

Study on automotive engines & Design Analysis of counter shaft bearing affecting by foreign particles & application of vibrations at variable loads and speeds

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Abstract - This paper deals with the Design and analysis of engine transmission gear box assembly focusing on the counter shaft bearings. During application of counter shaft bearing of the transmission box, it was noted to the worn-out of the same bearing; has much more chances of failure irrespective to the other parts. In case of any noise concern from vehicle during operation with effect to the vibrations in or from the engine; there are more chances to failure of the counter shaft bearing as per study, which is the cause of failure of the other parts of the engine transmission box. Nevertheless it would not be wrong to say that in case of noise concerns from engine transmission box, check the counter shaft bearing and replace it to resolve the concerns. It is merely applicable in vehicles used over Indian roads and the similar one's as present in India, it varies as of the road conditions and driving nature. Direct use of water on the bearing reduces its life as it corroded the inner & outer races of the bearings and as a result the bearing material strength gets reduced.

Key Words: Compressive strength, workability, marble slurry, concrete, Ground-granulated blast furnace slag, flexural strength, splitting tensile strength

1. INTRODUCTION

A bearing is a machine element, made up to withstand loads, and supports another moving machine element, known as journal. It permits a relative motion between the contact surfaces of the members, while carrying the load. The efficiency of the mechanical system depends to a great extent on the efficiency of its bearings equipped with. A necessity for the efficient working of the bearings is that the running surface should be adequately supplied with lubricant. With correctly formed oil grooves in the bearing shells ensure that in bearings the oil supply is maintained in all circumstances even at low revolutions.

The study is based on the standard root cause and counter-measure of procedure. In the present work by using the

vehicle in the town or in urban areas with variable loads & speeds is taken into consideration. When the counter shaft is rotated at variable speeds (rpm) and with the variable loads applied to the shaft which is mounted on the bearings by the engine input shaft it should not worn-out bearings during operation but exists. When the shaft is rotated under free conditions, deflections will be created due to the critical speed of the shaft due to this bearings want to change their position, but couldn't due to its fixed position and in case of loads with variable speed and application of water; may be somehow, reduces the life of the bearings on which the counter shaft is put over. In other words the life of a bearing is inversely proportional to the above mentioned factors. To compare this, two vehicles were taken into consideration and counter-shaft bearings were designed with same material strength and same bearing life, such that the natural frequency and speed is under limits. In this the counter-shaft which is affected by the above factors will not work as longer as the other one and as a result humming noise concern from vehicle will produced which will lead towards maintenance work and replacement of the counter shaft bearing, in most of the cases front or otherwise both. Meshing of the shaft model was done and the loads, speeds and stresses that were applied for the bearing to be checked out so that the life of the bearing is determined on the basis of comparison and counter measures

1.1 PURPOSE

Vibration exists widely in all machines working under high-speed and variable speeds. The unpredictability of vibration and the change of the relative surface speed may result in difficulties in the bearing life. By far there are few studies on bearing life published in various papers. The purpose of the present study is to investigate the effect of the variable speeds (rpm), with the variable loads, various lubricants (SAE) under the influence of temperatures and

water on the counter-shaft bearings to increase its life by removing the factors affecting bearing life.

Yuji Enomoto (1998) et. al describes about the development of improved technologies for environmental protection, resource utilization and customer satisfaction as it is necessary for the rapid, world-wide spread of automobiles. As the designs of automotive components have changed, emphasis has shifted to tribological approaches. New tribo-materials are needed for automotive components that must run at higher temperatures against higher pressure and velocity conditions. This paper outlines current issues related to tribo materials in passenger cars.

Yung-Chang Kang(2004)et. al.In this article author and his team introduced nano-metric particulate to the aluminum matrix by using a traditional powder metallurgy technique. It is clear from this work that the nano-metric particulates improve the mechanical properties in the monolithic system. However, as the particulate volume fraction increased, the extent of agglomerations of the particulates increased. When nano-particle content in the composites exceeded 4vol%, the agglomerations reduce the amount of „effective“ nano-particulates available, and the particle strengthening effect diminishes.

2. CALCULATION OF BEARING LIFE AT VARIABLE OPERATING CONDITIONS

In some applications, the operating conditions, such as the magnitude and direction of loads, speeds, temperatures and lubrication conditions are continually changing. In these types of applications, bearing life cannot be calculated without first reducing the load spectrum or duty cycle of the application to a limited number of simplified load cases.

In case of continuously changing loads, each different load level can be accumulated and the load spectrum reduced to a histogram of constant load blocks .Each block should characterize a given percentage or time-fraction during operation .Note that heavy and normal loads consume bearing life at a faster rate than light loads. Therefore, it is important to have shock and peak loads well represented in the load diagram, even if the occurrence of these loads is relatively rare and limited to a few revolutions. Within each duty interval, the bearing load and operating conditions can be averaged to some constant value .The number of operating hours or revolutions expected from each duty interval showing the life fraction required by that particular load condition should also be included. Therefore, if N_1 equals the number of revolutions required under the load condition P_1 , and N is the expected number of revolutions for

the completion of all variable loading cycles, then the cycle fraction $U_1 = N_1/N$ is used by the load condition P_1 , which has a calculated life of $L_{10 1}$. Under variable operating conditions, bearing life can be rated using

$$L_{10} = \frac{1}{\frac{U_1}{L_{10 1}} + \frac{U_2}{L_{10 2}} + \frac{U_3}{L_{10 3}} + \dots}$$

Where,

L_{10}	=	basic rating life (at 90% reliability) [million revolutions]
$L_{10 1}, L_{10 2}, \dots$	=	basic rating lives (at 90% reliability) under constant conditions 1, 2, ... [million revolutions]
U_1, U_2, \dots	=	life cycle fraction under the conditions 1, 2, ... Note: $U_1 + U_2 + \dots + U_n = 1$

The use of this calculation method depends very much on the availability of representative load diagrams for the application. Note that this type of load history can also be derived from a similar type of application.





Figure -1: Damaged of the Inner race of the counter shaft bearing



Figure -2: Gears clearances and the foreign particles accumulated on the magnetic brush

3. ROOT CAUSE AND COUNTERMEASURES

The lubricant was assumed to be Newtonian fluid which follows the Newton’s law of viscosity. The time-dependent numerical solutions were achieved instant after instant in each period of vehicle running condition. At each instant, the pressure field was solved with a multi-level technique, the surface deformation was solved with a multi-level multi-integration method, and the temperature field was solved with a finite different scheme through a sweeping progress. The periodic error was checked at each end of the counter shaft bearing until the responses of pressure, film thickness and temperature were all periodic functions with the frequency of the roller’s vibrations. But after the repetition of operations it was found that the clearance in the gears is although same in both but the counter-shaft bearings affected by the variable loads, speeds and application of pressurized water over breather or in the engine section in case of front wheel drives during washing causes corrosion as well as producing humming noise from inside the transmission box. Due to change in viscosity of lubricating oil, increase in backlash, lubricating oil gallery choked with foreign particles causing loss of lubrication which generally occurs due to service of vehicles at unauthorized service stations.

4. RESULT AND DISCUSSION

As a result of the above study it was found that the vehicle which runs under normal load, within specified operating speeds and with proper maintenance at the authorized dealership has low chances of failure of its counter-shaft bearings and less chances for any noise from the engine or transmission box as compared with the other vehicle which is operated under variable loads, frequently changed speeds and also serviced at an unauthorized service station as being unavailability of standard operating tools and trained manpower. In such a case of noise from transmission gear box, it is mandatory to open the gear box and checking of countershaft bearings which have most possibility of failure as compared with other parts inside the transmission box, under the influenced of the above described conditions.



5. CONCLUSIONS

A **bearing** is a machine element that constrains relative motion to only the desired motion, and reduces friction between moving parts. So it should not come in direct contact with water to enhance its life. Using water resistant lubricants can also increase the life of bearings.

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