

Lecture-07

Lubrication system demonstration

This is in continuation to, our earlier video. where we had shown, different parts of our engine, we have further stripped down this engine and now, we are in a position to show you, the different parts, strip open, it has been you

can see here, this is your crankshaft, look this is your crankshaft, complete shaft, this is the front portion, it is a flange shaft, you can see the flange here, this is a flange crankshaft, with different throws, this is one throw, this is another throw, you can see the counterweights here, which are meant for damping purpose, we had seen in our slides, what are the dampers? you can see here, the dampers you can further see here, two holes, there are big holes here, two holes, which have got the spool pins inside for damping purpose. we have seen in the slides it's a it gives a pendulum effect. so, this is complete thought balancing the crankshaft, this is your camshaft, this is your camshaft here and this is your crank, camshaft timing gear. Now, you can see here, this is your crankshaft gear, timing gear, this is your camshaft timing gear and you can see the difference in the sizes of the two gears, we have seen the ratio, of the gear teeth, we have seen the ratio, we have seen in our slides, we have read in our slides that, the camshaft timing gear. it is twice that of the crankshaft gear.

So, you can see here, this is your camshaft timing gear; this is your crankshaft timing gear. So, we can see the movement of the gears now, you see, I'm rotating the shaft crankshaft, you can see the movement of the gears here, you can see the gear train, how it is moving? The movement of the crankshaft, the movement of the camshaft, you can see the different lobes here, see, the different lobes and these are the points, where the tappets or the lifters are fitted. So, the movement, you can see the movement, of the shaft, crankshaft, camshaft, their timing gears. now, this is your crank pin area, this is your crank pin, this is your crank pin, journal here. You have the connecting rod, this is your connecting rod here and this connecting rod fits in this, on this crank pin. So now, this goes like this and this is your piston pin, this, this piston pin is goes through the other end of the connecting rod, this is your piston here, you can see the piston, you can see the piston pin holes here. these are your piston pin holes, this is how the piston pin will go inside and through the connecting rod, it connects to the crankshaft. so, this is how your, your connecting rod? And the piston is fitted, through the piston pin. You can see here, this is the this is how your piston is connected to the crankshaft, rotary motion of the crankshaft, you can see this. The rotary motion of the crankshaft is further converted to the reciprocating motion of the piston.

So, this is your second half of the crankcase, we have split the crankcase in two halves, this is the other half. Now, on this, half you can see this is the place where your crankshaft rests now, these are your main bearings, we will remove this, we can remove this, see this is your plane bearing this is your crank and this is, the place where your crankshaft rests here so, these are your plane bearings this bearing you can see here this bearing this is your forward bearing we also call it a 'Thrust Bearing' and this we will see in the lubrication how these, bearings are lubricated this is, and this bearing is different from these bearings the for the forward bearing or the thrust bearing is a flanged bearing so, this is your forward bearing we have removed this, this is your forward bearing or the thrust bearing here you can see this bearing is flashed, you can see the flange here and the rear bearings the rear main bearings they are normal plain bearings, so these you can see the area here, you can see the area here, here your forward bearing your crankshaft is, laid down so this is you can see these holes these are the holes, where your tappets or the lifters are fitted these are your holes where your tappets or lifters are fitted this is your tappet, you can see here this is your tappet it goes inside like this, and it is fitted it is further lifts your push rod we've seen in our earlier slides how this mechanism functions so this is just to demonstrate this is just to show you where the tap at wit's end and how does it look like now, this engine in front of you this is a wet sump system, we have seen in a slides, of the lubrications chapter that there are two types of lubrication systems and dry sump system and a wet sump system this particular engine is a wet sump lubrication system, in the wet sump lubrication system as we know that there is no separate oil tank there is no independent oil tank the oil is stored in the crankcase or the sump, so this as I have told you that this is your wet sump lubrication system so, I'll show you the sump, the Sun this is your sump here, here you can see this is your sump, where your oil is stored this is just mounted below the crankcase this is this is mounted at the bottom of the crankcase now we, we have also seen in our slides that the oil is lifted by, by the means of a suction screen so, this is, this is your suction screen here, you can see this is fixed here in the sump, it the oil pump will lift the oil from this sump this is your sump and oil is here this gets this is deep inside the oil, the

oil is filtered through this, this mesh screen the oil is filtered through this mesh screen and is sucked, by the pump in the oil line to the oil pump after the oil is lifted from the sump, it comes to your pressure pump the oil pressure pump this is your pump here, this pump you can see this is a gear type pump we have also seen in our slides the different types of pumps you can see this is your gear type pump, you can see two gears here, these are the two gears and this is your gear housing, before the oil enters the pump it comes to a manifold and from the manifold it goes it is the oil is picked by these, gears these gears the oil travels between the gear and the gear housing, so between the gear and the gear housing the oil is traveling it gets pressurized, now there are two gears this one and the one, one gear you can see the movement of these gears when the gears are moving, so one is moving in the clockwise direction the other is moving in the counterclockwise direction now, as the gears move the oil is picked up here it is pressurized between the gears and the pump housing and the housing after getting pressurized the oil, is further sent to the engine so I've removed this oil pump from the crankcase you will see these are your two gears, I am removing this gear also and the other gear also so, see the two gears have been removed, we have removed the two gears in our earlier chapter we have studied that the shaft is a spline shaft, you can see this is a spline shaft here and the two gears so, these two gears after pressurizing you can see the internal housing of the pump these are the two gears and now, you can see this is your outlet here there is an outlet inside you can see this one this is your outlet, after the oil is pressurized it goes through the outlet through this outlet to the engine, within this oil pump housing you can see this is your oil pressure screen this is to filter the oil this is your pressure screen here this is housed in this unit, then we have the relief valve here, this is your oil pressure relief valve we have seen in our slides what is the function of the relief valve this is just here to do more straight you, how is the pressure relief valve like, you can see this is a spring-loaded. So, this is your relief all and it goes inside like this, it is screwed in like this.

So, in this housing, this is your bypass valve, this is also spring-loaded, this will come out and you can see the spring here and the ball here. it is, it is mounted like this, you can see, the spring and the ball .this is your bypass ball, we have just seen ,this is you can see the ball, the spring, it is a spring-loaded bypass valve and it fits in, this housing, it goes in like this, it will go in goes like this and is screwed, coming to the oil pump again, see these are the two gears ,this this shaft, this shaft ,the other end of the shaft, you can see here, this shaft ,this fits in, this gear. you can see this is, your camshaft timing gear, this shaft is fitted it, meshes with this gear, it goes in this gear, it this, shaft drives this gear. So, this becomes your driving gear and this becomes your driven gear. you can see the movement ,this is your drive gear and this is your driven gear .so, the direction of rotation of both the gears opposite, the drive gear is rotating clockwise, the driven gear is rotating counterclockwise. So, this drive gear meshes with the camshaft timing gear, we have seen in our earlier slides, in our earlier chapter we have seen, how the oil pump is connected to the camshaft timing gear .that is why ? We call this, 'An Engine Driven Gear' .

It has a positive displacement, engine driven gear. another important component of the lubrication system is the oil filter, you can see this is a full flow spin on filter, we have seen in our slides, we have studied about this filter, this is a full flow spin on filter, it has a complete housing, disposable housing and the we have cut one filter, for demonstration purpose, see this is one filter, it is the, the internal element, is like this and this is, how your filter looks like? The filter has got, relief ball, within this housing, it has a spring, spring unit here. it is fitted on the top and it has a trained back valve, this is the bottom one and this is this has an entry drained back valve which we have seen in our slides. Now, you can see this filter here, you can see the holes here, these are your inlet holes, the oil goes through these holes, inside the filter it is moving around the complete oil is moving around the filter and after filled the oil is filtered, the filtered oil comes out through this opening. So, this is your outlet. these holes are your inlet, to the oil filter and this is your outlet, to the oil filter .there are different types of oil filters, different makes of filters, available and this is, this filter is used on Lycoming engines , this is a champion filter, full-floor spin-on filter, another filter, this is, this filter is installed on Rotax engines. So, different types of filters, the next component we have read about is the oil cooler, so this is your oil cooler, you can see here, we have seen, you know different

lines here, we have read about it in the slides this is just here to show you, how the oil cooler is like, it fritzen at this place in the engine .so, this is your oil cooler, we have also studied about the oil, oil cooler control valve, temperature control valve. So, this is the valve here, the oil temperature thermostat valve, you can see this is your oil temperature thermostat valve. This controls, the temperature of the oil going in and out of the oil cooler. So, we have seen the different components. Now, coming inside the engine, there are a lot of drilled holes here, inside the engine you can see this is the crankshaft ,see the hole here, you can see the hole here, they're all meant for lubrication purpose, the oil goes inside these holes, since it is a wet sump lubrication system ,the oil is there these crankshaft, this is submerged in the oil and since it is turning it turns like this, it picks up the oil from the sump ,picks up the oil, oil goes, oil goes in these holes, you can see there is a tube also here, through this hole, there's a tube connected ,the oil goes from this tube, comes out of these holes and also lubricates the connecting rod .the connecting rod, as we have seen earlier, the connecting rod is fixed like this here this whole oil comes out from this it lubricates the connecting rod bearing.

So, you can see different holes, different oil passages, the oil circulates through all these holes, lubricates, the crankshaft, the connecting rod ,the camshaft, there are different oil passages inside, it will lubricate ,your camshaft also ,then there are we as we know, that these are the openings, for the tappets, for the lifters ,the oil lubricates, the tappets, here. We know that this is the tappets here, the push rod is attached to the tappet like this, you see there are openings, there are openings here and here. You can see, the oil flows through these openings, to the push rod. there are openings you can see, this is a ball end of the push rod ,there are holes inside these are hollow rods, these are hollow roads and it look the oil flows through these openings and lubricates the push rods. These push rods, further the oil comes out of these holes and lubricates the rocker arm, we have seen earlier, how the rocker arm looks like? The oil flows, through, the tappets, the push rods and it further, you can see the rocker arm here. you can further see the hole inside this, where your push rod friction, the push rod connects to the rocker arm like this, you can see the hole inside, the rocker arm, there is a hole on the ball end of the push rod also so these disconnects like this, there is further lubrication of the rocker arm rocker arm and the rocker arm bushings. So, we are on the aircraft now, and I want to show you the different lubrication systems, this is Cessna 2:06 aircraft with the Lycoming IO 514 engine, this is like of being IO 540 engine, with six cylinders, this particular engine has got a wet sump lubrication system, here, this is the place from where we check the oil level, this is your oil dipstick, with this we can measure the quantity of oil. So, this is your oil dipstick. which goes in like this and or you can be measured from this dipstick, here, this is your sump, we call it a, 'Wet Sump'.

This is part of the crankcase, where the oil is stored .so; this is a wet sump lubrication system. The oil as I have told this, the oil is stored in the sum, the quantity the oil level can be measured from this dipstick, we which is part of our daily inspection, you can see the level of oil, you have to remove the dipstick, put it inside again after cleaning and check the oil level. So, there are graduations, there are marks, on the dipstick, the maximum quantity of oil that can be stored in this system is 11 quarts and you have the 11 cords graduation here. So, we have seen the oil quantity, this white, unit which you can see here, this is the oil filter, we have just seen that, this is a full flow spin on filter, it has a champion filter. Champion is the manufacturer's name, the company which manufactures this oil filter, so this is your oil filter. So, whenever we have to change ,the engine oil the oil filter is also supposed to be replaced and the periodicity of replacing the engine oil and oil filter is 50 hours of flying operation or four months, whichever is earlier, so either 50 hours or four months, whichever is earlier we have to replace the engine oil and the oil filter, I'll show you in this wet sump system, from where we are draining the oil there is a drain point in the at the, lowest point of the engine. So, this is the lowest portion of the sump, this is the drain point, this is the drain plug here, you can see this is wire locked, in order to remove it, we will cut this wire locking, open this drain plug and the oil will be drained from this point. So, once the oil is drained, this plug is again fitted back and wire locked. So, this is your drain plug and in order to replenish the system, in order to fill the oil, the oil is filled from the port from the point, where that oil dipstick was there so, from that we remove the dipstick and the oil is filled from that port.

Now, you see this point, this is your oil suction screen here, again this is the wire locked, you can see this is my rock, we will remove the wire locking and this is, this is a screwed in, we will unscrew the area this, this thing and the oil screen can be clean, it is a suction screen .so, here you on the stump, this is your drain point and this is your oil suction screen point. This is your oil pressure and evolved this is the point where, we can adjust the oil pressure setting; we have seen in the slides, this is your lock nut and there it has a slotted hat. So, we remove this lock nut and we can adjust the setting of the oil pressure, turning it clockwise increases the pressure and turning it counterclockwise decreases the pressure.

We have seen it in the slides, so this is here, just to show, you how the oil pressure relief ball is, another important unit of the lubrication system is the oil cooler. so this is your oil cooler mounted here, you can see it has fins here, we have read about the oil cooler in the slides and you can see, our tubing ,going out of the oil cooler. So, this is your oil cooler on the wet sump lubrication system and we will now sum up what we have seen on the this wet sump lubrication system, we have seen the filler point, we have seen how we measure the oil level, we have seen the oil filter, we have seen the oil pressure relief valve, we have seen the drain point, we have seen the suction screen and oil cooler. So, this is the wet sump lubrication system on Cessna 2:06 aircraft .now, we will see the other system, which is the dry sump lubrication system, on another aircraft. So, we have just seen the wet lubrication system. Now, we are on another aircraft, this is a sinus nine one, two motor glider fitted with the Rotax nine one, two engine. it has a dry sump lubrication system .so, this is your oil tank, in the dry sump lubrication system, as we have seen the oil tank that you have a separate oil tank and independent oil tank ,this is your oil tank ,there are three lines on the oil tank, this is your supply line, this is your line from which the oil is going from the tank to the engine, this is your return line, the oil from the engine after lubricating is coming back to the tank, this is your return line and this line you can see ,this is your vent line, to render we have seen in our slides that the tank is also supposed to be vented so this is your vent line.

So, this is your oil pump, on this dry sump lubrication system ,this is your oil pump ,this is your oil pressure, sensor, this is the sensor from where you can sense the oil pressure, this sensor you can see, this is the sensor for oil temperature .so ,oil pressure ,oil temperature sensors, oil pump and this black unit you can see, this is the oil filter ,as I earlier that this motor glider ,this aircraft has got a Rotax nine one two engine, so this these kind of filters are used on Rotax engines. so now, we will replace the engine oil on this motor glider, as I had told earlier that the frequency of replacement is 50 hours or four months whichever is earlier, so this is the oil tank and this is the drain plug here ,you can see the drain plug here, it is wire locked, we will cut open the small lock and unscrew the drain plug the oil will be drained from this tank, before doing the replenishment, before doing draining the oil, for oil change you need to do a ground run of the engine, you need to warm the engine, so that the complete oil is removed from the system ,so now we are going to replace the oil. so please, cut this wire lock, so you can see the wire lock being cut, so the wild log has been removed and the drain plug is being unscrewed .so you can see, the drain plug has been removed, now the oil is coming out, so this is the oil, which is being drained from the oil tank, this particular tank and the system has pickup has a capacity of 3 liters of oil. So, this oil is being drained. Now, see this the complete oil has come out. Now, we will put the plug back, the drain plug. Now, we can put it back, see the drain plug has been put back and now, we are going to remove the oil filter. So, this is your oil filter. Now, we will remove the oil filter and you can see how the filter is being removed .so, this is, this is your oil filter removal tool, this is your oil filter removal tool, this goes around the filter and we will unscrew the filter with the help of this tool, just see how it is done. Now, the oil filter is being unscrewed , see some oil is also going to come out from this, this thing and the oil filter is now coming out, see this oil filter, this has come out you can see the internal thing also, we have seen in our earlier slides also, this is a Rotax nine one two engine .so, this, this type of filter is there, as part of our inspection during the oil change we will cut open this filter and we will see the filter element inside ,the fit, the filter element inspection is required to see whether there is any metal particle ,which is a breast or there is any metal abrasion inside the system, this is the this is a new oil filter and we put some oil and lists this is aero shell oil

Sport+for. Which is used in this machine? So, before installing this filter, we fill this filter, with some oil, this is all this filter, is filled with oil now and we will install this new filter in on the engine.

The filter is now being installed, initially it will be hand tightened. Now, see the filter has been installed, it has hand tightened now, as I had told you earlier this is the drain plug now before putting in fresh oil, we have to talk the drain plug, we talked it with the help of a torque wrench and a talk required to be given here is 25 Newton meters .so, you can see here, we will give the talk 25 Newton meters here, with the help of a torque wrench. see the drain plug is being tightened by giving 25 Newton meters talk, see there's 25 Newton meters talk has been given and we are going to lock the drain plug .so now, the drain plug is tightened it has viola it will be by lock now and here you can see this is the oil filler cap, this is the filler cap here and this is the dipstick inside, you can see this, this dipstick, this is you minimum mark and this is your maximum mark. So, this is your minimum and this is your maximum, we and this is the filling point also from here we are going to put in the fresh oil, this oil aero shell oil sport+ for, this oil is put in the Matteson quantity is three liters, so the system requires three liters of oil .so, this was one liter, this was one liter, similarly we will put ,two more liters. So, this is how the oil fresh oil is potent.

So you have seen the red ,red system lubrication ,you have seen the dry sump lubrication system and you've seen how we replace oil from a dry sump lubrication system, in the wet sump lubrication system also the oil replacement is almost the same ,where you have seen the drain plug we unscrew the drain plug, ray in the oil what put the drain ,plug back while lock it and then replenish it with the fresh oil, before replenishing it with the fresh oil the oil filter again as champion oil filter pull flow spin-on filter is replaced. So now, this filter element has been cut open, you can see the inside of the filter element. Now, we are going to cut this element and this is the paper, paper pleats you can see here, this will be cut open and we are going to do the inspection of this paper element to see if there is any metal particle which has come along with the engine oil. So, the part of the filter element has been cut ,you can see we have stretched this, you can see it is a paper filter now ,we have to inspect all the pleats ,we will inspect at all the creases and look for any metal abrasion here, on the front side as well as on the back side. So, we don't see any metal particle here, we don't see any abrasion particle here, metal abrasion here. So, that means your internal mechanism in the engine all your rotating parts, they are all fine. There is no progression anywhere in the system. So, this is one very important check, to ensure that your internal system and the engine, all rotating parts are working fine.

Video End Time: (36:50)

