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A Review Paper on Optimization of Engine oil Pressure After Overhauling in HINO 6DTI Engine

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Abstract
Reliability and performance of modern engines are directly dependent on the effectiveness of lubricating systems. To be effective, an engine lubricating system must successfully perform the functions of minimizing friction between the bearing surfaces of moving parts, dissipating heat, and keeping the engine parts clean by removing carbon and other foreign matter. In almost all modern internal-combustion engines, the system that provides the lube for these functions is the forced lubrication system. Although there are many variations in lubricating systems for internal-combustion engines, the components and method of operation are basically the same. Steady state thermal analysis is carried out for the thermal fluid flow in the engine. In a tribological study which involves the contact between the two surfaces in relative motion, a lubricating oil plays a vital role in reducing friction and helps in protecting materials from wear. For conclusion, the quality of engine lubrication depends upon how much oil is supplied and how the lubricant is fed under thermal load of the components. This state of lubrication is closely related to the safe operation of an engine and its lifetime. Therefore, a practically optimized analytical method has been required by engine designers.

Keywords: *Low Oil Pressure, Viscosity, Oil Pump, Oil Temperature, clearance, Main bearing, Oil filter, Pressure relief valve.*

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I. INTRODUCTION

Oil pressure is an important factor for the long life of any internal combustion engine. In general lubrication system oil is picked up by variable flow or positive displacement pump and forced through the oil galleries into main bearing, big end bearing and camshaft bearing. Sufficient oil pressure ensures that the metal of all rotating shaft and bearing shell can never touch. There are many variables that affect the oil pressure of engine like oil temperature, viscosity of oil, engine speed, area of oil gallery. Engine oils have many functions in the engines, besides tribological tasks. The oils contribute to the sealing of the cylinder, transport particles (the sludge, soot and other particles) to the oil filter, etc. Some of the points inside the engine where lubricant influences the work are shown in Fig 1.1. There are different movement, different lubrication regimes, different speeds, wide range of temperatures, micron tolerances in between contacting surfaces, and other parameters that have to be covered from lubricant from the tribological aspect.

1.1 Engine Oil Pressure

Oil pressure is created by a fluid flow restriction in the outlet of the pump line. Oil pressure is not created by the pump as our general misconception. Pump only create discharge; pressure is generated by the restriction in the oil pathways. It is same as holding your finger over the end of a garden hose, the smaller opening created by your finger pressurize the water flowing through the hose. As engine speed keeps on increasing discharge from pumps keeps on increasing and pressure keeps on increasing. The maximum and minimum oil pressure range is set up by manufacturer. At high speed, oil pressure will maximum and at hot idle condition oil pressure will minimum.

1.2 Low Engine Oil Pressure

As mention above at idle hot condition oil pressure will minimum. When oil pressure is minimum viscosity of oil will less and flow of oil in the engine will good and it will lubricate properly but if oil pressure is below the limit given by the manufacturer then it is major cause of worry as it may cause major damage to the engine. Generally, in industry oil pressure mainly monitor at high speed and at hot idle speed. limit of the oil

pressure at high speed and at hot idle speed is fixed as per design of engine, type of oil pump and type of oil used. Oil pressure below the given value is dangerous for the engine and may leads to possible catastrophic engine failure. There are many factors that leads to low oil pressure like oil not flowing to the pump at start up, pump runs too slow to deliver sufficient oil flow, oil is too hot, viscosity too low, worn oil pump, increased clearances of engine part leads to too much flow of oil through clearance, restriction at inlet side of oil pump, plunger struck up in oil pump.

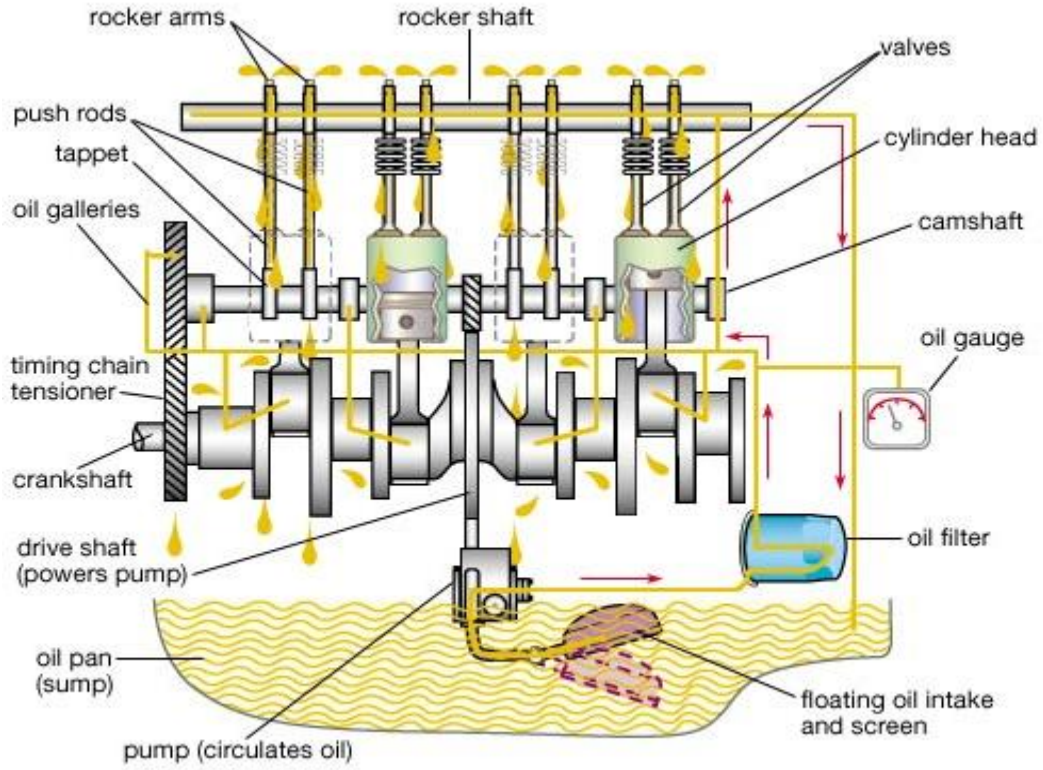

Figure1: Schematic of lubrication system in engine

1.3 Oil Pressure, Oil Viscosity and Oil Temperature

Oil pressure is depending on oil viscosity and oil temperature. As oil temperature increases oil viscosity decreases as result oil pressure decreases. As oil temperature decreases oil viscosity increases as result oil pressure increases. If oil viscosity is too high oil density will be on higher side, so resistance to flow will be high, so fluidity will be less and oil will not circulate properly in the engine. If oil viscosity is very low, resistance to flow will be less then proper film will not generate between rotating parts. Less load supported by oil at bearing on the crank and cam shaft.

II. RESULT AND DISCUSSION

The results obtained are as discussed below

1.4 General Problems in Low Oil Pressure Engine

1. Oil Level

First and for most step in diagnosis of low oil pressure engine is check oil level in engine. In each of the engine oil dip stick is given for checking oil level and high and low marks are given on the dip stick. Low level of oil leads to low oil pressure as oil pump not supplied with enough oil. Top up oil will solve the problem also checked leakages in the engine.

2. Oil Pressure Sensor

Sometimes faulty oil pressure sensor sense wrong pressure and shows very low or very high pressure on the oil pressure gauge. Replacing oil pressure sensor will solve the problem.

3. Oil System Leaks

Leakage between the oil pickup tube and pump, as well as between the pump and block can also suck air into the pump. It is not unusual to find engines where the pickup tube has fallen completely off, causing a complete loss of oil pressure.

4. Worn Engine Bearings

In a high mileage engine, low oil pressure is often due to worn main bearings. The oil pump itself does not create oil pressure. It produces flow and the resistance to that flow produces pressure. Resistance is created by the orifices in the engine block through which the oil flows, and the amount of clearance between the bearings and crankshaft journals. As the bearings wear, clearances increase allowing increased flow which reduces pressure. Excessive bearing clearances can cause up to a 20 percent or greater drop in oil pressure, which may in turn have an adverse effect on lubrication in rest of the engine. Low oil pressure can also cause problems in overhead cam engines with Variable Valve Timing. Whether the excessive clearances are due to normal wear or "loose" assembly tolerances makes no difference because the end result is exactly the same. Excessive bearing clearances will also increase engine noise and pounding, which over time can lead to bearing fatigue and failure. The only cure for low oil pressure due to excessive bearing clearances is to reduce the clearances by replacing the bearings or overhauling the engine. Installing a new oil pump or a higher pressure pump won't help because the bearings have too great a leakage rate to hold the required pressure.

5. Worn Oil Pump

Another common cause of low oil pressure is wear or excessive clearances inside the oil pump. Specifications vary, but as a rule gear type oil pumps should have less than about 0.0762 mm of end play between the gears and cover. The clearances between the teeth and pump housing should usually be less than about 0.127 mm. With rotor style pumps, the clearance between the outer rotor and pump housing should usually be less than 0.3048 mm, with no more than about 0.254 mm between the inner and outer rotor lobes. Too much clearance inside the pump will reduce the pump's ability to pump oil efficiency, which reduces flow and pressure. Because of the close tolerances that are required inside the oil pump, debris of any kind can cause problem if it gets sucked into the pump. Anything larger than the minimum internal clearances can score or jam the pump. Debris such as pieces of old valve stem seals, gasket material, plastic chips from a worn timing chain gear, bearing material, casting flashing, sand, dirt, etc., may be harmful or fatal if ingested.

But how can this kind of crud get inside the pump, The screen that is on the oil pump pickup tube in the crankcase only prevents relatively big pieces of debris from being drawn into the pump, and even then it does not always do that because most pickup screens have some type of bypass valve or vent that allows oil to bypass the screen if the screen becomes plugged or the oil is too thick to pass through the screen. The holes in the screen itself measure about 1.016 mm square, which are huge openings as far as debris is concerned. But the holes are large by design so the screen will flow an adequate amount of oil when the engine is cold and the oil in the crankcase is thick (which is why you should always follow the vehicle manufacturer recommendations on oil viscosity). All this means the oil pump is the only engine component that is continually lubed with unfiltered oil! The oil does not pass through the filter until after it leaves the pump. So any abrasive debris that finds its way into the crankcase will first pass through the pump before it is trapped by the filter. So oil pumps wear out and break.

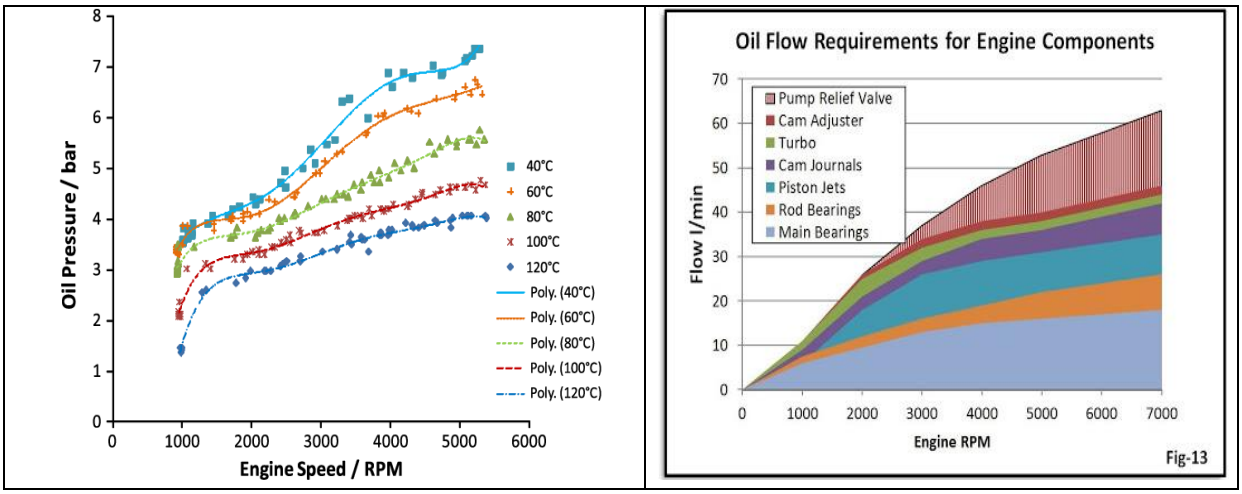

Figure 2: Oil pressure vs rpm and temperature

Restrictions in the pickup tube screen can choke off the flow of oil into the pump, reducing flow and pressure. Even a relatively small amount of varnish buildup on the screen can restrict oil flow at higher engine speeds. A coating only .005 inch thick on the screen will reduce the total "open" area of each hole to 0.762 mm, causing a 44 percent reduction in oil flow.

6. Weak or Leaky Oil Pressure Relief Valve

The pressure relief valve, which may be located on the pump body or elsewhere on the engine, can be another cause of low oil pressure if the valve struck open by a small piece of debris. The relief valve is designed to limit oil pressure as engine speed increases. The valve opens when pressure reaches a preset value. This drain oil back into the crankcase and limits maximum oil pressure in the engine. The reason for doing so is to prevent oil pressure from reaching very high. Too much oil pressure can be just as bad as too little because excessive pressure can rupture the oil filter or even blow out pressed-in oil galley plugs in the block.

7. Aerated Oil

Low oil pressure may also be the result of air in the pump. If there is too little oil in the pan, air can be drawn into the pump. But this can also happen if the crankcase has been overfilled. The oil can become aerated because it is making contact with the spinning crankshaft and is being churned into foam.

8. Plugged Oil Filter

A plugged oil filter can be yet another cause of low oil pressure. When the oil leaves the pump, it passes through the filter before going on to the bearings and oil galleys. All filters create a certain amount of resistance to flow that increases with the rate of flow. But the amount is not much, typically only a couple of pounds. But as the filter becomes clogged with debris, the restriction created increases. Eventually the point may be reached where no oil will pass through the filter element. So to prevent such a blockage, a pressure relief valve located in the filter or where the filter mounts to the block and it design to open if limit exceed a preset value(typically 5 to 40 psi). This allows the oil to bypass the filter and keep on flowing. But the engine's oil pressure will be reduced.

III. CONCLUSION

Oil pressure depends on many factors as mention above, so it is very difficult to find the solution of low oil pressure issue without following proper procedure. Step by step approach is required to find the right solution and have to monitor each variable that affect the oil pressure of the engine. Whole oil system consists of oil sump, oil strainer, oil pump, pressure relief valve, orifice, oil gallery, oil filter. So checking of each part is required to reach right solution of to identify the problem. Other parameter like oil viscosity, oil temperature is also important because they directly related to oil pressure of the engine.

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