

Federal Aviation Administration – [Regulations and Policies](#)
Aviation Rulemaking Advisory Committee

Transport Airplane and Engine Issue Area
General Structures Harmonization Working Group

Task 2 – Safe Life Scatter Factor

Task Assignment

Aviation Rulemaking Advisory Committee; General Structures Harmonization Working Group

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of establishment of General Structures Harmonization Working Group.

SUMMARY: Notice is given of the establishment of the General Structures Harmonization Working Group of the Aviation Rulemaking Advisory Committee (ARAC). This notice informs the public of the activities of the ARAC on transport airplane and engine issues.

FOR FURTHER INFORMATION CONTACT: Mr. William J. (Joe) Sullivan, Assistant Executive Director, Aviation Rulemaking Advisory Committee, Aircraft Certification Service (AIR-3), 800 Independence Avenue, SW., Washington, DC 20591, Telephone: (202) 267-9554; FAX: (202) 267-5364.

SUPPLEMENTARY INFORMATION: The Federal Aviation Administration (FAA) has established an Aviation Rulemaking Advisory Committee (ARAC) (56 FR 2190, January 22, 1991; and 58 FR 9230, February 19, 1993). One area the ARAC deals with is transport airplane and engine issues (56 FR 31995; July 12, 1991). These issues involve the airworthiness standards for transport airplanes, engines and propellers in parts 25, 33 and 35 of the Federal Aviation Regulations (14 CFR parts 25, 33 and 35) which are the responsibility of the FAA Director of Aircraft Certification.

The FAA announced at the Joint Aviation Authorities (JAA)-Federal Aviation Administration (FAA) Harmonization Conference in Toronto, Ontario, Canada, (June 2-5, 1992) that it would consolidate within the Aviation Rulemaking Advisory Committee structure an ongoing objective to "harmonize" the Joint Aviation Requirements (JAR) and the Federal Aviation Regulations (FAR). Coincident with that announcement, the FAA assigned to the ARAC those projects related to JAR/FAR 25, 33 and 35 harmonization which were then in the process of being coordinated between the JAA and the FAA. The harmonization process included the intention to present the results of JAA/FAA coordination to the public in the form of either a notice of proposed rulemaking or an advisory circular—an objective comparable to and compatible with that assigned to the Aviation Rulemaking Advisory Committee. The General Structures Harmonization Working Group is being formed to address general structures issues in JAR/FAR parts 25 identified below. The

General Structures Harmonization Working Group will forward recommendations to the ARAC which will determine whether to forward them to the FAA.

Specifically, the Working Group's tasks are the following: The General Structures Harmonization Working Group is charged with making recommendations to the ARAC concerning the FAA disposition of the following subjects recently coordinated between the JAA and the FAA:

Task 1—Bird Strike Damage: Develop new or revised requirements for the evaluation of transport category airplane structure for in-flight collision with a bird, including the size of the bird and the location of the impact on the airplane (FAR 25.571, 25.631, 25.775, and other conforming changes).

Task 2—Safe Life Scatter Factor: Develop recommendations for new or revised advisory and guidance material concerning the safe life scatter factors (FAR 25.571).

Reports

A. Recommend time line(s) for completion of each task, including rationale, for consideration at the meeting of the ARAC to consider transport airplane and engine issues held following publication of this notice.

B. Give a detailed conceptual presentation on each task to the ARAC before proceeding with the work stated under item C and D, below.

C. Draft for the ARAC a notice of proposed rulemaking for Task 1 proposing new or revised requirements, a supporting economic analysis and other required analysis, advisory and guidance material, and any other collateral documents the Working Group determines to be needed.

D. Draft for the ARAC appropriate advisory and guidance material for Task 2.

E. Give a status report on each task at each meeting of the ARAC held to consider transport airplane and engine issues.

The General Structures Harmonization Working Group will be comprised of experts from those organizations having an interest in the tasks assigned. A Working Group member need not necessarily be a representative of one of the member organizations of the ARAC. An individual who has expertise in the subject matter and wishes to become a member of the Working Group should write the person listed under the caption **FOR FURTHER INFORMATION CONTACT** expressing that desire, describing his or her interest in the task, and the expertise he or she would bring to the Working Group. The request will

be reviewed with the Chairs of the ARAC Transport Airplane and Engine Issues and the General Structures Working Group, and the individual will be advised whether or not the request can be accommodated.

The Secretary of Transportation has determined that the information and use of the ARAC are necessary in the public interest in connection with the performance of duties of the FAA by law. Meetings of the ARAC to consider transport airplane and engine issues will be open to the public except as authorized by section 10(d) of the Federal Advisory Committee Act. Meetings of the General Structures Harmonization Working Group will not be open to the public except to the extent that individuals with an interest and expertise are selected to participate. No public announcement of Working Group meetings will be made.

Issued in Washington, DC, on March 8, 1993.

William J. Sullivan,

Assistant Executive Director for Transport Airplane and Engine Issues, Aviation Rulemaking Advisory Committee.

[FR Doc. 93-5814 Filed 3-12-93; 8:45 am]

BILLING CODE 4910-13-M

Recommendation Letter

October 22, 2003

Federal Aviation Administration
800 Independence Avenue, SW
Washington, D.C. 20591

Attention: Mr. Nicholas Sabatini, Associate Administrator for Regulation and Certification

Subject: ARAC Tasking, General Structures – 25.631 Bird Strike

Reference: ARAC Tasking, Federal Register, dated March 15, 1993

Dear Nick,

The General Structures HWG has been unable to reach consensus with regard to the reference tasking on bird strike (25.631). After discussion with the WG group at the October 16, 2003 TAEIG meeting, it was concluded that the WG group report should be submitted to the FAA with the various individual positions documented. This report is attached.

The WG did note that one alternative that was discussed was “enveloping” the existing FAR and JAR rules. This proposal did not gain support from the JAA representative on the WG, apparently because it was felt there was insufficient technical justification for increasing the “JAR bird weight” from 4 to 8 pounds. The FAA may wish to consider if an opportunity still exists for enveloping the FAR and JAR requirements.

TAEIG and the Working Group regret that consensus could not be achieved on this tasking.

Sincerely yours,



C. R. Bolt
Assistant Chair, TAEIG

Copy: Dionne Krebs – FAA-NWR
Mike Kaszycki – FAA-NWR
Effie Upshaw – FAA-Washington, D.C.
Andrew Kasowski - Cessna

Acknowledgement Letter

SEP 20 2004

Mr. Craig R. Bolt
Assistant Chair, Aviation Rulemaking
Advisory Committee
Pratt & Whitney
400 Main Street, Mail Stop 162-14
East Hartford, CT 06108

Dear Mr. Bolt:

This letter acknowledges receipt of several letters that you sent for the Aviation Rulemaking Advisory Committee (ARAC) on Transport Airplane and Engine (TAE) Issues.

| Date of Letter | Description of Recommendation | Working Group |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|
| 01/06/2003 | Proposed rule and draft advisory material on bird ingestion capability (§ 33.76) | Engine Harmonization Working Group (HWG) |
| ✓ 10/22/2003 | Final report and position statements on bird strike requirements (§ 25.631) | General Structures HWG |
| 10/22/2003 | Final report and draft advisory material on alternative composite structure material (§ 25.603) | General Structures HWG |
| 05/14/2004 | Final report, proposed rule language, and draft advisory material on warning, caution, and advisory alerts installed in the cockpit (§ 25.1322) | Avionics Systems HWG |
| 06/17/2004 | Final report and draft advisory material on fire protection of flight controls, engine mounts and other flight structures (§ 25.865) | Loads and Dynamics HWG |
| 06/22/2004 | Final report, proposed rule, and draft advisory material on installed systems and equipment for use by the flight crew (§ 25.1302) | Human Factor HWG |

I wish to thank the ARAC and the working groups for the resources that industry gave to develop these recommendations. The recommendations from the Avionics Systems HWG, the Human Factor HWG, and the Loads and Dynamics HWG will remain open until these working groups complete a Phase 4 review. The remaining recommendations have been closed, as we consider submittal of the reports as completion of the tasks. All of these recommendations will be placed on the ARAC website at <http://www.faa.gov/avr/arm/arac/index.cfm>.

We will continue to keep you apprised of our efforts on the ARAC recommendations and the rulemaking prioritization at the regular ARAC TAE issues meetings.

Sincerely,

Original Signed By
Margaret Gilligan

Nicholas A. Sabatini
Associate Administrator for Regulation
and Certification

cc: ARM-1/20/200/204/207; AIR-100, ANM-110
ARM-207:JLinsenmeyer:fs:8/12/04:PCDOCS # 21644
Control Nos. 20041855-0; 20041944-0; 20042001-0

Recommendation

June 30, 2003
L350-03-114

Mr. Craig R. Bolt
Assistant Chair, TAEIG
Pratt & Whitney
400 Main Street
East Hartford, Ct 06108

Dear Craig,

Subject: Submittal of Results of Harmonization Effort on FAR/JAR §25.631, Birdstrike

This submittal is a follow-up to earlier submittals in July of 1995 and June of 1999 on the same subject. The General Structures Harmonization Working Group, having spent ten years of meetings and discussions on this subject, cannot reach consensus on a harmonized set of criteria for birdstrike. Two issues continue to divide the group: 1) bird weight and 2) cutback speed. The group therefore has agreed to disagree and has provided white papers attached to this working group report outlining the individual positions.

Summary

The GSHWG proceeded in good faith to harmonize the material related to birdstrike and did reach agreement within the GSHWG in May 1995 on changes to the rule(s) and the advisory material, with one documented dissenting opinion. A draft NPRM and AC were submitted to TAEIG in July of 1995 for review and submittal to the FAA for legal and economic evaluation. The dissenting opinion, held by the FAA, was noted and the GSHWG resolution of the dissenting opinion was enclosed with the submittal package. TAEIG voted to accept the package and to forward it to the FAA. The package was submitted to the FAA by the TAEIG for legal and economic review in May of 1996.

In January of 1999, the GSHWG chairperson received a memorandum from the economist assigned to the project providing a "rough estimate" of the evaluation of the NPRM and advisory material package that had been submitted. The economist had determined that the safety level had been reduced and that the expected decrease in cost to the industry was so small that it did not appear to justify the proposal. Based on this preliminary result, the FAA indicated they did not wish to invest any more time in completing the evaluation, since it would not be accepted. The GSHWG chairperson relayed this information to the TAEIG in March of 1999. In August of 1999 the TAEIG Assistant Chairperson requested formal technical positions regarding bird weight from the FAA and JAA so that it could be determined if harmonization was possible.

In April of 2000 the FAA provided to the JAA its justification for the FAA position on the eight-pound bird requirement. In August of 2000 the FAA requested the TAEIG opinion on whether or not to close the birdstrike issue. In addition, an FAA sponsored research project, "Assessment of Wildlife Strike Risk to Airframes", was initiated by the University of Illinois Airport Technology Center of Excellence. In October of 2000, the GSHWG made a recommendation to the TAEIG not to close the birdstrike tasking. The group agreed to review the outcome from FAA sponsored study.

L350-03-114

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In January of 2001 the SSG issued draft Temporary Guidance Material (TGM) on birdstrike cutback speeds. In August of 2001 the JAA withdrew its support of the GSHWG agreed position on birdstrike, indicating that the issue of “cutback” speeds must be addressed, i.e. “cutback” speeds could no longer be allowed. At the thirty-fourth meeting of the GSHWG in October of 2002, the results of the University of Illinois research (formally documented in a University of Illinois report dated December 2002) were reviewed and several attempts were made to reach group consensus on a harmonized position. The group finally agreed to disagree and submit separate white papers to the TAEIG along with a statement that harmonization cannot be achieved within the group.

The working group report being submitted reflects the lack of harmonization achieved on this subject and provides documentation of each of the major group member positions. The GSHWG deeply regrets that harmonization could not be attained but feels that further efforts at harmonization on this subject by the group would continue to be non-productive.

Sincerely,

Andrew H. Kasowski
General Structures HWG Chairperson
316-517-6008
315-517-1820 FAX
akasowski@cessna.textron.com

Attachment A

General Structures Harmonization Working Group Report

Birdstrike FAR/JAR §25.571(e)(1), 25.631, 25.775(b)(c)

General Structures Harmonization Working Group Report

Birdstrike FAR/JAR §25.571(e)(1), 25.631, 25.775(b)(c)

Transport Airplane Directorate

WG Report Format

Harmonization and New Projects

1 - BACKGROUND:

- *This section “tells the story.”*
- *It should include all the information necessary to provide context for the planned action. Only include information that is helpful in understanding the proposal -- no extraneous information (e.g., no “day-by-day” description of Working Group’s activities).*
- *It should provide an answer for all of the following questions:*

a. SAFETY ISSUE ADDRESSED/STATEMENT OF THE PROBLEM

- (1) What prompted this rulemaking activity (e.g., accident, accident investigation, NTSB recommendation, new technology, service history, etc.)? What focused our attention on the issue?

Part 25 bird strike requirements

Prior to 1970, the only U.S. airworthiness regulation concerning bird strikes on transport category airplanes was Civil Air Regulations (CAR) 4b, which requires no penetration of the windshield by a four pound bird impact at cruise speed. The requirement preceded the jet transport era, and was adopted after a number of crew injuries due to bird penetrations of windshields.

In 1970, the regulations were changed as a result of an accident that occurred in 1962, in which a Vickers Viscount turboprop airplane operated by a U.S. airline experienced loss of control and crashed with no survivors near Chesapeake, Maryland. The accident was caused by impact with a swan, estimated to weigh between 12 and 17 pounds, which damaged the horizontal stabilizer and elevator while the airplane was in cruise flight at 6,000 feet altitude. That resulted in an FAA review of existing statistical bird strike data. As a result of that review, the FAA concluded that transport airplanes should be capable of continued safe flight and landing after impact with birds weighing up to eight pounds. This was formalized as an FAA proposal for the 1966 Airworthiness Review Conference.

The FAA reviewed statistical data collected from actual air carrier operations and noted that the fail-safe design principles used for structure and control systems had provided a high degree of protection against catastrophic damage due to the impact of large birds such as geese even when multiple strikes had occurred. The FAA also conducted bird strike testing on several types of jet transport airplanes, which served to reinforce the service data. The FAA concluded that most existing transport airplanes were inherently bird resistant, although a few types, such as the one noted above which crashed, were not sufficiently resistant in the empennage area.

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Birdstrike FAR/JAR §25.571(e)(1), 25.631, 25.775(b)(c)

The FAA anticipated that jet transports would displace propeller-driven airplanes in the 1970's and 1980's. After considering the above factors, the FAA determined that a specific rule applying to the entire airplane would only add to the substantiation effort without providing any significant design changes. Therefore, Notice of Proposed Rulemaking 68-18 (33 FR 11913, August 22, 1968) proposed the addition of § 25.631 which would require airplanes to be capable of continued safe flight and landing after impact on the empennage by an eight pound bird at design cruise speed.

There were a number of comments received on the above FAA proposal. One European airworthiness authority commented that having a requirement only on the tail was illogical, and that smaller airplanes in the weight range of 13,000 to 40,000 lbs. would be vulnerable from wing impacts. Also noted by that commenter was the fact that the proposed eight-pound requirement would not have prevented the one accident (noted above), and that the size of the bird should be based on probability considerations. The US Aerospace Industries Association commented that four pounds would be sufficient, since it had proven satisfactory for windshields. There were several comments that the eight-pound bird was not realistic and that larger birds should be considered (one commenter proposed 12 pounds, another 20 pounds), and that any requirement should also be applied to the wings and the windshield as well as the tail.

The FAA responded to the comments that service experience did not indicate an inadequacy in the resistance to the impact of large birds on structures other than the empennage, and that impacts with birds weighing more than eight pounds were rare enough that they need not be considered.

As a result of Notice 68-18 and subsequent comments, part 25 was amended in 1970 (Amendment 25-23; 35 FR 5665, April 8, 1970) to add a new § 25.631 that required the empennage structure to be designed to assure the capability of continued safe flight and landing after impact with an eight pound bird at speeds up to the design cruise speed at sea level.

Other rule changes regarding bird strikes have been introduced since § 25.631 was adopted.

On August 15, 1977, the FAA published Notice 77-15 (41 FR 41236, August 15, 1977) proposing new damage tolerance requirements to be added to § 25.571, "Fatigue Evaluation of Flight Structure", including requirements for discrete damage caused by bird impact. Only a few comments were received regarding bird strike damage. Two stated that the proposed bird strike requirement (continued safe flight following impact with a four pound bird at likely operational speeds) was inconsistent with §§ 25.631 and 25.775 (the windshield requirement). A major European airplane manufacturer commented that §§ 25.631 and 25.775 were completely adequate to ensure safety and that there was no justification for the proposed additional bird requirement. On December 1, 1978, § 25.571 was amended (Amendment 25-45; 45 FR 46242, October 5, 1978) as proposed, although the FAA did note in the preamble that there was some merit to having consistent requirements. It is unclear why the FAA originally proposed an inconsistent weight requirement, or why it failed to fully address the comment concerning justification of the proposal. There has been no reported incident where impact by a bird weighing four pounds or less has resulted in a serious non-engine related safety hazard to any transport category airplane.

The bird strike requirement of § 25.571(e) was amended further by Amendment 25-72 (55 FR 29776, July 20, 1990), which changed the speed requirement from "likely operational speed" to "design cruise speed." That was accomplished in part to harmonize the requirement with the existing JAR, and to prevent possible ambiguous interpretations of likely operational speeds. There is a current FAA proposal to correct an unintentional error in that amendment; it would specify a speed of V_c at sea level or $0.85V_c$ at 8,000 feet, whichever is the more critical. That is also the current JAA requirement.

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Birdstrike FAR/JAR §25.571(e)(1), 25.631, 25.775(b)(c)

In some cases, special interpretations, equivalent safety findings and special conditions have been issued for bird strikes. Since § 25.631 does not apply to wings, the FAA has requested, and several manufacturers have agreed, to establish an acceptable level of safety for airplanes equipped with winglets, with one winglet missing to account for impact with a large bird. Special interpretations have also been necessary in the application of other rules, such as § 25.365 which applies to the structural design loads arising from depressurization events. The FAA has interpreted that section as requiring an evaluation of the effects of depressurization resulting from the loss of a complete windshield panel from large bird impacts at altitudes up to 8000 feet (above which such impacts have been considered extremely improbable). For some airplanes having certification bases prior to Amendment 25-23, § 25.631 has been applied to design changes involving composite empennage structure.

JAR-25 bird strike requirements

In the late 1960's and early 1970's, when JAR-25 was developed in Europe as an airworthiness code, part 25 was selected as the basic code. The discussions included review of §§ 25.631 and 25.775(b).

The text of § 25.631 (Amendment 23) was not adopted in Change 1 (effective 25 July 1975) of JAR-25. Instead, JAR 25.631 at Change 1 specified that "the aeroplane must be designed to assure capability of continued safe flight and landing after impact with a four pound bird when the velocity of the aeroplane (relative to the bird along the aeroplane's flight path) is equal to V_c at sea level or $0.85 V_c$ at 8000 ft, whichever is the more critical."

Partially based on the British BCAR Section D, it was purposefully decided to deviate from part 25 on a number of points:

- instead of the empennage only, it was decided to address the complete airplane;
- instead of an eight pound bird, a four pound bird was appropriate;
- an additional "spot-check" at 8000 ft was required to prohibit manufacturers choosing a low V_c at sea level, with a possible rapid increase of V_c just above sea level, that would avoid the intent of the requirement.

The protection of essential systems against bird impact was also addressed in JAR 25.631 (Change 1). This was later (Change 5, effective 1 January 1979) taken out of the basic requirement and put in a separate ACJ 25.631.

It was also decided to adopt the text of § 25.775(b) (Amendment 1) in Change 1 of JAR-25 as JAR 25.775(b), but to change the last part of the sentence of this subparagraph to make reference to JAR 25.631. Section 25.775(c) at Amendment 1 was later adopted as JAR 25.775(c) in Change 8 (effective 30 November 1981).

Amendment 25-45 of part 25 introduced the damage tolerance (discrete source) evaluations in § 25.571(e), where (e)(1) addressed bird strike. This was adopted as JAR 25.571(e)(1) in Change 7 (effective 24 November 1980) of JAR-25, but instead of adopting the part 25 text a reference was made to JAR 25.631. In ACJ 25.571 text was added to require (subparagraph 2.7.2.) the remaining structure (after bird impact) to be able to carry specific loads, and to be free from flutter.

In the latest version of JAR-25 (Change 15, effective 1 June 2000), JAR 25.631, 25.775(b)(c) and 25.571(e)(1) are still contained as described above.

FAA Reassessment of Bird Strike Requirements

In 1987 the FAA initiated a reassessment of the current bird strike regulations due to concerns with new technology. The new technology increased the use of critical systems and

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Birdstrike FAR/JAR §25.571(e)(1), 25.631, 25.775(b)(c)

composite materials, which were believed to be more sensitive to bird impact. These concepts were not considered when the original empennage requirement was enacted. A draft NPRM was prepared proposing the following new requirements: (1) Continued safe flight and landing after impact, at any location on the airplane, with an eight pound bird at design cruise speed. This would include effects of bird strike on structure as well as systems. (2) No penetration of the fuselage after impact with a four pound bird at design cruise speed.

The draft NPRM received significant negative comments from industry and the regulatory evaluation was revised after consideration of those comments. It then received its regulatory economic and legal evaluations, and in the latter part of 1992 was in final coordination prior to publication, even though substantial industry opposition still existed. At that point, the FAA decided to complete the rulemaking process through ARAC.

In 1989, a bird strike on a twin engine jet transport caused loss of information on four Cathode Ray Tube displays, and tripped a fuel shutoff valve, causing one engine to shut down. The bird, a vulture, approximately 10 pounds, struck (but did not penetrate) the top of the captain's panel of the windshield, while the airplane was flying at 250 KIAS at an altitude of 2500 ft. This incident is an example of what may happen to an airplane equipped with modern electronic flight control systems, where, although the bird does not penetrate the structure, the shock loading resulting from the impact still may have an effect on the functioning of essential systems. This issue is not clearly addressed in the current part 25 regulations, and partially addressed in ACJ 25.631 of JAR-25.

- (2) What is the underlying safety issue to be addressed in this proposal?

See Item 1 above.

- (3) What is the underlying safety rationale for the requirement?

See Item 1 above.

- (4) Why should the requirement exist?

See Item 1 above.

b. CURRENT STANDARDS OR MEANS TO ADDRESS

(1) If regulations currently exist:

- (a) What are the current regulations relative to this subject? (Include both the FAR's and JAR's.)

Current CFR 14 Part 25 text:

§ 25.631 Bird strike damage.

The empennage structure must be designed to assure capability of continued safe flight and landing of the airplane after impact with an 8-pound bird when the velocity of the airplane

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Birdstrike FAR/JAR §25.571(e)(1), 25.631, 25.775(b)(c)

(relative to the bird along the airplane's flight path) is equal to V_C at sea level, selected under § 25.335(a). Compliance with this section by provision of redundant structure and protected location of control system elements or protective devices such as splitter plates or energy absorbing material is acceptable. Where compliance is shown by analysis, tests, or both, use of data on airplanes having similar structural design is acceptable.

[Amdt. 25-23, 35 FR 5674, Apr. 8, 1970]

§ 25.571 Damage -- tolerance and fatigue evaluation of structure.

(e) *Damage-tolerance (discrete source) evaluation.* The airplane must be capable of successfully completing a flight during which likely structural damage occurs as a result of –

(1) Impact with a 4-pound bird when the velocity of the airplane relative to the bird along the airplane's flight path is equal to V_C at sea level or $0.85V_C$ at 8,000 feet, whichever is more critical;

(2) ...;

(3) ...; or

(4)

[Amdt. 25-45, 43 FR 46242, Oct. 5, 1978, as amended by Amdt. 25-54, 45 FR 60173, Sept. 11, 1980; Amdt. 25-72, 55 FR 29776, July 20, 1990; Amdt. 25-86, 61 FR 5222, Feb. 9, 1996; Amdt. 25-96, 63 FR 15714, Mar. 31, 1998; 63 FR 23338, Apr. 28, 1998]

§ 25.775 Windshields and windows.

(a)

(b) Windshield panes directly in front of the pilots in the normal conduct of their duties, and the supporting structures for these panes, must withstand, without penetration, the impact of a four-pound bird when the velocity of the airplane (relative to the bird along the airplane's flight path) is equal to the value of V_C , at sea level, selected under § 25.335(a).

(c) Unless it can be shown by analysis or tests that the probability of occurrence of a critical windshield fragmentation condition is of a low order, the airplane must have a means to minimize the danger to the pilots from flying windshield fragments due to bird impact. This must be shown for each transparent pane in the cockpit that --

(1) Appears in the front view of the airplane;

(2) Is inclined 15 degrees or more to the longitudinal axis of the airplane; and

(3) Has any part of the pane located where its fragmentation will constitute a hazard to the pilots.

(d)

(e)

[Doc. No. 5066, 29 FR 18291, Dec. 24, 1964, as amended by Amdt. 25-23, 35 FR 5676, Apr. 8, 1970; Amdt. 25-38, 41 FR 55466, Dec. 20, 1976]

Current JAR text:

JAR 25.631 Bird strike damage

The aeroplane must be designed to assure capability of continued safe flight and landing of the aeroplane after impact with a 4 lb bird when the velocity of the aeroplane (relative to the bird along the aeroplane's flight path) is equal to V_C at sea-level or $0.85 V_C$ at 2438 m (8000

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ft), whichever is the more critical. Compliance may be shown by analysis only when based on tests carried out on sufficiently representative structures of similar design. (See ACJ 25.631.)

JAR 25.571 Damage -- tolerance and fatigue evaluation of structure.

(e) *Damage-tolerance (discrete source) evaluation.* The aeroplane must be capable of successfully completing a flight during which likely structural damage occurs as a result of –

- (1) Bird impact as specified in JAR 25.631;
- (2) ...
- (3) ...
- (4) ...

JAR 25.775 Windshields and windows

- (a)
- (b) Windshield panes directly in front of the pilots in the normal conduct of their duties, and the supporting structures for these panes, must withstand, without penetration, the bird impact conditions specified in JAR 25.631.
- (c) Unless it can be shown by analysis or tests that the probability of occurrence of a critical windshield fragmentation condition is of a low order, the aeroplane must have a means to minimise the danger to the pilots from flying windshield fragments due to bird impact. This must be shown for each transparent pane in the cockpit that –
 - (1) Appears in the front view of the aeroplane;
 - (2) Is inclined 15° or more to the longitudinal axis of the aeroplane; and
 - (3) Has any part of the pane located where its fragmentation will constitute a hazard to the pilots.
- (d)
- (e).....

- (b) How have the regulations been applied? (What are the current means of compliance?) If there are differences between the FAR and JAR, what are they and how has each been applied? (Include a discussion of any advisory material that currently exists.)

See Item a.(1) above.

- (c) What has occurred since those regulations were adopted that has caused us to conclude that additional or revised regulations are necessary? Why are those regulations now inadequate?

See Item a.(1) above.

2. If no regulations currently exist:

- (a) What means, if any, have been used in the past to ensure that this safety issue is addressed? Has the FAA relied on issue papers? Special Conditions? Policy statements? Certification

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action items? Has the JAA relied on Certification Review Items? Interim Policy? If so, reproduce the applicable text from these items that is relative to this issue.

Not applicable, current rules exist.

- (b) Why are those means inadequate? Why is rulemaking considered necessary (i.e., do we need a general standard instead of addressing the issue on a case-by-case basis)?

Not applicable, current rules exist.

2. DISCUSSION of PROPOSAL

- *This section explains:*
 - *what the proposal would require,*
 - *what effect we intend the requirement to have, and*
 - *how the proposal addresses the problems identified in Background.*
- *Discuss each requirement separately. Where two or more requirements are very closely related, discuss them together.*
- *This section also should discuss alternatives considered and why each was rejected.*

a. SECTION-BY-SECTION DESCRIPTION OF PROPOSED ACTION

- (1) What is the proposed action? Is the proposed action to introduce a new regulation, revise the existing regulation, or to take some other action?

After 10 years of meetings and discussions the group could not reach consensus on a harmonized set of criteria. Two issues continue to divide the group: 1) Bird Weight and 2) Cutback Speed. The group therefore agrees to disagree and has provided white papers attached to this working group report outlining the individual positions.

- (2) If regulatory action is proposed, what is the text of the proposed regulation?

Not applicable, no rule changes are proposed.

- (3) If this text changes current regulations, what change does it make? For each change:

- What is the reason for the change?
- What is the effect of the change?

Not applicable, no rule changes are proposed.

- (4) If not answered already, how will the proposed action address (i.e., correct, eliminate) the underlying safety issue (identified previously)?

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Birdstrike FAR/JAR §25.571(e)(1), 25.631, 25.775(b)(c)

Not applicable, no rule changes are proposed.

- (5) Why is the proposed action superior to the current regulations?

Not applicable, no rule changes are proposed.

b. ALTERNATIVES CONSIDERED

- (1) What actions did the working group consider other than the action proposed? Explain alternative ideas and dissenting opinions.

Initial discussions of the General Structures Harmonization Working Group focused on the issue of bird weight (eight pounds vs. four pounds, or some other weight). Much time was spent on finding a statistically sound basis for a requirement. Statistical analyses showed the probability of exceeding the energy level associated with the four pound/Vc requirement of JAR-25 to be approximately 10^{-7} per flight (for the complete airframe). The probability of exceeding the energy level associated with an eight pound/Vc requirement was established at approximately 10^{-8} per flight. These numbers, however, are not absolute, since bird strike data are subject to considerable scatter and uncertainty, and further, not every exceedance of these energy levels would result in a catastrophic event. According to European bird strike data bases, in 1.2 % of all bird strikes the weight of the bird is above four pounds, whereas American data bases indicate this number to be 7.2%. For bird weights above eight pounds the numbers are 0.3% and 3.6% respectively. There is also scatter in bird strike rate per flight: European data indicate this rate to be approximately 10^{-3} per flight, whereas American data indicate this rate to be approximately 5×10^{-4} per flight. Although there have been numerous bird strikes on airplanes, it is very difficult to establish the bird weight involved. In addition, the reporting of bird strike events varies widely. These situations make it difficult to conclusively develop a statistical based requirement.

It was suggested that the overall exceedance rate should be 10^{-9} per hour (extremely improbable) or better for catastrophic events, and that therefore the eight pound/Vc requirement was the more appropriate one.

It was noted that the number 10^{-9} comes from the system safety assessment of FAR/JAR 25.1309, and is applicable to systems, but not necessarily to structures. The reliability and failure rate of systems can be calculated quite accurately, in contrast to the relatively unreliable bird strike data available, and all the uncertainties attached to bird strike exceedance evaluations based on statistical/probabilistic analyses.

Traditionally, for the definition of load cases the deterministic approach has always been taken rather than a probabilistic one, with the exception of gust loads (that are expressed in limit load only). Therefore, there is no direct comparison possible with the exceedance rate of other structural requirements.

Since bird strike considerations are not taken into consideration in the design of the major components of the airframe, there is an inherent residual strength capability present after bird impact. This is also addressed in the current regulations: continued safe flight and landing is required after a bird impact, with the emphasis on freedom from flutter and residual strength capability. ACJ 25.571 defines very specifically the residual strength capability of the airframe

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to be considered. These loads in themselves have a probability of exceedance attached to them, although the GSHWG could not define this probability. Defining this probability of exceedance would be even more difficult for flutter. The exceedance rate for a catastrophic event would be less than the probability of exceeding a specific bird impact energy level.

The issue of whether the bird weight should be the same for both airframe and engines was debated at length. A subgroup of the GSHWG and the ARAC Engine Installation Harmonization Working Group met to discuss this matter. Their conclusions are as follows:

There are sound technical reasons for having different bird strike requirements between engines (part 33/JAR-E) and airframes (part 25/JAR-25). Differences in bird strike requirements can be linked to the differences in approach between engine and airframe designers. The airframe structural justification is done at V_c , which at the lower altitudes where most bird strikes occur, is a speed that is rarely used. At the more typical lower operational speeds, the structure would be good for much heavier birds than four pounds, as supported by service experience. Hence, this concept provides an envelope design case for structural impact energy. With engines, forward speed is not the critical parameter, but is allied with the even more important parameters of fan speed, local inlet airflow and multiple birds. Hence protection against large birds may not be covered by an "envelope" case but will need to address the large bird impact directly. Another difference is the effects of the failure. For engines, gross damage may result in loss of all thrust (i.e. loss of function). For airframes, gross damage will rarely result in complete loss of load bearing capability. Current airplane designs for damage tolerance require a significant level of design load capability to be maintained after a four pound bird strike, implying that heavier birds could be tolerated. Effects of bird impact on systems is currently addressed by § 25.1309, where the bird weight is unspecified, and by § 25.631 of the FAR for flight control systems, where eight pounds is specified. There was no consideration by the subgroup of bird impact to systems.

As it is, both the part 25/JAR-25 airframe and part 33/JAR-E engine (proposed) bird strike requirements are actually very similar in approach. For engines, the "safe shutdown" criteria defined under § 33.77 of the FAR was used for large birds. The conclusion was that the historical large bird (eight pounds) engine ingestion rate was approximately linear with the engine inlet area and varied from 1.3×10^{-7} to 4.0×10^{-7} per engine cycle (for 2000 and 6000 sq. in. engine inlet areas respectively). It has therefore been recommended to design and test to a graduated bird size starting from four pounds for the 2000 sq. in. engine inlet area up to eight pounds for a 6000 (and larger) sq. in. engine inlet area in order to comply with the target of 10^{-7} per engine cycle occurrence rates for large birds. For airframes, the level of energy associated with the current (4 lb/ V_c) JAR-25 requirement is exceeded approximately 10^{-7} per flight.

As for the engines an eight pound bird ingestion rate of 10^{-7} per engine cycle has been agreed and considered as safe, it can be concluded that, by imposing the current JAR-25 bird strike requirement where the same exceedance rate of 10^{-7} per flight for the airframe is achieved, both requirements are in line with each other.

The GSHWG also discussed the safety record of those airplanes with a Maximum Take-Off Weight of 5700 kg or more (including business jets) in relation to bird strike. The following points were addressed.

(a) The only airplane that was destroyed after bird impact on the airframe (strikes on engines excluded) was a Vickers Viscount, in 1962, where a Whistling Swan (12-17 pounds) struck the tailplane, at an altitude of 6000 ft. This resulted in the eight pound bird requirement for the empennage of § 25.631 (Amendment 25-23). It was argued that the safe-life design and

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construction of the Viscount is not comparable to the current designs because safe life construction is not normally used, and more recent designs comply with the damage tolerance requirements of Amendment 25-45 (including multiple load paths). It was pointed out that multiple load path design is not a requirement that significant structural damage occurs occasionally on current design type of airplanes because of bird impacts. There have been more than 60 reported strikes resulting in major structural damage (including windshield penetrations), and there have been at least seven reported strikes resulting in major damage to electrical, flight control or fuel systems. Bird strikes have resulted in fuel leakage as well as total electrical failures and failure of flight instrument computers. As an example, in 1989, a twin turboprop commuter airplane impacted seven geese during a 230 knot descent at 4,500 feet altitude. Structural strength was significantly reduced as the front wing spar was heavily damaged and a number of adhesively bonded stringers were disbonded; nevertheless, the pilot was able to safely land the airplane. A large proportion of major incidents were verified as being caused by heavy birds such as geese or vultures. Approximately 80% of encounters with geese have involved multiple impacts. Except for engine ingestions, as of this date there has not been a catastrophic bird-caused accident on any jet transport. That fact supports the view that such airplanes were resistant to bird strikes because of their structural strength and redundancy, the design of their control systems, and the two-pilot requirement. It was also noted by several members of the GSHWG that one catastrophe in the last 32 years seemed to be a reasonable safety record, bearing in mind that since 1959 the commercial jet transport fleet (currently 85% of the total fleet) have accumulated approximately 400 million flight hours, with approximately 260 million flights. This would bring the safety record close to 10^{-9} catastrophic events per flight hour. Another observation was that this safety record was achieved with approximately [80%] of the current commercial jet transport fleet certified to part 25 pre-Amendment 25-23 requirements, i.e. four pound bird at V_c on the windshield only, with no requirement on the rest of the airplane.

(b) A survey was made to identify the number of injuries and fatalities as a result of non-engine related bird strikes. From 1970 on, 31 incidents could be identified where the flight deck area was penetrated. This resulted in 19 injuries and one fatality. There was consensus in the GSHWG that this is an acceptable level of safety.

Some time was spent on discussing the need for differentiation between turboprops and turbofans. In most countries, due to operational rules, a speed limitation of 250 KIAS below 10,000 ft is required. Since the cruise speed, V_c of most turbofans is in the 340-360 KIAS range, this provides a higher level of safety for turbofans: turboprops normally have a V_c in the 230-250 KIAS range, and operate closer to V_c (V_{mo}) than turbofans (below 10,000 ft). Therefore, by imposing a bird strike requirement related to V_c , the safety level will be less for turboprops than for turbofans. The operational difference results in a higher operational bird strike speed difference for jet airplanes, on the order of 40%. Propeller-driven airplanes have virtually no operational speed margin except at very low altitudes. In terms of impact energy, the 40% difference is approximately equivalent to doubling the bird weight. In other words, jet airplane structure designed for a four pound bird impact at V_c would be good for an eight pound bird when operated at normal speeds below 10,000 feet altitude. Somewhat compensating for the above disparity is the fact that current turboprops have a lower bird strike rate than larger jet airplanes.

The GSHWG discussed the turboprop/turbofan concern with several members suggesting that service experience seemed to indicate there is no need to change the regulations in that respect. There were two members of the group who believed that this was a significant problem that should be assessed and if necessary addressed by the NPRM. The GSHWG, while deciding

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not to further address this issue, agreed to express the concern in the published notice, which is hereby accomplished.

In attempting to reach consensus on the bird strike threat, several alternate proposals were presented and are discussed below.

(Note: these proposals were made in an attempt to reach agreement on the four pound vs. eight pound issue, and may therefore not be addressing all issues. They should not be regarded as complete proposals, but as working drafts.)

1. A proposal was made to require the airplane be designed for continued safe flight and landing after a bird impact at a minimum speed, V' , which is the greater of V_c at sea level or $0.85 V_c$ at 8000 ft altitude, where the bird weight is 8 lb. for values of V' up to 260 knots, and is linearly reduced to 4 lb. at V' at 350 knots. This proposal would lead to a situation where the current four pound/ V_c requirement would be maintained for most of the turbofan transport airplanes, but would be upgraded to eight pound/ V_c for the turboprop transport airplanes and some of the executive jets. The proposal was rejected, because part of the part 25 fleet would be faced with more stringent (eight pound) bird strike requirements (apart from the empennage), which were deemed unnecessary by the majority of the GSHWG.

2. A proposal was made to require limit load capability after bird impact (instead of the ACJ 25.571.2.7.2 discrete damage loads), and maintain the JAR-25 four pound/ V_c requirement. It was recognized that this also would mean an upgrade of the existing bird strike requirements, but one that may be easier to accept. This proposal was initiated by the fact that some part 25 airplanes are already certified with these higher discrete source damage loads, and that it would be possible to show that this proposal would satisfy the 10^{-9} probability of catastrophe required by the FAA. The proposal was rejected. The manufacturers of smaller Part 25 airplanes could not accept such an increase in loads.

3. A completely new rule was proposed, based on the engine non-containment requirement of FAR/JAR 25.903(d). This would assume a bird model and an associated amount of damage to the airplane, without the need for defining a bird weight/airplane velocity criterion. With that amount of damage, a certain load carrying capability would have to be demonstrated, together with freedom from flutter. Based for instance on the ratio of the critical area to the frontal area of the airplane, one could accept a certain probability of catastrophe, similar to the engine non-containment requirement. This proposal would solve many problems associated with the current regulatory approach in that the criteria would no longer be linked to a specific airplane design speed (e.g. V_c which may vary for each airplane type). The GSHWG foresaw great difficulties implementing a completely new bird strike regulatory approach, and rejected the idea in favor of the current approach.

4. A proposal was made to require the airplane be designed to assure capability of continued safe flight and landing, after impact with an eight pound bird when the velocity of the airplane (relative to the bird along the airplane's flight path) is equal to 250 KIAS at sea level to 8000 ft, whichever is most critical. If the airplane's frontal area is less than some value, yet to be specified, a four pound bird may be used. This proposal was withdrawn, mainly because an equivalent level of safety based upon variations in frontal area could not be substantiated.

5. A proposal was made to increase the level of safety by requiring (in combination with a four pound/ V_c requirement) no penetration of the flight deck. The proposal was based on the argument that although the overall safety record was satisfactory, there could be improvement regarding flight deck crew protection. Thirty-one penetrations in the flight deck area had been identified over the last twenty-four years. This resulted in nineteen injuries and one fatality. Objections were raised to the above proposal, arguing that the current level of safety with regard

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to flight deck crew protection is satisfactory, and penetration of the flight deck does not necessarily preclude safe flight and landing. The GSHWG rejected the proposal.

6. A proposal was made to prohibit manufacturers to cut back the Vc of their airplane below 8000 ft, combined with a rapid increase in Vc above this altitude. This would literally satisfy the requirement, but a reduction in energy level could lead to a reduction in safety. One of the members objected, stating that service experience gave no reason to assume this practice to be unacceptable. Therefore, the GSHWG rejected the proposal.

7. A proposal was made that there was a need for defining more clearly what the pass/fail criteria in relation to bird strike substantiation should be. The resulting discussion resulted in expansion of the already accepted wording in the advisory material. Specifically addressed were bird penetration in the flight deck area and bird penetration of wing and stabilizer leading edges and spars. Proposals to add in the advisory material considerations on bird strikes on tailplane tips and strikes on extended flaps were rejected by the GSHWG, because this is covered by the base requirement and not every conceivable type of bird strike could be included in the advisory material.

8. A proposal was made to add a § 25.631(b), in order to more clearly distinguish the airframe requirements of § 25.631 from the windshield requirements of § 25.775. This was supported and agreed by the GSHWG. Also the last sentence of § 25.631(a) was reworded for clarification.

Having reviewed the existing bird strike requirements in part 25/JAR- 25, the proposed FAA reassessment in 1987, the existing engine requirements JAR-E/part 33, all of the key issues and the above proposals, the GSHWG decided in 1995 that the current JAR-25 texts (§§ 25.631, 25.571(e) and 25.775(b)) would assure an acceptable level of safety. However one member specifically disagreed with this conclusion, believing the bird weight should be eight pounds instead of four pounds.

In 1998 the FAA contracted with the University of Illinois to conduct research in regard to three tasks: 1) a comprehensive analysis of wildlife strike data to determine the relationship between wildlife collisions and structural damage to aircraft, 2) a review of risk assessments and risk assessment approaches applied to wildlife/aircraft collisions, and 3) application of wildlife strike data and risk assessment procedures to support FAA rulemaking to airframes of wildlife strikes, with an emphasis on bird strikes (reference Contract # DOT 95-C-001-11). This research was concluded in 2002 with the release of the final report, "Assessment of Wildlife Strike Risk to Airframes", dated December 2002. The research concluded: 1) that it is possible to consider the physics of bird/aircraft collisions and use kinetic energy as a measure of the forces involved in the collision, 2) that to fully support risk assessment goals for Part 25 aircraft both the quality of the wildlife strike databases must be improved with better data on altitude, speed, species struck, actual mass of the species, and better information on damage or consequence, and that additional experimental data on damage and damage mechanisms in wildlife/aircraft collisions, and 3) that the risk assessment completed as part of this research is limited by basic data resources, including adequacy and accuracy of strike reporting, and the absence of fundamental data needed to determine actual forces in wildlife/aircraft collisions, the risk analysis performed does provide an initial result that has fully utilized existing strike database records, and specifically considers the kinetic energy of the wildlife/aircraft collision.

The results of the FAA sponsored research proved to be inconclusive in defining and/or supporting any specific bird strike requirements for rulemaking. Following additional discussions, two more proposals were considered. The first proposal developed to promote

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harmonization was to envelope the existing FAR/JAR requirements, including the FAA requirement for an eight pound bird on the empennage structure, and include a prohibition on the use of cutback speeds. This proposal was rejected by a JAA representative based on the lack of technical justification for an eight pound bird weight on the empennage. The second proposal was to impose a prohibition on cutback speeds but maintain the disharmony between FAR and JAR bird weight requirements. This proposal was rejected because it results in an increase in the bird strike regulatory requirements without harmonization.

Position papers for the FAA, JAA, TC, and OEM's are attached supporting the position of each of these groups.

- (2) Why was each action rejected (e.g., cost/benefit? unacceptable decrease in the level of safety? lack of consensus? etc.)? Include the pros and cons associated with each alternative.

See discussion in b.(1) above.

c. HARMONIZATION STATUS

- (1) Is the proposed action the same for the FAA and the JAA?

Not applicable, no rule changes are proposed. FAR and JAR will remain unharmonized.

- (2) If the proposed action differs for the JAA, explain the proposed JAA action.

Not applicable, no rule changes are proposed. FAR and JAR will remain unharmonized.

- (3) If the proposed action differs for the JAA, explain why there is a difference between FAA and JAA proposed action (e.g., administrative differences in applicability between authorities).

Not applicable, no rule changes are proposed. FAR and JAR will remain unharmonized.

3. COSTS AND OTHER ISSUES THAT MUST BE CONSIDERED

The Working Group should answer these questions to the greatest extent possible. What information is supplied can be used in the economic evaluation that the FAA must accomplish for each regulation. The more quality information that is supplied, the quicker the evaluation can be completed.

a. COSTS ASSOCIATED WITH THE PROPOSAL

- (1) Who would be affected by the proposed change? How? (Identify the parties that would be materially affected by the rule change – airplane manufacturers, airplane operators, etc.)

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Not applicable, no rule changes are proposed.

- (2) What is the cost impact of complying with the proposed regulation? Provide any information that will assist in estimating the costs (either positive or negative) of the proposed rule.

Not applicable, no rule changes are proposed.

b. OTHER ISSUES

- (1) Will small businesses be affected? *(In general terms, "small businesses" are those employing 1,500 people or less. This question relates to the Regulatory Flexibility Act of 1980 and the Small Business Regulatory Enforcement Fairness Act of 1996.)*

Not applicable, no rule changes are proposed.

- (2) Will the proposed rule require affected parties to do any new or additional record keeping? If so, explain. *[This question relates to the Paperwork Reduction Act of 1995.]*

Not applicable, no rule changes are proposed.

- (3) Will the proposed rule create any unnecessary obstacles to the foreign commerce of the United States -- i.e., create barriers to international trade? *[This question relates to the Trade Agreement Act of 1979.]*

Not applicable, no rule changes are proposed.

- (4) Will the proposed rule result in spending by State, local, or tribal governments, or by the private sector, that will be \$100 million or more in one year? *[This question relates to the Unfunded Mandates Reform Act of 1995.]*

Not applicable, no rule changes are proposed.

4. ADVISORY MATERIAL

- a. Is existing FAA or JAA advisory material adequate? Is the existing FAA and JAA advisory material harmonized?

There is no specific FAA advisory material for bird strike. However, ACJ 25.631 exists in the JAR.

- b. If not, what advisory material should be adopted? Should the existing material be revised, or should new material be provided?

Not applicable, no rule or advisory material changes are proposed.

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- c. Insert the text of the proposed advisory material here (or attach), or summarize the information it will contain, and indicate what form it will be in (e.g., Advisory Circular, Advisory Circular – Joint, policy statement, FAA Order, etc.)

Not applicable, no rule or advisory material changes are proposed.

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ATTACHMENT A

FAA BIRDSTRIKE POSITION PAPER

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FAA Bird Strike Position June 27, 2003

The FAA remains opposed to the existing General Structures Harmonization Working Group proposal to adopt a common weight bird for FAR §§ 25.571/25.775/25.631 of four pounds and a strike speed of V_c at sea level (or $0.85 V_c$ at 8,000 feet, whichever is more critical), because the net effect of the proposal for the FAR is to reduce the current empennage bird strike impact energy requirement of § 25.631 by approximately a factor of two.

Discussion:

The basic arguments of the FAA April 24, 2000 position still apply (copy attached). Between April 24, 2000 and January 1, 2003, FAA sponsored research to try to ascertain a bird strike energy criterion grounded in a risk assessment approach. This research, summarized in “Assessment of Wildlife Strike Risk to Airframes”, December 2002, by Edwin E. Herricks, Phil Mankin, and David J. Shaeffer, did not produce a definitive result; nevertheless, it did reveal some new information, which further reinforces the FAA’s reason for concern:

1. The Canada Goose represents a unique hazard to airplanes operating in North America because of its size, abundance, tendency to flock, and at times to fly at higher altitude.
 - a. The Canada Goose is the fourth most likely bird species to be reported struck by airframes in North America. The US Birdstrike data base contained 205 reports of Canada Geese being struck by the airframe.
 - b. The Canada Goose is a very large bird having a mean weight of about 8.5 pounds and a maximum weight up to 10.4 pounds for the most common subspecies.
 - c. Waterfowl are observed to fly at high altitudes at times, particularly during migration seasons. Although number of airplane impacts with all birds decline dramatically with altitude, impacts at high altitude are not unheard of. Impacts with waterfowl, including the Canada Goose, can be expected to occur at high altitude, albeit very infrequently. Impacts at high altitude can be expected to be at a high speed, because the speed of an airplane is increased as the airplane leaves the airport area and gains altitude. For example, the FAA notes that an impact of a large transport airplane with a flock of Northern Shovelers, a waterfowl significantly smaller than 4 pounds (0.69 – 2.43 pounds; avg 1.31 pounds), occurred in April 2001 during climbout at a 14,000 foot altitude and at an airplane airspeed of 330 knots IAS. Although the airplane returned to its point of origin safely, the event resulted in extensive airframe damage, including a cabin decompression. This event illustrates, however, that impacts with waterfowl, like the Canada Goose, can be expected to occur at high altitude with correspondingly high airplane speed.
 - d. US Geological Survey data indicate that the population of the Canada Goose in the US has increased dramatically (twenty fold) since 1967, and the trend is still upward. This suggests that impacts with Canada Geese are much more likely today than in the past.
 - e. The behavior of the Canada Goose, and other waterfowl, is to flock, so that an impact event is likely to involve more than one bird. Therefore, the 205 reports of Canada Goose strikes are probably reflective of around 500 individual airframe impacts.

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2. The populations of other bird species in North America having high mass and that can be encountered at high altitude have also increased over time, and in many cases the trend is still upward (e.g. Bald Eagle, Golden Eagle, Snow Goose)

Because of this, the FAA remains concerned with adequacy of the current FAR part 25 bird strike regulations. Therefore:

1. In the absence of a definitive risk assessment showing that an 8 pound bird strike to the empennage, occurring at V_c at sea level, is an unrealistic energy criterion, the FAA sees no justification for diminishing the current § 25.631 requirement.
2. The FAR § 25.571 requirement for the remainder of the airframe structure, of continued safe flight and landing after impact with a 4 pound bird at V_c , (or $0.85 V_c$ at 8,000 feet, whichever is more critical) is probably inadequate as a structural criterion, although it is likely that most airframe structure has acceptable capability due to structural redundancy typical of modern airplane construction. One area of concern, however, is the structure protecting the pilots or passengers from the direct effects of an impact, where the FAA believes that increased protection is necessary.
3. The § 25.775 four pound bird strike, at V_c , at sea level, with no penetration of the windshield, is not considered adequate. There have been, and continue to be, flight deck penetrations and injuries to the pilots. The FAA believes that the area of no penetration should be expanded beyond the windshield, and further, the bird mass should be increased to reduce the number of windshield failures and flight deck penetrations (although data have not developed to show how much the mass should be increased). The FAA is particularly concerned about the possibility of an injurious flight deck penetration occurring in conjunction with other severe airframe, systems, or engine damage due to an encounter with a flock of large waterfowl, such as the Canada Goose.

In conclusion, at this time, the FAA sees no reason to diminish any of the existing bird strike requirements of the FAR. The FAA would accept enveloping the FAR and JAR regulations for the sake of harmonization. Although the FAA is sympathetic with the elimination of the possibility of speed cutbacks at altitudes under 8000 feet, as proposed by the RLD, the FAA currently considers a rule change necessary to accomplish this.

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FAA Bird Strike Position April 24, 2000

Text of an April 24, 2000 e-mail message to Thaddee:

Subject: Harmonization of 25.631
Author: Dorenda Baker at ANM100
Date: 4/24/2000 6:49 PM

Hi Thaddee,

I coordinated the General Structures Harmonization Working Group (GSHWG) issue related to bird strike and FAR/JAR 25.631 with John Hickey, Manager of the Transport Airplane Directorate. The FAA position is that the current 8 pound bird strike impact weight requirement of § 25.631 remain unchanged.

The following is justification of the FAA position on this issue.

The Transport Airplane Directorate (TAD) had initiated a rulemaking project to upgrade the part 25 structural requirements for bird strike prior to the existence of ARAC. This was based on service experience data for bird strikes, which the FAA had become aware of, particularly the high incidence of bird penetrations into the cockpit. At that time the TAD was considering proposing that the entire airplane be capable of meeting the § 25.631 bird strike requirement (8 pounds at Vc) and expanding the zone for "no-penetration" in front of the pilots for their protection. With the advent of ARAC, the FAA project was turned over to the GSHWG of the Transport Aircraft and Engine Interest Group (TAEIG).

The GSHWG harmonization activity has been to recommend harmonizing on the bird strike requirements of the Joint Aviation Regulations (JAR). Since the JAR requires consideration of a 4-pound bird in JAR 25.631, the effect of this harmonization would be to reduce the stringency of the current § 25.631 requirement for the empennage. This proposal did nothing to alleviate the FAA's concern about obviating or at least reducing the frequency of bird penetrations into the flight deck.

The GSHWG contends that the service experience on airplanes since 1970 is mainly with airplanes that do not meet the 8-pound requirement because this requirement first came into effect in 1970. The requirements before that only required impact resistance of a 4 pound strike to the windshield, not the rest of the airplane. The GSHWG rationalized that service experience for the existing fleet of airplanes justifies the adequacy of a 4-pound strike at Vc and that the 4-pound criterion be applied to all structure including the empennage.

The FAA disagrees with the GSHWG position. The FAA does not concur that 1) the service experience with bird strikes, including 31 cockpit penetrations, with 19 injuries and 1 fatality, is indicative of an acceptable level of safety, and 2) that the service experience with bird strikes (which includes a catastrophic accident after a bird impacted the empennage of an airplane) supports alleviating the current

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8 pound bird at Vc requirement to the JAR value of 4 pounds at Vc. The FAA believes that service experience demonstrates that bird strikes pose a real threat to safety and that there is considerable room for improving the bird strike capability of modern aircraft.

Furthermore, the preliminary economic evaluation of the proposed rulemaking concluded that economics do not appear to justify the proposal either.

Per the GSHWG request, the FAA completed a rough estimate of the costs and benefits resulting from their proposal. This analysis indicated that "bird strikes occur regularly, they are not decreasing over time, and they do cause damage to the airplanes- all of which suggests that safety concerns should be carefully considered." The analysis also indicated that "bird strikes have had a 'negative impact' on a wide range of aircraft." The FAA economist determined that since the proposed regulatory change does not improve safety of air transportation, the benefits from the proposed rule would have to come from a reduction in costs to the aviation industry. According to the data provided by the GSHWG, the expected decrease in manufacturing and operating costs is relatively small. The FAA economist concluded:

.. data on accidents/incidents indicate an increasing number of bird strikes to the tail of airplanes - with accompanying damage to airplanes in a substantial number of cases. Thus, the risk of an accident has not decreased over time. The proposed rule would probably increase this risk and the severity of damage. On the other hand, the expected decrease in cost to the industry from the proposed rule is quite small. Consequently, the economics do not appear likely to justify the proposal.

If you need additional information please let us know.

Thanks

Dorenda

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ATTACHMENT B

JAA BIRDSTRIKE POSITION PAPER

General Structures Harmonization Working Group Report

Birdstrike FAR/JAR §25.571(e)(1), 25.631, 25.775(b)(c)

JAA Position on Bird Strike (Hoofddorp, 14 November 2002)

The JAA was requested to submit its position on harmonisation of the bird strike requirements of JAR-25 and FAR 25 (ref. GSHWG Action Item 33-12).

(a) Bird weight

The current JAR-25 and FAR 25 bird strike requirements are harmonised, except for FAR 25.631 that requires the empennage structure to be designed for impact with an 8-pound bird (JAR-25 requires a 4-pound bird) at Vc (sea-level).

The JAA is of the opinion that adoption of the FAR 25.631 8-pound bird (empennage) requirement in JAR-25 cannot be substantiated from a technical point of view. The rationale for this position is explained in more detail in Appendix 1 to this document.

It should be noted that this JAA position reflects the majority position of the GSHWG.

(b) Cut-back in Vc

More and more OEM's are reducing Vc below 8000 ft, with a sudden increase in Vc at that altitude, for bird strike reasons. There is a serious safety concern regarding reduction of Vc below 8000 ft. Although accepted by the JAA and FAA in the past on a case-by-case basis, this reduction, if generally applied, could reduce safety below a level acceptable to the JAA.

The JAA is of the opinion that JAR 25.631 should be amended to address this safety concern.

The JAA position on this issue is explained in more detail in Appendix 2 to this document.

It should be noted that the FAA has stated to be in agreement with this JAA position. Even the Industry representatives of the GSHWG could, for the sake of harmonisation, agree on this position (provided that harmonisation was also achieved on the bird weight as discussed under (a) above).

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[Appendix 1 to JAA Position on Bird Strike](#)

[BIRD STRIKE](#)

General Structures Harmonisation Working Group

(Issue 3)

= Hoofddorp, December 1995 =

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Birdstrike FAR/JAR §25.571(e)(1), 25.631, 25.775(b)(c)

Note: The content of this Discussion Paper is the same as the Final Draft NPRM, as agreed and signed by the GSHWG on the 12th of May, 1995.

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1. Background

In 1992, the Aviation Regulatory Advisory Committee (ARAC) chartered by notice in the Federal Register a General Structures Harmonisation Working Group (GSHWG) of industry and government structural specialists of Europe, the United States and Canada, to work on a number of issues to harmonise Part 25 of the Federal Aviation Regulations (FAR 25) and the European Joint Airworthiness Requirements, JAR-25. This notice is the recommendation of GSHWG of the Aviation Regulatory Advisory Committee (ARAC), which had been chartered by the FAA for this purpose. The GSHWG was comprised of representatives from the European Joint Aviation Authorities (JAA), Transport Canada, the FAA, and several European and U.S. aeroplane manufacturers.

At the start of this harmonisation effort, bird strike requirements existed in both FAR 25 and JAR-25. The development of the bird strike regulations for the U.S. and Europe is summarised below.

a) FAR 25 bird strike requirements

Prior to 1970, the only U.S. airworthiness regulation concerning bird strikes on transport category aeroplanes was CAR 4b., which requires no penetration of the windshield by a 4 lb. bird impact at cruise speed. The requirement preceded the jet transport era, and was adopted after a number of crew injuries due to bird penetrations of windshields.

In 1970, the regulations were changed as a result of an accident that occurred in 1962, in which a Vickers Viscount turboprop aeroplane operated by a U.S. airline experienced loss of control and crashed with no survivors near Chesapeake, Maryland. The accident was caused by impact with a swan, estimated to weigh between 12 and 17 lb., which damaged the horizontal stabiliser and elevator while the aeroplane was in cruise flight at 6,000 feet altitude. That resulted in a FAA review of existing statistical bird strike data. As a result of that review, the FAA concluded that transport aeroplanes should be capable of continued safe flight and landing after impact with birds weighing up to 8 lb. This was formalised as an FAA proposal for the 1966 Airworthiness Review Conference.

The FAA reviewed statistical data collected from actual air carrier operations and noted that the fail-safe design principles used for structure and control systems had provided a high degree of protection against catastrophic damage due to the impact of large birds such as geese even when multiple strikes had occurred. The FAA also conducted bird strike testing on several types of jet transport aeroplanes, which served to reinforce the service data. The FAA concluded that most existing transport aeroplanes were inherently bird resistant, although a few types, such as the one noted above which crashed, were not sufficiently resistant in the empennage area.

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The FAA anticipated that jet transports would displace propeller-driven aeroplanes in the 1970's and 1980's. After considering the above factors, the FAA determined that a specific rule applying to the entire aeroplane would only add to the substantiation effort without providing any significant design changes. Therefore, Notice of Proposed Rulemaking 68-18 (33 FR 11913) published on August 22, 1968, proposed the addition of § 25.631 which would require aircraft to be capable of continued safe flight and landing after impact on the empennage by an 8 lb. pound bird at design cruise speed.

There were a number of comments received on the above FAA proposal. One European airworthiness authority commented that having a requirement only on the tail was illogical, and that smaller aeroplanes in the weight range of 13,000 to 40,000 lb. would be vulnerable from wing impacts. Also noted by that commenter was the fact that the proposed 8 lb. requirement would not have prevented the one accident (noted above), and that the size of the bird should be based on probability considerations. The US Aerospace Industries Association commented that 4 lb. would be sufficient, since it had proven satisfactory for windshields. There were several comments that the 8 lb. bird was not realistic and that larger birds should be considered (one commenter proposed 12 lb., another 20 lb.), and that any requirement should also be applied to the wings and the windshield as well as the tail.

The FAA responded to the comments that service experience did not indicate an inadequacy in the resistance to the impact of large birds on structures other than the empennage, and that impacts with birds weighing more than 8 lb. were rare enough that they need not be considered.

As a result of Notice 68-18 and subsequent comments, Part 25 was amended in 1970 (Amendment 25-23; 35 FR 5665, April 8, 1970) to add a new § 25.631 that required the empennage structure to be designed to assure the capability of continued safe flight and landing after impact with an 8 lb. bird at speeds up to the design cruise speed at sea level.

Other rule changes regarding bird strikes have been introduced since § 25.631 was adopted.

On August 15, 1977, the FAA published Notice 77-15, 41 FR 41236, proposing new damage tolerance requirements, including requirements for discrete damage caused by bird impact. Only a few comments were received regarding bird strike damage. Two stated that the proposed bird strike requirement (continued safe flight following impact with a 4 lb. bird at likely operational speeds) was inconsistent with § 25.631 and § 25.775. A major European aeroplane manufacturer commented that § 25.631 and § 25.775 were completely adequate to ensure safety and that there was no justification for the proposed additional bird requirement. On December 1, 1978, § 25.571 was amended (Amendment 25-45; 45 FR 46242, October 5, 1978) as proposed, although the FAA did note in the preamble that there was some merit to having consistent requirements. It is

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unclear why the FAA originally proposed an inconsistent weight requirement, or why it failed to fully address the comment concerning justification of the proposal. There has been no reported incident where impact by a bird weighing 4 lb. or less has resulted in a serious non-engine related safety hazard to any transport category aeroplane.

The bird strike requirement of § 25.571(e) was amended further by Amendment 25-72, 55 FR 29776, July 20, 1990, which changed the speed requirement from "likely operational speed" to "design cruise speed." That was accomplished in part to harmonise the requirement with the existing JAR, and to prevent possible ambiguous interpretations of likely operational speeds. There is a current FAA proposal to correct an unintentional error in that amendment; it would specify a speed of V_c at sea level or $0.85V_c$ at 8,000 feet, whichever is the more critical. That is also the current JAA requirement.

In some cases, special interpretations, equivalent safety findings and special conditions have been issued for bird strikes. Since § 25.631 does not apply to wings, the FAA has requested, and several manufacturers have agreed, to establish an acceptable level of safety for aeroplanes equipped with winglets, with one winglet missing to account for impact with a large bird. Special interpretations have also been necessary in the application of other rules, such as § 25.365 which applies to the structural design loads arising from depressurization events. The FAA has interpreted that section as requiring an evaluation of the effects of depressurization resulting from the loss of a complete windshield panel from large bird impacts at altitudes up to 8000 feet (above which such impacts have been considered extremely improbable). For some aeroplanes having certification bases prior to Amendment 25-23, § 25.631 has been applied to design changes involving composite empennage structure.

b) JAR-25 bird strike requirements

In the late 60's and early 70's, when JAR-25 was developed in Europe as an airworthiness code, FAR 25 was selected as the basic code. The discussions included review of the FAR Sections 25.631 and 25.775(b).

The text of FAR 25.631 (Amendment 23) was not adopted in Change 1 (effective 25 July 1975) of JAR-25. Instead, JAR 25.631 at Change 1 specified that "the aeroplane must be designed to assure capability of continued safe flight and landing after impact with a 4 lb bird when the velocity of the aeroplane (relative to the bird along the aeroplane's flight path) is equal to V_c at sea level or $0.85 V_c$ at 8000 ft, whichever is the more critical."

Partially based on the British BCAR Section D, it was purposefully decided to deviate from FAR 25 on an number of points:

- instead of the empennage only, it was decided to address the complete aeroplane;
- instead of an eight-pound bird, a four-pound bird was appropriate;

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- an additional "spot-check" at 8000 ft was required to prohibit manufacturers choosing a low V_c at sea level, with a possible rapid increase of V_c just above sea level, that would avoid the intent of the requirement.

The protection of essential systems against bird impact was also addressed in JAR 25.631 (Change 1). This was later (Change 5, effective 1 January 1979) taken out of the basic requirement and put in a separate ACJ 25.631.

It was also decided to adopt the text of FAR 25.775(b) (Amendment 1) in Change 1 of JAR-25 as JAR 25.775(b), but to change the last part of the sentence of this subparagraph to make reference to JAR 25.631. FAR 25.775(c) at Amendment 1 was later adopted as JAR 25.775(c) in Change 8 (effective 30 November 1981).

Amendment 45 of FAR 25 introduced the damage tolerance (discrete source) evaluations in FAR 25.571(e), where (e)(1) addressed bird strike. This was adopted as JAR 25.571(e)(1) in Change 7 (effective 24 November 1980) of JAR-25, but instead of adopting the FAR 25 text a reference was made to JAR 25.631. In ACJ 25.571 text was added to require (subparagraph 2.7.2.) the remaining structure (after bird impact) to be able to carry specific loads, and to be free from flutter.

In the latest version of JAR-25 (Change 14, effective 27 May 1994), JAR 25.631, 25.775(b)(c) and 25.571(e)(1) are still contained as described above.

c) FAA reassessment of bird strike requirements

In 1987 the FAA initiated a reassessment of the current bird strike regulations due to concerns with new technology. The new technology increased the use of critical systems and composite materials, which were believed to be more sensitive to bird impact. These concepts were not considered when the original empennage requirement was enacted. A draft NPRM was prepared proposing the following new requirements:

1. Continued safe flight and landing after impact, at any location on the aeroplane, with an 8 lb. bird at design cruise speed. This would include effects of bird strike on structure as well as systems.
2. No penetration of the fuselage after impact with a 4 lb. bird at design cruise speed.

The draft NPRM received significant negative comments from industry and the economical evaluation was revised after consideration of those comments. It then received its regulatory economic and legal evaluations, and in the latter part of 1992 was in final coordination prior to publication, even though substantial industry opposition still existed. At that point, the FAA decided to complete the rulemaking process through ARAC.

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2. Discussion

In the Bird Strike Harmonisation effort the following key issues were identified and discussed:

- 1) Current regulations and advisory material
- 2) The basic requirements and differences between FAR and JAR
 - bird weight
 - aircraft speed and altitude
 - structure of the rules
- 3) Other considerations
 - Vc reduction below 8000 feet
 - flight crew protection
 - protection of essential systems
 - turboprops and turbofans
 - airframe and engine criteria
 - service experience
 - pass/fail criteria
 - safety target
 - discrete source event loads

The above issues are discussed below.

2.1. Definition of the basic requirement

Initial discussions focused on the issue of bird weight (8 lb. vs. 4 lb., or some other weight). Much time was spent on finding a statistically sound basis for a requirement. Statistical analyses showed the probability of exceeding the energy level associated with the 4 lb./Vc requirement of JAR-25 to be approximately 10^{-7} per flight (for the complete airframe). The probability of exceeding the energy level associated with an 8 lb./Vc requirement was established at approximately 10^{-8} per flight. These numbers, however, are not absolute, since bird strike data are subject to considerable scatter and uncertainty, and further, not every exceedance of these energy levels would result in a catastrophic event. According to European bird strike data bases, in 1.2 % of all bird strikes the weight of the bird is above 4 lb., whereas American data bases indicate this number to be 7.2%. For bird weights above 8 lb. the numbers are 0.3% and 3.6% respectively. There is also scatter in bird strike rate per flight: European data indicate this rate to be approximately 10^{-3} per flight, whereas American data indicate this rate to be approximately 5×10^{-4} per flight. Although there have been numerous bird strikes on aeroplanes, it is very difficult to establish the bird weight involved. In addition, the reporting of bird strike events

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varies widely. These situations make it difficult to conclusively develop a statistical based requirement.

It was suggested that the overall exceedance rate should be 10^{-9} per hour (extremely improbable) or better for catastrophic events, and that therefore the 8 lb./Vc requirement was the more appropriate one.

It was noted that the number 10^{-9} comes from the system safety assessment of FAR/JAR 25.1309, and is applicable to systems, but not necessarily to structures. The reliability and failure rate of systems can be calculated quite accurately, in contrast to the relatively unreliable bird strike data available, and all the uncertainties attached to bird strike exceedance evaluations based on statistical/probabilistic analyses.

Traditionally, for the definition of load cases the deterministic approach has always been taken rather than a probabilistic one, with the exception of gust loads (that are expressed in limit load only). Therefore, there is no direct comparison possible with the exceedance rate of other structural requirements.

Since bird strike considerations do not normally design the major components of the airframe, there is an inherent residual strength capability present after bird impact. This is also addressed in the current regulations: continued safe flight and landing is required after a bird impact, with the emphasis on freedom from flutter and residual strength capability. ACJ 25.571 defines very specifically the residual strength capability of the airframe to be considered. These loads in themselves have a probability of exceedance attached to them, although the GSHWG could not define this probability. Defining this probability of exceedance would be even more difficult for flutter. The exceedance rate for a catastrophic event would be less than the probability of exceeding a specific bird impact energy level.

The issue of whether the bird weight should be the same for both airframe and engines was debated at length. A subgroup of the GSHWG and the ARAC Engine Installation Harmonisation Working Group met to discuss this matter. Their conclusions are as follows:

There are sound technical reasons for having different bird strike requirements between engines (part 33/JAR-E) and airframes (part 25/JAR-25). Differences in bird strike requirements can be linked to the differences in approach between engine and airframe designers. The airframe structural justification is done at Vc, which at the lower altitudes where most bird strikes occur, is a speed that is rarely used. At the more typical lower operational speeds, the structure would be good for much heavier birds than 4 lb., as supported by service experience. Hence, this concept provides an envelope design case for structural impact energy. With engines, forward speed is not the critical parameter, but is allied with the even more important parameters of fan speed, local inlet airflow and multiple birds. Hence protection against large birds may not be covered by an "envelope" case but will need to address the large bird impact directly. Another difference is the effects of the failure. For engines, gross damage may result in loss of all thrust

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(i.e. loss of function). For airframes, gross damage will rarely result in complete loss of load bearing capability. Current aircraft designs for damage tolerance require a significant level of design load capability to be maintained after a 4 lb. bird strike, implying that heavier birds could be tolerated.

As it is, both the part 25/JAR-25 airframe and part 33/JAR-E engine (proposed) bird strike requirements are actually very similar in approach. For engines, the "safe shutdown" criteria defined under FAR Part 33.77 was used for large birds. The conclusion was that the historical large bird (8 lb.) engine ingestion rate was approximately linear with the engine inlet area and varied from 1.3×10^{-7} to 4.0×10^{-7} per engine cycle (for 2000 and 6000 sq. in. engine inlet areas respectively). It has therefore been recommended to design and test to a graduated bird size starting from 4 lb. for the 2000 sq. in. engine inlet area up to 8 lb. for a 6000 (and larger) sq. in. engine inlet area in order to comply with the target of 10^{-7} per engine cycle occurrence rates for large birds. For airframes, the level of energy associated with the current (4 lb/Vc) JAR-25 requirement is exceeded approximately 10^{-7} per flight.

As for the engines an 8 lb. bird ingestion rate of 10^{-7} per engine cycle has been agreed and considered as safe, it can be concluded that, by imposing the current JAR-25 bird strike requirement where the same exceedance rate of 10^{-7} per flight for the airframe is achieved, both requirements are in line with each other.

The GSHWG discussed also the safety record of those aeroplanes with a Maximum Take-Off Weight of 5700 kg or more (including business jets) in relation to bird strike. The following points were addressed.

- (a) The only aircraft that was destroyed after bird impact on the airframe (strikes on engines excluded) was a Vickers Viscount, in 1962, where a Whistling Swan (12-17 lb.) struck the tailplane, at an altitude of 6000 ft. This resulted in the 8 lb. bird requirement for the empennage of § 25.631 (Amendment 23).

It was argued that the design and construction of this aeroplane is not comparable to the current designs because safe life construction is not normally used, and designs comply with the damage tolerance requirements of Amendment 45 (including multiple load

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paths).

It was pointed out that multiple load path design is not a requirement, that significant structural damage occurs occasionally on current design type of aeroplanes because of bird impacts. There have been more than 60 reported strikes resulting in major structural damage (including windshield penetrations), and there have been at least 7 reported strikes resulting in major damage to electrical, flight control or fuel systems. Bird strikes have resulted in fuel leakage as well as total electrical failures and failure of flight instrument computers. As an example, in 1989, a twin turboprop commuter aeroplane impacted 7 geese during a 230 knot descent at 4,500 feet altitude. Structural strength was significantly reduced as the front wing spar was heavily damaged and a number of adhesively bonded stringers were disbonded; nevertheless, the pilot was able to safely land the aeroplane. A large proportion of major incidents were verified as being caused by heavy birds such as geese or vultures. Approximately 80% of encounters with geese have involved multiple impacts. Except for engine ingestions, as of this date there has not been a catastrophic bird-caused accident on any jet transport. That fact supports the view that such aeroplanes were resistant to bird strikes because of their structural strength and redundancy, the design of their control systems, and the two-pilot requirement.

It was also noted by several members of the GSHWG that one catastrophe in the last thirty-two years seemed to be a reasonable safety record, bearing in mind that since 1959 the commercial jet transport fleet (currently 85% of the total fleet) have accumulated approximately 400 million flight hours, with approximately 260 million flights. This would bring the safety record close to 10^{-9} catastrophic events per flight hour.

Another observation was that this safety record was achieved with approximately 80% of the current commercial jet transport fleet certified to FAR 25 pre-Amendment 23 requirements, i.e. 4 lb. bird at V_C on windshield only, with no requirement on the rest of the aeroplane.

- (b) A survey was made to identify the number of injuries and fatalities as a result of non-engine related bird strikes. From 1970 on, thirty-one incidents could be identified where the flight deck area was penetrated. This resulted in nineteen injuries and one fatality. There was consensus in the GSHWG that this is an acceptable level of safety.

Some time was spent on discussing the need for differentiation between turboprops and turbofans. In most countries, due to operational rules, a speed limitation of 250 KIAS below 10,000 ft is required. Since the cruise speed, V_C of most turbofans is in the 340-360 KIAS range, this provides a higher level of safety for turbofans: turboprops normally have a V_C in the 230-250 KIAS range, and operate closer to V_C (V_{MO}) than turbofans (below 10,000 ft). Therefore, by imposing a bird strike requirement related to V_C , the safety level will be less for

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turboprops than for turbofans. The operational difference results in a higher operational bird strike speed difference for jet aeroplanes, on the order of 40%. Propeller-driven aircraft have virtually no operational speed margin except at very low altitudes. In terms of impact energy, the 40% difference is approximately equivalent to doubling the bird weight. In other words, jet aircraft structure designed for a 4 lb. bird impact at V_c would be good for an 8 lb. bird when operated at normal speeds below 10,000 feet altitude. Somewhat compensating for the above disparity is the fact that current turboprops have a lower bird strike rate than larger jet aeroplanes.

The GSHWG discussed the above concern with several members suggesting that service experience seemed to indicate there is no need to change the regulations in that respect. There were two members of the group who believed that this was a significant problem which should be assessed and if necessary addressed by the NPRM. The GSHWG, while deciding not to further address this issue, agreed to express the concern in the published notice, which is hereby accomplished.

In attempting to reach consensus on the bird strike threat, several alternate proposals were presented and are discussed below.

(Note: these proposals were made in an attempt to reach agreement on the 4 lb. vs. 8 lb. issue, and may therefore not be addressing all issues. They should not be regarded as complete proposals, but as working drafts.)

1. The aeroplane must be designed for continued safe flight and landing after a bird impact at a minimum speed, V' , which is the greater of V_c at sea level or $0.85 V_c$ at 8000 ft altitude, where the bird weight is 8 lb. for values of V' up to 260 knots, and is linearly reduced to 4 lb. at V' at 350 knots.

This proposal would lead to a situation where the current 4 lb./ V_c requirement would be maintained for most of the turbofan transport aeroplanes, but would be upgraded to 8 lb./ V_c for the turboprop transport aeroplanes and some of the executive jets. The proposal was rejected, because part of the Part 25 fleet would be faced with more stringent (8 lb.) bird strike requirements (apart from the empennage), which were deemed unnecessary by the majority of the GSHWG.

2. A proposal was made to require limit load capability after bird impact (instead of the ACJ 25.571.2.7.2 discrete damage loads), and maintain the JAR-25 four pound/ V_c requirement. It was recognised that this also would mean an upgrade of the existing bird strike requirements, but one that may be easier to accept. This proposal was initiated by the fact that some Part 25 aeroplanes are already certified with these higher discrete source damage loads, and that it would be possible to show that this proposal would satisfy the 10^{-9} probability of catastrophe required by the FAA.

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The proposal was rejected. The manufacturers of smaller Part 25 aeroplanes could not accept such an increase in loads.

3. A completely new rule was proposed, based on the engine non-containment requirement of FAR/JAR 25.903(d). This would assume a bird model and an associated amount of damage to the aeroplane, without the need for defining a bird weight/aeroplane velocity criterion. With that amount of damage, a certain load carrying capability would have to be demonstrated, together with freedom from flutter. Based for instance on the ratio of the critical area to the frontal area of the aeroplane, one could accept a certain probability of catastrophe, similar to the engine non-containment requirement. This proposal would solve many problems associated with the current regulatory approach in that the criteria would no longer be linked to a specific aeroplane design speed (e.g. V_c which may vary for each aeroplane type).

The GSHWG foresaw great difficulties implementing a completely new bird strike regulatory approach, and rejected the idea in favour of the current approach.

4. The aeroplane must be designed to assure capability of continued safe flight and landing, after impact with an 8 lb. bird when the velocity of the aeroplane (relative to the bird along the aeroplane's flight path) is equal to 250 KIAS at sea level to 8000 ft, whichever is most critical. If the aeroplane's frontal area is less than TBD sq. ft., a 4 lb. bird may be used.

This proposal was withdrawn, mainly because an equivalent level of safety based upon variations in frontal area could not be substantiated.

Having reviewed the existing bird strike requirements in FAR/JAR Part 25, the proposed FAA reassessment in 1987, the existing engine requirements JAR-E/FAR Part 33, all of the key issues and the above proposals, the GSHWG decided that the current JAR-25 texts (25.631, 25.571(e) and 25.775(b)) would assure an acceptable level of safety. However one member specifically disagreed with this conclusion, believing the bird weight should be 8 lb. instead of 4 lb.

2.2. Other concerns

Several other proposals were made for improvement in the existing bird strike regulations.

- a) Thirty-one penetrations in the flight deck area had been identified over the last twenty-four years. This resulted in nineteen injuries and one fatality. A proposal was made to increase the level of safety by requiring (in combination with a 4 lb./ V_c requirement) no penetration of the flight deck. This was based on the argument that although the overall safety record was satisfactory, there could be improvement regarding flight deck crew protection.

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Objections were raised to the above proposal, arguing that the current level of safety with regard to flight deck crew protection is satisfactory, and penetration of the flight deck does not necessarily preclude safe flight and landing. The GSHWG rejected the proposal.

- b) A proposal was made to prohibit manufacturers to cut back the Vc of their aeroplane below 8000 ft, combined with a rapid increase in Vc above this altitude. This would literally satisfy the requirement, but a reduction in energy level could lead to a reduction in safety. One of the members objected, stating that service experience gave no reason to assume this practice to be unacceptable.

Therefore, the GSHWG rejected the proposal.

- c) It was suggested that there was a need for defining more clearly what the pass/fail criteria in relation to bird strike substantiation should be. This discussion resulted in expansion of the already accepted wording in the advisory material. Specifically addressed were bird penetration in the flight deck area and bird penetration of wing and stabiliser leading edges and spars.

Proposals to add in the advisory material considerations on bird strikes on tailplane tips and strikes on extended flaps were rejected by the GSHWG, because this is covered by the base requirement and not every conceivable type of bird strike could be included in the advisory material.

- d) It was proposed to add a subparagraph 25.631(b), in order to more clearly distinguish the airframe requirements of § 25.631 from the windshield requirements of § 25.775.

This was supported and agreed by the GSHWG. Also the last sentence of § 25.631(a) was reworded for clarification.

2.3. Protection of essential systems

In 1989, a bird strike on a twin engined jet transport caused loss of information on four Cathode Ray Tube displays, and tripped a fuel shut-off valve, causing one engine to shut down. The bird, a vulture, approximately 10 lb., struck (but did not penetrate) the top of the captain's panel of the windshield, while the aeroplane was flying at 250 KIAS at an altitude of 2500 ft. This incident is an example of what may happen to an aeroplane equipped with modern electronic flight control systems, where, although the bird does not penetrate the structure, the shock loading resulting from the impact still may have an effect on the functioning of essential systems. This issue is not specifically addressed in the current FAR 25 regulations, and partially addressed in ACJ 25.631 of JAR-25.

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Within the GSHWG there was consensus about the need to address this concern. It was decided to adopt in the advisory material the current text of ACJ 25.631, and add a reference to FAR/JAR 25.1309, which requires that the system safety assessment should consider the effects of a bird strike.

3. Summary of GSHWG conclusions

1. FAR 25.631 should be harmonised on the JAR requirement revised as shown in the proposed amendment.
2. FAR 25.571(e) should be revised to refer to 25.631 for the bird impact to be assessed as a discrete source of damage.
3. FAR 25.775(b) should refer to 25.631 for the bird impact for windshield design.
4. Advisory material was developed by the GSHWG to accompany the NPRM.

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Appendix 2 to JAA Position on Bird Strike

Proposal to Address Vc Cut-backs in Relation to Bird Strike
(Hoofddorp, 13/08/02)

Statement of issue

JAR 25.631 (Change 15) requires that the aeroplane must be designed to assure capability of continued safe flight and landing of the aeroplane after impact with a 4 lb 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.

In the early 1970's, when JAR-25 was developed, the 0.85 Vc at 8000 ft condition was added to the Vc at sea-level condition to prevent OEM's from choosing a low Vc at sea-level, with a sudden increase in Vc just above sea-level, which would render the requirement ineffective. By no means the 8000 ft condition suggests that bird strikes above that altitude do not occur.

More and more OEM's are reducing Vc below 8000 ft, with a sudden increase in Vc at that altitude, for bird strike reasons. There is nothing in the current regulations that prevents this; Vc can be "freely" chosen by the applicant, except that JAR 25.335(b) requires a certain margin between Vb and Vc (43 knots in Change 14, 1.32 Uref in Change 15). Until now, applicants have maintained this margin, even for the reduced Vc below 8000 ft. One OEM has argued that the margin was established for other reasons (inadvertent speed increases due to severe atmospheric turbulence) than bird strike, and that Vc could therefore be reduced even below this margin, but this approach has been denied by JAA (and FAA).

JAA position

There is a serious safety concern regarding reduction of Vc below 8000 ft. Although accepted by JAA and FAA in the past on a case by case basis, this reduction, if generally applied, could reduce safety below a level acceptable to the JAA. The main reasons for this position are:

(1) In many countries Air Traffic Control restrictions are such that below 10.000 ft aircraft speed must be reduced to 250 knots. For aeroplanes equipped with turbofans, whose Vc on the average is approximately 320 - 340 knots, this leads to an additional margin in terms of bird strike capability. Undoubtedly this additional margin has contributed significantly to the current level of safety regarding bird strike damage. Reducing Vc below 8000 ft would take away much (if not all) of this safety margin, and would put safety at risk.

(2) A survey of serious (world-wide) bird strike incidents over the last 30 years has shown that even with a correct application and interpretation (no cut-backs in Vc below 8000 ft) of JAR 25.631 the level of safety offered by the current bird strike regulations is only marginally

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acceptable. Since impact damage is approximately proportional to the speed of the aeroplane cubed (V^3), a cut-back in V_c of 10% (e.g. from 320 knots to 290 knots) is actually a decrease in impact criterion of 25%. Given the large amount of recent bird strike related incidents this is not an acceptable situation.

(3) Over the last 10 years a large increase in the bird population (particularly Canadian Geese) has been observed. This also supports the need for a correct application and interpretation of the current bird strike requirements.

Proposal

Taking the above into consideration, the JAA proposes to further modify (as indicated in bold text) JAR 25.631 as proposed by the GSHWG.

- (a) The aeroplane must be designed to assure capability of continued safe flight and landing, after impact with a 4 lb (1.81 kg) bird when the velocity of the aeroplane (relative to the bird along the aeroplane's flight path) is equal to **the most critical V_c expressed in KEAS, from sea-level to the altitude of the intersection with the constant cruise Mach number line.** When compliance is shown by analysis, it must be supported by bird strike tests carried out on sufficiently representative structures of similar design.
- (b) Windshield panes must be assessed in accordance with JAR 25.775(b) and (c).

Further clarification

The current regulations require an applicant to compare the sea-level condition with the 8000 ft condition. For this comparison the V_c at 8000 ft should be taken in KTAS. The factor 0.85 is understood to be (approximately) the square root of the ratio of the air densities at 8000 ft and sea level. So effectively the V_c (in KTAS) at 8000 ft is converted to KEAS. The most critical velocity (in KEAS) from this comparison is subsequently used in the bird strike substantiation (analysis and/or testing).

The same philosophy is maintained in the above proposal, except that, in lieu of two conditions (sea-level and 8000 ft), the full altitude range must be considered between sea level and the altitude of the intersection with the constant cruise Mach number line. The most critical V_c (in KEAS) in this altitude range should be used in the bird strike substantiation.

For most aeroplanes this intersection altitude would be somewhere between 20.000 and 25.000 ft, an altitude above which a bird strike becomes very unlikely.

* * *

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ATTACHMENT C

TRANSPORT CANADA

BIRDSTRIKE POSITION PAPER

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TRANSPORT CANADA Bird Impact Position Paper

Bird's mass

Transport Canada is in favor of a common bird mass in a requirement applying to the empennage as well as to the rest of the airplane including the windshield. The four-pound requirement appears to be easy to implement, for a non-harmonized, intermediate step in presence of the enduring FAA dissenting opinion. Also, in view of recent bird strike events and concerning statistics about population of certain species, Transport Canada and the airworthiness community could become more sensitive to studies and statistics that, in the near future, would help all parties converge to a bird mass intermediate between 4 and 8 lbs.

Altitude

It is agreed that no particular meaning is connected to the altitude of 8000 ft other than a few decades of arbitrary assumption that no bird impact will take place beyond such altitude. The assumption might well be justified. Even the Viscount accident took place at 6000 ft, well below this arbitrary threshold. Transport Canada would agree to retaining the 8000 ft ceiling as a lower limit for a cutback of the envelope. Also, T.C. would consider discussing a different ceiling of say, 10000 or 12000 ft

Speed

The present JAA formulation, requiring a birdproof structure up to V_c or $.85 V_c$ at 8000 ft, serves the vast majority of airplanes that make use of a constant KCAS value to define V_c . For these airplanes, the JAA formulation is equivalent to V_c at sea level adopted in FAR 25.631.

Envelope

The practice of envelope cutbacks or "notches" for bird impact purposes has been in use during the last 25 or more years and no adverse effect has been recorded by Transport Canada. Implementation of this feature poses no problem for fast jet airplanes where the 43 Kts or 1.32 Uref separation of V_c from V_b is easily satisfied while certain slower turboprops might not qualify. In any case, it remains understood that there is no "structural V_c " or "windshield V_c ". The flight envelope has to be one and has to satisfy with no exception all the requirements of para 25.335.

The benefits obtained by the use of speed cutbacks can be better seen in a flight envelope drawn in terms of KTAS. This gives a better picture of the crippling action introduced by the preclusion of speed cutbacks. That is, either the advantage of high altitude flight is denied or the airplane will have to be designed with unnecessary strength. Either way will mean a needless reduction in performance. A better approach would be the adoption of a higher upper limit or a tapered cutback justified by probability considerations.

In summary:

- 4 lb bird on the empennage. Non-harmonized.
- Notched envelope allowed.

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ATTACHMENT D

OEM BIRDSTRIKE POSITION PAPER

General Structures Harmonization Working Group Report

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OEM Bird Strike Position

June 10, 2003

Summary Position

The OEMs remain committed to the existing GSHWG proposal to adopt a common weight bird for FAR §§ 25.571/25.775/25.631 of 4 pounds, the net effect of the proposal would be to reduce the current 8 pound birdstrike impact weight requirement of § 25.631. In the spirit of harmonization, the OEMs would support enveloping the current FAA and JAA requirements of this rule. Although specific supporting data for the FAA eight pound bird mass requirement on the empennage is not evident from the preliminary report from the U of I, the OEMs are willing in the spirit of harmonization to envelope the current FAA and JAA requirements. The OEMs remain opposed in principle to the prohibition of “cutback” speeds for birdstrike.

Background

The following are some of the key events related to the development and progress of the draft Birdstrike NPRM and AC developed within the GSHWG:

| | |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 16 March 1993 | First meeting of the General Structures Harmonization Working Group (GSHWG) – birdstrike harmonization discussions were initiated. |
| 12 May, 1995 | General Structures HWG reached technical agreement and signed off draft NPRM and AC. |
| 7 July, 1995 | GSHWG submitted draft NPRM and AC to TAEIG for review and requested it be submitted to FAA for legal and economic evaluation. A dissenting opinion, held by the FAA, was noted and the GSHWG resolution of the dissenting opinion was enclosed with the submittal package. TAEIG voted to accept the package and to forward it to FAA. |
| 1 May, 1996 | GSHWG chair learned from assigned economist (Greg Won) that TAEIG had not submitted the package to FAA for evaluation and that no work had been done. TAEIG then submitted the package. |
| 2 May, 1996 | GSHWG chair received a fax with issues and questions from the economist. |
| 26 May, 1996 | GSHWG chair, FAA representative, and economist telecom regarding issues and questions. |
| 12 December, 1997 | JAA initiated rulemaking with P NPA 25D-289. |

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|--------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 15 September, 1998 | GSHWG chair and FAA representative discussed data needed by the new economist (Anthony Apostolides) to start on the economic evaluation. Large package of data and background material was provided to the economist. |
| 9 December, 1998 | GSHWG chair learned from the economist that the FAA had never requested “formal” evaluation and that the item is being treated with a low priority. |
| 18 December, 1998 | FAA representative received from economist status that a “preliminary” evaluation would be completed during week of January 7-11, 1999. |
| 19 January, 1999 | GSHWG chair received memorandum from the economist providing a “rough estimate” of the evaluation. The economist had determined that the safety level had been reduced and that the expected decrease in cost to the industry is so small that it does not appear to justify the proposal. Based on this preliminary result, the FAA indicated they did not wish to waste any more time in completing the evaluation, since it would not be accepted. |
| 16 March, 1999 | Gshwg reported to TAEIG the rough estimate. In the opinion of the GSHWG chair, the FAA economist largely ignored the GSHWG report and its conclusions regarding the required level of safety and the justifications for the changes, and essentially reverted to the FAA’s position from 1991. It is felt that the economic evaluation should be based on the GSHWG report, not on the conclusions and opinions held by the economist. |
| 4 August, 1999 | Letter from Craig Bolt, Assistant Chair - TAEIG, to Dorenda Baker – FAA requesting a formal technical position regarding bird weight from the FAA and JAA so that it could be determined if harmonization is possible. |
| 24 April, 2000 | Letter from Dorenda Baker, FAA, to Thaddee Soloki, providing justification for the FAA position on the eight-pound bird requirement. |
| 23 August, 2000 | FAA requests TAEIG opinion on whether to close issue or not. |

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| | |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 19 October, 2000 | GSHWG recommends to TAEIG not to close tasking. Group agrees to review outcome from FAA sponsored study by the University of Illinois (U of I) on “Assessment of Wildlife Strike Risk to Airframes.” |
| 23 January, 2001 | SSG issues draft Temporary Guidance Material (TGM) on birdstrike cutback speeds. |
| 13 August, 2002 | JAA withdraws support of GSHWG agreed position on birdstrike, indicating that issue of “cutback” speeds must be addressed, i.e. “cutback” speeds to no longer be allowed. |
| 25 October, 2002 | GSHWG Meeting #34 – group discussion, proposal to envelope rule and adopt prohibition of “cutback” speeds accepted by all members except CAA/UK. Proposal to impose prohibition of “cutback” speeds and remain unharmonized on empennage bird mass accepted by FAA and JAA regulators but rejected by all others in the group. Agreement reached to disagree. Agreed to submit separate white papers to TAEIG along with statement that harmonization cannot be achieved within the group. |

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The following table presents the evolution of the regulations associated with birdstrike.

| Rule | Amendment Level | Text |
|-----------|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 25.571(e) | 25-45 Effective 12/01/78 | The airplane must be capable of successfully completing a flight during which likely structural damage occurs as a result of impact with a 4-pound bird at likely operational speeds at altitudes up to 8,000 feet. |
| 25.571(e) | 25-72 Effective 08/20/90 | The airplane must be capable of successfully completing a flight during which likely structural damage occurs as a result of impact with a 4-pound bird at V_C at sea level to 8,000 feet. |
| 25.571(e) | 25-96 Effective 03/31/98 | The airplane must be capable of successfully completing a flight during which likely structural damage occurs as a result of impact with a 4-pound bird when the velocity of the airplane relative to the bird along the airplane's flight path is equal to V_C at sea level or $0.85 V_C$ at 8,000 feet, whichever is more critical. |
| 25.631 | 25-23 Effective 05/08/70 | The empennage structure must be designed to assure capability of continued safe flight and landing of the airplane after impact with an 8-pound bird when the velocity of the airplane (relative to the bird along the airplane's flight path) is equal to V_C at sea level, selected under Sec. 25.335(a). Compliance with this section by provision of redundant structure and protected location of control system elements or protective devices such as splitter plates or energy absorbing material is acceptable. Where compliance is shown by analysis, tests, or both, use of data on airplanes having similar structural design is acceptable. |
| 25.775(b) | 25-0 Effective 02/01/65 | Windshield panes directly in front of the pilots in the normal conduct of their duties, and the supporting structures for these panes, must withstand, without penetration, the impact of a four-pound bird when the velocity of the airplane (relative to the bird along the airplane's flight path) is equal to the value of V_C , at sea level, selected under Sec. 25.335(a). |

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Discussion

The OEMs favor enveloping the current FAA and JAA requirements of this rule in the spirit of harmonization. Although specific supporting data for the FAA eight pound bird mass requirement on the empennage is not evident from the preliminary report from the U of I, the OEMs are willing in the spirit of harmonization to envelope the current FAA and JAA requirements. The OEMs remain opposed in principle to the prohibition of “cutback” speeds for birdstrike.

There is an increased level of safety being proposed if the requirement is to specifically protect crew and/or individual passengers. The current requirement is for continued safe flight and landing, except for the windshield requirement in 25.775 that specifies no penetration. It should be noted that there has been no Part 25 aircraft losses attributed to birdstrike damage on the airframe since the Vicount.

Between April 24, 2000 and February 21, 2003 the FAA sponsored research to ascertain a birdstrike criterion grounded in a risk assessment approach. This research did not result in a definitive conclusion; nevertheless, it did reveal some new information. The OEMs point to some of the initial findings of the U of I study initiated by the FAA:

- ❖ Bird Mass
 - 95% of the 700 species of birds that breed in North America have mean body masses of ≤ 4 lbs. For at least one gender. (Reference 1, Section 2.3, page 18)
 - Only 14 species have mean body mass ≥ 8 lbs. (Reference 1, Section 2.3, page 18)
- ❖ Top 10 Species Struck in U.S. (Reference 1, Section 2.3, page 17)
 - 1) Blackbirds – general category 605 Reports
 - 2) European Starling 570 Reports
 - 3) Rock Dove 409 Reports
 - 4) Mourning Dove 230 Reports
 - 5) Canada Goose 205 Reports
 - 6) American Kestrel 188 Reports
 - 7) Killdeer 158 Reports
 - 8) Red-Tailed Hawk 153 Reports
 - 9) Mallard 109 Reports
 - 10) Herring Gull 96 Reports
- ❖ Number of Strikes
 - 3% of all strikes (882) between 1990 and 2001 were mammals and reptiles and 56% of these collisions caused damage to the aircraft (Reference 1, Section 1.1, page 4)
 - 97% of all strikes (33,488) between 1990 and 2001 were birds, but only 15% of these collisions caused damage to the aircraft (Reference 1, Section 1.1, page 4)
 - The combined reported birdstrike data from all sources during the time period of 10/04/1919 to 08/28/2000 has been 105,797 occurrences (Reference 1, Table 3, page 13)

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- ❖ Number of Flights
 - During the past 40 years, the report indicates there are 39,253 aircraft in the commercial fleet that have accumulated 637,390,214 total hours during 737,063,581 flights (Reference 1, Table 12, page 41)

- ❖ Altitude
 - In regard to the altitude that the majority of birdstrikes occur, the initial study results indicate that the overwhelming majority of birdstrikes occur at altitudes less than 8000 ft. (> 99.5%). (Reference 2, Slide 9) Although the reference to an altitude of 8000 ft. in defining the impact speeds for which bird impacts are to be considered may have been chosen arbitrarily, the data on birdstrikes gathered by the U of I tend to support the selection of this altitude as an upper limit to the overwhelming number of birdstrikes.
 - Additionally, 93.8% of all birdstrikes occur at ≤ 1000 ft. AGL. (Reference 2, Slide 10)

- ❖ Speed at Time of Impacts
 - Maximum speed below 10,000 ft. was assumed to be 250 kts. if a real speed was not recorded in the data. (Reference 1, Section 4.2.2, page 40)
 - Approach speed was estimated at 150 kts. if a real speed was not recorded in the data. (Reference 1, Section 4.2.2, page 40)
 - Takeoff and landing speeds were estimated at 120 kts. if a real speed was not recorded in the data. (Reference 1, Section 4.2.2, page 40)
 - 95% of all strikes occur below 210 kts. (Reference 3, Item 2)

- ❖ Extrapolation of Probability for all Part 25 Aircraft
 - For an assumed speed of 250 knots at the 10^{-9} probability level for flight hours, the expected mass of the bird would be approximately 2.4 pounds. (Reference 1, page 45)

Conclusions

A review of the data presented in this position paper leads one to the following conclusions:

- Greater than 99.5% of birdstrikes occur at an altitude of less than 8000 feet where the maximum aircraft velocity is 250 knots and typically 120 to 150 knots.
- The analysis indicates that to ensure a 10^{-9} level of safety at 250 knots the expected mass of the bird would be approximately 2.4 pounds, not 4.0 or 8.0 pounds as currently required in the regulations.
- Climb rates of current aircraft ensure minimal time is spent in the air space where impacts are likely to occur.
- Even for those designs not certified to the latest amendment levels, safety does not appear to be an issue.

In conclusion, the OEM position to adopt a common weight bird for FAR §§ 25.571/25.775/25.631 of 4 pounds, the net effect of which would reduce the current 8 pound birdstrike impact weight requirement of

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§ 25.631 is valid, based on field service history and the results of the study funded by the FAA with the University of Illinois (U of I).

References:

- 1) FINAL REPORT, Assessment of Wildlife Strike Risk to Airframes, Conducted by Airport Technology Center of Excellence University of Illinois at Urbana-Champaign For U. S. Department of Transportation Federal Aviation Administration William J. Hughes Technical Center – AAR 410, Contract # DOT 95-C-001-11, By Edwin E. Herricks, Phil Mankin, and David J. Schaeffer, Dated December 2002.
- 2) Power Point Presentation to GSHWG Members at Meeting #31 June 11, 2002, Supporting FAA Research and Development Activities, Project: Assessment of Wildlife Strike Risk to Airframes by Edwin E. Herricks, University of Illinois at Urbana-Champaign Center of Excellence. 3) GSHWG Observations From Presentations RE: Bird Impact R&D Studies, February 13, 2001, Enclosure (9) of GSHWG Meeting #27 Minutes, Boeing Letter BYR20-AWH-M01-003 dated 9 March 2001.

FAA Action: Damage Tolerance and Fatigue Evaluation of Structure, Advisory Circular 25.271-C -- [Regulatory and Guidance Library](#)