



# ***Structures Bulletin***

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**Subject:** Airframe PDR and CDR Exit Criteria

## **References:**

1. "Defense Acquisition Guidebook". Version 1.0. Department of Defense. 17 Oct 04. <http://akss.dau.mil/dag/>
2. MIL-STD-1521B, "Technical Reviews and Audits for Systems, Equipment, and Computer Software". Department of Defense. Original – 1 Sep 72, Rev. B – 4 Jun 85, Cancelled – 10 Apr 95.
3. MIL-STD-1530B, "Aircraft Structural Integrity Program". Department of Defense. 20 Feb 04.

## **Background:**

The purpose of this Structures Bulletin is to give the Air Force acquisition community generic exit criteria for the airframe during Preliminary Design Review (PDR) and Critical Design Review (CDR).

**Discussion:**

The recommended exit criteria in this Bulletin was determined from the definitions of PDR and CDR as contained in the Defense Acquisition Guidebook (Ref. 1, Para. 4.3.3.4.4-5) and MIL-STD-1521B (Ref. 2, p. 5-6), guidance in MIL-STD-1530 (Ref. 3), and the experience of ASC/ENFS technical experts. The criteria is applicable to the aircraft structures of weapon systems acquired by the United States Air Force (USAF) and is intended to be tailored by each USAF program office as necessary and appropriate.

The requirements for successful completion of each criterion should be determined by the government program office and clearly communicated to the contractor before each design review. ASC/ENFS recommends that an exit criterion be marked complete if the following are true:

- the contractor can show supporting analyses or documents as finished,
- government personnel approve of the supporting analyses or documents, and
- there is no evident concern by the government program office that significant program or design impacts may arise that would require significant redesigns or modifications.

It is also recommended that a method to track the closure of each open criterion be established before the design review.

## **Generic Airframe PDR Exit Criteria (p. 1 of 2)**

### **Systems Engineering**

- Air Vehicle specified and derived requirements (performance, survivability, supportability, etc.) are allocated to the airframe and documented
- Formal risk identification and mitigation program defined and documented
- All Requests for Action (RFAs), Requests for Information (RFIs), etc. from previous reviews are closed (government/contractor agreement)
- Airworthiness certification approach defined and documented for both flight test and initial operations

### **Structural Integrity**

- ASIP Master Plan documented and updated to be current
- Deviations to MIL-STD-1530 defined and approved in accordance with AFPD 63-10 and AFI 63-1001
- Design service life and anticipated usage profiles defined and documented
- Detailed structural design criteria defined and documented
- Environmental design criteria defined and documented
- Deviations to JSSG-2006 defined, risk quantified and approved in accordance with MIL-STD-882
- Durability and Damage Tolerance Control plan defined, documented, and updated to be current
- Corrosion Prevention and Control Plan defined, documented, and updated to be current
- NDI program established, documented, and updated to be current

### **Design Definition**

- Materials, processes, joining methods, and structural concepts defined, documented, and evaluated based on their stability, producibility, inspectability, supportability, and mechanical and physical properties
- Material properties and joint allowables established, documented, and updated to be current
- Design guidelines, analysis methods, and best practices documented and implemented
- Preliminary design development tests completed
- Airframe design meets requirements defined in structural design criteria
- Airframe design layouts complete
- Control documentation for critical air vehicle interfaces between structures and other systems (including propulsion, subsystems, other structures, etc.) defined, documented, and updated to be current
- Low observable design requirements (when applicable) documented and structural design features incorporated into airframe design layouts
- Low observable structural design features (when applicable) verified by testing
- Allocated airframe requirements (performance, survivability, supportability, etc.) are predicted to be achieved

### **Loads and Dynamics Analysis**

- Loads and dynamics design requirements defined and documented
- Loads and dynamics analysis guidelines documented and implemented
- Preliminary design service loads spectra complete
- External and internal loads development plan documented and executable
- Design external loads complete and supported by wind tunnel testing
- Airframe buffet environment defined and documented
- Thermally induced structural loads defined and documented
- Preliminary design flight loads analysis (static & dynamic) complete
- Preliminary design ground loads analysis (static & dynamic) complete
- Preliminary flutter analysis complete
- Preliminary static aeroelastic analysis complete
- Preliminary aeroservoelastic modeling and analysis complete
- Preliminary vibration and sonic fatigue analysis complete
- Loads and dynamics design requirements predicted to be achieved

## **Generic Airframe PDR Exit Criteria (p. 2 of 2)**

### **Strength Analysis**

- Strength design requirements defined and documented
- Strength analysis guidelines documented and implemented
- Preliminary finite element models, design-to loads and environments for structural sizing complete
- Preliminary internal loads determined and evaluated
- Preliminary stress analysis complete and documented
- Strength requirements predicted to be achieved

### **Durability and Damage Tolerance Analysis**

- DADT design requirements defined and documented
- DADT analysis methods evaluated, guidelines documented and implemented
- Preliminary DADT analysis spectrum complete
- Preliminary DADT analysis complete
- DADT design requirements predicted to be achieved

### **Mass Properties Analysis**

- Weight allocation for components and assemblies complete and tracked (includes such items as shims, sealants, paint, coatings, seals, low observable features and design elements, systems, installation and routing)
- Preliminary weight report complete and documented
- Mass Properties Control and Management Plan defined, documented, and updated to be current
- Current mass properties estimate reflected in performance status (projected airframe IOC weights)
- Current mass properties (projected airframe IOC weights) reflected in mission scenarios within CG envelope

### **Full Scale Testing**

- Full-scale qualification test requirements and schedule documented

### **Force Management**

- Loads/Environment Spectra Survey program requirements defined
- Individual Aircraft Tracking program requirements defined
- Force structural maintenance data requirements and methodology documented

**Program Unique Requirements - To be added as necessary**

## **Generic Airframe CDR Exit Criteria (p. 1 of 2)**

### **Systems Engineering**

- Air Vehicle specified and derived requirements (performance, survivability, supportability, etc.) are allocated to the airframe and documented
- Formal risk identification and mitigation program defined and documented
- All Requests for Action (RFAs), Requests for Information (RFIs), etc. from previous reviews are closed (government/contractor agreement)
- Airworthiness certification approach defined and documented for both flight test and initial operations

### **Structural Integrity**

- ASIP Master Plan documented and updated to be current
- Deviations to MIL-STD-1530 defined and approved in accordance with AFPD 63-10 and AFI 63-1001
- Design service life and anticipated usage profiles defined and documented
- Detailed structural design criteria defined, documented and updated to be current
- Environmental design criteria defined and documented
- Deviations to JSSG-2006 defined, risk quantified and approved in accordance with MIL-STD-882
- Durability and Damage Tolerance Control plan defined, documented, and updated to be current
- Corrosion Prevention and Control Plan defined, documented, and updated to be current
- NDI program established, documented, and updated to be current
- Production NDI capability assessment complete and documented
- Structural description report complete and documented
- Initial corrosion assessment complete
- Survivability analysis complete

### **Design Definition**

- Materials, processes, joining methods, and structural concepts defined, documented, and evaluated based on their stability, producibility, inspectability, supportability, and mechanical and physical properties
- Material properties and joint allowables established, documented, and updated to be current
- Design guidelines, analysis methods, and best practices documented and implemented
- Design development tests completed and evaluated
- Airframe design meets requirements defined in structural design criteria
- Loft and design data files complete
- Control documentation for critical air vehicle interfaces between structures and other systems (including propulsion, subsystems, other structures, etc.) defined, documented, and updated to be current
- Low observable design requirements (when applicable) documented and structural design features incorporated into airframe design layouts
- Low observable structural design features (when applicable) verified by testing
- Detailed design and analysis (Build-To Packages) completed for >90% of airframe structural parts
- Allocated airframe requirements (performance, survivability, supportability, etc.) are predicted to be achieved

### **Loads and Dynamics Analysis**

- Loads and dynamics design requirements defined and documented
- Loads and dynamics analysis guidelines documented and implemented
- Design service loads spectra complete and documented
- Design chemical/thermal/environment spectra complete and documented
- Design flight loads analysis (static & dynamic) complete and documented
- Design ground loads analysis (static & dynamic) complete and documented
- Dynamic FEM complete
- Flutter analysis complete and documented
- Static aeroelastic analysis complete and documented
- Aeroservoelastic modeling and analysis complete and documented
- Vibration and sonic fatigue analysis complete and documented
- Loads and dynamics design requirements predicted to be achieved

## **Generic Airframe CDR Exit Criteria (p. 2 of 2)**

### **Strength Analysis**

- Strength design requirements defined and documented
- Strength analysis guidelines documented and implemented
- Finite element models, design-to loads and environments for structural sizing complete
- Internal loads determined and evaluated
- Stress analysis complete and documented
- Strength requirements predicted to be achieved

### **Durability and Damage Tolerance Analysis**

- DADT design requirements defined and documented
- DADT analysis methods evaluated, guidelines documented and implemented
- DADT critical parts defined and documented
- DADT analysis spectrum complete
- DADT analysis complete and documented
- MRB process established
- DADT design requirements predicted to be achieved

### **Mass Properties Analysis**

- Weight allocation for components and assemblies complete and tracked (includes such items as shims, sealants, paint, coatings, seals, low observable features and design elements, systems, installation and routing)
- Calculated weight report complete and documented
- Mass Properties Control and Management Plan defined, documented, and updated to be current
- Current mass properties estimate reflected in performance status (projected airframe IOC weights)
- Current mass properties (projected airframe IOC weights) reflected in mission scenarios within CG envelope

### **Full-Scale Testing**

- Static test plan defined and documented
- Plans for first flight verification ground tests (i.e., mass properties, functional proof, pressure proof, strength proof, control surface rigidity & free play, ground vibration, and aeroservoelastic ground tests) defined and documented, and schedule support flight test schedule and envelope expansion requirements
- Plans for flight tests (including flight and ground loads survey, dynamic response, flutter, aeroacoustic, and vibration tests) defined and documented
- Durability test plan defined and documented
- Damage tolerance test plan defined and documented
- Climatic test plans defined and documented
- Plan for interpretation and evaluation of test results defined and documented

### **Force Management**

- Loads/Environment Spectra Survey program requirements defined
- Individual Aircraft Tracking program requirements defined
- Force Structural Maintenance Plan defined
- Preliminary Life Management Process demonstrated
- Force structural maintenance data requirements and methodology documented, and updated to be current

**Program Unique Requirements** - To be added as necessary

**Recommendation:**

USAF program offices should apply the generic airframe Preliminary Design Review (PDR) and Critical Design Review (CDR) exit criteria contained in this Structures Bulletin to assess the progress of each program at their respective Design Reviews. These criteria may be tailored by each program office as necessary and appropriate.

**Approved by:**



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