EASA	CERTIFICATION MEMORANDUM
	EASA CM No.: EASA CM - S – 001 Issue: 01 **Issue Date: 11th of April 2012** **Issued by: Structures section** **Approved by: Head of Certification Experts Department** **Regulatory Requirement(s): CS 25.571(e), CS 25.629, CS 25.631, CS 25.775(b)(c), CS 25.1309(b), CS 25.1323(j)**

EASA Certification Memoranda clarify the European Aviation Safety Agency's general course of action on specific certification items. They are intended to provide guidance on a particular subject and, as non-binding material, may provide complementary information and guidance for compliance demonstration with current standards. Certification Memoranda are provided for information purposes only and must not be misconstrued as formally adopted Acceptable Means of Compliance (AMC) or as Guidance Material (GM). Certification Memoranda are not intended to introduce new certification requirements or to modify existing certification requirements and do not constitute any legal obligation.

EASA Certification Memoranda are living documents into which either additional criteria or additional issues can be incorporated as soon as a need is identified by EASA.

Subject

Compliance with CS-25 Bird Strike Requirements

Log of Issues

Issue	Issue date	Change description
01	11.04.2012	First issue.

Table of Contents

1. INTRODUCTION

1.1. PURPOSE AND SCOPE

The purpose of this Certification Memorandum is to provide specific guidance for compliance with CS-25 bird strike requirements.

This Certification Memorandum addresses several issues associated with showing compliance with CS-25 bird strike requirements that in the opinion of the Agency need further clarification, based on experience gathered over many certification programmes.

1.2. REGULATORY REFERENCES & REQUIREMENTS

It is intended that the following reference materials be used in conjunction with this Certification Memorandum:

Reference	Title	Code	Issue	Date
25.571(e)	*Damage-tolerance (discrete source) evaluation*	CS-25	---	---
25.629	*Aeroelastic stability requirements*	CS-25	---	---
25.631	*Bird strike damage*	CS-25	---	---
25.775(b)(c)	*Windshields and windows*	CS-25	---	---
25.1309(b)	*Equipment, systems and installations*	CS-25	---	---
25.1323(j)	*Airspeed indicating system*	CS-25	---	---

1.3. ABBREVIATIONS

The following abbreviations are used in this Certification Memorandum:

Abbreviation	Meaning
AMC	**A**cceptable **M**eans of **C**ompliance
CS	**C**ertification **S**pecification
ft	**F**eet
lbs	**P**ounds
Vc	Design **C**ruise **S**peed

1.4. DEFINITIONS

The following definitions are used in this Certification Memorandum:

Definition	Meaning
---	---

2. BACKGROUND

CS 25.631 requires that the aeroplane must be designed to assure capability of continued safe flight and landing of the aeroplane after impact with a 4 lbs bird when the velocity of the aeroplane (relative to the bird along the aeroplane's flight path) is equal to Vc at sea-level or 0.85 Vc at 8000 ft, whichever is the more critical.

The phrase "continued safe flight and landing" in this respect may be interpreted in different ways and the effects of bird strike are also addressed in various other sections of CS-25:

(a) CS 25.571(e) which requires that the aeroplane must be capable of successfully completing a flight during which likely structural damage occurs as a result of bird impact as specified in CS 25.631. The AMC to 25.571 (in paragraph 2.7.2) specifies the loads associated with "get home" conditions that have to be met for this case;

(b) CS 25.629 which requires freedom from aeroelastic instability throughout the envelope described in CS 25.629 (b)(2) for any damage or failure condition, required or selected for investigation by CS 25.571 and any damage, failure or malfunction, considered under CS 25.631.

(c) CS 25.775(b) which requires no penetration of the windshield panes directly in front of the pilots in the normal conduct of their duties under the bird impact conditions of CS 25.631. In addition, CS 25.775(c) requires to minimize the danger to the pilots from flying windshield fragments due to bird impact;

(d) CS 25.1323(j) which stipulates that where duplicate airspeed indicators are required, their respective pitot tubes must be far enough apart to avoid damage to both tubes in a collision with a bird;

(e) AMC 25.631 which draws the attention to consideration of the location and installation of items, systems and equipment in relation to bird strike;

(f) AMC 25.1309(b) where bird strike is identified as a Particular Risk requiring investigation as part of the Common Cause Analysis.

As demonstrated by in-service events and during several certification programs there is a need to further clarify EASA's expectations when showing compliance to the bird strike requirements, as follows.

The EASA Certification Policy contained in Section 3 of this Certification Memorandum provides an overview of typical aircraft areas/zones prone to bird strike which normally are considered. This overview includes pressurised and non-pressurised area/zones, as well as primary and secondary structure, as the CS-25 bird strike requirements in principle make no distinction between these categories of structure in terms of applicability of these requirements (i.e. all should be considered). The EASA Certification Policy also recognizes that for flaps, slats and landing gears a lower impact speed than Vc has been accepted in the past as more appropriate for these items in the case that the deployment speed is limited due to certain (placard) restrictions.

The EASA Certification Policy further addresses the considerations related to those aircraft areas/zones where non-penetration and no part loss under bird impact conditions can be shown. This would be the preferred certification approach. Bird impact induced deformations and accelerations on structures, systems, equipment and other items should be addressed in this scenario. Based on previous in-service and certification experience guidance is given for addressing those cases. Examples of in-service events related to these cases include:

(a) In 1971, a DC-9 was struck by a buzzard, hitting the forward pressure bulkhead and tripping the circuit breakers leading to loss of DC power;

(b) In 1984, an A310 was struck by a bird in the nose area, causing loss of the flight augmentation computer;

(c) In 1986, the windshield of a DHC-8 was struck by a bird, causing complete electrical failure;

(d) In 1989, an A320 was struck by a vulture hitting the top of the captain's panel of the windshield. This resulted in loss of information on 4 flight displays and fuel valve cut-off, causing one engine to shut down.

In addition, during recent certification bird strike testing on a CS-25 aircraft the shock wave effect on certain systems installed in the cockpit area was such that a redesign was necessary.

Although not the preferred certification approach, the Policy also addresses those cases where penetration into certain aircraft areas/zones or part loss may occur under the impact conditions of CS 25.631. Based on previous in-service and certification experience guidance is given how to address those cases. Examples of in-service events related to this include:

(a) In 2000 a survey of Large Aeroplane fleet experience has been performed as part of the JAA/FAA harmonisation discussions on bird strike requirements. This survey identified thirty-one penetrations into the flight deck area over a period of about twenty years (1970 – 1993), resulting in nineteen injuries and one fatality. Since then a number of similar incidents have occurred;

(b) In 1992 a bird struck a hole in the nose area of an AN-124. This allowed the area between the nose and the front bulkhead to become pressurised by the ram-air causing failure of the upward opening freight door. Control was lost and the aircraft crashed.

In addition during recent certification of a CS-25 aircraft it was established that partial loss of a winglet may be more critical in terms of freedom from flutter than complete loss of a winglet.

3. EASA CERTIFICATION POLICY

3.1. EASA Policy

When showing compliance with the CS-25 bird strike requirements, several disciplines are involved, such as Structures, Systems and Flight Test. Co-ordination between these disciplines is required to address the following considerations (in addition to meeting all applicable requirements, such as discrete source damage requirements).

(1) Initially all areas/zones of the aircraft prone to bird strike should be considered, either pressurised or non-pressurised, either primary or secondary structure. This would normally include areas/zones such as:

(a) Windshields (transparencies, posts/sills);

(b) Canopy (fuselage area above windshields, overhead panels);

(c) Instrument panels (fuselage area below windshields);

(d) Nose/radome;

(e) Forward pressure bulkhead;

(f) Externally mounted instrumentation (e.g. airspeed indicators);

(g) Wings (leading edges (including slats), trailing edges (flaps));

(h) Engine pylons and nacelles;

(i) Landing gears and landing gear doors;

(j) Horizontal and vertical stabilizers (leading edges);

(k) Winglets;

(l) Externally mounted large antennas (antenna fairings);

(m) Externally mounted stores (storage pods);

(n) Fairings (e.g. wing to fuselage).

Note that ailerons, rudders, elevators and spoilers are typically not considered for compliance with bird strike requirements. This is deemed acceptable if the exposure of these elements to a bird strike is very limited, for example because of their location behind other structure such as wing and empennage (capable of stopping a bird) and/or the short deflection times. Criticality of these elements in relation to continued safe flight and landing, and/or available redundancy, should also be considered in determining the need for compliance with bird strike requirements.

Some of the areas/zones identified above (such as fairings and winglets) are typically considered as secondary structure. Although CS 25.571 is mainly focused on PSE's (Principal Structural Elements), this does not mean by definition that secondary structure need not be considered for bird impact. For example, if some systems essential for continued safe flight and landing are located behind a fairing, this area/zone would have to be evaluated for bird impact. Similarly a damaged winglet should be investigated for its potential to cause flutter. Compliance with residual strength requirements however is normally not expected for such secondary structure.

For those aircraft areas/zones where it is established that bird strike is of concern, probabilistic arguments (for example the likelihood of impact based on consideration of frontal area, flight phase, aircraft speed and altitude) will not normally be accepted by EASA as the basis for not complying with bird strike requirements.

For high lift devices (flaps and slats) instead of using Vc at sea-level or 0.85 Vc at 8000 ft, the appropriate maximum design speed (as per CS 25.335(e)) may be taken as the basis for determining the bird impact damage. For landing gears the appropriate maximum speed (as per CS 25.1515) may be taken as the basis for determining the bird impact damage.

(2) Showing that under the conditions of CS 25.631 no bird penetration and no part loss occurs in the aircraft areas/zones where bird strike is of concern, is the preferred certification approach. For this scenario, continued safe flight and landing should be further substantiated considering the following effects:

(a) Bird-strike induced deformation of structures on internal structural items, such as instrument panels or avionics racks;

(b) Bird-strike induced deformation of structures on underlying items, systems and equipment, or on operational approved performance (corrective pilot action may be considered); and

(c) Bird-strike induced accelerations on items, systems and equipment.

(3) If contrary to item (2) above, bird penetration and/or part loss does occur in the aircraft areas/zones where bird strike is of concern, the following should be considered:

(a) The effects of subsequent impacts on items, systems and equipment after penetration should not prohibit continued safe flight and landing;

(b) Bird penetration into the flight deck area (except via the windshields which is not allowed as per CS 25.775(b)) should be avoided as much as practicable and be limited to certain specific bird trajectories and/or flight phases. It should not result in the injury or incapacitation of the flight crew, nor in such workload increase for the flight crew, that it would preclude continued safe flight and landing. Any associated/collateral bird strike damage to affected items, systems and equipment for these bird trajectory paths should be considered. It is however recognized that such trajectory analyses are difficult to perform and to validate, which is another reason why showing no penetration under the regulatory bird impact conditions is the preferred certification approach;

(c) If the nose/radome area is penetrated, the structural effects of the air flow/dynamic pressure generated in the radome due to the hole imparted by the bird should be evaluated. Satisfactory structural performance of the radome, retention of the radome structure and aircraft supporting structure under these circumstances should be demonstrated, unless continued safe flight and landing can be substantiated with loss of the nose/radome. These considerations would also apply to large antenna or external radome installations;

(d) If the pressure vessel is penetrated the effect of rapid decompression should be considered. For example the effects of cabin pressurisation release into the radome area should be considered in addition to the dynamic pressure as per item (c) above;

(e) For winglets, freedom from flutter within the fail-safe envelope (as per CS 25.629) should be substantiated with complete loss or partial loss of the winglet due to bird strike. Complete loss or partial loss of the winglets should be considered to occur at obvious breaking points such as attachments or splices;

(f) For bird penetration into the fuel tanks (e.g. through wing leading edge and front spar) it must be substantiated that fire or other hazards (e.g. the resulting fuel imbalance or the inability to continue the normal flight) would not preclude continued safe flight and landing. Fuel tank leaks due to bird strike in the vicinity or upstream path of heat sources (landing gears, engines) would normally not be considered acceptable;

(g) The effects on continued safe flight and landing of damage and subsequent release of debris resulting from bird impact should also be addressed, for example for flaps, landing gear doors and large antennas. The effects of such parts loss should not prohibit continued safe flight and landing. This evaluation should include the effect of any debris impacting other parts of the aircraft (e.g. empennage area or engines) and should consider any hazardous asymmetric conditions arising. The use of design features such as multiple attachment points, the application of engineering judgement and the review of relevant service experience may be used to support this evaluation.

3.2. Who this Certification Memorandum Affects

This Certification Memorandum affects applicants who need to show compliance with CS-25 bird strike requirements.

4. REMARKS

1. Suggestions for amendment(s) to this EASA Certification Memorandum should be referred to the Certification Policy and Planning Department, Certification Directorate, EASA. E-mail CM@easa.europa.eu or fax +49 (0)221 89990 4459.

2. For any question concerning the technical content of this EASA Certification Memorandum, please contact:

Name, First Name: DOELAND, Wim

Function: Structures Expert

Phone: +49 (0)221 89990 4041

Facsimile: +49 (0)221 89990 4541

E-mail: willem.doeland@easa.europa.eu