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Automation in Rear Oil Seal Leak Test in a Car Using Pneumatic System

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Abstract: To automate a system that ensures the fulfillment of productivity improvement and maintain a quality in assembling engine, also considering with workers ends for critical characteristics on safety. For this, a study on power train department (LINE-2) has been carried out and the problems are identified and given with optimal solution. The aim of our project is to study the process and implement a method which reduces operator work without affecting the quality of process involved and also to overcome the bottle neck by increasing the productivity in power train section by modifying the existing job allocation without compromising quality.

Key words: Engine · Automation · Oil seal · Crank shaft · Leakage · Pneumatic system · Cylinder

INTRODUCTION

In a car engine the cylinder bore gets damaged very frequently. We chose the Renault Nissan as a testing company [1], for different variants in an engine department oil leakage in a cylinder found to be major issue to overcome we conducted a pneumatic test on a power train department (LINE-2).

An automatic pneumatic system to control the oil leak in an engine which [2] provides optimal solutions so that the operator productivity gets increased with high quality. The vast majority of leaks are due to degraded engine gaskets, oil seals or bad connections. Crawl under the car and check the oil pan seals. While you're there also check the oil pan drain plug [3]. Next check the timing cover seal and the valve cover gaskets.

Finding oil on the outside of your engine is never a good sign. Your engine needs oil to work and if it loses a lot then the engine will stop and in some cases [4], permanently. This is because the oil keeps parts lubricated to allow them to move. When oil is missing from the engine, then moving parts rub against each other eventually causing enough friction to melt out of shape and stop the engine. When you have found that oil is leaking from the engine you need to consider its source and then how to fix it [5]. The speed at which you do both these things will be dependent on how quickly the oil is leaking and how environmentally concerned you are. If you are looking for a quick fix to your engine oil leak, you could always try the additives approach. This is where you add a chemical to the oil in your engine or change your oil to one that has the additive in it.

Additive for Oil Leaks: Are chemicals added to your engine oil that try to stop leaks. They do this by filling in small holes in Oil Seals and by causing Oil Seals to expand/soften. Only problem with them is sometimes they make the Oil Seal expand too much which cause the Oil Seal to destroy itself [6]. This will make a small oil leak into a big oil leak. A common place to lose oil from is the Valve Cover or Covers (if you have a V type engine V6 [7], V8 etc. or boxer engine).

Valve Cover is attached to top of engine (cylinder head). It covers the valves which are soaked in oil. Oil allows the valves to move freely as the engine works [8]. *Valve Cover Gasket* purpose is to seal the Valve Cover against the cylinder head to prevent the oil escaping. Valve Cover Gaskets wear out after a few years and allow oil to escape down side of engine.

Common side effect of the Valve Cover leak is that it makes the accessory belt slip (this belt runs alternator, cooling pump, power steering, air conditioning) creating a screeching sound when the engine is running. Belt is ruined if oil is allowed to soak into it to the point that it slips. So after you fix the leak [9], you will need to replace the belt.

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Project Aim and Objective:

- Since same operator has to assemble rear oil seal and also check for oil leaks. It raises ergonomics issue and consumes more time for the operator to finish his job.
- To reduce ergonomics issue
- To reduce time cycle for process to be completed
- To reduce operator work and fatigue

"Rear Oil Seal Leak Test "Was Decided to Be Automated

Problem Definition: Rear oil seal leak testing (Station 22) observed keenly.

- Operator assembles rear oil seal into the required jig after applying lubricant to the inner circumference of oil seal
- With the help of oil seal jig, operator attaches the seal to the oil seal pressing machine which uses high pressurized servo motor
- Then operator checks for lip fold on the circumference and pallet moves for rear oil seal leak testing
- Operator attaches electric gun on the left of the engine to rotate the crankshaft at 20rpm with torque 6 Nm
- Then attaches masking jig on the right side which utilizes vacuum pressure to determine leaks on the oil seal
- Masking jig applies a pressure of 16kPa on the circumference of oil seal
- If there is no loss in pressure applied then engine has no oil leaks and finally engine is moved to next station.

Rear Oil Seal Leak Test Engine Cylinder Block:

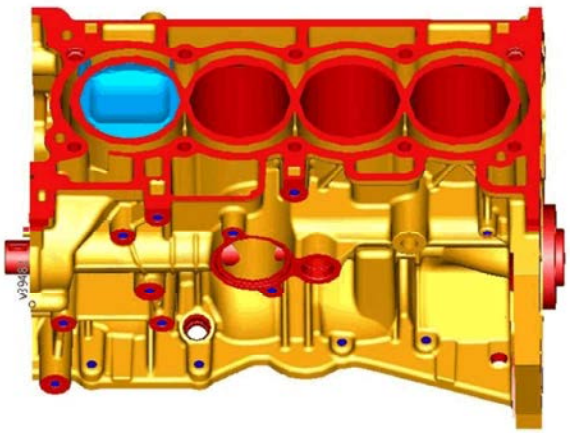


Fig. 1:

Why it Should Be Automation

Advantages of Automation:

- Increased through output or productivity.
- Improved quality or increased predictability of quality.
- Improved robustness (consistency), of processes or product.
- Increased consistency of output.
- Reduced direct human labor costs and expenses.
- Reduces operation time and work handling time significantly.
- Frees up workers to take on other roles.
- Replacing humans in tasks done in dangerous environments (i.e. fire, space, volcanoes, nuclear facilities, underwater, etc).

Proposed Automation:

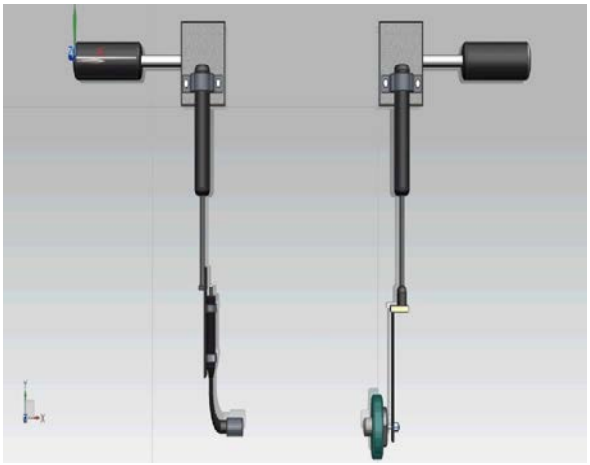


Fig. 2:

Pneumatic Circuit for Attaching Electric Gun to Left Side of Crank Shaft:

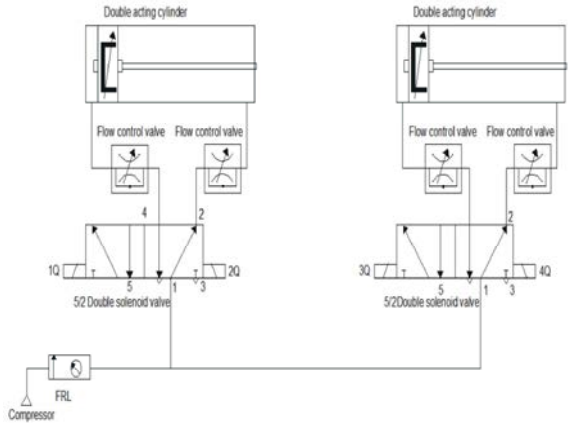


Fig. 3:

Pneumatic Circuit for Attaching Masking Jig to Right Side of Crankshaft:

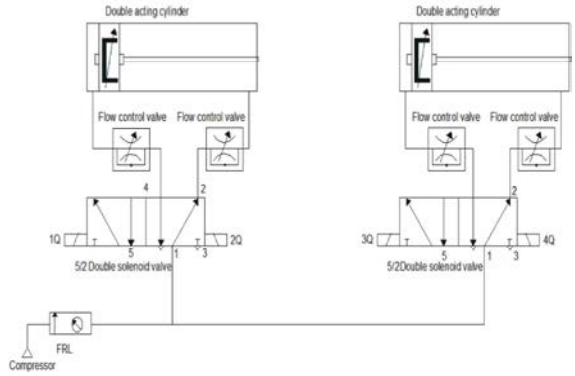


Fig. 4:

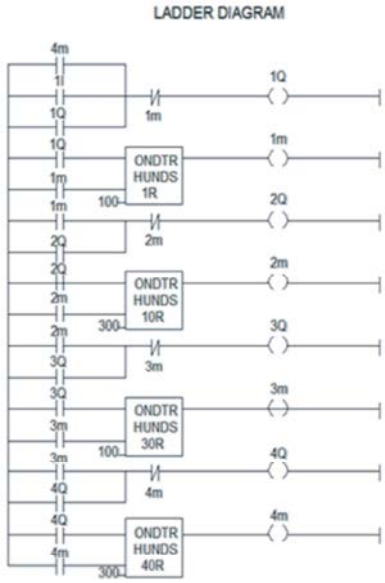


Fig. 5:

Since pneumatic system for automation is exactly the same as for both the left and right side A ladder diagram for one pneumatic system is represented here.

Selection of Pneumatic Cylinders: Following points need to be considered while selecting a pneumatic cylinder.

D = 8cm L = 30cm d = 2.5cm P = 5bar

Cylinder Thrust:

F = Cylinder thrust in Kg. D = Dia of piston in cm
d = Dia of piston rod in cm. P = Operating air pressure in bar.

- To calculate the thrust generated by an 80mm (8cm) double acting cylinder (forward stroke) at working pressure of 5 bar. (Neglecting **diameter of piston rod)**

$$F = \frac{\pi}{4} \times D^2 \times P$$

$$F = \frac{3.14}{4} \times 8^2 \times 5$$

F = 251.2 x 9.81 = **2464.27N**

- To calculate the thrust generated by an 80mm (8cm) double acting cylinder (return stroke) at working pressure of 5 bars with piston rod diameter of 2.5cm.

$$F = \{\frac{\pi}{4} \times (D^2-d^2) \times P\}$$

$$F= \{\frac{3.14}{4} \times (8^2-2.5^2) \times 5\}$$

F= 226.7kg
F= 226.7 x 9.81 = **2223.92N**

Air Consumption:

- The air consumption data for a cylinder is required to estimate the compressor capacity.
- The calculations include air consumption during forward as well as return stroke.
- Free air consumption(c) = piston area x (operating pressure +1.013) x stroke
- To calculate the air consumption in litres for 80mm (8cm) diameter bore cylinder **with** 300mm stroke having a piston rod diameter of 2.5cm and working at 5 bar air pressure.

Free Air Consumption for Forward Stroke:

$$C = \{\frac{\pi}{4} \times D^2 \times (P+1) \times L\} / 1000$$

$$C = \{\frac{3.14}{4} \times 8^2 \times 6 \times 30\} / 1000$$

C = 9.043litres.

Free Air Consumption for Return Stroke:

$$C = \{\frac{\pi}{4} \times (D^2 - d^2) \times (P+1) \times L\} / 1000$$

$$C = \{\frac{3.14}{4} \times (8^2 - 2.5^2) \times 6 \times 30\} / 1000$$

C = 8.16litres.

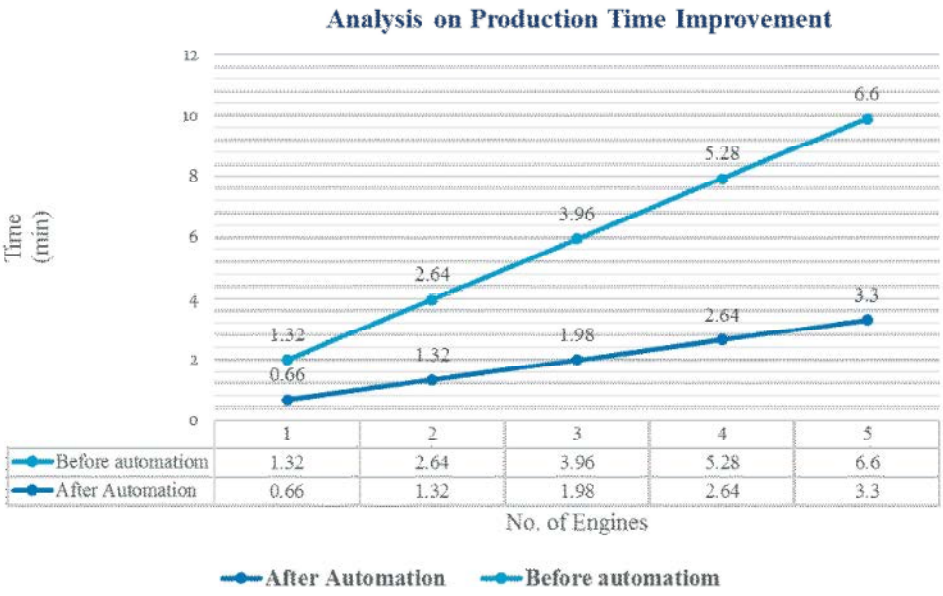
Hence for one complete cycle of operation for this cylinder, the free air Consumption will be **(9.043 + 8.16 = 17.203litres).**

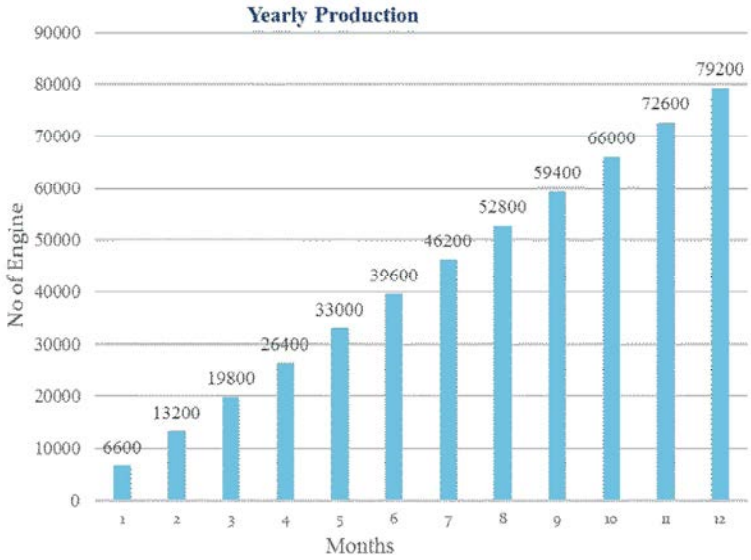
Specification of Airtac 5 Port 3 Position Double Solenoid Valve Closed Center:

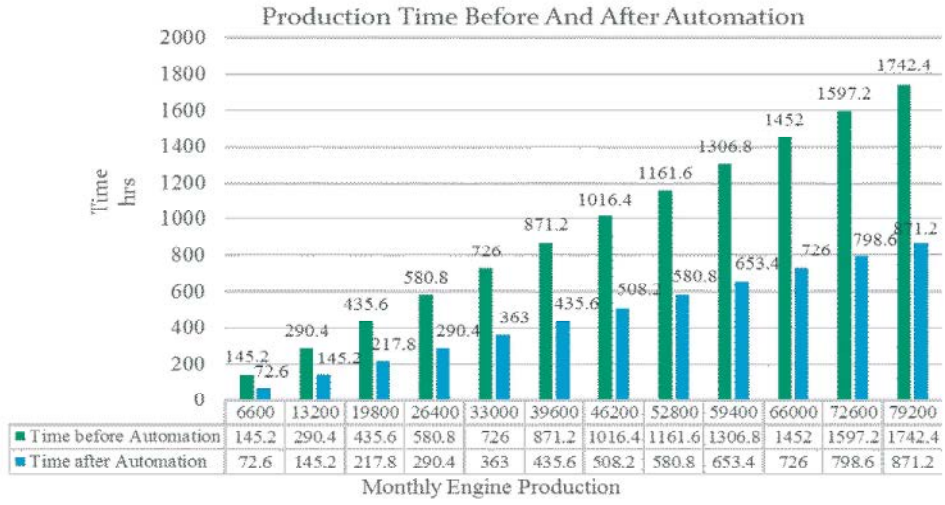
Model 4V230C-08

Orifice Size : 12 mm2
Pressure Range : 1.5 - 8.0 bar
Port Size : 1/4" IP 65, B Class Insulation
Available Voltage: 12V DC, 24V DC, 24V AC, 110V AC, 220V AC

Analysis on Production Time Improvement:







CONCLUSION

From this project we found that by implementing the automation by using pneumatic system in a cylinder for oil leakage the analysis report provides the pictorial representation by achieving all the below mentioned benefits.

Benefits:

- Time saving 0.66 min per engine.
- Ergonomics issue reduced.
- Reduced operation time and work handling time significantly.
- Frees up workers to take on other roles.
- Reduced operation cycle time.

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