TELEDYNE CONTINENTAL ® AIRCRAFT ENGINE

SERVICE BULLETIN

Compliance Will Enhance Safety

CATEGORY 3

SB96-11A

FAA APPROVED

Supersedes SB96-11, M84-16

SUBJECT: **PROPELLER STRIKES AND HYDRAULIC LOCKS.**

PURPOSE: PURPOSE: PART I: PROPELLER STRIKE INCIDENTS:

Provides definition of propeller strike and foreign object damage (FOD), possible resulting damage that can occur from such incidents and required inspections and corrective actions mandated by TCM to return the engine to service.

PART II: HYDRAULIC LOCK:

Provides definition of hydraulic lock, the conditions that can lead to a hydraulic lock event, how to prevent it, and the inspection and corrective actions mandated by TCM to return the engine to service.

COMPLIANCE: PART I: Anytime a propeller strike incident occurs, perform the inspections set forth in this Service Bulletin prior to further engine operation.

PART II: As set forth in the instructions contained in PART II.

MODELS AFFECTED: All Teledyne Continental Motors (TCM) engine models.

PART I - PROPELLER STRIKE INCIDENTS

A propeller strike is: (1) any incident, whether or not the engine is operating, that requires repair to the propeller other than minor dressing of the blades as set forth in Part I, B of this Service Bulletin or (2) any incident while the engine is operating in which the propeller makes contact with any object that results in a loss of engine RPM. Propeller strikes against the ground or any object, can cause engine and component damage even though the propeller may continue to rotate. This damage can result in catastrophic engine failure.

NOTE: This bulletin contains updates to the Manufacturer's Instructions For Continued Airworthiness as required by FAR43.13. A copy of this bulletin must be inserted into all TCM Maintenance, Overhaul and Operators manuals.

A. PROPELLER STRIKE INSPECTIONS.

Following any propeller strike complete disassembly and inspection of all rotating engine components is mandatory and must be accomplished prior to further operation. Inspect all engine accessories in accordance with the manufacturer's instructions. In addition to the engine component inspection requirements set forth in the appropriate overhaul manual, pay particular attention to the following areas while performing the specified non-destructive testing:

1. Crankshaft surfaces forward of the front main bearing journal. These surfaces must be free of sludge, paint or any other substance that could mask reliable magnetic particle inspection indications.

2. Forward crankcase bearing support and adjacent structure.

> NOTE ... In addition to any part that is damaged, TCM recommends for counterweight equipped engines, replacement of all counterweight pins, bushings, end plates and snap rings regardless of their condition.

B. MINOR FOREIGN OBJECT DAMAGE (FOD) INSPECTION.

For instances where the propeller is damaged by a small foreign object during operation, such as a small stone, inspection and repair must be accomplished in accordance with the propeller manufacturer's published instructions. Any time foreign object damage requires propeller removal for repairs other than minor dressing of the blades, the incident is considered a propeller strike and must be inspected as outlined in paragraph A above.

PART II - HYDRAULIC LOCK

WARNING

OVER PRIMING CAN CAUSE A FLOODED INTAKE RESULTING IN A "HYDRAULIC LOCK" EVENT AND SUBSEQUENT ENGINE MALFUNCTION OR FAILURE. IF YOU OVER PRIME, OR FLOOD YOUR ENGINE, MAKE CERTAIN THAT ALL FUEL HAS DRAINED FROM THE INTAKE MANIFOLD AND/OR CYLINDER PRIOR TO ATTEMPTING ENGINE STARTING.

WARNING

MODIFICATION OF OR DEVIATION FROM THE ORIGINAL INTAKE MANIFOLD DESIGN MAY RESULT IN INSUFFICIENT DRAINAGE OF THE INTAKE MANIFOLD, RESULTING IN AN INCREASED POTENTIAL FOR HYDRAULIC LOCK. ALL INTAKE MANIFOLD DRAINS MUST BE PROPERLY PLACED, AND OPERATIONAL.

A. GENERAL INFORMATION

Hydraulic lock is defined as a condition in which a volume of liquid, equal to or greater than the clearance volume of the combustion chamber, is drawn into the cylinder during starting. This liquid, being incompressible, restricts piston travel during the compression stroke. Damage only occurs after the preceding cylinder or cylinders in the firing order have fired, thereby providing the required force to drive the piston of the fluid filled cylinder through the compression stroke. Most hydraulic lock events in horizontally opposed aircraft engines are due to fuel accumulation in the induction system and/or cylinder assembly and usually occur in one of the forward cylinders. Over priming prior to or during engine starting will allow fuel to accumulate in the induction system or cylinder faster than the system drains can evacuate it. Other causes of hydraulic lock can be attributed to:

1. Restricted or clogged induction system or cylinder drain(s).
2. Extended operation of the electric boost pump:
    a. During failed engine start.
    b. Following loss of power during ground operation.
    c. Following momentary engine shutdown.
    d. During single engine operation for training purposes on twin engine aircraft.
3. Over priming and attempting engine start with the aircraft parked on an incline that negates the effective operation of the drain system.
4. A failure to drain oil from cylinders that have been preserved.

Damage from a hydraulic lock can be extensive. Engine components such as connecting rods, cylinder assemblies, pistons, piston pins, crankcase and crankshaft can be damaged due to the extreme stress. Subsequent failure of these components can occur if the instructions set forth in this service bulletin are not followed.

B. PRECAUTIONS PRIOR TO AND DURING STARTING

1. Owners, operators and maintenance personnel must become familiar with the type, operation, total number and location(s) of the fuel drain(s). This information is provided in the Aircraft Manufacturer's or STC holder's Maintenance and/or Flight Manual.

    NOTE: Verify that the boost pump switch(es) are in the "OFF" position prior to turning the master switch on.

Each time the engine is manually primed, or the electric boost pump is energized for fuel system leak check or for priming before or during engine start, observe the following precautions:

a. Fuel priming must be accomplished in accordance with the instructions specified by the Aircraft Manufacturer or STC holder and only with a properly functioning drain system.

b. Prime and start engine(s) while the aircraft is positioned on a level surface.

c. Prime only as long as required to achieve a stabilized fuel flow or pressure indication and in no case exceed the Aircraft Manufacturer or STC holder's limitations.

d. If prolonged priming or inadvertent operation of the boost pump has occurred, verify visually that fuel is running from the system drains. Starting must not be attempted until all fuel has drained from the induction system.

e. If fuel draining is not noticed during priming, discontinue priming and remove, repair or replace drain(s), associated hoses and hardware in accordance with the Aircraft Manufacturer's instructions. Make certain that the system drains are functioning properly and that fuel drains from the system prior to engaging the starter.

2. If the engine has been in storage and/or preserved, drain all preservative oil in accordance with the latest revision of the TCM Service Bulletin concerning engine preservation prior to engine operation.

C. SYSTEM DRAIN INSPECTION

At each scheduled maintenance interval, perform the following inspection to ensure that the drain(s) function properly:

WARNING

DO NOT ROTATE THE PROPELLER OR ALLOW ANY PERSONNEL TO STAND IN THE AREA OF THE PROPELLER ARC WHILE PERFORMING THE FOLLOWING INSPECTION.

1. Perform a normal engine start priming sequence in accordance with the Aircraft Manufacturer or STC holder's instructions.

2. Observe the drain location(s) in the engine cowling and make certain that fuel drains from each.

NOTE: On some installations, drains are located in the induction system where fuel draining will not be observed during priming. In this case, the drain must be inspected as necessary to determine that it is functioning properly.

3. Remove, clean or replace any drain that does not function properly.

D. INDICATIONS OF POSSIBLE HYDRAULIC LOCK

In the event the operator starts an over-primed/flooded engine, hydraulic lock may result. Indications of hydraulic lock are difficult to detect since the engine will not normally exhibit any unusual operation once the fuel-air mixture stabilizes. Therefore, the operator must be cognizant of the fact that a hydraulic lock can occur anytime an attempt to start an over-primed/flooded engine occurs. In the event that the operator starts an over-primed/flooded engine or suspects a hydraulic lock has occurred, he must make certain that the inspection procedures in Section E are followed.

E. INSPECTION PROCEDURES FOR SUSPECTED HYDRAULIC LOCK.

In the event of a suspected hydraulic lock, perform the following inspection:

1. Remove all cylinders and connecting rods in accordance with the applicable TCM Overhaul Manual. Inspect the connecting rods in accordance with applicable TCM Overhaul Manual.

2. If all rods meet the criteria specified by TCM, reassemble the engine in accordance with the overhaul manual.

3. If any connecting rod does not meet TCM acceptance criteria, remove and disassemble the engine to allow inspection of the crankcase and crankshaft in accordance with the applicable TCM Overhaul Manual. Replace any part that does not meet Overhaul Manual inspection criteria. Replace each non-conforming connecting rod and its associated piston, piston pin and cylinder assembly.

   NOTE: Any parts that require replacement must be destroyed to prevent future installation.

4. Reassemble the engine in accordance with the applicable TCM Overhaul Manual and return the aircraft to service.

AFFECTED PUBLICATIONS: ***Insert a copy of this service bulletin into the appropriate section of all TCM Maintenance and Operators Manuals.***