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MIL-PRF-9854C
29 November 1996
SUPERSEDING
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1 October 1969

PERFORMANCE SPECIFICATION

TECHNICAL MANUALS: STRUCTURAL REPAIR (AIRCRAFT)

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

1. SCOPE.

1.1 Scope. This specification covers the requirements for technical manuals containing aircraft structural repair instructions, excluding battle damage repair. In addition to paper" delivery, this specification provides for electronic delivery of data.

1.2 Battle damage data. The acquiring activity will specify whether battle damage data will be provided as a separate manual or as an appendix to the basic manual (see 6.2). When issued as a separate manual, the cover/title page of both manuals must reference each other.

1.3 Detail. The level of detail contained in this performance specification is necessary to comply with the requirements of the Joint Computer-aided Acquisition and Logistics Support (JCALS) system.

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 documents cited in sections 4 and 5 of this specification, whether or not they are listed.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Det 2, HQ ESC/AV-2, 4027 Col Glenn Hwy., Suite 300, Dayton, OH 45431-1672, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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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 issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

DEPARTMENT OF DEFENSE

MIL-PRF-28001	–	Markup Requirements and Generic Style Specification for Electronic Printed Output and Exchange of Text
MIL-PRF-83495	–	Manuals, Technical, On Equipment Set, Organizational Manuals: Detailed Requirements for Preparation of

STANDARDS

DEPARTMENT OF DEFENSE

MIL-STD-1808	–	System Subsystem Sub-subsystem Numbering (SSSN)
MIL-STD-38784	–	Technical Manuals: General Style and Format Requirements

(Unless otherwise indicated, copies of federal and military specifications, standards and handbooks are available from the Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

FEDERAL INFORMATION PROCESSING STANDARDS

FIPS PUB 152	–	Standard Generalized Markup Language (SGML)

(Copies of FIPS are available to Department of Defense activities from the Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094. Others must request copies of FIPS PUB from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161-2171.)

3. REQUIREMENTS.

3.1 Preparation. The general manner of preparation of the basic structural repair manual and battle damage data, when required, shall be in accordance with MIL-STD-38784. System Subsystem Sub-subsystem Numbering (SSSN) shall be developed in accordance with MIL-STD-1808.

3.1.1 Marginal Copy. When structural repair manuals will be used in conjunction with Organizational Maintenance Manuals prepared in accordance with of MIL-PRF-83495. Structural repair manuals shall display the applicable SSSN in the lower-outer corner of each page, using 18 point type, directly above the page number.

3.1.2 Nomenclature. When SSSNs are used, vehicle equipment nomenclatures excluding structural components shall be followed by the applicable higher level reference designation in

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parenthesis. Manual titles, chapter/section titles, and system/subsystem nomenclatures shall be followed by the applicable SSSN in parenthesis.

3.2 Basic structural repair manual. The extent of coverage shall be as follows:

3.2.1 Contents. The structural repair 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 Covered repairs. 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 manuals 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 New or peculiar structures. Repair instructions for new or peculiar structures, such as tapered skin, sandwich materials, honeycomb assemblies, reinforced plastics, and composite materials 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 also be provided.

3.2.1.3 Detail. Repairs contained shall be simple and practical (considering accessibility, adjacent structures, etc.). Wherever practical, repairs shall require only hand tools. The use of jigs, machine tools, etc., and rivets requiring heat treatment before driving, shall be specified when necessary.

3.2.1.4 Repairs involving extrusion. When a covered repair involves the use of an extrusion, an alternate repair, utilizing sheet, bar, or tubing, instead of extrusion, shall also be shown, when practical.

3.2.1.5 New types or classes of material. 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. Removal and installation instructions shall be included for all structure beyond organizational and intermediate level maintenance that is not included in the organizational maintenance manual.

3.2.1.7 Corrosion control information. Corrosion control information shall be included when a separate corrosion control manual is not being procured (see 6.2).

3.2.1.8 Special repair instructions. Instructions for one-time (ferry) flight repairs, temporary repairs, critical area repairs, and combat area repairs shall include information of 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, and combat area damage.

3.2.2.1 Defining classes of damage. 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

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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.

3.2.3 Repairs. The scope of the repairs to the various components shall provide for the repair of any repairable damage in any location. Definitive 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. It shall also maintain the structural capability of the aircraft with due considerations to stiffness and thermal problems. Illustrations of the members of 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 over stiffen 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 as many additions as required to illustrate detailed repair of the aircraft. Illustrations shall be located as close as possible to the related text.

3.2.4.1 Frontispiece. A three-quarter view frontispiece illustration of the aircraft shall face the first page of Section I.

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

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

3.2.4.4 Major structural groups. 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 Principal symmetry check dimensions. Diagrams(s) shall be provided showing the principal symmetry check dimensions and permissible field variations. These variations shall never

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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 Leveling of aircraft. 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. 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 Major structural components. Illustrations shall be included for the major structural components (wings, 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 Structural repair kits. 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 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 [see 6.2]).

(When these manuals are to be used in conjunction with Organizational Maintenance Manuals prepared in accordance with MIL-PRF-83495, the sections of major structural groups in the structural repair manuals shall be arranged in SSSN sequence. A separate manual shall be prepared for each section. The Introduction shall be located in the first manual only).

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

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3.2.5.1.1 Introduction. The introduction shall contain a brief explanation of the purpose of the manual and method of application. A statement shall also 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 be used to indicate a method for obtaining the best use from the manual. The introduction shall include a reference to the contractor's "Structural Repair Illustration Document" and a statement where copies can be obtained.

3.2.5.2 Section I, General. The general section shall as a minimum contain the following items:

3.2.5.2.1 Description of aircraft. Information relative to the aircraft description, 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 (see 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 of 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. Information on minor unstressed fittings and 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). Information relative to the equipment, methods, and procedures for lifting and moving damaged aircraft from the crash site. Information about corrosion prevention (see 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 Small, short range, or specialized aircraft. 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.

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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 damaged areas and adjacent areas, including information about critical points and access. Inspection methods and techniques, such as: fire damage inspection using portable testers and primer discoloration; alignment check of the aircraft and of its major assemblies; over "G" and hard landing inspection; corrosion damage (see 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 develop 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 the 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 eternal surface contour tolerances, reaming and bushing, allowable clearances, and replacement items.

3.2.5.3 Section(s), "Repair Sections". Each repair section (chapter) shall describe the construction of the major assemblies and 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 gear up, auxiliary gear tire blowout, 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 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.

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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 required by the acquiring activity, battle damage repair shall be covered in a separate publication (see 6.2).

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.

3.3 Digital Delivery. The basic structural repair and battle damage data, when required, shall be delivered in digital or paper copy as specified in the contract (see 6.2). Document type definitions (DTDs) have not been included at this time. If digital delivery of the manuals is required by the acquiring activity, the contractor shall contact Det 2, HQ ESC/AV-2 prior to developing any DTDs.

4. VERIFICATION.

4.1 Verification. Unless otherwise specified in the contract or purchase order:

a. Validity of the accuracy and scope of the technical content, shall be the responsibility of the contractor (see 6.2).

b. The contractor shall provide suitable facilities to perform the validation functions specified herein.

c. The contractor's existing quality assurance procedures shall be used.

d. The government reserves the right to review any of the verifications when such reviews are deemed necessary to ensure supplies and services conform to the prescribed contractual requirements.

4.1.1 Minimum verification requirements. As a minimum, verification shall ensure the following:

a. Suitability of the structural repair manuals, for the intended maintenance environment.

b. Usability by the intended users.

c. Compatibility with other Government systems.

4.1.2 Compliance. All structural repair manuals shall meet all of the requirements of sections 3 and 5 of this specification, as required 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.

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5. PACKAGING.

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite 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 Department's System Command. Packaging data retrieval 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 which may be helpful, but is not mandatory.)

6.1 Intended use. The technical manuals covered by this specification are intended for use by personnel to repair aircraft structure.

6.2 Acquisition requirements. Acquisition documents must specify the following:

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

b. Issue of the DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1.1, 2.1.2).

c. If corrosion control information is required (see 3.2.1.7)

d. If additional chapters, sections, or appendices are required (see 3.2.5.8).

e. If performance of inspection will be other than as specified in this document (see 4.1).

f. Type of delivery required (see 3.3).

g. Whether battle damage data will be covered in a separate manual or as an appendix to the basic structural repair manual (see 1.2, 3.2.5.7).

6.3 Definitions.

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

6.3.2 One-time (ferry) flight repair. A repair which restores limited-load-carrying requirements of the member to allow the aircraft to be flown to a depot for permanent repair.

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

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6.3.4 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.

6.3.5 Combat area repairs. Repairs that retain the functional capability of the aircraft and are capable of being accomplished in a minimum time, using limited tools, equipment, and materials.

6.4 Acronyms. The acronyms used in this document are defined as follows:

DoDISS - Department of Defense Index of Specification and Standards
ISO - International Organization For Standardization

6.5 Subject term (key word) listing.

Battle damage
Crash handling and shipping
Joint Computer-aided Acquisition and Logistic Support (JCALS)
Structural group
Symmetry check
System Subsystem Sub-subsystem Numbering

6.6 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

CONCLUDING MATERIAL:

Custodian:
Air Force - 16
Navy - AS
TM - TM

Review Activities:
Army – AV
Navy – MC, CG
Air Force – 01, 10, 11, 70, 71, 80, 82, 84, 90, 99

Preparing Activity:
Air Force - 16

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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waiver any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-PRF-9854C	2. DOCUMENT DATE (YYMMDD) 96/11/29

3. DOCUMENT TITLE
Technical Manuals: Structural Repair (Aircraft)

4. NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)*

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME *(Last, First, Middle Initial)*	b. ORGANIZATION	
c. ADDRESS *(include Zip Code)*	d. TELEPHONE *(Include Area Code)* (1) Commercial (2) AUTOVON *(If applicable)*	e. DATE SUBMITTED *(YYMMDD)*

8. PREPARING ACTIVITY

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c. ADDRESS *(Include Zip Code)* Det 2, HQ ESC/AV-2 4027 Col Glenn Hwy, Suite 300 Dayton, OH 45431-1672	**IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:** Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340

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