EASA
European Aviation Safety Agency

Antenna Installation / Classification

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General

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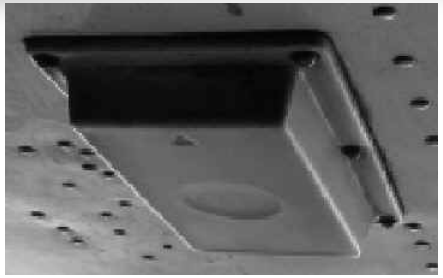
  - Need for Flight Testing

General

General

General



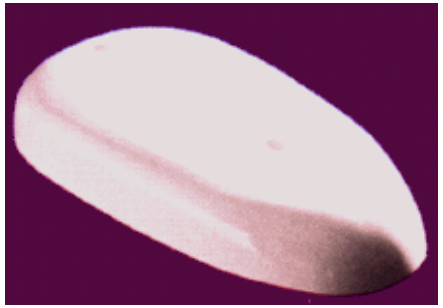
ADF LOOP

GLIDESLOPE

ELT

COM WHIP BENT

COM WHIP



ADF COMBINED SENSE LOOP

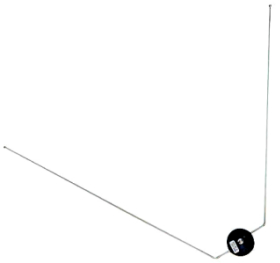
MARKER

COMBINED COM/VOR

GPS

DME/TRANSPONDER BLADE

VOR BLADES



VOR RABBIT EAR

General

Requirements for Standard Changes

Standard Change CS-SC004a

INSTALLATION OF ANTENNAS

1. Purpose

This SC covers the installation and exchange of antennas other than RADAR and directional SAT/COM antennas. For aircraft certified to operate in known icing conditions, this SC only covers the exchange of antennas. Installation of large antennas (such as High Frequency (HF) or Direction Finding (DF) antennas) in rotorcraft is not covered by this SC.

2. Applicability/Eligibility

Aeroplanes not being complex motor-powered aircraft, rotorcraft not being complex motor-powered aircraft and any ELA2 aircraft.

3. Acceptable methods, techniques and practices

The following standards contain acceptable data:

— FAA Advisory Circular AC 43.13-2B, Chapter 1 & 3; and

— FAA Advisory Circular AC 43.13-1B, Chapter 11, Section 15 (on electrical bonding).

Additionally, the following applies:

— The antenna is installed in non-pressurized secondary structure areas, unless the location is set for this purpose in the airframe documentation or provided by the TC holder (i.e. NTO), or the antenna is being exchanged and has the same footprint.

— The antenna is located in a distance to other antennas appropriate for the aircraft and the antennas.

— The antenna is compatible with the connected equipment and is suitable for the environmental conditions to be expected during normal operation.

— For aircraft certified to operate in known icing conditions, the new antenna is located at the same position and has a size similar to that of the existing antenna being replaced.

— Instructions and tests defined by the equipment manufacturer have to be followed.

— The performance of the new antenna installation or of the new antenna type has to be confirmed during testing after installation (e.g. range of radio).

4. Limitations

Any limitations defined by the equipment manufacturer apply.

5. Manuals

Amend the Instructions for Continuing Airworthiness to establish maintenance actions/inspections and intervals, as required.

6. Release to service

This SC is not suitable for release to service by the Pilot-owner.

Requirements for Non-Standard Changes

Requirement	Title
23.23	Load distribution limits
23.29	Empty weight and corresponding centre of gravity
23.251	Vibration and buffeting
23.301(b)	Loads
23.303, 23.305, 23.307	Static Strength
23.365	Pressurized Compartments
23.561	Emergency landing conditions
23.571/573/574	Fatigue & Damage Tolerance
	Lightning Protection
23.601	General (Design and Construction)
23.603	Materials
23.605	Fabrication Methods
23.607	Fasteners
23.609	Protection of structure
23.611	Accessibility provisions
23.613	Material Strength Properties and Material Design values
23.619	Special Factors
23.629	Aeroelasticity
23.841	High Altitude / High Performance Aircraft
23.1419	Ice Protection
23.1529	Instructions for Continued Airworthiness

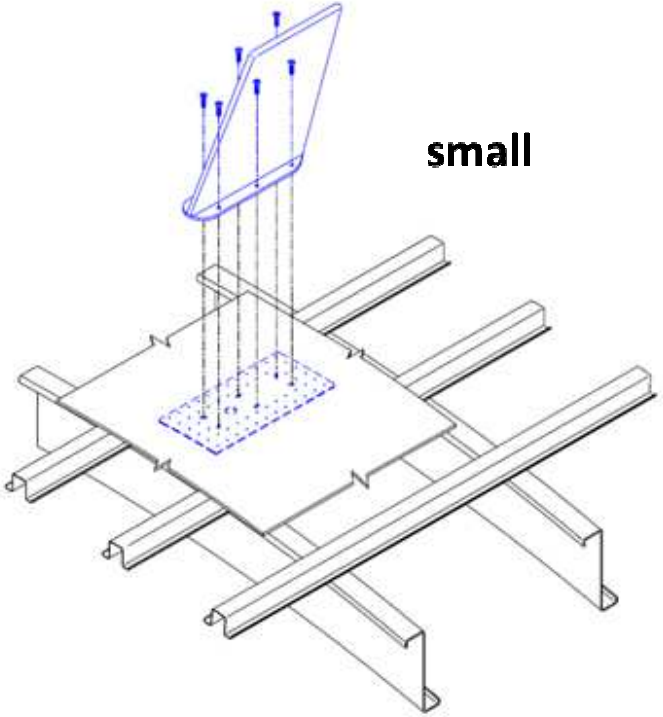
* Generic CRI on major set of requirements + CRI on vibration and buffeting to be envisaged!

Classification

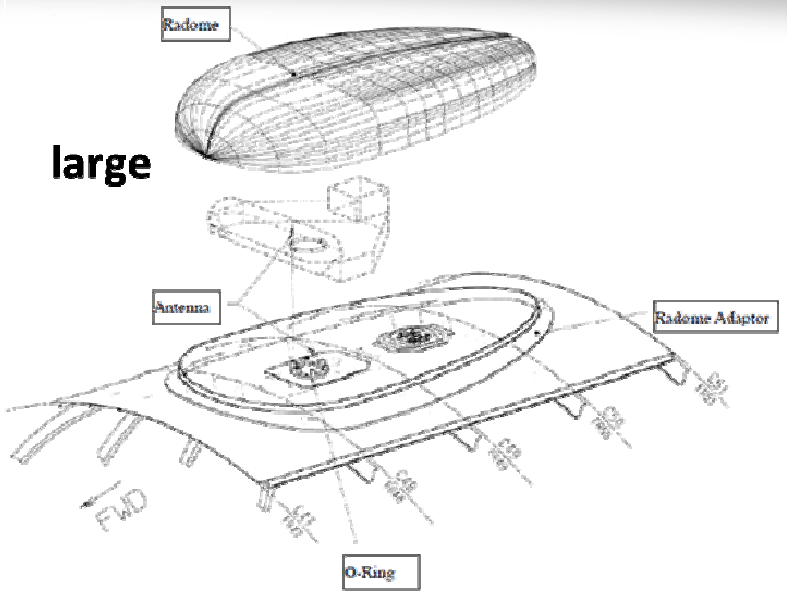
- Two initial criteria for classification:
  - **Geometry** (small to large) **/ (not necessarily minor to major)**
    - includes aerodynamic drag and aeroelastic effects
  - **Stress level** (low ↗ high ≡ non-pressurized ↗ pressurized)

Classification / Geometry

small



large



Classification / Stress

- Antenna installations typically located on the fuselage skin, bounded by frames and longerons, away from discontinuities like doors and windows
- For most of the fuselage the stress state is mainly biaxial loading (circumferential and longitudinal) due to pressure plus vertical inertia fuselage bending (longitudinal) only. Other loading could be reasonably neglected.

Total stress:

$f_{hoop} = \frac{\Delta p \cdot R}{t}$ [Pa] , circumferential stress

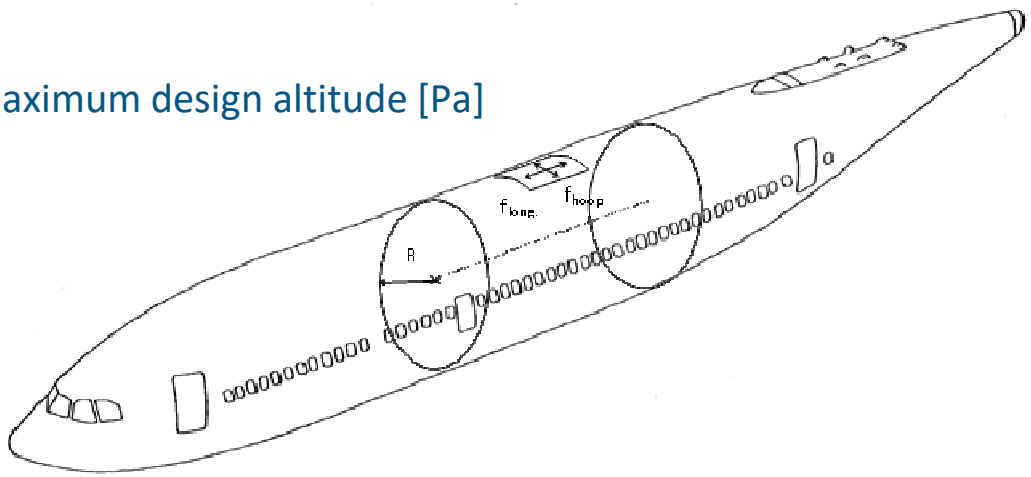
$f_{longitudinal} = \frac{\Delta p \cdot R}{2 \cdot t}$ [Pa] + bending stress , longitudinal stress

The longitudinal bending stress needs to be considered also for non-pressurized aircraft F&DT analysis

Δp = normal operating pressure differential at maximum design altitude [Pa]

R = fuselage radius [m]

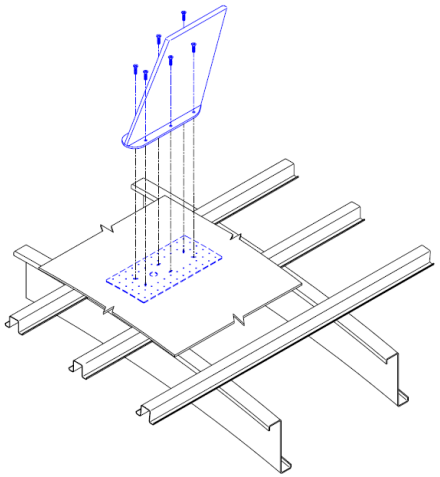
t = wall thickness [m]



Classification by Geometry and Stress

- geometrical small, non-pressurized and non PSE would fall under **SC** category according to CS-STAN (**minor**).
- geometrical small and PSE **(major)**
- geometrical small and pressurized always becomes **major** because of fatigue and damage tolerance issues and higher stresses through pressure.
- geometrical large and non-pressurized is no SC (always category **major** – also steered by classification requirements in part 21!)
- geometrical large and pressurized (always **major**)

Classification for metallic Structure



small

Classification of antennas

A/C metallic

Antenna < one skin bay *

Yes / No

Antenna **protruding** out of boundary layer (drag criteria)

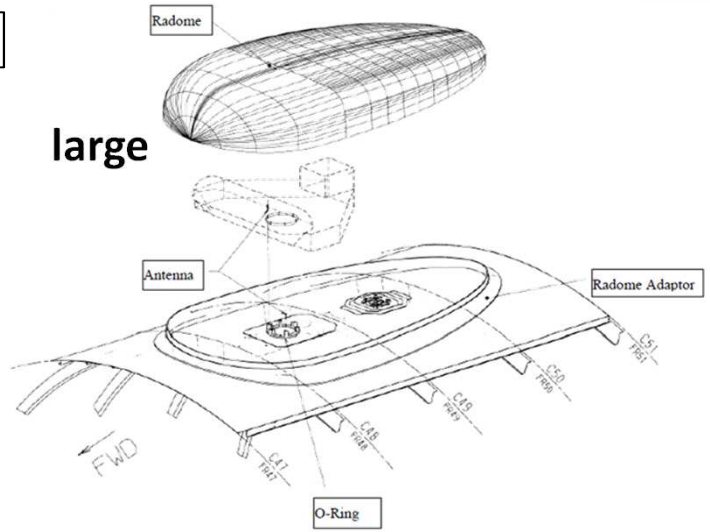
No / Yes

small antenna

EASA generic CRI on large antennas

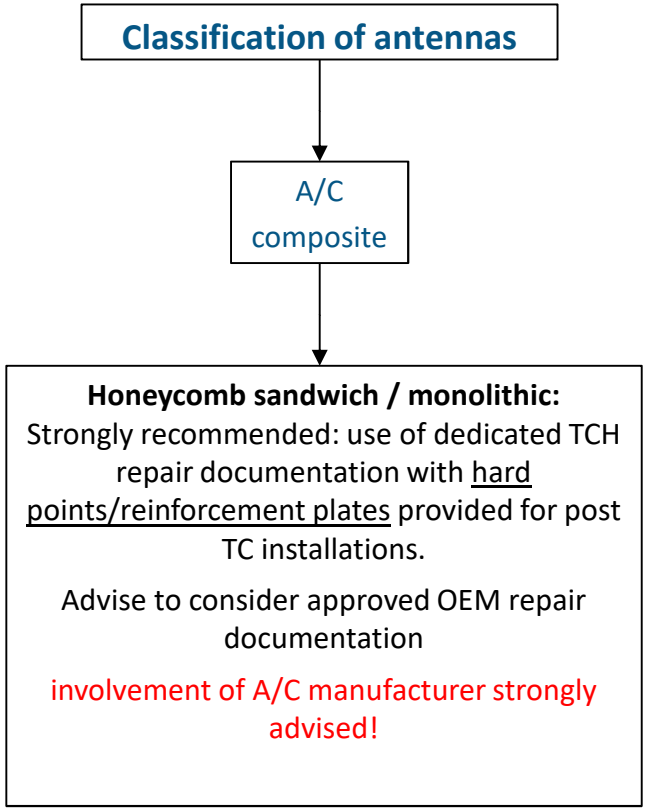
Pressurization makes all **major**!

large



* area between 2 adjacent frames and stringers

Classification for Composite Structure



Need for Flight Testing

Need for Flight Testing (for geometrical large antennas only!)

Vibration and buffeting / flutter excitation could be caused at radome location and at the empennage through a flow separation at the antenna radome and subsequent propagation of non-laminar flow.

- CS 23.301(b) requests **Flight Loads Validation (canard and tandem wing config.)**
  - Analysis needs to be validated - if needed - by Flight Test (Flight Load Survey)
  - Except a validated and approved analysis method is available
- CS 23.251 accounts for **Vibration and Buffeting**
  - Evaluate effect of modification on vibration and buffeting by validated analysis
  - In case of an effect a Flight Test is needed as the only acceptable MOC (means od compliance) for 23.251
  - It has been determined, that generally large antennas have an effect on vibration and buffeting, thus flight test is typically required
- Relevant Flight Conditions for testing (example)
  - Cruise condition flight (small α and β)
    - A flight testing up to V_{mo} is deemed necessary and reasonable
  - Approach/Take-Off condition (large α and β)
    - A flight testing up to V_{FE} with a variation in α and β is deemed necessary and reasonable

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Thank you for your attention!

Any questions

Your safety is our mission.

An agency of the European Union