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Prevention of Oil Leakage in Planetary Pin Groove of Hub Case Assembly

By

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ABSTRACT:

The modern world entirely depends on transportation and one of the best way of transporting is through roads with the help of automobiles. When we talk about the automobile transportation first thing which comes to mind is trucks and busses, so axel is integrated part of wheeled vehicle the main function of axel is to deliver driving torque to its wheels and it must also bear the load of vehicle plus cargo. During turn the outer wheel rotates faster than inner wheel. To make it possible differential axel are used in all most all the automobiles. A differential axel is a simple arrangement of planetary gear train.

In this present investigation Oil seepage is a major problem occurred in the area of hub case of a hub reduction axle, which is designed at Meritor Mysuru. This paper contains a number of methods used to overcome from the seepage issue, their efficiency and other programs we need to consider to beat the problem and continue problem less manufacturing of axles.

Method 1:- Actions taking at field

Method 2:- Metallurgic analysis done

Method 3:- Examining O-ring grove profile, core shift, entry chamfer and o ring to physical properties

Method 4:- Fish Bone Diagram

KEY WORDS:

Hub Case, Core Shift, Chamfering, O-ring and Planetary pin groove.

INTRODUCTION:

Producing high quality of products and services is one of the key concerns in order to keep up with the competition in the global markets. The main objective of manufacturing industries today is to increase productivity through system simplification and incremental improvements by using modern available techniques. One of the most recognized technique is Kaizen. By using technique of kaizen such as Poka-Yoke, 5 'S' Concept , 7 Kind of Productive Loss etc. we can increase the productivity of the process in the form of continuous improvement. The effective implementation of kaizen methodology will lead to the success of the organization.

This paper discusses different literatures that have been published in this field and presents a review of literature which will be helpful to new research in this field. Besides this while going through the literature it is observed that there is no standard sheet for poka-yoke. In view of this we specially designed a template sheet for poka-yoke users and research.

METHODOLOGY:

To improve and increase productivity by improving the process, reducing time and waste. The word indicates a process

of continuous improvement of the standard way of work. It is a compound word involving two concepts: Kai (change) and Zen (for the better).

There was problem occurred after marketing, that they found the oil leakage in the hub case.

We found the issue of oil leakage after the vehicle is used for 4000 to 5000 kms.

After some query and investigation we got the result as 8 nos. were failed out of 10 nos.

MATERIALS USED: Spheroidal graphite iron.

Material designation	Condition (1)	Form	Tensile Properties Std. 1014.202 (2)			Hardness Std. 1014.311 HBS (3)
			$R_{p\,0.2}$ N/mm²	R_m N/mm²	A_5 %	
Spheroidal graphite iron						
0727-02	As cast or heat treated	Test sample	Min 320	Min 500	Min 7	-
		Casting	(320-440)	(500-720)	(7-17)	170-320

Table - Mechanical properties.

Area of leak in hub case,

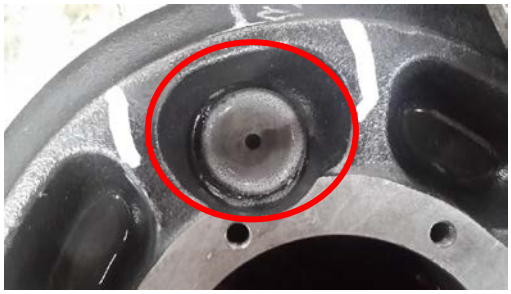
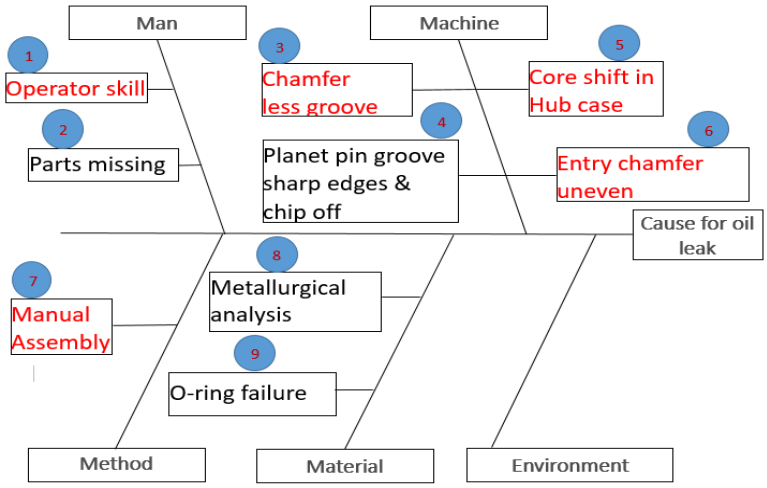


Fig. Leakage area.

Above figure showes exactly were the leakage is happening in the hub case. After the leak test is done at the manufacturing plant, we came to know that the leakage was happening exactly at the grove. Parts involved here are Planetary pin, Grove, O-ring and some washers.



Fish bone diagram.

ABC analysis to find the root cause by changing the different components at the area of leak:

Problem Statement

1. Two cases of leak through hub cases reported from DICV line.
2. Subsequently, 26 seepage issues reported from DICV field.

Initial Study done

1. The subject 2 nos. of hub cases received from DICV to Mysore Plant.
2. Initially, soapy water Leak test done at 0.45 Kg/cm^2 pressure on axle assembly - No leak observed through hub cases.
3. In order to simulate the leak found at DICV, leak check done at hub case sub assembly at higher pressure 1.5—2 Kg/cm^2
   I. Observed leakage at on > 1 Kg/cm^2 one hole
4. Further dimensional analysis done on hub case major components
   I. Hub case (diameter & chamfer) – found ok

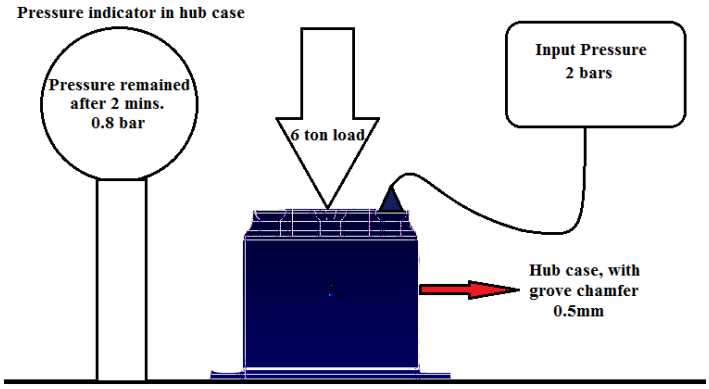
II. Pins (groove dimension) – found ok

III. O-ring dimension found ok

Solution:

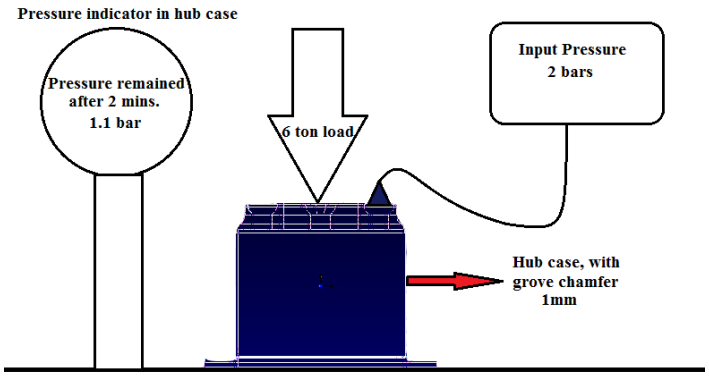
Providing chamfer for the grove by trial and error method.

Trial No. 1:



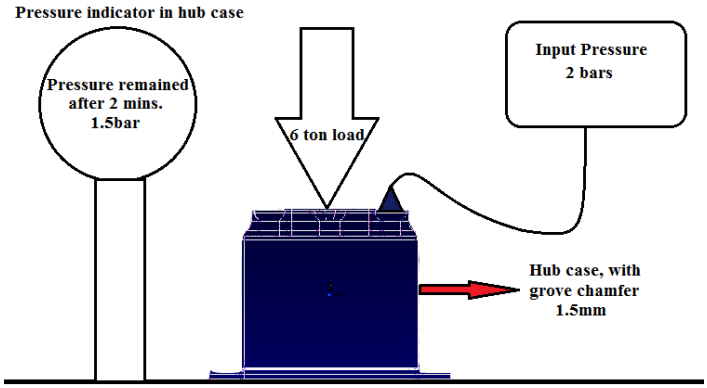
Leak test trial no. 1.

Trial No. 2:



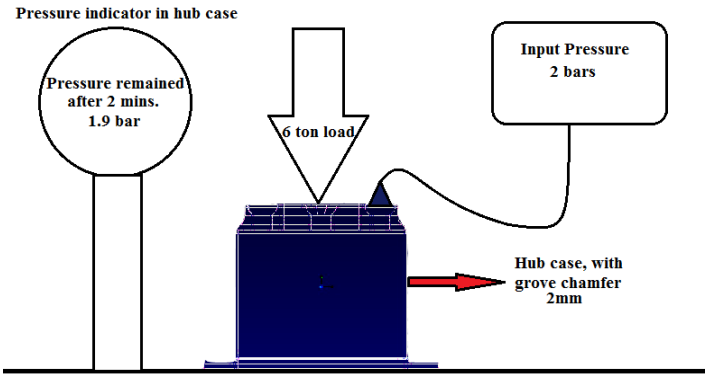
Leak test trial no. 2.

Trial No. 3:



Leak test trial no. 3.

Trial No. 4:



Leak test trial no. 4.

Result:

Trial number	Input Pressure In 'bars'	Chamfer dimension In 'mm'	Loss of pressure In 'bars/min'
1	2	0.5	1.2
2	2	1	0.9
3	2	1.5	0.5
4	2	2	0.1

Leak test results.

Oil Seepage Through Wheel- end Planetary Pins

DESCRIPTION:

At the preliminary stage the issue was big at the fields. Then we did an investigation through the axle of 15 trucks. Then we found around 8 to 9 axle's seepage issue through the hub case. For temporary solution thy changed the whole hub case component. After coming back to our plant we started searching for the problem causing that issue.

We did air leak test, checked for chamfer cutting, surface hardness and finally plotted the fish bone diagram. Later after all investigation and tests, the planetary pin was assembling manually which was effecting to chip off of the pin edges and also grove edges. We changed the chamfer dimension from 0.2 to 0.5 which reduced the sharp edges. Sharp edges leads to stress concentration factor and breaks up easily. Air leak test changed from assembly line to separate leak equipment so the leak test is increased from 1.5 to 2 bar pressure. Core shift were studied using the cp & cpk which is process capability and process capability index. This was studied and corrected the cp value to greater than 1.3, this is a standard value and greater than 1.3 is a good process according to process capability study. Surface hardness was ok. Then O-ring used was not having any kind of defect. The ultimate objective is to increase productivity through system simplification, organizational potential and incremental improvements by using modern technique like Kaizen. Hence the seepage is eliminated easily.

Manual Assembly

Photos:

Assembly using machine

Air leak test 1.5 – 2 bar pressure

RESULT and CONCLUSION:

The seepage in the hub case assembly has be stopped by,

a) Cp & Cpk study should be very compulsory for every process of manufacturing, which for us to reduce the core shift.
b) Should not lead to stress concentration factor or sharp edges.
c) The manual assembly should be eliminated for précised parts to maintain tolerance and reduce chipping off of the planetary pin edges.
d) From leak test we concluded that the pressure should be in the range of 1.5pa to 2pa.

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