QCB Bearings

SLEWING RINGS & DRIVES

Trailer & Slewing Ring Installation & Maintenance

Warranty

QCB slewing rings are guaranteed for 12 months after delivery to be free from material defect and manufacturing or assembly error. Any perceived faults should be documented and reported to QCB.

QCB slewing rings should work satisfactorily within the scope of normal use as defined in the clients enquiry, and for the estimated service life as calculated by QCB, but as this is a statistical calculation it can in no way be considered as binding. Slewing rings selected directly by client are not covered by this warranty.

Limitation of liability

The information in this manual is distilled from best practices, national standards and our own experience.

QCB assumes no liability for damages arising from

Failure to follow the instructions and information in this manual
Improper use of the product
The use of untrained personnel
Any modifications to the product as delivered

Cat RS 2019-11E

In the interests of continuous product improvement, QCB reserves the right to modify any product or specification. All weights and measures are approximate and for guidance only. Detailed information is available from QCB Technical Department.

QCB SLEWING RING NUMBERING SYSTEM

The QCB slewing ring numbering system is made up of numbers and letters in specific groups and format. They have the following meanings

H	Helical gear (omit if not required)
SEG	Style or family type code
H	Hardened gear (omit if not required)
1166	Outer diameter (mm)
2	Number of raceways if> 1 (otherwise omit)
20	Size of major rolling element (add X for crossed roller; WR for wire race designs)
01	Design variant
6	Precision grade (omit for standard QCB specification)
CC	Material code for inner and outer ring
LM	QCB internal design code

F

Family types

- FUN Flanged, ungeared
- FIG Flanged, internal gear
- FEG Flanged, external gear
- SUN Solid section, ungeared
- SIG Solid section, internal gear
- SEG Solid section, external gear

Design number

- 5- OEM designs, or a combination of features
- 6- Reserved for imperial or inch size bearings
- Other combinations - usually related to seal/ spacer or surface treatment variations

Precision grade

- - Standard industrial clearances as per drawing
- 6 QCB Grade 6 reduced internal clearances
- 5 QCB Grade 5 reduced internal clearances
- A Light preload

Common materials

1st digit = inner ring material, 2nd digit = outer ring material

- CC 50Mn Carbon steel equiv. to C45N (common in Europe)
- AA 42CrMo4 V Alloy steel equiv. to EN19, 708M40 or DIN 1.7725
- EE AISI 52100 Through hardened steel
- XX Other materials such as aluminium and stainless steel have specific codes

All QCB bearings are marked with their part number, a serial number and a factory/date code.

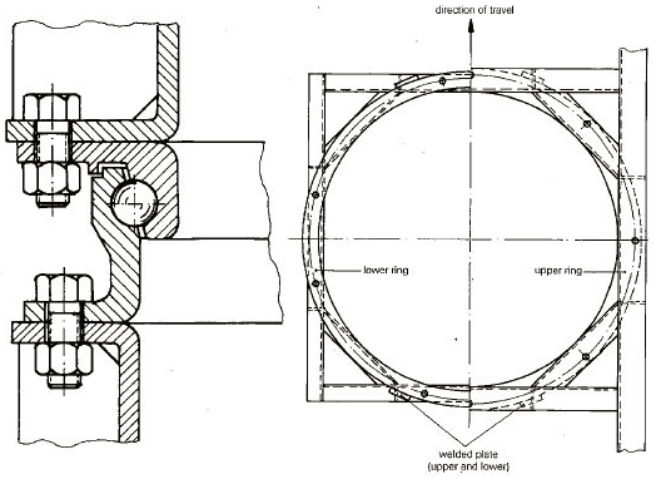
TRAILER RING INSTALLATION

Trailer rings generally do not have hardened raceways and therefore cannot be considered a replacement for a slewing ring under heavy load conditions. Trailer rings are NOT precision bearings and dimensions such as overall height of the Z and N series can vary by as much as 3mm, and diameters by as much as 5 mm!

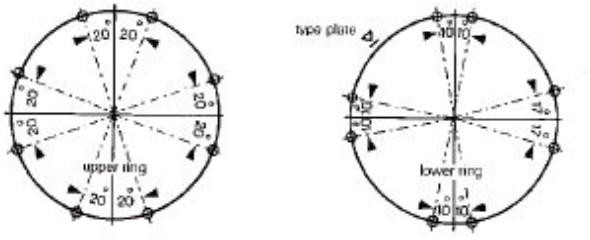
Support Structure

Trailer rings flanges should supported by a stiff frame over at least 50% of the surface area, with the loading plug located away from the direction of any radial load.

Metal tabs, pre-welded to the frame, can be used to improve radial location and reduce shear stress on the bolts caused by acceleration or deceleration. **Trailer rings should never be welded directly to the frame.**



Standard 8x45° bolt pattern



Other common bolt patterns

Bolt Data

Series U, L and N trailer rings are supplied undrilled. Eight equally spaced bolts size M12 to M16 (depending on trailer ring diameter) should be added to each flange. Typical bolt patterns are illustrated.

As trailer rings generally support lighter loads than slewing rings, Grade 8.8 bolts can be used. Bolt torques should be checked monthly.and are tabulated below

Bolt size	Tightening Torque (Nm)
M12	78
M14	126
M16	193

Lubrication

Trailer rings are supplied lightly greased and must be greased during installation and service as they are unsealed. A good quality lithium or lithium-calcium EP2 grease will be adequate in most applications.

Relubricate frequently to minimise contamination of the raceways - at least once per month. Rotate the ring during regreasing.

Slewing Ring Installation

Transport, Handling & Storage

Slewing rings should only be transported and stored in a horizontal position or on a specially built incline cradle. Shock loads should be avoided to limit any damage to the raceways.

2 or 3 lifting bolts should be used to lift large bearings. Use either the standard threaded bolt holes or those specifically machined for the purpose as indicated on the drawing. Check the weight of the ring to ensure slings and/or chains are of sufficient capacity.

Care must be taken not to dislodge seals or grease fittings during movement. Wooden or rubber spacers should be used to separate unwrapped bearings stacked vertically to avoid surface damage. Gear teeth must be protected from impact damage.

As supplied, slewing rings are generally packed for storage in a dry, covered store and for a period not exceeding 6 months.

Light surface corrosion may occur in humid conditions but this can usually be removed easily from external surfaces – it is most important that the raceways are well greased to remain rust free.

In extreme cases of long term storage the bearings should be professionaly dismantled, cleaned, inspected & reassembled before use.

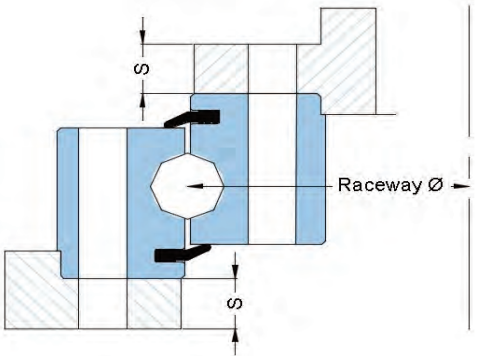
Standard commercial cold solvents (without chlorine) can be used to degrease the slewing rings if required. Use sparingly and do not let this work under the seals into the raceway volume.

Support Structures

Although slewing rings are designed to support large axial, radial and moment loads, they are inherently elastic structures that must be supported by flat, machined companion surfaces which are rigid enough to eliminate torsional buckling under load that would affect the smooth operation of the ring.

The width of the supporting flanges must at least equal the width of the ring it supports. Thick circular supports are preferred over thinner supports with reinforcement ribs. With modern finite element analysis it may be possible to work with thinner support materials.

The suggested minimum thickness (S) of the supporting material is indicated below.



Raceway dia (mm)	500	750	1000	1250	1500	2000	2500	3000
Minimum support thickness (mm)	25	30	35	40	50	60	70	80

Under load, flatness defects must not exceed the values tabulated below to avoid tight spots or seizure; both of which will reduce the life of the ring.

The values (in mm) tabulated below are for "long wave deviations" around the circumference.
SRB – single row ball bearings
XRB – double row ball, crossed roller bearings & preloaded ball bearings

Raceway (mm)	500	750	1000	1250	1500	2000	2500	3000
SRB	0.12	0.18	0.21	0.25	0.28	0.33	0.38	0.42
XRB	0.10	0.12	0.15	0.18	0.20	0.25	0.29	0.32

Shorter wave defects (e.g. between 2 bolt holes) must not exceed ¼ of these values.

Defects in the radial direction, sometimes referred to as "conicity", must not exceed 0.05mm /m based on the raceway diameter. **If the above tolerances cannot be met, epoxy resins may be used in some circumstances.**

Slew Ring Orientation

Rolling elements and spacers are inserted through the filling plug(s). These are usually positioned at the relevant raceway hardening junction. They are held in place with a tapered pin and a subtle modification in the raceway limits the load carrying characteristics of that area of the raceway.

As a result, the filling plugs should be positioned at the point of minimum strain (usually at right angles to the main load axis).

In some cases the bolt pattern will be asymmetric to force this orientation.

Dowel Pins Or Spigots

In the event of high radial loads, or if a slew ring is used with a horizontal axis of rotation, the circularity of the slewing ring may be affected, or the shear stresses generated may be too high for the bolts to carry the load safely.

If circularity cannot be maintained by use of a structural adhesive (e.g. LOCTITE 586 or similar), the toleranced location diameters on the bearing rings should be used.

Dowel pins can also be an effective way to limit radial forces and to achieve a similar effect.

Fastening Bolts

Flanged QCB slewing rings are designed to be used with Grade 8.8 hexagon head bolts. Solid ring bearings are deisgned to be used with Grade 10.9 Hex head bolts or Grade 12.9 Cap Screws.

QCB bolt curves are calculated using standard design methods (e.g. VDI 2230)

Check you have the correct grade of bolt in line with QCB design recommendations especially if a QCB bearing is replacing another manufacturer's part.

For "CC" steel (C45/50Mn) slewing rings the use of flat hardened washers is recommended to reduce surface pressures under the bolt head and nut. If cap screws are used the specific pressure under the bolt head should not exceed the limits of the material.

The use of any elastic (spring washers or Bellville washers) or serrated washers is prohibited and will negate the warranty.

Untreated bolts should be lightly oiled and tightened progressively in steps of 60%, 80% and 100% bolt torque using either a calibrated torque wrench or a hydraulic system, moving around the periphery of the slewing ring in approximately 120° steps.

Ensure that the slew ring rotation is rotated during the tightening process (if possible) as any "tight points" will become evident and prompt immediate investigation.

Large diameter bolts should be tightened hydraulically.

The bolt torque figures should be checked again before the machine enters service as a degree of "settling" may occur, then after 100 hours of operation, and thereafter at least on an annual basis.

Recommended bolt torque figures are tabulated opposite.

Bolt tightening torques DIN 13 Class 8.8, 10.9 & 12.9 EN ISO 898

Strength Class DIN/ISO 898			Grade 8.8		Grade 10.9		Grade 12.9	
Yield point Rp 0.2			<=M16 640 MPa > M16 660 MPa		940 MPa		1100 MPa	
ISO Thread DIN 13	Stress x-section area	Core x-section area	Tension force	Tightening torque	Tension force	Tightening torque	Tension force	Tightening torque
	mm2	mm2	KN	Nm	KN	Nm	KN	Nm
M12	84.3	76.2	38.5	78	56	117	66	135
M14	115	105	53	126	77	184	90	216
M16	157	144	72	193	106	279	124	333
M18	193	175	92	270	129	384	151	459
M20	245	225	117	387	166	558	194	648
M22	303	282	146	522	208	747	243	873
M24	353	324	168	666	239	954	280	1116
M27	459	427	221	990	315	1395	370	1665
M30	561	519	270	1350	385	1890	450	2250
M33	694	547	335	To be determined by bolt elongation measurement	450	To be determined by bolt elongation measurement	560	To be determined by bolt elongation measurement
M36	817	759	395		560		660	
M39	976	913	475		670		790	
M42	1120	1045	542		772		904	
M45	1300	1224	632		905		1059	
M48	1470	1377	714		1018		1191	
M52	1760	1652	857		1221		1429	
M56	2030	1905	989		1408		1648	
M60	2360	2227	1156		1647		1927	

Bolt tightening torques ANSI B1.1 SAE Grade 8 Coarse thread

Bolt size	Tensile area in^2	Tightening torque ft-lbs
1/4-20 UNC	0.0318	7.2
5/16-18 UNC	0.0524	15
3/8-16 UNC	0.0775	25.9
7/16-14 UNC	0.1063	40.9
1/2-13 UNC	0.1419	78
5/8-12 UNC	0.226	154
3/4-10 UNC	0.334	272
7/8-9 UNC	0.462	436
1-8 UNC	0.606	653
1.1/8-7 UNC	0.763	927
1.1/4-7 UNC	0.969	1299

Gearing

Metric slewing rings generally exhibit a 20 deg involute spur gear, but helical and worm gear bearings are also common.

Imperial slewing rings generally use either a Fellowes stub, an American stub or American full depth gear.

All standard QCB geared bearings are manufactured in 42CrMo4 V steel for superior gear strength when compared against other economy brands.

Slewing ring gears often have an addendum correction to improve gear strength or meshing characteristics; if so, the pinion gear should be suitably corrected to mesh most effectively.

QCB utilises the most up to date calculation software available to offer an optimal solution for high torque or multi-drive applications.

Theoretical tangential gear strength figures (Fz_{normal} and Fz_{max}) are listed on most drawings.

Other gearing products available:-

- Induction hardened gears
- Ring gears (whole or segmented)
- Gear racks
- Pinion shafts

Pinions

A comprehensive range of metric and imperial pilot bore pinions is stocked to suit the light series slewing rings.

Larger module pinions (to Mod 28) are made to order to suit customer requirements.

Seals

QCB slewing rings are fitted with a nitrile or NBR rubber lip seal which rides on the surface of the adjacent ring. For high temperature applications VITON lip seals are available.

Special seal arrangements are available for specific applications. These include:

- Double (secondary) seal systems
- V-ring seals
- Quad section seals
- Metal shields
- Labyrinth seals with grease injection port

When unwrapping, take care not to cut and damage the integral seal strips.

After long term storage it is not uncommon for the seal rubber to stick to the steel surface – creating the illusion that the bearing has seized. A blunt instrument such as a pallet knife should be run around the circumference to free the seal surfaces. A spray with a light oil (as well as proper regreasing of the ring) will avoid seal damage on start-up.

Seals require annual inspection and may require replacement.

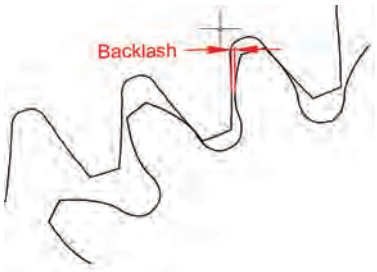
Are Replacement Seals Available?

Where possible, QCB slewing rings use a standard seal profile which is stocked in NBR (black) and VITON (Green).

If the QCB part and serial number are known, the seal size can be determined and replacement seals provided.

Setting Pinion Backlash

Pinion backlash must be set at the point of maximum eccentricity on the slew ring, usually indicated by 3 painted teeth.



Ensure each pinion is properly aligned to the gear with good contact maintained over the full face width. A backlash or clearance of between 0.03 – 0.05 x module is recommended under normal circumstances. This distance is set by either moving the pinion in a radial direction, or turning the drive motor on an eccentric flange mount.

During installation the slewing ring should be rotated a few times to check the gear mesh.

During maintenance the backlash should be checked. Wear on the gear flanks of up to 0.1 x module is permissible.

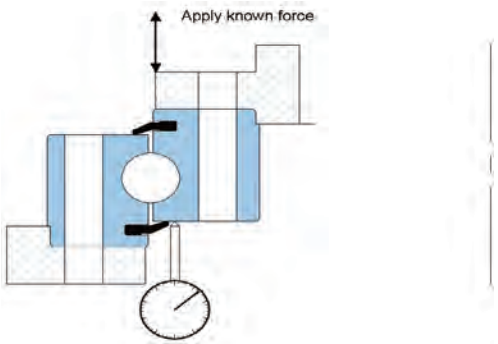
NOTE: For fixed centre designs either the pinion or slew ring addendum correction can be modified to achieve a suitable backlash figure for any specific centre distance.

Mod	Backlash (mm)	Mod	Backlash (mm)
4	0.12-0.16	14	0.42-0.56
5	0.15-0.20	16	0.48-0.64
6	0.18-0.24	18	0.54-0.72
8	0.24-0.32	20	0.60-0.80
10	0.30-0.40	22	0.66-0.88
12	0.36-0.48	24	0.72-0.96

Operational Clearance And Wear In The Raceway

Properly maintained, QCB slewing rings can offer years of satisfactory service.

After assembly the clearance or total deflection of the slewing ring should be determined under recorded test conditions to serve as reference data for future wear checks.



- The degree of "tilt" in the bearing should be measured, or the relative axial and radial movement of the rings using dial gauges.
- Apply a load in one direction to "zero" the dial gauge. The load direction is then reversed.
- An average of at least 4 measurements around the circumference should be recorded.
- Measurements should be taken as close to the raceways as possible to minimise the effects of elastic deflections in the structure.
- The measurement points should be marked and numbered so that the test can be recreated accurately in the future.

In general, slewing rings will wear at a linear rate in service.

Once the rate of wear accelerates it is a sign that the bearing is approaching the end of its service life.

As a "rule of thumb", once the measured deflection exceeds 1.5x the initial figure, plans for the replacement of the slew ring should be made. If the measured deflection exceeds 2x the initial clearance then the ring should be replaced immediately for safety reasons.

Proper maintenance and record keeping will ensure that a replacement can be obtained in the most economical fashion.

Customers should bear in mind that larger slewing rings can be long lead time items.

What about reconditioning?

In some cases rings can be reconditioned.

What are the steps?

1. Send the bearing to your QCB dealer where it will be inspected and catalogued.
2. A non-refundable standard charge will be raised to cover cleaning and inspection costs.
3. QCB will advise if the ring can be reconditioned economically and safely and await instruction.
5. QCB will quote for a new bearing if appropriate.
6. All transport costs are for the customers account.
7. Unless otherwise instructed, QCB will dispose of scrap parts if not collected within 6 months.

Typical allowable wear figures for normal applications are tabulated below:-

Single row and double row ball bearings

Track dia	Ball dia. & allowable bearing clearance increase						
	20	22	25	30	35	40	45
1000	1.4	1.4	1.4	1.5	1.7	1.9	2.1
1250		1.5	1.5	1.6	1.7	2	2.2
1500			1.6	1.7	1.7	2	2.3
1750				1.8	1.8	2.1	2.3
2000					1.9	2.2	2.4
2250					2	2.3	2.5
2500					2	2.3	2.6
2750						2.4	2.6
3000						2.5	2.7
3250						2.6	2.8
3500							2.9
3750							3.0

For single row x-roller bearings

Track dia	Roller size & allowable bearing clearance increase				
	16	20	25	32	40
400	0.22	0.22	0.24		
800	0.25	0.27	0.29	0.33	0.38
1000	0.30	0.32	0.34	0.38	0.43
1500	0.50	0.52	0.54	0.58	0.63
2000		0.62	0.64	0.68	0.73
2500			0.74	0.78	0.83

Raceway Lubrication

QCB standard stock slewing rings are factory filled with standard NLGI class 2 mineral oil based EP grease.

QCB Special order slewing rings can be delivered with varying amounts and types of grease depending on customer requirements.

Regreasing is mandatory after long storage.

WARNING: The onus is on customers to check that any slewing ring is properly lubricated when entered into service.

The raceways can be adequately lubricated with any good quality standard lithium based EP2 bearing grease. In general, and as slewing rings operate at high loads and low speeds the raceways can be entirely filled with grease which will then form an additional barrier to the entry of contaminants.

Typical raceway lubricants include:-

Brand	Raceway grease	Operating temp range
BP	Energrease LS EP2	-20 to +120 C
ESSO	Beacon EP2	-20 to + 120C
TOTAL	Multis EP2	-30 to + 120C
	Ceran XM460	-30 to + 180C
EXXONMOBIL	Mobilith SHC460	-30 to + 120C
SHELL	Retina EP2 or Alvania EP	-25 to + 120C
FUCHS	Stabyl LT #50	-50 to + 120C

The regreasing interval in service is best determined by the environment.

Environmental conditions	Recommended relube interval
Dry, clean / Workshop	300 hours duty or 6 months
Outside & exposed	-150 hours duty or 4 months
Aggressive	-50 hours duty or 2 months
Extreme	- continuous lubrication

Grease nipples are provided on one ring or the other, sometimes both. Use whichever is convenient.

During regreasing it is advisable to rotate the bearing to ensure distribution of the fresh grease as well as to avoid over pressurising the seals as this may force them out of their grooves. Ideally a thin smear of fresh grease should start to weep from under the lip seals.

A simple formula helps to determine the approximate amount of grease required in grams (all dimensions in mm)

- Single row ball brg

Grease qty = 0.7 x Raceway Ø x ball Ø ^{2} / 1000

- Single row roller brg

Grease qty = 0.5 x Raceway Ø x roller Ø ^{2} / 1000

Automatic relubrication systems such as the GreaseMax System are recommended as they maintain a positive pressure of grease in the raceways.

Gear Lubrication

The gear should be lubricated immediately after assembly and setting of the backlash.

Suitable open gear grease should be brushed or sprayed on to cover the teeth completely. Such greases will typically have a base oil viscosity of > 500 mm^2/s at 40C; good adhesive properties and a high resistance to water washout.

Common gear lubricants include

Brand	Grease / Oil	Operating temp range
BP	Energol WRL GR-XP Gear oils	-20 to + 120C
TOTAL	Carter open gear Ceran AD	-20 to + 125C
EXXONMOBIL	Mobiltac 81 Mobilgear OGL007	-20 to +120C
SHELL	Aeroshell Grease 14 Malleus GL 205	-54 to + 93C

Commissioning Checklist

Before installation

- Check for external damage
- Check seals are in place and undamaged
- Check dimensions of supporting structures
- Check flatness of supporting structures
- Understand appropriate position of filling plug relative to maximum load position if applicable

During fastening

- Check size and grade of bolts to be used
- Lubricate threads
- Check required bolt torque
- Check any washers are flat and hardened, not split or spring type
- Check rotation of slewing ring if possible to ensure it is not binding

Gearing

- Check pinion meshes to slew ring gear by hand
- Locate point of maximum eccentricity of slew ring gear ans set backlash at that point
- Check contact uniform across tooth
- Lubricate gearing

After installation

- Check deflection under test load and record results
- Check rotation is smooth and without abnormal noise
- Check slewing ring is fully lubricated
- Check operators know type, quantity and frequency of grease required for maintenance purposes

Ongoing maintenance

- Maintain proper maintenance records
- Observe condition of seals
- Check bolt torque
- Check deflection under test load and compare to allowable limits
- Check lubrication of raceway and gearing

QCB Bearings

SLEWING RINGS & DRIVES

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