EASA Safety Information Bulletin

SIB No.: **2010-08**
Issued: **08 March 2010**

Subject: **Engine-driven Cooling Fan Disk Failures**

Ref. Publication: CASA Airworthiness Bulletin (AWB) 63-007 dated 20 January 2010.

Description: The Civil Aviation Safety Authority (CASA) of Australia has published the referenced advisory document (attached as pages 2 through 5 of this bulletin) to remind owners, operators and maintainers of certain piston-engine powered helicopters of the need to properly maintain the cooling fans and their drive systems by using approved data from the current type certificate holder.

After reviewing the available information and recognising that CASA is not the 'State of Design' authority for any of the affected type designs, EASA concurs with the advisory and fully supports the CASA recommendations contained therein. This SIB is published to ensure that all owners, operators and maintainers of the affected helicopters, registered in European Union Member States or associated countries, are aware of these recommendations.

Applicability: all helicopters powered by a vertical piston engine that employs an engine-driven cooling fan 'disk' of thin sheet metal.

Contact: For further information contact the Airworthiness Directives, Safety Management & Research Section, Certification Directorate, EASA. E-mail: ADs@easa.europa.eu.

AIRWORTHINESS BULLETIN

Helicopter Vertical Piston Engine - Cooling Fans

AWB 63-007 **Issue** : 1
Date : 20 January 2009

1. Subject

All helicopters powered by a vertical piston engine that employs an engine driven cooling fan "disk" constructed of thin sheet metal.

2. Purpose

The purpose of this AWB is to remind maintainers and operators of the need to strictly adhere to the requirements of all current manufacturers approved data for the operation and maintenance of the subject cooling fans and their drive systems.

3. Background

Catastrophic failures of helicopter piston engine-cooling fans typically follow the radical imbalance caused by the loss of one or more fan blades. A liberated fan blade can inflict severe damage to components in the failure plane of the fan and have been known to damage flight controls with possible subsequent loss of control of the helicopter. Structural failures of the cooling fan are typically due to rapid progression of fatigue cracking originating at the fan blade root region, and may be attributed to improper operation or maintenance techniques, as discussed below.

3.1 Operational Exceedances.

The cooling fans of the type referred to in this AWB typically have a critical RPM band, usually in the lower engine/main rotor RPM range. Operation in this critical RPM band for longer than permitted during starting or run-down, will force the fan to operate in a destructive resonant condition for longer than permitted. An otherwise serviceable fan may quickly self-destruct if allowed to operate in the resonant RPM band for longer than the time permitted to accelerate/decelerate through the critical RPM range.

This critical RPM range is usually indicated by a coloured “Caution” sector on the dual engine/main rotor RPM indicator and operation in this range should be avoided, in accordance with the Pilot Operating Handbook (POH) or aircraft Flight Manual (AFM).

3.2 Fan Maintenance.

The cooling fan is a highly stressed component typically consisting of a thin sheet metal disk which may also embody the fan blades at the outer edge and may incorporate a pressed shallow cone or bolted hub assembly which is riveted or bolted to the disk. The fan hub usually also carries the fan drive arrangement in the form of a spline or pulleys.

(a) Daily & Periodic Inspection: The fan should be inspected in accordance with the manufacturer's requirements, typically for corrosion, bent blades or other damage, including nicks in the blades and cracks at the blade roots. Ensure the riveted or

bolted assembly is not "smoking" from the fasteners and the drive is secure. Any looseness between the central cone and the disk may affect the way the fan operates and may change its operational characteristics and strength. Bent and/or damaged blades (due foreign object damage) are reason for rejecting the fan. Do not attempt to straighten bent blades, except in accordance with approved data. Ensure all inspection access panels and ducts are re-secured. A flexible duct, as used in some installations, if not secured correctly, may be drawn into the fan in flight.

(b) **Surface protection - Removal:** During the removal of any protective finishes, ensure that the original surface finish of the fan structure is preserved in accordance with the original requirements specified by the manufacturer. Extreme care should be taken to ensure that the original surface finish of the fan structure is not damaged or "enhanced" in any way. Any unauthorised changes to the fan structural surface finish or contour may render the fan liable to unpredictable failure. In one case[1], cooling fan failure was attributed to a change in the metal surface finish caused by abrasive scratches and shot peening the surface of the fan in the fan blade root region, as part of the preparation for painting the fan. Changes to the designed surface finish can reduce the fans' resistance to fatigue.

(c) **Fan repairs:** The fan should only be repaired in accordance with the manufacturer's data. This is generally limited to blending minor nicks, etc. Straightening bent fan blades is usually limited to minor track adjustments.

(d) **Surface protection - Painting:** Adhere to the manufacturers recommendations with regard to surface protection. Some manufacturers require only primer for corrosion protection while others allow decorative/protective paint schemes. If painting is permitted, pay particular attention to the manufacturers' requirements in relation to masking to ensure, for example, that paint is not unintentionally deposited on faying surfaces.

1: Refer to ATSB report:
http://www.atsb.gov.au/publications/investigation_reports/1995/AAIR/aair19950101 9.aspx

(e) **Track & Balance:** Correct fan track and balance is crucial. An out of balance and/or track condition will cause the fan to vibrate which may result in a reduction of the structural integrity of the fan and the reliability of the drives. Fan track and balance should, therefore, be maintained strictly in accordance with the manufacturer's recommendations.

(f) **Fan installation:** Ensure that only the recommended surface protection is introduced on the mating surfaces between the fan and gear box attachment/drive surfaces at assembly. If these faying surfaces are improperly prepared, the intended fastener torque may be lost soon after the fan commences operation, due, for example, to paint loss between the surfaces under the heat and vibration of normal operation. Follow the manufacturers' recommendations for initial fan assembly, installation with regard to the fasteners used and follow-up torque checks of the fan installation. Loss of fastener torque in any fasteners in the hub and drive assembly means the hub cannot support the disc and blades as designed, and may introduce a change in the resonant vibration characteristics of the cooling fan and thus allow the fan to enter a destructive resonance phase during operation. Loss of fan drive spline fastener torque may also result in mechanical damage to the fan drive spline, the couplings and may result in loss of drive to the cooling fan.

(g) **Fan belts:** In some installations, the engine cooling fan is driven by a pair of belts running between pulleys mounted on the main transmission and the fan. The belts have a finite life and should be installed in matched pairs. Drive belts should be checked for correct tension and maintained in a serviceable condition. Care should be taken so as not to bend the fan blades while checking or tensioning the fan belts. Loose fan belts tend to be thrown off the pulleys. New belts tend to loose initial tension fairly quickly during the first few hours of the "run in" period.

(h) **Drive shaft:** Some engine cooling fans are shaft driven, with elastomeric couplings. Ensure all drive splines and elastomerics are serviceable, that shaft fasteners and drive alignment is correct.

(i) **Fan blade and duct rigging:** When the fan is installed, the fan blade tip clearance in relation to the fan shroud should be carefully established and adjusted, as necessary, in accordance with the manufacturer's requirements to ensure intended fan efficiency.

(j) **"Balance" tab rigging:** Some cooling ducts employ balance tabs at the fan duct rim. The condition and correct relationship of the tabs (where fitted) should also be checked. These small tabs establish a stabilising back pressure effect at their quadrant of the duct. If the tabs are not in the correct location, have the wrong clearance or setting with regard to the fan blades, or if one is missing, unbalanced cyclic air pressures at the tip of the fan blades may induce an unstable tip path plane motion which may lead to catastrophic fan failure.

(k) **Cooling duct:** The integrity of the cooling duct sealing is important with regard to engine cooling efficiency and fan reliability. The engine should only be operated when the entire cooling duct(s) are correctly installed and all the removable cooling duct inspection plates (where used) are installed. Operation with an inspection plate removed will reduce cooling efficiency and may introduce unbalanced cyclic air pressures at the tip of the fan blades causing an unstable tip path plane motion which may rapidly lead to catastrophic fan failure.

4. Recommendations

Operators are urged to review their operational and maintenance practices to ensure the helicopter is maintained in accordance with the current manufacturers' instructions and approved data.

5. Enquiries

Enquiries with regard to the content of this Airworthiness Bulletin should be made via the direct link e-mail address:

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Or in writing, to:

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