RR USA Inc.
Quality and Technology

SLEWING BEARINGS

The Original
GALPERTI®
TECH SRL

CONTENTS

General Information

ph. (610) 497-0154 • fax (610) 497-6085 • E-mail: info@rrusainc.com • www.rrusainc.com

General Information

GALPERTI Tech manufactures excellence in large diameter slew bearings, using state of the art development, design manufacturing, and testing methods that maximize the experience of our senior technicians.Their knowledge of calculation methods enhance CAD/CAM design tools and FEA analysis programs.A fully integrated server based computerized system allows manufacturing control of all manufacturing phases, supply chain survey and project management.
Every application requires a unique solution. GALPERTI Tech manufactures slewing rings from 250 mm to 4.600 mm outer diameter.These rings are available with ring gears on inner and outer diameter and also with a gearless option. GALPERTI Tech also offers various styles of rolling elements (show below) to achieve a product that meets the demands of your toughest application.

Single row ball slew bearings

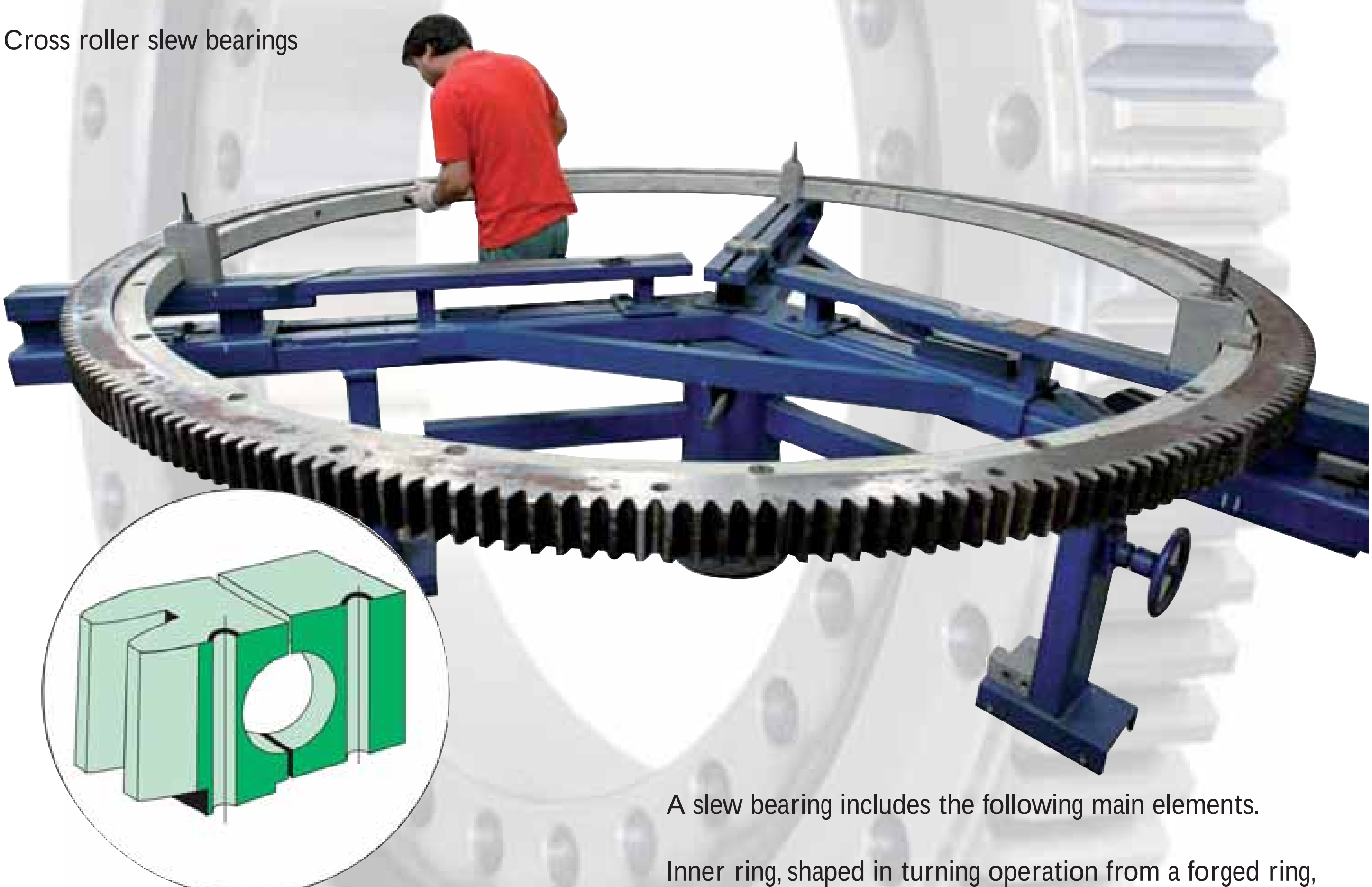
Double row ball slew bearings

Single row roller slew bearings

Three row roller slew bearings

Double row roller slew bearings

Cross roller slew bearings



A slew bearing includes the following main elements.

Inner ring, shaped in turning operation from a forged ring,
Outer ring, shaped in turning operation from a forged ring,
Drills for fasteners (thru or tapped),
Drills for filler plug(s) and filler plug(s),
Balls and/or rollers,
Polymer based spacers or polymer/metal cages,
Drills for grease zercs and lubrication refill,
Rubber based sealing systems,
Integral inner or outer gear.

Bearing Applications

GALPERTI Tech has successfully operated for many years in the petrochemical and energy industries.
GALPERTI Tech manufactures large-diameter ball and roller bearings utilized in many applications such as:

- Access platforms
- Amusement rides
- Antennas
- Bogie bearings for vehicles
- Boom conveyor
- Bottle filling machines
- Bridge cranes
- Canning and bottling machines
- Capstans
- Crane-hook rotators
- Concrete pumps
- Deck cranes
- Dragline
- Earth-drilling machines
- Excavators
- Floating cranes
- Forklift equipment
- Forrest machines
- Harbor cranes
- Ladle cranes
- Ladle turrets
- Ladle cars
- Manipulators
- Military applications
- Mobile cranes
- Moorings
- Packaging machines
- Plastic-film extruders and winders
- Railway cranes
- Rotable trolley
- Reclaimer
- Robots
- Scraper
- Shiploader/-unloader
- Shipyard cranes
- Swivels
- Stacker
- Steelmill equipment
- Tower cranes
- Trolley
- Truck cranes
- Tunnel-boring machines
- Turntables
- Water treatment
- Welding positioners
- Wind turbines

Etc

The slew bearings are manufactured in a variety of shapes and sizes, ranging from 250 mm up to 4600 mm in diameter.

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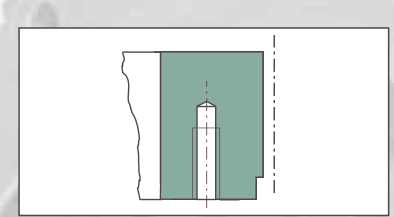
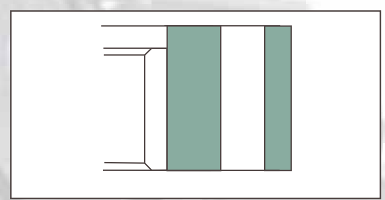
Bearing Types


V51.----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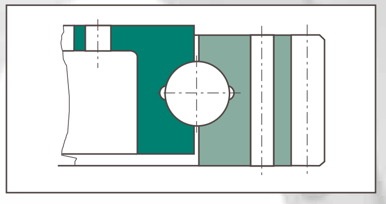
Geared rings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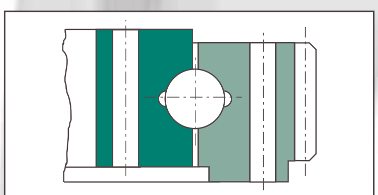
Profile Bearings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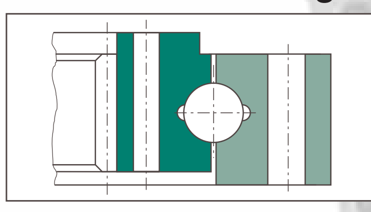
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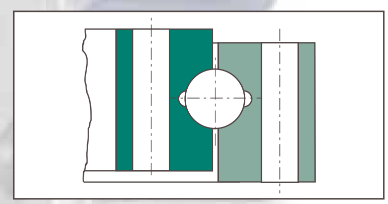
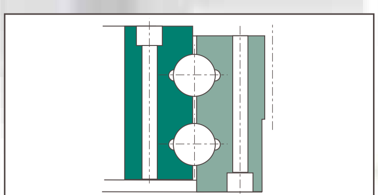

V43.----

Four-point contact bearings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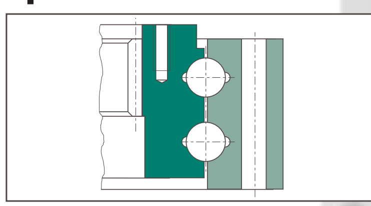
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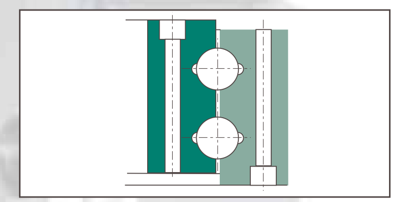
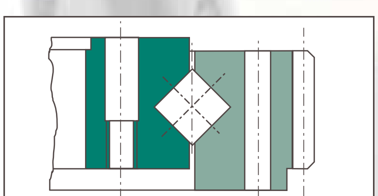

V83.----

Eight-point contact bearings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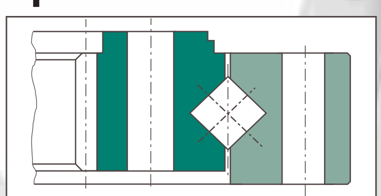
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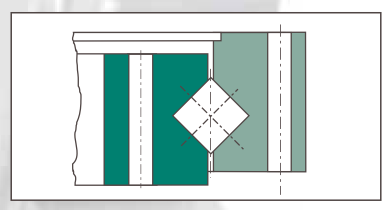
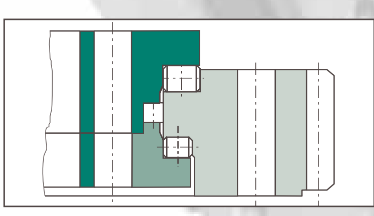

V03.----

Cross-roller bearings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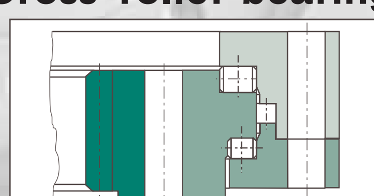

V92.----

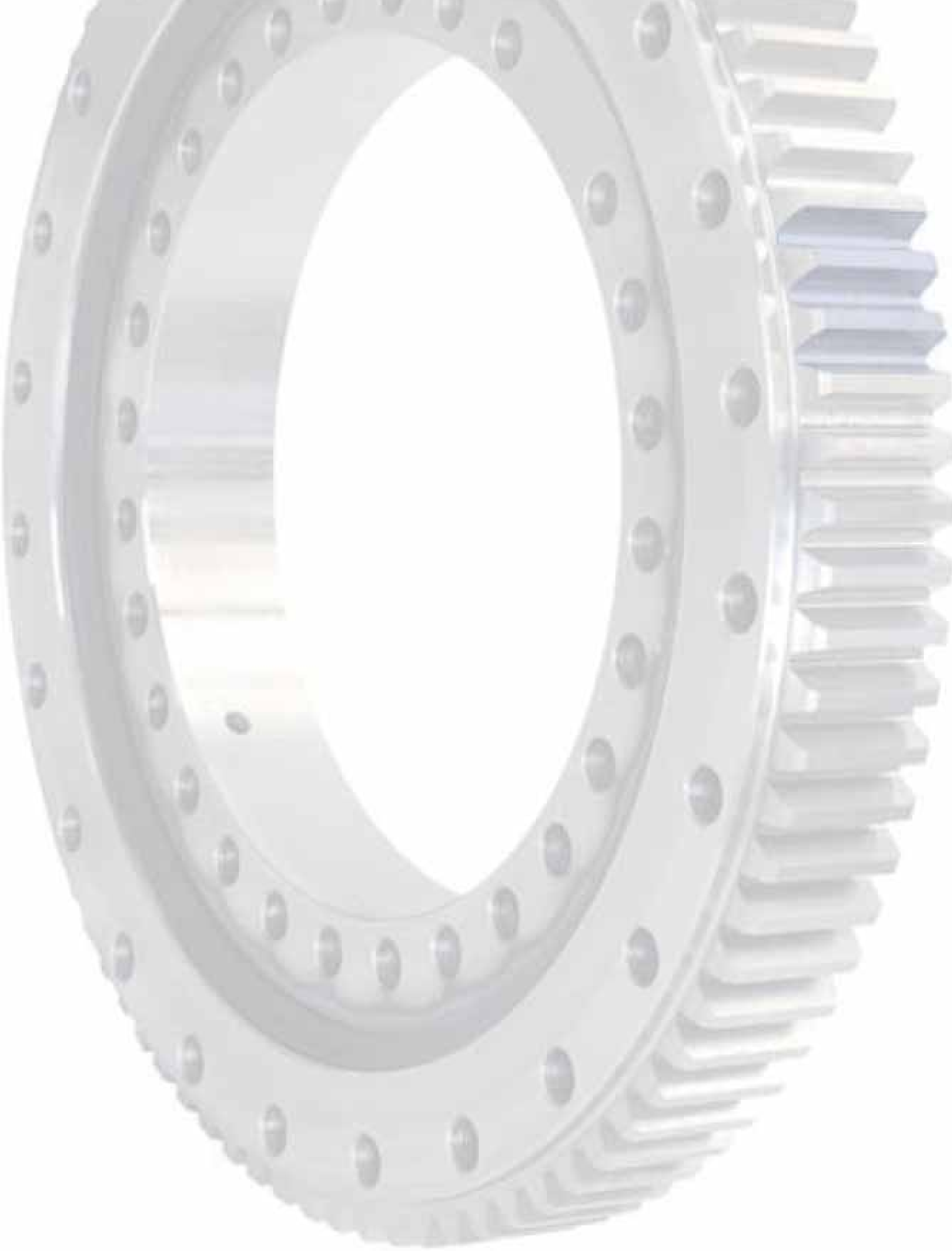

V93.----

3-Row roller bearing

We also design other bearing types for special applications

The raceway design determines the load capacity of the slew bearing. All GALPERTI Tech raceways are induction hardened using the scan induction hardening process. This process leaves a "soft spot" where the induction hardening starts and stops. The soft spot is identified with the letter "Y" etched on the slew bearing.This gap is accounted for in meeting the required load capacity for each bearing.

GALPERTI Tech technicians apply FEA analysis in addiction to conventional load and stress calculation methods to determine the proper dimensioning and type of bearing required in a specific application.



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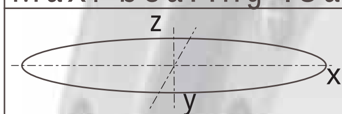
QUESTIONNAIRE

Application:		Axial loads on bolts under: Compression ☐	Tension ☐
External gear ☐	Axis of rotation: ☐	Slewing ☐	No. of revolutions
Internal gear ☐	Horizontal ☐	Continuos ☐	Norm.: rpm
Without gear ☐	Vertical ☐	Rotating ☐	Max.: rpm

Max. bearing loads, please inform us when factors are already included!



	1 max. operating loads	2 test load (overload condition)	3 survival loads (e.g. shocks)
Axial loads parallel to z-axis kN			
Radial loads parallel to x-axis kN			
Radial loads parallel to y-axis kN			
Res. moments from axial loads kNm			
Res. moments from radial loads kNm			
Resulting moment kNm			

Variable operating loads, required lifetime: Hours ☐ Cycles ☐

loadcaste	F axial kN	Resulting F radial kN	Resulting M tilting kNm	Rpm min^{-1}	% of time	No. of cycles	Slewing angle per cycle
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

Drive torque at the bearing center line: Norm: kNm, Max.: kNm	No. of pinions: Position of pinions: Grad

Remarks: Max operational temperature, min operational temperature, min idle temperature, required accuracies, bearing or gear dimensions, certifications etc.

Company:	Name:	Date:

Product Identification

GALPERTI Tech slew bearings are tagged with an ID plate. The plate prominently displays the bearing drawing number and individual serial number. The ID plate provides useful information for tracking the bearing through its operational life.

The ID plate shows:
Bearing type – drawing number
Manufacturing date
Galperti Tech job number
Serial number

The drawing number identifies the type of bearing and is a manufacturer code.
The manufacturing date refers to the date of the slew bearing finishing after successful testing.
The serial number identifies the single bearing and includes the batch and year and individual numbering.

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Drawing Number

Each slew bearing is assigned a drawing number code. This code identifies specific bearing criteria and reduce potential miscommunication in the manufacturing or service phase throughout the life of the bearing.

The table below shows the details of the drawing number code.

V4		1		0434	000	0		1		20		0344
		TOOTHING:		EXTERNAL DIAMETER: (mm)	REVISION LEVEL:	STATUS:		PLAYS:		ROLLERS / BALLS DIAMETERE: (mm)		ROLLING DIAMETER: (mm)
V0 =	roller bearing	1 =	external			0 =	study	0 =	normal	13 =	ball D13.00	
V1 =	light duty	2 =	internal			1 =	prototype	1 =	reduced	14 =	roller D25.00	
V4 =	single row of balls	3 =	no gear			2 =	production	2 =	no play	16 =	ball D16.00	
V5 =	ring gear					3 =	spare part	3 =	preloaded	18 =	roller D18.00	
V7 =	combined rollers/ ball bearing									20 =	ball D20.00	
V8 =	two row of balls									22 =	ball D22.00	
V9 =	three rows of rol-lers									25 =	ball/roller D25.00	
										30 =	ball/roller D30.00	
										32 =	roller D32.00	

NOTE

The information regarding the rolleing elements and raceway diameters is necessary for determining the service life

The letter "Y" punched into the ring indicates the hardness gap of "soft-spot" (transition between beginning and end of the raceway herdening).
On geared slew rings, the position of the largest deviation from circularity of the gearing is indicated by 2 teeth marked in color. The pinion depth and blacklash is set by meshing the gears using these specific teeth.

Bearing Selection

Initial bearing selection is dictated by the working condition loads.This loads are compared against the static and dynamic capacity curves for the raceway and fastening bolts.When a proper bearing is selected the load limit curves circumscribe the area of the working axial loads (F) and tilting moments (Mt).

Please remember the following general rules:

1. Radial forces can be neglected only if are < 0.1 times of the axial loads;
2. The loads must be positive with the configuration shown in Fig. 1 and Fig. 2 of this page, to be in valid conditions for the load curves;
3. Bolt curves are valid for a specified number of bolts and bolt quality grade 10.9 (see page 10).

If any of the above conditions are not met, please refer to GALPERTI Tech for assistance.The bearing operational loads are
calculated by taking the static load and multiplyng by Fstat.The dynamic load is multiplied by the Fdyn and the two are resolved into FA.The moment Mtilt is calculated in a similar way.The static moment is multiplied by the Fstat and the dynamic moment is multiplied by the Fdyn to produce the Mtilt value.These values are used to determine the bearing load point.This point on the bearing load chart must fall inside the area costrained by the load curve.

GALPERTI Tech must approve all loads and duty cycles prior to the start of manufacturing. This allows GALPERTI Tech to determine the final selection and design of the slew bearing. For this reason, all request must be accompanied by the completed questionnaire sheet found in this manual. It is important to include as many details as possible when reporting values in the questionnaire to assist in the evaluation.

Fig. 1

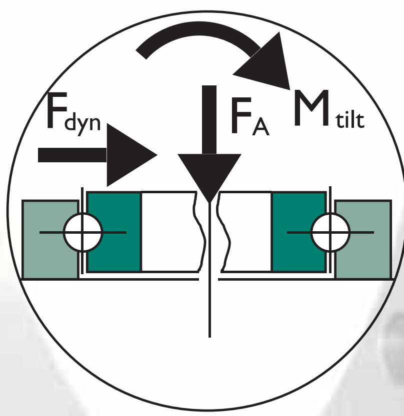
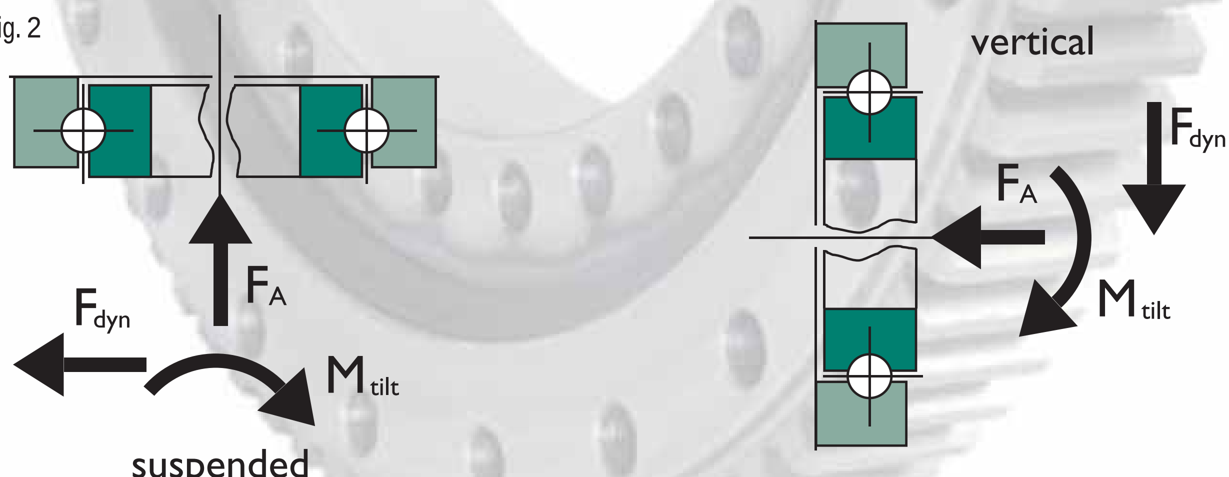


Fig. 2



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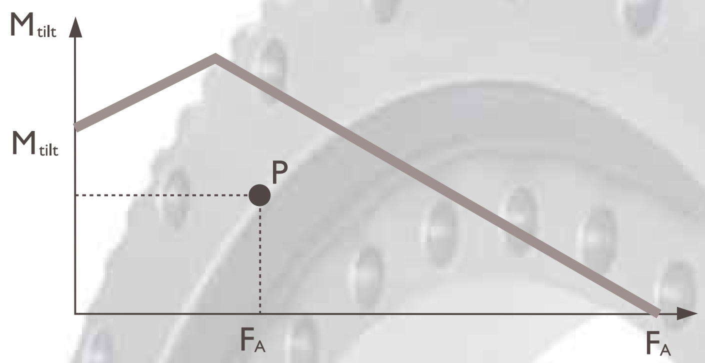

static load capacity

$F_A = F_A \cdot F_{stat}$
$M_{tilt} = M_{tilt} \cdot F_{stat}$

dynamic load capacity

$F_A = F_A \cdot F_{dyn}$
$M_{tilt} = M_{tilt} \cdot F_{dyn}$

Fig. 3
Limiting load curve

NOTE

A properly designed slew bearing has the load point inside the area circumscribed by the laod curve

For negative loads, as a picture 1 and 2 the displayed load curve cannot be used.
In such occurrence please refer to GALPERTI Tech technical reccomendation

Table: load factors

	F_{stat}	F_{dyn}
Stacker (Bucket wheel excavator)	1,15	
Shipdeck crane	1,1	1,0
Conveyor jib	1,1	
Transfer conveyor	1,1	
Revolving table/Turntable	1,15	1,15
Slewing crane (general cargo)	1,25	1,2
Slewing crane (grab/magnet)	1,5	1,8
Overhead rotating trolley	1,5	1,8
Turntable ladder	1,1	1,15
Railway crane	1,0	
Mobile crane (general cargo)	1,1	1,0
Mobile crane (grab)	1,5	1,8
Hydraulic excavator ≤ 1,5 m^3 > 1,5 m^3	1,5 1,8	
Stockpile tipper	1,1	1,0
Bucket wheel excavator	1,7	2,25
Floating crane (general cargo) (grab)	1,1 1,5	1,0 1,8
Stacker crane	1,25	1,15
Slewing Shovel	1,3	
Cable dredger	1,3	
Ship-loader and unloader	1,35	1,25
Tower crane	1,35	1,35
Travelling bridges	1,5	1,8
Wharf crane or shipyard crane	1,25	1,25

NOTE

Applications without the F_{dyn} parameter shown, have high variable operating conditions.
Calculation of the operational life is possible only if the angle width and the rotational speed are known

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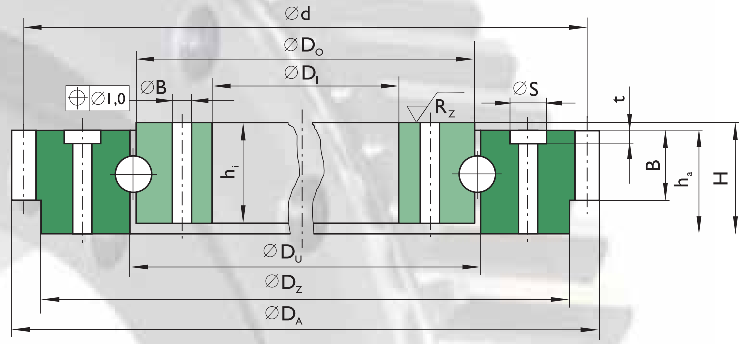
Bearing Tolerance

Standard bearing tolerances unless otherwise noted



Surface quality

machined surface	average value R_z in µm
holes	160
mounting surfaces	
V81 - V82 - V83	100
V91 - V92 - V93	25
V41 - V42 - V43	40
V01 - V02 - V03	40
external surfaces	160
spigot registers, (pilots)	40
gear	40

∅ D_I; D_O; D_U; D_A in mm	permissible deviation in mm
≥ 120	± 0,3
≥ 120 ≤ 400	± 0,5
> 400 ≤ 1000	± 0,8
> 1000	± 1,2

Gear backlash for quality 12cd27 according to DIN 3962, 3967

reference ∅ in mm	module m	addendum circle backlash in mm internal gear D_I (+) external gear D_Z (-)	concen-tricity f_R in mm
560 - 1000	6	0,20	0,25
560 - 1000	8, 10	0,25	0,28
1000 - 1600	10	0,30	0,32
1000 - 1600	12, 14	0,40	0,36
1600 - 2500	12,14,16	0,45	0,36
1600 - 2500	18	0,50	0,40
2500 - 4000	18,20,24	0,60	0,45

Height tolerance

	permissible deviation in mm
h_a, h_i	± 0,5
H	± 1,0

Hole tolerance

bolt size	∅ B H13 DIN ISO 273 "mean" in mm	∅ S in mm	t in mm	∢ deviation from the mounting surface
M16	+0,27	+0,33		
M18		+0,33		
M20			+0,4	
M22	+0,33			0,5 °
M24		+0,39		
M27				
M30				
M33				
M36	+0,39	+0,46		0,25 °
M39		+0,46		
M42				

Installation

Prior to installation make sure that all mounting surfaces are free of welding pearls, paint residues, burring and other contaminations. Examination of the contact surfaces by means of a levelling instrument or laser machine is recommended.
Do not exceed the values shown in the table on page 17. The bearing should be checked for running by rotating the unbolted bearing two revolutions. After rotating remove the protective coating from the contact surfaces and from the gear. No solvent should come in contact with the seals or infiltrate the raceways.

Do not carry weld on or around the bearing as the heat generated may cause distortions or destroy seals and plastic spacers.
Electric current flow and arching will severely damage the races and balls and must be mandatorily avoided.

Hardness Gap (Soft spot)

Most of the induction hardened bearings have a small unhardened zone between the beginning and the end of the hardened area. This spot is identified near the type plate or filler plug at the outer or inner diameter of each bearing ring. A stamped letter "T" on the plug and a "Y" on the opposite axial mounting surface can be found.

The plug or the soft area should be positioned 90° from the load axis (outside the main load-carrying areas) when possible.

Gear ring

The backlasch has to be adjusted at the 3 teeth marked with blue (narrowest point)if no fixed center existe. At this point the backlash has to be 0,03 x module. After final tightening the backlash neads to be checked over the entire circumference.

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Fastening Bolts

The bolt connection is crucial to the slew bearing functionality and life. Proper fastening of the slew bearing is required by calculation.This calculation determines the quantity, size and quality and preload force of the fastening bolts.

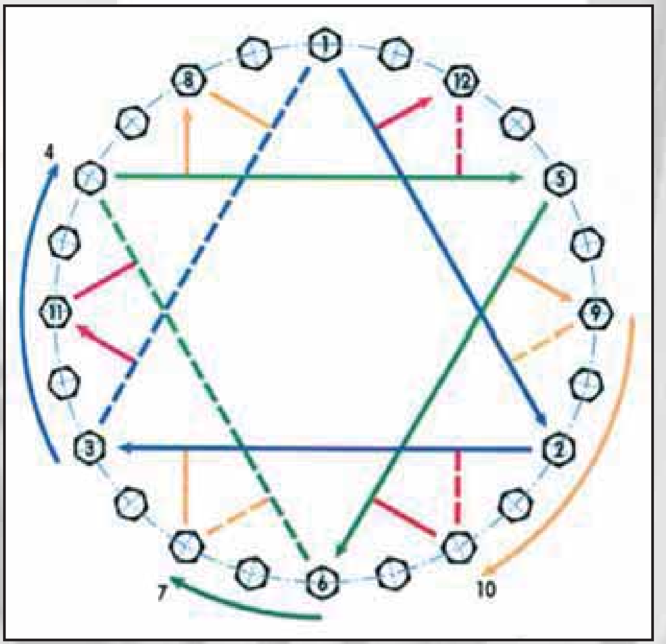
Proper preload is met with:

1. High precision torque wrench
2. Hydraulic tensioning equipment
3. Length measurement on calibrated bolts

The torque is affected by:

1. Bolt quality
2. Grade thread connection friction
3. Friction between the contact surfaces of bolt head, nut and parts themselves

The fastening hole location of the structure must match those of the bearing or distortions will appear.
Excessive distortion results in high friction and reduced bearing life. If friction increases by tightening the bolts, the bearing should be removed and the contact surfaces checked for flatness.
The specified diameters, strength class, quantities and degree of preload must be followed. We recommend a minimum clamping length of 5 x bolt diameter.
The bolts must be carefully tightened crosswise to the specified preload, as shown below.



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The following table gives some recommended values for the tightening torques.
The values are based on lightly oiled threads and contact surfaces.(mTOTAL = 0,14)

Thread diameter mm	Tightening Torques in Nm			
	hydr. torque wrench	mech. torque wrench	hydr. torque wrench	mech. torque wrench
	8.8	**8.8**	**10.9**	**10.9**
M12	87	78	130	117
M16	215	193	310	279
M20	430	387	620	558
M24	740	666	1060	954
M27	1100	990	1550	1395
M30	1500	1350	2100	1890
	8.8	**8.8**	**10.9**	**10.9**
UNC 5/8” - 11”	200	180	286	260
UNC 3/4” - 10”	352	320	506	460
UNC 7/8” - 9”	572	520	803	730
UNC 1” - 8”	855	770	1210	1100
UNC 11/8” - 7”	1068	970	1716	1560
UNC 11/4” - 7”	1507	1370	2410	2190

Dry threads require higher tightening torques whereas heavily oiled threads.The variation, particulary on bolts larger than M27 or 1 1/4” is considerable.We recommend to use hydraulic tensioning cylinders for these sizes.

It is necessary to tighten the bolts to the required preload and to ensure this torque value over the lifetime of operation. We recommend to check the torque after 3 months of operation and then once every year.

NOTE **Securing elements such as lock and springs washers may not be used. Only the preloading of the bolt serves to secure the bolt**

Mounting Procedure
1. Check all required components such as rings, balls, rollers, spacers, or cages consistency as requested on the drawings and parts list;
2. Identify the soft spot “Y” of the slew bearing;
3. Duly clean the rings from dirt and chips from previous operations;
4. Procedure for ball slew bearings and cross roller slew bearings:
    - 4.1 Position the ring with the plug on the assembly devicewith the reference surface oriented downwards;
    - 4.2 Remove the dow locking the plug;
    - 4.3 Remove the plug;
    - 4.4 Position the second ring as shown in the drawing;
    - 4.5 Raise the toothed ring (if both rings are non geared, the ring with no plug) and insert a total of 3 balls at approx 120° one from the other, so that a free rotation is allowed;
    - 4.6 Insert the balls or rollers leaving empty spots as requested by the drawings/parts list;
    - 4.7 Insert the plug and dow it;
5. Three row rollers bearings:
    - 5.1 Position the lower ring;
    - 5.2 Fill the first roller track with rollers and spacers/cage in specified quantities;

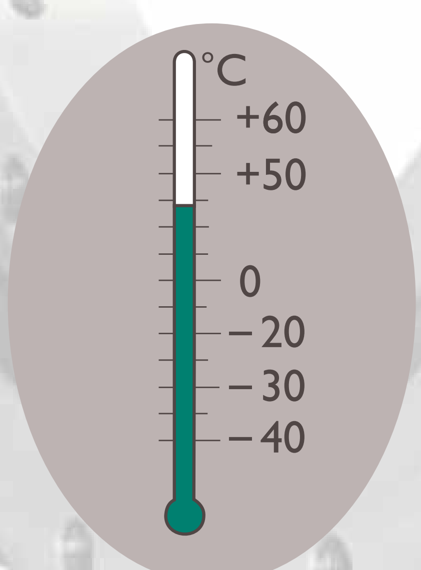
5.3 Position the center ring;
5.4 Fill the vertical roller track with rollers and spacers in specified quantities;
5.5 Fill the upper roller track with rollers and spacers/cage in specified quantities;
5.6 Position the upper ring;
5.7 Close and lock with bolts the two rings;

6. Verify the slew bearing rotates properly;
7. Verify the radial/axial clearances and torque value;
8. Verify the run-out of the connection surfaces
9. For geared bearings, verify the maximum eccentricity spot, and identify the three teeth painted blue;
10. For painted slew bearings: protect the slew bearing oarts not to be painted and proceed with the required paint operation.
11. As the paint operation is finished, remove all the paint protection and carefully check no residual paint is in the roller tracks;
12. Assemble the gaskets;
13. Add the slew bearing the requested type and quantity of grease, as specified in the part list. Rotate the slew bearing as this step is carried out;
14. Add the slew bearing the ID plate;
15. Protect the non painted parts of the slew bearing with temporary protective compound;
16. Proceed with the slew bearing packing.

NOTE	**The assembly procedure is to be considered indicative and must be finalized by the machine manufacturer, depending on the size of the equipment and the companion structure**

Operating Temperatures

In general the slew bearings are rated to work from -20 °C to + 50 °C. With different solutions the operating temperature can be extended to -30 °C and + 60 °C, with static extreme temperature of -40 °C. During the preliminary phases the Customer must state the required uppermost and lowermost operating and static temperatures and the performance required at these temperatures.



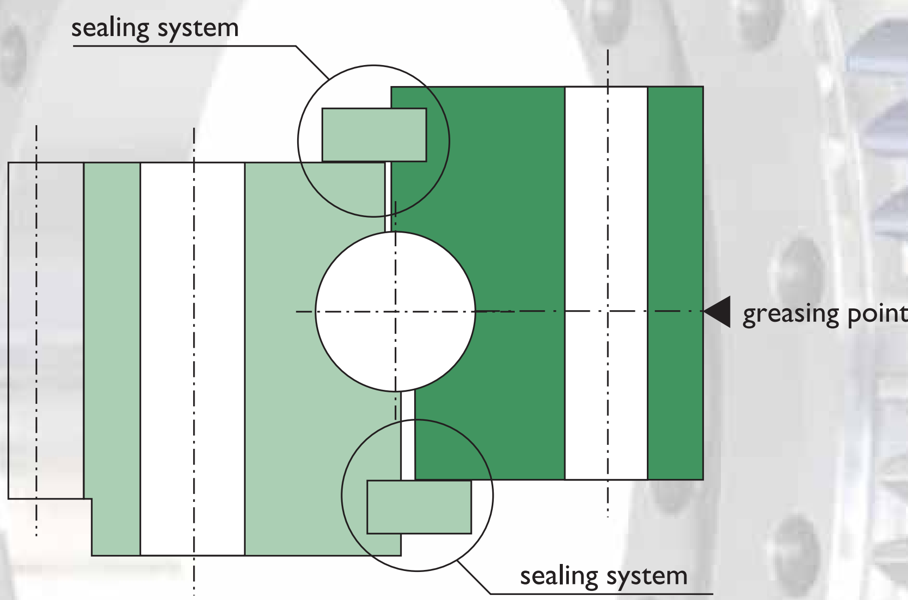
-40°C up to +60 °C.

Sealing Systems

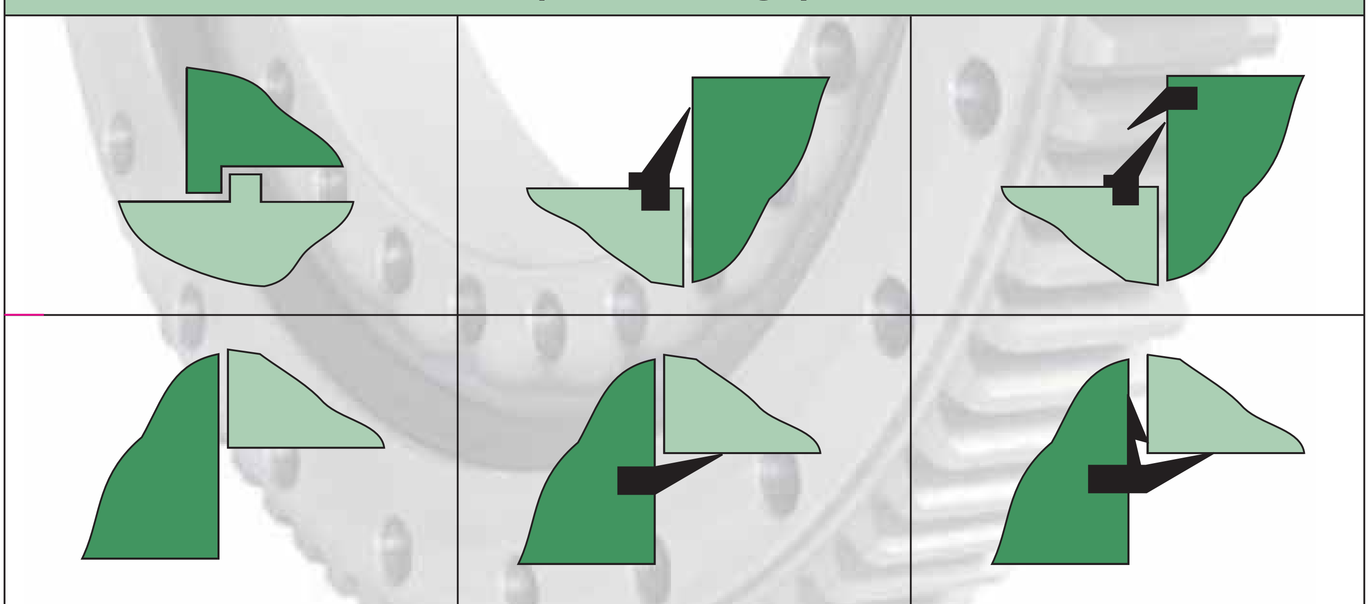
The sealimg of slewing ring is provided by a labyrinth system filled with grease, or by special seals.
The selection of the seal primarily depends on the operating conditions and leak-proof requirements.
Under extreme conditions such as:

- shipdeck cranes (spray water and seawater)
- bulk materials handling equipment for coal and ore

Special seals are necessary and special design arrangements have to made.
A slight increase of the total bearing height or increase in external diameter compared with the standard line of products may be necessary if special sealing system are required.
For extreme operating conditions, slewing rings with internal gears are preferred providing an additional protection by means of the surrounding structures

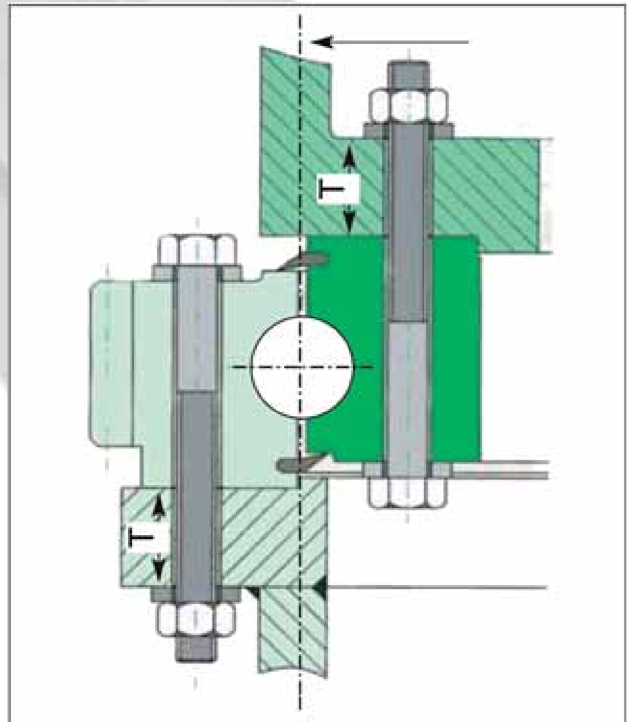


Examples of sealing systems



Companion Structures

The cross section of the bearings compared to their diameters are relatively small.The bearings therefore need a rigid structure with low distortions under the operating loads to ensure a good load distribution in the bearing race and the bolt connection.
That means, the deviation curve must rise and fall equally in a sector of 0°- 90°-180°. Peaks in smaller sectors have to be avoided, otherwise tight spots may cause local overloads in the raceway and bolts.
In order to keep the deflections of the supporting structures under max. loads to a minimum the vertical line of force in the companion structures must be near the race diameter.
Space for the bolt tightening tools has to be considered.
Accurate machining of the contact surfaces is required and the surfaces must be flat and clean to prevent the bearing from becoming distorted when it is bolted down.
Lastly mechanical handling is necessary after welding.
We do not recommend the use of stiffening rips welded to the flanges!



Permissible out-of-flatness and deflections in companion structures.

Raceway Diameter	Out- of-flatness per suppert surface			Max. axial deflections at max . load	Min.Thickness of flange T
	4-Point ball bearings Type V1-.	4-Point and 8-Point ball bearings	Roller bearings		
500	0,2	0,1	0,07	0,35	25
750	0,25	0,12	0,09	0,4	30
1000	0,3	0,15	0,11	0,5	35
1250		0,17	0,13	0,65	40
1500		0,2	0,15	0,8	50
2000		0,22	0,17	1	60
2500		0,25	0,19	1,3	70
3000		0,28	0,21	1,6	80
3500		0,3	0,23	2	90
4000		0,33	0,25	2,5	100
4500		0,35	0,28	3	110

all dimensions in mm

For precision bearings and preloaded bearings above values may not be used.

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Tightening Procedures

Tightening the bolt by means of a torque wrench

The preloading force is applied by means of a torque wrench with an adjustable moment. The installation uncertainty as a result of friction depends on

- the length of the thread of the thread in contact
- the bolt head or nut support contact area
- the size and angular deviations of the support surfaces
- the surface roughness
- the surface treatment
- the means of lubrication

These influence are taken into account by a tightening factor α_A=1.6

This tightening method can be used for up to M30 bolt diameters.
For larger bolts the influence of the friction increases to an extent that the overall stress of the bolt fluctuates considerably.

When using fastening bolts larger than M30, the necessary preloading force can be determinated by changing the length of the bolt.
Depending on the clamping length l_K and th bolt dimensions, the elasticity α_S of the bolt can be determined. The mathematical installation clamping force F_M of the bolt used is yielded at 70% of the preloading force as opposed to the aelongation limit $R_{P0,2}$
The change in length Δl to the force allocated to the elastic region F_M (installation tension force) is yelded from

$$\Delta l = F_M \cdot \delta_S$$
$$F_M = 0{,}7 \cdot R_{P0,2} \cdot A_S$$

The bolt are tightened until the required length of elongation is displayed by a suitable measuring instrument. Center holes in the bolt for positioning a measuring gauge are recommended.

The applied torque can be read fron the tightening tool. A mean value is determined from several measurements. Both ends of the bolt must be accessible in the screwed down state. If the possibility does not exist, the tightening torque is determined by a test model. For the propagation of the experimental results, all the bolts (including the best bolts) must be from the same production batch, torqued with the same vrench, and the surface quality and the number of joints match.

Hydraulic Tightening of the Bolts

The preloading force is applied by means of hydraulic tensioning equipment. In this case, the section of the bolt projecting beyond the nut is gripped and put under torsion-free tension against the parts to be clamped. When clamping the parts, the nut is raised from the supporting surface and can be screwed down into contact again.

In the bolt calculation, a tightening factor α_A=1.4 can be used.

The theoretical clamping force of the bolt is 90% of the elongation limit. It should be noted that the bolts must be loaded in excess of necessary preloading force, since by relieving the load off the studs, a setting in the thread and the nut contact area occurs, as well as a elastic and plastic deformation in the joints. When washers are used, the outside diameter should be dimensioned such that these are also loaded by the tightening equipment. Setting phenomena means a loss of clamping force. Moreover, the clamping force of the first preloaded bolt will be influenced by the preloading of further bolts.

NOTE	**It is necessary to attain the required preloading force on the bolts by repeating the tensioning a second time**

With the use of hydraulic tensioning equipment the thread is elastically elongated by the tension force. In order to avoid a jamming of the nut, it is necessary to specify the thread play according din 2510. The bolt length is to be chosen such that the thread projects beyond the nut in order to be gripped by the tensioning equipment, and has to be revised with the supplier of the tensioning equipment. In the planning phase, the space requirements of the tightening equipment have to be taken into account

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Friction Torque Calculation

The value of the turning torque (M^{fr}) depends on a large number of variables. These variables all cannot be calculated theoretically and therefore the formula below is also based on empirical experience.
The frictional torque, among others, is affected by following factors:

- Friction coefficient of bearing type — factor μ
- The loads — Fa, Fr, Mt
- Design of bearing races — factor κ and tan α
- Seals (lubrication and preload of the seals)
- Lubrication of the race system (Type and filling of grease or oil)
- Accuracy and stiffness of the companion structure
- Clearance of the race system
- Temperatures

$$Mfr = m/2\ (\kappa * M_t + F_a * D + k/2 * F_r * D * \tan \alpha)$$

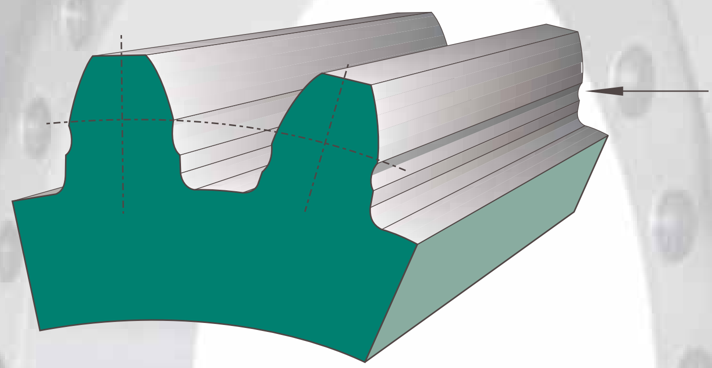
F_a - Axial load
F_r - Radial load
M_t - Tilting moment

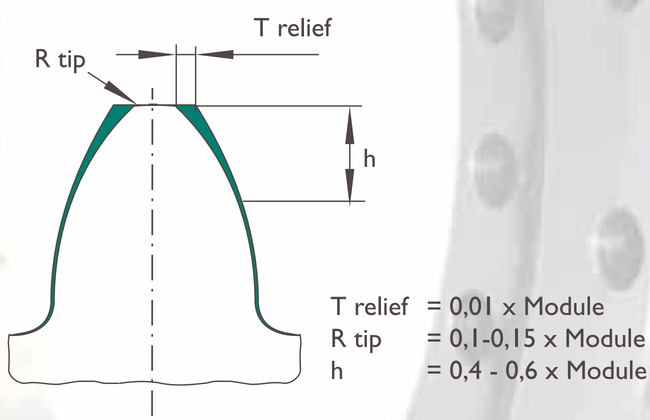
Because of the above mentioned influence factors a variation of approximately +/- 25% can be estimated.

Type of bearing (see page 4)	μ	κ	tan α
ball bearings (V1-)	0,007	4,37	1,73
ball bearings (V4-)	0,006	4,37	1,73
ball bearings (V8-)	0,009	4,37	1,73
roller bearings (V0-)	0,004	4,08	1,73
roller bearings (V9-)	0,003	4,08	1,00

Tip Relief at the Pinion

Due to high forces (bending) in combination with pitch errors (manufactoring tolerances) removing of material at the dedendum flank of the wheel may occur as shown in the picture below.These meshing problems are encreased by deflections of the pinion shaft of pinions mounted in overhung position and elastic deformations between slewing drive and companion stucture.
All this influence factors affect the lubrication and metallic contact may occur.To reduce the tooth damage a relief at the pinion and a radius at the tip edges is recommended.
The transition of the tooth tip radius and the tip relief into the flanks must be rounded absolutely free of sharp edges!





Integral Gears on Slew Bearings

The gear on the slew bearing can be internal or external with the internal configuration being the most common. If a helical gear is required, GALPERTI Tech must evaluate the application.The geared slew bearing are manufactured in steel alloy with different heat treat processes, to improve mechanical characteristics:

- Normalized (annealed) steel
- Quench and tempered steel

Normalized steel provides an adequate tooth stress range for many applications. For special applications such as offshore application and special wind power generators, low temperature resilience, a quench and tempered heat treat process is required.

Additional superficial induction hardening can be performed upon request.The possible induction harden profiles are: tooth root and flank hardening or tooth flank hardening.

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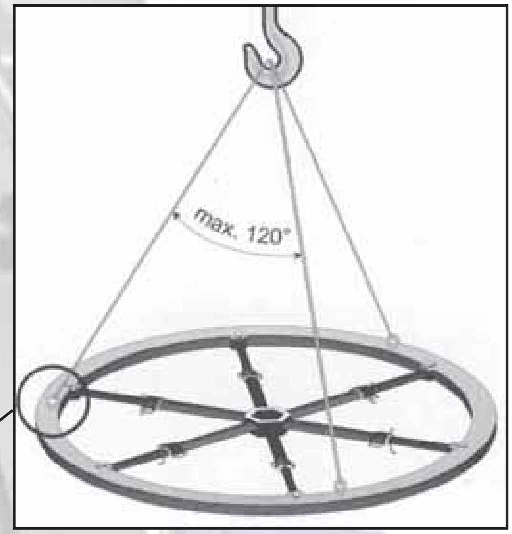
Transport & Storage

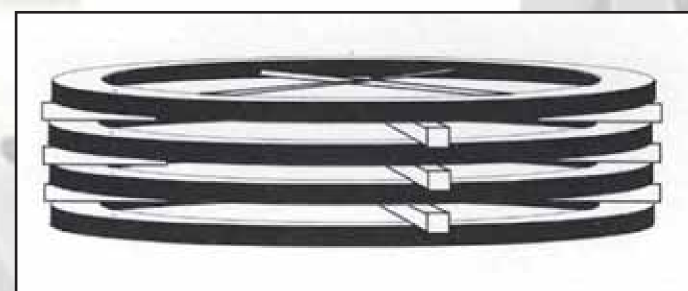
Transport



Large-diameter bearings are machined parts that require careful handling.They should be transported in a horizontal direction and all shock to the bearing must be avoided.When large diameter bearing are transported inclined or vertically they require an internal cross support.The support must be removed after installation and the bearing should not be lifted from this point. For transport use the eyebolts only!

Storage

Store bearing horizontally in a dry area with its original packaging until installation. GALPERTI Tech bearings are protected at the factory by internal grease and external surface protection. Use parallel spacers when you pile the bearings.



If not otherwise specified by customer, the bearings are delivered oiled and swaddled in plastic sheet film.This package guarantees moisture proofing for:

- Appr. 6 month in roofed storage areas;
- Appr. 12 month in enclosed temperatured areas;
- Longer storge periods require special measures.

If after a longer storage the seals become suctioned to their running surfaces, lift up the seals carefully with a blunt tool around the whole circumference.This will reduce the suction force to normal values.

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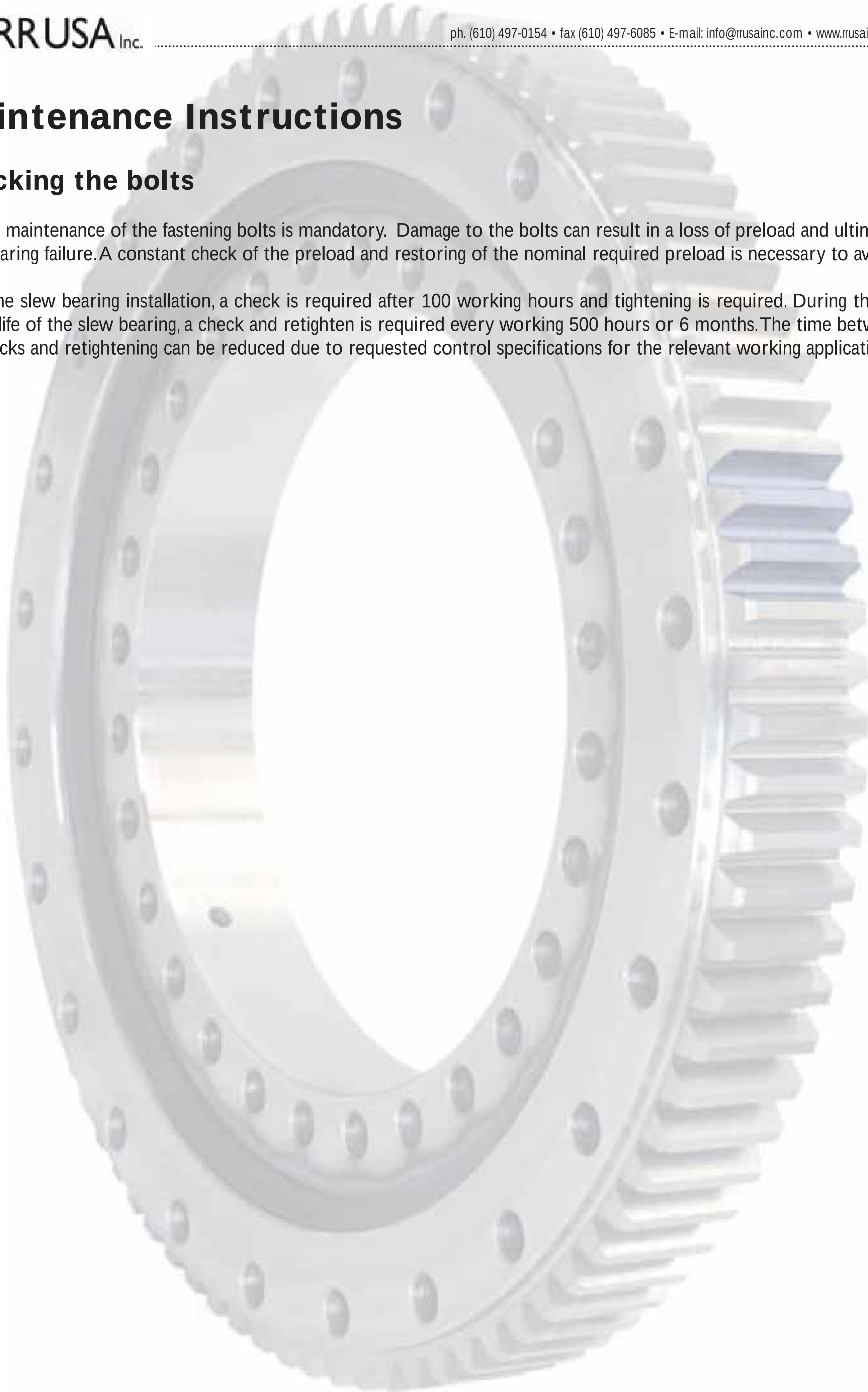
Maintenance Instructions

Checking the bolts

Regular maintenance of the fastening bolts is mandatory. Damage to the bolts can result in a loss of preload and ultimately slew bearing failure. A constant check of the preload and restoring of the nominal required preload is necessary to avoid failure.

After the slew bearing installation, a check is required after 100 working hours and tightening is required. During the following life of the slew bearing, a check and retighten is required every working 500 hours or 6 months. The time between the checks and retightening can be reduced due to requested control specifications for the relevant working application.



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Lubrication

All grease nipples must be easily accessible.
Lithium saponified mineral oils of NLGI grade 2 with EP additives must be used.The table below shows a list of lubricants for raceway and gear. Below is a table listing approved lubricants.

MANUFACTURER	RACE	GEAR
AGIP	MUEP 2 Dropping point 180°C -20°C to +120°C	-
ARAL	Aralub HLP 2 MKA-Z 1 -30°C to +130°C	Aralub HLP 2 MKA-Z 1 -25°C to +130°C
BP	Energrease LS-EP 2 -20°C to +120°C	Energrease LC 2 -25°C to +160°C
CASTROL	Spheerol EPL 2 -20°C to +110°C	Castrol LZV-EP -30°C to +150°C
ESSO	Beacon EP 2 -25°C to +135°C	Esso Multi-Purpose Grease (Molly) -25°C to +150°C
MOBIL	Mobilux EP 2 -25°C to +120°C	Mobil Gear OGL 461 -20°C to +120°C
SHELL	Shell Alvania EP 2 -20°C to +130°C	Shell Malleus OHG -20°C to +150°C
TOTAL	Total Multis EP 2 - 30°C to +120°C	Total Gardrexa GR 1-AL -20°C to +200°C

Other grease of the same quality of other manufacturers may also be used, but compatibility with the existing grease and the material of spacers and seals has to be confirmed (please call our design departement).The raceway system of our bearings is usually filled with Agip EP 2 grease. Applications operating in low temperatures require special lubricants. When an automatic lubricating device is installed, the lubricant manufacturer must confirm the pumpability over the range of operating temperatures.
For continuous rotation at high speeds oil lubrication may be required to minimize internal friction and oil circulation may be necessary to reduce the operating temperature.

Regreasing

The required frequency of lubrication varies with the application. Regreasing not only replaces old grease in order to reduce friction, but also seals the bearing, flushes out contaminants and wear particles and protects against corrosion. Therefore, as a general rule, the bearing should always be regreased to allow a collar of fresh grease around the whole circumference.
The bearings must be rotated during regreasing. When that is not possible the number of fittings must be increased in order to distribute the grease around the whole circumference.
We recommend a frequency of lubrication every 100 operating hours on slewing applications. (operating hours refers to the time the machine is in use, not to the bearing rotation). If the existing grease is in good condition the interval may be extended.
Continuous rotation motions, high moisture, dust, dirt and temperature effects may require shorter regreasing periods. Other applications require long-term lubrication and for special regulations please contact our engineers.
At the beginning and end of non operating time, regreasing is absolutely necessary

Wear Control

Normally most bearings are manufactured with an internal clearance.This clearance increases during operation. The manufactured clearance depend on:

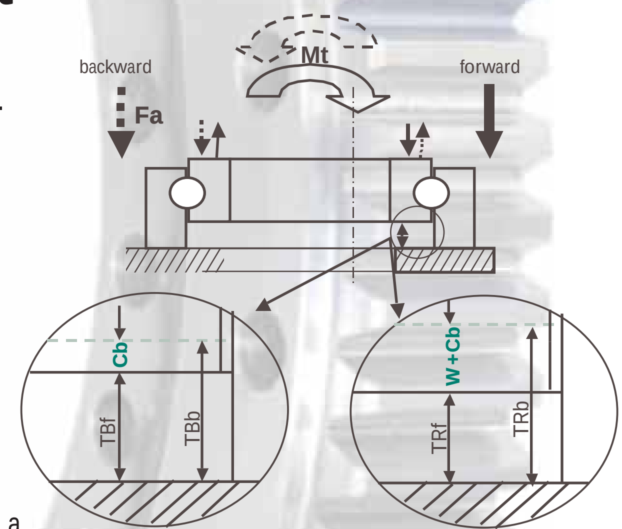
- Type of bearing
- Diameter of raceway and rolling elements
- Operating conditions
- Production tolerances

Depending on the working conditions and application the clearance may be increased or reduced to zero in special cases. As clearance is reduced, the requirements for stiffness and precision of the mounting structure are increased.
We recommended the customer to carry out a base measurement for assessing wear after installation. Base measurement should takes place every 12 months. If the wear is increasing more then at linear rate the time between measurements should be shortened.
Dial gauges attached close proximity to the bearing are neaded to minimize the influence of elastic deformations of the companion structure.
Depending on the load combination two possibilities are available for wear measurement (see sketches below).

Tilting Clearance Measurement

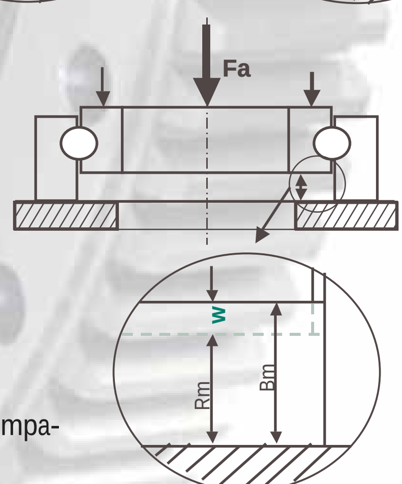
Start with the maximum backward tilting moment and set the dial gauges to zero. Then apply a forward tilting moment with a lift off load.

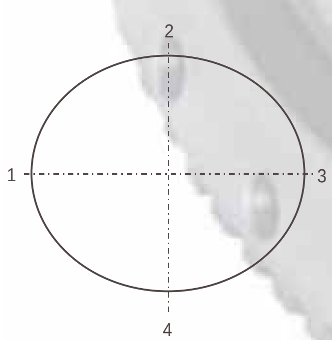
TBb	Tilting base measurement, backward
TBf	Tilting base measurement, forward
TRb	Tilting repeat measurement, backward
TRf	Tilting repeat measurement, forward
Cb	Basic clearance
W	Wear



Axial Reduction Measurement

When the load combinations do not genetrate a tilting moment with a lift up load, take the first measurement when the application is put into operation. Take this measurement for subsequent wear assesments.
For basic and repeat measurements make measuring points around the circumference. Take basic measurements on at least 4 points (4 x 90°) by rotating the superstructure. The measurements must be repeated under the same conditions.





The values have to be recorded and compared to the base values.
When deviations from the base measurements exceeds the values in the tables below, please contact our engineers

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Table 1 • Permissible clearance increase in mm under load for triple-row V91 - V92 - V93

raceway diameter in mm	roller diameter in mm				
	20	24	30	38	45
1200 1500	0,40 0,50	0,45 0,55	 0,58		
1900 2300	0,60 0,65	0,65 0,70	0,63 0,70	0,65 0,75	 0,75
2700 3100			0,80 0,85	0,85 0,90	0,85 0,95
3500 3900				0,95 1,00	1,00 1,05

Table 1 • Permissible clearance increase in mm under load for triple-row V91 - V92 - V93

raceway diameter in mm	roller diameter in mm			
	20	24	30	45
500 650	0,20 0,23	0.25 0.28		
800 950	0.26 0.30	0.32 0.37	0.40 0.45	
1200 1500	0.38	0.45 0.55	0.50 0.57	0.55 0.62
1900 2300		0.60	0.65 0.73	0.70 0.78
2700 3100			0.80	0.85 0.90

Quality Assurance

Galperti Tech is ISO 9001 certified and the product specification comply with the highest standards required by the market.
The bearings are supplied with certification according to EN 10204 2.2, EN 10204 3.1.B or EN 10204 3.1.C.

GALPERTI Tech inspect 100% of the bearing produced for functionality. If a products quality compromise the performance or functionality the manufacturing process is reassessed and the affected products are removed.

The following certificates and test reports are available:
Ring-Material Certificate: Chemical Composition and Physical Properties
Certificate of Heat-Treatment
Ultrasonic Testing
Magnetic Particle Inspection
Hardness Test
Torque Test Record
Certificate of Compliance: Toleranced dia., Total height, Position of holes. Axial clearance, Radial clearance, Axial runout, Radial runout.
Mechanical Tests on the bearing rings: Tensile Tests, Impact Notch Tests.

For further Tests or Certificates please ask our design departement.

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