NOT MEASUREMENT SENSITIVE

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# DEPARTMENT OF DEFENSE
# STANDARD PRACTICE

# AVIONICS INTEGRITY PROGRAM (AVIP)

Reinstated after 13 October 2011 and may be used for new and existing designs and acquisitions.

AMSC N/A

FSG 15GP

DISTRIBUTION STATEMENT A. Approved for public release, distribution is unlimited.

# FOREWORD

1. This standard is approved for use by the Department of the Air Force and is available for use by all Departments and Agencies of the Department of Defense.

2. The Avionics Integrity Program (AVIP) identifies the design tasks needed to achieve high reliability, long life, safe operation and supportability of aviation electronics in operational environments.

3. This standard replaces the Avionics/Electronics Integrity Process (AVIP) handbook, MIL-HDBK-87244. AVIP originated in the mid-1980s as a "reliability by design" standard to improve electronic products used in military applications, then was replaced in the late 1980's by a less prescriptive handbook. This new version of AVIP revives the original MIL-STD-1796 number and title and is, once again, a standard which can be cited as a contractual requirement.

4. AVIP is focused on the "integrity" performance requirements (tolerate the environment, perform reliably, etc.), as opposed to "mission" performance requirements (e.g., radar range, navigation accuracy, communication capability, etc.). The document focuses on tasks to be performed to define and achieve avionics integrity rather than focusing on specification requirements.

5. The task and product requirements in this standard are to be referenced or copied into statements of work and other contractual documents. The tasks required by this version of AVIP are not new or exotic – they are the same tasks successful programs have used in the past to build robust avionics. The need for consistent application of these system engineering techniques is driven by the user's requirement for systems with high mission-capable rates, high availability rates and low support cost.

6. The AVIP requirements and process tasks are to be used in conjunction with the other integrity program documents as part of a balanced systems engineering process to foster an engineering and manufacturing climate that is consistent with integrated program development concepts.

7. AVIP does not focus on aircraft safety certification, but some products used in AVIP will also support certification of avionics to MIL-HDBK-516, Airworthiness Certification Criteria.

8. Comments, suggestions, or questions on this document should be addressed to the Aeronautical Systems Center, Engineering Standards Office: ASC/ENRS, 2145 Monahan Way, Wright-Patterson AFB OH 45433-7017, or emailed to Engineering.Standards@wpafb.af.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at https://assist.daps.dla.mil.

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# 1 SCOPE

## 1.1 Scope.

This standard identifies the design tasks needed to achieve high reliability, long life, safe operation and supportability of aviation electronics in operational environments.

## 1.2 Use.

This standard should be applied to avionics subsystem and system development programs for military aircraft. Apply the requirements of section 5 to acquisitions by calling out MIL-STD-1796 as a contractual compliance document. Include the potential of a developer to execute section 5 requirements as source selection evaluation criteria and as statement of work tasking. This standard may be used as a contractual requirement by any group or agency, program office or contractor. This standard also supports development of statements of work, systems engineering management plans, schedules, specifications and other program documentation. Requirements of the document are intentionally limited such that this standard can be invoked as a contract requirement without over-constraining the design or process.

## 1.3 Applicability.

This standard is applicable, when tailored, to Technology Development, Engineering and Manufacturing Development, Production & Deployment, and Operations & Support phases of a program. It is applicable to acquisition of new, existing and modified existing aviation electronics ("avionics"); including equipment referred to as commercial off-the-shelf (COTS) or non-developmental items (NDI). Aviation electronics includes all airborne electronics and may include ground electronics when they are specifically associated with the air vehicle (e.g., ground control stations for unmanned vehicles).

## 1.4 Tailoring.

The requirements of this document should be tailored as necessary by incorporating a requirement to comply with this standard into appropriate contractual documents, along with caveats excluding any paragraphs that should not apply, and adding any additional related requirements.

## 1.5 Approach.

The Avionics Integrity Program (AVIP) is intended to be one part of an integrated product development effort, not a separate program. AVIP assumes that a disciplined systems engineering management process is in place, based on the practices defined in the ASC/EN systems engineering guide. This document does not cover manufacturing processes and quality control. This document deals only with integrity of the avionics. Therefore, it does not address:

a. Mission performance issues (e.g., radar range, display brightness, radio performance, navigation accuracy, etc.)

b. Normal "best practices" of system engineering (e.g., configuration control, data management and submittal, etc.)

c. Software safety levels or criteria

# 2 APPLICABLE DOCUMENTS

## 2.1 General.

The documents listed in this section are specified in sections 3, 4, or 5 of this standard. This section does not include documents cited in other sections of this standard or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3, 4, or 5 of this standard, whether or not they are listed.

## 2.2 Government documents.

### 2.2.1 Specifications, standards, and handbooks.

The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

DEPARTMENT OF DEFENSE STANDARDS

| | |
|---|---|
| MIL-STD-1798 | Mechanical Equipment and Subsystems Integrity Program |

DEPARTMENT OF DEFENSE HANDBOOKS

| | |
|---|---|
| MIL-HDBK-338 | Electronic Reliability Design Handbook |

(Copies of this document are available online at https://assist.daps.dla.mil/quicksearch/ or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

## 2.3 Non-Government publications.

The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

GOVERNMENT ELECTRONICS AND INFORMATION TECHNOLOGY ASSOCIATION (GEIA)

| | |
|---|---|
| GEIA-STD-0005-1 | Performance Standard for Aerospace and High Performance Electronic Systems Containing Lead-Free Solder |
| GEIA-HB-0005-1 | Program Management/Systems Engineering Guidelines for Managing the Transition to Lead-Free Electronics |

(Copies may be obtained from Government Electronics and Information Technology Association, Standards & Technology Department, 2500 Wilson Boulevard, Arlington VA 22201, phone 703-907-7566, or online at http://www.geia.org/.)

### 2.4 Order of precedence.

Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

## 3 DEFINITIONS

### 3.1 Definitions.

Definitions of key terms are provided below, where use of these terms is more restrictive than a standard dictionary definition.

#### 3.1.1 Aging.

1) The deterioration of materials properties from stress chronologically accrued over the service life, often resulting in the loss of functional performance. 2) To acquire a desirable quality by standing undisturbed for some time (e.g., age hardened metals and composites).

#### 3.1.2 Analysis.

The diagnostic effort that illustrates contractual requirements has been achieved. This effort may include solution of equations, performance of simulations, evaluation and interpretation of charts and reduced data, and comparisons of analytical predictions versus test data. The normal reduction of data generated during ground and flight tests is not included.

#### 3.1.3 Anti-tamper (AT).

The application of system engineering related activities to prevent and/or delay exploitation of critical technologies in U.S. weapon systems across the entire life cycle of systems acquisition, including research, design, development, implementation, and testing of AT measures.

#### 3.1.4 Commercial off-the-shelf (COTS).

An existing non-military spec item. An example would be a commercially available radio used in airliners.

#### 3.1.5 Corrosion.

The deterioration of a material or its properties due to the reaction of that material with its chemical environment.

#### 3.1.6 Defect.

A flaw or abnormal condition which should not be present in a product and can be avoided with quality process technology.

**3.1.7 Demonstration.**
An engineering effort performed to show contractual requirements have been met. Compliance or noncompliance is determined by observation only. Fit and function checks may be accomplished as demonstrations.

**3.1.8 Derating.**
Using an item such that the stresses applied during operation are lower than the stresses the item was designed to withstand.

**3.1.9 Design life.**
The period of time during which an item is designed to work within its specified parameters. This may or may not equal the operational service life specified for the system, subsystem, or component—usually defined in terms of service or operation time in years.

**3.1.10 Durability.**
The ability of a system to resist any degradation requiring maintenance action, including inspection, caused by fatigue damage (cracking and delamination), wear and deterioration/thermal degradation, vibration fatigue, foreign object damage, maintenance-induced damage, and corrosion during normal operational and maintenance usage for the design life.

**3.1.11 Durability life test.**
Testing to verify that production representative equipment meets performance requirements without catastrophically failing while operating for the equivalent of one design life.

**3.1.12 Economic life.**
The operational service period during which it is judged to be more economically advantageous to repair than replace a component, based on an evaluation of data developed during system development and/or sustainment. For modules or devices which are designated to be "throw away at failure" (due to low cost, high reliability, or difficulty of repair), the economic life is the point at which their performance or reliability has degraded to an unacceptable level.

**3.1.13 Failure.**
Any condition which indicates that the electronics will not perform its intended function (BIT indication, aircrew squawk, equipment malfunction, etc.).

**3.1.14 Inspection.**
The visual evaluation of physical items, documentation, drawings, etc., for conformance with contractual requirements.

**3.1.15 Integrity.**
The essential characteristics of systems and equipment which allow specified performance, reliability, safety and supportability to be achieved under specified operational and environmental conditions over a defined design life.

### 3.1.16 Life limited items.
Items with a design life less than the design life of the higher level assembly.

### 3.1.17 Lead-free electronics.
Electronics, including assemblies, circuit cards, components, joints and coatings, that use Pb (lead) free solder that contains tin.

### 3.1.18 Maintenance.
The process of applying established procedures to a product or service to retain or return the item to full mission performance or readiness.

### 3.1.19 Maintenance action/event.
Any expenditure of maintenance hours (repair, calibration, troubleshooting, false failure indications, preventive maintenance, opportunistic repairs, etc.).

### 3.1.20 Margin.
The amount allowed or available between the specification limit and the functional limit (e.g., value where circuit will no longer perform properly) of the design or manufacturing parameter (see FIGURE 1).

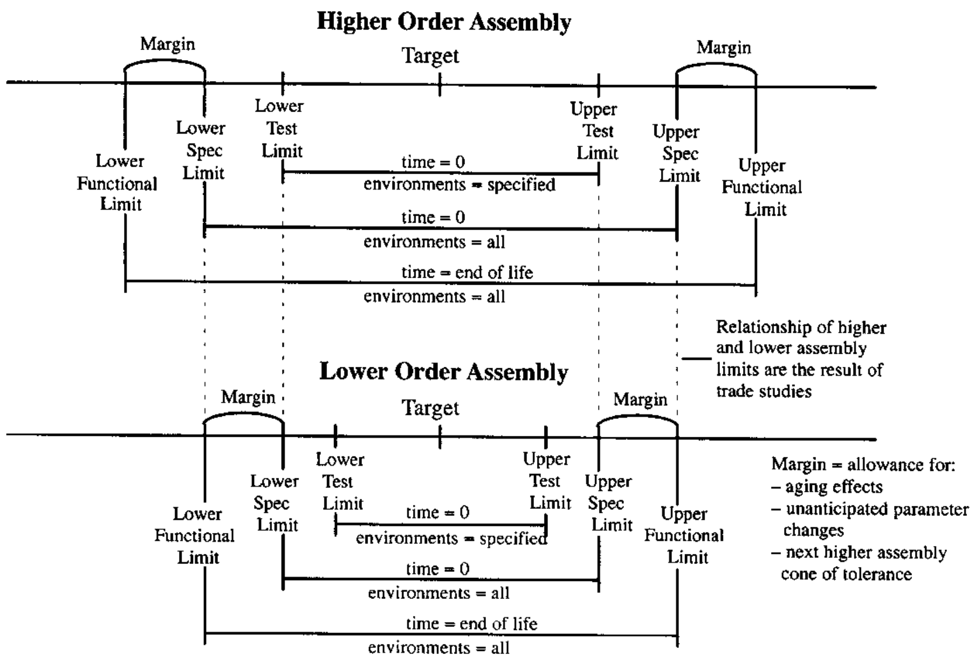


**FIGURE 1. Tolerance and margin relationship.**

### 3.1.21 Mission critical.
A function, equipment or item that is required for completion of the mission. Loss of a mission critical function will: (a) prohibit the execution of a critical mission, or (b) significantly reduce

the operational mission capability, or (c) significantly increase the system vulnerability during a critical mission. This is sometimes referred to as “mission abort critical function.”

**3.1.22 Non-critical.**
A term applied to a function, equipment or item whose loss does not affect flight safety or mission capability. An example would be a cockpit video recorder used to provide visual aids for debriefing.

**3.1.23 Opportunistic maintenance.**
Maintenance performed on an item when it is "down" already having some other maintenance performed.

**3.1.24 Parts integrity.**
The assurance that an electronic component and/or subcomponent will perform according to its specification and comes from a trusted source without risk of containing malware, containing malicious code, containing malicious circuitry, being counterfeit, or having counterfeit elements.

**3.1.25 Preventive maintenance.**
Systematic inspection, detection and correction of incipient failures either before they occur or before they develop into major defects. For example, periodic adjustment and lubrication of mechanical parts and dry gas purging of optical cavities are included in the definition of preventive maintenance, sometimes referred to as periodic maintenance.

**3.1.26 Safety critical.**
A term applied to any condition, event, operation, process, or item whose proper recognition, control, performance, or tolerance is essential to safe system operation.

**3.1.27 Safety Critical Function (SCF).**
Top-level air vehicle or system functions whose loss could potentially result in loss of air vehicle and life. This includes functions such as control of engine, take-off, landing, aerial refueling, terrain following, altitude indication, in-flight restart, fire detection, attitude indication, fuel quantity indication, control of flight, heading indication, etc.

**3.1.28 Scheduled maintenance.**
Preventive maintenance and/or maintenance that can be scheduled and performed in advance of a failure or to prevent premature failure.

**3.1.29 Supportability.**
The ability of the equipment to be kept in a state of operational readiness.

**3.1.30 Test.**
An empirical effort performed to show that requirements have been met. Documented procedures, instrumentation, and known environmental conditions are normally applicable. Compliance or noncompliance is determined by observation, where practical, and evaluation of

collected data. Most ground and flight empirical efforts associated with procurement and acquisition qualify as tests.

**3.1.31 Tolerance.**
The permissible variation allowed in a given design or manufacturing parameter; for example, specification limits (see FIGURE 1).

**3.1.32 Unscheduled maintenance.**
Unexpected maintenance of critical items that must be accomplished for mission and/or safety reasons.

**3.1.33 Usage.**
The operational parameters that define how an item is used. These parameters may be critical to function, performance, and service-life of the system and equipment (e.g.; number of missions or duty cycles, degree of loading, environments, etc.).

**3.2 Acronyms.**
Acronyms used in this document are expanded as follows:

| | | |
|---|---|---|
| AIMP | – | avionics integrity master plan |
| ALC | – | Air Logistics Center |
| AT | – | anti-tamper |
| AVIP | – | avionics integrity program |
| BIT | – | built-in-test |
| CDR | – | critical design review |
| FMECA | – | failure modes, effects, and criticality analysis |
| FMET | – | failure modes and effects testing |
| LFE | – | lead-free electronics |
| PDR | – | preliminary design review |
| RFP | – | request for proposal |
| R&M | – | reliability and maintainability |
| SIL | – | system integration laboratory |
| SOF | – | safety of flight |
| SOW | – | statement of work |
| TO | – | technical order |

## 4 GENERAL REQUIREMENTS

### 4.1 Avionics integrity program (AVIP).
AVIP supports achievement of overall program objectives. It should improve operational readiness and mission success of the avionics, and reduce demand for maintenance manpower and logistic support. The acquisition program should identify the resources, schedule,

management structure, and controls necessary to ensure specified tasks are satisfactorily accomplished.

AVIP will focus on the following:

a. Environmental design and qualification

    1) Defining the total environment

    2) Designing to ensure equipment will operate in the required environment

    3) Verifying (often by test) that equipment operates in and survives the environment

b. Durability/life requirements to ensure equipment will meet design life requirements in the defined environment.

c. Impact on integrity of implementing requirements such as lead-free electronics and anti-tamper.

d. Identification and management of flight/safety critical functions, parts obsolescence, and parts integrity.

e. Follow-up control through maintenance, inspection, and data gathering from the deployed force.

**4.2 Summary of requirements.**
TABLE I summarizes the requirements which apply to the five phases and eight elements of AVIP. These requirements are detailed in section 5 of this document.

Where this document requires that something be "documented" or "established," such information is to be available for use by the product team (including the customer or procuring activity) and preserved for use in future stages of the program. A prime contractor will typically generate this data (or collect it from subcontractors) and maintain it in a program data base. The procuring agency should have access to the data on a Data Accession List or receive it as a Contract Data Requirements List item, but the specifics of the documentation process are outside the scope of this document.

**TABLE I. Summary of AVIP requirements.**

| | **5.1 Phase 1**<br>**Design information**<br>**Proposal and contract** | **5.2 Phase 2**<br>**Prelim planning & design**<br>**Complete by PDR** | **5.3 Phase 3**<br>**Design & manufacturing development**<br>**Complete by CDR** | **5.4 Phase 4**<br>**Verification & production**<br>**Complete by delivery** | **5.5 Phase 5**<br>**Force management/ operational** |
|---|---|---|---|---|---|
| **Planning and Coordination** | Avionics Integrity Master Plan (AIMP) proposed<br>User requirements evaluated | AIMP defines system, subsystem and component integrity rqts.<br>Requirements updated<br>Integrity requirements flowed down | AIMP updated | AIMP updated<br>Verification results documented<br>Tracking plan for life limited items established | |
| **Establishing Design Criteria** | Design life requirement established (system level)<br>Reliability requirement established | Design criteria for life and reliability established<br>Sub tier requirements flowed down | Design criteria updated, and updates are flowed down and tracked | | |
| **Characterizing the environment** | Aircraft Environmental criteria established for system | Aircraft Environmental criteria updated<br>Subsystem Environmental criteria established | Aircraft Environmental criteria updated based on tests<br>Subsystem Environmental criteria updated based on tests | | |
| **Characterizing materials and components** | Characterization methods for any new materials or components proposed<br>Plan for tracking and managing lead-free electronics (LFE)<br>Plan for addressing Parts Integrity | Component and materials criteria established<br>Parts obsolescence issues defined<br>Identify initial LFE, risks, & mitigations<br>Parts Integrity requirements & processes defined | Parts obsolescence issues addressed<br>LFE items and issues addressed<br>Processes that prevent Parts Integrity risks implemented & initial risks identified | Identification of all LFE items used, identification of risks, and mitigations in place<br>Verification of Parts Integrity via approved procedures<br>Parts Integrity risks identified & mitigations in place | Establish suitable replacements for discontinued components<br>Implement LFE mitigations<br>Replacement parts meet same level of integrity as original parts |
| **Identification and tracking of critical items and critical functions** | Approach to identify, track and design for critical functions proposed | Level of criticality of each subsystem or function defined | Criticality level updated<br>Safety Critical Functions analyzed | Track Safety Critical Functions performed by avionics | Maintain data package on Safety Critical Functions performed by avionics |

**TABLE I. Summary of AVIP requirements – Continued.**

| | **5.1 Phase 1**<br>**Design information**<br>**Proposal and contract** | **5.2 Phase 2**<br>**Prelim planning & design**<br>**Complete by PDR** | **5.3 Phase 3**<br>**Design & manufacturing development**<br>**Complete by CDR** | **5.4 Phase 4**<br>**Verification & production**<br>**Complete by delivery** | **5.5 Phase 5**<br>**Force management/ operational** |
|---|---|---|---|---|---|
| **Analysis** | Analytical basis and approach to analyses established | FMECA on critical avionics items conducted<br>Thermal, vibration, shock, etc, effects on equipment analyzed | Analysis of each item (e.g., circuit board) for response to environment completed<br>Design analyzed for compliance to Rel, Maint & Diagnostics requirements<br>Avionics impacts on FMECA analyzed | Rel, Maint & diagnostics analyses updated<br>Durability analyses updated to reflect final design and results of test | |
| **Tests and demonstrations** | Environmental verification (qual) requirements established | Component development tests conducted for new or high risk items<br>Development tests to characterize basic design conducted | Environmental and Durability development test and analysis complete<br>Risk Reduction tests complete<br>Environmental and acceptance tests defined | Environmental and durability verifications complete<br>SIL tests related to integrity (e.g., FMET) complete<br>Acceptance test performed/validated Diagnostic tests validated | |
| **Life management** | Maintainability and Diagnostics requirements established<br>Strategy to address component obsolescence & component performance improvements proposed | Support concept defined<br>Maintenance & Diagnostics requirements refined | Anti-tamper protection methods impact on integrity defined | Adequacy of source of repair and level of repair established<br>Go/NoGo criteria for fielded system established and validated<br>Integrity issues addressed in TO's<br>Special maintenance for Anti-tamper defined | Life limited items tracked Deficiency tracking system implemented<br>Repair processes controlled<br>Bad actor program implemented |

## 4.3 Criticality and incremental verification.

The level of verification and time phasing of tests or other verifications will depend on the criticality of the hardware/function. TABLE II shows typical test timing requirements.

**TABLE II. Timing of environmental and life testing.**

| | **Flight critical** | **Safety critical** | **Non-Flight and Non-Safety critical** |
|---|---|---|---|
| **Complete prior to formal integration testing** | SOF portion of environmental qual | | |
| **Complete prior to first flight** | Full environmental qual and 25% of life testing | SOF portion of environmental qual. | SOF portion of environmental qual. |
| **Complete prior to production decision** | Full environmental qual and full life testing | Full environmental qual and full life testing | Most of environmental qual and life testing, to be determined based on cost and schedule risk |
| **Complete prior to delivery of production items/fielding** | All | All | All |

Hardware items may be grouped into criticality categories such as flight critical and safety critical, through the failure modes, effects and criticality analysis (FMECA) process. Guidance for conducting FMECAs is in MIL-HDBK-338.

To prevent loss of life and aircraft, safety critical functions must be designed to assure that a situation cannot occur that leads to loss of the required performance. Less severe than safety critical functions, but still very important, is the need to avoid loss of the ability to perform an assigned mission because of failures in the system. Redundancy is used in flight critical, safety critical, and some mission critical functions as a method to reduce the probability of a loss of required performance.

For example, if presentation of airspeed to the pilot is a safety critical function performed by avionics, the system design must be assessed to determine if level of redundancy, reliability, failure detection, etc. are adequate to meet safety requirements. The hardware which performs this function must meet the requirement of the safety critical column of TABLE II.

Maintenance trade-offs are also based on the life predictions and the criticality of the hardware items. For example, life limited items which are safety critical or mission critical are usually assigned preventive maintenance at designated time intervals.

Durability critical components are defined in MIL-STD-1798 as primarily mechanical items "whose failure may entail costly maintenance and or part repair and replacement of which, if not performed, would significantly degrade performance and operational readiness." This category generally has very limited application in electronics, but in cases where it does apply, the design should include ample margin to preclude early and unscheduled maintenance which could adversely impact the operational capability and availability of the weapon system.

"Safety of flight tests" include any test or analysis needed to show that an item will not cause a hazard in the aircraft. For most avionics, this includes operation over the range of temperature, altitude, humidity, shock and vibration expected in flight, as well as explosive atmosphere. Tests to show long-term durability, including fungus resistance, salt fog, durability/life, etc., are sometimes not required prior to first flight. Delaying such tests increases risk that problems identified by the test will generate design changes and force some flight tests to be repeated, but this risk must be weighed against the schedule delay associated with performing full qualification prior to flight.

## 5 DETAILED REQUIREMENTS

The following paragraphs provide detailed requirements associated with each of the tasks summarized in TABLE I.

### 5.1 Phase I: Design information (proposal and contract).

The user and procuring activity must provide basic design information. This design information includes operational requirements, maintenance concepts, mission profiles, mission environments, design life and usage constraints. Phase 1 defines things that must be available to start a formal development contract. They may be the result of a material solution analysis, concept/technology development program, user requirements development, RFP development, offerors' proposal development, or negotiation of a contract.

#### 5.1.1 Planning and coordination.

System performance requirements, including system usage requirements will be established by the contract. The procuring activity shall require the offerors to propose and implement an Avionics Integrity Master Plan (AIMP) which addresses the AVIP requirements of TABLE I either directly or by reference to other documents. The procuring activity shall define the design life, environmental, usage, reliability and other integrity-related requirements to be incorporated in the RFP and the contract. The AVIP requirements shall also be flowed down to subtier/ subcontracted efforts by the prime contractor.

#### 5.1.2 Design criteria.

The procuring activity should define design life, reliability, environmental, usage, and other integrity-related requirements at the system level. Subtier design criteria shall be proposed by the offeror and included in the contract. The statement of work (SOW) should reflect the activity of the AIMP.

#### 5.1.3 Characterizing the environment.

The RFP and specification shall define the environments in which the system will be used (defined at the system level). This should include temperature, altitude, shock, vibration, humidity, etc., as applicable. If these parameters can't be defined prior to contract award, then a SOW task shall be incorporated to assess and define these items early in the program and subsequently place the results on contract with approval of the procuring activity. The environments for operation, transportation and storage must each be assessed also to ensure that all environmental stressing factors are captured.

**5.1.4 Characterizing materials and components.**
The RFP shall require the offeror to propose characterization methods for any new materials or components to be used. This characterization shall establish, prior to system detailed design, that such new materials or components are technically mature and suitable for use in the required environments. This approach shall be documented in the AIMP.

Additionally, due to ongoing issues and unknown reliability with lead-free electronics, the RFP shall also require the offeror to propose the method by which they will identify, track, and manage equipment and components that contain lead-free solder and/or lead-free tin containing finishes. Reference GEIA-STD-0005-1, Performance Standard for Aerospace and High Performance Electronic Systems Containing Lead-free Solder, and GEIA-HB-0005-1, Program Management/Systems Engineering Guidelines for Managing the Transition to Lead-Free Electronics, for discussion on Lead Free Control Plans. This approach shall also be documented in the AIMP.

The RFP shall also require the offeror to propose how they will address the potential problem of malware, malicious code, malicious circuitry, and counterfeit parts being introduced into the avionics. The plan for addressing Parts Integrity shall be documented in the AIMP.

**5.1.5 Identification and tracking of critical items/critical functions.**
In the AIMP, the offerors shall define their approach to:

a. identifying and tracking critical functions

b. identifying any avionics items that are critical

c. meeting specific design criteria for critical items

This includes identifying and tracking avionics functions which support overall weapon system safety and mission critical operations, identifying avionics architectural considerations in support of these functions, and allocating these architectural considerations to avionics components. The offeror shall define his approach to identifying and tracking specific design criteria in response to these allocations.

**5.1.6 Analysis.**
The offeror shall define the analytical basis and approach to the various analyses that will be performed. Analytical basis should include the pedigree (source and historical use) of any analytical models to be used, with justification for assumptions and calibration factors used to make models function accurately for the specific system being developed. This should include

defining the level of FMECA and defining environmental, reliability, and maintainability analyses to be performed.

**5.1.7 Tests and demonstrations.**
The procuring activity shall require the offerors to propose environmental qualification test requirements. While concept development programs often include demonstrations and risk reduction testing prior to system development or production contract, these efforts are not the subject of this document and they are not covered here.

**5.1.8 Life management.**
The procuring activity shall define overall maintainability and diagnostics requirements and require the offerors to propose their approach to meeting these requirements. The procuring activity shall require the offerors to identify and justify any avionics devices that are expected to require life management effort. The procuring activity shall require the offeror to propose and justify the strategy to address component obsolescence and component performance improvements relative to the proposed design in support of system producibility, sustainability, and capability improvements. This shall be documented in the AIMP.

**5.2 Phase II: Preliminary planning and design (complete by PDR).**
Phase II consists of all the tasks that occur between contract award and preliminary design review (or equivalent program event/milestone). During this phase, the contractor shall establish detailed integrity requirements, document them in the AIMP, use them to support initial trade studies, and use them in the preliminary design.

**5.2.1 Planning and coordination.**
The contractor shall establish detailed integrity requirements and plans and document them in the AIMP. Requirements shall be updated as necessary and flowed down to subsystems and subcontractors.

**5.2.2 Design criteria.**
The contractor shall establish design criteria, to include the following:

a. Design life requirements shall be allocated or flowed down to all subsystems and subcontractors. The design life of subsystems is usually the same as for the system although in some cases, subsystem design life is less than that of the system. An economic evaluation should be conducted to determine the appropriateness of subsystem design life that is less than system design life.

b. Reliability requirements shall be allocated or flowed down to all subsystems and subcontractors.

c. Impact of anti-tampering and reverse engineering countermeasures on R&M, where applicable, are understood.

d. Environments in at least the following areas:

1) Mechanical. Characteristics such as allowable circuit board deflection, sizes, and configurations for anticipated vibration and shock levels, defect sizes, fatigue and fracture characteristics of the materials.

2) Thermal. The allowable stress or strains for temperature, temperature cycles and manufacturing and repair processes.

3) Chemical. The allowable degradation caused by various moisture and corrosive environments and by material couples.

4) Electrical. The allowable power dissipation, electrical stress, static discharge, voltage fluctuation, tolerance limits, and electrical parts/connectors derating considerations.

**5.2.3 Characterizing environment.**
The contractor shall assemble system level environmental data and document the environment that each subsystem will experience. This is generally documented in an environmental criteria document that defines the environment in the various zones of an aircraft (typically documented at the weapon system level, and provided to the subsystems).

**5.2.4 Characterizing materials and components.**
The contractor shall characterize the durability and reliability of materials and components that are to be used in the design. Where possible, this should make use of data available from existing designs used in similar applications. Studies, analysis and testing should be performed for any new or unproven devices. Parts which may become obsolete or difficult to support within the life of the system shall be identified. Initial identification, risks and potential mitigations to use of lead-free electronics shall be addressed.

The contractor shall analyze the system risks and criticalities, and determine which electronics shall be subject to Parts Integrity management and verification. The results of this analysis shall be subject to procuring activity approval. The contractor shall define the processes used to prevent and manage Parts Integrity risks. Risks shall be addressed.

**5.2.5 Identification and tracking of critical items/critical functions.**
The contractor shall assess each avionics system/subsystem which contributes to performance of a critical function to determine its level of criticality. The contractor shall assign corresponding levels of environmental and life verification and establish criteria for when verification must be complete, using TABLE II for guidance and providing rationale for any deviations from the table.

**5.2.6 Analysis.**
The contractor shall perform a FMECA at the system level to identify any failure modes that require mitigation in the final design. The contractor shall complete preliminary analysis to determine the effects of the environments on the avionics.

### 5.2.7 Tests and demonstrations.

The contractor shall perform component development tests on any new technology or high risk items. The contractor shall conduct development testing to characterize environmental and durability performance of the basic design.

### 5.2.8 Life management.

The contractor shall establish the adequacy of the required maintenance support concept for each avionics subsystem to maintain system integrity, or propose alternative support concepts with justification. Requirements and preliminary design for maintenance and diagnostics shall be completed, to include expected BIT coverage, false alarm rate, and recording/reporting methods.

## 5.3 Phase III: Design and manufacturing development (complete by CDR).

Phase III consists of all the tasks that occur between PDR and CDR, including detailed design, manufacturing methods development, final trade studies, analyses, and prototype testing.

### 5.3.1 Planning and coordination.

The contractor shall document any changes (from earlier phases) to system, subsystem and component integrity requirements in the AIMP and flow them down to subsystems and subcontractors.

### 5.3.2 Design criteria.

The contractor shall document any changes (from earlier phases) to integrity design criteria and flow the changes down to subsystems and subcontractors. These changes are often the result of tests such as data measured in flight on a prototype vehicle.

### 5.3.3 Characterizing the environment.

The contractor shall document any changes (from earlier phases) to system level environmental data and subsystem level environmental criteria and flow the changes down to subsystems and subcontractors. These changes are often the result of tests such as data measured in flight on a prototype vehicle.

### 5.3.4 Characterizing materials and components.

The contractor shall identify materials, parts and devices used in the design that are subject to parts obsolescence and define the method to be used to provide and maintain these parts over the life of the system. The contractor shall identify any usage of lead-free solder and lead-free electronics and shall address associated risks and mitigations.

The contractor shall implement processes that mitigate risks to Parts Integrity and shall identify known and projected risks.

### 5.3.5 Identification and tracking of critical items and critical functions.

The contractor shall update assessments of the level of criticality of each avionics item. The contractor shall identify and document the performance of any avionics flight or safety critical items or functions. The contractor shall support use of this information in any first flight readiness or aircraft certification effort required by the contract.

**5.3.6 Analysis.**
The contractor shall complete detailed analysis to determine the effects of the environments on each avionics subsystem. The contractor shall analyze the design for compliance with the reliability, maintainability and diagnostics requirements of the contract. The contractor shall analyze avionics impacts on the system level FMECA.

**5.3.7 Tests and demonstrations.**
The contractor shall complete development tests for durability and design life of any high risk items (new technology, extreme environment, innovative packaging scheme, etc). The contractor shall define test procedures or other verification methods for environmental qualification and durability or life tests. The contractor shall define equipment acceptance tests.

**5.3.8 Life management.**
The contractor shall define the impact on integrity of any anti-tamper protection methods applied to avionics items. The contractor shall perform updates based on program needs.

**5.4 Phase IV: Verification and production (complete by delivery).**
Phase IV includes test, inspection, or analysis to verify that the released avionic design meets all integrity requirements. These tasks are performed in conjunction with efforts under the manufacturing and quality integrity program to verify that production quality is maintained.

**5.4.1 Planning and coordination.**
The contractor shall document any changes to system, subsystem and component integrity requirements in the AIMP and document them appropriately. The contractor shall document results of verification tests, analyses and demonstrations. The contractor shall develop and document a plan for tracking any life-limited or scheduled maintenance items within the avionics system.

**5.4.2 Design criteria.**
No major or specific tasks are identified for this element during this phase.

**5.4.3 Characterizing the environment.**
No major or specific tasks are identified for this element during this phase.

**5.4.4 Characterizing materials and components.**
The contractor shall identify and document all lead-free solder usage, identify associated risks, and document/implement any mitigations required.

The contractor shall verify Parts Integrity (including sources) via approved procedures and methodologies, shall identify known risks, and shall implement risk mitigations.

**5.4.5 Identification and tracking of critical items and critical functions.**
The contractor shall track the flight and safety critical functions performed by avionics and identify the impact of any changes from the earlier phases.

**5.4.6 Analysis.**
The contractor shall update any reliability, maintainability and diagnostics analysis as needed. The contractor shall update durability and design life analysis to reflect the final design and results of testing.

**5.4.7 Tests and demonstrations.**
The contractor shall complete environmental and electro-magnetic qualification verification. The contractor shall complete durability verification. This may include retest or analysis to verify results of earlier design refinements. The contractor shall complete system integration lab tests, on-aircraft ground tests and flight tests to verify integrity requirements. This may include failure modes effects testing. The contactor shall perform acceptance tests on equipment to be delivered and validate that acceptance tests are an adequate measure of performance. The contractor shall establish and validate diagnostic test or evaluation criteria that will be used to declare each subsystem serviceable or not serviceable in the operational environment. Failures should be tracked during these various tests and potential design shortcomings addressed.

**5.4.8 Life management.**
The contractor shall establish the adequacy of (or changes needed to) the chosen source of repair and level of repair for each subsystem or replaceable module to maintain integrity of the fielded system. The contractor shall define any special maintenance required to maintain integrity of the system in conjunction with anti-tamper measures. Integrity issues affecting maintenance or operations shall be documented in Technical Orders (TOs). For example, if a flight-line test to verify that back-up modes are functional is needed, it must be documented in the TOs.

**5.5 Phase V: Force management (operational).**
Phase V consists of maintaining the data and processes necessary to support the fielded system. Responsibility for these tasks may not be awarded to the development prime contractor and may be accomplished by the responsible Air Logistics Center (ALC) or alternate supporting contractor. For avionics, this includes tracking of life-limited items (if any), along with the criteria and process for maintenance of any critical parts or critical functions. Redesign or replacement of avionics equipment is typically only done on a case-by-case basis when a device is used beyond its original intended life, when an unanticipated “bad actor” part is identified, when a device becomes non-repairable, or when the system is upgraded to incorporate new mission capabilities.

**5.5.1 Planning and coordination.**
No major or specific tasks are identified for this element during this phase.

### 5.5.2 Design criteria.
No major or specific tasks are identified for this element during this phase.

### 5.5.3 Characterizing the environment.
No major or specific tasks are identified for this element during this phase.

### 5.5.4 Characterizing materials and components.
A parts obsolescence program shall be established aimed at identifying parts obsolescence issues as soon as practicable in the program life cycle and identify cost-effective mitigation for each identified part. The program shall establish suitable replacements for obsolete and no-longer-available components needed to maintain the system. Mitigations for lead-free electronics shall be implemented. The contractor and/or parts procuring agency shall define and implement a plan to require all replacement parts to meet the same level of Parts Integrity as the original parts.

### 5.5.5 Identification and tracking of critical items and critical functions.
Tracking of flight and safety critical items, and the flight and safety critical functions definition and analysis that justifies their status as being flight or safety critical shall be maintained.

### 5.5.6 Analysis.
No major or specific tasks are identified for this element during this phase.

### 5.5.7 Tests and demonstrations.
No major or specific tasks are identified for this element during this phase.

### 5.5.8 Life management.
Any life-limited items shall be tracked. Tracking data is needed to determine when additional spares must be procured, maintenance must be scheduled, etc. The contractor, in conjunction with the operational unit, shall implement a deficiency tracking system to track and respond to deficiencies identified by users of the system. The contractor shall define repair procedures that will maintain the integrity of repaired items. A “bad actor” program to identify and track troublesome fielded items shall be implemented.

## 6 NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

### 6.1 Intended use.
The intended use of AVIP is to identify the design tasks needed to achieve high reliability, long life, safe operation and supportability of aviation electronics in operational environments.

### 6.2 Acquisition requirements.
Acquisition documents should specify the following:

a. Title, number, and date of this standard.

### 6.3 Subject term (key word) listing.

Anti-tamper
Components
Durability
Electronics
Environment
Lead free
Parts
Safety

### 6.4 Changes from previous issue.

Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

Custodians:
Air Force – 11

Preparing activity:
Air Force – 11
(Project 15GP-2009-003)

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at https://assist.daps.dla.mil.