International Journal of Research Publication and Reviews, Vol 5, no 7, pp 3960-3966 July 2024

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Design and Development of Test Rig for Analysis of Hydrodynamic Bearing Grooves

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ABSTRACT:

In the industry basically for heavy load and for low speed hydrodynamic bearings are used. There are many industrial applications the hydrodynamic bearings are used. The analysis and design of hydrodynamic journal bearings has a great attention to the engineers. Emphasis has been given to design those bearings so as to avoid metal-to-metal contact. To design these elements, few important characteristics, like load-carrying capacity, maximum pressure and their location ,lubricant flow requirement between mating surfaces and so on are to be predicted accurately. Journal bearings with grooves or cavities in mating surfaces shows better properties than standard ones with smooth-surface. In this paper we have tried to analyze the hydrodynamic bearing having different square grooves.We will fabricate housing of pummer block bearing in such a way that there is lubricant flow between bearing lining and shaft to be tested.We will fabricate three types of lining with different condition for testing purpose.

Keywords: Hydrodynamic ,Hydrostatic,,Stribeck curve

Introduction:

Following fig shows different failure modes of hydrodynamic bearing in the industrial applications.

Fig. Failure modes of hydrodynamic bearing

The over pictures are appearing the disappointment modes of hydrodynamic heading due to taking after reason:-

Fundamental Bearing Disappointment Modes:

Four wear patterns can be used to classify the most prevalent disappointment types observed in motor primary orientation.

Exhaustion:

The majority of basic wrench heads consist of several layers joined by a fine Babbitt cloth or overlay on top of a steel foundation that is more grounded. The over weariness character of the overlay cloth is not met by bearing powers, which leads to this form of dissatisfaction. Wear accelerates as the overlay fragments of the stack accumulate onto the extruding surfaces.

Cleaning:

Cleaning occurs when the bearing's internal strength or temperature rises to such a high level that the Babbitt fabric covering it is largely loosened or uprooted, transferred to a zone that is cooler or less crowded, and then stored. The "Hot Short" disaster is an extreme example of wiping, where the internal bearing temperature rises to the point where the overlay cloth truly melts and tears completely off of the metallic backing.

Rating / inappropriate oil:-

This type of bearing letdown is the most prevalent, and it is typically caused by external molecular contamination of the oil supply, such as soil and metallic wear debris. As these random item particles uproot the bearing's fabric in the form of scratches, a tall area forms in the bearing surface, allowing iron on metal contact to interact with the journal area.

Deterioration:

An erosion failure of a bearing is defined as corrosion of its outermost layer induced by chemical assault. This is frequently the result of oil contamination and weakness caused by excessive blow-by, coolant or moisture in the oil, and poor oil change intervals. Destruction of the wearing is frequently followed by other failure modes because the deteriorated bearing surface accelerates wear and generates large amounts of wear particles, which can induce cutting of the bearing face.

Misassemble:

This is a typical problem with gasoline and diesel engines used on the road. Surprisingly, introducing heading parts in reverse or turned is a leading shape of assembly that can block the oil gulf and cause the bearing to fail owing to oil hunger. Improper pulverize clearances in component orientation are also a common cause of mis assembly, resulting in dense stack at the bearing separation line.

Misalignment

This causes competing layering over the face of the bearing as well as concentrated stacking zones, which can accelerate surface weakening. An overburdened bearing responds similarly to a misaligned state. Overheating and "lugging" are examples of unusual working conditions that accelerate surface wear and may heat the effect to the point of cleaning.

Methodology:

Identifying the fundamental reason of an associated disappointment is critical in avoiding a repeat of the dismay, since a simple replacement of the heading on a regular basis fails to address the factors that contributed to the regret in the first place. It is important to remember that in many cases, late bearing disappointment is caused by a combination of several factors.

In this extend work we will analyze on hydrodynamic bearing grooves and its impact on the working of heading. In this, we are going to examine the three modes of bearing grooves as below:-

a. Plain lining races.

b. Axial groove lining.

c. Radial groove lining.

Objectives :-

- To analyze the proficiency of bearing with distinctive grooves in lining.
- To analyze the impact of grooves over the working of bearing.
- To diminish the chance of disappointment of bearing.
- To check the capacity of bearing by testing essentially on created extend set up.

Typically mounted beneath or around the pivot shaft, fluid devices are noncontact devices which employ a thin film of rapidly moving squeezed gas or other liquid over the rotating bearing faces. The weight of the fluid in motion is the only thing supporting the stack limitation because there is no sliding resistance because the moving parts are not coming into contact with one another. There are two main ways to supply the bearing with liquid:

Aqueous enters inactive, hydrostatic, and different gas or discussion headings via an opening or permeable fabric. A rotor positioning control mechanism, which modifies the water weight and usage according to the turn speed and propeller load, should be used to establish such a heading.Dynamic aqueous heading creates a greasing layer below or around the shaft by sucking liquid onto the bearings inside surface during revolution.Hydrostatic orientation is reliant on a distant impeller. The control wanted by the compressor causes framework vitality loss, similar to carrying contact with whatever else does. Superior seals can lower spill rates as well as enhance flow control, but they can also raise wear. Hydrodynamic alignment relies on gear action to draw fluid from the bearing, which can result in heavy crushing and a brief lifespan at speeds lower than desired when it starts and stops. To avoid damaging the fluid bearing, startup as well as shutdown can be done with a separate pump or extra bearing. An extra bearing may have a long grinding life and a short working life, but it will have a long benefit life if the bearing starts and stops only seldom. The Reynolds criteria can be used to determine the liquids' administration guidelines. Note that when gasses are utilized, their determination is much more involved.The lean movies appear to have heft and heavy forces acting on them. Because the speeds differ, so will planar tension matrices. Due of bulk preservation, companies may accept weight gain, resulting in diverse body powers.

Hydrodynamic lubrication – properties:

1. As the stack increases, the gas layer at the lowest thickness shrinks in width.

2. The stress within the fluid mass rises as the amount of film lowers due to load.

3. Pull inside the fluid mass is most visible at a few locations nearer to the least elimination and low at the point of highest clearing (due to divergence).

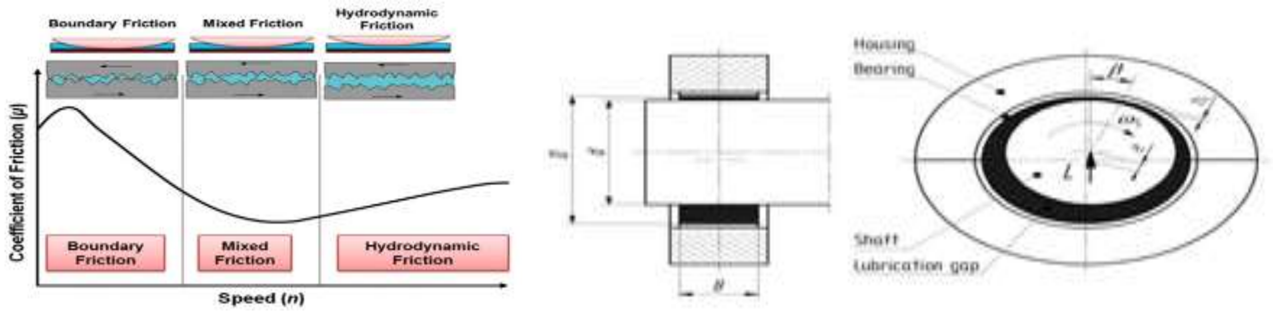
4. Viscosity rises with weight (more resistant to shear).

5. The addition of more fluids that are viscous causes an increase in film depth at the site of least clearance.

6. For the same stack, the mass increases as the total quantity of liquid increases.

7. For a given mound and fluid, the length of the film grows as speed increases.

8. Pneumatic contact increases when there is oil consistency becomes noticeable



Stribeck curve showing friction coefficient.

Oil reduces grinding of both sides (for example, the faces that glide on a ball bearing and shafts) in rotation. It is generally characterized as limit, hybrid, or hydrodynamic oil, as demonstrated held Heywood (1988), Becker (2004), Gleghorn & Bonassar (2008). Because a diary gear runs below barrier oil, mechanism and shaft's sliding edges are in nearly perfect coordination, having contact at its greatest level. Reduced grind levels are achieved by using mixed grease, which partially isolates the sliding surfaces, or hydrodynamic oil, which completely isolates the sliding surfaces.

Stribeck curves (or charts) are widely used in several building sciences to describe how contact moves under different oil conditions. In the Stribeck curve, the interaction coefficient is represented as a work of a parameter without dimensions determined from the dynamic consistency; exact speed and weight. The aforementioned parameter is commonly known as the duty parameter or the Hersey number. The lowest grinding ratio is found at the load parameter's base value, on the boundary of the blended and fluid lubrication zones. Heywood (1988) presented a Stribeck bent as a diary gear. De Kraker et al. (2007) studied several methods to calculate Stribeck bends.

They estimated the grinding factor as a function of the journal recurrence at various times.

A fluid diary gear (see Figure 2-2) is designed to function normally beneath aerodynamic oil, where dynamic heaviness (see Figure) in the fluid isolates the sliding areas of the from and shaft from one another. The sliding movement is what produces the hydrodynamic weight.

Results

Procedure of experiment

1. Connect the motor to supply and place the plain hydrodynamic bearing with bushing
2. Apply the initial load and gradually increased at the steps of 5Kg
3. Note down the temperature readings at each stage
4. Accerlometer is place on the top of bushing
5. Note down the readings of frequency at each stage
6. Take a screen shot of the reading for reference.
7. Replace plain hydrodynamic bearing with axial groove bearing and repeat the same procedure

8. Replace axial groove hydrodynamic bearing with radial groove bearing and repeat the same procedure

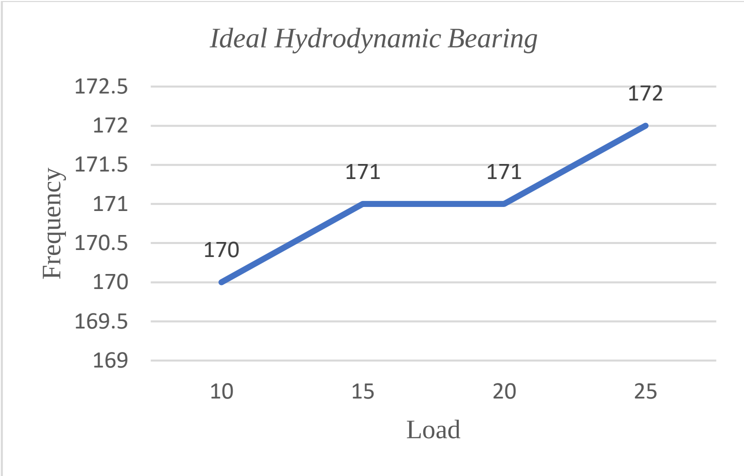
Observation table for hydrodynamic bearing:

Ideal hydrodynamic bearing						
Load on bearing	Temperature T1	Temperature T2	Temperature T3	Frequency (Using FFT)	Noise level	Remark
10	41	41	41	170	Low	NA
15	41.5	41.5	41.5	171	Low	NA
20	42.3	42.3	42.3	171	Medium	NA
25	45	45	45	172	Medium	NA

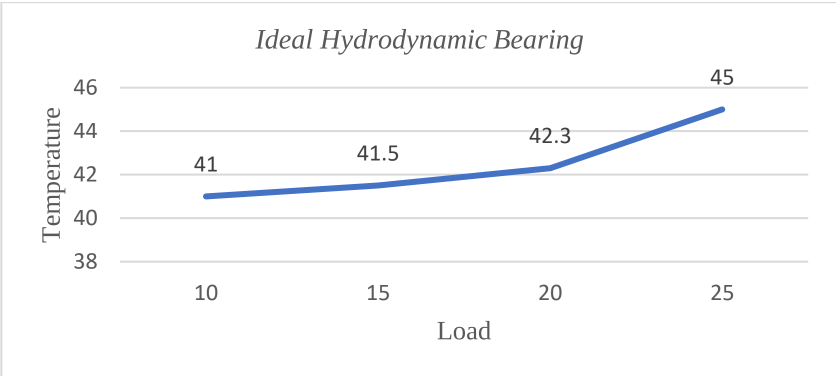
Axial groove hydrodynamic bearing						
Load on bearing	Temperature T1	Temperature T2	Temperature T3	Frequency (Using FFT)	Noise level	Remark
10	41	41	41	170	Low	NA
15	41.5	41.5	41.5	171	Low	NA
20	42.3	42.3	42.3	171	Medium	NA
25	45	45	45	172	Medium	NA

Radial groove hydrodynamic bearing						
Load on bearing	Temperature T1	Temperature T2	Temperature T3	Frequency (Using FFT)	Noise level	Remark
10	41	41	41	170	Low	NA
15	41.5	41.5	41.5	171	Low	NA
20	42.3	42.3	42.3	171	Medium	NA
25	45	45	45	172	Medium	NA

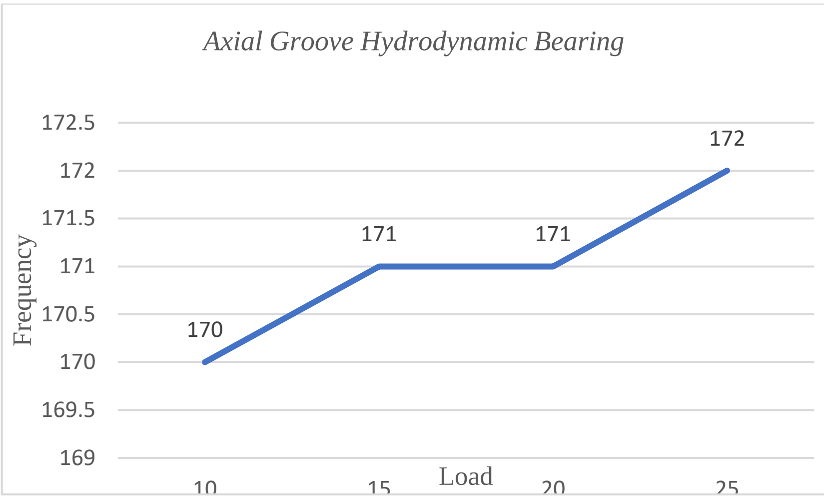
Graphical Analysis



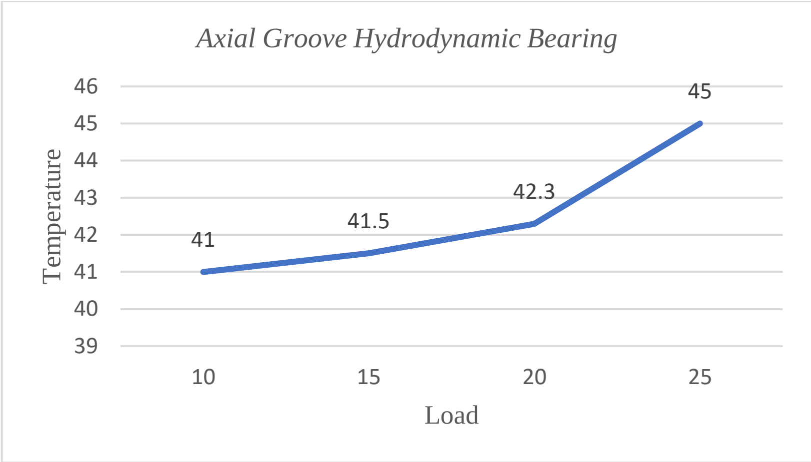
Load vs Frequency for ideal hydrodynamic bearing



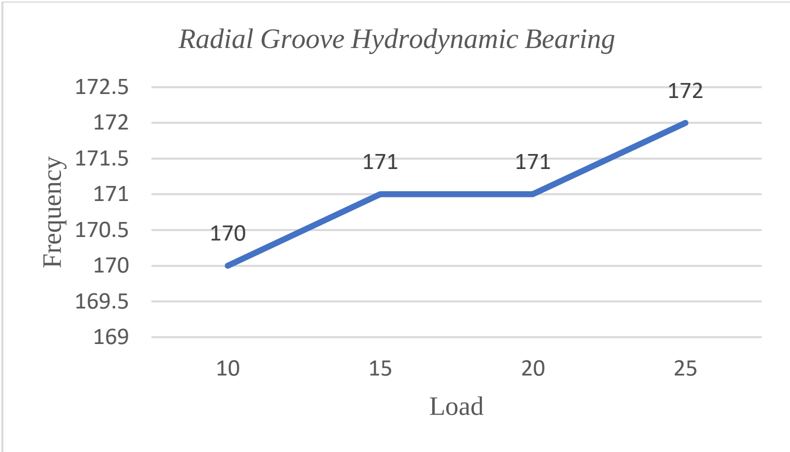
Load vs Temp for ideal hydrodynamic bearing



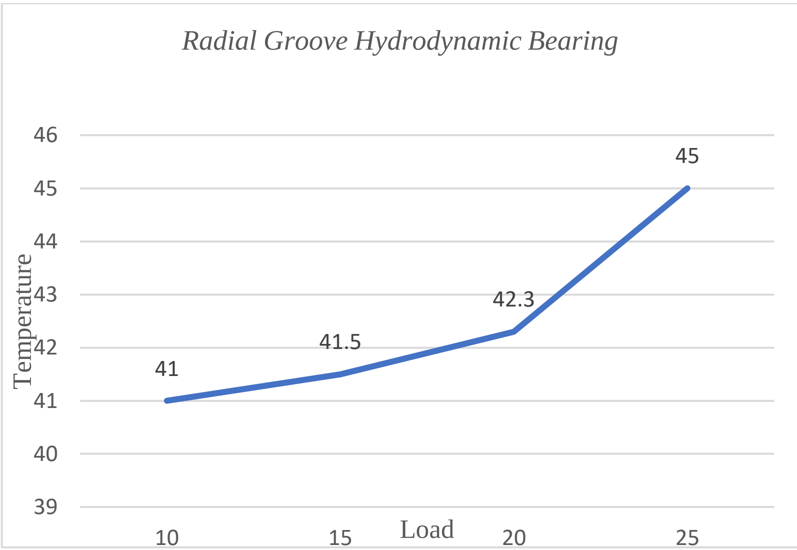
Load vs Frequency for axial hydrodynamic bearing



Load vs Temp for axial hydrodynamic bearing



Load vs Frequency for radial hydrodynamic bearing



Load vs Temp for radial hydrodynamic bearin

Conclusion

Hydrodynamic journal bearings provide a load-supporting fluid layer based on the shape and position of the slide surface, avoiding metal-to-metal contact between the driveshaft and the bearing. As a result, there will be no friction, and a pressure profile will be developed to simulate load action on the journal bearing.

Hydrodynamic bearing is suited for high load and high speed condition particularly from considerations of long life also noise created by hydrodynamic journal bearing is lesser as compared to other bearing. Frictional loss is only at the starting condition & after that, certain speed power loss due to friction is lower.

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