Comparative study of Crankshaft Thrust Washer Bearing Materials Under Different Conditions

Rakesh B.Thakare[1], Sujit B. Deshmukh[2] Atul M. Bobade[3]

[1,2,3]Lecturer, Mechanical Engineering, Sandip Polytechnic, Maharashtra, India.

ABSTRACT

Abstract—Crankshaft thrust washers are generally made from aluminum base material and copper base material and form an important part of the main journal bearing that transmit and resolve axial forces in rotating mechanisms to keep components aligned along the shaft. Thrust washers are designed to prevent movement along the axis of a shaft. These rugged washer like flat bearings are used to prevent wheels from moving sideways on axles whenever the bearing that handles the radial load such as a bushing or roller bearing has no specific provision for axial and thrust loads. Thrust washers are a class of thrust bearings that use hydrodynamic lubrication action to support load. The lubricant film allows relative motion to occur between the surfaces while minimizing friction and wear. This paper will focus on wear rate under dry condition and lubricating condition for aluminum base material and copper Base Material.

Keywords: *Crankshaft, analysis, thrust bearing, wear rater, aluminum base material, copper base material*

1. INTRODUCTION

Crankshaft located axially in the crankcase by plain thrust bearing which restrain it against endwise movement from loading imposed mainly by transition system. This loading may be forward direction during release friction clutch and in reward direction when fluid coupling is in operation. The axial movement of the crankshaft is controlled by two half thrust washer position both side of centre main bearing. Semicircular thrust washer which install either pair or singly on each side of the main bearing housing. When thrust washer of small size used in pairs each lower half key to bearing cap thus preventing both lower and upper valve from rotating once cap fitted. If lower thrust washer is only use rotation is prevented by upper ends abutting joint faces of crankcase bearing saddle. Since thrust surface of the bearing must be separated by oil film the washer are provided with grooves or pocket to distribution the oil reaching then from main bearing they embrace. Friction bearings thrust surface on the shaft get rubs against a same surface on crankcase. A precision insert main bearing may have a thrust flange for the crank to rub against it thrust washer use**.**

Crankshaft thrust washer bearing material:

Aluminium Base material

Aluminium silicon are the most important ones mainly due to their excellent combination of properties such as good cast ability, good surface finish, light weight, fewer behaviour to oxidation, action to modification, less coefficient of thermal expansion, more strength-to-weight ratio and better corrosion resistance. It is more tolerance derbies and oil. Aluminium based material is softer and therefore it gets deformed during punching of thrust washers.
Application: Mahindra and Mahindra, Maruti Suzuki, Tata motors Etc.

Copper Base material

Copper alloy of given combination have properties such as strong, high thermal conductivity, machinability, corrosion resistance and ductility. Copper base alloy give the longer life but copper based material is much harder and corrosive hence coated by tin (Sn) layer.
Application: Audi, Honda, Fugi etc

Objective

- The purpose of this work is to develop an understanding of the physical phenomena that governs the behavior and life of a thrust washer bearing.The project work has following objectives:
- Experimental testing of aluminium and copper based material by using pin on disc apparatus to analyse behaviour of them under varying loads, speed and sliding velocity in dry and lubricated condition.
- Compare performance of materials under given condition.
- To suggest the suitable bearing material for crankshaft thrust washer considering wear rate criteria.

2. LITERATURE REVIEW

Robert L. Jackson and Itzhak proven that Experimental results show that by decreasing the friction between the components, TEI and scuffing are less likely to occur. This can be accomplished by using a low friction coating on the bearing surfaces. [1]

Dooroo Kim et al. stated that the he grooved washers performed better than the flat-faced control washer the coefficient of friction of the grooved washers is either similar to the other tested washers or lower. This can decrease the effects of distress and wear from TEI and TVD by dampening the occurrence of hot spots and preventing the decrease in viscosity. [2]

Andrew T. Cross, Farshid Swadeshi et al. stated that A thrust washer test rig was designed and developed to visualize oil flow and cavitation inside a surface pocket. A novel fabrication method was developed to create a semitransparent thrust washer. In this approach, a flat piece of steel shim stock was laser machined and then adhered to a glass disk, providing windows into the bottom of each pocket, enabling observation and measurement of the lubricant flow. Thrust washer use6mm, 8mm, 10 mm pocket compare 10-mm, 25-μm pocket was the best design among the ones considered in this investigation. [3]

3. Experimental Procedure:

A. Friction and wear tests are performed on this test rig. It is fully computerized and is programmable to study friction reaction against speed, load and wear. The test rig uses Medium carbon Steel disc with give specification in chart and Copper and aluminium bearing material sample in the form of pin of different diameter & length. Each test sample was mounted on load arm and pressed against the rotating disc. The sliding speed of rotating disc was varied from 455 to 700 rpm and the test duration was 15 minutes. The surface of the sample and disc was grounded with 320-grid sand paper before beginning the test. The normal load was varied from 5kg to 9 kg to achieve a constant friction force.

B Test Equipment:

The experimental set up includes all hardware and software needed to collection of all necessary data and analysis of obtained data. Wear and Friction parameter with details Monitor TR 20 LE-PHM-400 DUCOM is as shown in figure with following specifications.

Table 3.1. Specification of pin on disc machine

SR. NO.	PARAMETERS	VALUES/Remarks
1	Specimen Size	3 to 12mm diameter 25 to 30 mm length
2	Disc Size	165 mm × 8 mm thick
3	Wear Track Diameter	50 mm to 140 mm
4	Sliding Speed Range	0.5 m/s to 10 m/s
5	Normal Load	5N to 200N Max.

6	Disc Rotating Speed	200 to 2000 rpm
7	Friction Force	0 to 200 N
8	Wear Measurement Range	-2000 micrometer to 2000 micrometer
9	Temperature	Ambient to 400^{o} C
10	Environmental & Lubrication Chamber	Top Portion Detachable for clamping the Specimen : Tests for Dry, Heated & Lubricated Conditions

Table 3.2 shows the detail of the experimental conditions.

Sr. No.	Parameters	Operating Conditions
1	Normal Load	5 kg , 7 kg
2	Sliding Velocity	1.47m/s , 2.22 m/s, 3.675m/s ,
3	Duration of Rubbing	30 minutes
4	Surface Condition	Dry And Lubricated condition
5	Lubricant	15W40 Engine oil
6	Pin Material	Aluminium base material Copper Base material
7	Disc Material	Medium Carbon steel (steel No. 1045)

Fig 3.1 Experimental set up

A. Testing Conducted:

Friction and wear tests are performed on this test rig. It is fully computerized and is programmable to study friction reaction against speed, load and wear. The test rig uses Medium carbon Steel disc with give specification in chart and Copper and aluminium bearing material sample in the form of pin of different diameter & length. Each test sample was mounted on load arm and pressed against the rotating disc. The sliding speed of rotating disc was varied from 455 to 700 rpm and the test duration was 15 minutes. The surface of the sample and disc was grounded with 320-grid sand paper before beginning the test. The normal load was varied from 5kg to 9 kg to achieve a constant friction force.

4. Experimental Results:

Table 4.1 Experimental Result Dry Condition

Material	Load (Kg)	Speed (RPM)	Wear Dry condition (Micron)	COF Dry condition
Aluminium Base Material	5	455	189.34	0.27
		683	239.45	0.30
		1133	1295	0.55
Copper Base Material	5	455	134.19	0.54
		683	89.30	0.56
		1133	71.08	0.83
Aluminium Base Material	7	455	337	0.35
		683	530	0.52
		1133	1692	0.61
Copper Base Material	7	455	127.02	0.57
		683	82.16	0.85
		1133	62.80	0.91

Table 4.2 Experimental Result Lubricating Condition

Material	Load (Kg)	Speed (RPM)	Wear Lubricated condition (micron)	COF Wet
Aluminium Base Material	5	455	17.11	0.039
		683	28.17	0.037
		1133	76.17	0.043
Copper Base Material	5	455	36.20	0.053
		683	77.59	0.041
		1133	153.47	0.039
Aluminium Base Material	7	455	37.81	0.020
		683	75.80	0.035
		1133	138.30	0.058
Copper Base Material	7	455	59.91	0.038
		683	94.85	0.047
		1133	187.11	0.029

5.RESULTS

At maximum load of 7 kg and maximum speed of 1133 RPM wear occurs in Aluminium base material is 1692 microns in dry condition and 138.30 in lubricating condition while wear occurs in Copper base material is 62.80 microns in dry condition and 187.11 in lubricating condition.

6.CONCLUSION

As shown in results the above there is considerable decrease in wear rate of aluminum base material under lubricating condition. wear rate of copper base material is less as compare to aluminium base material. At the same time in copper base material small amount of wear is observed in the disc, whereas no wear observed in aluminium base material. In lubricated condition under given parameters observed the better wear characteristics and Friction characteristics of Aluminium bearing material as compare copper base bearing material. Under given condition it is observed that Aluminium bearing material is better material for crankshaft thrust washer.

7.REFERENCES

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