EUROPEAN SPALLATION SOURCE

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Stuck bearing of the MR shaft

DOCUMENT REVISION HISTORY

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1	New Document	
2	Workflow added	

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The weight to be carried on the axial bearing is app. 5 ton. With an angle of app. 45° the reaction force on the bearings is 70 kN, see Figure 1.

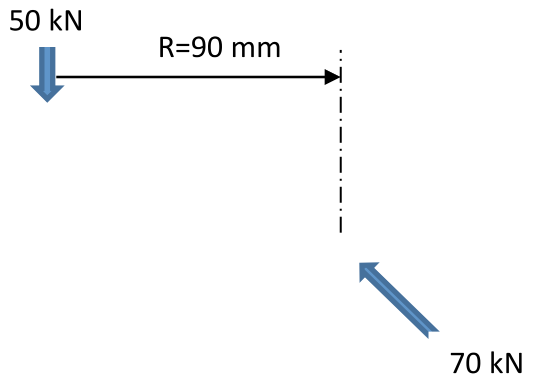


Figure 1 CAD model of the bearing

There are 21 rollers so each roller carries a load of 3.3 kN. The rollers are asymmetrical but assume they are cylindrical with a diameter of 28 mm and a length of 34 mm. Furthermore neglect the curvature of the mating surfaces. With these assumptions the contact width becomes 0.25 mm, see Figure 2. If this contact gets stuck by cold welding and conservatively assuming a rupture strength of 2000 MPa of the roller and/or race this contact can withstand a bending moment of

$$M_b = \sigma Z_b = 2000\frac{34 \cdot 0.25^2}{4} = 1100\,\text{Nmm}$$

This corresponds to a shear load on the rollers of

$$F = \frac{2M_b}{d} = \frac{2 \cdot 1100}{28} = 80\,\text{N}$$

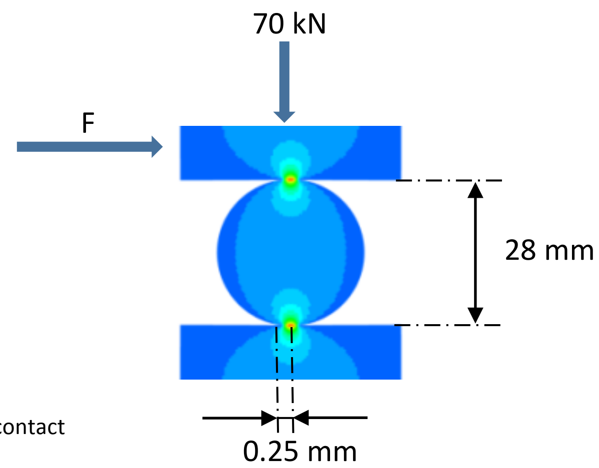


Figure 2 Roller contact

There are 21 rollers on a radius of 90mm so the moment needed on the shaft to break the contact is

$$M_s = 21 \cdot F \cdot R = 21 \cdot 80 \cdot 0.090 = 150 \text{ Nm}$$

The conclusion is therefore that there is no problem to achieve a rotating moment on the shaft in order to overcome possible cold welded rollers in the bearing.

Spherical plain thrust bearings

To get the comparison how high the moment need to be to break the contact in case of using plain bearing.

A spherical plain thrust bearing is chosen from the SKF catalog. A size of is 120 mm is chosen instead of 140 mm as the larges standard size is 120 mm. In the first approximation this is regarded as good enough to make a comparison.

The Figure 3 the spherical plain thrust bearing including dimensions is shown. According to the dimensions the contact surface can be approximated to calculated to 32 835 mm2.

With the contact line of the triangle

$$\sqrt{39{,}5^2 + 37{,}5^2} = 55\ mm$$

and the circumference of the bearing

$$D * \pi = 190 * \pi = 597\ mm$$

the contact area gets.

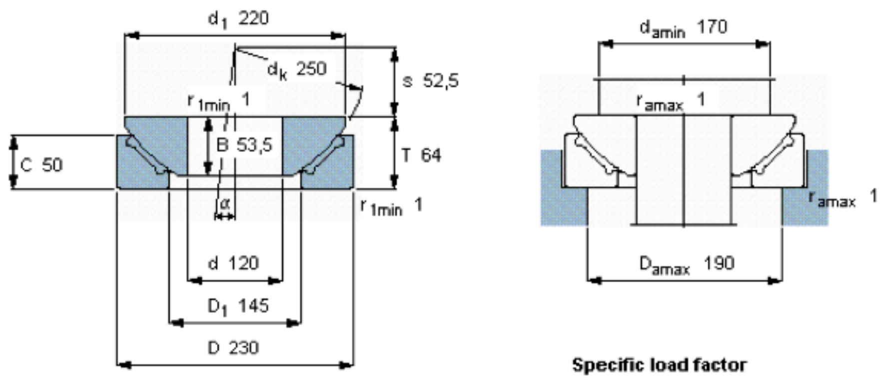
$$A = 55 * 597 = 32835\ mm^2$$

with a reduction of 50% due to holes for graphite

$$A_{final} = \frac{32825}{2} = 16418\ mm^2$$

Radial spherical plain bearings requiring maintenance, Maintenance-free spherical plain thrust bearings

Principal dimensions				Angle of tilt	Basic load ratings		Designation
					dynamic	static	
d	D	B	C	±	C	C0	
mm				degrees	kN		-
120	230	53,5	50	4	880	1430	GX 120 F



Specific load factor
K 50

Material constant
K_M 670

Figure 3: Spherical plain thrust bearing SKF

With the a shear force of 50 MPa for bronze the shear force is

$$F = A * \tau_a = 16418 * 50 = 820900\ N$$

With this the moment to break becomes

$$M_s = F \cdot R = 820900 \cdot 0.090 = 73881 Nm$$

Which is high. In case of the need to use a plain bearing it should be though of a solution with included, well-designed breaking points. See Figure 4

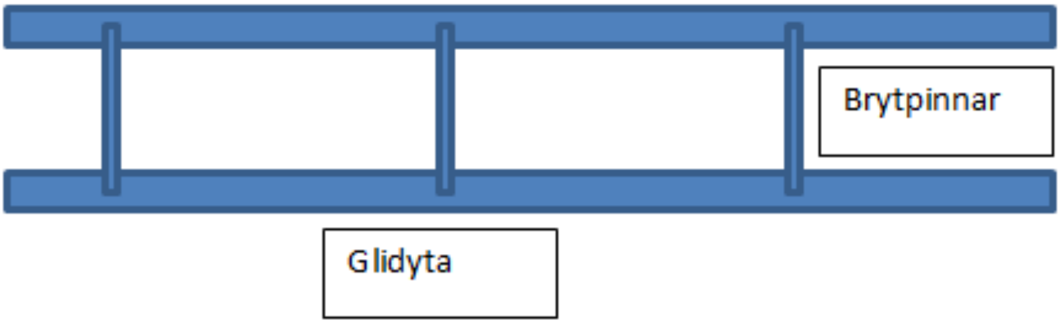


Figure 4: Design with breaking points