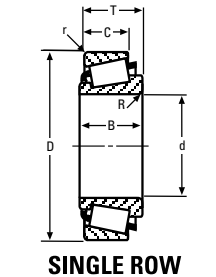
- The outside diameter of the outer ring, or cup, is known as the O.D. (D). The other basic dimension of this part is the cup width (C). Both are important for fitting the bearing onto the housing.
- The inside diameter of the inner ring, or cone is called the bore (d). This diameter must be correct in order to fit the bearing onto the shaft. The other basic dimension of this part is the cone width (B).
- When cup and cone are mated (including rollers and cage), the overall dimension is called the overall bearing width (T).

Bearing components or assemblies must be in alignment. Their fit onto a shaft or within a housing must be square or in alignment by checking:

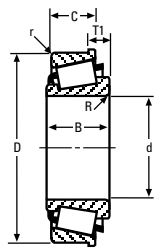
- The maximum shaft radius (R), which allows the cone backface to make contact with the shoulder of the shaft.
- The maximum housing radius (r), which allows the cup backface to make contact with the shoulder of the housing.



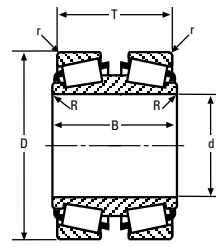
NP and XC PARTS



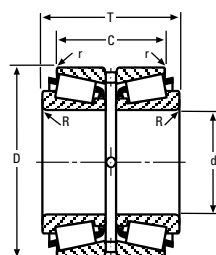
SINGLE ROW



SINGLE ROW
WITH FLANGE



DOUBLE CONE



DOUBLE CUP

13

CONE			Max Shaft Fillet Radii R'	CUP			Max Hs'ng Fillet Radii r'	Remarks				
Number	BORE d	WIDTH B		Number	OUTSIDE DIA D	WIDTH C						
*XC2455CF	120.650 4.7500	52.388 2.0625	.5 .02	XC2456D	190.525 7.5010	34.925 1.3750	1.5 .06	XC2451CF: KEYWAY IN FRONTFACE TAPERED BORE				
								XC2451CG: TQI/TQO (NON-INTERLOCKING) REVERSE TAPERED BORE				
*XC2463CL	827.527 32.5798	171.450 6.7500	9.7 .38									
*XC2463CN	872.769 34.3610	171.450 6.7500	9.7 .38									
*XC2465CC	34.988 1.3775	17.000 .6693	spcl. spcl.									
								XC2455CF: GROOVE IN OD BACKFACE BROKEN FRONTFACE ID SHOULDER ON OD BACKFACE EXTENDED LARGE RIB				
*XC2475C	777.875 30.6250	219.075 8.6250	9.7 .38									
*XC2475CA	759.618 29.9062	406.400 16.0000	4.8 .19									
*XC2475CB	725.752 28.5729	219.075 8.6250	9.7 .38									
								XC2463CL: REVERSE TAPERED BORE				
XC2480C	220.662 8.6875	115.888 4.5625	1.5 .06	*XC2477D	736.600 29.0000	177.800 7.0000	1.5 .06	XC2463CN: TAPERED BORE				
				*XC2477DA	736.600 29.0000	177.800 7.0000	1.5 .06	XC2465CC: FRONTFACE CHAMFER SPECIAL BACKFACE RADIUS				
								XC2475C: TAPERED BORE KEYWAY IN FRONTFACE				
				*XC2480D	314.782 12.3930	106.362 4.1875	1.5 .06	XC2475CA: TQI/TQO (NON-INTERLOCKING) TAPERED BORE				
				*XC2481DA	73.025 2.8750	38.892 1.5312	1.5 .06	XC2475CB: REVERSE TAPERED BORE KEYWAY IN FRONTFACE				
				*XC2481DB	73.414 2.8903	38.892 1.5312	1.5 .06					
				XC2488DA	122.238 4.8125	38.100 1.5000	3.3 .13	XC2477D: GROOVE IN OD CENTER HOLES IN OD CENTER				
								XC2477DA: HOLES IN OD CENTER GROOVE IN OD CENTER				
								XC2480D: GROOVE IN OD CENTER HOLES IN OD CENTER				
								XC2481DA: SHOULDER ON OD FRONTFACE GROOVE IN ID CENTER				
*JXC2493CA	120.000 4.7244	36.000 1.4173	3.5 .14	JXC2568DA	100.000 3.9370	23.020 .9063	3.3 .13	XC2481DB: GROOVE IN ID CENTER SHOULDER ON OD FRONTFACE				
XC2527CB	95.000 3.7402	45.500 1.7913	5.0 .20					JXC2493CA: HOLES IN BACKFACE TO UNDERCUT				
								XC2836C: TAPERED BORE KEYWAY IN FRONTFACE				
*XC2836C	604.838 23.8125	109.538 4.3125	6.4 .25									
*XC2836CA	595.709 23.4531	201.612 7.9375	3.3 .13									
*XC2836CB	578.909 22.7917	109.538 4.3125	6.4 .25									
XC2837CT	53.975 2.1250	32.791 1.2910	3.5 .14									
								XC2837D	123.825 4.8750	25.400 1.0000	3.3 .13	
								XC2840D	62.000 2.4409	15.500 .6102	1.5 .06	
								XC5240D	358.775 14.1250	23.812 .9375	3.3 .13	XC2836CA: TAPERED BORE TQI/TQO (NON-INTERLOCKING)
XC5936CE	234.950 9.2500	49.212 1.9375	3.5 .14	*XC5939D XC5939DB XC5940D	457.098 17.9960 457.098 17.9960 336.550 13.2500	49.212 1.9375 49.212 1.9375 50.800 2.0000	3.3 .13 3.3 .13 3.3 .13	XC2836CB: KEYWAY IN FRONTFACE REVERSE TAPERED BORE				
*XC5939CA	343.052 13.5060	122.238 4.8125	1.5 .06					XC5939CA: MADE FROM SPECIAL STEEL				
XC5939CD	343.052 13.5060	122.238 4.8125	1.5 .06					XC5939D: MADE FROM SPECIAL STEEL				
XC5940CC	235.331 9.2650	69.850 2.7500	1.5 .06									

NP Parts are made for specific applications.
XC Parts are in limited production.

①These Maximum Fillet Radii will be cleared by the Cone or Cup Radii.
* See Remarks Column.

AUXILIARY PARTS – LOCKNUTS, LOCKWASHERS, AND TONGUED WASHERS

Standard Locknut, Lockwasher, and Tongued Washer Assemblies

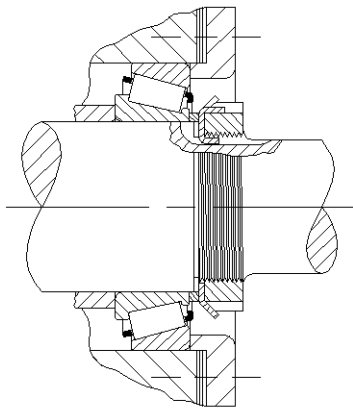


Figure 1

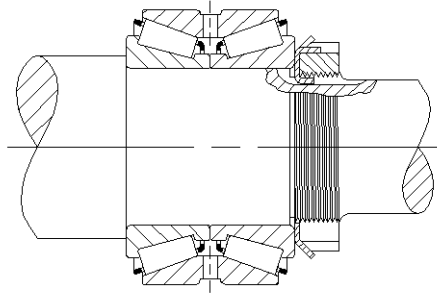


Figure 2

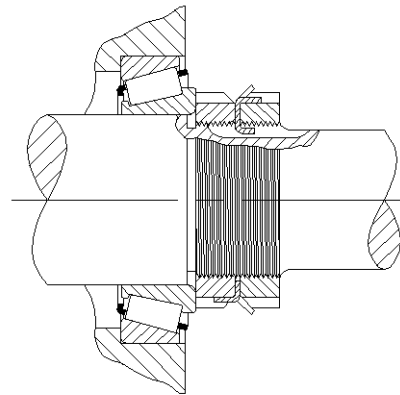


Figure 3

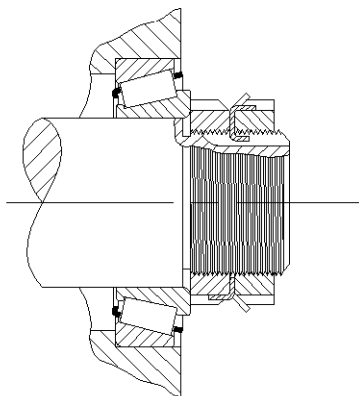


Figure 4

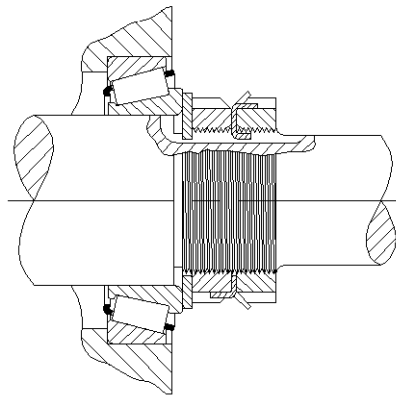


Figure 5

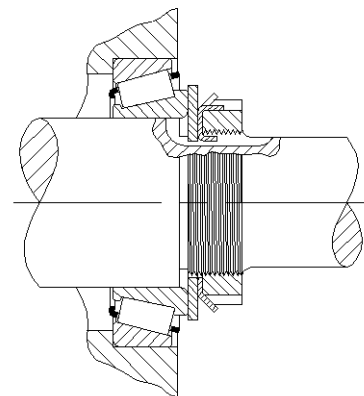


Figure 6

The designs shown in figures 1 to 6 inclusive show various methods of using standard locknuts, lockwashers, and tongued washers, indicated in the tables on pages 285 through 286. A single locknut and lockwasher can be used to clamp the cone against a sleeve, shown in figure 1, or directly against a shaft shoulder. A narrow spacer is applied between the front face of the cone and the lockwasher so that the lockwasher will clear the bearing cage by a minimum of 3mm (0.12 in). The spacer outside diameter should be made a minimum of 6mm (0.24 in) smaller than the cage inside diameter, but must still provide the recommended cone backing diameter as found in the Timken engineering journal. Figure 2 shows another clamped design using a single locknut and lockwasher with a two-row bearing of either type TDO with cone spacer or type TNA. Since no cage clearance problem is present, the narrow spacer shown in figure 1 is unnecessary.

Figures 3, 4, and 5 indicate an adjustable bearing arrangement using two locknuts and a lockwasher. These may be used with either single or two-row bearing of the types permitting a cone adjusted arrangement. The design in figure 3 allows the maximum shaft extension diameter that can be used with a shaft thread outside diameter, which will be less than the cone

bore. Figure 4 shows an alternate design with smaller thread diameter and corresponding smaller locknuts and lockwasher. The locknut outside diameter, minus 2 times "r" (pages 285 through 286), must not be less than the recommended cone backing diameter as found in the Timken engineering journal. Figure 5 indicates the use of a tongued washer located between the inner locknut and cone. This is intended for applications where the cones are applied with loose fits on hardened stationary shafts as found in many automotive applications. The hardened tongued washers are not sold by The Timken Company.

When space does not permit the use of two locknuts and a lockwasher in an adjustable arrangement, and a single locknut and a lockwasher is used, then a tongued washer must be placed between the cone and lockwasher as illustrated in figure 6. This is necessary to provide adequate backing for the cone, in most cases, and to prevent damage to the lockwasher if the cone should creep on the shaft. The tongued washers are available from The Timken Company.

The Timken Company has created a family of literature to assist customers in specifying the appropriate bearing for each application and then maximizing its useful life. To assist that effort, reference material has been developed to help bearing selection for a market segment's specific needs, to implement proper maintenance practices and to utilize the full spectrum of design and service solutions.

Please contact your Timken sales representative to receive copies of the following literature:

MARKET SPECIFIC LITERATURE

- The Right Solution for the Rolling Mill Industry
- Precision Tapered Roller Bearings for Machine Tools
- Tapered Roller Bearings for Printing Presses

MAINTENANCE LITERATURE

- Bearing Maintenance Manual for Transportation Applications
- Bearing Maintenance Manual for Mobile Industrial Equipment
- Bearing Maintenance Manual for General Industrial Equipment
- Bearing Damage Analysis Poster
- Maintaining Quality on TQO Bearings

PRODUCT-SPECIFIC LITERATURE

- Aircraft Landing Wheel Bearings
- AP Bearings for Industrial Applications
- AquaSpexx Corrosion-Resistant Bearings
- Bearings Plus Service Kits
- Debris-Resistant Bearings
- Precision Crossed Roller Bearings
- Spexx Performance Bearings
- TNASWH Bearings
- Thrust Bearings

LITERATURE ON TIMKEN SERVICES

- Bearing Express
- Gear Express
- Industrial Bearing Services
- Mill Express
- Spacer Assembly Value Express (SAVE)