



## ADVISORY LEVEL: Mandatory Operational

DESCRIPTION: HL Avoidance

ENGINE TYPE: R2800 R3600

INSPECTION FREQUENCY: At every Engine Start

### AVOIDANCE OF HYDRAULIC LOCK September 2007

Rotec has reviewed the procedure required in avoiding Hydraulic Lock (HL) and has changed the steps in the process. Its important that you memorise these steps and understand the reasoning behind each step. Please confirm that you have read and understood - if any questions arise please send them to Rotec for an explanation/answer.

### THE BEST WAY TO AVOID ROD DAMAGE:

FOR THIS PROCEDURE TO WORK IT IS MOST IMPORTANT THAT IN YOUR WIRING THAT THE STARTER MOTOR IS SEPARATED FROM THE IGNITION CIRCUIT BY A SAFETY SWITCH IN THE COCKPIT. PLEASE CHECK THAT THIS IS SO BEFORE STARTING THE ENGINE.

You'll find a drain cock on the fuel intake tube of the 2 lower cylinders of the R2800. On the R3600 there is a drain cock on each of the fuel intake tubes of the 3 bottom cylinders.

1. Check that the drain cocks were left open from a previous engine start. If they were left shut then open them now and allow the oil to drain out completely before proceeding. No drips at all must be observed. If necessary remove the drain cocks completely.
2. \* Hand prop the engine with the drain cocks open as described in the manual. If you detect a lock - carefully reverse the rotation of the prop - make sure your drain cocks are open. After several turns return to normal hand propping. If the lock persists then remove the spark plugs and let the oil drain whilst slowly turning the prop. Once the oil stops flowing return the plugs and start again from item 1
3. Close the drain cocks.
4. Turn ignition off double check that it is OFF!
5. Use the starter motor to turn the engine over for a few seconds.
6. If the starter motor is unable to turn the engine over on dead MAGS then you have a "lock". Open the drain cocks then please remove the spark plugs on the lower cylinders and slowly rotate the prop draining any accumulated oil out of the bottom cylinders. Once drained replace the spark plugs. Start again from 1.
7. With dead MAGS, if the starter turns the engine over for 3 seconds, STOP CRANKING. Turn ignition on and start the engine.
8. After the conclusion of each flight open the drain cocks and allow any oil to drain.
9. Before the next flight: Start the procedure from 1 even if your stop was a brief one

\* *In the early stages of ownership the hand propping phase will be subjective as to what is and what is and what is not resistance. However, it needs to be stressed that one needs to gain/learn this experience and the only way to gain it is by "feel" at every start..At the early stages remove the plugs, rotate the prop to push out all the oil, return the plugs and start from item 2; by repeating this at every start a feel for what is and what is not resistance will develop.*

At any time if in doubt please remove the plugs and rotate to force any trapped oil out of the cavity then continue from step 1.

**If you have an auxiliary oil pump installed be aware its an aid and its use does not in any way modify the need to go through all the steps as outlined above.**

## HL - The reasoning:

Depending on the shut down the positioning of the valves may be such as to allow oil to seep past and into the intake pipe. This accumulated oil, unless removed, can be sucked back into the combustion chamber resulting in HL. The procedure, as defined in the 9 steps is designed to avoid this from happening.

The most efficient way in removing any oil trapped in the intakes is to open the drain plugs on the intake pipes on the bottom cylinders (*Incidentally, if you forget to close these and go flying no damage will result*).

If oil accumulates in the cylinder or in the intake pipes through natural drainage after shut down, it needs to be removed (*Note: there is roughly 2 liters of oil in the engine while running*):

1.0 Correct use of the drain cocks will eliminate any oil trapped in the intake tubes

2.0 If small quantity of oil is trapped in the combustion cavity it will lead to HL. To remove this oil:

2.1 Remove the plugs and rotate the prop to push out the oil.

2.2 When more experienced use hand propping for resistance to detect the oil's presence. On detecting reversing the rotation of the prop can/should push the oil out and then through the drain plugs drain out.

2.3 If there is any doubt always remove the plugs and rotate the prop to remove the oil

The process of using the starter motor with ignition off is an important secondary method to detect oil in the head because the starter motor should not develop enough torque to get past a lock (*hence the need for the isolation circuit between ignition and starter motor*). The starter motor is used as in a "last chance" method to avoid HL if residual oil is trapped in the cavity through either incorrect procedure, negligence or human error.

**To Stress Again:** It is important to understand that there is enough leverage in the prop to force past a lock and in the process bend a rod; if you are unsure the safest option would be to remove the spark plugs from each of the cylinders that has a drain cock attached to its fuel intake pipe and use slow hand propping to force the oil out.

Once you shut down, no matter for how short a time, it is imperative that the drain cocks be opened.

If you have an auxiliary oil scavenge pump this can be an **aid** to the procedure but the emphasis is on "aid" as **no** reliance should be placed on the pump as a means of avoiding HL. Prior to shut down turn the pump on while the engine is still running; then on shut down allow the pump to continue pumping for 30 seconds. Before the next flight operate the pump for 15 or so seconds prior to going through the procedure. During a long taxi, in or out, it is wise to have the auxiliary oil scavenge pump on.

In purchasing a Rotec you've purchased a fine piece of purpose built engineering, but none the less the engine is still a radial and as such requires the care that all radial engines demand.

The fact that the R2800 starts easily and runs so smoothly can lead to complacency don't let complacency creep into your start up and shut down procedures.