Transport Canada Safety and Security
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Your file Votre référence
Federal Register, Notice 99-02
Our file Notre référence
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AARD-5009-5-57 1

July 29, 1999

U.S. Department of Transportation Dockets
Docket No. FAA-1999-5401 - 36
400 Seventh St. SW
Room Plaza 401
Washington, DC 20590
U. S. A.

Subject : Proposed Rulemaking On Aging Airplane Safety (Docket No. FAA- 1999-540 1)

This is in response to your invitation for comments on the proposed rulemaking to address the safety of aging airplanes.

The Transport Canada comments on the various aspects of the proposal are contained in Attachment 1 to this letter, and are submitted for the FAA's consideration in their final rulemaking. The rest of the Attachments (2, 3 and 4) are supplemental detailed information on items that were mentioned in the discussion of our comments, and are provided for convenience of reference.

Sincerely,

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Chief, Regulatory Standards (AARDH)
Aircraft Certification

Canada

26-0585 (98-06)

Comments to Docket FAA- 1999-540 1; Notice 99-02 Aging Airplane Safety

1) Summary, Page 16298

The NPRM's fundamental philosophy as stated throughout the document can be quoted as: "The proposed rule also would prohibit operation of these airplanes after specified deadlines unless damage-tolerance-based inspections and procedures are included in their maintenance or inspection program". "Damage-Tolerance-Based Inspections and Procedures . ..refer to an inspection program that specifies procedures, thresholds, and repeat intervals that have been developed using damage-tolerance principles." (Page 1630 1)

Comment:

Transport Canada believes that the overall requirement to mandate a program to require a damage-tolerance based _inspection program_ *is restrictive and may lead to creating an unsafe condition as the airframe ages.*

Transport Canada, in accordance with the Canadian Aviation Regulations (CAR) Section 51 I. 34 Supplemental Integrity Instructions (Attachment 2 to this letter), believes that a structural integrity program shall include mandatory component replacement (safe-life) as well as a mandatory inspection program together with a Corrosion Protection and Control program to insure that the fatigue inspections/part replacement remains valid. (N.B. It must be stressed that the methodology used to determine a safe-life may use fracture mechanics (damage tolerance principles) but nevertheless is, in the final analysis, a component replacement program).

Transport Canada believes there are many reasons to include a component/part replacement (safe-life) program but will site two reasons here. First, a safe-life may be required in order to avoid the risks associated with structural degradation due to a form of Widespread Fatigue Damage known as Multiple Site Damage (MSD). Multiple Site Damage is characterized by the simultaneous presence offatigue cracks in the same structural element. Such cracks are initially independent and usually non-uniform, but may interact with increasing size. This could result in a significant increase in crackpropagation rate and/or a reduction in residual strength capability. Because these cracks are relatively small, they are difficult to detect with any available inspection method that assures a reliable detection probability. Failure to detect MSD exposes the airframe to a risk of sudden crack coalescence, possibly leading to total structural failure without adequate prior warning. In order to insure continued structural integrity, it is Transport Canada's position that a structure that is exposed to the risk of MSD must be replaced or repaired at the appropriate interval. An inspection program may not alleviate the risk because of the reliance on an inspection of cracks that may be too small to be reliably detected. In order to determine the appropriate component/part replacement interval (safe-life) a number of *methodologies may be used including fracture mechanics (crack-growth) techniques and tear down inspections.*

The second reason to include safe-life methodology lies in the reasons associated with the inclusion of safe-life in FAR 25.571 (equivalent to our CAR 525.571). Compliance with the damage-tolerance requirements is not required if the applicant establishes that their application for particular structure is impractical. For new designs Transport Canada has limited the interpretation of this part to landing gear and, in the past, engine mount structures because the stress, geometry and material of those parts, including their manufacturing process, makes the use of damage tolerance requirements difficult to apply. For aging aircraft, particularly in the small commuter class (CAR 3, FAR 23, SFAR 41 etc.) we are dealing with old designs where the component design was not influenced by damage tolerance inspection principles (the requirements did not exist). As such, it may be impractical (in an airworthiness sense) to apply the damage-tolerance requirements in a retroactive manner owing to the increased risk associated with mandating damage tolerance inspections. The designers of those airframes (years ago) may not have considered the inspectability aspect of their design. Components may have been designed to be replaced to insure structural integrity. In order to understand what is meant by the increased risk associated with inspections it must be understood that the application of a damage tolerance inspection program is intended to require an inspection of structure at the appropriate time in order to have the highest probability of detecting a crack. Too frequent or unnecessary inspections may expose the structure to the risks associated with accidental damage. (N. B. Accidental damage being defined as in the order of a typical imperfection flaw in accordance with dated MIL-8-3444). To require an inspection program for airframe components that were not designed to be inspectable, exposes that structure to the risks associated with the introduction of a accidental damage (typical imperfection flaw) and the associated increased safety risk. The continuing application of a safe-life (component replacement) program may be justified following a review of the structural detail at issue. The structural review may include a review of the substantiation to show compliance and/or the application of fracture mechanics principles to the safe-life structure if the geometry and material make it practical.

An additional point associated with the risks of mandating a damage-tolerance-based inspections for components that were not designed to be inspectable relates to an operator's ability to perform such inspections. Operators of small commuter class aicraft (CAR 3, FAR 23, SFAR 41 etc.) may not have the resources, training and capability to perform reliable inspections without introducing a risk to the continued airworthiness and safety of the aircraft's operation. AC No: 91 -MA pagraraph 7 page 3 states "Each operator must determine, subject to FAA approval, how the applicable damage-tolerance-based inspections andprocedures will be applied considering the uniqueness of the operator's maintenance program, operating *environment, and fleet modification status. Each amendment will be evaluated and approved on an individual basis." A component replacement program will allow an operator, who may not be able to perform the inspection requirements without the possibililty of risk to the structure, to operate their aircraft without introducing that risk. This allows flexibility to the operator, type certificate holder and airworthiness authority to approve a program that considers the uniqueness of each operator and approve a component/part replacement program in lieu of an inspection program.*

The merits associated with the use of Palmgrin-Miner (and all other associated similar techniques) methodologies versus fracture mechanics (crack growth) methodologies is a separate issue that should be included in AC No: 91-MA. Transport Canada's issue relates to the NPRM's proposal to mandate a damage tolerance <u>inspection program</u> and in particular its application to the small commuter class (CAR 3, FAR 23, SFAR 41 etc.). The determination of the merits associated with the best technique to show compliance with aging airplane safety should be left up to the appropriate specialists when determining compliance with an applicable regulation or standard. The application of Miner (or similar) techniques have been used to show compliance with even the damage tolerance requirements in the United States and countries in Europe (ie. Threshold inspection determination). Transport Canada recognizes that the latest techniques associated with fracture mechanics (crack growth) principles should be used to their maximum extent practical - including the determination of a safe-life (part/component replacement). Transport Canada supports the intent of NPRM 99-02 to require the use of fracture mechanics (crack growth) methodologies by using the words "damage tolerance principles" (Pg 16301). The NPRM should recognizefiacture mechanics methodology, which is used to develop acceptable threshold and repeat inspection intervals, can be used (and is used) for a "safe-life" or <u>component replacement program</u> and supports the premise of damage-tolerance principles. Again, this allows flexibility to the airworthiness authority to approve a program that considers the uniqueness of each operator and approve a component/part replacement program in lieu of an inspection program.

Finally, it has been Airworthiness Authorities 'practice to include component/part replacement as terminating action to an Airworthiness Directive. Such an approach has been found to be acceptable to insure airworthiness and safety.

Owing to the very extensive nature ofproviding detailed recommendations to the text, Transport Canada recommends that 121.3 70a, 129.16 and 135.168 be re-written to include and explicitly state, together with damage tolerance inspections, safe-life (component replacement) as a "procedure" to assure continued structural integrity as an airframe ages. Not to explicitly include component replacement in the rule may lead to creating an unsafe condition as the airframe ages.

Transport Canada also recommends that AC No: 91-MA be re-written to include safe-life (component/part replacement) program and the methodology by which such a safe-life is determined.

2) Damage-Tolerance-Based Inspections and Procedures, Page 1630 1

The NPRM states that damage-tolerance-based inspections and procedures should be developed under technical direction of the type certificate (TC) holder for that airplane (Pg 16301).

Comment:

It is unclear how Supplemental Type Certificate holders are required to support their designs as far as a structural assessment is concerned. The reference to STC holders is not mentioned in the NPRM. For major modifications/alterations (including major repairs) there may have been a significant alteration to the design that may have affected the usage spectrum associated with the STC. This may lead to an undue burden on the operator of an aircraft type who, owing to the configuration and operation of the aircraft, may need to perform a damage-tolerance based assessment without assistance from the type certificate holder. Take for example a DHC-6 aircraft modified under a FAA STC for Grand Canyon Site-Seeing operation. Transport Canada (and Bombardier DeHavilland) is not cognizant of the details associated with the major change to the fuselage structure and usage spectrum. It is inappropriate to require the TC holder in such cases to provide assistance when the TC holder is unable to do so.

Transport Canada recommends that the FAA provide procedures to allow operators to perform a supplemental integrity program for their aircraft when the type certificate holder is not able to do so because of an STC or major repair.

3) Proposed Appendixes, Page 16302,

a) DeHavilland DHC-6 (all models), Page 16303

The NPRM statement "This Canadian AD, issued in September 1996, mandates the retirement of the airplane at 66,000 hours." is incomplete.

Comment:

The retirement at 66,000 hours is dependent upon the completion of the mandatory supplemental integrity requirements contained in Canadian Airworthiness

Directive CF-96-15 (Attachment 4 to this letter). To achieve the 66,000 hour design life goal, a program of inspections and part replacement is required

Transport Canada recommends that the statement be amended to say "The retirement of the airplane at 66,000 hours is required as a result of AD CF-96-15, providing all the requirements of the AD are accomplished.".

b) Appendix N to Part 12 1 - Design Life Goals, Page 163 16
Appendix B to Part 129 - Design Life Goals, Page 163 18
Appendix G to Part 135 - Design Life Goals, Page 163 19

The DeHavilland DHC-6 aircraft design life goal is stated as 33,000 hours.

Comment.

This is inconsistent with the earlier statement in DeHavilland DHC-6 (all models), Page 16303. Furthermore it is fundamentally inappropriate. The 33,000 hour life is related to the wing life of one DHC-6 model under one design modification status. It does not relate to the life of the complete aircraft. It would be more appropriate to list the wing life limits and all other life limits for the DHC-6 in accordance with DHC-6 Structural Components Service Life Limits document PSM 1-6-l 1 Revision 4, August 6, 1996.

4) International Compatibility, Page 163 15

Comment:

Transport Canada has Canadian Aviation Regulation (CAR) 511.34, Supplemental Integrity Instructions, requiring additional actions to insure continued structural integrity as an airframe ages. The provisions of CAR 511.34 and the supporting standards from the Canadian Airworthiness Manual are provided in Attachments 2 and 3 to this letter, respectively.

The Bombardier DeHavilland DHC-6 Twin Otter meets the requirements of CAR 511.34 with the application of Transport Canada Airworthiness Directive CF-96-15 published 17 September 1996. As of this date, Transport Canada is unaware that the FAA has published a similar Airworthiness Directive to be applicable to DHC-6 aircraft with United States Registration. AD CF-96-15 is provided in Attachment 4 to this letter for your reference.

5) 12 1.368 Aging airplane records reviews and inspections, Page 163 15
129.33 Aging airplane records reviews and inspections, Page 163 17
13 5.422 Aging airplane records reviews and inspections, Page 163 19
Paragraph (d)(9) A list of major structural alterations;

Comment:

As this is related to the responsibility of the Type Certificate holder and Domestic Certifying (Exporting) airworthiness Authority responsible as per comment 2), Transport Canada requests the FAA to provide their interpretation on what is a major structural alteration.

CAR 511.34, Supplemental Integrity Instructions

(1) This section applies in respect of an aeroplane for which a type certificate in the commuter category or the transport category has been issued and that is operated under Subparts 4 and 5 of Part VII.

(2) Before an aeroplane referred to in subsection (1) meets the in-service criterion set out in subsection (3), the holder of the type certificate in respect of the aeroplane shall, in accordance with Chapter 5 11 of the Airworthiness Manual,

(a) develop supplemental integrity instructions in accordance with subsection (4) and submit them to the Minister for approval; and

(b) on their being approved under subsection (5), make the supplemental integrity instructions available to every owner and every operator of an aeroplane of that type.

(3) The in-service criterion that an aeroplane must meet for the implementation of supplemental integrity instructions is that if, in respect of the aeroplane,

(a) a Corrosion Protection and Control Program is in place, the aeroplane reaches the design goal, within the meaning of section 5 11.34 of the Airworthiness Manual, as established by the type certificate holder ;

(b) if no Corrosion Protection and Control Program is in place, the aeroplane completes 20 years of service; or

(c) if no design goal has been established, the aeroplane completes 20 years of service.

(4) The holder of a type certificate who is required by subsection (2) to develop supplemental integrity instructions in respect of an aeroplane shall ensure that the instructions

(a) set out a method of ensuring continued compliance with the basis of the type certification of the aeroplane;

(b) incorporate any recommendation resulting from a detailed engineering assessment of the primary airframe structure of the aeroplane and from the service requirements of that aeroplane;

(c) identify for periodic review all principal structural elements the failure of which could result in the loss of the aeroplane or significantly reduce the overall structural strength of its airframe; and

(d) include a supplemental structural integrity document that provides the information specified in section 5 11.34 of the Airworthiness Manual.

(5) The Minister shall approve the supplemental integrity instructions submitted in respect of an aeroplane if it is determined that the instructions provide for the same level of safety of the aeroplane as was the case at the time the type certificate was issued for that aeroplane.

(6) The holder of a type certificate who proposes to make a change to the supplemental integrity instructions in respect of an aeroplane shall

(a) submit the change to the Minister for approval; and

(b) on approval of the change, make the changed instructions available to every owner and every operator of an aeroplane of that type.

AWM Section 511.34, Supplemental Integrity Instructions

(1) Pursuant to CAR 5 11.34 Paragraph (1), Supplemental Integrity Instructions are applicable for aeroplane types that have been type approved to the requirements of AWM 523 (Commuter) or AWM 525 or their equivalent.

Information Note:

Current Canadian standards have been listed here. However, the requirement is intended to apply equally to similar standards such as earlier Canadian standards or other national standards e.g. CAR 4b, JAR 25, FAR 25.

Special purpose aircraft (e.g. CL21 5 Water Bomber), aircraft which were certificated and primarily used in Bush-plane operations (e.g. DHC-2 Beaver, DHC-3 Otter) and aircraft that were never used in commercial air service (e.g. DHC-4 & DHC-5) would not normally be consideredfor Supplemental Integrity Instructions unless requested by the Type Certificate holder.

(2) Supplemental Integrity Instructions must be developed and implemented in accordance with the requirements of CAR 5 11.34(2) and (4). Such instructions are to be contained within a Supplemental Structural Integrity Document (SSID).

(3) For the purpose of this chapter, design life goal means the expected period of operational service of the aeroplanes.

Information Note:

The design life goal is normally establishedfor the fatigue analysis or fatigue tests performed as part of the original aeroplane certification. It is usually set to be coincident with the period of service after which a substantial increase in maintenance is expected to be required to assure operational safety and is consequently sometimes referred to as the economic design goal. In some aeroplane designs, operation beyond the design life goal may risk the occurrence of Widespread Fatigue Damage (WFD) leading to catastrophic structural failure.

When a design life goal is requiredfor this purpose but has not been developed during the design life of the aeroplane, a design life goal may be established by the Type Certificate holder using conservative assumptions of the aeroplane's mission profile.

Transport Canada requires that operators incorporate supplemental integrity instructions into their maintenance program prior to the design life goal. As such, sufficient lead time is required to develop, approve and incorporate Supplemental Integrity Instructions.

A long aircraft service life is dependent on a sound Corrosion Prevention and Control Program (CPCP), as any propensity for fatigue cracking will be greatly accelerated by the presence of corrosion. Corrosion is principally calendar time dependent, so it is important that effective corrosion control is verified if an aircraft is to remain in service for an extendedperiod. Consequently, if no Corrosion Protection and Control Program has been implementedfor the aeroplane, a service history review would be required at the

20 year mark to verify adequate corrosion control and to correct any deficiencies. Provided that calendar time related ageing effects are demonstrated to be controlled, the Supplemental Structural Integrity Document may then be developedjust in time for introduction by the design life goal. For additional guidance on CPC Programs refer to: Air Transport Association of America (ATA) Airline/Manufacturer Maintenance Program Development Document MSG_3 Revision 2; United States Federal Aviation Administration (FAA) Advisory Circular (AC) 43-4A "Corrosion Control for Aircraft" and FAA Order 8300.12 "Corrosion Prevention and Control Programs".

(4) In developing Supplemental Integrity Instructions pursuant to CAR 5 11. 34, the Type Certificate holder for each type of aeroplane registered in Canada shall:

(a) take into consideration:

(i) aeroplane Basis of Certification, and method of compliance with that basis;

(ii) detailed engineering examination of the primary airframe structure; and

(iii) service history.

(b) accomplish a complete review of the primary structure and identify all principal structural elements (PSEs) which could lead to the loss of the aeroplane or would significantly reduce the overall structural strength of the airframe if they were to fail.

Information Note:

Principal structural elements may have already been determined and identified during the original type certification process . The PSE locations identified at the time of type certification, would be acceptable in order to comply with this requirement . However, a review of the primary structure may still be necessary in order to add additional PSEs as a result of service history.

(c) publish a Supplemental Structural Integrity Document (SSID). This document shall include:

(i) A description of each PSE (i.e. structural location, component or damage site) that has been selected for inspection, modification or replacement;

(ii) The type of damage expected (i.e., fatigue, corrosion, delamination, disbond, accidental damage, multiple-site damage) for each structural location identified in (i);

(iii) A reference to existing maintenance manual or service bulletin requirements where relevant;

(d) For each PSE selected for inspection under (a), recommended initial (threshold) inspection interval and repeat inspection intervals together with inspection methods and procedures appropriate for the type of damage identified in (b), including any alternatives to the inspection intervals, methods and procedures;

(e) Reference, where applicable, to optional or mandatory modifications, replacement or corrosion control measures which could change or terminate the inspection requirements determined in (a); and

(f) Guidance for reporting the findings from inspections conducted in a SSID.

Information Note:

The basis of type certification of aeroplane structure can fall into one or more of the four following categories:

(a) safe life,

(b) fail safe,

(c) damage tolerant, or

(d) none of the above.

In all cases a mission profile and associatedfatigue spectra will need to be determined from service history. In the event that a mission profile andfatigue spectra were determined at the time of the original certification, a review of the original data to incorporate any changes necessary in light of the service history would be required.

For all PSEs identified and where this is practical, establish threshold inspection times, repeat inspection intervals and inspection methods which ensure that cracks and corrosion are detected before catastrophic failure of the aeroplane occurs. Generally, these times should be determined using fracture mechanics analysis supported by tests (where necessary) and the fatigue spectra. Where a structural design feature makes this impractical, the safe life approved at the original certification should be reviewed and revised as necessary, or a new safe life determined if the PSE was not previously designed to a safe life.

A safe life may need to be determinedfor parts of the aeroplane which were not safe life, by analysis, test, tear-down inspection or service history such that catastrophic failure of the aeroplane due to Widespread Fatigue Damage will not occur.

The Supplemental Structural Integrity Document (SSID) supplements any existing inspection requirements that may already exist for the aeroplane. CPC Programs may be part of the aeroplane's Maintenance Program Development. Inspection Requirements for aeroplanes certificated to Damage Tolerance may contain information that in part addresses paragraph (4)(b), (c)(i), (ii) and (d). Such information would be referenced in the SSID under the requirements of paragraph (4)(c) and need not be duplicated in the SSID.

CF-96- 15 DE HAVILLAND

Applies to all de Havilland DHC-6 “Twin Otter” aircraft.

Compliance is required as indicated.

The de Havilland DHC-6 airframe has recently undergone a structural re-evaluation. This re-evaluation has resulted in life extensions for some structural components and life reductions for others; as well, new structural inspections have been introduced. The most notable determination has been the validation of a life limit for the aircraft structure.

New service life limit information is detailed in de Havilland Structural Components Service Life Limits Manual, PSM 1-6- 11, Revision 4 (hereafter referred to as the "PSM") dated 3 1 May 1996.

With the introduction of Revision 4 of PSM 1-6- 11, some aircraft will be immediately affected by:

(a) the introduction of the main spar lug inspection detailed in de Havilland Service Bulletin 6/525 dated 6 September 1996;

(b) the earlier incorporation of Modification 6/13 18 (Service Bulletin 6/268, Revision E, dated 27 September 1996) by 3000 hours/6000 flights;

(c) the lowering of the threshold for the initial inspection of the main spar at WS 152.8 by 3000 hours/6000 flights;

(d) the introduction of a wing lower skin inspection at WS 185;

(e) the introduction of inboard trailing and fore flap inspections for landplanes;

(f) the introduction of an inspection for the wing flap hinge arm attachment fittings at WS 97.5 for landplanes;

(g) he introduction of an inspection of the engine nacelle structure; and

(h) the introduction of life limits for the primary flight control cables.

To maintain the structural integrity of DHC-6 aircraft, inspect, modify and/or retire the affected structural components as specified in the de Havilland PSM l-6-11, Revision 4 dated 3 1 May 1996, or later revisions approved by the Director, Aircraft Certification, Transport Canada, Ottawa. For aircraft that are approaching or will exceed the new/decreased compliance schedule specified in the PSM on the effective date of this directive, compliance may be modified in accordance with the information provided in the following table:

Inspection, Modification, Life Limit	**Status on Effective Date of this AD**	**Phase-In Schedule Compliance**
Initial inspection of main spar lug.	As per SB 6/525 dated 6 September 1996.	As per SB 6/525 dated 6 September 1996.
Incorporation of Modification 6/1 3 18	Exceeds PSM modification incorporation threshold or will reach the threshold in less than 600 flight hours or 1200 flights	Prior to the accumulation of a further 600 flight hours or 1200 flights, whichever occurs first, but not later

		than 6 months after the effective date of this directive.
Main spar inspection at WS 152.8.	Exceeds PSM inspection threshold or will reach the threshold in less than 600 flight hours or 1200 flights.	Prior to the accumulation of a further 600 flight hours or 1200 flights, whichever occurs first, but not later than 6 months after the effective date of this directive.
Wing lower skin inspection at WS 185.	Exceeds PSM inspection thresh will reach the threshold in less than old or 400 flight hours or 800 flights	Prior to the accumulation a further 400 flight hours or of 800 flights, whichever occurs first, but not later than 6 months after the effective date of this directive.
Inboard fore and trailing flap inspections - landplanes.	Initial inspection required for all landplane aircraft.	Prior to the accumulation of a further 600 flight hours or 1200 flights, whichever occurs first, but not later than 6 months after the effective date of this directive.
Engine nacelle structure,	Initial inspection required for all aircraft.	Prior to the accumulation of a further 600 flight hours or 1200 flights, whichever occurs first, but not later tha6 months after the effective date of this directive.n
Primary flight control cables.	<u>60-Month Flight Control Cables</u>	
	Exceeds 60-month primary flight control cables PSM l-6-11 Revision 4 life limit of 60 months or will reach the limit in less than 12 months or if date of last replacement of cables is unknown.	Not later than 12 months after the effective date of this directive
	<u>12-Month Flight Control Cables</u>	
	Exceeds 12-month primary flight control cables PSM l-6-11 Revision 4 life limit of 12 months or will reach the limit in less than 6 months or if date of last replacement of cables in unknown.	Not later than 6 months after the effective date of this directive.

Alternative means of compliance with the requirements of this directive may be used only if approved by the Director, Aircraft Certification, Transport Canada, Ottawa. Any application should be made to the appropriate regional office.

This directive supersedes Airworthiness Directive CF-82-24 issued 24 August 1982.

This directive becomes effective 11 October 1996.