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**MIL-PRF-9854B**

1 October 1969

**SUPERSEDING**

**MIL-M-9854A**

9 January 1963

## Performance Specification

# TECHNICAL MANUALS: STRUCTURAL REPAIR (For Aircraft)

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

## 1. SCOPE

1.1 *Basic manual.* This specification covers the requirements for the preparation of technical manuals of instructions for structural repair of aircraft, excluding Battle Damage repair.

1.2 *Battle damage data.* The procuring activity will specify whether Battle Damage data shall be provided as a separate manual or as an appendix to the basic manual. When issued as a

separate manual, the cover/title page of both manuals shall reference each other.

## 2. APPLICABLE DOCUMENTS

2.1 The following documents of the issue in effect on the date of invitation for bids, or request for proposal, form a part of this specification to the extent specified herein.

## SPECIFICATIONS

### Military

MIL-M-63000	Manuals, Technical, General Preparation Instructions for Manuscripts and Illustrations.
MIL-M-38784	Manuals, Technical: General Requirements for Preparation of
*MIL-P-38790	Printing Production of Technical Manuals: General Requirements for

(\*Applicable to Army only, only when specified by the procuring activity.)

(Copies of documents required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer).

## 3. REQUIREMENTS

3.1 *Preparation.* The general manner of preparation of the basic manual and Battle Damage data (when required) shall conform to MIL-M-63000, MIL-M-38784, and MIL-P-38790, as applicable. Air Force and Navy manuals shall be divided into chapters and sections.

3.2 *Basic Manual.* The extent of coverage shall be governed by the following criteria.

3.2.1 *Contents.* The manual shall contain information required by maintenance personnel for determining the extent of damage to the aircraft structure and instructions for its repair that are not contained in general manuals for structural repair and other general repair manuals.

3.2.1.1 When repairs covered in the general repair manuals are acceptable for the applicable aircraft, it shall be so stated and referenced in the appropriate chapter/section of the manual. If the information in the general repair manual is unacceptable, the aircraft manual shall contain the proper information as the aircraft manual will take precedence over the general manual.

3.2.1.2 Repair instructions for new or peculiar structures, such as tapered skin, sandwich materials, honeycomb assemblies, and reinforced plastics, shall be included in the manual if they are not covered in the general repair manuals. Coverage of structural components of pods and external tanks shall be provided.

3.2.1.3 The repairs outlined in the manual shall be as simple and practical as possible

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(considering accessibility, adjacent structures, etc) and wherever practicable, shall require only hand tools. However, the use of jigs, machine tools, etc, and rivets requiring heat treatment before driving, shall be specified when necessary.

3.2.1.4 When a repair outlined in the manual involves the use of an extrusion, an alternate repair, utilizing sheet, bar, or tubing, instead of extrusion, shall also be shown, whenever such a repair is practicable.

3.2.1.5 When new types or classes of material are incorporated in the original construction of the aircraft, an alternate repair, if practical, shall be included based on using the more common materials generally available.

3.2.1.6 Removal and installation instructions shall be included for all structure beyond organizational and intermediate level maintenance that is not included in the organizational maintenance (flight line) manual; such as, structural members, large wing and fuselage panels, stabilizers, floor panels, that are removed for access and repair at Specialized Repair Activities, Inspection Repair As Necessary facilities, and Depot/Overhaul installations.

3.2.1.7 When a separate Corrosion Control manual is being procured, corrosion control information shall not be included in the Structural Repair manual.

3.2.1.8 Instructions for one time (ferry) flight repairs, temporary repairs, critical area repairs, and combat area repairs shall include information on flight restrictions to be imposed (if applicable) until such time as permanent repairs have been completed.

3.2.2 *Damage.* Classification shall be as follows: negligible damage, repairable damage, crash damage, combat area damage.

3.2.2.1 Each class of damage shall be clearly defined, with examples cited, for each component of the major structural groups covered by the structural group repair sections in the manual. The definitions of each class of damage for a component shall appear in the section of the manual covering the component to which the definitions apply.

3.2.3 *Repairs.* The scope of the repairs to the various components shall provide for the repair of any repairable damage in any loca-

tion. Definite positive statements regarding repair decisions shall be made to preclude misinterpretation and indecision in connection with typical repairs. Cautions shall be included to prohibit unauthorized repairs and materials. Where the loads, material thickness, and margin of safety vary, a table indicating the station, material, thickness, fastener diameter, number of fastener rows, fastener spacing, doubler overlap and bonding requirements, extent of allowable damage, and information regarding reinforcement data to transfer design loads, shall be provided. Where the loads do not vary, typical loads and minimum design loads for tension, compression, and shear shall be shown.

3.2.3.1 *Description of repairs.* The description of repairs shall be complete and show compliance with all relevant design requirements. The repair shall be such as to make the strength of the repaired structure equal to or greater than that required to maintain the structural capability of the aircraft with due considerations to stiffness and thermal problems. Illustrations of the members or components showing where the various types of repairs are to be employed shall be given and the areas where each type is to be used shall be indicated by shading or other appropriate means. When a combination of two or more repairs will weaken or overstiffen the member beyond the safe limit, the combination shall be indicated and a caution shall be given to prohibit such a combination. All specific repairs shall be identified by part numbers.

3.2.3.2 *Use of standard parts.* Wherever possible, Government standard parts shall be specified for use in repair or replacement. References in the manual to these parts shall be by the applicable Government standard part designation.

3.2.4 *Illustrations.* In addition to the illustrations specified in 3.2.3.1, the following illustrations, diagrams, and charts shall be included in the manual with such additions as may be required to illustrate detailed repair of the aircraft. Illustrations shall be located as closely as possible to the related text.

3.2.4.1 A three-quarter view frontispiece illustration of the aircraft shall face the first page of Section I, (Chapter 1, Army manuals).

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3.2.4.2 A three-quarter front view illustration in exploded form, indexing all major structural groups, shall be placed in Section I (Chapter 1, Army Manuals).

3.2.4.3 Diagram(s) shall be provided in Section I (Chapter 1, Army manuals) identifying by number the airplane stations. Numbers shall be identified with the stations by use of connecting lines.

3.2.4.4 The manual shall include a full page illustration of each major structural group in the applicable repair section. This illustration shall be indexed to show the location of the repair index of each component. Component repair index illustrations shall be coded and an accompanying table shall indicate, as applicable, the index number, major or subassembly drawing number, description, size, gage, material, heat treatment, and reference to the repair illustrations.

3.2.4.5 Diagram(s) shall be provided showing the principal symmetry check dimensions, such as nose to wing tips, wing tips to tail, etc., and permissible field variations. These variations shall never be less than the original manufacturing tolerances. Measurements shall be taken from clearly defined points which may be easily located and identified in the field. Diagrams and text shall also be provided giving alignment check data for landing gear, wing, stabilizers, etc., to ensure proper aerodynamic performance.

3.2.4.6 An illustration shall be included clearly showing and identifying the special points used in leveling the airplane transversely and longitudinally. Leveling tools shall be described and illustrated, as necessary.

3.2.4.7 Repair diagrams and illustrations shall be provided. These diagrams and illustrations shall show all dimensions required for repairs. Such diagrams and illustrations shall consist of patch size, patch overlaps, cover plates, extrusions, stringers, longerons; rivet, bolt, plug, and screw sizes; spacings, edge distances, materials, etc. Sketches shall be included of specific repairs, and repairs typical to the construction of the applicable aircraft, which are not covered in general manuals for structural repair.

3.2.4.8 Illustrations shall be included for the major structural components (wing, stabilizer,

etc) which will provide contour data and dimensions necessary for the construction of templates, support fixtures, and repair jigs for use in repairing the principal components. Where applicable, contour data shall include the list of contour and master dimension drawings.

3.2.4.9 Illustrations of structural repair kits (and explanation of the use of each kit) shall be provided, when applicable.

3.2.5 *Arrangement.* The manual shall be arranged in the following order and the sections (chapters, Army manuals) numbered consecutively.

Front Matter

Section I, General

Section —. Separate sections shall be provided for each of the major structural groups, such as fuselage, empennage, wing, landing gear, engine, etc., as applicable. Separate sections shall also be provided for peculiar Fuel Tank Sealing and peculiar Radome Repairs.

Section —. Damage Due to Landing Gear Failure.

Section —. Typical Repairs and Applications.

Section —. Repair Materials and Special Tools.

Appendix —. Battle Damage Repair (when specified by the procuring activity).

3.2.5.1 *Front matter.* In addition to the requirements of MIL-M-38784, the following is applicable.

3.2.5.1.1 *Introduction.* The introduction shall be a brief explanation of the purpose of the manual and method of application. A statement shall be included to the effect that use of battle damage repair instructions (when contained in the appendix) shall be restricted to units operating under actual combat conditions. When Battle Damage instructions are covered in a separate manual, the preceding statement shall appear in the Battle Damage manual introduction. A series of simple sketches may indicate a method for obtaining the best use from the manual. The introduction shall include a reference to the contractor's "Structural Repair Illustration

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Document" and a statement where copies can be obtained.

3.2.5.2 *Section 1, General.* The general section shall cover, but not be limited to, the following items:

3.2.5.2.1 *Description.* Information relative to describing the aircraft, such as: type of construction, new materials used, categories of repair capabilities, classification of damage, types of repair, aerodynamic smoothness, principal dimensions, definition of reference lines, and major structural group breakdown.

3.2.5.2.2 *Airframe cleaning and finishing.* Information relative to cleaning, removal of finishes, and finishing, such as: cleaning procedures and materials required; finishes required on the various areas of the airplane with procedures for application of the finishes; corrosion preventive measures and treatment (refer to 3.2.1.7); and precautions to be followed in working with the materials.

3.2.5.2.3 *Airframe sealing.* Information on all areas requiring sealing, type of seal required in each area (using Government specifications where applicable), sealing procedures to use, and precautions to be followed in working with the materials. (Fuel tank sealing shall be in a separate section.)

3.2.5.2.4 *Pressure testing.* Information on pressure testing of sealed compartments wherever such testing will be required after repair to check for leakage or structural integrity.

3.2.5.2.5 *Control surface rebalancing.* Information for mass rebalancing of all hinged control surfaces by calculated and improvised methods with allowable field tolerances; and instructions covering dynamic rebalancing.

3.2.5.2.6 *General shop practices.* Information on sheet metal forming; working titanium alloys; installation, removal, and substitution of fasteners equal to or better than those removed; filling dimpled holes; coin dimpling and special tools. Information relative to weld repair that may be accomplished on assemblies which are of welded fabrication, on minor unstressed fittings, on castings which are manufactured from weldable materials. Substitute parts and locally manufactured parts shall be identified.

3.2.5.2.7 *Crash handling and shipping.* Information relative to safety precautions, such as

removal of batteries, fuel, oil, liquid oxygen and explosive activated escape devices (prior to crash handling) and the equipment, methods, and procedures for lifting and moving damaged aircraft from the crash site. Information about corrosion prevention (refer to 3.2.1.7) and, where applicable, crating and shipping instructions, which would include crates, cradles, support points, weight and center of gravity, of each component.

3.2.5.2.7.1 For small, short range, or specialized aircraft, complete aircraft shipping information shall be provided covering disassembly, crating, shipment (mooring) and reassembly with appropriate references to related manuals.

3.2.5.2.8 *Damage evaluation.* Criteria so that the following inspections may be accomplished:

a. Preliminary external inspection for skin buckles, deformation, etc.

b. Detailed visual inspection information for obvious damage areas and adjacent areas, including information about critical points and access. Inspection methods and techniques, such as: fire damage inspection by use of portable testers and primer discoloration; alignment check of the aircraft and of its major assemblies; over "G" and hard landing inspection; corrosion damage (refer to 3.2.1.7); severe engine stalls; pitch up or use of drag chute as a spin chute and abnormal drag chute deployment; external pressure testing of items for strength as well as leaks; heat damaged or delaminated honeycomb structure.

c. Identification of those areas requiring structural engineering to design an acceptable repair.

d. Identification of the nondestructive inspection method to be used to determine the extent of damage, or reference to the applicable nondestructive inspection manual.

3.2.5.2.9 *Support of structure.* Required locations for supporting the structure during repair and details for fabrication and use of supports. All stress plates or stress panels of the aircraft which require shoring or structural supporting prior to removal, shall be identified.

3.2.5.2.10 *In-service use criteria.* Permissible wear and deviation over and above original manufacturing tolerances, critical external surface contour tolerances, reaming and bush-

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ing, allowable clearances, and replacement items.

3.2.5.2.11 *Forms and records, reporting of errors.* (Army only). The requirements of MIL-M-63000 are applicable.

3.2.5.3 *Section(s) ... "Repair Sections".* (Chapters, Army manuals). Each repair section (chapter) shall describe the construction of the major assemblies of the structural group involved. Wear tolerance charts shall be provided, when applicable, and the negligible damage limits shall be given for each component in the group. One-time flight (ferry) repairs, temporary repairs, and permanent repairs shall also be shown for each component, as applicable. Contour data and dimensions necessary for the construction of templates and repair jigs for use in repairing the principal components shall be provided at the end of each section. Peculiar Fuel Tank Sealing and peculiar Radome Repairs shall be in separate sections (chapters).

3.2.5.4 *Section/Chapter ... Damage Due to Landing Gear Failure.* This section shall cover the type of damage resulting from landing gear failure, such as auxiliary gear up, main gear up, all gears up, auxiliary gear tire blow-out, main gear tire blowout, and explain the inspections and repair thereof.

3.2.5.5 *Section/Chapter ... Typical Repairs and Application.* This section shall cover typical repairs which are those considered applicable to more than one section of the manual, i.e., skin patches, extrusion repairs, honeycomb type structures, formed structure repairs, transparent panel repairs, thermal buckling, deformation due to pressurization, trim strip manufacture, and installation requirements for removable panels/doors/hatches/etc.

3.2.5.6 *Section/Chapter ... Repair Materials and Special Tools.* Tables listing special tools, jigs, templates, leveling tools, etc., shall be given. Tables listing all materials required to make repairs shall be provided. Substitute materials and thicknesses of aluminum, magnesium, titanium, steel, etc., shall be stated. Such tables shall also list specification numbers, part numbers, extrusions by die number, or procurement sources.

3.2.5.7 *Appendix ... Battle Damage (when specified by the procuring activity).* This

appendix shall cover combat area damage and stress the usage of materials requiring relatively unsophisticated fabrication techniques, and their application in the restoration of structural integrity of the aircraft. (When contractually required, Battle Damage repair shall be covered in a separate publication.)

3.2.5.7.1 *References (Army only).* The requirements of MIL-M-63000 are applicable.

3.2.5.8 *Additional sections/chapters.* Sections/chapters or appendices in addition to those specified herein may be added to the manual to permit fulfillment of the intent of this specification. Special charts, tables (such as Tables of Minimum Margins of Safety), or diagrams not specifically required by this specification but considered necessary for a particular type of aircraft shall be included in the manual.

#### 4. QUALITY ASSURANCE PROVISIONS

4.1 Quality assurance provisions shall be in accordance with MIL-M-38784 and MIL-P-38790.

#### 5. PREPARATION FOR DELIVERY

5.1 Packaging, packing, and marking for shipment of the manual shall be in accordance with MIL-M-38784 and MIL-P-38790.

#### 6. NOTES

6.1 *Intended use.* The manuals prepared in accordance with this specification are intended to provide instructions and guidance to personnel in the repair of aircraft structure.

##### 6.2 Definitions.

6.2.1 *Negligible damage.* That damage or distortion which can be permitted to exist as is, or corrected by a simple procedure (removing dents, stop drilling cracks, temporary fabric patching, etc) without placing restrictions on flight.

6.2.2 *One time (ferry) flight repair.* A repair which restores limited load-carrying requirements of the member to allow flying the aircraft to a depot for application of a permanent repair.

6.2.3 *Temporary repair.* A repair which restores full load-carrying requirements of the member, but is deficient either from the standpoint of aerodynamic smoothness or from the



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interchangeability aspects of the parts involved. At the earliest convenience, each temporary repair shall be removed and a permanent repair installed in its place.

6.2.4 *Critical area.* An area of the aircraft that is highly stressed, fatigue critical, or that experience has shown to be subject to corrosion and damage in normal usage and which would affect the safety of the aircraft.

6.2.5 *Combat area repairs.* Repairs that shall be of an adequacy to retain functional capability of the aircraft and have the capability of being accomplished in a minimum amount of time, using limited tools, equipment, and materials.

6.3 *Ordering data.* Procurement documents should specify:

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

b. Whether Battle Damage data shall be covered in a separate manual or as an appendix to the basic manual. (1.2, 3.2.5.7)

Custodians:

Army—TM  
Navy—AS  
Air Force—16

Preparing Activity:

Air Force—16

Review Activities:

Army—AV  
Navy—MC  
Air Force—01, 10, 11, 70, 71, 80, 82, 84

User Activities:

Navy—CG

Project No. TMSS-0043

SPECIFICATION ANALYSIS SHEET		Form Approved Budget Bureau No. 22-R255
<p><b>INSTRUCTIONS:</b> This sheet is to be filled out by personnel, either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity. Comments and suggestions submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or serve to amend contractual requirements.</p>		
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1. HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE? A. GIVE PARAGRAPH NUMBER AND WORDING.		
B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES		
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4. REMARKS (Attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity)		
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