OIL SEAL: INSTALLATION TECHNIQUES AND PREVENTIVE MEASURES TO AVOID LEAKAGE

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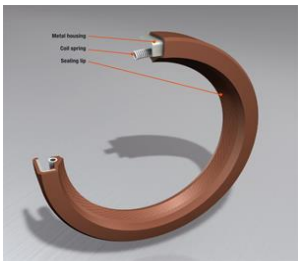
***Abstract*— In this world of moving parts, whenever a shaft rotates, it needs a bearing for smooth, effective operation. In most cases, where there's a bearing, you'll find a seal helping it to do its job better. In simple terms, a oil seal is a barrier. Oil seals are designed to: Retain lubricants or liquids Confine pressure Exclude dirt Separate fluids.Oil seal pressing tool is used to press oil seal on its proper position without damaging the wear sleeve by applying uniform pressure on oil seal. If the oil seal is not properly installed then there are high chances of leakage from rear crank side and due to leakage, the efficiency as well as the performance of engine will be affected. So it is necessary to install oil seal on correct position.**

***Index Terms*—Oil Seal, Wear Sleeve**

I. INTRODUCTION

Oil seal is the physical barrier design to retain oil and pressure but excludes dirt, moisture and contamination. It is an integral part in any rotating and reciprocating system. The purpose of oil seals is to provide sealing between the rotating crankshaft and the outside. Oil seals consist of a metal housing that carries the dynamic sealing lip and also provides the static sealing function. The oil seal consists of metal ring as the inner skeleton which provides structural stability to the oil seal also known as wear sleeve. The outer skin material should be based on size, operating temperature, pressure and maximum shaft surface speed. Mostly these are Poly Tetra Fluor Ethylene (PTFE), Nitrile rubber, Fluoroelastomers, Silicon, Poly-Acrylate.

An oil seal is fitted between each rear end of the crankshaft and the bores of the flywheel housing and gear case cover to retain the lubricating oil in the crankcase. Seals are pressed into the bores after the housing is assembled to the engine. The oil seal also helps to prevent external entities like dirt and dust particles from entering the system containing the lubricating oil. The sealing lip of the oil should never be in contact with the shaft. If this happens, the seal would wear out in a matter of hours, therefore proper precaution must be taken that the seal is correctly lubricated prior to fitting. If this lubrication is not present burning of seal lip can occur, which could lead to the seal.



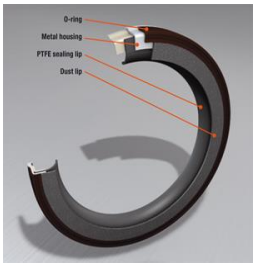


Fig 1:Oil SealFig 2: Wear Sleeve

II. COMMON REASONS FOR INDUSTRIAL OIL SEAL FAILURES AND CAUSES

1. Excessive Lip Wear:

The lip edge is severely worn. Insufficient Lubrication which has led to increased friction and as a result, abnormally high wear. The amount of lubricant applied was below the specified level and therefore, did not reach the sealing lip.

2. Oil seal deformation:

The oil seal is damagedwhen the inside diameter of the Oil Seal is too small. The oil seal may also have been deformed due to an inappropriate jig or wrong installation tools being used.

3. Lip hardening:

The lip wear band is smooth and glossy. The entire sealing lip is hardened and cracks appear.When the oil temperature near sealing lip exceeds the heat-resistance limits of the rubber or oil temperature exceeds the design temperature limits lip hardening occur.

4. Collapse or tearing of sealing lip:

The sealing lip gets scraped or collapsed or the flexible part is torn due to improper shaft chamfer or incorrecttools being used during assembly. Also because of high pressure directed at the flexible part.

III. PROBLEM DUE TO IMPROPER POSITIONING OF OIL SEAL

The rear main seal is the seal that goes around crankshaft at the rear of the engine. The crankshaft in engine is held to the bottom of engine block using main caps at each of the bearings. The oil pan is then bolted on over that, and a seal has to be placed over the crankshaft in between the block and the oil pan. This seal helps keep dust and dirt out of engine and helps hold the oil inside the oil pan.[1]

The inside of rear main seal is in contact with crankshaft as it is spinning around thousands of times every minute. This seal is also right next to one of the main bearings in engine which needs to be constantly lubricated by oil. The constant bath of oil combined with the spinning motion of the crankshaft will cause a rear main seal leak to allow a significant amount of oil to leak from engine in its running. Once rear main seal starts to fail, the rotation of crank shaft can cause the problem to go from bad to worse extremely quickly. Rear main seals usually start to leak due to a worn surface or a small crack and the constant stress of rubbing on the spinning crank shaft can make worn surfaces or cracks get much worse very quickly. A rear main seal leak can cause problems for engine quickly because it can allow such a significant amount of oil to leak out very quickly. Most engine oil leaks will lower over level to a dangerous point over a matter of weeks or even months. A rear main seal leak, on the other hand can cause engine oil level to drop to dangerous levels in a matter of minutes, or perhaps even more quickly.

A low oil level in engine is one of the quickest ways to cause permanent engine damage. A low oil level will uncover oil pump pick up screen causing oil to stop flowing through motor leaving cam shaft, bearings, and valves to move without lubrication. Also, a low oil level means crank shaft is no longer splashing in the oil which helps cool and lubricate main bearings, rods and piston rings. Even at normal driving speeds this lack of oil can cause permanent damage to happen in a matter of seconds.[2]

IV. DIFFERENT INSTALLATION TECHNIQUES

1. Motorcycle Engines:

In small scale low power engines the oil seal is installed with the help of Screw type mechanism which is operated by hands.

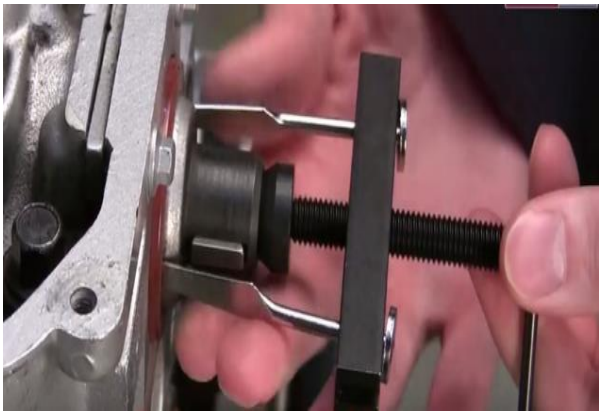


Fig 3: Oil Seal Installation at Workshop

2. Heavy Duty Engines:

The oil seal installed in Engines of trucks and buses is installed with the help of special tool as shown in figure and it is tightened with the help of spanners.

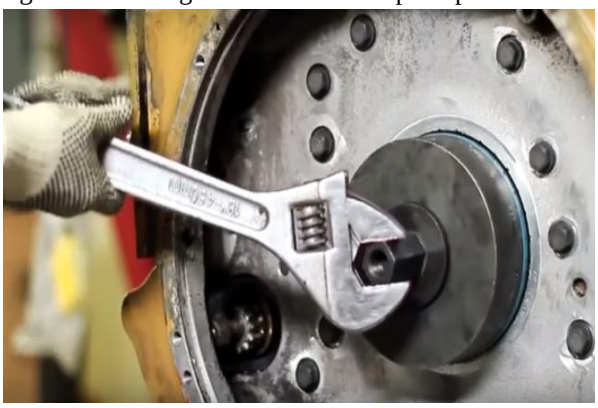


Fig 4: Oil Seal installation of heavy duty Engine

3. Volvo Truck Engines:

In Volvo industry the oil seal is installed with a special tool as shown in blue color. In this case the tool is placed on jig which has threads on it and which is placed on the crank shaft. Then the V shape rotor is rotated with the help of hands and the seal is installed on its position.

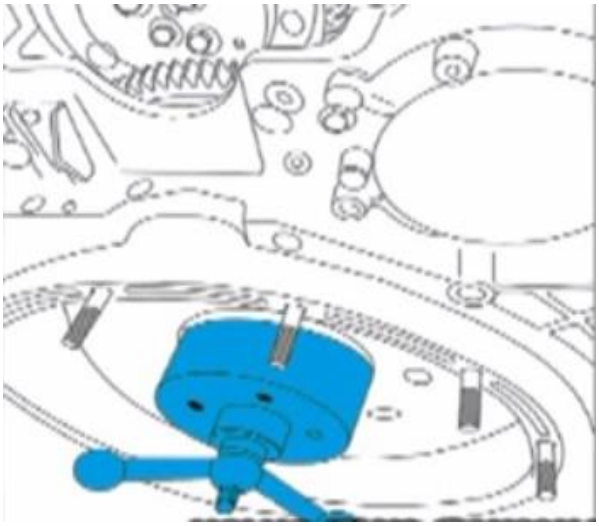


Fig 5: Oil seal installation tool of Volvo Truck

4. Large Scale Production of Small Engines:

At the Large Scale industries of Motorbikes like Honda, Hero, Suzuki, etc. the Oil seals are installed with the help of electric screw type linear actuators. It generates sufficient torque and this is one of the fast ways of installation of oil seal.

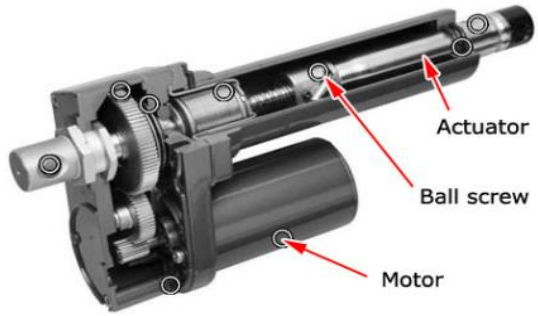


Fig 6: Oil Seal Installation tool

5. Rack And Pinion Press:

A rack and pinion is a linear actuator that comprises a pair of gears which convert rotational motion into linear motion. A circular pinion engages with teeth on a linear rack. A rotational motion given to the pinion causes the rack to move relative to the pinion. Rack and pinion combinations can be used as part of a simple linear actuator, where the rotation of a shaft is converted to linear motion.

Rack and pinion presses are manually operated bench-top presses. In rack and pinion presses the press force is generated with manual force applied to the lever, this force on lever starts up the transmission mechanism. In rack and pinion mechanism the gear transmission ratio remains constant so that the press force is constant in direct relation to the manual force applied during the entire stroke.

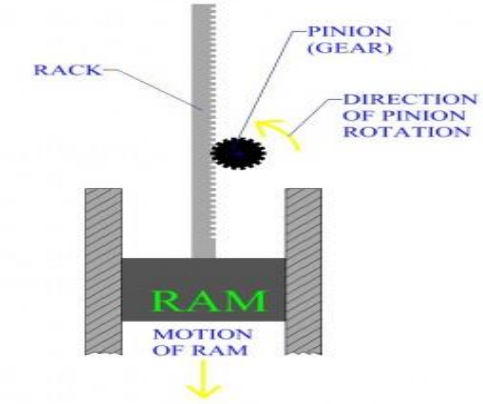


Fig 7: Rack And Pinion Press

6. Pneumatic Press:

Pneumatic Linear actuators are mechanical devices which uses power of compressed gas to generate a force in linear direction. Like hydraulic presses, pressurized fluid forces a piston to move in the desired direction. And the piston rod develops the force it needs to be transferred. This is a cheaper solution as the air is free. As the operating fluid is mostly air, so even after the leakage it won`t contaminate the environment.

A pneumatic actuator mainly consists of a piston, a cylinder, and valves or ports. The piston is covered by a diaphragm or seal. Diaphragm is used to hold the air in the upper portion of the cylinder which allows air pressure to force the diaphragm downwards. Valves require little pressure to operate and usually double the input force. As the piston size is large, pressure required will be more.

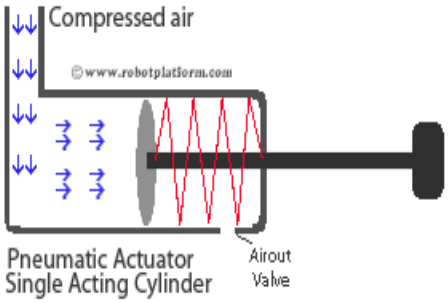


Fig 8: Pneumatic Press

7. Hydraulic Press:

Hydraulic presses are a powerful class of machine tool; they derive the energy and deliver through hydraulic pressure. With the use of pumps and valves fluid pressure in a particular chamber can be increased or decreased. Sometimes devices and

systems may be used to increase the capacity of the pumps in more powerful presses. These presses can be operated over a long distance and at a constant speed. Hydraulic presses are usually slower relative to other press machine types. This involves longer contact with the job; therefore the cooling of the job can be an issue when hot forming a part with hydraulic tool.

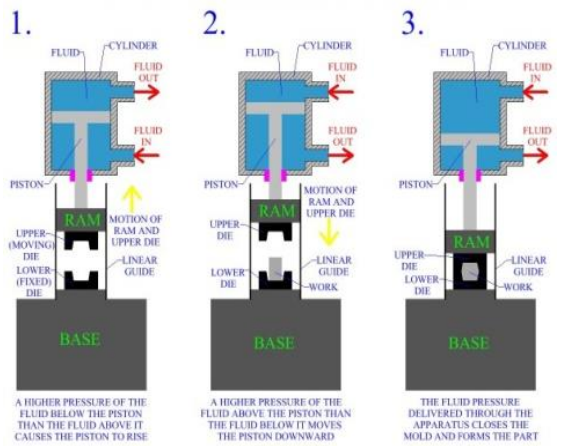


Fig 9: Hydraulic Press

V. PREVENTIVE MEASURES AND SOLUTION

There are many factors that can affect sealing including the lubricant, temperature, pressure, shaft speed and misalignment. Most conventional oil seals are designed for low-pressure applications. Seals must also be continuously lubricated with a lubricant that has the correct viscosity and that is compatible with the seal material. Both the temperature of the oil and the environment should be assessed, as the temperature range cannot exceed the range of the seal elastomer. In addition, if the shaft and bore are misaligned, it will cause wear to be centered on one side of the seal. However, when selecting a seal, shaft speed is one of the most important factors and governs all the other factors.

The main reasons for seal failure and leakage are the result of incomplete procedures, lack of condition monitoring equipment, poor maintenance practices and cost-cutting by machine designers. Establishing a regularly scheduled oil analysis program, performing consistent maintenance on your system and ensuring correct sealing design with the proper lubricant will go a long way in your efforts to prevent leaking seals and machine failures.

Problem- Excessive Lip Wear

Solution- Lubricant should be added up to specified level so that the excessive lip wear will not occur.

Problem- Oil seal deformation

Solution- To fix this issue, one have to use appropriate installation tool and proper jig assembly.

Problem- Lip hardening

Solution- Investigate the cause of failure and take the necessary measures to prevent future temperature spikes. If the oil temperature exceeds the design temperature limits, choose a seal with a better heat resistant lip material, for example, changing from nitrile rubber (NBR) to acrylic rubber (ACM), or acrylic rubber (ACM) to fluorocarbon rubber (FKM). Do take note that a change in lip material also means the oil resistance will be changed.

Problem- Collapse or tearing of sealing lip

Solution- Chamfer the shaft to the correct size, choose the correct assembly tool, and apply grease to the chamfered area before assembly. Also, choose an oil seal suitable in handling high pressures. Proper material handling is also key.

VI. CONCLUSION

The installation techniques discussed in the paper are capable of positioning different types of oil seals with respect to the various parameters such asretain lubricants or liquids, confine pressure, exclude dirt separate fluids. The oil seal install with the help of these techniques are capable of performing the leakage performance test in which the machine runs for several hours.

REFERENCES

[1]Nakamura K. Sealing mechanism of rotary shaft lip-type seals. Tribology International (Sept 2011); 1987, 20(2), 90-101

[2] Dana and Galser Pvt. Lim. - service and practical information guide. http://glaser.es/EN/Products/Oil-seals.aspx