DATA ITEM DESCRIPTION

Title: DURABILITY AND DAMAGE TOLERANCE (DADT) ANALYSIS REPORT

Number: DI-SESS-81983

Approved Date: 20150602

AMSC Number: F9547

Limitation:

DTIC Applicable: No

GIDEP Applicable: No

Preparing Activity: 11 (AFLCMC/EZFS)

Project Number: SESS-2015-036

Applicable Forms: N/A

Use/Relationship: The report identifies the aircraft structure locations analyzed for durability and damage tolerance as required by MIL-STD-1530. The report details the assumptions, methods, procedures, and results of the airframe durability and damage tolerance analyses. The report also identifies inspection intervals and techniques necessary to detect damage growth in service. The report identifies the material quality and defines damage acceptance limits for honeycomb, bonded, and composite aircraft structures.

a. This Data Item Description (DID) contains the format and content preparation instructions for the data product generated by the specific and discrete task requirement as delineated in the contract.

b. This DID interfaces with DI-SESS-81485, Durability and Damage Tolerance (DADT) Test Report.

c. This DID supersedes DI-MISC-81486 and DI-MISC-81487.

(Copies of these documents are available online at http://quicksearch.dla.mil.)

Requirements:

1. Reference documents. The applicable issue of the documents cited herein, including their approval dates and dates of any applicable amendments, notices, and revisions, shall be as specified in the contract.

2. Format. The report shall be in the contractor's format.

3. Content. The contractor shall document the specific assumptions, computational methods, and analytical results of the durability and damage tolerance analyses utilizing guidance and requirements as described in the latest version of MIL-STD-1530 (USAF), *Aircraft Structural Integrity Program (ASIP)*.

a. The report shall include the following data for metallic and non-metallic parts:

(1) Criteria used to identify both durability and damage tolerance critical areas of the aircraft structure.

(2) Critical parts list of the aircraft structure components identified as critical for durability and damage tolerance and shall include sketches and diagrams of the areas.

(3) The methodology used in the development of the design service loads and stress spectra or a reference to such document. The report shall also state the relationships between numbers of cycles in the load spectra and the numbers of flight hours and ground-air-ground or pressurization cycles.

(4) The design service loads and stress spectra used in the durability and damage tolerance analyses shall identify the loads and stresses, stress types (bearing, bending, tension, and compression), and the associated load levels and numbers of applied cycles with the corresponding analyses that were conducted.

(5) Material properties assumed in both the durability and damage tolerance analyses to include the sources from which the properties were derived.

b. For metallic materials:

(1) The report shall include material designations, thicknesses, product forms, yield strengths, threshold stress intensity values, critical fracture toughness values, crack growth rate functions, and crack growth rate data plots for the critical thicknesses and grain directions. In cases where the government has approved classical fatigue analysis for use as the principle durability analysis technique, the report shall also include plots of the stress/strain-life (σ-n/ε-n) data, the stress concentrations (K_t) assumed in the analyses and the K_t notch values of the test specimens from which the σ-n/ε-n data were derived.

(2) For any analysis based on crack growth, the report shall document the stress intensity solutions, the crack growth retardation or crack closure models, load interaction functions, spectrum load counting and arranging methods, crack growth rate shifting functions used to account for varying stress ratios, derivation of stress equation, design limit stress, maximum spectrum stress, the methods used to account for bending, bearing, and tension, and the critical crack size estimation methods used in the analyses.

(3) When crack growth analysis is used, the report shall provide crack growth curves which are plots of the number of flight hours, pressurizations cycles, or ground-air-ground cycles vs. the dimensions of the predicted cracks from the initial durability and/or damage tolerance flaw sizes to failure of the component, to the point of functional impairment of the aircraft, or to at least four lifetimes, whichever occurs first. If functional impairment is predicted to occur first, the report shall describe the potential impact to the operation of the aircraft. Based on the results of the crack growth predictions, the report shall state the projected minimum durable life of the airframe.

(4) The report shall include tables of crack size versus flight hours or flight cycles, and the corresponding values of stress intensity per reference stress level (K/σ) versus crack size.

(5) For durability analysis based on crack initiation or classic fatigue analysis, the report shall provide stress concentration levels and fatigue damage calculations including a summary which presents those conditions producing fatigue damage along with fatigue damage values and total fatigue damage.

c. For non-metallic materials:

(1) Material properties shall include material designations (fiber, resin, adhesive), fiber geometry details and designation (unidirectional, woven, braided, random mat, etc.), fiber volume fraction, and glass transition temperature. The report shall include pertinent geometries, thicknesses, and layup orientation. Material environmental properties shall include long-term moisture absorption rates, and plots of moisture absorption effects and temperature effects within the thermal envelope of the airframe. Material mechanical properties shall include threshold strengths for tension and compression, and elastic moduli

for the critical fiber or layup directions. For laminated materials the report shall include the interlaminar critical energy release rate and for bonded joints, the report shall include the adhesive critical energy release rate.

(2) The report shall describe the processing methods (autoclave, out-of-autoclave, resin transfer molding, etc.), the manufacturing methods (hand lay-up, automated tape placement, etc.) and the tooling concepts (hard tooling, soft tooling, etc.) used to manufacture structures/parts.

(3) For components utilizing bonded, honeycomb, or advanced composite types of construction, the report shall also describe the assumed in-service material quality in terms of delamination and disbonding limits, temperature limits, potential moisture intrusion paths and ultraviolet radiation exposure locations and maximum guaranteed porosity content used in the durability and damage tolerance analyses. For these components, the report shall also define damage acceptance limits for impact, compression, delamination, and disbonding.

(4) The report shall describe the structural joining concepts (bolted, co-bonding, co-curing, secondary bonding, etc.), the joint allowables and the temperature effects within the thermal envelope of the airframe on the joint allowables.

(5) For the structural durability analysis, identify regions of the structure that have a relatively high likelihood of damage from maintenance, impact, or other sources and regions where there is a relatively low probability of the structure being damaged in service.

(6) For damage tolerance, identify the damage sources and limits for manufacturing initial flaws and in-service damage used in the damage tolerance analysis used to demonstrate residual strength requirements after two lifetimes of loading.

d. For each durability part analyzed that does not show two lifetimes of predicted stable crack growth without failure or functional impairment, the report shall describe the approach the contractor will take to bring the component into compliance with the lifetime requirement of the contract. For each damage tolerance part analyzed that indicates unstable, rapid crack propagation or failure, in less than two lifetimes or inadequate residual strength, the report should state the contractor’s plans to modify the area or identify inspection times and recommended inspection techniques.

e. The report shall include revised analyses based on refined material data and other pertinent information from the design development test program and shall include any additional analysis of locations identified as critical in the full-scale test program. The report shall be updated to incorporate revisions and updates of the durability and damage tolerance analyses as necessary as a result of subsequent evaluations, durability test findings, and service discrepancies.

End of DI-SESS-81983.