SCAN AVIATION

ENGINE BREAK-IN

Service Engineers at the Reciprocating Engine Division get a surprising number of telephone calls asking about engine break-in. Because aircraft owners who are having a replacement engine put into their aircraft are very interested in achieving the maximum performance from that engine, a review of break-in planning and procedures is in order.

Any reciprocating engine installed as a replacement should be subject to break-in procedures.

The engine may be new, remanufactured or overhauled. Even an engine, which has had a cylinder replaced, or just had new rings installed after the cylinder barrels were re-honed, should be broken in all over again.

What is the objective of engine break-in ? To obtain a compression gas and oil seal between the cylinder walls and the piston rings while also keeping friction to a minimum. This objective is achieved by first ground running the engine, and then continuing the break-in by running the engine at high cruise power settings during all flights until break-in is complete. These high power settings cause expansion of the piston rings so that excess oil will be scraped from the cylinder walls. Under these conditions, the oil is not baked into a shiny glaze on the cylinder walls and the rings and cylinders will form the seal which is desired. All engines new or overhauled will arrive with an hour or more of running time in the test cell. This in-plant test run assures new owners that the engine meets all specifications for RPM, manifold pressure, fuel flow, oil pressure, and the amount of power produced. Although this test run starts the engine break-in, a through break-in sometimes takes as long as 50 hours. The initial engine testing in the aircraft will be discussed here. Following this initial engine running, the new owner should continue to utilize the recommended power setting for the specific engine until satisfactory break-in is assured.

Before proceeding further, the subject of oil used for engine break-in should be discussed. Lubricating oils recommended for use in reciprocating engines are as a general rule STRAIGHT MINERAL OIL.

There are a few engine models which are exceptions to this rule, check the procedure for your specific engine., and also be aware that some engines must be serviced with oil additive.

The new or overhauled engine as stated earlier, will always have an initial test run. Installation of the engine in the airframe should be in acceptance with standard shop practise. To avoid contamination of the replacement engine, the oil cooler and the lines should be cleaned and flushed before they are installed. All vent and breather lines must be properly installed and secured as described in the airframe maintenance

manual. Air frame and inter cylinder baffles must be installed along with the engine cowling to ensure that optimum cooling is achieved, and that engine temperatures are maintained within specified operating limits during both ground and flight testing. Although all new and overhauled engines have been run in the test cell, an engine ground test in the aircraft will be beneficial for these engines as well as for those overhauled in the field with no test cell. On start up it is imperative that adequate oil pressure be shown on gage within 30 seconds or the engine should immediately be shut down.

The engine should be run until it is completely warmed up so that several items can be checked before the aircraft is released for flight. These items include a standard magneto check with the engine producing power, and a quick OFF and ON check at engine idle to insure that the magneto is not hot with the switch in the OFF position. Operation of the alternator, vacuum pump, and carburettor heat or alternate air system should be checked during this period of ground operation. Cycling of the propeller for models with a controllable prop, a feather check if the engine is installed in a multiengine aircraft, and a brief run to full power to determine the operation of the propeller. During this engine run up, the oil pressure should be carefully checked to determine if any adjustment is necessary. After a period of idle for engine cool down, idle mixture and idle speed are checked to see if adjustment may be needed. After shut down, the engine should be inspected for oil leaks. Finally, the oil suction screen, and the oil pressure screen or oil filter should be checked for contamination. If no contamination is evident, the aircraft is ready for test flight.

The test flight after installing a replacement engine should follow the procedures outlined here.

1. Start the engine and perform a normal pre-flight run-up in accordance with the engine operator's manual.
2. Take off at airframe recommended power, while monitoring RPM, fuel flow, oil press. and temp. and cylinder head temp.
3. As soon as possible, reduce to climb power specified in operator's manual. Assume a shallow climb angle to a suitable cruise altitude. Adjust mixture per pilot's operating handbook.
4. After establishing cruise altitude, reduce power to approximately 75% and continue flight for TWO hours. For the second hour , alternate power setting between 65% and 75% per the operator's manual.
5. Increase engine power to maximum airframe recommended and maintain for 30 minutes, provided engine and aircraft are performing within operating manual specifications.

Avoid low manifold pressure (under 15" hg) during high engine speeds. Also avoid rapid changes in engine speed with engines that have dynamic counterweight assemblies. These conditions can damage the dampers, rollers, and bushings in the counterweights.

6. Descend at low cruise power, while closely monitoring the engine instruments. Avoid long descents at low manifold pressure. Do not reduce altitude too rapidly or the engine temperature may drop too quickly.
7. After landing and shutdown, check for leaks at fuel and oil fittings and at engine and accessory parting surfaces. Compute fuel and oil consumption and compare to the limits given in the operator's manual. If consumption exceeds figures shown in manual, determine the cause before releasing the aircraft for service.
8. Remove oil suction screen and pressure screen or oil filter to check again for contamination.

After the initial flight has been accomplished and the aircraft is released for flight, it is the responsibility of the owner / pilot to continue the break-in procedure. To seat the rings properly, the engine should be run at cruise settings between 65% and 75% power for 50 hrs. of operation or until oil consumption stabilizes. If the engine is operated at low power settings during this break-in period, a condition commonly known as glazing of the cylinder walls may occur. When this happens, the ring break-in stops, and excessive oil consumption often occurs. Extensive glazing can only be corrected by removing the cylinders and re-honing the cylinder walls. Because this is an expensive procedure it is a good reason for accomplishing a correct and thorough break-in of the engine.
Many questions which are being asked about engine break-in should be answered by the material in this article. To summarize, these are the items which owners should keep in mind when a replacement engine is installed in their aircraft.

1. Follow the manufacturer's recommendations regarding the oil to be used for break-in.
2. Run the engine at high cruise power levels for the best piston ring / cylinder wall mating.
3. Continue break-in operation for 50 hours or until oil consumption stabilizes, then switch to an Ash less Dispersant (AD) oil to keep the engine clean during its operating life.

Follow these simple rules and your engine will produce many hours of fun flying time.