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DEPARTMENT OF DEFENSE HANDBOOK

AIRCRAFT STRUCTURAL INTEGRITY PROGRAM, GENERAL GUIDELINES FOR

AMSC N/A FSG 15GP

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Airplane Structural Integrity Program, Airplane Requirements

MIL-STD-1530A(11)

1. This Military Standard is approved for use by all Departments and Agencies of the Department of Defense.

2. Recommended corrections, additions, or deletions should be addressed to Aeronautical Systems Division, ASD/ENFS, Wright-Patterson Air Force Base, Ohio 45433.

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1. SCOPE

1.1 Purpose. The purpose of this standard is to describe the Air Force Aircraft Structural Integrity Program, define the overall requirements necessary to achieve structural integrity of USAF airplanes, and specify acceptance methods of contractor compliance. This standard shall be used by:

a. Contractors in conducting the development of an airframe for a particular weapon or support system

b. Government personnel in managing the development, production, and operational support of a particular airplane system throughout its life cycle.

1.2 Applicability. The degree of applicability of the various portions of this standard may vary between airplane systems as specified in 1.3.

1.2.1 Type of aircraft. This standard is directly applicable to manned power driven aircraft having fixed or adjustable fixed wings and to those portions of manned helicopter and V/STOL aircraft which have similar structural characteristics. Helicopter-type power transmission systems, including lifting and control rotors, and other dynamic machinery, and power generators, engines, and propulsion systems are not covered by this standard. For unmanned vehicles, certain requirements of this standard may be waived or factors of safety reduced commensurate with sufficient structural safety and durability to meet the intended use of the airframe. Waivers and deviations shall be specified in the contract specifications and shall have specific Air Force approval prior to commitment in the design.

1.2.2 Type of program. This standard applies to:

a. Future airplane systems

b. Airplane systems procured by the Air Force but developed under the auspices of another regulatory activity (such as the FAA or USN)

c. Airplanes modified or directed to new missions.

1.2.3 Type of structure. This standard applies to metallic and nonmetallic structures unless stated otherwise in the specifications referenced herein.

1.3 Modifications. The Air Force will make the decision regarding application of this standard and may modify requirements of this standard to suit system needs. The description of the modifications shall be documented in accordance with 5.1.1.

2. REFERENCED DOCUMENTS

2.1 Issues of documents. The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of this standard to the extent specified herein:

SPECIFICATIONS

Military

MIL-I-6870	Inspection Program Requirements, Nondestructive, for Aircraft and Missile Materials and Parts
MIL-A-8860	Airplane Strength and Rigidity, General Specification for
MIL-A-8861	Airplane Strength and Rigidity, Flight Loads
MIL-A-8862	Airplane Strength and Rigidity, Landplane, Landing and Ground Handling Loads
MIL-A-8865	Airplane Strength and Rigidity, Miscellaneous Loads
MIL-A-8866	Airplane Strength and Rigidity, Reliability Requirements, Repeated Loads, and Fatigue
MIL-A-8867	Airplane Strength and Rigidity, Ground Tests
MIL-A-8869	Airplane Strength and Rigidity, Nuclear Weapons Effects
MIL-A-8870	Airplane Strength and Rigidity, Vibration Flutter and Divergence
MIL-A-8871	Airplane Strength and Rigidity, Flight and Ground Operations Tests
MIL-A-8892	Airplane Strength and Rigidity, Vibration
MIL-A-8893	Airplane Strength and Rigidity, Sonic Fatigue
MIL-R-83165	Recorder, Signal Data, MXU-553/A
MIL-C-83166	Converter-multiplexer, Signal Data, General Specification for
MIL-A-83444	Airplane Damage Tolerance Requirements

STANDARDS

Military

MIL-STD-499	Engineering Management
MIL-STD-882	System Safety Program for Systems and Associated Subsystems and Equipment, Requirements for
MIL-STD-1515	Fasteners to be Used in the Design and Construction of Aerospace Mechanical Systems
MIL-STD-1568	Materials and Processes for Corrosion and Prevention and Control in Aerospace Weapons Systems

HANDBOOKS

Military

MIL-HDBK-5	Metallic Materials and Elements for Aerospace Vehicle Structures
MIL-HDBK-17	Plastics for Flight Vehicles
MIL-HDBK-23	Structural Sandwich Composites

Air Force Systems Command Design Handbooks

DH 1-0	General
DH 1-2	General Design Factors
DH 2-0	Aeronautical Systems
DH 2-7	System Survivability

(Copies of specifications, standards, drawings and publications required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following document forms a part of this standard to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

Other Publications

MCIC-HB-01	Damage Tolerance Design Handbook

(Application for copies should be addressed to the Metals and Ceramics Information Center, Battelle Memorial Institute, Columbus, Ohio 43201.)

3. DEFINITIONS. Definitions will be in accordance with the documents listed in Section 2 and as specified herein.

3.1 Durability. The ability of the airframe to resist cracking (including stress corrosion and hydrogen induced cracking), corrosion, thermal degradation, delamination, wear, and the effects of foreign object damage for a specified period of time.

3.2 Economic life. That operational life indicated by the results of the durability test program, i.e., test performance interpretation and evaluation in accordance with MIL-A-8867 to be available with the incorporation of Air Force approved and committed production or retrofit changes and supporting application of the force structural maintenance plan in accordance with this standard. In general, production or retrofit changes will be incorporated to correct local design and manufacturing deficiencies disclosed by test. It will be assumed that the economic life of the test article has been attained with the occurrence of widespread damage which is uneconomical to repair and, if not repaired, could cause functional problems affecting operational readiness. This can generally be characterized by a rapid increase in the number of damage locations or repair costs as a function of cyclic test time.

3.3 Initial quality. A measure of the condition of the airframe relative to flaws, defects, or other discrepancies in the basic materials or introduced during manufacture of the airframe.

3.4 Structural operating mechanisms. Those operating, articulating, and control mechanisms which transmit structural forces during actuation and movement of structural surfaces and elements.

3.5 Damage tolerance. The ability of the airframe to resist failure due to the presence of flaws, cracks, or other damage for a specified period of unrepaired usage.

4. GENERAL REQUIREMENTS

4.1 Discussion. The effectiveness of any military force depends in part on the operational readiness of weapon systems. One major item of an airplane system affecting its operational readiness is the condition of the structure. The complete structure, herein referred to as the airframe, includes the fuselage, wing, empennage, landing gear, control systems and surfaces, engine mounts, structural operating mechanisms, and other components as specified in the contract specification. To maintain operational readiness, the capabilities, condition, and operational limitations of the airframe of each airplane weapon and support system must be established. Potential structural or material problems must be identified early in the life cycle to minimize their impact on the operational force, and a preventive maintenance program must be determined to provide for the orderly scheduling of inspections and replacement or repair of life-limited elements of the airframe.

4.1.1 The overall program to provide USAF airplanes with the required structural characteristics is referred to as the Aircraft Structural Integrity Program (ASIP). General requirements of the ASIP are to:

a. Establish, evaluate, and substantiate the structural integrity (airframe strength, rigidity, damage tolerance, and durability) of the airplane.

b. Acquire, evaluate, and utilize operational usage data to provide a continual assessment of the in-service integrity of individual airplanes.

c. Provide a basis for determining logistics and force planning requirements (maintenance, inspections, supplies, rotation of airplanes, system phaseout, and future force structure).

d. Provide a basis to improve structural criteria and methods of design, evaluation, and substantiation for future airplanes.

4.1.2 The majority of detail requirements are published in the referenced military specifications. This standard repeats some of these requirements for emphasis and contains additional requirements which are not currently included in the military specifications. Any differences in detail requirements that may exist between this standard and the referenced documents listed in Section 2 shall be brought to the immediate attention of the Air Force for resolution. The applicable specifications, including the latest revisions thereto, for a particular airplane shall be as stated in the contract specifications.

4.2 Requirements. ASIP consists of the following five interrelated functional tasks as specified in table 1 and figures 1, 2, and 3:

a. Task I (design information): Development of those criteria which must be applied during design so that the specific requirements will be met.

b. Task II (design analysis and development tests): Development of the design environment in which the airframe must operate and the response of the airframe to the design environment.

c. Task III (full scale testing): Flight and laboratory tests of the airframe to assist in determination of the structural adequacy of the design.

d. Task IV (force management data packagq): Generation of data required to manage force operations in terms of inspections, modifications, and damage assessments.

e. Task V (force management): Those operations that must be conducted by the Air Force during force operations to ensure damage tolerance and durability throughout the useful life of individual airplanes.

5. DETAIL REQUIREMENTS

5.1 Design information (Task I). The design information task encompasses those efforts required to apply the existing theoretical, experimental, applied research, and operational experience to specific criteria for materials selection and structural design for the airplane. The objective is to ensure that the appropriate criteria and planned usage are applied to an airplane design so that the specific operational requirements will be met. This task begins as early as possible in the conceptual phase and is finalized in subsequent phases of the airplane life cycle.

5.1.1 ASIP master plan. The contractor shall prepare an ASIP Master Plan in accordance with the detail requirements specified in the contract specifications. The purpose of the ASIP Master Plan is to define and document the specific approach for accomplishment of the various ASIP tasks throughout the life cycle of the airplane. The plan shall depict the time phased scheduling and integration of all required ASIP tasks for design, development, qualification, and tracking of the airframe. The plan shall include discussion of unique features, exceptions to the requirements of this standard and the associated rationale, and any problems anticipated in the execution of the plan. The development of the schedule shall consider all interfaces, impact of schedule delays (e.g., delays due to test failure), mechanisms for recovery programming, and other problem areas. The plan and schedules shall be updated annually and when significant changes occur. The ASIP Master Plan shall be subject to approval by the Air Force.

5.1.2 Structural design criteria. Detail structural design criteria for the specific airplane shall be established by the contractor in accordance with the requirements of the specifications as specified in 5.1.2.2. These specifications contain design criteria for strength, damage tolerance, durability, flutter, vibration, sonic fatigue, and weapons effects. The structural design criteria for damage tolerance and durability are further specified in 5.1.2.1 for special emphasis.

5.1.2.1 Damage tolerance and durability design criteria. The airframe shall incorporate materials, stress levels, and structural configurations which:

a. Allow routine in-service inspection

b. Minimize the probability of loss of the airplane due to propagation of undetected cracks, flaws, or other damage

c. Minimize cracking (including stress corrosion and hydrogen induced cracking), corrosion, delamination, wear, and the effects of foreign object damage.

Damage tolerance design approaches shall be used to insure structural safety since undetected flaws or damage can exist in critical structural components despite the design, fabrication, and inspection efforts expended to eliminate their occurrence. Durability structural design approaches shall be used to achieve Air Force weapon and support systems with low in-service maintenance costs and improved operational readiness throughout the design service life of the airplane.

5.1.2.1.1 Damage tolerance. The damage tolerance design requirements are specified in MIL-A-83444, and shall apply to safety-of-flight structure. Damage tolerance designs are categorized into two general concepts:

a. Fail-safe concepts where unstable crack propagation is locally contained through the use of multiple load paths or tear stoppers

b. Slow crack growth concepts where flaws or defects are not allowed to attain the size required for unstable rapid propagation.

Either design concept shall assume the presence of undetected flaws or damage, and shall have a specified residual strength level both during and at the end of a specified period of unrepaired service usage. The initial damage size assumptions, damage growth limits, residual strength requirements and the minimum periods of unrepaired service usage depend on the type of structure and the appropriate inspectability level.

5.1.2.1.2 Durability. The durability design requirements are specified in MIL-A-8866. The airframe shall be designed such that the economic life is greater than the design service life when subjected to the design service loads/ environment spectrum. The design service life and typical design usage requirements will be specified by the Air Force in the contract specifications for each new airplane. The design objective is to minimize cracking or other structural or materi . degradation which could result in excessive maintenance problems or functional problems such as fuel leakage, loss of control effectiveness, or loss of cabin pressure.

5.1.2.2 Structural design criteria requirements. Using the requirements in the System specification and the referenced military specifications the contractor shall prepare the detailed structural design criteria for the particular airplane. These criteria and all elements thereof shall require approval by the Air Force. Detail structural design criteria are specified in AFSC DH 1-0 and DH 2-0 and in MIL-A-8860, MIL-A-8861, MIL-A-8862, MIL-A-8865, MIL-A-8866, MIL-A-8869, MIL-A-8870, MIL-A-8892, MIL-A-8893, and MIL-A-83444. Where applicable, specific battle damage criteria will be provided by the Air Force. These criteria will include the threat, flight conditions, and load carrying capability and duration after damage is imposed, etc. The structure shall be designed to these criteria and to other criteria as specified in AFSC DH 2-7.

5.1.3 Damage tolerance and durability control plans. The contractor shall prepare damage tolerance and durability control plans and conduct the resulting programs in accordance with this standard, MIL-A-8866, and MIL-A-83444. The plans shall identify and define all of the tasks necessary to ensure compliance with the damage tolerance requirements as specified in 5.1.2.1.1 and MIL-A-83444, and the durability requirements as specified in 5.1.2.1.2 and MIL-A-8866. The plans and their individual elements shall require approval by the Air Force. The disciplines of fracture mechanics, fatigue, materials selection and processes, environmental protection, corrosion prevention and control, design, manufacturing, quality control, and nondestructive inspection are involved in damage tolerance and durability control. The corrosion prevention and control plan shall be in accordance with MIL-STD-1568. The plans shall include the requirement to perform damage tolerance and durability design concepts/material/weight/performance/cost trade studies during the early design phases to obtain low weight, cost effective designs which comply with the requirements of MIL-A-8866 and MIL-A-83444.

5.1.3.1 Damage tolerance control plan. The damage tolerance control plan shall include as a minimum the following tasks:

a. Basic fracture data (i.e., K_{IC}, K_C, K_{ISCC}, da/dn, etc.) utilized in the initial trade studies and the final design and analyses shall be obtained from existing sources or developed as part of the contract in accordance with 5.2.1.

b. A fracture critical parts list shall be established by the contractor in accordance with MIL-A-83444. The fracture critical parts list shall require approval by the Air Force and the list shall be kept current as the design of the airframe progresses.

c. Design drawings for the fracture critical parts shall identify critical locations and special processing (e.g., shot peening) and inspection requirements.

d. Complete nondestructive inspection requirements, process control requirements, and quality control requirements for fracture critical parts shall be established by the contractor and shall require approval by the Air Force. Nondestructive inspections shall comply with MIL-I-6870. This task shall include the proposed plan for certifying and monitoring subcontractor, vendor, and supplier controls.

e. The damage tolerance control plan shall include any special nondestructive inspection demonstration programs conducted in accordance with the requirements of MIL-A-83444.

f. Material procurement and manufacturing process specifications shall be developed and updated as necessary to minimize the possibility that basic materials and the resulting fracture critical parts have fracture toughness properties in the important loading directions which are less than those used in design.

g. Traceability requirements shall be defined and imposed by the contractor on those fracture critical parts that receive prime contractor or subcontractor in-house processing and fabrication operations which could degrade the design material properties.

h. Damage tolerance analyses, development testing, and full scale testing shall be performed in accordance with this standard, MIL-A-8867 and MIL-A-83444.

i. For all fracture critical parts that are designed for a degree of inspectability other than in-service noninspectable, the contractor shall define the necessary inspection procedures for field use for each appropriate degree of inspectability as specified in MIL-A-83444.

5.1.3.2 Durability control plan. The durability control plan shall include as a minimum the following tasks:

a. A disciplined procedure for durability design shall be implemented to minimize the possibility of incorporating adverse residual stresses, local design details, materials, processing, and fabrication practices into the airplane design and manufacture which could lead to cracking or failure problems (i.e., those problems which have historically been found early during durability testing or early in service usage). The durability control plan shall encompass the requirements specified in the durability detail design procedures of MIL-A-8866.

b. Basic data (i.e., initial quality distribution, fatigue allowables, etc.) utilized in the initial trade studies and the final design and analyses shall be obtained from existing sources or developed as part of the contract in accordance with 5.2.1.

c. A criteria for identifying durability critical parts shall be established by the contractor and shall require approval by the Air Force. It is envisioned that durability critical parts will be expensive, noneconomical-to-replace parts that are either designed and sized by the durability requirements of MIL-A-8866 or could be designed and sized by the requirements of MIL-A-8866 if special control procedures are not employed. A durability critical parts list shall be established by the contractor and shall be kept current as the design of the airframe progresses.

d. Design drawings for the durability critical parts shall identify critical locations and special processing and inspection requirements.

e. Material procurement and manufacturing process specifications shall be developed and updated as necessary to minimize the possibility that initial quality is degraded below that assumed in the design.

f. Experimental determination sufficient to estimate initial quality by microscopic or fractographic examination shall be required for those structural areas where cracks occur during full scale durability testing. The findings shall be used in the full scale test data interpretation and evaluation task as specified in 5.3.8 and, as appropriate, in the development of the force structural maintenance plan as specified in 5.4.3.

g. Durability analyses, development testing, and full scale testing shall be performed in accordance with this standard, MIL-A-8866, and MIL-A-8867.

5.1.4 Selection of materials, processes, and joining methods. Materials, processes, and joining methods shall be selected to result in a light-weight, cost-effective airframe that meets the strength, damage tolerance, and durability requirements of this standard and supporting specifications. A primary factor in the final selection shall be the results of the design concept/material/weight/cost trade studies performed as a part of the damage tolerance and durability control programs.

5.1.4.1 Structural materials, processes, and joining methods selection requirements. In response to the request for proposal, prospective contractors shall identify the proposed materials, processes, and joining methods to be used in each of the structural components and the rationale for the individual selections. After contract award and during the design activity, the contractor shall document the complete rationale used in the final selection for each structural component. This rationale shall include all pertinent data upon which the selections were based including the data base, previous experience, and trade study results. The requirements of AFSC DH 1-2, Sections 7A, paragraph entitled, Materials, and 7B, paragraph entitled, Processes, shall be met as applicable. The selection of fasteners shall be in accordance with MIL-STD-1515. The materials, processes, and joining method selections for fracture and durability critical parts shall require approval by the Air Force.

5.1.5 Design service life and design usage. The Air Force will provide the required design service life and typical design usage as part of the contract specifications. These data shall be used in the initial design and analysis of the airframe. The design service life and design usage will be established through close coordination between the procuring activity and the advanced planning activities (i.e., Hq USAF, Hq AFSC, Hq AFLC, and using commands). Design mission profiles and mission mixes which are realistic estimates of expected service usage will be established. It is recognized that special force management actions will probably be required (i.e., early retirement, early modification, or rotation of selected airplanes) if the actual usage is more severe than the design usage. All revisions in these data subsequent to contract negotiations shall be at the discretion of the Air Force but will require separate negotiations between the Air Force and contractor.

5.2 Design analyses and development tests (Task II). The objectives of the design analyses and development tests task are to determine the environments in which the airframe must operate (load, temperature, chemical, abrasive, vibratory and acoustic environment) and to perform preliminary analyses and tests based on these environments to design and size the airframe to meet the required strength, damage tolerance, and durability requirements.

5.2.1 Material and joint allowables. The contractor shall utilize as appropriate the materials and joint allowables data in MIL-HDBK-5, MIL-HDBK-17, MIL-HDBK-23, and MCIC-HDBK-01 to support the various design analyses. Other data sources may also be used but will require approval by the Air Force.

For those cases where there are insufficient data available, the contractor shall formulate and perform experimental programs to obtain the data. Generation and analysis of test data shall meet the requirements of MIL-HDBK-5. The scope of these programs shall be defined by the prospective contractors in their responses to the request for proposal and shall require approval by the Air Force.

5.2.2 Loads analysis. The contractor shall comply with the detail requirements for loads analysis as specified in the contract specifications. The loads analysis shall consist of determining the magnitude and distribution of significant static and dynamic loads which the airframe may encounter when operating within the envelope established by the structural design criteria. This analysis consists of determining the flight loads, ground loads, powerplant loads, control system loads, and weapon effects. When applicable, this analysis shall include the effects of temperature, aeroelasticity, and dynamic response of the airframe.

5.2.3 Design service loads spectra. The contractor shall comply with the detail requirements for design service loads spectra in MIL-A-8866 as specified in the contract specifications. These spectra shall require approval by the Air Force. The purpose of the design service loads spectra is to develop the distribution and frequency of loading that the airframe will experience based on the design service life and typical design usage. The design service loads spectra and the design chemical/thermal environment spectra as specified in 5.2.4 will be used to develop design flight-by-flight stress/environment spectra as appropriate to support the various analyses and test tasks specified herein.

5.2.4 Design chemical/thermal environment spectra. The contractor shall comply with the detail requirements for design chemical/thermal environment spectra in MIL-A-8866 as specified in the contract specifications. These spectra shall require approval by the Air Force. These spectra shall characterize each environment (i.e., intensity, duration, frequency of occurrence, etc.).

5.2.5 Stress analysis. The contractor shall comply with the detail requirements for stress analysis as specified in the contract specifications. This analysis shall require approval by the Air Force. The stress analysis shall consist of the analytical determination of the stresses, deformation, and margins of safety resulting from the external loads and temperatures imposed on the airframe. The ability of the airframe to support the critical loads and to meet the specified strength requirements shall be established. In addition to verification of strength the stress analysis shall be used as a basis for durability and damage tolerance analyses, selection of critical structural components for design development tests, material review actions, and selection of loading conditions to be used in the structural testing.

The stress analysis shall also be used as a basis to determine the adequacy of structural changes throughout the life of the airplane and to determine the adequacy of the structure for new loading conditions that result from increased performance or new mission requirements. The stress analysis shall be revised to reflect any major changes to the airframe or to the loading conditions applied to the airframe.

5.2.6 Damage tolerance analysis. The contractor shall comply with the detail requirements for damage tolerance analysis in MIL-A-83444 as specified in the contract specifications. This analysis shall require approval by the Air Force. The purpose of this analysis is to substantiate the ability of the structural components to meet the requirements of MIL-A-83444.

5.2.6.1 Analysis procedures. The design flight-by-flight stress/environment spectra based on the requirements of 5.2.3 and 5.2.4 shall be used in the damage growth analysis and verification tests. The calculations of critical flaw sizes, residual strengths, safe crack growth periods, and inspection intervals shall be based on existing fracture test data and basic fracture allowables data generated as a part of the design development test program. The effect of variability in fracture properties on the analytical results shall be accounted for in the damage tolerance design.

5.2.7 Durability analysis. The contractor shall comply with the detail requirements for durability analysis in MIL-A-8866 as specified in the contract specifications. This analysis shall require approval by the Air Force. The purpose of this analysis is to substantiate the ability of the structure to meet the requirements of MIL-A-8866.

5.2.7.1 Analysis procedures. The design flight-by-flight stress/environment spectra based on the requirements of 5.2.3 and 5.2.4 shall be used in the durability analysis and verification tests. The analysis approach shall account for those factors affecting the time for cracks or equivalent damage to reach sizes large enough to cause uneconomical functional problems, repair, modification, or replacement. These factors shall include initial quality and initial quality variations, chemical/thermal environment, load sequence and environment interaction effects, material property variations, and analytical uncertainties. In addition to providing analytical assurance of a durable design, the durability analysis will provide a basis for development of test load spectra to be used in the design development and full scale durability tests.

5.2.8 Sonic durability analysis. The contractor shall comply with the detail requirements for sonic durability analysis in MIL-A-8893 as specified in the contract specifications. This analysis shall require approval by the Air Force. The objective of the sonic durability analysis is to ensure that the airframe is resistant to sonic durability cracking throughout the design service life.

The analysis shall define the intensity of the acoustic environment from potentially critical sources and shall determine the dynamic response, including significant thermal effects. Potentially critical sources include but are not limited to powerplant noise, aerodynamic noise in regions of turbulent and separated flow, exposed cavity resonance, and localized vibratory forces.

5.2.9 Vibration analysis. The contractor shall comply with the detail requirements for vibration analysis in MIL-A-8892 as specified in the contract specifications. This analysis shall require approval by the Air Force. The design shall control the structural vibration environment and the analysis shall predict the resultant environment in terms of vibration levels in various areas of the airplane such as the crew compartment, cargo areas, equipment bays, etc. The structure in each of these areas shall be resistant to unacceptable cracking as specified in 5.2.7.1 due to vibratory loads throughout the design service life. In addition, the design shall control the vibration levels to that necessary for the reliable performance of personnel and equipment throughout the design life of the airplane.

5.2.10 Flutter and divergence analysis. The contractor shall comply with the detail requirements for flutter and divergence analysis in MIL-A-8870 as specified in the contract specifications. This analysis shall require approval by the Air Force. The analysis shall consist of determination of the airplane flutter and divergence characteristics resulting from the interaction of the aerodynamic, inertia, and elastic characteristics of the components involved. The objective of the analysis is to substantiate the ability of the airplane structure to meet the specified flutter and divergence margins. Flutter analysis for failure modes as agreed to by the Air Force and the contractor shall also be conducted.

5.2.11 Nuclear weapons effects analyses. The contractor shall comply with the detail requirements for nuclear weapons effects analyses in MIL-A-8869 as specified in the contract specifications. These analyses shall require approval by the Air Force. The objectives of the nuclear weapons effects analyses are to:

a. Verify that the design of the airframe will successfully resist the specified environmental conditions with no more than the specified residual damage

b. Determine the structural capability envelope and crew radiation protection envelope for other degrees of survivability (damage) as may be required.

The contractor shall prepare detail design criteria and shall conduct the nuclear weapons effects analyses for transient thermal, overpressure, and gust loads and provide the substantiation of allowable structural limits on the structures critical for these conditions. The contractor shall also prepare and report the nuclear weapons effects capability envelope, including crew radiation protection, for a specified range of variations of weapon delivery trajectories, weapon size, aircraft escape maneuvers, and the resulting damage limits.

5.2.12 Non-nuclear weapons effects analysis. The contractor shall comply with the detail requirements for non-nuclear weapons effects analysis in AFSC DH 2-7 as specified in the contract specifications. This analysis shall require approval by the Air Force.

5.2.13 Design development tests. The contractor shall comply with the detail requirements for design development tests in MIL-A-8867, MIL-A-8870, MIL-A-8892, and MIL-A-8893 as specified in the contract specifications. The design development test program shall require approval by the Air Force. The objectives of the design development tests are to establish material and joint allowables; to verify analysis procedures; to obtain early evaluation of allowable stress levels, material selections, fastener systems, and the effect of the design chemical/thermal environment spectra; to establish flutter characteristics through wind tunnel tests; and to obtain early evaluation of the strength, durability (including sonic durability), and damage tolerance of critical structural components and assemblies. Examples of design development tests are tests of coupons; small elements; splices and joints; panels; fittings; control system components and structural operating mechanisms; and major components such as wing carry through, horizontal tail spindles, wing pivots, and assemblies thereof. Prospective contractors shall establish the scope of their proposed test program in their response to the request for proposal. After contract award and during the design analysis task, the contractor(s) shall finalize the plans and submit them to the Air Force for approval. The contractor shall revise and maintain approved updated versions of the test plans as the design develops. The plans shall consist of information such as rationale for selection of scope of tests; description of test articles, procedures, test loads and test duration; and analysis directed at establishing cost and schedule trade-offs used to develop the program.

5.3 Full scale testing (Task III). The objective of this task is to assist in determining the structural adequacy of the basic design through a series of ground and flight tests.

5.3.1 Static tests. The contractor shall comply with the detail requirements for static tests in MIL-A-8867 as specified in the contract specifications. Prior to initiation of testing, the test plans, procedures, and schedules shall be subject to approval by the Air Force. The static test program shall consist of a series of laboratory tests conducted on an instrumented airframe that simulates the loads resulting from critical flight and ground handling conditions. Thermal environment effects shall be simulated along with the load application on airframes where operational environments impose significant thermal effects. The primary purpose of the static test program is to verify the design ultimate strength capabilities of the airframe. Full scale static tests to design ultimate loads shall be required except:

a. Where it is shown that the airframe and its loading are substantially the same as that used on previous aircraft where the airframe has been verified by full scale tests

b. Where the strength margins (particularly for stability critical structure) have been demonstrated by major assembly tests.

When full scale ultimate load static tests are not performed, it shall be a program requirement to conduct a strength demonstration proof test. Deletion of the full scale ultimate load static tests shall require approval by the Air Force. Functional and inspection type proof test requirements shall be in accordance with MIL-A-8867.

5.3.1.1 Schedule requirement. The full scale static tests shall be scheduled such that the tests are completed in sufficient time to allow removal of the 80 percent limit restrictions on the flight test airplanes in accordance with MIL-A-8871 and allow unrestricted flight within the design envelope on schedule.

5.3.2 Durability tests. The contractor shall comply with the detail requirements for durability tests in MIL-A-8867 as specified by the contract specifications. Prior to initiation of testing, the test plans, procedures, and schedules shall require approval by the Air Force. Durability tests of the airframe shall consist of repeated application of the flight-by-flight design service loads/environment spectra. The objectives of the full scale durability tests are to:

a. Demonstrate that the economic life of the test article is equal to or greater than the design service life when subjected to the design service loads/environment spectra

b. Identify critical areas of the airframe not previously identified by analysis or component testing

c. To provide a basis for establishing special inspection and modification requirements for force airplanes.

5.3.2.1 Selection of test articles. The test article shall be an early Full Scale Development (FSD) or Research Development Test & Evaluation (RDT&E) airframe and shall be as representative of the operational configuration as practical. If there are significant design, material, or manufacturing changes between the test article and production airplanes, durability tests of an additional article or selected components and assemblies thereof shall be required.

5.3.2.2 Schedule requirements. The full scale airframe durability test shall be scheduled such that one lifetime of durability testing plus an inspection of critical structural areas in accordance with 5.3.2.2.a and b shall be completed prior to full production go ahead decision. Two lifetimes of durability testing plus an inspection of critical structural areas in accordance with 5.3.2.3.a and b shall be scheduled to be completed prior to delivery of the first production airplane. If the economic life of the test article is reached prior to two lifetimes of durability testing, sufficient inspection in accordance with 5.3.2.3.a and b and data evaluation shall be completed prior to delivery of the first production airplane to estimate the extent of required production changes and retrofit. In the event the original schedule for the production decision and production delivery milestones become incompatible with the above schedule requirements, a study shall be conducted to assess the technical risk and cost impacts of changing these milestones. An important consideration in the durability test program is that it be completed at the earliest practical time. This is needed to minimize force modifications due to deficiencies found during testing. To this end the following needs to be accomplished:

a. Timely formulation of the test load spectra

b. Early delivery of the test article

c. Early establishment of managerial and contractual procedures for minimizing downtime in the event of a test failure.

Truncation, elimination, or substitution of load cycles in the test spectra to reduce test time and cost will be allowed. The contractor shall define by analysis and laboratory experiment the effect of any proposed truncation on the time to reach detrimental crack sizes to comply with the durability and damage tolerance requirements of MIL-A-8866 and MIL-A-83444 respectively. The results of these analyses and experiments shall be used to establish the final test spectra and, as necessary, to interpret the test results. The final test spectra shall require approval by the Air Force.

5.3.2.3 Inspections. Major inspection programs shall be conducted as an integral part of the full scale airframe durability test. The inspection programs shall require approval by the Air Force. These inspection programs shall include:

a. In-service design inspections developed in accordance with the damage tolerance requirements of MIL-A-83444 and the durability requirements of MIL-A-8866

b. Special inspections to monitor the status of critical areas and support the milestone schedule requirements of 5.3.2.2

c. Teardown inspection at the completion of the full scale durability test including any scheduled damage tolerance tests to support the interpretation and evaluation task of 5.3.8.

5.3.2.4 Test duration. The minimum durability test duration shall be as specified in MIL-A-8867. It may be advantageous to the Air Force to continue testing beyond the minimum requirement to determine life extension capabilities and validate design life capability for usage that is more severe than design usage. The decision to continue testing beyond the minimum duration shall be made based upon a joint review by the contractor and appropriate Air Force activities. The prospective contractors shall provide, in their responses to the request for proposal, the estimated cost and schedule for two additional lifetimes of durability testing beyond the minimum requirement.

5.3.3 Damage tolerance tests. The contractor shall comply with the requirements for damage tolerance tests in MIL-A-8867 as specified in the contract specifications. Prior to initiation of testing, the test plans, procedures, and schedules shall require approval by the Air Force. The damage tolerance test program shall be of sufficient scope to verify Category I fracture critical parts in accordance with MIL-A-83444. The intent shall be to conduct damage tolerance tests on existing test hardware. This may include use of components and assemblies of the design development tests as well as the full scale static and durability test articles. When necessary, additional structural components and assemblies shall be fabricated and tested to verify compliance with the requirements of MIL-A-83444.

5.3.4 Flight and ground operations tests. The contractor shall comply with the detail requirements for flight and ground operations tests in MIL-A-8871 as specified in the contract specifications. Prior to initiation of testing, the test plans, procedures, and schedules shall require approval by the Air Force. An early Full Scale Development (FSD) or Research Development Test and Evaluation (RDT&E) airplane shall be used to perform the flight and ground operations tests. Load measurements shall be made by the strain gage or pressure survey methods agreed to between the contractor and the Air Force. An additional airplane, sufficiently late in the production program to ensure obtaining the final configuration, shall be the backup airplane for these flight tests and shall be instrumented similar to the primary test aircraft. Special types of instrumentation (e.g., recording equipment, mechanical strain recorders, strain gages, etc.) to be used during the loads/environment spectra survey and the individual airplane tracking programs shall be placed on the structural flight test airplane as appropriate for evaluation and correlation. The flight and ground operations tests shall include a flight and ground loads survey and dynamic response tests.

5.3.4.1 Flight and ground loads survey. The flight and ground loads survey program shall consist of operating an instrumented and calibrated airplane within and to the extremes of its limit structural design envelope to measure the resulting loads and, if appropriate, to also measure pertinent temperature profiles on the airplane structure. The objectives of the loads survey shall be as follows:

a. Verification of the structural loads and temperature analysis used in the design of the airframe

b. Evaluation of loading conditions which produce the critical structural load and temperature distribution

c. Determination and definition of suspected new critical loading conditions which may be indicated by the investigations of structural flight conditions within the design limit envelope.

5.3.4.2 Dynamic response tests. The dynamic response tests shall consist of operating an instrumented and calibrated airplane to measure the structural loads and inputs while flying through atmospheric turbulence and during taxi, takeoff, towing, landing, refueling, store ejection, etc. The objectives shall be to obtain flight verification and evaluation of the elastic response characteristics of the structure to these dynamic load inputs for use in substantiating or correcting the loads analysis, fatigue analysis, and for interpreting the operational loads data.

5.3.5 Sonic durability tests. The contractor shall comply with the detail requirements for sonic durability tests in MIL-A-8893 as specified in the contract specifications. Prior to initiation of testing, the test plans, procedures, and schedules shall require approval by the Air Force. Measurements shall be made of the acoustic environments on a full scale airplane to verify or modify the initial design acoustic loads/environment. The sonic durability test shall be conducted on a representative airplane (or its major components) to demonstrate structural adequacy for the design service life. Sonic durability tests normally are accomplished by ground testing of the complete airplane with the power plants operating at full power for a time sufficient to assure design service life. However, testing of major portions of the airplane in special nonreverberant ground test stands using the airplane propulsion system is the noise source, or in high intensity noise facilities, may be acceptable.

5.3.6 Flight vibration tests. The contractor shall comply with the detail requirements for flight vibration tests in MIL-A-8892 as specified in the contract specifications. Prior to initiation of testing, the test plans, procedures, and schedules shall require approval by the Air Force. These tests shall be conducted to verify the accuracy of the vibration analysis. In addition, the test results shall be used to demonstrate that vibration control measures are adequate to prevent cracking and to provide reliable performance of personnel and equipment throughout the design service life.

5.3.7 Flutter tests. The contractor shall comply with the detail requirements for flutter related tests in MIL-A-8870 as specified in the contract specifications. Prior to initiation of testing, the test plans, procedures, and schedules shall require approval by the Air Force. Flutter related tests shall consist of ground vibration tests, thermoelastic tests, limit load rigidity tests, control surface free play and rigidity tests, and flight flutter tests.

5.3.7.1 Ground vibration tests. The ground vibration tests shall consist of the experimental determination of the natural frequencies, mode shapes, and structural damping of the airframe or its components. The objective is to verify mass, stiffness, and damping characteristics which are used in the aeroelastic analyses (flutter analysis, dynamic analysis, math models, etc.).

5.3.7.2 Structural rigidity tests. The thermoelastic tests, limit load rigidity test, and control surface free play and rigidity tests shall consist of the experimental determination of the structural elastic and free play properties of the airframe and its components. The objective of these tests is to verify supporting data used in aeroelastic analyses and dynamic model design.

5.3.7.3 Flight flutter tests. Flight flutter tests shall be conducted to verify that the airframe is free from aeroelastic instabilities and has satisfactory damping throughout the operational flight envelope.

5.3.8 Interpretation and evaluation of test results. Each structural problem (failure, cracking, yielding, etc.) that occurs during the tests required by this standard shall be analyzed by the contractor to determine the cause, corrective actions, force implications, and estimated costs. The scope and interrelations of the various tasks within the interpretation and evaluation effort are illustrated in figure 4. The results of this evaluation shall define corrective actions required to demonstrate that the strength, rigidity, damage tolerance and durability design requirements are met. The cost, schedule, operational, and other impacts resulting from correction of deficiencies will be used to make major program decisions such as major redesign, program cancellation, awards or penalties, and production airplane buys. Structural modifications or changes derived from the results of the full scale test to meet the specified strength, rigidity, damage tolerance, and durability design requirements shall be substantiated by subsequent tests of components, assemblies, or full scale article as appropriate. (See figure 3.) The test duration for durability modifications shall be as specified in MIL-A-8867 and the contract specifications. The contractor shall propose these additional test requirements together with the associated rationale to the Air Force for approval.

5.4 Force management data package (Task IV). Maintaining the strength, rigidity, damage tolerance, and durability is dependent on the capability of the appropriate Air Force commands to perform specific inspection, maintenance, and possibly modification or replacement tasks at specific intervals throughout the service life (i.e., at specified depot or base level maintenance times and special inspection periods). To properly perform these tasks, the Air Force must have detailed knowledge of the required actions. Additionally, experience has shown that the actual usage of military airplanes may differ significantly from the assumed design usage. It is necessary that the Air Force have the technical methods and actual usage data to assess the effect of these changes in usage on airplane damage tolerance and durability. Task IV describes the minimum required elements of a data package which the contractor shall provide so that the Air Force can accomplish the force management tasks as specified in 5.5. It should be noted that Task IV contains basic ASIP requirements to be performed by the contractor but, unlike Tasks I through III, is not for the purpose of providing compliance to the basic structural design requirements.

5.4.1 Final analyses. The contractor shall revise the design analyses as appropriate to account for significant differences between analysis and test that are revealed during the full scale tests and later during the loads/environment spectra survey. These analyses updates shall be prepared as discussed below and shall require approval by the Air Force.

5.4.1.1 Initial update of analyses. The design analyses as specified in 5.2 shall be revised when the results of the design development and full scale tests as specified in 5.2.13 through 5.3.7 are available. These initial updates will be used to identify the causes of problems, corrective actions, and production and force modifications required by the interpretation and evaluation of test results task as specified in 5.3.8.

5.4.1.2 Final update of analyses. The initial update of the damage tolerance and durability analyses shall be revised to reflect the baseline operational spectra as specified in 5.4.3. These analysis updates shall form the basis for preparation of the updated force structural maintenance plan as specified in 5.4.3.2. The analyses shall identify the critical areas, damage growth rates, and damage limits required to establish the damage tolerance and durability inspection and modification requirements and economic life estimates required as part of the force structural maintenance plan.

5.4.1.3 Development of inspection and repair criteria. The appropriate analyses (stress, damage tolerance, durability, etc.) shall be used to develop a quantitative approach to inspection and repair criteria. Allowable damage limits and damage growth rates established by the analyses shall be used to develop inspection and repair times for structural components and assemblies. These analyses shall also be used to develop detail repair procedures for use at field or depot level. Special attention shall be placed on defining damage acceptance limits and damage growth rates for components utilizing bonded, honeycomb, or advanced composite types of construction. These inspection and repair criteria shall be incorporated into the force structural maintenance plan as specified in 5.4.3.

5.4.2 Strength summary. The contractor shall summarize the final analyses and other pertinent structures data into a format which will provide rapid visibility of the important structures characteristics, limitations and capabilities in terms of operational parameters. It is desirable that the summary be primarily in diagrammatic form showing the airplane structural limitations and capabilities as a function of the important operational parameters such as speed, acceleration, center of gravity location, and gross weight. The summary shall include brief descriptions of each major structural assembly, also preferably in diagrammatic form, indicating structural arrangements, materials, critical design conditions, damage tolerance and durability critical areas, and minimum margins of safety. Appropriate references to design drawings, detail analyses, test reports, and other back-up documentation shall be indicated. The strength summary shall require approval by the Air Force.

5.4.3 Force structural maintenance plan. The contractor shall prepare a force structural maintenance plan to identify the inspection and modification requirements and the estimated economic life of the airframe. Complete detailed information (when, where, how, and cost data as appropriate) shall be included. It is intended that the Air Force will use this plan to establish budgetary planning, force structure planning, and maintenance planning. This plan shall require approval by the Air Force.

5.4.3.1 Initial force structural maintenance plan. The initial plan shall be based on the design service life, design usage spectra, the results of the full scale test interpretation and evaluation task as specified in 5.3.7 and the upgraded critical parts list required as specified in 5.1.3.

5.4.3.2 Updated force structural maintenance plan. The force structural maintenance plan shall be updated to include the baseline operational spectra through use of the final analyses update as specified in 5.4.1.2. The first update of the plan shall be based on the analyses that utilized data obtained from the initial phase of the loads/environment spectra survey. Additional updates that may be required to reflect significant changes determined during continuation of the loads/environment spectra survey will be provided through separate negotiation between the Air Force and contractor.

5.4.4 Loads/environment spectra survey. The objective of the loads/environment spectra survey shall be to obtain time history records of those parameters necessary to define the actual stress spectra for the critical areas of the airframe. It is envisioned that 10-20 percent of the operational airplanes will be instrumented to measure such parameters as velocity, accelerations, altitude, fuel usage, temperature, strains, etc. The data will be obtained by the Air Force as part of the force management task as specified in 5.5 and shall be used by the contractor to construct the baseline operational spectrum as specified in 5.4.4.3. Data acquisition shall start with delivery of the first operational airplane. The contractor shall propose, in response to the request for proposal, the number of airplanes to be instrumented and the parameters to be monitored. For the purposes of the program definition, cost estimating, and scheduling, it shall be assumed that the duration of the survey will be 3 years or when the total recorded flight hours of unrestricted operational usage equals one design lifetime, whichever occurs first. The contractor shall also propose the method to be used to detect when a significant change in usage occurs to require an update in the baseline operational spectra. If the individual airplane tracking program as specified in 5.4.5 obtains sufficient data to develop the baseline operational spectra and detect significant usage changes, a separate survey program (or continuation thereof) as described herein may not be required. The scope of the program (e.g., the number of airplanes to be instrumented, and the number and type of parameters to be monitored) will be defined in the contract specifications.

5.4.4.1 Data acquisition provisions. The contractor shall select qualified functioning instrumentation and data recording systems in accordance with the requirements of this standard as specified in the contract specifications. The contractor shall select the specific instrumentation and data recording equipment to accomplish the survey task, obtain Air Force approval of the selections, and make the necessary instrumentation and data recording installations in the specified airplanes. If recording equipment and converter multiplexer equipment are selected, they shall meet the requirements of MIL-R-83165 and MIL-C-83166 respectively. Every effort should be made to use existing qualified instrumentation and recording equipment to reduce program costs and utilize proven operational capabilities. The contract shall specify whether the instrumentation and recording equipment (including spares) shall be Government Furnished Equipment (GFE) or Contractor Furnished Equipment (CFE).

5.4.4.2 Data processing provisions. The contractor shall coordinate with the Air Force the data processing provisions (including reformatting) to be used to ensure that the computer analysis methods will be compatible with the Air Force data analysis system. It is envisioned that contractor facilities and personnel, except for reformatting/transcribing and other data processing and analysis functions for which capabilities exist within the Air Force and are approved for use, will be used to process data collected during the 3-year period beginning with delivery of the first production airplane. Plans for transfer of data processing provisions from contractor to Air Force facilities including training of Air Force personnel shall be included.

5.4.4.3 Analysis of data and development of baseline operational spectra. The contractor shall use the flight data to assess the applicability of the design and durability test loads/environment spectra and to develop baseline operational spectra. The baseline operational spectra shall be used to update the durability and damage tolerance analyses as specified in 5.4.1.2 when a statistically adequate amount of data has been recorded. Subsequent revisions of the baseline operational spectra may be required but will require separate negotiations between the Air Force and contractor.

5.4.5 Individual airplane tracking program. The objective of the individual airplane tracking program shall be to predict the potential flaw growth in critical areas of each airframe that is keyed to damage growth limits of MIL-A-83444, inspection times, and economic repair times. Data acquisition shall start with delivery of the first operational airplane. The program shall include serialization of major components (e.g., wings, horizontal and vertical stabilizers, landing gears, etc.) so that component tracking can be implemented by the Air Force. The contractor shall propose for Air Force review and approval, an individual airplane tracking program for the specific airplane.

5.4.5.1 Tracking analysis method. The contractor shall develop an individual airplane tracking analysis method to establish and adjust inspection and repair intervals for each critical area of the airframe based on the individual airplane usage data. The damage tolerance and durability analyses and associated test data will be used to establish the analysis method. This analysis will provide the capability to predict crack growth rates, time to reach the crack size limits, and the crack length as a function of the total flight time and usage data. The contractor shall coordinate this effort with the Air Force to ensure that the computer analysis method will be compatible with the Air Force data analysis system. The individual airplane tracking analysis method shall require approval by the Air Force.

5.4.5.2 Data acquisition provisions. The contractor shall select qualified functioning instrumentation and data recording systems in accordance with the requirements of this standard as specified in the contract specifications. The recording system shall be as simple as possible and shall be the minimum required to monitor those parameters necessary to support the analysis methods as specified in 5.4.5.1. Counting accelerometers, electrical or mechanical strain recorders, electrical resistance gages, simplified manual data forms, etc. shall be considered. The contractor shall select the specific instrumentation and data recording equipment to accomplish the individual airplane usage tracking, obtain Air Force approval of the selections, and make the necessary instrumentation and data recording installations in the specified airplanes. The contract shall specify whether the instrumentation and recording equipment (including spares) shall be Government Furnished Equipment (GFE) or Contractor Furnished Equipment (CFE).

5.5 Force management (Task V). Task V describes those actions that must be conducted by the Air Force during force operations to ensure the damage tolerance and durability of each airplane. Task V will be primarily the responsibility of the Air Force and will be performed by the appropriate commands utilizing the data package supplied by the contractor in Task IV with the minimum amount of contractor assistance. Contractor responsibilities in Task V will be specified in the contract specifications.

5.5.1 Loads/environment spectra survey. The Air Force will be responsible for the overall planning and management of the loads/environment spectra survey and will:

a. Establish data collection procedures and transmission channels within the Air Force

b. Train squadron, base, and depot level personnel as necessary to ensure the acquisition of acceptable quality data

c. Maintain and repair the instrumentation and recording equipment

d. Ensure that the data are of acceptable quality and are obtained in a timely manner so that the contractor can analyze the results, develop the baseline spectrum (see 5.4.4.3), and update the analyses (see 5.4.1.2) and force structural maintenance plan (see 5.4.3.2).

The Air Force will also be responsible for ensuring that survey data are obtained for each type of usage that occurs within the force (training, reconnaissance, special tactics, etc.). Subsequent to completion of the initial data gathering effort, the Air Force will elect whether or not to continue to operate either all or a portion of the instrumentation and recording equipment aboard the survey airplanes to support additional updates of the baseline spectra and force structural maintenance plan.

5.5.2 Individual airplane tracking data. The Air Force will be responsible for the overall planning and management of the individual airplane tracking data gathering effort and will:

a. Establish data collection procedures and data transmission channels within the Air Force

b. Train squadron, base, and depot level personnel as necessary to ensure the acquisition of acceptable quality data

c. Maintain and repair the instrumentation and recording equipment

d. Ensure that the data are obtained and processed in a timely manner to provide adjusted maintenance times for each critical area of each airplane.

5.5.3 Individual airplane maintenance times. The Air Force will be responsible for deriving individual maintenance (inspection and repair) times for each critical area of each airplane by use of the tracking analysis methods as specified in 5.4.5.1 and the individual airplane tracking data as specified in 5.5.2. The objective is to determine adjusted times at which the force structural maintenance actions as specified in 5.4.3 have to be performed on individual airplanes and each critical area thereof. With the force structural maintenance plan and the individual aircraft maintenance time requirements available, the Air Force can schedule force structural maintenance actions on a selective basis that accounts for the effect of usage variations on structural maintenance intervals.

5.5.4 Structural maintenance records. AFLC and the using command will be responsible for maintaining structural maintenance records (inspection, repair, modification, and replacement) for individual airplanes. These records shall contain complete listings of structural maintenance actions that are performed with all pertinent data included (Time Compliance Technical Order (TCTO) action, component flight time, component and airplane serial number, etc.).

6. NOTES

6.1 Data requirements. The data requirements in support of this standard will be selected from the DOD Authorized Data List (TD-3) and will be reflected in a contractor data requirements list (DD Form 1423) attached to the request for proposal, invitation for bids, or the contract as appropriate.

6.2 Relationship to system engineering management. When appropriate, the conduct of the work efforts by the contractor in achieving airplane structural integrity will be included in the System Engineering Management Plan in accordance with MIL-STD-499A(USAF) for the airplane and will be compatible with the system safety plan in accordance with MIL-STD-882.

Custodian:
Air Force - 11

Review activities:
Air Force - 01, 10, 16

Preparing activity:
Air Force - 11

Project No. 15GP-F019

TABLE I. USAF Aircraft structural integrity program tasks.

TASK I	TASK II	TASK III	TASK IV	TASK V
DESIGN INFORMATION	DESIGN ANALYSES AND DEVELOPMENT TESTS	FULL SCALE TESTING	FORCE MANAGEMENT DATA PACKAGE	FORCE MANAGEMENT
ASIP MASTER PLAN	MATERIALS AND JOINT ALLOWABLES	STATIC TESTS	FINAL ANALYSES	LOADS/ENVIRONMENT SPECTRA SURVEY
STRUCTURAL DESIGN CRITERIA	LOAD ANALYSIS	DURABILITY TESTS	STRENGTH SUMMARY	INDIVIDUAL AIRPLANE TRACKING DATA
DAMAGE TOLERANCE & DURABILITY CONTROL PLANS	DESIGN SERVICE LOADS SPECTRA	DAMAGE TOLERANCE TESTS	FORCE STRUCTURAL MAINTENANCE PLAN	INDIVIDUAL AIRPLANE MAINTENANCE TIMES
SELECTION OF MAT'LS, PROCESSES, & JOINING METHODS	DESIGN CHEMICAL/ THERMAL ENVIRONMENT SPECTRA	FLIGHT & GROUND OPERATIONS TESTS	LOADS/ENVIRONMENT SPECTRA SURVEY	STRUCTURAL MAINTENANCE RECORDS
DESIGN SERVICE LIFE AND DESIGN USAGE	STRESS ANALYSIS	SONIC TESTS	INDIVIDUAL AIRPLANE TRACKING PROGRAM	
	DAMAGE TOLERANCE ANALYSIS	FLIGHT VIBRATION TESTS		
	DURABILITY ANALYSIS	FLUTTER TESTS		
	SONIC ANALYSIS	INTERPRETATION & EVALUATION OF TEST RESULTS		
	VIBRATION ANALYSIS			
	FLUTTER ANALYSIS			
	NUCLEAR WEAPONS EFFECTS ANALYSIS			
	NON-NUCLEAR WEAPONS EFFECTS ANALYSIS			
	DESIGN DEVELOPMENT TESTS			

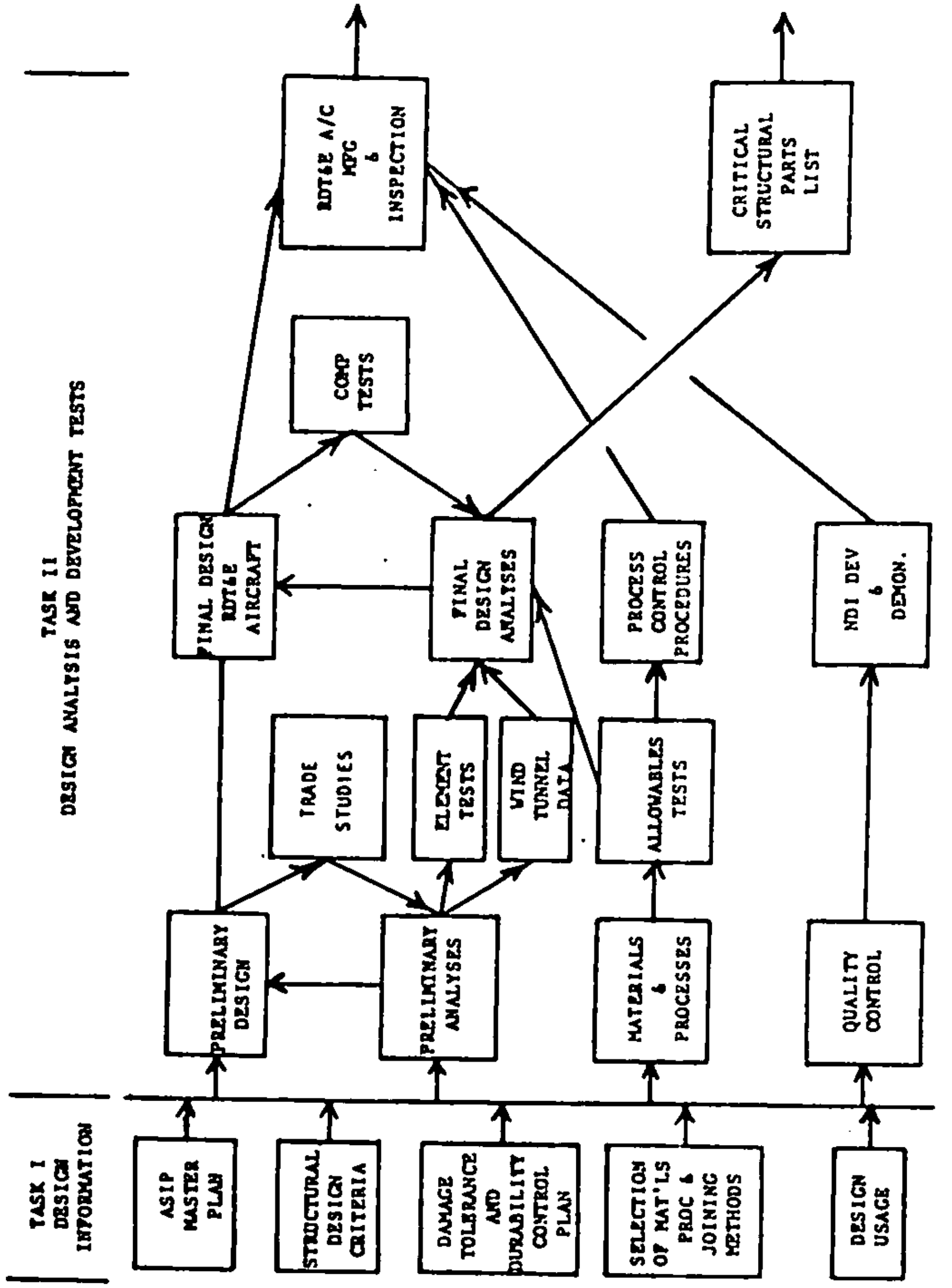

FIGURE 1. Aircraft structural integrity program.

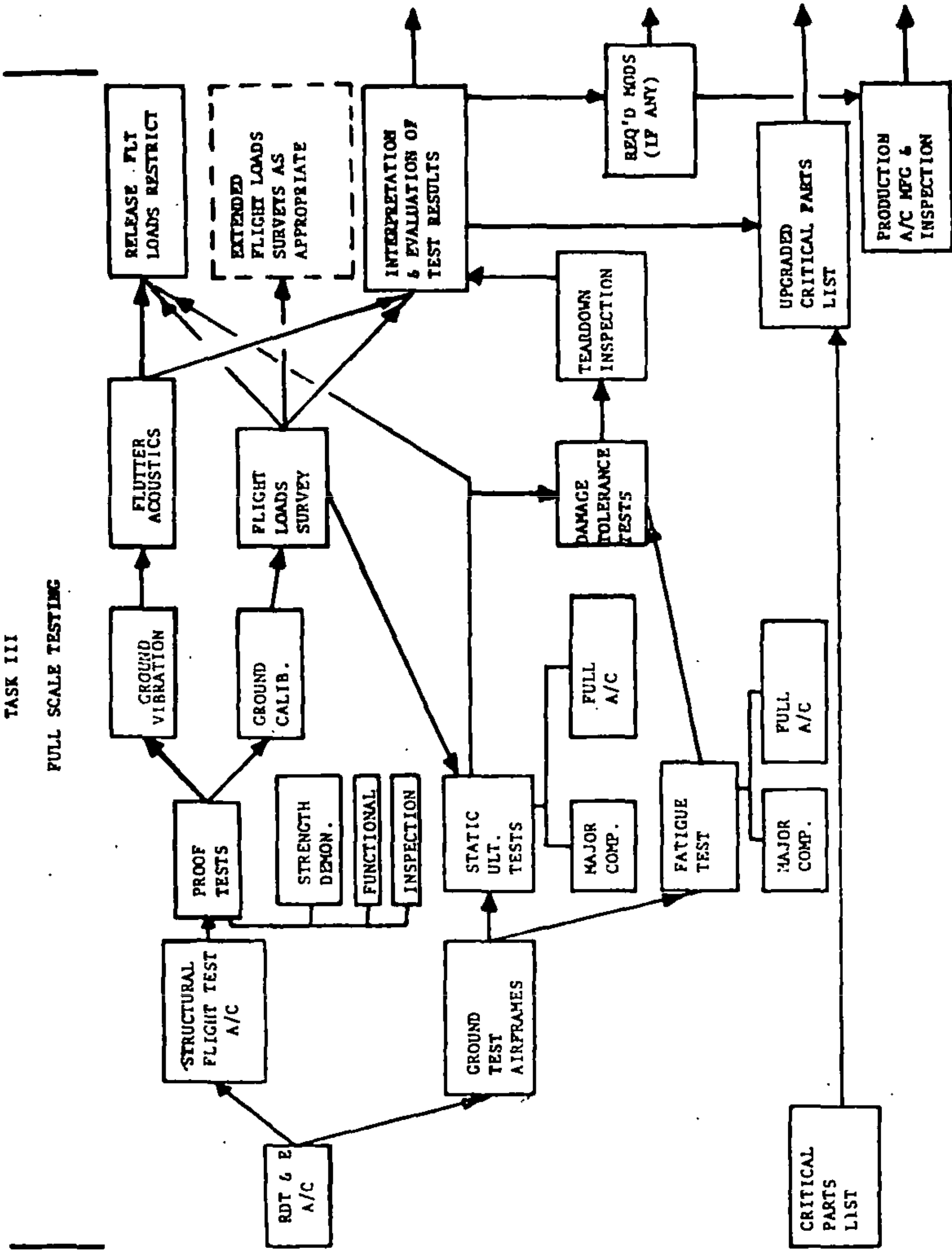

FIGURE 2. Aircraft structural integrity program.

TASK IV - FORCE MANAGEMENT DATA PACKAGE & TASK V - FORCE MANAGEMENT

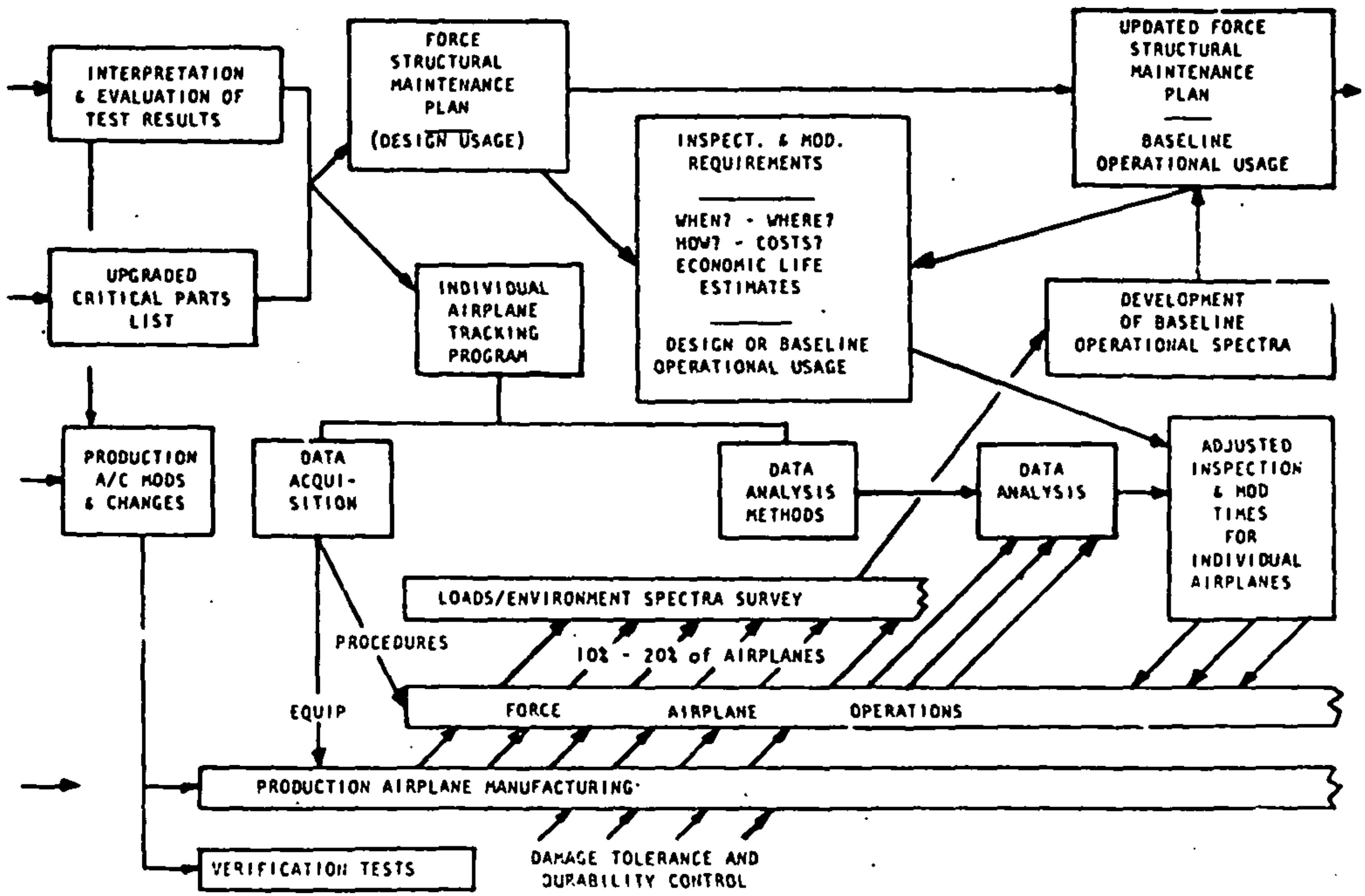

FIGURE 3. Aircraft structural integrity program.

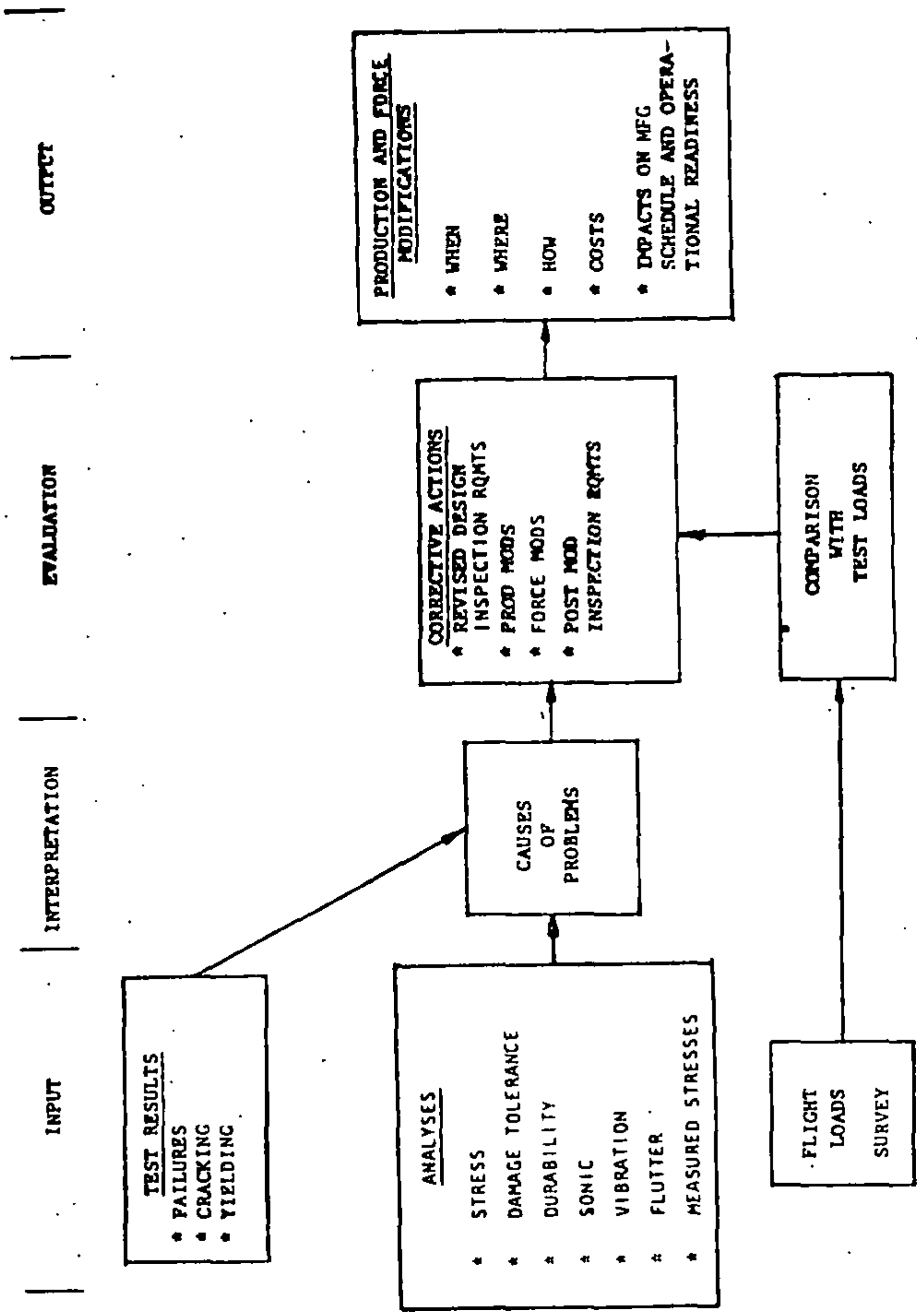

FIGURE 4. Interpretation and evaluation of test results (based on design service life and design usage).

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c. Reason/Rationale for Recommendation:

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