AMC 20-20
Continuing Structural Integrity Programme

TABLE OF CONTENTS

1. PURPOSE

a) This Acceptable Means of Compliance (AMC) provides guidance to type- certificate holders, STC holders, repair approval holders, maintenance organisations, operators and competent authorities 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.

b) This AMC is primarily aimed at large aeroplanes that are operated in Commercial Air Transport or are maintained under Part-M. However, this material is also applicable to other aircraft types.

c) 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.

d) Like all acceptable means of compliance material, this AMC is not in itself mandatory, and does not constitute a requirement. 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 requirements.

2. RELATED REGULATIONS AND DOCUMENTS

a) Implementing Rules and Certification Specifications:

Part 21A.61	Instructions for continued airworthiness.
Part 21A.120	Instructions for continued airworthiness.
Part 21A	
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

b) FAA Advisory Circulars

AC 91-60	The Continued Airworthiness of Older 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 Minimising 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 Pressurised Fuselages, FAA. December 14, 2000
AC 25.1529-1	Instructions for continued airworthiness of structural repairs on Transport Airplanes, August 1, 1991 FAA.

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 pressurised 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 these elements consisted of the following:

a) Select service bulletins describing modifications and inspections necessary to maintain structural integrity;
b) Develop inspection and prevention programmes to address corrosion;
c) Develop generic structural maintenance programme guidelines for ageing aeroplanes;
d) Review and update the Supplemental Structural Inspection Documents (SSID) which describe inspection programmes to detect fatigue cracking; and
e) 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 aircraft, and in particular those in the transport fleet. Accordingly, the inspection and evaluation programmes outlined in this AMC are intended to provide:

- 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 (DT)** 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.
- **Fatigue Critical Structure (FCS)** is structure that is susceptible to fatigue cracking that could lead to a catastrophic failure of an aircraft. For the purposes of this AMC, FCS refers to the same class of structure that would need to be assessed for compliance with § 25.571(a) at Amendment 25-45, or later. The term FCS may refer to fatigue critical baseline structure, fatigue critical modified structure, or both.
- **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 allow safe operation and in particular 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** is structure that carries flight, ground, crash or pressurisation loads.
- **Repair Evaluation Guidelines (REG**) provide a process to establish damage-tolerance inspections for repairs that affect Fatigue Critical Structure.
- **Repair Assessment Programme (RAP)** is a programme to incorporate damage tolerance-based inspections for repairs to the fuselage pressure boundary structure (fuselage skin, door skin, and bulkhead webs) into the operator’s maintenance and/or inspection programme.
- **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	irworthiness 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
FCBS	Fatigue Critical Baseline Structure
FCS	Fatigue Critical Structure
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
REG	Repair Evaluation Guidelines
SB	Service Bulletin
SMP	Structural Modification Point
SRM	Structural Repair Manual
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 Agency representative(s). 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. All DAHs will 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 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 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 report, 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 role of the operator is principally to comment on the practicality of the inspections and any other procedures defined by the TCH and to implement them effectively.

The SSID, 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 inspection threshold, repeat interval, inspection methods and procedures. The applicable modification status, associated life limitation and types of operations for which the SSID is valid should also be identified and stated. In addition, the inspection access, the type of damage being considered, likely damage sites and details of the resulting fatigue cracking scenario should be included as necessary to support the prescribed inspections.

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 should the SSID not be available in time to effectively control the safety concern. 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. SERVICE BULLETIN REVIEW and MANDATORY MODIFICATION PROGRAMME

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:

    i) There is a high probability that structural cracking exists
    ii) Potential structural airworthiness concern.
    iii) Damage is difficult to detect during routine maintenance
    iv) There is Adjacent Structural damage or the potential for it.

    This may be done by the TCH alone or in conjunction with the operators at 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. The 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 its own CPCP, or may be required to if none is available from the TCH. In developing its 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:

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

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

Note: For an aeroplane with an ALS, in addition to providing a suitable baseline programme in the ICA and to ensure compliance with CS 25.571 it is appropriate for the TCH to place an entry in the ALS stating that all corrosion should be maintained to Level 1 or better. (This practice is also described in ATA MSG-3)

9. REPAIR EVALUATION GUIDELINES AND REPAIR ASSESSMENT PROGRAMMES

Early fatigue or fail-safe requirements (pre-Amdt 45) did not necessarily 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. Furthermore, it is known that application of later fatigue and damage tolerance requirements to repairs was not always fully implemented according to the relevant certification bases.

Repair Evaluation Guidelines (REG) are intended to assure the continued structural integrity of all relevant repaired and adjacent structure, based on damage-tolerance principles, consistent with the safety level provided by the SSID or ALS as applied to the baseline structure. To achieve this, the REG should be developed by the TCH and implemented by the Operator to ensure that an evaluation is performed of 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. Nonetheless, following further studies by AAWG working groups it has been agreed 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.)

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. Existing repairs may not have been assessed for damage-tolerance and appropriate inspections or other actions implemented. Repairs are to be assessed, 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 REG should provide data to address repairs to all structure that is susceptible to fatigue cracking and could contribute to a catastrophic failure. The REG may refer to the RAP, other existing approved data such as SRM and SBs or provide specific means for obtaining data for individual repairs.
Documentation such as the Structural Repair Manual and service bulletins needs to be reviewed for compliance with damage-tolerance principles and be updated and promulgated consistent with the intent of the REGs.

Where repair evaluation guidelines, 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.

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 the REGs and the maintenance programme may be developed are incorporated in Appendix 3.

10. LIMIT OF VALIDITY OF THE MAINTENANCE PROGRAMME AND EVALUATION FOR WIDESPREAD FATIGUE DAMAGE

a) Initial WFD Evaluation and LOV

All fatigue and damage tolerance evaluations are finite in scope and also therefore in their long term ability to ensure continued airworthiness. The maintenance requirements that evolve from these evaluations have a finite period of validity defined by the extent of testing, analysis and service experience that make up the evaluation and the degree of associated uncertainties. **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 allow safe operation and in particular to preclude development of widespread fatigue damage. The LOV should be based on fatigue test evidence.

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 generally 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 all forms of fatigue damage before they become critical. Nonetheless, it has become apparent that as aircraft have approached and exceeded their DSG only some SSIPs have correctly addressed Widespread Fatigue Damage (WFD) as described below.

With extended usage, uniformly loaded structure may develop cracks in adjacent fastener holes, or in adjacent similar structural details. 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 maintenance programme established at time of certification. Furthermore, these cracks, while they may or may not interact, can have an adverse effect on the large damage capability (LDC) of the airframe before the cracks become detectable.

The TCH's role is to perform a WFD evaluation and, in conjunction with operators, is expected to initiate development of a maintenance programme with the intent of precluding operation with WFD. Appendix 2 provides guidelines for development of a programme to preclude the occurrence of 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 operator's role is to provide service experience, to help ensure the practicality of the programme and to ensure it is implemented effectively.

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.

b) Revision of WFD evaluation and LOV

New service experience findings, improvements in the prediction methodology, better load spectrum data, a change in any of the factors upon which the WFD evaluation is based or economic considerations, may dictate a revision to the evaluation. Accordingly, associated new recommendations for service action should be developed including a revised LOV, if appropriate, and submitted to the Agency for review and approval of both engineering and maintenance aspects.

In order to operate an individual aircraft up to the revised LOV, a WFD evaluation should also 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 evaluation should be conducted by the DAH for the changed structure in conjunction with the operator prior to the aircraft reaching its existing LOV. The results together with any necessary actions required to preclude WFD from occurring before the aircraft reaches the revised LOV should be presented for review and approval by the Agency.

This process may be repeated such that, subject to Agency approval of the evaluations, 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.

The LOV and associated actions should be incorporated in the ALS. For an aircraft without an ALS, it may be appropriate for the DAH to create an ALS and to enter the LOV in the ALS, together with a clear identification of inspections and modifications required to allow safe operation up to that limit.

In any case, should instructions provided by the DAH in their ICA (e.g. maintenance manual revision) clearly indicate that the maintenance programme is not valid beyond a certain limit, this limit and associated instructions must be adhered to in the operator's maintenance programme as approved by the competent authority under Part-M requirements, unless an EASA approved alternative programme is incorporated and approved.

11. SUPPLEMENTAL TYPE-CERTIFICATES AND MODIFICATIONS

Any modification or supplemental type-certificates (STC) affecting an aircraft's structure 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, where, for example an STC holder no longer exists. Appendix 3 provides further details.

STC holders are expected to review existing designs that may have implications for continued airworthiness in the context of ageing aircraft programmes and collaborate with operators and TCHs, where appropriate.

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 DAH.

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

Programme	Affected Structure*	Implementation
CPCP	All Primary Structure	½ DSG
SSID	PSEs as defined in CS25.571	½ DSG
SB-Review	SBs that address a potentially unsafe structural condition	¾ DSG
REGs and RAPs	Repairs to fatigue critical structure (FCS).	¾ DSG
WFD	Prmary structure susceptible to WFD	1 DSG

* Note: The certification philosophy for safe-life items under CS 25.571 neccessitates no further investigation under ageing aircraft programmes that would provide damage tolerance based inspections. However, this does not exclude safe-life items such as landing gear from the CPCP and SB Review or from re-assessment of their safe-life if the aircraft usage or structural loading is known to have changed.

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.

Programme implementation times in flight hours, flight or landing cycles, or calendar period, as appropriate, should be established by the TC/STC Holder 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 once they become available from the DAH. 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, for maintenance actions beyond threshold, full implementation of these maintenance actions across the whole fleet should be accomplished within 4 years of the operator's programme being approved by the competent authority.

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.

One prerequisite for the successful application of the damage tolerance approach for managing fatigue is that crack growth and residual strength can be anticipated with sufficient precision to allow inspections to be established that will detect cracking before it reaches a size that will degrade the strength below a specified level. When damage is discovered, airworthiness is ensured by repair or revised maintenance action. Evidence to date suggests that when all critical structure is included, fatigue and damage-tolerance based inspections and procedures (including modification and replacement when necessary) provide the best approach to address aircraft fatigue.

Pre FAR Part 25 Amendment 25-45 (JAR-25 Change 7) 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. Under Part-M requirements it is expected that an operator will automatically incorporate the SSID into their maintenance programmeme.

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 is designated by some TCH's 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. SUPPLEMENTAL STRUCTURAL INSPECTION PROGRAMME (SSIP)

Increased utilisation, 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 and replacement or modification of structure where inspection is not practical.

Large transport aeroplanes that were certificated according to 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 ATA MSG-3. However, for pre ATA MSG-3 rev 2 aeroplanes there are no requirements for regular MRB Report review and for post ATA 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 part of the MRB Report 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 Paragraph 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 amendments are damage-tolerant. The airworthiness limitations including the inspections and procedures established in accordance with 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 DAH should therefore check this information 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. GUIDELINES FOR DEVELOPMENT OF THE SUPPLEMENTAL STRUCTURAL INSPECTION DOCUMENT

This paragraph 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 emphasises 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 or other DAH modifications on individual aircraft. The operator has the responsibility for ensuring notification and consideration of any such aspects in conjunction with the DAH.

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 damage tolerance certification specification of CS 25.571 requires not only fatigue damage to be addressed but also accidental and environmental damage. Some types of accidental damage (e.g. scribe marks) can not be easily addressed by the MSG process and require specific inspections based on fatigue and damage tolerance analysis and tests. Furthermore, some applicants may chose to address other types of accidental damage and environmental damage in the SSID or ALS by modelling the damage as a crack and performing a fatigue and damage tolerance analysis. The resulting inspection programme may be tailored to look for the initial type of damage or the resulting fatigue cracking scenario, or both.

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 CS 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:

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

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

(c) 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 to the Agency:

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

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

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

(d) 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:

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

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

(c) The recommended inspection methods for the area;

(d) 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

(e) 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 Paragraphs 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 CS 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 3.3 above, giving due consideration to the following:

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

(b) Confidence in the proposed inspection technique; and

(c) 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.

(a) 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.

(b) 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 Paragraph 1 of this Appendix 1).

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:

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

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

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

(d) 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.

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

(f) 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:

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

(b) Relevant service experience.

(c) Likely site(s) of damage.

(d) Inspection method and procedure, and alternatives.

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

(f) 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).

(g) Initial inspection threshold.

(h) Repeat inspection interval.

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

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

(k) 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

The terminology and methodology in this appendix is based upon material developed by the AAWG.

2. DEFINITIONS

- **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.

- **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.

- **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.

- **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.

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

- **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.

- **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.

- **Teardown** inspections can be destructive and can be performed on fatigue tested structural components or those that have been removed from service. Alternatively they involve local teardown (non-destructive) disassembly and subsequent refurbishment of specific areas of high-time aircraft in service. The liberated sections of structure are then inspected using visual and non-destructive inspection technology, to characterise the extent of damage within the structure with regard to corrosion, fatigue, and accidental damage.

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

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 DAH and/or the operator(s) should conduct structural evaluations to determine where and when MSD/MED may occur. Based on these evaluations the DAH 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 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:

(a) Identify Primary Structure susceptible to MSD/MED, see paragraph 4.2.
(b) Predict when it is likely to occur; see paragraph 4.3 and
(c) 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 provides examples of known types of structure susceptible to MSD/MED. (The list is not exhaustive):

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

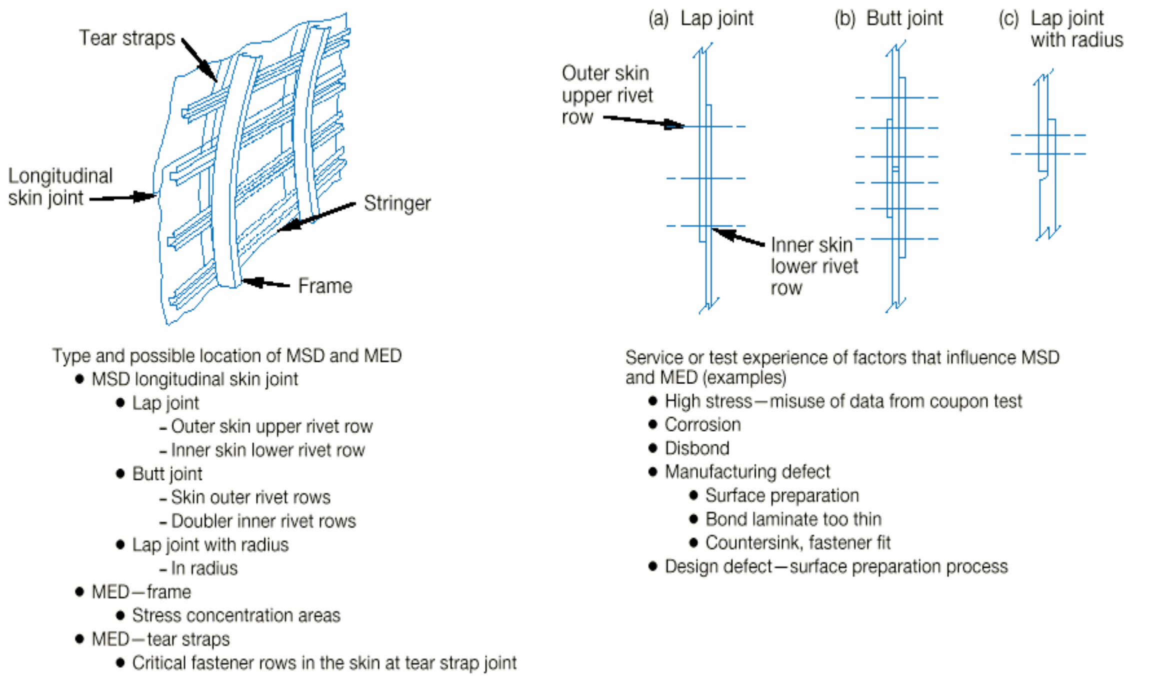


Figure A2-1 ***Longitudinal Skin Joints, Frames, and Tear Straps (MSD/MED)***

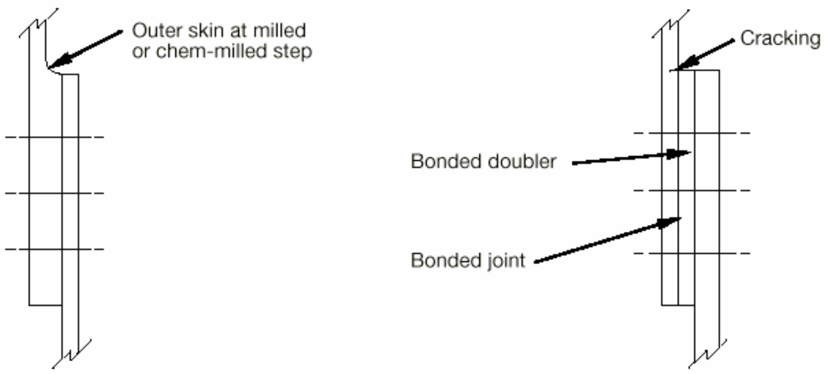
Type and possible location of MSD/MED

- MSD—circumferential joint
  - Without outer doubler
    - Splice plate—between and/or at the inner two rivet rows
    - Skin—forward and aft rivet row of splice plate
    - Skin—at first fastener of stringer coupling
  - With outer doubler
    - Skin—outer rivet rows
    - Splice plate/outer doubler—inner rivet rows
  - MED—stringer/stringer couplings
    - Stringer—at first fastener of stringer coupling
    - Stringer coupling—in splice plate area

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

- High secondary bending
- High stress level in splice plate and joining stringers (misuse of data from coupon test)
- Poor design (wrong material)
- Underdesign (over-estimation of interference fit fasteners)

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



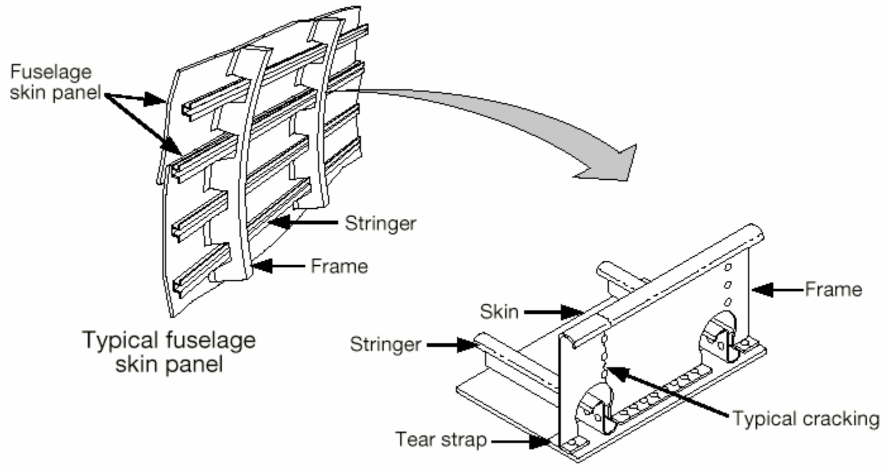
Type and possible location of MSD and MED

- MSD—abrupt cross section change
- Milled radius
- Chem-milled radius
- Bonded doubler runout

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

- High bending stresses due to eccentricity

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



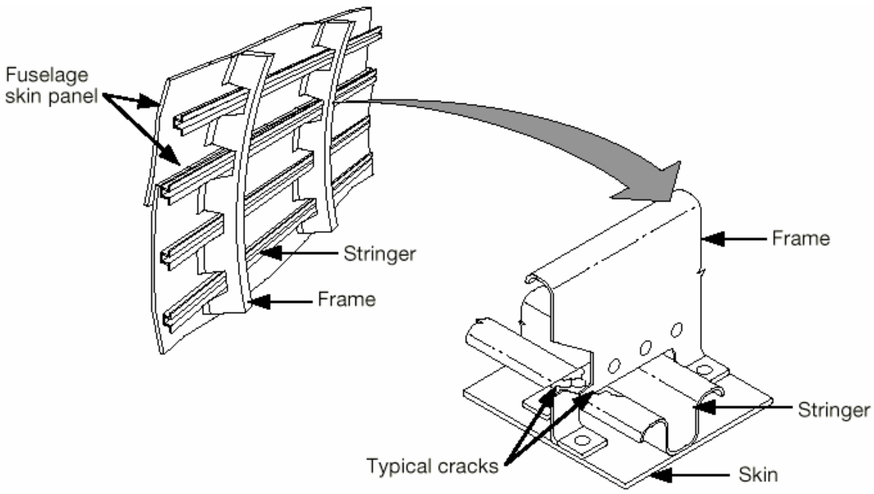
Type and possible location of MSD/MED

- MED—the cracking of frames at stringer cutouts at successive longitudinal locations in the fuselage. The primary concern is for those areas where noncircular frames exist in the fuselage structure. Fractures in those areas would result in panel instability.

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

- High bending—noncircular frames
- Local stress concentrations
  - Cutouts
  - Shear attachments

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



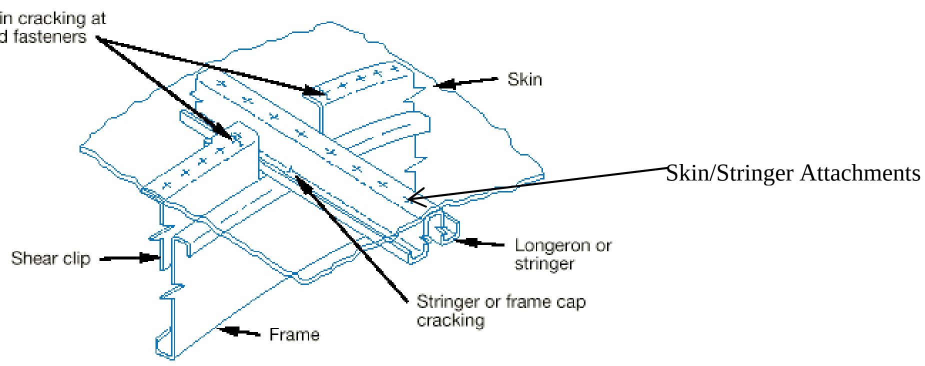
Type and possible location of MED

- MED—any combination of fracture of frames, clips, or stringers, including the attachments, resulting in the loss of the shear tie between the frame and stringer. This condition may occur at either circumferential or longitudinal locations at fuselage frame/stringer intersection.

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

- Poor load path connection

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



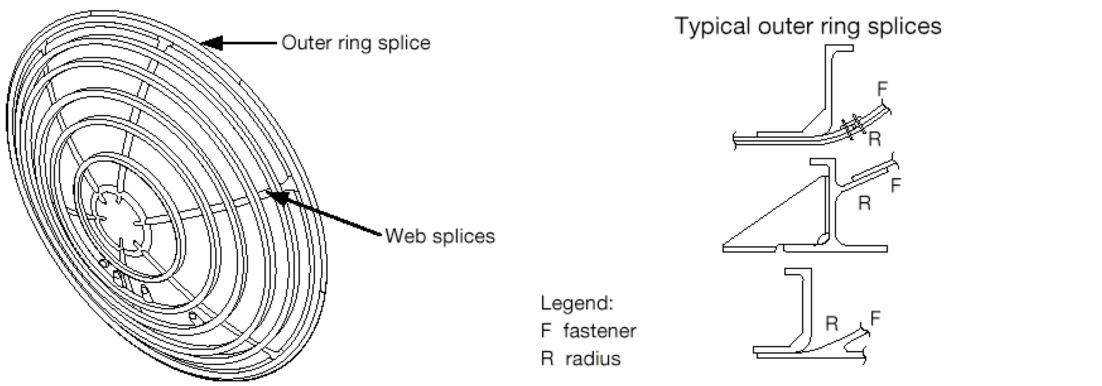
Type and possible location of MSD and MED

- MSD—skin at end fastener of shear clip
- MED—cracking in stringer or longeron at frame attachment
- MED—cracking in frame at stringer or longeron attachment

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

- Preload
- Localized bending due to pressure
- Discontinuous load path

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



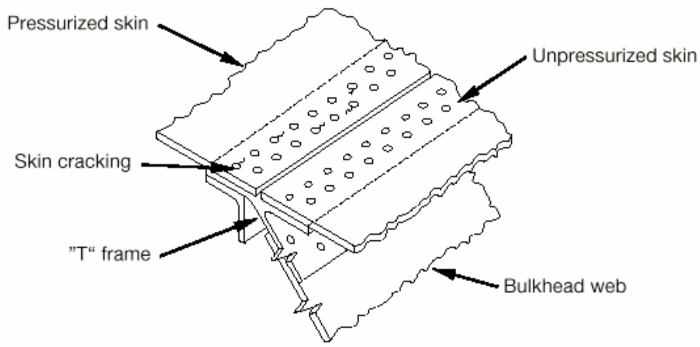
Type and possible location of MSD/MED

- MSD/MED—outer ring splice
  - Attachment profiles—at fastener rows and/or in radius area
- MED—web splices
  - Bulkhead skin and/or splice plates—at critical fastener rows

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

- Corrosion
- High stresses—combined tension and compression
- High induced bending in radius
- Inadequate finish in radius—surface roughness

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



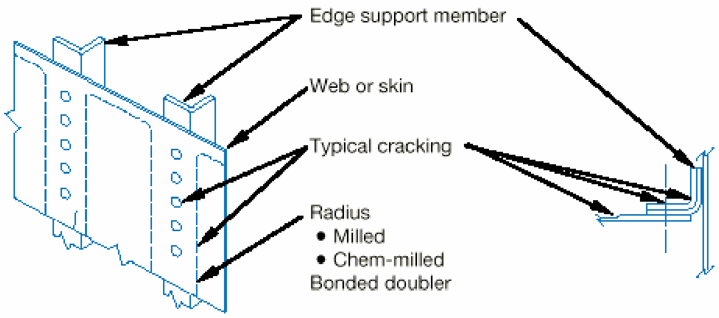
Type and possible location of MSD and MED

- MSD—skin at end fastener holes

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

- Shell discontinuous induced bending stresses
- High load transfer at fastener

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



Type and possible location of MSD and MED

Abrupt change in stiffness*
- Milled radius
- Chem-milled radius
- Bonded doubler
- Fastener row at edge support members

Edge member support structure
- Edge member - in radius areas

Service or test experience of factors that influence MSD and MED

Pressure structure
- High bending stresses at edge support due to pressure

Non-pressure structure
- Structural deflections cause high stresses at edge supports

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

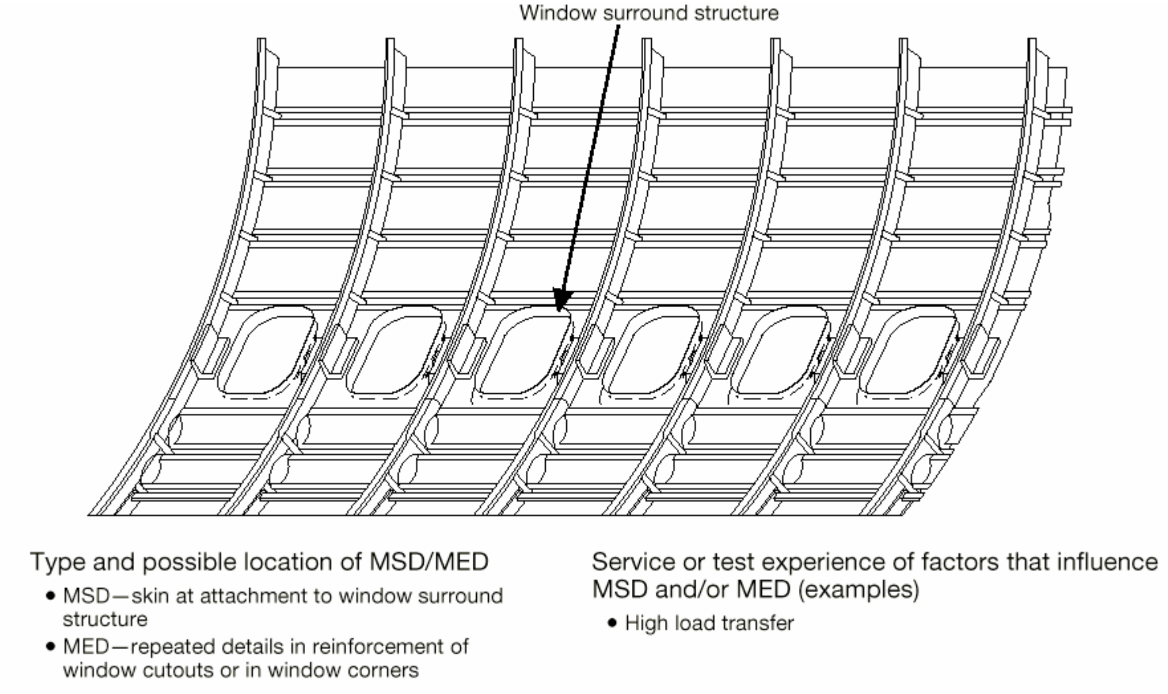


Figure A2-10 ***Window Surround Structure (MSD, MED)***

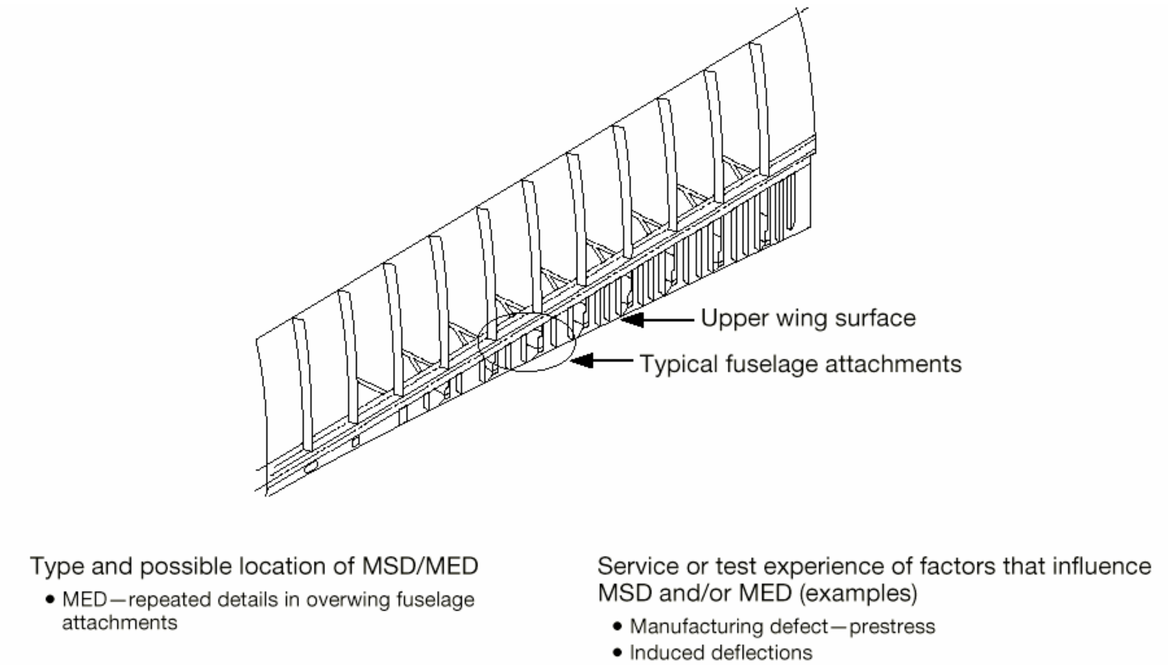
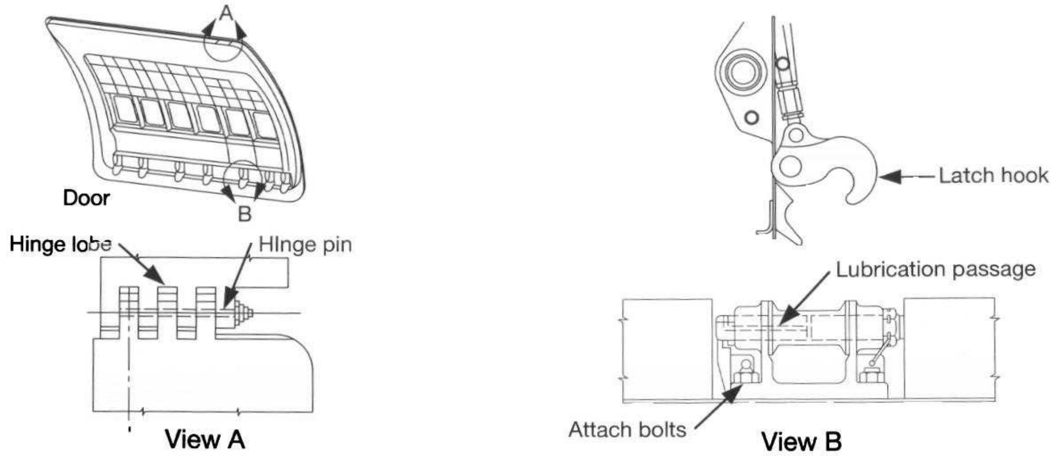


Figure A2-11 ***Over Wing Fuselage Attachments (MED)***



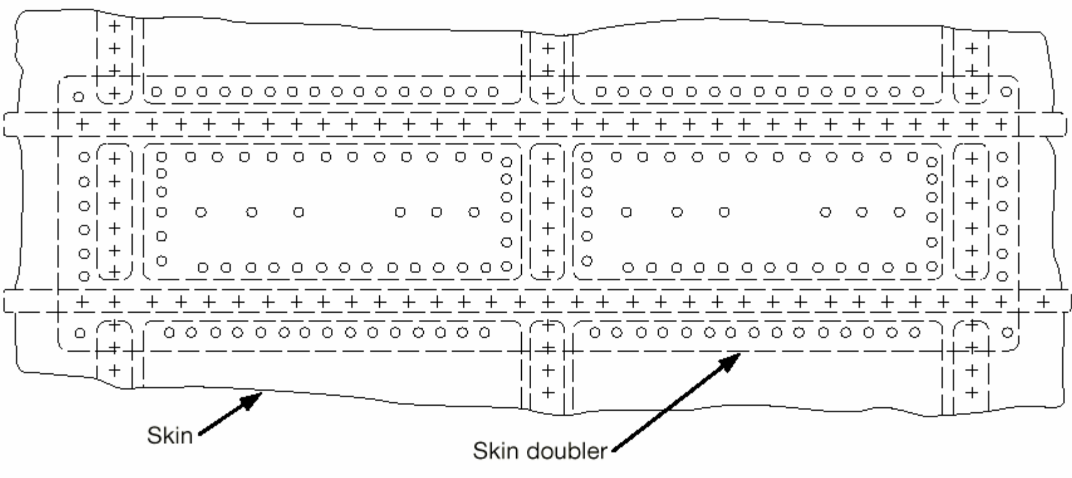
Type and possible location of MSD/MED

- 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)***



Type and possible location of MSD/MED

- MSD—cracks initiated at multiple critical fastener holes in skin at runout of doubler

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

- High load transfer—high local stress

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

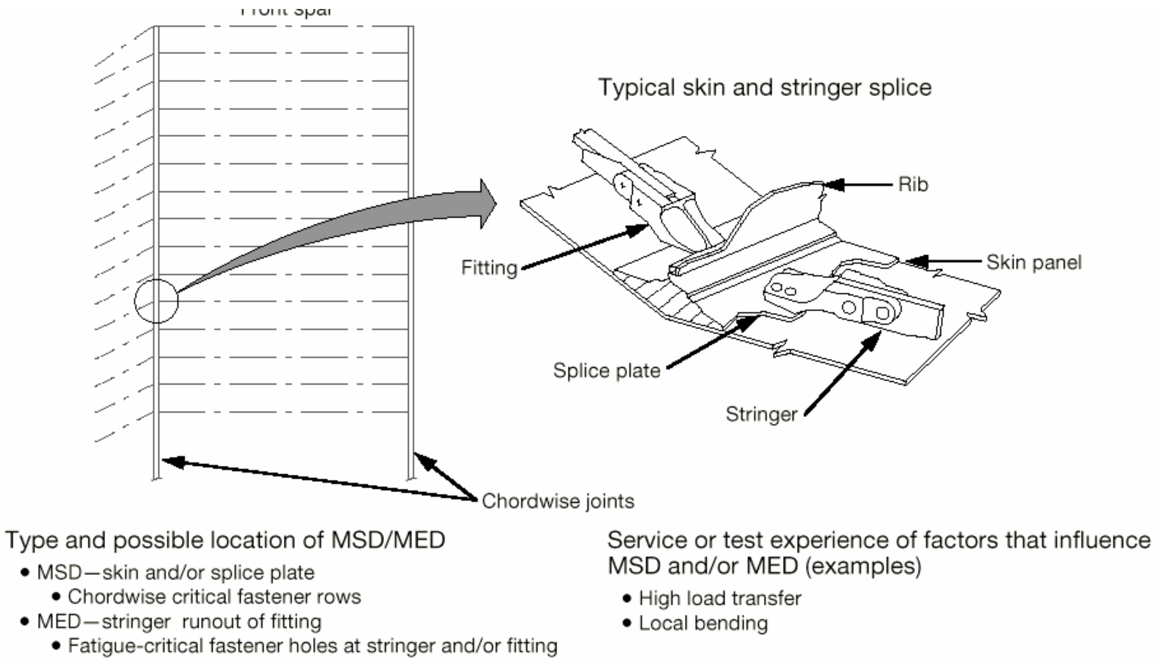


Figure A2-14 ***Wing or Empennage Chordwise Splices (MSD/MED)***

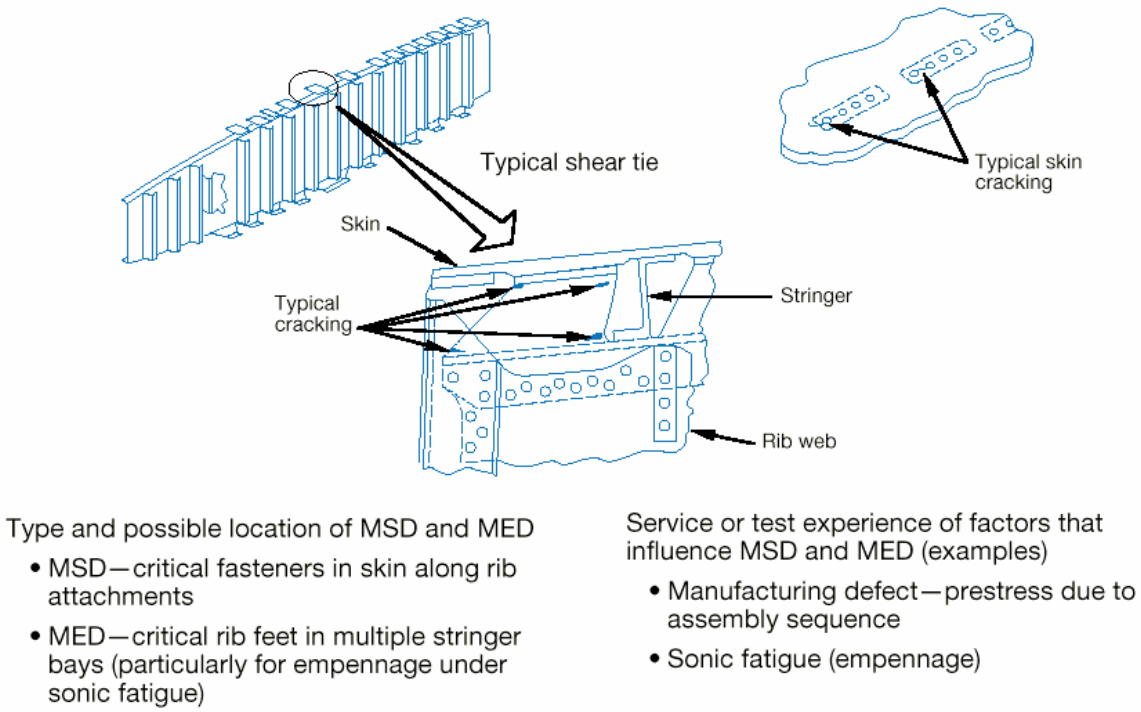


Figure A2-15 ***Rib to Skin Attachments (MSD/MED)***

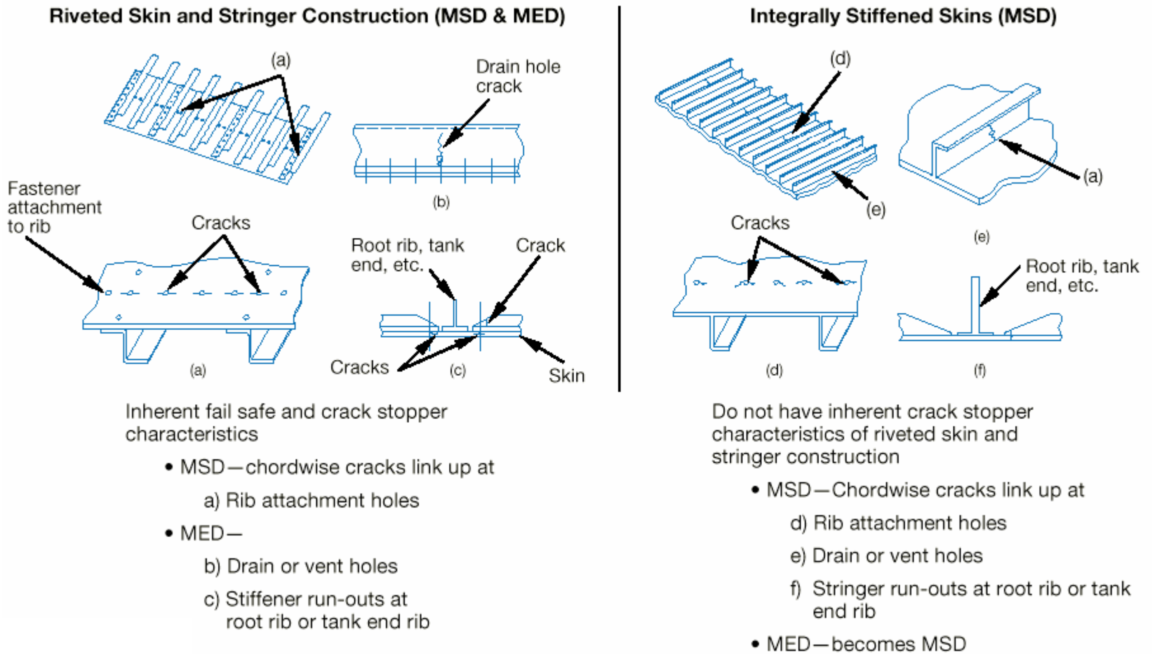


Figure A2-16 ***Typical Wing and Empennage Construction (MSD/MED)***

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 Identification of structure potentially susceptible to WFD

The TCH should identify each part of the aircraft's structure that is potentially susceptible to WFD for further evaluation. A justification should be given that supports selection or rejection of each area of the aircraft structure. DAHs for modified or repaired structure should evaluate their structure and its affect on existing structure.

Typical examples of structure susceptible to WFD are included in paragraph 4.2 of this appendix.

4.3.2 Determination of WFD average behaviour in the fleet:

The time in terms of flight cycles/hours defining the WFD average behaviour in the fleet should be established. The data to be assessed in determining the WFD average behaviour includes:

- a review of the service history of the susceptible areas to identify any occurrences of fatigue cracking,
- evaluation of the 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),
- fatigue test evidence including relevant full-scale and component fatigue and damage tolerance test data (see sub-paragraph 4.3.10 for more details),
- 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 full-scale fatigue test evidence is used, Figure A2-18, below, relates how that data might be utilised in determining WFD Average Behaviour. Evaluation may be analytically determined, supported by test and, where available, service evidence.

4.3.3 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.

4.3.4 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.

4.3.5 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.

4.3.6 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.

4.3.7. 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 bound behaviour as opposed to mean behaviour.

The following parameters are developed from paragraphs 4.3.2 through 4.3.7 above, and are necessary to establish a MSD/MED maintenance programme for the area under investigation.

4.3.8 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.

4.3.9 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 typically rely on internal inspections, which may not be practical at the frequency necessary to preclude MED due to the time required to gain access to the structure. 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.

4.3.10 Structural Modification Point (SMP)

The applicant should demonstrate that the proposed SMP established during the evaluation 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 structure with the expected extent of MSD/MED at the SMP maintains a LDC.

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/DAH 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/DAH should expeditiously evaluate selected high time aircraft in the fleet to determine their structural condition. From this evaluation, the TCH/DAH should notify the competent authorities and propose appropriate service actions.

The initial SMP may be adjusted based on the following:

(a) In some cases, the 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 may generally be described under the umbrella of additional fatigue test evidence and include either or a combination of any or all of the following:

- 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, taking into account future variability in service usage and loading compared to the surveyed aircraft. This data may be used to support increasing the original SMP by an amount that is agreed by the competent authority.

(b) If cracks are found in the structural detail for which the evaluation 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.

4.3.11 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 and compare them to the maintenance needs established in this evaluation. Issues to be considered include the following:

(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 WFD Evaluation Validity:

At whatever point the WFD evaluation is made, it should support the limit of validity (LOV) of the maintenance programme. Consistent with the use of test evidence to support individual SMPs, as described above in paragraph 4.3.10, the LOV of the maintenance programme should be based on fatigue test evidence. The initial WFD evaluation of the complete airframe will typically cover a significant forward estimation of the projected aircraft usage beyond its DSG, also known as the "proposed ESG." An evalution 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 adjust the evaluation validity period depending on issues such as:

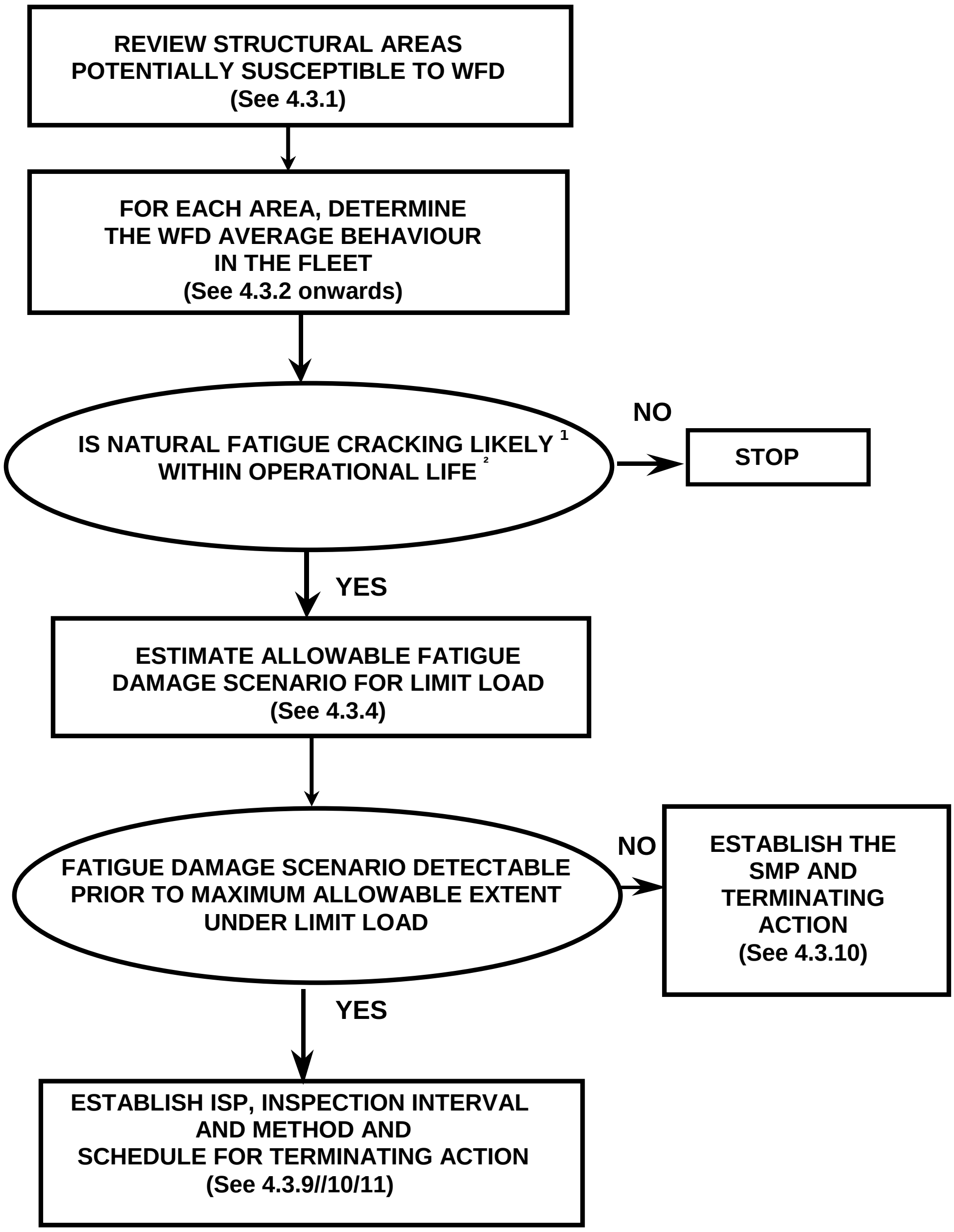
(a) The projected useful life of the aircraft at the time of the initial evaluation;

(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 Limit of Validity (LOV)

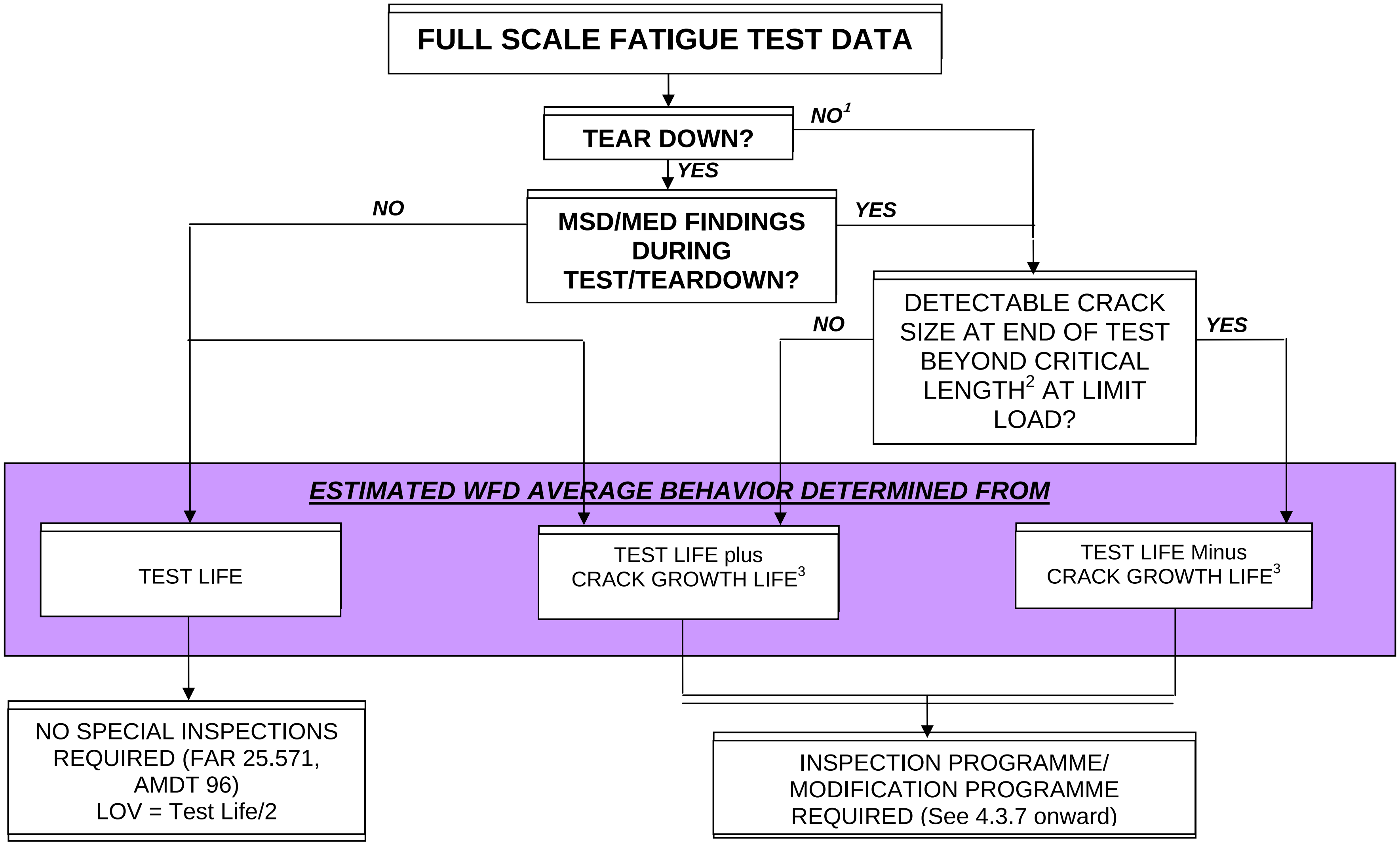
Note: This assumes that all other aspects of the maintenance programme that are required to support the LOV (such as SSID, CPCP, etc.) are in place and have been evaluated to ensure they too remain valid up to the LOV.



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. (See 4.4.1).

Figure A2-17: ***Aircraft Evaluation Process***



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 or actual state at end of test and critical crack length.

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

5. DOCUMENTATION

Any person developing a programme should 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:

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

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

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

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

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

(f) 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:

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

(b) 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;

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

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

(e) 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

(f) Guidance to the operator on which inspection findings should be reported to the TCH/DAH, 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:

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

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

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

(d) Adjacent repairs.

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/DAH. Indications of a developing MSD/MED problem may include:

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

(b) Repetitive part replacement; or

(c) Adjacent repairs.

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 are 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:

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

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

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

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

(e) Engine hush-kits and nacelle modifications;

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

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

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

(i) Multiple adjacent repairs.

Other potential areas that must be considered include:

(a) 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.);

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

(c) 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

While the primary responsibility is with the DAH to perform the analyses and supporting tests, it is expected that the evaluation will be conducted in a cooperative effort between the operators and TCHs/DAHs, with participation by the Agency.

APPENDIX 3

Guidelines for establishing instructions for continued airworthiness of structural repairs and modifications.

1. INTRODUCTION

With an SSID, CPCP and LOV in place an individual aircraft may still not meet the intended level of airworthiness for ageing aircraft structures. Repairs and modifications to aircraft structure also require investigation. For large transport aeroplanes, all repairs and modifications that affect FCS should be assessed using some form of damage-tolerance based evaluation. A regulatory requirement for damage-tolerance was not applied to aeroplane designs type certificated before 1978, and even after this time, implementation of DTE on repairs and modifications was not consistent. Therefore the damage-tolerance characteristics of repairs and modifications may vary widely and are largely unknown. In view of these concerns it is necessary to perform an assessment of repairs and modifications on existing aircraft to establish their damage-tolerance characteristics.

2. DEFINITIONS

For the purposes of this Appendix, the following definitions apply:

- **Damage Tolerance Data** are damage tolerance evaluation (DTE) documentation and the damage tolerance inspections (DTIs).

- **Damage Tolerance Evaluation (DTE)** is a process that leads to a determination of maintenance actions necessary to detect or preclude fatigue cracking that could contribute to a catastrophic failure. As applied to repairs and modifications, a DTE includes the evaluation of the repair or modification and the fatigue critical structure affected by the repair or modification. The process utilises the damage tolerance procedures as described in CS-25 AMC 25.571.

- **Damage Tolerance Inspections (DTIs)** are the inspections developed as a result of a DTE. A DTI includes the areas to be inspected, the inspection method, the inspection procedures, including acceptance and rejection criteria, the threshold, and any repetitive intervals associated with those inspections. The DTIs may specify a time limit when a repair or modification needs to be replaced or modified. If the DTE concludes that DT-based supplemental structural inspections are not necessary, the DTI documentation should include a statement that the normal zonal inspection programme is sufficient.

- **Fatigue Critical Baseline Structure (FCBS)** is the baseline structure of the aircraft that is classified as fatigue critical structure.

3. ESTABLISHMENT OF A DAMAGE-TOLERANT BASED INSPECTION PROGRAMME FOR REPAIRS AFFECTING FCS

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 existing repairs increase. Along with this increase 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 or in some cases replacement of the repair). To develope 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 Aircraft 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.

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). One prerequisite for the successful application of the damage tolerance approach for managing fatigue is that crack growth and residual strength can be anticipated with sufficient precision to allow inspections to be established that will detect cracking before it reaches a size that will degrade the strength below a specified level. 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.

The evidence to date is that when all critical structure is included, damage-tolerant based inspections and procedures, including modification and replacement, 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.

The following guidance is intended to help TCHs and operators establish and implement a damage-tolerant based maintenance programme for repairs affecting FCBS. Additional guidance for repairs to modified structure is provided in paragraph 4.

3.1 Overview of the TCH tasks for repairs that may affect FCBS

(a) Identify the affected aircraft model, models, aircraft serial numbers, and DSG stated as a number of flight cycles, flight hours, or both.

(b) Identify the certification level.

(c) Submit the list of FCBS to EASA for approval, and make it available to operators and STC holders.

(d) Review and update published repair data as necessary.

(e) Submit any new or updated published repair data to EASA for approval, and make it available to operators.

(f) Develop Repair Evaluation Guidelines (REGs) and submit them to EASA for approval, and make the approved REGs available to operators.

3.2. Certification Level

In order to understand what data is required, the TCH should identify the amendment level of the original aircraft certification relative to CS 25.571. The amendment level is useful in identifying what DT Data may be available and what standard should be used for developing new DT Data. The two relevant aircraft groups are:

Group A - Aircraft certified to CAR 4b or § 25.571, prior to Amendment 25-45 or equivalent. These aircraft were not evaluated for damage tolerance as part of the original type certification. Unless previously accomplished, existing and future repairs to FCBS will need DT Data developed.

Group B - Aircraft certified to § 25.571, Amendment 25-45 or later. These aircraft were evaluated for damage tolerance as part of the original type certification. As noted in the introduction, some of these repairs may not have repair data that includes appropriate DTI and the TCH and operators may need to identify and perform a DTE of these repairs and develop DTI.

3.3. Identifying Fatigue Critical Baseline Structure (FCBS)

TC Holders should identify and make available to operators a list of baseline structure that is susceptible to fatigue cracking that could contribute to a catastrophic failure. The term “baseline” refers to the structure that is designed under the original type certificate or amended type certificate for that aircraft model (that is, the as delivered aircraft model configuration). Guidance for identifying this structure can be found in CS-25 AMC 25.571. This structure is referred to in this AMC as “fatigue critical baseline structure.” The purpose of requiring identification and listing of fatigue critical structure (FCS) is to provide operators with a tool that will help in the evaluating existing and future repairs or modifications. In this context, fatigue critical structure is any structure that is susceptible to fatigue that could contribute to a catastrophic failure, and should be subject to a damage-tolerance evaluation (DTE). The DTE would determine if DTIs need to be established for the repaired or modified structure. For the purpose of this AMC, structure that is modified after aircraft delivery from the TCH is not considered to be “baseline” structure.

CS 25.571(a) states “An evaluation of the strength, detail design, and fabrication must show that catastrophic failure due to fatigue…will be avoided throughout the operational life of the aircraft. This evaluation must be conducted…for each part of the structure which could contribute to a catastrophic failure (such as wing, empennage, control surfaces, fuselage, engine mounts, and their related primary attachments)….” When identifying FCBS, it is not sufficient to consider only that structure identified in the supplemental structural inspection document (SSID) or airworthiness limitation section (ALS). Some SSIDs or ALSs might only include supplemental inspections of the most highly stressed elements of the FCBS. A SSID and ALS often refer to this structure as a Principal Structural Element (PSE). If repaired, other areas of structure not identified as a PSE in the SSID or ALS may require supplemental inspections. The term PSE has, at times, been applied narrowly by industry. The narrow application of the term PSE could incorrectly limit the scope of the structure that would be considered relative to fatigue if repairs or modifications exist or are subsequently made. The relationship between PSE and FCS could vary significantly depending on the TCH’s working definition of PSE. In addition, there may be structure whose failure would be catastrophic, but due to low operational loads on the part, the part will not experience fatigue cracking. However, if the subject part is repaired or modified, the stresses in the part may be increased to a level where it is now susceptible to fatigue cracking. These types of parts should be considered as fatigue critical structure.

TC Holders should develop the list of FCBS and include the locations of FCS and a diagram showing the extent of FCS. TC Holders should make the list available to STC Holders and to operators.

3.4. Certification Standard Applied When Performing a DTE

For Group A aircraft, the TC Holder should use the requirements of § 25.571, at Amendment 25-45, as a minimum standard. For Group B aircraft, the TC Holder should use the requirements that correspond to the original certification basis as a minimum standard. For each repair requiring a DTE, the DAH should apply not less than the minimum standard when developing new or revised DT Data. The certification standard applied by the TC Holder in performing a DTE for repairs should be included with the relevant approved documentation to the operator.

3.5. Performing a DTE on a Repair That Affects FCBS

When performing a DTE on a repair that affects FCBS, the DTE would apply to the affected FCBS and repair. This may consist of an individual analysis or the application of a DT-based process such as RAGs that would be used by an operator. The result of the DTE should lead to developing DTI that address any adverse effects the repair may have on the FCBS. If the DTE results determine that DTIs are not required to ensure the continued airworthiness of the affected FCBS, the TC Holder should note that in the DTE documentation.

The term ''adverse effects'' refers to a degradation in the fatigue life or inspectability of the affected FCBS. Degradation in fatigue life (earlier occurrence of critical fatigue cracking) may result from an increase in internal loading, while degradation of inspectability may result from physical changes made to the structure. The DTE should be performed within a time frame that ensures the continued airworthiness of affected FCBS.

3.6. Review of Published Repair Data

Published repair data are generally applicable instructions for accomplishing repairs, such as those contained in SRMs and SBs. TCHs should review their existing repair data and identify each repair that affects FCBS. For each such repair, unless previously accomplished, the TCH must perform a DTE and develop any necessary DTI for the affected FCBS and repair data. For some repairs, the results of the DTE will conclude that no new DTI will be required for the affected FCBS or repair. For these cases, the TCH should provide a means that informs the operator a DTE was performed for the subject repair. This may be accomplished, for example, by providing a statement in a document, such as an SRM, stating that all repairs contained in this manual have had a DTE performed. This should preclude operators from questioning those repairs that do not have DTIs. TCHs should provide a list of its published repair data to operators and a statement that a DTE has been performed on this data. The following examples of published repair data developed by the TCH should be reviewed and included in this list:

(a) SRMs,

(b) SBs,

(c) Documents containing AD mandated repairs, and

(d) Other documents available to operators (for example, aircraft maintenance manuals and component maintenance manuals) containing approved repair data.

3.7. Developing DT Data for Existing Published Repair Data

3.7.1. SRMs

The TCH should review the repair data contained in each SRM and identify repairs that affect FCBS. For these repairs, the TCH will need to determine if the SRM needs revising to provide adequate DTI. In determining the extent to which an SRM may need to be revised for compliance, consider the following:

(a) Whether the existing SRM contains an adequate description of DTIs for the specific model.

(b) Whether normal maintenance procedures (for example, the inspection threshold and/or existing normal maintenance inspections) are adequate to ensure the continued airworthiness (inspectability) equal to the unrepaired surrounding structure.

(c) Whether SRM Chapter 51 standard repairs have a DT evaluation.

(d) Whether all SRM specific repairs affecting FCBS have had a DTE performed.

(e) Whether there is any guidance on proximity of repairs.

(f) Whether superseded repairs are addressed and how a DTE is performed for future superseded repairs and how any DTI will be made available.

3.7.2. SBs

The TCH should review the repair data contained in its SBs and identify those repairs that affect FCBS. For those repairs, the TCH should then determine if a new DTE will need to be performed. This review may be done in conjunction with the review of SBs for modifications that affect FCBS.

3.7.3. ADs

The TCH should review ADs that provide maintenance instructions to repair FCBS and determine if the instructions include any necessary DT Data. While the maintenance instructions supporting ADs are typically contained in SBs, other means of documentation may be used.

3.7.4. Other Forms of Data Transmittal

In addition to SRMs, SBs, and documentation for ADs, the TCH should review any other documents (for example, aircraft maintenance manuals and component maintenance manuals) that contain repair data. Individual repair data not contained in the above documents will be identified and DT Data obtained through the Repair Evaluation Guidelines process.

3.8. Developing DT Data for Future Published Repair Data

Following the completion of the review and revision of existing published data any subsequent repair data proposed for publication should also be subject to DTE and DTI provided.

3.9. Approval of DT Data Developed For Published Repair Data

For existing published repair data that requires new DT Data for repairs affecting FCBS, the TCH should submit the revised documentation to EASA for approval unless otherwise agreed. The DT Data for future published repair data may be approved according to existing processes.

3.10. Documentation of DT Data Developed for Published Repair Data

TCH should include the means used to document any new DTI developed for published repair data. For example, in lieu of revising individual SBs, the TCH may choose to establish a collector document that would contain new DTI developed and approved for specific repairs contained in various SBs.

3.11. Existing Repairs

TCHs should develop processes that will enable operators to identify and obtain DTI for existing repairs on their aircraft that affect FCBS. Collectively, these processes are referred to as the REGs and are addressed below.

3.12. Future Repairs

Repairs to FCBS conducted after the operator has incorporated the REGs into his maintenance programme must have a DTE performed. This includes blendouts, trim-outs, etc. that are beyond published TCH limits. For new repairs, the TCH may, in conjunction with an operator, use the three stage approval process provided in Annex 1 of this Appendix. This process involves incremental approval of certain engineering data to allow an operator to return its aircraft to service before all the DT Data are developed and approved. The TCH should document this process for the operator's reference in their maintenance programme if it intends to apply it.

3.13. Repair Evaluation Guidelines

The REG provides instructions to the operator on how to survey aircraft, how to obtain DTI, and an implementation schedule that provides timelines for these actions. An effective REG may require that certain DT Data be developed by the TCH and made available to operators. Updated SRMs and SBs, together with the existing, expanded, or new RAG documents, form the core of the information that will need to be made available to the operator to support this process. In developing the REG the TCH will need to determine what DT Data are currently available for repairs and what new DT Data will need to be developed to support operator compliance. The REG should include:

(a) A process for conducting surveys of affected aircraft that will enable identification and documentation of all existing repairs that affect fatigue critical baseline structure;

(b) A process for obtaining DTI for repairs affecting FCBS that are identified during an aircraft survey; and

(c) An implementation schedule that provides timelines for:

    (1) Conducting aircraft surveys,

    (2) Obtaining DTI, and

    (3) Incorporating DTI into the operator's maintenance programme.

3.13.1. Implementation Schedule

The TCH should propose a schedule for Approval by EASA based on the guidance given in paragraph 12 of the main body of this AMC that takes into account the distribution of the fleet relative to ¾ DSG, the extent of the work involved and the airworthiness risk. The Agency notes that many fleets are currently approaching or beyond DSG and these should be given priority in the implementation schedule.

3.13.2. Developing a Process for Conducting Surveys of Affected Aircraft

The TCH should develop a process for use by operators to conduct aircraft surveys. These aircraft surveys are conducted by operators to identify and document repairs and repairs to modifications that may be installed on their aircraft. The survey is intended to help the operators determine which repairs may need a DTE in order to establish the need for DTI. Identification of repairs that need DTI should encompass only existing repairs that reinforce (for example, restore strength) the FCBS. This typically excludes maintenance actions such as blend-outs, plug rivets, trim-outs, etc. unless there are known specific risks associated with these actions in specific locations. The process the TCH developes to conduct surveys should include:

(a) A survey schedule.

(b) Areas and access provisions for the survey.

(c) A procedure for repair data collection that includes:

(1) Repair Dimensions,
(2) Repair Material,
(3) Repair Fastener Type,
(4) Repair Location,
(5) Repair Proximity to other repairs,
(6) Repairs covered by Published Repair Data, and
(7) Repairs requiring DTI.

(d) A means to determine whether or not a repair affects FCBS.

3.13.3. Developing a Process to Obtain DT Data for Repairs.

(a) The TCH must develop a process that operators can use to obtain DTIs that address the adverse effects repairs may have on FCBS. In developing this process, TCHs will need to identify all applicable DTIs they have developed that are available to operators. This may include updated SRMs and SBs, existing RAGs, expanded or new RAGs, and other sources of DTIs developed by the TCH. For certain repairs, the process may instruct the operators to obtain direct support from the TCH. In this case, the TCH evaluates the operator's request and makes available DTI for a specific repair or group of repairs, as needed. These may include operator or third-party developed/approved repairs, and repairs that deviate from approved published repair data.

(b) The process should state that existing repairs that already have DTIs developed and in place in the maintenance programme require no further action. For existing repairs identified during an individual aircraft survey that need DTIs established, the process may direct the operators to obtain the required DTIs from the following sources:

(1) TCH published service information such as DT-based SRMs, SBs, or other documents containing applicable DT Data for repairs.

(2) Existing approved RAG documents (developed for compliance with § 121.107).

(3) Expanded or newly developed RAG documents. In order to expedite the process for an operator to obtain DTI necessary to address the adverse affects repairs may have on FCBS, the TCH may determine that the existing RAG document should be expanded to address other FCBS of the aircraft pressure boundary. In addition, for aircraft that do not currently have a RAG, the TCH may determine that in order to fully support operators in obtaining DTI, a new RAG document may need to be developed. General guidance for developing this material can be found in Annex 2 below, which is similar to AC 120-73, *Damage Tolerance Assessment of Repairs to Pressurised Fuselages*. The RAGs or any other streamlined process developed to enable operators to obtain DTI without having to go directly to the TCH.

(4) Procedures developed to enable operators to establish DTIs without having to contact the TCH for direct support. These procedures may be similar in concept to the RAG documents.

(5) Direct support from the TCH for certain repairs. The operator directly solicits DTIs from a TCH for certain individual repairs as those repairs are identified during the survey.

3.14 Repairs to Removable Structural Components

Fatigue critical structure may include structure on removable structural parts or assemblies that can be exchanged from one aircraft to another, such as door assemblies and flight control surfaces. In principle, the DT Data development and implementation process also applies to repairs to FCS on removable components. During their life history, however, these parts may not have had their flight times recorded on an individual component level because of removal and reinstallation on different aircraft multiple times. These actions may make it impossible to determine the component's age or total flight hours or total flight cycles. In these situations, guidance for developing and implementing DT Data for existing and new repairs is provided in Annex 3 of this Appendix.

3.15 Training

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

4. <u>MODIFICATIONS AND REPAIRS TO MODIFICATIONS</u>

4.1. TCH and STC Holder Tasks – Modifications and Repairs to Modifications

The following is an overview of the TCH and STC Holder tasks necessary for modifications that affect FCBS. This overview also includes TCH and STC Holder tasks necessary for repairs that may affect any FCS of the subject modifications. These tasks are applicable to those modifications that have been developed by the TCH or STC Holder.

(a) Establish a list of modifications that may affect FCBS. From that list establish a list of modifications that may contain FCS.

(b) In consultation with operators, determine which aircraft have the modification(s) installed.

(c) STC Holders should obtain a list of FCBS from the TCH for the aircraft models identified above.

(d) STC Holders should identify:

- Modifications that affect FCBS, or
- Modifications that contain FCS.

(e) Determine if DT Data exist for the identified modifications.

(f) Develop additional DT Data, if necessary.

(g) Establish an implementation schedule for modifications.

(h) Review existing DT Data for repairs made to modifications that affect FCBS.

(i) Develop additional DT Data for repairs made to modifications that affect FCBS.

(j) Establish an implementation schedule for repairs made to modifications.

(k) Prepare documentation, submit it to EASA for approval, and make it available to operators.

4.2. Specific Modifications to be Considered

The TCH should consider modifications and any STCs it owns for modifications that fall into any of the categories listed in Annex 5 of this Appendix. STC Holders should do the same for their STC modifications. For modifications that are not developed by a TCH or STC Holder the operator should consider whether the modification falls into any of the categories listed in Annex 5 of this Appendix.

4.3. Modifications that need DT data

Using the guidance provided in AMC 25.571 and the detailed knowledge of the modification and its affect on the FCBS, the TCH and STC Holder, and in certain cases the operator, should consider the following situations in determining what DT data need to be developed

4.3.1. Modifications that affect FCBS

Any modification identified in Annex 5 that is installed on FCBS should be evaluated regardless of the size or complexity of the modification. In addition, any modification which indirectly affects FCBS (for example, modifications which change the fatigue loads environment, or affect the inspectability of the structure, etc.) must also have a DT evaluation performed to assess its impact.

4.3.2. Modifications that contain new FCS

For any modification identified in Annex 5 of this appendix that affects FCBS, the TCH or STC Holder should identify any FCS of the modification. Any modification that contains new FCS should be evaluated regardless of the size or complexity of the modification. Examples of this type of modification may be a modification that adds new structural splices, or increases the operational loads causing existing structure to become fatigue critical. If a modification does not affect FCBS, then it can be assumed that this modification does not contain FCS.

4.4. Reviewing Existing DT Data for Modifications that Affect FCBS

Based on the CS 25.571 certification amendment level and other existing rules, the modification's approval documentation may already provide appropriate DT data.

The TCH or STC Holder should identify modifications that have existing approved DT data. Acceptable DT data contain a statement of DTE accomplishment and are approved. Confirmation that approved DT data exists should be provided to the operators.

Modifications that have been developed by a TCH may affect FCBS. These include ATCs and in some cases STCs. These changes to type design also require review for appropriate DT data.

4.5. Developing Additional DT Data for Modifications that Affect FCBS

The DT data may be published as follows:

(a) **STC modifications** – The additional DT data for existing modifications may be published in the form of an amended STC, a supplemental compliance document, or an individual approval.

(b) **TC Holder modifications** – The additional DT data for existing modifications may be published in the form of an amended TC, TCH service information, etc.

(c) **Modifications not developed by a TCH or STC Holder** – For modifications identified in Annex 5 of this appendix that affect FCBS and were not developed by a TCH or STC Holder, the operator is responsible for obtaining DT data for those modifications. For those existing individual modifications that do not have DT data or other procedures implemented, establish the DT data according to an implementation plan approved by the Competent Authority.

NOTE: The TCH and STC Holder should submit data that describes and supports the means used to determine if an modification affects FCBS, and the means used for establishing FCS of an modification.

4.6. DT Data Implementation Schedule then the TCH or STC Holder is no longer in business or a TC or STC is surrendered

For those modifications where the TCH or STC Holder is no longer in business or the TC or STC is surrendered, this paragraph provides guidance for an operator to produce a DT data implementation schedule for that modification. The operator's DT Data Implementation Schedule should contain the following information:

(a) A description of the modification;

(b) The affected aircraft and the affected FCS

(c) The DSG of the affected aircraft;

(d) A list of the modification FCS (if it exists);

(e) The 25.571 certification level for determining the DT data;

(f) A plan for obtaining the DT data for the modification; and

(g) A DT Data Implementation Schedule for incorporating the DT data once they are received.

5. DEVELOPMENT OF TCH AND STC HOLDER DOCUMENTATION AND EASA APPROVAL

TCH, STC Holders, operators and the airworthiness authorities should work together to develop model-specific documentation with oversight provided by those authorities and assistance from the ARAC AAWG. It is anticipated that TCHs will utilise structural task groups (STG) to support their development of model-specific documents. EASA will approve the TCH or STC Holder submissions of the REGs and any other associated documentation required by the operator to provide appropriate DTI to all repairs and modifications to FCS whether submitted as separate documents or in a consolidated document.

6. OPERATOR TASKS – REPAIRS, MODIFICATIONS AND REPAIRS TO MODIFICATIONS.

(a) Review the applicable Documents supplied by TCH and STC Holders.

(b) Identify modifications that exist in the operators' fleet that affect FCBS.

(c) Obtain or develop additional DT data for modifications not addressed by the TCH or STC Holder's documents.

NOTE: If the TCH or STC Holder no longer exists or is unwilling to comply with this request it becomes the responsibility of the operator to develop or obtain approved DT data. The data should be provided by a Design Organisation with an appropriate DOA.

(d) Incorporate the neccessary actions into the Maintenance programme for Approval by the Competent Authority.

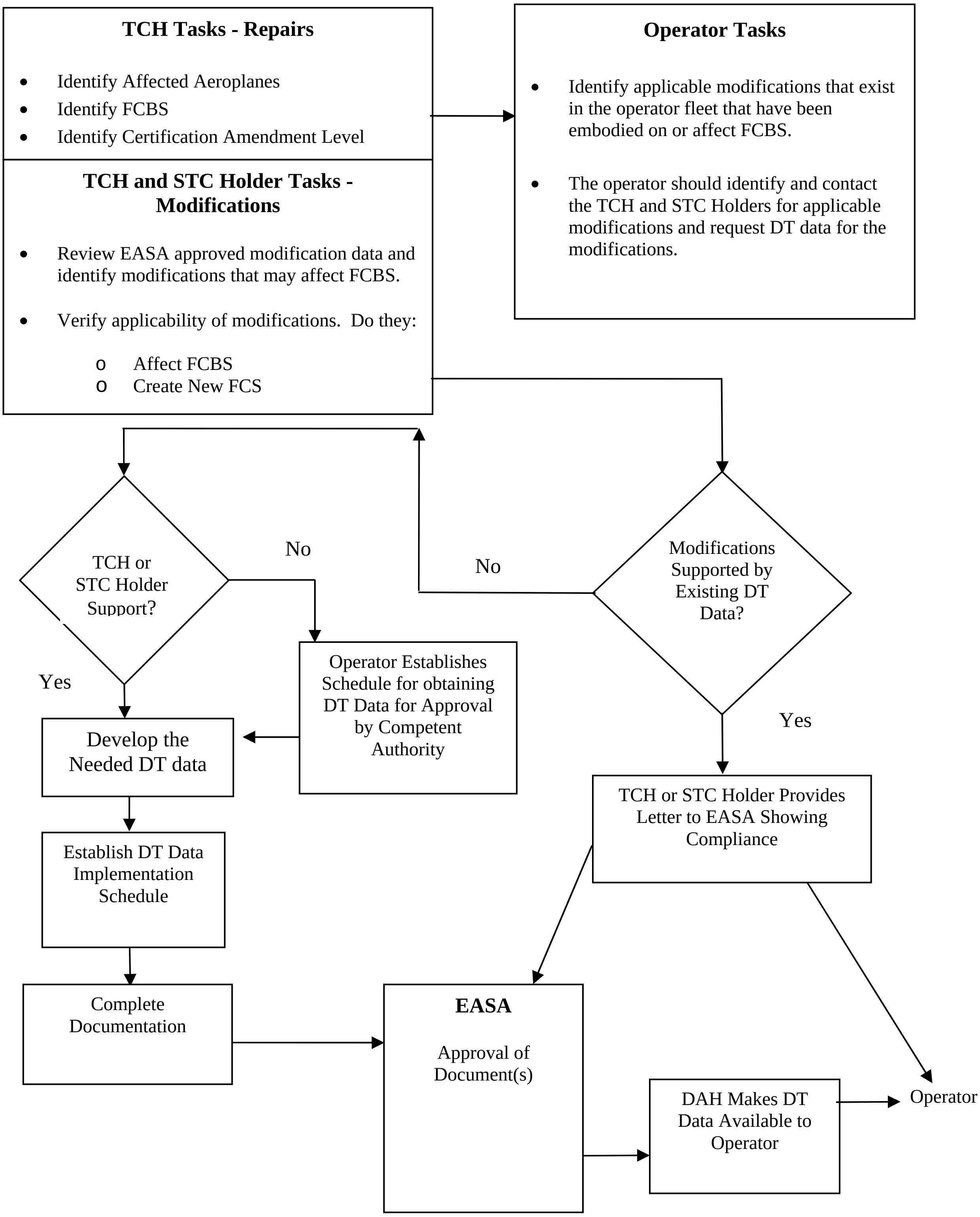


Figure A3-1 – Developing a Means of Compliance for Modifications

6.1. Contents of the Maintenance Programme

(a) The operator should include the following in their Maintenance Programme:

(1) A process to ensure that all new repairs and modifications that affect FCBS will have DT data and DTI or other procedures implemented.

(2) A process to ensure that all existing repairs and modifications to FCBS are evaluated for damage tolerance and have DTI or other procedures implemented. This process includes:

(i) A review of operator processes to determine if DT data for repairs and modifications affecting FCBS have been developed and incorporated into the operator's maintenance programme for the operational life of the aircraft. If an operator is able to demonstrate that these processes ensure that DT data are developed for all repairs and modifications affecting FCBS, then no further action is required for existing repairs and modifications.

(ii) A process to identify or survey existing repairs (using the survey parameters from Annex 3 of this Appendix) and modifications that affect FCBS and determine DTI for those repairs and modifications. This should include an implementation schedule that provides timing for incorporation of the DT data into the operator's maintenance programme, within the timeframe given in the applicable TCH or STC Holder's approved documentation.

(b) Figure A3-2, below, outlines one possible means an operator can use to develop an implementation plan for aircraft in its fleet.

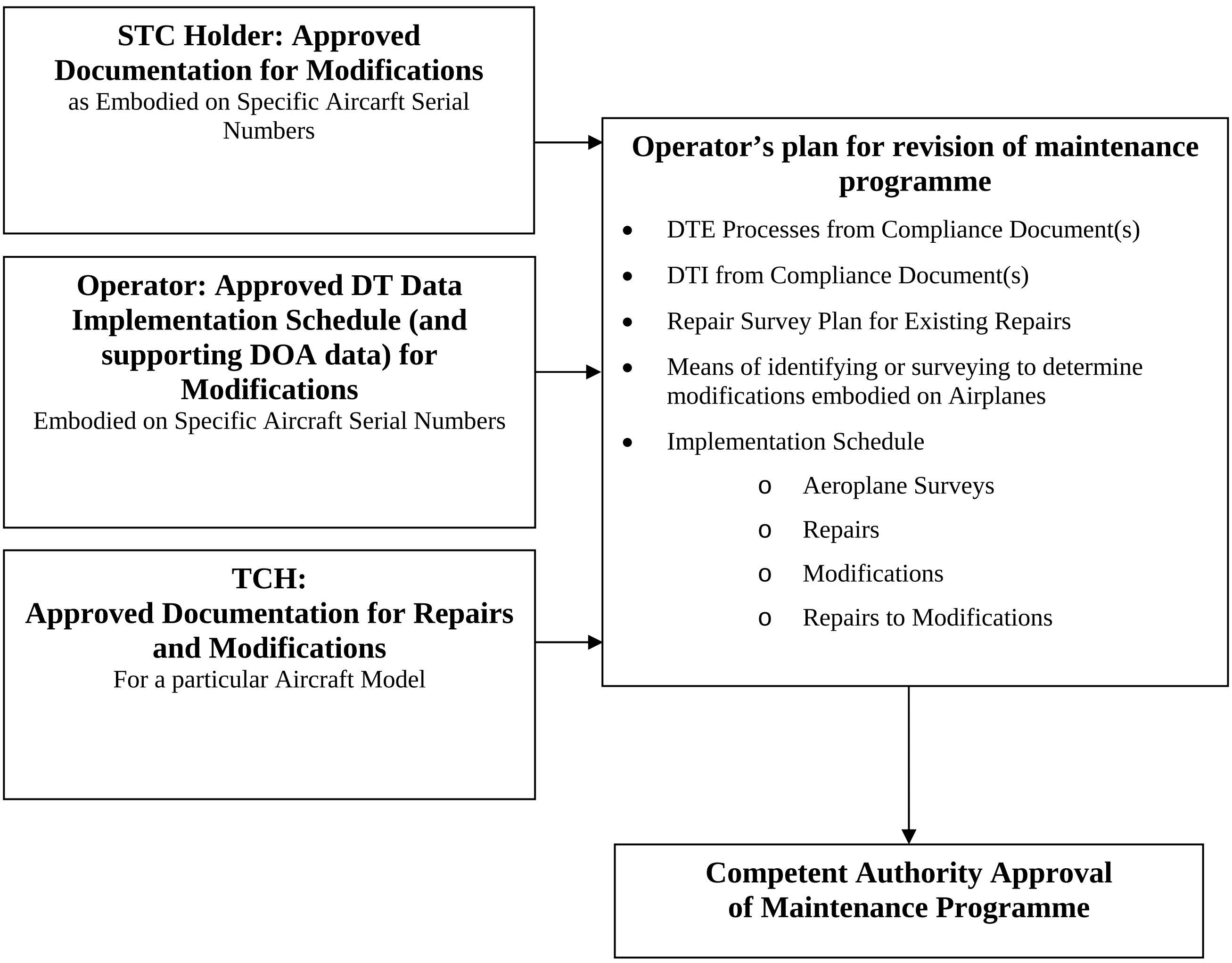


Figure A3-2 - Operator's Maintenance Programme Approval Process

6.1.1. Implementation Plan for Repairs

Repair Survey Plan. The maintenance programme should include a repair survey schedule to identify repairs that may need DT data developed. The TCH's REG may be used as a basis for this plan. (See Paragraph 3 above and Annex 2 for further information)

6.1.2. Implementation Plan for Modifications:

(a) The plan should include a process for producing a list of modifications that affect FCBS on an operator's aircraft. The list may be developed by obtaining data through a review of aircraft records and by a survey of the aircraft. If the means for identifying the subject modifications is by a records review, the operator will need to show its competent authority that the aircraft records are a reliable means for identifying modifications that affect the FCBS. Per the guidance in paragraph (3), below, the operator may identify modifications developed by TCH and STC Holders by performing a records review. A records review, however, may not be adequate to identify modifications not developed by a TCH or STC Holder. An aircraft survey may need to be conducted to identify such modifications. For each modification that affects FCBS, the process should document the means of compliance for incorporating DT data associated with that modification, whether through a TCH or STC Holder Compliance Document, an operator's DT data implementation schedule, or existing DT-based ICA.

(b) The plan should:

(1) Include the process for when and how to obtain DT data for those modifications included in a DT data implementation schedule,

(2) Include a means of ensuring that the aircraft will not be operated past the time limit established for obtaining DT data,

(3) Include DT data associated with an modification that is provided in a Compliance Document, and

(4) Identify how DT data will be incorporated into the operator's maintenance programme.

(c) To support identification of modifications that TCH and STC Holders need to address the operators should, concurrent with the TC and STC Holders' tasks, identify the TCH or STC Holder-developed modifications that exist in its fleet of aircraft. This may be done by reviewing the operator's aircraft configuration records, if record keeping is complete. During the review the TCH and STC Holder of each specific modification should be identified. The operator should then establish which modifications have been installed on or are likely to affect FCBS and prepare a list of modifications by aircraft. Modifications not developed by a TCH or STC Holder that affect FCBS should be identified at the time the operator conducts its aircraft survey for repairs.

(1) Compile a listing of all TCH and STC Holder developed modifications that are currently installed on its active fleet;

(2) Delete from the listing those modifications that do not affect FCBS. Documents from the TCH may be used to identify the FCBS.

(3) The remaining modifications that affect FCBS on this list require a DTE and DT data, unless previously accomplished.

(4) The operator must review each modification to determine whether:

(i) The DT data already exist; or

(ii) The DT data need to be developed.

(5) Notify both the STC Holder and the Competent Authority and EASA when STCs owned by the STC Holder are identified on the operator's fleet and that DT data are required.

NOTE: The operator should begin developing this modifications list as soon as the TCHs make their FCBS listing available.

(d) The operator should consider the list of modifications contained in Annex 5 of this AMC in determining which modifications may affect FCBS on a model-specific basis.

(e) The operator should submit a letter that provides a list of modifications it has on its active fleet to the Competent Authority and a status on the TCH or STC Holders' support for developing required DT data.

(f) The operator should also contact the TCH or STC Holder for the applicable modification to determine if DT data are available for that modification. If the data do not exist, and the TCH or STC Holder intends to support the development of DT data, and this modification is likely to exist on other operators' fleets, the group of affected operators may wish to collectively meet with the TCH or STC Holder. If the TCH or STC Holder no longer exists, or is unwilling to support the modification, or if an modification affecting FCBS has not been approved under a TC or STC, it is the responsibility of the operator(s) to develop the data, either internally, or by using an third party with the appropriate design approval.

(g) Some individual modifications may not be easily identified through a review of aircraft maintenance records. In these situations, the means of compliance is a plan to survey the aircraft for modifications in the similar manner as repairs and repairs to modifications as given in paragraph 3 of this Appendix. The DT data for those modifications identified in the survey should be developed and implemented into an operator's maintenance programme. It is anticipated that most aircraft will need to be surveyed in order to ensure all modifications are identified. This survey can be conducted at the same time the survey for repairs is performed.

6.1.3. DT Data Implementation Process

(a) Use the regular maintenance or inspection programme for repairs where the inspection requirements utilise the chosen inspection method and interval. Repairs or modifications added between the predetermined maintenance visits, including Category B and C repairs (see Annex 2 of this Appendix) installed at remote locations, should have a threshold greater than the predetermined maintenance visit. Repairs may also be individually tracked to account for their unique inspection method and interval requirements. This ensures the airworthiness of the structure until the next predetermined maintenance visit, when the repair or modification will be evaluated as part of the repair maintenance programme.

(b) Where inspection requirements are not fulfilled by the chosen inspection method and interval, Category B or C repairs will need additional attention. These repairs will either require upgrading to allow utilising the chosen inspection method and interval, or individual tracking to account for the repair's unique inspection method and interval requirements.

6.2 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 utilisation of the chosen inspection method and interval, or re-categorise 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 Annex 2 of this AMC.

7. THE COMPETENT AUTHORITY

The competent authority is responsible for approving the means for incorporating the Agency Approved DT data for repairs and modifications into the operator's maintenance programmeme.

ANNEX 1: APPROVAL PROCESS FOR NEW REPAIRS

In the past, FAA AC 25.1529-1, *Instructions for Continued Airworthiness of Structural Repairs on Transport Aircraft*, August 1, 1991, described a two-stage approach for approving repairs to principal structural elements. The two-stage approach consisted of:

- Evaluating type design strength requirements per CS 25.305 before return to service.
- Performing a damage tolerance evaluation and developing DT Data to demonstrate compliance with CS 25.571 within 12 months of return to service.

The FAA guidance material in AC 25.1529-1 is now embodied in this AMC, and is modified to describe a three-stage approach now commonly used in the aviation industry. The three-stage approach is in lieu of the two-stage approach discussed above.

The DT Data include inspection requirements, such as inspection threshold, inspection method, and inspection repetitive interval, or may specify a time limit when a repair or modification needs to be replaced or modified. The required data may be submitted all at once, prior to the aircraft return to service, or it may be submitted in stages. The following three-stage approval process is available, which involves incremental approval of engineering data to allow an aircraft to return to service before all the engineering data previously described are submitted. The three stages are described as follows:

(a) The first stage is approval of the static strength data and the schedule for submittal of the DT Data. This approval is required prior to returning an aircraft to service.

(b) The second stage is approval of the DT Data. This should be submitted no later then 12 months after the aircraft was returned to service. At this stage the DT Data need only contain the threshold when inspections are required to begin as long as a process is in place to develop the required inspection method and repetitive intervals before the threshold is reached. In this case, the submittal and approval of the remaining DT Data may be deferred to the third stage.

(c) The third stage is approval of the inspection method and the repetitive intervals. This final element of the repair certification data in compliance with CS 25.571 must be submitted and approved prior to the inspection threshold being reached.

ANNEX 2: ASSESSMENT OF EXISTING REPAIRS

A DTI assessment process consists of an aircraft repair survey, identification and disposition of repairs requiring immediate action and development of damage tolerance based inspections, as described below:

1. AIRCRAFT REPAIR SURVEY

A survey will be used to identify existing repairs and repair configurations on FCBS and provide a means to categorise those repairs. The survey would apply to all affected aircraft in an operator's fleet, as defined in the maintenance programme, using the process contained in the REG or similar document. The procedure to identify repairs that require DTE should be developed and documented using CS 25.571 and AMC 25.571 (dependent on aircraft certification level), together with additional guidance specific to repairs, such as:

(a) Size of the repair,

(b) Repair configuration,

 (1) SRM standards

 (2) Other

(c) Proximity to other repairs, and

(d) Potential affect on FCBS

 (1) Inspectability (access and method)

 (2) Load distribution.

See Paragraph 4 of this Annex for more details.

2. IDENTIFICATION AND DISPOSITION OF REPAIRS REQUIRING IMMEDIATE ACTION

Certain repairs may not meet minimum requirements because of cracking, corrosion, dents, or inadequate design. The operator should use the guidance provided in the Compliance Document to identify these repairs and, once identified, take appropriate corrective action. In some cases, modifications may need to be made before further flight. The operator should consider establishing a fleet campaign if similar repairs may have been installed on other aircraft.

3. DAMAGE TOLERANCE INSPECTION DEVELOPMENT

This includes the development of the appropriate maintenance plan for the repair under consideration. During this step determine the inspection method, threshold, and repetitive interval. Determine this information from existing guidance information as documented in the RAG (see Paragraph 4), or from the results of an individual damage tolerance evaluation performed using the guidance in AMC 25.571. Then determine the feasibility of an inspection programme to maintain continued airworthiness. If the inspection programme is practical, incorporate the DTI into the individual aircraft maintenance programme. If the inspection is either impractical or impossible, incorporate a replacement time for the repair into the individual aircraft maintenance programme. The three-stage approach discussed in Annex 1 of this AMC may be used, if appropriate.

4. REPAIR ASSESSMENT GUIDELINES

4.1. Criteria to assist in developing the repair assessment guidelines

The following criteria are those developed for the fuselage pressure boundary, similar to those found in FAA AC 120-73 and previous JAA and EASA documentation. DAHs may find it appropriate to develop similar practices for other types of aircraft and areas of the structure.

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:

(a) Specific repair size limits for which no assessment is necessary may be selected for each model of aircraft and structural location. This will enable the burden on the operator to be minimised while ensuring that the aircraft's baseline inspection programme remains valid.

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

(c) 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.

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

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

4.2. 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 DAH. 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 DAHs 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 DAH 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 DAH 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.

When the LOV of the maintenance programme is extended the initial Categorisation of Repairs may need review by the TCH and operator to ensure these remain valid up until the new LOV.

4.3. 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. DAHs 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. (See Figure.A3(2)-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 DAHs 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 categorisation 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.

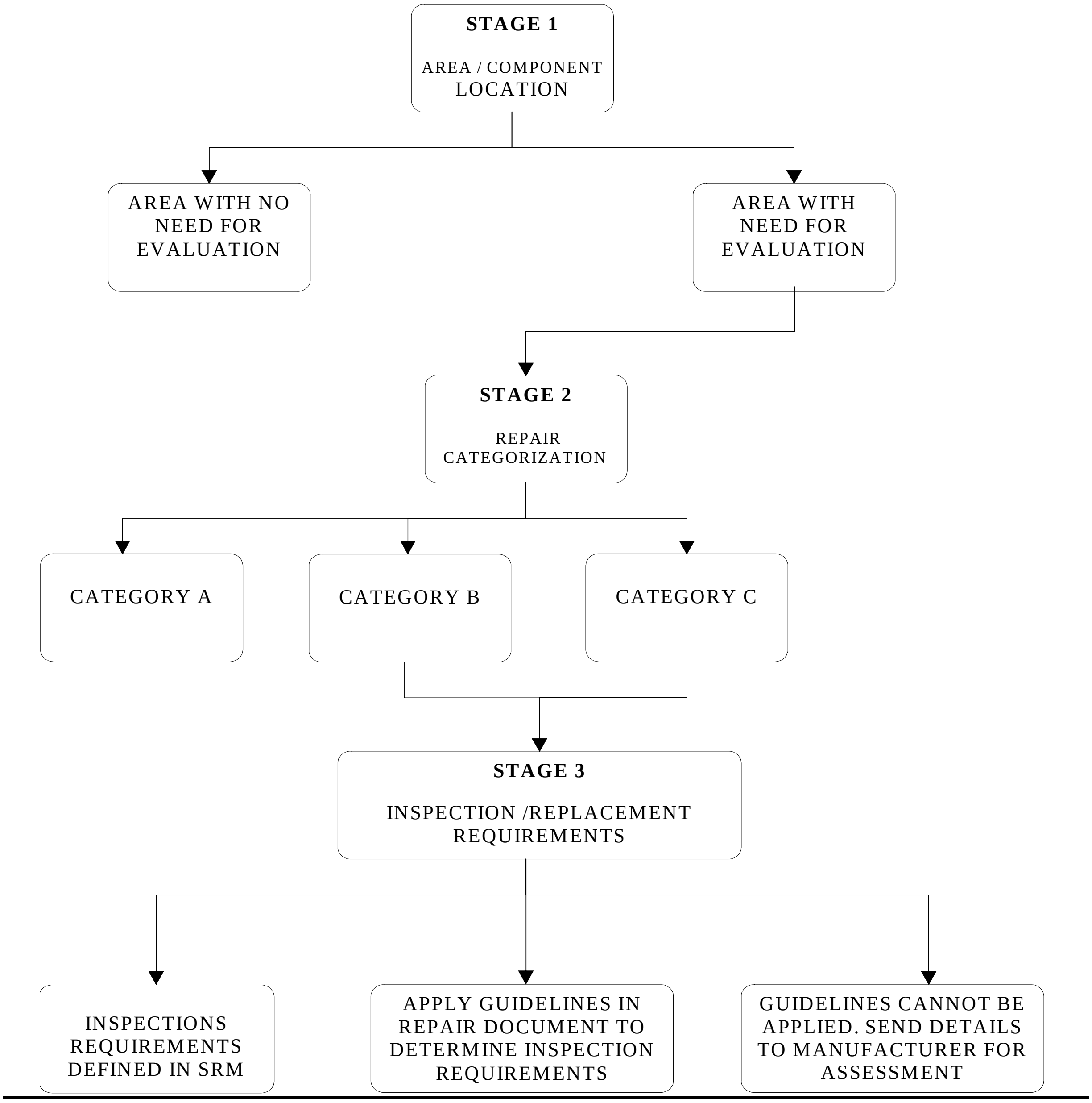


Figure A3(2)-1. Repair Assessment Stages

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 DAH, 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:

(a) Upgraded to allow utilisation of the chosen inspection method and interval, or

(b) 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.

5. <u>MAINTENANCE PROGRAMME CHANGES</u>

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 utilisation of the chosen inspection method and interval, or re-categorise 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.

6. <u>SRM UPDATE</u>

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.

7. 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 structure modified by STC should be evaluated by the operator in conjunction with the STC holder. The STC holder 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.

ANNEX 3: REPAIRS AND MODIFICATIONS TO REMOVABLE STRUCTURAL COMPONENTS

1. DETERMINING THE AGE OF A REMOVABLE STRUCTURAL COMPONENT

Determining an actual component age or assigning a conservative age provides flexibility and reduces operator burden when implementing DT data for repairs and modifications to structural components. In some cases, the actual component age may be determined from records. If the actual age cannot be determined this way, the component age may be conservatively assigned using one of the following fleet leader concepts, depending upon the origin of the component:

(a) If component times are not available, but records indicate that no part changes have occurred, aircraft flight cycles or flight hours can be used.

(b) If no records are available, and the parts could have been switched from one or more older aircraft under the same maintenance programme, it should be assumed that the time on any component is equal to the oldest aircraft in the programme. If this is unknown, the time should be assumed equal to the same model aircraft that is the oldest or has the most flight cycles or flight hours in the world fleet.

(c) A manufacturing date marked on a component may also be used to help establish the component's age in flight cycles or flight hours. This can be done by using the above reasoning and comparing it to aircraft in the affected fleet with the same or older manufacturing date.

If none of these options can be used to determine or assign a component age or total number of flight cycles or flight hours, a conservative implementation schedule can be established by using the guidelines applied in paragraph 3. of this appendix, for the initial inspection, if required by the DT data.

2. TRACKING

An effective, formal, control or tracking system should be established for removable structural components that are identified as FCBS or that contain FCS. This will help ensure compliance with maintenance programme requirements specific to repairs and modifications installed on an affected removable structural component. Paragraph 4 of this appendix, provides options that could be used to alleviate some of the burdens associated with tracking all repairs to affected removable structural components.

3. DEVELOPING AND IMPLEMENTING DT DATA

(a) Repairs

Accomplish the initial repair assessment of the affected structural component at the same time as the aircraft level repair survey for the aircraft on which the component is installed. Develop the DT data per the process given in Step 3 of Appendix 6 and incorporate the DTI into the maintenance programmeme.

(b) Modifications

Accomplish the initial modification assessment of the affected structural component at the same time as the aircraft level modification assessment for the aircraft on which the component is installed. Develop the DT data and incorporate the DTI into the maintenance programmeme.

If the actual age of the repairs or modifications installation, or the total number of flight cycles or flight hours is known, use that information to establish when the initial inspection of the component should be performed. Repeat the inspection at the intervals provided by the TCH or STC Holder for the repair or modification installed on the component.

If the actual age of the repairs or modifications installation, or the total number of flight cycles or flight hours is unknown, but the component age or total number of flight cycles or flight hours is known, or can be assigned conservatively, use the component age, or total number of flight cycles or flight hours to establish when the initial inspection of the component should be performed. Repeat the inspection at the intervals provided by the TCH or STC Holder for the repairs and modifications against the component.

As an option, accomplish the initial inspection on the affected component at the next C-check (or equivalent interval) following the repair assessment. Repeat the inspection at the intervals provided by the TCH or STC Holder for the repairs and modifications against the component.

4. EXISTING REPAIRS AND MODIFICATIONS – COMPONENTS RETRIEVED FROM STORAGE.

(a) If the time on the component (in flight cycles or flight hours) is known, or can be conservatively assigned, perform the following:

(1) Survey the component,

(2) Disposition the repairs and modifications,

(3) Implement any DTI in accordance with the approved schedule,

(4) Accomplish the initial inspection using the actual age of the repairs or modifications, or total number of flight cycles or flight hours, if known. If the age of the repairs or modifications is not known, use the component age. Repeat the inspection at the intervals given for the repairs or modifications against the component.

(b) If the time on the component (in flight cycles or flight hours) is unknown and cannot be conservatively assigned, perform the initial repair or modification assessment of the affected component prior to installation, perform the following actions:

(1) Develop the DT data per the process given in paragraph 3 or 4 of Appendix 3 of this AMC as applicable.

(2) Incorporate any DTI into the maintenance programme.

(3) Accomplish the first inspection on the affected component at the next C-check (or equivalent interval) following the repair or modification assessment.

(4) Repeat the inspection at the intervals given for the repair or modification against the component.

5. IMPLEMENTATION OPTIONS TO HELP REDUCE TRACKING BURDEN

The following implementation techniques could be used to alleviate some of the burdens associated with tracking repairs to affected removable structural components. These techniques, if used, would need to be included in the Maintenance Programmeme and may require additional EASA approval and TCH or STC Holder input for DTI.

(a) Upgrading Existing Repairs

As an option, existing repairs may be removed and replaced to zero time the DTI requirements of the repair and establish an initial tracking point for the repair. Normally, this would be done at or before the survey for maximum benefit. The initial and repetitive inspections for the upgraded repair would then be accomplished at the intervals given for the repair against the component.

A repair could also be upgraded to one whose inspection requirements and methods are already fulfilled by an operator's maintenance or inspection programmeme. That repair would then be repetitively inspected at each routine inspection interval applicable to the repair. Specific tracking would not be required because that area of the aircraft would already be normally inspected on each aircraft in the fleet as part of the existing approved maintenance programme. If the operator's programme intervals were changed, the affect on requirements for specific tracking would have to be re-evaluated.

(b) Special Initial and/or Routine Inspections

As an option, existing repairs may have special initial inspections accomplished during the component survey. This initial inspection establishes an initial tracking point for the repair. Following this initial inspection, the DTI requirements (e.g., repetitive inspections) of the repair would be implemented.

In addition, special routine inspections could be defined for typical repairs that could be applied at a normal interval. In this case, an operator could check the affected components on each aircraft for this type of a repair at the defined interval. If the repair were found, the special inspection would be applied to ensure its airworthiness until the next scheduled check. This alleviates the need to specifically track affected components for every repair, especially typical ones.

The development of inspection processes, methods, applicability and intervals will probably require the assistance of the TCH or STC Holder for the FCS in question.

ANNEX 4. SERVICE BULLETIN REVIEW PROCESS

Guidelines for Following the Service Bulletin (SB) Flow Chart

NOTE: While it is believed that this guidance is fairly comprehensive, it may not address every possible situation. It is therefore incumbent on the user to use good judgment and rationale when making any determination.

Screening SBs to determine which ones require DT data is primarily a TCH responsibility.

The result of this screening is a list of SBs which require special directed inspections to ensure continued airworthiness. The SBs included on the list will be grouped into Type I and Type II SBs. Type I SBs have existing DT data and Type II SBs require developing DT data. The list is not comprehensive and will not include all of the SBs associated with an aircraft. Specifically, the list will not include those SBs where a BZI programme developed for the Repair Assessment Programme has been determined to be sufficient to meet the damage tolerance requirements for the FCBS that is affected by the SB. A note should be prominently placed somewhere in the Compliance Document stating that SBs not included in the list satisfy the DT data requirement.

> **"ALL SBs HAVE BEEN EVALUATED FOR DAMAGE TOLERANCE INSPECTION REQUIREMENTS; SERVICE BULLETINS NOT INCLUDED IN THIS LIST HAVE BEEN DETERMINED TO SATISFY THE DAMAGE- TOLERANCE REQUIREMENT BY INSPECTIONS COVERED IN THE BZI. THE BZI IS DOCUMENTED IN SECTION X.XXX.XX.X OF THE MAINTENANCE PLANNING DOCUMENT."**

Query 1 – Does the SB address a structural repair or a modification to FCS?

Historically, any SB, service letter or other document that lists ATA chapters 51 through 57 could provide repair or modification instructions that may require DT data. In addition, certain repairs or modifications accomplished under other ATA chapters may affect FCS. The first step in the screening process is to identify all such service instructions and develop a list of candidates for review (Q2).

Query 2 – Does the service instruction specify either a repair or modification that creates or affects FCS?

If it does, then the service instruction requires further review (Q3). If it does not, then the service instruction does not require further review.

Query 3 – Is the service instruction mandated?

Service bulletins and other service instructions that are mandated by an AD have requirements to ensure inspection findings (e.g., detected cracks or other structural damage/degradation) are addressed in an approved manner. If the TCH can demonstrate that it applies a process for developing inspection programmes for mandated SBs using DT data and/or service-based inspection results, and for continuously reviewing the SBs for their adequacy to detect cracks in a timely manner, the mandated SBs should then be considered as compliant with the intent of this process. Otherwise, the TCH will need to demonstrate the inspection programme in the mandated SB has been developed using DT data and/or appropriate service-based inspection results. The outcomes of Query 3 branch to two unrelated boxes (Q4 – if mandated by an AD) or (Q7- if not mandated by an AD).

Query 4 – Does the SB or service instruction contain terminating action?

Query 3 established that the inspection programme for the baseline configuration is acceptable.

Query 5 – Does the terminating action have DT data?

If the terminating action has a documented continuing airworthiness inspection programme based on damage tolerance principals, then no further review is required. The SB should be documented in the list. If the terminating action does not have DT data, or the status of the inspection programme cannot be verified, then further review is necessary (Q6).

Query 6 – Does the SB address a safe-life part?

If it does no further action is required. Otherwise, damage-tolerance based inspections will need to be developed and provided to the operators. The SB should be included in the list along with where to find the required continued airworthiness inspection programme.

Query 7 – In Query 3 a structural SB that was mandated by AD was identified.

Query 7 asks if a one-time inspection is required to satisfy the intent of the requirement. If it does, it is deemed that this is being done to verify that a condition does not exist and, on finding that condition, correct that condition to baseline configuration. As such, normal SSID programmes would then be expected to cover any required continued airworthiness inspections. If a repair is necessary, it is further assumed that this was done by reference to the SRM or other suitable means. No further action is required if this is the case and, if a repair was necessary, other means exist to determine the required DT data. If no inspections or multiple inspections are required, additional evaluation is required (Q8).

Query 8 – Is this a major structural design change (e.g., modification)?

This is a TCH decision that is part of the original certification process and is not a major/minor repair decision. If it is not a major design change then proceed to Q10, if not, proceed to Q9.

Query 9 – Does the change require non-destructive inspections to verify the integrity of the structure or are normal routine maintenance inspections (as delineated in the BZI) sufficient?

This is a subjective question and may require re-evaluating the change and determining where specific fatigue cracking might be expected. If normal maintenance inspections are adequate, no further action is required. Otherwise, proceed to Q10.

Query 10 – Does the SB contain DT data for both the baseline and modified aircraft configurations?

If so, the SB is satisfactory. Otherwise, damage tolerance-based inspections will need to be developed and provided to the operators. The SB should be documented in the list along with where to find the required continued airworthiness inspection programme.

Service Bulletin Screening Procedure

1. The TCH will perform the screening and the Structures Task Group will validate the results.

2. A list of all SBs requiring action will be included in the TCH Compliance Document. Those not requiring action will not be in the list.

3. Service Bulletins included on the list will fall into one of two general types:

Type I - SBs which have existing DT data.

Type II - Service Bulletins that require developing DT data.

4. TCH actions:

Type I – No action required.

Type II – Develop DT data and make it available to operators.

5. Operator actions (apply to both SB Types):

- Review SB incorporation on a tail number basis.

- For incorporated SBs that rely on BZI (i.e., no special inspections required based on DTE performed), reconcile any maintenance planning document structural inspection escalations.

- For incorporated SBs that require DTI, verify that DTI has been included in the operations specification and include it if it is missing.

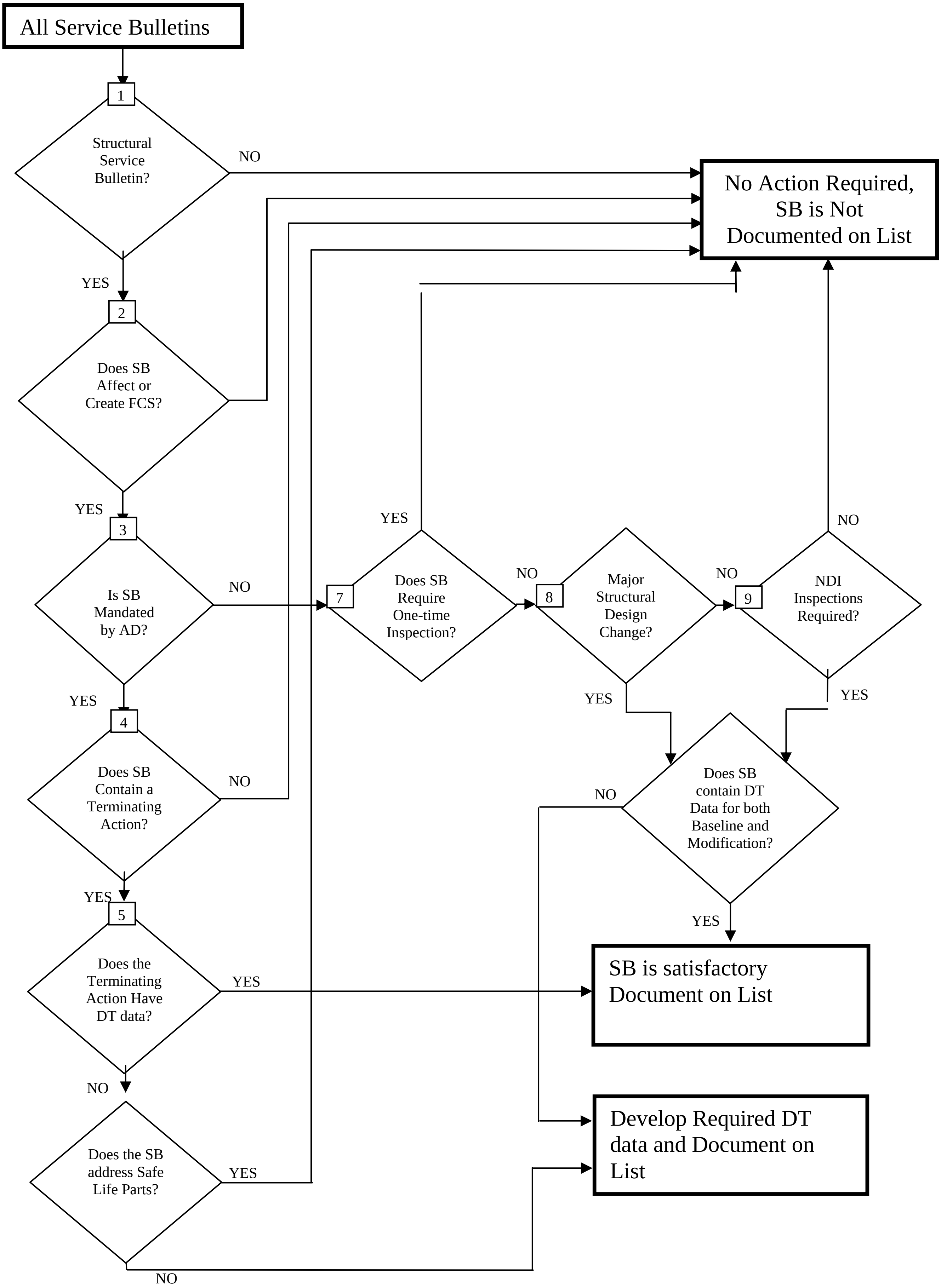


Figure A3(4)-1. Service Bulletin (SB) Flow Chart

ANNEX 5. LIST OF SIGNIFICANT STCs THAT MAY ADVERSELY AFFECT FATIGUE CRITICAL STRUCTURE

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 or pylon modifications.

5. Engine hush-kits.

6. Wing modifications such as installing winglets or changes in flight control settings (flap droop), and modification of wing trailing edge structure.

7. Modified skin splices.

8. Antenna Installations.

9. Any modification that affects several stringer or frame bays.

10. An modification that covers structure requiring periodic inspection by the operator's maintenance programme.

11. An modification that results in operational mission change that significantly changes the manufacturer's load or stress spectrum (e.g., passenger-to-freighter conversion).

12. An modification that changes areas of the fuselage that prevents external visual inspection (e.g., installation of a large external fuselage doubler that results in hiding details beneath it).

13. In general, attachment of interior monuments to FCS. Interior monuments include large items of mass such as galleys, closets, and lavatories.

APPENDIX 4

Guidelines for the development of a corrosion control programme

1. GENERAL

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:

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

(b) 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 DAHs who are developing and implementing a Corrosion Prevention and Control Programme (CPCP) for aeroplanes maintained in accordance with a maintenance programme developed in compliance with Part M M.A.302.

CPCPs have been developed by the DAH 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 ATA MSG-3 Scheduled Maintenance Development document, which introduced the CPCP concept in revision 2, circa 1993. 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 AMC.

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/DAH. The Agency may, also, establish *allowable limits*. The DAH 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 and 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.

  <u>OR,</u>

  <u>Corrosion occurring between successive inspections that is widespread and requires a single blend-out approaching allowable rework limits. i.e. it is not light corrosion as provided for in Level 1, definition (3).</u>

  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 DAH.

- **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 in compliance with the maintenance programme of Part-M an operator should include in its maintenance or inspection programme an approved CPCP. An operator may adopt the baseline programme provided by the DAH or it may choose to develop its own CPCP, or may be required to if none is available from the DAH. In developing its 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 jeopardises 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:

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

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

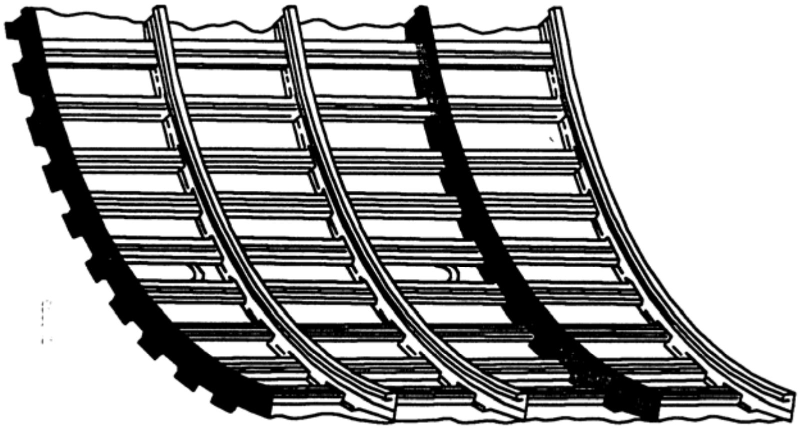
(c) The protective treatments used;

(d) The general practices applied during construction and maintenance; and

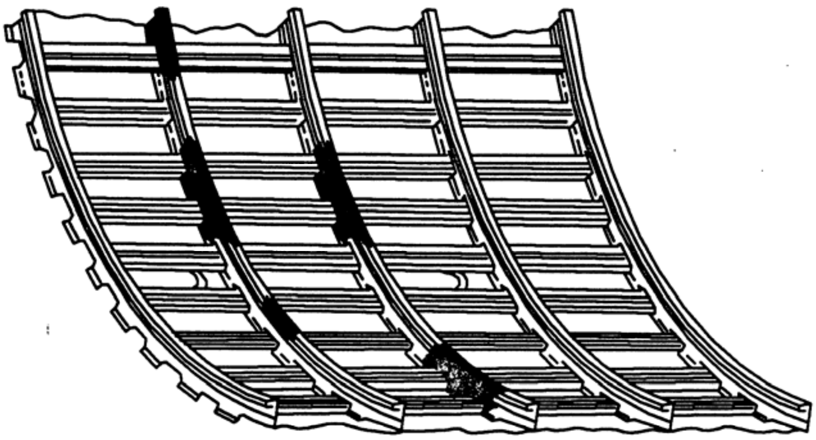
(e) Local and widespread corrosion (See Figure A4-1).

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.

EXAMPLES OF LOCAL AND WIDESPREAD CORROSION IN FUSELAGE FRAMES



LOCAL CORROSION
(Corrosion occurring in non-adjacent frames)



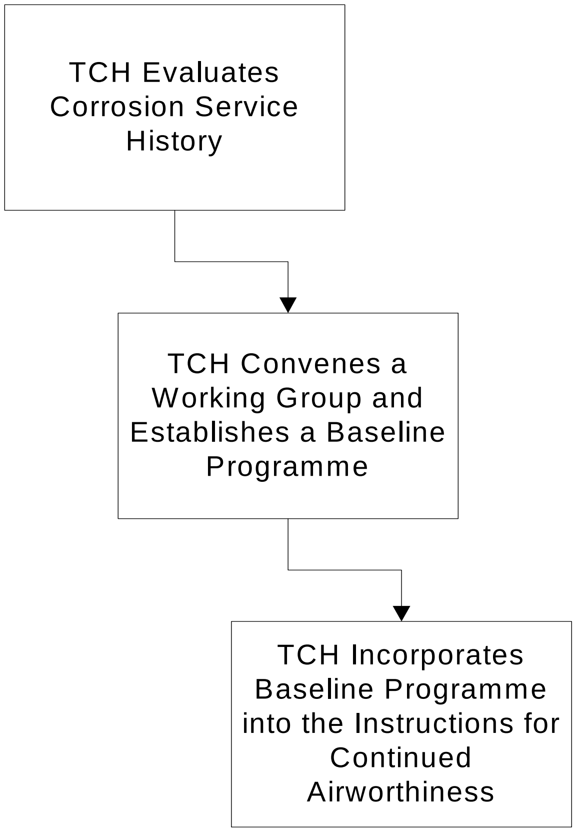
WIDESPREAD CORROSION
(Corrosion occurring in adjacent frames)

Figure A4-1

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. Where no similar design with service experience exists those structural features concerned should be assessed using the environmental damage approach of ATA MSG-3. 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 A4-2)

Figure A4-2: Type-Certificate Holder Developed Baseline Programme



3.1.3 Operator Developed Programme.

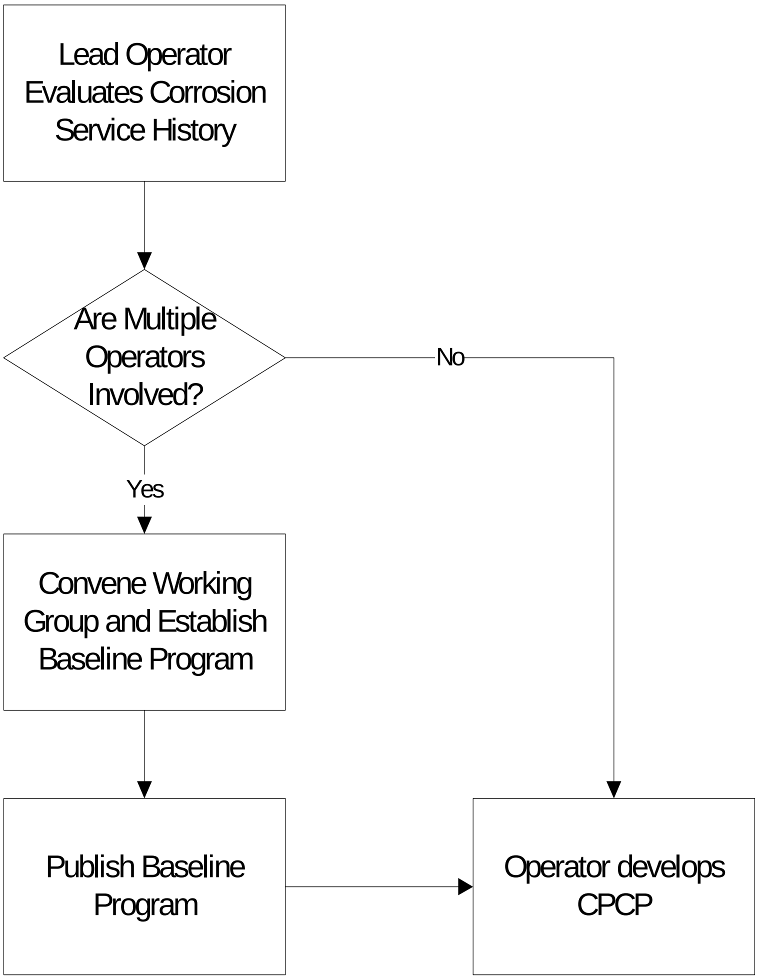
There may be instances where the TCH does not provide a baseline programme. In such instances, an operator may develop its CPCP without using a baseline programme, as long as the operator developed CPCP is consistent with the requirements.. It would be beneficial for an operator developing its own CPCP 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.

(a) 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.



(b) **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 jeopardise 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 jeopardise 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 categorising 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:

(a) Removal of all systems equipment and interior furnishings to allow access to the area.
(b) Cleaning of the area as required.
(c) Visual inspection of all task areas and zones listed in the baseline programme.
(d) Removal of all corrosion, damage evaluation, and repair of structure as necessary.
(e) Unblocking holes and gaps that may hinder drainage.
(f) Application of corrosion protective compounds.
(g) 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 DAH 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:

(a) 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)

(b) 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.

(c) The operator should not defer maintenance actions for Level 2 and Level 3 corrosion. These maintenance actions should be accomplished in accordance with the operator's maintenance manual.

(d) 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. <u>DEVELOPMENT OF OPERATORS PROGRAMME</u>

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:

(a) Aeroplanes that have exceeded the implementation threshold for certain tasks,
(b) Aeroplanes being removed from storage,
(c) Unanticipated scheduling adjustments,
(d) Corrosion findings made during non CPCP inspections,
(e) Adding newly acquired aircraft, and
(f) 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 paragraph 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:

(a) 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.

(b) 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 Paragraph 3 of this appendix for a baseline programme as well as the provisions listed in sub-paragraphs 4.1.1 through 4.1.6 of this paragraph.

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 Figure A5-1. 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 A5-2. 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)

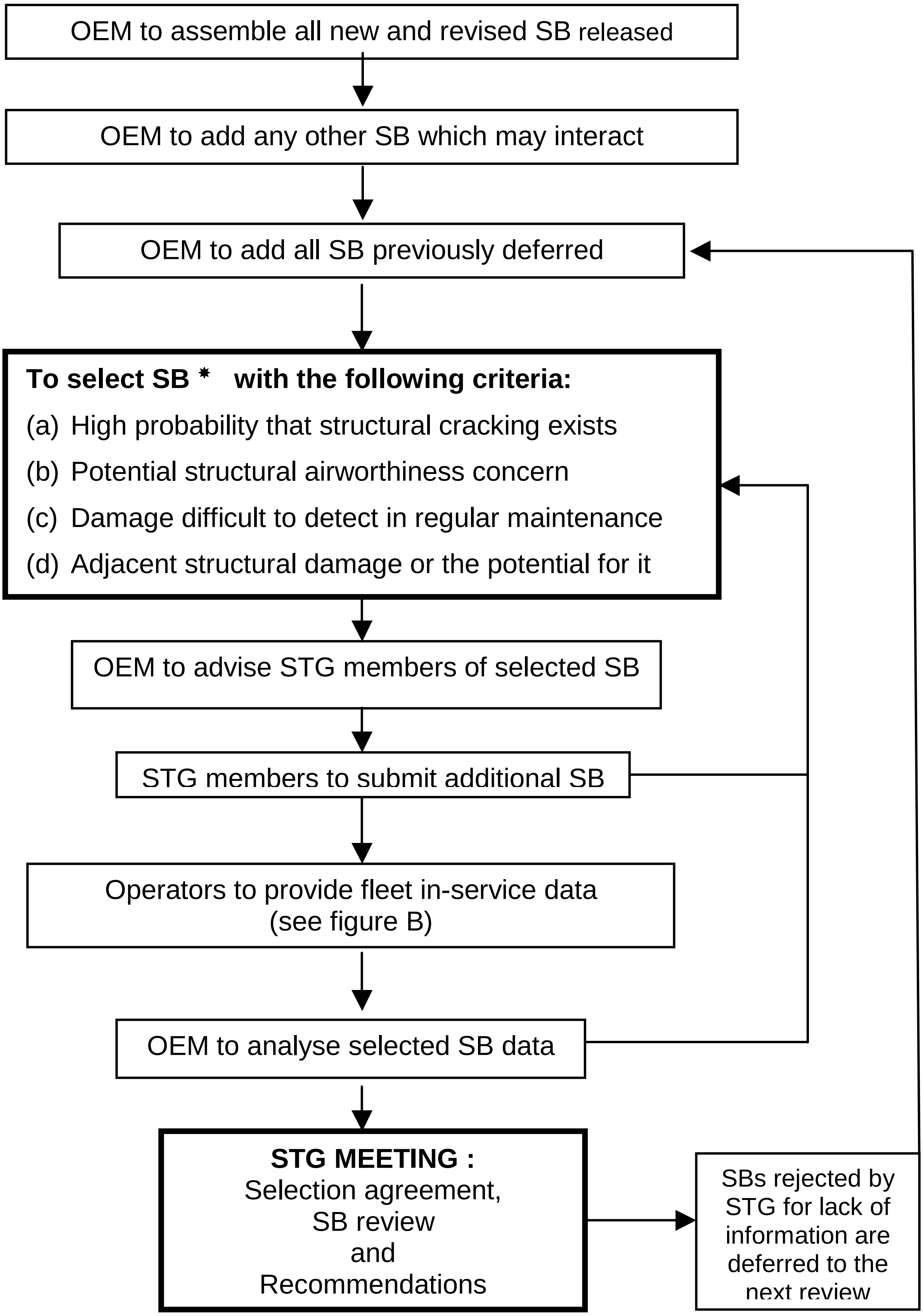
3. STG MEETING, SB REVIEW AND RECOMMENDATIONS

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 A5-2) against each criteria to come to a consensus recommendation. Such a STG recommendation for a selected SB shall consider the following options:

- (a) To mandate a structural modification at a given threshold
- (b) To mandate selected inspection SB
- (c) To revise modification or repair actions
- (d) To revise other SB in the same area concerned by damages
- (e) To review inspection method and related inspection intervals
- (f) To review ALI/MRB or other maintenance instructions
- (g) 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 A5-1: 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 A5-2: 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.