TELEDYNE CONTINENTAL ® AIRCRAFT ENGINE

CATEGORY 4

SERVICE INFORMATION DIRECTIVE

Compliance Will Enhance Safety, Maintenance or Economy Of Operation

SID10-4

Technical portions are FAA APPROVED

SUBJECT: Engine maintenance for Volcanic Ash contamination

PURPOSE: To establish maintenance recommendations for engines that have experienced Volcanic Ash contamination

COMPLIANCE: At any time Volcanic Ash contamination is suspected

MODELS AFFECTED: All engines

Section 1) General

The recent events in Europe have brought questions of potential damage that may be caused to piston aircraft engines operating in a Volcanic Ash contaminated environment.

Operation in areas of visible ground ash contamination and especially in areas where ash is visible in the atmosphere (ash clouds) is NOT RECOMMENDED.

Except in the cases where volcanic ash severely restricts the airframe and engine induction system such that engine power is reduced in flight, the issue with volcanic ash is accelerated engine wear. The engine entry point for ash is the airframe engine air induction system, through any points of leakage, the system's alternate air source or the reference lines plumbed directly into the induction system. This SID provides for inspection of these entry points and actions to be taken if contamination is found.

In aircraft with Manifold Absolute Pressure gauges, monitor readings in flight for changes. If the MAP no longer holds steady, displays unusual changes in flight or the engine ceases to run smoothly while in flight in known ash areas, land as soon as possible and inspect starting with the induction air system. If the engine runs rough during pre-flight run-up on the ground, do not take off without inspection as follows.

Ingestion of ash will occur more often during ground operations. Airborne ash will dissipate after volcano eruption ceases. All aircraft operating in areas affected by fallen ash will continue to require periodic inspections until the ash is dissipated. Historically the inspection requirements have continued for a year or more in ash fallout areas.

Any aircraft known to have been exposed to volcanic ash during ground operations or while in flight, must accomplish the following inspections as soon as possible but no longer than 10 hours from known exposure.

Airframe fuel system inspection is required. Inspection should start with fuel tanks, fuel vents, gascolators and fuel filters. Contact airframe manufacturer's maintenance documentation for inspection requirements.

- **Continued operation in ground or airborne ash contaminated areas;**
  - WILL INCREASE THE RISK OF INTERNAL ENGINE DAMAGE
  - IS NOT RECOMMENDED.
- INADVERTENT OR INTENTENIAL OPERATION IN KNOWN ASH CONTAMINATED AREAS WILL REQUIRE CONTINUAL INSPECTION OF THE ENGINE AND AIRFRAME AS RECOMMENDED BY THE MANUFACTURER.

Section 2) Inspection

- Prior to cowl removal, the induction air filter assembly must be inspected to assure that no gaps or breaks exist in the filter media. If any gaps or breaks exist, replace filter element prior to further flight. Inspect the inlet face of the induction air filter for volcanic ash. In worst case, the induction air flow to the engine may be severely restricted by ash residue clogging the induction air filter or inlet air duct. Air filter assemblies utilizing "wettable" filtration inserts may be more susceptible to clogging. Air filter removal, reinstallation and replacement must be done in accordance with the appropriate airframe manufacturer's instructions (ICA). Inspect any cowl mounted ducting for sign of ash contamination.
- Remove cowling in accordance with airframe manufacturers maintenance instructions.
- The use of clean, dry compressed air at a low pressure setting (5-20 psi) to assist in cleaning tight and hidden areas is acceptable. Direct any air blast and any blowing ash away from the engine to reduce recontamination.
- Clean entire engine compartment to include baffles, baffle seals, all bracket areas, inner cylinder head baffling (crossflow style), inter-cylinder baffles, clamps, wire bundles and any location where ash could accumulate. Stoddard solvent or soap and water solution may be used. Always consult the airframe manufacturer's maintenance manual for recommended cleaning procedures and recommended cleaning products. Caustic commercial cleaners may not be used in this cleaning process as they may react with the chemicals in the ash and cause corrosion to the surface of the engine or airframe. Liquid may cause the ash to become a solid mass causing washing away to be a chore.
- Inspect the aircraft induction air system for any visible evidence of ash. Inspect the alternate air door or carburetor heat valve for quality of seal and any signs of ash leakage. These two locations are unfiltered and if opened, will allow ingestion of ash. If ash is present, inspect the airframe and engine induction air system for leakage at all joints and connections. Repair all leaks prior to further flight.
- During visual inspection of the induction system, inspect the venturi, jet area and the throat of the carburetor (if so equipped). The carburetor airbox may require removal to facilitate inspection. Consult the airframe maintenance manual for assistance.
- Engines equipped with an RSA style fuel servo manufactured by Precision Airmotive LLC, must be inspected for ash in the inlet air duct and air inlet opening of the servo prior to further flight.

- Visually inspect the entire engine installation. Inspect the cylinders in accordance with Service Bulletin SB96-12 part 1. Cylinder heads, barrels, inter-cylinder baffles, brackets, fuel injection lines and nozzles and cylinder induction systems to include all overboard drain tubes for components (i.e. fuel pump, manifold distributor valves) induction pipes and/or cylinder intake ports (crossflow). Inspect the crankcase for ash impact damage or chemical corrosive action.

- For inspection and required service for Kelly Aerospace alternators and starters see Kelly Aerospace Power Systems Overhaul manual OE-A2. See contact information at the end of this bulletin.

- TCM alternator inspection information is in the enfgine maintenance manual and Alternator Service manual.

- Inspect the oil cooler for evidence of ash trapped in the cooling fins. Inspect for impact damage caused by abrasive ash particulate. Visible damage to the cooling fins or oil passage tubes may require oil cooler repair or replacement prior to further flight.

- Inspection of magnetos; Both TCM and Slick (Champion Aerospace) recommend a 500 hour type inspection when ever visible contaminant is found in the magneto, magneto pressurization hoses or filter assembly (if so equipped).

- Inspect cylinders per latest revision of Service Bulletin SB96-12 part 1. Cylinders found to be damaged by ash impact or chemical contact must be repaired or replaced prior to further flight.

- Immediately following any known ash contamination, an oil and filter change with oil analysis should be accomplished. The oil filter must be cut and inspected for any particulate content. An increase of silicon content and primary wear metals in the oil analysis, indicates the requirement for more frequent oil changes, oil filter changes with oil analysis at each oil change for at least the next 100 hours of operation. If abnormal results continue, additional inspections will be required as follows in Section 3.

- A primary indicator of accelerated internal cylinder wear after ash exposure, is increased oil consumption. Monitor oil consumption during and after operation in any confirmed ash environment. Any increase in oil consumption of 25% or more within 100 hours of known ash exposure requires inspection by latest revision of Service Bulletin SB03-3.

- Airframe fuel systems should be inspected for evidence of ash. Any indication of ash in the airframe fuel system will require a full inspection of the engine fuel system for contaminant. See Section 3) for inspection recommendations.

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Section 3) Actions required if ash is evident in inspection

- Any occurrence of ash in the engine induction system requires the entire induction system be cleaned of all ash contaminant prior to return to service. Consult the appropriate overhaul or maintenance manual for instruction in removal and reinstallation of the engine induction system.

- Evidence of ash in the induction system indicates the requirement for internal cylinder inspection. See the latest revision of Service Bulletin SB03-3 for internal cylinder inspection criteria. Both differential compression testing and borescope inspection should be completed.

- Inspect engine for signs of wear with a borescope within 10 hours of any confirmed ash exposure. Re-inspect at 25 hour intervals thereafter. Borescope inspection may be discontinued after 4 consecutive inspections showing no abnormal cylinder wear, no unusual indications of particulate wear materials in oil filter or oil analysis and no increased oil consumption should be experienced.

- Ash present in sufficient quantity to be visible in the carburetor venturi, jet or throat area, will require removal of the carburetor for cleaning. Contact Tempest (Volare) for inspection and cleaning recommendations. For assistance, see contact information at the conclusion of this bulletin.

- Ash present in the fuel servo in sufficient quantity to visibly coat the throat, venturi or air tube will require the removal of the servo for cleaning; see Precision Airmotive Service Information Letter RS-82 for system cleaning recommendations prior to further flight. For assistance, see contact information at the conclusion of this bulletin.

- Ash contamination in the airframe fuel system requires inspection of the engine's fuel injection system.

    - TCM Fadec equipped. Fuel filters are to be replaced with new units. All engine fuel lines must be inspected and cleaned. All cylinder fuel injection valves (nozzles) and fuel system transducers must be replaced. Any fuel pump related issues will require pump replacement. Cleaning of the fuel lines may be accomplished using mineral spirits and low pressure clean dry compressed air. See FADEC Manuals OH-22, OH24 or M26 for instruction.

    - TCM Continuous Flow Fuel Injection system may be inspected using the appropriate engine maintenance or overhaul manual. Cleaning may be accomplished using mineral spirits and clean dry compressed air.

- Any turbocharger systems found to have evidence of ash in the air inlet duct must be inspected, cleaned and serviced prior to further flight. Detach the air inlet duct to allow visual inspection. Ash present in the ducts connecting the turbo to the induction air manifold will require the entire system to be removed, inspected, cleaned and reinstalled. Intercoolers (aftercoolers) with evidence of ash at both inlet and outlet must be flushed internally. This is accomplished by an oil cooler service facility capable of flushing the intercooler (aftercooler) unit. Air pressure or liquid flow alone are not sufficient to dislodge ash contaminant. All sense lines attached to the induction system must be inspected for debris, i.e. upper deck reference and turbo controller reference lines. Consult the overhaul or maintenance manual of the appropriate engine model for

assistance in removal and reinstallation. Prior to reinstallation, inspect the airframe alternate air system for effective seal and correct operation. See airframe maintenance instructions for assistance.

- For required cleaning and inspection of the turbocharger assembly, see Kelly Aerospace Power Systems Turbocharger Overhaul manual 400600-0000. For associated valves, wastegates and controllers, see Kelly Aerospace Power Systems Aircraft Valves and Controllers Overhaul manual 400999-0000. For assistance, see contact information at the conclusion of this bulletin.

Section 4) Continued operation in known ash environment

- If the engine is to continue operation in ash contaminated areas oil change frequency must be adjusted to compensate for continual contamination. In heavy ash concentrations, a 5 hour oil and filter change with oil analysis is recommended. In areas that where there are less contaminants, 25 hours may be appropriate. If the ash can be seen in the prop wash around the airframe during run up, take off and landing, the 5 hour oil change interval should be used. As all evidence of ash during operations cease, a return to normal oil change intervals may be considered. If ash reappears or there are indications of increased oil consumption, visible particulate in the oil filter at change or abnormal oil analysis results, return to a lower frequency oil change interval of 25 hours until inspections results return to normal.

- If oil consumption increases, oil filter inspections show increased particulate content or oil analysis continues to be abnormal, additional inspection is required. Service Bulletin SB03-3 borescope inspections of internal condition of the cylinder walls must be continued. If cylinders are removed for further inspection or repair, remove the connecting rod bearing of the corresponding cylinder for condition inspection. Consult the appropriate overhaul or maintenance manual for instruction in removal and reinstallation of the connecting rod and bearing.

Contact Information

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