Proposed Special Conditions on Loss of Oil from Gearboxes Utilising a Pressurised Lubrication System

Applicable to AW 189

Introductory note:
The hereby presented Special Condition has been classified as important and as such shall be subject to public consultation, in accordance with EASA Management Board decision 12/2007 dated 11 September 2007, Article 3 (2.) of which states:

"2. Deviations from the applicable airworthiness codes, environmental protection certification specifications and/or acceptable means of compliance with Part 21, as well as important special conditions and equivalent safety findings, shall be submitted to the panel of experts and be subject to a public consultation of at least 3 weeks, except if they have been previously agreed and published in the Official Publication of the Agency. The final decision shall be published in the Official Publication of the Agency."

Statement of issue
The AW189 is an 8 ton class twin turbine engine rotorcraft which has a passenger seating capacity of 19 and is being certified under the requirements applicable to Category A.
Following a fatal accident of a Part 29 helicopter in 2009, and the associated accident investigation, the FAA, EASA and TCCA set up a "Joint Certification Team" in order to review Part 29 rules and AC which affect the likelihood of loss of transmission oil and the consequences of such an event on the helicopter. This group reported its findings in October 2012, concluding that certain aspects of 29.927(c) may be ambiguous and consequently, this AC material has been updated.

In addition, the JCT considered that existing Part / CS 29 regulations do not adequately address the reliability of rotor drive system lubrication systems, particularly with respect loss of oil, and that this should also be addressed by changes to the rule and / or AC. The following requirements are potentially applicable to the lubrication system design.

- CS 29.901(c) For each powerplant and auxiliary power unit installation, it must be established that no single failure or malfunction or probable combination of failures will jeopardise the safe operation of the rotorcraft except that the failure of structural elements need not be considered if the probability of any such failure is extremely remote.
- CS 29.917(a) General. The rotor system includes any part necessary to transmit power from the engines to the rotor hubs. This includes gearboxes, shafting, universal joints, couplings, rotor brake assemblies, clutches, supporting bearings for shafting, any attendant accessory pads or drives, and any cooling fans that are a part of, attached to, or mounted on the rotor drive system.
- CS 29.901(b) Design assessment. A design assessment must be performed to ensure that the rotor drive system functions safely over the full range of conditions for which certification is sought. The design assessment must include a detailed failure analysis to identify all failures that will prevent continued safe flight or safe landing, and must identify the means to minimise the likelihood of their occurrence.
- CS 29.1309(b)(2)(ii) The rotorcraft systems and associated components, considered separately and in relation to other systems, must be designed so that – For Category A rotorcraft:

The occurrence of any other failure conditions which would reduce the capability of the rotorcraft or the ability of the crew to cope with adverse operating conditions is improbable.

In order to address the limitations identified with the existing regulations, the JCT has concluded that:

1) So that the reliability of the lubrication system will be assessed against powerplant / rotor drive system specific requirements, it should be considered to be part of the rotor drive system and included in the definition of 29.917(a).

- Accordingly, a Special Condition is necessary to add the lubrication system to this definition of the rotor drive system.

2) Rotor drive system lubrication systems are part of the Powerplant Installation as defined in 29.901. The AC material states “While this procedure is usually straight forward, the following items of FAA/AUTHORITY powerplant responsibility are listed to minimize questions regarding authority and responsibility: (viii) Oil systems for engines, auxiliary power units, rotor drive transmissions, and gearboxes, including grease lubricated gears and bearings of the drive system.” However, historically the requirement of 29.901(c) has sometimes only been applied to the engine installation.

- In order to address safety assessment of lubrication systems, a Special Condition will add an additional paragraph to 29.917.

3) The safety of the helicopter after an event of loss of gearbox oil is dependent upon a combination of the ability of the gearbox to continue operation without oil, the flight conditions and the duration for which the helicopter is flown. Accordingly, the parameters defined in the associated Flight Manual Emergency Procedures are critical in order to reduce the likelihood of continued operation up to the point of gearbox failure.

– Therefore a Special Condition is considered necessary to add a paragraph to 29.1521 requiring that any duration of continued operation after gearbox loss of oil is substantiated by test data and reduced by a safety factor derived by analysis.

Proposed Special Conditions

For the reasons identified by the JCT and stated above, the following Special Conditions will be applicable as part of the a/c certification basis:

SC 29. 917 Design.

(a) *General*

The rotor drive system includes any part necessary to transmit power from the engines to the rotor hubs. This includes gearboxes, shafting, universal joints, couplings, rotor brake assemblies, clutches, supporting bearings for shafting, any attendant accessory pads or drives, any cooling fans and any associated lubrication system components including oil coolers, that are a part of, attached to, or mounted on the rotor drive system**.**

SC 29. 917 Design

(d) *Lubrication system failure analysis*.

In addition to meeting 29.901(c), a failure analysis must be performed for each pressurized gearbox lubrication system which will, as a minimum, establish any single failures and likely common cause failures which could lead to rapid loss of oil and consequent inability to continue safe flight or safe landing.

SC 29.1521 Powerplant limitations*.*

(k) *Continued operation after loss of oil from a rotor drive system gearbox pressurized lubrication system*.

The maximum duration of operation after a loss of oil resulting in a red oil pressure warning may not be greater than the maximum value demonstrated by test, reduced by a suitable safety factor to account for variability of gearbox components due to design tolerances and wear