

INCH-POUND

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SUPERSEDING  
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# **DETAIL SPECIFICATION MANUALS, TECHNICAL - AIRCRAFT BATTLE DAMAGE ASSESSMENT AND REPAIR**



Comments, suggestions, or questions on this document should be addressed to AFLCMC/HIS Technical Data Section, 4170 Hebble Creek Road, Bldg. 280, Door 15, Area A, Wright-Patterson AFB, OH 45433-5653 or emailed to [SGMLsupport@us.af.mil](mailto:SGMLsupport@us.af.mil). Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at <https://assist.dla.mil>.

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This specification is approved for use by all Departments and Agencies of the Department of Defense.

## 1 SCOPE

1.1 Scope. This detail specification covers requirements for the preparation of technical manuals on Aircraft Battle Damage Assessment and Repair (ABDAR), and quick repair instructions not included in TO 1-1H-39/NAVAIR 01-1A-39. Aircraft specific manuals will describe quick ABDAR procedures to be applied to the specific aircraft. Duplication of information contained in other maintenance manuals should be kept to a minimum in the specific ABDAR manual. Appendix A provides information for utilization of markup language tools for the digital preparation of flight manual technical data to be delivered to the government.

1.2 Illustrations. The illustrations appearing in this specification are used only as examples. If there is any conflict between the text and illustrations in this document, the text applies.

## 2 APPLICABLE DOCUMENTS

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

### 2.2 Government Documents.

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

#### DEPARTMENT OF DEFENSE STANDARDS

**MIL-STD-38784 -** Manuals, Technical: General Style and Format Requirements for Technical Manuals

(Copies of this document are available online on ASSIST online at <https://quicksearch.dla.mil/>.)

2.2.2 Other government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

#### AIR FORCE TECHNICAL MANUALS PUBLICATIONS

**TO 1-1H-39 -** General Aircraft Battle Damage Repair

(Copies of this document required by users with “.mil” government web address access are available online at <https://www.my.af.mil/etims/ETIMS/index.jsp>. Refer to helpdesk information if obtaining copies without a TO subscription account. Copies of documents required by contractors in connection with specific procurement functions should be obtained from the acquiring activity or as directed by the contracting officer.)

#### NAVAIR MANUALS

**NAVAIR 01-1A-39 -** Naval Aircraft Battle Damage Repair

(Copies of this document required by users with “.mil” government web address access are available online at <https://mynatec.nav.air.navy.mil/>. Copies of documents required by contractors in connection with specific procurement functions should be obtained from the acquiring activity or as directed by the contracting officer.)

### 2.3 Deleted.

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

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## 3 REQUIREMENTS

### 3.1 Deleted.

3.2 Manual preparation. The style and format of the specific ABDAR manual shall be in accordance with the requirements of MIL-STD-38784. The manual shall be as brief as appropriate; however, each required system on the aircraft shall be described sufficiently, so that personnel trained in other specific weapon systems, but untrained in this specific weapon system, could apply the repair procedures described. The specific ABDAR manual shall contain information necessary for maintenance personnel to determine the extent of damage to the aircraft, and instructions to make deferment/repair decisions. A cross-reference between system components, subsystems, and critical components, required to support a specific mission, shall be included.

3.2.1 Illustrations. Illustrations shall be simple, clear, and contain only essential elements in accordance with MIL-STD-38784.

3.2.2 Diagrams. Diagrams shall be furnished where applicable, to identify aircraft structural members and applicable systems/components (e.g., electrical, egress, fuel) essential for mission success. Internal and external structural members, panels, and skin, shall be included. The diagrams shall also identify the component materials. Vulnerability reduction features (armor, foam, etc.) shall be noted. See 6.6 for preparation of wiring data and schematic diagrams.

3.3 Arrangement. The specific ABDAR manual shall be arranged in the following order and the chapters numbered consecutively:

- a. Front Matter - See 3.3.1.
- b. Chapter 1 - General Information. See 3.3.2.
- c. Chapter 2 - System Description. See 3.3.3.
- d. Chapter 3 - Materials. See 3.3.4.
- e. Chapter 4 - Support Equipment/Special Tools. See 3.3.5.
- f. Chapter 5 - Abbreviated Functional Checks. See 3.3.6.
- g. Chapter 6 - Typical Repairs. See 3.3.7.
- h. Chapter 7 - Interchangeability Data. See 3.3.8.
- i. Chapter 8 thru n - Zone 1 through xxx. See 3.3.9.
- j. Chapter n+1 - Engines. See 3.3.10.
- k. Chapter n+2 - Electrical Wiring/Harnesses (optional). See 3.3.11.

3.3.1 Front matter. Front matter shall be in accordance with the requirements of MIL-STD-38784.

3.3.1.1 Introduction. The introduction shall contain a brief explanation of the specific ABDAR manual and how it is to be applied. The following statement shall be included at the end of the introduction:

“The damage limits and repairs established in this manual shall only be applied in time of war. Under no circumstances shall this manual be used wholly or in part for peacetime maintenance of the aircraft. The criteria contained herein allow rotary wing/fixed wing aircraft to be flown with battle damage which exceeds peacetime limits. Assessment of aircraft battle damage requires extreme care and diligence, and strict adherence to the instructions and criteria contained in this manual. If, at any stage of damage assessment, the assessor believes that oversights or errors have been made, the assessment shall be stopped at that point and repeated from the beginning. Under no circumstances, shall the requirements of this manual be waived or circumvented, without the expressed approval of the commander or designated representative.”

3.3.2 Chapter 1 - General Information. This chapter shall provide general information relative to the specific weapon system and, as a minimum, shall contain the following sections:

- a. Section I - General Information. See 3.3.2.1.
- b. Section II - Mission Identification. See 3.3.2.2.
- c. Section III - Damage Assessment. See 3.3.2.3.

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d. Section IV - Aircraft Zones. See 3.3.2.4.

3.3.2.1 Section I - General Information. Instructions on how to use the manual shall be provided for the assessor and technician. Structure analysis methods, employed in generating the damage limits, shall be provided for the ABDAR engineer, who may be tasked to provide additional engineering assumptions and procedures which are not specified in the manual.

3.3.2.2 Section II - Mission Identification. This section shall identify each generic type mission as designated for that particular weapon system (e.g., air-to-air, air-to-ground, tanker support). Missions shall be as identified by the flight manual, or as otherwise specified by the acquiring activity (see 6.2b).

3.3.2.3 Section III - Damage Assessment. Damage limits, repair guidelines, instructions, and references to applicable publications, which enable an assessor to make the correct deferment/repair decisions, shall be provided. Previous data from damage levels on similar aircraft, vulnerability assessments, and system criticality information from failure modes and effects analysis on the specific aircraft, shall be used as a guide in determining contents and scope of procedures to be addressed in the specific ABDAR manual. Flight operational limits shall be addressed after deferments/repairs assessments are made.

3.3.2.3.1 Fire and heat damage. Instructions on how to determine the degradation of material properties, caused by fire and heat, shall be provided. A chart to show conductivity values and hardness readings for materials used on the aircraft, when exposed to damaging fire or heat, shall be included. The chart shall include procedures for quick determination of the extent of damage to ferrous, nonferrous, organic, and inorganic composite materials (see figure 1). The chart shall identify those areas of the engine bays where the integrity of fire walls must be maintained to prevent excessive heat damage. Allowable damage limits shall be specified, and any peculiar firewall repairs shall be included in the appropriate zone.

3.3.2.3.2 Weight and balance. Instructions for the assessor to determine the effects on weight and balance, which significantly affects the Center of Gravity (CG) as a result of repairs on the aircraft, shall be provided.

3.3.2.3.3 Logic procedure. This section shall include an assessment logic tree that applies to structure/system/components that pertain to the weapon system (see figure 2).

3.3.2.4 Section IV - Aircraft Zones. This section shall provide a three dimensional illustration identifying rotary wing/fixed wing aircraft zones. A brief explanation of the selected rotary wing/fixed wing aircraft zones shall be included. The zones shall be identified by rotary wing/fixed wing aircraft station numbers. These zones shall be selected such that they are essentially repair-independent and physically distinct, based on structural features/equipment commonality. When all the zones are put together, the results shall be a complete rotary wing/fixed wing aircraft.

Print presentation: Each zone section shall begin on a right-hand page (see figures 3 and 4 for an example of rotary wing/fixed wing aircraft zones).

3.3.3 Chapter 2 - System Descriptions. This chapter shall contain a brief description of the aircraft systems. Each system description shall include a reference to the applicable maintenance manual. This chapter shall also include diagrams, drawings, and schematic illustrations, as necessary. The following are examples of aircraft systems (contained in sections):

### EXAMPLE OF AIRCRAFT SYSTEM

Section I - Airframe

Section II - Crew Station

Section III - Landing Gear System

Section IV - Flight Control System

Section V - Power Plant

Section VI - Engine Starting System

Section VII - Electrical Power Supply

Section VIII - Environmental Control System

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Section IX - Hydraulic and Pneumatic System

Section X - Fuel System

Section XI - Flight Instruments

Section XII - VHF Communications

Section XIII - UHF Communications

Section XIV - Interphone System

Section XV - Fire Control System

Section XVI - Weapons Delivery

Print presentation: A brief description of the aircraft systems shall be approximately one page or less.

3.3.4 Chapter 3 - Materials. Repairs shall be designed using ABDAR Tool/Material Kit listings approved by the acquiring activity. Preferred material required for a specialized repair shall be specified. A consolidated listing, by part number, containing aircraft peculiar fasteners (types and dimensions), unique materials, sealants, parting agents, films, pads, solvents, cleaning materials, bonding materials, primers, honeycomb, and alternate materials for each, shall be included. All items shall be identified using Military/Federal Specifications, if applicable. This chapter shall contain a table listing materials and suitable substitute materials that are not contained in the ABDAR Tool/Material Kit Listing. Materials shall be grouped by specification number, and shall be in alpha-numeric sequence, by part number and Contractor and Government Entity (CAGE) code. A table shall be prepared in accordance with the following format:

PART NUMBER/CAGE	NOMENCLATURE
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3.3.5 Chapter 4 - Support Equipment/Special Tools. This chapter shall contain a listing of support equipment/special tools that are not included in the ABDAR tool/material kit listing. Special tools shall be grouped by part number/CAGE code. The number of tools shall be kept to a minimum, and they shall be common type tools, where possible.

3.3.6 Chapter 5 - Abbreviated Functional Checks. This chapter shall contain limited functional checks for those essential systems, for which a full system operational check and support equipment is normally required. The checks shall be brief, and shall contain only those items necessary to ensure mission capability.

3.3.7 Chapter 6 - Typical Repairs. This chapter shall illustrate, describe, and include procedures for typical repairs that are common to two or more zones. Typical repairs shall be provided for all aircraft systems, subsystems, and components, as applicable. Repair steps that affect survivability/vulnerability, hardness, or Radar Cross Section (RCS) characteristics, shall be identified. Typical repairs shall not duplicate repairs covered in TO 1-1H-39/NAVAIR 01-1A-39.

3.3.8 Chapter 7 - Interchangeability Data. Interchangeability data, not already identified in the illustrated parts breakdown manual, shall be provided, where applicable. Mission essential system components shall be identified in a consolidated list, by CAGE code/part number and nomenclature.

3.3.9 Chapter 8 through n - Zone 1 through xxx. These chapters shall be numbered consecutively by aircraft zones, and each chapter shall contain a description and illustration(s) of that zone. Each chapter shall include the following:

- a. Section I - Structures Assessment (see [3.3.9.2](#)).
- b. Section II - System Assessment (see [3.3.9.3](#)).

3.3.9.1 Safety factors. Analysis supporting ABDAR structural repairs shall be based on ultimate strength. Repairs shall have stiffness that is compatible with the original structure. However, service life, corrosion, and aesthetic considerations may be overlooked in exchange for a rapid repair procedure. Strength related calculations, for the unrepaired structure, shall be made to obtain maximum utilization under wartime conditions, and accommodate worst case contingencies. Calculations shall be made to determine the static

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strength of the damaged and unrepaired structure. Operation of the aircraft shall be restricted to two-thirds of that strength, or to restriction engendered by damage tolerance residual strength considerations, whichever is lower. Safety of flight primary structures shall provide for adequate residual strength in the presence of cracks from damage remaining in the structures. The size and types of remaining damage, that are to be assumed, shall be established for each primary structural member in each zone, for each damage category. Structures with the assumed remaining damage shall be capable of sustaining limit load, or 1.2 times the maximum load associated with any operating restriction. Care shall be exercised to assure that deformation, that would degrade the load carrying or operating capability, shall not occur at the operational restriction.

3.3.9.2 Section I - Structures Assessment. Section I shall contain a brief description of the structure, and shall include illustrations of external and internal members in each zone.

3.3.9.2.1 Categories. Five separate categories shall be used to categorize all external and internal structural members as follows (see figure 5).

3.3.9.2.1.1 Category I - Primary Airframe Structure (see 6.5.3.1). These members shall include, but are not limited to: main longerons, bulkheads, spars and ribs; structural torque boxes in highly stressed areas; stress panels which serve to stabilize tension and compression loads between primary load carrying members; and any group of structural members in which a single failure may result in the immediate loss of an aircraft at the maximum expected load. For this category, limits shall be listed for all three damage classes (see 6.5.5).

3.3.9.2.1.2 Category II - Secondary Structure (see 6.5.3.2). Limits shall be listed for all three damage classes (see 6.5.5).

3.3.9.2.1.3 Category III - Nonessential Structure (see 6.5.3.3).

3.3.9.2.1.4 Category IV - Special Structure (see 6.5.3.4). Limits shall be listed for all three damage classes (see 6.5.5).

3.3.9.2.1.5 Category V - Repair-restrained Structure (see 6.5.3.5). Limits shall be listed for A and C damage classes (see 6.5.5). The three groups shown below are examples of Category V structures.

- (1) Group 1. Complex machined and forged components used in construction of the airframe. Components such as splice plates, attachments, and irregular shaped segments of Category I structures. Fracture and fatigue critical areas shall be identified for these components.
- (2) Group 2. Attachment fittings, supports, etc., that transmit high loads onto primary structural members; especially attachment fittings that transmit high vibration loads such as engine vibration loads.
- (3) Group 3. All essential mechanical systems required for airworthiness, machined or forged: gears, screw jackets, actuators, etc., and all nonrepairable bell cranks, gear casing, and component mounting plates.

3.3.9.2.2 Illustrations and tables. Each structural illustration shall consist of a coded orthographic view drawing and table, depicting index number, nomenclature, material, damage class limitations, reference for repair, and remarks. The code shall include an index number and category numbers identifying each item as required. In conjunction with the category number, external illustrations shall use shading as indicated. Internal structural illustrations may use shading, if it does not detract from, or obscure details (see figure 5). In order to simplify tables, nonessential (Category III) members need not be addressed.

3.3.9.2.3 Damage limitations. Damage limitations for all Category I, II, IV, and V structures shall be provided. The limitations shall include the size and location for classes A, B, and C damage up to which repairs can be made under ABDAR constraints. The maximum number of repairs, and the limits for the proximity of multiple damage to a given structural component, shall be included. Guidelines, instructions, and illustrations for accomplishing repair, shall be provided in the zone chapter. Specific weapon system typical repairs, not covered by the general ABDAR TO 1-IH-39/NAVAIR 01-1A-39, shall be developed, and included in Chapter 6, using applicable illustrations/tables.

3.3.9.2.4 Category/class. Each category/class of damage, for each component of the major structural groups, shall be clearly defined within the zone chapter of the manual.

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**3.3.9.3 Section II - System Assessment.** This section shall contain the following requirements for each system assessment:

- a. System serviceability criteria for the specific ABDAR manual shall be classified as fully capable (FC), degraded performance (DP), or not required (NR), as related to minimum essential systems, subsystems, and components required for a designated mission. Systems, subsystems, and components coded NR shall be noted in the zone chapter, but shall not be discussed in text, except when a maintenance action is required to safe/disable the system to prevent further damage or interference with other required operational systems. This criteria shall be illustrated in a table which shall include system/subsystem, mission serviceability criteria, and remarks (see figure 6).
- b. A brief description and damage assessment of each mission essential system, subsystem, and component in the zone, shall be included.
- c. Orthographic view drawing(s) showing location of mission essential system components in the zone, shall be included.
- d. Tables shall be developed to include index number, nomenclature, acceptable damage, maintenance action/repair reference, functional checks, and effects/restrictions, if applicable (see figure 7).
- e. Specialized repair procedures for aircraft systems, subsystems, or components that are unique to that zone, shall be developed, and included in the zone chapter. Instructions outlining recommended procedures for locating and disabling/capping off damaged system lines not required, shall be included in the zone chapter. Specialized repairs for fuel tank areas, flight controls, radomes, and transparencies, shall be developed, as appropriate. Changes to vulnerability reduction features such as armor, foam, and electromagnetic pulse, shall be addressed, if repair or deactivation is necessary. Repair procedures to restore line replaceable units to a serviceable condition, shall be provided, if applicable. These repairs shall be addressed in each applicable zone.

**3.3.9.3.1 Avionic/Electrical System Assessment.** This system assessment shall contain the requirements of [3.3.9.3](#). If wire/harness identifications for the specific aircraft vary from that of general ABDAR TO 1-1H-39/NAVAIR 01-1A-39, clarification shall be provided. Warnings concerning maximum power/voltage usable for systems checks shall be specified, if applicable, to preclude inadvertent system operations (e.g., munitions).

**3.3.9.3.2 Mechanical System Assessment.** This system assessment shall contain the requirements of [3.3.9.3](#). Schematics or figures to define pertinent limitations/dimensions between bellcranks, actuators, and pivot points, shall be developed. Rotary wing aircraft components, such as main and intermediate tail gear boxes, and main and tail rotor blades, shall be included. Pressure/volume/travel limits shall be specified, if applicable.

**3.3.9.3.2.1 Cable System.** Locations where cables are used shall be identified, and any peculiar repairs shall be described. Instructions outlining recommended procedures for disabling secondary flight control systems which are desirable, but not essential, shall be included. Cable systems shall include cable tension, travel limits, and special tools.

**3.3.9.3.3 Pneudraulics System Assessment.** This system assessment shall contain the requirements of [3.3.9.3](#). Pressure/volume/travel limits shall be specified, if applicable. Pneudraulic system lines shall be classified by temperature, if appropriate, and pressure, to correspond with pressure ranges specified in appropriate aircraft pneudraulic technical manuals. Allowable leak rates for each system shall be specified.

**3.3.9.3.4 Fuel System Assessment.** This system assessment shall contain the requirements of [3.3.9.3](#). Illustrations shall include isolation points, access covers, single point receptacles, typical fuel tank arrangements, and fuel tank components and plumbing locations. Distinction shall be made between fuel leaks that constitute a flight safety hazard, and those that do not. Alternate settings or modifications to the fuel control panel, which will permit isolation of various tanks, shall be included. Weight and balance implications of these actions shall be addressed. Any specialized fuel tank sealing instructions shall be provided.

**3.3.9.3.5 Armament System Assessment.** This system assessment shall contain the requirements of [3.3.9.3](#). The minimum/maximum power and voltage requirements, needed for operation of each armament system, shall be included. Warnings concerning maximum power/voltage usable for system checks shall be specified,

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to preclude inadvertent system operations (e.g., munitions). Quick repair methods, such as “hot-wiring” around inoperative black boxes, in order to operate the armament, shall be included. Armament limitations shall be specified for operation of systems, regardless of gear/wing positions.

3.3.9.3.6 Landing Gear System Assessment. This assessment category shall contain the requirements of 3.3.9.3. Pressure/volume/travel limits shall be specified, if applicable.

3.3.9.3.7 Egress System Assessment. This system assessment shall contain the requirements of 3.3.9.3. Repair of damaged egress systems shall be restricted to direct replacement of components, or minor acceptable repair to hoses, tubing, cables, wiring, and crew ejection systems. Acceptable repair limits, such as size, location of damage, and minimum distance between repairs, shall be specified. Repair procedures for each seat type, rather than for aircraft type, shall be developed.

3.3.10 Chapter n+1 - Engines. This chapter shall contain a brief description and illustrations, showing location of mission essential engine system/components.

3.3.10.1 Illustrations. Each illustration shall consist of an orthographic view drawing of the engine system components within that zone.

3.3.10.2 Tables. There shall be a minimum of two tables. Table 1 shall include system/subsystem, mission serviceability criteria, and remarks (see figure 6). Table 2 shall include index number, nomenclature, acceptable damage, maintenance action/repair reference, functional checks, and effects/restrictions (see figure 7). Pressure/volume/travel limits shall be specified, if applicable. Minimum required functional capabilities for appropriate components, shall be described. Allowable limited repairs shall be included. Any repairs to propellers of propeller-driven aircraft shall be included. A table outlining the engine minimum power requirements and functional checks shall be included. Full and partial operational capabilities shall be refined per mission refinements.

3.3.11 Chapter n+2 - Electrical Wiring/Harnesses. A list of essential wiring by zone, harness number, connector number, pin number, wire tie number and location, ground point and location, system, and aircraft effectivity by mission, shall be provided in this chapter, with specialized repair, if applicable. The electrical wiring/harness data may be organized by harness number, location, or other method as required (see figure 8).

## 4 VERIFICATION

4.1 Verification Requirements. When the technical data produced according to this specification is offered for acceptance, all tests, reviews, and verifications required by the acquiring activity to determine that it conforms to the requirements in Section 3 of the specification, shall be accomplished as specified in the solicitation or contract (see 6.2c and 6.7).

4.2 Compliance. Technical manuals (TMs) shall meet all requirements of Section 3 of this specification and the applicable Digital Support Suite (DSS) appendix as specified by the acquiring activity (see 6.2). The requirements set forth in this specification shall become a part of the contractor’s overall inspection system or quality program. The absence of any requirements in this specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the government for acceptance comply with all requirements of the contract. Use of sampling inspections shall be at the discretion of the contractor, and in accordance with commercially acceptable quality assurance procedures. However, use of sampling in QA procedures does not authorize submission of known defective material, either indicated or actual, nor does it commit the government to accept defective material.

## 5 PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2d). When packaging of material is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point’s packaging activity within the Military Department or Defense Agency, or within the military service system commands. Packaging data retrieval

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is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

**6 NOTES**

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

6.1 Intended use. The manuals prepared in accordance with this specification are intended to provide instructions and guidance for personnel in battle damage assessment and repair of military assigned aircraft/equipment with military specific requirements.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- a. Title, number, and date of this document.
- b. If missions are to be other than those identified by the Flight Manual (see [3.3.2.2](#)).
- c. The requirements for tests, reviews, and verifications specified for manuals developed under this specification (see [4.1](#)).
- d. Packaging requirements (see [5.1](#)).

6.3 Technical manuals. The requirement for technical manuals should be considered when this specification is applied on a contract. If technical manuals are required, specifications and standards that have been authorized and assigned an Acquisition Management Systems Control (AMSC) number must be listed on a separate Contract Data Requirements List (DD Form 1423), which is included as an exhibit to the contract. The technical manuals must be acquired under separate contract line item in the contract.

6.4 Subject term (key word) listing.

ABDAR  
Damage limitations  
Fire and heat damage  
Rotary wing/fixed wing aircraft zones  
Structural repairs  
Structure analysis

6.5 Definitions. For the purposes of this document, the following definitions apply.

6.5.1 Aircraft Battle Damage Assessment and Repair (ABDAR). Maintenance actions taken in wartime to quickly return battle damaged aircraft to some degree of mission capability, through effective use of maintenance resources to assess, defer repair, repair, or cannibalize those aircraft.

6.5.2 Assessors. Personnel from aircraft maintenance career fields that have been trained to evaluate the extent of battle damage, determine repair, deferability, estimate repair times, specify repair to be accomplished, and estimate the resultant capability of the aircraft.

6.5.3 Categories. Used in structures assessment (see [3.3.9.2](#)) to categorize all external and internal structural members. Categories are defined as follows:

6.5.3.1 Category I - Primary Airframe Structures. Category I consists of airframe structural members which are absolutely essential to maintain aircraft structural integrity and are of primary significance. Any repair of these members requires retention of some minimum value of structural strength and stiffness, consistent with the original design parameters, and fabricated structural repairs for them are possible. These members are to receive first and foremost consideration from the assessor (see [3.3.9.2.1.1](#)).

6.5.3.2 Category II - Secondary Structures. Category II involves structures which serve to transfer aerodynamic and other loads to the primary structural members. These structures primarily consist of external skin panels that are not considered primary stress panels, intermediate ribs, stringers, and formers which only serve to transfer loads to primary members. Repair of these structural members does not require restoration of original design strength and stiffness within the context of a wartime environment (see [3.3.9.2.1.2](#)).

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6.5.3.3 Category III - Nonessential Structures. Category III consists of structures such as doors, panels, tips, fairings, etc., which may be extensively damaged or completely missing, and no repair or replacement is required to maintain the airworthiness or mission capability (see 3.3.9.2.1.3).

6.5.3.4 Category IV - Special Structures. Category IV involves structures that are non-structural, but essential for safe flight and aircraft performance. Repair requirements for these structures are based upon considerations other than strength; such as aerodynamics, pressurization, or engine performance (see 3.3.9.2.1.4).

6.5.3.5 Category V - Repair-restrained Structures. Category V includes structures that are not feasible to repair under battle damage repair restraints, due to design and shape. These structures include all complex machined or forged parts, and irregular shaped extrusions, channels, or angles, etc. These structures are not feasible to replace or local manufacture, without depot support. The only repairs consist of minor nick, dent, and scratch removal (see 3.3.9.2.1.5).

6.5.4 Coded. Shading and cross-hatching of structural drawings, indicating category of structure (see figure 5).

6.5.5 Damage classes. The damage classes referenced in 3.3.9.2.1.1 are defined as follows:

6.5.5.1 Class A - Degraded Capability. Class A involves damage limits that result in establishing operational restrictions when repair is not accomplished. The only purpose of this damage class is to permit restricted use of the aircraft when time to repair is an operationally critical factor.

6.5.5.2 Class B - Repairable Damage. Class B consists of damage limits that permit structural repair within 24 hours or less, per single repair. Repairs, to restore static strength and stiffness of the damaged component for Category I, II, and IV structures, will restore full operational capability of the aircraft for at least one more flight.

6.5.5.3 Class C - Acceptable Damage. Class C involves damage limits that do not impose any operational restrictions on the aircraft, when structural repair is not performed. Minimal cleanup of damage may be required (e.g., stop drill, stress reduction, etc.).

6.5.6 Degradation. The reduction in systems/subsystems/components performance capability that is required for a designated mission or system operation.

6.5.7 Essential. Those systems/subsystems/components that are required for a designated mission or system operation.

6.5.8 Flight safety hazard. An existing or potential condition that can result in a flight mishap.

6.5.9 Full capability (FC). Those systems/subsystems/components that are required, as originally designed, for full mission operation.

6.5.10 Not required (NR). Those systems/subsystems/components that are not required for a designated mission.

6.5.11 Degraded performance (DP). Identifies those systems/subsystems/components that can fulfill the requirements of a designated mission while operating at less than normal level.

6.5.12 Interchangeability. As defined in this specification, interchangeability is above the scope of the classic definition. The intent/purpose of this specification is to allow fully innovative fixes/repairs to the aircraft. This includes minor modifications that can be made to achieve interchangeability.

6.5.13 Leak rate. The speed or rate of flow of fluid or gas escaping from a system, when the escape is caused by damage processes. The leak rate is influenced by such factors as the hole size, internal/external pressures, and fluid level.

6.5.14 Orthographic view drawing. As outlined in ASME Y14.3:2012 (see <http://www.asme.org>).

6.5.15 Load limit. The design load for unrestricted operations, and/or the equivalent of a designated condition for the load envelope cases consistent with any aircraft operational restrictions.

6.5.16 Typical repairs. Typical ABDAR repairs are all repairs that provide full or partial mission capability (e.g., safing a nonessential system).

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6.6 Wiring data and schematic diagrams. See 3.2.2. For instructions for preparing wiring data and schematic diagrams, refer to MIL-HDBK-863, Department of Defense Handbook for Wiring Data and System Schematic Diagrams, Preparation of (available through ASSIST online - see 2.2.1 for information on obtaining copies).

6.7 TM Verification Requirements. See 4.1. The Air Force Technical Order Policy and Procedures (AF TOPP) team, AFMC/A4FI, provides the specific requirements for verification of technical data developed and delivered through this specification, as well as guidance for including these requirements in the solicitation or contract (see TO 00-5-3.)

6.8 Amendment notations. The margins of this specification are marked with vertical lines to indicate modifications generated by this amendment. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations.

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MATERIAL AND CONDITION	ULTIMATE TENSILE STRENGTH (UTS) (KSI)	REDUCED STRENGTH (80%) (KSI)	HARDNESS (ROCKWELL)	CONDUCTIVITY (ALUM ONLY) (% IACS)(1)	MIN. TEMP TO AFFECT UTS (°F)
4130	100	80	86-93Rb	-	1250
	120	96	93-100Rb	-	1050
	140	112	21-28Rc	-	925
	160	128	27-35Rc	-	850
4340	120	96	91-101Rb	-	1200
	140	112	21-28Rc	-	1100
	160	128	27-35Rc	-	1050
D6ac	180	144	32-37Rc	-	1100
	200	160	35-39Rc	-	1050
	220	176	39-44Rc	-	1000
	260	208	44-49Rc	-	550
HY-180 (10 Nickel)	180	144	32-40Rc	-	950
300M	270	216	45-52Rc	-	550
301 - A	110	88	91-98Rb	-	1850
	125	100	95-102Rb	-	200
	150	120	24-30Rc	-	200
	175	140	30-5-36Rc	-	200
H	185	148	33-40Rc	-	200

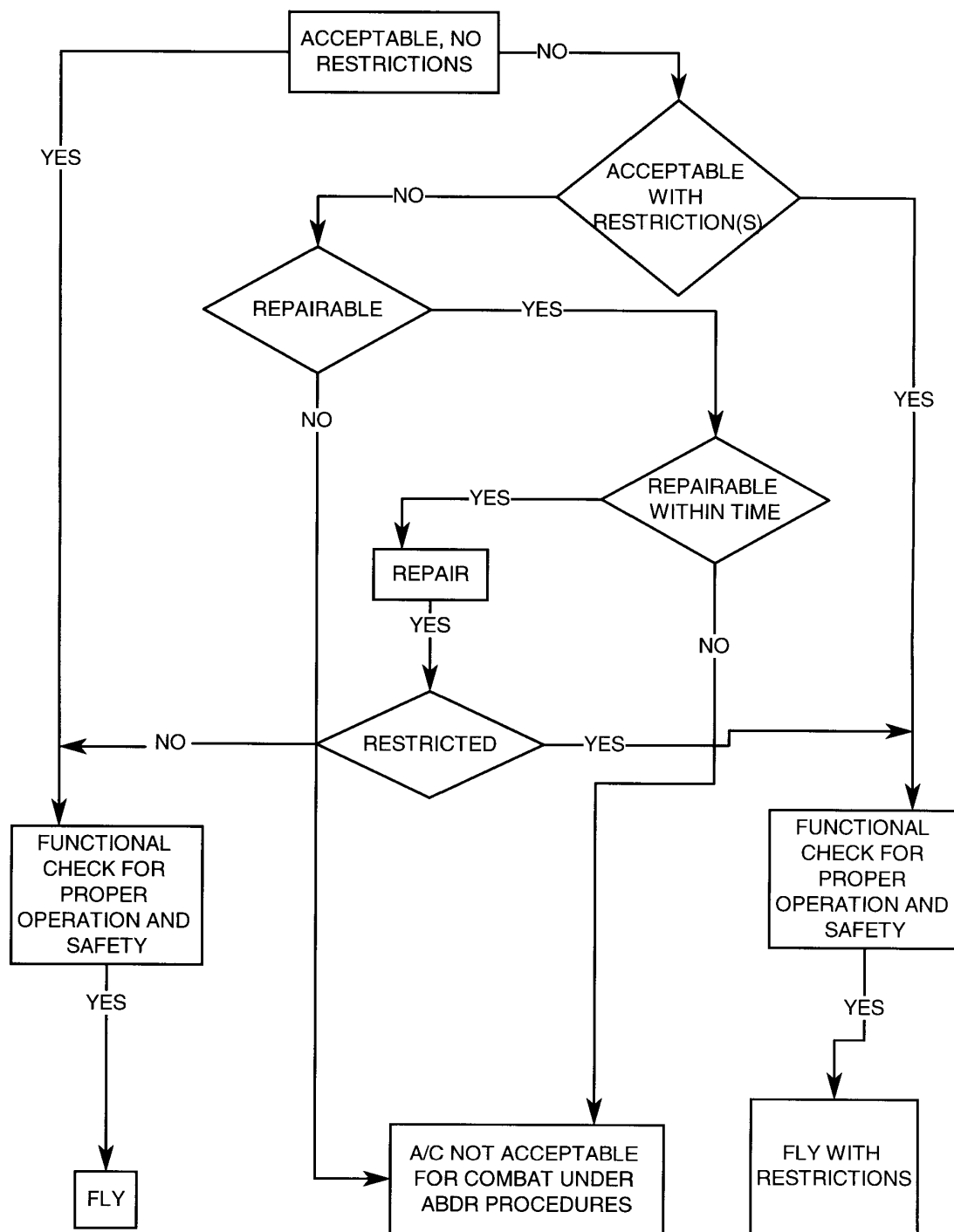
**NOTES:**

- (1) On aluminum alloys, conductivity measurements should be compared to known undamaged areas to identify the general area of heat damage. Hardness is a more reliable measurement of property degradation.
- (2) At temperature exposures slightly above 385°F., strength and hardness may actually increase, but corrosion resistance will deteriorate. For short-term use, material in this condition may be used without repair.
- (3) Approximate hardness only. Significantly higher hardness may indicate embrittlement.

**FIGURE 1. Example of degradation of material properties.**

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**ASSESSMENT LOGIC AND REPAIR DISPOSITION**



**FIGURE 2. Repair assessment logic.**

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ZONE	TITLE
1.	COCKPIT
2.	CABIN
3.	MAIN ROTOR PYLON
4.	REAR FUSELAGE
5.	TAIL CONE
6.	TAIL ROTOR PYLON
7.	STABILATOR

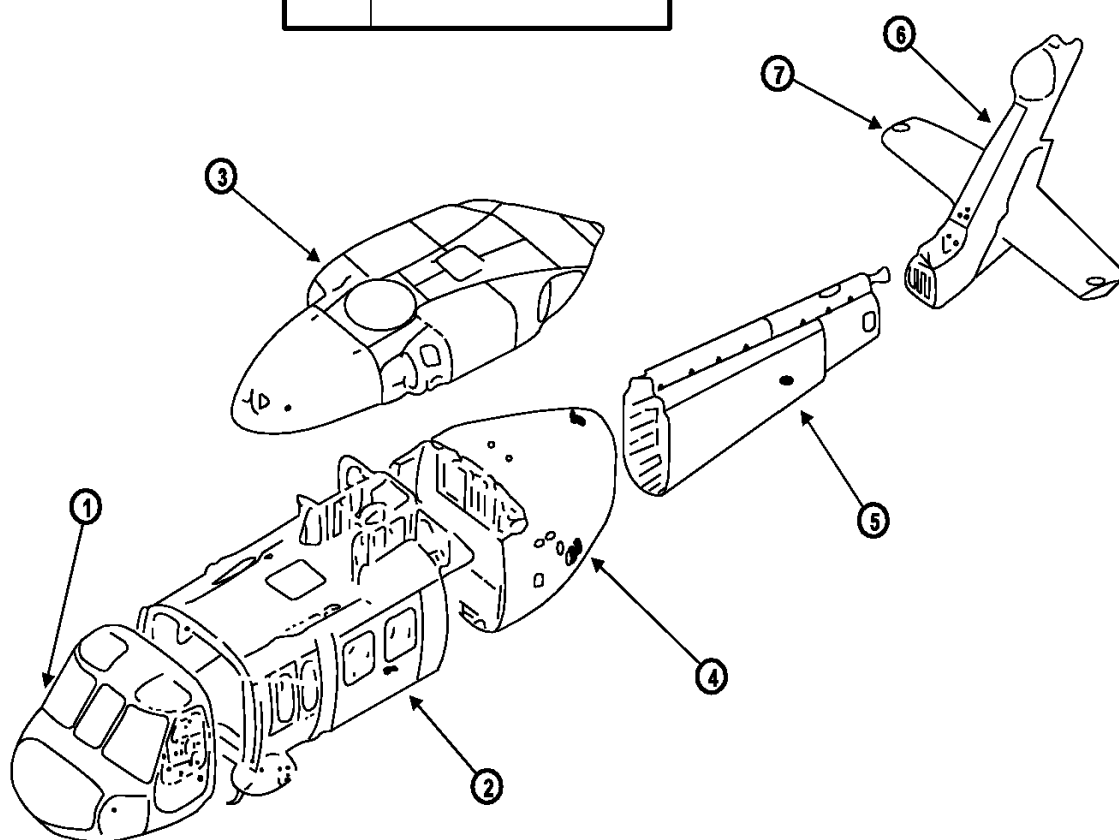
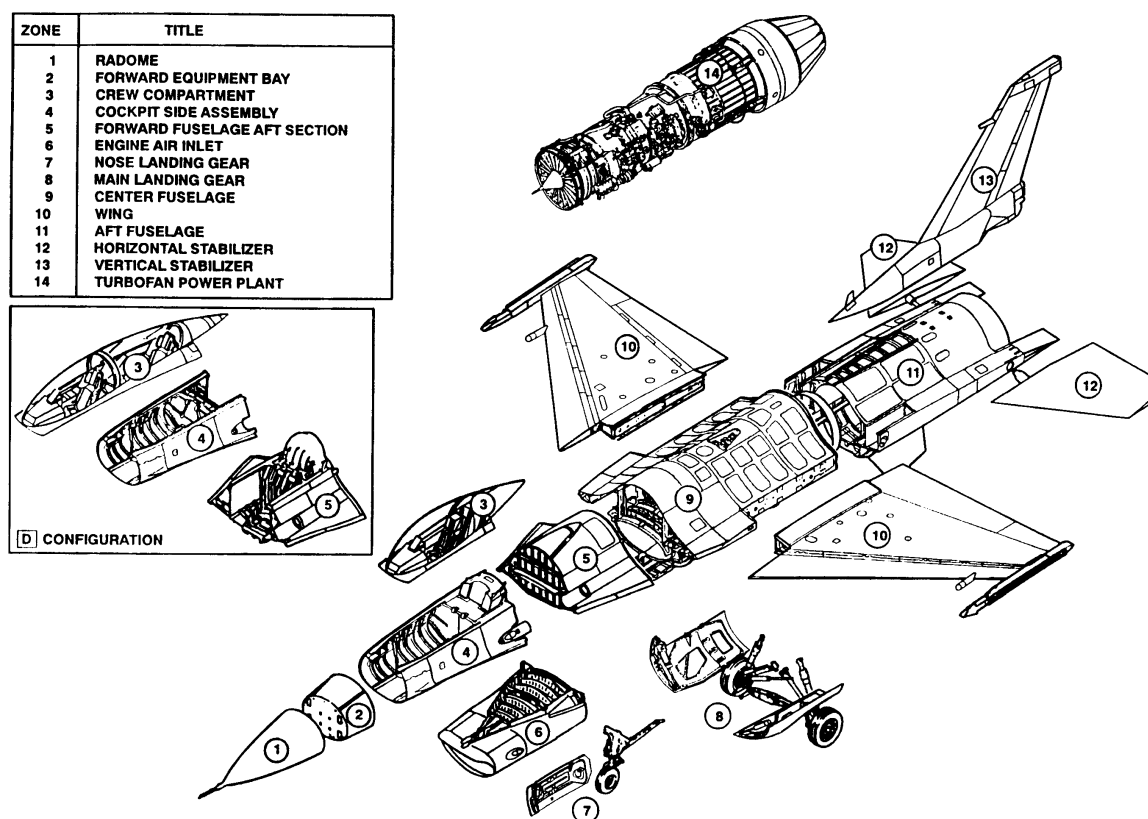


FIGURE 3. Example of rotary wing aircraft zone breakout.

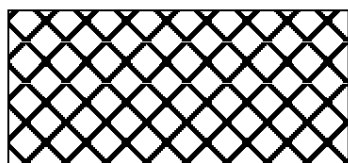
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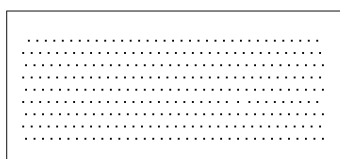
**FIGURE 4. Example of fixed wing aircraft zone breakout.**

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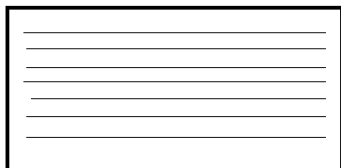
**CATEGORY CODES**



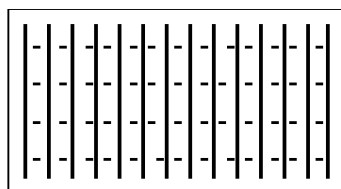
**CATEGORY 1**  
FULL STRENGTH  
NET 3



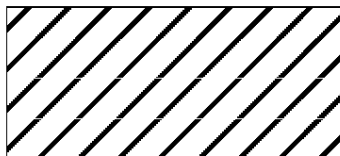
**CATEGORY 2**  
PARTIAL STRENGTH  
DOTS



**CATEGORY 3**  
NO REPAIR REQUIRED  
LINF



**CATEGORY 4**  
SPECIAL REQUIREMENTS  
NET



**CATEGORY 5**  
REPAIRS NOT ALLOWED  
SACNCR

NOTE: CROSSHATCH PATTERNS CAN BE ROTATED.

**FIGURE 5. Examples of category codes.**

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MISSION SERVICEABILITY CRITERIA				
<u>SYSTEM/SUBSYSTEM</u>	<u>FERRY</u>	<u>LOGISTICS</u>	<u>REMARKS</u>	<u>PAGE</u>
Logistics Rail System	NR	DP	Refer to FORWARD LOADING SYSTEM DAMAGE ASSESSMENT	8-76
Toes	NR	FC	Refer to FORWARD LOADING SYSTEM DAMAGE ASSESSMENT	8-77
LANDING GEAR SYSTEM				
NLG Control System				
Extension/Retraction System	DP	DP	Refer to LANDING GEAR DAMAGE ASSESSMENT	8-77
Emergency Electrical Override System	NR	NR		
Kneeling System	NR	DP	Refer to LANDING GEAR DAMAGE ASSESSMENT	8-78
NLG Steering System	DP	DP	Refer to LANDING GEAR DAMAGE ASSESSMENT	8-72
NLG Fiber Optic Scope	FC	FC	Refer to LANDING GEAR DAMAGE ASSESSMENT	8-78
FLIGHT CONTROL SYSTEM				
Aileron System	FC	FC	Refer to FLIGHT CONTROLS DAMAGE ASSESSMENT	8-79
Elevator System	FC	FC	Refer to FLIGHT CONTROL DAMAGE ASSESSMENT	8-79

**FIGURE 6. Mission Serviceability Criteria.**

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<u>EFFECTS RESTRICTIONS</u>	
<u>FUNCTIONAL CHECK</u>	
<u>MAINTENANCE ACTION/ REPAIR REFERENCE</u>	
<u>ACCEPTABLE DAMAGE</u>	
<u>NOMENCLATURE</u>	
<u>INDEX</u>	

**FIGURE 7. System assessment.**

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**Table 20-86. Electrical Harness H16DW355**

MISSION	FROM	THRU		VIA		THRU		TO	SYSTEM			
		ZONE	CONNECTOR	PIN	WIRE	GA	CONNECTOR			PIN	ZONE	H16DW
H16DW355-13 Eff: 87												
A-G	555	4	9153P309	11	019	22	9471P403	17	4	9471A1	FC	94
	153	5	3238P501A	5	022	26	9471P402	41	4	9471A1	FC	94
	153	5	3238P501A	6	023	26	9471P402	42	4	9471A1	FC	94
	153	5	3238P501A	17	027	22	9471P403	15	4	9471A1	FC	94
	153	5	3238P501A	18	028	22	9471P403	6	4	9471A1	FC	94
	555	4	9153P309	18	201	26-1	9471P403	26	4	9471A1	FC	94
	555	4	9153P309	19	201	26-2	9471P403	11	4	9471A1	FC	94
	355	4	9153P309	8	201	99SH	9471P403	8	4	355	FC	94
	555	4	9153P309	3	203	26-1	9483P552A	1	4	146	DP NOTE 3(A)	94
	555	4	9153P309	4	203	26-2	9483P552A	2	4	146	DP NOTE 3(A)	94
	355	4	9153P309	8	203	99SH	9483P552A	8	4	355	DP NOTE 3(A)	94
	555	4	9153P309	14	204	26-1	9483P551A	1	4	146	DP NOTE 3(B)	94
	555	4	9153P309	15	204	26-2	9483P551A	2	4	146	DP NOTE 3(B)	94
	355	4	9153P309	8	204	99SH	9483P551A	8	4	355	DP NOTE 3(B)	94
	9471A1	4	9471P403	40	207	26-1	9483P552A	5	4	146	DP NOTE 3(A)	94
	9471A1	4	9471P403	41	207	26-2	9483P552A	6	4	146	DP NOTE 3(A)	94
A-A	355	4	9471P403	8	207	99SH	9483P551A	8	4	355	DP NOTE 3(A)	94
	9471A1	4	9471P402	30	208	26-1	9483P551A	5	4	146	DP NOTE 3(B)	94
	9471A1	4	9471P402	49	208	26-2	9483P551A	6	4	146	DP NOTE 3(B)	94
	355	4	9471P402	8	208	99SH	9483P551A	8	4	355	DP NOTE 3(B)	94
	555	4	9153P309	9	209	26-1	9483P551A	7	4	146	DP NOTE 3(B)	94
	555	4	9153P309	10	209	26-2	9483P551A	8	4	146	DP NOTE 3(B)	94
	355	4	9153P309	8	209	99SH	9483P551A	8	4	355	DP NOTE 3(B)	94
	153	5	3238P501A	10	210	26-1	9471P402	27	4	9471A1	FC	94
	A-G	5	3238P501A	10	210	26-1	9471P402	27	4	9471A1	DP NOTE 5	94
	A-A	5	3238P501A	11	210	26-2	9471P402	28	4	9471A1	FC	94
	A-G	5	3238P501A	11	210	26-2	9471P402	28	4	9471A1	DP NOTE 5	94
	555	4	9153P309	7	215	26-1	9483P551A	3	4	146	DP NOTE 3(B)	94
	555	4	9153P309	8	215	26-2	9483P551A	4	4	146	DP NOTE 3(B)	94
	355	4	9153P309	8	215	99SH	9483P551A	8	4	355	DP NOTE 3(B)	94
	153	5	3238P501A	9	300	26-1	9471P402	24	4	9471A1	DP NOTE 5	94
	A-G	5	3238P501A	8	300	26-2	9471P402	25	4	9471A1	DP NOTE 5	94
A-G	5	3238P501A	7	300	26-3	9471P402	11	4	9471A1	DP NOTE 5	94	

**FIGURE 8. Examples of electrical harness with pin location.**

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## APPENDIX A

### ABDAR TECHNICAL MANUAL MARKUP LANGUAGE TOOLS

#### A.1 SCOPE.

A.1.1 Scope. This appendix describes the standard Air Force (AF) markup language digital tools created for developing and delivering AF Technical Manuals (TMs). These tools are available as subsets in the Digital Support Suites (DSS) provided by the AF TMSS activity (see [A.2](#)). This appendix is a mandatory part of this detail specification. The information herein is intended for compliance.

A.1.2 Template Tool. The DTD is the primary tool that is used as the structure for authoring AF TMs and is based on rules outlined in MIL-HDBK-28001 and ISO 8879. See [A.2.1](#) for information about the DTD specified for this appendix subset.

#### A.2 DSS.

The DSS is comprised of the following tools for authoring and rendering the TM. See [A.3](#) for information about obtaining DSS component files in digital format through the TMSS activity website. For information about the current status and availability of DSS tools, see [A.3.4](#).

A.2.1 DTD. The DTD provides the structure and content template in accordance with the content specific requirements of this specification (see Section [3](#)). To be delivered digitally, the TM shall be tagged using the applicable DTD provided through the TMSS activity. Information concerning the markup language type and use of DTDs currently provided, i.e., Standardized General Markup Language (SGML), may be obtained through the contacts listed under [A.3](#).

A.2.2 Deleted.

A.2.3 Tag Description Table (TDT). The TDT provides detailed descriptions of the elements contained in the DTD. The TDT contains the element tagging structure, parent elements, full element name, source paragraph for this specification, attribute descriptions unique to the element, and entities.

A.2.4 Deleted.

#### A.3 OBTAINING DSS TOOLS.

A.3.1 Obtaining files by users with .mil web site access. The following applies to those interested in obtaining DSS component files who are on a .mil internet domain, having .mil web address access.

A.3.1.1 AF TMSS web site. DTDs, TDTs, and other files in the DSS can be accessed on the TMSS web site at <https://techdata.wpafb.af.mil/TMSS/>. On the web page, the “Baseline” menu option in the left pane contains three bulleted options called “Specifications”, “Standards”, and “Handbooks”. Hover the cursor over “Specifications” and a listing of the TMSS specifications will appear. Hover over the desired specification number and another drop down list will appear that contains an entry indicating the Portable Document Format version of the specification and other entries for the associated appendices. To obtain the preferred subset DTD, select the desired appendix from the list. The following items will appear on the downloading page: The name of the specification, the appendix number and name, the current version of the DSS, buttons to download specific DSS files provided and a “Download” button to download the entire DSS zip file.

A.3.2 Obtaining files by users with a Public Key Infrastructure (PKI) certificate or a Common Access Card (CAC). The following applies to those interested in obtaining DSS component files who have a PKI certificate or a CAC:

A.3.2.1 AF TMSS SharePoint web site. DTDs, TDTs, and other files in the DSS can be accessed at the AF TMSS SharePoint web site: <https://cs2.eis.af.mil/sites/12316/default.aspx>.

A.3.3 Obtaining files by users without .mil access, PKI certificate, or CAC. Those seeking to obtain DSS files who do not have .mil web access, a PKI certificate, or a CAC should contact their government Program Management Office or see [A.3.4](#) to obtain information.

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**APPENDIX A**

A.3.4 TMSS Helpdesk assistance. Address any requests or questions relating to the DSS by E-mail to [SGMLSUPPORT@us.af.mil](mailto:SGMLSUPPORT@us.af.mil) (organizational address: Wright-Patterson AFLCMC/HIS-TMSS HLPDSK) or by postal mail to Air Force Technical Manual Specifications and Standards, AFMC AFLCMC/TMSS, 4170 Hebble Creek Road, Building 280, Door 15, Wright-Patterson AFB OH 45433-5653.

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**CONCLUDING MATERIAL**

Custodians:

Army - TM

Navy - AS

Air Force - 16

Preparing activity:

Air Force - 16

(Project TMSS-2019-013)

Review activities:

Army - AV

Air Force - 10, 11

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