

**SUBJECT** : **Rotating Antenna Installation**

**REQUIREMENTS incl. Amdt.** : CS 25.251, CS 25.301, CS 25.302, CS 25.303, CS 25.305, CS 25.307, CS 25.561, CS 25.563, CS 25.571, CS 25.629, CS 25.631, CS 25.671, CS 25.901, CS 25.1309 and Appendix K amdt. 27

**ASSOCIATED IM/MoC** : Yes  / No  *[Delete last page of associated IM/MoC if not applicable]*

**ADVISORY MATERIAL** : **Cert-Memo CM-S-013 Issue 01 “Installation of Antennas on Large Aeroplanes (CS-25)”**

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**INTRODUCTORY NOTE:**

The following Special Condition (SC) 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.) 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."*

**ABBREVIATIONS:**

None

**IDENTIFICATION OF ISSUE:**

An application was made for the certification of a high speed rotating antenna installation on a CS-25 pressurised aeroplane. Installations of high speed or high energy rotating antennas are considered novel design features, not adequately addressed by the certification specifications in CS-25 Amdt 27.

Considering all the above, the following Special Condition is proposed:

**M-TS-0000336****Special Condition****Rotating Antenna Installation****1. APPLICABILITY**

This SC is applicable to CS 25 aeroplanes with a high speed or high energy rotating antenna installation.

**2. SPECIAL CONDITION**

A high speed or high energy rotating antenna installation including radome must comply with subparagraphs (1) to (3) of this Special Condition, which address normal operation (nominal condition), failure cases and impact conditions.

Note, proposed Cert-Memo CM-S-013 Issue 01 "Installation of Antennas on Large Aeroplanes (CS-25)" provides general guidance regarding the installation of antennas, including antennas installed under a composite radome.

**(1) Normal Operation:**

The antenna installation must be shown to be able to withstand inertia, aerodynamic and decompression loads, and any vibration and buffeting loads, acting on the installation, in accordance with CS 25.251 and CS 25 Subpart C.

In addition, the following loads under normal operation are considered as limit loads, to be multiplied by a safety factor of 1.5 to determine ultimate loads, in accordance with CS 25.303.

- a) The maximum loads resulting from the normal operation of the rotating antenna must be evaluated including the torque due to maximum acceleration/deceleration and braking of the antenna rotation, and the cyclic loading (excitation) from static and dynamic imbalance. Effects of wear and free-play need to be included in this evaluation of the antenna installation.
- b) The loads and aircraft handling effects from gyroscopic effects during aircraft manoeuvring, gust conditions and landing conditions need to be evaluated.

**(2) Failure Cases:**

The loads resulting from mechanical failure conditions can be considered as ultimate loads, i.e., with a safety factor of 1, whereas for system failures the safety factor is determined in accordance with CS-25 Appendix K, Interaction of System and Structure.

- a) System failures that may lead to increased loading on the antenna installation must be evaluated, for example failures leading to sudden acceleration/deceleration, overspeed or sudden braking/stoppage. CS-25 Appendix K, Interaction of System and Structure, may be adapted for these systems, for any failure not shown to be extremely improbable. The following aspects shall be addressed:
  - i. System in the failure condition: at the time of occurrence

- ii. System in the failure condition: continuation of flight
- iii. Failure indication and detection.

The evaluation shall cover static strength, fatigue and damage tolerance, freedom from aeroelastic instability, vibration, the effects on aircraft handling, and loads including gyroscopic effects.

- b) Mechanical failures of the antenna installation must be evaluated, including jamming, sudden seizure/stoppage and structural failures that may reasonably be expected. The structural failure modes will be dependent on the specific design of the antenna and its attachment. The structural failure conditions to be evaluated shall be discussed and agreed with EASA and must include consideration of single part failures and any relevant in-service experience of similar installations. The antenna attachment and affected airframe structure must be designed to withstand 1g flight loads combined with the transient dynamic loads resulting from the failure condition.
- c) Mechanical or system failures leading to debris must be demonstrated to be contained within the radome and not penetrate any airframe structure. Alternatively, any resulting damage to the radome, airframe structure or systems must be evaluated to ensure no injuries to occupants will occur, as well as ensuring continued safe flight and landing, including consideration of static strength, decompression and aeroelasticity. Any parts departing the aircraft shall not prevent continued safe flight and landing.
- d) Mechanical or system failures resulting in increased static or dynamic imbalance loading must be evaluated. The analysis must show that during continued operations, until the failure is detected, and corrective measures are carried out, the induced vibrations will not cause damage that would prevent continued safe flight and landing. This evaluation must consider damage to the airframe primary structure, antenna attachment structure and effects on equipment necessary for continued safe flight and landing. The principles of AMC 25-24 "Sustained Engine Imbalance" may be adapted for this failure condition.

(3) Impact Cases:

- a) In accordance with CS 25.631, the applicant must show that a bird strike on the radome, including attachments, will not prevent continued safe flight and landing. The effect of the dynamic impulse generated by the bird impact must be evaluated. Bird strike must be evaluated at the most critical antenna rotational speed or most critical antenna orientation (if inoperative) consistent with antenna operational limitations, up to the maximum altitude that a bird strike could reasonably occur. The most critical scenario could be different to the altitudes specified in CS 25.631.
- b) For installations on the bottom of the fuselage, crashworthiness must be addressed including wheels-up-landing and ditching, as well as possible impacts of wheel/tyre debris.