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AN ATTEMPT TO IMPROVE THE AUTOMATIC DISPENSING PROCESS OF SEALANT ON OIL PRESSURE SWITCH IN CAR ENGINE BLOCK

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Abstract: - Automatic dispensing process on oil pressure switch is a new technique of applying bond of sealant. Oil pressure switch is working as a sensor of pressure of lubrication oil flow by pump. However, some problems related to low oil pressure has been found on testing conveyer and by the end users (customer). In this paper, these problems are analyzed using various techniques. Further, an attempt is made to design a special jig and a nozzle, and there performance is studied.

Keywords: Dispensing jig, oil pressure switch, lubrication oil, sealant, metallic nozzle.

1. Introduction

Automatic dispensing is a method by which drop the sealant on oil pressure switch without human error. Oil pressure switch is the pressure measuring equipment, used in car engine for measure the pressure of lubrication oil. The oil pressure switch is located in the front upper portion of the right cylinder block bank. The purpose of this switch is to monitor the operation of the oil pump as well as the lubricating oil pressure when the engine is running. Oil pressure should be in car engine block at idle condition 29 kPa and oil pressure at running condition 500 kPa. Oil pressure switch consist of a spring loaded in between two plates. Pressure of engine oil engine is less so it will glow a light on cluster meter indicating the low pressure.

Inside car engine oil plays a vital role when it comes to lubricating, cooling and cleaning. A problem with any one of these three can have major consequences for the engine. The role of the oil pressure sensor we need to understand how oil works inside the engine. The pistons need oil to prevent them from coming into direct contact with the cylinders they slide up and down in. Even though their allies in the car's engine and rub against each other they would soon become damaged and there will also be a lot less efficient that is why oil is needed to provide a cushion for them to glide over. Oil also lubricates the bearings inside the crankshaft. Again, this stops the bearings from wearing out and increases the efficiency as they are used to drive the crankshaft and change the linear motion coming from the pistons into rotary motion that can be used to turn the wheels.

Problem will be faced of low oil pressure of lubrication but the cross checking of oil pressure, find that oil pressure is desired but it has some measuring error. So detect the oil pressure switch and found that's it work properly but pressure of oil was not reaching on sensor. Because hole of oil sensor blocks by sealant. And then check the process of sealant dispensing on oil pressure switch. This process is manual and depends on human skill. For identify this process, check the previous history of those types error and found some cases of this problem in both testing line and market.

Now, change the process of dispensing of sealant on oil pressure switch. Before, first apply bond of sealant on oil pressure switch and then install it in engine block. This is result of new problem of oil leakage begins in engine block by bonding of sealant applied on back side of threads. So analyse this process and get idea of making a jig for apply bond of sealant on oil pressure switch. In first step, make a holding plate for hold oil pressure switch when apply bond of sealant. Before, for holding oil pressure switch use hand. In next step install an air gun for dispensing sealant on oil pressure switch for reduce human effort. Then found a new problem of sealant wastage. Sealant is dropping through a plastic nozzle. Because sealant come out through nozzle and if unused for some time, became dry and affix with plastic nozzle so improve it, cut the plastic nozzle and increase the diameter of nozzle and more discharge of sealant according to continuity equation. So design a metallic nozzle for control discharge. Nozzle is design according to sealant viscosity, density, inner diameter of nozzle and discharge rate. Finally, control of discharge rate of sealant through nozzle. Now, in next step check the problem of sticking of sealant on oil pressure switch. For solving it uses a lifting cylinder. It used for air gun lifting. When the oil pressure switch enter in holding plate and then air gun come down and dispensing sealant and further lift up in previous position. This process is **control sticking problem**. Because gap between oil pressure switch and nozzle tip should be 5-6 mm in dispensing time. After this process jig designing is completed.

2. Experimental work

There are many challenges for dispensing sealant for oil pressure switch. The choice for dispense sealant is important for its end use. The right sealant material for the end application is selected based on defined life time, reliability concerns, and functionality of the device. Many varieties of dispensing technologies are used based on reliability requirements. . Choose the right material for their dispensing requirements based on longtime of the fixing. Dispensing can be one option if liquid-type sealant is used. Dispensing process is attractive in high-volume production because yield can be improved by immediate protection, and handling is easier.

For preventing the oil pressure switch's hole, change the process of sealant dispensing. In this new process first switch is semi installed in engine block then drop sealant on its. After counter measurement new problem of oil leakage from oil pressure switch is begins. Sealant bond apply on last threads. And install in engine block. When engine started and lubrication oil pressure generate by oil pump then leakage found near threads of oil pressure switch. So its new process is failed.

Then new idea come in picture that making a fix stand for dispensing sealant on switch's threads. But in this holding process sealant is not uniformly distributed on oil pressure switch. And in some case sealant is drop on oil pressure sensing hole, by which sensor show on dash board that lubrication pressure is low. Then decide that, a gun should be used for drop the sealant. To improve, it make a fix sealant gun for drop sealant by hand but fix stand for holding oil pressure switch is taken and modified it.

Now, sealant is drop by air pressure from air gun so bond is apply uniformly on oil pressure switch more time. Oil hole is cover by modified holding stand. This procedure is less skill based. So need further improvement in this procedure. Because, the distance between oil pressure switch and nozzle tip is not fixed. By this problem wastage of sealant on oil pressure switch face. And distance between jig and oil pressure switch is less. While removing Oil pressure switch from the Jig a layer of sealant comes on oil hole. Reason is gap between Nozzle & Oil pressure switch is less around 5mm to 6mm due to which sealer layer comes in front of oil hole.

- To keep the distance between oil pressure switch & gun to be same (5-6 mm) at the time of dispensing & use a cylinder for gun's up & down motion.
- Make a lock like stand to keep switch in a stationary position.

Problem of sealant come on oil hole is still there. No benefit to increase the distance between oil pressure switch and sealant nozzle tip. While removing the oil pressure switch, bond stick on the tip of switch. Now, we should use the up and down cylinder. Cylinder is holding the air gun at upper position.

Other problem is faced that sealant is sticking with nozzle tip and became dry by air. This is required for preventing of cut the plastic nozzle because sealant is affix with nozzle tip around. When sealant is come out from nozzle, contact with air and if some time is rest then affix and dry with plastic nozzle tip. For proper dispensing cut the nozzle tip and dispensing sealant but diameter of nozzle increased. This result volumetric flow rate of sealant increased and wastage of sealant start. More volume of sealant is covered more thread than standard threads of oil pressure switch and sensing capacity decreased and dash light glow, indicate low pressure of lubrication oil in engine. So prevent it, design a metallic nozzle for dispensing sealant by which sealant will not affix with nozzle tip around. Nozzle dimensions are depending on flow rate, volumetric accuracy, viscosity, density, temperature, air gun pressure, velocity of sealant.

To design, nozzle tip diameter based on Continuity Equation and flow rate. Length of nozzle is based on Poiseuille's law.

Sealant dispensing on oil pressure switch is manual process so mistake chance is more. Problem shows in process of dropping sealant, quantity of sealant, non uniformly bond, nozzle tip sticking but less before. So we design automatic process for apply bond on oil pressure switch.

- Use air pressure gun for drop sealant.
- Use solenoid valve for air flow control for air gun and air cylinder.
- Use timer for dropping sealant in 3 second.
- Install a metallic sensor for sensing availability of oil pressure switch
- Use switch mode power supply for control electric power.
- Make electric circuit for connect all working components.

And finally automatic dispensing jig making process is completed. By use of this jig neglect the problem of low oil pressure by sealant dropping on sensing hole and oil leakage.

3. Use of Tables, Figures and Equations

3.1 Figures

Process of dispensing is the reason of low oil pressure because blocking of sensing hole by sealant. Dispensing process 1 is required for proper and correct dispensing on 2-3 threads of middle but process 2 is the reason of neglect dispensing by dropping sealant on starting threads.

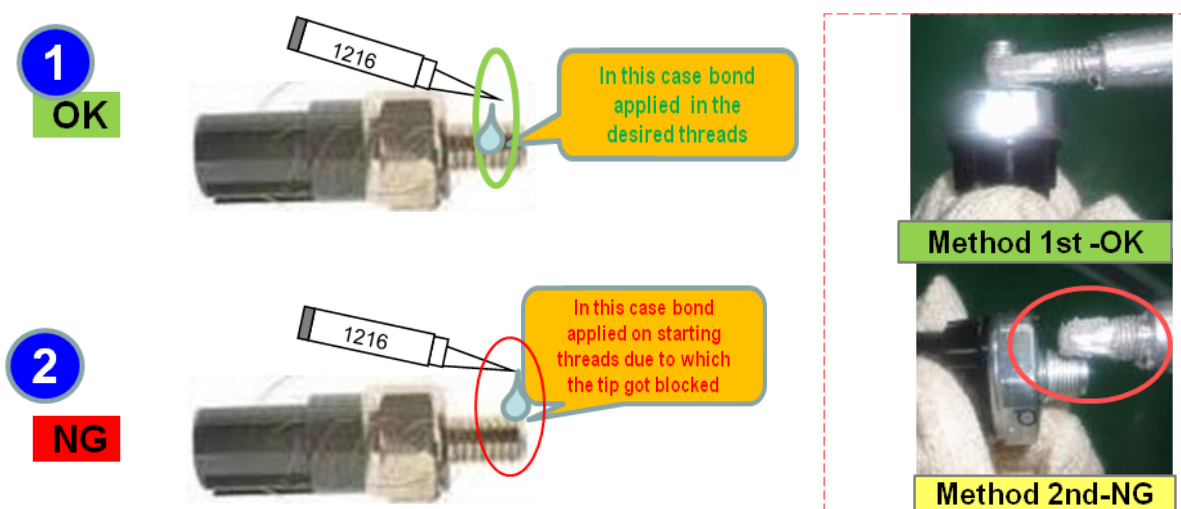
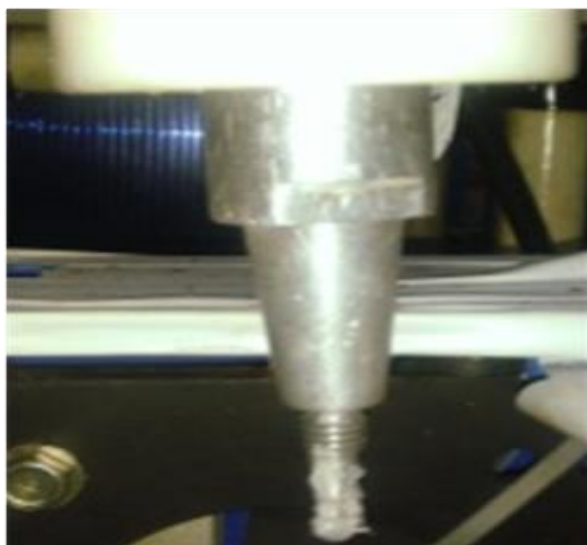


Figure 3.1 – Bond apply method

Plastic nozzle is replaced by metallic nozzle to prevent the sticking of nozzle tip to sealant. Nozzle is designed as same dimensions of plastic nozzle but length of nozzle is designed by Poiseuille's law.



3.2 Tables

Table 3.3: Properties of sealant

Chemical type	Di-methacrylate ester
Appearance	White opaque paste
Density, Kg/m ³	1210
Viscosity, Ns/m ²	21
Chemical resistance	Gasoline oil, water, glycol
Pressure Resistance (psi)	10,000
Temperature Range (°C)	-50 to +200
Breakaway torque (in.-lb.)	40

Table 3.4: Standard and experimental data for metallic nozzle

Density (d)	1210 Kg/m ³
Viscosity (μ)	21 N-s/m ²
Gravity (g)	9.8 m/s ²
Mass(m) of sealant on threads	5×10 ⁻⁴ Kg/cycle
Time taken dispensing on switch	3 Sec
Standard diameter at outlet of nozzle tip(d _o)	0.002 m
Standard diameter at inlet of nozzle (d _i)	0.008 m
Pressure at outlet of tip(P _o)-	1 bar Atm. Pressure
Pressure at inlet of nozzle(P _i)	5 bar

$$\begin{aligned} \text{Area of outlet nozzle tip} &= (\pi \times d_o^2)/4 \\ &= (\pi \times 0.002 \times 0.002)/4 = 3.14 \times 10^{-6} \text{ m}^2 \\ \text{Volume (m}^3\text{)} &= \text{mass/density} \\ &= 5 \times 10^{-4} \text{ Kg} / 1210 \text{ Kg/m}^3 = 4.132 \times 10^{-7} \text{ m}^3 \\ \text{Discharge or flow rate (Q)} &= \text{volume/time} \\ &= 4.132 \times 10^{-7} \text{ m}^3 / 3 \text{ Sec.} = 1.37741 \times 10^{-7} \text{ m}^3/\text{sec.} \\ \text{By Continuity Equation-} \\ Q &= AV \\ V_o = Q/A &= 1.37741 \times 10^{-7} / 3.14 \times 10^{-6} = 0.04386 \text{ m/sec} \end{aligned}$$

$$A_1 V_1 = A_0 V_0 \text{ or } V_1 = V_0 A_0 / A_1$$

$$= 0.04386 \times d_0^2 / d_1^2 = 0.04386 \times 4 / 64 = 2.74 \times 10^{-3} \text{ m/sec}$$

By Poiseuille's law –

$$Q = \pi d_0^4 \Delta p / 128 \mu L$$

$$L = \pi d_0^4 \Delta p / 128 \mu Q$$

$$= 3.14 \times 0.002^4 \times (5-1) \times 10^5 / 128 \times 21 \times 1.37741 \times 10^{-7}$$

$$= 0.05427 \text{ m } (\sim 60 \text{ mm})$$

Length of nozzle should be near by 60 millimeter.

After increasing the height of gun we analysed the present condition & found -

- The bond width got changed with each working cycle as it's a manual process.
- Due to increase in distance between the switch & gun's nozzle bond is not coming uniformly.

Table 3.5: Mass of sealant dropping in different cycle on oil pressure switch

Number	1st cycle	2nd cycle	3rd cycle
1	2.5gm	4gm	1.5gm
2	3gm	3gm	4.5gm
3	1.5gm	1.5gm	1gm

After designed the nozzle and fixed all parameter of sealant dispensing, require the time of regular dispensing of sealant by air gun on threads. By experimental data, found that as time increase with dispensing depth also increase. Standard depth of sealant on threads is 1.5 – 3 mm. On this depth dispensing time is 3 second, as per requirement.

S. No.	Time(sec.)	Dispensing depth	Remarks
1	1	.5mm~1mm	Very Less amount of sealant
2	2	1mm~2mm	Always required on max. side
3	3	2mm~3mm	Dispensing as per requirement
4	4	3mm~4mm	Always required on min. side

4. Conclusion

Automatic dispensing jig designed to prevent the problem of low oil pressure and oil leakage. Designing of jig is a long process, which complete in many step with experiment. Problem of low oil pressure found by wrong dispensing of sealant on oil pressure switch, when sealant cover sensing hole and leakage problem also found by wrong dispensing, in which sealant is not fully cover of thread because sealant dispensing process depended on human skill. Then design automatic dispensing jig, in which use air gun for dropping sealant Process of sealant, mass of sealant drop on oil pressure switch should be 0.5 gm. Use lifting cylinder for drop sealant on oil pressure switch's thread, have distance of 5-6 mm by which prevent the problem sensing hole covered. Design a metallic nozzle because we used a plastic nozzle before, by which sealant stucked on plastic nozzle tip and block sealant dropping gap, so require cut the tip and increase diameter of hole, increase sealant flow. Use metallic sensor for check the availability of oil pressure switch in holding plate when drop sealant on oil pressure switch. After design automatic jig checked all performance parameter. In this results, saved time 5 second of sealant dispensing, maintenance cost, 0.5 gram sealant in one dispensing on oil pressure switch and save market value of product.

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