NOTICE OF PROPOSED AMENDMENT (NPA) No 05/2006

DRAFT DECISION OF THE EXECUTIVE DIRECTOR OF THE AGENCY

AMENDING
DECISION NO. 2003/12/RM OF THE EXECUTIVE DIRECTOR OF THE AGENCY
of 5 November 2003

on general acceptable means of compliance for airworthiness of products, parts and appliances (« AMC-20 »)

AGEING AEROPLANE STRUCTURES

TABLE OF CONTENTS.

A. EXPLANATORY NOTE

I. General

1. The purpose of this Notice of Proposed Amendment (NPA) is to envisage amending Decision 2003/12/RM of the Executive Director of 5 November 2003[1]. The scope of this rulemaking activity is outlined in ToR 20.005 and described in more detail below.

2. The Agency is directly involved in the rule-shaping process. It assists the Commission in its executive tasks by preparing draft regulations, and amendments thereof, for the implementation of the Basic Regulation[2] which are adopted as "Opinions" (Article 14(1)). It also adopts Certification Specifications, including Airworthiness Codes and Acceptable Means of Compliance and Guidance Material to be used in the certification process (Article 14(2)).

3. When developing rules, the Agency is bound to follow a structured process as required by Article 43(1) of the Basic Regulation. Such process has been adopted by the Agency's Management Board and is referred to as "The Rulemaking Procedure" [3].

4. For practical reasons, the initial issue of AMC-20 was based upon JAA GAI-20 at Amendment 1 dated 1st January 2003. During the transposition from JAR/ACJ into Certification Specifications (CS) and Acceptable Means of Compliance (AMC), however, the rulemaking activities under the JAA system where not stopped and significant rulemaking proposals have since been developed. In order to assure a smooth transition from JAA to EASA, the Agency has committed itself to continue as much as possible the JAA rulemaking activities. It has therefore included most of the JAA rulemaking programme into its own plans. This EASA NPA is a result of this commitment and implements rulemaking task 20.005 "Ageing Aircraft Structures", which is included in the Agency's rulemaking programme for completion in 2006. It is based on JAA NPA 20-10 that was circulated for comments from March to June 2003.

5. The text of this NPA was originally developed by the European Ageing Aircraft Working Group (EAAWG) and later adapted to conform to EASA regulatory procedures by the Agency. It is submitted for consultation of all interested parties in accordance with Article 43 of the Basic Regulation and Articles 5(3) and 6 of the EASA rulemaking procedure.

---

[1] Decision No 2003/12/RM of the Executive Director of the Agency of 05.11.2003 on general acceptable means of compliance for airworthiness of products, parts and appliances (AMC-20)

[2] Regulation (EC) No 1592/2002 of the European Parliament and of the Council of 15 July 2002 on common rules in the field of civil aviation and establishing a European Aviation Safety Agency *(OJ L 240, 7.9.2002, p.1.)*

[3] Management Board Decision MB/7/03 from 27 June 2003 concerning the procedure to be applied by the Agency for the issuing of opinions, certification specifications and guidance material ("rulemaking procedure").

II. Consultation

6. To achieve optimal consultation, the Agency is publishing the draft decision of the Executive Director on its internet site. Comments should be provided within 3 months in accordance with Article 6(4) of the EASA rulemaking procedure.

7. Comments on this proposal may be forwarded *(preferably by e-mail)*, using the attached comment form, to:

By e-mail: NPA@easa.eu.int

By correspondence: Process Support
Rulemaking Directorate
EASA
Ref: NPA 05-2006
Postfach 10 12 53
D-50452 Cologne
Germany

Comments should be received by the Agency before 25 July 2006. If received after this deadline they might not be treated. Comments may not be considered if the form provided for this purpose is not used.

III. Comment response document

8. All comments received in time will be responded to and incorporated in a comment response document (CRD). This may contain a list of all persons and/or organisations that have provided comments. The CRD will be widely available on the Agency's website.

The review of comments will be made by the Agency unless the comments are of such a nature that they necessitate the establishment of a group.

IV. Content of the draft decision

9. The objective of this AMC is primarily to provide technical guidance to aid development of an ageing aircraft structures programme required by Part M[4]. It is relevant to design approval holders, operators, maintenance organisations, and competent authorities.

10. Compliance with this AMC is not in itself mandatory, but may become so if subsequently referenced through an appropriate Book 1 rule or through specific Airworthiness Directive action.

11. The nature of ageing aircraft structures issues covers many areas of regulation and will require a complex change in the regulatory framework to address fully. At the time of

[4] Annex 1 of Commission Regulation (EC) No 2042/2003 of 20 November 2003 on the continuing airworthiness of aircraft and aeronautical products, parts and appliances, and on the approval of organisations and personnel involved in these tasks

writing this NPA, such developments to the regulatory framework are still on-going and subject to the EASA rulemaking procedures. However, the technical advice provided in this proposed AMC is considered to be mature and is being published at this time to prevent any avoidable delay in making this material available within the public domain and to encourage its use by industry in developing ageing aircraft structures plans on a voluntary basis.

12. The guidance provided in proposed AMC 20-20 specifically addresses large aircraft and has been derived mainly from service experience gained with large aircraft. However, the issue of ageing aircraft structures is more generic and much of this material would be equally applicable to all aircraft. In the past, some competent authorities have mandated action for small aircraft through changes to their regulatory framework or by the use of Airworthiness Directives. While no policy decision has yet been taken by EASA on the applicability of ageing structures programmes to aircraft other than large aircraft, all stakeholders are encouraged to consider the technical guidance material contained in this proposal.

V. Regulatory Impact Assessment:

1. Purpose and intended effect:

a. Issue which the NPA is intended to address:
Aircraft were originally designed to meet continuing structural airworthiness requirements for an indefinite period. In the late eighties, however, several accidents prompted an international activity to address ageing aircraft structures issues. The subsequent investigations identified a number of areas where structural maintenance programmes needed to be enhanced to ensure the continuing airworthiness of ageing aircraft.

Commission Regulation (EC) No. 2042/2003 (Part M), stipulates, inter alia, that maintenance programmes should be developed and updated to incorporate specific structural maintenance programmes where issued by the type certification holder (TCH) (see Appendix 1 to AMC M.A.302 and M.B.302). However, there are currently no rules that mandate the TCH, or other design approval holder (DAH), to develop ageing aircraft structures programmes and limited guidance material is available on how to develop programmes that would be acceptable to the Agency.

b. Scale of the issue:
The issue of ageing aircraft affects operators, maintenance organisations, design approval holders and competent authorities. It is applicable to all aircraft types and to both new aircraft designs and to the existing fleet.

c. Brief statement of the objectives of the NPA:
The purpose of this NPA is to provide technical guidance to be used by industry in developing continuing structural integrity programmes, with the objective of ensuring that ageing aircraft structure is adequately maintained throughout the aircraft's operational life.

2. Options:

a. Three options could be identified for EASA action:
Option 1: Do nothing
Option 2: Allow the industry to develop its own structural integrity programmes under the Agency's guidance. This would be a non-mandatory action.
Option 3: Provide mandatory requirements. The scope of such regulations would be determined based on a more detailed regulatory impact assessment.

b. <u>The preferred option selected:</u>
Please see paragraph V-5 below.

3. Sectors concerned:

Those affected by this proposal would include: operators, design approval holders, maintenance organisations, and competent authorities.

4. Impacts:

a. All identified impacts

i. <u>Safety</u>
Ensuring that an aircraft's structural integrity is maintained throughout its service life is fundamental in controlling aviation safety. However, service experience has shown that existing maintenance provisions are insufficient in achieving this goal and that the structural integrity of aircraft may be compromised with age.

Option 1 would not control the identified safety risks and the number of accidents/incidents is likely to increase as the fleet ages.

Options 2 would allow industry to develop structural integrity programmes with the knowledge that they would be acceptable to the Agency. However, without a mandatory status, commercial factors may limit the level of uptake by industry, and lead to different standards being applied.

Option 3 would mandate minimum requirements. The scope of the regulation may vary according to the size of aircraft or type of operation being undertaken. Any proposal would need to be developed further.

ii. <u>Economic:</u>
Option 1 would have no immediate economic impact. However, any increase in the accident rate would have an associated increase in costs.

Options 2, being non-mandatory, would not force addition costs on industry. However, if adopted by industry, some additional costs would be incurred in developing ageing aircraft structures programmes, in required maintenance and in the management and control of these programmes. These costs would need to be offset against the costs of an accident or the cost of replacing an aircraft.

Options 3, would incur additional costs on industry. The nature and extent of these additional costs have yet to be established.

iii. Environmental
No effects on the environment have been identified.

iv. Social:
No social impacts have been identified.

v. Other aviation requirements outside EASA scope:
The technical work to develop continuing structural integrity programmes was originally undertaken in cooperation with industry the FAA and other foreign regulatory authorities. Due to structural differences in the regulatory framework of different countries, full harmonisation of requirements has not been possible and individual authorities have adopted different approaches to meet their own specific needs. However, the technical content and intent of ageing aircraft structures programmes remains closely coordinated.

Aircraft operators must take an active part in the development and implementation of ageing aircraft structures programmes. There may therefore be consequences on JAR-OPS.

vi. Security:
No security impacts have been identified.

b. Equity and fairness in terms of distribution of positive and negative impacts among concerned sectors:
Ageing structures issues are applicable to all aircraft. However, application of common rules may have a greater impact on certain sectors of the industry. Conversely, it may be perceived as being unfair if different requirements are applied to different aircraft categories or operations. The scope of any proposed mandatory action would therefore need to be justified, considering the safety risks for each aircraft category or type of operation and the associated impact on industry.

5. Summary and Final Assessment:

a. Comparison of the positive and negative impacts for each option:
Option 1 has no effect on industry but will not address a known safety issue. This option will therefore not meet the safety objectives of the Agency.
Option 2 can be seen as a pragmatic, short-term, step towards addressing the safety issue. It provides industry with clear guidance to enable them to develop continuing structural inspection programmes, in the full knowledge that they will be acceptable to the Agency. However, being non-mandatory, this option may not provide a uniform level of civil aviation safety throughout Europe.
Option 3 would fulfil the Agency’s objectives and create a high uniform level of safety that addresses the identified risks. However, changing the regulatory framework will take time to achieve.

b. <u>Summary describing who would be affected by these impacts and analysing issues of equity and fairness</u>:
Those affected by this proposal would include: operators, design approval holders, maintenance organisations, and competent authorities.

c. <u>Final assessment and recommendation of a preferred option</u>:
On balance Option 2 provides a realistic short-term objective. It will provide the basis on which industry can develop continuing structural integrity programmes, in the full knowledge that they will be acceptable to the Agency. In the longer term, regulation is necessary to ensure a uniform minimum safety standard is set. Option 3 is therefore being implemented through a further rulemaking task (MDM.028).

VI. Information on Future Ageing Aircraft Rulemaking Developments

Although not forming part of this NPA, this section provides information on the Agency's longer term strategy for addressing ageing aircraft issues and will assist the reader in putting into context these proposals.

The publication of this AMC is one step in developing a regulatory framework for ageing aircraft and is being published at this time to provide visibility of ageing aircraft structural issues and to provide technical guidance in developing an ageing aircraft structures plan which is technically harmonised. It provides guidance to those required to develop maintenance programmes to address ageing aircraft issues in accordance with Part M and updates and supersedes JAA Temporary Guidance Leaflet 11: "*Continued Airworthiness of Ageing Aircraft Structures*".

Ageing aircraft issues are somewhat complex from a regulatory standpoint as they impact much of the regulatory framework. Issues which need to be addressed include:

- Amendment to certification specifications to improve the standards for ageing aircraft issues. This will address the case of future TC and future amendments to TC/ future STC in accordance with the changed product rule.
- Requirements on existing design approval holders (e.g. TC, STC holders) to review their existing designs to address ageing aircraft issues.
- Revisions to Part M, as necessary, to provide further clarification of the applicability of ageing aircraft issues and to ensure their implementation.
- Additional requirements, as necessary, to introduce modifications in individual aircraft resulting from the design review.

Rulemaking task MDM.028 "*Development of an Ageing Aircraft Structure Plan*" is an EASA initiative to develop European rules to reflect work currently on-going elsewhere, most notably in the USA, and to provide an opportunity to contribute to all aspects of this subject. A joint task to ensure full harmonisation of rules is not possible due to the different regulatory framework within each country. However, close coordination is being maintained to ensure that technical and procedural requirements are closely aligned. Rulemaking task MDM.028 will establish a Working Group to develop the technical elements to be incorporated in the regulatory framework (e.g. proposals for CS modifications, proposals for mandatory actions or not, implementation dates, affected aircraft and operations) and aims to complete this task in the 2008/2009 timeframe. Specific tasks to be covered in this activity include:

<u>For large aeroplanes:</u>

- Review the 5 ageing aircraft issues (see B.2 below for explanation) and identify options for implementation to both the existing and future fleet. Consideration should be given to both mandatory and non-mandatory actions and for which aircraft and operations.
- Select options and justify proposed actions through development of a Regulatory Impact Assessment.
- For issues deemed to be mandatory, develop the following based on the technical work and recommendations previously established:
  - The actions needed by the TC/STC holder and the time scales necessary for compliance
  - Rule and AMC material for incorporation into maintenance requirements
  - New standards to be included in the CSs (if appropriate).

<u>For other aircraft:</u>

- <u>Develop a Regulatory Impact assessment for identifying the need to go beyond large aeroplanes</u>
- <u>Based on the results, develop comparable technical elements for a plan.</u>
- <u>Review and develop AMC 20-20, to reflect its wider applicability, as necessary</u>

B. JUSTIFICATION FOR JAA NPA 20-10

As the proposals were already circulated for comments as a JAA NPA, this Section contains the original justification used in the JAA NPA. Where appropriate, information has been updated by EASA to reflect changes made since the JAA NPA was released, including changes to the regulatory framework, where the JAA has been replaced by the EASA and JAR-25 and GAI-20 by CS-25 and AMC-20 respectively.

B.1 INTRODUCTION

Ageing aircraft have been and continue to be a safety concern internationally with high public profile. Over the last ten years under the auspices of the Airworthiness Assurance Working Group AAWG (formerly Ageing Aircraft Task Force AATF) many meetings and significant technical work have been carried out on the subject of ageing aircraft. Although much of the activity has taken place in the USA, the effort is international and under the umbrella of ARAC-TAEIG, the topics are considered as harmonisation ones.

The ageing aircraft structures issue is primarily an in-service problem of continued airworthiness and the regulatory activity focuses in the operations and maintenance areas. Additionally considerable Type-Certificate Holder (TCH) input is required to establish technically what needs to be done to the fleet before the maintenance can be performed. Consequently this NPA is proposed as AMC-20 material relevant to both maintenance and certification.

Service experience has demonstrated that there is a need to have continuing updated knowledge concerning the structural integrity of aircraft, especially as they become older. The structural integrity of aircraft is of concern since such factors as fatigue cracking and corrosion are flight cycle and time dependent. Knowledge concerning them can best be assessed on the basis of real time operational experience and the use of modern tools of analysis and testing. The inspection and evaluating programmes outlined in this document are intended to ensure that a continuing structural integrity assessment is carried out and that results are incorporated into the maintenance programmes.

B.2 BACKGROUND TO THE PROPOSALS

Many large aircraft were originally designed to meet continuing structural airworthiness requirements for an indefinite period. This approach is valid providing structural integrity is maintained by an effective inspection and corrective maintenance programme. The programme may be adjusted to reflect real time operational experience and analytical findings through the use of modern tools of analysis and testing. Maintenance programmes must ensure that aircraft structure continues to meet required ultimate strength, fatigue, fail safe and damage-tolerance requirements.

To achieve this, in August 1988 the Air Transport Association of America (ATA) and the Aerospace Industries Association of America (AIA) presented the FAA with a proposal to form the Ageing Aircraft Task Force (AATF), an international group comprised of technically qualified individuals representing the airlines and aeroplane manufacturing industry, to direct several ageing aircraft initiatives, results of which were to be incorporated in operators structural maintenance programmes of the "AATF eleven" aeroplanes. In 1992 this group became the AAWG, and was chartered under the auspices of the ARAC. This group was composed of representatives from aeroplane operators, aeroplane TCHs and civil Airworthiness Authorities.

Subsequently, the investigations of the AAWG and the associated task groups have developed into programmes covering general guidelines for structural maintenance programmes and the following 5 key structural issues:

1) Review and update the Supplemental Structural Inspection Programme (SSIP) for effectiveness;
2) Review existing corrosion prevention programmes and develop a baseline Corrosion Prevention/ Control Programme (CPCP) to maintain corrosion to an acceptable level;
3) Review all structurally related Service Actions/ Bulletins and determine which require mandatory terminating action or enforcement of special repetitive inspections;
4) Develop guidelines to assess the damage-tolerance of existing structural repairs, which may have been designed without using damage-tolerance criteria. Damage-tolerance methodology needs to be applied to future repairs;
5) Evaluate individual aircraft design regarding the susceptibility to Widespread Fatigue Damage (WFD) and develop a programme for corrective action.

Various competent authorities have issued a mixture of Airworthiness Directives and Operational Rules with supporting Advisory Material to mandate the actions on a variety of aircraft types. The material proposed in this NPA is intended to provide standardised technical guidance within the Agency's regulatory framework and its use is encouraged in developing an ageing aircraft structures programme. It is equally applicable in determining maintenance actions for both current and future designs of aircraft.

When applicable, Part M already requires maintenance programmes to include specific consideration of ageing aircraft structures programmes and for these to be reviewed regularly to ensure new or modified maintenance instructions promulgated by the TCH are complied with and accounted for.

This NPA introduces in one document the advisory material derived by, or submitted to, the FAA during the course of the AAWG activity and is in the process of being issued. It follows the format of FAA AC 91-56 with some additional material taken from other FAA operational rules.

Studies of fleet ages in the USA indicate that several aeroplane types have ageing related problems and are reaching the point where Widespread Fatigue Damage could occur and such events have been detected in several fleets since the 1988 Aloha accident.

Consequently it is important to establish and implement the necessary maintenance actions prior to the design service goal being reached on a particular aircraft type. Specific guidance is also given in the proposed AMC on appropriate implementation times.

C. PROPOSAL

The following will amend EC Decision No. 2003/12/RM of the Executive Director of the Agency of 5 November 2003:

AMC 20-20
Continuing structural integrity programme

1. PURPOSE

a) This Acceptable Means of Compliance (AMC) provides guidance to type-certificate holders and operators for use in developing a continuing structural integrity programme to ensure safe operation of ageing aircraft throughout their operational life, including provision to preclude Widespread Fatigue Damage. While primarily aimed at large aircraft that are operated in Commercial Air Transport or are maintained under Part M, this guidance material could also be applicable to all aircraft.

b) The means of compliance described in this document provides guidance to supplement the engineering and operational judgement that must form the basis of any compliance findings relative to continuing structural integrity programmes.

c) The guidance provided in this document is directed to operators, design appoval holders, maintenance organisations, and competent authorities.

d) Like all acceptable means of compliance material, this AMC is not in itself mandatory, and does not constitute a regulation. It describes an acceptable means, but not the only means, for showing compliance with the requirements. While these guidelines are not mandatory, they are derived from extensive industry experience in determining compliance with the relevant regulations.

e) This acceptable means of compliance does not change, create any additional, authorise changes in, or permit deviations from, regulatory requirements.

2. RELATED REGULATIONS AND DOCUMENTS

a) Implementing Rules, Certification Specifications and Operational Requirements:

Part 21A.61	Instructions for continued airworthiness.
Part 21A.120	Instructions for continued airworthiness.
Part 21A.433	Repair design
Part M.A.302	Maintenance programme
CS 25.571	Damage-tolerance and fatigue evaluation of structure
CS 25.903	Engines
CS 25.1529	Instructions for continued airworthiness
JAR-OPS	Subpart M 1.910 Operators aeroplane maintenance programme.

b) FAA Advisory Circulars

AC 91-60	The Continued Airworthiness of Older Aeroplane Airplanes, June 13, 1983, FAA.
AC 91-56A	Continuing Structural Integrity for Large Transport Category Airplanes April 29 1998 FAA (and later draft 91-56B)
AC 20-128A	Design Considerations for Minimizing Hazards Caused by Uncontained Turbine Engine and Auxiliary Power Unit Rotor Failure, March 25, 1997, FAA.
AC 120 – 73	Damage Tolerance Assessment of Repairs to Pressurized Fuselages, FAA. December 14, 2000
AC 25.1529-1	Instructions for continued airworthiness of structural repairs on Transport airplanes, August 1, 1991 FAA.
AC120-XX	Development and Implementation of Corrosion Prevention and Control Program, Draft, August 1999 FAA.

AC 120-AAWG Damage Tolerance Inspections for Repairs (draft)

c) Related Documents

- "Recommendations for Regulatory Action to Prevent Widespread Fatigue Damage in the Commercial Aeroplane Fleet," Revision A, dated June 29, 1999 [A report of the Airworthiness Assurance Working Group for the Aviation Rulemaking Advisory Committee Transport Aircraft and Engine Issues.]
- AAWG Final Report on Continued Airworthiness of Structural Repairs, Dec 1996.
- ATA report 51-93-01 structural maintenance programme guidelines for continuing airworthiness May 1993.
- AAWG Report on Structures Task Group Guidelines, Rev 1 June 1996
- AAWG Report: Recommendations concerning ARAC taskings FR Doc.04-10816 Re: Aging Airplane safety final rule. 14 CFR 121.370a and 129.16

3. BACKGROUND

Service experience has shown there is a need to have continuing updated knowledge on the structural integrity of aircraft, especially as they become older. The structural integrity of aircraft is of concern because such factors as fatigue cracking and corrosion are time-dependent, and our knowledge about them can best be assessed based on real-time operational experience and the use of the most modern tools of analysis and testing.

In April 1988, a high-cycle transport aeroplane en-route from Hilo to Honolulu, Hawaii, suffered major structural damage to its pressurized fuselage during flight. This accident was attributed in part to the age of the aeroplane involved. The economic benefit of operating certain older technology aeroplanes has resulted in the operation of many such aeroplanes beyond their previously expected retirement age. Because of the problems revealed by the accident in Hawaii and the continued operation of older aircraft, both the competent authorities and industry generally agreed that increased attention needed to be focused on the ageing fleet and on maintaining its continued operational safety.

In June 1988, the FAA sponsored a conference on ageing aircraft. As a result of that conference, an ageing aircraft task force was established in August 1988 as a sub-group of the FAA's Research, Engineering, and Development Advisory Committee, representing the interests of the aircraft operators, aircraft manufacturers, regulatory authorities, and other aviation representatives. The task force, then known as the Airworthiness Assurance Task Force (AATF), set forth five major elements of a programme for keeping the ageing fleet safe. For each aeroplane model in the ageing transport fleet:

(1) Select service bulletins describing modifications and inspections necessary to maintain structural integrity;
(2) Develop inspection and prevention programmes to address corrosion;
(3) Develop generic structural maintenance programme guidelines for ageing aeroplanes;
(4) Review and update the Supplemental Structural Inspection Documents (SSID) which describe inspection programmes to detect fatigue cracking; and
(5) Assess damage-tolerance of structural repairs.

Subsequent to these 5 major elements being identified, it was recognised that an additional factor in the Aloha accident was widespread fatigue cracking. Regulatory and Industry experts agreed that, as the transport aircraft fleet continues to age, eventually Widespread Fatigue Damage (WFD) is inevitable. Therefore the FAA determined, and the EASA concurred, that an additional major element of WFD' must be added to the Ageing Aircraft programme. Structures Task Groups sponsored by the Task Force were assigned the task of developing these elements into usable programmes. The Task Force was later re-established as the AAWG of the ARAC. Although there was JAA membership and European Operators and Industry representatives participated in the AAWG, recommendations for action focussed on FAA operational rules which are not applicable in Europe. It was therefore decided to establish the EAAWG on this subject to implement Ageing Aircraft activities into the Agency's regulatory system, not only for the initial "AATF eleven" aeroplanes, but also other old aircraft and more recently certificated ones. This AMC is a major part of the European adoption and adaptation of the AAWG recommendations which it follows as closely as practicable.

It is acknowledged that the various competent authorities, type certificate holders and operators have continually worked to maintain the structural integrity of older aircraft on an international basis. This has been achieved through an exchange of in-service information, subsequent changes to inspection programmes and by the development and installation of modifications on particular aircraft. However, it is evident that with the increased use, longer operational lives and experience from in-service aircraft, there is a need for a programme to ensure a high level of structural integrity for all aeroplanes, and in particularly those in the transport fleet. Accordingly, the inspection and evaluation programmes outlined in this AMC are intended to ensure:

- a continuing structural integrity assessment by each type-certificate holder, and
- the incorporation of the results of each assessment into the maintenance programme of each operator.

4. DEFINITIONS AND ACRONYMS

a) For the purposes of this AMC, the following definitions apply:

- **Damage-tolerance** is the attribute of the structure that permits it to retain its required residual strength without detrimental structural deformation for a period of use after the structure has sustained a given level of fatigue, corrosion, and accidental or discrete source damage.

- **Design Approval Holder (DAH)** is the holder of any design approval, including type certificate, supplemental type certificate or repair approval.

- **Design Service Goal (DSG)** is the period of time (in flight cycles/hours) established at design and/or certification during which the principal structure will be reasonably free from significant cracking including widespread fatigue damage.

- **Extended Service Goal (ESG)** is an adjustment to the design service goal established by service experience, analysis, and/or test during which the principal structure will be reasonably free from significant cracking including widespread fatigue damage.

- **Limit of validity (LOV)** is the period of time, expressed in appropriate units (e.g. flight cycles) for which it has been shown that the established inspections and replacement times will be sufficient to preclude development of widespread fatigue damage.

- **Multiple Element Damage (MED)** is a source of widespread fatigue damage characterised by the simultaneous presence of fatigue cracks in similar adjacent structural elements.

- **Multiple Site Damage (MSD)** is a source of widespread fatigue damage characterised by the simultaneous presence of fatigue cracks in the same structural element (i.e., fatigue cracks that may coalesce with or without other damage leading to a loss of required residual strength).

- **Primary Structure** Those portions of the structure, the failure of which would seriously endanger the aircraft.

- **Widespread Fatigue Damage (WFD)** in a structure is characterised by the simultaneous presence of cracks at multiple structural details that are of sufficient size and density whereby the structure will no longer meet its damage-tolerance requirement (i.e., to maintain its required residual strength after partial structural failure).

b) The following list defines the acronyms that are used throughout this AMC:

AAWG	Airworthiness Assurance Working Group
AC	Advisory Circular
AD	Airworthiness Directive
ALS	Airworthiness Limitations Section
AMC	Acceptable Means of Compliance
ARAC	Aviation Rulemaking Advisory Committee
BZI	Baseline Zonal Inspection
CPCP	Corrosion Prevention and Control Programme
CS	Certification Specification
DAH	Design Approval Holder
DSD	Discrete Source Damage
DSG	Design Service Goal
EAAWG	European Ageing Aircraft Working Group
EASA	European Aviation Safety Agency
ESG	Extended Service Goal
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulation
ICA	Instructions for Continued Airworthiness
ISP	Inspection Start Point
JAA	Joint Aviation Authorities
JAR	Joint Aviation Regulation
LDC	Large Damage Capability
LOV	Limit of Validity
MED	Multiple Element Damage
MRB	Maintenance Review Board
MSD	Multiple Site Damage
MSG	Maintenance Steering Group
NAA	National Airworthiness Authority
NDI	Non-Destructive Inspection
NTSB	National Transportation Safety Board
PSE	Principal Structural Element
RAP	Repairs Assessment Programme
SB	Service Bulletin
SMP	Structural Modification Point
SSID	Supplemental Structural Inspection Document
SSIP	Supplemental Structural Inspection Programme
STG	Structural Task Group
TCH	Type-Certificate Holder
WFD	Widespread Fatigue Damage

5. WAY OF WORKING

a) General

On the initiative of the TCH and the Agency, a STG should be formed for each aircraft model for which it is decided to put in place an ageing aircraft programme. The STG shall consist of the TCH, selected operator members and a representative from the Agency. The objective of the STG is to complete all tasks covered in this AMC in relation to their respective model types, including the following:

--Develop model specific programmes
--Define programme implementation
--Conduct recurrent programme reviews as necessary.

It is recognised that it might not always be possible to form or to maintain an STG, due to a potential lack of resources with the operators or TCH. In this case the above objective would remain with the Agency and operators or TCH as applicable.

An acceptable way of working for STGs is described in “Report on Structures Task Group Guidelines” that was established by the AAWG with the additional clarifications provided in the following sub-paragraphs.

b) Meeting scheduling

It is the responsibility of the TCH to schedule STG meetings. However if it is found by the Agency that the meeting scheduling is inadequate to meet the STG working objectives, the Agency might initiate themselves additional STG meetings.

c) Reporting

The STG would make recommendations for actions via the TCH to the Agency. Additionally, the STG should give periodic reports (for information only) to AAWG/EASA as appropriate with the objective of maintaining a consistent approach.

d) Recommendations and decision making

The decision making process described in the AAWG Report on Structures Task Group Guidelines paragraph 7 leads to recommendations for mandatory action from the TCH to the Agency. In addition it should be noted that the Agency is entitled to mandate safety measures related to ageing aircraft structures, in addition to those recommended by the STG, if they find it necessary.

e) Responsibilities

(i) The TCH is responsible for developing the ageing aircraft structures programme for each aircraft type, detailing the actions necessary to maintain airworthiness. Other DAH should develop programmes or actions appropriate to the modification/repair for which they hold approval, unless addressed by the TCH. The TCH/DAH will also be responsible for monitoring the effectiveness of their specific programme, and to amend the programme as necessary.

(ii) The Operator is responsible for incorporating approved TCH/DAH actions necessary to maintain airworthiness into its aircraft specific maintenance programmes, in accordance with Part M.

(iii) The competent authority of the state of registry is responsible for ensuring the implementation of the ageing aircraft programme by their operators.

(iv) The Agency will approve ageing aircraft structures programmes and may issue ADs to support implementation, where necessary. The Agency, in conjunction with the TCH/DAH, will monitor the overall effectiveness of ageing aircraft structures programmes.

6. SUPPLEMENTAL STRUCTURAL INSPECTION PROGRAMME (SSIP)

In the absence of a damage-tolerance based structural maintenance inspection programme (e.g. MRB document, ALS), the TCH, in conjunction with operators, is expected to initiate the development of a SSIP for each aircraft model. Such a programme must be implemented before analysis, tests, and/or service experience indicates that a significant increase in inspection and/or modification is necessary to maintain structural integrity of the aircraft. This should ensure that an acceptable programme is available to the operators when needed. The programme should include procedures for obtaining service information, and assessment of service information, available test data, and new analysis and test data. A SSID should be developed, as outlined in Appendix 1 of this AMC, from this body of data.

The recommended SSIP, along with the criteria used and the basis for the criteria should be submitted to the Agency for review and approval. The SSIP should be adequately defined in the SSID. The SSID should include the type of damage being considered, and likely sites; inspection access, threshold, interval, method and procedures; applicable modification status and/or life limitation; and types of operations for which the SSID is valid.

The Agency's review of the SSID will include both engineering and maintenance aspects of the proposal. Because the SSID is applicable to all operators and is intended to address potential safety concerns on older aircraft, the Agency expects these essential elements to be included in maintenance programmes developed in compliance with Part M. In addition, the Agency will issue ADs to implement any service bulletins or other service information publications found to be essential for safety during the initial SSID assessment process. Service bulletins or other service information publications revised or issued as a result of in-service findings resulting from implementation of the SSID should be added to the SSID or will be implemented by separate AD action, as appropriate.

In the event an acceptable SSID cannot be obtained on a timely basis, the Agency may impose service life, operational, or inspection limitations to assure structural integrity.

As a result of a periodic review, the TCH should revise the SSID whenever additional information shows a need. The original SSID will normally be based on predictions or assumptions (from analyses, tests, and/or service experience) of failure modes, time to initial damage, frequency of damage, typically detectable damage, and the damage growth period. Consequently, a change in these factors sufficient to justify a revision would have to be substantiated by test data or additional service information. Any revision to SSID criteria and the basis for these revisions should be submitted to the Agency for review and approval of both engineering and maintenance aspects.

7. <u>SERVICE BULLETIN REVIEW and MANDATORY MODIFICATION PROGRAMME</u>

Service Bulletins issued early in the life of an aircraft fleet may utilise inspections (in some cases non-mandatory inspections) alone to maintain structural integrity. Inspections may be adequate in this early stage, when cracking is possible, but not highly likely. However, as aircraft age the probability of fatigue cracking becomes more likely. In this later stage it is not prudent to rely only on inspections alone because there are more opportunities for cracks to be missed and cracks may no longer occur in isolation. In this later stage in the life of a fleet it is prudent to reduce the reliance strictly on inspections, with its inherent human factors limitations, and incorporate modifications to the structure to eliminate the source of the cracking. In some cases reliance on an inspection programme, in lieu of modification, may be acceptable through the increased use of mandatory versus non-mandatory inspections.

The TCH, in conjunction with operators, is expected to initiate a review of all structurally related inspection and modification SBs and determine which require further actions to ensure continued airworthiness, including mandatory modification action or enforcement of special repetitive inspections

Any aircraft primary structural components that would require frequent repeat inspection, or where the inspection is difficult to perform, taking into account the potential airworthiness concern, should be reviewed to preclude the human factors issues associated with repetitive inspections

The SB review is an iterative process (see Appendix 5) consisting of the following items:

a) The TCH should review all issued structural inspection - and modification SBs to select candidate bulletins, using the following 4 criteria:

   1) There is a high probability that structural cracking exists
   2) Potential structural airworthiness concern.
   3) Damage is difficult to detect during routine maintenance
   4) There is Adjacent Structural damage or the potential for it.

This may be done by the TCH alone or in conjunction with the operators as a preliminary STG meeting.

b) The TCH and operator members will be requested to submit information on individual fleet experience relating to candidate SBs. This information will be collected and evaluated by the TCH. The summarised results will then be reviewed in detail at a STG meeting (see c. below).

c) The final selection of SBs for recommendation of the appropriate corrective action to assure structural continued airworthiness taking into account the in-service experience, will be made during an STG meeting by the voting members of the STG, either by consensus or majority vote, depending on the preference of the individual STGs.

d) An assessment will be made by the TCH as to whether or not any subsequent revisions to SBs affect the previous decision made. Any subsequent revisions to SBs previously chosen by the STG for mandatory inspection or incorporation of modification action that would affect the previous STG recommended action should be submitted to the STG for review.

e) The TCH should review all new structural SBs periodically to select further candidate bulletins. The TCH should schedule a meeting of the STG to address the candidates. Operator members and the competent authority will be advised of the candidate selection and provided the opportunity to submit additional candidates.

8. CORROSION PREVENTION AND CONTROL PROGRAMME.

A corrosion prevention and control programme (CPCP) is a systematic approach to prevent and to control corrosion in the aircraft's Primary Structure. The objective of a CPCP is to limit the deterioration due to corrosion to a level necessary to maintain airworthiness and where necessary to restore the corrosion protection schemes for the structure. A CPCP consists of a basic corrosion inspection task, task areas, defined corrosion levels, and compliance times (implementation thresholds and repeat intervals). The CPCP also includes procedures to notify the competent authority and TCH of the findings and data associated with Level 2 and Level 3 corrosion and the actions taken to reduce future findings to Level 1 or better. See Appendix 4 for definitions and further details.

As part of the ICA, the TCH should provide an inspection programme that includes the frequency and extent of inspections necessary to provide the continued airworthiness of the aircraft. Furthermore, the ICA should include the information needed to apply protective treatments to the structure after inspection. In order for the inspections to be effectively accomplished, the TCH should provide corrosion removal and cleaning procedures and reference allowable limits. The TCH should include all of these corrosion-related activities in a manual referred to as the Baseline Programme. This Baseline Programme manual is intended to form a basis for operators to derive a systematic and comprehensive CPCP for inclusion in the operator's maintenance programme. TCH is responsible for monitoring the effectiveness of the Baseline Programme and, if necessary, to recommend changes based on operators reports of findings. In line with Part M requirements, when the TCH publishes revisions to their Baseline Programme, these should be reviewed and the operator's programme adjusted as necessary in order to maintain corrosion to Level 1 or better.

An operator may adopt the Baseline Programme provided by the TCH or it may choose to develop it's own CPCP, or may be required to if none is available from the TCH. In developing it's own CPCP an operator may join with other operators and develop a Baseline Programme similar to a TCH developed Baseline Programme for use by all operators in the group.

Before an operator may include a CPCP in its maintenance or inspection programme, the competent authority should review and approve that CPCP. The operator should show that the CPCP is comprehensive in that it addresses all corrosion likely to affect Primary Structure, and is systematic in that it provides:

1) Step-by-step procedures that are applied on a regular basis to each identified task area or zone, and

2) These procedures are adjusted when they result in evidence that corrosion is not being controlled to an established acceptable level (Level 1 or better).

9. <u>REPAIRS ASSESSMENT PROGRAMME</u>

The Repairs Assessment Programme (RAP) is intended to assure the continued structural integrity of all repaired and adjacent structure, based on damage-tolerance principles. To achieve this, the RAP should evaluate all repairs to structure that is susceptible to fatigue cracking and could contribute to a catastrophic failure.

Even the best maintained aircraft will accumulate structural repairs when being operated. The AAWG conducted two separate surveys of repairs placed on aircraft to collect data. The evaluation of these surveys revealed that 90% of all repairs found were on the fuselage, hence these are a priority and RAPs have already been developed for the fuselage pressure shell of many large transport aeroplanes not originally certificated to damage-tolerance requirements. 40% of the repairs were classified as adequate and 60% of the repairs required consideration for possible additional supplemental inspection during service.

Where repair assessment programmes or similar documents have been published by the TCH they should be incorporated into the aircraft's maintenance programme according to Part M requirements. TCHs should further develop these programmes or create new ones to address all Primary Structure susceptible to fatigue for which existing repairs may not have been assessed for damage-tolerance and appropriate inspections or other actions implemented.

As aircraft operate into high cycles and high times the ageing repaired structure needs the same considerations as the original structure in respect of damage-tolerance. Repairs are to be reassessed, replaced if necessary or repeat inspections determined and carried out as supplemental inspections or within the baseline zonal inspection programme. A damage-tolerance based inspection programme for repairs will be required to detect damage which may develop in a repaired area, before that damage degrades the load

carrying capability of the structure below the levels required by the applicable airworthiness standards.
The Structural Repair Manual and repair instruction documentation needs to be reviewed for compliance with damage-tolerance principles.

The basic structure that would be affected by this programme was required at the time of original certification to meet the applicable regulatory standards for fatigue or fail-safe strength. Repairs and modifications to this structure were also required to meet these same standards. These early fatigue or fail-safe requirements did not provide for timely inspection of critical structure so that damaged or failed components could be dependably identified and repaired or replaced before a hazardous condition developed.

In order to establish an effective RAP, the TCH should consider the following three main subjects and:

1) Provide a guidelines document to enable the operators to assess the existing structural repairs.
2) Update the Structural Repair Manual to reflect damage-tolerance repair considerations.
3) Review repairs identified in SBs to determine any requirements for supplemental inspections.

This fatigue and damage-tolerance evaluation of repairs will establish an appropriate inspection programme or a replacement schedule if the necessary inspection programme is too demanding or not possible. Details of the means by which a programme may be developed are incorporated in Appendix 3.

10. EVALUATION FOR WIDESPREAD FATIGUE DAMAGE.

The likelihood of the occurrence of fatigue damage in an aircraft's structure increases with aircraft usage. The design process generally establishes a design service goal (DSG) in terms of flight cycles/hours for the airframe. It is expected that any cracking that occurs on an aircraft operated up to the DSG will occur in isolation (i.e., local cracking), originating from a single source, such as a random manufacturing flaw (e.g., a mis-drilled fastener hole) or a localised design detail. It is considered unlikely that cracks from manufacturing flaws or localised design issues will interact strongly as they grow. The SSIP described in paragraph 6 and Appendix 1 of this AMC are intended to find this form of damage before it becomes critical.

With extended usage, uniformly loaded structure may develop cracks in adjacent fastener holes, or in adjacent similar structural details. These cracks, while they may or may not interact, can have an adverse effect on the large damage capability (LDC) before the cracks become detectable. The development of cracks at multiple locations (both MSD and MED) may also result in strong interactions that can affect subsequent crack growth, in which case the predictions for local cracking would no longer apply. An example of this situation may occur at any skin joint where load transfer occurs. Simultaneous cracking at many fasteners along a common rivet line may reduce the residual strength of the joint below required levels before the cracks are detectable under the routine maintenance programme established at time of certification.

The TCH, in conjunction with operators, and in some cases the operators themselves are expected to initiate development of a maintenance programme with the intent of precluding operation with WFD. Such a programme must be implemented before analysis, tests, and/or service experience indicates that widespread fatigue damage may develop in the fleet.

The results of the WFD evaluation should be presented for review and approval to the Agency for the aircraft model being considered. Since the objective of this evaluation is to preclude WFD from the fleet, it is expected that the results will include recommendations for necessary inspections or modification and/or replacement of structure, as appropriate to support the LOV. It is expected that the TCH will work closely with operators in the development of these programmes to assure that the expertise and resources are available when implemented.

The Agency's review of the WFD evaluation results will include both engineering and maintenance aspects of the proposal. The Agency expects any actions necessary to preclude WFD (including the LOV) to be incorporated in maintenance programmes developed in compliance with Part M. Any service bulletins or other service information publications revised or issued as a result of in-service MSD/MED findings resulting from implementation of these programmes may require separate AD action.

In the event an acceptable WFD evaluation cannot be completed on a timely basis, the Agency may impose service life, operational, or inspection limitations to assure structural integrity of the subject type design.

It is expected that the original recommended actions stemming from a WFD evaluation will be focused on those structural items that are soon expected to reach a point at which MSD/MED is predicted to occur. As the fleet ages, more areas of the aircraft may reach the life at which MSD/MED is predicted to occur in those details, and the recommended service actions should be updated accordingly. Also, new service experience findings, improvements in the prediction methodology, better load spectrum data, or a change in any of the factors upon which the WFD evaluation is based may dictate a revision to the evaluation. Accordingly, associated new recommendations for service action should be developed including a LOV and submitted to the Agency for review and approval of both engineering and maintenance aspects. This process may be repeated such that subject to Agency approval of the evaluation, a revised LOV may be established and incorporated in the operator's maintenance programme, together with any necessary actions to preclude WFD from occurring before the aircraft reaches the revised LOV established by the TCH.

In order to operate beyond the initial LOV a WFD evaluation should be performed for all applicable modified or repaired structure to determine if any new structure or any structure affected by the change is susceptible to WFD. This should be conducted by the DAH for the changed structure in conjunction with the operator. The results should be presented for review and approval by the Agency together with any necessary maintenance actions to preclude WFD from occurring before the aircraft reaches the current LOV established by the TCH .

11. SUPPLEMENTAL TYPE-CERTIFICATES.

Any modification or supplemental type-certificates (STC) affecting Primary Structure (e.g. PSEs) could have an effect on one or all aspects of ageing aircraft assessment as listed above. Such structural changes will need the same consideration as the basic aircraft and the operator should seek support from the STC holder (who has primary responsibility for the design/certification of the STC), or an approved Design Organisation.

12. IMPLEMENTATION.

In compliance with Part M, operators must amend their current structural maintenance programmes to comply with and to account for new and/or modified maintenance instructions promulgated by the TCH/DAH.

From the industry/Agency discussions leading to the definition of the programmes detailed in sections 6 to 10, above, appropriate implementation times have emerged. These programme implementation times are expressed as a fraction of the aircraft model's DSG/ESG.

CPCP	½ DSG/ESG
SSID	½ DSG/ESG
SB-Review	¾ DSG/ESG
RAP	¾ DSG/ESG
WFD	1 DSG/ESG

In the absence of other information prior to the implementation of these programmes the limit of validity of the existing maintenance programmes should be considered as the DSG/ESG.

Programme implementation times in flight hours, flight or landing cycles, or calendar period, as appropriate, should be established by the TCH based on the above table.

A period of up to one year may be allowed to incorporate the necessary actions into the operator's maintenance programme. Grace periods for accomplishment of actions beyond threshold should address the level of risk and for large fleets the practicalities of scheduling maintenance activities. Typically, full implementation of maintenance actions for the fleet should be accomplished within 4 years for actions beyond threshold.

Unless data is available on the dates of incorporation of repairs and modifications [STCs] they will need to be assumed as having the same age as the airframe.

APPENDIX 1

Guidelines for the development of a Supplementary Structural Inspection Programme

1. GENERAL

1.1 Purpose

This Appendix 1 gives interpretations, guidelines and acceptable means of compliance for the SSIP actions.

1.2 Background

Service experience has demonstrated that there is a need to have continuing updated knowledge concerning the structural integrity of aircraft, especially as they become older. Early fatigue requirements, such as "fail safe" regulations did not provide for timely inspection of an aircraft's critical structure to ensure that damaged or failed components could be dependably identified and then repaired or replaced before hazardous conditions developed.

In 1978 the damage-tolerance concept was adopted for transport category aeroplanes in the USA as Amendment 25-45 to FAR 25.571. This amended rule required damage-tolerance analyses as part of the type design of transport category aeroplanes for which application for type-certification was received after the effective date of the amendment. In 1980 the requirement for damage-tolerance analyses was also included in JAR 25.571 Change 7.

An underlying principle for damage-tolerance is that the initiation and growth of structural fatigue damage can be anticipated with sufficient precision to allow damage-tolerance based inspections and procedures to detect damage before it reaches a size that affects an aircraft's airworthiness. When damage is discovered, airworthiness is ensured by repair or revised maintenance action. Evidence to date suggests that when all critical structure is included, damage-tolerance based inspections and procedures provide the best approach to address aircraft fatigue.

Pre Amendment 25-45 aeroplanes were built to varying standards that embodied fatigue and fail safe requirements. These aeroplanes, as certified, had no specific mandated requirements to perform inspections for fatigue. Following the amendment of FAR 25 to embody damage-tolerance requirements, the FAA published Advisory Circular 91-56A. That AC was applicable to pre-Amendment 25-45 aeroplanes with a maximum gross weight greater than 75.000 pounds. According to the AC the TCH, in conjunction with operators, was expected to initiate development of a SSIP for each aeroplane model.

AC 91-56A provided guidance material for the development of such programmes based on damage-tolerance principles. Many TCH's of large aeroplanes developed SSIPs for their pre-Amendment 25-45 aeroplanes. The documents containing the SSIP are designated Supplemental Structural Inspection Documents (SSID) or Supplemental Inspection Documents (SID)

The competent authorities have in the past issued a series of ADs requiring compliance with these SSIPs. Generally these ADs require the operators to incorporate the SSIPs into their maintenance programmes

For post Amendment 25-45 aeroplanes, it was required that inspections or other procedures should be developed based on the damage-tolerance evaluations required by FAR 25.571, and included in the maintenance data. In Amendment 25-54 to FAR 25 and change 7 to JAR 25 it was required to include these inspections and procedures in the Airworthiness Limitations Section of the Instructions for Continued Airworthiness required by 25.1529. At the same amendment, 25.1529 was changed to require applicants for type-certificates to prepare Instructions for Continued Airworthiness in accordance with Appendix H of FAR/JAR 25. Appendix H requires that the Instructions for Continued Airworthiness must contain a section titled Airworthiness Limitations that is segregated and clearly distinguishable from the rest of the document. This section shall contain the information concerning inspections and other procedures as required by FAR/JAR/CS 25.571.

The content of the Airworthiness Limitations Section of the Instructions for Continued Airworthiness are by some TCH's designated as Airworthiness Limitations Instructions (ALI). Other TCH's have decided to designate the same items as Airworthiness Limitations Items (ALI).

Compliance with FAR/JAR 25.571 at Amendment 25-45 and Change 7 respectively, or later amendments, results in requirements to periodically inspect aeroplanes for potential fatigue damage in areas where it is most likely to occur.

2. SUPPLEMENT STRUCTURAL INSPECTION PROGRAMME (SSIP)

Increased utilization, longer operational lives, and the high safety demands imposed on the current fleet of transport aeroplanes indicate the need for a programme to ensure a high level of structural integrity for all aeroplanes in the transport fleet.

This AMC is intended to provide guidance to TCHs and other DAHs to develop or review existing inspection programmes for effectiveness. SSIPs are based on a thorough technical review of the damage-tolerance characteristics of the aircraft structure using the latest techniques and changes in operational usage. They lead to revised or new inspection requirements primarily for structural cracking.

Large transport aeroplanes that were certificated with FAR 25.571 Amendment 25-45/54 or JAR 25 Change 7 are damage-tolerant. The fatigue requirements are part of the MRB Report, as required by MSG 3. However, for pre MSG 3-rev 2 aeroplanes there are no requirements for regular MRB Report review and for post MSG 3-rev 2 aeroplanes there is only a requirement for regular MRB Report review in order to assess if the CPCP is effective. Concerning ageing aircraft activities, it is important to regularly review the MRB part containing the structural inspections resulting from the fatigue and damage-tolerance analysis for effectiveness.

2.1 Pre-Amendment 25-45 aeroplanes

The TCH is expected to initiate development of a SSIP for each aeroplane model. Such a programme must be implemented before analysis, test and/or service experience indicate that a significant increase in inspection and or modification is necessary to maintain structural integrity of the aeroplane. This should ensure that an acceptable programme is available to the operators when needed. The programme should include procedures for obtaining service information, and assessment of service information, available test data, and new analysis and test data.

A SSID should be developed in accordance with Chapter 3 of this Appendix 1. The recommended SSIP, along with the criteria used and the basis for the criteria, should be submitted by the TCH to the Agency for approval. The SSIP should be adequately defined in the SSID and presented in a manner that is effective. The SSID should include the type of damage being considered, and likely sites; inspection access, threshold, interval method and procedures; applicable modification status and/or life limitation; and types of operation for which the SSID is valid.

The review of the SSID by the Agency will include both engineering and maintenance aspects of the proposal. In the event an acceptable SSID cannot be obtained on a timely basis the competent authority may impose service life, operational, or inspection limitations to assure structural integrity

The TCH should check the SSID periodically against current service experience. This should include an evaluation of current methods and findings. Any unexpected defect occurring should be assessed as part of the continuing assessment of structural integrity to determine a need for revision to the document.

2.2. Post-Amendment 25-45 aeroplanes

Aeroplanes certificated to FAR 25.571 Amendment 25-45, JAR 25.571 Change 7 and CS 25 or later amendment are damage-tolerant. The airworthiness limitations including the inspections and procedures established in accordance FAR/JAR/CS 25.571 shall be included in the Instructions for Continuing Airworthiness, ref. FAR/JAR/CS 25.1529. Further guidance for the actual contents is incorporated in FAR/JAR/CS 25 Appendix H.

To maintain the structural integrity of these aeroplanes it is necessary to follow up the effectiveness of these inspections and procedures. The TCH should therefore check this information (ALI) periodically against current service experience. Any unexpected defect occurring should be assessed as part of the continuing assessment of structural integrity to determine a need for revision to this information. The revised data should be developed in accordance with the same procedures as at type- certification giving consideration to any additional test or service data available and changes to aeroplanes operating patterns.

3. <u>GUIDELINES FOR DEVELOPMENT OF THE SUPPLEMENTAL STRUCTURAL INSPECTION DOCUMENT</u>

This chapter is based directly on Appendix 1 to FAA AC 91-56A which applies to transport category aeroplanes that were certificated prior to Amendment 25-45 of FAR 25 or equivalent requirement.

3.1. General

Amendment 25-45 to § 25.571 introduced wording which emphasizes damage-tolerant design. However, the structure to be evaluated, the type of damage considered (fatigue, corrosion, service, and production damage), and the inspection and/or modification criteria should, to the extent practicable, be in accordance with the damage-tolerance principles of the current § 25.571 standards. An acceptable means of compliance can be found in AC 25.571-1C ("Damage-Tolerance and Fatigue Evaluation of Structure," dated April 29, 1998) or the latest revision.

It is essential to identify the structural parts and components that contribute significantly to carrying flight, ground, pressure, or control loads, and whose failure could affect the structural integrity necessary for the continued safe operation of the aeroplane. The damage-tolerance or safe-life characteristics of these parts and components must be established or confirmed.

Analyses made in respect to the continuing assessment of structural integrity should be based on supporting evidence, including test and service data. This supporting evidence should include consideration of the operating loading spectra, structural loading distributions, and material behaviour. An appropriate allowance should be made for the scatter in life to crack initiation and rate of crack propagation in establishing the inspection threshold, inspection frequency, and, where appropriate, retirement life. Alternatively, an inspection threshold may be based solely on a statistical assessment of fleet experience, if it can be shown that equal confidence can be placed in such an approach.

An effective method of evaluating the structural condition of older aeroplanes is selective inspection with intensive use of non-destructive techniques, and the inspection of individual aeroplanes, involving partial or complete dismantling ("teardown") of available structure.

The effect of repairs and modifications approved by the TCH should be considered. In addition, it may be necessary to consider the effect of repairs and operator-approved modifications on individual aircraft. The operator has the responsibility for ensuring notification and consideration of any such aspects.

3.2. Damage-tolerant structures

The damage-tolerance assessment of the aircraft structure should be based on the best information available. The assessment should include a review of analysis, test data, operational experience, and any special inspections related to the type design.

A determination should then be made of the site or sites within each structural part or component considered likely to crack, and the time or number of flights at which this might occur.

The growth characteristics of damage and interactive effects on adjacent parts in promoting more rapid or extensive damage should be determined. This determination should be based on study of those sites that may be subject to the possibility of crack initiation due to fatigue, corrosion, stress corrosion, disbonding, accidental damage, or manufacturing defects in those areas shown to be vulnerable by service experience or design judgement.

The minimum size of damage that is practical to detect and the proposed method of inspection should be determined. This determination should take into account the number of flights required for the crack to grow from detectable to the allowable limit, such that the structure has a residual strength corresponding to the conditions stated under § 25.571.

Note: In determining the proposed method of inspection, consideration should be given to visual inspection, non-destructive testing, and analysis of data from built-in load and defect monitoring devices.

The continuing assessment of structural integrity may involve more extensive damage than might have been considered in the original fail-safe evaluation of the aircraft, such as:

(1) A number of small adjacent cracks, each of which may be less than the typically detectable length, developing suddenly into a long crack;

(2) Failures or partial failures in other locations following an initial failure due to redistribution of loading causing a more rapid spread of fatigue; and

(3) Concurrent failure or partial failure of multiple load path elements (e.g., lugs, planks, or crack arrest features) working at similar stress levels.

3.3. Information to be included in the assessment

The continuing assessment of structural integrity for the particular aircraft type should be based on the principles outlined in paragraph 3.2 of this Appendix 1. The following information should be included in the assessment and kept by the TCH in a form available for reference:

(1) The current operational statistics of the fleet in terms of hours or flights;

(2) The typical operational mission or missions assumed in the assessment;

(3) The structural loading conditions from the chosen missions; and

(4) Supporting test evidence and relevant service experience.

In addition to the information specified in paragraph 3.3. above, the following should be included for each critical part or component:

(1) The basis used for evaluating the damage-tolerance characteristics of the part or component;

(2) The site or sites within the part or component where damage could affect the structural integrity of the aircraft;

(3) The recommended inspection methods for the area;

(4) For damage-tolerant structures, the maximum damage size at which the residual strength capability can be demonstrated and the critical design loading case for the latter; and

(5) For damage-tolerant structures, at each damage site the inspection threshold and the damage growth interval between detectable and critical, including any likely interaction effect from other damage sites.

Note: Where re-evaluation of fail-safety or damage-tolerance of certain parts or components indicates that these qualities cannot be achieved, or can only be demonstrated using an inspection procedure whose practicability or reliability may be in doubt, replacement or modification action may need to be defined.

3.4. Inspection programme

The purpose of a continuing airworthiness assessment in its most basic terms is to adjust the current maintenance inspection programme, as required, to assure continued safety of the aircraft type.

In accordance with Chapters 1 and 2 of this Appendix 1, an allowable limit of the size of damage should be determined for each site such that the structure has a residual strength for the load conditions specified in § 25.571. The size of damage that is practical to detect by the proposed method of inspection should be determined, along with the number of flights required for the crack to grow from detectable to the allowable limit.

The recommended inspection programme should be determined from the data described in paragraph 3.4 above, giving due consideration to the following:

(1) Fleet experience, including all of the scheduled maintenance checks;

(2) Confidence in the proposed inspection technique; and

(3) The joint probability of reaching the load levels described above and the final size of damage in those instances where probabilistic methods can be used with acceptable confidence.

Inspection thresholds for supplemental inspections should be established. These inspections would be supplemental to the normal inspections, including the detailed internal inspections.

(1) For structure with reported cracking, the threshold for inspection should be determined by analysis of the service data and available test data for each individual case.

(2) For structure with no reported cracking, it may be acceptable, provided sufficient fleet experience is available, to determine the inspection threshold on the basis of analysis of existing fleet data alone. This threshold should be set such as to include the inspection of a sufficient number of high-time aircraft to develop added confidence in the integrity of the structure (see Chapter 1 of this Appendix 1). Thereafter, if no cracks are found, the inspection threshold may be increased progressively by successive inspection intervals until cracks are found. In the latter event, the criteria of subparagraph (1), above, would apply.

3.5. The supplemental structural inspection document

The SSID should contain the recommendations for the inspection procedures and replacement or modification of parts or components necessary for the continued safe operation of the aircraft up to the LOV. The document should be prefaced by the following information:

(1) Identification of the variants of the basic aircraft type to which the document relates;

(2) A summary of the operational statistics of the fleet in terms of hours and flights, as well as a description of the typical mission, or missions;

(3) Reference to documents giving any existing inspections or modifications of parts or components;

(4) The types of operations for which the inspection programme are considered valid;

(5) A list of service bulletins (or other service information publication) revised as a result of the structural reassessment undertaken to develop the SSID, including a statement that the operator must account for these service bulletins.

(6) The type of damage which is being considered (i.e., fatigue, corrosion and/or accidental damage).

(7) Guidance to the operator on which inspection findings should be reported to the type-certificate holder.

The document should contain at least the following information for each critical part or component:

(1) A description of the part or component and any relevant adjacent structure, including means of access to the part.

(2) Relevant service experience.

(3) Likely site(s) of damage.

(4) Inspection method and procedure, and alternatives.

(5) Minimum size of damage considered detectable by the method(s) of inspection.

(6) Service bulletins (or other service information publication) revised or issued as a result of in-service findings resulting from implementation of the SSID (added as revision to the initial SID).

(7) Initial inspection threshold.

(8) Repeat inspection interval.

(9) Reference to any optional modification or replacement of part or component as terminating action to inspection.

(10) Reference to the mandatory modification or replacement of the part or component at given life, if fail-safety by inspection is impractical; and

(11) Information related to any variations found necessary to “safe lives” already declared.

The SSID should be compared from time to time against current service experience. Any unexpected defect occurring should be assessed as part of the continuing assessment of structural integrity to determine the need for revision of the SSID. Future structural service bulletins should state their effect on the SSID.

APPENDIX 2

Guidelines for the development of a programme to preclude the occurrence of widespread fatigue damage.

1. INTRODUCTION

This appendix directly follows the FAA draft AC 91-56B on the same subject and contains the same technical text

2. DEFINITIONS

WFD (average behaviour) is the point in time when 50% of the fleet is expected to reach WFD for a particular detail.

Inspection Start Point (ISP) is the point in time when special inspections of the fleet are initiated due to a specific probability of having a MSD/MED condition.

Structural Modification Point (SMP) is a point reduced from the WFD average behaviour (i.e., lower bound), so that operation up to that point provides equivalent protection to that of a two-lifetime fatigue test. No aircraft should be operated beyond the SMP without modification or part replacement.

Teardown is the destructive inspection of structure, using visual and non-destructive inspection technology, to characterise the extent of damage within a structure with regard to corrosion, fatigue, and accidental damage.

Large Damage Capability (LDC) is the ability of the structure to sustain damage visually detectable under an operator's normal maintenance that is caused by accidental damage, fatigue damage, and environmental degradation, and still maintain limit load capability with MSD to the extent expected at SMP.

Scatter Factor is a life reduction factor used in the interpretation of fatigue analysis and fatigue test results.

Test-to-Structure Factor is a series of factors used to adjust test results to full-scale structure. These factors could include, but are not limited to, differences in:

- stress spectrum,
- boundary conditions,
- specimen configuration,
- material differences,
- geometric considerations, and
- environmental effects.

Monitoring period is the period of time when special inspections of the fleet are initiated due to an increased risk of MSD/MED (ISP) and ending when the SMP is reached.

3. GENERAL.

The likelihood of the occurrence of fatigue damage in an aircraft's structure increases with aircraft usage. The design process generally establishes a design service goal (DSG) in terms of flight cycles/hours for the airframe. It is expected that any cracking that occurs on an aircraft operated up to the DSG will occur in isolation (i.e., local cracking), originating from a single source, such as a random manufacturing flaw (e.g., a mis-drilled fastener hole) or a localised design detail. It is considered unlikely that cracks from manufacturing flaws or localised design issues will interact strongly as they grow.

With extended usage, uniformly loaded structure may develop cracks in adjacent fastener holes, or in adjacent similar structural details. These cracks may or may not interact, and they can have an adverse effect on the LDC of the structure before the cracks become detectable. The development of cracks at multiple locations (both MSD and MED) may also result in strong interactions that can affect subsequent crack growth; in which case, the predictions for local cracking would no longer apply. An example of this situation may occur at any skin joint where load transfer occurs. Simultaneous cracking at many fasteners along a common rivet line may reduce the residual strength of the joint below required levels before the cracks are detectable under the routine maintenance programme established at the time of certification.

Because of the small probability of occurrence of MSD/MED in aircraft operation up to its DSG, maintenance programmes developed for initial certification have generally considered only local fatigue cracking. Therefore, as the aircraft reaches its DSG, it is necessary to take appropriate action in the ageing fleets to preclude WFD so that continued safe operation of the aircraft is not jeopardised. The TCH and/or the operator(s) should conduct structural evaluations to determine where and when MSD/MED may occur. Based on these evaluations the TCH and in some cases the operators would provide additional maintenance instructions for the structure, as appropriate. The maintenance instructions include, but are not limited to inspections, structural modifications, and limits of validity of the new maintenance instructions. In most cases, a combination of inspections and/or modifications/replacements is deemed necessary to achieve the required safety level. Other cases will require modification or replacement if inspections are not viable.

There is a distinct possibility that there could be a simultaneous occurrence of MSD and MED in a given structural area. This situation is possible on some details that were equally stressed. If this is possible, then this scenario should be considered in developing appropriate service actions for structural areas.

Before MSD/MED can be addressed, it is expected that the operators will incorporate an augmented structural maintenance programme that includes the Mandatory Modifications Programme, the CPCP, the SSIP and the Repair Assessment Programme.

There are alternative methods for accomplishing a WFD assessment other than that given in this AMC. For example, FAA AC 25-571-1C Paragraph 6.C(4) or latest revision contains guidance material for the evaluation of structure using risk analysis techniques.

4. STRUCTURAL EVALUATION FOR WFD.

4.1 General.

The evaluation has three objectives:

(1) Identify Primary Structure susceptible to MSD/MED, see paragraph 4.2.
(2) Predict when it is likely to occur; see paragraph 4.3 and
(3) Establish additional maintenance actions, as necessary, to ensure continued safe operation of the aircraft; see paragraph 4.4.

4.2 Structure susceptible to MSD/MED.

Susceptible structure is defined as that which has the potential to develop MSD/MED. Such structure typically has the characteristics of multiple similar details operating at similar stresses where structural capability could be affected by interaction of multiple cracking at a number of similar details. The following list contains known types of structure susceptible to MSD/MED:

STRUCTURAL AREA	SEE FIGURE
Longitudinal Skin Joints, Frames, and Tear Straps (MSD/MED)	A2-1
Circumferential Joints and Stringers (MSD/MED)	A2-2
Lap joints with Milled, Chem-milled or Bonded Radius (MSD)	A2-3
Fuselage Frames (MED)	A2-4
Stringer to Frame Attachments (MED)	A2-5
Shear Clip End Fasteners on Shear Tied Fuselage Frames (MSD/MED)	A2-6
Aft Pressure Dome Outer Ring and Dome Web Splices (MSD/MED)	A2-7
Skin Splice at Aft Pressure Bulkhead (MSD)	A2-8
Abrupt Changes in Web or Skin Thickness — Pressurised or Un-pressurised Structure (MSD/MED)	A2-9
Window Surround Structure (MSD, MED)	A2-10
Over Wing Fuselage Attachments (MED)	A2-11
Latches and Hinges of Non-plug Doors (MSD/MED)	A2-12
Skin at Runout of Large Doubler (MSD)—Fuselage, Wing or Empennage	A2-13
Wing or Empennage Chordwise Splices (MSD/MED)	A2-14
Rib to Skin Attachments (MSD/MED)	A2-15
Typical Wing and Empennage Construction (MSD/MED)	A2-16

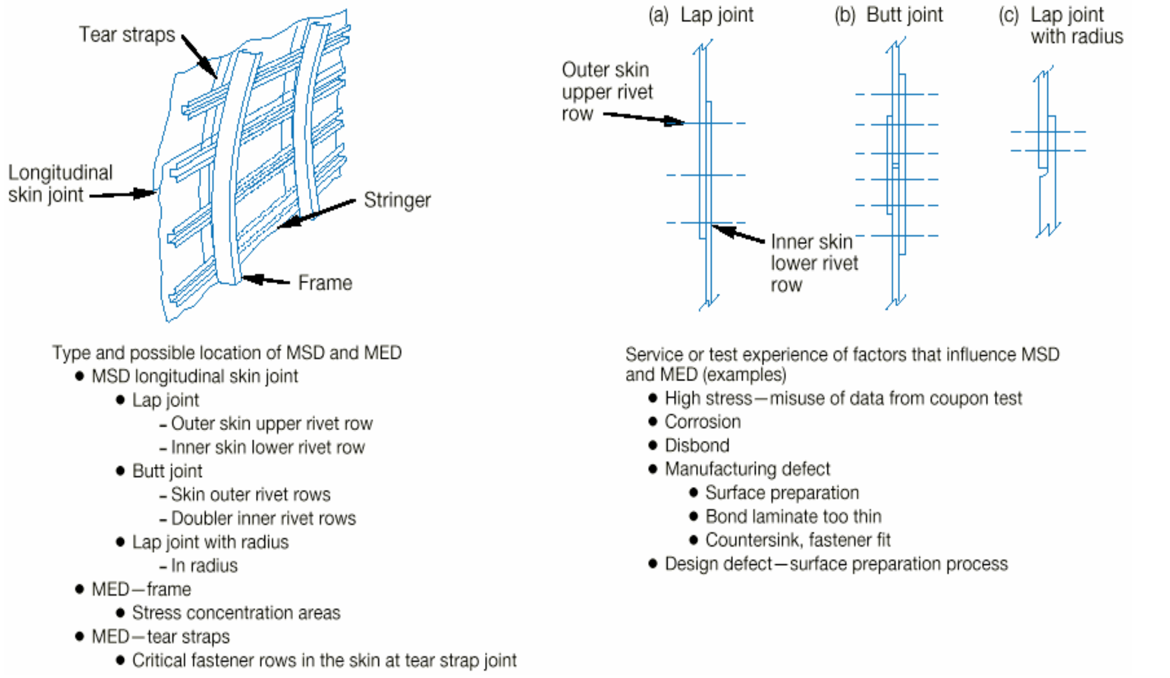


Figure A2-1 ***Longitudinal Skin Joints, Frames, and Tear Straps (MSD/MED)***

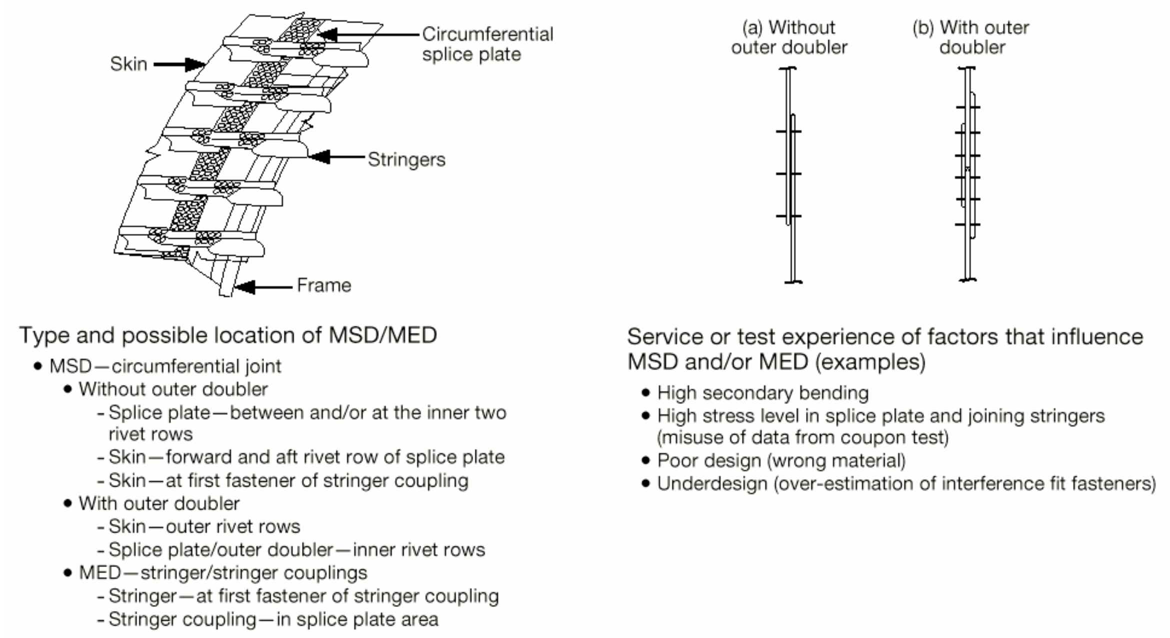


Figure A2-2 ***Circumferential Joints and Stringers (MSD/MED)***

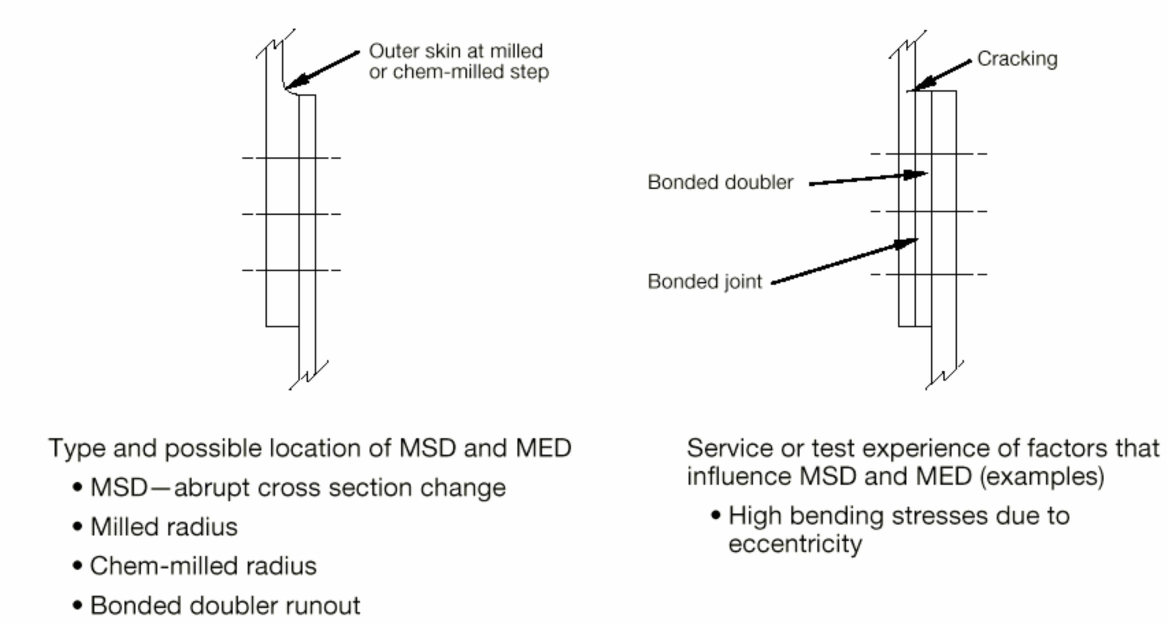


Figure A2-3 ***Lap joints with Milled, Chem-milled or Bonded Radius (MSD)***

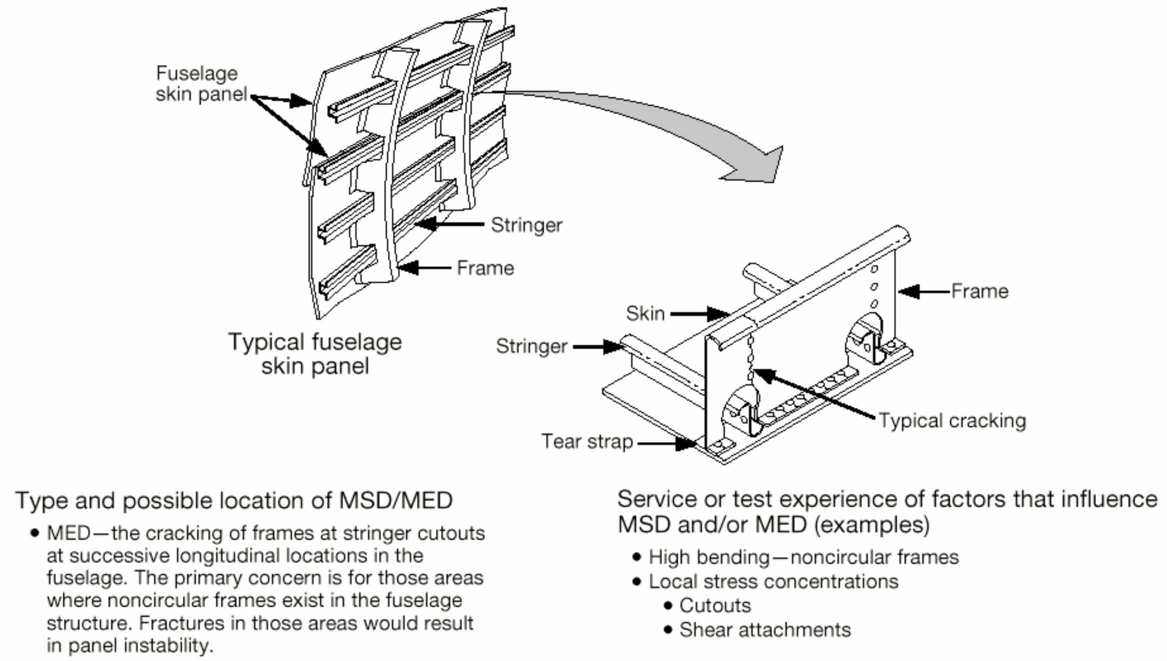


Figure A2-4 ***Fuselage Frames (MED)***

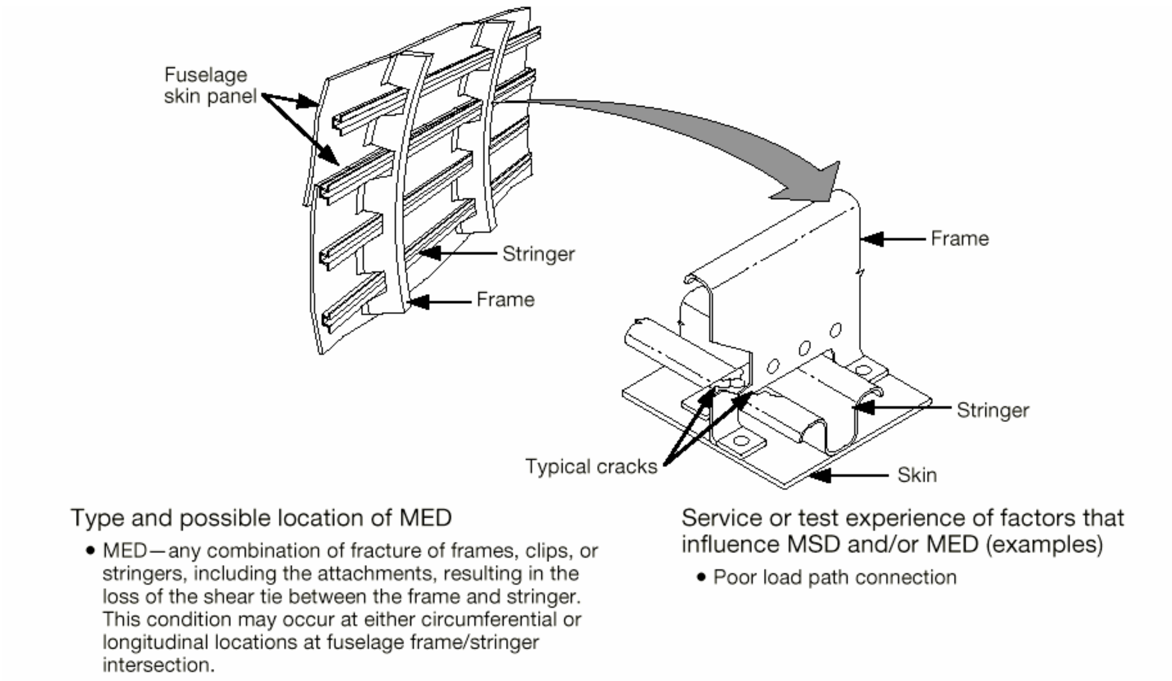


Figure A2-5 ***Stringer to Frame Attachments (MED)***

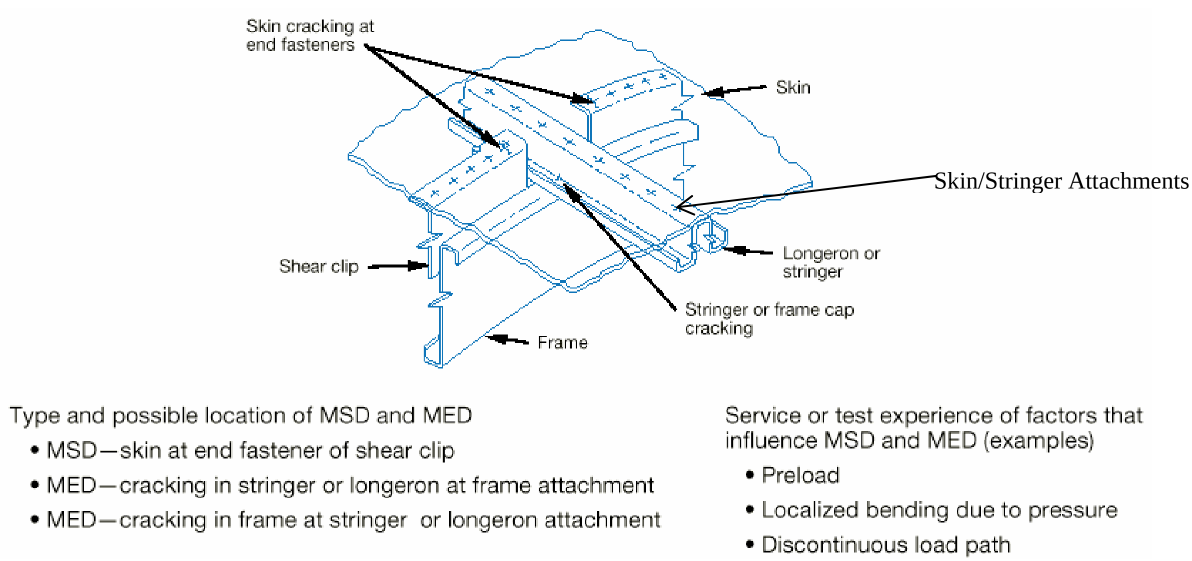


Figure A2-6 ***Shear Clip End Fasteners on Shear Tied Fuselage Frame (MSD/MED)***

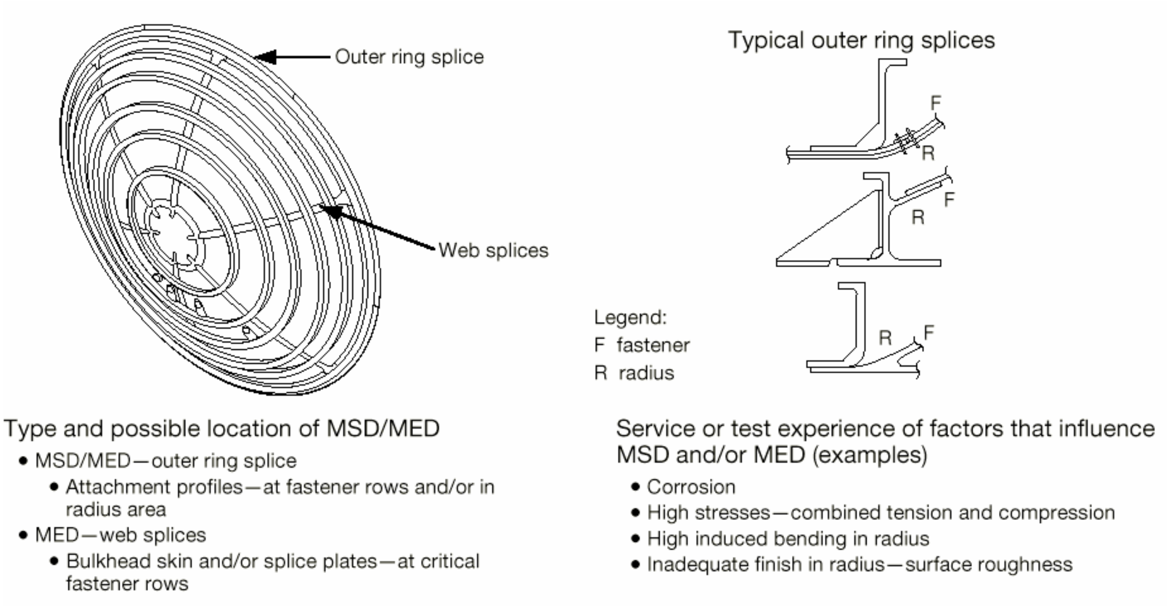


Figure A2-7 ***Aft Pressure Dome Outer Ring and Dome Web Splices (MSD/MED)***

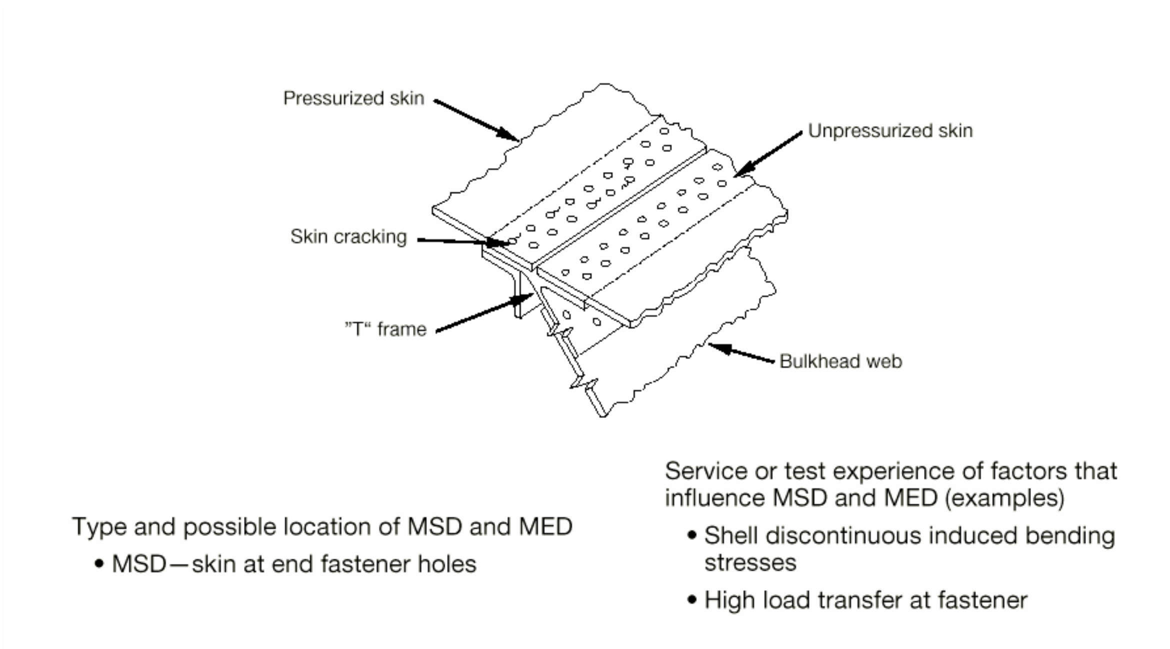


Figure A2-8 ***Skin Splice at Aft Pressure Bulkhead (MSD)***

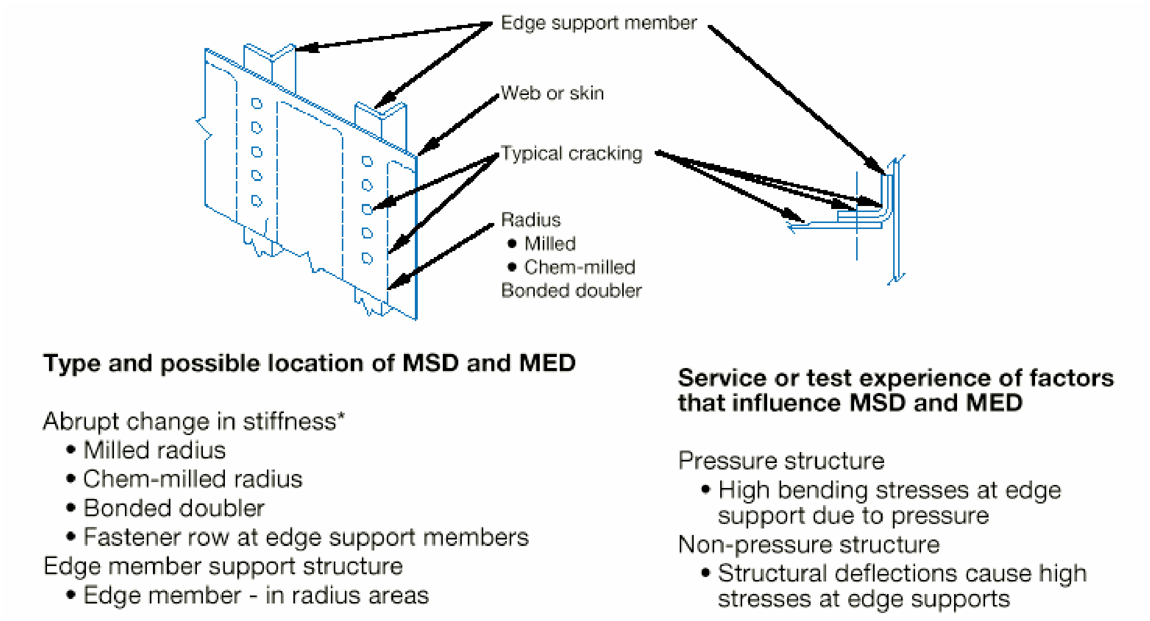


Figure A2-9 ***Abrupt Changes in Web or Skin Thickness — Pressurized or Unpressurized Structure (MSD/MED)***

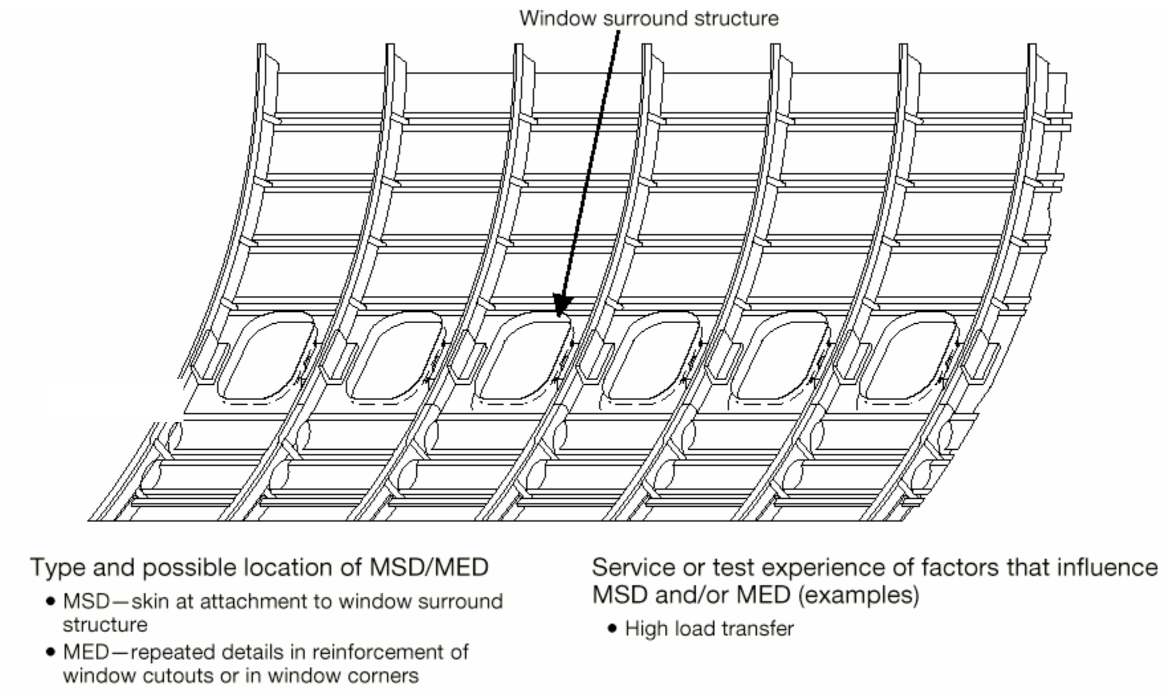
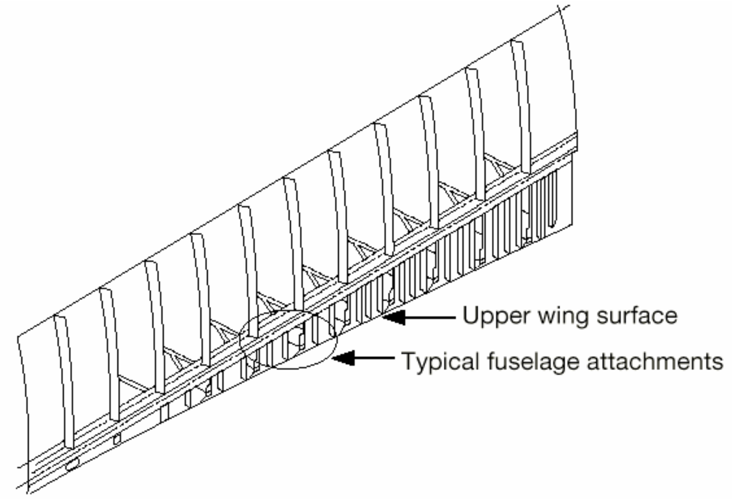


Figure A2-10 ***Window Surround Structure (MSD, MED)***



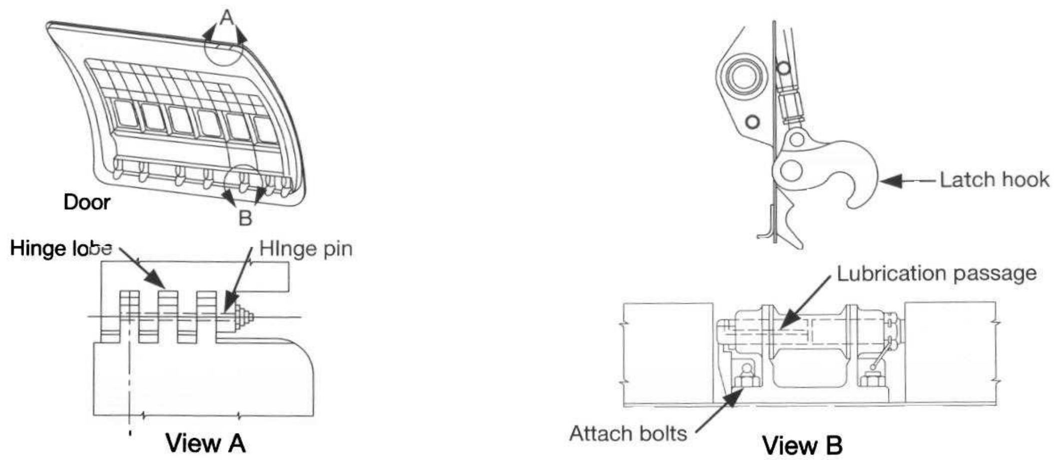
Type and possible location of MSD/MED

- MED—repeated details in overwing fuselage attachments

Service or test experience of factors that influence MSD and/or MED (examples)

- Manufacturing defect—prestress
- Induced deflections

Figure A2-11 *Over Wing Fuselage Attachments (MED)*



Type and possible location of MSD/MED

- MSD—piano hinge
  - At hinge fastener attachment row
  - In fillet radius
  - Emanating from hole in lobes
- MED—latches
  - In multiple latch hooks
  - At lube channel of latch spool
  - At spool bracket attach bolts (also corrosion)

Service or test experience of factors that influence MSD and/or MED (examples)

- Bending stresses due to fuselage elongation
- High local stress
- Fretting

Figure A2-12 *Latches and Hinges of Non-plug Doors (MSD/MED)*

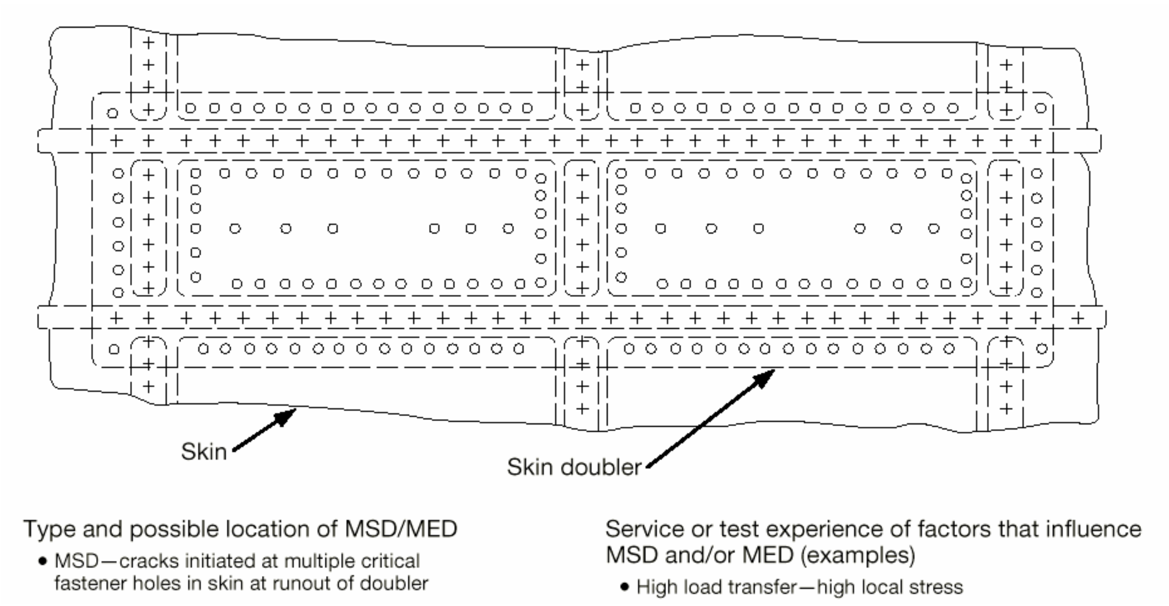


Figure A2-13 ***Skin at Runout of Large Doubler (MSD) — Fuselage, Wing or Empennage***

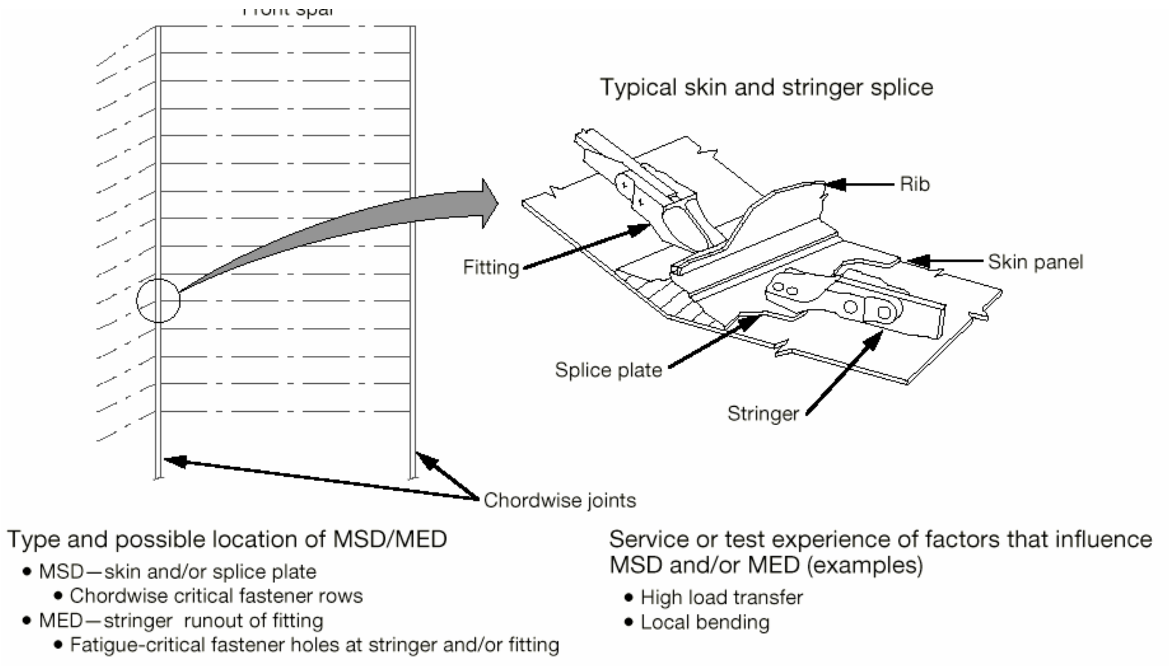


Figure A2-14 ***Wing or Empennage Chordwise Splices (MSD/MED)***

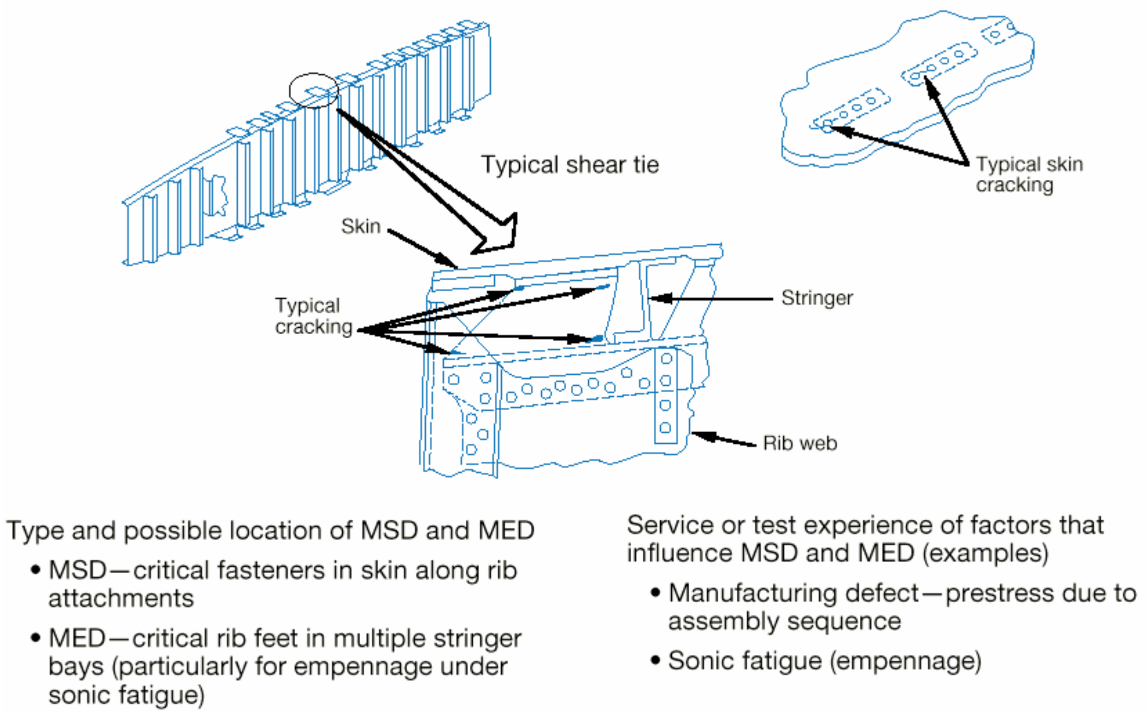


Figure A2-15 ***Rib to Skin Attachments (MSD/MED)***

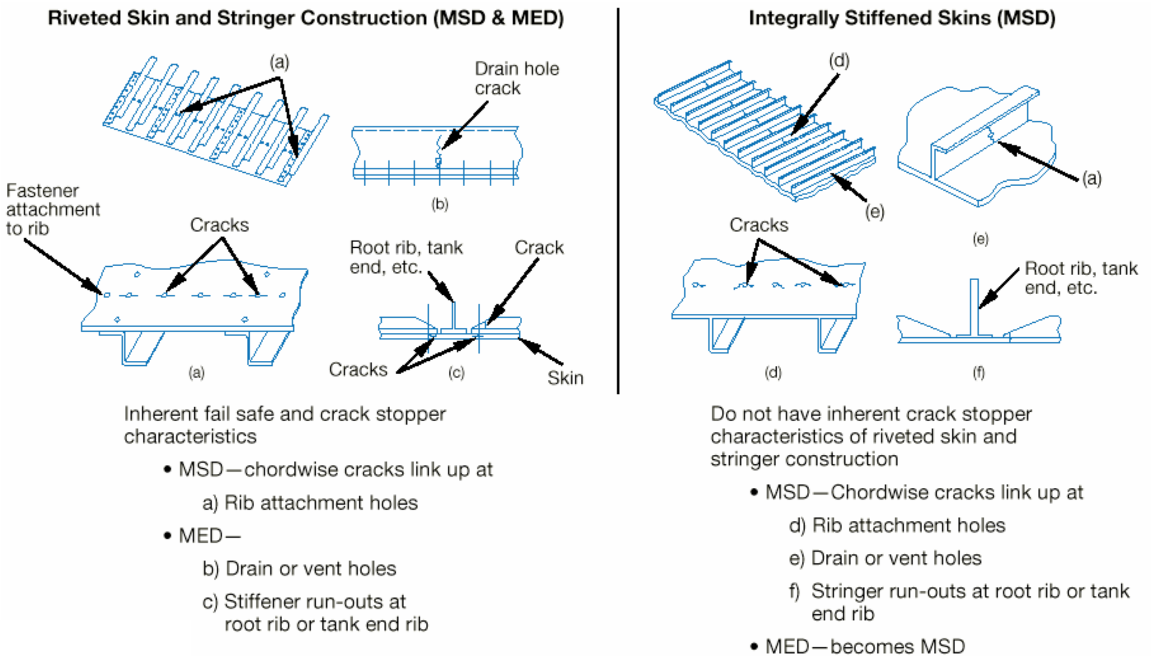


Figure A2-16 ***Typical Wing and Empennage Construction (MSD/MED)***

4.3 WFD Evaluation.

By the time the highest-time aircraft of a particular model reaches its DSG, the evaluation for each area susceptible to the development of WFD should be completed. A typical evaluation process is shown in Figure A2-17, below. This evaluation will establish the necessary elements to determine a maintenance programme to preclude WFD in that particular model's aircraft fleet. These elements are developed for each susceptible area and include:

4.3.1 Determination of WFD average behaviour in the fleet:

The time in terms of flight cycles/hours to the WFD average behaviour in the fleet should be established. The evaluation should include:

- a complete review of the service history of the susceptible areas (including operational statistics of the fleet in terms of flight hours and landings),
- significant production variants (material, design, assembly method, and any other change that might affect the fatigue performance of the detail),
- relevant full-scale and component fatigue test data,
- teardown inspections, and
- any fractographic analysis available.

The evaluation of the test results for the reliable prediction of the time to when WFD might occur in each susceptible area should include appropriate test-to-structure factors. If fatigue test evidence is used, Figure A2-18, below, relates how that data might be reduced in determining WFD Average Behaviour. Evaluation may be analytically determined, supported by test or service evidence.

4.3.2 Initial Crack/Damage Scenario

This is an estimate of the size and extent of multiple cracking expected at MSD/MED initiation. This prediction requires empirical data or an assumption of the crack/damage locations and sequence plus a fatigue evaluation to determine the time to MSD/MED initiation. Alternatively, analysis can be based on either:

- the distribution of equivalent initial flaws, as determined from the analytical assessment of flaws found during fatigue test and/or teardown inspections regressed to zero cycles; or
- a distribution of fatigue damage determined from relevant fatigue testing and/or service experience.

4.3.3 Final Cracking Scenario

This is an estimate of the size and extent of multiple cracking that could cause residual strength to fall to certification levels. Techniques exist for 3-D elastic-plastic analysis of such problems; however, there are several alternative test and analysis approaches available that provide an equivalent level of safety. One such approach is to define the final cracking scenario as a sub-critical condition (e.g., first crack at link-up at limit load). Use of a sub-critical scenario reduces the complexity of the analysis and, in many cases, will not greatly reduce the total crack growth time.

4.3.4 Crack Growth Calculation

Progression of the crack distributions from the initial cracking scenario to the final cracking scenario should be developed. These curves can be developed:

- *analytically*, typically based on linear elastic fracture mechanics, or
- *empirically*, from test or service fractographic data.

4.3.5 Potential for Discrete Source Damage (DSD)

A structure susceptible to MSD/MED may also be affected by DSD due to an uncontained failure of high-energy rotating machinery (i.e., turbine engines). The approach described in this guidance material should ensure the MSD sizes and densities, that normally would be expected to exist at the structural modification point, would not significantly change the risk of catastrophic failure due to DSD.

4.3.6. Analysis Methodology:

The evaluation methods used to determine the WFD average behaviour and associated parameters will vary. The report "Recommendations for Regulatory Action to Prevent Widespread Fatigue Damage in the Commercial Aeroplane Fleet", Revision A, dated June 29, 1999 (a report of the AAWG for the ARAC's Transport Aircraft and Engine Issues Group), discusses two Round Robin exercises developed by the TCHs to provide insight into their respective methodologies. One outcome of the exercises was an identification of key assumptions or methods that had the greatest impact on the predicted WFD behaviour. These assumptions were:

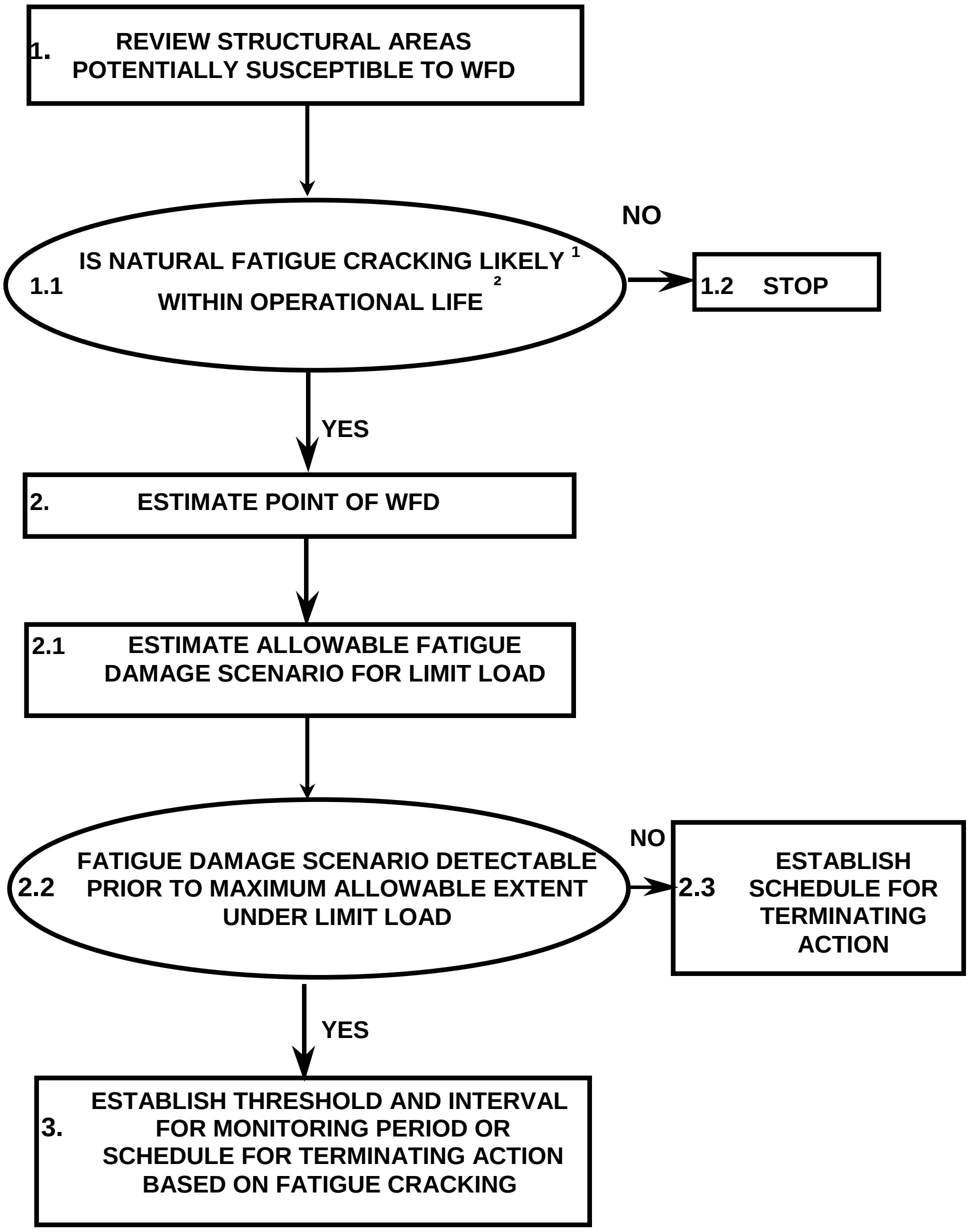
- the flaw sizes assumed at initiation of crack growth phase of analysis;
- material properties used (static, fatigue, fracture mechanics);
- ligament failure criteria;
- crack growth equations used;
- statistics used to evaluate the fatigue behaviour of the structure (e.g., time to crack initiation);
- methods of determining the structure modification point (SMP);
- detectable flaw size assumed;
- initial distribution of flaws; and
- factors used to determine were bound behaviour as opposed to mean behaviour.

The following parameters are developed from paragraphs 4.3.1 through 4.3.6 above, and are necessary to establish a MSD/MED maintenance programme for the area under investigation.

4.3.7 Inspection Start Point (ISP):

This is the point at which inspection starts if a monitoring period is used. It is determined through a statistical analysis of crack initiation based on fatigue testing, teardown, or service experience of similar structural details. It is assumed that the ISP is equivalent to a lower bound value with a specific probability in the statistical distribution of cracking events. Alternatively, the ISP may be established by applying appropriate factors to the average behaviour.

AEROPLANE EVALUATION PROCESS - STEP 1

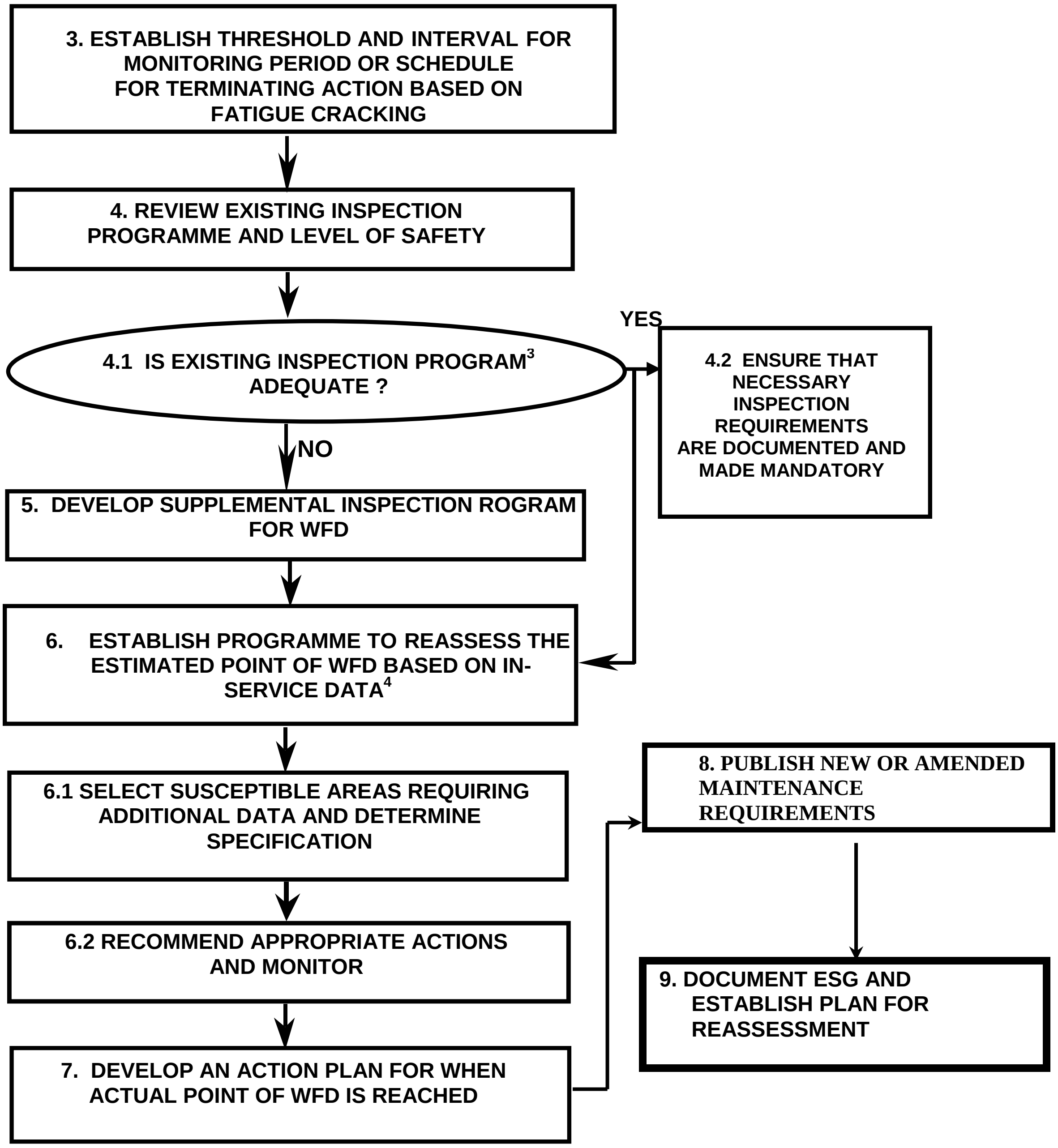


NOTES

1. Fatigue cracking is defined as likely if the factored fatigue life is less than the projected ESG of the aircraft at time of WFD evaluation.

2. The operational life is the projected ESG of the aircraft at time of WFD evaluation.

Figure A2-17 ***Aeroplane Evaluation Process, Part 1 of 2***

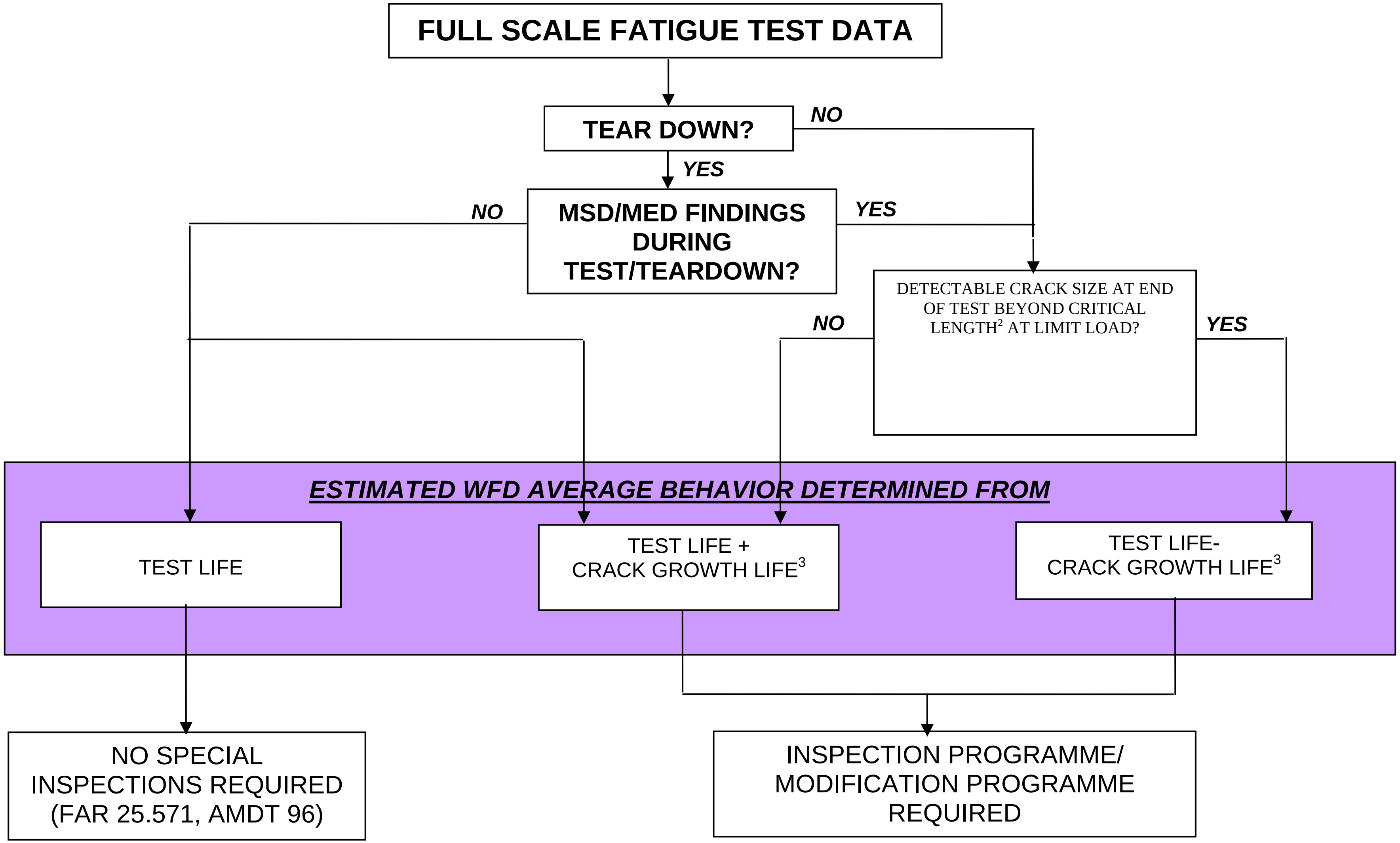


NOTES:

3. Inspection threshold, inspection intervals and inspection methods must be adequate to detect single or multiple cracking.

4. The evaluation process must be repeated if the operational life is increased

Figure A2-17 ***Aeroplane Evaluation Process Part 2 of 2***



1 **ASSUMED STATE AT END OF TEST**: Best estimate of non-detected damage from inspection method used at end of test or during teardown.
2 **CRITICAL CRACK LENGTH**: First link-up of adjacent cracks at limit load (locally) or an adequate level of large damage capability.
3 **CRACK GROWTH LIFE**: Difference between assumed state at end of test and critical crack length.

Figure A2-18 ***Use of Fatigue Test and Teardown Information to Determine WFD Average Behaviour***

4.3.8 Considerations:

Due to the redundant nature of semi-monocoque structure, MED can be difficult to manage in a fleet environment. This stems from the fact that most aircraft structures are built-up in nature, and that makes the visual inspection of the various layers difficult. Also, visual inspections for MED rely on internal inspections and, therefore, recurring intervals are normally much greater than for external skin inspections. However, these issues are dependent on the specific design involved and the amount of damage being considered. In order to implement a viable inspection programme for MED, the following conditions must be met:

a) Static stability must be maintained at all times.

b) Large damage capability should be maintained.

c) There is no concurrent MED with MSD in a given structural area.

4.3.9 Structural Modification Point (SMP).

The applicant should demonstrate that the proposed SMP established during the audit has the same confidence level as current regulations require for new certification. In lieu of other acceptable methods, the SMP can be established as a point reduced from the WFD Average Behaviour, based on the viability of inspections in the monitoring period. The SMP can be determined by dividing the WFD Average Behaviour by a factor of 2 if there are viable inspections, or by a factor of 3 if inspections are not viable.

Whichever approach is used to establish the SMP, a study should be made to demonstrate that the approach ensures that the expected extent of MSD/MED at the SMP still has a LDC to address damage from sources such as accidental damage, fatigue damage, or environmental degradation.

An aircraft should not be operated past the SMP unless the structure is modified or replaced, or unless additional approved data is provided that would extend the SMP. However, if during the structural evaluation for WFD, a TCH finds that the flight cycles and/or flight hours SMP for a particular structural detail have been exceeded by one or more aircraft in the fleet, the TCH should expeditiously evaluate selected high time aircraft in the fleet to determine their structural condition. From this evaluation, the TCH should notify the competent authorities and propose appropriate service actions independent of the audit.

The initial SMP may be adjusted based on the following:

(i) In some cases, the initial SMP may be extended without changing the required reliability of the structure, i.e. projection to that of a two life time full-scale fatigue test. These cases are:

- Additional fatigue and/or residual strength tests on a full-scale aircraft structure or a full-scale component followed by detailed inspections and analyses.

- Testing of new or used structure on a smaller scale than full component tests (i.e., sub-component and/or panel tests).

- Teardown inspections (destructive) that could be done on structural components that have been removed from service.

- Local teardown by selected, limited (non-destructive) disassembly and refurbishment of specific areas of high-time aircraft.

- In-service data from a statistically significant number of aircraft close to the original SMP showing no cracking compared with the predictions. This data may be used to support increasing the original SMP by an amount that is agreed by the competent authority.

- Or a combination of any or all of the above.

(ii) If cracks are found in the structural detail for which the audit was done during either the monitoring period or the modification programme, the SMP should be re-evaluated to ensure that the SMP does in fact provide the required confidence level. If it is shown that the required confidence level is not being met, the SMP should be adjusted and the adjustment reflected in appropriate service bulletins to address the condition of the fleet. Additional regulatory action may be required.

4.3.10 Inspection Interval and Method:

An interval should be chosen to provide a sufficient number of inspections between the ISP and the SMP so that there is a high confidence that no MSD/MED condition will reach the final cracking scenario without detection. The interval is highly dependent on the detectable crack size and the probability of detection associated with the specific inspection method. If the crack cannot be detected, the SMP must be re-evaluated to ensure there is a high confidence level that no aircraft will develop MSD/MED before modification.

4.4 Evaluation of Maintenance Actions

For all areas that have been identified as susceptible to MSD/MED, the current maintenance programme should be evaluated to determine if adequate structural maintenance and inspection programmes exist to safeguard the structure against unanticipated cracking or other structural degradation. The evaluation of the current maintenance programme typically begins with the determination of the SMP for each area.

Each area should then be reviewed to determine the current maintenance actions that are directed against the structure and compare them to the maintenance requirements.

(a) Determine the inspection requirements (method, inspection start point, and repeat interval) of the inspection for each susceptible area (including that structure that is expected to arrest cracks) that is necessary to maintain the required level of safety.

(b) Review the elements of the existing maintenance programmes already in place

(c) Revise and highlight elements of the maintenance programme necessary to maintain safety.

For susceptible areas approaching the SMP, where the SMP will not be increased, or for areas that cannot be reliably inspected, a programme should be developed and documented that provides for replacement or modification of the susceptible structural area.

4.4.1 Period of Evaluation Validity:

The initial evaluation of the complete airframe should cover a significant forward estimation of the projected aircraft usage beyond its DSG, also known as the "proposed ESG." Typically, an assessment through at least an additional twenty-five percent of the DSG would provide a realistic forecast, with reasonable planning time for necessary maintenance action. However, it may be appropriate to vary the evaluation validity period depending on issues such as:

(a) The projected useful life of the aircraft at the time of the initial evaluation;

(b) Current non-destructive inspection (NDI) technology; and

(c) Airline advance planning requirements for introduction of new maintenance and modification programmes, to provide sufficient forward projection to identify all likely maintenance/modification actions essentially as one package.

Upon completion of the evaluation and publication of the revised maintenance requirements, the "proposed ESG" becomes the ESG or Limit of Validity (LOV)

5. <u>DOCUMENTATION</u>.

Any person developing a programme to comply with the proposed rule must develop a document containing recommendations for inspection procedures and replacement or modification of parts or components necessary to preclude WFD, and establish the new limit of validity of the operator's maintenance programme. That person also must revise the SSID or ALS as necessary, and/or prepare service bulletins that contain the recommendations for inspection procedures and replacement or modification of parts or components necessary to preclude WFD. Since WFD is a safety concern for all operators of older aircraft, the Agency will make mandatory the identified inspection or modification programmes. In addition, the Agency may consider separate AD action to address any service bulletins or other service information publications revised or issued as a result of in-service MSD/MED findings resulting from implementation of these programmes.

The following items should be contained in the front of the approved document:

(1) Identification of the variants of the basic aircraft type to which the document relates;

(2) Summary of the operational statistics of the fleet in terms of hours and flights;

(3) Description of the typical mission, or missions;

(4) The types of operations for which the inspection programme is considered valid;

(5) Reference to documents giving any existing inspections, or modification of parts or components; and

(6) The LOV of the maintenance programme in terms of flight cycles or flight hours or both as appropriate to accommodate variations in usage.

The approved document should contain at least the following information for each critical part or component:

(1) Description of the Primary Structure susceptible to WFD;

(2) Details of the monitoring period (inspection start point, repeat inspection interval, SMP, inspection method and procedure (including crack size, location and direction) and alternatives) when applicable;

(3) Any optional modification or replacement of the structural element as terminating action to inspection;

(4) Any mandatory modification or replacement of the structural element;

(5) Service bulletins (or other service information publications) revised or issued as a result of in-service findings resulting from the WFD evaluations (added as a revision to the initial WFD document); and

(6) Guidance to the operator on which inspection findings should be reported to the TCH, and appropriate reporting forms and methods of submittal.

6. REPORTING REQUIREMENTS

Operators, TCHs and STC Holders are required to report in accordance with various regulations, for example Part 21.3, Part 145.60. The regulations to which this AMC relates do not require any reporting requirements in addition to the current ones. Due to the potential threat to structural integrity, the results of inspections must be accurately documented and reported in a timely manner to preclude the occurrence of WFD. The current system of operator and TCH communication has been useful in identifying and resolving a number of issues that can be classified as WFD concerns. MSD/MED has been discovered via fatigue testing and in-service experience. TCHs have been consistent in disseminating related data to operators to solicit additional service experience. However, a more thorough means of surveillance and reporting is essential to preclude WFD.

When damage is found while conducting an approved MSD/MED inspection programme, or at the SMP where replacement or modification of the structure is occurring, the TCHs, STC Holders and the operators need to ensure that greater emphasis is placed on accurately reporting the following items:

(1) A description (with a sketch) of the damage, including crack length, orientation, location, flight cycles/hours, and condition of structure;

(2) Results of follow-up inspections by operators that identify similar problems on other aircraft in the fleet;

(3) Findings where inspections accomplished during the repair or replacement/modification identify additional similar damage sites; and

(4) Adjacent repairs within Primary Structure.

Operators must report all cases of MSD/MED to the TCH, STC Holder or the competent authority as appropriate, irrespective of how frequently such cases occur. Cracked areas from in-service aircraft (damaged structure) may be needed for detailed examination. Operators are encouraged to provide fractographic specimens whenever possible. Aeroplanes undergoing heavy maintenance checks are perhaps the most useful sources for such specimens.

Operators should remain diligent in the reporting of potential MSD/MED concerns not identified by the TCH. Indications of a developing MSD/MED problem may include:

(1) Damage at multiple locations in similar adjacent details;

(2) Repetitive part replacement; or

(3) Adjacent repairs within the same Primary Structure.

Documentation will be provided by the TCH and STC Holder as appropriate to specify the required reporting format and time frame. The data will be reviewed by the TCH or STC Holder, operator(s), and the Agency to evaluate the nature and magnitude of the problem and to determine the appropriate corrective action.

7. STRUCTURAL MODIFICATIONS AND REPAIRS

All major modifications (STCs) and repairs that create, modify, or affect structure that is susceptible to MSD/MED (as identified by the TCH) must be evaluated to demonstrate the same confidence level as the original manufactured structure. The operator is responsible together with the DAH for ensuring the accomplishment of this evaluation for each modified aircraft. The operator may first need to conduct an assessment on each of its aircraft to determine what modifications or repairs exist and would be susceptible to MSD/MED. The following are some examples of types of modifications and repairs that present such concerns:

(1) Passenger-to-freighter conversions (including addition of main deck cargo doors);

(2) Gross weight increases (increased operating weights, increased zero fuel weights, increased landing weights and increased maximum takeoff weights);

(3) Installation of fuselage cutouts (passenger entry doors, emergency exit doors or crew escape hatches, fuselage access doors and cabin window relocations);

(4) Complete re-engine and/or pylon modifications;

(5) Engine hush-kits and nacelle modifications;

(6) Wing modifications, such as the installation of winglets or changes in flight control settings (flap droop), and changes to wing trailing edge structure;

(7) Modified, repaired, or replaced skin splice;

(8) Any modification or repair that affects several frame bays; and

(9) Multiple adjacent repairs.

Other potential areas that must be considered include:

(1) A modification that covers structure requiring periodic inspection by the operator's maintenance programme (Modifications must be reviewed to account for the differences with TCH baseline maintenance programme requirements.);

(2) A modification that results in operational mission change that significantly changes manufacturers load/stress spectrum (for example, a passenger-to-freighter conversion); and

(3) A modification that changes areas of the fuselage from being externally inspectable using visual means to being uninspectable (for example, a large external fuselage doubler that resulted in hidden details, rendering them visually uninspectable).

8. RESPONSIBILITY

It is expected that the evaluation will be conducted in a cooperative effort between the operators and TCHs, with participation by the Agency during the evaluation.

APPENDIX 3

Guidelines for establishing instructions for continued airworthiness of structural repair

1. GENERAL

1.1 Purpose

This appendix is intended to provide guidance for operators for the development and incorporation of repair assessment guidelines into the maintenance or inspection programme, as well as to TCH's who should develop a repair assessment guidelines document and a Structural Repair Manual as well as repairs identified in SB's, updated to include the results of a damage-tolerance assessment which may determine any specific supplemental inspections and / or limitations.

2. ELEMENTS OF REPAIR ASSESSMENT

2.1 Introduction

The Industry have recognized the need for a repair assessment guidelines document and a Structural Repair Manual (SRM) as well as repairs identified in SB's, updated to include the results of a damage-tolerance assessment which may determine any specific supplemental inspections and / or limitations.
The intent is that all repairs to the fuselage pressure boundary will be evaluated for damage-tolerance, and that the resulting inspections, modifications and corrective actions (if any) be accomplished in accordance with the model specific repair assessment guidelines (refer to section 3 this appendix).

> **Note:** Repairs for which the design has already been justified / approved according to damage-tolerance standards do not need to be assessed by this programme.

2.2 Concerns posted by older repairs

Repairs are a concern on older aircraft because of the possibility that they may develop, cause, or obscure metal fatigue, corrosion, or other damage during service. This damage might occur within the repair itself or in the adjacent structure and might ultimately lead to structural failure.

In general, repairs present a more challenging problem to solve than the original structure because they are unique and tailored in design to correct particular damage to the original structure. Whereas the performance of the original structure may be predicted from tests and from experience on other aircraft in service, the behaviour of a repair and its effect on the fatigue characteristics of the original structure are generally known to a lesser extent than for the basic un-repaired structure.

Repairs may be of concern as time in service increases for the following reasons:

As aircraft age, both the number and age of the existing repairs increase. Along with this increase in the number of and age of repairs is the possibility of unforeseen repair interaction, failure, or other damage occurring in the repaired area. The continued operational safety of these aircraft depends primarily on a satisfactory maintenance programme (inspections conducted at the right time, in the right place, using the most appropriate technique). To develop this programme, a damage-tolerance evaluation of repairs to aircraft structure is essential. The longer an aircraft is in service, the more important this evaluation and a subsequent inspection programme becomes.

The practice of repair justification has evolved gradually over the last 20 plus years. Some repairs described in the aircraft manufacturers' SRMs were not designed to fatigue and damage-tolerance principles. (Ref. AAWG Report: Recommendations concerning ARAC taskings FR Doc.04-10816 Re: Aging Airplane safety final rule. 14 CFR 121.370a and 129.16.) Repairs accomplished in accordance with the information contained in the early versions of the SRMs may require additional inspections if evaluated using the fatigue and damage-tolerance methodology.

c. Because a regulatory requirement for damage-tolerance was not applied to aeroplane designs type certificated before 1978, the damage-tolerance characteristics of repairs may vary widely and are largely unknown. In view of these concerns it is necessary to perform an assessment of repairs on existing aircraft to establish their damage-tolerance characteristics.

2.3 Establishment of a damage-tolerant based SSIP for repairs and adjacent structure.

The basic structure that would be affected by this programme was required at the time of original certification to meet the applicable regulatory standards for fatigue or fail-safe strength. Repairs and modifications to this structure were also required to meet these same standards. These early fatigue or fail-safe requirements did not provide for timely inspection of critical structure so that damaged or failed components could be dependably identified and repaired or replaced before a hazardous condition developed. In 1978 a new certification requirement called damage-tolerance was introduced to assure the continued structural integrity of large aeroplanes certificated after that time.

Damage-tolerance is a structural design and inspection methodology used to maintain safety considering the possibility of metal fatigue or other structural damage (i.e., safety is maintained by adequate structural inspection until the damage is repaired). The underlying principle for damage-tolerance is that the initiation and growth of structural fatigue damage can be anticipated with sufficient precision to allow inspection programmes to safely detect damage before it reaches a critical size. A damage-tolerance evaluation entails the prediction of sites where fatigue cracks are most likely to initiate in the aircraft structure, the prediction of the crack path and rates of growth under repeated aircraft structural loading, the prediction of the size of the damage at which strength limits are exceeded, and an analysis of the potential opportunities for inspection of the damage as it progresses. This information is used to establish an inspection programme for the structure that will be able to detect cracking that may develop before it precipitates a major structural failure. A damage-tolerant structure is one in which damage would be detected by reliance on normally performed maintenance and inspection actions long before it becomes hazardous.

The evidence to date is that when all critical structure is included, the damage-tolerant concept, and the supplemental inspection programmes that are based on it, provide the best assurance of continued structural integrity that is currently available. In order to apply this concept to existing transport aeroplanes, the competent authorities issued a series of ADs requiring compliance with the first supplemental inspection programmes resulting from application of this concept to existing aeroplanes. Generally, these ADs require that operators incorporate SSIDs into their maintenance programmes for the affected aeroplanes. These documents were derived from damage-tolerance assessments of the originally certificated type designs for these aeroplanes. For this reason, the majority of ADs written for the SSIP did not attempt to address issues relating to the damage-tolerance of repairs that had been made to the aeroplanes. The objective of this programme is to provide the same level of assurance for areas of the structure that have been repaired as that achieved by the SSIP for the baseline structure as originally certificated.

The fatigue and damage-tolerance evaluation of a repair would be used in an assessment programme to establish an appropriate inspection programme, or a replacement schedule if the necessary inspection programme is too demanding or not possible. The objective of the repair assessment is to assure the continued structural integrity of the repaired and adjacent structure based on damage-tolerance principles. Any identified supplemental inspections are intended to detect damage which may develop in a repaired area, before that damage degrades the load carrying capability of the structure below the levels required by the applicable airworthiness standards.

2.4 Update of repairs identified in SBs to include the results of a damage tolerance assessment

Structural repairs included in SBs do not always contain instructions for future supplemental inspection requirements. It is necessary to evaluate the need for inspections for these repairs. A list of SBs calling for repairs will be contained in the model specific repair assessment guidelines, with post repair inspection programmes as required. It is necessary for the TCH to complete the review of SB related repairs in conjunction with the initial SRM updates.

2.5 Update of SRM to include the results of a damage-tolerance assessment.

It is recognised that repair assessment guidelines would add to, or in some cases appear to be in conflict with, existing repair approval data. All repairs assessed under this programme should have been previously approved, but not necessarily to damage-tolerance standards. In some cases, it is necessary to update the affected SRMs, as well as repairs identified in SBs, to determine requirements for supplemental inspections, if not already addressed.

2.6 Aeroplane structure to be assessed

Concern over the repairs programme dictated that accurate data be collected to identify the scope of the programme. The AAWG conducted two separate surveys of repairs placed on aeroplanes to collect the necessary data. The first survey occurred in 1992, and the second survey in 1994.This survey was expanded to include all areas of the airframe. The evaluation revealed substantially similar results to the 1992 survey in which 40% of the repairs were classified as adequate and 60% of the repairs required consideration for additional supplemental inspection during service. In addition, only a small number of repairs (less than 10%) were found on other structure than the fuselage.

The repair assessment of pre FAR 25.571 Amendment 25-45 aeroplanes was initially limited to the fuselage pressure boundary (fuselage skin, door skin and bulkhead webs). This limitation was based on two considerations: First, the fuselage is more sensitive to structural fatigue than other aeroplane structure because its normal operating loads are closer to its limit design loads. Stresses in a fuselage are primarily governed by the pressure relief valve settings of the environmental control system, and these are less variable from flight to flight than the gust or manoeuvre loads that typically determine the design stresses in other structure. Second, the fuselage is more prone to damage from ground service equipment than other structure and requires repair more often. The result of the second survey described above supports the conclusion that repairs to the fuselage are far more frequent than to any other structure. Nonetheless, following further studies by AAWG working groups it is expected that repairs to all structure susceptible to fatigue and whose failure could contribute to catastrophic failure will be considered. (Ref. AAWG Report: Recommendations concerning ARAC taskings FR Doc.04-10816 Re: Aging Airplane safety final rule. 14 CFR 121.370a and 129.16.)

For aeroplanes certified to a post FAR 25.571 Amendment 25-45 standard, where as per 2.2(b) above the SRM and / or operator designed repairs may have been originally accomplished without consideration of fatigue & damage-tolerant principles, a repair assessment will also need to be accomplished. In this case, the assessment of repairs is extended to all Primary Structure.

2.7 Training

The complexity of the repair assessment may require adequate training for proper implementation. In that case, it is necessary that each TCH provide training for all operators of the aircraft considered by this AMC

3. <u>REPAIR ASSESSMENT GUIDELINES</u>

3.1 Criteria to assist in developing the repair assessment guidelines

The purpose is to develop repair assessment guidelines requiring specific maintenance programmes, if necessary, to maintain the damage-tolerance integrity of the repaired airframe. The following criteria have been developed to assist in the development of that guidance material:

(1) Specific repair size limits for which no assessment is necessary should be selected for each model of aircraft.

(2) Repairs that are not in accordance with SRM must be reviewed and may require further action.

(3) Repairs must be reviewed where the repair has been installed in accordance with SRM data that have been superseded or rendered inactive by new damage-tolerant designs.

(4) Repairs in close proximity to other repairs or modifications require review to determine their impact on the continued airworthiness of the aircraft.

(5) Repairs that exhibit structural distress should be replaced before further flight.

3.2 Repair assessment methodology.

The next step is to develop a repair assessment methodology that is effective in evaluating the continued airworthiness of existing repairs for the fuselage pressure boundary. Older aircraft models may have many structural repairs, so the efficiency of the assessment procedure is an important consideration. In the past, evaluation of repairs for damage-tolerance would require direct assistance from the TCH. Considering that each repair design is different, that each aircraft model is different, that each area of the aircraft is subjected to a different loading environment, and that the number of engineers qualified to perform a damage-tolerance assessment is small, the size of an assessment task conducted in that way would be unmanageable. Therefore, a new approach has been developed as an alternative

Since repair assessment results will depend on the model specific structure and loading environment, the TCHs should create an assessment methodology for the types of repairs expected to be found on each affected aircraft model. Since the records on most of these repairs are not readily available, locating the repairs will necessitate surveying the structure of each aircraft. A survey form is created by TCH that may be used to record key repair design features needed to accomplish a repair assessment. Airline personnel not trained as damage-tolerance specialists can use this form to document the configuration of each observed repair.

Some TCH have developed simplified methods using the information from the survey form as input data, to determine the damage-tolerance characteristics of the surveyed repairs. Although the repair assessments should be performed by well trained personnel familiar with the model specific repair assessment guidelines, these methods enable appropriate staff, not trained as a damage-tolerance specialist, to perform the repair assessment without the assistance of the TCH. This methodology should be generated by the aircraft TCH. Model specific repair assessment guidelines will be prepared by the TCHs.

From the information on the survey form, it is also possible to classify repairs into one of three categories:

Category A: A permanent repair for which the baseline zonal inspection (BZI), (typical maintenance inspection intervals assumed to be performed by most operators), is adequate to ensure continued airworthiness.

Category B: A permanent repair that requires supplemental inspections to ensure continued airworthiness.

Category C: A temporary repair that will need to be reworked or replaced prior to an established time limit. Supplemental inspections may be necessary to ensure continued airworthiness prior to this limit.

3.3 Repair assessment process

There are two principal techniques that can be used to accomplish the repair assessment. The first technique involves a three-stage procedure. This technique could be well suited for operators of small fleets. The second technique involves the incorporation of the repair assessment guidelines as part of an operator's routine maintenance programme. This approach could be well suited for operators of large fleets and would evaluate repairs at predetermined planned maintenance visits as part of the maintenance programme. TCHs and operators may develop other techniques, which would be acceptable as long as they fulfil the objectives of this proposed rule, and are approved by the Agency.

The first technique generally involves the execution of the following three stages (fig.1):

Stage 1 Data Collection

This stage specifies what structure should be assessed for repairs and collects data for further analysis. If a repair is on a structure in an area of concern, the analysis continues, otherwise the repair does not require classification per this programme.
Repair assessment guidelines for each model will provide a list of structure for which repair assessments are required. Some TCHs have reduced this list by determining the inspection requirements for critical details. If the requirements are equal to normal maintenance checks (e.g., BZI checks), those details were excluded from this list.

Repair details are collected for further analysis in Stage 2. Repairs that do not meet the minimum design requirements or are significantly degraded are immediately identified, and corrective actions must be taken before further flight.

Stage 2 Repair Categorisation

The repair categorization is accomplished by using the data gathered in Stage 1 to answer simple questions regarding structural characteristics.

If the maintenance programme is at least as rigorous as the BZI identified in the
TCH's model specific repair assessment guidelines, well designed repairs in good condition meeting size and proximity requirements are Category A. Simple condition and design criteria questions are provided in Stage 2 to define the lower bounds of Category B and Category C repairs. The process continues for Category B and C repairs.

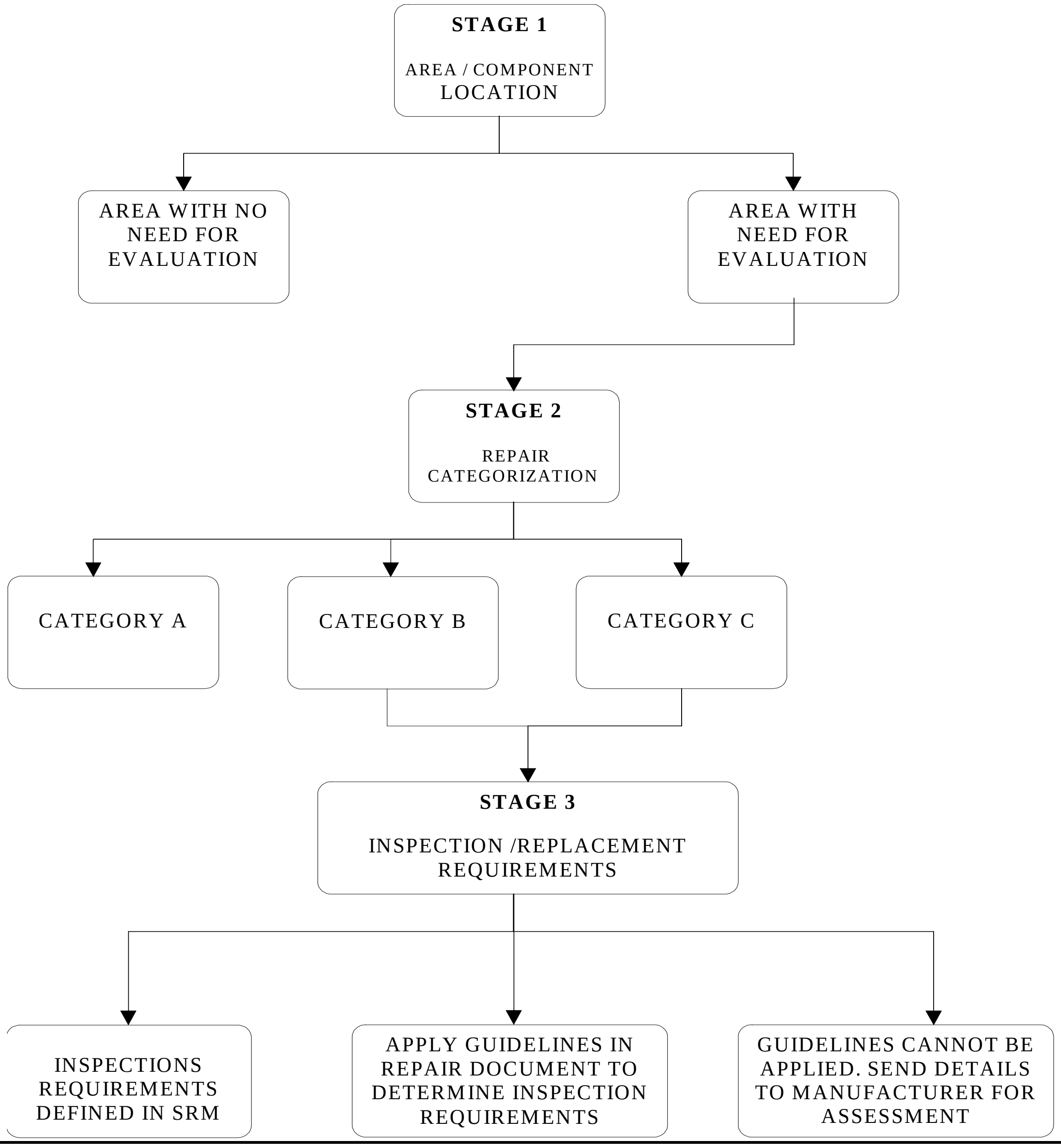


Figure 1. Repair Assessment Stages

Stage 3 Determination of Structural Maintenance Requirements

The specific supplemental inspection and/or replacement requirements for Category B and C repairs are determined in this stage. Inspection requirements for the repair are determined by calculation or by using predetermined values provided by the TCH, or other values obtained using an Agency approved method.

In evaluating the first supplemental inspection, Stage 3 will define the inspection threshold in flight cycles measured from the time of repair installation. If the time of installation of the repair is unknown and the aircraft has exceeded the assessment implementation times or has exceeded the time for first inspection, the first inspection should occur by the next "C-check" interval, or equivalent cycle limit after the repair data is gathered (Stage 1).

An operator may choose to accomplish all three stages at once, or just Stage 1. In the latter case, the operator would be required to adhere to the schedule specified in the Agency approved model specific repair assessment guidelines for completion of Stages 2 and 3. Incorporating the maintenance requirements for Category B and C repairs into an operator's individual aircraft maintenance or inspection programme completes the repair assessment process for the first technique.

The second technique would involve setting up a repair maintenance programme to evaluate all applicable structure as detailed in paragraph 2.6 at each predetermined maintenance visit to confirm that they are permanent. This technique would require the operator to choose an inspection method and interval in accordance with the Agency approved repair assessment guidelines. The repairs whose inspection requirements are fulfilled by the chosen inspection method and interval would be inspected in accordance with the approved maintenance programme. Any repair that is not permanent, or whose inspection requirements are not fulfilled by the chosen inspection method and interval, would either be:

(1) Upgraded to allow utilization of the chosen inspection method and interval, or
(2) Individually tracked to account for the repair's unique inspection method and interval requirements.

This process is then repeated at the chosen inspection interval.

Repairs added between the predetermined maintenance visits, including interim repairs installed at remote locations, would be required either to have a threshold greater than the length of the predetermined maintenance visit or to be tracked individually to account for the repair's unique inspection method and interval requirements. This would ensure the airworthiness of the structure until the next predetermined maintenance visit, at which time the repair would be evaluated as part of the repair maintenance programme.

3.4 Maintenance programme changes

When a maintenance or inspection programme interval is revised, the operator should evaluate the impact of the change on the repair assessment programme. If the revised maintenance or inspection programme intervals are greater than those in the BZI, the previous classification of Category A repairs may become invalid. The operator may need to obtain approval of an alternative inspection method, upgrade the repair to allow utilization of the chosen inspection method and interval, or re-categorize some repairs and establish unique supplemental inspection methods and intervals for specific repairs. Operators using the "second technique" of conducting repetitive repair assessments at predetermined maintenance visits would evaluate whether the change to the predetermined maintenance visit continues to fulfil the repair inspection requirements in accordance with the guidance provided in paragraph 3.3 of this ACJ.

3.5 SRM update

The general section of each SRM will contain brief descriptions of damage-tolerance considerations, categories of repairs, description of baseline zonal inspections, and the repair assessment logic diagram. In updating each SRM, existing location specific repairs should be labelled with appropriate repair category identification (A, B, or C), and specific inspection requirements for B and C repairs should also be provided as applicable. SRM descriptions of generic repairs will also contain repair category considerations regarding size, zone, and proximity. Detailed information for determination of inspection requirements will have to be provide in for each model. Repairs which were installed in accordance with a previous revision of the SRM, but which have now been superseded by a new damage-tolerant design, will require review. Such repairs may be reclassified to Category B or C, requiring additional inspections and/or rework.

3.6 Structure modified by a STC

The current repair assessment guidelines provided by the TCH do not generally apply to structure modified by a STC. Nonetheless it is expected that all modified structure should be evaluated by the operator in conjunction with the DAH. The DAH should develop, submit, and gain Agency approval of guidelines to evaluate repairs to such structure or conduct specific damage-tolerance assessments of known repairs and provide appropriate instructions to the operator.

It is expected that the STC holder will assist the operators by preparing the required documents. If the STC holder is out of business, or is otherwise unable to provide assistance, the operator would have to acquire the Agency approved guidelines independently. To keep the aircraft in service, it is always possible for operators, individually or as a group, to hire the necessary expertise to develop and gain approval of repair assessment guidelines and the associated DSG. Ultimately, the operator remains responsible for the continued safe operation of the aircraft.

APPENDIX 4

Guidelines for the development of a corrosion control programme

1. GENERAL

This appendix directly follows the FAA draft AC 120–XX on the same subject and contains the same technical text.

Before an operator may include a CPCP in its maintenance or inspection programme, the Agency should review and approve that CPCP. The Agency review is intended to ensure that the CPCP is comprehensive and systematic. The operator should show that the CPCP is comprehensive in that it addresses all corrosion likely to affect Primary Structure and is systematic in that if it provides:

(1) Step-by-step procedures that are applied on a regular basis to each identified task area or zone, and

(2) These procedures are adjusted when they result in evidence that corrosion is not being controlled to an established acceptable level (Level 1 or better).

1.1 Purpose

This appendix gives guidance to operators and TCHs who are developing and implementing a Corrosion Prevention and Control Programme (CPCP) for aeroplanes operated under JAR-Ops 1

CPCPs have been developed by the TCH with the assistance of aircraft operators and competent authorities. They relied heavily on service experience to establish CPCP implementation thresholds and repeat intervals. Since that time a logical evaluation process has been developed to ensure environmental damage is considered in the evaluation of aircraft structure. This process is identified in Maintenance Programme Development Document MSG-3. The Agency will accept a CPCP based on this document and the information in this advisory circular. The Agency will also accept any other process that follows the guidelines in this advisory circular.

2. DEFINITIONS

Allowable Limit. The *allowable limit* is the amount of material (usually expressed in material thickness) that may be removed or blended out without affecting the ultimate design strength capability of the structural member. *Allowable limits* may be established by the TCH. The Agency may, also, establish *allowable limits*. The TCH normally publishes allowable limits in the SRM or in SBs.

Baseline Programme. A *baseline programme* is a CPCP developed for a specific model aeroplane. The TCH typically, develops the *baseline programme*. (See TCH Developed Baseline Programme, below) However, it may be developed by a group of operators who intend to use it in developing their individual CPCP (See Operator Developed Programme, below). It contains the corrosion inspection tasks, an implementation threshold, and a repeat interval for task accomplishment in each area or zone. development of a systematic and comprehensive CPCP for inclusion in the operator's maintenance programme.

Basic Task(s). The *basic task* is a specific and fundamental set of work elements that should be performed repetitively in all task areas or zones to successfully control corrosion. The contents of the *basic task* may vary depending upon the specific requirements in an aeroplane area or zone. The *basic task* is developed to protect the Primary Structure of the aeroplane.

Corrosion Prevention and Control Programme (CPCP). A *Corrosion Prevention and Control Programme (CPCP)* is a comprehensive and systematic approach to controlling corrosion such that the load carrying capability of an aircraft structure is not degraded below a level necessary to maintain airworthiness. It contains the basic corrosion inspection task, a definition of corrosion levels, an implementation threshold and a repeat interval for task accomplishment in each area or zone, and specific procedures if corrosion damage exceeds Level 1 in any area or zone. A CPCP consists of a basic corrosion inspection task, task areas, defined corrosion levels, and compliance times (implementation thresholds and repeat intervals). The CPCP also includes procedures to notify the competent authority of the findings and data associated with Level 2 and Level 3 corrosion and the actions taken to reduce future findings to Level 1.

Implementation Threshold (IT). The *implementation threshold* is the aircraft age associated with the first time the basic corrosion inspection task should be accomplished in an area or zone.

Level 1 Corrosion. *Level 1 corrosion* is:

(1) Corrosion, occurring between successive corrosion inspection tasks that is local and can be reworked or blended out within the allowable limit; or

(2) Corrosion damage that is local but exceeds the allowable limit but can be attributed to an event not typical of operator's usage of other aircraft in the same fleet (e.g. mercury spill); or

(3) Operator experience has demonstrated only light corrosion between each successive corrosion inspection task inspection; and, the latest corrosion inspection task results in rework or blend out that exceeds the allowable limit.

Level 2 Corrosion. *Level 2 corrosion* is that corrosion occurring between any two successive corrosion inspections task that requires a single rework or blend out which exceeds the allowable limit. A finding of *Level 2 corrosion* requires repair, reinforcement, or complete or partial replacement of the applicable structure.

Note: A statement of fact in previously mandated CPCPs states: corrosion findings that were discovered during the corrosion inspection task accomplished at the implementation threshold, and which require repair, reinforcement, or complete or partial replacement of the applicable structure, should not be used as an indicator of the effectiveness of the operators CPCP. The argument is that an operator's corrosion programme effectiveness can only be determined after a repeat inspection has been performed in a given inspection task area. This argument is valid for aircraft with mandated corrosion prevention and control programmes introduced after the aircraft has been in service for a number of years without a CPCP. This argument, however, may not be valid for aircraft that have been maintained using a design approval holders CPCP. Consequently, corrosion findings exceeding level 1 found on the corrosion inspection task implementation threshold may have been set too high by the design approval holder and action should be taken to readjust the implementation threshold.

Level 3 Corrosion. *Level 3 corrosion* is that corrosion occurring during the first or subsequent accomplishments of a corrosion inspection task that the operator determines to be an urgent airworthiness concern.

Note: If level 3 corrosion is determined at the implementation threshold or any repeat inspection then it should be reported. Any corrosion that is more than the maximum acceptable to the design approval holder or the Agency must be reported in accordance with current regulations. This determination should be conducted jointly with the TCH.

Light Corrosion. *Light corrosion* is corrosion damage so slight that removal and blend-out over multiple repeat intervals (RI) may be accomplished before material loss exceeds the allowable limit.

Local Corrosion. Generally, *local corrosion* is corrosion of a skin or web (wing, fuselage, empennage or strut) that does not exceed one frame, stringer, or stiffener bay. *Local corrosion* is typically limited to a single frame, chord, stringer or stiffener, or corrosion of more than one frame, chord, stringer or stiffener where no corrosion exists on two adjacent members on each side of the corroded member.

Operator Developed Programme. In order to operate an aeroplane under JAR OPS 1 an operator should include in its maintenance or inspection programme an approved CPCP. An operator may adopt the baseline programme provided by the TCH or it may choose to develop it's own CPCP, or may be required to if none is available from the TCH. In developing it's own CPCP an operator may join with other operators and develop a baseline programme similar to a TCH developed baseline programme for use by all operators in the group. The advantages of an operator developed baseline programme are that it provides a common basis for all operators in the group to develop their CPCP and it provides a broader experience base for development of the corrosion inspection tasks and identification of the task areas.

Repeat Interval (RI). The *repeat interval* is the calendar time between the accomplishment of successive corrosion inspection tasks for a task area or zone.

Task Area. The *task area* is a region of aircraft structure to which one or more corrosion inspection tasks are assigned. The *task area* may also be referred to as a zone.

TCH Developed Baseline Programme. As part of the ICA, the TCH should provide an inspection programme that includes the frequency and extent of inspections necessary to provide the continued airworthiness of the aircraft. Furthermore, the ICA should include the information needed to apply protective treatments to the structure after inspection. In order for the inspections to be effectively accomplished, the TCH should include, in the ICA, corrosion removal and cleaning procedures and reference allowable limits. The TCH should include all of these corrosion-related activities in a manual, referred to as the Baseline Programme. The Baseline Programme manual is intended to facilitate operator

Urgent Airworthiness Concern. An *urgent airworthiness concern* is damage that could jeopardizes continued safe operation of any aircraft. An urgent airworthiness concern typically requires correction before the next flight and expeditious action to inspect the other aircraft in the operator's fleet.

Widespread Corrosion. *Widespread corrosion* is corrosion of two or more adjacent skin or web bays (a web bay is defined by frame, stringer or stiffener spacing). Or, *widespread corrosion* is corrosion of two or more adjacent frames, chords, stringers, or stiffeners. Or, *widespread corrosion* is corrosion of a frame, chord, stringer, or stiffener and an adjacent skin or web bay.

Zone. See *task area.*

3. DEVELOPMENT OF A BASELINE PROGRAMME

3.1. Baseline Programme.

The objective of a baseline programme is to establish requirements for control of corrosion of aircraft structure to Level 1 or better for the operational life of the aircraft. The baseline programme should include the basic task, implementation thresholds, and repeat intervals. The baseline programme should also include procedures to notify the competent authority of the findings and data associated with Level 2 and Level 3 corrosion and the actions taken to reduce future findings to Level 1.

3.1.1 Baseline Programme considerations.

To establish an effective baseline programme consideration of the following is necessary:

(1) The flight and maintenance history of the aircraft model and perhaps similar models;

(2) The corrosion properties of the materials used in the aircraft structure;

(3) The protective treatments used;

(4) The general practices applied during construction and maintenance; and
(5) Local and widespread corrosion (See Figure 2.0).

When determining the detail of the corrosion inspection tasks, the implementation threshold, and the repeat interval, a realistic operational environment should be considered. Technical representatives of both the TCH and the operators should participate in evaluating the service history and operational environment for the aircraft model. For new aircraft models and for aircraft models that have been in operation for only a short time, technical representatives of operators of similar aircraft models should be invited to participate.

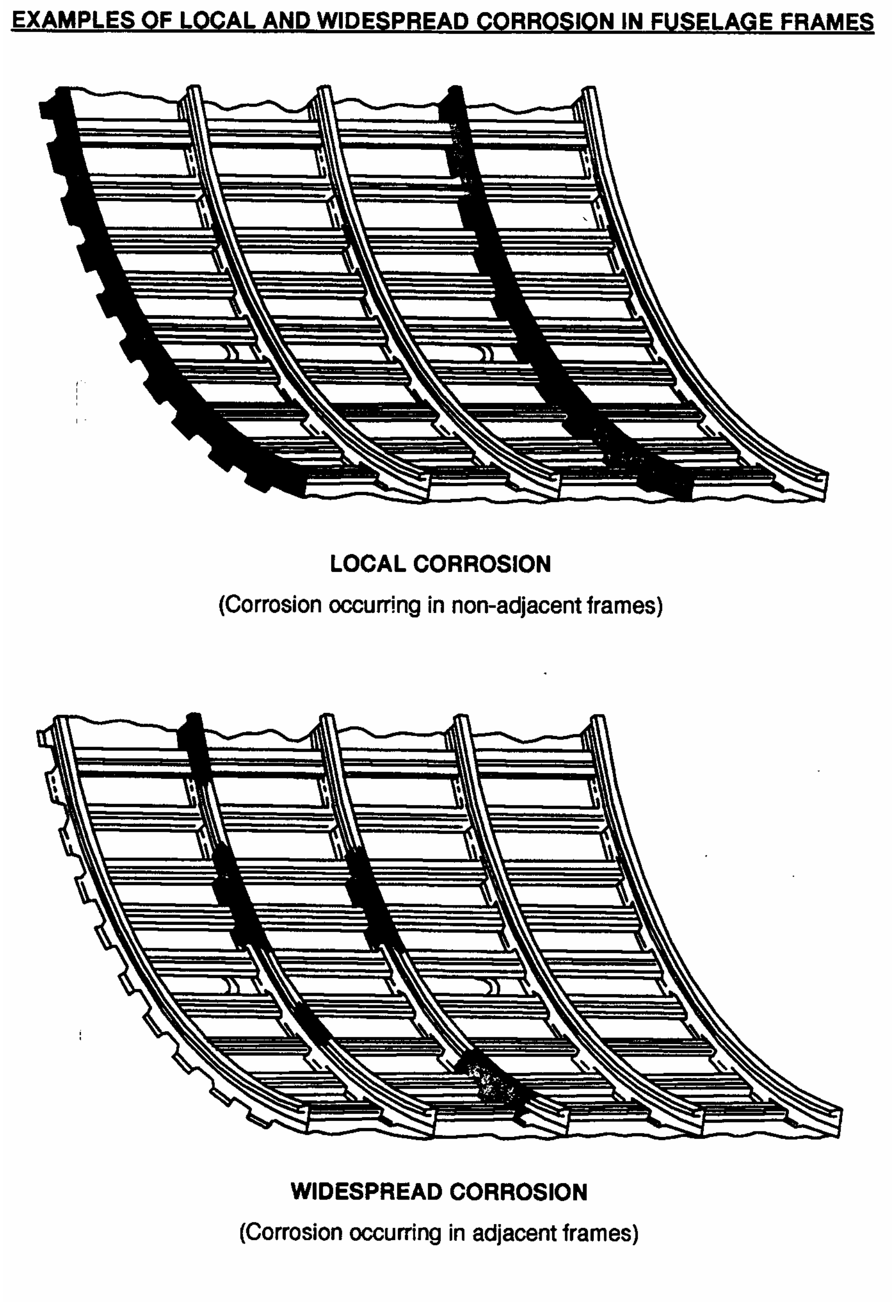


Figure 2

3.1.2. TCH developed Baseline Programme

During the design development process, the TCH should provide a baseline programme as a part of the instructions for continued airworthiness. The TCH initially evaluates service history of corrosion available for aircraft of similar design used in the same operational environment. The TCH develops a preliminary baseline programme based on this evaluation.

The TCH then convenes a working group consisting of operator technical representatives and representatives of the participating competent authorities. The working group reviews the preliminary baseline programme to assure that the tasks, implementation thresholds, and repeat intervals are practical and assure the continued airworthiness of the aircraft. Once the working group review is complete, the TCH incorporates the baseline programme into the instructions for continued airworthiness. (See Figure 2-1.)

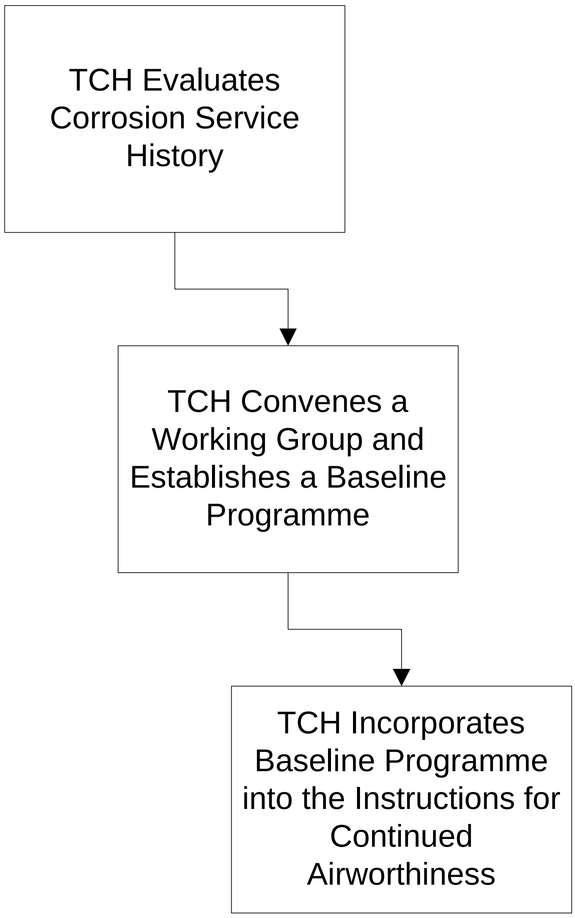


Figure 2-1. Type-Certificate Holder Developed Baseline Programme

3.1.3 Operator Developed Programme.

There may be instances where the TCH does not provide a baseline programme. In such instances, an operator may develop its CPCP without using a baseline programme, as long as the operator developed CPCP is consistent with the requirements.. It would be beneficial for an operator developing its own CPCP to consult other operators of the same or similar aircraft models in order to broaden the service experience available for use in preparing its programme. When a TCH prepared baseline programme is unavailable, a group of operators may prepare a baseline programme from which each operator in the group will develop its CPCP.

(1) Operator Developed Baseline Programme. An operator-developed baseline programme should pay particular attention to corrosion prone areas of the aircraft such as:

(i) Exhaust trail areas,
(ii) Battery compartments and battery vent openings,
(iii) Areas surrounding lavatories, buffets, and galleys,
(iv) Bilges,
(v) Fuselage internal lower structure,
(vi) Wheel wells and landing gear,
(vii) External skin areas,
(viii) Water entrapment areas,
(ix) Engine frontal areas and cooling air vents,
(x) Electronic or avionics compartments, and
(xi) Flight control cavities open during takeoff and landing.

Note: Corrosion Prevention and Control Programmes for large transports were developed based on a triad amongst the Airworthiness Authorities, design approval holders, and the operators for the particular model aeroplane. If operator(s) were to develop a CPCP they may want to follow the example of the large transports.

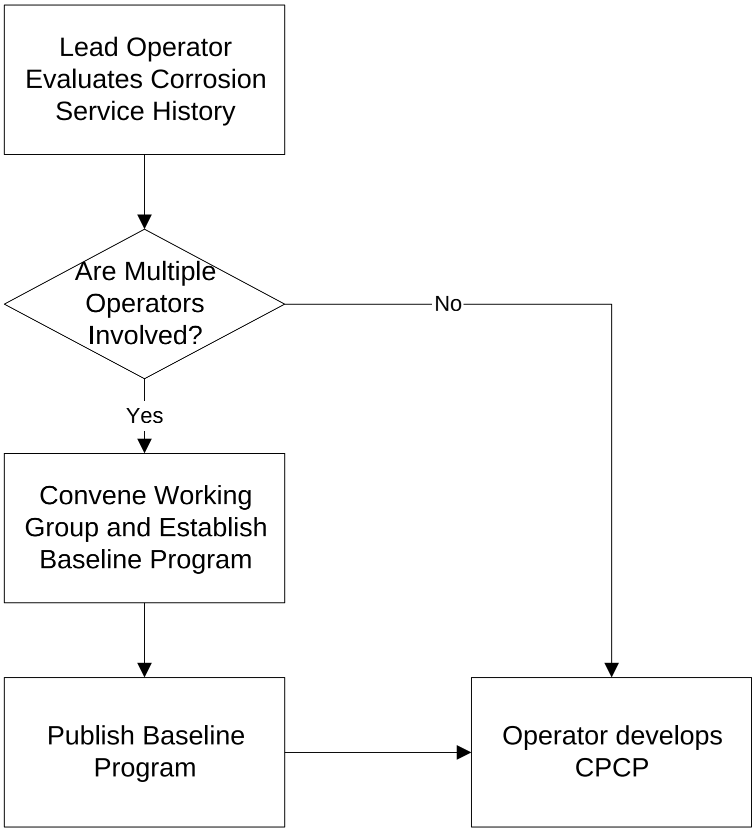


Figure 2-2. Operator Developed Baseline Program

(2) Individual Operator Developed CPCP. An operator may develop its CPCP without reference to a baseline programme; so long as the CPCP is consistent with the requirements of the applicable operating rules. Any operator who develops its own CPCP without a baseline programme, should review all available corrosion related service data on the individual aircraft model and on like design details in similar aircraft models when the operator's data and the Service Difficulty Report data shows no entries.

3.1.4 Continuous Analysis and Surveillance.

The operator's continuous analysis and surveillance system should contain procedures to review corrosion inspection task findings and establish corrosion levels. These procedures should provide criteria for determining if findings that exceed allowable limits are an isolated incident not typical of the operator's fleet. The operator's programme should also provide for notifying the competent authority whenever a determination of Level 2 or Level 3 corrosion is made. Due to the potential urgent airworthiness concern associated with a Level 3 finding, the operator's procedures should provide for notification as soon as possible but not later than 3 calendar days after the Level 3 determination has been made.

3.2. Baseline Programme Manual.

The baseline programme manual should include instructions to implement the baseline CPCP. It may be in a printed form or other form acceptable to the competent authority. It should, also, be in a form that is easy to revise. The date of the last revision should be entered on each page. The baseline programme manual should clearly be identified as a baseline CPCP programme. The aircraft make, model and the person who prepared the manual should also be identified.

3.2.1. Purpose and Background.

This section of the manual should state the purpose of the baseline programme which is, to establish minimum requirements for preventing and controlling corrosion that may jeopardize continuing airworthiness of the aircraft model fleet. The section should further state that an operator should include an effective CPCP in its maintenance or inspection programme.

3.2.2 Introduction.

The introduction should include a general statement that corrosion becomes more widespread as aircraft age and that it is more likely to occur in conjunction with other damage such as fatigue cracking. The introduction should also indicate that it is not the intent of a CPCP to establish rigid requirements to eliminate all corrosion in the fleet, but to control corrosion at or below levels that do not jeopardize continued airworthiness. However, due to the unpredictability of corrosion it must be removed and the structure repaired and corrosion prevention treatment reapplied.

3.2.3. Programme Application.

For a programme to be fully effective, it is essential that a corrosion inspection task be applied to all areas where corrosion may affect Primary Structure. This section should recommend that priority for implementing the CPCP be given to older aeroplanes and to areas requiring significant changes to previous maintenance procedures in order to meet corrosion prevention and control requirements. This section should allow an operator to continue its current corrosion control procedures in a given task area or zone where there is documentation to show that corrosion is being consistently controlled to level 1.

3.2.4. Baseline Programme.

This section should fully describe the baseline programme. It should include the basic task, corrosion inspection task areas, implementation thresholds, and repeat intervals.

3.2.5. Reporting System.

Procedures to report findings of Level 2 and 3 corrosion to the competent authority should be clearly established in this section. All Level 2 and Level 3 findings should be reported in accordance with the applicable AD, operator's service difficulty reporting procedures or reporting required by other competent authorities. Additional procedures for alerting the competent authority of level 3 findings should be established that expedite such reporting. This report to the competent authority shall be made after the determination of the corrosion level.

3.2.6 Periodic Review.

This section should establish a period for the TCH (or lead operator) and participating operators to meet with the competent authority and review the reported Level 2 and 3 findings. The purpose of this review is to assess the baseline programme and make adjustments if necessary.

3.2.7. Corrosion Related Airworthiness Directives.

This section should include a list of all ADs that contain requirements related to known corrosion related problems. This section should state that these ADs are in addition to and take precedence over the operator's CPCP.

3.2.8. Development of the Baseline Programme.

This section should identify the actions taken in preparing the baseline programme. It should include a description of the participants, the documents (e.g., SBs, service letters, ADs, service difficulty reports, accident and incident reports) reviewed, and the methodology for selecting and categorizing the corrosion prone areas to be included in the baseline programme. Selection criteria for corrosion prone areas should be based on areas having similar corrosion exposure characteristics and inspection access requirements. Some corrosion prone areas that should be considered are the main wing box, the fuselage crown, the bilge, areas under lavatories and galleys, etc. This section should state that the implementation threshold was selected to represent the typical aircraft age beyond which an effective corrosion inspection task should be implemented for a given task area.

3.2.9. Procedures for Recording Corrosion Inspection Findings.

The Agency has not imposed a requirement for additional record keeping for an operator's CPCP. However, the operator should maintain adequate records to substantiate any proposed programme adjustments. For example, an operator should maintain records to enable the operator to determine the amount of damage that has occurred during the repeat interval for each corrosion inspection task. Such data should be maintained for multiple repeat intervals in order to determine whether the damage remains constant or is increasing or decreasing. Such records are necessary when an operator is seeking approval for Interval extension or task reduction.

3.2.10. Glossary.

This section should define all terms specifically used in the baseline manual.

3.2.11. Application of the Basic Task.

This section should describe in detail the basic task. It should provide procedures describing how to accomplish the following actions:

(1) Removal of all systems equipment and interior furnishings to allow access to the area.
(2) Cleaning of the area as required.

(3) Visual inspection of all task areas and zones listed in the baseline programme.
(4) Removal of all corrosion, damage evaluation, and repair of structure as necessary.
(5) Unblocking holes and gaps that may hinder drainage.
(6) Application of corrosion protective compounds.
(7) Reinstallation of dry insulation blankets, if applicable.

3.2.12. Determination of Corrosion Levels Based on Findings.

This section should describe how the corrosion level definitions are used in evaluating the corrosion findings and assigning a corrosion level. This section should also instruct the operator to consult the TCH or the competent authority for advice in determining corrosion levels.

3.2.13. Typical Actions Following Determination of Corrosion Levels.

This section should establish criteria for evaluating whether or not the Level 2 or 3 corrosion is occurring on other aircraft in the operator's fleet. Criteria to be considered include: cause of the corrosion problem, past maintenance history, operating environment, production build standard, years in service, and inspectability of the corroded area. These and any other identified criteria should be used in identifying those aircraft that should be included in a fleet campaign. The results of the fleet campaign should be used to determine necessary adjustments in the operator's CPCP. The following instructions should also be included in this section:

(1) If corrosion exceeding the allowable limit is found during accomplishment of the corrosion inspection task implementation threshold for a task area, it may be necessary to adjust the CPCP. (see NOTE under level 2 corrosion definition)
(2) A single isolated occurrence of corrosion between successive inspections that exceeds Level 1 does not necessarily warrant a change in the operators CPCP. If the operator experiences multiple occurrences of Level 2 or Level 3 corrosion for a specific task area, then the operator should implement a change to the CPCP.
(3) The operator should not defer maintenance actions for Level 2 and Level 3 corrosion. These maintenance actions should be accomplished in accordance with the operators maintenance manual.
(4) The operator may implement changes such as the following to improve the programme effectiveness:

(i) Reduction of the repeat interval,
(ii) Multiple applications of corrosion treatments, or
(iii) Additional drainage provisions.
(iv) Incorporation of design approval holders service information, such as service bulletins and service letters.

3.2.14. Programme Implementation.

This section should state that each task is to be implemented on each aircraft when the aircraft reaches the age represented by the implementation threshold for the task. It should, also, describe procedures to be used for establishing a schedule for implementation where the aircraft age exceeds the implementation threshold for individual tasks. It should state that once a task is implemented in an area, subsequent tasks are to be accomplished at the repeat interval in that task area.

4. DEVELOPMENT OF OPERATORS PROGRAMME

4.1 Baseline Programme available.

If a baseline programme is available, the operator should use that baseline programme as a basis for developing its CPCP. In addition to adopting the basic task, task areas, implementation thresholds and repeat intervals of the baseline programme, the operator should make provisions for:

(1) Aeroplanes that have exceeded the implementation threshold for certain tasks,
(2) Aeroplanes being removed from storage,
(3) Unanticipated scheduling adjustments,
(4) Corrosion findings made during non CPCP inspections, and
(5) Adding newly acquired aircraft.
(6) Modifications, configuration changes, and operating environment,

4.1.1. Provisions for aircraft that have exceeded the implementation threshold.

The operator's CPCP must establish a schedule for accomplishing all corrosion inspection tasks in task areas where the aircraft age has exceeded the implementation threshold (see main text of AMC chapter 12). Repeat paragraph 12 text on implementation.

4.1.2. Aeroplanes being removed from storage.

Corrosion inspection task intervals are established based on elapsed calendar time. Elapsed calendar time includes time out of service. The operators CPCP should provide procedures for establishing a schedule for accomplishment of corrosion inspection tasks that have accrued during the storage period.
The schedule should result in accomplishment of all accrued corrosion inspection tasks before the aircraft is placed in service.

4.1.3. Unanticipated scheduling adjustments.

The operators CPCP should include provisions for adjustment of the repeat interval for unanticipated schedule changes. Such provisions should not exceed 10% of the repeat interval. The CPCP should include provisions for notifying the competent authority when an unanticipated scheduling adjustment is made.

4.1.4. Corrosion findings made during non-CPCP inspections.

Corrosion findings that exceed allowable limits may be found during any scheduled or unscheduled maintenance or inspection activities. These findings may be indicative of an ineffective CPCP. The operator should make provision in its CPCP to evaluate these findings and adjust its CPCP accordingly.

4.1.5. Adding newly acquired aircraft.

Before adding any aircraft to the fleet, the operator should establish a schedule for accomplishing all corrosion inspection tasks in all task areas that are due. This schedule should be established as follows:

(1) For aircraft that have previously operated under an approved maintenance programme, the initial corrosion inspection task for the new operator must be accomplished in accordance with the previous operator's schedule or in accordance with the new operator's schedule, whichever would result in the earliest accomplishment of the corrosion inspection task.

(2) For aircraft that have not previously been operated under an approved maintenance programme, each initial corrosion task inspection must be accomplished either before the aircraft is added to the operator's fleet, or in accordance with schedule approved by the competent authority. After each corrosion inspection task has been performed once, the subsequent corrosion task inspections should be accomplished in accordance with the new operator's schedule.

4.1.6. Modifications, configuration changes and operating environment.

The operator must ensure that their CPCP takes account of any modifications, configurations changes and the operating environment applicable to them, that were not addressed in the Baseline Programme Manual.

4.2. Baseline Programme not available.

If there is no baseline programme available for the operator to use in developing its CPCP, the operator should develop its CPCP using the provisions listed in Chapter 5 of this appendix for a baseline programme as well as the provisions listed in paragraph 1 of this Chapter.

APPENDIX 5

Guidelines for the development of a SB review and mandatory modification programme

1. GENERAL

This appendix provides interpretation, guideline and Agency accepted means of compliance for the review of Structural Service Bulletins including a procedure for selection, assessment and related recommended corrective action for ageing aircraft structures.

2. SB SELECTION PROCESS

The SB selection, review, assessment and recommendation process within the Structural Task group (STG) is summarised in the figure **A**. For the first SB review within STG meeting, all inspection SB should be selected. Afterwards, the TCH should update periodically a list of SB which were already selected for a review with all decisions made, and add to this list all new and revised SB. Moreover, some specific modification SB not linked to an inspection SB may also be selected for review.

Operators information input should address the points as detailed in figure B. This information should be collected and analysed by the TCH for the STG meeting.

If for a given selected SB there is not sufficient in-service data available before the STG meeting that would enable a recommendation to be made, its review may be deferred until enough data are available. The TCH should then check periodically until these data become available.

The operators and the Agency should be advised by the TCH of the SB selection list and provided the opportunity to submit additional SB. For this purpose, the TCH should give the operators enough information in advance (e.g. 2 months), for them to be able to properly consider the proposed selection and to gather data.

When an SB is selected, it is recommended to select also, in the same package, inspection SB that interact with it and all related modification SB. The main criteria for selecting SBs are defined in the following sub-paragraphs

2.1 High probability that structural cracking exists

Related to the number and type of finding in service and from fatigue testing.

A “no finding” result should be associated to the number of performed inspections

The type of finding should include an analysis of its criticality.

2.2 Potential structural airworthiness concern

Structural airworthiness of the aircraft is dependent on repeat inspections to verify structural condition and therefore on inspection reliability.

A short repeat inspection interval (e.g. short time to grow from detectable crack to a critical length divided by a factor*)* will lead to increased work load for inspectors and possible increased risk of missing damage.

Special attention should be paid to any single inspection tasks involving multiple repeat actions needed to verify the structural condition that may increase the risk of missing damage (e.g. lap splice inspections).

2.3 Damage is difficult to detect during regular maintenance

The areas to inspect are difficult to access;

NDI methods are unsuitable;

Human factors associated with the inspection technique are so adverse that crack detection may not be sufficiently dependable to assure safety.

2.4 There is adjacent structural damage or the potential for it

Particular attention should be paid to areas susceptible to Widespread Fatigue Damage (WFD) and also to potential interaction between corrosion and fatigue cracking e.g. between fastener damage (due to stress corrosion or other factors) and fatigue cracking.

It is recommended to consider the potential interaction of modifications or repairs usually implemented in the concerned areas to check whether the inspections are still reliable or not (operators input)

3 STG MEETING, SB REVIEW AND RECOMMENDATIONS

It is recommended to review at the same time all the SBs that can interact, the so-called SB package in the selection process. The meeting should start with an STG agreement on the selected SB list and on those deferred. At the meeting the TCH should present its analysis of each SB utilising the collection of operator input data. The STG should then collectively review the ratings (Figure B) against each criteria to come to a consensus recommendation. Such a STG recommendation for a selected SB shall consider the following options:

(1) To mandate a structural modification at a given threshold

(2) To mandate selected inspection SB

(3) To revise modification or repair actions

(4) To revise other SB in the same area concerned by damages

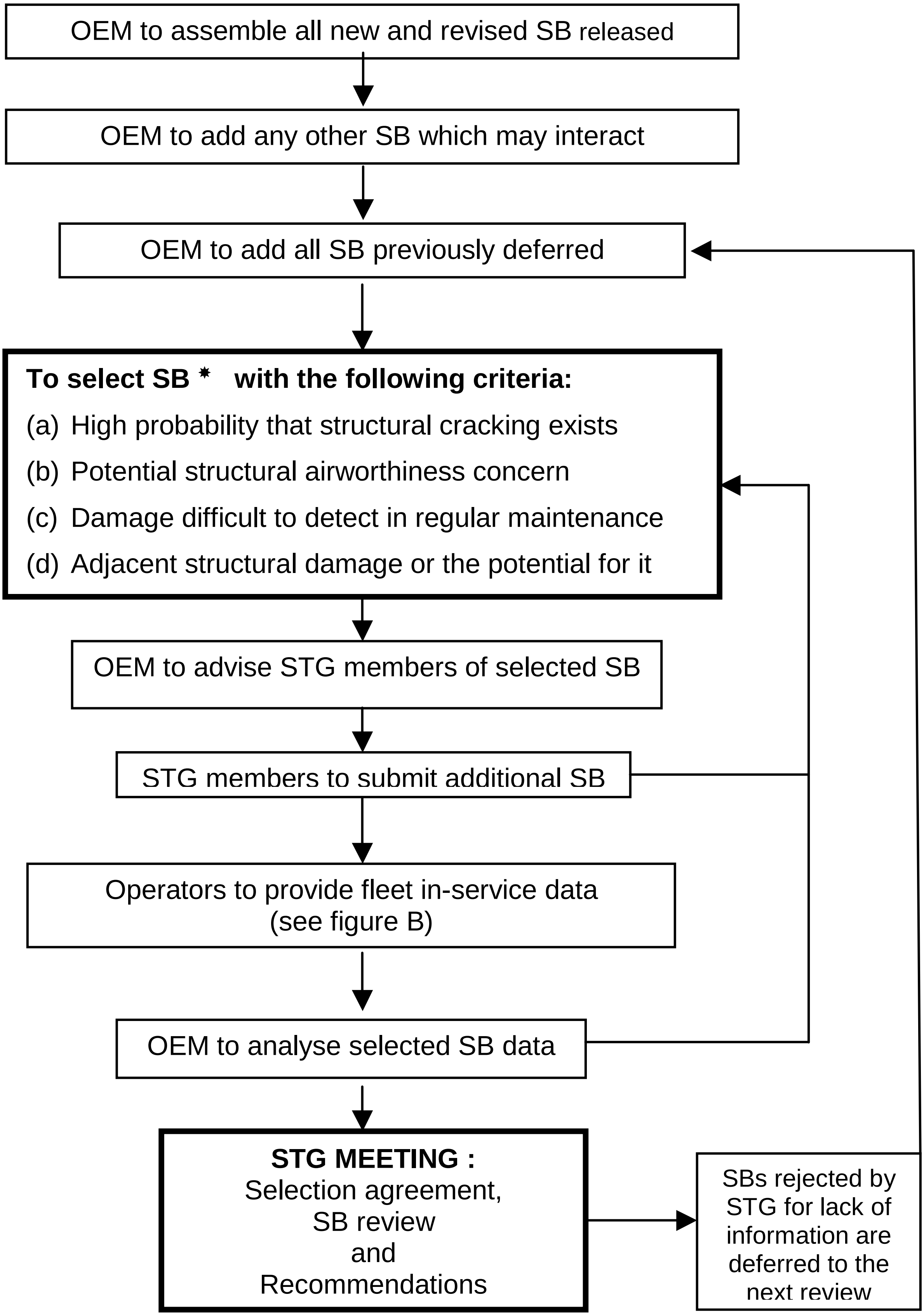
(5) To review inspection method and related inspection intervals

(6) To review ALI/MRB or other maintenance instructions

(7) To defer the review to the next STG and request operators reports on findings for a specific SB or request an inspection sampling on the oldest aircraft

STG recommendations for mandatory action are the responsibility of the TCH to forward to the Agency for appropriate action. Other STG recommendations are information provided to the STG members. It is their own responsibility to carry them out within the appropriate framework.

FIGURE A SB SELECTION PROCESS AND SB REVIEW



* This may be done by the TCH alone or in conjunction with the operators as a preliminary STG meeting

FIGURE B: OPERATORS FLEET EXPERIENCE

IN-SERVICE DATA / SECTION 1

NAME OF THE OPERATOR
____

AIRCRAFT MODEL/SERIES
____

SERVICE BULLETIN (SB) NUMBER ________________________________

TITLE
____

RELATED INSPECTION/MODIFICATION SB :
1/____

2/____

3/____

SB MANDATED ? ☐ YES ☐ NO
IF NOT, SB IMPLEMENTED IN MAINTENANCE PROGRAMME ? ☐ YES ☐ NO

NUMBER OF AIRCRAFT TO WHICH SB APPLIES (INCLUDING ALL A/C IN THE SB EFFECTIVITY)_________________

NUMBER OF AIRCRAFT EXCEEDING SB INSPECTION THRESHOLD (IF APPLICABLE)
____

NUMBER OF AIRCRAFT INSPECTED PER SB (IF APPLICABLE) ?
____

SPECIFY TYPE OF INSPECTION USED
____

NUMBER OF AIRCRAFT WITH REPORTED FINDINGS
____

TYPE OF FINDINGS

____

____
NUMBER OF FINDINGS DUE TO OTHER INSPECTIONS THAN THE ONE PRESCRIBED IN SB (IF APLICABLE) ___________
SPECIFY TYPE OF INSPECTION USED
____

NUMBER OF AIRCRAFT EXCEEDING SB TERMINATING MODIFICATION THRESHOLD (IF APPLICABLE) _____________
NUMBER OF AIRCRAFT IN WHICH TERMINATING MODIFICATION HAS BEEN ACCOMPLISHED (IF APPLICABLE) ______

NEED THIS SB (OR RELATED SB) BE IMPROVED ? ☐ YES ☐ NO

COMMENTS:____
____

IN-SERVICE DATA / SECTION 2

	(A)	(B)	(C)	(D)	(E)
CRITERIA	INSPECT-ABILITY ACCESS	FREQUENCY REPETITIVE INSPECTION	FREQUENCY OF DEFECTS	SEVERITY RATING	ADJACENT STRUCTURE DAMAGE
RATING					

(A) INSPECTABILITY/ACCESS RATING

OK ◆ Inspection carried out with little or no difficulty.

Acceptable ◆ Inspection carried out with some difficulty.

Difficulty ◆ Inspection carried out with significant difficulty.

Note: Rating should consider difficulty of access as well as inspection technique and size of inspection area.

(B) FREQUENCY OF REPETITIVE INSPECTIONS RATING

OK ◆ Greater than 6 years.

Acceptable ◆ Between 2 and 6 years.

Difficulty ◆ Less than 2 years.

(C) FREQUENCY OF DEFECTS NOTED RATING = % OF THOSE AEROPLANES BEYOND THRESHOLD ON WHICH DEFECTS HAVE BEEN FOUND

OK ◆ No defect noted.

Acceptable ◆ Defects noted but not of a significant amount (less than 10%).

Difficulty ◆ Substantial defects noted (greater than 10%).

(D) FINDING SEVERITY RATING

OK ◆ Airworthiness not affected.

Acceptable ◆ Damage not of immediate concern, but could progress or cause secondary damage.

Difficulty ◆ Airworthiness affected. Damage requires immediate repair.

(E) ADJACENT STRUCTURE DAMAGE RATING (MULTIPLE SITE DAMAGE, MULTIPLE ELEMENT DAMAGE, CORROSION, ETC.)

OK ◆ Low rate of adjacent structural damage.

Acceptable ◆ Medium rate of adjacent structural damage.

Difficulty ◆ High rate of adjacent structural damage/Multiple service actions in area.

D. JAA NPA 20-10 COMMENT-RESPONSE DOCUMENT

This Section summarizes the comments made on the JAA NPA and the responses to those comments. The numbering of the chapters, paragraphs and sub-paragraphs in this proposed AMC do differ from the numbering of the chapters, paragraphs and sub-paragraphs in the JAA NPA 20-10. Where appropriate the comments received regarding the JAA NPA 20-10 have been added in brackets in Italic lettering to reflect this change in numbering.

Subject: NPA 20-10 "Continued Airworthiness of Ageing Aircraft Structures"

Sponsor: European Ageing Aircraft Working Group (EAAWG)

Introduction

NPA 20-10 was published for comment on March 1, 2003. The comment period was open for 3 months to June 1, 2003. The guidance material contained in this NPA is intended to standardise the JAA regulatory framework for the maintenance development of both current and future designs.

General

Comments were received from two National Aviation Authorities, one type- certificate holder and two Airlines. In total 56 detail comments were made.

Preamble

One commentator pointed out that in the list of issues in the preamble Widespread Fatigue Damage is included. However, in the Background section of the main text Widespread Fatigue Damage does not appear on the numbered list. This is acknowledged by the Working Group. However, Widespread Fatigue Damage is discussed later in the same section of the main text. Therefore, no change to either section is to be made.

An operator pointed out inconsistency in the way the ACJ is referenced in the preamble. This has been addressed in this EASA NPA.

Main Text

An operator commented that although reference is made to AC91-56B draft this document is omitted from the list of Regulated Regulations and Documents. The reference has now been added.

The only occurrence of SSI in the draft ACJ was a misprint. The particular reference should have been to SSIP.

The same commentator wanted the wording of the definition of PSE changed. As the term PSE is not used in the document its definition has been deleted.

An airline commentator required text to be added to the third sentence in section 6, paragraph 2. The amended sentence would read (added text underlined). "The SSID should include the type of damage being considered, and likely sites; inspection access, threshold, interval, method, <u>definition of inspection level</u>, and procedures…". The Working Group has not agreed on adopting the additional text as it is believed that "method" adequately covers the full definition of the inspection.

The same commentator wanted to add in section 6, paragraph 3, a statement that an AD against an SSIP is only necessary if the type design is pre Title 14 CFR Amendment 25-54. The opening paragraph of this section, however, makes it clear that an SSIP is required if a damage-tolerance based inspection programme does not already exist. It is considered that the additional explanation is not required.

A NAA suggested that for clarity the following text be inserted as the first paragraph of section 7: "*Service Bulletins issued early in the life of a fleet of aircraft may utilize inspections (in some cases non-mandatory inspections) alone to manage the development of fatigue cracking. Inspections may be adequate in this early stage, when cracking is possible, but not highly likely. However, as aircraft age the probability of fatigue cracking becomes more likely. In this later stage it is not prudent to rely only on visual inspections alone because there are more opportunities for cracks to be missed and cracks may no longer occur in isolation. In this later stage in the life of a fleet it is prudent to reduce the reliance strictly on inspections, with its inherent human factors limitations, and incorporate modifications to the structure to eliminate the source of the cracking. In some cases an inspection programme reliability increase, through the use of mandatory versus non-mandatory inspections, may be acceptable in lieu of modification*". The Working Group agrees with the intent of the comment. The text is to be added to give greater clarity to the purpose of the programme, with some editorial changes to the original wording.

The same NAA also requested additional wording to the lead in paragraph to section 8. The changed text is shown underlined. "*A corrosion prevention and control programme is a systematic approach to <u>preventing and</u> controlling corrosion in the aircraft's Primary Structure. The objective of a CPCP is to <u>restore the corrosion protection schemes for the structure</u> and to limit the deterioration due to corrosion to a level necessary to maintain airworthiness. A CPCP consists of a <u>basic corrosion task</u>, task areas, defined corrosion levels, and compliance times…"*. Despite the question of whether any programme can be fully successful in preventing corrosion it is felt that the suggested changes give greater clarification to the objectives. The text is to be adopted but reordered to emphasise that the primary objective of the CPCP is to limit corrosion to the level necessary to maintain airworthiness. Restoration of protective schemes is one means of achieving the objective not the objective itself.

An operator requested that the reference to Primary Structure in paragraph 1 of section 8 be amended to PSE. This is one of several comments expressing a view of the definition of structure to be inspected within the CPCP. Some wish to extend the inspection beyond Primary Structure and some to restrict the inspections. On balance the term Primary Structure is to be retained.

A TCH commentator requested that in Section 11 the statement "*affecting Primary Structure (e.g. PSEs)*" should be amended to "*affecting Primary Structure (e.g. including PSEs)*". Since all PSEs are part of Primary Structure the addition does not appear relevant. Therefore, no change to the wording is made.

A NAA suggest that 1 DSG/ESG be added for WFD to bring it into line with the other entries. The suggestion is accepted.

The TCH questioned the threshold of 1/2 DSG/ESG for the SB review. The threshold agreed by the Working Group for SB review threshold is 3/4 DSG/ESG. The figure of 1/2 is a typographical error and is corrected.

An airline submitted three comments which are essentially the same expressing concern over the business impact of mandating further maintenance programmes on small fleet sizes. NPA 20-10 only proposes advisory material, an ACJ, in support of operational and design rule changes which are outside the scope of this particular NPA. The purpose of the ACJ is a move towards consistency of safety action throughout Europe by giving guidance to operators, designers and competent authorities in Europe as to the content of an ageing aircraft programme for structures. As such it is well suited to give guidance to national authorities working in conjunction with operators to ensure that the maintenance programme reflects applicable continued airworthiness elements as the comment requests. No change to the text is proposed.

<u>Appendix 1</u>

The TCH requested a change in the wording of the definition of PSE. This is the same request as occurred in the main text. For the reason already given the definition is removed from the document.

An airline suggested that in paragraph 1.2(10) *(paragraph 7)* the reference to the "Maintenance Manual" should be changed to maintenance planning document (MPD)". The Working Group agrees with the reason to change but will use "…maintenance data" as the term MPD is not universally used.

The airline also requests that the first sentence in paragraph 10 of section 2 (*Section 2.1 paragraph 4*) should end with "(this should include an evaluation of whether the specific inspection task and method is still representative of the fleet.)". The sentiment of the comment is agreed by the Working Group. However, the visibility of the total fleet may not be available to the TCH. The following words are to be added "(This should include an evaluation of current methods and findings.)"

The TCH requested that it should be made clear that SSID be valid to the LOV of the aircraft. The Working Group agrees. The first sentence of paragraph 3.5.a *(first sentence of paragraph 3.5)* is changed to read "The SSID should contain… …for the continued safe operation of the aircraft up to the LOV".

The TCH asked for several paragraphs to be deleted or moved, these are 3.5.a(2) *), 3.5.b(2), 3.5.b(3) and 3.5.b(8) **). The data in paragraphs 3.5.a(2) *)and 3.5.b(3) **) gives useful background to the airline and advises the competent authorities of the operating assumptions on which the programme is based. The paragraphs are to be retained. The other paragraphs are of a general nature and are to be transferred from 3.5.b **) to 3.5.a *).

The same commentator wished for the introduction of NDT as the method of inspection in paragraph 3.5.b(6). The method of inspection is not necessarily NDT so no change is made.

**) Refers to first part of 3.5*
***) refers to second part of 3.5*

<u>Appendix 2</u>

It is pointed out by an Airline that Limit of Validity (LOV) is not defined in the document. The definition is therefore added and LOV added to the acronym list.

The same operator suggests that in paragraph 5b *(Paragraph 6, Reporting Requirements, second sentence (4))* the text "Adjacent repairs within the same PSE" should read "Adjacent repairs within the same Primary Structure". The Working Group agrees and the text is amended. This change removes the only reference to PSE in the body of the text.

A spelling error has been noted by a NAA in paragraph 6 *(Paragraph 7)*. It is to be corrected.

An operator requested that paragraph 6a *(Paragraph 7, first section))*should be expanded to provide guidance when fastener holes are re-lifed. The level of detail requested is beyond the scope of the ACJ.

An operator requested a definition of "Natural Fatigue Cracking". A separate note has not been included as the term "Natural" indicates fatigue was not caused by accidental or other anomalous damage and as such is considered self explanatory.

<u>Appendix 3</u>

It is noted by a JAA NAA that SB is not included in the list of acronyms. As a result "Service Bulletin" is added to the list.

The same Airworthiness Authority pointed out that in paragraph 3.2c *(Paragraph 3.2, "Category A")* BZI is defined variously as "Basic" and "Baseline" Zonal Inspection. The text is to be revised to change "Basic" to "Baseline".

The Authority also questioned if the final paragraph in section 3.3 should read "a threshold greater than" in the first sentence. The paragraph states that unless the threshold of inspection is greater than the time to the next maintenance visit then the repair will be tracked individually. The current wording is to be maintained.

A TCH suggested that the first sentence of paragraph 2.2b *(Paragraph 2.2, fourth sentence)* be changed from "The practice of damage-tolerance methodology has evolved gradually over the last 20 years" be changed to "The practice of repair justification has evolved gradually over the last 20 years". The Working Group concur with this suggestion. The text is revised.

An operator commented that the words "All fuselage pressure boundary repairs" in Section 3.3 stage 3 paragraph 4 would be better as "All applicable structure as detailed in section 2.6". This change is agreed.

Appendix 4

A TCH requested that in the last sentence of 3c “Primary Structure” *(2 -Basic Task(s))* is replaced by "SSI". This is one of several comments expressing opposing views about the definition of structure to be inspected for CPCP purposes. One view is that it should be less than all Primary Structure and another that it should be all SSIs. On balance the term Primary Structure is retained.

The TCH made suggestions simplifying the definitions of Level 1, 2 and 3 corrosion. The definition of corrosion in the original text gives an interval over which the corrosion will develop. The suggested changes take away the time limitations. The original text is also harmonised with the FAA draft AC 120-XX. The existing text is retained.

The TCH requested that paragraph 3k *(2 –Local Corrosion)*, the definition of local corrosion, be deleted. The term "local corrosion" is used in the definition of level 1 corrosion, thus the paragraph is retained.

The TCH requested that in paragraph 3m “Urgent Airworthiness Concern” *(2 -Urgent Airworthiness Concern-)* be replaced by "Airworthiness Concern". The phrase "Urgent Airworthiness Concern" was introduced into the text to emphasise the need for immediate action. The current wording is retained.

The same commentator requested the deletion of paragraph 3o the definition of widespread corrosion *(2 -Widespread Corrosion).* Since any corrosion that is widespread cannot be level 1 corrosion an indication of what is considered widespread is felt to be useful. The paragraph is retained.

Following on from the request to delete paragraphs 3k and 3o *(2 -Local Corrosion and 2 -Widespread Corrosion)*, the commentator requested all reference to local and widespread corrosion in paragraph 5.1a *(3.1.1 -Baseline programme considerations-)* be erased. As the original paragraphs are to be retained no change is to be made to paragraph 5.1a *(3.1.1.)*

The TCH requested that guidance for the escalation of intervals should be included in paragraph 5.2f *(3.2.6 -Periodic Review).* Guidance for interval escalations is given in paragraph 5.2i *(3.2.9 -Procedures for Recording Corrosion inspection Findings).* No change is to be made to paragraph 5.2f *(3.2.6).*

Again a request is made to change "Primary Structure" to "SSI" in paragraph 3c *(2 -Basic Task(s)).* In line with the rest of the document "Primary Structure" is retained.

The non JAA NAA has commented that although the NPA recognises the FAA AC 120-XXX, it is a draft and could change based on comments received on the FAA NPRM on corrosion. The comment is noted.

An airline has noted that paragraph 3h *(3.2.8 -Development of the Baseline Programme)* provides a definition of level 2 corrosion that omits reference to widespread corrosion. It is suggested that "widespread" be included in the definition. The commentator also noted that having reviewed the FAA draft AC120-XXX some material on page 1 of the AC has been omitted along with the appendices to the AC. The references to AC120-XXX should be amended to the later AC120-CPCP. The general content of the GAI20X11 follows the draft AC120-CPCP including the corrosion level definitions. The appendices are not to be added.

The airline noted that Appendix 4 does not provide any guidance on the general level of inspection required. The commentator believes the proposed ACJ would be enhanced if a statement on the general level of inspection were included. The specific level of inspections required to complete a successful CPCP programme are the responsibility of the TCH. Such detail cannot be included in the ACJ.

Appendix 5

An airline notes that paragraph 2.1(b) *(2.2 -Potential structural airworthiness concern)* second sentence states "A short repeat inspection (e.g. short time...) will lead to possible increased risk of missing damage. The commentator believes this statement is incorrect and should be removed. The factors applied to inspection intervals allow for the possibility of a defect to be missed without an unsafe condition occurring. However, the more inspections that are carried out the greater the possibility of there being sequential missed defects. The shorter the interval the more inspections will be required. The existing text is retained.