

TIMKEN

Timken® TQO Bearing Maintenance Manual





WARNING *Failure to observe the following warnings could create a risk of serious injury.*

Proper maintenance and handling practices are critical. Failure to follow installation instructions and to maintain proper lubrication can result in equipment failure.

NOTE: This manual is not intended to substitute for the specific recommendations of your equipment supplier.

Every reasonable effort has been made to ensure the accuracy of the information contained in this writing, but no liability is accepted for errors, omissions, or for any other reason.

INTRODUCTION

This manual is your guide to proper maintenance practices for Timken® TQO bearings. It provides practical information on how to properly maintain the complete roll neck, chock and bearing assembly to improve the performance and extend the life of your equipment. Learn how to properly:

- Remove the bearing from the chock;
- Inspect bearing components and the chock;
- Install the bearing into the chock;
- Inspect the roll neck; and
- Mount the chock assembly onto the roll neck.

TQO bearings are a vital component in the metal rolling industry, where the operating conditions are harsh, loads are heavy and contamination by dirt, scale and rolling solution is common. It is essential to follow proper maintenance practices to ensure reliable operations, peak equipment performance and the lowest possible maintenance costs.

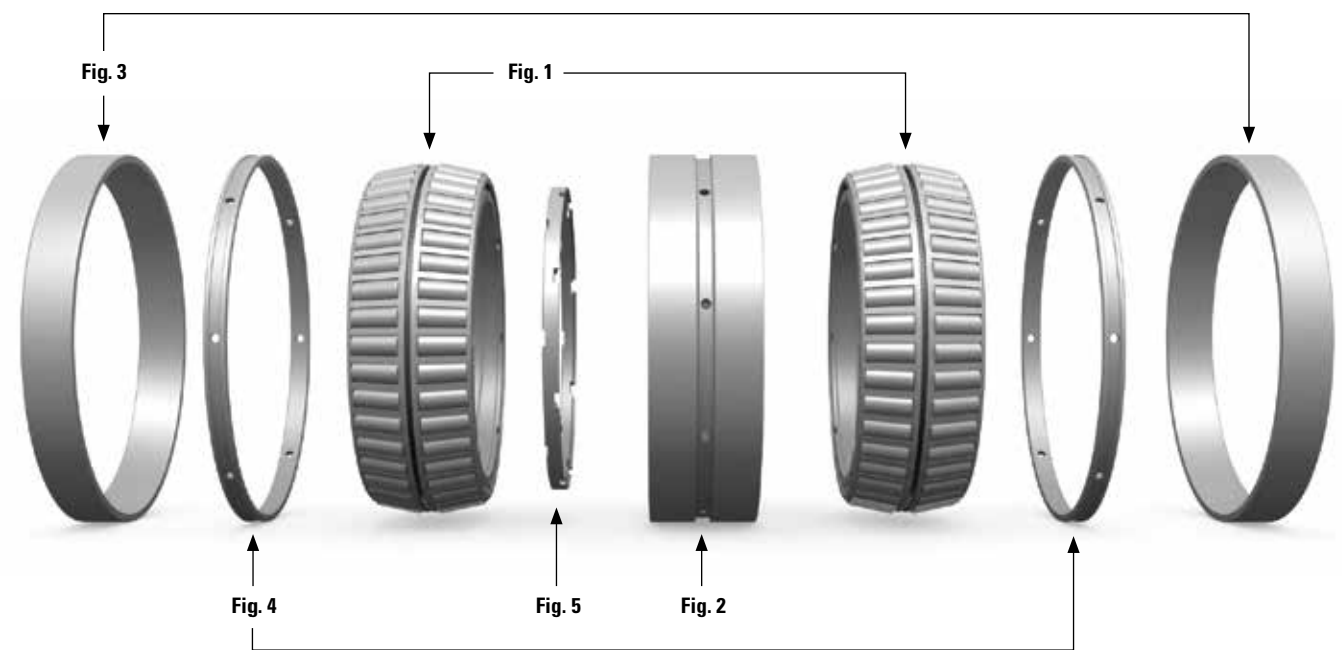
The TQO bearing is the most commonly used anti-friction roll neck bearing in the metal rolling industry. It includes five components: two double cones (Fig. 1), one double cup (Fig. 2), two single cups (Fig. 3), two cup spacers (Fig. 4) and one cone spacer (Fig. 5).

TQO bearings range in size from 83.4 mm (3.281 in.) to 1915.00 mm (75.394 in.) in outside diameter (O.D.). The basic construction is the same in all sizes.

However, based on the size of the TQO bearing, cage types differ. Smaller sizes feature a stamped steel cage design. Larger TQO bearings have either a pin-through-the-roller- or external-pin-type cage with lifting holes in the cage rings (Fig. 6).



Fig. 6 A TQO bearing with lifting holes in the cage ring



TQO Bearing Components

One of the most important steps in maintaining your TQO bearing is keeping accurate service records. The Timken Roll Neck Bearing Service Record card (Fig. 7) is available to record the chock, roll and stand number; cup load zones; and tonnages or hours used. These cards should be kept up-to-date with every inspection.

Bearings must be removed from operation and inspected regularly to ensure maximum roll neck bearing life. The frequency of the inspections will vary with the operating conditions, but are often conducted at three-, six- or even 12-month intervals. These inspections allow you to identify trouble areas before they become serious.

REMOVE THE BEARING FROM THE CHOCK

Special lifting methods and handling tools are used to remove the bearing from the chock and handle the bearing during inspection. For pin-type cage bearing designs, bearing removal is usually completed in three lifts. The first lift (Fig. 8) removes the top single cup and double cone. Four eye bolts and locking nuts are inserted into the lifting holes of the cage to remove these components. The locking nut should be tightened against the cage, prior to lifting.

The second lift (Fig. 9) removes the double cup, bottom double cone, along with the cone spacer and top cup spacer. Again, the lifting holes in the bottom double cone are used to remove these components.

The final lift (Fig. 10) removes the bottom single cup and cup spacer. The bearing hook is used to remove these components.

Smaller TQO bearings with stamped steel cages also require three lifts and special lifting fixtures. Contact your Timken representative for more information.

Roll Neck Bearing Service Record

TIMKEN

Plant: _____ Mill: _____
 Two-row Four-row Back-up Roll Work Roll Lubricant: _____
 Serial Number: _____ Part Number/Assembly Number: _____ BEPRIC: _____

Times in Service	Date In	Chock No.	Roll No.	Stand No.	Position	Cup Load Zone	A Cup Down	Date Out	Service Hours	Service Tons	Total Hours	Total Tons	Remarks On Tonnage Or Repair And Inspections
1					T D D D	B D C D	□						
2					T D D D	B D C D	□						
3					T D D D	B D C D	□						
4					T D D D	B D C D	□						
5					T D D D	B D C D	□						
6					T D D D	B D C D	□						
7					T D D D	B D C D	□						
8					T D D D	B D C D	□						
9					T D D D	B D C D	□						
10					T D D D	B D C D	□						
11					T D D D	B D C D	□						
12					T D D D	B D C D	□						
13					T D D D	B D C D	□						
14					T D D D	B D C D	□						

Fig. 7 The Timken Roll Neck Bearing Service Record card



Fig. 8 Remove the top single cup and double cone



Fig. 9 Remove the double cup, bottom double cone, cone spacer and top cup spacer



Fig. 10 Remove the bottom single cup and cup spacer

INSPECT BEARING COMPONENTS

CLEAN THE BEARING

After removal, clean the TQO bearing to eliminate any accumulation of scale, water, lubricant, debris or other contaminants which can cause damage to the bearing. The bearing must be cleaned thoroughly to allow for proper inspection. Small bearings or small quantities of bearings may be cleaned in a commercially available parts cleaner that circulates a cleaning solution such as kerosene, mineral spirits, or other OSHA approved commercial solvents. Large bearings may be cleaned in a wash tank that circulates alkali cleaners.

Alkali cleaners such as tri-sodium phosphate (TSP), soda ash, or metasilicate should be mixed with the ratio of 15 to 25 ml per liter (2 to 3 ounces per gallon) of hot water. These hot water solutions often are used as a final cleaning or rinse after the initial bearing cleaning in a hot oil tank. The cleaning tank should have provisions for heating the oil or water solution as well as for agitating or recirculating the cleaner.

After cleaning, the bearing should be covered with a coating of light oil to protect against rusting if it is not inspected immediately.

INSPECT FOR DAMAGE

After cleaning the bearing, it is necessary to visually inspect the bearing components for damage and wear. Rollers can be inspected by rotating the cage or by turning the individual rollers. The pin-type cages on most large bearing cones have one or two inspection pins which allow you to remove individual rollers. These pins can be removed by prying out the locking wire and unscrewing the pin (Fig. 11). Drawings of pin removal sockets can be provided by your Timken representative.

Next, remove the roller to inspect the cone O.D. or raceway (Fig. 12). If small spalls or surface breakouts are found on the cone O.D. or rollers, minor repairs often can be made to the bearing. Any component damage should be recorded.

The cone and rollers are the rotating bearing parts in a roll neck application. All areas of the cone O.D. will carry part of the rolling load during each revolution of the cone assembly. Large spalled areas on the cone O.D. will not be able to support the rollers under the load. Repairing large spalls in this location is not suggested.

Rollers cannot be removed from stamped-steel-type cage assemblies. If damage is found on the assembly, the bearing may be repaired at a Timken service facility.



Fig. 11 Remove the pin locking wire



Fig. 12 Remove the roller to inspect the bearing raceway for damage

To complete the cone inspection, reinstall the rollers, retighten the inspection pins and replace the locking wires. The cone bore should also be measured to check that it is within the manufacturer's acceptable limits.

Bearing cups should be wiped clean and thoroughly inspected. The condition of these components can provide information about problems in the mill. Contact your Timken representative to discuss the cause of the damage and to help determine a corrective action plan.

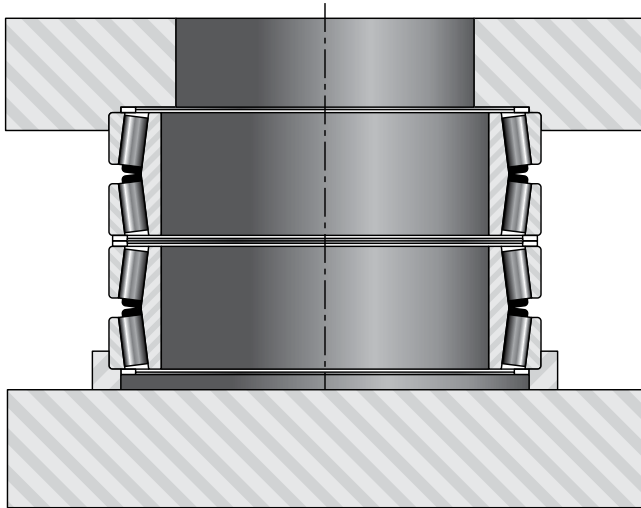


Fig. 13 Weighted bearing



Fig. 14 Weight the bearing to properly seat components

CHECK THE BEARING FOR WEAR

Wear on TQO bearings should be checked annually. For wear measurement, the bearing should be stacked without spacers on a flat solid surface with the lower cup supported in a base fixture (Fig. 13). This base fixture must be counter bored for cage clearance and allow for free rotation of the cone assembly. It is necessary to add weight to the bearing being measured in order to properly seat the components (Fig. 14). The weight should be made to pilot on the bearing cup outside diameter and counter-bored to clear the cage. Bearings with a long service life need this weight since components may be out-of-round and can be difficult to seat properly. The weight applied should be equal to the weight of the bearing being measured. As a safety precaution, the chains used to lift the added weight should be kept in place with slack at all times.

Any time the bearing is stacked, whether for wear measurements (when the cup and cone spacers are left out) or for assembly into the chock, the proper stacking sequence of the components must be followed for the bearing to have the correct setting or running clearance. Timken uses a lettering system to ensure proper stacking (Fig. 15). In the TQO bearing, parts are lettered A through E and must be kept in proper sequence. The bearing can be stacked with either the A cup down or the E cup down, but the components must remain in proper sequence. The B cup spacer must be placed in the B gap and the D cup spacer in the D gap. The C cone spacer can only be placed between the double cones in the C gap, with the flange side down to keep the spacer centered. The complete marking system used on most Timken TQO bearings is shown in Fig. 16.



Fig. 15 Follow the Timken lettering system to ensure proper stacking order

Every spacer adjusted bearing has a serial number, and all components of that bearing must have the same number. These components are not interchangeable.

After weighting the bearing, the components must be rotated to seat the rollers against the large cone rib. A coat of light oil should be applied to help protect the bearing (Fig. 17). Considerable rotation of the bearing may be necessary to seat the rollers, particularly those with a long service life.

Approximate seating can be checked by inserting a 0.050 mm (0.002 in.) feeler gage between the large end of the rollers and the large cone rib, as illustrated in Fig. 18.

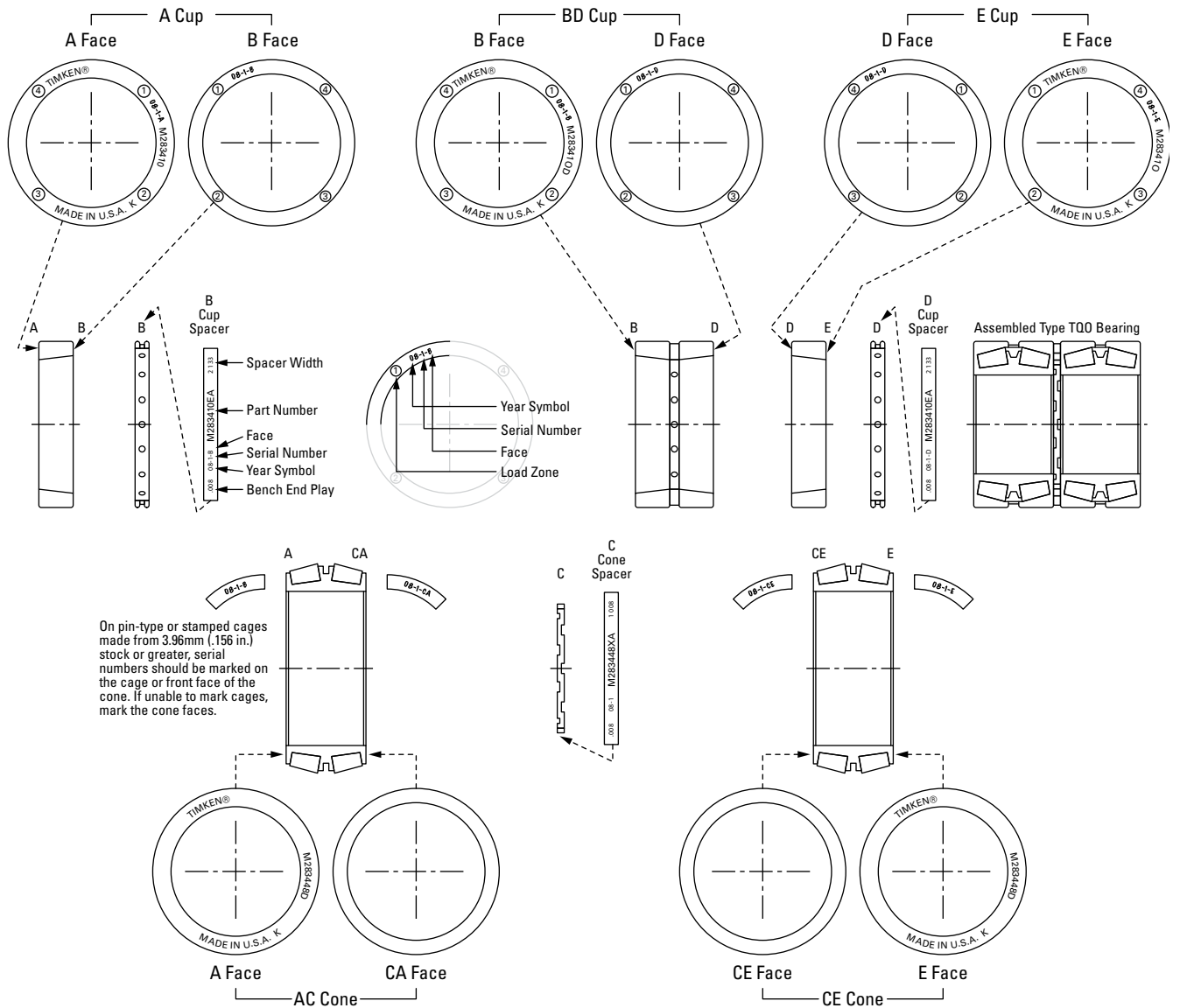


Fig. 16 Timken TQO lettering system



Fig. 17 Apply a light coating of oil to protect the bearing



Fig. 18 Use a feeler gage to check for proper bearing seating



Fig. 19 Measure the B, D and C gap for wear

Once you begin the B, D and C gap measurements, the bearing should not be rotated. With all components seated, the B, D and C gaps are measured at four places, 90 degrees apart, around the bearing (Fig. 19). The average of the four measurements for each gap is then used for that specific gap. Contact your Timken representative for more information on gap measurement tools.

The B, D and C spacers are then measured to obtain their width (Fig. 20). Bearings properly set with end play will always have a spacer width greater than the corresponding spacer gap, as demonstrated in Fig. 21. The difference between the spacer width and gap measurement is the axial end play in the two adjacent rows of rollers.

Component wear within a bearing may not be the same. The axial end play in each set of rollers may be different. This may be caused by an unusual operating condition that severely loaded one end of the bearing or a faulty seal causing localized contamination of lubricants.

The bearing setting can be adjusted by regrinding each spacer width. Usually, it is not necessary to regrind the spacers until the wear has increased the axial end play to double the amount of the original end play. For instance, on a bearing with a 0.31 mm (0.012 in.) original axial end play, regrinding the spacers would not be necessary until the bearing measurement for wear showed 0.61 mm (0.024 in.) axial end play.



Fig. 20 Measure the B, D and C spacer width

It is suggested to regrind the spacer widths in order to provide for 1.5 times the original bearing end play. If the new bearing requires 0.30 mm (0.012 in.) end play, regrind the spacer to provide 0.46 mm (0.018 in.) end play. The increase over new bearing end play is necessary to compensate for the use of weights during measurement. Fig. 22 shows a sample calculation for a bearing with an original end play of 0.30 mm (0.012 in.) A record of the spacer gap and spacer width should be noted on the Roll Neck Bearing Service Record card. This method should only be incorporated when measuring new assemblies. Contact your Timken representative for further instruction.

INSPECT THE CHOCK

The bearing chock should be cleaned thoroughly and all lubrication and vent holes blown out with air. If oil mist lubrication is used, special attention should be given to ensure the mist re-classifier fittings are clean. It is equally important to inspect the chock, rocker plates and keeper plates on an annual basis or during regular service intervals.

The chock should be inspected for damage and the chock bore should be measured to confirm it is still within the acceptable limits of the original manufacturer's specifications for size and taper. The distance across the liner seats should also be within specification. Rocker plates should be inspected to make sure they are in serviceable condition and have proper bevels permitting the chock to rock and align under roll neck deflections. Keeper plates need to be checked for wear and cracking. This will ensure that proper clearance between the chock and the windows in the mill housing are maintained.



Fig. 21 With the proper bearing end play, the spacer width is greater than the spacer gap

Bearing End Play Readjustment	
When To Readjust End Play	
Original end play in bearing (new)	0.31 mm 0.012 in.
Regrind spacers when end play doubles to	0.61 mm 0.024 in.
Regrind spacers to provide 1.5 times original end play	0.46 mm 0.018 in.
Spacer Width Calculation	
Space measurement	26.01 mm 1.024 in.
End play desired	+ 0.46 mm 0.018 in.
Regrind spacer to	26.47 mm 1.042 in.
All three spacers, B, C and D, are calculated using the actual values of space measurement.	

Fig. 22 Sample end play readjustment calculation

Heavy corrosion or fretting in the chock should be buffed or polished (Fig. 23). Long-service life can distort the chock bore, therefore periodic checks for bore size and out-of-roundness should be made (Fig. 24). The bearing cups are a loose fit in the chock and the fitting practice (Fig. 25) varies based on the nominal O.D. size of the cup. Suggestions for permissible chock bore out-of-roundness and over-size limits due to service are shown in Fig. 26.



Fig. 23 Remove any heavy corrosion and fretting in the chock



Fig. 24 Check for chock bore size and out-of-roundness

Cup Fitting Practice				
Outside Diameter Cup		Chock Bore Variance from Nominal Cup O.D.		Fit.
Over	Incl.	Min.	Max.	
mm in.	mm in.	mm in.	mm in.	mm in.
0 0	304.8 12	+0.05 +0.002	+0.08 +0.003	0.02 L 0.08 L 0.001 L 0.003 L
304.8 12	609.6 24	+0.10 +0.004	+0.15 +0.006	0.05 L 0.45 L 0.002 L 0.006 L
609.6 24	914.4 36	+0.15 +0.006	+0.23 +0.009	0.08 L 0.23 L 0.003 L 0.009 L
914.4 36	1219.2 48	+0.20 +0.008	+0.31 +0.012	0.10 L 0.31 L 0.004 L 0.012 L
1219.2 48	1524 60	+0.25 +0.010	+0.38 +0.015	0.13 L 0.38 L 0.005 L 0.014 L

Fig. 25 Cup fitting practice

Chock Bore Rework Limits						
Chock Bore - Metric <i>(Note: for tapered bore bearings in mills running at 1200 mpm (4000 fpm) or higher consult with your Timken representative)</i>						
Size Range Bearing O.D.		Chock Bore - Variance from Nominal Cup O.D.		Max. Out of Round	Max. Oversize Variance from Nominal Cup O.D.	Max. Taper
Over	Incl.	Min.	Max.			
mm in.	mm in.	mm in.	mm in.	mm in.	mm in.	mm in.
0 0	304.8 12	+0.05 +0.002	+0.08 +0.003	0.08 0.003	+0.20 +0.008	0.04 0.0015
304.8 12	609.6 24	+0.10 +0.004	+0.15 +0.006	0.15 0.006	+0.38 +0.015	0.05 0.002
609.6 24	914.4 36	+0.15 +0.006	+0.23 +0.009	0.23 0.009	+0.58 +0.023	0.08 0.003
914.4 36	1219.2 48	+0.20 +0.008	+0.31 +0.012	0.31 0.012	+0.76 +0.030	0.10 0.004
1219.2 48	1524 60	+0.25 +0.010	+0.38 +0.015	0.38 0.015	+1.01 +0.040	0.13 0.005

Fig. 26 Chock bore rework limits

Backing shoulders inside the chock (Fig. 27) and cover plate (Fig. 28) should be free of burrs and damage to permit proper seating of the cups and backing support.

All seals should be inspected and replaced if worn or damaged (Fig. 29). Seals play an important role in extending bearing life and care should be taken to maintain the proper seals and seal orientation in the chock at all times.

Record each chock inspection and corresponding measurements. When the chock measurements are outside of the manufacturer's specifications, contact your Timken representative to discuss possible options for rebuild or repair.

INSTALL THE BEARING INTO THE CHOCK

TQO bearings should be installed in a clean environment, free from dust, debris and other contaminants. It is important to plan your work, making sure you have the necessary components, tools and lubrication. Before assembling the bearing into the chock, check your records to determine which load zone quadrant should be used.

CUP LOAD ZONES

Since the bearing cups are stationary in the chocks, only one cup load zone of the cup carries the rolling load. The suggested load zone is 90 degrees inside diameter (I.D.) or raceway (Fig. 30). If you find that the cup load zone is greater or less than 90 degrees, contact your Timken representative for further instruction.

The bearing inspection period is an ideal time to rotate the cups to bring a new cup load zone into position in the chock. Make sure you record this activity. Rotating the cups at every inspection will extend the useful life of the bearing by gradually distributing the load over the entire cup working raceway surface. After the cup has been rotated four times, it is suggested that you invert the bearing assembly A side down to E side down (Fig. 16) while maintaining the proper component sequence. This allows for equal distribution of the load zones across alternate roller sets, helping to extend bearing life.



Fig. 27 Remove any nicks or burrs from the chock backing shoulder



Fig. 28 The chock cover plate should also be free of damage



Fig. 29 Seals should be inspected and replaced if necessary

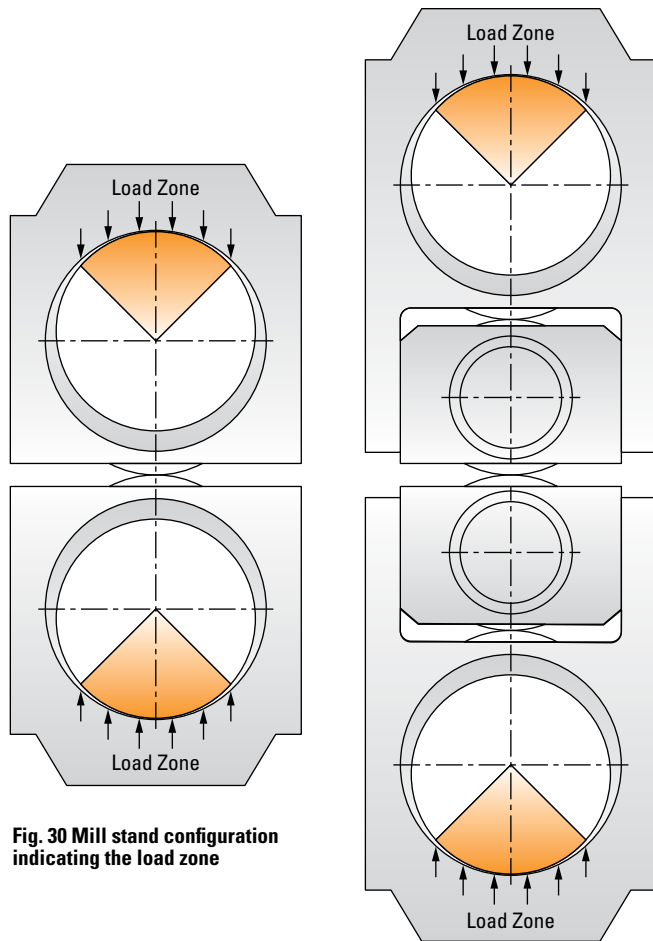


Fig. 30 Mill stand configuration indicating the load zone

Most roll neck bearing cups are marked on their faces to show four quadrants (Fig. 31). These markings allow you to keep record of the quadrants already used in the load zone. A good practice is to start each new bearing in cup quadrant 1, followed by 2 through 4, and then returning to quadrant 1 on subsequent inspections. Record the cup load zones and the cup position when servicing the bearing.



Fig. 31 Each cup quadrant is specified on the bearing



Fig. 32 The load zone in a back-up roll chock

In back-up rolls, the load zone is located at the top of the upper chock and below the lower chock (Fig. 32). The chocks are usually heavier in section at these points. For work rolls, the position of true load zone is less clear.

Any repaired spalls located in the cup should be kept out of the load zone when the bearing is reassembled into the chock.



Fig. 33 Install the bottom cup into the chock



Fig. 34 Install the cup spacer

ASSEMBLE THE BEARING INTO THE CHOCK

Use a light coat of bearing lubricant in the bore of the chock to help ease assembly and reduce fretting or corrosion between the cups and the chock bore while in service.

First, install the bottom cup into the chock (Fig. 33). Each cup should be turned until the proper load zone number is in the required position.

The corresponding cup spacer is installed next (Fig. 34). Care should be taken to avoid nicking or raising burrs on the spacers. Heavy burrs can cause cocking and misalignment of the components or a faulty bearing setting.

When grease is used to lubricate the bearings, each cone should be packed with grease as the components are assembled into the chock. (Fig. 35) Make sure to fill the gap between each roller with grease. Additional grease should be added through the regular fittings after the bearing is completely assembled into the chock. If using circulating oil or oil mist lubrication, a light coating of oil should remain on the components as they are assembled. Additional oil must be added to meet the required oil level after the chock is set upright.



Fig. 35 Lubricate the bearing with grease



Fig. 36 Install the bottom double cone and double cup into the chock



Fig. 37 Place the cone spacer and top cup spacer into position

Install the bottom double cone and double cup into the chock (Fig. 36).

The cone spacer (Fig. 37) and top cup spacer are placed into position next. The cone spacer pilots on the face of the bottom cone to keep the spacer from shifting out of position. To make sure the cup spacers are not cocked, slide or rotate the spacer into position on the cup.

The top double cone and cup are the last components to be installed into the chock (Fig. 38). If the cup becomes slightly cocked in the chock bore, use an appropriate sized hammer on a mild steel bar against the cup face to ease assembly.



Fig. 38 The top double cone and cup are the last components to be installed into the chock



Fig. 39 Notch the gasket



Fig. 40 Use a feeler gage to make sure the cups are properly clamped



Fig. 41 Before mounting the bearing, check the roll neck for size



Fig. 42 Remove any nicks or gouges on the roll neck

CHOCK COVER PLATE GASKET SELECTION

The cover plate should be mounted without gaskets and four equally spaced bolts tightened evenly until the bearing cover is uniformly seated against the bearing cup. Do not over tighten the bolts since this could deflect the cover, resulting in a false gap reading.

The gap between the cover plate flange and the face of the chock is measured at four places adjacent to the bolts. The average of the four measurements is used as the width of the gap. If cork or other similar compressible gasket material is used, the gasket should equal the width of the gap plus 25 percent to allow for compression. If a harder gasket material is used, reduce the gasket pack to only 5 to 10 percent over the actual measured gap and confirm that it compresses. If metal shims are used, a cup clamp-up of 0.05 to 0.08 mm (0.002 to 0.003 in.) is suggested.

The cover plate should be removed after measuring the gap, selecting the proper gasket and notching the gasket (Fig. 39). After applying the cover plate with the gasket in place, tighten the bolts evenly back and forth across the chock. Using a feeler gage, check the notched sections of the gasket to ensure the cups are properly clamped (Fig. 40).

INSPECT THE ROLL NECK

Before mounting the completed chock and bearing assembly onto the roll neck, the neck should be cleaned, checked for size and inspected for general condition (Fig. 41). Make sure any raised nicks or gouges on the roll neck are stoned or filed down before reassembly (Fig. 42). Heavy burrs can make it difficult to assemble the cones onto the neck and may wear the roll neck while in operation. The bearing cones are usually applied with a loose fit. Suggestions for permissible service wear limits on roll necks are shown in Fig. 43.

The seal riding surfaces should be inspected for wear and any burrs or sharp edges should be removed (Fig. 44).

Coat the neck and seal riding surface with the same lubricant as the bearing to help combat scuffing and ease installation.

Roll Neck Wear Limits - Diameter					
Size Range Bearing Bore		Neck Diameter - New Variance from Bearing Nominal		Minimum Undersize Variance from Bearing Nominal	Max. Taper
Over	Incl.	Min.	Max.		
mm in.	mm in.	mm in.	mm in.	mm in.	mm in.
101.6 4	127.0 5	-0.13 -0.005	-0.10 -0.004	-0.28 -0.011	0.04 0.0015
127.0 5	152.4 6	-0.15 -0.006	-0.13 -0.005	-0.36 -0.014	0.04 0.0015
152.4 6	203.2 8	-0.18 -0.007	-0.15 -0.006	-0.43 -0.017	0.05 0.002
203.2 8	304.8 12	-0.20 -0.008	-0.18 -0.007	-0.51 -0.020	0.05 0.002
304.8 12	609.6 24	-0.25 -0.010	-0.20 -0.008	-0.61 -0.024	0.08 0.003
609.6 24	914.4 36	-0.33 -0.013	-0.25 -0.010	-0.84 -0.033	0.10 0.004
914.4 36	1219.2 48	-0.40 -0.016	-0.33 -0.013	-1.12 -0.044	0.13 0.005

Fig. 43 Roll neck wear limits

MOUNT THE CHOCK ASSEMBLY ONTO THE ROLL NECK

The final step in maintaining your TQO bearing is to install the chock assembly onto the roll neck. Carefully handle the chock while sliding it onto the roll neck to prevent damage to the bearing and seal. Once the chock is installed onto the roll neck, the threaded and keyed retaining ring, retaining nut and split hinged ring should be fixed in place. The threaded ring is held into position by the split hinged ring, which is fitted into a groove within the roll neck and secured. This arrangement helps to locate the bearing.

If the retaining nut is provided, it is important to make sure it is loosened at least a sixth of a turn after it is drawn tight against the cone follower and locked. This allows a small gap between the cone faces and thrust rings to permit lubrication and help prevent damage. This practice applies to all straight bore bearings with loose cone fits used in either work rolls or back-up rolls.



Fig. 44 Remove any burrs or sharp edges from the seal riding surface of the roll neck

TIMKEN

The Timken team applies their know-how to improve the reliability and performance of machinery in diverse markets worldwide. The company designs, makes and markets high-performance mechanical components, including bearings, gears, belts, chain and related mechanical power transmission products and services.

Stronger Commitment. Stronger Value. Stronger Worldwide. Stronger Together. Stronger.

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