A REPORT OF THE AIRWORTHINESS ASSURANCE WORKING GROUP

RECOMMENDATIONS CONCERNING ARAC TASKING FR Doc. 04-10816
RE: AGING AIRPLANE SAFETY FINAL RULE
14 CFR 121.370a AND 129.16
TASK 3 FINAL REPORT

FINAL REPORT

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REVISION PAGE

LTR	DATE	CHANGE	PAGES ADDED	PAGES DELETED	PAGES CHANGED	APPROVED BY
A	11 Apr 07	Page 9, Paragraph A2, Change the word "need" to "should". Page 11, Repair Recommendation No. 3, Change the phrase "…recommends that repairs for WFD be addressed on a ….." to "….recommends that published repairs be addressed for WFD on a….."			9, 11	AWH

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List of Abbreviations

The following abbreviations are used throughout this report

AAWG	Airworthiness Assurance Working Group
AC	Advisory Circular (FAR)
AD	Airworthiness Directive
ALS	Airworthiness Limitation Section
ARAC	Aviation Rulemaking Advisory Committee
ATC	Amended Type Certificate
CAR	Civil Airworthiness Requirements
CFR	Code of Federal Regulations
DAH	Design Approval Holder
DSG	Design Service Goal
EASA	European Aviation Safety Agency
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulation
HPF	Hours per Flight
ISP	Inspection Start Point
LOV	Limit of Validity
MED	Multiple Element Damage
MPD	Maintenance Planning Document
MSD	Multiple Site Damage
MTGW	Maximum Takeoff Gross Weight
NPA	Notice of Proposed Amendment
NPRM	Notice of Proposed Rule Making
PMI	Principal Maintenance Inspector (FAA)
OIP	Operator Implementation Plan
RAG	Repair Assessment Guidelines
RAM	Repairs, Alterations and Modifications
RAP	Repair Assessment Program
REG	Repair Evaluation Guidelines
SB	Service Bulletin
SMP	Structural Modification Point
SRM	Structural Repair Manual
STC	Supplemental Type Certificate
STG	Structures Task Group
RI	Repeat Inspections
TC	Type Certification
TCH	Type Certificate Holder
WFD	Widespread Fatigue Damage

Executive Summary

On May 13, 2004, the FAA published a new ARAC tasking and assigned it to the Transport Airplane and Engine Issue Group/Airworthiness Assurance Working Group. The Tasking requested Industry assistance in preparing guidance material for certificate holders wishing to show compliance to the Aging Airplane Safety Final Rule, 14 CFR 121.1109 and 129.109. The Tasking consisted of four sub-tasks to be accomplished in two phases. In Phase 1, tasks 1, 2, and 3 are completed; in Phase 2, task 4 will be completed.

The AAWG has submitted two reports (References B.5.n and B.5.o) dated 28 October 2005 and 12 May 2006, respectively. The first report contained an AC which proposed a means of compliance for damage tolerance inspections and procedures for repairs (Task 1). The second report presented a modified version of the originally submitted AC that provided guidance for the DAH (refers to Type Certificate Holder (TCH) or Supplemental Type Certificate Holder) and operators in developing damage tolerance inspections and procedures for alterations (Task 2). This report presents a separate advisory circular (AC) that provides direction to the TCH and Operator in determining maintenance programs for baseline fatigue critical structure for widespread fatigue damage (WFD). In addition, this report outlines the procedures to be used for the consideration of widespread fatigue damage that might develop in repairs, alterations and modifications (RAMs) to baseline structure. This report completes Task 3.

Conclusions and Recommendations (Widespread Fatigue Damage)

The proposed AC addresses actions to be accomplished to preclude the development of WFD in the baseline as delivered structure as modified by any AD. The report also outlines how repairs and alterations to both baseline structure as well as repairs to alteration and modifications should be considered for WFD.

The AC contained in Appendix C conforms to FAA policy delineated in Reference B.2.a and represents a consensus position of Industry. The positions developed and presented in this report have evolved over a period of time and are based on reasoned discussions that occurred during the Tasking. . However, Rulemaking is underway and guidance material is being published even as these positions are being submitted. In light of this very the conclusions and recommendations made in this report must be considered as based on the best available information. It is expected that the FAA will consider the information contained herein in developing the final guidance on this subject. Should the FAA make changes to their anticipated course of action, or if other information comes to light, specific recommendations in this report may no longer be the most appropriate course. To help continue in moving this effort forward, the AAWG is

available to discuss any of these positions that the FAA may find unclear or confusing, or based on outdated assumptions.

The following conclusions and recommendations are made:

Conclusions

A. ARAC Tasking

1. The AAWG concludes that the simultaneous requirements of developing data to enable operator compliance to both the DT and WFD rules for all applicable airplanes would create a significant resource shortfall across the industry with no clear means to mitigate that shortfall.
2. The AAWG concludes that there is insufficient fleet evidence to support a rule for the assessment of RAMs for WFD and that the FAA should not promulgate final rules that contain provisions for the assessment of RAMs for WFD. Therefore specific guidance, in the form of an AC for WFD, is not warranted for RAMs at this time. A
3. The AAWG concludes that there is a significant cost burden imposed on the TCH, operator and FAA to require separate updates of repair publications and assessments for DT and WFD if requirements for WFD of repairs are mandated at a later time.
4. The AAWG concludes that the Structures Task Group process will be required to develop the necessary data under §25.WFD for operator compliance to §121.WFD and §129.WFD.
5. The AAWG concludes that a review of all alterations would create an unnecessary burden on the industry that would not enhance continued airworthiness.
6. The AAWG concludes that a simplified methodology is needed to support third parties for the WFD development for RAMs.
7. The AAWG concludes that there is a concern that the subjects discussed in this report have not been harmonized between the FAA and EASA.

B. Baseline Structure

1. The AAWG concludes that it is necessary to define the means of compliance for assessing the WFD characteristics of airplane baseline structure before a means of compliance could be defined for repairs and alterations.
2. The AAWG concludes that airplanes certified prior to 1958 should not be considered for WFD. These aircraft do not fall under consideration for 14 CFR 121.370a or 129.16 for Damage Tolerance, and there is insufficient information to successfully complete a WFD assessment on these airplanes.
3. The AAWG concludes that the baseline configuration, including model variants and any mandated modifications should be defined prior to the analysis of specific WFD prone areas.
4. The AAWG concludes that an LOV is only required if the high-time airplane will reach and exceed the DSG.

5. The AAWG concludes that the timing of the development of an LOV and maintenance actions should be based on the flight cycles and/or hours of the high-time airplane relative to the DSG
6. The AAWG concludes that an LOV extension package will, based on current understanding of the processes and available technology, take a minimum of 4 years to prepare and should follow the same process used to develop the initial LOV.
7. The AAWG concludes that there is a misunderstanding in the industry of what the DSG represented and has therefore further developed this topic in the report.

C. Repairs

The AAWG concludes that there is no information that a properly installed repair has exhibited WFD in service.

D. Alterations

AAWG concludes that certain categories of alterations have the potential of developing WFD and should be reviewed.

Recommendations

A. ARAC Tasking

1. In support of the ARAC tasking and possible future rulemaking on RAMs, the AAWG provided the following information.
   a. An analytical methodology to be used by third parties to perform WFD evaluations of repairs and alterations.
   b. Scope of testing required to support WFD evaluations of new repairs and alterations.
   c. Screening process for new repairs and alterations.
   d. Approval process for new repairs and alterations.
   e. Assessing need to evaluate existing repairs and alterations.
2. If the FAA promulgates new rulemaking for assessment of RAMs for WFD, the AAWG recommends that guidance information should be placed in an amended AC 120-WFD.
3. The AAWG recommends that the requirements and means of compliance for Damage Tolerance and Widespread Fatigue Damage in FAA and EASA are harmonized.

B. Baseline Structure

1. The AAWG recommends that the FAA adopt AC 120.WFD as a means of compliance for WFD assessment of baseline structure as presented in Appendix C.

2. The AAWG recommends that the airplanes most at risk for the development of WFD be the first to be evaluated for WFD. These would include all airplanes that have exceeded their DSG.
3. The AAWG recommends that the applicability of the WFD rule be changed to match applicability requirements of the AASR and EAPAS proposed rule. Specifically, the applicability statement should be amended to include the following criteria - Transport category, turbine-powered airplanes with a type certificate issued after January 1, 1958.
4. The AAWG recommends that the TCH should be allowed to define the structural baseline configuration of the airplane, including all model derivatives, incorporating those structural ADs that have a significant effect on the WFD characteristics of the airplane.
5. If the high-time airplane has already exceeded the DSG, the AAWG recommends the LOV be made available to the FAA by June 20, 2009 or one and a half years prior to the compliance date of the WFD rule, whichever is later.
6. For airplanes where the high-time airplane is within five years of reaching the DSG, the AAWG recommends the LOV for the baseline structure should be made available to the FAA three and a half years after the effective date of the rule or one and a half years prior to the time the high time airplane reaches DSG, whichever is later.
7. For all other airplanes, the AAWG recommends that the process of determining the LOV needs to begin when the high-time airplane reaches 75% DSG or roughly 5 years before it reaches the DSG.
8. The AAWG recommends the operator contact the TCH to initiate LOV extension preparation a minimum of 4 years in advance of the need.
9. The AAWG recommends the TCH establish/maintain STG's for the affected airplane models to develop the required data, including the LOV and associated maintenance actions as well as provide technical and economic input to the overall process.

C. Repairs

1. For airplanes that require updates to their publications for DT and which have airplanes above DSG on December 20, 2009, the AAWG recommends that the update for WFD compliant repair publications occur at the same time.
2. For all other airplanes, the AAWG recommends that for repairs, WFD is addressed by the TCH by updating their publications (SRMs, SBs, RAG, DT Compliance Document, etc…) to include WFD instructions by the same time they publish the WFD LOV and maintenance actions for the baseline structure.
3. For airplanes that will require updates of published repair data, the AAWG recommends that published repairs be addressed for WFD on a go forward basis and should not occur separately from the DT review for Pre-amendment 45 airplanes. A

4. The AAWG recommends that there should be no rulemaking initiative that would require retrospective requirements to re-review repairs for WFD after a DT assessment, unless a specific airworthiness concern is identified.

D. Alterations

The AAWG recommends that alterations for WFD be addressed in a two-step approach.

a. New Alterations certified after the effective date of the §25.WFD should be handled by the change product rule 14 CFR 21.101 by making 14 CFR 25.WFD applicable.
b. Existing alterations should be categorized into a few special types and reviewed in a FAA Special Certification Review (SCR) with the outcome being a determination if a WFD assessment is necessary in addition to the already required DT assessment.

1. Introduction

A. New Tasking

On May 13, 2004, the FAA published a new ARAC tasking and assigned it to the Transport Airplane and Engine Issue Group/Airworthiness Assurance Working Group. The Tasking requested Industry assistance in preparing guidance material for certificate holders wishing to show compliance to the Aging Airplane Safety Final Rule, 14 CFR 121.1109 and 129.109. The Tasking consisted of four sub-tasks to be accomplished in two phases. In Phase 1, Tasks 1, 2, and 3 are completed; in Phase 2, Task 4 is completed. The complete tasking statement is contained in Appendix B. Section 2 of this report documents the data provided to support the task contained in Phase 1, Task 3 - Consideration of Widespread Fatigue Damage for RAMs.

B. Airworthiness Assurance Working Group

The AAWG is a duly constituted Federal Advisory Committee Act (FACA) entity. The AAWG reports to the Aviation Rulemaking Advisory Committee, Transport Airplane and Engine Issues Group (ARAC TAEIG). The AAWG was formed shortly after the 1988 Accident in Hawaii involving an older Boeing 737 in which a large section of fuselage departed the airplane. The AAWG has been active ever since examining the health of the fleet and proposing additional programs to maintain overall integrity of the commercial fleet. The membership of the AAWG consists of representation from:

ABx Air*
Airbus *
Airline Pilot's Association
American Airlines*
Air Transport Association
American West Airlines
Boeing Commercial Airplanes*
British Airways*
Continental Airlines*
Delta Air Lines Incorporated*
Evergreen International Airlines
Federal Aviation Administration*
Federal Express*
Fokker Service
International Air Transport
Japan Air Lines*
EASA*
Northwest Airlines*
Regional Airline Association
United Airlines*
United Parcel Service*
US Airways*

The AAWG established a task group to prepare and finalize the recommendations from this Tasking. The entities identified by an asterisk participated in the task group. A list of meeting venues and meeting attendance is documented in Appendix H respectively.

2. Task 3 – WFD Considerations for Baseline Structure and RAMs

A. Tasking Statement

The AAWG was asked to consider the following in regards to WFD of RAMs:

Provide a written report providing recommendations on how best to enable part 121 and 129 certificate holders of airplanes with a maximum gross take-off weight of greater than 75,000 pounds to assess the WFD characteristics of structural repairs, alterations, and modifications as recommended in a previous ARAC tasking.

B. Introduction To Task 3

In May 2006, the FAA issued a draft AC 120-YY that attempted to define the steps needed to perform a WFD assessment of the baseline, as delivered structure. The industry reviewed this document and provided feedback to the FAA in September 2006. That feedback largely discounted AC 120-YY as a usable document and requested that the industry be enlisted to assist the FAA in rewriting the document. The information contained in this section and Appendix C provides industry guidance and a proposed AC on this matter. The AAWG believed that it was necessary to define the means of compliance for the baseline structure before a means of compliance could be defined for repairs and alterations. To this end, the AAWG developed AC 120.WFD (see Appendix C) that addresses TCH compliance actions required for baseline structure. Those compliance actions include the determination of an LOV and supportive maintenance actions to preclude WFD up to the LOV for the baseline structure. The AAWG recommends that the FAA adopt AC 120.WFD as a means of compliance for the baseline structure.

C. Summary of AAWG Position on Repairs and Alterations

1) Repairs

For repairs, the AAWG recommends that the TCH update their publications (SRMs, SBs, RAG, DT Compliance Document, etc…) to include WFD instructions at the same time they issue the WFD maintenance requirements for the baseline structure. If the TCH has an additional task to update his documents for damage tolerance (DT), the AAWG suggests that the update for WFD occur at the same time. The TCH should consider doing this with or without specific rule requirements for WFD. Once published, the operators have the opportunity to revise their maintenance program to include repairs that have maintenance instructions that include both DT and WFD considerations for future published repairs.

2) Alterations

For Alterations, the AAWG recommends that alterations for WFD be addressed in a two-stage approach. For new alterations certified after the effective date of

the §25.WFD, those alterations should be handled by the change product rule 14 CFR 21.101 already in place by making 14 CFR 25 Amendment 96 applicable. For existing alterations, they should be categorized into a few special types that are detailed later in this report. Depending on category, these alterations should be reviewed in a Special Certification Review (SCR) with the outcome being a determination if additional action is required.

D. AAWG Understanding of FAA Position on WFD.

1) WFD NPRM

There have been no WFD attributed accidents in the last nineteen years. There is, however, a technical concern that WFD will occur in the commercial fleet and could potentially affect any airplane in service.

The AAWG is aware that the FAA is considering that when and if the final rule is published, it may be limited to the baseline structure since this is the only structure that has demonstrated development of WFD in-service.

The original concept for the NPRM was to require the TCH to establish an LOV for all models on a certain date via a part 25 rule and then require the operators to adopt the LOV requirement into the maintenance program through an operational rule.

Because of due process considerations, any maintenance actions required to preclude WFD up to the LOV will need to be mandated by AD.

2) Repairs

The FAA position on existing un-published repairs in the WFD NPRM was that a WFD evaluation was not required until an extension of the OL (LOV) was sought. Notwithstanding, the FAA NPRM proposes the TCH update published repair data for all applicable airplanes by a certain date. In making this finding, the FAA has determined that rules for existing repairs requiring a DT evaluation alone are sufficient up to first LOV.

Given the repairs position put forward in the WFD NPRM, it would be extremely difficult to include existing repairs in the proposed rule without supplemental rulemaking since this would be viewed by OMB as increased scope.

The AAWG is aware that the FAA is considering the options for the assessment of existing repairs for WFD at this time

3) Alterations

The NPRM proposes the TCH to make available guidelines to third parties to enable them to determine the appropriate maintenance actions for WFD of alterations. In response to this requirement the industry commented that this was not an achievable task based on several factors. The AAWG is aware that the FAA is considering postponement of the requirement for WFD of alterations

since there are no usable guidelines for third parties to use and the development of these guidelines are not likely

4) Future Action On RAMs

Any future action on RAMs will be dependent on the publication of a rule for baseline structure and the development of acceptable standards for third parties.

It is the AAWG's understanding that it is the desire of the FAA to align the WFD requirements for RAMs with the DT rule, however timing considerations may force implementation at a later time by supplemental NPRM.

The FAA has requested the AAWG provide information that would be used to support future WFD rulemaking for repairs and alterations, should the FAA decide that repairs and alterations require such rules.

5) The FAA ARAC Tasking

While the direction of the FAA rulemaking is not fully known at this time, the FAA's desire is to have ARAC complete the tasking to provide credible information should rulemaking be later found to be necessary. They are interested in the AAWG position on Baseline structure and RAMs.

E. Harmonization

1) Potential Impact to the Industry if EASA Deviates From FAA Approach

There is an AAWG concern that EASA may not follow the FAA approach adopted for both DT and WFD and may create additional compliance issues for the industry. In 2006, EASA issued NPA 05-2006 dealing with the Aging Airplane requirements. The AAWG is aware that the NPA does not follow the FAA chosen approach for either DT or WFD. In this NPA the EASA asked for review of all modified or repaired structure to ensure that any required maintenance action for the prevention of WFD is defined and enacted. This is in contradiction to the FAA proposed plan to review repairs later in life or maybe only at DSG or LOV. If two different authorities publish conflicting requirements, this will mean that the TCH will need to comply with the more restrictive rule. Therefore the TCH will have to perform the WFD analysis and update his in-service documents covering all RAMs and possibly do the work twice as described above.

There is distinct possibility that if the update of published documents twice, that the two sets of documents will be quite different and lead to significant confusion over which standards are applicable. This would also be a challenge for the PMI to approve the operator maintenance plan.

Some foreign operators also operate N-registered airplanes in addition to airplanes registered in their home countries. This could present a significant increase in cost of maintaining two separate maintenance programs within one model fleet.

Approximately 30 % of the airplanes in service today are leased airplanes which are transferred frequently from one operator to another. Having a non-harmonized WFD rule will have a significant impact on the leasing companies as well as when an operator buys or sells an airplane to another part of the world. In this case this would either mean a reduced residual value of the airplane or additional cost to upgrade the plane to comply with the different requirement.

2) AAWG Recommendations Concerning Harmonization

The AAWG recommends that the FAA and EASA requirements and means of compliance for Damage Tolerance and Widespread Fatigue Damage are harmonized so that there is only one means of compliance.

F. AAWG Previous Recommendations RE: WFD

1) Previous ARAC Recommendations regarding WFD to Baseline Structure

In 2001, ARAC recommended (see Reference (B.5.d)) that large transport airplanes can be operated up to DSG before a WFD assessment of the baseline structure is required. This position was restated in 2003 (see Reference (B.5.b)) and again in the October 2005 report (see Reference (B.5.n)). This recommendation was primarily for airplanes certified prior to 14 CFR Amendment 45 yet the AAWG believed that this is also appropriate for all post amendment 45 airplanes where a two lifetime fatigue test was performed. One of the AAWG recommendations was to determine a Limit of Validity (LOV) for the maintenance program. Another AAWG recommendation was to establish maintenance actions that would preclude the development of WFD on the baseline structure up to the LOV.

2) Discussion of Previous Recommendations

Separately the FAA issued an interim final rule in December 2002 requiring operators to have a damage tolerance based structures maintenance program. This operational rule, the Aging Airplane Safety Rule (AASR) was finalized in February 2005 with a compliance date of December 2010. In addition, the FAA published NPRMs for WFD and supplemented the AASR rules in April 2006 that proposed that specific timelines be imposed on the type certificate and STC holders in developing work packages required to support operator compliance to the final and proposed rules. These time schedules created significant and untenable resource issues within the industry.

The WFD and AASR rulemaking initiatives in 2006 would place a regulatory requirement on the TCH via a 14 CFR Part 25 rule to produce documentation that would support operator compliance to a corresponding a 14 CFR Part 121/129 operational rule. This rulemaking change is a result of a new FAA Policy (Reference B.2.a) that defines the roles and the responsibility/burden of compliance and affects the organization of guidance material to support compliance. Specifically, the TCH will be required to make available any

necessary compliance data that the operator requires to demonstrate compliance to the operational rules

The AAWG still believes that guidance material is needed to support the TCH to develop a WFD plan for baseline structure

G. AAWG Discussion and Recommendations for Baseline Structure

1) 2007 ARAC Recommendations regarding WFD to Baseline Structure

The development of maintenance instructions for RAMs requires the knowledge of the WFD requirements for the baseline structure. Attempting to address RAMs before the baseline structure may result in inappropriate and perhaps incorrect maintenance instructions. The definition of the baseline WFD program forms the basis of how future actions must be treated. For example, a baseline detail that requires inspections for WFD will be mandated by AD. Repairs and/or alterations to that detail will require an AMOC. Therefore, the AAWG has made a determination that a program to address WFD on baseline structure needs to defined prior to considering how and when to implement a means to address WFD of RAMs.

The AAWG recommends that the program for baseline structure consist of a determination of LOV and associated maintenance actions to preclude WFD up to the LOV. These recommendations are consistent with the 2001 recommendations for Pre-amendment 45 and further extend these recommendations to airplanes certified to amendment 45 or later as well. The AAWG has drafted a suggested revision to AC 120-yy entitled AC 120.WFD. This AC is contained in Appendix C of this report.

2) AAWG Recommended Changes for Guidance Material For Baseline Structure

a) Need to Address High-Risk Airplanes First.

The proposed FAA WFD NPRM required that all airplanes receive an audit for WFD on the baseline structure by a certain date. This requirement included the establishment of an LOV and any maintenance actions required to preclude the occurrence of WFD up to the established LOV. The FAA based their requirements on the 2001 AAWG recommendations concerning WFD. These recommendations were provided without the knowledge of FAA's intent to publish the Aging Airplane Safety Rule in late 2002. As a result, the simultaneous requirements of developing data to enable operator compliance to both rules for all applicable airplanes would create a significant resource shortfall across the industry with no clear means to mitigate that shortfall.

The AAWG recommends that the airplanes most at risk for the development of WFD be the first to be evaluated for WFD. These would include all airplanes that have exceeded their DSG. The AAWG has established that most of the work has already been completed on the airplanes in question and it would be

possible to have the maintenance material ready by the compliance date established in the AASR Final Rule. The Airplane Models that fall into this category would be:

A300*
A300-600
A310-200/300

B707/720*
B727*
B737 CL*
B747 CL*
DC-8*
DC-9/MD-80*
DC-10*

L1011*

F28*

BAC 1-11*

**** Eleven Aging Airplane Models considered by the AAWG***

For airplanes where the high time airplane has not exceeded the DSG, the AAWG recommends that the data required for compliance to the WFD rule be provided by one and a half years before the high-time airplane reaches DSG or three and a half years after the effective date of the rule whichever occurs later. This is consistent with the AAWG recommendations for a proposed amendment to AC 91-56 which was never released.

See Appendix F for a discussion of DSG and how it would be applied in determining when a High Time Airplane would exceed the DSG.

b) Airplanes Certified Prior to 1958

The FAA NPRM includes consideration for all airplanes certified to operate under 14 CFR Parts 121/129 with maximum takeoff gross weights greater than 75,000 lbs. There are several airplanes that were certified prior to 1958 that will qualify for consideration for WFD under this proposed requirement. These airplanes are not considered under 14 CFR 121.370a or 129.16 for Damage Tolerance. However, these airplanes would require consideration under the proposed rules for WFD. While the original NPRM submitted in 2001 did allow this interpretation, the AAWG never in fact intended such an interpretation. The main concern that the AAWG focused on was the 11 airplane models listed above in paragraph 2.F.2.a.

The AAWG believes that there is insufficient information based on the certification procedures and requirements existing at the time of certification, including lack of fatigue test requirements and specific airplane flight cycles and flight hour data recording requirements to successfully complete a WFD assessment on these airplanes. The AAWG also would point out that it would be impossible to complete a WFD assessment before an analysis of the damage tolerance characteristics of the airplane.

Therefore the AAWG has concluded that airplanes certified prior to 1958 should not be considered for WFD. These aircraft do not fall under consideration for 14 CFR 121.370a or 129.16 for Damage Tolerance, and there is insufficient information to successfully complete a WFD assessment on these airplanes. The AAWG recommends that the applicability of the WFD rule be changed to match certain applicability requirements of the AASR and EAPAS proposed rule. Specifically, the applicability statement should be amended to include the following criteria - Transport category, turbine powered airplanes with a type certificate issued after January 1, 1958.

c) Baseline Considerations

i. Baseline Airplane AD Configuration

The FAA NPRM on WFD contains a requirement to establish the configuration of the airplane considering all models and derivatives combined with all airworthiness directives that required structural modification. While the AAWG agrees with the basic concept presented in the FAA NPRM the provision of the requirement for ALL ADs seems inappropriate. The AAWG recommends that the TCH should be allowed to define the structural baseline configuration of the airplane to be analyzed including all model derivatives and those structural ADs that have a significant effect on the WFD characteristics of the airplane. The TCH should propose the analysis configuration to the FAA with supporting rationale.

ii. Baseline LOV Process

The development of the LOV is primarily a TCH task assisted by the operators. Two basic things must be determined:

1. Economic consideration that the airplane will be operated past DSG; and
2. Service experience necessary to complement the fatigue test evidence.

In 1999, ARAC provided some details (Reference B.5.a) concerning how LOV was to be determined. The following is an excerpt from that report:

"The process used to establish a LOV requires data that extends the fatigue test evidence. The AAWG looked at conditions to be met in defining and extending the LOV for in-service airplanes.

The defining and moving of the LOV for in-service airplanes involves four independent tasks.

The first task is to ensure that the basics of the aging airplane program are in existence. This means that the following programs are active and are achieving the desired program goals:

- *Mandatory Modifications*
- *Corrosion Prevention and Control*
- *Pressure Boundary Repair Assessment*
- *Supplemental Structural Inspections or Airworthiness Limitations*

In addition, all currently known structural airworthiness issues, including WFD, have been recognized and maintenance actions have been initiated under existing applicant processes.

The second is the collection of data necessary to extend fatigue test evidence. Fatigue Test Evidence consists of reductions of data collected from more than one of the following sources:

- *Full Scale Fatigue Test with or without tear down*
- *Full Scale component tests with or without tear down*
- *Tear down and refurbishment of a high time airplane*
- *Less than full scale component tests*
- *Fleet Proven Life Techniques*
- *Evaluation of in-service problems experienced by other airplanes with similar design concepts*
- *Analysis methods which have been parametrically developed to reflect fatigue test and service experience.*

Normally this data is airplane level data and does not reflect on any detail or component level behavior. The data collected can be used in the applicant's methods and procedures to predict a new LOV (e.g. LOV_2). In some cases, data may not exist for a component or area of the structure. In this case, the applicant may want to consider the collection of additional data as a conditional requirement before any particular airplane is allowed to operate beyond the initial LOV. Detailed teardown and refurbishment inspections are particularly effective in these conditions. Sufficient data is required to establish that WFD will be precluded to a high degree of confidence.

Third, a formal analysis of the structure for MSD/MED, done in agreement with Advisory Circular 91-56C (to be published), is required to establish specific maintenance actions for MSD/MED. This analysis predicts when MSD and MED is likely to occur and the maintenance programs required (e.g. ISPs and SMPs) to preclude the occurrence of widespread fatigue damage. During this analysis, it may be determined that additional experimental and service data is required to support analyses (tests, tear-down of retired high time aircraft).

Fourth, maintenance documents will need to be created/updated to include maintenance actions (e.g. inspections (ISP, RI), and modifications (SMP)) for those areas where it has been predicted that MSD/MED will occur before the newly established LOV (e.g. LOV_2). The ALI will also need to be updated with LOV_2."

The AAWG has had several discussions with the FAA since the publication of the WFD NPRM where the FAA requested clarification of the industry position presented above. These clarifications deal with the AAWG position, the terminology used and a request for a formal process to derive the LOV. In response to these requests for clarification, the following is offered:

1. The FAA noticed that the AAWG has asserted that the RAP must be in place and operational as a prerequisite to starting the WFD program. The FAA has noted that not all airplanes have a RAP and has asked if this means that a RAP will be developed for airplanes that do not have it. The AAWG believes that the development of a RAP is an economic issue for the TCH to consider: some airplanes will benefit from a RAP; others may not. Nevertheless a REG is required for the AASR and gives guidance to the operators in determining damage tolerance based maintenance programs for repairs on the airplanes they own. As a result the AAWG is removing this item from the prerequisites list.

2. The FAA has noted that some terminology could be confusing. The AAWG offers the following clarifications:
    a. ***Tear down***, when used by itself means the detail examination of disassembled components using visual (magnifying glass, dye penetrant etc) and/or other NDI techniques (eddy current, ultrasound etc) to establish the structural condition. Structure that undergoes this type of a tear down is considered destroyed in the process.
    b. ***Tear down and refurbishment*** is a process where the structural condition of a local area of an in-service airplane is determined by the removal of fasteners and subsequent inspection of the holes using NDI techniques. Following inspection and correction of any conditions found, the holes are oversized, appropriate sized fasteners are re-installed and the airplane is returned to service. Data collected from a number of airplanes is useful in establishing specific fatigue test evidence were actual fatigue test may not exist.
    c. ***Component*** is used to mean a major or entire section of the Wing, Fuselage or Empennage.

3. In consideration of a formal process to arrive at an LOV, the AAWG notes that this process is TCH specific. Airbus and Boeing have nonetheless established a generic process that could be used to develop an LOV. The following, which is also included in the proposed AC, is offered as one way but not the only way of determining LOV:

(iii) Ascertain Interest To Operate The Airplane Past DSG

The first objective is normally determined with conversations with the operators/owners of the airplane model under consideration. The TCH should establish a candidate LOV. Nominally the means to develop the candidate LOV will be different for airplanes that have reached DSG verses those who have yet to reach it. Older airplanes may rely on Fleet Proven life to provide an initial estimate; younger airplanes may rely on an estimate based on a reduction of the fatigue reduction factor used in the analysis or test data. Discussion with operators may also be useful in determining an initial number. A candidate LOV does not necessarily establish the actual LOV. Depending on the airplane under consideration, the LOV may be expressed in terms of flight cycle, flight hours, or both and should take into account the anticipated future usage of the fleet, as well as the means available to the TCH to justify it.

(iv) Service Experience Necessary To Complement The Fatigue Test Evidence

The second objective is accomplished by the collection and reduction of data necessary to extend Fatigue Test Evidence. This task is normally performed by the TCH. Fatigue Test Evidence is a collection of direct and derived data and includes data from the following:

- Data from Fatigue Tests
  - Full scale fatigue test with or without tear down
  - Full scale component (wing, fuselage, empennage, etc.) tests with or without tear down
  - Less than full scale component tests
- Data derived from Analysis based of Fatigue test and service experience
  - Fleet proven life techniques
  - Tear down of a high time airplane
  - Evaluation of fatigue test data and in-service problems experienced by other airplanes with similar design concepts using analysis methods which have been parametrically developed to reflect fatigue test and service experience.

Normally the data collected above is airplane level data. It is assumed that any issue that has been revealed in service has already been addressed and the data collected is representative of future predictive behavior. The data collected can be used in the applicant's methods and procedures to predict the LOV. In some cases, data may not exist for a component or area of the structure. In this case, the applicant may want to consider the collection of additional data as a conditional requirement before any particular airplane is allowed to operate beyond the DSG or previously established LOV. Detailed teardown and refurbishment inspections are particularly effective in these conditions. Sufficient

data is required to establish that WFD will be precluded to a high degree of confidence.

The validation of the LOV for a particular fleet represents an evaluation of the data available, including technical, economic and managerial issues. It is more than examining fatigue test evidence.

Once established, the candidate LOV is validated by the seven-step process outlined below:

Step 1 – Validate that the Aging Programs are in place and operational.

Step 2 – Examine the data that establishes the amount of Fatigue Test Evidence available.

- **a.** Full scale Fatigue Test Results – WFD findings and what done about the findings including extension of test coverage to other models and derivatives.
- **b.** Fleet specific in-service WFD findings and what done about them. Rationalization with fatigue test results.
- **c.** Calculation of the Fleet Proven Life.
- **d.** Establish an understanding of the Design factors such as:
  a. Fatigue Reduction Factor
  b. Expected Wing/Fuselage/Empennage/1P Stress levels
  c. Analytical predicted fatigue lives
- **e.** Rationalization of other fleet model MSD/MED events relative to expected in-fleet fatigue performance and what was done about it. Cross model safety evaluations.
- **f.** Understanding of which areas of the airplane requiring additional data and establish a plan to collect that data.
  a. Additional fatigue tests; and/or,
  b. Teardown and refurbishment of a percentage of in service airplanes prior to entering an extended usage; and/or,
  c. Destructive teardown of one or several retired high-time airplanes.

Step 3 - Estimate the cost of additional TCH/operator actions required in collecting additional Fatigue Test Evidence

Step 4 - Make an upper limit estimate of the LOV based on the data examined. This will rely on looking on the fatigue test and analysis data collected in Tasks B and C.

Step 5 – Evaluate the maintenance actions and economics required to maintain safety out to the candidate LOV.

1. Determine the areas that are susceptible to WFD (See Appendix 4)

2. Establish the analysis configuration relative to production variants and AD mandated maintenance actions that would affect the analysis results (See Section 203 and Appendix 5)
3. Determining WFD Average Behavior (See Appendix 5)
4. For each area determine the ISP and SMP (See Appendix 6)
5. For those items that have an ISP within the candidate LOV, establish the proposed inspection if feasible.
6. For those items that have an SMP within the candidate LOV, establish the proposed rework/design change required.
7. Estimate cost of the package both to the TCH and to the operator.

Step 6 – The economics of the package must be rationalized. The candidate LOV may need to be adjusted based on the economics of additional required testing or data collection and the maintenance actions required to maintain safety. The results are the LOV.

Step 7 – Revision of required certification documents for an operator to take advantage of the LOV including the development of maintenance actions.

c) Timing of LOV Development

As discussed in Section 2.F.2.a, the AAWG has concluded that the timing of the development of LOV and maintenance actions need to be based on the flight cycles and hours of the high-time airplane relative to the DSG.

Most older airplanes already have high-time airplanes that have exceeded DSG. Airplanes certified to 14 CFR 25 Amendment 45 or later that have two-lifetime fatigue tests have had a history of reaching DSG before there is a significant probability of occurrence of WFD. Therefore, the AAWG has concluded that an evaluation for LOV is only required if the high-time airplane will reach the DSG. The determination of LOV is, in part, based on the amount of fatigue test evidence held by the TCH. Fatigue test evidence comes, in part from in-service experience. Therefore the amount of fatigue test evidence is generally maximized when the high time airplane reaches DSG allowing the highest reasonable determination of the LOV before there is a significant exposure to the prospect of developing WFD. The LOV is stated in terms of flight cycles or flight hours or both.

Based on this, the AAWG is recommending a staged approach to when the LOV is determined based on the position of the high-time airplane within a model relative to DSG.

If the high-time airplane has already exceeded the DSG, the AAWG recommends the LOV be made available to the FAA by June 20, 2009 or one and a half years prior to the compliance date of the WFD rule, whichever is later.

For airplanes where the high-time airplane is within five years of reaching the DSG, the AAWG recommends the LOV for the baseline structure should be

made available to the FAA three and a half years after the effective date of the rule or one and a half years prior to the time the high time airplane reaches DSG, whichever is later.

For all other airplanes, the AAWG recommends that the process of determining the LOV needs to begin when the high-time airplane reaches 75% DSG or roughly 5 years before it reaches the DSG.

Following FAA review and approval of the LOV, the TCH would make the LOV available to the operator to incorporate into their maintenance program.

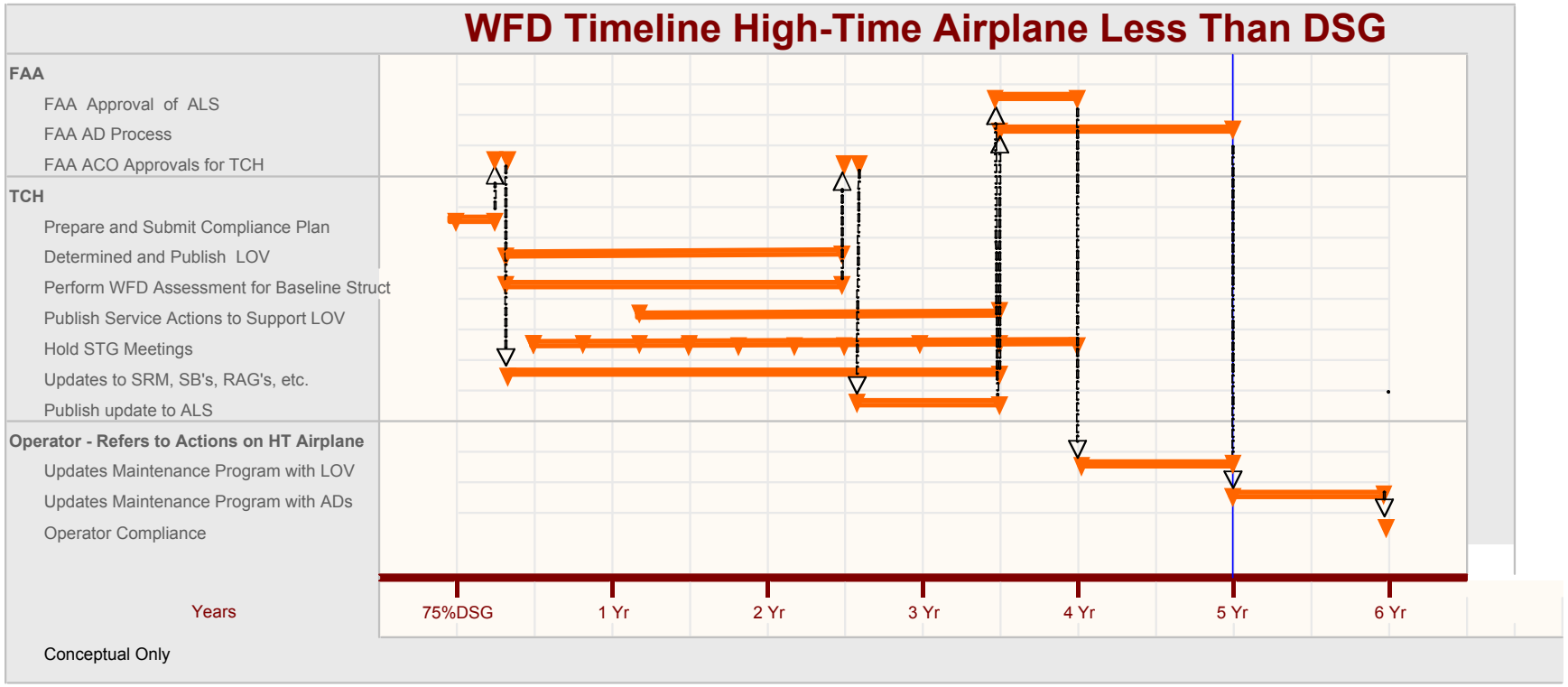


FIGURE 2.G.1 TIMELINE FOR WFD ACTION – HIGH-TIME AIRPLANE LESS THAN DSG ON RULE EFFECTIVE DATE

§25.WFD requires that the LOV be published as a revision to the ALS. This revision provides a notification to the operators of what will be required to operate the airplane beyond DSG, up to LOV. Unless further revised and accepted by the FAA, operation of the airplane beyond LOV would not be allowed.

A TCH may propose extensions to the LOV using the same approach required for establishing the original LOV.

d) Maintenance Actions to Support LOV

In addition to the determination of an LOV, the AAWG recommends the TCH determine what maintenance actions, if any, are needed to address areas susceptible to WFD to ensure the structure is free from WFD up to the LOV. These maintenance actions could be inspections and/or structural modification.

Publication of the maintenance actions should be by normal TCH processes including the publication of service bulletins. If the operator desires to operate the airplane past DSG up to the LOV, then they would need to comply with the maintenance actions as specified in the Airworthiness Directive (AD).

Any maintenance actions required should be given to the FAA for review and approval at the same time the LOV is submitted for approval. The FAA should review and process an ADon each maintenance action.

e) Updating TCH Publications to support airplane repairs - WFD

Published information such as SRMs and Service bulletins should be updated to incorporate maintenance actions that include consideration for the possible development of WFD. Such updates would include new or revised maintenance inspections and or replacement times. These documents would be provided to the FAA for approval at the same time the LOV and related maintenance actions are submitted for approval.

f) Operator Requirements

(i) Initial LOV

14 CFR 121.WFD and 129.WFD require the operator to incorporate a revision to their maintenance program that includes a LOV. This should be done within the period of time specified in the respective rule.

The FAA will publish airworthiness directives that are required to support the LOV.

(ii) Obtaining and incorporating subsequent LOVs and Maintenance actions.

If the operator desires to operate beyond the published LOV, then the operator should contact the TCH to investigate the possibility of a revised LOV. This contact should provide a minimum of four years in advance of the need for a revised LOV to provide sufficient time to prepare an amendment to the ALS. The ALS amendment should include the revised LOV and any maintenance actions required to support operation up

to the revised LOV. This package should be developed using the procedures outline in Chapter 2 of the AC. Once approved by the cognizant FAA ACO, the TCH would make available the FAA approved amendment to the operator so that their maintenance program could be updated.

H. AAWG Discussion and Recommendations – Repairs and Alterations

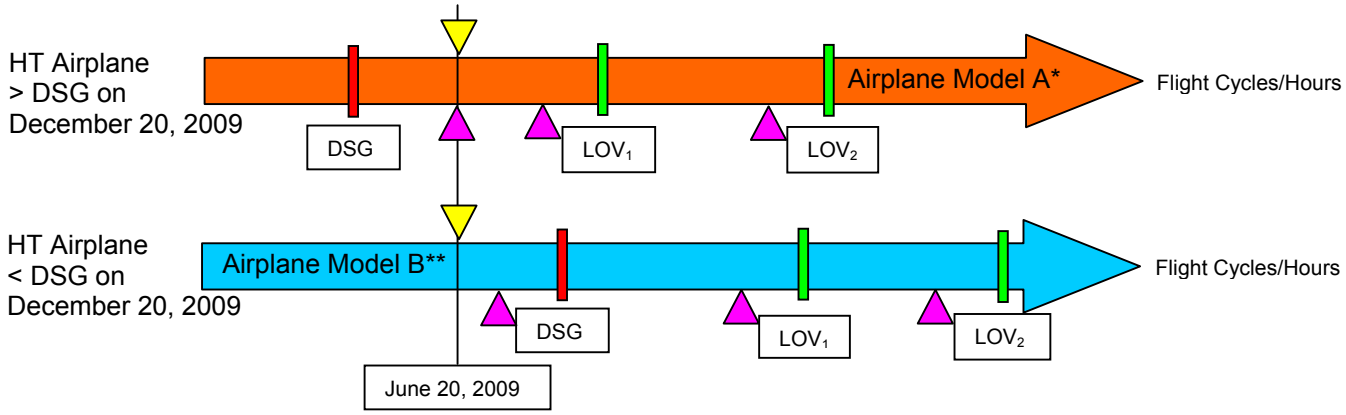
1) Introduction

Operator requirements to provide damage tolerance based maintenance instructions for repairs on fatigue critical structure were finalized in February 2005 when the Aging Airplane Safety Rule was published. This requires that repairs are assessed for damage tolerance and maintenance programs upgraded to ensure continued airworthiness of the repair. A companion rule, that would require the TCH to provide information to the operator on how to comply with the AASR, is in the final stages of rulemaking. This rulemaking will require the TCH to update all of his published documents that provide repair instructions to include damage tolerance based inspections for repairs on fatigue critical structure. This update is a significant cost item for the TCH that would need to be repeated if WFD requirements for repairs are mandated at a later time and would further impact operators who would be required to do a second detailed assessment of repairs. The AAWG's recommendations are therefore based on a balance of technical logistics for compliance, economic burden, and an increment gain in safety.

2) AAWG Position on Repairs

a) AAWG RECOMMENDATIONS ON REPAIRS:

The AAWG recommends that for repairs, WFD be addressed by the TCH updating their publications (SRMs, SBs, RAG, DT Compliance Document, etc…) to include WFD instructions by the same time they publish the WFD instructions for the baseline structure. If the TCH has a task to update his documents for DT, the AAWG suggests that the update for WFD occur at the same time for the reasons discussed below if the necessary data for WFD is available (e.g. baseline structure evaluation). The TCH should consider doing this with or without a rule requirement for WFD. Once published, the operators can revise their maintenance program to include instructions that all new or upgrading repair approvals to FCS structure susceptible to WFD will contain a WFD evaluation and approval. For airplanes where the published documents are already DT compliant, the update for WFD will be done before the high-time airplane reaches DSG. For these airplanes there is no intent to re-evaluate existing repairs for WFD unless a defined airworthiness issue exists. See Figure 2.2.



* **Models include A300, B 727, DC-8 etc.**
** **Models include A330, MD-11, B 767 etc.**

▽ **Compliance Data required to Support Operator Compliance to AASR**

△ **Compliance data required for WFD one and a half years before HT airplane exceeds DSG or LOV.**
Exceptions:
(1) compliance data due June 20, 2009 if HT airplane has already exceeded DSG on December 20, 2009
(2) minimum period is 3.5 years after December 20, 2009 or one and a half years before DSG which ever is longer for those airplanes whose HT airplane has not exceeded DSG on December 20, 2009

FIGURE 2.H.1 – TIMING OF TCH COMPLIANCE DATA SUBMITTAL TO FAA

b) DISCUSSION OF AAWG RECOMMENDATIONS ON REPAIRS

The AAWG has reviewed the accident record and has observed that while there is a technical possibility of a WFD related accident involving a repair, there have been no accidents on record that have been attributed to WFD occurring in properly installed repairs.

The AAWG has therefore adopted a position that a review of repairs is necessary however that review should not occur separately from the DT review for Pre-amendment 45 airplanes. For all airplanes there is a requirement to provide DT data to the FAA by June 20, 2009. Most of the pre-amendment 45 airplanes are beyond DSG and as a result will have an immediate need for developing a WFD program when the WFD final rule is issued. Doing a separate updating of documents for WFD when the WFD rule is released is not economically justifiable.

For airplanes that are certified at Amendment 45 or beyond, many of these airplanes already have published documents that support the DT requirements. For airplanes that already have DT published documents, there will be a requirement to update the published information for WFD considerations before the high-time airplane reaches DSG.

If the AAWG recommendations are followed, the repairs surveys should begin after the documents are updated for both DT and WFD. In the case where surveys have already been done based on DT assessments alone, ***there is no intent to initiate retrospective requirements to re-review repairs for WFD, unless a specific airworthiness concern is identified.***

The recommended program has the following advantages:

1) There a significant economy of effort if the WFD analysis can be accomplished in the same time frame as the DT analysis;
    a. A small incremental increase in cost to accomplish the fatigue analysis will provide the most benefit to the industry with the least burden.
    b. A good portion of the repairs will benefit from an enhanced maintenance program that accounts for likely WFD in addition to the substantial safety net that the DT maintenance program provides.
2) It minimizes the risk of accomplishing a potential future review of repairs for WFD if the US or other international regulators decide to implement a repairs program for WFD at a later time.
3) ARAC has had very limited EASA participation on this matter and the AAWG cannot predict what EASA may decide to implement in the future. The AAWG is aware that EASA is in the process of codifying NPA 05-2006 that has substantially different repair requirements than the FAA is currently considering. The AAWG recommendations on WFD implementation has the least risk to the industry of requiring a subsequent repairs program that will require a second repairs survey and associated costs. This issue is addressed later in this section.
4) Existing repairs will be evaluated in the AASR surveys using the updated material and will be provided enhanced inspections based on WFD or be removed and replaced.

3) AAWG Position on Alterations

a) AAWG RECOMMENDATION ON ALTERATIONS:

The AAWG recommends that alterations for WFD be addressed in a two-step approach. New Alterations certified after the effective date of the §25.WFD should be handled by the change product rule 14 CFR 21.101 by making 14 CFR 25 Amendment 96 applicable. Existing alterations should be categorized into a few special types that detailed later in this report. Depending on category, these alterations should be reviewed in a Special Certification Review (SCR) with the outcome being a determination if additional action is required.

b) DISCUSSION OF AAWG RECOMMENDATIONS ON ALTERATIONS

The AAWG has reviewed the accident record and has observed that there have been no accidents on record that have been attributed to WFD occurring in properly installed alterations but it is recognized that this is a technical possibility. Nevertheless the AAWG believes that there are some categories of alterations that

have the potential of developing WFD that should be reviewed such as, cargo door installations, large doublers, etc. The AAWG has categorized these alterations into a few special types that are detailed later in this report. Depending upon category, these alterations should be reviewed in a Special Certification Review (SCR) with the outcome being a determination if a WFD assessment is necessary in addition to the already required DT assessment.

The recommended program has the following advantages:

a. Existing alterations will also receive a DT evaluation and a maintenance program as a result of the AASR. This provides a substantial safety net even if it does not consider WFD.
b. For new Alterations, rulemaking is already in place via the change product rule (14CFR21.101) to address this issue. The AAWG believes this is sufficient. FAA enforcement will need a standardized approach for the various FAA ACO offices.
c. Consideration of any broader scope regarding existing alteration would create an industry burden due to lack of resources, guidance, and methodology.

The AAWG does not believe specific guidance in the form of an AC is warranted for alterations at this time for the reasons developed in Section 2.I below.

I. AAWG Position on Means and Methods for RAMs

The AAWG's understanding of the FAA's considerations for WFD of RAMs is that there are no plans to include requirements for WFD of RAMs in the initial issue of the rule. The FAA may decide at a later time to supplement the proposed WFD rule with requirements for RAMs. Nevertheless the FAA's tasking to the AAWG was to provide guidance on how an operator might be able to incorporate WFD considerations for RAMs. To this end, the AAWG provides the following information based on the following specific requests from the FAA on this subject.

a. Acceptable analytical methodology to be used by third parties to perform WFD evaluations of repairs and alterations.
b. Need for and scope of testing required to support WFD evaluations of new repairs and alterations.
c. Screening process for new repairs and alterations.
d. Approval process for new repairs and alterations.
e. Assessing need to evaluate existing repairs and alterations.
f. Where recommendations a.-e. should reside (e.g. new AC or existing) assuming the requirement to evaluate repairs and alterations is withdrawn from the WFD rule.

These issues are discussed below.

1) WFD Analysis Methodology for Repairs and Alterations

For third parties to evaluate their repairs and alterations for WFD and establish appropriate maintenance actions to preclude WFD, the AAWG has developed and is proposing a simplified methodology.

The methodology is intended to be conservative to compensate for its simplicity. The proposed methodology does not include the methodology to determine inspection intervals or inspection techniques. Developing such inspections requires an NDI knowledge base and infrastructure that, in general today, only TCHs possess. The only required maintenance action that results from the methodology is modification at a specified time in-service regardless of condition.

The methodology estimates the fatigue life of a structure susceptible to WFD, known as the $WFD_{(average\ behavior)}$. The time at which the structure must be modified is established by applying a factor to the $WFD_{(average\ behavior)}$ to achieve a certain level of reliability of not having an occurrence of WFD. Since the crack initiation phase represents a significant percentage of the $WFD_{(average\ behavior)}$, a crack initiation analysis could be used to conservatively estimate it. In order to do this, the analyst would need to know the stress applied to the detail under consideration, the fatigue life versus stress relation for the detail (e.g. SN curve), the Probability Density Function (PDF) for the fatigue life of the detail and the number of details in the component (e.g. repair) being assessed.

Even though this methodology is far less complex than the ones developed and applied by the TCHs, its application is intended for use by persons who have the minimum capability to carry out fatigue and damage tolerance analyses. Persons having the capability to apply this methodology may be limited outside TCH organizations today. This may represent an issue with respect to the total number of RAMs that can be addressed by third parties. Another major issue is the reliability associated with the fatigue endurance data used to perform the calculations (mean life for one detail, and associated PDF). Whereas conservative assumptions could be considered for PDF, the assessment of fatigue life may be linked to various parameters that are not necessarily available to third parties (e.g. material properties, fastener type and installation, clad/unclad, …).

This methodology is provided by the AAWG for use in determining the maintenance requirements for analysis of STC modifications with the following caveats. Viewing the resource requirements and the total number of alterations that need focused attention, the AAWG believes that a rule requiring the development of Maintenance actions for all STCs is not justifiable. As discussed in Section 2.H.3 of this report, the FAA should begin Special Certification reviews of these alterations and within the context of the review oversee the application of the methodology contained in the Appendix D.

2) Need For And Scope Of Testing Required To Support WFD Evaluations Of New Repairs And Alterations

The applicant should have analysis procedures that are supported by test evidence. This fact should be developed in discussions between the applicant and the regulator.

The applicant may be expected to conduct tests (both static and fatigue) if there is not an adequate history of test evidence.

3) Screening of RAMs for Susceptibility to WFD

Repairs and alterations affecting fatigue critical structure either already have or will have a damage tolerance evaluation to provide a DT based maintenance requirements (Certification, RAP, AASR). The AAWG discussion of WFD for repairs and alterations has been to determine if there are any of these repairs or alterations which have the potential to cause WFD to occur on the repaired or altered structure.

a) Repairs

If the FAA chooses to mandate a WFD program for repairs the AAWG concluded that a screening process would be necessary to determine which repairs need a further consideration for WFD. The AAWG has concluded that this screening process would eliminate a substantial number of repairs from requiring further WFD assessment. This screening approach would be especially helpful since few entities have the knowledge or data to perform a WFD analysis.

The screening process is based on the following considerations:

- repair type (skin or web vs stiffening members);
- location;
- adjacency to baseline WFD susceptible FCS;
- adjacency to other repairs; and,
- the size of the repair.

The expectation of the AAWG was that each manufacturer could provide the necessary information to the operators for each model fleet during STG meetings. This would enable operators conducting surveys or reviews of repairs would be able to determine which of these repairs would need further WFD assessment or analysis.

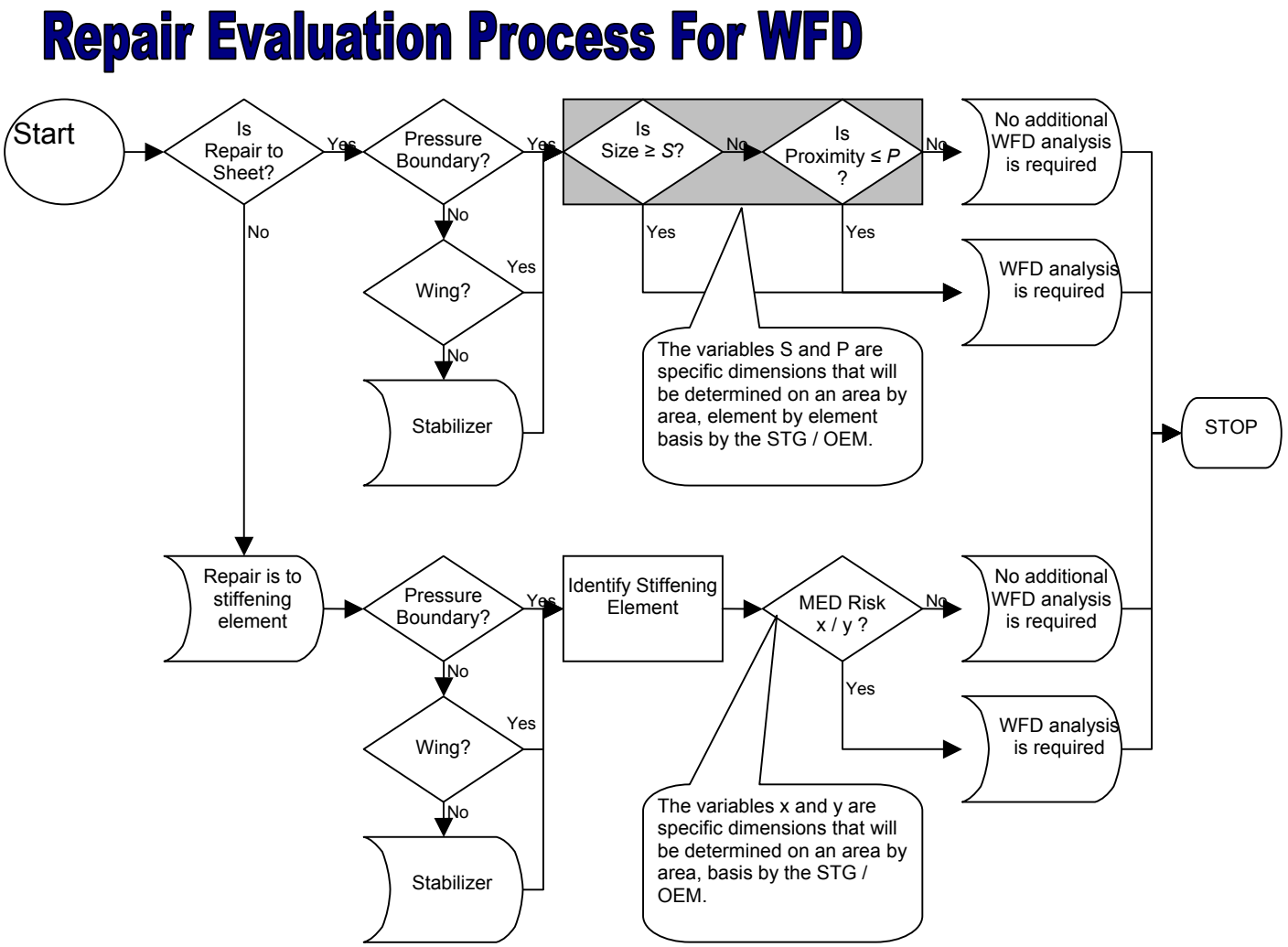


FIGURE 2.I.1 – WFD SCREENING FOR REPAIRS

This process is a detailed description of the WFD filter for repairs. The process can be looked at in sections:

- The first step of the process separates the repairs into types.

  The “Sheet” decision block would be assessed as yes for any repair to a skin or pressurized or stressed web.

  The “stiffening element” decision block would be assessed as yes for any repair to a stringer, longeron, frame, bulkhead stiffener, floor beam, chord, etc.
- The next step categorizes the repair based on its location on the aircraft.
  These elements are self explanatory.
- The next section does the final filter based on multiple site damage (MSD) or multiple element damage (MED) potential.

For sheet repairs, MSD potential is accounted for by ensuring the size of a repair is less that what is critical for WFD, and by ensuring there is a minimum spacing between the subject repair and any adjacent repairs and WFD susceptible fatigue critical baseline structure.
The variables S and P are specific dimensions that will be determined on an area by area, element by element basis by the STG / OEM. A critical size dimension on the wing may be different than for the fuselage, and a critical size dimension for a stabilizer web may be different than that for the wing. The same analogies hold true for proximity dimensions. The size and proximity evaluations will be done for each repair based on the critical dimensions for S and P.

For stiffening element repairs, MED potential is accounted for by ensuring no more than x out of any y consecutive elements are repaired in the same area. The variables x and y are specific quantities that will be determined on an area by area basis by the STG / OEM. The number of consecutive wing stringers that can be repaired without affecting WFD may be different than the number of consecutive bulkhead stiffeners that can be repaired. The MED evaluations will be done for each repair based on the critical dimensions for x and y.

While certain decisions in the flow chart may result in other steps being omitted, if the end point of the processes indicates the need for a WFD analysis, all pertinent data shall be gathered. This includes:

- Element description,
- Location of repair including enough reference points to positively identify location,
- Size of repair,
- Proximity of repair to WFD susceptible fatigue critical baseline structure and/or other repairs,
- Number of adjacent repairs, and
- Sketch of repair with above details provided.

b) Alterations

As stated in Paragraph 2.H.3, the AAWG concluded that a screening process would be necessary to determine which existing alterations need a further consideration for WFD. This screening process would eliminate a substantial number of existing alterations from requiring further consideration.

Alteration screening for WFD includes the following considerations to determine alterations that may be susceptible to WFD. Does the alteration affect several stringer or frame bays and:

a) Does the alteration either affect or create fatigue critical structure; and/or,
b) Does the alteration affect a baseline program intended to preclude WFD?

For example, installation of the following general types of alterations may qualify:

a) Fuselage cutouts (passenger entry doors, emergency exit doors or crew escape hatches, fuselage access doors, and cabin window relocations); and
b) Passenger-to-freighter conversions (including addition of main deck cargo doors).

The AAWG applied this screening criteria to a listing of 642 STC's submitted by Eleven US and Foreign operators to determine the potential impact of 14 CFR 121.WFD and 129.WFD, it was determined that 14 STC's or 2.18% out of the 642 STC's surveyed would require assessment for WFD. This survey is provided in Appendix G. The following STCs were noted:

STC Number	Description	Airplane Model(s)	# Airplanes Affected	Airplane Cert. Basis	Comments
SA3968SW-D	Inboard Refueling - Improved Fuel Mixing	DC9-82/83	231	10	Wing Rib Cut-outs for Piping Changes
SA2628SW-D	Install Mid Cabin Lavatories (Fuselage Dblr)	DC10-10	~45	22	External Reinforcement Doubler
SA1802SO	Instl Cargo Door,Restraint Blkhd,Heavy Floor, Class E Compartment, Pallet Restraint Syst.	DC8	4	CAR 4b	
ST01670AT-D	Installation of Main Deck & Lower Lobe Floor Mod & 9G Restraint Systems	767	24	45	
ST00788SE	Installation of a LiveTV Satellite Television System.	A319-111, 112 A318-111	43	FAR 25-86	
SA1767SO	727-100/-200 Main Cargo Door Inst.	B 727-100, 200 series	98		
ST00312AT	Modification to allow passenger to freighter conversion.	DC-10-10			
ST00100NY	A310 P-F Conversion	Airbus A310			
ST01438CH	Inst. Of NASI Vent Door System	B727			
SA1474SO	Installation of Winters Auxilliary Fuel Tanks	B727-2S2F	1		Tank mounting structure span multiple circumferential frames and floor beams.
ST00252WI	Conversion-PAX Aircraft to Special Freighter	747-200B	2	Pre-45	JAPAN STC-2-HQT
	P-F Cargo Door Installation	747			
ST00255WI-D	Conversion of a passenger airplane to a main deck side cargo door dedicated special freighter	747			
SA553NE	PATS Installation of 425 or 500 Gallon Aux. Fuel System in Aft Cargo Compartment	737-300/-400	65	A16WE	Tank mounting structure span multiple circumferential frames and floor beams.

Table 2.I.1 – Significant STCs

4) Approval Process For New Repairs And Alterations.

All new repairs and alterations installed on FCS on airplanes operated beyond the DSG require an assessment for WFD after the effective date of the WFD rule. The approval process for WFD assessment of repairs should use the same 3 stage approach established for the DTA provisions of the AASR when required. New alterations should be assessed for WFD at time of certification.

5) Assessing Need To Evaluate Existing Repairs And Alterations.

a) Repairs

In the development of the fuselage pressure boundary repair assessment program required under §121.370, the industry conducted a statistically significant review of repairs on airplanes. That survey and subsequent repair evaluations revealed that no repairs on any airplane surveyed required removal because of a structural issue. The conclusions reached indicated that the industry as a whole has a competent program where repairs are evaluated and replaced, on condition through the routine maintenance programs. It was therefore established that repairs installed on airplanes had a reasonable expectation of reaching the DSG of the airplane without supplemental inspections like those required by the SSID/ALS programs. Routine maintenance programs apparently are providing adequate coverage up to the DSG.

As a result of these studies, the industry proposed and the FAA accepted a program for the fuselage pressure boundary repairs program that began at approximately 75% DSG and required full incorporation of the program by 100% DSG. These programs were directed toward considering the damage tolerance characteristics of the repair.

For substantial technical reasons, the AAWG believes that the prospect of developing WFD in repairs will happen later in the life of the airplane as opposed to cracks developing from the local damage considered in the DTA assessment. With this knowledge, the AAWG is recommending that the WFD aspects of a published repair that might develop WFD should be done at the same time as the assessment of the DTA characteristics. The resulting maintenance program recommendations for the repair will represent a composite of both the DTA assessment and the WFD assessment.

b) Alterations

The AAWG believes that there are certain classes of alterations that require a high level of scrutiny as compared to other alterations. While the current proposed rule would focus activity on all alterations, the AAWG believes that this would create an unnecessary burden on the industry that would not contribute to continued airworthiness. The AAWG has identified certain alterations that require the additional level of scrutiny. It is suggested that the FAA conduct SCR for each of these categories of Alterations to establish any additional actions required for continued airworthiness. The AAWG believes that if a rule is promulgated for alterations, the focus of that rule should be on future alterations rather than having any retrospective considerations.

6) Where Recommended Guidance For RAMs Should Reside.

If the FAA promulgates new rulemaking for assessment of RAMs for WFD, the AAWG recommends that guidance information should be placed in an amended AC 120-WFD.

J. Consequences Of Other Approaches For RAMs - Potential Impact of FAA Approach to the Industry

If the FAA is not able to align the timing of the WFD requirements with the AASR timelines, additional, significant, work will be required.

The TCH may be required to update the model specific in-service documents (SB's & SRM) twice if the rules are not aligned. The update of published documents is a significant task involving justification, technical publication and the approval of the documents. Updating the documents for WFD when the documents are being updated DT is only a relatively small additional workload compared to doing WFD and DT at the same time.

Separation of the AASR and WFD activities may also require operators to perform their tasks twice. They may need to make a separate repair assessment for DT and WFD, installed two separate SRM updates and update their maintenance program twice. This could be done by the operator in one operation similar to the TCH task with relative small additional workload.

The FAA may face a similar resource issues if the updates are performed at separate times.

In addition to the labor cost, there will be a significant additional cost because airplanes may need to be removed from service twice to conduct surveys and possibly to perform specific maintenance tasks on RAMs.

K. STG Activities

STG should be formed for each model for which the fleet leader is within or above75% DSG. The STG should assist the TCH in determining the LOV for the airplane. They should also participate in reviewing the proposed maintenance actions required to support operation of the airplane to the proposed LOV and provide technical and economic input to the overall process. The following compliance tables should assist the STG in their activities.

Table 2.K.1 – Type Certificate Holder Compliance Table

For
AASR and WFD NPRMs

Entity	Cert Category	Regulation	Date or Event*		
			December 20, 2010	**HT Airplane Reaches DSG**	**Extend LOV**
TCH	Pre Admt 45	DTA	• DTA Compliance Document • DTA Compliant SRM/SB	N/A	N/A
		WFD	• LOV • WFD Compliant SRM/SB • SB Information to FAA for AD action	N/A	Baseline LOV Extension Justification
	Admt 45 to 95	DTA	• DTA Compliance Document • DTA Compliant SRM/SB	N/A	N/A
		WFD	N/A	• LOV • WFD Compliant SRM/SB • SB Information to FAA for AD action	Baseline LOV Extension Justification
	≥ Amdt 96	DTA	N/A	N/A	N/A
		WFD	N/A	LOV plus supportive maintenance actions to FAA	Baseline LOV Extension Justification

Note: The Documents or data items in this table must be in existence on these dates or events according to the schedule presented AC 120-AAWG. In some cases, these documents must be published and made available substantially before these dates to facilitate operator and third party compliance.

Table 2.K.2 – Supplemental Type Certificate Holder Compliance Table

For

AASR and WFD NPRMs

Entity	Cert Category	Regulation	Date or Event*		
			December 20, 2010	**HT Airplane Reaches DSG**	**Extend LOV**
STC Holder	Pre Admt 45	DTA	• DTA Compliance Document • DTA Compliant SRM/SB	N/A	N/A
		WFD	Unclear at this time – STC Holders have no means to comply**	N/A	Unclear at this time – STC Holders have no means to comply**
	Admt 45 to 95	DTA	• DTA Compliance Document • DTA Compliant SRM/SB	N/A	N/A
		WFD	N/A	Unclear at this time – STC Holders have no means to comply**	Unclear at this time – STC Holders have no means to comply**
	≥Amdt 96	DTA	N/A	N/A	N/A
		WFD	N/A	N/A	Validate STC for extension

Notes: * The Documents or data items in this table must be in existence on these dates or events according to the schedule presented AC 120-AAWG. In some cases, these documents must be published and made available substantially before these dates to facilitate operator compliance.

***** The FAA does no have guidelines to enable third parties to perform the analysis therefore unless some simplified analysis method is presented there will be no requirement.***

Table 2.K.3 – Operator Compliance Table

For
AASR and WFD NPRMs

Entity	Cert Category	Regulation	Date or Event*		
			December 20, 2010	**HT Airplane Reaches DSG**	**Extend LOV**
Operator	Pre Admt 45	DTA	OIP Incorporated and PMI Approval	N/A	N/A
		WFD	Compliance with FAA issued ADs	N/A	Compliance with FAA issued ADs
	Admt 45 to 95	DTA	OIP Incorporated and PMI Approval	N/A	N/A
		WFD	N/A	Compliance with FAA issued ADs	Compliance with FAA issued ADs
	≥Amdt 96	DTA	N/A	N/A	N/A
		WFD	N/A	Compliance with FAA issued ADs	Compliance with FAA issued ADs

Note: The Documents or data items in this table must be in existence on these dates or events according to the schedule presented AC 120-AAWG. In some cases, these documents must be available substantially before these dates to facilitate PMI/FAA Approval.

For WFD, the operator must comply with the FAA issued ADs.

Appendix A: List of References

The following is provided as a means to access current rules and regulations together with previous ARAC Recommendations from the AAWG. Documents noted by an (*) are available at the following web site.

http://www.faa.gov

A. REGULATIONS.

The regulatory basis of this AC is 14 CFR part 21, Certification Procedures for Products and Parts; 14 CFR part 25, Airworthiness Standards: Transportation Category Airplanes; 14 CFR part 43, Maintenance, Preventive Maintenance, Rebuilding, and Alteration; 14 CFR part 119, Certification: Air Carriers and Commercial Operators; 14 CFR part 121, Operating Requirements: Domestic, Flag, and Supplemental Operations; Part 121, Subpart G, Manual Requirements; 14 CFR part 129, Foreign Air Carriers and Foreign Operators of U.S.-Registered Aircraft Engaged in Common Carriage.

1. § 21.3, Reporting of failures, malfunctions, and defects.
2. § 21.21, Issue of type certificate: normal, utility, acrobatic, commuter, and transport category aircraft; manned free balloons; special classes of aircraft; aircraft engines; propellers.
3. § 21.50, Instructions for continued airworthiness and manufacturer's maintenance manuals having airworthiness limitations sections.
4. § 21.99, Required design changes.
5. § 21.97, Classification of changes in type design.
6. § 21.101, Designation of applicable regulations.
7. § 21.113, Requirements of supplemental type certificate.
8. § 25.571, Damage-tolerance and fatigue evaluation of structure.
9. § 25.WFD, Widespread fatigue Damage
10. § 25.1529, Instructions for continued airworthiness.
11. § Appendix H to part 25, Instructions for Continued Airworthiness.
12. § 43.13, Maintenance
13. § 43.16, Airworthiness limitations.
14. § 121.153, Aircraft requirements: General.
15. § 121.363, Responsibility for airworthiness.
16. § 121.367, Maintenance, preventive maintenance, and alteration programs.
17. § 121.373, Continuing analysis and surveillance.

18. § 121.703, Mechanical reliability reports.
19. § 121.WFD, Widespread fatigue damage.
20. § 129.11, Operations specifications.
21. § 129.14, Maintenance program and minimum equipment list requirements for U.S.-registered aircraft.
22. § 129.WFD, Widespread fatigue damage.
23. § 25.AASR DAH Rule

B. DOCUMENTS.

The following related documents are provided for information purposes and are not necessarily directly referenced in this AC.

1. Advisory Circulars. An electronic copy of the following ACs can be downloaded from the Internet at http://www.airweb.faa.gov/rgl. A paper copy may be ordered from the U.S. Department of Transportation, Subsequent Distribution Office, M-30, Ardmore East Business Center, 3341 Q 75th Avenue, Landover, MD 20785.

(a) AC 20-107A, "Composite Aircraft Structure"
(b) AC 21.101-1, "Establishing the Certification Basis of Changed Aeronautical Products"
(c) AC 25.19, "Certification Maintenance Requirements"
(d) Proposed AC 25.XX, "Subpart I, Continued Airworthiness and Safety Improvements"
(e) Proposed AC 25.571-1X, "Damage Tolerance and Fatigue Evaluation of Structure"
(f) Proposed AC 25.1529-1X, "Instructions for Continued Airworthiness of Structural Repairs on Transport Airplanes"
(g) AC 91-56A, "Continuing Structural Integrity Program for Large Transport Category Airplanes"
(h) AC 91-60, "The Continued Airworthiness of Older Airplanes"
(i) AC 120-16D, "Air Carrier Maintenance Programs"
(j) AC 120-73, "Damage Tolerance Assessment of Repairs to Pressurized Fuselages"
(k) Proposed Advisory Circular 120-XX, Damage Tolerance Inspections for Repairs, Published for comment April 21, 2006
(l) AC 121-22A, "Maintenance Review Board Procedures"
(m) Draft AC 120-YY, Widespread Fatigue Damage on Metallic Structure, Published for comment May 12, 2006.

2. FAA Policy. An electronic copy of the following Policy Statement can be downloaded from the Internet at http://www.airweb.faa.gov/rgl. A paper copy may be ordered from the Federal Aviation Administration, Transport Airplane Directorate, Transport Standards Staff, Standardization Branch, ANM-113, 1601 Lind Avenue SW., Renton, WA 98055-4056.

(a) PS-ANM110-7-12-2005, Policy Statement, “Safety – A Shared Responsibility - New Direction for Addressing Airworthiness Issues for Transport Airplanes,” issued July 6, 2005, effective July 12, 2005.

3. Federal Aviation Administration Final Rules. An electronic copy of the following Final Rule can be downloaded from the Internet at http://www.airweb.faa.gov/rgl.

(a) The “Fuel Tank Safety Rule Compliance Extension and Aging Airplane Program,” (69 FR 45936, dated July 30, 2004).

(b) “14 CFR Parts 119, 121, 129, 135, and 183 Aging Airplane Safety; Final Rule,” (70 FR 5518, dated February 2, 2005)

4. FAA Orders.

(a) Order 8110.54, “Instructions for Continued Airworthiness”

(b) Proposed Order 8300.10 Rev. XX, “Airworthiness Inspectors Handbook”

(c) Proposed Order 8110.XX, “Continued Airworthiness and Safety Improvements Responsibilities, Requirements, and Contents for Design Approval Holders”

5. Related Documents.

(a) “Recommendations for Regulatory Action to Prevent Widespread Fatigue Damage in the Commercial Airplane 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.)

Note: Certain terminology has changed in this AC from the above noted report. Fatigue crack initiation is now inspection start point. Point of WFD is now structural modification point.

(b) “Widespread Fatigue Damage Bridging Task Multiple Element Damage”, dated July 23, 2003 (A report of the Airworthiness Assurance Working Group for the Aviation Rulemaking Advisory Committee’s Transport Aircraft and Engine Issues Group.)

(c) Final Report of the AAWG – Continued Airworthiness of Structural Repairs*

(d) A Report of the AAWG – Recommendations for Regulatory Action to Prevent Widespread Fatigue Damage in the Commercial Airplane Fleet, Draft NPRM and Advisory Information. Dated June 2001.*

(e) A Report of the AAWG - Recommendations For Regulatory Action To Enhance Continued Airworthiness Of Supplemental Type Certificates*

(f) Repair Assessment Guidelines, FAA Approved Model Specific Guideline Documents**

(g) FAA Approved Model Specific Supplemental Inspection Documents**

(h) ATA Report 51-93-01 - Structural Maintenance Program Guidelines For Continuing Airworthiness***

(i) A Report to the AAWG - Structures Task Group Guidelines Document, June 1996*
(j) FAA Notice of Proposed Rule Making, Aging Aircraft Program: Widespread Fatigue Damage, Docket Number FAA-2006-24281, Published April 18, 2006.
(k) FAA Notice of Proposed Rule Making, Damage Tolerance Data for Repairs and Alterations, Docket Number FAA-2005-21693, Published April 21, 2006.
(l) Federal Register/ Vol. 67, No. 235 / Friday, December 6, 2002 / Rules and Regulations Aging Airplane Safety
(m) Aviation Rulemaking Advisory Committee; Transport Airplane and Engine Issues—New Task Federal Register / Vol. 69, No. 93 / Thursday, May 13, 2004 / Notices 26641
(n) A Report of the AAWG – Recommendations Concerning ARAC Tasking FA Doc. 04-10816 RE: Aging Airplane Safety Final Rule 14 CFR 121.370a and 129.16. Published October 28, 2005.
(o) A Report of the AAWG – Recommendations Concerning ARAC Tasking FA Doc. 04-10816 RE: Aging Airplane Safety Final Rule 14 CFR 121.370a and 129.16. Task 2 Closeout, dated 12 May 2006.

* Documents are available at the following web site. http://www.faa.gov
** Various manufacturers publish these documents. Please contact those manufacturers to determine the general availability of the documents.
*** Please contact the ATA.

Appendix B: Copy of FAA Tasking Notice

Federal Register / Vol. 69, No. 93 / Thursday, May 13, 2004 / Notices

Pages 26641 through 26644

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

Aviation Rulemaking Advisory Committee; Transport Airplane and Engine Issues—New Task

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of new task assignment for the Aviation Rulemaking Advisory Committee (ARAC).

SUMMARY: The FAA assigned the Aviation Rulemaking Advisory Committee a new task to develop guidance that will support industry compliance with the Aging Airplane Safety Final Rule requirements that relate to supplemental structural inspections. This new tasking will also address certain aspects of recommendations made during a previous ARAC tasking related to widespread fatigue damage. This notice is to inform the public of this ARAC activity.

FOR FURTHER INFORMATION CONTACT: Mike Kaszycki, Federal Aviation Administration, Transport Standards Staff, 1601 Lind Avenue, SW., Renton, Washington 98055–4056, *mike.kaszycki@faa.gov.*

SUPPLEMENTARY INFORMATION:

Background

The FAA established the Aviation Rulemaking Advisory Committee to provide advice and recommendations to the FAA Administrator on the FAA's rulemaking activities with respect to aviation-related issues. This includes obtaining advice and recommendations on the FAA's commitments to harmonize Title 14 of the Code of Federal Regulations (14 CFR) with its partners in Europe and Canada.

Airplane Applicability of Tasking

This new tasking shall apply to transport category airplanes with a type certificated passenger seating capacity of 30 or greater, or a maximum payload capacity of 7,500 pounds or greater, operated under part 121 or under part 129 (U.S. registered airplanes).

Statement of Tasking

There are four major tasks to be completed under this tasking:

Task 1.—Repairs to Baseline Primary Structure and Repairs to Alterations and Modifications

Draft an Advisory Circular (AC) that contains guidance to support the following two

paths of compliance with §§ 121.370a and 129.16 of the Aging Airplane Safety Interim Final Rule (AASIFR):

1. *Damage-tolerance-based inspection program developed by part 121 and 129 certificate holders:* Develop guidelines and procedures that will enable part 121 and 129 certificate holders to develop a damage-tolerance-based inspection program that addresses repairs made to aircraft structure that is susceptible to fatigue cracking that could contribute to a catastrophic failure.

2. *Model specific damage-tolerance-based inspection program:* Develop Guidance that can be used by Type Certificate (TC) holders, Supplemental Type Certificate (STC) holders, and Structural Task Groups to support the development of a model specific damage-tolerance-based inspection program. The model specific damage-tolerance-based inspection program will address repairs made to aircraft structure that is susceptible to fatigue cracking that could contribute to a catastrophic failure. The developed model specific inspection program will support part 121 and 129 certificate holders' compliance with the AASIFR.

A written report will also be submitted that includes an action plan for the implementation of the recommendations of task 1 that will be addressed in task 4 below. The report is to be submitted to the Aviation Rulemaking Advisory Committee (ARAC), Transport Airplane and Engine Issues Group, for approval. The ARAC, Transport Airplane and Engine Issues Group, will determine as appropriate the means by which the action plan will be implemented. The proposed actions and implementation process approved by the ARAC, Transport Airplane and Engine Issues Group, will be subject to FAA concurrence.

In the process of drafting the AC, the ARAC should assess the effectiveness of AC 91–56B to provide guidance to TC and STC holders for developing damage-tolerance-based inspections and procedures for repairs made to aircraft structure that is susceptible to fatigue cracking that could contribute to a catastrophic failure. The ARAC should do the following:

• Assess the effectiveness of AC 91– 56B to support Industry compliance with the AASIFR with respect to repairs.

• Document any improvements to the AC that would provide better direction with respect to the guidance for TC and STC holders in their development of damage-tolerance-based inspections and procedures for repairs.

The ARAC is requested to validate that the guidance material in the new AC will result in programs that provide a high degree of autonomy for part 121 and 129 certificate holders while supporting compliance with the AASIFR. In order to determine a rational approach for addressing repairs to aircraft structure that is susceptible to fatigue cracking that could contribute to a catastrophic failure, and are not currently covered by a mandated program, the AC should provide guidance to the part 121 and 129 certificate holders and to the type certificate holder to address the seven issues listed below.

1. The significance of the airplane certification amendment level in providing direction for the development of damage tolerance inspections and methods for repairs.

2. The degree to which Supplemental Structural Inspection Documents/ Programs (SSID/P) or equivalent documents/programs provide direction to repair the structure using damage-tolerance-rated repairs. The assessment should apply to SSID/Ps or equivalent documents/programs developed for 14 CFR part 25 pre-amendment 25–45 transport airplane models having a maximum gross takeoff weight of 75,000 lbs or greater. The following should be identified:

• Areas of aircraft structure that is susceptible to fatigue cracking that could contribute to a catastrophic failure, which are not covered by SSID/ Ps or equivalent documents/programs

• Significant assumptions applied in developing SSID/Ps or equivalent documents/programs

• Any significant issues in the implementation of the requirements of SSID/Ps or equivalent documents/ programs

• Data from SSID/Ps or equivalent documents/programs that would be useful in supporting this new tasking

3. The degree to which an applicable airplane model's Airworthiness Limitations Section (ALS) provides direction to repair the structure using damage-tolerance-rated repairs. This assessment should apply to damage-tolerance-based inspection programs/ data developed for 14 CFR part 25 amendment 25–45 or later transport airplane models having a maximum gross takeoff weight of 75,000 lbs or greater. The following should be identified:

• Areas of aircraft structure that is susceptible to fatigue cracking that could contribute to a catastrophic failure, which are not covered by a damage-tolerance-based inspection program/data

• Any significant issues in the implementation of the requirements of the damage-tolerance-based inspection programs/data

• Data from the damage-tolerance-based inspection programs that would be useful in supporting this new tasking

4. The degree to which existing Repair Assessment Guideline documents developed for §§ 121.370 and 129.32 provide damage-tolerance-based inspections for repairs made to aircraft structure that is susceptible to fatigue cracking that could contribute to a catastrophic failure. The assessment should identify the following:

• Areas of the aircraft structure that is susceptible to fatigue cracking that could contribute to a catastrophic failure, which are not covered by these documents

• Data from these documents that would be useful in supporting this new tasking

5. Identify the issues/difficulties industry has encountered with establishing damage-tolerance-based inspections and procedures for repairs as required by various FAA approaches in issuing SSIP airworthiness directives (*e.g.*, 727/737 AD 98–11–03 R1, AD 98– 11–04 R1 verses other SSIP AD approaches like the 747). The assessment should identify the following:

• Comparison of approaches with pros and cons for each approach

• Data from these documents that would be useful in supporting this new tasking

6. Assess the extent to which Structural Repair Manuals (SRM) provide damage-tolerance-based inspections for repairs made to aircraft structure that is susceptible to fatigue cracking that could contribute to a catastrophic failure.

7. Assess the need to include damage-tolerance-based inspections and procedures in TC and STC Holder issued Service Bulletins (SB) that provide repair instructions for aircraft structure that is susceptible to fatigue cracking that could contribute to a catastrophic failure.

Task 2.—Alterations and Modifications to Baseline Primary Structure, Including STCs and Amended Type Certificates (ATCs)

Prepare a written report assessing how an operator would include damage tolerance-based inspections and procedures for alterations and modifications made to aircraft structure that is susceptible to fatigue cracking that could contribute to a catastrophic failure. This assessment would include, but is not limited to, alterations and modifications performed under an STC, ATC, FAA field approval (*e.g.*, FAA form 337) and/or FAA approved TC holder design data. The report should include a recommendation on the best means to develop damage-tolerance-based inspections and procedures for these alterations and modifications and the applicability of AC 91–56B. The ARAC should assess the effectiveness of AC 91–56B to provide guidance to STC holders for developing damage-tolerance-based inspections and procedures for alterations and modifications. The ARAC should do the following:

• Assess the effectiveness of AC 91– 56B to support Industry compliance with the AASIFR with respect to alterations and modifications.

• Document any improvements to the AC that would provide better direction with respect to the guidance for STC holders in their development of damage-tolerance-based inspections and procedures for alterations and modifications.

The written report will include a proposed action plan to address and/or accomplish these recommendations, including actions that should be addressed in task 4 below. The report should also provide a recommendation on the means of compliance provided by the AC developed in Task 1 in regards to repairs installed on STC or ATC approved alterations and modifications. The report is to be submitted to the ARAC, Transport Airplane and Engine Issues Group, for approval. The ARAC, Transport Airplane and Engine Issues group, will determine as appropriate the means by which the action plan will be implemented. The proposed actions and implementation process approved by the ARAC, Transport Airplane and Engine Issues Group, will be subject to FAA concurrence (FAA concurrence is necessary to ensure actions will support industry compliance with the AASIFR).

Task 3.—Widespread Fatigue Damage (WFD) of Repairs, Alterations, and Modifications

Provide a written report providing recommendations on how best to enable part 121 and 129 certificate holders of airplanes with a maximum gross take-off weight of greater than 75,000 pounds to assess the WFD characteristics of structural repairs, alterations, and modifications as recommended in a previous ARAC tasking. The written report will include a proposed action plan to address and/or accomplish these recommendations

including actions that should be addressed in task 4 below. The report is to be submitted to the ARAC, Transport Airplane and Engine Issues Group, for approval. The ARAC, Transport Airplane and Engine Issues Group, will determine as appropriate the means by which the action plan will be implemented. The proposed actions and implementation process approved by the ARAC, Transport Airplane and Engine Issues Group, will be subject to FAA concurrence.

Task 4.—Model Specific Programs

Oversee the Structural Task Group (STG) activities that will be coordinated for each applicable airplane model by the respective type certificate holders' and part 121 and 129 certificate holders. These STG activities will involve the development of model specific approaches for compliance with §§ 121.370a and 129.16 under the guidance material supplied in Task 1. As part of this tasking, the AAWG will identify those airplane models that do not have an STG, and will assess the need to form one (based on industry benefit). For those airplane models that will need to form an STG, the AAWG will initiate the coordination required to form the STG with the respective type certificate holder and/or part 121 and 129 certificate holders.

In addition, the AAWG will support the implementation of the action plan to address recommendations made in tasks 2 and 3 as determined necessary by the ARAC, Transport Airplane and Engine Issues Group, and concurred with by the FAA.

Schedule

The tasking will be performed in two phases. In Phase 1, the ARAC will provide to the FAA the results of Tasks 1 through 3. Phase 1 should be accomplished by December 16, 2005. In Phase 2, the Structures Task Groups, under the direction of the ARAC, should produce the model specific guidance material, Task 4, using the guidelines and procedures of the AC produced in Phase 1. The ARAC will be responsible for coordinating and overseeing the STG's application of the AC. Phase 2 documents should be completed by December 18, 2009.

ARAC Acceptance of Task

ARAC accepted the task and assigned the task to the Airworthiness Assurance Working Group, Transport Airplane and Engine Issues. The Structural Task Groups (STG) composed of type certificate and part 121 and 129 certificate holders familiar with the specific model aircraft will support the working group. The working group will serve as staff to ARAC and assist in the analysis of the assigned task. ARAC must review and approve the working group's recommendations. If ARAC accepts the working group's recommendations, it will forward them to the FAA.

Working Group Activity

The Airworthiness Assurance Working Group must comply with the procedures adopted by ARAC. As part of the procedures, the working group must:

1. Recommend a work plan for completion of the task, including the rationale supporting such a plan for consideration at the next meeting of the ARAC on transport airplane and engine issues held following publication of this notice.

2. Give a detailed conceptual presentation of the proposed recommendations prior to

proceeding with the work stated in item 3 below.

3. Draft the appropriate documents and required analyses and/or any other related materials or documents.

4. Provide a status report at each meeting of the ARAC held to consider transport airplane and engine issues.

Participation in the Working Group

The Airworthiness Assurance Working Group will be composed of technical experts having an interest in the assigned task. A working group member need not be a representative or a member of the full committee. If you have expertise in the subject matter and wish to become a member of the working group you should write to the person listed under the caption **FOR FURTHER INFORMATION CONTACT** expressing that desire, describing your interest in the task, and stating the expertise you would bring to the working group. We must receive your request to participate no later than May 28, 2004. The assistant chair, the assistant executive director, and the working group chair will review your request and will advise you whether your request is approved. If you are chosen for membership on the working group, you must represent your aviation community segment and actively participate in the working group (*e.g.*, attend all meetings, provide written comments when requested to do so, *etc.*). You must also devote the resources necessary to support the working group in meeting any assigned deadlines. You must keep your management chain and those you may represent advised of working group activities and decisions to ensure that the proposed technical solutions don't conflict with your sponsoring organization's position when the subject being negotiated is presented to ARAC for approval.

Once the working group has begun deliberations, members will be added or substituted only with the approval of the assistant chair, the assistant executive director, and the working group chair.

The Secretary of Transportation determined that the formation and use of the ARAC is necessary and in the public interest in connection with the performance of duties imposed on the FAA by law.

Meetings of the ARAC will be open to the public. Meetings of the Airworthiness Assurance Working Group will not be open to the public, except to the extent that individuals with an interest and expertise are selected to participate. The FAA will make no public announcement of working group meetings.

Issued in Washington, DC, on May 4, 2004.

Anthony F. Fazio,

Executive Director, Aviation Rulemaking Advisory Committee.

[FR Doc. 04–10816 Filed 5–12–04; 8:45 am]

BILLING CODE 4910–13–P

Appendix C: Draft AC 120-WFD

Subject: WIDESPREAD FATIGUE DAMAGE – Baseline Structure	**Date:** Draft **Initiated by:**	**AC No:** 120-WFD Rev 12 Mar 22, 2007

1. PURPOSE.

This advisory circular (AC) provides guidance to Type Certificate Holder (TCH) on establishing Limits of Validity (LOV) for certain transport category airplanes and provides guidance for establishing maintenance actions to preclude the occurrence of widespread fatigue damage (WFD) prior to an aircraft reaching the LOV. In addition, guidance is provided to the operators on how an operator adopts an LOV into their maintenance programs.

2. APPLICABILITY.

a. This guidance is for TCHs and operators of transport category airplanes that:

1. Were certificated under the requirements of Civil Air Regulations (CAR) 4b or 14 Code of Federal Regulations (CFR) part 25; and

   (1) Have a maximum takeoff gross weight (MTGW) greater than 75,000 pounds; or

   (2) Were certificated with an MTGW of 75,000 pounds or less, and later increased to greater than 75,000 pounds by an amended type certificate (ATC) or supplemental type certificate (STC)

   (3) Transport Category, turbine powered airplanes with a type certificate issued after January 1, 1958

2. Are operated under 14 CFR part 121 or part 129

b. Like all AC material, this AC is not, in itself, mandatory, and does not constitute a regulation. It describes an acceptable means, but not the only means, for showing compliance with the requirements for transport category airplanes. The Federal Aviation Administration (FAA) will consider other means of showing compliance that an applicant may elect to present. While these guidelines are not mandatory, we derived them from extensive FAA and industry experience in showing compliance with the relevant regulations. On the other hand, if we become aware of circumstances that convince us that following this AC would not result in compliance with the applicable regulations, we

will not be bound by the terms of this AC. We may require additional substantiation or design changes as a basis for finding compliance.

c. This material does not change, create any additional, authorize changes in, or permit deviations from, regulatory requirements.

d. Terms in this AC, such as “shall” or “must” are used only in the sense of ensuring applicability of this particular means of compliance when the acceptable means of compliance described herein is used.

(Signature block will go here)

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APPENDIX 5. WFD EVALUATION

APPENDIX 6. DETERMINATION OF ISP AND SMP

APPENDIX 7. DESIGN SERVICE GOAL

APPENDIX 8. FLEET PROVEN LIFE

CHAPTER 1. WIDESPREAD FATIGUE DAMAGE

100. GENERAL INFORMATION ABOUT THIS ADVISORY CIRCULAR.

Chapter 2 of this AC provides guidance to the TCH and the tasks the TCH must perform to comply with §25.WFD. Chapter 3 of this AC provides guidance to the operator for incorporation of a Limit of Validity into their maintenance program to comply with ¶121.WFD and 129.WFD.

101. WFD BACKGROUND

a. Metal fatigue has long been considered a significant issue to the continued airworthiness of airplanes. Fatigue cracks can grow under the repeated loads environment of the airplane eventually reducing the strength of the structure to below certification strength requirements. In recognition of this issue, the airworthiness standards for the certification of new transport category airplanes have evolved to ensure that fatigue is addressed throughout the operational life of the airplane. This has led to periodic changes in the certification standards based on the relevant knowledge base and technological advances in design, analysis, testing, manufacturing and inspection of airplanes.

b. Two forms of fatigue damage have been recognized to occur in airplanes. The first form of damage occurs in local areas of the airplane and is associated with locally high stresses and design details that do not have sufficient fatigue margins. The second form of fatigue damage is associated with general degradation of a large area of structure and is associated with similar structural details that are subjected to similar stress levels in a given structural component. This type of damage has been found in design details such as lap splices and is known as multiple site damage (MSD) or multiple element damage (MED). In some cases, MSD and MED manifests cracks that are generally too small to be reliably detected using normal inspection methods. Without intervention, MSD or MED cracks will grow and eventually compromise the structural airworthiness of the airplane. This condition is known as widespread fatigue damage (WFD).

c. The FAA, with the help of the industry has established robust programs that address long-term operational issues such as fatigue and corrosion. Even with these programs in place, it is recognized that there is a limit to the amount of data available before additional data in the form of fatigue tests and or tear down is required to extend the database. Therefore the FAA is requiring the TCH to develop a LOV of the maintenance program. Operation past the LOV would be prohibited under Parts 121 and 129 without an FAA approved addition to the maintenance program.

d. MSD and MED conditions typically occur later in the life of the airplane and may be hard to detect. Because of difficulty presented in detecting MSD and MED, the FAA has determined that maintenance based on inspection alone will not be adequate

for continued airworthiness. Situations where MSD and MED occur will require the structure be replaced or refurbished at a predetermined point in the life of the airplane

e. §25.WFD, requires the TCH to assess the design details of the airplane to determine their susceptibility to WFD, establish the LOV, and any maintenance actions required to operate up to the LOV. §§121.WFD, 129.WFD, requires operators to incorporate operational limits of validity.

102-199. RESERVED

CHAPTER 2. WIDESPREAD FATIGUE DAMAGE – BASELINE STRUCTURE

200. GENERAL INFORMATION ABOUT THIS CHAPTER

This chapter provides guidance to Type Certificate Holders (TCH) on assessing airplanes for widespread fatigue damage (WFD) and establishing maintenance actions based on that assessment to prevent WFD development.

201. DEVELOPMENT OF COMPLIANCE PLANS

14 CFR 25.WFD requires the TCH to submit a compliance plan detailing how they will accomplish the necessary tasks leading to compliance with the rule. This plan must be submitted within 90 days of the effective date of the rule and must be subsequently approved by the FAA ACO. If a model fleet's high time airplane is less than Design Service Goal (DSG), the compliance plan will establish a time frame for activities to begin, if required.

202. OVERVIEW OF WFD MAINTENANCE INSTRUCTION DEVELOPMENT AND INCORPORATION.

a. Developing maintenance instructions to prevent the development of WFD in the baseline structure involves accomplishing tasks typically performed by a TCH, assisted by interested operators. There are two products that result from these tasks:

1. LOV; and,
2. Specific maintenance actions required to prevent the development of WFD.

The development of the LOV is discussed in Section 204 of this report. The development of maintenance actions required to preclude WFD up to the LOV is contained in Section 205.

The LOV would be published in an Airworthiness Limitations Section (ALS) document and is required to be adopted into an operators maintenance program by §121/129.WFD. The TCH will provide a list of maintenance actions required for safe operation beyond the DSG up to the LOV. The FAA will publish airworthiness directives for any maintenance actions required for safety. Incorporation of the WFD related information into a maintenance program will be accomplished by the operator.

b. The timing of the development of data (e.g LOV and the Maintenance actions) to prevent WFD is keyed to the high time airplane reaching the DSG when adjusted for the specific operational usage (See Appendix 7). For airplanes that have already surpassed the DSG adjusted for the specific operational usage, this information is required to be in place by compliance date of §25.WFD. For all other airplane models, this data must be provided within the timeframes discussed in Paragraph 206.

c. TCH and operators should establish Structures Task Groups (STG) for each model type and develop model specific WFD maintenance actions with oversight provided by aviation airworthiness authorities and the Aviation Rulemaking Advisory Committee's (ARAC) Airworthiness Assurance Working Group (AAWG).

203. IDENTIFICATION OF AFFECTED AIRPLANES AND CONFIGURATION. The TCH should identify all models that they hold approval authority that conform to the applicability section of this AC:

For each model identified that will require the development of an LOV beyond the DSG, the TCH should develop WFD data needed to support compliance with the WFD Rule.

The TCH should define the structural baseline configuration of the airplane to be analyzed including all model derivatives and those structural ADs that have a significant effect on the WFD characteristics of the airplane. The TCH will propose the analysis configuration to the FAA with supporting rationale.

204. Determination of Limit of Validity (LOV)

A. What is the LOV

LOV is the limit of validity of the engineering data that supports the maintenance program that has been substantiated through service experience, analysis, and/or test to preclude widespread fatigue damage.

B. Data Required to establish an LOV

The development of the LOV is a TCH task assisted by the operators. The TCH must determine if there is commercial interest in developing an LOV in discussion with their operators. If there is interest, the TCH must develop the data necessary to complement the fatigue test evidence. This shall be accomplished with the assistance of their operators and regulators, within the STG process.

The TCH should establish a candidate LOV. Nominally the means to develop the candidate LOV will be different for airplanes that have reached DSG verses those who have yet to reach it. Older airplanes may rely on Fleet Proven life to provide an initial estimate; younger airplanes may rely on an estimate based on a reduction of the fatigue reduction factor used in the analysis or test data. Discussion with operators may also be useful in determining an initial number. A candidate LOV does not necessarily establish the actual LOV. Dependant upon the airplane under consideration, the LOV may be expressed in terms of flight cycle, flight hours, or both and should take into account the anticipated future usage of the fleet, as well as the means available to the TCH to justify it.

The collection and reduction of data necessary to extend Fatigue Test Evidence includes data derived from the following sources:

- Data from Fatigue Tests
  - Full scale fatigue test with or without tear down
  - Full scale component (wing, fuselage, empennage, etc.) tests with or without tear down
  - Less than full scale component tests
- Data derived from Analysis based on Fatigue test and service experience
  - Fleet proven life techniques
  - Tear down of a high time airplane
  - Evaluation of fatigue test data and in-service problems experienced by other airplanes with similar design concepts using analysis methods which have been parametrically developed to reflect fatigue test and service experience.

Normally the data collected above is airplane level data. It is assumed that any issue that has been revealed in service has already been addressed and the data collected is representative of future predictive behavior. The data collected can be used in the applicant's methods and procedures to predict the LOV. In some cases, data may not exist for a component or area of the structure. In this case, the applicant may want to consider the collection of additional data as a conditional requirement before any particular airplane is allowed to operate beyond the DSG or previously established LOV. Detailed teardown and refurbishment inspections are particularly effective in these conditions. Sufficient data is required to establish that WFD will be precluded to a high degree of confidence.

The validation of the LOV for a particular fleet represents an evaluation of the data available, including technical, economic and managerial issues. It is more than examining fatigue test evidence.

Once established, the candidate LOV is validated by the seven step process outlined below:

Step 1 – Validate that the Aging Programs are in place and operational, if applicable.

Step 2 – Examine the data that establishes the amount of Fatigue Test Evidence available.

g. Full scale Fatigue Test Results – WFD findings and what was done about the findings including extension of test coverage to other models and derivatives.
h. Fleet specific in-service WFD findings and their corrective action(s). Rationalization with fatigue test results.
i. Calculation of the Fleet Proven Life. (See Appendix 8)
j. Establish an understanding of the design factors such as:
   a. Fatigue Reduction Factor

b. Expected Wing/Fuselage/Empennage/1P Stress levels
c. Analytical predicted fatigue lives

k. Cross model safety evaluations-rationalization of other fleet model MSD/MED events relative to expected in-fleet fatigue performance and what was done about it.

l. Understanding of which areas of the airplane requiring additional data and establish a plan to collect that data.
1. Additional fatigue tests; and/or,
2. Teardown and refurbishment of a percentage of in service airplanes prior to entering an extended usage; and/or,
3. Destructive teardown of one or several retired high-time airplanes.

Step 3 - Estimate the cost of additional TCH/operator actions required in collecting additional Fatigue Test Evidence

Step 4 - Make an upper limit estimate of the LOV based on the data examined. This will rely on looking on the fatigue test and analysis data collected in Tasks B and C.

Step 5 – Evaluate the maintenance actions and economics required to maintain safety out to the candidate LOV.

8. Determine the areas that are susceptible to WFD (See Appendix 4)
9. Establish the analysis configuration relative to production variants and AD mandated maintenance actions that would affect the analysis results (See Section 203 and Appendix 5)
10. Determining WFD Average Behavior (See Appendix 5)
11. For each area determine the ISP and SMP (See Appendix 6)
12. For those items that have an ISP within the candidate LOV, establish the proposed inspection if feasible.
13. For those items that have an SMP within the candidate LOV, establish the proposed rework/design change required.
14. Estimate cost of the package both to the TCH and to the operator.

Step 6 – The economics of the package must be rationalized. The candidate LOV may need to be adjusted based on the economics of additional required testing or data collection and the maintenance actions. The results are the LOV.

Step 7 – Revision of required certification documents for an operator to take advantage of the LOV including the development of maintenance actions.

E. Extension of LOV

Extension of the LOV must follow the same processes defined in the establishment of the LOV at DSG.

F. Publication of the LOV

The LOV, once established, will be published as a line item in the ALS document required under §25.1529 Appendix H. §121.WFD and 129.WFD will require the operators of these airplanes to update their maintenance program.

G. **Updating of Published Information**

Published information such as SRMs and Service bulletins must be updated to incorporate maintenance actions that include consideration for the possible development of WFD. Such updates would include new or revised maintenance inspections and or replacement times. These documents would be provided to the FAA for approval at the same time the LOV and related maintenance actions are submitted for approval.

205. Publication of Maintenance Actions required to preclude WFD

The TCH should publish maintenance actions to support the operation of the airplane up to the LOV. TCH would publish the maintenance actions using his normal procedures. The FAA would review, approve and mandate the required maintenance actions via an airworthiness directive (AD). Once the AD is issued, the operator will incorporate the requirements into his maintenance program.

206. TCH SCHEDULE REQUIREMENTS.

For those airplanes where the high-time airplane has already exceeded the DSG, the WFD related maintenance instructions (LOV plus required maintenance actions to preclude WFD) should be provided to the FAA for AD action by June 20, 2009 or one and a half years prior to the compliance date of §121.WFD or §129.WFD, whichever is later.

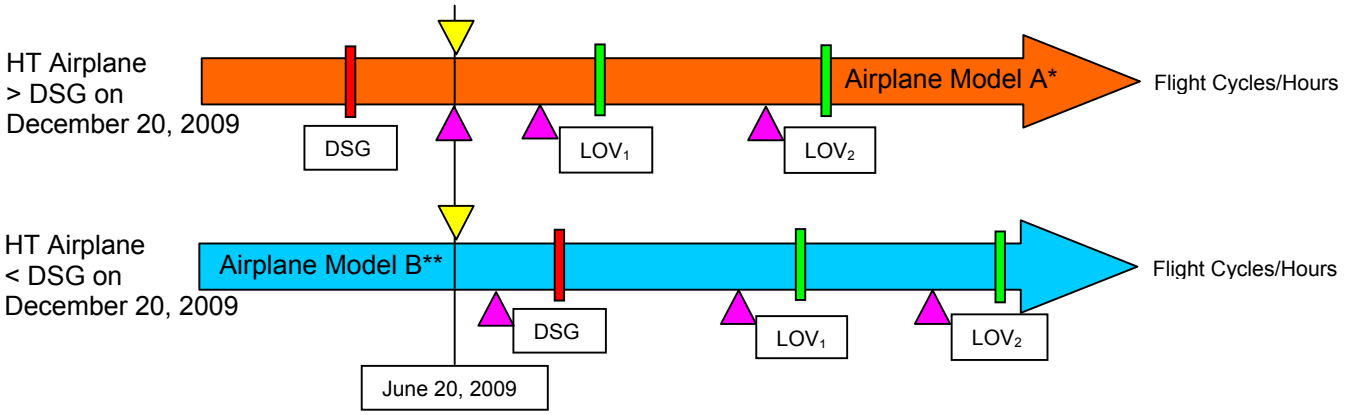
For all other airplanes, the WFD related maintenance instructions (LOV plus required maintenance actions to preclude WFD) for the baseline structure should be made available to the FAA three and half years after the effective date of §25.WFD or one and a half years prior to the estimated time the high time airplane reaches DSG, whichever is later. The FAA would approve the maintenance instructions and issue an AD to mandate the requirements. The implementation timing is illustrated in Figure 2.1

The development of WFD related maintenance data is a significant task. This activity needs to begin when the high-time airplane reaches 75% DSG or 5 years before the high-time airplane is estimated to reach the DSG. All TCH related WFD material must be submitted to the FAA for AD action one and a half years prior to when it is estimated that the high time airplane will reach DSG. The process is illustrated in Figure 2.2

207. FAA APPROVAL

The LOV and any maintenance actions to support the LOV together with the changes to published information must be presented to the cognizant FAA Aircraft Certification Office (ACO) for approval.

208. thru 299. Reserved.



* **Models include A300, B 727, DC-8 etc.**

** **Models include A330, MD-11, B 767 etc.**

Compliance Data required to Support Operator Compliance to AASR

Compliance data required for WFD one and a half years before HT airplane exceeds DSG or LOV.
Exceptions:

(3) compliance data due June 20, 2009 if HT airplane will exceed DSG on December 20, 2009

(4) minimum period is 3.5 years after December 20, 2009 or one and a half years before DSG which ever is longer for those airplanes whose HT airplane will not exceed DSG on December 20, 2009

Figure 2.1 Timing of TCH Compliance Data Submittal to FAA

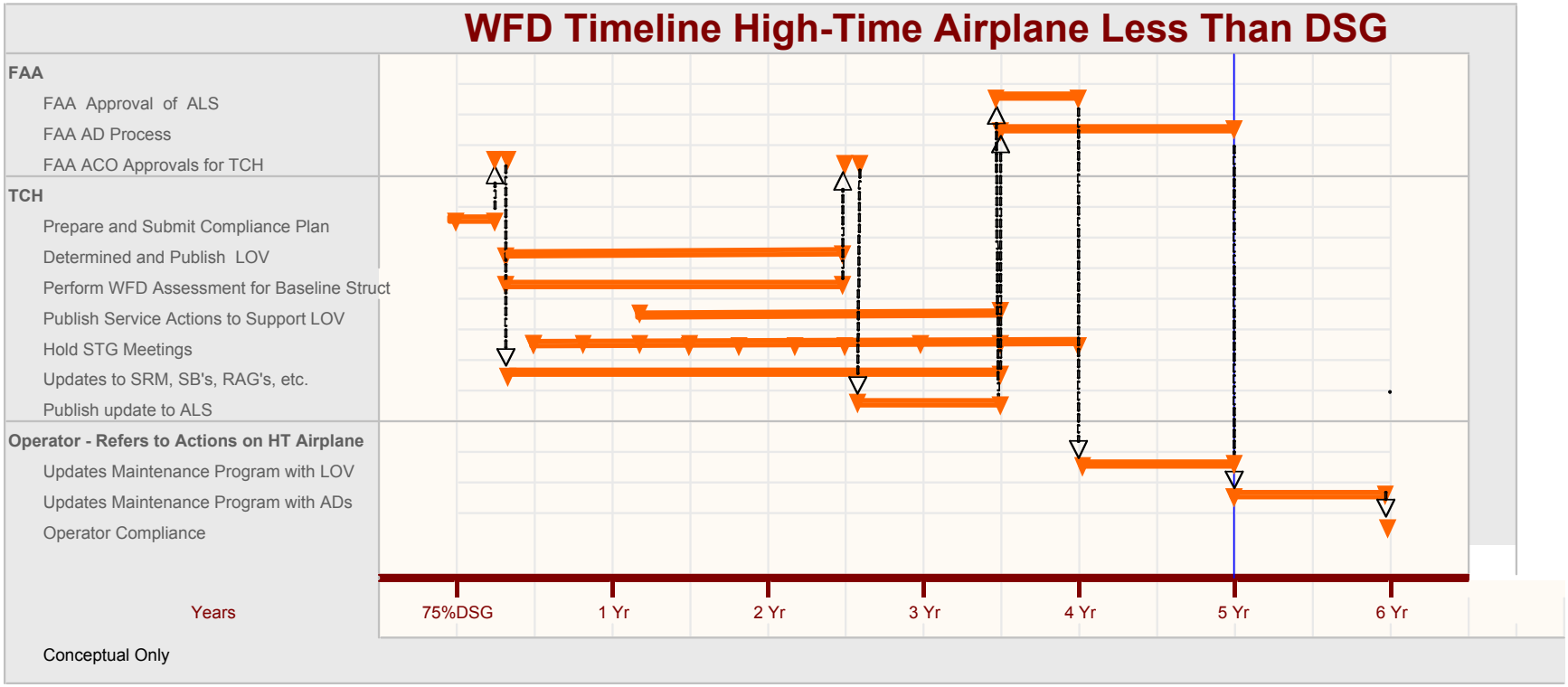


Figure 2.2 Timeline for WFD Action – High-Time Airplane Less than DSG on Rule Effective Date

CHAPTER 3. OPERATORS IMPLEMENTATION REQUIREMENTS

300. GENERAL INFORMATION ABOUT THIS CHAPTER.

This Chapter provides guidance to operators on the procedures on how to revise their maintenance programs as required by WFD rulemaking.

301. INCORPORATION OF INITIAL LOV AND MAINTENANCE ACTIONS.

For compliance to §121.WFD and §129.WFD, an operator must adopt an FAA approved ALS developed under Appendix H to part 25 into their maintenance program. This ALS must contain the LOV stated as a number of flight cycles or flight hours or both, approved under § 25.571 or § 25.1807.

Airworthiness directives will mandate maintenance actions, if any, that are required to support operation up to the initial LOV.

302. OBTAINING AND INCORPORATING SUBSEQUENT LOV AND MAINTENANCE ACTIONS.

If the operator desires to operate beyond the published LOV, then the operator should contact the TCH to investigate the possibility of a revised LOV. This contact should provide a minimum of four years in advance of the need for a revised LOV to provide sufficient time to prepare the extension package. The extension package should include the revised LOV and any maintenance actions required to support operation up to the revised LOV. This package should be developed using the procedures outline in Chapter 204 of this AC. Once approved by the cognizant FAA ACO, the operator can adopt the FAA Approved amendment to the ALS containing a revised LOV and associated maintenance actions.

303. EXISTING RESPONSIBILITIES.

a. Reporting Requirements. There are no added reporting requirements associated with the WFD rulemaking. However, the FAA encourages operators to report significant findings to the type certificate holders to ensure that prompt fleet action is taken. Existing reporting requirements under 14 CFR § 121.703 still apply.

b. Recordkeeping Requirements. There are no added recordkeeping requirements associated with the WFD rulemaking. Existing record-keeping requirements are still applicable.

c. Transfer of Airplanes after WFD rulemaking compliance date. Before adding an airplane to an air carrier's operations specifications or operator's fleet, the following should apply:

(1) For airplanes previously operated under an FAA-approved maintenance program, the new operator should ensure all applicable WFD rulemaking requirements

(LOV, maintenance actions, etc…) are incorporated into the new operator's maintenance program.

(2) For airplanes not previously operated under an FAA-approved maintenance program, the operator incorporates all applicable WFD rulemaking requirements (LOV, maintenance actions, etc…) as required.

d. Operation of Leased Foreign-Owned Airplanes. Acquisition of a leased foreign-owned airplane for use in operations under 14 CFR parts 121, or 129 will require the certificate holder to develop and implement the ALS.

304. THRU 399 RESERVED.

CHAPTER 4. ADMINISTRATIVE REQUIREMENTS

400. ADVISORY CIRCULAR AVAILABILITY

HOW DO I GET A COPY OF THE PUBLICATIONS REFERRED TO IN THIS AC?

a. The CFR and those ACs for which a fee is charged may be obtained from the Superintendent of Documents at the following address. A listing of the CFR and current prices is located in AC 00–44, "Status of Federal Aviation Regulations," and a listing of all ACs is found in AC 00–2, "Advisory Circular Checklist."

Superintendent of Documents
P.O. Box 371954
Pittsburgh, PA 15250–7954

b. To be placed on our mailing list for free ACs contact:

U.S. Department of Transportation
Subsequent Distribution Office
M-30
Ardmore East Business Center
3341Q 75th Avenue
Landover, MD 20785

c. You may view and print the CFR and Aircraft Certification Service and Flight Standards Service ACs on the FAA Web page at http://www.airweb.faa.gov/rgl.

401. WHO DO I SUBMIT COMMENTS TO ABOUT THIS AC?

Submit direct comments regarding this AC to:

U.S. Department of Transportation
Federal Aviation Administration
Aircraft Maintenance Division, AFS-300
800 Independence Avenue SW.
Washington, DC 20591

402. thru 499. Reserved.

APPENDIX 1. RELATED REGULATIONS AND DOCUMENTS

REGULATIONS.
The regulatory basis of this AC is 14 CFR part 21, Certification Procedures for Products and Parts; 14 CFR part 25, Airworthiness Standards: Transportation Category Airplanes; 14 CFR part 43, Maintenance, Preventive Maintenance, Rebuilding, and Alteration; 14 CFR part 119, Certification: Air Carriers and Commercial Operators; 14 CFR part 121, Operating Requirements: Domestic, Flag, and Supplemental Operations; Part 121, Subpart G, Manual Requirements; 14 CFR part 129, Foreign Air Carriers and Foreign Operators of U.S.-Registered Aircraft Engaged in Common Carriage.

24. § 21.3, Reporting of failures, malfunctions, and defects.
25. § 21.21, Issue of type certificate: normal, utility, acrobatic, commuter, and transport category aircraft; manned free balloons; special classes of aircraft; aircraft engines; propellers.
26. § 21.50, Instructions for continued airworthiness and manufacturer's maintenance manuals having airworthiness limitations sections.
27. § 21.99, Required design changes.
28. § 21.97, Classification of changes in type design.
29. § 21.101, Designation of applicable regulations.
30. § 21.113, Requirements of supplemental type certificate.
31. § 25.571, Damage-tolerance and fatigue evaluation of structure.
32. § 25.WFD, Widespread fatigue Damage
33. § 25.1529, Instructions for continued airworthiness.
34. § Appendix H to part 25, Instructions for Continued Airworthiness.
35. § 43.13, Maintenance
36. § 43.16, Airworthiness limitations.
37. § 121.153, Aircraft requirements: General.
38. § 121.363, Responsibility for airworthiness.
39. § 121.367, Maintenance, preventive maintenance, and alteration programs.
40. § 121.373, Continuing analysis and surveillance.
41. § 121.703, Mechanical reliability reports.
42. § 121.WFD, Widespread fatigue damage.
43. § 129.11, Operations specifications.
44. § 129.14, Maintenance program and minimum equipment list requirements for U.S.-registered aircraft.
45. § 129.WFD, Widespread fatigue damage.

DOCUMENTS. The following related documents are provided for information purposes and are not necessarily directly referenced in this AC.

a. Advisory Circulars. An electronic copy of the following ACs can be downloaded from the Internet at http://www.airweb.faa.gov/rgl. A paper copy may be ordered from the U.S. Department of Transportation, Subsequent Distribution Office, M-30, Ardmore East Business Center, 3341 Q 75th Avenue, Landover, MD 20785.

(1) AC 20-107A, "Composite Aircraft Structure"
(2) AC 21.101-1, "Establishing the Certification Basis of Changed Aeronautical Products"
(3) AC 25.19, "Certification Maintenance Requirements"
(4) Proposed AC 25.XX, "Subpart I, Continued Airworthiness and Safety Improvements"
(5) Proposed AC 25.571-1X, "Damage Tolerance and Fatigue Evaluation of Structure"
(6) Proposed AC 25.1529-1X, "Instructions for Continued Airworthiness of Structural Repairs on Transport Airplanes"
(7) AC 91-56A, "Continuing Structural Integrity Program for Large Transport Category Airplanes"
(8) AC 91-60, "The Continued Airworthiness of Older Airplanes"
(9) AC 120-16D, "Air Carrier Maintenance Programs"
(10) AC 120-73, "Damage Tolerance Assessment of Repairs to Pressurized Fuselages"
(11) Proposed AC 120-XX "Damage Tolerance Inspections for Repairs"
(12) AC 121-22A, "Maintenance Review Board Procedures"
(13) Draft AC 120-YY, Widespread Fatigue Damage on Metallic Structure, Published for comment May 12, 2006.

b. FAA Policy. An electronic copy of the following Policy Statement can be downloaded from the Internet at http://www.airweb.faa.gov/rgl. A paper copy may be ordered from the Federal Aviation Administration, Transport Airplane Directorate, Transport Standards Staff, Standardization Branch, ANM-113, 1601 Lind Avenue SW., Renton, WA 98055-4056.

(1) PS-ANM110-7-12-2005, Policy Statement, "Safety – A Shared Responsibility - New Direction for Addressing Airworthiness Issues for Transport Airplanes," issued July 6, 2005, effective July 12, 2005.

c. Federal Aviation Administration Final Rules. An electronic copy of the following Final Rule can be downloaded from the Internet at http://www.airweb.faa.gov/rgl.

(1) The "Fuel Tank Safety Rule Compliance Extension and Aging Airplane Program," (69 FR 45936, dated July 30, 2004).

(2) **14 CFR Parts 119, 121, 129, 135, and 183 Aging Airplane Safety; Final Rule,** (70 FR 5518, dated February 2, 2005)

d. FAA Orders.

i. Order 8110.54, “Instructions for Continued Airworthiness”

ii. Proposed Order 8300.10 Rev. XX, “Airworthiness Inspectors Handbook”

iii. Proposed Order 8110.XX, “Continued Airworthiness and Safety Improvements Responsibilities, Requirements, and Contents for Design Approval Holders”

e. Related Documents.

(1) “Recommendations for Regulatory Action to Prevent Widespread Fatigue Damage in the Commercial Airplane 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.)
Note: Certain terminology has changed in this AC from the above noted report. Fatigue crack initiation is now inspection start point. Point of WFD is now structural modification point.

(2) “Widespread Fatigue Damage Bridging Task Multiple Element Damage”, dated July 23, 2003 (A report of the Airworthiness Assurance Working Group for the Aviation Rulemaking Advisory Committee’s Transport Aircraft and Engine Issues Group.)
(3) Final Report of the AAWG – Continued Airworthiness of Structural Repairs*
(4) A Report of the AAWG – Recommendations for Regulatory Action to Prevent Widespread Fatigue Damage in the Commercial Airplane Fleet*
(5) A Report of the AAWG - Recommendations For Regulatory Action To Enhance Continued Airworthiness Of Supplemental Type Certificates*
(6) Repair Assessment Guidelines, FAA Approved Model Specific Guideline Documents**
(7) FAA Approved Model Specific Supplemental Inspection Documents**
(8) ATA Report 51-93-01 - Structural Maintenance Program Guidelines For Continuing Airworthiness***
(9) A Report to the AAWG - Structures Task Group Guidelines Document, June 1996*
(10) FAA Notice of Proposed Rule Making, Aging Aircraft Program: Widespread Fatigue Damage, Docket Number FAA-2006-24281, Published April 18, 2006.
(11) FAA Notice of Proposed Rule Making, Damage Tolerance Data for Repairs and Alterations, Docket Number FAA-2005-21693, Published April 21, 2006.
(12) Federal Register/ Vol. 67, No. 235 / Friday, December 6, 2002 / Rules and Regulations Aging Airplane Safety

(13) Aviation Rulemaking Advisory Committee; Transport Airplane and Engine Issues—New Task Federal Register / Vol. 69, No. 93 / Thursday, May 13, 2004 / Notices 26641
(14) A Report of the AAWG – Recommendations Concerning ARAC Tasking FA Doc. 04-10816 RE: Aging Airplane Safety Final Rule 14 CFR 121.370a and 129.16. Published October 28, 2005.
(15) A Report of the AAWG – Recommendations Concerning ARAC Tasking FA Doc. 04-10816 RE: Aging Airplane Safety Final Rule 14 CFR 121.370a and 129.16. Task 2 Closeout, dated 12 May 2006.

APPENDIX 2. DEFINITIONS

a. Airplane structural configuration is the approved type certificate design, including the original; any model variations or derivatives; and alterations or replacements mandated by AD.

b. Airworthiness Limitations Section (ALS) is a collection of mandatory maintenance actions required for airplane structure and fuel tank system. For structural maintenance actions, the ALS includes structural replacement times, structural inspection intervals, and related structural inspection procedures.

c. Alteration or modification is an FAA-approved design change that is made to an airplane. Within the context of this AC, the two terms are synonymous.

d. Amended Type Certificate (ATC) is a process where the type certificate holder may modify the airplane and have the modification approved by amending the original type certificate under § 21.177.

e. 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 specific levels of fatigue, corrosion, accidental or discrete source damage.

f. Design Approval Holder (TCH) is a person that holds a type design approval for an airplane or any FAA-approved data necessary to repair, alter, or modify airplane structure.

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

h. Federal Aviation Administration Oversight Office is the Aircraft Certification Office or office of the Transport Airplane Directorate having oversight responsibility for the relevant type certificate or supplemental type certificate, as determined by the Administrator.

i. 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.

j. Instructions for Continued Airworthiness (ICA) are maintenance actions defined by the TC or STC holder in accordance with 14 CFR 25.1529 and delivered with the airplane in accordance with § 21.509. ICAs are documented information that include the applicable methods, inspections, processes, procedures and airworthiness limitations.

k. Limit of Validity (LOV) is the limit of validity of the engineering data that supports the maintenance program that has been substantiated through service experience, analysis, and/or test to preclude widespread fatigue damage.

l. Maintenance Actions would include inspections, modifications, replacements or any combination of these.

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

m. Multiple Site Damage (MSD) is a source of widespread fatigue damage characterized by the simultaneous presence of fatigue cracks in the same structural element.

n. Supplemental Type Certificate (STC) Issued for major design changes to type certificated products when the design change is not so extensive as to require a new type certificate.

o. Structural Modification Point (SMP) is the point in time when a structural area must be modified to preclude WFD.

p. Structures Task Group (STG) is a model specific group that consists of TCHs and operators responsible for the development of aging airplane model specific programs. It also includes regulatory authorities who approve and monitor those programs.

q. Teardown, is the destructive inspection of structure using visual (magnifying glass, dye penetrant etc) and/or other NDI techniques (eddy current, ultrasound etc) to characterize the extent of damage within a structure with regard to corrosion, fatigue and accidental damage.

r. Type Certificate (TC) includes the type design, operating limits, the type certificate data sheet, the applicable regulations, and any other conditions or limitations prescribed by the Administrator.

s. Type Design consists of drawings and specifications; information on dimensions, materials, and processes; airworthiness limitations; and any other data necessary to describe the design of the product (see § 21.31).

t. Type Certificate Holder (TCH) is the person who holds the type certificate.

u. Widespread Fatigue Damage (WFD) is the simultaneous presence of cracks at multiple structural locations that are of sufficient size and density such that the structure will no longer meet its residual strength requirements of §25.571(b).

APPENDIX 3. ACRONYMS

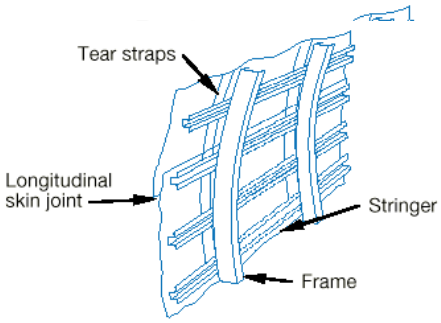
The following abbreviations are used throughout this report

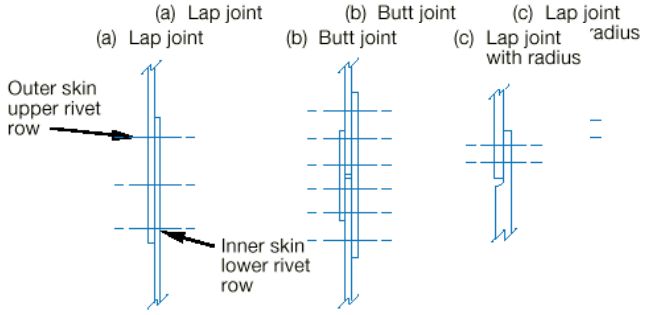
AAWG	Airworthiness Assurance Working Group
AC	Advisory Circular (FAR)
AD	Airworthiness Directive
ALS	Airworthiness Limitation Section
ARAC	Aviation Rulemaking Advisory Committee
ATC	Amended Type Certificate
CAR	Civil Airworthiness Requirements
CFR	Code of Federal Regulations
DSG	Design Service Goal
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulation
HPF	Hours per Flight
ISP	Inspection Start Point
LOV	Limit of Validity
MED	Multiple Element Damage
MPD	Maintenance Planning Document
MSD	Multiple Site Damage
MTGW	Maximum Takeoff Gross Weight
PMI	Principal Maintenance Inspector (FAA)
SB	Service Bulletin
SMP	Structural Modification Point
SRM	Structural Repair Manual
STC	Supplemental Type Certificate
STG	Structures Task Group
RI	Repeat Inspections
TC	Type Certification
TCH	Type Certificate Holder
WFD	Widespread Fatigue Damage

APPENDIX 4. IDENTIFICATION OF STRUCTURE SUSCEPTIBLE TO WFD

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 were structural capability could be affected by interaction of multiple cracking at a number of similar details. The following list contains known types of structure susceptible to MSD/MED.

STRUCTURAL AREA	SEE FIGURE
Longitudinal Skin Joints, Frames, and Tear Straps (MSD/MED)	A4-1
Circumferential Joints and Stringers (MSD/MED)	A4-2
Lap joints with Milled, Chem-milled or Bonded Radius (MSD)	A4-3
Fuselage Frames (MED)	A4-4
Stringer to Frame Attachments (MED)	A4-5
Shear Clip End Fasteners on Shear Tied Fuselage Frames (MSD/MED)	A4-6
Aft Pressure Dome Outer Ring and Dome Web Splices (MSD/MED)	A4-7
Skin Splice at Aft Pressure Bulkhead (MSD)	A4-8
Abrupt Changes in Web or Skin Thickness — Pressurized or Unpressurized Structure (MSD/MED)	A4-9
Window Surround Structure (MSD, MED)	A4-10
Over Wing Fuselage Attachments (MED)	A4-11
Latches and Hinges of Non-plug Doors (MSD/MED)	A4-12
Skin at Runout of Large Doubler (MSD)—Fuselage, Wing or Empennage	A4-13
Wing or Empennage Chordwise Splices (MSD/MED)	A4-14
Rib to Skin Attachments (MSD/MED)	A4-15
Typical Wing and Empennage Construction (MSD/MED)	A4-16

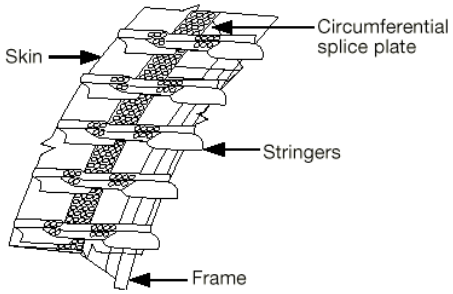


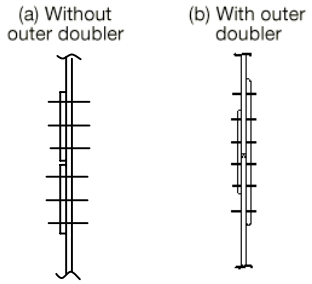


Type and possible location of MSD and MED
- MSD longitudinal skin joint
  - Lap joint
    - Outer skin upper rivet row
    - Inner skin lower rivet row
  - Butt joint
    - Skin outer rivet rows
    - Doubler inner rivet rows
  - Lap joint with radius
    - In radius
- MED—frame
  - Stress concentration areas
- MED—tear straps
  - Critical fastener rows in the skin at tear strap joint

Service or test experience of factors that influence MSD and MED (examples)
- High stress—misuse of data from coupon test
- Corrosion
- Disbond
- Manufacturing defect
  - Surface preparation
  - Bond laminate too thin
  - Countersink, fastener fit
- Design defect—surface preparation process

Figure A4-1 ***Longitudinal Skin Joints, Frames, and Tear Straps (MSD/MED)***

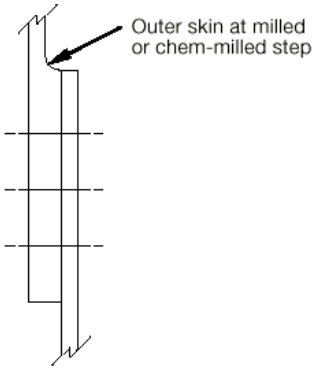


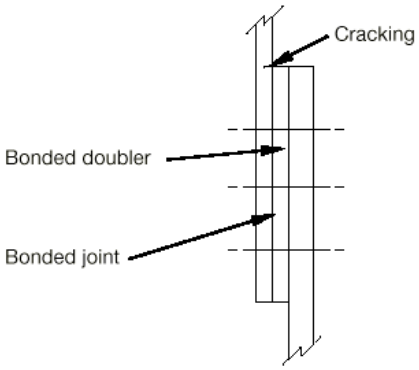


Type and possible location of MSD/MED
- MSD—circumferential joint
  - Without outer doubler
    - Splice plate—between and/or at the inner two rivet rows
    - Skin—forward and aft rivet row of splice plate
    - Skin—at first fastener of stringer coupling
  - With outer doubler
    - Skin—outer rivet 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 A4-2 ***Circumferential Joints and Stringers (MSD/MED)***





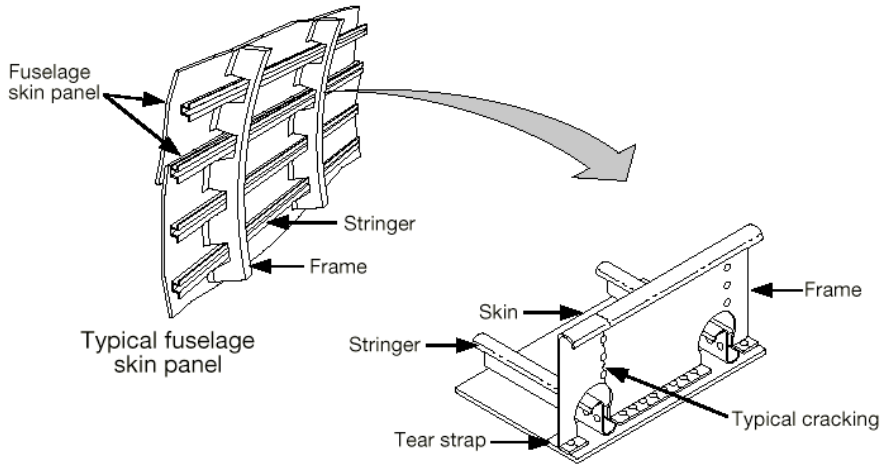
Type and possible location of MSD and MED

- 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 A4-3 ***Lap joints with Milled, Chem-milled or Bonded Radius (MSD)***



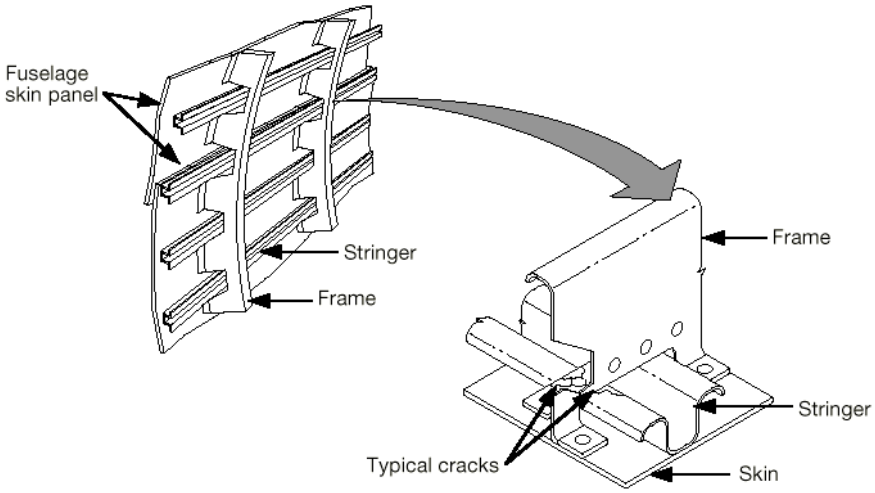
Type and possible location of MSD/MED

- 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 A4-4 ***Fuselage Frames (MED)***



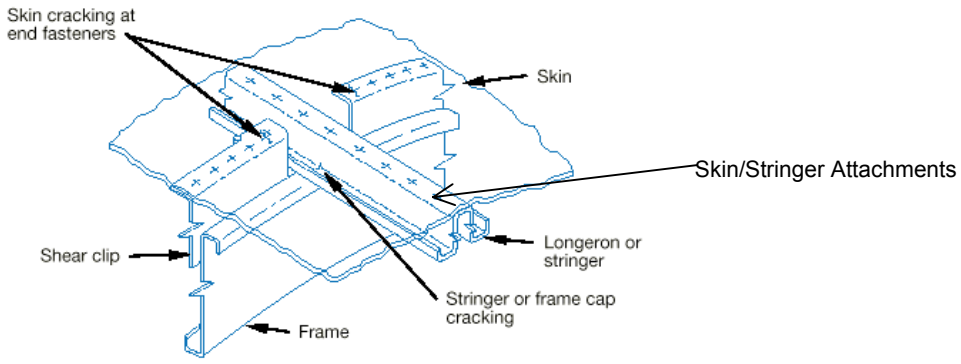
Type and possible location of MED

- 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 A4-5 ***Stringer to Frame Attachments (MED)***



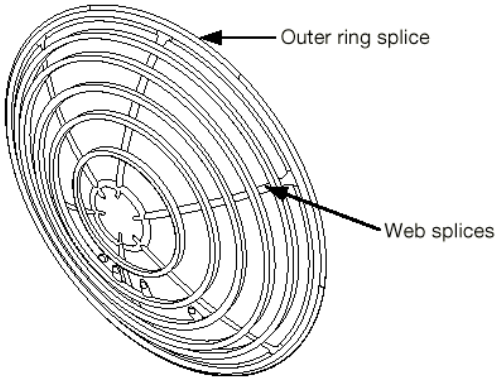
Type and possible location of MSD and MED

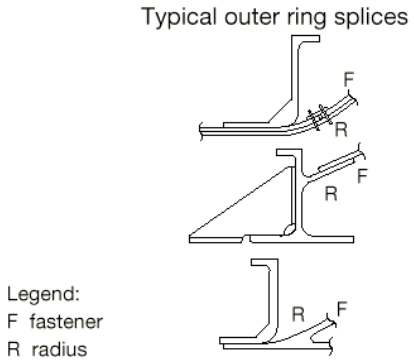
- MSD—skin at end fastener of shear clip
- MED—cracking in stringer or longeron at frame attachment
- MED—cracking in frame at stringer or longeron attachment

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

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

Figure A4-6 ***Shear Clip End Fasteners on Shear Tied Fuselage Frame (MSD/MED)***





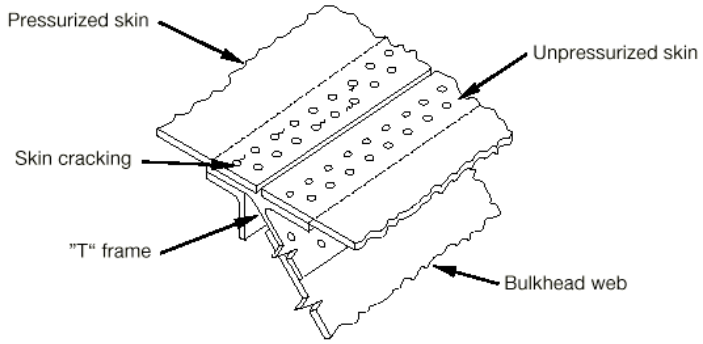
Type and possible location of MSD/MED

- 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 A4-7 ***Aft Pressure Dome Outer Ring and Dome Web Splices (MSD/MED)***



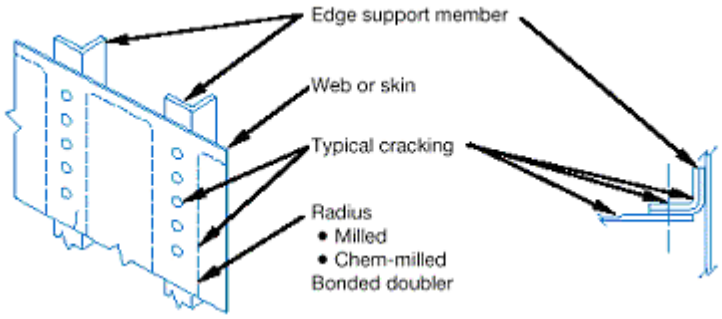
Type and possible location of MSD and MED

- 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 A4-8 ***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

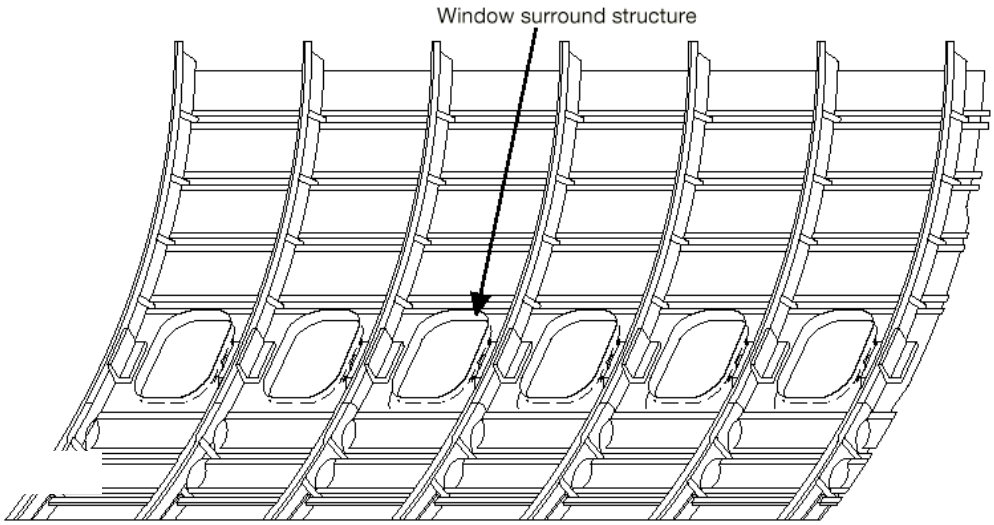
Edge member support structure
- Edge member - in radius areas

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

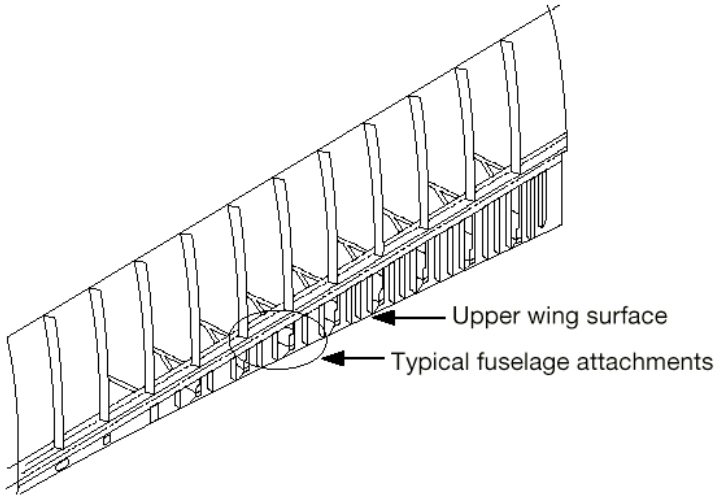
Figure A4-9 ***Abrupt Changes in Web or Skin Thickness — Pressurized or Unpressurized Structure (MSD/MED)***



Type and possible location of MSD/MED
- MSD—skin at attachment to window surround structure
- MED—repeated details in reinforcement of window cutouts or in window corners

Service or test experience of factors that influence MSD and/or MED (examples)
- High load transfer

Figure A4-10 ***Window Surround Structure (MSD, MED)***



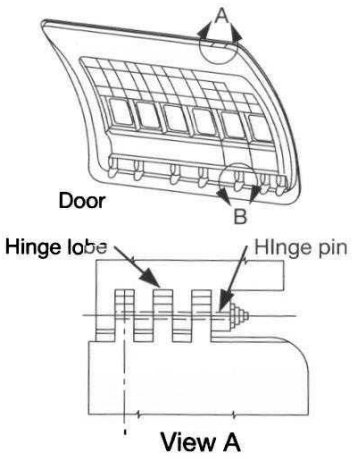
Type and possible location of MSD/MED

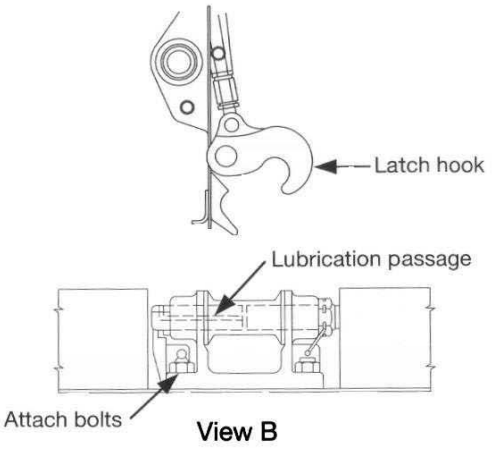
- MED—repeated details in overwing fuselage attachments

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

- Manufacturing defect—prestress
- Induced deflections

Figure A4-11 ***Over Wing Fuselage Attachments (MED)***





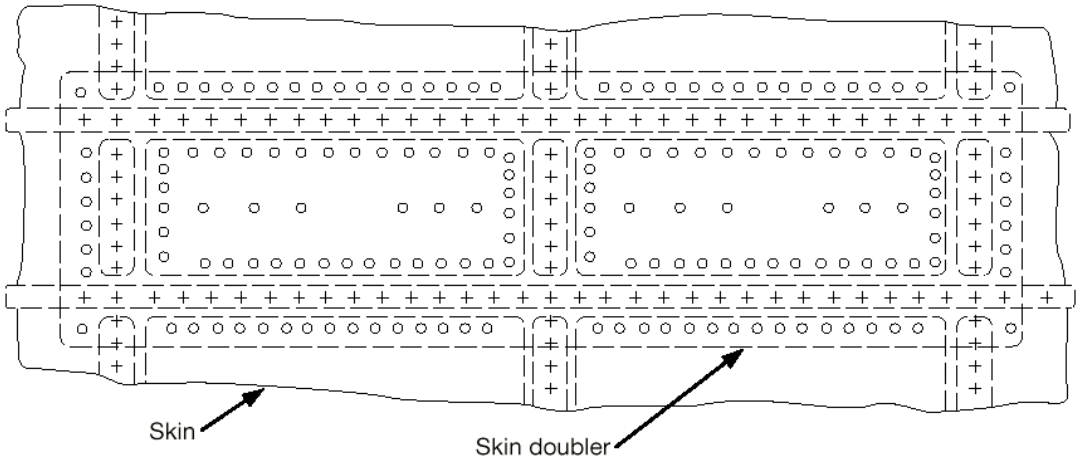
Type and possible location of MSD/MED

- 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 A4-12 ***Latches and Hinges of Non-plug Doors (MSD/MED)***



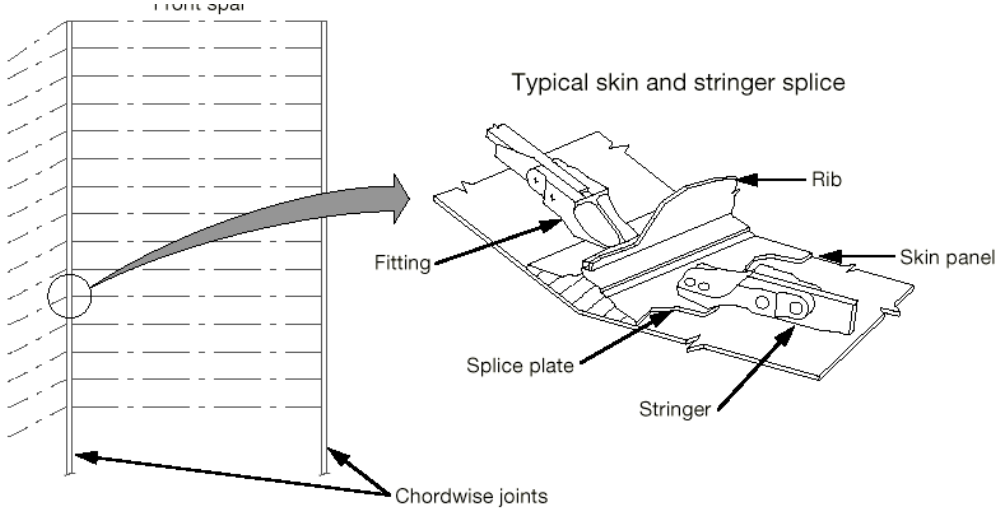
Type and possible location of MSD/MED

- 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 A4-13 ***Skin at Runout of Large Doubler (MSD) — Fuselage, Wing or Empennage***



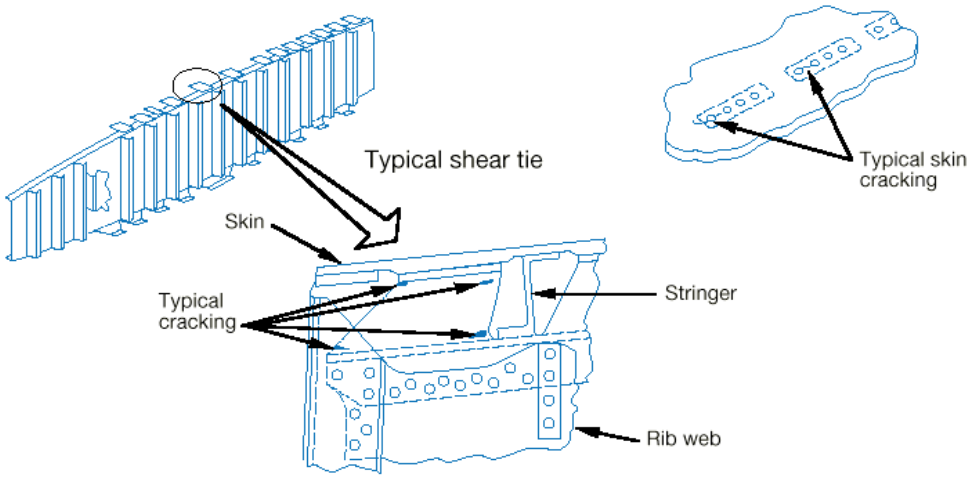
Type and possible location of MSD/MED

- MSD—skin and/or splice plate
  - Chordwise critical fastener rows
- MED—stringer runout of fitting
  - Fatigue-critical fastener holes at stringer and/or fitting

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

- High load transfer
- Local bending

Figure A4-14 ***Wing or Empennage Chordwise Splices (MSD/MED)***



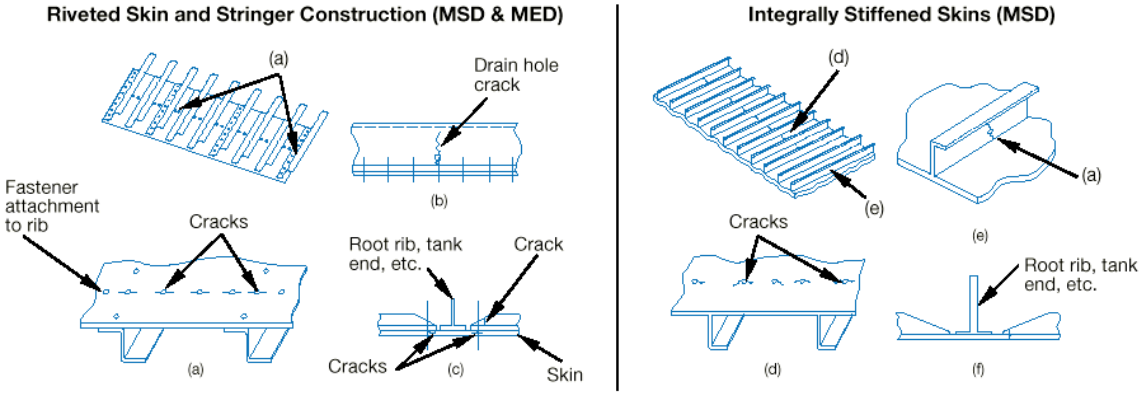
Type and possible location of MSD and MED

- MSD—critical fasteners in skin along rib attachments
- MED—critical rib feet in multiple stringer bays (particularly for empennage under sonic fatigue)

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

- Manufacturing defect—prestress due to assembly sequence
- Sonic fatigue (empennage)

Figure A4-15 ***Rib to Skin Attachments (MSD/MED)***



Inherent fail safe and crack stopper characteristics

- MSD—chordwise cracks link up at
  - a) Rib attachment holes
- MED—
  - b) Drain or vent holes
  - c) Stiffener run-outs at root rib or tank end rib

Do not have inherent crack stopper characteristics of riveted skin and stringer construction

- MSD—Chordwise cracks link up at
  - d) Rib attachment holes
  - e) Drain or vent holes
  - f) Stringer run-outs at root rib or tank end rib
- MED—becomes MSD

Figure A4-16 ***Typical Wing and Empennage Construction (MSD/MED)***

APPENDIX 5. WFD EVALUATION

a. Characterization of Events Leading to WFD. The events that lead to WFD are shown in Figure A5-1. This figure is applicable to both MSD and MED. For any susceptible structural area, it is not a question of if WFD will occur, but when. In Figure A5-1, the "when" is defined by WFD (average behavior) which is the point when 50 percent of the airplanes in a fleet would have experienced WFD in the considered area. (Note that the probability density function for flight cycles or flight hours to WFD has been depicted for reference.) Therefore, WFD (average behavior) includes crack initiation phase and crack propagation phase with the former generally being the majority of the total life. During the crack initiation phase, there is little or no change in the basic strength capability of the structure.

The actual residual strength curve depicted in Figure A5-1 is flat and equal to the strength of the structure in its pristine state. However, at some time after the first small cracks start to grow, the residual strength begins to degrade. The crack growth continues until the capability of the structure is equal to the minimum strength required for establishing damage-tolerance-based inspections in accordance with § 25.571(b). In this context, WFD is a condition that represents a point when 50 percent of the airplanes in a fleet do not meet the minimum strength required in accordance with § 25.571(b).

b. Widespread Fatigue Damage (average behavior). The WFD (average behavior) for each susceptible structural area should be estimated. This may be done based primarily on in-service history, full-scale fatigue test evidence, analyses, or any combination of these. In making this estimate the following should be considered:

(1) a complete review of the in-service history of the susceptible areas (including loads, mission profiles, environment, and operational statistics of the fleet, stated as a number of accumulated flight cycles or flight hours);

(2) significant production variants (material, design, assembly method, and any other change that might affect the fatigue performance of the detail) including any mandated maintenance actions that would change the analysis result;

(3) relevant full-scale and component fatigue test data;

(4) teardown inspections; and

(5) any fractographic analysis available.

The evaluation of 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 (See definition in Appendix 2 of this AC). The WFD evaluation may be analytically determined, supported by test or in-service information.

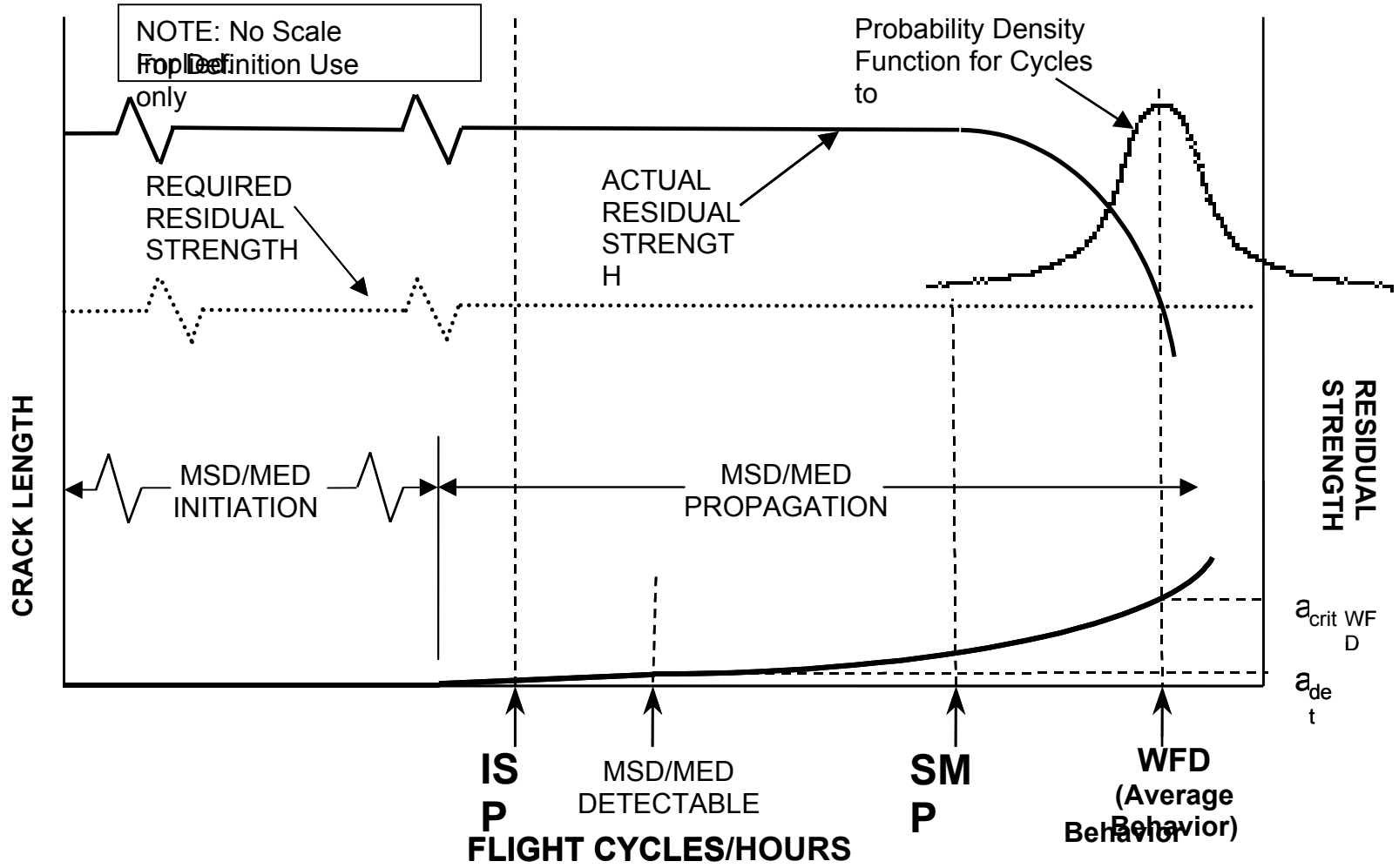


Figure A5-1
MSD/MED Residual Strength Curve

c. Cracking Pattern. Regardless of whether the assessment of WFD (average behavior) is based on in-service data, full-scale fatigue test evidence, or analyses; or a combination of any of these, the following should be considered:

(1) Initial cracking scenario. This is the size and extent of multiple location cracking expected at MSD or MED initiation. Determination requires empirical data or an assumption of the crack locations and sequence plus a fatigue evaluation to determine the time to MSD or MED initiation. Alternatively, analysis can be based on either:

(a) the distribution of equivalent initial flaws, as determined from the analytical assessment of flaws found during fatigue test or teardown inspections regressed to zero cycles, or both; or

(b) a distribution of fatigue cracking determined from relevant fatigue testing or service experience, or both.

(2) Final cracking scenario. This is an estimate of the size and extent of multiple location cracking that could cause residual strength to fall to the minimum required level (WFD condition), as shown in Figure A5-1. Techniques exist for 3-D elastic-plastic analysis of such problems; however, there are several alternative test and analysis approaches available that provide acceptable estimates. One such approach is to define the final cracking scenario as a sub-critical condition. An example of an MSD problem would be the occurrence of the first crack link-up in a row of fastener holes. An example of an MED problem would be simultaneous cracking of two or three adjacent structural elements. Use of a sub-critical scenario reduces the complexity of the analysis and, in many cases, will not greatly reduce the total time to WFD (average behavior) because the majority of the total time is generally associated with crack initiation.

(3) Crack growth. Progression of the crack distributions from the initial cracking scenario to the final cracking scenario should be developed. Crack growth predictions can be developed:

(a) *analytically*, typically based on linear elastic fracture mechanics; or

(b) *empirically*, from test or service fractographic data.

(4) Differences between MSD and MED. The details of the approach used to characterize the events that lead to WFD are expected to be different depending on whether MSD or MED is being considered. This is especially true with respect to crack interaction.

(a) Crack Interaction. With MSD, there is the potential for strong crack interaction and the effect of multiple cracks on each other needs to be addressed. With MED in most cases, there is not the potential for strong crack interaction. The differences between interaction effects for MSD and MED are illustrated in Figure A5-2.

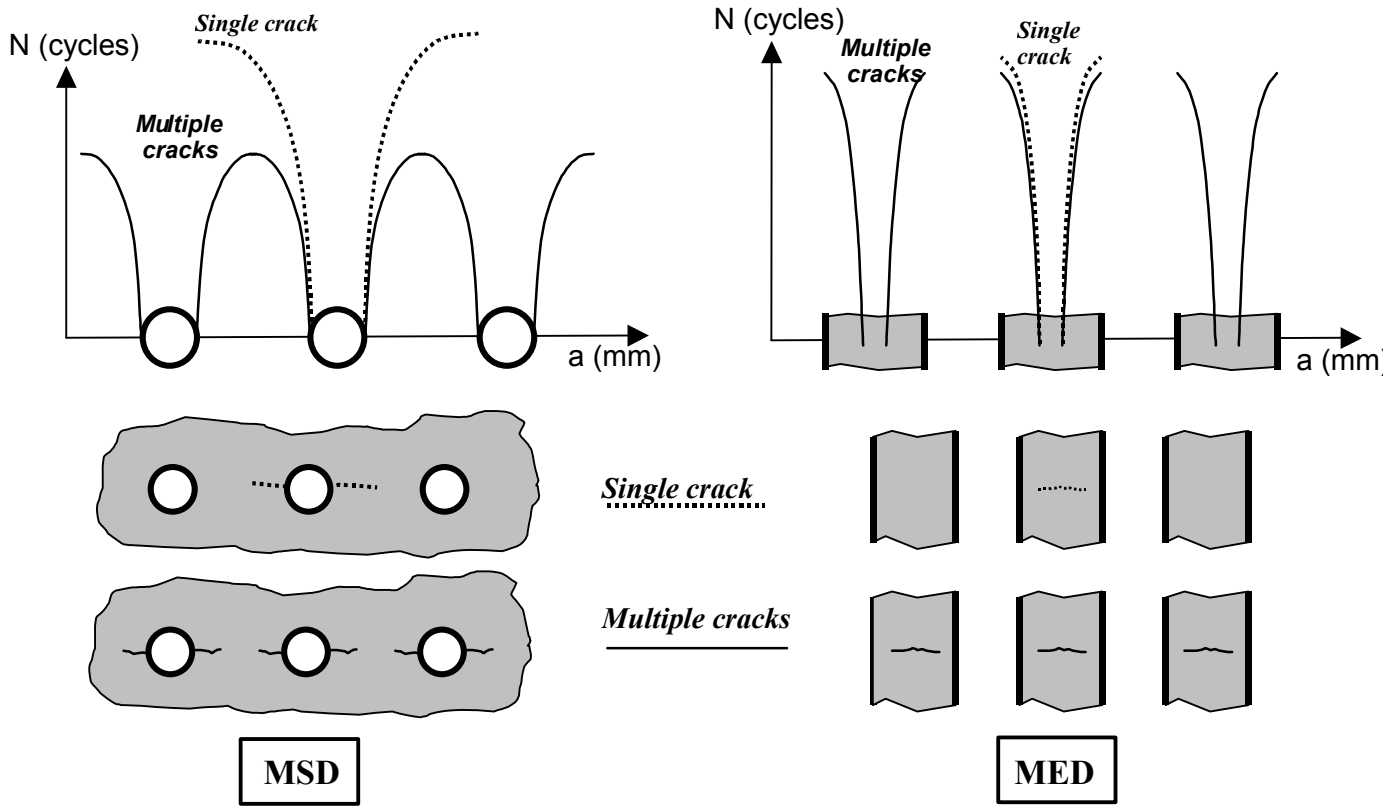


Figure A5-2
Difference Between Interaction Effects Between MSD and MED

(b) Multiple Site Damage and MED interaction. Although not considered commonplace, there is the possibility of simultaneous occurrence of MSD and MED. When this is the case, both MSD and MED should be considered and any interaction between them should be addressed. It is suggested that if an area is potentially susceptible to both MSD and MED then both problems should be worked independently. If the thresholds (ISP or SMP or initiation (nucleation)) for both MSD and MED indicate a high probability of interaction, then this scenario must be considered.

(5) Multiple Site Damage. When assessing MSD, certain assumptions or methods may have a greater impact than others on the final outcome of the WFD evaluation[1]. The following items were found to have such an impact:

(a) the flaw sizes assumed at initiation of the crack growth phase of analysis;

(b) material properties used (static, fatigue, fracture mechanics);

(c) ligament[2] failure criteria;

(d) crack growth equations used;

(e) statistics used to evaluate the fatigue behavior of the structure (e.g., time to crack initiation);

(f) methods of determining the SMP;

(g) detectable flaw size assumed;

(h) initial distribution of flaws; and

(i) factors used to determine lower bound behavior as opposed to mean behavior.

(6) Multiple Element Damage. The procedures developed and documented for MSD in the Aviation Rulemaking Advisory Committee (ARAC) Working Group report, referenced in Appendix B of this AC, are considered generally applicable to MED. However, the determination of failure modes and effects may not be as well defined in the MED case as compared to the MSD case. One of the reasons for this is that crack interaction appears to have a less significant effect on residual strength of the structure in the MED case.

[1] "Recommendations for Regulatory Action to Prevent Widespread Fatigue Damage in the Commercial Airplane Fleet," Revision A, dated June 29, 1999 (a report of the Airworthiness Assurance Working Group for the Aviation Rulemaking Advisory Committee's Transport Aircraft and Engine Issues Group).

[2] Ligament is the material between discontinuities in a given structure. Type of discontinuities include holes, cutouts, or cracks.

Another issue identified as unique to MED is the significance of simultaneous cracking of adjacent structural members. While the probability that subsequent to the first crack initiating in an element, the next crack to initiate will occur in an element right next to it may not be very high, the consequences to the overall structure may be severe. This is because having two structural members failed right next to each other can completely negate any ability the structure had to tolerate any additional damage.

In considering MED scenarios with more than one element failed, it should be assumed that failures are adjacent and no benefit should be taken based on the calculated probability of such an event. Specific conclusions[3] that may be reached relative to MED are summarized below:

(a) The subject of the development of adjacent cracks for MED situations was studied and, while it was determined that there was only a small probability of this happening at an SMP, adjacency should be assumed for conservatism as previously discussed.

(b) Typically, there is no crack interaction in MED situations; however, load redistribution should be considered when load path failure occurs.

[3] "WIDESPREAD FATIGUE DAMAGE BRIDGING TASK Multiple Element Damage," dated July 23, 2003.

APPENDIX 6. DETERMINATION OF ISP AND SMP

a. General. Fatigue damage is the gradual deterioration of a material subjected to repeated loads. This gradual deterioration is a function of use and can be statistically quantified. Widespread fatigue damage is an advanced form of fatigue where the structure is no longer able to carry the residual strength loads and is a continuation of existing deterioration that can be statistically quantified. As depicted in Figure A6-1, WFD cannot be absolutely precluded because there is always some probability, no matter how small, of it occurring. Therefore, modifying or replacing structure at a pre-determined analytically derived time, stated in flight cycles or flight hours, minimizes the probability of having WFD in the fleet. This point is referred to as the SMP and it is illustrated in Figure A6-1. The SMP is generally a fraction of the WFD (average behavior) and should result in the same reliability as a successful two-lifetime fatigue test. This level of reliability for setting the SMP is acceptable as long as MSD or MED inspections are shown to be effective in detecting cracks. The MSD or MED inspections must be implemented prior to that SMP. The implementation times for these inspections are known as ISP. Repeat inspections are usually necessary to maintain this effectiveness in detecting cracks. If MSD or MED inspections are not effective in detecting cracks, then SMP should be set at the time of ISP. For the purposes of this AC, an inspection is "effective" if, when performed by properly trained maintenance personnel, the inspection will readily detect the damage in question.[4]

As a result, the SMP should minimize the extent of cracking in the susceptible structural area in a fleet of affected airplanes. In fact, if this point is appropriately determined, a high percentage of airplanes would not have any MSD or MED by SMP.

b. Structural modification point. The SMP should be established as a point reduced from the WFD (average behavior). The establishment of the SMP should represent a specific probability of survivability and be established with the cognizant FAA ACO. As an example, the SMP may be determined by dividing the WFD (average behavior) by a factor of 2 if there are effective inspections or by a factor of 3 if inspections are not effective.

It is possible that during the structural evaluation for WFD, a TCH may find that the SMP for a particular structural area has been exceeded by one or more airplanes in the fleet. In this case, the TCH should expeditiously evaluate selected high time airplanes in the fleet to determine their structural condition. The TCH may use this data to further evaluate the required actions at SMP, which may include adjusting the SMP [See Paragraph e].

[4] The cracking identified in airworthiness directive (AD) 2002-07-09 is an example of where MSD inspections are "effective." These cracks grow from the fastener holes in the lower row of the lower skin panel in such a way that the cracking is readily detectable using non-destructive inspection methods. The cracking identified in AD 2002-07-08 is an example of where MSD inspections are not "effective." These cracks grow in the outer surface and between the fastener holes in the lower row of the lower skin panel in such a way that the cracking is not readily detectable using non-destructive inspection methods. Therefore, modification is the only option to address this type of cracking.

c. Inspection start point. If an inspection is determined to be effective, then this is the point at which the inspection starts. This point is illustrated in Figure A6-1 and determined through a statistical analysis of crack initiation based on fatigue testing, teardown, or in-service experience of similar structure. It is assumed that the ISP is equivalent to a lower bound value with a specific probability in the statistical distribution of cracking events. The specific probability should be established in discussion with the cognizant FAA ACO. Alternatively, the ISP may be established by applying appropriate factors (e.g., a factor of 3) to the WFD (average behavior).

d. Inspection interval. The interval should be based on the effectiveness of the inspection method because it is highly dependent on the detectable crack size and the probability of detection associated with the specific inspection method.

e. Adjustment of SMP. The initial SMP may be adjusted (extended or reduced) based on one of the following:

(1) The SMP may be extended by showing freedom from WFD up to the new SMP by performing:

(a) Additional fatigue or residual strength tests, or both, on a full-scale airplane structure or a full-scale component followed by detailed inspections and analyses.

(b) Fatigue tests of new or structure from in-service airplanes on a smaller scale than full component tests (i.e., sub-component or panel tests, or both).

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

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

(e) Analysis of in-service data (e.g., inspections) from a statistically significant number of airplanes.

(f) A combination of any or all of the above.

(2) If cracks are found in the structure during an inspection or during modification or replacement, the SMP should then be reevaluated to determine if the SMP provides freedom from WFD. If this is not the case, the SMP should be reduced. This reduction should be reflected in appropriate service information that describes necessary maintenance actions to address the condition of the fleet.

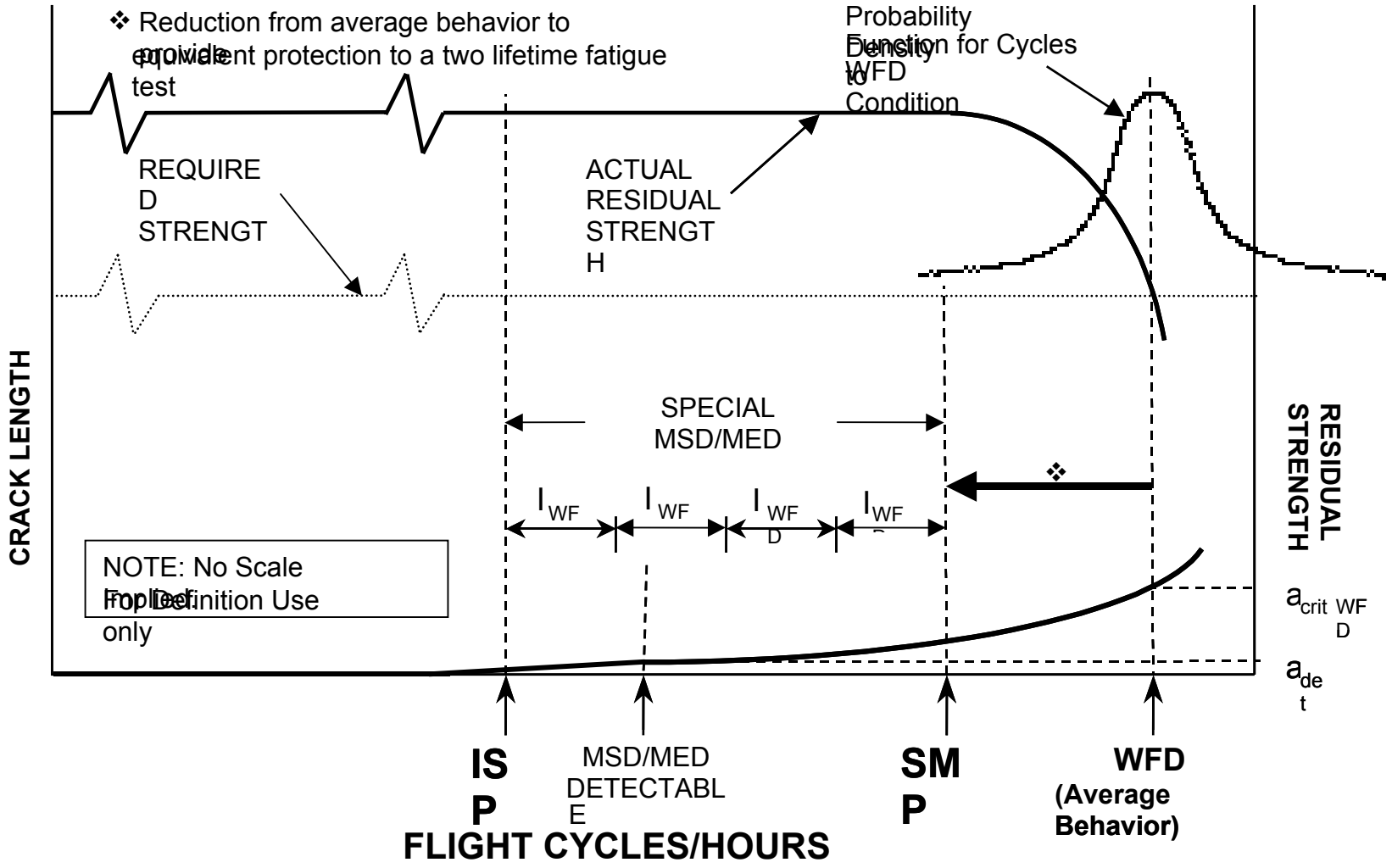

❖ Reduction from average behavior to provide equivalent protection to a two lifetime fatigue test
Probability Density Function for Cycles to WFD Condition
REQUIRED STRENGTH
ACTUAL RESIDUAL STRENGTH
SPECIAL MSD/MED
❖
I_{WF}
I_{WF}
I_{WF}
I_{WF}
NOTE: No Scale For Definition Use Only
CRACK LENGTH
RESIDUAL STRENGTH
$a_{crit\ WFD}$
a_{det}
ISP
MSD/MED DETECTABLE
SMP
WFD (Average Behavior)
FLIGHT CYCLES/HOURS

Figure A6-1

MSD/MED Residual Strength Curve

(Including WFD Inspection)

Appendix 7 – Design Service Goal

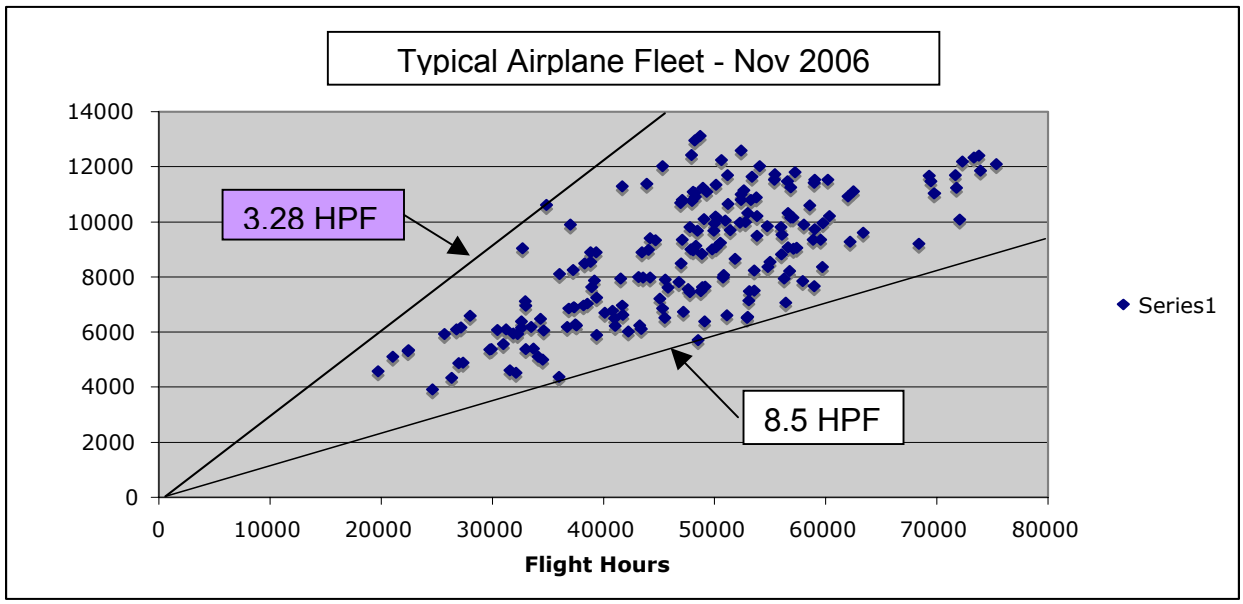
Establishment of DSG:

The DSG is associated with an airplane model specific fatigue life objective expressed in Flight Cycles. Assumptions for flight duration are taken into account in the development of the fatigue missions and loads used to design and certify the airplane. Consequently, the objective in Flight Cycles is associated to a specific flight hour objective, corresponding to the assumptions used to design and certify the airplane.

Revisiting DSG according to actual usage:

Utilization of airplanes in service will vary from Short to Long Range. The specific number of Flight Cycles and Hours expressed by the DSG may not correspond with the actual usage experienced in service. The DSG figures can be reevaluated to provide new sets of Flight Cycles and Hours that will match the service expectations. In determining these new sets of flight cycles and hours it must be insured that the fatigue damage accumulated within the adapted DSG by any structural component in the airplane will not exceed the damage cumulated within the original DSG. The published DSG is the average of several different missions used to design the airplane.

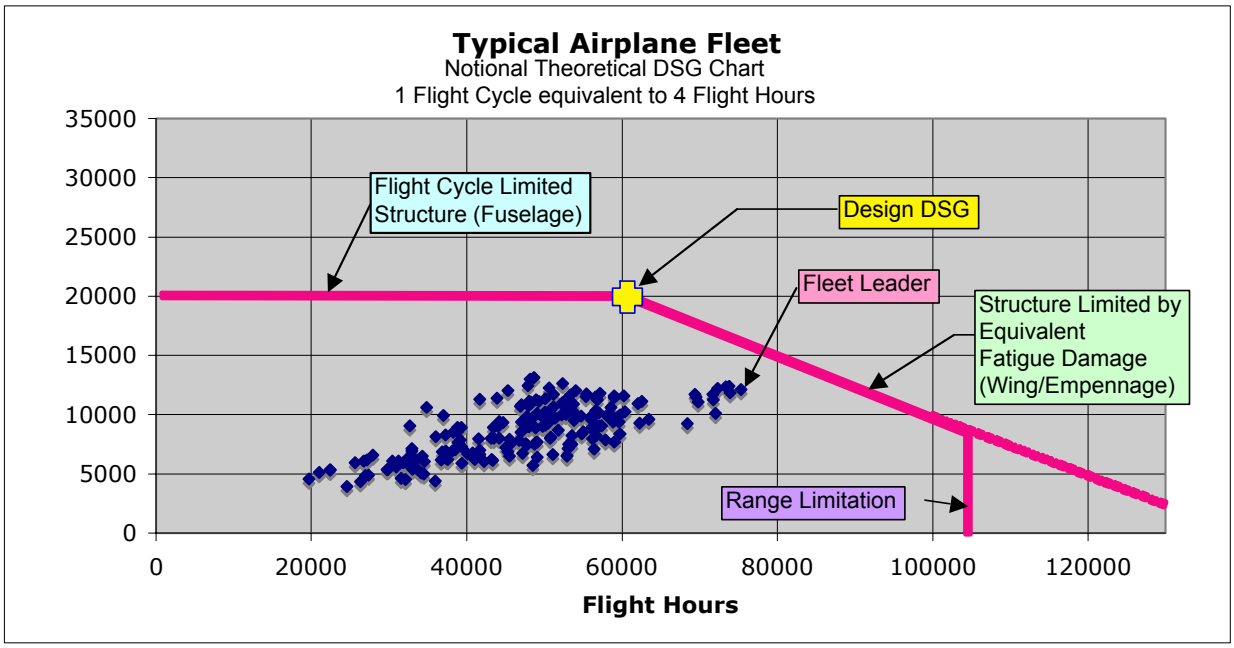
In the design of an airplane, the TCH must characterize the expected use of the airplane for the purpose of establishing fatigue test requirements for the airframe and landing gear as required under 14 CFR Part 25.571. The TCH establishes design requirements for fatigue called the Design Service Goal (DSG) with the realization that actual usage may greatly vary when airplanes enter enters service. The scatter plot below is of a typical fleet of airplanes as of November 2006. Fleet usage appears to be between 3.28 Hours per Flight (HPF) and 8.5 HPF. The airplane was designed for 20, 000 - 3 hour flights. However none of these airplanes is being used for the designed 3 HPF.



The problem is to assess what this variation in usage means in terms of fatigue damage relative to the design DSG of 20,000 – 3 hour flights.

One way would be to select one or more range critical points on the lower surface of the wing and compute the damage caused from 20,000 – 3 hour flights and then repeat the process for other different flight lengths, say 5 and 10 hours. This approach requires that flight profiles representative an average 5 and 10 hour flight be developed. When the data from the different average flights lengths becomes available, one may assess the relative damage to that of a 20,000 – 3 hour flights.

To illustrate the process, an approximation could be made concerning the number of flight hours that would be equivalent to one flight cycle. Fractrographic evidence collected from crack growth, in service of the lower wing areas suggest that the most significant damage is related to the ground-air-ground (G-A-G) cycle. While the actual relationship for a given model is dependent on a number of things, a rule of thumb is that it takes 4 flight hours to do the same amount of damage as one G-A-G cycle. Using this as a notional concept, one could plot a line of equivalent fatigue damage showing the relationship between flight cycles and flight hours. This graph is shown below for an example. The upper limit of the DSG is controlled by Flight Cycle sensitive structure Such as the fuselage), the lower end is decided based on the airplane range limitations. Thus while it might be concluded from a glance at the data that the high time airplane is above DSG (based on Flight Hours) in fact not. **The DSG of the fleet has been exceeded only when the high time airplane crosses the line of equal damage.**



Appendix 8 - Fleet Proven Life

Fleet Proven Life is a fatigue life estimate based upon the probability of a condition based on usage of and service experience for a fleet of airplanes. This approach sometimes includes the probability of a limit load occurring. An example of one such methodology is described below.

Statement of Problem

Given **n** un-failed items which are presumed to belong to a population with a fatigue life distribution of F(x, $\mathbf{X}$), but with an unknown characteristic life $\mathbf{X}$, determine to some level of confidence, a bound estimate of $\mathbf{X}$ and then a "Proven Life" according to a suitable criterion. The fleet proven life represents a 95% survivability with a 95% confidence level.

Characteristic Life Determination

Let x_i (i = 1, 2, 3,……n) be the un-failed individual airplane lives (Flights or Hours).

The probability of one or more failures in the fleet, for a given characteristic life, $\mathbf{X}$, is:

$$P_c = \prod_{i=1}^{n} \{1 - f(x_i, X)\}$$

Where:

$\{1 - f(x_i, X)\}$, represents the probability of the ith item failure.

Once a suitable P_c is established, the Characteristic Life is normally determined by iteration.

"Proven Life" Determination

The proven life calculation is generally based on the total probability of failure considering both the probability of condition and the probability of a limit load occurring. The total probability of failure is generally consider to be less than or equal to:

$$P_T = P_{cfr} * P_{LL} = 1 \times 10^{-9}$$

The probability of P_{cfr} is established as an allowable failure rate by the following equation:

$P_{cfr} = f(x)/(1-F(x))$

When f(x) is the probability density corresponding to F(x).

Design Practices:

In determining Fleet Proven Life for airplanes, the following criteria have been used:

(i) log-normal fatigue life distributions with σ = 0.14-0.20 for aluminum structure (Note: Weibul may also be used)
(ii) Pc = 0.95 – i. e. 95% confidence of survivability
(iii) Maximum allowable failure rate of 3×10^{-6} (per hour or flight) at 95% confidence.

Appendix D: Simplified WFD Methodology

Simplified WFD Methodology for the Evaluation of Repairs, Alterations and Modifications

Introduction

The proposed WFD rule would require type certificates (TC) holders to establish limits of validity (LOV) for certain affected airplane models. Additionally, the TC holders must show that the inherent fatigue and damage tolerance characteristics of the baseline structure combined with specified maintenance actions, if needed, will preclude any occurrence of WFD prior to the LOV being reached. The process used to assess the structure has been referred to as a "widespread fatigue damage evaluation" and generally includes analyses, testing, evaluation of service experience, and teardown inspections.

Recommendations on how to perform WFD evaluations were included in [Reference B.5.a] and guidance has been included in Chapter 3 of [Reference B.1.m]. Both references discuss analytical methodology that can be used to estimate the fatigue and crack growth characteristics of the structure and determine when the structure must be modified and, if practical, when inspections for fatigue cracking at multiple locations must begin. The analytical methodology presented in [Reference B.5.a] and [Reference B.1.m] is based on approaches that have been developed by TC holders and is intended to result in optimum modification and inspection requirements. However its application generally requires a comprehensive knowledge base not typically available to other than TC holders.

In accordance with existing regulations all repairs, alterations and modifications made to airplanes whose certification basis includes 14 CFR § 25.571 at amendment 96 will need to be addressed relative to WFD. If they are determined to be fatigue critical structure and susceptible to WFD then a WFD evaluation will be required. The applicant will need to show that widespread fatigue damage will not occur within the design service goal of the airplane.

If the WFD evaluation is performed by the TC holder it is expected that the methodology used will be similar to that described in [Reference B.5.a] and [Reference B.1.m]. However it is recognized that there may be repairs, alterations and modifications that are engineered by third parties that will need to be evaluated and these third parties may not have the knowledge base required to apply the methodology described in [Reference B.5.a] and [Reference B.1.m]. Because of this a simplified analysis methodology is described below that requires less of a knowledge base but could be used satisfy the intent of the requirement.

Ground Rules and Assumptions

The simplified methodology described below is intended for use by persons already possessing fatigue or damage tolerance approval authority. It is further assumed that those persons applying this methodology have the capability and/or available resources to adequately address external loads, internal loads/stresses and usage spectra/sequences required to support the methodology.

The methodology is intended to be conservative to compensate for its simplicity. It is considered an acceptable default approach if the applicant is unwilling or unable to incorporate additional elements of the more comprehensive methodology described in [Reference B.5.a] and [Reference B.1.m].

The events that lead to WFD are shown in Figure D.1. This figure is applicable to both MSD and MED. For any susceptible structural area, it is not a question of if WFD will occur, but when. In Figure D.1, the "when" is defined by $WFD_{(average\ behavior)}$ which is the point when 50 percent of the airplanes in a fleet would have experienced WFD in the area being considered. (Note that the probability density function for flight cycles or flight hours to WFD has been depicted for reference.) Therefore, $WFD_{(average\ behavior)}$ includes a crack initiation phase and a crack propagation phase with the former generally being the majority of the total life. During the crack initiation phase, there is little or no change in the basic strength capability of the structure.

The actual residual strength curve depicted in Figure D.1 is initially flat and equal to the strength of the structure in its pristine state. However, at some time after the first small cracks start to grow, the residual strength begins to degrade. The crack growth continues until the capability of the structure is equal to the minimum strength required for establishing damage-tolerance-based inspections in accordance with § 25.571(b). In this context, WFD is a condition that represents a point when 50 percent of the airplanes in a fleet do not meet the minimum strength required in accordance with § 25.571(b).

The methodology described in [Reference B.5.a] and [Reference B.1.m] determines both the crack initiation life and crack growth life to predict $WFD_{(average\ behavior)}$. The time at which the structure must be modified is established by applying a factor to the $WFD_{(average\ behavior)}$ to achieve a certain level of reliability of not having an occurrence of WFD in a fleet of airplanes. The factor applied depends on whether or not inspections for MSD/MED are also going to be mandated. Inspections for MSD/MED, if practical and if implemented, provide a second line of defense against an occurrence of WFD and therefore the factor could be less than if there are no inspections. As discussed in [Reference B.5.a] and [Reference B.1.m] a factor of 2 would typically be applied with inspections and 3 without.

The simplified methodology discussed below does not allow for inspection. This is because inspections required for reliable detection of MSD/MED must typically detect relatively small cracks and must be performed over large areas and to many details. Developing such inspections requires an NDI knowledge base and infrastructure that, in general, only TC holders possess.

The only required maintenance action that results from the simplified methodology is modification at a specified time in-service (TIS) regardless of condition. This TIS is referred to as the structural modification point (SMP). The SMP is determined by applying a factor to the estimated $WFD_{(average\ behavior)}$ to achieve a certain reliability that WFD will not occur prior to modification.

Simplified WFD Methodology

The simplified methodology includes two different approaches that may be used to estimate the $WFD_{(average\ behavior)}$. The first approach is based on fatigue crack initiation and relies on traditional SN fatigue data. The second is based on crack growth and requires application of fracture mechanics principles.

Fatigue Crack Initiation Approach

The $WFD_{(average\ behavior)}$, by definition, corresponds to a point in time where multiple cracks have initiated due to a normal fatigue process (i.e. no contributing anomalies) and have propagated to the point that the residual strength has degraded to the level required by 25.571(b).

Since the crack initiation phase represents a significant percentage of the $WFD_{(average\ behavior)}$ a crack initiation analysis could be used to conservatively estimate it. In order to do this the analyst would need to know the stress applied to the detail under consideration, the fatigue life versus stress relation for the detail (e.g. SN curve), the PDF for the fatigue life of the detail and the number of details in the component (e.g. repair) being assessed.

The determination of the SMP is illustrated in Figure D.2 for a repair subject to a constant alternating stress, Sa, (e.g. fuselage skin doubler where the skin stress is due to internal pressure only). The repair has n occurrences of the same critical detail (e.g. outer fastener holes). The PDF of the fatigue life for the detail is shown and p1 is the probability of crack initiation at N1. The PDF for the fatigue life of the repair is also shown. P_n is the probability of initiating a crack at one detail at N1 and it is given by,

$$P_n = 1 - (1 - p_1)^n$$

Calculation of the SMP for this repair would proceed as follows,

a) Enter the average fatigue life curve at the applied stress level, S_a, to determine the average fatigue life of a single detail, N_D. (Note: If the applied stress is not uniform across all details being considered use the maximum.)
b) For $P_n = .5$ solve for p_1 using the relation given above.
c) Using p_1 and the PDF for the detail determine N_1. This is also the average life for the repair to initiate a crack in one detail which will be used as an estimate of the $WFD_{(average\ behavior)}$
d) Divide N_1 by a factor of 3 to determine the SMP.

WORKED EXAMPLE:

Consider a fuselage repair doubler that spans 5 frame bays as illustrated below.

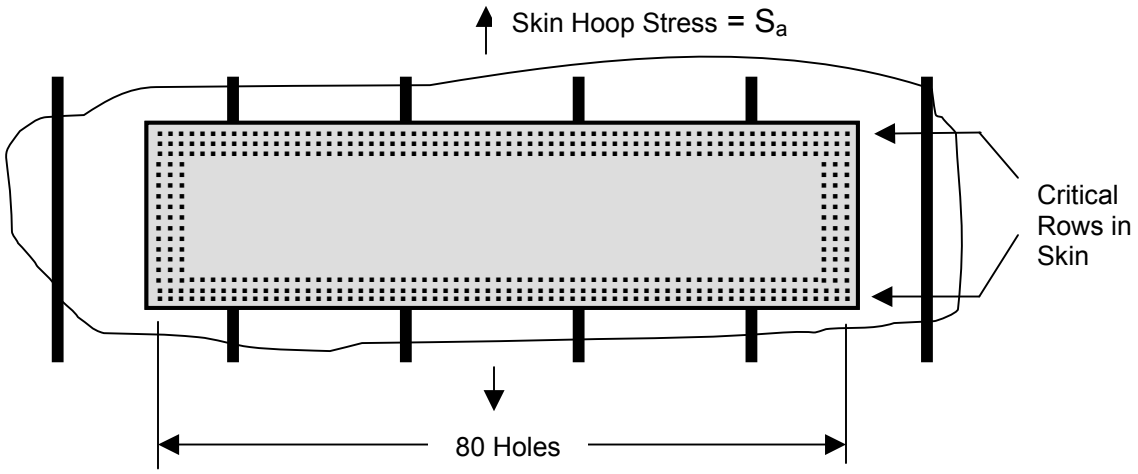


Figure D.2 – Repair Example

For this example it is assumed that the critical fuselage longitudinal skin crack size is less than 2 frame bays in length. Additionally the detail most like to develop normal fatigue cracks first are the holes in the skin that are coincident with the outer longitudinal row of holes in the doubler. Multiple site cracking in these holes could eventually result in a skin crack larger than the critical size without detection during normal maintenance. It would require special directed inspections for relatively small cracks at 160 holes to adequately manage normal fatigue wear out. This is considered impractical and unreliable. Therefore it will be necessary to eventually modify this repair before there is a significant probability of any crack initiation at these holes. An SMP is calculated as follows:

Given –

- The mean SN curve for a single outer skin hole (i.e. one detail) subjected to a alternating far field skin stress of S_a gives a mean fatigue life of 100,000 cycles.
- The fatigue life for a single hole is log normally distributed with a standard deviation, σ = .15.

Solve for p1,

$$P_n = .5 = 1 - (1 - p_1)^{80}$$
$$1 - p_1 = (.5)^{1/80}$$
$$p1 = .008627$$

The life associated with this probability, $N_{.008627}$ is given by,

$\text{Log } N_{.008627} = \text{Log } 100000 - z\sigma$

Where z is the normal standard variate corresponding to an area under the normal distribution curve of 1-.008627-.5 = .4914. z is given in the standard normal distribution table as 2.382.

Solving for $N_{.008627}$,

$z\sigma = \text{Log } 100000 - \text{Log } N_{.008627}$

$z\sigma = \text{Log}(100000/N_{.008627})$

$10\text{^}(z\sigma) = 100000/N_{.008627}$

$10\text{^}(2.382 \times .15) = 2.27667$

$N_{.008627} = 100000/2.27667 = 44000$ cycles

The SMP is,

SMP = 44000/3 = 14667 cycles

(1) Draft Advisory Circular 120-YY, “Widespread Fatigue Damage”.

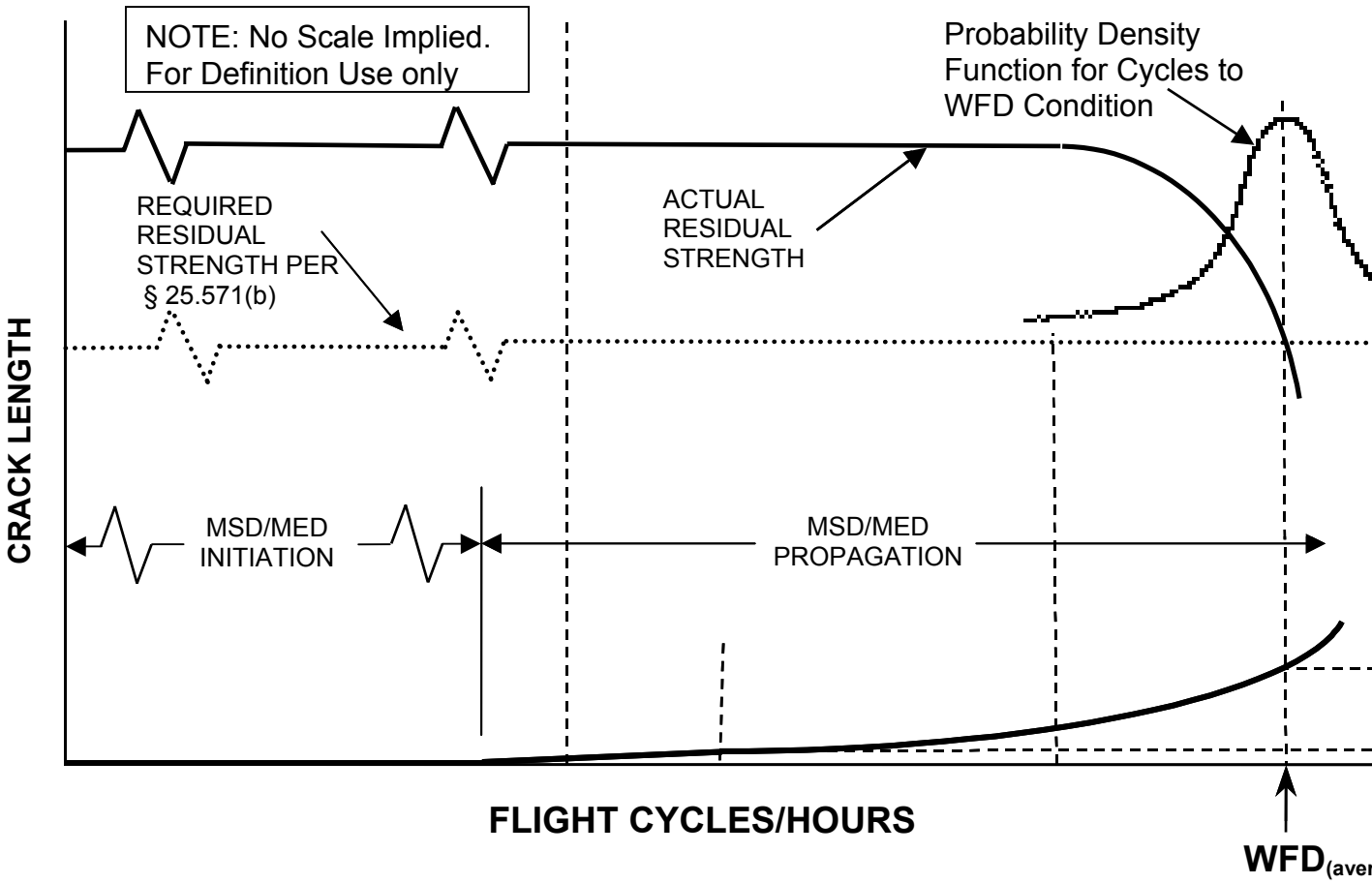


FIGURE D.1 EVENTS LEADING TO WFD

Appendix E: Screening of Repairs

Comments on the screening process to be used to come up with a short list of structure that needs a WFD Assessment

The screening process will consist of a model specific screening criteria developed by TCH/STG. The operator, in the process of surveying the airplane for compliance to the AASR, would apply the criteria to each repair found to arrive at a list of repairs and alterations that will require further evaluation as part of the WFD assessment. It is conceivable that some repairs and alterations that are listed will not require a WFD based maintenance program as a result of the assessment.

The goal in establishing the screening criteria will be to develop criteria that are simple and easily implemented without ambiguity. The operator will most likely be given certain repair attributes such as repair/alteration physical size, location and proximity to other repairs to record during the survey. Later, the operator will use the recorded data to note which repairs will require a WFD assessment based on the model specific data provided by the TCH/STG. The screening criteria provided by the TCH/STG should be based, in part, on whether or not a damage tolerance based inspection[1], by itself, can be relied upon to preclude a catastrophic failure due to fatigue should a WFD condition develop. All repairs identified by the screening process will require a WFD assessment and development of an SMP. If an inspection program is determined to be feasible, an ISP and inspection requirements should also be developed and rationalized with the required damage tolerance inspections to arrive appropriate inspections to preclude catastrophic failure. If an inspection program is not feasible, the SMP must be set at the ISP. It is conceivable that the SMP may be much greater that LOV and for all practical purposes might have no impact on operation.

Even though the screening criteria developed is in terms of physical attributes that are easily determined it must be made clear that the criteria were arrived at based on the reliability of damage tolerance based inspections continued airworthiness. If the initial focus is put on physical attributes like the number of details involved, type of stress gradient, size of repair, etc. one could easily loose track of the fundamental issue which is inspection reliability.

1. A damage tolerance based inspection is one that is based on predicted (e.g. analysis supported by test) crack growth and residual strength. The cracking scenario considered could be single cracks or multiple cracks in multiple or singular elements.

Appendix F: Design Service Goal

1. Establishment of DSG:

The DSG is associated with an airplane model specific fatigue life objective expressed in Flight Cycles. Assumptions for flight duration are taken into account in the development of the fatigue missions and loads used to design and certify the airplane. Consequently, the objective in Flight Cycles is associated to a specific flight hour objective, corresponding to the assumptions used to design and certify the airplane.

2. Revisiting DSG according to actual usage:

Utilization of airplanes in service will vary from Short to Long Range. The specific number of Flight Cycles and Hours expressed by the DSG may not correspond with the actual usage experienced in service. The DSG figures can be reevaluated to provide new sets of Flight Cycles and Hours that will match the service expectations. In determining these new sets of flight cycles and hours it must be insured that the fatigue damage accumulated within the adapted DSG by any structural component in the airplane will not exceed the damage cumulated within the original DSG.

In the design of an airplane, the TCH must characterize the expected use of the airplane for the purpose of establishing fatigue test requirements for the airframe and landing gear as required under 14 CFR Part 25.571. The TCH establishes design requirements for fatigue called the Design Service Goal (DSG) with the realization that actual usage may greatly vary when the airplane enters service. The scatter plot below is of a typical fleet of airplanes as of November 2006. Fleet usage appears to be between 3.28 Hours per Flight (HPF) and 8.5 HPF. The airplane was designed for 20, 000 - 3 hour flights. However none of these airplanes is being used for the designed 3 HPF.

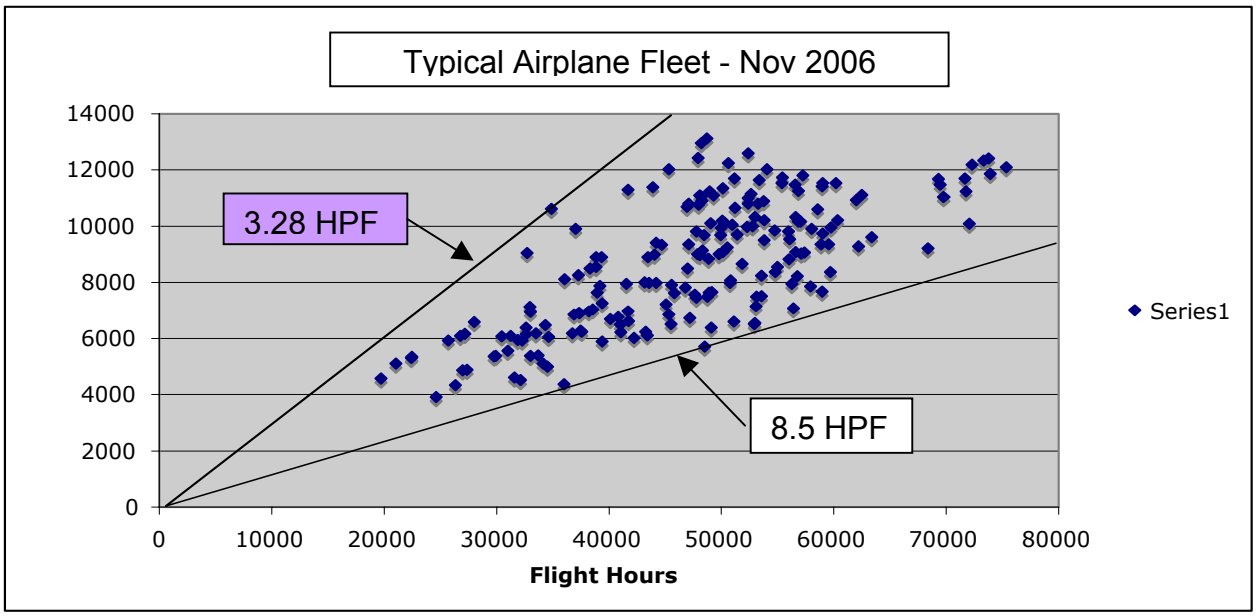


FIGURE F.1 SCATTER PLOT OF TYPICAL AIRPLANE FLEET, NOVEMBER 2006

The problem is to assess what this variation in usage means in terms of fatigue damage relative to the design DSG of 20,000 – 3 hour flights.

One way would be to select one or more range critical points on the lower surface of the wing and compute the damage caused from 20,000 – 3 hour flights and then repeat the process for other different flight lengths, say 2 and 10 hours. This approach requires that flight profiles representative of a 2 and 10 hour flight be developed. When the data from the different flights lengths becomes available, one may assess the relative damage to that of a 20,000 – 3 hour flights.

To illustrate the process, an approximation could be made concerning the number of flight hours that would be equivalent to one flight cycle. Fractrographic evidence collected from crack growth, in service of the lower wing areas suggest that the most significant damage is related to the ground-air-ground (G-A-G) cycle. While the actual relationship for a given model is dependent on a number of things, a rule of thumb is that it takes 4 flight hours to do the same amount of damage as one G-A-G cycle. Using this as a notional concept, one could plot a line of equivalent fatigue damage showing the relationship between flight cycles and flight hours. This graph is shown below for an example. The upper limit of the DSG is controlled by Flight Cycle sensitive structure (such as the fuselage), the lower end is decided based on the airplane range limitations. Thus while it might be concluded from a glance at the data that the high time airplane is above DSG (based on Flight Hours) in fact not. **The DSG of the fleet has been exceeded only when the high time airplane crosses the line of equal damage.**

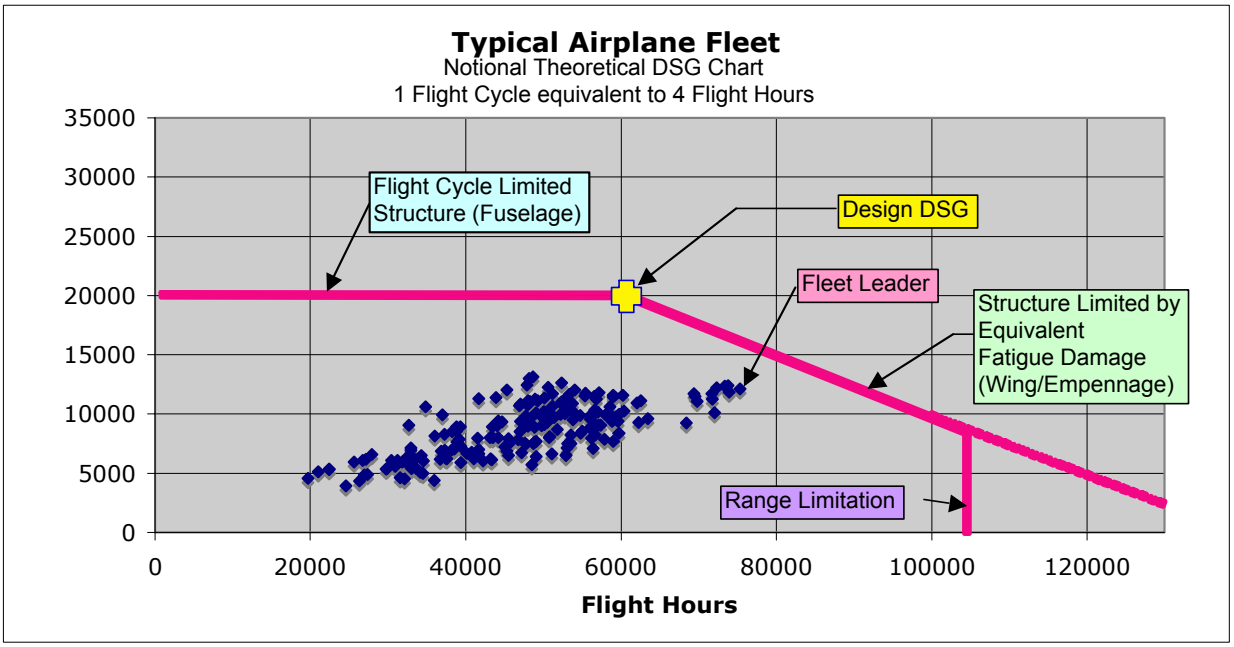


FIGURE F.2 – DSG CHART OF A TYPICAL AIRPLANE

Appendix G: Existing STC Modifications

The following pages represent the STCs reviewed to determine the total number of STCs that might require an assessment for WFD. Eleven US and Foreign operators were surveyed and 642 STC were considered.

Table G.1 STCs Considered

STC Number	Description	Airplane Model(s)	Airplane Cert. Basis	Comments	WFD Assessment Required? 1 = YES / 0 = NO
ST10147SC-D	Installation of Dual Medium Data Rate Satelite System	DC9-82/83	10	Antenna and Racks / 25.571 - 25-10 (40 on rest)	0
ST9680SC-D	Install Main Deck Crew Rest	777-200	82	Decompression Anal.; Frame Attachment	0
SA3981SW-D	Global Positioning System - Eval.	DC9-82/83	10	Antenna	0
SA3968SW-D	Inboard Refueling - Improved Fuel Mixing	DC9-82/83	10	Wing Rib Cut-outs for Piping Changes	1
SA3961SW-D	Installation of Partial TCAS Provisions	DC10-10	22	Doubler covered per DAC design (SB 34-125)	0
SA3960SW-D	Installation of Partial TCAS Provisions	767 Series	45	Boeing DER Approved Doubler Instl.	0
SA3953SW-D	MOD S Transponder Installation	DC9-82	10	Antenna Cut-out	0
SA3954SW-D	TCAS Provisions	DC9-82	10	Antenna	0
SA3955SW-D	MOD S Transponder Installation - Not Used	727-200	CAR 4b	Antenna; 1.0" cut-out; Equiv. to Boeing Instl.	0
SA3956SW-D	TCAS Installation	727-200	CAR 4b	Antenna Cut-out	0
SA3920SW-D	Install Airfone - Sold to Airfone 12/2/86	767-200/-300	45	Antenna - Under 1.0" dia. Hole (Sold to Airfone)	0
SA3915SW-D	Install Galley and Overhead Bins	727-200	CAR 4b	Significant Change to Celing Attachment	0
SA2628SW-D	Install Mid Cabin Lavatories (Fuselage Dblr)	DC10-10	22	External Reinforcement Doubler	1
ST830SE	Installation of Winglets/Wing Changes	737-800	77/91	Not Purchased/Reviewed Only	0

STC Number	Description	Airplane Model(s)	Airplane Cert. Basis	Comments	WFD Assessment Required? 1 = YES / 0 = NO
In-Work	Installation of Winglets/Wing Changes	757-200	45	Not Avail. Yet - In Development	0
ST225NY	AT&T Passenger Phone	DC10 Series	22	Antenna	0
ST270NY	Install Claircom Air Terminal System	767-200/-300	45	Antenna	0
ST284NY	AT&T Passenger Phone	757-200	45	Antenna	0
SA337AL	Palletized Seating Sys - Cargo Roller	737-200C	?	No History at AAL but in STC file	0
ST350AT	Hushkit - Heavyweight	727-200	CAR 4b	SSID Report Provided (91-054)	0
ST431AT	SATCOM Installation - Collins SAT-906	767 Series	45	Antenna	0
ST553SE	Noise Suppression, Nose Cowls	727-100/-200	CAR 4b	Engine Cowl Mod Only/AFM Change Only	0
ST555SE	Noise Suppression, Slat and Flap	727-100/-200	CAR 4b	AFM Change Only	0
ST601AT	SATCOM Installation	MD11	61	Antenna	0
SA931GL	Air-to-Ground Public Telephone	737-200/-300	?	Surrendered; No History at AAL (AirCal 737s)	0
ST1215AT-D	SATCOM Installation - Collins SAT-906	A300 Series	45	Antenna	0
ST1322AT-D	SATCOM - Marconi Antenna System	767-300	45	Antenna	0
ST1334LA	Installation of Reinforced Cockpit Door	757-200		Considered in Analysis	0
ST1335LA	Installation of Reinforced Cockpit Door	737-800		Considered in Analysis	0
ST1336LA	Installation of Reinforced Cockpit Door	DC9-82/83			0
SA2471NM	Installation of Centerline Overhead Bin	DC10-10/30	22	Significant Change to Ceiling Attachment	0
SA4225NM-D	Sliding Carpet Installation - 757 Cargo	757-200	45	Unknown if CPCP Reviewed	0
SA4226NM-D	Scandanavian Cargo Loading System	757-200	45	Unknown if CPCP Reviewed	0
SA4228NM-D	Install SBC/Sliding Carpet Loading System	757-200	45	Unknown if CPCP Reviewed	0
SA4833NM	Hushkit - Lightweight	727-200	CAR 4b	No Structural Supplemental/AFM Only	0
SA5825NM	Air-to-Ground Communication System	DC9-82	10	Antenna	0

STC Number	Description	Airplane Model(s)	Airplane Cert. Basis	Comments	WFD Assessment Required? 1 = YES / 0 = NO
SA5839NM	Hushkit - Heavyweight	727-200	CAR 4b	No Structural Supplemental/AFM Only	0
SA9015NM-D	Claircom Passenger Phone System	DC9-82/83	10	Antenna	0
SA1195SO	Installation Cockpit Blkhd & Courier Seat Instl Separate Oxygen System for Flight Att.	DC9	CAR 4b		0
SA1360GL	Install Parker Hannifin Freon A/C System	DC8	CAR 4b		0
SA1462GL	Installation of Cargo Handling System in DC8-61F & 63F	DC8	CAR 4b		0
SA1563GL	Stage 3 Hushkit Installation	DC9	CAR 4b		0
SA1613GL	Stage 3 Hushkit Installation	DC9	CAR 4b		0
SA1670GL	Installation Of Loran KLN-88 System	DC9	CAR 4b		0
SA1785GL	Stage 3 Hushkit	DC9	CAR 4b		0
SA1802SO	Instl Cargo Door,Restraint Blkhd,Heavy Floor, Class E Compartment, Pallet Restraint Syst.	DC8	CAR 4b		1
SA1893SO	Instl 9G Barrier Net and Floor Mod	DC9	CAR 4b		0
SA1894SO	Installation Type "C" Containers	DC9	CAR 4b		0
SA1998SO	Installation Cargo Handling System for Type C Container	DC8	CAR 4b		0
SA1998SO	Installation Cargo Handling System for Type C Container	DC9	CAR 4b		0
SA2305SO	Installation of Dual KNS-660 FMS	DC8	CAR 4b		0
SA2594CE	Instl of Single Collins TPR-720 Mode S Transponder	DC9	CAR 4b		0
SA2823CE	Instl of Collins Traffic Alert and Collision Avoidance System TTR-920 (TCAS II)	DC9	CAR 4b		0
SA3086NM	Increase in Maximum Zero Fuel Weight Mod.	DC8	CAR 4b		0
SA3201SO	Top Drawing,MK VII Installation on Mcdonnell Douglas DC-9 Series Aircraft	DC9	CAR 4b		0
SA3300SO	Installation of a Sundstrand MK-VII Ground Proximity & Windshear Warning System	DC8	CAR 4b		0
SA4892NM	Modification Aircraft Installation Noise Reduction Nacelles	DC8	CAR 4b		0
SA5455NM	Modification Aircraft Installation Noise Reduction Nacelles	DC8	CAR 4b		0
ST00393AT	Installation of TCAS II System	767	45		0
ST00670CH	Apollo Navigation Management System, GPS	DC8	CAR 4b		0

STC Number	Description	Airplane Model(s)	Airplane Cert. Basis	Comments	WFD Assessment Required? 1 = YES / 0 = NO
ST00844WI-D	Mod of TCAS II or TCAS-94 (TCAS II) System Installation with Collins TTR-920	DC9	CAR 4b		0
ST00844WI-D	Mod of TCAS II or TCAS-94 (TCAS II) System Installation with Collins TTR-920	767	45		0
ST00881WI-D	Installation-TCAS with Dual ADF System	DC9	CAR 4b		0
ST00973CH	Honeywell Mode S Transponder	DC9	CAR 4b		0
ST00974CH	Automatic Dependent Surveillance Broadcast (ADS-b)	DC9	CAR 4b		0
ST01057CH	ADS-B/CDTI STC Master Drawing List	DC9	CAR4b		0
ST01487CH	Installation TCAS TTR-921 and Mode S TPR901 System	DC8	CAR4b		0
ST01494CH	Instl of TAWS and a Univ. Avionics GPS-1000 Global Positioning System	DC8	CAR4b		0
ST01669AT-D	Instl of Class "E" Provisions, Environmental Control Sys & Smoke Detection System	767	45		0
ST01670AT-D	Installation of Main Deck & Lower Lobe Floor Mod & 9G Restraint Systems	767	45		1
ST01671AT-D	Installation of Main Deck & Lower Lobe Cargo Handling System	767	45		0
ST01779CH	Installation Of An Universal Avionics Terrain Awareness Warning System (TAWS)	DC9	CAR4b		0
ST01807CH	Enhanced Ground Proximity Warning System	767	45		0
ST01985CH	Installation Of An Apollo Navigation Management System	DC9	CAR4b		0
ST00788SE	Installation of a LiveTV Satellite Television System.	A319-111, 112 A318-111 See STC	FAR 25-86		1
ST00535DE	Installation of Multichannel Aircraft Suscriber Equipment (Telephone)	A319-111	FAR 25-86		0
ST00537DE	Installation of Cargo Floor Panel Reinforcements	A319-111, 112	FAR 25-86		0
ST01447NY	Harris Ground Wireless Aircraft Data Link	A320-200	FAR 25-56		0
ST10065SC	Electronic Equipment Rack	A320-232	FAR 25-56		0
ST02483AT	Cabin mounted Video Camera System	A320-Series	FAR 25-56		0
ST01060CH	GPS Antenna Doubler Instl	737-300	?	Did not specify cert basis, probably TC	0

STC Number	Description	Airplane Model(s)	Airplane Cert. Basis	Comments	WFD Assessment Required? 1 = YES / 0 = NO
ST01449CH	GPS Antenna Doubler Instl	757-200	?	Did not specify cert basis, probably TC	0
SA6081NM	Phone Antenna Doubler Instl	737-300	?	Did not specify cert basis, probably TC	0
ST00109LA-D	Phone Antenna Doubler Instl	A320	?	Did not specify cert basis, probably TC	0
ST01625LA	Fuelmizer Instl	737-300	25-71	Only one clearly stated 25.571	0
SA1332SO	Modification of thrust reversers. (727-116)	B 727			0
SA1602NM	Installation of a Lear Siegler performance data computer system.	B 727 B727-100C Series			0
SA1603NM	Cockpit instrument/overhead panel standardization.	B 727			0
SA1604NM	Install IPECO crew seats on flight decks.	B 727			0
SA1747SO	727--25C, S/N 19720, LTN-51 Instl	B 727-25C			0
SA1767SO	727-100/-200 Main Cargo Door Inst.	B 727-100, 200 series			1
SA1768SO	727-200/-200 "E" Class Compartment	B 727-100, 200 series			0
SA1992SO	Installation of modified 727-200 type acoustic nose cowls and acoustic tailpipes.	B 727-100			0
SA2039SO	Installation of the Dual Litton, LTN 72R inertial navigation system.	B 727-100,200 series			0
SA2078SO	This STC certificate represents airworthiness approval of the Litton LTN-92, inertial navigation systems.	DC-10-10 DC-10-30			0
SA2103NM	3M (Ryan) WX-10 stormscope weather mapping systems.	B 727-100C series			0
SA2105SO	Installation of the single Litton LTN-92 inertial navigation system.	B 727-100 series			0
SA2609SO	Installation of Dual Collins FD-110 Flight directors.	B 727-200 series			0
SA2729SO	Installation of SP150 MB V dual channel CAT III automatic landing system.	B 727-200 series			0
SA2849SO	Installation of dual Collins FD-109 flight directors.	B 727-100 series			0

STC Number	Description	Airplane Model(s)	Airplane Cert. Basis	Comments	WFD Assessment Required? 1 = YES / 0 = NO
SA2851SO	Replacement of Garrett low flow control valve, P/N396440-01, P/N B27-36-003-01	B 727-200 series			0
SA2861SO	Installation of a class E cargo compartment smoke detection system.	B 727-100C series			0
SA2920SO	DC10/MD11 Window Plug	MD-11 DC-10			0
SA3175SO	DC10 CRAF Configuration	DC-10			0
SA3993NM	727-100 Hush Kits	B 727-100 series			0
SA4156WE	Installation of a two-place courier seat.	DC-10-10F			0
SA4833NM	727-200 Light Weight Hush Kit.	B 727-200 series			0
SA5839NM	727 Heavy Weight Hush Kit.	Boeing 727-200 series			0
SA7447SW	727-100 modification from an eight unit load device to a nine unit load device configuration. 727-200 modification from and eleven unit load device to a twelve unit load device.	B 727-100,200 series			0
ST00143AT	Installation of a collins ACARS management unit.	MD-11			0
ST00230AT	Installation of a trimble TNL-2100 GPS navigator.	B 727-200 series			0
ST00312AT	Modification to allow passenger to freighter conversion.	DC-10-10			1
ST00350AT	727-200 Hush Kit Structural Provisions.	B 727-200 series			0
ST00368AT	Installation of liquid crystal EADI and EHSI displays.	B 727-200 series			0
ST00453AT	Installation of special equipment and twelve passenger seats for animal charter flights.	MD-11			0
ST00453AT	Installation of special equipment and twelve passenger seats for animal charter flights.	DC-10-10F DC-10-30F			0
ST00542LA	X-Box Cargo System	DC10F MD10F			0
ST01020AT	Installation of modifications for increased capacity air conditioning for upper cabin.	DC-10-30F			0
ST01047LA	Installation of a fan and core cowl wire harness.	DC-10-10 DC-10-10F DC-10-30 DC-10-30F			0

STC Number	Description	Airplane Model(s)	Airplane Cert. Basis	Comments	WFD Assessment Required? 1 = YES / 0 = NO
ST01072LA	Installation of a red cover fuel shut-off handle assembly.	MD-10-10F MD-10-30F			0
ST01115AT	727-200 5 Inch ATI LCD Installation	B 727-200			0
ST01165AT	Installation of a second air conditioning system supply duct in upper cabin & modification of the environmental control system & temperature sensor wiring.	MD-11			0
ST01225AT	Installation of an Aircraft Communication addressing and reporting system(ACARS).	DC-10			0
ST01325AT	Installation of an ARINC 717 digital flight data acquisition data (DFDAU) Allied Signal P/N 967-0214-001.	MD-11			0
ST01393AT	Installation of liquid crystal display electronic attitude direction indicators and horizontal situation indicators (EADI/EHSI)	DC-10			0
ST01691AT	Installation of expanded parameter flight data recorder.	B 727-100 , 200 series			0
ST01955AT	Installation of a triple Rockwell Collins 618M5 VHF transceivers and the replacement of control heads with gables G74406-04 to meet the 8.33 KHz channel space frequencies.	B 727-100, 200 series			0
ST02078AT	Installation of a triple Rockwell Collins VHF 900B transceiver and the replacement of control heads with Gables G7400-13 and G7400-16 to meet the 8.33 KHz channel space frequencies.	Airbus A300, A310 series			0
ST02276AT	Installation of a Rockwell Collins high frequency data link.	MD-11F			0
SA6076NM	Installation of Honeywell TCAS II & Dual Mode-S Transponder Systems	Airbus A300-600			0
ST01477CH	Installation of Onboard Network System	Airbus A300-600			0
ST00747LA-D	Installation of Flight Data Recorder Expanded Parameter Sensors	Airbus A300-600, A310			0
ST00708WI-D	Upgrade ACARS MU To Phase II Software	Airbus A300-600, A310-200			0
ST00440SE	Installation of Honeywell EGPWS	Airbus A300-600, A310-200, A300-300			0
SA5814NM	Installation of Honeywell TCAS II & Dual Mode-S Transponder Systems	Airbus A310-200, -300			0
SA36NW	Installation of Sundstrand MKII GPWS	B727-100			0

STC Number	Description	Airplane Model(s)	Airplane Cert. Basis	Comments	WFD Assessment Required? 1 = YES / 0 = NO
SA604SO	Installation of Dual FD-109 Flight Director Systems	B727-100			0
ST00579SE	Installation of ADS-B	B727-100			0
ST00697AT-D	Conversion From Bendix RDR-1E to Collins WXR-700X Weather Radar System	B727-100			0
SA4834NM	Installation of Honeywell TCAS II & Dual Mode-S Transponder Systems	B727-100, -200			0
SA5105NM	Installation of Allied-Signal MKVII GPWS/Windshear Warning System	B727-100, -200			0
ST00221AT	Installation of Solid State Flight Data Recorder & Expanded Parameters	B727-100, -200			0
ST510SO	Installation of Dual HF Systems	B727-100, -200			0
ST00535SE	Installation of Honeywell EGPWS	B727-100, -200			0
SA1220NW	Installation of Digital Flight Data Recorder	B727-200			0
SA3912NM	Installation of Litton Dual LTN-92 INS Systems	B727-200			0
SA5917SW	Installation of Dual Tracor 7800 VLF/Omega Nav Systems	B727-200			0
ST00556CH	Installation of Dual Honeywell/Trimble HT9100 Global Nav Systems	B727-200			0
ST00935WI-D	Mod. Bendix KNR6030 Nav Receiver (VOR/ILS) System to Collins GNLU-930 Multi Mode Receiver	B727-200F			0
ST00896WI-D	Installation of GLS Data Recording Equipment	B727-200F			0
ST01166CH	Installation of Pilot Access Terminal	MD-11			0
ST01307CH	Installation of Gatelink	MD-11 Boeing MD-10			0
ST00800CH	Installation of OMT	MD-11 Boeing MD-10			0
ST01539CH	Installation of a Smiths Industries Combined Voice and Flight Data Recorder and optional Recorder Control Unit	MD-11 MD-11F			0
ST00503LA	Installation of Securaplane Battery Charger	DC 10-10, -10F, -15, -30, -30F, -40, -40F, MD-10-10F, -30F, MD-11, -11F			0

STC Number	Description	Airplane Model(s)	Airplane Cert. Basis	Comments	WFD Assessment Required? 1 = YES / 0 = NO
SA4836NM	Installation of Honeywell TCAS II & Dual Mode-S Transponder Systems	DC-10-10 DC-10-30			0
SA5794NM	Installation of Allied-Signal MKVII GPWS/Windshear Warning System	DC-10-10 DC-10-30			0
ST00680CH	Installation of Dual Honeywell/Trimble HT9100 GPS Ferry Pallet	DC-10-10 DC-10-30			0
ST00803NY	Installation of IS&S Standby Metric Altimeter	DC-10-30			0
SA5891NM	Installation of Honeywell TCAS II & Dual Mode-S Transponder Systems	MD-11			0
ST00704LA	Installation of Honeywell TCAS II & Dual Mode-S Transponder Systems	MD-11			0
ST00743LA-D	Installation of Control Column & Rudder Pedal Position Sensors for Flight Data Recorder	MD-11 DC-10-10 DC-10-30			0
ST00536SE	Activation of Honeywell EGPWS Peaks & Obstacles Functions	MD-11 MD-10			0
ST00100NY	A310 P-F Conversion	Airbus A310			1
ST01438CH	Inst. Of NASI Vent Door System	B727			1
ST00878CH	Cargo System	A300 Model F4-605R			0
ST00878CH	A300-600 MD Cargo Loading System	Airbus A300 series			0
ST01393NY	A300 Lower Deck Replacement	Airbus A300 A310 series			0
ST504CH	A310/300 MD Cargo Loading System	Airbus A300 A310 series			0
SA1956NM	Cargo System	B727-100			0
SA5015NM	Containers	B727-100, 200 Series			0
SA5041NM	Containers	B727-100, -200 Series			0
SA3113NM	Cargo System	B727-100, -200 Series			0
SA3173NM	Containers	B727-100, -200 Series			0
SA3929NM	Cargo System	B727-100/-100F			0
SA4894NM	Floor Panel Replacement	B727-100C, -200C Series			0
SA4553NM	Cargo System	B727-200, -200F			0

STC Number	Description	Airplane Model(s)	Airplane Cert. Basis	Comments	WFD Assessment Required? 1 = YES / 0 = NO
SA2481NM	Cargo System	B727-233			0
SA1991NM	Cargo System	B727-2S2F, B727-200F			0
ST01338CH	DC 10/MD-10 APU Door Actuation System	Boeing DC 10, MD-10			0
SA5466NM	Belly Cargo System	DC 10 Series			0
ST00502LA	3 Piece 9-G Net Installation	DC 10 Series, MD-11 Series			0
ST00677NY	Emergency Equipment, Slide/Raft	DC 10 Series, MD-11 Series			0
SA3172NM	Containers	DC 10-10, -30			0
SA5040NM	Containers	DC 10-10, -30, MD-11			0
SA5016NM	Containers	DC 10-10, -30, MD-11, A300F4-605R			0
SA4222NM-D	Belly Cargo System	DC 10-10, DC 10-30			0
SA3278SO	Smoke Barrier Installation	DC-10-10, DC-10-30			0
ST00349LA	Inst. Of Cargo Handling Systems	DC 10-10, DC 10-30, MD-10-10, MD-10-30			0
SA5003NM	Inst. Of Cargo Handling Systems	DC 10-10, DC 10-30, MD-10-10, MD-10-30			0
ST00399DE	Inst. Of Nose Radome Shell Assy.	DC 10-10, DC 10-30, MD-10-10, MD-10-30, MD-11			0
ST01120LA	Inst. Of Insulation Blankets	DC 10-10, DC 10-30, MD-10-10, MD-10-30, MD-11			0
SA4920NM	Horse Containers	DC 10-10CF & -30CF			0
SA3415NM	Cargo System	DC 10-10F & DC 10-30F			0
ST00628LA	Containers	DC 10-30F			0
SA6063NM	Seat Pallet Assembly	DC 10-30F			0
ST00152LA	Cargo System	MD-11F			0

STC Number	Description	Airplane Model(s)	Airplane Cert. Basis	Comments	WFD Assessment Required? 1 = YES / 0 = NO
SA4098WE	Cargo System				0
SA298NE	Installation of Simmonds Digital Fuel Quantity Indicating System	B727-100			0
ST00387LA-D	Lower Cargo Smoke Detection and Fire Suppression System	B727-100, -200			0
ST00736SE	727-100/-200 Instl. Of Full Face Oxygen Masks	B727-100, -200			0
SA3468NM	Installation of Smiths Digital Fuel Quantity Indicating System	B727-200			0
SA1474SO	Installation of Winters Auxilliary Fuel Tanks	B727-2S2F			1
SA3432WE	DC 10 Engine/Pylon Fire Detection	DC 10-10, DC 10-30			0
ST01040CH	Flap Position Transmitter	DC 10-10, DC 10-30			0
ST01341CH	Flap Position Transmitter	DC 10-10, DC 10-30			0
ST00113LA-D	Flap Position Indicator	DC 10-10, DC 10-30			0
ST00456AT	Installation of Gull Digital Fuel Quantity Indicating System	DC 10-10, DC 10-30			0
ST00828CH	Flap Position Transmitter	MD-11			0
ST09368SC	3/4 Oxygen Bottle Installation	MD-11 MD-10			0
ST10471AT	Engine Fire Detection Harness Repl.	MD-11 A300-600			0
SA2826WE-D	727-22/-22C/-222 GPWS Installation	Boeing 727-22/-22C/-222			0
SA1949NM-D	Roll & Pitch Computers	DC10-30			0
SA2702NM-D	FMS System	DC10-10			0
SA2711NM-D	EEL Battery	DC10-10, -30			0
SA2726NM-D	ACARS	DC10-30			0
SA2790NM-D	TCAS ll, Mode S	DC10-30			0
SA2794NM-D	Ground Prox, Windshear	DC10-30			0
SA2795NM-D	TCAS	DC10-30			0
SA2756NM-D	TCAS Wiring Provisions	DC10-10			0
SA2782NM-D	TCAS	DC10-10			0
SA2784NM-D	Wiring Provisions Windshear	DC10-10			0
SA2792NM-D	Ground Pro, Windshear Activation, computer	DC10-10			0
SA2817WE-D	Provisions for Ground Prox Warming Sys.	DC10-10, -30F			0

STC Number	Description	Airplane Model(s)	Airplane Cert. Basis	Comments	WFD Assessment Required? 1 = YES / 0 = NO
SA2830WE-D	Ground Prox Warning Sys. Computer	DC10-10, -30F			0
SA3025WE-D	DME Interrogators Cooling	DC10-10			0
SA3036WE-D	INS System	DC10-10			0
SA3580WE-D	ACARS	DC10-10			0
SA3585WE-D	Flight Management SyS. S/N 47969 only	DC10-10			0
SA5995NM-D	Global Position Sys. Provisions	DC1010			0
SA5996NM-D	SATCOM	DC-10-10			0
ST00008LB-D	HSI/ADI Installation	DC10-10			0
ST00009LB-D	Electronic Resource Sys. Provisions	DC10-10			0
ST00552LA-D	GPS/SATCOM/EFI/ERS Deactivation	DC10-10			0
SA2836WE-D	Bell & Howell Video	DC10-10			0
SA3046SO	TRA-67 Mode S Transponder	DC10-30			0
SA3061SO	CAS8/TCASII	DC10-30			0
SA2459NM	Installation Video Sys.	DC10 Series			0
ST00935LA	Video System	MD-11			0
ST9416SC-D	Installation VHF	MD-11			0
ST00601AT	SATCOM	MD-11			0
SA6076NM	TCAS Sys.	A300B4-600, -600R			0
SA5835NM	Digital Flight Data Inst'l.	A300-200, -300 Series			0
ST00145AT	TCAS, Mode S, WX Radar	A310-200, -300 Series			0
SA3400NM	Floor Prox Lights	A300, A310-200, -300 Series			0
ST01609CH	Combined Voice & FDR. Recorder control Unit	Airbus			0
SA1948NM-D	Passenger Seat Provisions	DC10-30			0
SA2705NM-D	Passenger Seats.	DC10-30			0
SA2755NM-D	Passenger Seating	DC10-30			0
ST00562LA-D	Ribbon Heat Strips, P Water Lines	DC10-30F			0
SA2706NM-D	Galley Lower Conversion	DC10-10			0
SA 2816WE	Inst'l Spacer Pallets	DC10-10			0
SA2837WE-D	Lavatory, Main Deck Flooring	DC10-10			0
SA3031WE-D	Serving Cart Tie Downs	DC10-10			0

STC Number	Description	Airplane Model(s)	Airplane Cert. Basis	Comments	WFD Assessment Required? 1 = YES / 0 = NO
SA3035WE-D	Slide Raft	DC10-10			0
SA3358WE-D	Interior Arrangement	DC10-10			0
SA1144NW-D	Cart Installation	DC10-10			0
SA2720NM-D	Interior Configuration	DC10-10			0
ST00019LB-D	Ribbon Heaters Water Lines.	DC10-10			0
ST00399AT	330 Tourist Class Seating	DC10-10			0
SA2524WE	Inst'l of Seats, Bar, Tables	DC10-10, -10F			0
SA3875WE	Flight Attendant Seat	DC10-10, -10F			0
SA3997SW-D	Electrical power at passenger seats.	MD-11			0
SA3986SW-D	Modify passenger cabin	MD-11			0
SA5928NM	Cargo Liner	A300-600, A310-200,-300 Series			0
ST00355AT	189 Passenger Interior	A310-200 Series			0
SA3134SO	Class Divider, Work Table	A31-200, -300 Series			0
ST00757NY	Food Service Cart	A300B4-600, -600R			0
ST00913NY	Install Meal Cart	A300B4-600, -600R			0
SA1135NW-D	Fan Reverser Fire Proof Blankets	DC10-10, -30			0
SA1947NM-D	Traning Requirements	DC10-30			0
SA3696WE	Training requirements	DC10-10			0
SA3990SW-D	Passenger Cabin Mods	MD-11			0
SA1506NM	Revised Interior	DC-9-82			0
SA1529NM	Revised Interior	DC-9-80			0
SA2424NM	Installation Of Interior Arrangement	DC-9-82			0
SA2732NM	Revised Interior	DC-9			0
SA2734NM	Revised Interior	DC-9			0
SA2739NM	Revised Interior	DC-9-81, -82			0
SA2747NM	Revised Interior	DC-9-81,-82			0
SA2752NM	Installation of Nordskog Galleys	DC-9-81, -82			0
SA2753NM	Revised Interior	DC-9-81,-82			0
SA2877SW	Modify Upper And Lower Galley Attach Points, Install Galleys	DC-9			0
SA3906NM	Installation Of KME Galleys G1 Through G4	DC-9-82			0

STC Number	Description	Airplane Model(s)	Airplane Cert. Basis	Comments	WFD Assessment Required? 1 = YES / 0 = NO
SA4212SW	Installation Of Galley #3	DC-9-14, -15, -31, -32			0
SA4323SW	Two 5-Abreast Seating Arrangements (Limited 29 Inch, 30 Inch, And 31 Inch Spacing)	DC-9-32			0
SA4612SW	Modify Two Existing Forward Double Flight Attendant Seats	DC-9-14, -15, -15F, -31, -32			0
SA4613SW	Modify 2 Existing Aft Flight Attendant Seats	DC-9-15, -15F, -31, -32			0
SA4616SW	Modify Existing Forward Single Flight Attendant Seat	DC-9-14, -15, -15F, -31, -32			0
SA4617SW	Modify Existing Aft Double Flight Attendant Seats	DC-9-14, -31, -32			0
SA5506NM	Installation Of 4 Galleys And One Stowage Unit	DC9-82, MD-82			0
ST0756AC-T	Modification of Existing Side Facing Coat Closet	DC-9-80			0
ST09110AC	Modification of Existing Side Facing Coat Closet	DC-9-80			0
SA1381NM	Inst'l Fwd & Mid Cabin Seating	DC-10-10 DC-10-10F			0
SA2425NM	Installation Of Interior Arrangement	DC-10-30			0
SA2524WE	Installation Of Lounge Seats, Four-Place Divan, L-Shape Bar, And Cocktail Tables	DC10-10-10F			0
SA2984WE	Installation of Buffet/Bar and Bustle Assembly	DC-10-10, -10F			0
SA2985WE	Modification of Installed G1 and G1A Galleys	DC-10-10, -10F			0
SA2987WE	Installation of Cabin Lounge Swivel Seats And Adjustable Table	DC-10-10			0
SA3103WE	Installation of Forward Cabin Convertible Passenger Seats And Associated Oxygen System Modification	DC-10-10, -10F			0
SA3212WE	Installation of Forward Cargo Compartment Positive Vent Sump Drain	DC-10-10, -10F			0
SA3367WE	Installation of Nine-Abreast Coach Seating And Associated Oxygen And Electrical System Modificaitons	DC-10-10, -10F			0

STC Number	Description	Airplane Model(s)	Airplane Cert. Basis	Comments	WFD Assessment Required? 1 = YES / 0 = NO
SA3368WE	Installation of Eight-Abreast Coach Seating In The Forward Cabin Behind The First Class Section And Associated Oxygen And Electrical System Modifications	DC-10-10, -10F			0
SA3407WE	Inst of Lermer Apparatebau GMBH Beverage Cart	DC-10-10, -10CF			0
SA3471NM	Installation of Triple Litton LTN-92 Inertial Navigation System	DC-10-30			0
SA3818NM	Reconfiguration Interior	DC-10-30			0
SA3827WE	Inst'l Folding Leaf Table	DC-10-10 DC-10-10F			0
SA3843WE	Installation Of Galley	DC-10-10			0
SA3844WE	Installation Of Coat Closet	DC-10-10, -10F			0
SA3845WE	Inst'l Buffet / Bar Unit	DC-10-10 DC-10-10F			0
SA3847WE	Installation Of Lounge And First Class Accomodation	DC-10-10, -10F			0
SA3875WE	Installation Of Flight Attendant Seat	DC-10-10, -10F			0
SA3996WE	Installation Of Litton LTN-211 Omega/VLF	DC-10-10, -10F, -30			0
SA4006WE	Installation Of 3-Place Courier Seat	DC-10-10F			0
SA4058WE	Inst'l Folding Leaf Table	DC-10-10 DC-10-10F			0
SA4122WE	Installation Of Aluminum Cabin Window Plug Assembly To Replace Outercabin Window Pane	DC-10-10, -10F			0
SA4158WE	Installation Of Beverage Cart	DC-10-10, 10F			0
SA4372NM	Installation Of Structural Provisions for Galley G1A	DC10-20 S/N 46576			0
SA4373NM	Installation Of Structural Provisions for Galleys G1, G2, G3, G5, G6, and G7	DC10-30			0
SA5872NM	Installation Of Seat Tracks	DC-10-30			0
SA5894NM	Installation Of Galleys and Stowage Compartments	DC-10-30			0
ST09183AC	Installation Of G1 Galley	DC10-30			0
ST09184AC	Installation Of G2 Galley	DC10-30			0

STC Number	Description	Airplane Model(s)	Airplane Cert. Basis	Comments	WFD Assessment Required? 1 = YES / 0 = NO
ST09185AC	Installation Of G3 Galley	DC10-30			0
ST09186AC	Installation Of G5 Galley	DC10-30			0
ST09187AC	Installation Of G6 Galley	DC10-30			0
ST09188AC	Installation Of G7 Galley	DC10-30			0
ST09302AC	Fabrication/Installation G1 & G2 Galleys	DC-10-30			0
ST09303AC	Fabrication/Installation G3, G5, G6, G7 Galleys	DC-10-30			0
ST09405AC	Fabrication/Installation Lower Galley Modules	DC-10-10			0
SA1304NM	Inst'l Dual Litton 211 Omega / VLF Navigation Systems	B727-100/-200			0
SA2048NM	Interior Modification	B727-224			0
SA2672WE	Installation Of A Coat and Luggage Stowage Unit	B727-200			0
SA2886WE	Interior Arrangement	B727-24C, -92C			0
SA2899WE	Installation Of A Courier Seat	B727-24C, -92C			0
SA2942WE	Inst'l Nordskog Galleys	B727-24C			0
SA3153WE	Inst'l Fwd Coat Closet	B727, 727C, 727-100, 727-100C			0
SA3408WE	Installation of Lermer Apparatebau GMBH Beverage Cart	B727-30, -224			0
SA3488WE	Inst'l Cabin Divider	B727-92C, SN 19174			0
SA3521WE	Installation of A Cabin Divider	B727, -100, -200, -100c			0
SA3655WE	Installation of Nordskog Co. Auxiliary Galley	B727-22, -24C, -30,			0
		-76, -92C			0
SA3717WE	Installation of Cabin Divider	B727, 727C, -100, 100C			0
SA4133WE	Installation of an ARINC Communications Addressing and Reporting System (ACARS)	B727-100, -200			0
SA4157WE	Installation of Beverage Cart	B727-22, 24C, -30, -76, -92C, -224			0
SA5477NM	Galley Reconfiguration And Installation	B727-200			0
ST115RM	Installation of Interior Arrangement	B737-248			0

STC Number	Description	Airplane Model(s)	Airplane Cert. Basis	Comments	WFD Assessment Required? 1 = YES / 0 = NO
ST116RM	Installation of Interior	B737-219			0
ST139RM	Installation of Interior Arrangement	B737-2A1			0
ST158RM	Installation of Interior Arrangement	B737-291			0
SA1540NM	Installation Of Grimes Galley	B737-200			0
SA1550NM	Installation of Provisioned Wiring And Hardware For Sperry Performance Management System	B737-291			0
SA1965WE	Interior Arrangement Modification	B737-2C0, -214, -291			0
SA2491WE	Installation of Frontier Airlines Galley Tray Cart	B737-291, -2CO, -214, -2H4			0
SA2731NM	Revised Interior	B737-200			0
SA55RM	Installation Galley Tray Cart	B737-200			0
SA6RM	Interior Arrangement Modification	B737-2C0, -2H4, -212,-214,-291,-222			0
SA62RM	Installation Beverage Cart	B737-200			0
SA66RM	Revision of Aft Coat Closet Capacity From 100 lbs. to 250 lbs.	B737-2CO, -2H4, -212, -247, -291			0
SA67RM	Installation of Trash Module In Aft Coat Closet	B737-2CO, -2H4, -212, -214, -222, -247, -291			0
SA75RM	Installation of Mapco Closet Module Under Forward Left Side Hatrack	B737-2CO, -2H4, -212,-214, -222, -247, -291			0
SA8990SW	Installation Of A Slimline Under-Bin G2 Galley	B737-200			0
ST09460AC	Fabrication & Instl of Ceiling Bin, Raft Stowage	B737-300			0
ST09462AC	Fabrication & Instl of Class Dividers	B737-300			0
ST09467AC	Fabrication & Instl of Galleys & Closets	B737-300			0
ST09469AC	Installation Of G2 Galley & Closet	B737-300			0
ST09549AC	Installation of Class Dividers	B737-800			0
SA7016NM-D	Modification Of Interior Configuration, Installation Of Electrically Operated Seats, And Installation Of Individual In Seat Video System	B757-200			0

STC Number	Description	Airplane Model(s)	Airplane Cert. Basis	Comments	WFD Assessment Required? 1 = YES / 0 = NO
ST09554AC	Installation of SAT-2000 Satellite Communications System	B767-200			0
SA2195WE	Interior Arrangement	B747			0
SA3547WE	Installation of Cargo Container	B747-100			0
SA2265WE	Change Of Seating Configuration To Add Bar.	B747-124			0
SA2276WE	Interior Arrangement Modification	B747-124			0
SA5496NM	Installation/Relocation Of Sell Galleys And Provisions For Passenger Overhead Stowage Bins	B747-230B			0
SA1900SO	Installation of Airfone Air/Ground Telephone System	A300B4			0
ST00840SE	Rearrangement-C80→K51-K54	747-400	Pre-45	JAPAN STC-101-TYO	0
ST00822SE	Rearrangement-K05 to K25 Seat Configuration	747-400	Pre-45	JAPAN STC-97-TYO	0
N/A	Conversion-K25 to K23/k24 Seat Configuration	747-400	Pre-45	JAPAN STC-98-TYO	0
ST00252WI	Conversion-PAX Aircraft to Special Freighter	747-200B	Pre-45	JAPAN STC-2-HQT	1
ST00857SG	Installation-U/D Galley to Special Freighter	747-200B	Pre-45	JAPAN STC-3-HQT	0
ST00853SE	Rearrangement-C71 to C72 Seat Configuration	747-400	Pre-45	JAPAN STC-104-TYO	0
N/A	Installation-Crew Rest Seat at Door 4	747-400	Pre-45	JAPAN STC-106-TYO	0
N/A	Installation-Crew Rest Seat at Door 4	747-300	Pre-45	JAPAN STC-108-TYO	0
ST00705SE	Installation-EGPWS (747 Conf.1)	747	Pre-45	JAPAN STC-117-TYO	0
ST00536SE	Installation-EGPWS (DC-10 Without TERR Display)	DC-10	Pre-45	JAPAN STC-120-TYO	0
N/A	Rearrangement-K25 to K27 Seat Configuration	747-400	Pre-45	JAPAN STC-98-1-TYO	0
N/A	Rearrangement of U/D Compt B,C - Business Class Seat with IFE and Coat Closet installation	747-400	Pre-45	JAPAN STC-123-TYO	0

STC Number	Description	Airplane Model(s)	Airplane Cert. Basis	Comments	WFD Assessment Required? 1 = YES / 0 = NO
N/A	Installation-L4 Crew Rest Curtain	747-400	Pre-45	JAPAN STC-116-TYO	0
N/A	Installation-Closet/Stowage	DC-10	Pre-45	JAPAN STC-119-TYO	0
N/A	Rearrangement Configuration	747-300	Pre-45	JAPAN STC-140-TYO	0
ST8072LA-T	Avionics In-Flight Systems Index list 246212 Rev. A - MDDS System Installation	747-300	Pre-45	JAPAN STC-141-TYO	0
N/A	Rearrange - A32 to A33 with Recaro	767	BTWN	JAPAN STC-131-TYO	0
N/A	Installation - Curtain for L4 Crew Rest	747-300	Pre-45	JAPAN STC-139-TYO	0
N/A	B07 Seat Configuration to B99 Seat Configuration	747-200B	Pre-45	JAPAN STC-4-HQT	0
ST01128SE	Interior Reconfiguration (Shell Flat Seat Installation)	747-400	Pre-45	JAPAN STC-152-TYO	0
N/A	Medical Equipment Installation	747-400	Pre-45	JAPAN STC-148-TYO	0
N/A	Stretcher Installation	767-300ER	BTWN	JAPAN STC-156-TYO	0
N/A	Stretcher Installation	777-200ER	Post-54	JAPAN STC-157-TYO	0
N/A	Crew Rest Curtain Installation	777-200ER	Post-54	JAPAN STC-153-TYO	0
N/A	Cockpit AFT Curtain Installation	767-300ER	BTWN	JAPAN STC-159-TYO	0
N/A	Cockpit AFT Curtain Installation	777-200ER	Post-54	JAPAN STC-158-TYO	0
ST01391LA Amendment	Replacement - FLT Compt Door	DC-10 MD-11	Pre-45 Post-54	JAPAN STC-155-TYO JAPAN STC-155-1-TYO	0
N/A	B99 Seat Configuration to B09 Seat Configuration	747-200	Pre-45	JAPAN STC-164-TYO	0
ST01152SE Amendment	747-400D UD Big Bin Modification	747-400	Pre-45	JAPAN STC-167-TYO	0
ST01391SE	Installation - New Class Seat	777-200	Post-54	JAPAN STC-199-TYO	0
N/A	Installation - Handicap Economy Class Seat	747-400	Pre-45	JAPAN STC-190-TYO	0

STC Number	Description	Airplane Model(s)	Airplane Cert. Basis	Comments	WFD Assessment Required? 1 = YES / 0 = NO
N/A	Installation - Galley Insert, 747-400D New A2 Galley	747-400	Pre-45	JAPAN STC-191-TYO	0
N/A	Rearrangement - A13 to A14	767	BTWN	JAPAN STC-180-TYO	0
ST01352SE	Rearrangement - A13 to A14	767	BTWN	JAPAN STC-181-TYO	0
ST01365SE	Installation - New Solo Seat	400	Pre-45	JAPAN STC-192-TYO	0
N/A	Bed Installation (P/N 123000-300)	747-400	Pre-45	JAPAN STC-193-TYO	0
ST00773SE Amend	Installation - U/D Big Bin 747-400 Int	747-400	Pre-45	JAPAN STC-134-1-TYO	0
ST01472LA-D 2004-5-25	Installation - Cockpit Door Surveillance Camera	747-200 747-400	Pre-45	JAPAN STC-201-TYO JAPAN-STC-210-TYO	0
N/A	Rearrangement - A20 to A22	767-300	BTWN	JAPAN STC-205-TYO	0
ST01423SE	Replace - Seat Track For New Seat Installation	767-300	BTWN	JAPAN STC-206-TYO	0
ST02861AT	Installation - Broadband SATCOM System for CBB (Conexion by Boeing) System	747-400	Pre-45	JAPAN STC-217-TYO	0
ST01691LA	Installation - Cockpit Door Surveillance Camera	767-200 767-300	BTWN	JAPAN STC-215-TYO	0
N/A	Insstallation - Baby Bassinet	767-300	BTWN	JAPAN STC-219-TYO	0
N/A	Bed Installation (P/N 123000-300)	767-200	BTWN	TBD	0
ST01741LA	Installation - Cockpit Door Surveillance Camera	777	Post-54	JAPAN STC-225-TYO	0
ST165CH, SA1785GL, SA1613GL	Hushkits	DC-9	Car 4		0
	P-F Cargo Door Installation	747			1
	Weight Increases	none for NWA			0
	TCAS Antenna	747			0
SA4853NM	TCAS Antenna	DC-9			0
	TCAS Antenna	DC-10			0
	TCAS Antenna	A320/319			0
	TCAS Antenna	A330			0

STC Number	Description	Airplane Model(s)	Airplane Cert. Basis	Comments	WFD Assessment Required? 1 = YES / 0 = NO
ST00385-LA-D, ST00391LA-D, ST00392LA-D, ST00393LA-D	Cargo Compt Halon Bottle Instl	DC-9	Car 4		0
	GPS Antenna	757	25.45		0
	GPS Antenna	747			0
ST01167CH	GPS Antenna	DC-9			0
	GPS Antenna	DC-10			0
	GPS Antenna	A320/319			0
	GPS Antenna	A330			0
	Phone antenna	747			0
ST00032NY	Phone antenna	DC-9			0
	Phone antenna	DC-10			0
	Phone antenna	A330			0
	Cargo Compartment Loaders (Telair)	757	25.45		0
ST00434LA-D	Cabin Pressure System Cutout	DC-9			0
ST00433LA-D ST00201SE ST00450SE ST00396SE	AIM Interior Galley, Drain Mast Cutout	DC-9			0
ST00201SE	LAV Service Panel Cutout	DC-9-30			0
SA9040NM-D	Video System	757	25.45		0
SA1040NE	Installation of the Claircom air to ground telephone system.	DC9			0
SA1177CE	Installation of Collins FPC-75 ground proximity warning system.	DC9			0
SA2594CE	Install single Collins TPR-720 Mode S Transponder	DC9			0
SA3950NM SA4853NM	TCAS II	DC9			0
ST00293LA-D	Active Noise/Vibration Control System (Barry Controls STC)	DC9			0
ST00336LA	Installation of Securaplane battery charger system.	DC9			0

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ST00385LA-D ST00390LA-D ST00391LA-D ST00392LA-D ST00393LA-D	Installation of provisions for smoke/fire dectection/suppression system, lower cargo compartments.	DC9			0
ST393CH	Installation of a Rosemount model0861FG4 angle of attack sensor.	DC9			0
ST536CH	Installation of Rosemount Aerospace Model 0070J Flap Position Transmitters.	DC9			0
SA1215EA	Installation of Air Cruisers slide/raft evacuation system	747			0
SA1728GL	Install an air to ground telephone communication system (Seatfone)	747			0
SA1307GL	Install cargo conveyer system	747			0
SA1955NM	Installation of Brownline Center Guide Assembly, P/N 46675-101	747			0
SA223NE	Installation of Inflight Service Video Projection System	747			0
SA2440NM	Installation of a Hughes-Avicom video Entertainment System	747			0
SA252NE	Installation of Inflight Services video projection system	747			0
SA2636CE	Install dual Collins TPR-720 Mode S transponders	747			0
SA4204NM-D	Installation of one (1) crew rest area(non-flight crew).	747			0
SA4750NM	Installation of a crew rest area, a flight deck seat and non-operating video monitor	747			0
SA4885NM	Installation of Honeywell Traffic Alert and Collision Avoidance System (TCAS II)	747			0
SA5865NM	Manufacture and installation of a cargo transfer system	747			0
SA5881NM	Installation of Video Entertainment System	747			0
ST00058LA	Installation of cargo handling system, lower bay	747			0
ST00255WI-D	Conversion of a passenger airplane to a main deck side cargo door dedicated special freighter	747			1
ST00425CH	NWA Enhanced GPWS Antenna, 747 aircraft	747			0
ST00634LA	Installation of IIMorrow navigation management system, with global positioning navigation sensor	747			0

STC Number	Description	Airplane Model(s)	Airplane Cert. Basis	Comments	WFD Assessment Required? 1 = YES / 0 = NO
ST01367AT	Installation of upper deck crew rest module, P/N 5310100-1	747			0
SA1007GL	Installation of air to ground public telephone communication system	757			0
SA3475NM	Installation of a Hughes-Avicom video entertainment system	757			0
SA403NE	Installation of video monitor system	757			0
SA4839NM	Installation of provisions for wiring and hardware for Honeywell Traffic Alert and Collision Avoidance System (TCAS II)	757			0
SA5831NM	Installation of USA Today sky radio	757			0
SA9013NM-D	Installation of Claircom passenger phone system	757			0
SA3804NM	INSTALLATION OF THE CENTERLINE SKYBIN STOWAGE INTERIOR KIT W/ PSU PROVISIONS IN THE DC10-30	DC-10			0
SA5836NM	INSTALLATION OF LITTON DUAL LTN-2001 GLOBAL POSITIONING SENSORS (GPS)	DC-10			0
ST00078LA	INSTALLATION OF INERTIAL NAVIGATION SYSTEMS AND DUAL LTN-2001 GPS	DC-10			0
ST00225NY	INSTALLATION OF CLAIRCOM AIR TERMINAL SYSTEM	DC-10			0
ST00584LA	INSTALL. CENTERLINE BIN KIT	DC-10			0
ST01026AT	Installation of global positioning system monitoring unit.	DC-10			0
SA5800NM	Installation of Honeywell TCAS system	A320/319			0
SA5859NM	Installation of video entertainment system	A320/319			0
ST01181NY ST01182NY	Installation of Claircom Air Terminal Systems	A320/319			0
ST133CH	Installation of Sky radio receiver system	A320/319			0
SA2747NM-D	Install air-ground telephone system (antenna hull penetration)	737-300	pre 45		0
SA2763NM-D	TCAS (antenna hull penetration)	737-300	pre45		0
ST09191AC	Devore Position Light (hull penetation)	737-300	pre45		0
SA5634NM-D	SatCom Instl (antenna hull penetration)	747-400	pre 45		0
SA2767NM-D	air-ground telephone (antenna hull penetration)	757	45		0
SA2704NM-D	air-ground telephone (antenna hull penetration)	767-200	45		0

STC Number	Description	Airplane Model(s)	Airplane Cert. Basis	Comments	WFD Assessment Required? 1 = YES / 0 = NO
SA5991NM-D	SatCom Instl (antenna hull penetration)	767-300	45		0
SA6044NM	GPS antenna	767-300	45		0
SA1889SO	Installation of Emergency Escape Path Lighting System	737-200, -300	A16WE		0
SA2401SO	Installation of Aft Centerline Trash Container	737-200, -300	A16WE		0
SA3140NM	Installation of Floor Proximity Emergency Escape Path Marking System (Bruce Industries)	737-200, -300	A16WE		0
SA3456NM	Installation of C & D Interiors Class Divider	737-200, -300	A16WE		0
SA1339GL	Installation of GTE Airfone Public Telephone System	737-200,-300,-400	A16WE		0
SA1529GL	Installation of E3-6 Electronic Equip. Rack	737-200,-300,-400	A16WE		0
SA2065SO	Reconfiguration of 737-300 Pax Seating to an 8F/120Y Mixed Class Configuration in Accordance with USAir Drawing 5H2540685	737-300	A16WE		0
SA2066SO	Installation of Curtain Header	737-300	A16WE		0
SA2351SO	Installation of Galley Inserts	737-300	A16WE		0
SA2353SO	Installation of USAir Seats in Piedmont All Tourist Seating Cabin Configuration	737-300	A16WE		0
SA2453SO	Installation of Galleys per PIE EA 737-1221	737-300	A16WE		0
SA2455SO	Installation of Class Divider per PIE EA 737-1223	737-300	A16WE		0
SA2456SO	Galley Modifications per PIE EA 737-1225	737-300	A16WE		0
SA2725SO	Installation of Bendix/King CAS-81 TCAS II System	737-300	A16WE		0
SA3443NM	Installation of a Video Projection System	737-300	A16WE		0
ST00132NY-D	Seating Configuration	737-300	A16WE		0
ST00740LA-D	Instl. of Smoke Detection & Fire Suppression Systems	737-300	A16WE	Bottle instl.on BS 727 BHD Beams.	0
SA2410SO	Installation of a Cabin class Divider Curtain Header	737-300, -400	A16WE		0
SA2454SO	Installation of Fwd LH Closet	737-300, -400	A16WE		0
SA6081NM	Install Air-to-Ground Passenger Comm. System	737-300, -400	A16WE		0
SA553NE	PATS Installation of 425 or 500 Gallon Aux. Fuel System in Aft Cargo Compartment	737-300/-400	A16WE	Doublers on Center Wing Tank Skin	1

STC Number	Description	Airplane Model(s)	Airplane Cert. Basis	Comments	WFD Assessment Required? 1 = YES / 0 = NO
ST00003NY	Replace existing FDR with Fairchild solid state digital flight recorder	737-300/-400	A16WE		0
ST00115NY-D	Installation of Optical Quick Access Recorder (OQAR) (Amended 7/30/96)	737-300/-400	A16WE		0
SA1080NE	Reconfiguration of 737-400 Pax Seating to an 8F/138Y Mixed Class Configuration in Accordance With USAir Dwg 5C2540166 Rev. "E" Dated 1/27/93. (Amended 1/12/96 7/16/97)	737-400	A16WE		0
SA2408SO	Installation of the Avicom International Video Entertainment System	737-400	A16WE		0
SA2653SO	Rework of Galleys	737-400	A16WE		0
SA2741SO	Installation of Bendix/King CAS-81 TCAS II and Compatible Mode "S" Transponders	737-400	A16WE		0
ST00112NY-D	737-400 HF/SELCAL	737-400	A16WE		0
ST00114NY-D	737-400 Overwater Installation of C & C Left Hand Class Divider	737-400	A16WE		0
ST00404LA-D	Instl. of Smoke Detection & Fire Suppression Systems	737-400	A16WE	Bottle instl.on BS 727 BHD Beams.	0
SA1727GL	In-Flight Phone Equipment Installation (Reference SA5527NM & SA1319GL)	757 (EX-EAL)	A2NM		0
SA5527NM	Seat Rework per SB 7090-25-001 for Both Weber 4000 & PTC 950	757 (EX-EAL)	A2NM		0
SA1329GL	For Antenna & Rack Installation	757(Ex-EAL)	A2NM		0
SA2853SO	Installation of Bendix/King CAS-81 TCAS II System	757-200	A2NM		0
SA5731NM	Installation of a Windscreen Which Includes a Flight Attendant Seat	757-200	A2NM		0
SA5750NM	Installation of a Windscreen and a Triple Seat	757-200	A2NM		0
SA5751NM	Installation of Closet Provisions	757-200	A2NM		0
SA5754NM	Installation of Three Galleys	757-200	A2NM		0
SA5819NM	Installation of Closet and Class Divider	757-200	A2NM		0
ST00103NY-D	Underbin Class Closet Installation - G2A Position	757-200	A2NM		0
ST00104NY-D	Installation of Cabin Class Divider Curtain Header	757-200	A2NM		0
ST00105NY-D	Mixed Class Seating Reconfiguration - 24F/158Y (amended 4/23/97)	757-200	A2NM		0

STC Number	Description	Airplane Model(s)	Airplane Cert. Basis	Comments	WFD Assessment Required? 1 = YES / 0 = NO
ST00106NY-D	Installation of the Avicom Six Inch LCD Video Monitor on the Class Divider	757-200	A2NM		0
ST00113NY-D	Replacement of Hughes Video Monitors with Sony Video	757-200	A2NM		0
ST00119NY-D	Air Conditioning - Ventilation Aft Equip/Lav/Galley Vent System Modification	757-200	A2NM		0
ST00133NY-D	Pax Seat/Int Accommodiation Layout/Installation	757-200	A2NM		0
SA2836SO	Installation of Galley Cart P/N 397100-3	767-200	A1NM		0
ST00101NY-D	Closet Installation - BA Wet Lease	767-200	A1NM		0
SA1674GL	For Antenna & Rack Installtion	767-200,-300	A1NM		0
ST00108NY-D	Installation of LH & RH Modified Video Monitors (Amended June 2, 1994)	767-200ER	A1NM		0
ST00124NY-D	Install Optical Quick Access Recorder (OQAR)	767-200ER	A1NM		0
ST00130NY-D	Instll of Aft Cargo Bay Avionics Racks	767-200ER	A1NM		0
ST00134NY-D	Instl. a Modified Teledyne Digital Flight Data Acquisition Unit (DFDAU)	767-200ER	A1NM		0
ST00129NY-D	Reconfig of Pax Cabin to Single Class Layout	A319	A28NM		0
SA1693GL	Instl of GTE Airfone	A319, A320	A28NM		0
ST00131NY-D	Install 8.33 VHF Communications system	A320	A28NM		0
ST00951LA	Instl. of Pax Entertainment System	A330	A46NM		0
ST00135NY-D	Instl. of a Bassinet	A330-323	A46NM		0
SA863EA	Interior Conversion - Chromalloy Emergency Lighting Slide	PICO			0
AAN 27564	Installation of Honeywell Mark V EGPWS	B737-382	pre amdt 45		0
ST00657SE	Installation of Heath Tecna ATIX2 Interior retrofit kit.	B737-382	pre amdt 45	FAA STC validated by CAA	0
ST00127BO	BF Goodrich Aerospace transient suppression unit for fuel quantity indication system AD Compliance (FAA AD 99-03-04)	B737-382	pre amdt 45	FAA STC validated by CAA	0
ST01335LA	Instn. of C & D Aerospace reinforced cockpit door.	B737-382	pre amdt 45	FAA STC validated by CAA	0
ST00971SE-D	Instn of BF Goodrich Aviation Technical Services cockpit door surveillance system.	B737-382	pre amdt 45	FAA STC validated by CAA	0
AAN 27482	Instn of ACAS II	737-36N and -37Q	pre amdt 45		0
AAN 27733	ACAS II software update	737-300	pre amdt 45		0

STC Number	Description	Airplane Model(s)	Airplane Cert. Basis	Comments	WFD Assessment Required? 1 = YES / 0 = NO
AAN 26488	Certification of B737-36Q / -36N in the transportation category.(passenger)	737-36Q /-36N	pre amdt 45		0
AAN 26445	Omnibus mod for cabin interior changes of B737-3L9	737-300	pre amdt 45		0
AAN 27717	Omnibus Mod - UK certification and BA reqts for B737-300	737-3Y0	pre amdt 45		0
AAN 24692	Club Europe Relaunch	737-400	pre amdt 45		0
AAN 25691	Instn of Honeywell TCAS II system	737-436	pre amdt 45		0
AAN 25695	Instn of Honeywell TCAS II system and Mode S transponders	737-4S3	pre amdt 45		0
AAN 26313	Instn of Allied signal EGPWS.	737-436	pre amdt 45		0
AAN 27734	ACAS II	737-400	pre amdt 45		0
AAN 25992	Omnibus Mod - Introduction into service of Boeing 737-4S3 for GB airways	737-4S3	pre amdt 45		0
AAN 27070	Omnibus mod - intro of project magic	737-436	pre amdt 45		0
AAN 27215	Intro into service of Boeing 737-59D	737-59D	pre amdt 45		0
AAN 26385	Repair to Fuselage structure, section 41	737-4Q8	pre amdt 45		0
ST00971SE-D	Insn. Cockpit Door Security System	737-400	pre amdt 45	FAA STC Validated by CAA	0
ST00782SE	ATI Bin Extension	737-4Q8	pre amdt 45	FAA STC Validated by CAA	0
AAN 26788	Instn of a Meggitt avionics Secondary Flight Display System.	737-528	pre amdt 45		0
AAN 27553	Instn of ACAS II	737-59D	pre amdt 45		0
AAN 27554	Introduction of EGPWS and PWS	737-505	pre amdt 45		0
AAN 27215	Intro into service of Boeing 737-59D	737-59D	pre amdt 45		0
AAN 27346	Instn of ACAS II	737-528	pre amdt 45		0
AAN 25427	SATCOM Installation	B747-436	pre amdt 45		0
AAN 27539	MORS cabin telecom unit installation	B747-436	pre amdt 45		0
AAN 27475	Instn. of World Traveller Plus seats	B747-436	pre amdt 45		0
AAN 25224	Instn. of First Class Slingshot	B747-436	pre amdt 45		0
AAN 26421	Omnibus Mod - World Traveller re-launch	B747-436	pre amdt 45		0
AAN 26794	Omnibus Mod - Project 'Dusk'	B747-436	pre amdt 45		0
ST00497SE	Door 5 extended crew rest area	B747-436	pre amdt 45		0

STC Number	Description	Airplane Model(s)	Airplane Cert. Basis	Comments	WFD Assessment Required? 1 = YES / 0 = NO
ST00837LA	Instn. Telair Cargo Load System (IPL)	B747-436	pre amdt 45		0
AAN 24639	Interactive Video System	B747-436	pre amdt 45		0
ST01681CH	Insn. Cockpit Door Security System	B747-436	pre amdt 45		0
ST01471SE	Instn. of Elementary and Enhanced Mode S	B747-436	pre amdt 45		0
AAN 28527	Security Flight Deck Door	B747-436	pre amdt 45	Approval of Boeing SB's747-25-3302, 3306, 3312, 3314, 3321	0
ST02617AT and TA0692	Instn. of Connexion by Boeing	B747-436	pre amdt 45		0
AAN 21412	Instn of ARINC communication addressing and reporting system and VHF transceiver	757-236	post 45 pre 54		0
AAN 24418	Instn. of Terrestrial Flight Telephone System	757-236	post 45 pre 54		0
ST00976SE-D	Insn. Cockpit Door Security System	757-236	post 45 pre 54	CAA TCDS FA28	0
AAN 20109	Instn. of Evacuation Alarm System	757-236	post 45 pre 54		0
AAN 22098	Instn. of 3 Life Rafts and Survival Equipment for Overwater Operatoins	757-236	post 45 pre 54		0
AAN 24336	Club Europe Re-launch	757-236	post 45 pre 54		0
AAN 20091	Instn. of Toilet Smoke Detectors	757-236	post 45 pre 54		0
AAN 20150	Instn. of Floor Proximity Escape Path Marking	757-236	post 45 pre 54		0
AAN 23308	Instn. of Traffic Alert and Collision Avoidance System	757-236	post 45 pre 54		0
AAN 25690	Instn. of Honeywell TCAS II System	757-236	post 45 pre 54		0
AAN 25694	Instn. of Honeywell TCAS II System	757-236	post 45 pre 54		0
AAN 26310	Instn. of Enhanced Ground Proximity Warning System	757-236	post 45 pre 54		0
AAN 26612	Instn. of ILS Only Muti-Mode Receiver	757-236	post 45 pre 54		0
AAN 23073	Revised seating configuration	B767-336	post 45 pre 54		0
AAN 24039	Installation of metric altimeter	B767-336	post 45 pre 54		0
AAN 27446	Introduction of ACAS II	B767-336	post 45 pre 54		0

STC Number	Description	Airplane Model(s)	Airplane Cert. Basis	Comments	WFD Assessment Required? 1 = YES / 0 = NO
AAN 24158	AFM change AP/FD system	B767-336	post 45 pre 54		0
AAN 24341	Introduction of EGPWS	B767-336	post 45 pre 54		0
ST01753CH	Insn. Cockpit Door Security System	B767-336	post 45 pre 54	FAA STC Validated by CAA	0
ST01485SE	Instn. of Elementary and Enhanced Mode S	B767-336	post 45 pre 54	FAA STC Validated by EASA. A1NM	0
ST00852SE	Instn of overhead bin extensions	B767-300	post 45 pre 54	FAA STC Validated by CAA. CAA TCDS FA33.	0
EASA.A.S. 00607	Instn. of Dusk Configuration	B767-336	post 45 pre 54		0
EASA.A.S. 00606	Instn. and Activation of GPS to EGPWC	B767-336	post 45 pre 54		0
EASA STC TBD	Instn. of TES	B767-336	post 45 pre 54		0
EASA.A.S 01142	Replacement of Galley 3A	B767-336	post 45 pre 54		0
AAN 27175	Certification of the A319-131 in the transport category(passenger)	A319-131	post 54		0
AAN 24900	Club Europe relaunch including new convertible seats	A320-111	post 54	Mod 25G166	0
AAN 25696	Installation of Honeywell ACAS II (Change 7)	A320-111 /-211	post 54	Mod 34G465	0
AAN 26314	Instalation of an Allied signal EGPWS	A320-111 / 211	post 54	Mod 34G252	0
AAN 26087	Omnibus mod for interior of A320-231	A320-231	post 54		0
ST00901SE	Instn. of Overhead Attendant Rest Area	B777-236	post 54		0
AAN 27608	Instn. of Phase II First Class Seats	B777-236	post 54		0
AAN 27167	Instn. of Flight Crew Rest Area	B777-236	post 54		0
AAN ST01717CH	Cockpit Door Surveillance System	B777-236	post 54	FAA STC Validated by CAA	0
AAN 28578	Omnibus Mod. Three Class Conversion (Dusk)	B777-236	post 54		0
ST01717CH	Instn of Floor mounted Stowage	B777-236	post 54	FAA STC Validated by CAA	0
AAN 28879	Instn. of Two L.H Wardrobes	B777-236	post 54		0
AAN 27337	Fuselage Damage Repair	B777-236	post 54		0

STC Number	Description	Airplane Model(s)	Airplane Cert. Basis	Comments	WFD Assessment Required? 1 = YES / 0 = NO
EASA IM.A.S.0190	Instn. of Elementary and Enhanced Mode S	B777-236	post 54	FAA STC Validated by EASA	0

Appendix H: AAWG Meetings and Attendance Records

1. Meeting Dates and Venues

AAWG Meetings

July 23, 2003	--	Atlanta Georgia (Delta Air Lines)
June 30, 2004	--	Long Beach CA (FAA)
March 1, 2005	--	Miami FL (Airbus)
October 26, 2005	--	Memphis TN (FedEx)
January 25, 2006	--	Miami FL (Airbus)
May 3, 2006	--	Long Beach CA (Boeing/FAA)
June 28, 2006	--	Miami FL (Airbus)
August 30, 2006	--	Washington DC (Boeing)
March 14, 2007	--	Seattle WA (Boeing)

Task Group Meetings

Ad-hoc Task Planning Group

September 15-17, 2003	–Mtg 1	Seattle Washington (Boeing)
November 11-14, 2003	–Mtg 2	London England (British Airways)
March 29-April 2, 2004	–Mtg 3	Toulouse France (Airbus)
May 17-21, 2004	–Mtg 4	Memphis Tennessee (FedEx)

Task Group Meetings

July 12-16, 2004	–Mtg 1	Gatwick England (CAA-UK)
September 20-21, 2004	–Mtg 2	Long Beach (Boeing)
November 15-19, 2004	–Mtg 3	Brussels Belgium (FAA)
January 31- Feb 4, 2005	–Mtg 4	Miami FL (Airbus)
March 14-18, 2005	–Mtg 5	Hamburg GE (Airbus)
May 2-6, 2005	–Mtg 6	Long Beach CA (FAA/Boeing)
June 13-19, 2005	–Mtg 7	Collioure FR (Airbus)
September 26-30, 2005	–Mtg 8	Seattle WA (Boeing)
November 7-11, 2006	--Mtg 9	Bristol UK (Airbus)
January 23-27, 2006	--Mtg 10	Miami FL (Airbus)
March 6-10, 2006	--Mtg 11	Seville SP (Airbus)
May 1-5, 2006	--Mtg 12	Long Beach CA (FAA/Boeing)
July 10-14, 2006	--Mtg 13	Brussels Belgium (FAA)
October 23-27, 2006	--Mtg 14	Seattle WA(Boeing)
December 4-8, 2006	--Mtg 15	Hamburg GE (Airbus)
January 15-19, 2007	--Mtg 16	Miami FL (Airbus)
February 19-23, 2007	--Mtg 17	Toulouse Fr (Airbus)

2. AAWG Organizational Meeting Attendance

	MEETING DATE							
Organization	**07/03**	**06/04**	**03/05**	**10/05**	**01/06**	**05/06**	**08/06**	**03/07**
Airborne Express (M)	X	X	X	X		X	X	X
Airbus (M)	X	X	X	X	X	X	X	X
ALPA								
America West								
American Airlines (M)	X	X		X	X	X	X	X
ATA (M)				X				
Boeing (M)	X	X	X	X	X	X	X	X
British Aerospace (M)	X							
British Airways (M)	X	X		X	X			X
CAA-UK(JAA) (M)	X							
Continental Airlines (M)	X	X	X	X	X	X	X	X
Delta Air Lines (M)	X	X						
Evergreen Aviation								
FAA (M)	X	X	X	X	X	X	X	X
Federal Express (M)	X	X	X	X	X		X	X
Fokker Services								
IATA								
Japan Air Lines		X						
Lockheed (M)	X							
Northwest Airlines (M)		X	X	X	X		X	X
SIE		X				X		
TIMCO		X						
United Airlines (M)	X	X	X		X	X		X
UPS (M)	X	X	X	X				X
US Airways (M)	X	X		X	X		X	

(M) – AAWG Voting Member

3. AAWG Task Planning Group Organizational Attendance

	MEETING DATES			
Organization	**Sep 2003**	**Nov 2003**	**Mar 2004**	**May 2004**
Airborne Express	**X**	**X**		**X**
Airbus	**X**	**X**	**X**	**X**
American Airlines	**X**	**X**	**X**	**X**
ATA				
Boeing	**X**	**X**	**X**	**X**
British Airways	**X**	**X**	**X**	**X**
Continental Air Lines	**X**	**X**	**X**	**X**
Delta Air Lines	**X**	**X**	**X**	**X**
EASA		**X**	**X**	
FAA	**X**	**X**	**X**	**X**
Federal Express	**X**	**X**		**X**
Gulfstream		**X**	**X**	
Japan Air Lines	**X**	**X**	**X**	**X**
Lockheed			**X**	**X**
Northwest Airlines	**X**	**X**	**X**	**X**
SIE				
TIMCO				
United Airlines	**X**			
UPS	**X**	**X**		**X**
US Airways	**X**	**X**	**X**	**X**

4. AAWG Task Group Organizational Attendance

	MEETING NUMBER																
Organization	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
Airborne Express		X		X		X								X		X	
Airbus	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
American Airlines	X		X	X	X	X	X		X	X	X	X	X	X	X		X
ATA																	
Boeing	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
British Airways	X	X	X	X	X		X	X	X	X	X	X	X	X	X		X
Continental Air Lines																	
Delta Air Lines	X	X															
EASA	X	X	X	X													
FAA	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Federal Express	X	X	X	X		X	X	X	X	X	X	X	X	X		X	X
Gulfstream																	
Japan Air Lines	X	X		X				X					X				
Lockheed																	
Northwest Airlines	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SIE						X						X					
TIMCO																	
Transport Canada								X				X					
United Airlines																	
UPS	X	X	X	X	X	X	X	X	X						X		X
US Airways	X	X								X				X	X	X	