U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

Subject: CONTINUED AIRWORTHINESS OF OLDER SMALL TRANSPORT AND COMMUTER AIRPLANES; ESTABLISHMENT OF DAMAGE-TOLERANCE-BASED INSPECTIONS AND PROCEDURES

Date:
Initiated By: ACE-100

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1. PURPOSE. This advisory circular (AC) provides information and guidance material to manufacturers and operators for use in developing continued structural integrity programs to ensure the safe operation of small transport and commuter airplanes throughout their operational usage. The material provides an acceptable means, but not the only means, of showing compliance with the operational requirements of Title 14 of the Federal Regulations (14 CFR) applicable to the establishment of damage-tolerance-based inspections and procedures. It is for guidance purposes and provides an example of a method of compliance that has been found acceptable. Because the method of compliance presented in this AC is not mandatory, the terms "shall" and "must" used in this AC apply only to an applicant who chooses to follow this particular method without deviation. The applicant may elect to follow an alternate method provided the alternate method is deemed acceptable by the Aircraft Certification Service.

2. APPLICABILITY. The procedures set forth by this AC are applicable to multi-engine airplanes that are required to have damage-tolerance-based inspections and procedures included in their maintenance or inspections programs in accordance with 14 CFR Parts 121, 129, and 135.

3. RELATED REGULATIONS AND DOCUMENTS.

a. Regulations:

§ 121.212	Supplemental inspections.
§ 129.16	Supplemental inspections for U.S.-registered aircraft.
§ 135.168	Supplemental inspections.
§ 23.573	Damage tolerance and fatigue evaluation of structure.
§ 25.571	Damage tolerance and fatigue evaluation of structure.

b. Advisory Circulars*:*
The free AC's listed below may be obtained from the U.S. Department of Transportation, Subsequent Distribution Office, Ardmore East Business Center, 3341 Q 75th Avenue, Landover, MD 20785

AC 25.571-1C Damage Tolerance and Fatigue Evaluation of Structure.
AC 91-56A Supplemental Structural Inspection Program for Large Transport Category Airplanes.
AC 91-60 Continued Airworthiness of Older Airplanes.

4. BACKGROUND.

a. Service experience has revealed a need to assess the continuing airworthiness of small transport and commuter sized airplanes as they age. The structural integrity of these airplanes should be assessed on the basis of the most modern tools of analyses, testing, and nondestructive inspections in conjunction with the gathering of operational service experience. Fatigue cracking is usage dependent and, if left uncorrected, will degrade the integrity of the airframe to unsafe levels. Additional inspections, component modification, or structural component replacement may be essential to maintain the required level of safety.

b. Increased utilization, longer operation, and the high safety demands imposed on airplanes currently operating in air transportation service indicates that there is a need for a program to provide a high level of structural integrity for all airplanes in the commuter air transportation fleet. Accordingly, the program outlined in this AC is intended to describe a structural integrity assessment of each airplane type, to be accomplished by its manufacturer or other competent engineering organization having access to design data; and the adaptation of the results of that assessment into each operator's maintenance program.

5. DEFINITIONS.

a. Principal Structural Element (PSE). A PSE is an element that contributes significantly to carrying flight, ground or pressurization loads, and whose integrity is essential in maintaining the overall structural integrity of the airplane.

b. Damage Tolerance. Damage tolerance is the attribute of a structure that permits it to retain its required residual strength for a period of use after the structure has sustained a given level of fatigue, corrosion, accidental or discrete source damage.

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

d. Fail Safe. Fail safe is the attribute of the structure that permits it to retain its required residual strength for a period of unrepaired usage after the failure or partial failure of a PSE.

e. Baseline Usage. The baseline usage represents the average utilization of the airplane in terms of operational profiles, gust environment, maneuver load factor exceedances, and weight.

6. CONTINUED STRUCTURAL INTEGRITY PROGRAM.

a. Content of Continued structural integrity programs._The continued airworthiness of the small transport and commuter sized airplanes addressed by this AC is provided by the implementation of a continued structural integrity program for each type of airplane. Each continued structural integrity program would supplement the existing maintenance program and must include, as a minimum, the damage tolerance based inspections and procedures needed to operate the airplane for the duration of effectivity specified in the continued structural integrity program. In addition, each program should include all of the following:

(1) Special inspections to determine the condition of the airplane at the time of initial implementation of the continued structural integrity program.

(2) Descriptions of repairs and/or modifications needed to operate the airplane for the duration of effectivity specified in the continued structural integrity program.

(3) Listing of optional replacement components that may be installed to reduce, delay, or eliminate specific damage tolerance based inspections and/or modifications.

(4) Modifications of the airplane to provide access to accomplish, or to reduce the need for the inspections of item (1) above, or to provide access to accomplish the necessary damage tolerance based inspections and procedures.

(5) A review of the repairs and modifications to assess their structural integrity and damage tolerance.

b. Development of damage tolerance based inspections and procedures.

(1) The manufacturer (or other competent engineering organization having access to design data), in consultation with operators, is expected to develop a damage tolerance based inspection program for each aircraft model. Inspection findings from the current maintenance program, in conjunction with the airplane's design data base, should provide the basis for the damage tolerance based inspection program. The damage tolerance based inspection program should include evaluations of the crack growth of critical areas of each PSE for the baseline usage. The development of the damage

tolerance based inspection program should include an assessment of service information, available test data, as well as new analyses and its supporting test data. It should also specify the operational assumptions (flight hours, weights, segments, etc.) used to develop the damage tolerance based inspection program and provide an estimate of the number of flight hours to the onset of WFD, if applicable. Appendix 1 prescribes guidelines for establishing the DT-based inspection program.

(2) As specified in the operating rules (121.212, 129.16, and 135.168), damage tolerance based inspections and procedures are required to make the airplane eligible for specific operations under each part. Damage tolerance based inspections and procedures for each type of airplane, and the other actions listed above, will provide continuing airworthiness throughout the airplane's operational usage. If the operator determines that it is not economically justifiable to implement the necessary inspections, modifications, repairs, and/or replacements, then the airplane will no longer be eligible for use in those particular operations where the regulations require the inclusion of damage tolerance based inspections and procedures as part of the maintenance or inspection programs of the airplane.

7. IMPLEMENTATION. A continued structural integrity program that includes damage tolerance based inspections and procedures will be included in each Operating Specification. Operators will amend their current structural maintenance programs to comply with, and account for, the applicable damage tolerance based inspections and procedures. Affected operating certificate holders should submit their proposed amendment for the areas covered by the damage tolerance based inspection program to the FAA for approval. Each operator must determine, subject to FAA approval, how the applicable damage tolerance based inspections and procedures will be applied considering the uniqueness of the operator’s maintenance program, operating environment, and fleet modification status. Each amendment will be evaluated and approved on an individual basis.

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APPENDIX 1. GUIDELINES FOR DEVELOPMENT OF THE DAMAGE TOLERANCE BASED INSPECTION PROGRAM

1. GENERAL. This Appendix provides guidelines for the development of a damage tolerance based inspection program. These guidelines apply to airplanes of conventional construction using conventional metallic materials.

a. The essence of the damage tolerance based inspection program is the structural evaluation of the airplane. Four major elements must be included in the structural evaluation:

(1) The threshold of inspection for critical areas of each Principal Structural Element (PSE).

(2) The repeat inspection intervals

(3) The onset of Widespread Fatigue Damage (WFD), if applicable (Fail-safe certified structure only).

(4) Inspection procedures

b. Information relative to these four major elements of the structural evaluation is to be contained in the damage tolerance based inspection program.

2. STRUCTURAL EVALUATION.

a. Introduction. The structural evaluation entails the identification of the critical areas of the PSE's. Once identified, each critical area requires the following types of analyses:

(1) Develop the stress spectrum.

(2) Establish the initial flaw sizes.

(3) Determine the inspectable flaw sizes.

(4) Perform residual strength and crack growth analyses.

(5) Determine inspection thresholds.

(6) Determine repeat inspection.

(7) Predict the onset of WFD, if applicable.

b. Identify Critical Areas of PSE. The structural evaluation begins with the identification and selection of the critical areas of the PSE. A critical area of a PSE is one that will require specific actions such as focused inspections, repair, and/or modifications, etc., in order to maintain continued airworthiness within the desired operational usage of the airplane.

(1) Several different approaches and factors should be considered in identifying these critical areas:

(i) The best indicators of criticality are the cracking experiences encountered through service operations and/or fatigue testing of full scale components.

(ii) Areas that show high stresses either through measurements or analyses.

(iii) Structural details that are sensitive to manufacturing processes.

(iv) Areas that are difficult to inspect.

(v) Areas that are susceptible to corrosion.

(vi) The manufacturer's structural philosophy, design details, and manufacturing processes.

(2) Examples of PSE's that may contain critical areas are described as follows:

(i) PSE with a significantly severe fatigue stress spectrum and/or static stresses in tension, e.g., wing lower skin panels, stabilizer skin panels, and the fuselage pressure shell (including pressure bulkheads and domes).

(ii) PSE incorporating a design feature that, based on analysis, test, or service experience, could be prone to cracking during the service usage of the airplane. Structural discontinuities such as skin panel, spar-cap and stringer splices, shell cut-outs, highly loaded fittings (in wing/fuselage joints, stabilizer attachment joints and flap track attachment joints), and flight compartment window posts and door stops or latches (on pressurized airplanes) are examples.

(3) At this stage it is useful to make preliminary estimates of the flaw growth in the candidate critical areas. With this information, it is much easier to decide which of the candidate areas should be subjected to a more detailed analysis. For airplanes that are addressed by this advisory circular (AC), the number of candidate areas generally will be of the order of 40 to 70. These, typically, will be screened down to 10 to 30 for a more detailed analysis.

c. Develop Stress Spectrum for Each Critical Area. The development of the stress spectrum for each area identified for a detailed analysis is one of the more demanding aspects of the process because of the large changes in the rate of flaw growth due to small changes in the cyclic stress. To perform this task, three data items must be available to the analyst.

(1) There must be operational experience available in a usable form. This operational data will provide a basis for establishing a flight-by-flight sequence of altitude, weight, and airplane motion parameters. The baseline usage is defined by the number and frequency of typical flight profiles. If the airplane has been in service for a considerable period, such utilization data should be readily available from a survey of typical operators. Each flight profile should be defined in terms of the typical flight parameters, stage length, flight time, take-off weight, fuel load, altitude, climb-cruise descent speeds, flap settings, etc. As a minimum, spectra should be developed to specify the loading conditions listed below[1]:

(i) Vertical and Lateral Gust Loads.
SOURCES:
FAA Report No. AFS-120-73-2
PSD Gust Spectrum Analysis, Part 2-5, Appendix G, ESDU 69023[2]
DOT/FAA-CT-91/20 General Aviation Aircraft Normal Acceleration Data Analysis and Collection Project

(ii) Maneuver Loads.
SOURCES:
MIL-A-8866B
FAA Report No. AFS-120-73-2
TM-84660
DOT/FAA-CT-91/20 General Aviation Aircraft Normal Acceleration Data Analysis and Collection Project

(iii) Taxi Loads.
SOURCES:
ESDU 75008
FAA Report No. AFS-120-73-2
MIL-A-8866B

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[1] The reference sources of loads data and analysis methods listed herein are provided as information on acceptable methods. Alternate data acceptable to the FAA may be used.

[2] ESDU data contain maneuver as well as gust loads. For some airplane types it may be necessary to add maneuver loads separately.

(iv) Landing Loads.
SOURCES:
MIL-A-8866B
FAA Report No. AFS-120-73-2

(v) Pressurization Loads (if applicable).
In considering fatigue of pressure cabins, full normal operating differential pressure, plus external aerodynamic pressure, shall be assumed to occur once per flight unless the usage profile specifically defines a pressurization spectrum.

(vi) Empennage Loads.
SOURCES:
FAA Report No. ACE-100-01 entitled, "Fatigue Evaluation of Empennage, Forward Wing, and Winglets/Tip Fins on Part 23 Airplanes."

(2) The second data item necessary for the derivation of the stress spectrum is the external loading (i.e., shear, bending moment, and torsion) for a given flight condition. This is usually accomplished through analyses, wind tunnel testing, and flight load surveys. A "global" spectrum is one that specifies the occurrence frequency of fatigue loads expressed in terms of flight load factor, ground load factor, gust velocity, and landing sink rate. The spectrum must be derived to reflect the airplane usage specified by the flight profiles. If spectra data have been recorded for the airplane type under consideration (ideally during operation representing typical service), this data should be used in preference to handbook data.

(3) The final data item needed for the generation of the stress spectrum is the transformation of external loads to internal stresses. For this purpose it is desirable to have experimentally derived stresses from previous static and fatigue tests. Stress or local load spectra for each PSE must be determined by analysis from the global load spectra if stress or local load spectra are not available from flight measurements. A means to transform the global load parameters of load factor, gust velocity, and landing sink rate into stress or local load at each critical area must be developed. Satisfactory "global load-to-stress" (or "global load-to-local load") transformations may be determined by finite element analysis (or classical methods, as applicable) for each of the following unit fatigue cases:

(i) A 1g level flight case for each significant flight phase in the flight profile (e.g., a case for each flap setting used may be required).

(ii) A unit vertical gust case (e.g., a 2g vertical acceleration) for each significant phase in the flight profile.

(iii) A unit lateral gust case for a nominal lateral gust velocity (e.g., 10 feet/second).

(iv) A 1g on-ground case.

(v) A unit cabin pressure case if the airplane is pressurized.

Note: As an alternative, internal stresses could be obtained from a strain survey under flight conditions that correspond to the above cases. If analysis is used to transform global loads to internal stresses, then some strain measurements may be needed to validate the analysis methods. In the generation of the local stress spectra, ground-air-ground cycle loading must be taken into account.

(4) The baseline usage may be applicable to all airplanes of the same type. However, if individual airplanes of a particular type are used in specialized roles or environments that differ significantly from the average usage or environment, then a separate evaluation for this operation may be needed. The FAA may choose to impose specific additional requirements on the establishment of the damage tolerance based inspection program on those airplanes used in specialized roles.

d. Establish Initial Flaw Sizes for Each Critical Area. If crack propagation analysis is to be used to establish the inspection threshold, the initial flaw size must be established.

(1) The largest initial flaw that can be expected must be established for each critical area that meets the criterion of paragraph 2.g.(5) of this Appendix. Commercial and military service experience have provided the background to make a reasonable estimate of the size of this flaw in airplane structures. Manufacturing inspection data shall also be considered when selecting this initial flaw size.

(2) In some aspects of the analysis there is a need to define a more "typical" flaw size representative of the initial quality of the structure. This is the minimum flaw assumed to exist in any fastener hole. Extrapolation from crack sizes found in fatigue tests or service shall be considered. This initial flaw is used for evaluating continuing damage for both monolithic and fail safe structures.

(3) The fastener system also has an influence on the size of the initial flaw. There are many techniques, such as interference fit pins, the cold working of holes, etc., that can be used to reduce the effect of the stress concentration around fastener holes. Numerous tests on pre-flawed holes have shown that the effect of the initial flaw can be significantly reduced by such techniques. Consequently, it may be reasonable to reduce the initial flaw size but not account for the stress changes from the fastener installation. The rationale for this is that the combined possibility of a poor installation and a severely flawed hole is low enough to be ignored.

(4) The proposed initial flaw sizes will be submitted to the FAA for approval prior to the final analysis.

e. Determine Inspectable Flaw Sizes for Each Critical Area.

(1) The inspectable flaw size at each critical area is one that has an acceptably high probability of detection using the specific inspection instrument and procedures to be employed during the in-service inspection. Normally the flaw size that has a 90 percent probability of detection with a 95 percent confidence is considered acceptable.

(2) A number of factors can affect this probability of detection (POD) for a specific inspection technique. These include human factors, instrument types, instrument calibration, structural geometry, and degree of accessibility. The FAA has developed POD curves for the more commonly used inspection techniques (e.g., visual, eddy current, ultrasonic, etc.). Also, the Air Force Materials Directorate at Wright-Patterson Air Force Base and some airplane manufacturers have developed POD data. Such data should be reviewed prior to selecting the inspectable flaw size to be used in the determination of repeat inspection intervals.

The following reference provides information on the capability of specific inspection techniques:

(i) Rummel, W.D., et al, "Nondestructive Evaluation (NDE) Capabilities DataBook," NTIAC: DB-95-02, Contract DLA900-90-D-0123.

(3) The proposed inspectable flaw sizes will be submitted to the FAA for approval prior to final analysis.

f. Perform Crack Growth Analysis for Each Critical Area.

(1) The crack growth analysis for each critical area can be performed once a stress spectrum is available. Linear elastic crack propagation analysis can be used. If the effects of crack growth retardation are taken into account, appropriate test validation must be provided. Crack growth rate (da/dN) data and fracture toughness data may be experimentally determined by appropriate coupon testing. In some cases, data from the following references can be used:

(i) MCIC-HB-01R.

(ii) MIL-HDBK-5.

(iii) ESDU data sheets.

(iv) NASGRO

(2) Crack geometry factors for most configurations are available (or can be derived by superposition or compounding) from the following references:

(i) Rooke, D. P. and Cartwright, D. J., "Compendium of Stress Intensity Factors."

(ii) Tada, H. Paris, P. and Irwin, G., "The Stress Analysis of Cracks Handbook."

(iii) Murakami, Y., "Stress Intensity Factors Handbook," Volumes 1 and 2.

(iv) VNTSC, "Damage Tolerance Assessment Handbook", Volume 1, Fracture Mechanics Fatigue Crack Propagation.

g. Establish Inspection Threshold for Each Critical Area.

(1) An evaluation should be made by observation, analysis, and/or tests to determine the fail-safe features, if any, of the structure. If it can be shown that a load path failure in crack arrest, "fail-safe" structure will be detected and repaired prior to failure at limit load of the remaining structure, the inspection threshold can be established using either (1) fatigue analyses and tests with an appropriate scatter factor, or (2) slow crack growth analyses and tests based on appropriate initial manufacturing damage, as described below for single load path structures.

(2) In the case of g(1) above, care should be exercised in assessing the fail-safe capability of the structure. In the past, structures have been designated as fail-safe if they have been capable of sustaining fail-safe loads /with a single principal structural element failed. This concept has not been universally successful. Undetectable primary member failure due to fatigue is usually accompanied by secondary small fatigue damage, which may tear in a slow stable manner to critical size during application of fail-safe loading. This phenomenon, described in detail in the following two references, can degrade the fail-safe qualities of the structure:

(i) Swift, T., "Unarrested Fast Fracture." Presented to International Workshop on Structural Integrity of Aging Airplanes, Atlanta, Georgia, 31 March-April 1992.

(ii) Swift, T., "Damage Tolerance Capability." Fatigue of Aircraft Materials, Delft University Press, 1992.

Note: The rationale for allowing a conventional fatigue evaluation (which does not account for initial manufacturing or induced service damage) to establish the inspection threshold for a fail-safe structure is that fail-safety provides a second line of defense. Thus, in the event that fatigue cracking occurs prior to the threshold determined by the fatigue evaluation, fail safety will prevent catastrophic failure at limit load.

(3) A number of conventional fatigue evaluation approaches, which may satisfy (2) above, have been used to predict fatigue crack initiation. Two approaches, both of which use the Palmgren-Miner rule for fatigue damage accumulation are the nominal stress method and the local strainmethod.

Note: Appropriate scatter factors, approved by the FAA, must be applied to the results of these fatigue evaluations.

(4) For the types of structure listed below, the inspection threshold shall be established based on crack growth analysis and tests assuming the structure contains an initial flaw of the maximum probable size that could exist as a result of manufacturing or service.

(i) Single load path structure.

(ii) Multiple load path and crack arrest "fail-safe" structure where it cannot be demonstrated that load path failure, partial failure, or crack arrest will be detected and repaired prior to failure of the remaining structure at limit load.

Note: The rationale for this requirement is that a second line of defense does not exist for this type of structure.

(5) When crack propagation analysis is used to establish the inspection threshold, as described above, an initial crack, representing the largest expected manufacturing or service induced flaw located at the most critical area in the structure covered by the PSE being evaluated, is assumed. The analysis should be carried out using a representative fatigue spectrum such as that determined using the above guidelines. Analysis should commence with a crack of appropriate size and orientation. The inspection threshold is the time taken for this crack to propagate to the largest size at which the structure still retains the required residual strength at limit load divided by a suitable factor, as discussed below.

(i) A factor of 2.0 should be used when there is no full-scale fatigue test data, and there is no loads substantiation through a flight and ground loads survey.

(ii) A factor of 1.5 should be used when there has been a fatigue test but no loads survey.

(iii) A factor of 1.5 should also be used when there has been a loads survey but no fatigue test.

(iv) In the event that both fatigue testing and a loads survey has been accomplished, the scatter factor should be 1.0.

h. Establish Repeat Inspection Interval for Each Critical Area.

(1) The repeat inspection interval for each critical area is a function of the largest flaw size that has an acceptably low probability of escaping detection during in-service inspection and the time required for such a flaw to grow to its critical size during operational usage. The critical flaw size is one that can still sustain limit loads. The repeat inspection interval is the time from detectable to critical size divided by a suitable factor, as discussed below.

(i) A factor of 4 should be used when there is no full-scale fatigue test data, and there is no loads substantiation through a flight and ground loads survey.

(ii) A factor of 3 should be used when there has been a fatigue test but no loads survey.

(iii) A factor of 3 should also be used when there has been a loads survey but no fatigue test.

(iv) In the event that both fatigue testing and a loads survey has been accomplished, the scatter factor should be 2.

(2) For all critical areas, a procedure that can reliably detect cracks of the assumed detectable size must be developed and documented. The following inspection procedures are commonly used:

(i) Visual.

(ii) Eddy current (usually paint removal is not required).

(iii) Visual with fluorescent dye penetrant (paint removal is usually required).

(iv) Ultrasonic.

(v) Radiographic - this is not a preferred method. The probability of detection is dependent on crack opening (more than crack length), on beam orientation, and on operator judgment.

(vi) Magnetic particle.

(3) Detectable crack size depends on such factors as:
(i) Inspection technique.

(ii) Structure geometry, accessibility and the amount of structure to be inspected.

(iii) Inspection specificity (i.e., whether the inspection is directed at specific point(s)).

(iv) Damage location indicators (i.e., fuel leaks, pressure loss, and loose fasteners).

i. Prediction of Onset of Widespread Fatigue Damage (WFD).

(1) The definition of WFD is provided in the main body of this AC. WFD is a major threat to the continued airworthiness of fail-safe structure. There have been two sources of this damage observed in operational airplanes.

(i) Multiple Site Damage. Multiple site damage is characterized by the simultaneous presence of fatigue cracks in the same structural element. Simultaneous cracking at multiple locations can occur because a particular feature is replicated many times, with equal or very nearly equal stress exposure at all locations (a fuselage longitudinal skin joint is an example of such structure).

(ii) Multiple Element Damage. Multiple element damage is characterized by the simultaneous presence of fatigue cracks in similar adjacent structural elements in a multi-load path component (a control surface hinge consisting of side-by-side duplicated elements is an example of such structure).

(2) For fail-safe structure, it is essential that the onset of WFD be predicted and the affected structure modified to avoid WFD prior to the time of onset. If this is not accomplished, the airplane will not be eligible for use in those particular operations where the regulations require the inclusion of damage tolerance based inspections and procedures as part of the maintenance or inspection programs of the airplane (reference AC section 6c(2)).

(3) Further information on the evaluation of WFD are given in the following references:

(i) Swift, Tom; "Widespread Fatigue Damage Monitoring-Issues and Concerns." Proceedings from 5th International Conference on Structural Airworthiness of New and Aging Aircraft, June 16-18, 1993.

(ii) Maclin, James; "Performance of Fuselage Pressure Structure," Proceedings of 1991 International Conference on Aging Aircraft and Structural Airworthiness, NADSA CP-3160.

(iii) Lincoln, J. "Risk Assessments of Aging Aircraft," Presented at the First DoD, FAA, NASA Aging Aircraft Conference, Ogden, Utah, July 1997.

(iv) NRC report Publication NMAB-488-2, Aging of U.S. Air Force Aircraft, National Academy Press,2101 Constitution Avenue, N.W.,Box 285,Washington, D.C. 20055

3. THE DAMAGE TOLERANCE BASED INSPECTION PROGRAM.

a. The damage tolerance based inspection program should contain the recommendations for the inspection procedures and replacement or modification of parts or components necessary for the continued safe operation of the airplane. The document should be prefaced by the following information:

(1) Identification of the variants of the basic airplane type to which the document relates.

(2) The operational statistics of the fleet in terms of hours and flights should be summarized. The typical mission, or missions, should be described.

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

(4) A statement of the types of operations for which the inspection program is considered valid.

(5) A list of service bulletins (or other service information publication) revised as a result of the structural assessment undertaken to develop the damage tolerance based inspection program. The damage tolerance based inspection program should have a statement that the operator must account for these service bulletins.

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

(1) Description of the part or component and any relevant adjacent structure and means of access to the part or component.

(2) The type of damage being considered.

(3) Any relevant service information.

(4) The likely critical areas of damage.

(5) Recommended inspection method and procedure alternatives.

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

(7) Service bulletins (or other service information publications) revised or issued as a result of in-service findings resulting from implementation of the damage tolerance based inspection program (added as revision to the initial damage tolerance based inspection program).

(8) Guidance to the operator on which inspection findings should be reported to the manufacturer.

(9) Recommended initial inspection threshold.

(10) Recommended repeat inspection interval.

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

(12) Reference to any mandatory modification, or replacement of part, or component.

4. CONTINUING STRUCTURAL EVALUATION DATA REQUIREMENTS.

a. The continuing evaluation of structural integrity for the particular airplane type should be based on the principles outlined in section 2 of this appendix. The following information should be included in the evaluation and supplied to the FAA for approval:

(1) The current operational statistics of the fleet in terms of hours andr flights.

(2) The typical operational flight profiles assumed in the assessment.

(3) The structural loading and stress spectra for the chosen missions.

(4) Supporting test evidence.

(5) Relevant service experience.

b. In addition to the information specified in 4(a), the following should be included for each critical area:

(1) The basic data used (i.e., crack growth rate data, initial and NDI detectable flaw sizes, etc.) for evaluating the damage tolerance characteristics of the part or component.

(2) The area, or areas, within the part, or component where damage may affect the structural integrity of the airplane.

(3) The recommended inspection methods for the area.

(4) The critical crack size based on limit load.

(5) The time in flight cycles or flight hours for the onset of WFD, if applicable.

5. CONTINUING STRUCTURAL INSPECTION PROGRAM LIMITATIONS.
An upper boundary for the continuing structural inspection program must be established. The upper boundary may be set at the value of flight hours, flight cycles, and/or calendar time. It may be set at any value chosen by the manufacturer that does not exceed:

1) the limit validated by the analyst and approved by the FAA, or

2) the time when repair or replacement of a critical PSE (e.g. the wing spar) is due, and the action is considered uneconomical.

In such cases, inspection programs for other PSEs that will not have reached their inspection threshold by that time (e.g. empennage structure) will not need to be developed. In order to operate the airplane beyond that upper boundary of the continuing structural inspection program, additional validation (analysis and/or tests) must be accomplished, inspection intervals and procedures (including modifications and repairs) defined, and the effectivity of the continuing structural inspection program extended.