CHAPTER 4

This chapter presents typical requirements for technical reviews, data, and documentation necessary to support the qualification of rotorcraft and other air vehicles. Information on technical reviews include program progress reviews, preliminary and critical design reviews, flight and firing readiness reviews, software reviews, special technical reviews, and integrated product team reviews (IPTs). Data and documentation requirements are provided for component, subsystem, and system qualification.

4-1 INTRODUCTION

Technical reviews, data and documentation form the basis for presenting the status and results of the airworthiness qualification process. They are the means by which the contractor conveys to the Government the technical characteristics of the item under development or modification. By the same token, Government review and comments to contractor reviews, data, and documentation are the vehicle for the Government to present its assessment of the contractor's qualification activities. This chapter addresses the various types of reviews that might be required; however, integrated product team (IPT) reviews are preferred, see Department of Defense Regulation No. 5000.2-R, *Mandatory Procedures for Major Defense Acquisition Program (MDAPs) and Major Automated Information System (MAIS) Acquisition Program*, (Ref. 1).

4-2 CONTRACT DATA

Contract data include such things as test plans, test reports, technical analyses, specifications, drawings, and other reports that are generated during the development process and delivered to the Government as a contractual requirement. These data serve several functions, including configuration control, documentation of test results, and provide the basis for reprocurement. The data may be informative only, or for review, approval, or other action.

4-2.1 REQUIREMENTS

Proposed data requirements should be established by an Integrated product team (IPT). Only the minimum data needed to permit cost-effective support of research, development, production, cataloging, provisioning, training, operation, training, maintenance, and related logistics functions over the life cycle of the item should be acquired.

TABLE 4-1 provides a representative sample of data items that may be required to support a qualification effort. This table is a representation of a management tool only, and does not pertain to any specific program. The table shows the reference in the airworthiness qualification plan (AQP) which requires the preparation of the data, a description of the data, a reference to the data item description (DID) (subparagraph 4-2.2), the submittal requirements for the data, and the form in which the data is to be presented.

4-2.2 DATA ITEM DESCRIPTIONS

The DID is a redefined description for a specific type of data, and it specifies how the data is to be prepared and presented. DoD 5010.12.1, The Acquisition Management Systems and Data Requirements Control List (AMSDL), periodically updated, (Ref. 2) provides a list of Office of Management and Budget

(OMB) cleared current data item descriptions that have been assigned OMB control number 0704-0188

TABLE 4-1

TASK-DATA MATRIX

AQP Para	Data Description	DID	Submittal Requirements	Form
1.5.4.1	Airworthiness Qualification Spec (AQS)	DI-CMAN-80008A	60 MAC	Hard copy and MS-Word Disk
1.5.5.2	Specifications	DI-E-1104A	90 DAC	Hard Copy
6.2.5.2	NBC Contamination Survivability Final Report	DI-MISC-80711	FF	Hard Copy
6.3.1.1	Test/Inspection Reports	DI-NDTI-80809A	60 DAT	Hard Copy
6.3.1.2.	Scientific and Technical Report	DI-MISC-80711	As Required	Hard Copy
6.3.8.2	Electromagnetic Interference Test Plan	DI-EMCS-60201A	120 DAC	Hard Copy

MAC Months after contract award
D With Draft Proposal
DAC Days after contract award
DAT Days after test
F With Final Proposal Flight
M Monthly

The AMSDL is used to find DIDs by identification number, title, and subject matter. Requests for individual DIDs or the AMSDL will be honored from military activities, Government agencies, private industry, and individuals.

4-2.3 CONTRACT DATA REQUIREMENTS

The formal and contractual mechanism for the Government to require the preparation and submittal of data is through the Contract Data Requirements List (CDRL), DD Form 1423. The CDRL is the portion of contract that identifies the specific data that the contractor should prepare and submit as part of its effort under the contract. The CDRL contains the reference number and title of the data item being procured; the DID (paragraph 4-2.2) number; and a reference to the portion of the contract (usually a statement of work or system specification) that requires the generation of the data item. In addition, the CDRL includes administrative data such as the Government office of primary technical responsibility of the submittal; location for performance of Government inspection and approval; frequency of

submittal of the data; and the number of copies and required medium for submittal.

Continuous Acquisition and Life-cycle Support (CALS) (previously known as Computer-Aided Acquisition and Logistics Support) is the Department of Defense (DoD) effort to migrate from a manual, paper-intensive defense system operation to an integrated highly automated acquisition and support process. Based on modeling efforts reflected in the current CALS Architecture Study, the Director of Defense Information created the DoD Enterprise Model to depict the activities and data needed to accomplish the defense mission. CALS will expand the architecture to include the bridge linking DoD with industry and international participants. CALS will also define the infrastructure required to integrate DoD and industry databases into one logical weapon system database - referred to as the Integrated Weapon System Database (ISWDB). A key initiative supporting this goal is optimization of information technology and the construction of a National Infrastructure - "Information Superhighways." All new contracts should require on-line access to, or delivery of, their programmatic and technical data in digital form, unless analysis shows that life-cycle time or life-cycle cost would be increased by doing so, DoDR 5000.2-R, (Ref. 2).

4-3 CLASSIFIED AND CONTROLLED DATA

Classified data and its' related requirements are discussed in the subparagraphs which follow.

4-3.1 CLASSIFIED DATA

Classified data is data that the US Government has determined to be of such a nature that its uncontrolled release would be detrimental to US security interests. Requirements for safeguarding classified data are described in paragraphs 4-3.1.1 and 4-3.1.2 for Army and contractor activities, respectively.

4-3.1.1 Army Requirements

AR-380-5, *Department of the Army Information Security Program,* (Ref. 3) is the Army's implementation of the requirements for information security. It establishes a system for classification, downgrading, and declassification of information requiring protection in the interest of National security. It contains policy and procedures for safeguarding such information and provides for program oversight and administrative sanctions for violations. Specific topics addressed include classification, declassification and downgrading, marking of information, safekeeping and storage, access, dissemination, accountability, disposal and destruction, security education, foreign Government information, special access programs, program management, and safeguarding Joint Chiefs of Staff papers. Key to determining the classification of technical data of a program is the security classification guide for that program. The guide is a document issued by an authorized original classifier that prescribes the level of classification and appropriate declassification instructions for the information.

4-3.1.2 Industrial Requirements

Executive Order 12829, *National Industrial Security Program,* (Ref. 4) and DoD 5220.22-M, *National Industrial Security Program Operating Manual,* (Ref. 5) establish the requirements for safeguarding classified information provided to industrial, commercial, and educational institutions under the provisions of a DoD Security Agreement (DD Form 441). These documents provide specific information as to whom will have access to classified information, how that information is to be shipped, stored, and disposed of, and the record keeping activities required for classified information. In addition to the requirements of these DoD publications, each organization that has classified information safeguarding responsibilities is required to establish and follow its own "standard practice procedures" (SPP) that take into account the organization's specific situation. Further, organizations that use computers for processing classified information are required to develop and implement an Automated Information System (AIS) addendum to the SPP.

4-3.2 CONTROLLED DATA

The Congress declared it to be the policy of the United States to use export controls to the extent necessary to restrict the export of goods and technology that could make a significant contribution to the military potential of any other country or combination of countries that would prove detrimental to the national interests. Controlled data is that type of data whose distribution is limited and requires special handling but yet whose content does not warrant marking it as classified data. Sensitive test reports that may reveal critical characteristics of a weapon system are an example of such controlled data. Controlled data should have an appropriate distribution statement as provided for in DoD Directive 5230-24, *Distribution Statements on Technical Documents,* (Ref. 6) on such data.

4-4 APPLICABLE DOCUMENTS

Documents that are included in a contract, specification, plan, or other requirement's document by reference are referred to as applicable documents. Tiering from one specification or standard to another is discouraged. All requirements should be tailored to the performance needs and should be clearly

specified in the contract. The use of government specifications and standards should be minimized if not eliminated. Use of widely available commercial standards, such as ASTM, ANSI, FARs, IEE, SAE, etc., should be encouraged.

4-5 PROGRAM PLANS

The purpose of program plans is to provide a road map for determining how the qualification effort is to be accomplished. Program plans belong to the Project, Program, or Weapons System Manager (PM) and are to be used by the PM to manage program execution throughout the life-cycle of the program. Program plans are a description of the detailed activities necessary to carry out program strategies. The PM, in coordination with the PEO, determines the type and number of program plans. Three or more plans might be required, such as an integrated program plan, airworthiness qualification plan, and a test and evaluation master plan (TEMP). Data generated in performance of the work required by these plans is submitted in accordance with CDRL requirements. A brief description of each of the aforementioned plans follows:

1. Integrated Program Plan - The integrated program plan should provide a road map for the entire project. It should define the following:

a. Integrated product team- Intended use of product teams. Number of teams and their purpose. Contractor support and participation in Government integrated teams.

b. System Safety - a basis of understanding between the contractor and the procuring activity as to how system safety requirements will be incorporated into hardware, software, and operating instructions and procedures.

c. Reliability - a basis of understanding between the contractor and the procuring activity as to how reliability performance requirements, reliability growth requirements, reliability tests, and reliability data will be identified, incorporated, accomplished or collected.

d. Human Factors - scope and obligation of the contractor to meet human factors performance requirements and obtain human factors data.

e. Maintainability - a basis of understanding between the contractor and the procuring activity as to how maintainability performance requirements will be identified, and demonstrated.

f. Other - a basis of understanding between the contractor and the procuring activity as to what other engineering activities, such as configuration control, producibility, transportability, weaponization, advanced quality system, etc., are required for execution of the contract.

2. Airworthiness Qualification Plan - An airworthiness qualification plan should be prepared by the procuring activity and included in the request for proposal or request for quotation. An integrated product team approach should be used for preparing the plan. This plan should provide general guidance on engineering analyses, design reviews. safety assessments, contractor demonstrations, and all contractor and Government qualification tests considered essential to defining and implementing the procurement of any major Army air vehicle, major modification, and its allied equipment. This general information than will provide the basis for an airworthiness qualification specification which should be prepared by the contractor.

3. Test and Evaluation Master Plan - planning document used to generate

detailed test and evaluation plans to ascertain schedule and resource implications. The TEMP should provide a road map for integrated simulation, test, and evaluation plans, schedules, and resource requirements necessary to accomplish the test and evaluation program.

4-6 TECHNICAL REVIEWS AND AUDITS

The PM decides how the program is to be managed. The PM may choose to have formal or informal periodic reviews, or could rely on continuous integrated product team reviews. Also, the PM could rely on the contractor to propose the type of reviews and audits to be used. The agenda for these reviews should be coordinated between contractor and government representatives several weeks prior to the meeting. Meetings should not only provide for Government oversight; but, should also provide insight. The objectives and typical requirements of the following type reviews will be discussed in this paragraph:

Program Progress Reviews
Preliminary Design Reviews
Critical Design Reviews
Flight Readiness Reviews
Firing Readiness Reviews
Special Technical Reviews
Software Reviews
Configuration Audits
Technical Interchange Reviews
Integrated Product Team Reviews

4-6.1 PROGRAM PROGRESS REVIEWS

A Program Progress Review is a periodic review conducted by the contractor to present the status of the development program. It is at this review that Government representatives gain knowledge of the overall progress of the contractor's activities. The contractor should describe the status of his design effort in terms of the number of drawings and specifications released versus a projected release schedule. The program progress review should include but not be limited to a system requirements review (SRR) where the system/segment specification (SSS), the proposed computer languages, and processing hardware architecture are reviewed; and also a system design review (SDR) where the system/segment design document (SSDD) and a preliminary software requirements specification (SRS) are reviewed. Estimates of software lines of code written versus projections should also be presented. The results of analysis work to substantiate that design requirements will be met may be discussed. As the development effort progresses, the contractor would typically present test results and planned testing activities. It is at these reviews that problems are identified either by the contractor or Government representatives and that potential solutions are discussed and reviewed in subsequent meetings. The frequency of these reviews and the specific topics covered are strongly dependent on the stage of developments.

4-6.2 PRELIMINARY DESIGN REVIEWS

The preliminary design review (PDR) is a formal review of the basic design approach for a configuration item or a functionally related group of configuration items. It is conducted after the development specifications are developed. During the PDR, special attention is directed toward interface documentation, high risk areas, long lead times, and system level trade studies that

integrate preliminary design concepts. Software and hardware PDRs have the same objectives and are conducted in a similar manner, but may address different issues related to the qualification process. The objectives of these one time formal reviews could also be satisfied by integrated product team reviews. Qualification relevant data and issues to be addressed at a hardware PDR include:

1. A preliminary design synthesis that shows that the selected design will meet its development specification requirements
2. The results of tradeoff studies that show the alternatives considered for the design and the basis for the selection of the proposed approach
3. Functional flows, requirements allocation and tractability data, and schematic diagrams
4. Layout drawings showing the functional relationships between elements
5. Analyses showing the results of environmental control and thermal design aspects
6. Analyses showing proper consideration of electromagnetic compatibility aspects of the design
7. Power distribution and grounding aspects of the preliminary design, including power regulation and compatibility between power generation and utilization equipment
8. Preliminary mechanical and packaging design of consoles, racks, drawers, printed circuit boards, and connectors
9. Safety engineering considerations
10. Security engineering considerations
11. Survivability and vulnerability (including nuclear, biological, and chemical as well as signatures and crashworthiness) considerations
12. Design margins - cycle margins, memory margins,
13. Preliminary lists of materials, parts and processes
14. Built-In-Test
15. Reliability, availability, and maintainability data, including failure modes and effects
16. Weight and balance status
17. Development test data
18. Interface requirements
19. Instrumentation interfaces and requirements for flight test telemetry
20. Development schedule
21. Mock-ups, models, breadboards, or prototype hardware when appropriate
22. Producibility and manufacturing considerations
23. Value engineering considerations
24. Transportability, packaging, and handling considerations
25. Human engineering and biomedical considerations
26. Standardization considerations
27. Description and characteristics of commercially available equipment
28. Existing documentation for commercially available equipment
29. Data processing hardware, e.g., microprocessors, programmable array logic (PAL), programmable logic devices (PLD), and gate arrays to be provided with the system
30. Review considerations applicable to computer resource hardware items as appropriate, e.g., microprocessor, non-volatile memory (NVM), and application specific integrated circuits (ASIC).
31. Life cycle cost analysis
32. Armament compatibility

33. Corrosion prevention/control considerations

34. Status of Quality Assurance Program

35. Support equipment requirements

Typical issues to be addressed at a software critical design review (CDR) include:

1. Functional flow
2. Storage allocation data
3. Control function description
4. Computer Software Configuration Item structure
5. Built-In-Test
6. Security considerations
7. Reentrance considerations
8. Computer software development facilities
9. Relationship between the computer software development facility and the operational system
10. Software development tools
11. Software test tools
12. Maintenance and upgrade interfaces, requirements, and techniques
13. Description and characteristics of commercially available computer resources
14. Existing documentation for commercially available computer resources
15. Software support resources
16. Operation and support documents
17. Software related CDRL items
18. Supplemental data (e.g.; software files, procedures) required for use with the "make-from" hardware device should be documented.

Firmware has both hardware and software parts separately handled at the applicable PDRS. The memory portion of firmware is usually referred to an embedded memory. Firmware is defined as software that has been implemented in hardware using memory devices such as read only memory (ROM), programmable ROM (PROM), erasable PROM (EPROM), and electrically erasable PROM (EEPROM). These devices, and other similar devices which are genetically referred to as integrated circuits, allow software to be permanently implemented and not easily changed.

4-6.3 CRITICAL DESIGN REVIEWS

The Critical Design Review is conducted prior to the release for fabrication or production in the case of hardware or prior to the initiation of coding in the case of software. During the CDR, the detailed design for each configuration item is disclosed in the form of a draft product specification (Type C) and related engineering drawings. The approved detailed design from this review serves as a basis for final production planning and often initial fabrication. In the case of software, completion of the CDR initiates the development of source and object code. A primary objective of the CDR should be to insure the qualification requirements will be met. The objectives of these one time formal reviews could also be satisfied by integrated product team reviews. For a hardware CDR, the following issues are typically addressed:

1. Adequacy of the detail design as reflected in the draft hardware product specifications in satisfying the hardware development specification requirements.

2. Adequacy of the detailed engineering drawings for the hardware configuration item, including schematic diagrams.

3. Adequacy of the detailed design in the following areas:

a. Electrical design
b. Mechanical design

c. Environmental control and thermal design aspects

d. Electromagnetic compatibility

e. Power generation and grounding

f. Electrical and mechanical interface compatibility

g. Mass properties

h. Survivability and vulnerability (including nuclear, biological, and chemical, as well as signatures and crashworthiness considerations)

4. Interface control drawings

5. Mock-ups, breadboards, and prototype hardware

6. System allocation document

7. Initial manufacturing readiness

8. Preliminary value engineering change proposals

9. Life cycle costs

10. Detail design information on all firmware

11. Verification that corrosion prevention and control considerations are compatible with the operating environment

12. Status of quality assurance program.

At the CDR for systems that incorporate software, the following deliverables would be reviewed for accuracy and suitability:

1. Software detailed design data, data base design, and interface design documents

2. Supporting documentation describing results of analyses and testing

3. System allocation document

4. Progress on activities required by the PDR

5. Schedules for remaining milestones

6. Updates of software related CDRL items.

4-6.4 FLIGHT READINESS REVIEWS

Flight readiness reviews are conducted prior to first flight, prior to any subsequent flight for which the configuration of the air vehicle or software has significantly changed, and prior to conducting flight test activities which have not been covered in previous flight readiness reviews. The objective of the review is to ensure that all airworthiness and qualification relevant issues have been addressed and that the hardware and software are sufficiently mature to warrant proceeding with flight testing. Data required for presentation at flight readiness reviews includes (yet, is not limited to include) analysis data, results of design support test, component design and qualification data, subsystem design and qualification data, and system design and qualification data, operating procedures, limitations and restrictions, software version descriptions for flight critical processors, modeling complete, and remaining hazard analysis for software and hardware. See integrated product team reviews.

The nature of the data and degree of detail of data presented at the flight readiness review must be such that they will support the anticipated contractor flight releases and/or airworthiness releases. See integrated product team reviews.

4-6.5 FIRING READINESS REVIEWS

Firing readiness reviews are conducted to ensure that the system hardware and software are sufficiently mature to allow safe weapons firing. Included as a firing readiness review is the pre-first-live-firing weapon firing review. This review is conducted before the first live firing. Qualification data to be presented include missile or projectile trajectory and structural clearance

information, weapon firing modes, firing inhibits for specific flight conditions, clearance, jettison analysis or jettison results, ripple firing effect on engine performance, firing impact zone safety footprint, susceptibility to electromagnetic radiation emitters, ordnance compatibility information, weapon system excursion limits, primary and emergency weapon stores jettison information, provisions for protecting the crew from weapon gases, and blast pressure distribution information. The nature of the data and degree of detail should be such that they will support the anticipated weapon firing activities to be authorized by the contractor flight releases and airworthiness releases. Additional firing readiness reviews should be conducted when the proposed firing tests differ significantly from those approved by previous firing readiness reviews. See integrated product team reviews.

4-6.6 SPECIAL TECHNICAL REVIEWS

Special technical reviews may be conducted any time that such reviews are necessary for the proper progress of the qualification program. For example, in order to support his design activities, the contractor may have decided to build a mock-up for the purpose of identifying and demonstrating interface requirements between subsystems. The most expedient way for the Government to review the results of the mock-up activities may be to attend a special technical review convened for that purpose. As another example, a specific technical problem may arise which would require a special technical review to be conducted. The contractor would present the problem and possible alternative solutions. Government reviewers would discuss the situation and implications on technical, schedule, cost, and contractual issues and provide direction or guidance as necessary. As a last example, a backlog of data may have occurred which precludes the conduct of a test event until the data is reviewed. The most efficient and expedient way to resolve the problem may be for the Government to review the backlogged data at a special technical review. See integrated product team reviews.

4-6.7 SOFTWARE REVIEWS

In addition to the software PDRs and CDRS, software also undergoes software specification reviews (SSRs), SDRS, and software Test Readiness Reviews (TRR). The SSR is a formal review of computer software configuration item (CSCI) requirements as specified in the software specifications. The purpose of the SSR is to review the software and interface requirements stated in the software requirements specification (SRS) and the interface requirements specification (IRS) for completeness and tractability to the system specification. The TRR is a formal review of readiness to begin formal CSCI testing. The purpose of the software TRR is to confirm that the computer software configuration item is ready for formal qualification testing. See integrated product team reviews.

4-6.8 CONFIGURATION AUDITS

A configuration audit is an audit conducted against a configuration item to ensure that it meets requirements. Two types of configuration audits could be conducted, the functional configuration audit (FCA) and the physical configuration audit (PCA). The objective of the FCA is to verify that the configuration item's actual performance complies with its hardware development or software requirement and interface requirements'

specifications. Test data are reviewed to verify that the hardware or computer software performs as required by its functional or allocated configuration identification. For configuration items developed at Government expense, an FCA is a prerequisite to acceptance of the configuration item. For software, a technical understanding is reached on the validity and the degree of completeness of the software test reports, and, as appropriate, computer system operator's manual, software user's manual, computer system diagnostic manual, computer resources integrated support document, upgraded operation and support documents, software programmer's manual, and firmware support manual.

The PCA is the formal examination of the as-built version of the configuration item against its design documentation in order to establish the product baseline. As a result of acquisition reforms, the contractor is totally responsible for the physical configuration. Except for validation of technical manuals, the procuring activity will not typically perform a physical audit. The contractor should be required to update the technical manuals, anytime the physical configuration changes. For software, a technical understanding is reached on the validity and the degree of completeness of the software test reports, and, as appropriate, computer system operator's manual, software user's manual, computer system diagnostic manual, computer resources integrated support document, upgraded operation and support documents, software programmer's manual, and firmware support manual.

4-6.9 INTEGRATED PRODUCT TEAM (IPT) REVIEWS

The objectives of the aforementioned reviews could be satisfied on a continuous basis by IPTs. The Secretary of Defense has directed that as many functions as possible, including oversight and review, should be performed using IPTs, DoDR 5000.2-R, (Ref. 1). IPTs are cross-functional teams that are formed for the specific purpose of delivering a product for an external or internal customer. These IPTs should function in a spirit of teamwork with participants empowered and authorized, to the maximum extent possible, to make commitments for the organization or the functional area they represent. IPTs are composed of representatives from all appropriate functional disciplines. IPTs operate under the following broad principals:

1. Open discussions with no secrets.
2. Qualified, empowered team members
3. Consistent, success-oriented , proactive participation
4. Continuous "up-the-line" communications
5. Reasoned disagreement
6. Issues raised and resolved early

4-7 COMPONENT DESIGN AND QUALIFICATION DATA

This paragraph describes the design and qualification data applicable at the component level. The contractor is totally responsible for the physical design. Normally, qualification involves a review of performance, interface, safety, and the various "Itities", such as reliability and maintainability, via analysis and test reports. Engineering drawings are also useful for this purpose but not always essential. Performance and interface specifications are preferred for new

procurement and for procurement of commercially developed components, reference chapter 5, subparagraph 5.11.1. Widely available commercial specifications and standards which satisfy the government's preference for performance based specifications are also acceptable. In those cases where the Government must pay for development of the design, the Government typically is entitled to full rights in data; hence, procurement of engineering and manufacturing drawings or computer aided design and manufacturing data should be considered. Contractor's form and format is usually acceptable. Also, the contractor could remain the repository for this data. Except for reprocurement of an identical component, performance and interface verification data should be required for all components. The data should define all design specific performance requirements, all as integrated and as installed characteristics, and all key functional and physical attributes to be measured. Further, a software requirements specification might be needed for embedded software, etc. Logistics considerations usually dictate the type of data and required rights in data. For the case of contractor logistics support, only qualification data should be required.

4-7.1 STANDARD AND QUALIFIED PARTS DATA

For standardization purposes, a program establishes its Program Part Selection List (PPSL). The PPSL is generally established and managed by the contractor, but may be approved by the government. Items on the list are approved for use in the design provided that they meet the performance and interface requirements of the system. As long as the part usage is consistent with its original qualification criteria, the part may generally be used in the design without additional qualification requirements. The PPSL becomes the governing document for part selection for the subject contract in order to control the scope of total parts population, compress the variety of part types, and to direct contract and subcontract designers to approved parts. The contractor could be required to submit their list for Government review.

4-7.2 STRUCTURAL COMPONENTS DATA

Paragraph 4-7 defines the type of data which should be required. Structural performance criteria should be defined in terms of mission, crashworthiness, and dynamic performance requirements. Also, the PA should require demonstration of compliance by means of analysis and test reports. Structural analysis should include material composition, heat treatment characteristics, finish characteristics, and geometric shape. Also, tensile strength, modulus of elasticity, fatigue life, modulus of rupture, shear strength, endurance limit, compressive strength and hardness should be included, as applicable. In contrast to most metals, composite materials exhibit structural characteristics which are strongly dependent on the direction of the applied load. In describing composite material characteristics, it is necessary to specify the direction of the applied load with respect to the directional characteristic of the material. Analysis may include determination of the loadings that are critical to the component, and substantiation of the structural adequacy. Structural component testing may include fatigue testing, failure mode testing, and ultimate strength testing.

4-7.3 ENGINE AND DRIVE TRAIN COMPONENTS DATA

Paragraph 4-7 defines the type of data which should be required. Engine and drive train components include as examples, gears, bearings, shafts, couplings, clutches, housings, turbine blades, compressor blades, discs, nozzles, seals, combustors, ignitors, and fuel controls. Component qualification data describing these components may be in the form of performance specifications, analyses, and reports. Examples of bearing characteristics are static load carrying capacity (radial and trust), dynamic load capacity, life, efficiency, friction, and speed rating. Examples of gear characteristics are load capacity, mesh ratio, contact ratio, backlash, surface durability, lubrication requirements, and hardness. Shafts are characterized by their ability to withstand combined bending and torsional stresses which may either be steady, variable, or a combination of the two. Lubrication characteristics, cooling and wear tests, gear patterns, and power limits are all applicable to engine and drive train components.

4-7.4 HYDRAULIC-PNEUMATIC-FUEL SYSTEMS COMPONENTS DATA

Paragraph 4-7 defines the type of data which should be required. Hydraulic, pneumatic, and fuel systems share the common characteristics of pressurized fluids. Examples of components which comprise these systems include tubes, pipes, hoses, fittings, valves, couplers, pumps, fans, accumulators, and filters. These components, as part of subsystems, are used to actuate controls, deliver fluids such as fuel and lubricants, and to provide environmental control. Component qualification data used to describe these components typically include schematics and diagrams, and test and analysis reports. Examples of information included as part of the data are working pressure or vacuum (the pressure or vacuum at which the component is designed to operate), fluid compatibility (the types of fluids which will come in contact with the component), fire resistance (the temperature and pressure conditions at which the fluid will ignite), ballistic tolerance (the degree to which the component can withstand an impact from a projectile), and grounding requirements (the necessity to electrically connect components to avoid electrical potential differences between components). Filters separate unwanted contaminants from a fluid. They are characterized by flow rate (the amount of fluid which can pass through the filter per unit time), clean pressure drop (the pressure difference which the filter presents to fluid moving through it), cold surge (pressure rise at start up when cold), its contaminant effectiveness (the size and fraction of particles in the case of particle contamination or the amount of contaminant such as water in the case of non particle filtering which the filter can separate from the fluid), the contaminant load capacity, and the bypass characteristics.

4-7.5 ELECTRONIC COMPONENTS DATA

Paragraph 4-7 defines the type of data which should be required. Also, descriptions from manufacturers' data books along with industry and military specifications and standards provide a description of the operation of the parts along with appropriate hints and warnings. Electronic and schematic diagrams show the logical layout. Timing diagrams show critical timing requirements. Truth tables

combined with the logic diagrams and timing diagrams describe the output states of a logic device based on its input states. MIL-HDBK-175, *Microelectronics Device Data Handbook*, (Ref. 7) and MIL-HDBK-978, *NASA Parts and Application Handbook*, (Ref. 8) present detailed information on the characteristics of electronic devices. These handbooks address basic process and design considerations, system design considerations, testing, specifications and procurement, along with the reliability and physics of failure.

Typical electronic components are as follows:

1. Linear passive components - resistors, capacitors, thermistors, inductors, crystals, delay lines, and electromagnetic interference (EMI) filters
2. Semiconductors - transistors, diodes, thrusters, and transorbs
3. Microelectronics - integrated circuits, microprocessors, memory devices, comparators, and amplifiers
4. Interconnect hardware - wire, cable, terminal blocks, connectors, plugs, and sockets
5. Electromechanical components - switches, relays, solenoids, and motors
6. Hybrid and printed circuit assemblies.

Examples of terms which are used to define these devices are as follows:

1. Electronic characteristics, e.g., voltage and current levels (power supply requirements, input and output signal levels, and switching thresholds), impedances (resistance, capacitance, and inductance), frequency information (frequency response and frequencies of operation), transient response times, time delays, signal distortions, and noise level generation and suppression.
2. Thermal characteristics - power dissipation, junction to case thermal resistance, and ambient junction temperatures
3. Packaging characteristics - hermeticity, thermal expansion, mounting, size, weight, and strength
4. Reliability characteristics - failure rates, testing levels, and rating requirements
5. Handling - electrostatic discharge, storage, and soldering
6. Environmental requirements - temperature range, cooling, electrical loading, fanout, impedance, and timing.

4-7.6 OPTICAL COMPONENTS DATA

Paragraph 4-7 defines the type of data which should be required. Examples of optical components are lenses, mirrors, prisms, lasers, and detectors.

Lenses and mirrors are characterized by their effective focal length, effective entrance and exit apertures, aberration characteristics, wavelength or wave band of interest, and transmission percentage. Lenses depend upon the index of refraction principle for shaping and bending of rays. The lens material, however, has absorption characteristics that are wavelength dependent. Mirrors and lenses usually have optical coating for minimizing light reflections or transmission. In addition to diffraction effects, which broaden focused light to a defined blur circle in lenses and mirrors instead of a point, optical aberrations, such as spherical, coma, astigmatism, and chromatic aberration, cause degradation to image resolution and contrast. A lens designer will balance aberration reduction against satisfying design specifications. The terms used here are defined and pictorially represented in any good lens design textbook.

Prisms are used to bend light into specified angle but not focus it. Angles of reflection and transmission in the prism are controlled by the accuracy of angle fabrication and quality of coatings.

Laser design uses optics - mirrors and lenses to build cavity interferometers. Lasers can use crystal, diode, gas, or organic liquids to produce stimulated radiated emission. Terms used to define laser characteristics are wavelength, beam divergence, power output, pulsed or continuous wave, and pointing control of the beam.

Detectors convert optical radiation into electronic signals or images by the pyroelectric, photo conductive or photo voltaic, etc., effect. Detectors are wavelength dependent and combinations of detector systems can detect optical radiation from the new ultra violet (0.3 micron) through the long wave infrared (0.8 micron and longer). Characteristics of detectors include signal to noise (SIN), noise equivalent power (NEP), or net equivalent temperature (NET), instantaneous field-of-view (IFOV), electrical bandwidth (BW), optical responsitivity (R), and D-star performance.

4-7.7 FLIGHT SAFETY PARTS DATA

Detail specifications and engineering drawings might be required for flight safety parts. Critical characteristics and the procedures necessary to ensure that these critical characteristics have been achieved should be identified. Commercial specifications and standards may be used in lieu of detailed military specifications and standards, unless no practical alternative exists to meet the user's needs. The data should define all design specific performance requirements, all as integrated and as installed characteristics, and all key functional and physical attributes to be measured. For additional information see Chapter 1, paragraph 1-5.2.5.

4-7.8 MATERIALS DATA

Relevant information for materials and processes are usually used in the design and construction of Army air vehicles can be found in ADS-13, *Air Vehicle Materials and Processes,* (Ref. 9). The design standard addresses the general material data including: material properties, corrosion protection requirements, temperature effects, minimum gauge of materials, fracture toughness, characteristics of steel, aluminum, magnesium alloys, organic materials, fiber reinforced materials, transparent materials, lubrication requirements, materials used for survivability, radioactive materials, and process selection. The contractor should be totally responsible for design and for satisfying the performance requirements of the specification. For additional information concerning materials and testing, see Chapter 7.

Relevant information pursuant to the establishment of data basis for composite material properties and design allowables can be in Chapter 7, paragraph 7-6, and also in ADS-35, *Composite Materials for Helicopters*, (Ref. 10). The design standard addresses material property requirements, generation of material allowables, design considerations, and control of processing. Specific topics of discussion include:

1. Physical properties: description, material content, density, glass transition temperature, moisture absorption, flammability resistance

2. Mechanical properties: tensile properties, compressive properties, flexural properties, fatigue properties, creep

properties, damage tolerance, and bearing strength

3. Chemical properties: environmental resistance, solvents/cleaners/air vehicle fluids

4. Thermal properties: thermal expansion coefficients, thermal conductivities, heat capacity/specific heat, thermal/oxidative stability, thermal mechanical stability, thermal transitions

5. Electrical properties: dielectric constant, dielectric strength, dissipation factor, surface resistivity/volume resistivity.

Materials datais often required to support documentation requirements of a process specification (Chapter 5).

4-8 SUBSYSTEM DESIGN AND QUALIFICATION

Data required at the subsystem level should be basically the same as that described for components in paragraph 4.7. These specifications, analyses, test plans, and test reports should include diagrams, etc. Subsystem survey data may be used as the basis for analysis in qualitative and relational assessments and as the basis for derivation of pass/fail criteria that cannot be directly measured. Under specified conditions, formal demonstration of qualification characteristics provides a basis for subsystem description data. Relevant information needed for performing a detailed analysis of the performance, handling qualities, rotor dynamics, airframe dynamics, and acoustics of a proposed new development or derivative air vehicle can be found in ADS-10, *Air Vehicle Technical Data*, (Ref. 11). The design standard addresses the following:

1. Air vehicle dimensional data - drawings, tabulated dimensions, and areas

2. Description of the rotor system - rotor data, radial distribution of blade properties

3. Airfoil section data

4. Airframe aerodynamic data- aerodynamics of the fuselage, drag buildup, stability and control derivatives

5. Rotor structural dynamics data- blade mode shapes, data for ground resonance model

6. Airframe structural dynamics data- airframe modal data, description of airframe mounted absorbers and isolators

7. Aerodynamic surface data- surface 3-dimensional force and moment data, rotor wake aerodynamic interference

8. Control system data- system description, control travel, cockpit to swashplate linkages, swashplate to blade linkages

9. Propulsion and drive system data- system performance losses.

4-8.1 ENGINE, TRANSMISSION, AND DRIVE SUBSYSTEMS,

The type of data required for engines, transmissions, and drive subsystems should be basically the same as that described for components in paragraph 4.7, except that subsystem description and qualification data should include:

1. Propulsion system schematic drawings showing the functional arrangement, location, and identification of all pertinent components of the subsystems and elements: lubrication, fuel, air induction, cooling, power transmission, auxiliary power, engine inlet anti-icing filtering or particle separator, accessory drives, firewalls, infrared radiation suppression, exhaust, controls, and smoke abatement. For turbine engines, a report of the calculation of duct losses should be submitted with the induction system schematic drawing. An analysis of the

propulsion system cooling and exhaust systems should be submitted, showing temperature and pressure design limits for fuselage and components, required airflow, and heat generation. These analyses should be submitted with schematic drawings of these systems.

2. Propulsion system installation drawings, excluding fuel and oil tanks, detailing the location, mounting, vibratory isolation, and access for inspection and maintenance of all systems and elements: engine, auxiliary power plant, fuel, lubrication, air induction, cooling, starting, propulsion controls, engine inlet anti-icing, filtering or particle separator, accessory drives, infrared radiation suppression, power transmission, and smoke abatement. For power transmission systems, including gearboxes, drawings also will include lubrication system, bearings, and gearing; typical views of transmission housing including mounting provisions; typical cross sections and details of clutch mechanism, free-wheeling devices, rotor brake, shafting and shaft supports, and torque-limiting devices.

Relevant information for propulsion system ground and flight surveys and demonstration requirements can be found in ADS-1B-PRF, *Rotorcraft Propulsion System Airworthiness Qualification Requirements, Ground and Flight Test Surveys,* (Ref. 12). Relevant information concerning the preparation and submittal of test reports can be found in ADS-50-PRF (Ref. 14).

Relevant information to assist in the definition of technical data required *Propulsion System Technical Data* for air vehicle technical proposals can be found in ADS-9, , (Ref. 13). This document includes the requirements for system analyses such as stress, fatigue, cooling, torsional stability, and dynamic and diagnostic system analysis.

Relevant information pursuant to defining the gas turbine engine performance characteristics, ratings, and performance can be found in ADS-50-PRF, *Rotorcraft Propulsion Performance and Qualification Requirements and Guideline* (Ref. 14). Typical data requirements can be found in ADS-25, *Engine Performance Data,*
(Ref. 15).

4-8.2 FUEL AND OIL SUBSYSTEMS 4-8.2 FUEL AND OIL SUBSYSTEMS

The type of datarequired for fuel and oil subsystems should be basically the same as that described for components in paragraph 4.7, except that installation and schematic diagrams should also be required. Analyses for the fuel subsystem should include; but, not necessarily be limited to include capacity, flow rates, transfer rates, vulnerability, and fuel feed capabilities. Additional data for external tanks should include analysis of transfer rates, and jettison capabilities. Data for the oil subsystem and oil distribution subsystem should include analyses of the flow, filtering, cooling, and lubricating capabilities. Maintenance data should be provided for the fuel and oil system. This should include the requirements and procedures for purging the fuel system using nitrogen inerting systems.

Aerial refueling subsystem (as tanker and/or receiver) data should include refueling capability data such as aerial refueling envelope of altitude versus true airspeed, fuel transfer rate versus pressure at the reception coupling or receiver nozzle; weight and balance related information, and tanker package and component descriptions.

4-8.3 ROTOR, PROPELLER, AND PROPROTOR SUBSYSTEMS

The type of data required for rotor, propeller, and proprotor subsystems should be basically the same as that described for components in paragraph 4.7, except that installation and schematic diagrams should also be required. Relevant information on describing rotor, propeller, and proprotor subsystems can be found in ADS-10 (Ref. 11). Further, the reports required for qualification should include structural analyses, flutter and divergence analysis, aeroelasticity analysis, and performance analysis. Model, wind tunnel, and tower test data should be provided to support these analyses. For alternative tail rotor equivalent thrust systems, special data may be required. This may include theory of operation, special limitations, wind tunnel results, and flight test data.

4-8.4 HYDRAULIC AND PNEUMATIC SUBSYSTEMS

The type of data required for hydraulic and pneumatic subsystems should be basically the same as that described for components in paragraph 4.7, except that installation drawings, schematic diagrams, and a detailed description of flow distribution, filtering, pressure, and maintenance requirements and capabilities may also be required. Hydraulic applications primarily include flight control and utility functions. Pneumatic applications may include such functions as engine starting, auxiliary utility systems, and emergency backup systems. In addition, analyses should be required to document safety, maintenance, and vulnerability characteristics and performance. The data should be sufficiently detailed to substantiate that performance requirements have been achieved.

4-8.5 LANDING GEAR

The type of data required for landing gear subsystems should be basically the same as that described for components in paragraph 4.7, except the following should also be required:

1. A general arrangement drawing of the landing gear, showing the side view elevation relationship of landing gear to fuselage structure, and to the most forward and most aft center of gravity (CG) locations.

2. Three-view drawing(s) of the main and auxiliary gear showing principal members. If the gear is retractable, it should be shown in the fully extended and retracted positions, and the most critical clearance dimensions of the wheel well between structural members and other equipment should be identified. The principal members of the gear should include outlines of the shock strut, drag brace, tension strut, torque arms, jackpoints, towing and tiedown fittings, wheels (and brackets, if used), retraction and extension linkages, actuators, shrink linkages, steering and/or shimmy damper, uplocks, and downlocks. Wheel and tire toe-in and/or camber angles in relation to the axle or strut should be indicated. Outline of door linkages should be shown in relation to gear linkages and functions. Type of material and heat treatment information should be listed or indicated for all principal members of the gear.

3. Nose steering, towing, and turnover angle drawing, consisting of a plan view showing the tread and wheel base of landing gear and distance between dual wheels; maximum nose steering angle and corresponding minimum turning radius about the main gear; maximum auxiliary gear swivel-angle for towing using towbar and minimum turning radius about the

main gear; and turnover angle with the most critical CG location.

4. Tiedown arrangement drawing, consisting of a plan view showing the complete tiedown configuration; attachments to rotorcraft gear; fuselage, wing, and tail fittings; and angles extending to ground tiedown points

5. Air vehicle jacking drawing, showing location of jacks and air vehicle jackpoints, including all fuselage and/or wing points, and wheel axle and/or strut points

6. Landing gear design report

7. Landing gear specification or specification control drawings, as applicable, for the wheel tire

a. Nose or tail wheel

b. Nose or tail wheel tire

c. Nose shock strut

d. Nose gear steering and shimmy damper

e. Solid tail and/or bumper wheel

f. Bumper wheel tire

g. Main wheel and brake assembly

h. Main wheel tire

i. Main wheel shock strut

j. Anti-skid brake control system

k. Main and nose gear actuators

l Ski installations and/or emergency flotation gear

m. Rotor brake

n. Steering and damper.

4-8.6 ELECTRICAL SUBSYSTEMS

The type of data required for electrical subsystems should be basically the same as that described for components in paragraph 4.7, except that the following data should also be required:

1. AC and DC electrical load analyses. Information pursuant to this purpose can be found in MIL-E-7016, *Analysis of Aircraft Electrical Load and Power Source Capability*, (Ref. 16). Specific analyses that should be performed are:

a. Preliminary load analysis, which should form the basis for selecting power generation equipment and for design of generation and distribution system

b. Intermediate load analyses incorporating significant load or power source changes subsequent to the submittal of the preliminary load analysis

c. Final corrected load analysis, which should be marked "Final Corrected" and will include all changes incorporated in the complete air vehicle. If no changes have been made to data previously submitted, a new cover sheet should be submitted stating no changes have been made. The values entered in this analysis should be measured values.

2. Wiring diagrams showing sufficient equipment internal circuitry to allow for understanding the system function. A brief description of any system or equipment not having readily recognizable operating functions should be included with the following diagrams:

a. Preliminary wiring diagrams, consisting of both elementary, single-line functional diagrams and schematic functional diagrams of the power distribution and lighting systems

b. Master wiring diagrams, consisting of installation schematic wiring diagrams giving information of interconnection of components. This should include identification of wires, connectors, junction points, terminal blocks, and equipment. Information pursuant to the selection of wire and cable is given in Appendix A of MIL-W-5088, *Aerospace Vehicle Wiring*, (Ref. 17). Also, information pursuant to for assigning significant wire identification codes is provided in Appendix B of MIL-W-5088.

3. General arrangement drawings of the electrical equipment installation showing the location of all major items of electrical equipment

4. Exterior light installation drawings showing location and visibility characteristics. Relevant information can be found in MIL-L-6730, *Aircraft Exterior Lighting Equipment*, (Ref. 18).

5. Nonstandard electrical equipment specifications and substantiating data. Relevant information can be found in MIL-STD-7080 *Selection and Installation of Aircraft Electronic Equipment*, (Ref. 19).

6. Cooling requirements for electronic and avionics systems.

7. Specific information on the electrical subsystem should be included in the following electrical subsystem design documents (ESDDs):

a. Preliminary ESDD (prior to electrical hot bench testing):

(1) Complete descriptions and diagrams that identify all source capacities (under all conditions) and all possible distribution configurations. Automatic and manual electrical subsystem monitoring and control of air vehicle and ground power source.

(2) Specific circuit identification and details including, normal and peak power consumption, wire size, all protective and switching devices between each load and its normal power bus, and the proposed grounding, types and ratings of all protective and switching devices.

(3) Fault current (magnitude and duration) estimates for all sources and the current capacity of all bus feed and bus-tie contractors in series with those sources.

b. Final ESDD (subsequent to electrical subsystem hot bench testing): In addition to final revisions of the information identified in the preliminary ESDD, the final ESDD should include test data from the electrical hot bench testing. The testing should include, but not be limited to, simulated fault conditions and measurements of the fault current magnitude and duration for all possible fault conditions. Test results should verify the performance of all fault protection in the electrical subsystem including the source protection, bus feed, and bus-tie contractors. In addition, hot bench test data should verify that the power quality is in accordance with MIL-STD-704, *Aircraft Electrical Power Characteristics*, (Ref. 20) for all operational conditions of electrical subsystem (normal, abnormal, and emergency). Basically this is a performance and interface standard; however, a waiver is required to cite this standard.

4-8.7 AVIONIC SUBSYSTEMS

This category of equipment includes electronics associated with communications, navigation, crewstation controls and displays, aircraft survivability equipment, radar and visionics equipment, antennae, data buses and bus controllers, central processors, flight instruments, and the myriad of other air vehicle subsystems that have electronic boxes dedicated to special functions, such as secure voice and tempest controlled systems. Tempest is an unclassified short name referring to investigation and studies of compromising emanations. This refers to unintentional, intelligence bearing signals that, if intercepted or analyzed, will result in disclosure of national security information transmitted, received, handled, or otherwise processed by any information processing system. It is sometimes used synonomously for the term compromising emanation, e.g., tempest tests and tempest

inspections. The type of data required for avionic subsystems should be should be basically the same as that described for components in paragraph 4.7, except that the following may also be required:

1. General arrangement drawings of equipment installations showing the location of all major items of electronic equipment and their interconnections

2. Drawings, schematics, interface control drawings, and performance data in sufficient detail to substantiate that the performance and interface requirements have been achieved.

3. Antenna system drawings, schematics, interface control drawings, and performance data in sufficient detail to substantiate that the design requirements have been achieved

4. Test plans and test reports to substantiate the environmental qualification of the electronic equipment. Guidelines for environmental testing are provided in MILSTD-810, *Environmental Test Methods and Engineering,* (Ref. 21)

5. Test plans and test reports to substantiate the electromagnetic environmental effects (E3) qualification of the electronic equipment

6. Classified plans and test reports as needed for qualification of secure voice and other tempest controlled systems

7. System safety and hazard analysis data

8. Software data as applicable

9. General qualification assurance and operational readiness data

10. Survivability data, as applicable

11. Radome engineering data, defining the radome and its characteristics, including overall transmissibility curves, boresight shaft characteristics, radar tracking noise, effects of equipment located in or affixed to the radome, and the changes to electrical characteristics resulting from radome heating

12. Navigation engineering data to determine navigation equipment performance in terms of accuracy for both piloting and weapon delivery functions. Also, data to describe overall navigation equipment architecture, interfaces with other air vehicle systems, expected accuracy for each navigation mode, error budgets for various sensor inputs, and algorithms used to integrate the various sensor inputs, (e.g., use of Kalman filter). Data might be classified or restricted.

13. Air data typically include total pitot pressure, static pressure, air density, slip angles, and temperature to validate accuracy of various equipment receiving pitot static directly or through an electronic air data conversion. These data may be for analysis of atmospheric effects on overall performance, i.e., navigation accuracy

4-8.8 CREWSTATIONS DISPLAYS AND CONTROLS

The type of data required for crewstation displays and controls should be basically the same as that described for components in paragraph 4.7 and avionic subsystems in subparagraph 4-8.7, except that layout drawings, human engineering analyses, subsystem modeling data, and subsystem functional descriptions should also be required. Information pursuant to qualification can be found in MIL-STD-250, *Aircrew Station Controls and Displays for Rotary Wing Aircraft,* (Ref. 22) and
MIL-STD-1472, *Human Engineering Design Criteria for Military Systems, Equipment, and Facilities*, (Ref. 23). For multifunction displays, additional description characteristics include character size, display modes, display brightness and contrast control data

necessary to substantiate that the displays will be visible in all specified lighting conditions. Virtual cockpit helmet data should include display characteristics, mass properties of the helmet, and helmet tracking system accuracy. Voice interactive systems should include any special learning requirements for the system to adapt to the wide range of voice characteristics of potential users, and the vocabulary range and resulting actions of the system. For pilot's associate systems, descriptions of functions and the basis for the system's decision making should be described. Special training or learning required by the system should also be provided.

Air vehicle interior lighting characteristics should be described in terms of schematic and layout drawings, function descriptions of lighting switches and controls, and luminance and illuminance measurements. Information pursuant to establishing performance and validation requirements for air vehicle interior lighting can be found in MIL-L-85762, *Aircraft Interior Lighting, Night Vision Imaging System (NVIS) Compatible,* (Ref. 24).

4-8.9 CREWSTATIONS EQUIPMENT

The type of data required for crewstations equipment should be basically the same as that described for components in paragraph 4.7, except that the contractor should also furnish drawings of all seat assemblies and installation for crew and passengers, and litters for medical evacuees. If applicable, these drawings should show range of adjustment and include all safety belt, shoulder harness, or other restraint installations and controls; parachute provision take-up mechanisms or devices; tracks; catapults or rockets motors, rails, operating gear, stabilizing, and other components or subassemblies required for ejectable seats. The sequence of emergency escape operations using the ejectable seats should be indicated. Further, the following additional data may be required to support subsystem qualification:

1. Heating and ventilating system installation drawings and data
2. Thermal insulation installation drawings
3. Cabin pressurization installation for pressurized air vehicles, including heating, cooling, and ventilating provisions
4. Engineering data for air-conditioning and pressurization systems which cover the air vehicle profile should include an air supply for cooling and demonstrate that moisture does not condense within electronic components. In addition, the means used for eliminating entrapped moisture should be indicated
5. Installation drawings and data of acoustical insulation
6. Anti-icing and/or deicing, defogging, and defrosting installation data as follows: wing and empennage anti-icing system, all transparencies requiring protection, and systems for protection of periscope lenses, fuel vents, radomes, antennas, and stores

Crashworthiness characteristics should be described for the air vehicle. Data will include design criteria and features incorporated to achieve crashworthiness requirements along with analyses and test plans and reports which substantiate achievement of requirements. Information pursuant to an evaluation of crashworthiness can be found in Appendix 1 of ADS-11, *Survivability Program Rotary Wing,* (Ref. 25).

Flight recorder data should include a description of the storage medium, storage capacity, parameters monitored, and the equipment's ability to withstand crash conditions.

Nuclear, biological, and chemical (NBC) protection provisions should be described by schematic and layout drawings, and functional descriptions which provide the specific design features incorporated to provide NBC protection. Specific protection levels should be addressed.

Aviation life support equipment data should include the capability, operation, and limitations of such equipment.

4-8.10 PASSENGER FURNISHINGS

The type of data required for passenger furnishings should be basically the same as that described for components in paragraph 4.7, except that schematics and layout drawings and reports and analyses which describe the functional characteristics of these items should also be provided. Intercom data should include system capabilities and interfaces with electrical and communication subsystems. Fire retardant properties of materials used in passenger furnishings should be described in terms of their placement in the air vehicle and capability to withstand temperature extremes. Soundproofing materials' data should be provided to show their location and acoustic attenuation characteristics.

4-8.11 HOISTS

The type of data required for hoists should be basically the same as that described for components in paragraph 4.7, except that cargo and rescue hoist qualification data should describe the load capacities of the equipment, angle of application (cone angle), etc. Achievement of performance and interface requirements should be validated by means of analysis and test reports. Data should be provided as to any flight restrictions applicable to hoist operation.

4-8.12 CARGO PROVISIONS

Cargo provisions should be described in term of schematics and layouts showing the openings and location of the cargo compartments, their capacities, tiedown limits and locations,.floor loading restrictions, and balance considerations. Reports and analyses should be provided to show that the design satisfies specification requirements.

4-8.13 LAVATORIES AND GALLEYS

The type of data required for lavatories and galleys should be basically the same as that described for components in paragraph 4.7, except that the data should include schematics and layout drawings detailing location and operation, storage capacities, disposal provisions, and special corrosion prevention considerations. Lavatory data should include, but not be limited to; portable water and waste tank capacity, operation procedures, maintenance requirements, and fill and dump provisions and restrictions. Galley data should include maintenance and operation data, storage location and capacities, and human factors analysis.

4-8.14 TARGETING, ARMAMENT, AND FIRE CONTROL

The type of data required for targeting, armament, and fire control subsystems should be basically the same as that described for components in paragraph 4.7, except for the additional information

needed to validate performance, such as ground and flight test results for each armament fire control subsystem. Information pursuant to this purpose can be found in ADS-20, *Armament/Fire Control System Survey*, (Ref. 26). Typical ground and flight test data requirements that should be submitted for qualification of these subsystems are as follows:

1. Armament/fire control operations
2. Armament/fire control boresight
3. Arming procedures
4. Display resolution
5. Display characteristics
6. Sensor and field of view switching
7. Target acquisition/designation subsystem characteristics for:
   a. Laser designation
   b. Laser range finding
   c. Laser spot tracking
   d. Cooling performance
   e. Weapons accuracy
   f. Boresight retention
   g. Environmental qualification; see MIL-STD-810 (Ref. 21) for guidance
   h. Electromagnetic environmental effects (E3); see subparagraph 4-9.11.

4-8.15 SOFTWARE DATA

Typically, a software requirements specification (SRS), interface requirements specifications (IRS)(defines the relationship among two or more entities, or software unit, software unit in which the entities share, provide, or exchange data, version description document (VDD), software test descriptions (STDs) and reports for validating performance and determining airworthiness should be required. The SRS should be updated as test and evaluation proceeds. Also, other data could be required. Information pursuant to this purpose can be found in MIL-STD-498, *Software Development and Documentation*, (Ref. 27). For additional information concerning software and the use of the Ada programming language, see DoD Regulation 5000.2-R, (Ref. 1). DoD Directive 3405.1, *Computer Programming Language Policy*, (Ref. 28), establishes the DoD policy and prescribes procedures for using the Ada programming language. The VDD is used by the contractor to release computer software configuration items (CSCI) versions to the Government. The term "version" may be applicable to the initial release of a CSCI, to a subsequent release of that CSCI, or to one of multiple forms of the CSCI released at approximately the same time (e.g., to different sites). The VDD is used by the Government to track and control versions of software to be released to the operational environment. The VDD is used as part of the configuration management applied to a CASI. Any executable code regardless of the storage medium should be considered as software and documented as a CSCI. JIAWG categories should be considered. Also, any data stored in nonvolatile memory and used by a CSCI is part of that CSCI and should be included in the documentation of that CSCI.

Qualification testing for a CSCI is defined in the software test description (STD). Information pursuant to integration and testing of airborne processor hardware, and software can be found in ADS-32, *Airborne Processor Hardware, Software and Interfacing Device Systems Integration*, (Ref. 29).

The Software Test Report (STR) is a permanent record of qualification testing performed on a CSCI. The STR summarizes test discrepancies and references their corresponding problem or change reports. Also, the STR may be

used by the contractor as a basis for re-testing of a CSCI.

4-9 SYSTEM DESIGN AND QUALIFICATION DATA

The air vehicle taken as a whole should be considered the end item system. Other portions of the air vehicle are subsystems or components of the end item air vehicle. Integrated subsystems are often tested as part of the end item system. The procuring activity usually includes a system specification and an airworthiness qualification plan as part of its request for proposal. The contractor usually is required to submit their proposed system specification, proposed airworthiness qualification specification (AQS), and other system design and qualification data. System design and qualification data includes the data which describes the air vehicle and its subsystems (such as diagrams and physical drawings), test plans and test reports, and analyses and integration data. This data is used to substantiate airworthiness, and also that specified performance and interface requirements have been satisfied. Data is typically derived from the results of design analysis, sample tests, simulation models, subsystem mock-ups and installed subsystems. Subsystem survey data may be used as the bases for analysis in qualification and relational assessments in determining system level characteristics. Also, subsystem survey data may be used as the bases for derivation of pass/fail criteria that cannot be directly measured. Formal demonstrations of qualification characteristics are normally required by the airworthiness qualification specification (AQS) to show the air vehicle complies with the requirements of the detailed specification.

4-9.1 CHARACTERISTIC AND PERFORMANCE DATA

Air vehicle system characteristics may be described by drawings, analyses, and reports. All basic aerodynamic data used in the calculation of the air vehicle performance such as the geometric characteristic data defining the air vehicle configuration, and the documents and references showing the derivation of the data (drawings, analyses, substantiating calculations, tests) should be provided. Refer to ADS-10 (Ref. 11) for typical requirements regarding the reporting of air vehicle dimensional data, description of rotor subsystems, airfoil section data, airframe structural dynamics data, aerodynamics surface data, control subsystem data, and propulsion and drive subsystem data. Air vehicle drawings, should show to a practical degree major structure; propulsion and power train and gearboxes; equipment; armament; useful load items; normal entrance ways, emergency exits, and escape hatches; and location of crew, passengers, and their equipment. System level analyses and reports should be sufficiently detailed to substantiate that performance and interface requirements have been achieved, and provide sufficient characteristic and performance data for generation of charts required for flight performance and limitations in the operators manual. This should include: lift and drag data; nondimensional hover and forward flight performance curves; blade stall and compressibility limits; net thrust, power available and fuel flow variation versus appropriate altitudes, temperatures, and speeds; and a complete aerodynamic description of the air vehicle. Information pursuant to determining aerodynamic performance properties can be found in subparagraph 4-9.5 and ADS-40, *Air*

Vehicle Flight Performance Description, (Ref. 30).

4-9.2 STRUCTURAL DATA

Structural qualification data includes drawings, design criteria, analysis and test results which substantiate that the air vehicle meets the required structural performance and interface requirements. Analyses data should be provided for structural strength, vibration, fatigue, mechanical stability, and static, dynamic, landing, and crash loads. Information pursuant to the establishment of structural design criteria for Army rotorcraft can be found in ADS-29, *Structural Design Criteria for Rotary Wing Aircraft*, (Ref. 31). Vibration analysis and testing is an important part of the structural data qualification requirements. Relevant information for establishing vibration requirements for rotorcraft, rotorcraft subsystems, and equipment requirements can be found in ADS-27, *Requirements for Rotorcraft Vibration Specifications, Modeling and Testing*, (Ref. 32). When analytical models are used to substantiate structural requirements, detailed documentation of the analytical methodology, the analytical model used, and the analytical results should be delivered to the Government. Information pursuant to establishing crashload analysis and test data requirements can be found in MIL-STD-1290, *Light Aircraft and Rotary Wing Aircraft Crash Resistance*, (Ref. 33).

Structural drawings should include a plan and elevation view of the fuselage structure showing centerlines of all main members; general distribution of main structural material with typical cross sections of stringers, bulkheads, and frames; and typical views of rotor pylons, masts, stabilizing surfaces, booms, landing gear, engine mount, and jacking and/or hoisting sling attachment fittings and carry-through structures, and installation and assembly of fixed and movable sections of cockpit or cabin enclosures, including all operating and emergency controls. The drawings should be in sufficient detail to show the method and materials employed in reinforcing and mounting transparent components and hinges, tracks, rollers, guides, lift assemblies, and other components of movable section mechanisms; the method of latching movable sections in open, closed, and intermediate positions; and the method of emergency operating of jettisonable movable sections. If power operation is used, the drawing should be accompanied by calculations indicating the power and time required for both normal and emergency actuation under critical loading conditions.

Information pursuant to the conduct of structural demonstrations can be found in ADS-24, *Structural Demonstration,* (Ref. 34). The primary objectives of the test are to demonstrate the safe operation of the air vehicle to the maximum attainable operating limits consistent with structural design, and to verify the loads used in the structural analyses and static tests are not exceeded at the structural design limits of the V-n diagram.

4-9.3 PROPULSION AND POWER TRAIN DATA

Paragraph 4-8.1 provides data requirements for engines, transmissions and drive subsystems. At the system level, data provided should include drawings, analyses, and test to substantiate the achievement of engine/airframe compatibility, critical temperatures, inlet and exhaust characteristics, fuel flow and

consumption, lubrication, accessory drives, and fire detection and fire suppression subsystems requirements.

Relevant information pursuant to preparation and submittal of propulsion subsystem analysis can be found in ADS-9 (Ref. 13). Specific performance capabilities such as drain/fill rates, capacities, crash load factors, operating limits, indicating subsystem accuracy's, engine control rigging/hysteresis characteristics, and operating procedures and capabilities should be determined by analysis and test. The torsional stability of the rotorcraft drive subsystem should be completely analyzed and the results of the analysis showing both gain margin and phase margin throughout the operational envelope should be included.

Engine installation and interface data should include the drawings, analyses, and interface requirements necessary to ensure proper function, operation, and control of the engine. Turboshaft engines installed in rotorcraft, torsional stability is a major concern. The damping or attenuation of signals at the rotorcraft rotor frequency is a stability requirement. Additional information pursuant to establishing installation and interface data requirements may be obtained in ADS-26, *Engine Installation Data*, (Ref. 35). The ADS-1B-PRF (Ref. 18) provides the qualification requirements which are needed to verify compliance with allocated performance requirements. Included in the engine/airframe interface tests are compatibility tests to evaluate the torsional stability and control response characteristics of the engine, and surveys pertinent to engine vibration, propulsion subsystem cooling, air induction, and exhaust subsystem.

The ADS-25 (Ref. 15) provides information for establishing data requirements for engine performance characteristics, ratings, and performance data presentation. The performance data should include flowrates, pressure, frictional loads, power consumption and torque requirements.

4-9.4 FATIGUE LIFE DATA

The contractor should be responsible for submitting data to substantiate that it has met or exceeded specified fatigue lives. As measured flight loads and full scale component fatigue strengths become available, lives should be computed using a mission spectrum. The usage spectrum should be provided by the procuring agency. Also, the minimum B-10 life of bearings should computed by the contractor. These computational analyses should be submitted to the procuring agency as part of a report. Also, the procuring agency will usually require preparation and submittal of S-N curves, test plans, and test reports. Typically, a flight load survey is conducted to determine the component stress levels (mean plus oscillatory) resulting from each flight condition in the operational maneuver spectrum and over the operational range of gross weight, airspeed, CG, and altitude. Thereafter, a report is submitted to the procuring activity which compares flight load survey data to the S-N curve data to determine component fatigue life characteristics.

4-9.5 AERODYNAMIC PROPERTIES

Aerodynamic properties' data includes drawings, analyses, plans, and reports which should be submitted to the procuring agency as a means of validating the achievement of specified performance requirements. Data may be obtained from wind tunnels, models, and flight simulators. A flight simulation

mathematical model and documentation showing model inputs, outputs, flow logic, and equations used may be used to characterize aerodynamic properties. Data obtained from models and simulations should be validated, and the mathematical models should be delivered-as data. other reports include aerodynamic flutter, aeroelastic stability, aerodynamic stability and control (natural frequencies, damping, and response of both aircraft and control system), flying qualities, and ground resonance. Compound, tilt rotor, and other multimedia air vehicles require unique data and description of the air vehicle's transition mode characteristics.

Aerodynamic component drawings should include data on airfoil characteristics, aerodynamic center, plan form area, span, aspect ratio, chord (tip to root), sweep angle of quarter chord, orientation with respect to fuselage reference system, thickness (tip and root), and control surface data.

Handling Qualities data is required for assuring that no limitations on flight safety or on the capability to perform intended mission will result from deficiencies in flying qualities. Relevant information can be found in ADS-33, *Handling Qualities Requirements for Military Rotorcraft*, (Ref. 36). The data provided should include response time, hover and low speed data, forward flight data, transition between rotor-borne and wing-borne flight, controller characteristics, failures, transfer between response types, and ground handling and ditching characteristics.

An aerodynamic data report should show the planned aerodynamic and flutter investigation program and schedule. This report should outline the purpose and scope of each proposed investigation; indicate the test facilities to be employed and test dates and occupancy time required; describe the scale and type of models to be constructed and tested; and present the ranges of test variables to be investigated.

1. Interim Letter Reports. These should be submitted immediately following completion of testing at each test facility. They should cover items, such as tests conducted, scope, contractor's observations of the tests, including any difficulties encountered, significant results, and any conclusions or recommendations based on inspection of the available preliminary test results.

2. Aerodynamic Test Data Reports. These should present the basic aerodynamic data and test results obtained from the investigations conducted in contractor-furnished and private test facilities. Aerodynamic test data obtained from Governmental facilities will be provided by the facility. The reports should identify the configurations tested, any differences from the configuration tested and reported on previously, and from the current air vehicle configuration. Graphic presentation is desired with reference (if possible) to axes consistent with the stability and control and estimated flying quality report.

3. Flutter Analysis Reports. These reports should compare the flutter and divergence limit speeds for the rotor blades and for the fixed lifting and control surfaces of the rotorcraft. Flutter analysis reports for other air vehicles should include the flutter and divergence limit speeds for all lifting and control surfaces.

4-9.6 WEIGHT AND BALANCE DATA

The contractor should establish a system of weight control and reporting. Information pursuant to this purpose can be found in MIL-W-25140, *Weight and Balance Control System (for Aircraft and*

Rotorcraft), (Ref. 37). Weight and balance control and management generally includes data on intent, approach, and methods to be used to insure minimal weight and balance variations within constraints of specification design requirements, program cost and schedule. The MIL-STD-1374, *Weight and Balance Data Reporting Forms for Aircraft (Including Rotorcraft),* (Ref. 38) describes standard weight statements and forms, Parts I, II, and III, for procurement of weight and balance data, and for instructions for uniform compilation of the required weight and descriptive data. The ADS-16, *Weight and Balance Substantiation Report Format and Technical Content,* (Ref. 39) describes the type of weight and balance data reporting typically required with the submission of a proposal. In general, weight and balance data required for a proposal are the data describing the contractor's weight and balance management plan. The ADS-19, *Weight and Balance Status Report-Reason for Change (SRFC) Format and Technical Content,* (Ref. 40) describes the basic requirements for MIL-STD-1374, Part III, (Ref. 38) standard reasons for change to be used with the "Government/Contractor Responsibility Changes Since Last Report" pages of the Weight and Balance Status Reports. These reports of changes provides the Government a means to monitor the weight and balance management of the program.

4-9.7 SYSTEM VIBRATION DATA

Information pursuant to establishing vibrational related requirements for development and qualification of rotorcraft, subsystems and equipment to be installed on rotorcraft, including external stores can be found in ADS-27 (Ref. 32).

Early during the development, the contractor should submit modeling data sufficient to show that no vibrational problems will exist, or submit sufficient data to enable full system modeling by the procuring activity. Modeling data includes rotor and airframe compatibility, engine and airframe compatibility, and stores and airframe compatibility. Compatibility data includes data to show vibratory loads do not exceed limits specified, resonant amplifications are not present, and all components and subsystems will meet their functional and reliability requirements when subjected to the vibration levels as installed on the air vehicle.

Vibration test data includes airframe shake tests data, rotor blade and hub properties' determination data, component shake table tests data, flight vibration survey data, and production acceptance test data.

4-9.8 ACOUSTICAL NOISE DATA

Acoustical noise data include results of surveys of the internal and external acoustical environment indicating measurement locations and measured levels in terms of amplitude and frequency. The data should be sufficiently detailed to substantiate achievement of design requirements. Information pursuant to the determination that an acoustical environment that will not cause personnel injury, interference with voice or other communication, cause fatigue, or in any other way degrade way degrade overall system effectiveness can be found in MIL-STD-1472 (Ref. 23).

4-9.9 CLIMATIC DATA

Climatic tests are performed under simulated conditions and in actual climatic zones. Climatic data is used to demonstrate adequate safety of operation and compliance with applicable specifications, and formulate

recommendations for design changes, if required. Climatic data reports should describe the conditions under which the system has been subjected, as well as the operating modes tested. All anomalies should be described.

4-9.10 ICING DATA

Icing data should include descriptions of surfaces with anti-icing or de-icing provisions, as well as the level of protection provided. Test data should include descriptions of test conditions, test set ups, and results. Data should substantiate the capability of the windshield subsystem to maintain required visibility, power is adequate to maintain flight, adequacy of the electrical and de-ice subsystems, air vehicle controllablity, and that vibration and ice shed characteristic are acceptable.

4-9.11 ELECTROMAGNETIC ENVIRONMENTAL EFFECTS DATA

ADS-37-PRF, *Electromagnetic Environmental Effects (E3) Performance and Verification Requirements,* (Ref. 41) establishes E3 performance and verification test criteria for implementation at all stages in the life cycle of the air vehicle, subsystems, and components. The E3 control plan is a planning document used to describe the E3 program, document the design criteria and testing requirements. The purpose of the E3 control plan is to define E3 activities. It addresses the following content requirements:

1. Responsibility and authority for E3 implementation and management
2. Personnel
3. Methods for ensuring compliance with requirements
4. Predicted problem areas
5. Radiation characteristics
6. Approach to cable design
7. Impact of corrosion control requirements
8. Design criteria for lighting protection
9. Design criteria for electrification
10. Implementation of design changes
11. Special requirements, test methods, and limits
12. Facilities to be used for testing
13. Vendor design review and coordination
14. Spike protection requirements
15. Bonding criteria
16. Grounding criteria
17. off the shelf equipment
18. Interference control specifications
19. Electromagnetic compatibility board

20. Criticality category and degradation criteria

21. Spectrum utilization

22. Schedule and milestones

Test data should substantiate the performance and interface conformance of all electrical and electronic subsystems to the requirements indicated in ADS-37-PRF (Ref. 41); MIL-STD-461, *Requirements for the Control of Electromagnetic Interference, Emissions, and Susceptibility,* (Ref. 42); and MIL-STD-462, *Measurement of Electromagnetic Interference Characteristics*, (Ref. 43). A waiver is required to cite the later two documents. Qualification data for electromagnetic interference and electromagnetic compatibility should include test conditions tested and the results to document the radiated emissions, radiated susceptibilities, and their system effects.. Also, lightning strike test data should include structural, as well as electromagnetic, effects data to substantiate that critical components including rotor blades, fuel subsystem components, and weapon subsystems remain flight worthy during and after the strike.

Special analysis and tests may include hazards of electromagnetic radiation to ordnance (HERO), hazards of electromagnetic radiation to fuel (HERF), and hazards of electromagnetic radiation to personnel (HERP). Data should demonstrate that the levels of electromagnetic radiation is not hazardous to personnel, nor cause hazards to fuel or ordnance through inadvertent ignition or duding.

Nuclear electromagnetic pulse data includes a listing of piece parts, materials, components, assemblies, and subsystems to be tested with detailed information concerning tests and parameters to be measured before, during, and after the test.

4-9.12 WEAPON SYSTEM (SUBSYSTEM)

Air vehicle weapon subsystem and installation data required for qualification includes error budgets, boresighting, acquisition, tracker lock-on and tracking, man-in-the-loop control, weather and obscurant effects, stabilization, test targets, and scene clutter. The data should substantiate achievement of performance and interface requirements. Typical data requirements are as follows:

1. Functional diagrams showing all items of the entire armament subsystem. These diagrams should identify each item and should include the functional relationships and purposes of the items.

2. Equipment installation and arrangement drawings showing the location of all major items of armament equipment for which provision has been made, and the location of exterior equipment. The interconnection to subsystems, such as hydraulic, pneumatic, and electrical should be shown. Drawings of the console mount and control panel in relation to all other control panels in each compartment.

3. Air vehicle armament characteristic report.

4. Contractor furnished equipment (CFE) armament performance and interface data.

4-9.13 EXTERNAL STORES DATA

Air vehicle external stores qualification data should include analyses, tests, and reports to substantiate performance and safe operation of the air vehicle with the stores. Data should include impact on performance (i.e., climb rate, power required, air speed restrictions, etc.), handling qualities, and allowable

jettison flight envelopes. External stores data should also include descriptions of asymmetrical loading, weight and balance effects, fuel disconnects, forced ejection, and hang-fire effects data. Simulations of stores separation characteristics may be used.

4-9.14 SURVIVABILITY

Air vehicle survivability data, including analysis, test results, and reports should be provided to substantiate that the air vehicle meets the survivability requirements of the system specification. Data should be provided that describes and documents the effectiveness of armor panels, Air vehicle Survivability Equipment (ASE)(such as radar detectors and jammers, flares, etc.), nuclear hardening, and crash resistance. Installation drawings showing extent, shape, thickness, and type of armor equipment and other protective features, and structure in the vicinity; and installation and removal features for removable armor and other features should be provided. Ballistic capability of the armor in terms of caliber, velocity, and obliquity should be indicated.

The contractor's proposal should explain the means which they will use to define the survivability characteristics of the air vehicle and also satisfy survivability performance requirements of the contract. The contractor should submit analyses, plans, and reports which are sufficient to demonstrate that the survivability performance requirements of both the system specification and airworthiness qualification specification have been satisfied. Data to be provided include ballistic hardening, directed energy, nuclear hardening, NBC hardening, and crashworthiness.

Information pursuant to establishing minimum crash resistance criteria can be found in MIL-STD-1290 (Ref. 33). Addressed are crash resistance, design impact conditions, general crash survivability design factors, and testing.

4-9.15 ENGINE AND FLIGHT CONTROL ELECTRONICS DATA

Data that should be submitted include drawings, engineering data, and calculations for the engine and flight control subsystems. Also, drawings should be submitted that include an engineering layout showing location of subsystem components, range of movement of controls and control surfaces, diagrams and other engineering data as appropriate. Test plans and test reports should substantiate the environmental qualification of the engine and flight control systems. Relevant information can be found in MIL-STD-810 (Ref. 21). Also, test plans and test reports should be submitted to substantiate the electromagnetic environmental effects (E3) qualification of the engine and flight control systems in accordance with subparagraph 4-9.11.

A control subsystem can be configured as either "feed forward" or "feedback." A feed forward subsystem commands the item under control without watching what the item does. On the other hand, a feedback servo mechanism senses the states of the item under control and takes appropriate action to minimize the difference between the sensed states and the desired states.

Sufficient data should be submitted for all control subsystems that are configured as feedback servo mechanisms to substantiate the following:

1. Stability

2. Algorithm reliability. The substantiation effort should incorporate both theoretical and application specific analysis, making use of mathematical derivation, established figures of merit, and simulation. Areas of concern include the following as applicable:

a. Adaptive limiter adjustments

b. Adaptive gain adjustments

c. Adaptive filter (e.g., notch) adjustments

d. Adaptive control law configurations

e. State estimators and system identifiers

f. New, non-classical control methodologies

3. Fault tolerances

4. Transient response.

The substantiation effort should incorporate theory of operation, simulation, and hardware mock-ups (if practical). All simulation models should contain any existing nonlinear hardware traits, such as hysteresis, deadbands, limiters, nonlinear forces, and static friction. The substantiation should analyze the following response topics as applicable:

1. Command input

2. Load perturbation and disturbance

3. Parameter changes (force, damper, mass, or spring)

4. Effects of actuator limiting (position or rate)

a. Control state "wind-up"

b. Methods used to alleviate adverse responses from wind-up providing for acceptable performance throughout a transient event

c. Measuring the amount of wind-up

d. Calculating the amount of wind-up, the assumptions, sensitivities, and reliability

e. Tuning out wind-up effects, the sensitivities, and reliability

f. Inaccuracies

g. Smoothness of various control function transitions (e.g., on/off and mode changes)

h. Effect of control implementation and modeling fudge factor gains, biases, and functions; their relative contributions, sensitivities, and reliability

i. Effect of 50ms bus switching power interruptions (Relevant information can be found in MIL-STD-704 (Ref. 20).)

j. In-flight power interruption from other causes, such as a nuclear event

5. The pilot's sense of controllability and predictability. This subject combines the repeatability of transient responses, the gradual change of a transient response with respect to a gradually changing input command of load distribution profile, and the pilot's sense of an expected and appropriate response to an input command or load disturbance.

In addition to the above data, special data may be required for stability augmentation subsystems, autopilots, engine controls, instrument landing subsystems, and totally unmanned air vehicles. In particular, all failure modes of these subsystems should be analyzed and tested (either in the air vehicle or simulator) to determine any impact to handling qualities or safe operation of the air vehicle. Also, data should be provided to demonstrate proper integration of the subsystems. For example, flight control inputs made by the autopilot should not generate an unacceptable engine response.

4-9.16 SYSTEM ENDURANCE DATA

Air vehicle qualification data should include analyses showing achievement of endurance requirements, a description of the test conditions, and

results in terms of flight time or operating time before it becomes necessary for major subsystem overhaul or replacement. Because endurance requirements are often stated in terms of very long periods of operation, actual testing is usually not practicable.

4-9.17 SYSTEM SAFETY DATA

Typically the air vehicle system safety data to be submitted include:

1. Hazard analyses which defines the safety interfaces between subsystems and to identify possible safety hazards in the overall system. Relevant information can be found in MIL-STD-882, *System Safety Program Requirements,* (Ref. 44).

2. A system safety program plan (SSPP) (paragraph 3-9) or the applicable portion of an overall integrated plan which defines the SSPP scope and objective and provides a basis of understanding between the contractor and the procuring activity as to how the system safety program will be incorporated into the development effort.

3. System specification - defines the safety performance requirements for the air vehicle and each contract end item.

4. Flight Safety Parts - identification of all safety of flight parts, their critical characteristics, and serialization records (paragraph 3-13).

4-9.18 INTERFACE CONTROL DOCUMENTS

Formal interface documentation should be required as part of the systems engineering process to provide an exact definition of every interface by medium and by function. The interface control document (ICD) should include descriptions of the following interfaces: physical, environmental, sensitivities, signal characteristics, logic interfaces, and special data requirements. Interface Memorandums and Interface Agreements are used to define the responsibilities and methods for implementing interface changes. Airframe-Engine Integration Plans are used to develop and define the engine to airframe interfaces and test requirements. Interface control documents provide the formal documentation of the design requirements that allow effective integration of components and subsystems from separate procurements.

4-9.19 MISCELLANEOUS

Miscellaneous data includes descriptions of:

1. Cartridge-actuated devices used in any system, such as canopy jettisoning, hoist cable guillotine, flight refueling, hose guillotine, and emergency escape door actuation. The list should show clearly the type, quantity, and subsystem in which the devices are used. Relevant information can be found in ADS-31, *Cartridge and Propellant Actuated Devices*, (Ref. 45).

2. Commercial specifications, source control drawing, or performance and interface specifications for each mechanical, hydraulic, and pneumatic nonstandard part such as bearings, bolts, cable connecting fittings, power transmission chains, loop clamps, eyelets, fasteners, etc.

3. Special material part lists such as structural adhesive bonding list, specific adhesives and adherents used, and the facing and core materials of sandwich construction (needed for maintenance and repair).

4. Finish specifications (needed for maintenance and repair).

5. Report of material and processes development and evaluation, consisting of a summary technical description of materials and processes research, development and evaluation work which has been conducted or planned under the development contract.

6. If a component containing a radioactive element requiring a license from the Nuclear Regulatory Commission (NRC) is used in the air vehicle, the procuring activity should be notified of the need for a license as soon as the design has been sufficiently defined.

7. Nomenclature and nameplate data.

4-10 GENERAL QUALIFICATION ASSURANCE AND OPERATIONAL READINESS DATA

The qualification process should include the data required to demonstrate the quality of data collected, and should include data to substantiate the operational readiness of the system. This paragraph discusses general qualification assurance data requirements; testability, standardization, and producibility; reliability and related data requirements; training and trainers data; transport data; MANPRINT data; logistics data; battle damage,corrosion and interoperability data; and ship compatibility data.

4-10.1 GENERAL QUALIFICATION ASSURANCE

General qualification assurance data includes the collection-of test plans and test reports which comprise the qualification process. The test plans describe how, and under what conditions the tests were to be conducted; what data were to be collected; and what instrumentation were required. The test report describes the results of the test and any deviations that were made to the test plan. Instrumentation and calibration data should be included in the test report, and should contain the accuracy levels required of the instrumentation and calibration equipment. If special test facilities are required, a description of the test facilities and its unique capabilities should be provided. Simulations validation data (par. 6-8) should also be provided if the simulation is to be used to generate qualification data..

4-10.2 TESTABILITY, STANDARDIZATION, AND PRODUCIBILITY

System testability data should include testability criteria, testability analyses, fault insertion procedures (and rationale for selected faults) and results of fault detection and isolation tests. The test method (on-board automatic testing, built-in test, common test equipment and troubleshooting procedures) should be described. Standardization data includes standard parts lists, and standard maintenance tools and procedures, as applicable. Producibility data will include specific design provisions incorporated for ease of production, as well as the expected benefits to be gained from those provisions.

4-10.3 RELIABILITY AND RELATED DATA

Reliability and related data establish the reliability, availability, and maintainability (RAM) characteristics of the system. Reliability allocations are the means of apportioning reliability requirements to subsystems and components. Reliability predictions allow the designer to determine the design's potential for meeting requirements. Failure data collection provides a means for quantitatively assessing the degree of achievement of reliability requirements and form the basis for tracking corrective actions to eliminate or reduce the frequency of occurrence of failure modes encountered. The FMECA summarizes the failure modes and evaluates their effects on the performance of the system. It presents the results in a manner useful for severity level assessments and testability analyses. Reliability growth curves are useful as management tools for establishing reliability test requirements necessary to achieve reliability goals and to assess the effectiveness of failure corrections.

Warranty data should include warranty provisions, length of warranty, exclusions, and methods for obtaining repairs under the warranty.

4-10.4 TRAINING AND TRAINERS

Training and trainers data include system descriptions, trainee prerequisites, skills to be acquired, and the significance of the training to the qualification process.

4-10-5 TRANSPORT DATA

The transportability report describes the transportability characteristics of the system in terms of transportation modes, preparation requirements (time, support equipment, tools), special procedures, and requirements for restoring the system to an operational condition.

4-10.6 MANPRINT

The manpower and personnel integration (MANPRINT) data compendium is descibed in the following subparagraphs. MANPRINT is an engineering analysis and management process to identify and articulate requirements and constraints of human resources, human performance, and hazards to personnel so these matters will influence system design. The contractor is responsible for selecting the engineering and management process needed to satisfy associated performance and interface requirements. However, relevant information for measurement of operator workload can be found in ADS-30, *Human Engineering Requirements for Measurement of Operator Workload,* (Ref. 46).

4-10.6.1 MANPOWER

Manpower refers to required human resources. Data on manpower necessary to operate and maintain the system should be provided. This data should include the determination of the organization, skills, and personnel numbers required to operate and support the equipment.

4-10.6.2 PERSONNEL

Personnel data in terms of grade and skill levels necessary to operate and support the equipment should be provided.

4-10.6.3 TRAINING

A description of training required to impart the requisite knowledge, skills, and abilities that are required to operate and maintain the system should be provided. This data should include identification of critical tasks and the prescribed training standard.

4-10.6.4 HUMAN FACTORS

Human Factors data should be provided to address the people-equipment interface. This data supports the requirement for the human capability to operate and maintain the system be included in the design of the air vehicle. The data includes the measurements to demonstrate the capabilities to reach, lift, see, communicate, comprehend, and to act to the functions and circumstances required.

4-10.6.5 SYSTEM SAFETY

System safety concerns encompass all personnel and equipment which may be affected by program plans and operations. Pertinent data from all testing should be provided to form a basis to evaluate safety characteristics. Safety critical items and operations should be identified, and documentation should be provided to show these issues have been controlled to reduce the hazards to an acceptable level of risk. System safety is addressed in detail in Chapter 3.

4-10.6.6 HEALTH HAZARDS

Health hazard data in terms of the application of biomedical knowledge and principles to identify, evaluate, eliminate, or control risks to the health and

effectiveness of personnel requirements should be provided. Health hazard considerations relevant to the operation and maintenance of the system should be provided. These data should include the identification and evaluation of health hazards presented by radioactive materials, radio frequency emitters, toxic gases, laser devices, toxic and carcinogenic materials, gaseous emissions, blast overpressure, and harmful noise sources.

4-10.7 LOGISTICS

The Logistic Support Analysis Record (LSAR) documents the results of the Logistic Support Analysis (LSA). LSAR data are comprised of: operation and maintenance requirements, reliability and maintainability characteristics, failure mode and effects analysis, criticality and maintainability analysis, operation and maintenance task summary, operation and maintenance task analysis, personnel and support requirements, support equipment or training material description and justification, unit under test and automatic programs, facility description and justification, skill evaluation and justification, support item identification, and transportability engineering characteristics.. one of the main purposes of the LSAR is to document the extent to which the contractor has satisfied in the design for maintainer requirements as depicted in MIL-STD-1472 (Ref. 23). In addition, the detailed design of the maintainer and maintainer equipment interface should be analyzed and included in the LSAR.

4-10.8 BATTLE DAMAGE, CORROSION, AND INTEROPERABILITY

Battle damage repair data should be provided in the-form of field procedures necessary for expedient repair of battle damaged air vehicle. These data include reparability criteria based on extent and type of damage, inspection procedures, and necessary materials and tools.

Corrosion prevention data include a description of the techniques used to prevent corrosion. In addition, any data required to ensure the integrity of the corrosion preventive procedures should be provided for inclusion in the technical manuals. Design and operating features incorporated to meet international standardization requirements should be described and included in the international standardization report.

4-10.9 SHIP COMPATIBILITY

Ship compatibility features should be described. Included will be electromagnetic compatibility consideration as well as physical characteristics, such as the air vehicle dimensions, air vehicle tie down provisions, and blade folding provisions. This data should be in sufficient detail to determine the capabilities to operate the air vehicle from a given ship.

4-11 TECHNICAL DATA PACKAGE

The TDP is a technical description required to define and document an engineering design or product configuration (sufficient to allow duplication of the original items), and is used to support production, engineering, and logistics activities. The Government typically requires the right during the term of the contract, to purchase from time to time, “Technical Data Packages” (TDPs). Upon written notice of the Government’s intent to purchase TDPs or technical assistance, the contractor is normally given 60 calendar days after receipt of such notice, which proposal should include the

costs of preparation and reproduction of such TDPs, and the amount to be paid as compensation for the data/software/patent rights included the TDPs and/or the cost of providing technical assistance. The scope of these additional data rights to be acquired pursuant to this clause cover only the uses of the contractor's data consistent with Government Purpose Rights under DFARS 252.227-7013 with conversion to unlimited rights. Information pursuant to this purpose can be found in MIL-T-31000, *Technical Data Packages, General Specification For,* (Ref. 47).

4-11.1 ENGINEERING DRAWINGS AND ASSOCIATED LISTS

Conceptual design drawings, development design drawings, and product drawings are all part of the technical data package (TDP). Conceptual design drawings and associated lists define design concepts in graphic form, and include appropriate textual information required for analysis and evaluation of those concepts.

Developmental design drawings and associated lists provide sufficient data to support the analysis of a specific design approach and the fabrication of prototype hardware for test or experimentation. Drawings and lists required to present a design approach may vary from simple sketches to complex drawings, or a combination of both product drawings and associated lists provide the necessary design, engineering, manufacturing, and quality assurance requirements information necessary to enable the procurement or manufacture of an interchangeable item that duplicates the physical and performance characteristics of the original design activity. Product drawings reflect the level of design maturity that the item has attained.

Contractor format, development design drawings are the minimum requirements for a developmental project.

Minimum TDP requirements consist of all applicable technical data, such as plans, drawings, and associated lists, specifications, standards, performance requirements, quality assurance provisions, packaging data, manufacturing data, manufacturing operation/process sheets, and corresponding equipment/tooling requirements.

4-11.2 PERFORMANCE SPECIFICATIONS

A performance specification states requirements in terms of the required results with criteria for verifying compliance, but without stating the methods for achieving the required results. A performance specification defines the functional requirements for the item, the environment in which it must operate, and interface and interchangeability characteristics. Relevant information concerning the format and contents of a performance specification can be found in MIL-STD-961, *Standard Practice for Defense Specifications,*
(Ref. 48)

4-11.3 MANUFACTURING AND PROCESS SPECIFICATIONS

Manufacturing and process specifications are applicable to a service which is performed on a product or material. Examples of processes are: heat treatment, welding, plating, packing, microfilming, marking, etc. Process specifications cover manufacturing techniques which require a specific procedure in order that a satisfactory result may be achieved. Contractor's should use commercial products, processes and practices to reduce development,

production and operational costs. However, performance requirements should still be satisfied. The DoD strongly discourages the development of manufacturing and process specifications; except, where the DoD alone has the technological expertise to specify a military unique process.

4-11.4 TOOLING DRAWINGS

Performance specifications, commercial specifications, or source control drawings which describe all performance and interface requirements will usually be acceptable. Additional information on tooling drawings may be obtained in
MIL-T-31000 (Ref. 47).

4-12 DATA MANAGEMENT

Technical data are recorded information used to define a design and to produce, support, maintain, or operate items of defense materiel. These data may be recorded as graphic or pictorial delineation's in media, such as drawings or photographs; text in specifications or related performance or design type documents; in machine forms, such as punched cards, magnetic tape, computer memory printouts; or may be retained in computer memory. Examples of recorded information include engineering drawings and associated lists, specifications, standards, process sheets, manuals, technical reports, catalog item identifications, and related information..

The objectives of the DoD program for the management of technical data are to assure optimum effectiveness and economy in the support of systems and equipment within the Defense establishment. The management of these data is not an end in itself, but is supportive in nature.

4-12.1 TAILORING DATA REQUIREMENTS

Tailoring of data refers to the selective application of data requirements so that only the minimum necessary data is procured. Only the minimum data needed to permit cost effective support of research, development, production, cataloging, provisioning, training, operation,

maintenance, and related logistics functions over the life cycle of the item will be acquired. Paragraph 2-6 provides additional discussion of tailoring principles. TABLE 4-1 illustrates that the requirements can be selectively applied in the specification of deliverable data. In TABLE 4-2, it can be seen that appropriate category selection can be used in application of specification requirements.

TABLE 4-2

EXAMPLE DOCUMENT SUMMARY LIST

Document	Title	Specification Reference	Date	Category
SAE ARP 1281B	Actuators: Aircraft Flight Controls, Power Operated, Hydraulic, General Specification For	3.5.2.1	1993	Guidance
ASTM-D-1655A	Aviation Turbine Fuels	3.5.2.2	1995	Guidance
STANAG 3294, ED3, AMD 5	Aircraft Fuel Caps and Fuel Cap Access Covers	3.1.2.3	1973	Mandatory
DoDD 3405.2	Use of Ada on Weapons Systems	3.5.2.4		Mandatory
FAR 27.610	Lightning Protection	3.3.1.3	1 January 1991	Mandatory
FAR 27.303	Factor of Safety	6.2.7	1 January 1991	Mandatory

4-12.2 REPORTS AND DATA

Reports and data can be submitted in the form most appropriate for its intended usage. The CDRL specifies the form, format, and copy quality of deliverable data. CALS data, for example, is typically submitted in digital format. In addition to paper and digital data, qualification data may be submitted in the form of still photograph, video tape, or motion picture, as appropriate. Data developed for purposes other than qualification assurance can still provide valuable qualification assurance information. In the preparation of data, it should always be remembered that data content is significantly more important than data format.

4-12.3 DATA SUBMITTAL

The CDRL DD Form 1423 provides the specific data submittal requirements. Data are normally distributed directly to those Government offices having technical cognizance of the data with transmittal letter provided to the Contracting Office and/or the Data Management Office. Data may be submitted in a digital form and may be available on floppy disk, compact disk, or by direct access to the contractor's computer. The procuring activity must ensure that the delivered digital data can be received, stored, retrieved, and used by the Government. CALS implementation (paragraph 4-2) will result in more and more data being submitted or accessed by electronic means.

4-12.4 RECORDS AND MANUALS

An air vehicle inventory record provides the means for documenting the air vehicle's configuration in terms of installed equipment and location of the installed equipment.

The flight log book is used for tracking the operation of the air vehicle in terms of who flew the air vehicle, when and where it was flown, and the purpose of the flight. It is also used to track the operating time of the air vehicle, to record faults encountered, and to track deferred maintenance actions.

Maintenance performed, inspection requirements, and component time-change requirements are recorded in the maintenance log books.

The Operator's Manual contains a description of the operation of the air vehicle, its configuration, operating limits and restrictions; weight, balance, and loading information; flight performance data, and normal and emergency procedures. The Operator's Manual also contains the operator's and crew members normal and emergency amplified checklists. The Operator's checklist contains a condensed version of the applied checklists. Relevant information for air vehicle manuals and checklists can be found in MIL-M-63029, *Manuals, Technical: Requirements for Operator's Manuals and Checklists for Aircraft*, (Ref. 49) provides air vehicle manual data requirements.

Maintenance manuals provide detailed troubleshooting and repair procedures for the air vehicle, as well as detailed part information necessary to perform the repair.

The repair parts and special tool list (RPSTL) documents the repair parts and special tools required for all maintenance actions on the air vehicle, and provides the basis for developing maintenance manual information.

4-13 CONFIGURATION MANAGEMENT

The contractor should be required to maintain configuration control and status accounting through best commercial practices and throughout the length of the contract, except that the procuring activity should maintain control of all performance, interface, and flight safety parts specifications. The contractor's means for satisfying configuration control, such as Electronic Industries Association (EIA) Standard IS-649, *Configuration Management* (Ref. 51) should be described in their response to a request for proposal. The configuration management effort should include identifying, documenting, and verifying the functional and physical characteristics of an item; recording the configuration of an item; and controlling changes to an item and its documentation. It should provide a complete audit trail of decisions and design modifications, reference DoD Regulation 5000.2-R (Ref. 1). See paragraph 4-11 for additional information.

In those cases where the procuring activity maintains control, an engineering change proposal should be used to change the specification.

An engineering change proposal (ECP) is a proposed engineering change and documentation by which the change is described, justified, and submitted to the procuring activity for approval or disapproval. The ECP may be in contractor format; however, there should be two class of ECPs:

An ECP should be classified as a Class I ECP if:

1. the functional configuration identification, allocated configuration

identification, or product configuration identification, once established, is affected to the extent that any of the following requirements would be outside specified limits or specified tolerances:

a. performance;

b. reliability, maintainability, or survivability;

c. weight, balance, moment of inertia;

d. interface characteristics;

e. electromagnetic characteristics; or

f. other technical requirements specified in the functional configuration identification or allocated configuration identification or product configuration identification.

2. a change to the product configuration identification, once established, impacts one or more of the following:

a. government furnished equipment (GFE);

b. safety;

c. deliverable operational, test, or maintenance computer software associated with the configuration item or computer software configuration item being changed;

d. compatibility or specified interoperability with interfacing configuration items or computer software configuration items, support equipment/software, spares, trainers, or training devices/equipment/software;

e. configuration to the extent that retrofit action is required;

f. delivered operation and maintenance manuals for which adequate change/revision funding is not provided in existing contracts;

g. preset adjustments or schedules affecting operating limits or performance to such extent as to require assignment of a new identification number;

h. interchangeability, substitutability, or replaceability as applied to configuration items and to all subassemblies and parts except the pieces and parts of non-reparable subassemblies; or as applied to computer software configuration items and to all computer software components and computer software units;

i. sources of configuration items or reparable items at any level defined by source control drawings; or

j. skills, manning, training, biomedical factors, or human engineering design.

k. Any of the following contractual factors are affected:

(1). cost to the Government, including incentives and fees;

(2). contract guarantees or warranties;

(3). contractual deliveries; or

(4). scheduled contract milestones.

An ECP should be classified as a Class II ECP if the change identifies a minor change to a configuration item or its documentation that can be effected entirely by a contractor within the scope of the current contract effort without changing the Government approved configuration identification other than to incorporate the Class II change into the product configuration identification. Examples of Class II changes are:

1. changes that do not affect interchangeability, substitutability, or replaceability of configuration items, or when reparable, their subassemblies and parts;

2. substitution of parts or material which do not have a functional, logistic, or reliability impact;

3. changes in documentation only (e.g., correction of errors, addition of clarifying notes or views, addition, deletion

or correction of non-executable comment lines-ofcode to software).

Prior to manufacture of an item, if a contractor considers it necessary to depart from the mandatory requirements of a performance or interface specification, the contractor may request that a deviation be authorized. As an example, if a component will no longer be capable of performing its intended function or satisfying specified interface requirements, contractual authorization in the form of an approved waiver is required prior to the delivery of items incorporating known departure from documentation.

An item which through error during manufacture does not conform to the configuration identification should not be delivered unless a waiver has been processed and approved by the procuring activity.

4-13.1 FUNCTIONAL BASELINE

The functional baseline configuration is established with the initially approved documentation describing a system's or item's functional characteristics and the verification required to demonstrate the achievement of those functional characteristics. Typically, a system specification developed at the initiation of a development program would constitute a functional baseline. The contracting agency will usually retain control of the functional baseline.

4-13.2 ALLOCATED BASELINE

The allocated baseline configuration is established with the initially approved documentation describing an item's functional and interface characteristics that are allocated from those of a higher level configuration item, interface requirements with interfacing configuration items, additional design constraints, and the verification required to demonstrate the achievement of those specified functional and interface characteristics. Typically, prime item development specification (PIDS) and interface control document (ICD) are used to describe the allocated baseline. These are also prepared early in the development cycle. For software, the allocated baseline is documented by the approved SRS and IRS following SSR.

4-13.3 ALLOCATED BASELINE EXPANSION

As additional requirements become allocated to lower level configuration items, the allocated baseline is expanded to cover these additions. Changes to the baseline are approved and documented through SCNs and the Change Control Board (CCB).

4-13.4 PRODUCT BASELINE

The product baseline configuration is established with the initially approved documentation describing all of the necessary functional and physical characteristics of the configuration item, any required joint and combined operation's interoperability characteristics of a configuration item (including a comprehensive summary of the other service(s) and allied interfacing configuration items or systems and equipment), and the selected functional and physical characteristics designated for production acceptance testing and tests necessary for the support of the configuration item. Typically, the product baseline is established at the end of development (following successful FCA and PCA) when the design has matured sufficiently to enter production.

4-14 GOVERNMENT INDUSTRY DATA EXCHANGE PROGRAM (GIDEP)

The Government-Industry Data Exchange Program (GIDEP) is a cooperative data interchange among Government and Industry participants seeking to reduce or eliminate expenditures of time and money by making maximum use of existing knowledge. Relevant information can be found in MIL-STD-1556, *Government Industry Data Exchange Program (GIDEP) Contractor Participation Requirements*, (Ref. 50). GIDEP provides a means to exchange certain types of data essential during the life cycle of systems and equipment. GIDEP was initially established to minimize duplicate testing of parts and materials through the interchange of environmental test data and technical information among contractors and Government agencies involved in design, development, and fabrication of Government-funded equipment. Information contained within the GIDEP storage and retrieval system includes environmental test reports and procedures, reliability specifications, failure analysis data, failure rate data, calibration procedures, and other technical information related to the application, reliability, quality assurance, and testing of parts and related materials. To enable immediate data access, all information is computer indexed and recorded on microfilm. Unclassified and non-proprietary test reports and other technical information generated by a participant are submitted to the GIDEP Operations Center. This information is reviewed for program applicability, indexed for computer retrieval, processed for microfilming, and automatically distributed to qualified contractors and Government agencies participating in GIDEP.
TABLE 4-3, "DATA AVAILABLE IN GIDEP," provides details of the GIDEP.

4-15 LESSONS LEARNED

4-15.1 THE SAFETY DATA BASE.

The safety database provides mechanism for recording safety related incidents. Data is maintained concerning the cause and corrective actions taken to preclude recurrence. Review of the database information provides insight on avoiding similar incidents in future designs and operations.

4-15.2 THE COMBAT DATABASE

The combat database is means of storing and retrieving operational combat deficiencies. Its value lies in the fact that operational combat situations often cannot be simulated, no matter how realistic the test scenario. Lessons learned from combat situations are valuable considerations for future design.

4-15.3 THE LOGISTIC DATABASE

The logistic database provides a means of collecting and disseminating logistics related lessons learned. It contains information on repair problems, supply, support equipment, manuals, and other documentation. Again, examining lessons from the past will help preclude their future occurrence.

TABLE 4-3

DATA AVAILABLE IN GIDEP

DATA INTERCHANGE	CONTENTS
Engineering Data Interchange (EDI)	Engineering studies, testing, specification preparation, data processing and analysis, manufacturing processes planning and selection, quality assurance, non-stand parts justification data
Failure Experience Data Interchange (FEDI)	ALERTs/SAFE-ALERTs (actual or potential problems with parts, components, materials, manufacturing processes, equipment or safety conditions), diminishing manufacturing sources and material shortages
Reliability and Maintainability Data Interchange (RMDI)	mathematical modeling and reliability, maintainability/logistics data and methods
Metrology Data Interchange (MDI)	calibration procedures, plans, and methods

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None

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LIST OF ACRONYMS AND ABBREVIATIONS

ABL	=	Allocated baseline
AIS	=	automated information system
AJPO	=	ada joint program office
AMSDL	=	acquisition management systems and data requirements control list
ANSI	=	american national standards institute
AQP	=	airworthiness qualification plan
ASIC	=	application specific integrated circuit
ASTM	=	american society for testing & materials
BW	=	bandwidth
CALS	=	continuous acquisition and life-cycle support
CCB	=	change control board
CDR	=	critical design review
CDRL	=	contract data requirements list
CFE	=	contractor furnished equipment
CG	=	center of gravity
CI	=	configuration item
CID	=	commercial item description
CSCI	=	computer software configuration item

D	=	with draft proposal
DAC	=	days after contract award
CID	=	commercial item description
DoD	=	department of defense
DODISS	=	department of defense (dod) index of specifications and standards
DSSE	=	developmental software support environment
E3	=	electromagnetic environmental effects
ECP	=	engineering change proposal
EDI	=	engineering data interchange
EEPROM	=	electrically erasable prom
EIA	=	electronic industries association
EMI	=	electromagnetic interference
EPROM	=	erasable prom
ESDD	=	electrical subsystem design documents
F	=	with final proposal
FAA	=	federal aviation administration
FAR	=	federal aviation regulation
FBL	=	functional baseline
FCA	=	functional configuration audit
FEDI	=	failure experience data interchage
FF	=	before first flight
FMECA	=	failure mode, effect, and criticality analysis

GFE = government furnished equipment

GIDEP = government-industry data exchange program

HERF = hazards of elctromagnetic radiation to fuel

HERO = hazards of electomagnetic radiation to ordnance

HERP = hazards of electromagnetic radiation to personnel

HWCI = hardware configuration item

ICD = interface control document

IEE = institute of electrical and electronic engineers

IFOV = instantaneous field-of view

IPT = integrated product team

IRS = interface requirements specification

ISWDB = integrated weapon system database

LCSSE = life cycle software support environment

LSA = logistic support analsis

LSAR = logistic support analysis record

M = monthly

MAC = months after contract award

MANPRINT = manpower and personnel integration

MDI = metrology data interchange

NATO = north atlantic treaty organization

NBC = nuclear, bilogical, and chemical

NEP = noise equivalent power

NET = net equivalent temperature

NRC	=	nuclear regulatory commission
NVIS	=	night vision imaging system
NVM	=	nonvolatile memory
OMB	=	office of management and budget
PAL	=	programmable logic devices
PBL	=	product baseline
PCA	=	physical configuration audit
PDL	=	program design language
PDR	=	preliminary design review
PIDS	=	prime item development specification
PLD	=	programmable logic devices
PPSL	=	program part selection list
PROM	=	programmable rom
R	=	responsitivity
RAM	=	reliability, availability, and maintainability
RMDI	=	reliability and maintainability data interchange
ROM	=	read only memory
RPSTL	=	repair parts and special tool list
SAE	=	society of automotive engineers
S/N	=	signal to noise
SDDD	=	software detailed design document
SDR	=	system design review

SIE	=	special inspection equipment
SMD	=	standardized military drawings
SPP	=	standard practice procedure
SQPP	=	software quality program plan
SRFC	=	status report-reason for change
SRR	=	system requirements review
SRS	=	software requirements specification
SSDD	=	system segment design document
SSPP	=	system safety program plan
SSR	=	software specification review
SSS	=	system/segment specification
STANAG	=	standardization agreement
STD	=	software test description
STLDD	=	software top level design document
STR	=	software test report
TDP	=	technical data package
TRR	=	test readiness review
UUT	=	unit under test
VDD	=	version description document