A RESEARCH PAPER ON OIL SEEPAGE ANALYSIS IN POWER-PACK VEHICLE

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Abstract- This paper presents an experimental investigation on oil leakage and seepage into power-pack engine into the three wheeler vehicle which irritate to customer of the company. Through the experiment identify the main causes of the issue and also the solution of the problem. There are variable factor that affects and create a problem of oil seepage and leakage from the engine of the vehicle. In this research paper, some problems along with their solution had discussed which faced by the company.

Keywords- Gasket**,** Oil-Seepage, Power-pack engine, capillarity rate, material handling, lubrication.

I. INTRODUCTION

Lubrication is the process or technique through which the friction between two or more motion parts into vehicle and also its prevent from wear of one or both parts, and the surfaces are moving relative and are in proximity to each other, from interposing a substance called a lubricant in between them. The lubricant are be in a solid, solid/liquid dispersion, a liquid such as oil or water, liquid-liquid dispersion (grease) or a gas. From fluid lubricants, the applied load is either carried by pressure generated within the liquid due to the frictional viscous resistance to motion of the lubricating fluid between the surfaces, or by the liquid being pumped under pressure between the surfaces. [3]

Sometimes lubricants are capable to escape from the closed body, this phenomena is known as leak. A **leak** is a way (usually an opening) for fluid to escape a container or fluid-containing system, such as a tank or a ship's hull, through which the contents of the container can escape or outside matter can enter the container. Leaks are usually unintended and therefore undesired. The word 'leak' usually refers to a gradual loss; a sudden loss is usually called a 'spill'.
The matter leaking in or out can be gas, liquid, a highly viscous paste, or even a solid such as a powdered or granular solid or other solid particle.

In some applications, such as piston engines, the film between the piston and the cylinder wall also seals the combustion chamber, preventing combustion gases from escaping into the crankcase. And for preventing the leakage and accurate of any kind of the pressurized or not pressurized between two mating surface part of the engine a material used is known as GASKETS.

1.1 Gasket

Gasket is a known as the type of mechanical seal which is filling or fitting the space between two or more mating surfaces, usually to prevent leakage from or into the joined objects while under any compression. It provide to the "less-than-perfect" mating surfaces on any machine parts where they can fill the between the irregularities of surface. Gaskets are commonly produced by cutting from thin sheet of materials.
Usually gaskets are made up of flat material and some require a sealant to the gasket surface. A gasket is believed to last longer if it is able to carries a heavier load, and undergoes a compression test to measure and its having an "ability to withstand under compressive holding."[2]

1.2 Gasket Function

A cylinder head gasket is required to affect a seal between the cylinder head and block of a gasoline. The gasket must seal against air, coolants, combustion and engine oil at their respective peak operating temperature and pressure. The materials used and design employed must be thermally and chemically resistant to the products of combustion and the various chemicals, coolants and oils used in the engine. The required gasket must be resistance against media and temperature within the range of the given application and its requirements for a gasket are:
(i) Good compressibility and face adaptability- to conform to the distortions and undulations of the mating flanges.
(ii) Good recovery- to follow the flanges as they shift in response to thermal or mechanical forces.

(iii) Strength- to resist crush and/or extrusion at high stress, to handle the thermally induced shear motion of the mating flanges and to resist blow-out from internal pressure.
(iv) Limited relaxation-to retain sufficient stress for continued sealing over an extended period of time.
(v) Chemical resistance- to accommodate fluid impingement in gaskets that function as a metering device.
(vi) Temperature resistance- to withstand the temperature of the environment.
(vii) Compatibility- to be resistant to the media being sealed.
(viii) Micro-conformability-to "flow into" irregularities in the surface finish of the mating flanges.
(ix) Anti-stick--to prevent the gasket from sticking upon removal.
(x) Heat conductivity-to facilitate the heat transfer.
(xi) Acoustic isolation-to muffle noise generated by the application.

1.3 Reason of gaskets failure
The main reasons of failure of the gasket are as followed:

A. Distribution of Uneven Pressing Force
Uneven pressure can be caused by a variety of factors. Main factor failure is the human factor: asymmetric application of the bolt preload, which can cause uneven pressure. The density of bolt arrangement also having an obvious impact on the pressure distribution, nearer from the bolts, more uniforms the pressure. The seal surfaces will be more or less deformed and the pressure reduced, the running load, prone to leakage. The density of bolt arrangement also having an obvious impact on the pressure distribution, nearer from the bolts, more uniforms the pressure.

B. Torque Loss and Stress Relaxation
During tighten the bolts on the flange. Due to vibration, temperature changes, and other factors such as spiral wound gasket stress relaxation, the bolt tension will gradually decrease, resulting in loss of torque, causing a leak. In general longer bolts and smaller diameters of bolt are better at preventing the loss of torque

C. No smooth surface
It is important to make that the sealing finish properly otherwise it will cause leakage.

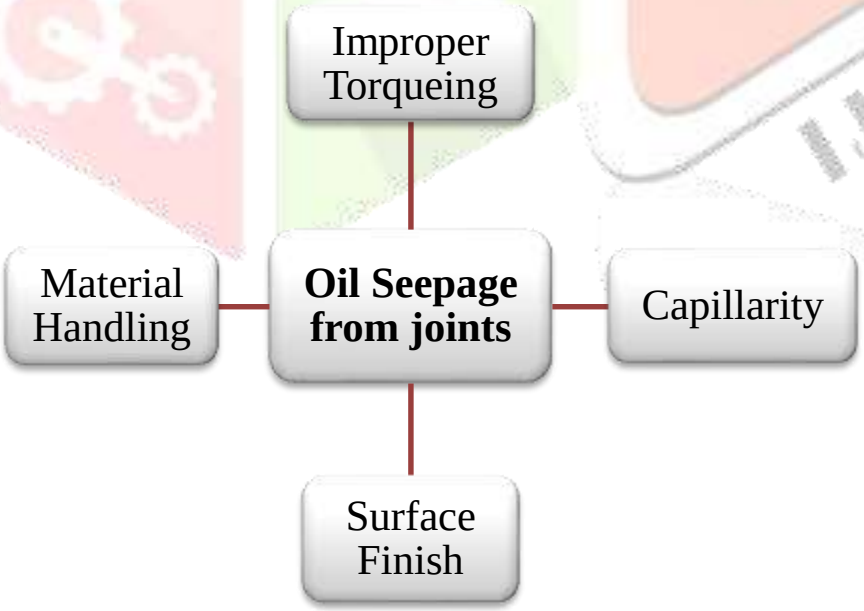
II. PROBLEM DEFINE
One of the most irritating issues facing by the customer of company into vehicle is oil-seepage. Oil-seepage is one of the type of oil spill but it does not produce drip nor it affect over the oil level. , which create a muddy layer on the surface of power-pack. Oil-seepage visualize to variant and ranging from PDI (pre-delivery inspection) to out of warranty vehicle, mostly at the multi-location where joints are present. Oil-seepage visualize usually in old vehicle and after a long period of run.
For observation purpose, field visit have been carried out at different locations and result conclude that the problem identified in all of vehicles ranging from lower to higher level of oil spill(100%).
The most common location into the power-pack is:
(i) Propeller shaft oil seal-The most severe location of seepage from where it can easily turn to leakage
(ii) Fare meter unit-Fare meter unit is a standard fitment in ‘PAXX’ (passenger vehicle)
(iii) Gear shifter hosing-Gear shifter consists of roller, sector, shifter lever, slider block, fasteners (Allen bolts, gasket) and most of the components are of motion parts.
(iv) Lever and sector assembly-Lever and sector plate assembly used for reverse gear shifting purpose and located at the differential cover side.
(v) Clutch oil deflector mounting fasteners-Oil deflector plate located on top of main housing in order to direct the path of splashed lubricant oil at maximum quantity to clutch assembly.
(vi) Joints: Engine side cover to main housing, Gear box cover to main housing-A complete transmission consists of three components; Main housing, Engine Side Cover, Gear Box Cover.
(vii)Clutch bellow-The function is to prevent oil spillage to outside and dust entry to inside and the bellow is fitted with clutch lever by mean of circlip to clutch cover housing.
(viii) Oil level arm with plug-Oil level arm with plug plays a vital role in transmission which showing the lubricant presence in quantity with range and also ranging purpose having ‘Min’ and ‘Max’ mark on it.[4]

Figure 1-Formation of muddy layer on different location

As mean while number of overhauling have been carried out from the observation as:
(a) The life span of gasket is at end.
(b) Mating surface may undergone for deformation,
(c) Improper viscosity of lubricating oil.
(d) Poor stability of fasteners against vibration.
(e) Poor breathing results in increased vapor pressure inside the vessel.

III. METHODOLOGY

To resolve this problem experiment testing carried out into two categories are (i) rectifying testing and (ii) corrective testing. Into the rectifying testing, in which the test taken for identify the main cause through due to this issue is carried into the power-pack engine.



A. Torqueing and tighten sequence

Torquing is the process where the fasteners are subjected to assembly and it can be defined as twisting force, moment subjected to shaft which result in tighten of two different parts accurate amount of force require. A sequence must be kept in order to align matching surfaces with multiple fasteners and stress free assembly. These are the technique use for tighten torque fastener in which

applied torque to adjacent and random manner which result as (i)Uneven torque results in breaking material, (ii) Not accurate tighten of two joint and (iii)Loose fitment.

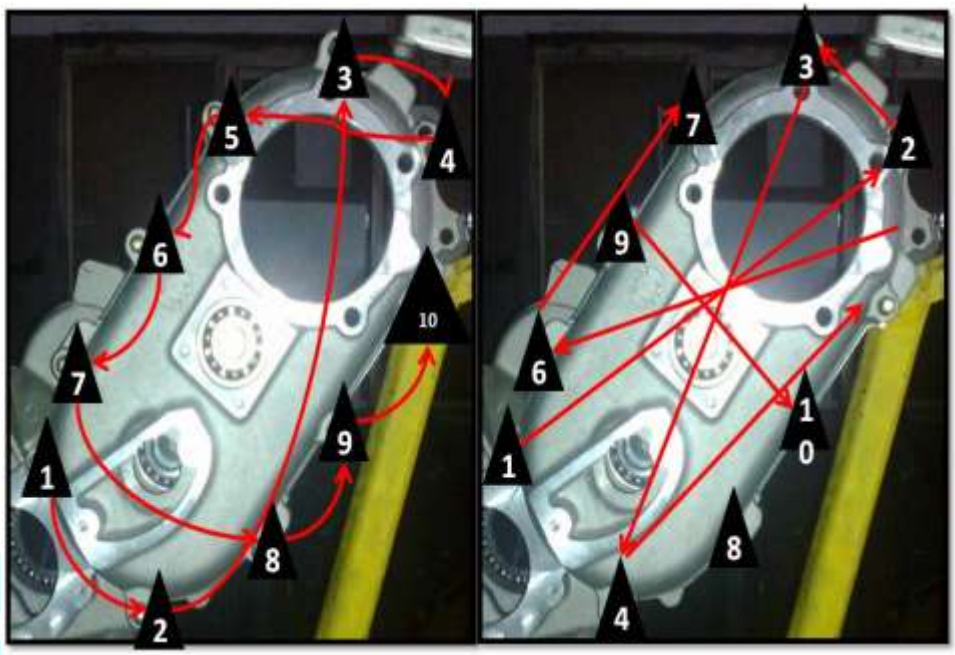


Figure 2- Existing sequence technique for torquing

Above mention result cause failure of gasket and uneven torque cause loosen fitment of two parts which create chance of leakage. To avoid or reduce this problem, some technique suggested is shown in below figures:-

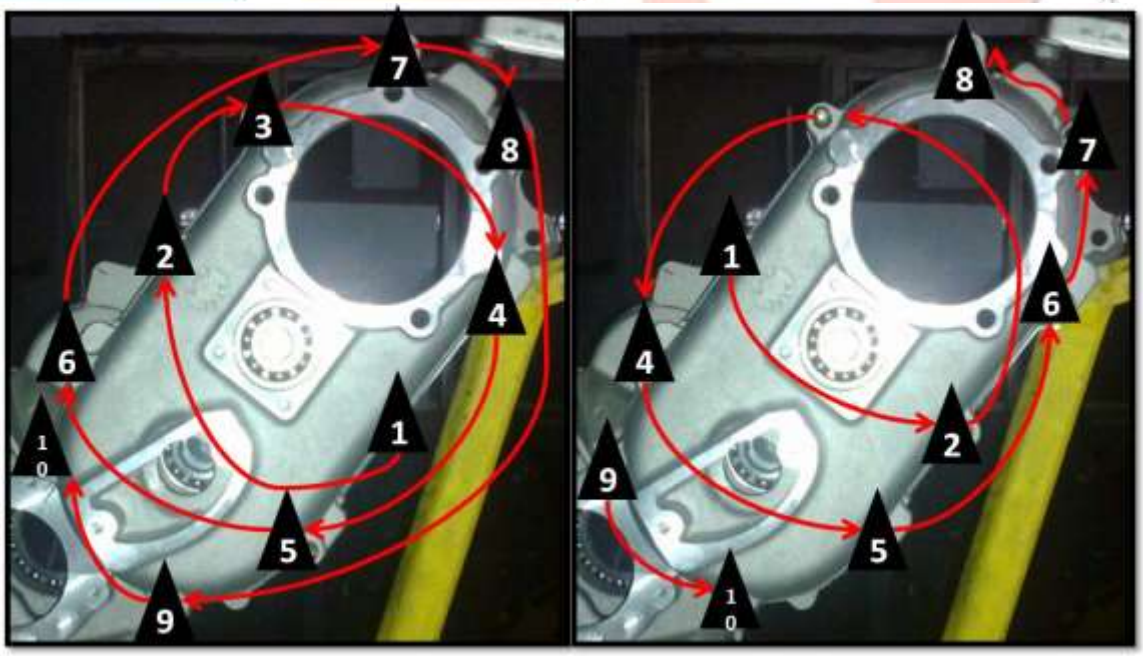


Figure 3- Suggests technique for torquing

B. Material Handling

Material handling is the function of moving the right material to the right place in the right time, in the right amount, in sequence, and in the right condition to minimize production cost. Its improper material handling leads to prevent damage of specify object and good material handling increase the optimum life of material and packaging should be as per standard as the manufacturer print, quality sealing, protection against jerks, good quality box, cartoon material, stacking limit etc.

Mostly we are having these components via transporter and in two stops. We can clearly see the damage to the box due to heavy tightening of rope, no stacking limit, poor quality corrugated box material.

The material handling from the vendor to company undergo up to worst condition. Standard for material packaging should be implemented by vendor like quality of corrugated box, protective material; stack limit, vendor mark etc and standard for storage should be upgraded to minimize the pre damage and low space accommodation by mean of implementing trolleys, trays, racks, stand etc.

Figure 4-The Corrugated Box

C. Surface flatness

Surface finish in terms of flatness, roughness, machining marks, and parallelism etc., the flatness indicates the horizontal surface without slope, slot or curvature and having smooth, even, level surface. As the degree flatness is higher; the joint result of such mating surface is excellent.

Figure 4-Flatness using Standards

Flatness testing procedure carried out at standard room with standard specimen like surface plate, strainer as base coat and dust free environment. This test is perform over the different mating part of the engine like main housing, engine side cover, differential side cover at all side of covers where different components are attached. Minimum 80% flatness of total area should be present on any surface. The tolerance as well as the ratio of flatness for both the surfaces should be considered as mandatory base. The process of turning on various components should be verified at vendor base. Mishandling of material can also leads to increase the degree of roughness due to minor dents, scratches, damages, etc.

D. Capillarity

Capillarity is the physical property of a liquid. The movement of a liquid along the surface when adhesive forces of liquid to solid molecules are greater than cohesive force of liquid molecules which resultant force in upward direction opposite to gravity force.
The suitable material boost capillarity i.e. porous structure, Fibrous Structure
Principle of capillarity based on the lighter weight of fluid within thinner tube it will achieve more height compare to thicker tube.

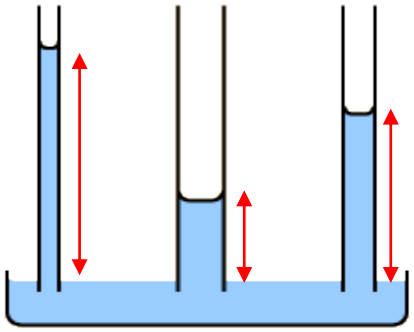


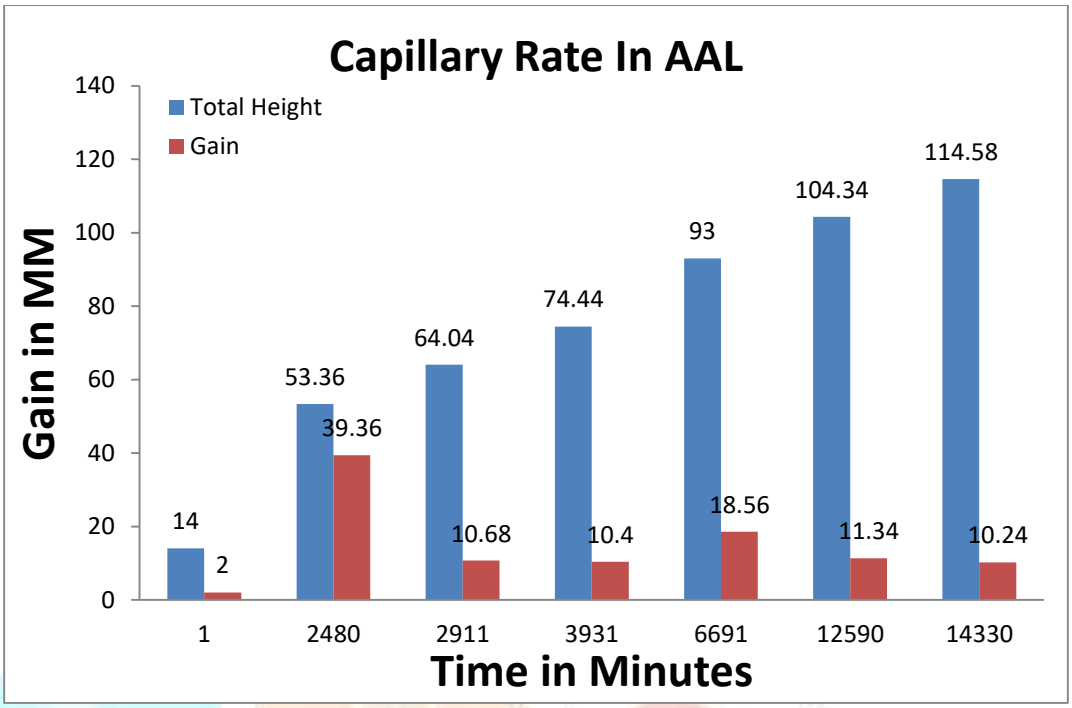
Figure 5-Principle of capillarity

Gaskets thickness and compressibility must be matched to the rigidity, roughness and unevenness of the mating flanges. An effective gaskets seal is achieved only if the stress level imposed on the gasket at installation is adequate for the specific gasket and joint requirements. Gaskets made of compressible materials should be as in thin as possible. Adequate gasket thickness is required to seal and conform to the unevenness of the mating flanges, including surface finish flatness and flange war-page during use. A gasket that is too thick can compromise the seal during pressurization cycles and is more likely to exhibit creep relaxation over time.
This test performed over the gaskets which is used in-between mating of two different parts of engine, gaskets used in engine are made of material paper which have property to absorbs liquid like oil used in vehicle. Generally seepage cause rise at vehicle where paper gaskets are used but these seem into the old vehicle, so test performing that absorption of oil by the gaskets.

IV. RESULTS AND DISCUSSION

From this report,

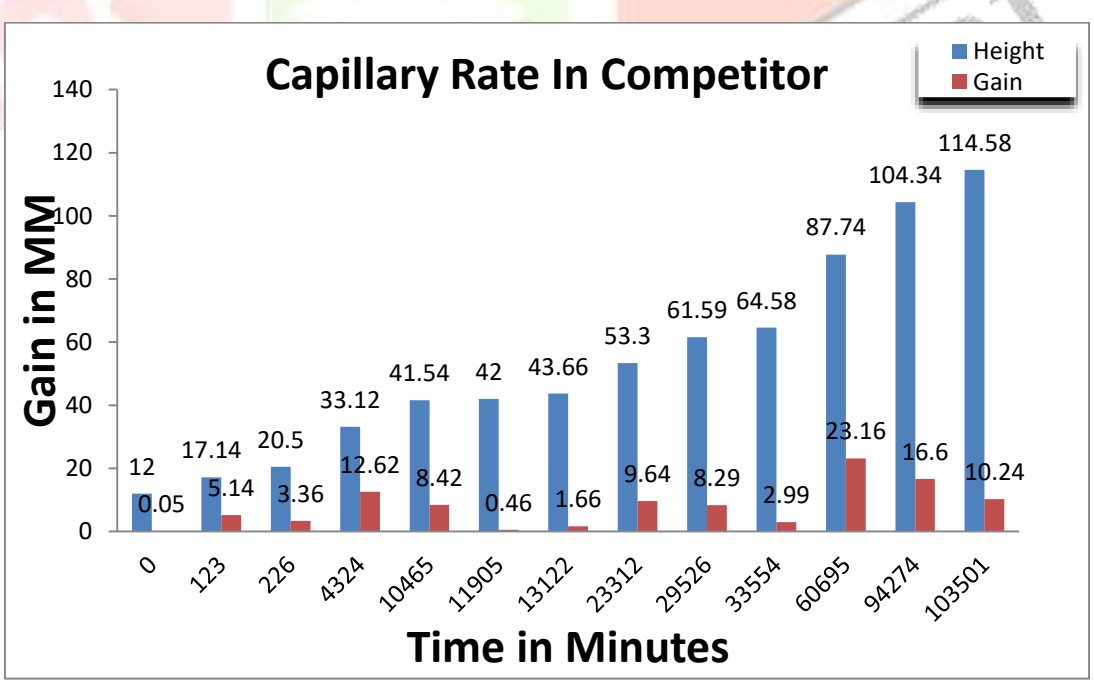
- The problem is somewhat resolve at any location where the fastener tighten by some specify torque because of using the technique suggested for tightening which reduce or remove the uneven heeling.
- Cause of seepage and leakage is also by the improper handling of material which cause because of breaking or wear and tear of material which reduce by the proper material handling into the all means i.e. during transporting of material from one place to another, placing of oxe s into the cargo vehicle and at the storage selection it the company.
- From testing of surface finish check the results are carried out that the mating surface of the different bodies are at uneven level. For having no leakage issue its require proper fitment of bodies and accurate torque at the fastener.
- Also the accurate fitment a gaskets is used, it is made paper material which having capability of absorption of liquid by pouring the gasket into the two type of oil i.e. standard oil and used oil which use into company and pour for days until gasket reach to its saturation point after that it will not able to absorb the oil.



Graph 1- Capillarity rate in gasket

Above graph 1 is the test result of capillarity of gasket. Which drawn between the gain height of abortion of oil with respect of time (W.R.T) in minutes, it is a comparison of total height of absorption area to the gain height of absorption portion of area in the particular amount of time.

In the graph, gain height represented by per bar with respect to particular time, which show that at the starting during absorption start at that time rate of capillarity of gaskets is high. At the time 2,480 minutes the rate of capillarity is 39.36 mm is very high with respect of any other time duration gain height rate of capillarity.



Graph 2- Capillarity rate of Competitor

Above graph 2 is the test result of capillarity rate of different company gasket, this is of same type and size but the thinness of the gasket is varies. To reach saturation point it take 1,03,501 minutes or it may be approximate 65 days, which is comparably large from this result it conclude that due to greater thickness of gasket larger the rate of capillarity.
This gasket also not having varies with time as having varying property of AAL gasket; at which during starting capillarity rate is high and later is decrease. In this gasket rate of capillarity is approximate is even from the start till it saturation point reach.

- From rectifying testing result, shows that improper torquing, surface flatness and material handling are the cause for the oil-leakage but the oil-seepage cause because of not appropriate gasket is used.

❖ **CORRECTIVE TESTING**

So, we decided to change material from current to most appropriate ASAP are:

- Asbestos Gasket
- 'Flexoid' Gasket
- S – 407 Gasket
- Non asbestos Gasket

From selecting the accurate gasket test are carried are:-

- STATIC TESTING-

In this test, the bowl filled with engine oil up to the level of 15mm and sample material soaked in this oil and checked for routine checkup for a period of time duration at room temperature. From this capillarity rate of the gasket can be known.

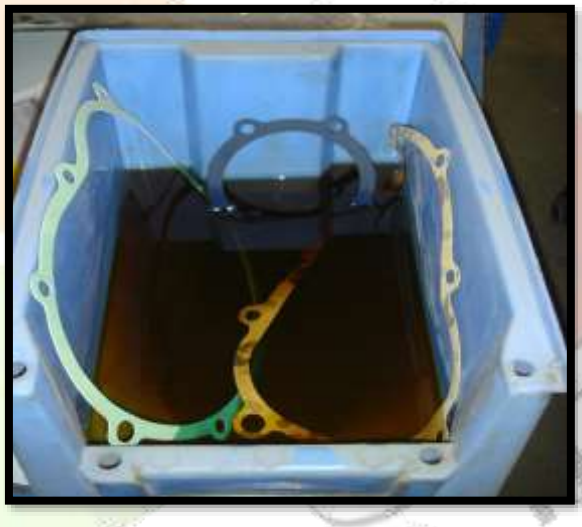


Figure 6- Status testing

- DYNAMIC TESTING-

In this test, engine run for 15 to 30 minutes at the medium speed around of 2200±300 rpm. During test it is not possible to run drive shaft, so during the test differential unit remains steady. During kinematic test the engine temperature kept at 80°C.
From this result can conclude that what will be the behavior of gasket and also the capillarity rate.

Figure 7- Dynamic testing

Test result conclusions over the different type of gasket

- **S –407:-**

Figure 8-S 407 gaskets

This gasket having high rate of capillarity, thickness of gasket is normal and the recovery is also normal and the benefit of this is it also able to works better if used in wick stove.
While having advantage it also having same drawbacks also this gasket having higher degree of roughness, Shabbier than current material and also Higher capillarity w.r.t. current gasket.

- **Non-asbestos gasket:**

This gasket having normal rate of capillarity, it is the thickest gasket, recovery is normal and this gasket are in blackish grey in color. Due to high rate of thickness, at the joint section oil seepage is seemed.

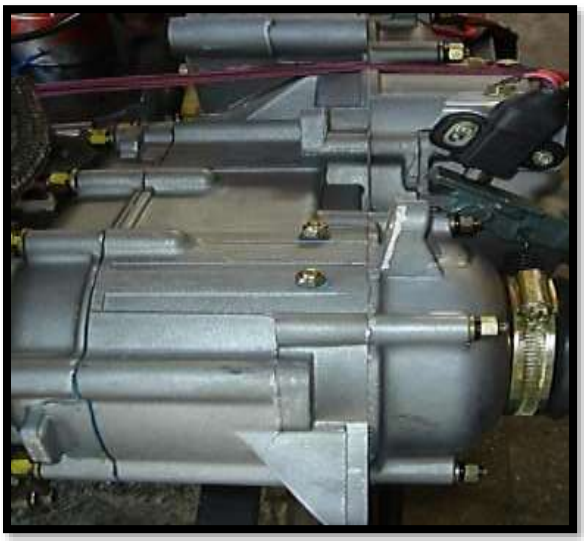


Figure 9- Non-Asbestos gasket

➢ **Asbestos gasket:-**

Figure10- Asbestos gasket

This gasket having lower rate of capillarity, thickest gasket, the recovery is also normal and the caution of the gaskets is Dirt particles/ fumes generated by asbestos directly affected to respiratory system of humans who are working with. The benefits of the gasket are cheapest material works better as a sealant to avoid kind of oil seepage/ leakage.

Drawback of this gasket is having a chances of fumes/vapor of asbestos could be as this gasket is for used of Gear box. There is a possibility to inhale these fumes by the customer and also passenger as well as the technician who has to work with closer. There is much greater risk of lung cancer in those exposed to asbestos who also smoke cigarettes: if asbestos exposed to open atmosphere its cause risk of multiply fivefold of as harmful effect to non-smoke and also Dirt particles/ fumes generated by asbestos directly affected to respiratory system of humans who are working with this material gasket.

➢ Flexoid:-

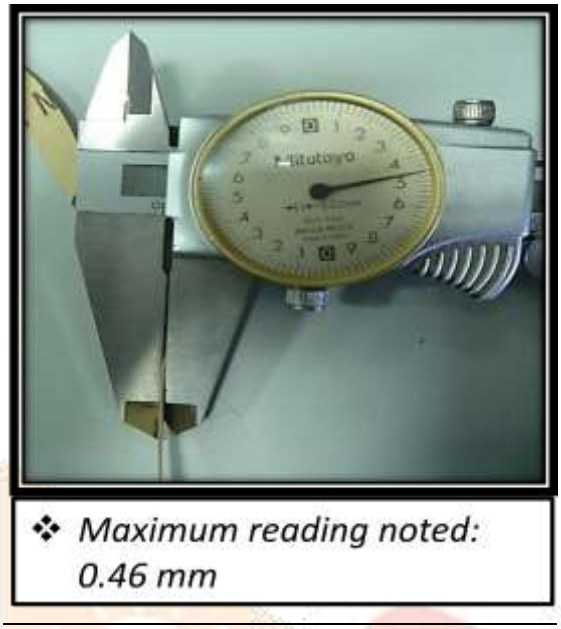


Figure 11- Flexoid gasket

This gasket having rate of capillarity is comparatively very low, it is the thinnest gasket, and recovery is quiet good.
The benefit of this gasket is having very low degree of roughness to negligible value, thinnest gasket and considerably low amount of capillarity.
And also having drawback, handle with care is essential as it is the thinnest among all of the gaskets, Closure control on machining especially flatness.

V. CONCLUSION

This research paper concludes that the oil spill problem created in the power-pack is described and also the factor affecting this issue:
☐ Oil-leakage is because of improper torquing and tightens sequence, surface flatness and material handling.
☐ Oil-seepage is because of using of gasket which having high capillarity rate due to which this issue found earlier.
By rectifying this problem, it concludes that:
☐ Suggest a most accurate technique for tighten and sequence for torquing.
☐ By changing the current gasket from the Flexoid gasket which is an accurate way to overcome the oil-seepages.

VI. ACKNOWLEDGEMENT

We thank our colleagues from ATUL AUTO LIMITED who provided insight and expertise that greatly assisted the research, although they may not agree with all of the interpretations/conclusions of this paper.
We would also like to show our gratitude to the General Manager, ATUL AUTO LIMITED for sharing their pearls of wisdom with us during the course of this research, and we thank for "anonymous" reviewers for their so-called insights.

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