



Structures Bulletin

ASC/ENFS

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Subject: Joint USAF/USN Aircraft Strength Flight Release Methodology

Background:

The purpose of this bulletin is to document a joint USAF/USN methodology for defining fixed wing aircraft operational flight limitations during aircraft structural validation testing. The methodology generally considers the scope of structures development activities, availability of structural integrity data and historical approaches for conducting structural validation flight testing. This summary draws on standard practices and guidance outlined in historical military specifications, i.e. Mil-8860 series, and the Joint Service Guide Specification for Structures (JSSG-2006).

Reference:

1. **Joint Service Specification Guide 2006: Aircraft Structures.** Department of Defense. 30 October 1998.

USAF/USN Methodology for Establishing Flight Limits for Various Validation Approaches

Strength Demonstration/Validation	Applicability	Flight Limits
None	All Aircraft	40% DLL
Strength Proof Test	Proofed Aircraft	{PL/1.15}*LF
Strength Proof Test	Non-Proofed Aircraft	{PL/1.5 }*LF
Static Test Program	All Aircraft	{SL/FS }*LF
100% DLL Static & 80% DLL Loads Calibration	Loads Cal. Aircraft	80% DLL

The Factor of Uncertainty (FS) shall be 1.5 unless otherwise approved by the Airworthiness Certifying Official

Where: PL = Proof Test Load, SL = Static Test Load, LF = Loads Validation Factor

LF = 0.8 when loads are not measured and correlated

LF = 1.0 when loads are measured and correlated, provided the flight limits do not exceed the loads validation levels

LF between 0.8 and 1.0 may be used in special cases as approved by the procuring agency

Note 1: Above criteria applies to non-FAA certified USAF/USN fixed wing aircraft only

Note 2: Flight limits applicable to aircraft when the following conditions are met (otherwise limits should be reduced):

- a. The air vehicle meets all the structural integrity requirements as documented in JSSG-2006. Standard deterministic criteria is followed unless a system level probabilistic analysis, based on substantial statistical data, addressing all tailored requirements is completed which defines the overall probability of structural failure and is approved by the appropriate approving authority as defined in MIL-STD-882D.
- b. Flight releases are based on up-to-date design criteria, mass properties and the appropriate analyses and ground tests involving loads, structural dynamics, strength, and stiffness upon which the structural data substantiates the structural design.
- c. Loads correlated and stress analysis updated to reflect measured loads prior to flight test and/or fleet envelope expansion.
- d. A Physical Configuration Audit has been conducted to confirm the "as built" configurations are per design and to verify that clamping/bracket criteria are met (tap testing recommended).

Note 3: Flight limits must provide a minimum symmetrical maneuver capability of +2.0/0.0g.

Note 4: The following conditions must be achieved prior to first flight:

- a. Structural analyses (loads, strength, limited DADT, etc.) correlated to all ground testing, reviewed and approved, and resulted in margins ≥ 0 .
- b. Functional proof test demonstrated adequate control surface clearances for deflections at 100% DLL.
- c. Pressure proof tests conducted for cockpit & fuel tank pressure to 100% DLL (each aircraft).
- d. Selected strength proof or static tests conducted for: hydraulic systems, flight control surfaces/attachments/back-up structure, and others as needed/appropriate to cover local or component loads that may exceed aircraft limits within expansion envelope.
- e. Test to 150% DLL for unconventional structure or for design concepts/configurations with which the contractor has no experience is required.
- f. Formal airworthiness review process utilized and approved flight test envelope.
- g. All structural dynamics tests (e.g. GVT) and correlation required prior to first flight complete.
- h. Structural analysis substantiating sufficient strength for gust. Gust loads based upon worse case of discrete and continuous gust analysis.

Note 5: The following conditions are applicable to the flight loads program:

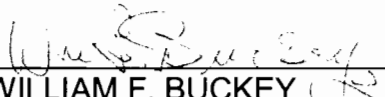
- a. Aircraft must be calibrated to at least 80% DLL **unless approval to a lower level is obtained from procuring agency.**
- b. Flight test conducted in a controlled manner with an initial phase to 80% DLL and a final phase to 100% DLL.
- c. Loads increased to final cleared value incrementally with real-time monitoring.
- d. Flight loads aircraft lead the fleet.
- e. Substantiation of loads predictions to 100% after completion of initial phase of tests to 80%

Note 6: The use of an increased factor of uncertainty of 1.875 or greater in lieu of verification by static test, as noted in paragraph A.4.10.5.2 of JSSG 2006, can be used on a case by case basis for certification of selected secondary/tertiary structural components, minor modifications, minor design and material changes, and repairs to airframes previously tested to design ultimate load. Components certified by this methodology must be subject to highly predictable loads, statically determinate reactions and non-critical failure modes. Changes certified by this methodology should entail linear elastic analysis, no deviations to critical load paths, and minor extrapolation of existing test data. Use of this certification basis is at the discretion and approval of the procuring agency.

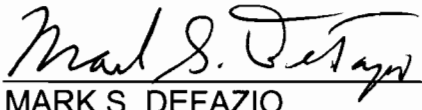
Recommendation:

The USAF/USN Strength Envelope Flight Limits for Various Strength and Loads Validation Approaches should be used as the methodology to establish operational flight limits for fixed wing aircraft.


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