
Maintenance Manual

SINGLE ENGINE MODELS 172, 182, T182, 206 AND T206 1996 And On



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STRUCTURAL REPAIR MANUAL

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INTRODUCTION

1. General

- A. The information in this publication is based on data available at the time of publication and is updated, supplemented, and automatically amended by all information issued in Service News Letters, Service Bulletins, Supplier Service Notices, Publication Changes, Revisions, Reissues and Temporary Revisions. All such amendments become part of and are specifically incorporated within this publication. Users are urged to keep abreast of the latest amendments to this publication through information available at Cessna Authorized Service Stations or through the Cessna Product Support subscription services. Cessna Service Stations have also been supplied with a group of supplier publications which provide disassembly, overhaul, and parts breakdowns for some of the various supplier issued revisions and service information which may be reissued by Cessna's Authorized Service Stations and/or through Cessna's subscription services.

WARNING: All inspection intervals, replacement time limits, overhaul time limits, the method of inspection, life limits, cycle limits, etc., recommended by Cessna are solely based on the use of new, remanufactured, or overhauled Cessna approved parts. If parts are designed, manufactured, remanufactured, overhauled, purchased, and/or approved by entities other than Cessna, then the data in Cessna's maintenance/service manuals and parts catalogs are no longer applicable and the purchaser is warned not to rely on such data for non-Cessna parts. All inspection intervals, replacement time limits, overhaul time limits, the method of inspection, life limits, cycle limits, etc., for such non-Cessna parts must be obtained from the manufacturer and/or seller of such non-Cessna parts.

2. Coverage

- A. The Cessna Single Engine Structural Repair Manual is prepared in accordance with the Air Transport Association Specification 2200 for Manufacturers' Technical Data.
- B. This Structural Repair Manual contains material identification for structure subject to field repair; typical repairs applicable to structural components; information relative to material substitution and fastener installation; and a description of procedures that must be performed with structural repair, such as protective treatment of the repair and sealing.
- C. This manual will serve as a medium through which all single engine operators will be advised of actual repairs. As service records indicate a requirement, this manual will be revised to include additional specific repairs.

3. Airplane Identification

- A. To identify structural differences to associated airplanes, the specific airplane identity may appear in the figure and the text. Items not identified for a specific airplane or group of airplanes are suitable for all airplanes.

4. Aerofiche (microfiche)

- A. The Structural Repair Manual is prepared for Aerofiche presentation in addition to 8 ½ by 11 inch loose leaf manual format. To facilitate the use of the aerofiche, a list of chapters with an aerofiche frame reference has been tabulated and incorporated into the Introduction of the Structural Repair Manual.
- B. Aerofiche is a microform reproduction of the contents of the 8 ½ by 11 inch manual in a form convenient for service areas. An aerofiche reader is required to view the 4-inch by 6-inch aerofiche card. Each aerofiche card contains 12 horizontal rows of 24 images each. An image displays information equal

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to an 8 ½ by 11 inch loose leaf page and represents a frame. Horizontal rows are lettered from A at the top to L at the bottom. Vertical columns are numbered 1 to 24. The combination of a letter and a number identifies a frame (image) in the aerofiche card. The List of Chapters provides a quick reference to information contained in the aerofiche.

5. Using the Structural Repair Manual or Aerofiche

- A. Division of Subject Matter.
 - (1) Structural repair information is divided into chapters in accordance with Air Transport Association Specification 100. Each Chapter is further subdivided to provide individual or related structural member presentation.
 - (2) Chapter 51 provides general structural information required to perform a repair. Also included in Chapter 51 are general repair procedures that may be accomplished in noncritical areas.
- B. Effectivity Page.
 - (1) A list of effective pages is provided with each chapter. All pages listed are active and shall appear in sequence as recorded in the Effectivity Page.
 - (2) The Effectivity Page contains tabular listing of ATA number, page and date of each page in that chapter. A change in the chapter requires a revision to the chapter's Effectivity Page. The date corresponds to the date that appears on the individual page which defines when that page was issued.
- C. Page Numbering System.
 - (1) The Structural Repair Manual or corresponding aerofiche page numbering system consists of the Air Transport Association Specification 100 three element numbers separated by dashes. The page number and date are printed immediately to the right of the three element number. The three element number is assigned to a component, with the first set of numbers corresponding to the ATA-100 assigned chapter number.
 - (2) The page number complies with Air Transport Association Specification 100 for subdividing a Structural Repair Manual. Blocks of sequential page numbers are used to identify:
 - Pages 1 Through 100 - Structural Identification
 - Pages 101 Through 199 - Allowable Damage
 - Pages 201 through 999 - Repair Procedures
 - (3) The date which appears below the page number signifies when the page was issued. If no revisions to that page have occurred, the date signifies original date.
 - (4) Illustrations use the same figure numbering as the page block in which they appear. For example: Figure 202 would be the second figure in a repair procedure.

6. Revision (Manual)

- A. Regular Revision.
 - (1) Pages to be removed or inserted in the Structural Repair Manual are controlled by the Effectivity Page. Pages are listed in sequence by the three element number and then by page number. When two pages display the same three element number and page number, the page displaying the most recent Date of Page Issue shall be inserted into the Structural Repair Manual. The date column on the corresponding chapter Effectivity Page shall verify the active page.
- B. Temporary Revision.
 - (1) For paper publications:
 - (a) Temporary revision pages are filed in the Structural Repair Manual by replacing existing pages in the manual. File the temporary revision cover page according to the filing instructions on the Temporary Revision Cover Page.
 - (2) For aerofiche publications:
 - (a) Draw a line through any aerofiche frame (page) affected by the Temporary Revision with a permanent red ink marker. This will be a visual identifier that the information on the frame (page) is no longer valid and the Temporary Revision should be referenced. For "added" pages in a temporary Revision, draw a vertical line between the applicable frames which is wide enough to show on the edges of the pages. Temporary Revisions should be collected and maintained in a notebook or binder near the aerofiche library for quick reference.

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7. Identifying Revised Material

- A. Additions or revisions to text in an existing section will be identified by a revision bar in the left margin of the page and adjacent to the change.
- B. When additions or revisions are made to text in an existing section, all pages displaying the same three element number shall also display the same Date of Page Issue. The date column on the corresponding chapter Effectivity Page shall verify the active page. These pages will display the current revision date in the Date of Page Issue location.
- C. When extensive technical changes are made to text in an existing section that requires extensive revision, revision bars will appear the full length of text.
- D. When art is revised or added, a change bar will appear on the full length of the page.

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LIST OF REVISIONS

1. General

- A. This Structural Repair Manual includes the original issue and the following listed revisions. To make sure that information in this manual is current and the latest maintenance and inspections procedures are available, revisions must be incorporated in the manual as they are issued.

Table 1. Original Issue--2 December 1996

Revision Number	Date	Writer	Revision Number	Date	Writer
1	16 May 1997		2	16 July 1999	
3	15 January 2001		4	1 June 2005	jmk

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NOTE 1: *Represents date of page one of each chapter's List of Effective Pages which is applicable to Manual revision date.

CHAPTER

51

**STANDARD
PRACTICES -
STRUCTURES**

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STANDARD PRACTICES AND STRUCTURES - GENERAL

1. General

- A. Chapter 51 describes general repair practices, materials and procedures which are applicable throughout the subsequent chapters. This chapter also provides general information for performing any structural repairs.
- B. Unless otherwise specified, all dimensions are in inches; forces are in pounds and torques are in inch-pounds.
- C. The airplanes are of an all metal, semimonocoque construction, with the skin carrying a portion of all structural loads.
- D. To obtain information covering dimensions, areas and stations diagrams, refer to current appropriate Model 172, Model 182 or Model 206 Maintenance Manual, Chapter 6, Dimensions and Areas.
- E. For information covering leveling and weighing, refer to current appropriate Model 172, Model 182 or Model 206 Maintenance Manual, Chapter 8, Leveling and Weighing.

2. Description

- A. The fuselage is of conventional semimonocoque construction. Construction consists of formed bulkheads, longitudinal stringers, reinforcing channels, and skin panels.
- B. The wings are of an all metal, strut-braced, semimonocoque construction, utilizing two spars. Each wing consists of a wing panel with an integral fuel bay, an aileron and a flap.
- C. The empennage group is of a fully cantilevered design and consists of a conventional rudder and elevator configuration. The horizontal stabilizer is of one-piece construction, consisting of spars, ribs, and skins. Elevators are constructed of spars, ribs, and skin panels. The skin panels are riveted to the ribs and spars. A balance weight is located in the outboard end of each elevator, forward of the hinge line. An elevator trim tab is attached to the right hand elevator and is constructed of a spar, ribs, and skin, riveted together. The vertical stabilizer is constructed of a forward and aft spar, ribs, and skin. The rudder is constructed of spars, ribs, and skin panels.
- D. The main landing gear consists of 6150M alloy spring-steel, cantilevered with attaching parts of high-strength 7075-T73 aluminum alloy forgings. Nose gear components are 4130 alloy steel and 7075-T73 aluminum alloy forgings.
- E. The engine mount is constructed of welded 4130 steel tubing on the 172 and 182. The 206 has a built-up aluminum sheet metal engine mount.
- F. The removable engine cowling is made of 2024 Alclad secured with quarter turn fasteners.

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DAMAGE INVESTIGATION AND CLASSIFICATION

1. General

- A. For the purposes of this manual, damage is considered to be a deviation from the original configuration of a structural part that compromises its structural integrity by significantly reducing its strength, significantly decreasing its resistance to fatigue, significantly increasing its susceptibility to corrosion, significantly altering its flutter characteristics, or adversely affecting the flight characteristics of the airplane. This can include - but is not limited to - scratches, dents, dings, gouges, cracks, drill starts, double drilled holes, plastic deformation, reduction in cross-sectional areas, changes in component center-of-gravity, missing or inadequate fasteners, corrosion, dissimilar metal contact, work hardening, temper change due to excessive heat, and so forth.
- B. Use good judgment in determining the type of significant change to flat stock structural material. The terms, dent, crease, abrasion, gouge, nick, scratch, crack and corrosion, referred to elsewhere in the manual, are defined below as a guide for this determination, particularly with respect to the external skin of the airplane:
- (1) Dent - A dent is normally a damaged area which is depressed with respect to its normal contour. There is no cross sectional area change in the material. Area boundaries are smooth. Its form is generally the result of contact with a relatively smoothly contoured object.

NOTE: A dent-like form of damage to skin may be the result of the peening action of a smoothly contoured object contacting it. If the inner surface of skin shows no contour change, consider that such damage results in a local cross sectional area change.

- (2) Crease - A damaged area which is depressed or folded back upon itself in such a manner that its boundaries are sharp or well defined lines or ridges. Consider it to be the equivalent of a crack.
- (3) Abrasion - An abrasion is a damaged area of any size which results in a cross sectional area change due to scuffing, rubbing, scraping or other surface erosion. It is usually rough and irregular.
- (4) Gouge - A gouge is a damaged area of any size, which results in a cross sectional area change. It is usually caused by contact with a relatively sharp object which produces a continuous, sharp or smooth channel-like groove in the material.
- (5) Nick - A nick is a local gouge with sharp edges. Consider a series of nicks, in a line pattern to be the equivalent of a gouge.
- (6) Scratch - A scratch is a line of damage of any depth in the material and results in a cross sectional area change. It is usually caused by contact with a very sharp object.
- (7) Crack - A crack is a partial fracture or complete break in the material with the most significant cross sectional area change. In appearance, it is usually an irregular line and is normally the result of fatigue failure.
- (8) Corrosion - Corrosion, due to a complex electrochemical action, is a damaged area of any size and depth which results in a cross sectional area change. Depth of such pitting damage must be determined by a cleanup operation. Damage of this type may occur on surfaces of structural elements. Refer to Corrosion and Corrosion Control, Section 51-11-00.
- C. Use good sense and proper visual measurement in the determination of significant cross sectional area changes of both depth and length of any type (or combinations) of damage mentioned above.

2. Damage Investigation

- A. After a thorough cleaning of the damaged area, all structural parts should be carefully examined to determine the extent of damage. Frequently, the force causing the initial damage is transmitted from one member to the next, causing strains and distortions. Abnormal stresses incurred by shock or impact forces on a rib, bulkhead, or similar structure, may be transmitted to the extremity of the structural member, resulting in secondary damage, such as sheared or stretched rivets, elongated bolt holes, or canned skins or bulkheads. Points of attachment should be examined carefully for distortion and security of fastenings in the primary and secondary damaged areas at locations beyond the local

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damage. This is particularly true with wing tip, horizontal stabilizer tip, or vertical fin tip damage. If the damage is due to an aft load, the rear spars should be checked for indications of compression damage for the full length, including the fuselage components.

3. Damage Classification

- A. Damage to the airplane can be divided into three major categories: negligible damage, repairable damage, and major replacement damage. These categories are intended to provide the mechanic with some general guidelines to use in determining the extent and criticalness of any damage. Obviously, there will be some overlapping between categories, and common sense should be used in determining the final action to be taken with regard to any damage.
 - (1) For damage criteria of specific structure (wings, fuselage, and so forth), refer to applicable chapters within this repair manual.

4. Refinishing Damaged Areas Following Repairs

- A. Areas of structure which are damaged and then repaired in the field, must be refinished to restore the original paint and corrosion protectant properties to factory standards. Refer to applicable airplane Maintenance Manual, Chapter 20, Exterior Finish - Cleaning/Painting, for refinishing procedures and required materials.

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CORROSION AND CORROSION CONTROL - GENERAL

1. General

- A. Corrosion is a natural phenomenon which destroys metal by chemical or electrochemical action and converts it to a metallic compound such as an oxide, hydroxide, or sulfate. All metals used in airplane construction are subject to corrosion. If exposed, attack may take place over an entire metal surface. It may penetrate a surface at random forming deep pits or may follow grain boundaries. Corrosion may be accentuated by stresses from external loads or from lack of homogeneity in the metallic structure or from improper heat treatment. It is promoted by contact between dissimilar metals or with materials which absorb moisture such as wool, rubber, felt, dirt, and so forth.

NOTE: For additional information on corrosion control for aircraft, refer to the FAA Advisory Circular No. 43-4.

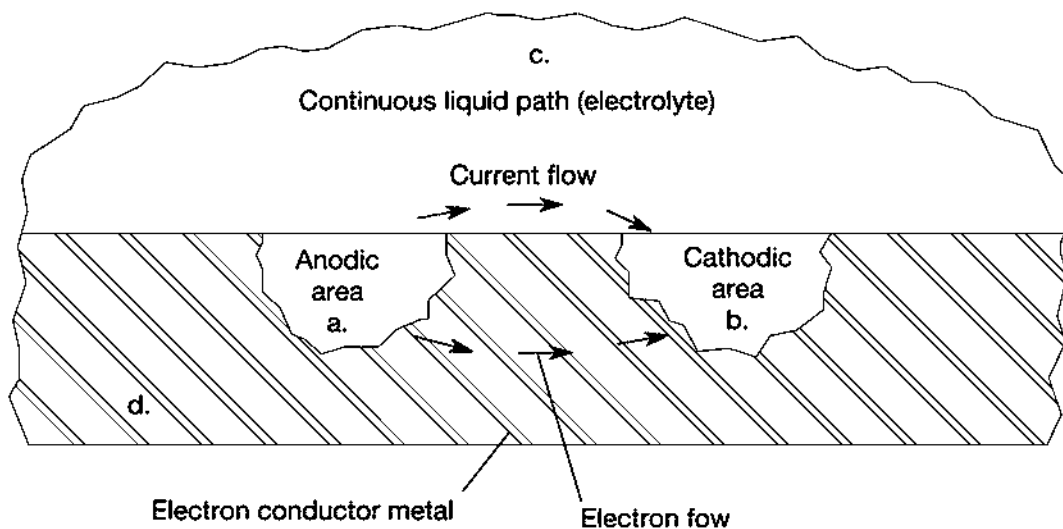
- (1) Refer to Figure 1 for a simplified illustration of the conditions which must exist for electrochemical corrosion to occur.
 - (a) There must be a metal that corrodes and acts as the anode.
 - (b) There must be a less corrodible metal that acts as the cathode
 - (c) There must be a continuous liquid path between the two metals which acts as the electrolyte, usually condensation and salt or other contamination.
 - (d) There must be a conductor to carry the flow of electrons from the cathode to the anode. This conductor is usually in the form of a metal-to-metal contact (rivets, bolts, welds, etc.)
- (2) The elimination of any one of the four conditions described above will stop the corrosion reaction process as shown in Figure 1.
- (3) One of the best ways to eliminate one of the four described conditions is to apply an organic film (such as paint, grease, plastic, etc.) to the surface of the metal affected. This will prevent the electrolyte from connecting the cathode to the anode, and since current cannot flow, it prevents corrosive reaction.
- (4) At normal atmospheric temperatures, metals do not corrode appreciably without moisture, but the moisture in the air is usually enough to start corrosive action.
- (5) When components and systems constructed of many different types of metals must perform under various climatic conditions, corrosion becomes a complex problem. The presence of salts on metal surfaces (from sea coast operation) greatly increases the electrical conductivity of any moisture present and accelerates corrosion.
- (6) Other environmental conditions which contribute to corrosion are:
 - (a) Moisture collecting on dirt particles.
 - (b) Moisture collecting in crevices between lap joints, around rivets, bolt, and screws.

2. Types of Corrosion

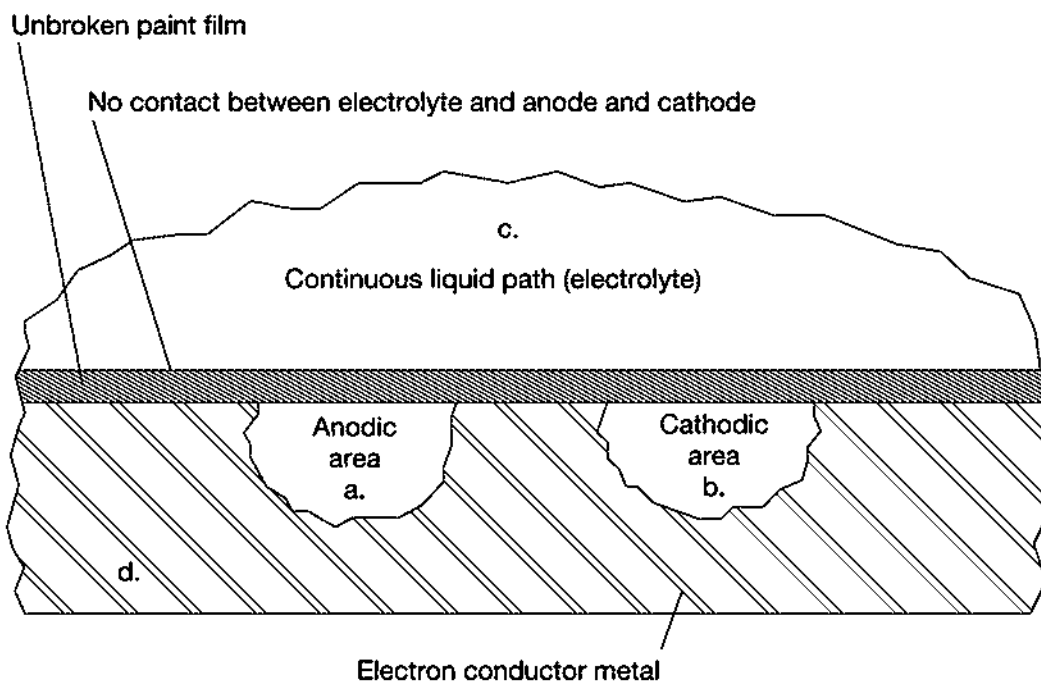
- A. Direct Surface Attack.
- (1) The most common type of general surface corrosion results from direct reaction of a metal surface with oxygen in the atmosphere. Unless properly protected, steel will rust and aluminum and magnesium will form oxides. The attack may be accelerated by salt spray or salt bearing air, by industrial gasses, or by engine exhaust gasses.
- B. Pitting.
- (1) While pitting can occur in any metal, it is particularly characteristic of passive materials such as alloys of aluminum, nickel, and chromium. It is first noticeable as a white or gray powdery deposit similar to dust, which blotches the surface. When the deposits are cleaned away, tiny pits can be seen in the surface.
- C. Dissimilar Metal Corrosion.
- (1) When two dissimilar metals are in contact and are connected by an electrolyte (continuous liquid or gas path), accelerated corrosion of one of the metals occurs. The most easily oxidized surface becomes the anode and corrodes. The less active member of the couple becomes the cathode

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B149



Simplified Corrosion Cell



Corrosion eliminated by application of organic film

26821017

Corrosion Identification
 Figure 1 (Sheet 1)

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of the galvanic cell. The degree of attack depends on the relative activity of the two surfaces; the greater the difference in activity, the more severe the corrosion. Relative activity in descending order is as follows:

- (a) Magnesium and its alloys.
- (b) Aluminum alloys 1100, 3003, 5052, 6061, 220, 355, 356, cadmium, and zinc.
- (c) Aluminum alloys 2014, 2017, 2024, and 7075.
- (d) Iron, lead, and their alloys (except stainless steel).
- (e) Stainless steels, titanium, chromium, nickel, copper, and their alloys.
- (f) Graphite (including dry film lubricants containing graphite).

D. Intergranular Corrosion.

- (1) Selective attack along the grain boundaries in metal alloys is referred to as intergranular corrosion. It results from lack of uniformity in the alloy structure. It is particularly characteristic of precipitation hardened alloys of aluminum and some stainless steels. Aluminum extrusions and forgings in general may contain nonuniform areas, which in turn may result in galvanic attack along the grain boundaries. When attack is well advanced, the metal may blister or delaminate which is referred to as exfoliation.

E. Stress Corrosion.

- (1) This results from the combined effect of static tensile stresses applied to a surface over a period of time. In general, cracking susceptibility increases with stress, particularly at stresses approaching the yield point, and with increasing temperature, exposure time, and concentration of corrosive ingredients in the surrounding environment. Examples of parts which are susceptible to stress corrosion cracking are aluminum alloy bell cranks, landing gear shock struts with pipe thread-type grease fittings, clevis points, and shrink fits.

F. Corrosion Fatigue.

- (1) This is a type of stress corrosion resulting from the cyclic stresses on a metal in corrosive surroundings. Corrosion may start at the bottom of a shallow pit in the stressed area. Once attack begins, the continuous flexing prevents repair of protective surface coating or oxide films and additional corrosion takes place in the area of stress.

3. Typical Corrosion Areas

A. This section lists typical areas of the airplane which are susceptible to corrosion. These areas should be carefully inspected at periodic intervals to detect corrosion as early as possible.

- (1) Engine Exhaust Trail Areas.
 - (a) Gaps, seams, and fairings on the lower fuselage, aft of the engine exhaust pipe(s) are typical areas where deposits may be trapped and not reached by normal cleaning methods.
 - (b) Around rivet heads, skin laps and inspection covers on the airplane lower fuselage aft of the engine exhaust pipe(s) should be carefully cleaned and inspected.
- (2) Battery Box and Battery Vent Opening.
 - (a) The battery, battery cover, battery box, and adjacent areas, especially areas below the battery box where battery electrolyte may have seeped, are particularly subject to corrosive action. If spilled battery electrolyte is neutralized and cleaned up at the same time of spillage, corrosion can be held to a minimum by using a baking soda solution to neutralize the lead acid-type battery electrolyte. If baking soda is not available, flood the area with water.
- (3) Stainless Steel control cables.
 - (a) Checking for corrosion on control cables is normally accomplished during the preventative maintenance check. During preventative maintenance, broken wire and wear of the control cable is also checked.

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- (b) If the surface of the cable is corroded, carefully force the cable open by reverse twisting and visually inspect the interior. Corrosion on the interior strands of the cable constitutes failure and the cable must be replaced. If no internal corrosion is detected, remove loose external rust and corrosion with a clean, dry, coarse-weave rag or fiber brush.

NOTE: Do not use metallic wools or solvents to clean installed cables. Use of metallic wool will embed dissimilar metal particles in the cables and create further corrosion. Solvents will remove internal cable lubricant, allowing cable strands to abrade and further corrode.

- (c) After thorough cleaning of the exterior cable surface, apply a light coat of lubricant (VV-L-800) to the external cable surface.

4. Corrosion Detection

- A. The primary means of corrosion detection is visual, but in situations where visual inspection is not feasible, other techniques must be used. The use of liquid dye penetrants, magnetic particle, X-ray, and ultrasonic devices can be used, but most of these sophisticated techniques are intended for the detection of physical flaws within metal objects rather than the detection of corrosion.

- (1) Visual Inspection.

- (a) A visual check of the metal surface can reveal the signs of corrosive attack, the most obvious of which is a corrosive deposit. Corrosion deposits of aluminum or magnesium are generally a white or grayish-white powder, while the color of ferrous compounds varies from red to dark reddish-brown.

- 1 The indications of corrosive attack are small localized discoloration of the metal surface. Surfaces protected by paint or plating may only exhibit indications of more advanced corrosive attack by the presence of blisters or bulges in the protective film. Bulges in lap joints are indications of corrosive buildup which is well advanced.

- 2 In many cases, because the inspection area is obscured by structural members, equipment installations, or for other reasons, it is awkward to check visually. In such cases, mirrors, boroscopes, or like devices must be used to inspect the obscured areas. Any means which allows a thorough inspection can be used. Magnifying glasses are valuable aids for determining whether or not all corrosion products have been removed during cleanup operations.

- (2) Liquid Dye Penetrant Inspection.

- (a) Inspection for large stress-corrosion or corrosion fatigue cracks on nonporous or nonferrous metals may be accomplished using dye penetrant processes. The dye applied to a clean metallic surface will enter small openings or cracks by capillary action. After the dye has an opportunity to be absorbed by any surface discontinuities, the excess dye is removed and a developer is applied to the surface. The developer acts like a blotter to draw the dye from cracks or fissures back to the surface, giving visible indication of any fault that is present on the surface. The magnitude of the fault is indicated by the quantity of dye brought back to the surface by the developer.

5. Corrosion Damage Limits

- A. Following cleaning and inspection of the corroded area, the actual extent of the damage may be evaluated using the following general guidelines and sound maintenance judgement.

- (1) Determine the degree of corrosion damage (light, moderate, or severe) with a dial-type depth gage, if accessibility permits. If the area is inaccessible, clay impressions, or any other means which will give accurate results, should be used. In the event the corrosion damage is severe or worse, contact Cessna Propeller Aircraft Product Support, P.O. Box 7706, Wichita, KS 67277 USA, for assistance.

- (2) Light Corrosion.

- (a) Characterized by discoloration or pitting to a depth of approximately 0.001 inch maximum.

- (3) Moderate Corrosion.

- (a) Appears similar to light corrosion except there may be blistering or some evidence of scaling or flaking. Pitting depths may be as deep as 10 percent of the material thickness.

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- (4) Severe Corrosion.
 - (a) General appearance may be similar to moderate corrosion with severe blistering exfoliation and scaling or flaking. Pitting depths may be as deep as 15 percent of the material thickness. This type of damage is normally repaired by complete part replacement, but patches or other types of repair may be available. Contact Cessna Propeller Aircraft Product Support, P.O. Box 7706, Wichita, KS 67277 USA, for assistance.

6. Corrosion Removal

A. The following methods are provided as an aid in determining the correct method for corrosion removal.

- (1) Standard Methods
 - (a) Several standard methods are available for corrosion removal. The method normally used to remove corrosion are chemical treatments, hand sanding with aluminum oxide or metal wool that is of similar material to the surface being treated, and mechanical sanding or buffing with abrasive mats or grinding mats. The method used depends on the metal and the degree of corrosion. Select appropriate materials from the abrasives chart as illustrated in Figure 2.
- (2) Aluminum and Aluminum Alloys.
 - (a) Most formed aluminum parts and skins of this airplane consist of various gauges of sheet 2024-T3 and 2024-T42 Alclad. Alclad is formed by laminating a thin layer of relatively pure aluminum, one to five mils thick, over the higher strength base alloy surface. Since pure aluminum has relatively greater corrosion resistance than the stronger alloy, it is imperative the clad surface be maintained intact to the maximum extent possible and to avoid unnecessary mechanical removal of the protective coating. In addition, aluminum parts receive a chemical conversion coating and are then epoxy-primed.
 - 1 Clean area to be reworked. Strip paint as required.
 - 2 To determine the extent of corrosion damage refer to Corrosion Damage Limits.
 - 3 Remove light corrosion by light hand sanding.
 - 4 Mechanically remove moderate or severe corrosion by hand scraping with a carbide-tipped scraper or fine-fluted rotary file.
 - 5 Remove residual corrosion by hand sanding. Select appropriate abrasive from Figure 2.
 - 6 Blend into surrounding surface any depressions resulting from rework and surface finish with 400 grit abrasive paper.
 - 7 Clean reworked area.
 - 8 Determine depth of faired depressions to ensure that rework limits have not been exceeded.
 - 9 Chemically conversion-coat rework area.
 - 10 Restore original finish (epoxy prime).
- (3) Steel.
 - (a) Unlike some other metal oxides, the red oxide of steel (rust) will not protect the underlying base metal. The presence of rust actually promotes additional attack by attracting moisture from the air and acting as a catalyst in causing additional corrosion to take place. Light red rust on bolt heads, hold-down nuts, and other nonstructural hardware is generally not dangerous. However, it is indicative of a general lack of maintenance and possible attack in more critical areas, such as highly stressed steel landing gear components and flight control surface actuating components. When paint failures occur or mechanical damage exposes highly stressed steel surfaces to the atmosphere, even small amounts of rusting are potentially dangerous and must be removed. The most practical means of controlling corrosion of steel is the complete removal of the corrosion products by mechanical means. Except on highly stressed steel surfaces, the use of abrasive papers, small power buffers and buffing compounds, and wire brushes are acceptable for clean up procedures. However, residual rust usually remains in the bottom of small pits and crevices.
 - 1 Clean area to be reworked.
 - 2 Strip paint as required.
 - 3 Remove all degrees of corrosion from steel parts using a stainless steel hand brush or hand operated power tool. Alternatively, use dry abrasive blasting process.

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Metals or Materials to be Processed	Restrictions	Operation	Abrasive Paper or Cloth			Abrasive Fabric or Pad	Aluminum	Stainless Steel	Pumice 350 Mesh or Finer	Abrasive Wheel
			Aluminum Oxide	Silicon Carbide	Garnet					
Ferrous Alloys	Does Not Apply to Steel Heat-Treated to Strengths to 220,000 psi and Above	Corrosion Removal or Fairing	150 Grit or Finer	180 Grit or Finer		Fine to Ultra-Fine	x	x	x	x
		Finishing	400				x	x	x	
Aluminum Alloys Except Clad Aluminum	Do Not Use Silicon Carbide Abrasive	Corrosion Removal or Fairing	150 Grit or Finer		7/0 Grit or Finer	Very Fine and Ultra-Fine	x		x	x
		Finishing	400				x		x	
Clad Aluminum	Sanding Limited to the Removal of Minor Scratches	Corrosion Removal or Fairing	240 Grit or Finer		7/0 Grit or Finer	Very Fine and Ultra-Fine			x	x
		Finishing	400						x	
Magnesium Alloys		Corrosion Removal or Fairing	240 Grit or Finer			Very Fine and Ultra-Fine	x		x	x
		Finishing	400				x		x	

Abrasives for Corrosion Removal
Figure 2 (Sheet 1)

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- 4 Remove residual corrosion by hand sanding.
- 5 After removing all corrosion visible through a magnifying glass, fair depression resulting from rework and finish with 400-grit abrasive paper.
- 6 Clean reworked area.
- 7 Determine depth of rework area to ensure rework limits are not exceeded.
- 8 Prime using rust-inhibitive primer within one hour of rework.
- 9 Reapply finish topcoat if required.

7. Control of Corrosion on Landing Gear Springs

A. General

- (1) The main landing gear springs are made from high strength steel that is shot peened on the lower surface to increase the fatigue life of the part.
- (2) The shot peened layer is between 0.010 and 0.020 inch thick.
- (3) If the protective layer of paint is chipped, scratched or worn away the steel may corrode (rust).
 - (a) If the corrosion pit depth is greater than the thickness of the shot peen layer, the gear spring fatigue life will be greatly reduced.
- (4) Operation from unimproved surfaces increases the likelihood of damage.

B. Corrosion removal and repair.

- (1) If damage to the paint finish of the landing gear spring is found, examine the damage area for signs of corrosion (red rust).

WARNING: High strength steel parts are very susceptible to hydrogen embrittlement. Acidic solutions, such as rust removers and paint strippers have been found to cause hydrogen embrittlement. Hydrogen embrittlement is an undetectable, time delayed process. Since the process is time delayed, failure may occur after the part is returned to service. The only reliable way to prevent hydrogen embrittlement is not to use chemical rust removers or paint strippers on landing gear springs.

- (2) Carefully remove any rust by light sanding.
 - (a) The sanding should blend the damage into the surrounding area in an approximate 20:1 ratio.

EXAMPLE: An 0.005 inch pit must be blended to a 0.10 inch radius or 0.20 inch diameter.

- (b) Make sure the final sanding marks are along an inboard to outboard direction, or along the long dimension of the spring.
- (3) After the sanding is complete, measure the depth of the damage removal.
 - (a) Make sure the depth of the damage is not more than 0.010 to 0.012 inch deep and has not penetrated the shot peen layer.
- (4) If the shot peened layer has been penetrated, the gear spring must be removed and sent to an approved facility to be re-shotpeened.
 - (a) The shotpeen specification is to be Almen intensity of 0.012 to 0.016 using 330 steel shot.
- (5) After the spring is installed, refinish any damaged or removed finish paint.

NOTE: Additional information regarding corrosion control can be found in AC-43-4, Chapter 6, or AC43.13-1B Chapter 6.

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- C. Axle bolt hole corrosion.
- (1) Operation of an airplane on skis increases the loads on the lower part of the gear spring because of the unsymmetrical and twisting loads.
 - (a) The increased loads have produced spring fractures that originate from pits in the axle attach holes.
 - 1 Catastrophic failures have occurred from fatigue cracks as small as 0.003 to 0.010 inch long that originated at pits.
 - (b) Although operation on skis causes more loads, the criteria applies to all airplanes.
 - (2) There is no acceptable damage depth for pits that develop in the axle bolt holes. If pits or corrosion is found it must be removed by reaming, subject to the following limitations:
 - (a) Remove the minimum material required to clean up the damage.
 - (b) Make sure the diameter of the axle attachment holes is 0.383 inches maximum for 3/8 inch bolts.
 - (c) Make sure the diameter of the axle attachment holes is 0.321 inches maximum for 5/16 inch bolts.
 - (d) If reaming to the maximum dimension does not remove all signs of corrosion, discard the landing gear spring.

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REPAIR MATERIALS

1. General

- A. This section provides information covering the materials used for repairs.

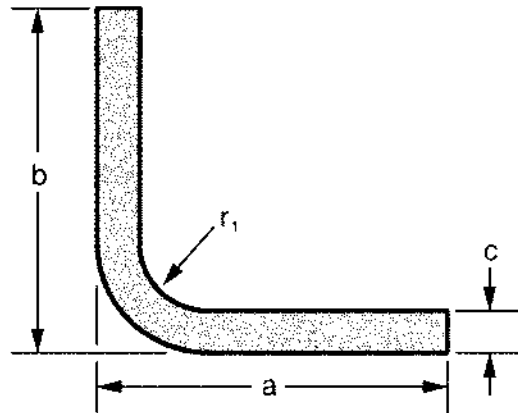
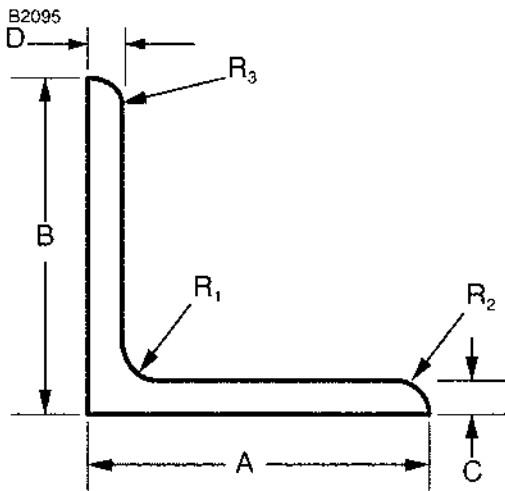
2. Repair Materials

- A. In general, materials used in the airplane include 2024 and 7075 aluminum alloys. Sheet material requiring little or no forming will generally be of 2024-T3 clad aluminum. Formed parts, such as ribs, bulkheads, etc., will be of 2024-T42 clad aluminum. Forgings are of 7075-T73. Materials used in repairs should be, where possible, of the same material and heat treated to the same temper. The thickness should be equal to or greater than the material being repaired unless otherwise noted. If the type of material cannot be readily determined and the forming required is not severe, 2024-T3 may be used generally, since the strength of -T3 is greater than that of -T4 or -T42 (-T4 and -T42 may be used interchangeably, but they may not be substituted for -T3). When it is necessary to form a part with a smaller bend radius than the standard bend radius for 2024-T3 or 2024-T4, use 2024-O, and then heat treat to 2024-T42 after forming. In the event that the original temper was -T3, it may be necessary to increase the material thickness sufficiently to provide strength equivalent to that of the original part. It is often practical to cut repair pieces from service parts listed in the parts catalog. Steel sheet material for reinforcement is 4130 steel heat treated to a minimum of 90,000 pounds per square inch. The firewall is annealed stainless steel sheet.

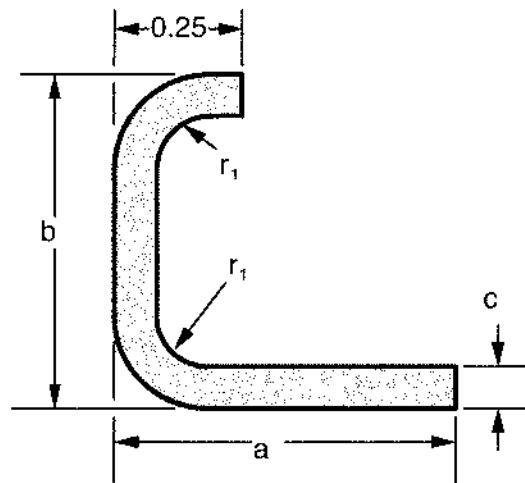
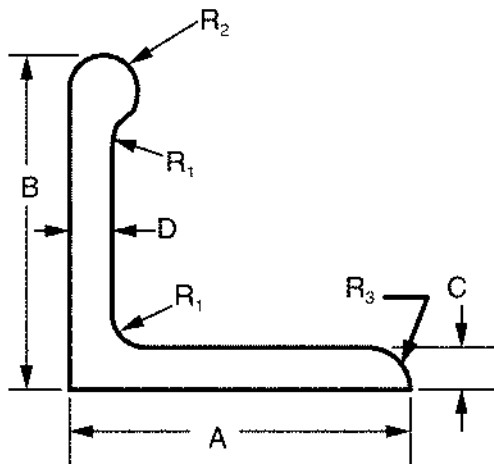
3. Extrusions and Formed Sections

- A. (Refer to Figure 1.) This section provides information on extrusions and formed sections. It also provides details of equivalent built up sections for extrusions. Alternative materials are provided for equivalent sections and formed sections.
- B. Use of equivalent built up sections for extrusions are to be utilized only when the proper extrusions are not available. They are intended to be cold formed from raw stock in sheet forms that have already been heat treated to the required condition. But when workability is required, the parts may be formed from 2024-O aluminum and then heat treated to the -T42 condition before installation. When forming the section, care must be taken to ensure that the bend radii and the cross section areas are not reduced below the minimum shown in the diagrams. In some cases, equivalent sections are not given because it is impractical to build them from sheet stock.
- C. Illustrated Parts Catalogs do not identify the standard shape from which parts are fabricated. Detailed measurements of damaged areas are required to determine the standard section from which parts are fabricated.

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EXTRUDED ANGLE		ORIGINAL MATERIAL							SUBSTITUTION 2024 SHEET			
STD. SHAPE	MATERIAL	A	B	C	D	R ₁	R ₂	R ₃	a	b	c	r ₁
S-85	2024-T3511	0.625	0.625	0.045	0.045	0.060	0.045	0.045	0.625	0.625	0.040	0.050
S-97	2024-T3511	0.875	0.875	0.063	0.063	0.094	0.063	0.063	0.875	0.875	0.063	0.125
S-107	2024-T3511	1.000	0.750	0.062	0.062	0.060	0.031	0.031	1.000	0.750	0.063	0.075
S-111	2024-T3511	0.750	0.750	0.094	0.094	0.125	0.094	0.094	0.750	0.750	0.090	0.125
S-125	2024-T3511	0.750	0.625	0.062	0.062	0.062	0.031	0.031	0.750	0.625	0.063	0.100
S-174	2024-T3511	1.000	1.000	0.062	0.062	0.062	0.031	0.031	1.000	1.000	0.063	0.100
S-376	2024-T3511	0.875	0.750	0.063	0.063	0.125	0.063	0.063	0.875	0.750	0.063	0.100
S-1111	2024-T3511	0.750	0.750	0.050	0.050	0.050	0.025	0.025	0.750	0.750	0.050	0.050

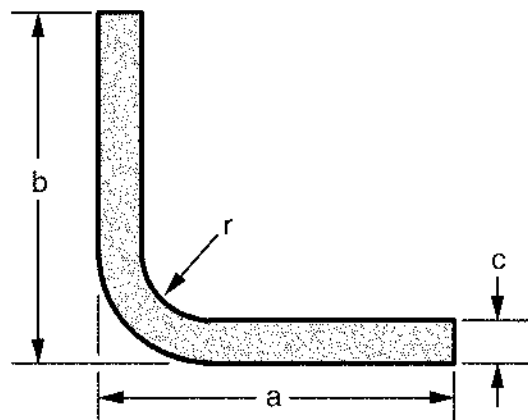
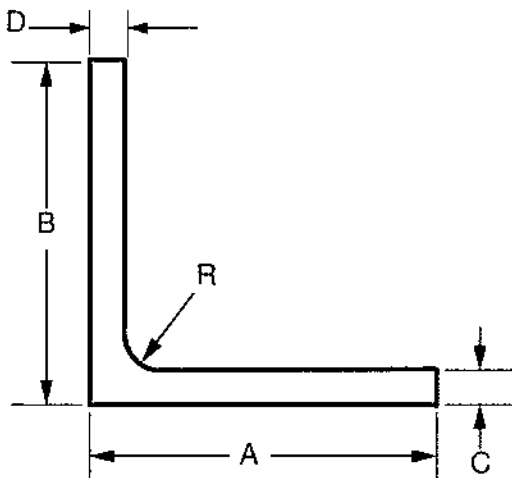


EXTRUDED ANGLE		ORIGINAL MATERIAL							SUBSTITUTION 2024 SHEET			
STD. SHAPE	MATERIAL	A	B	C	D	R ₁	R ₂	R ₃	a	b	c	r ₁
S-81	2024-T3511	0.600	0.650	0.045	0.045	0.060	0.060	0.000	0.600	0.650	0.050	0.120
S-86	2024-T3511	0.750	0.562	0.051	0.051	0.060	0.060	0.000	0.750	0.562	0.063	0.160
S-95	2024-T3511	0.800	0.800	0.050	0.050	0.062	0.060	0.000	0.800	0.800	0.063	0.160
S-1969-1	2024-T3511	0.625	0.813	0.050	0.050	0.075	0.075	0.050	0.625	0.813	0.063	0.160

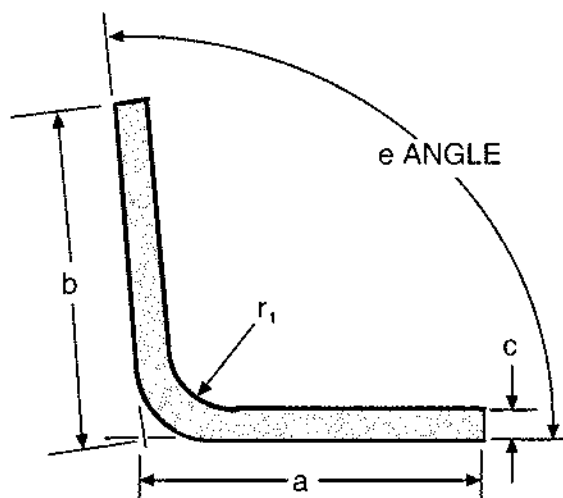
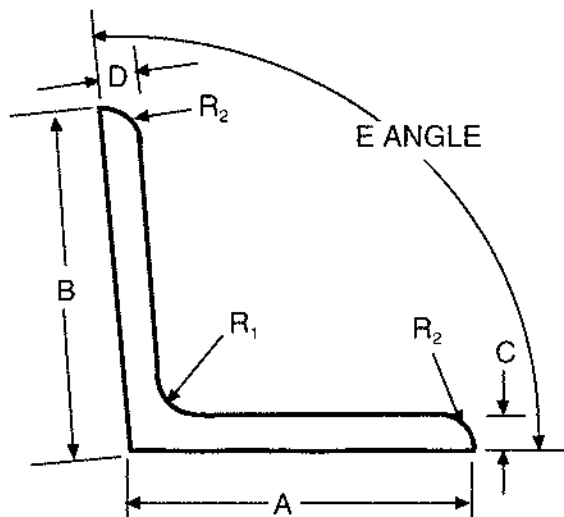
Extrusions and Formed Sections
Figure 1 (Sheet 1)

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STD. SHAPE	EXTRUDED ANGLE				ORIGINAL MATERIAL			SUBSTITUTION 2024 SHEET		
	MATERIAL	A	B	C	D	R	a	b	c	r
S-109	2024-T3511	0.500	0.500	0.050	0.050	0.050	0.500	0.500	0.050	0.120

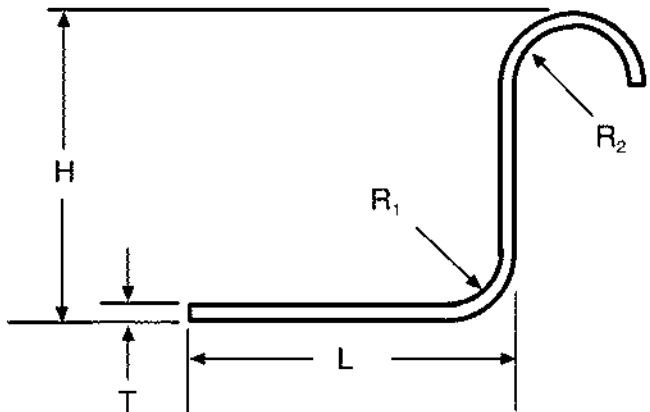
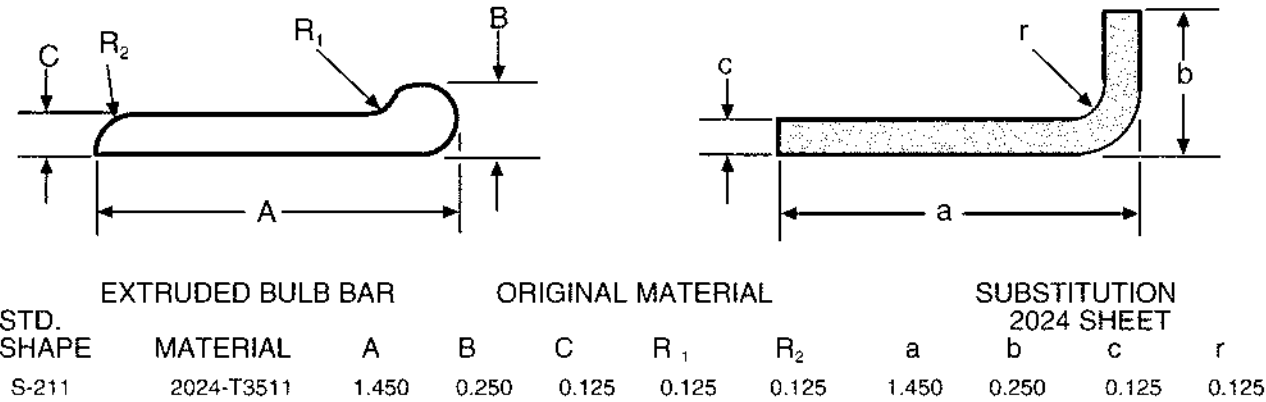


STD. SHAPE	EXTRUDED ANGLE				ORIGINAL MATERIAL				SUBSTITUTION 2014 SHEET				
	MATERIAL	A	B	C	D	R ₁	R ₂	E	a	b	c	r ₁	e
S-214	2024-T3511	1.000	1.000	0.125	0.125	0.125	0.094	95°45'	1.000	1.000	0.125	0.125	95°45'

Extrusions and Formed Sections
 Figure 1 (Sheet 2)

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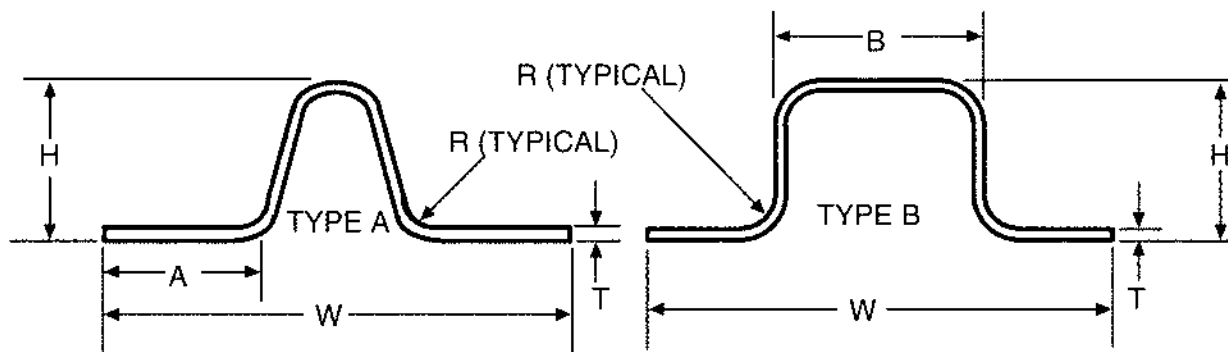


ROLLED J-SECTIONS			DIMENSIONS (INCHES)			MATERIAL: 2024-T3 OR T4 CLAD ALUMINUM ALLOY	
STD. SHAPE	T	L	H	R ₁	R ₂	AREA (SQ. INCHES)	
S-49	0.032	0.750	0.620	0.125	0.125	0.0500	
S-282	0.032	0.620	0.620	0.120	0.120	0.0456	
S-1113-1	0.020	0.750	0.620	0.125	0.125	0.0314	

Extrusions and Formed Sections
 Figure 1 (Sheet 3)

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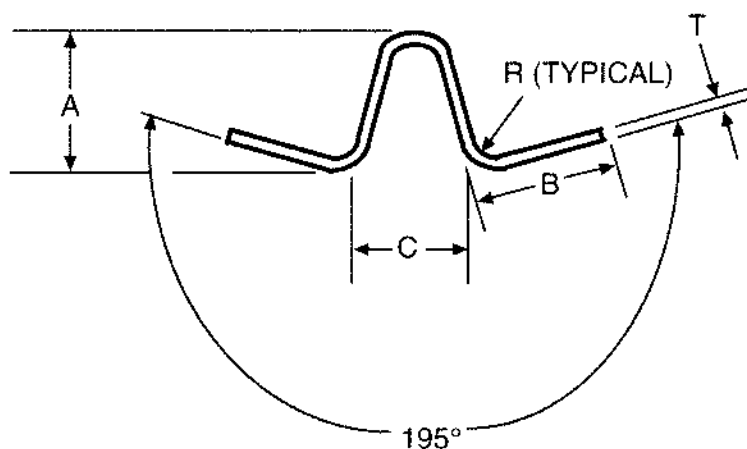


ROLLED HAT SECTIONS

DIMENSIONS (INCHES)

MATERIAL: 2024-T3 OR T4
CLAD ALUMINUM ALLOY

STD. SHAPE	TYPE	A	B	W	H	R	T	AREA (SQ. INCHES)
S-370	A	7.000	-	2.000	0.650	0.150	0.032	0.0889
S-1039-1	B	-	0.500	1.500	0.380	0.060	0.032	0.0661
S-1126	B	-	1.050	2.200	0.500	0.090	0.025	0.0744
S-1541-1	B	-	1.060	2.200	0.750	0.090	0.032	0.1106



ROLLED HAT SECTIONS

DIMENSIONS (INCHES)

MATERIAL: 2024-T4 CLAD
ALUMINUM ALLOY

STD. SHAPE	A	B	C	R	T	AREA (SQ. INCHES)
S-1162	0.650	0.700	0.600	0.150	0.025	0.0691

Extrusions and Formed Sections
 Figure 1 (Sheet 4)

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FASTENERS

1. General

- A. Fasteners used in the airplane are generally solid aluminum rivets, blind rivets, and steel threaded fasteners. Usage of each is primarily a function of the loads to be carried, accessibility and frequency of removal. Rivets used in airplane construction are usually fabricated from aluminum alloys. In special cases, monel, corrosion-resistant steel and mild steel, copper, and iron rivets are used.

2. Rivets

- A. Standard solid shank MS rivets are those generally used in airplane construction. They are fabricated in the following head types: roundhead, flathead, countersunk head, and universal head. Flathead rivets are generally used in the airplane interior, where head clearance is required. MS20426 countersunk head rivets are used on the exterior surfaces of the airplane to minimize turbulent airflow. MS20470 universal head rivets are used on the exterior surfaces of the airplane where strength requirements necessitate a stronger rivet head than that of the countersunk head rivet. Hi-Shear rivets are special, patented rivets having a high shear strength equivalent to that of standard NAS bolts. They are used in special cases in locations where high shear loads are present, such as in spars, wings, and in heavy bulkhead ribs. This rivet consists of a cadmium plated pin of alloy steel. Some have a collar of aluminum alloy. Some of these rivets can be readily identified by the presence of the attached collar in place of the formed head on standard rivets. Blind rivets are used, where strength requirements permit, where one side of the structure is inaccessible, making it impossible or impractical to drive standard solid shank rivets.

3. Replacement Of Hi-Shear Rivets

- A. Replacement of Hi-Shear rivets with close tolerance bolts or other commercial fasteners of equivalent strength properties is permissible.
- (1) The hardware used for the Hi-Shear rivets is determined according to the size of the holes and the grip lengths required.
 - (2) Bolt grip length should be chosen so that no threads remain in the bearing area.
 - (3) Holes must not be elongated, and the Hi-Shear substituted must be a smooth, push-fit.
- B. Field replacement of main landing gear forgings on bulkheads may be accomplished by using the following hardware:
- (1) NAS464P, NAS436P, and either: NAS1103 through NAS1120, NAS1303 through NAS623 or NAS6203 through NAS6220 bolt, and either:
 - (a) MS21042 nut and AN960/NAS1149 washers in place of Hi-Shear rivets for forgings with machined flat surfaces around the attachment holes.
 - (b) ESNA2935 mating base washer and ESNA RM52LH2935 self-aligning nut with forgings (with a draft angle of up to a maximum of eight degrees) without machined flat surfaces around the attachment holes.

4. Substitution Of Rivets

- A. When adapting the typical repairs shown in this manual to suit actual conditions, it may be necessary to use different fasteners than those originally used. This may be due to non-availability of a particular fastener, restricted access, or other difficulties. When replacing rivets, it is desirable to use rivets identical to the type of rivet removed. Countersunk head rivets are to be replaced by rivets of the same type and degree of countersink. When rivet holes become enlarged, deformed, or otherwise damaged, several options are available.
- (1) The simplest solution is to install a 1/32 inch (0.032 inch) larger size rivet as a replacement. This solution uses the designed repairability of the structure, and is the quickest repair.
 - (2) Repair rivets are available.
 - (a) Repair rivets have a shank that is 1/64 inch (0.016 inch) larger diameter than a standard rivet but have the same size and shape heads.
 - (b) NAS1241 repair rivets replace MS20426 rivets if they have the same suffix.
 - (c) NAS1242 repair rivets replace MS20470 rivets if they have the same suffix.

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- (d) NAS1738, NAS1939 and some NAS9301 through NAS9311 blind rivets also have oversize shanks.
- B. Replacement shall not be made with rivets of lower strength material.
- C. Hi-Shear Rivets.
 - (1) When Hi-Shear rivets are not available, replacement of sizes 3/16 inch or greater rivets shall be made with bolts of equal or greater strength than the rivet being replaced, and with self-locking nuts of the same diameter. It is permissible to replace Hi-Shear rivets with Hi-Lok bolts of the same material, diameter and grip length.
- D. Blind Rivets.
 - (1) Blind rivets have higher deflection rates in shear than standard solid rivets, are more susceptible to fatigue failure and are not as strong as solid rivets in thin sheets. For this reason, it is not advisable to replace any considerable number of solid rivets in a given joint by blind rivets, because this may result in overstressing the remaining solid rivets. The hollow blind rivet shall not be used. The blind rivet shall be of the same or greater strength than the rivet it replaces. In cases of dimpled assemblies (the process of forming the metal around a hole to form a conical indentation to receive the tapered head of a flush rivet or a screw), the rivet holes shall be drilled after the sheets are dimpled. When possible, the exposed end of each clipped plug shall be coated with epoxy primer. Blind rivets shall not be used in fuel bay areas except in cases of absolute necessity, and must be sealed. If blind fasteners other than blind rivets are encountered, it is recommended that replacements be made with identical fasteners.
- E. For a list of approved solid shank and Hi-Shear rivet substitutions, refer to Tables 1 and 2.

5. Rivet Diameters

- A. Rivet diameters range from 3/32 inch to 3/8 inch. Sizes of 1/8 inch, 5/32 inch, and 3/16 inch are most frequently used. Since smaller diameter rivets lack proper structural qualities and larger diameter rivets dangerously reduce the splice or patch area, extreme care should be exercised before substituting other than the specified sizes of rivet diameter.

6. Rivet Lengths

- A. Proper length of rivets is an important part of a repair. Should too long a rivet be used, the formed head will be too large, or the rivet may bend or be forced between the sheets being riveted. Should too short a rivet be used, the formed head will be too small or the riveted material will be damaged. If proper length rivets are not available, longer rivets may be cut off to equal the proper length (not grip). Rivet length is based on the grip.

7. Solid Shank Rivets

- A. Removal of Solid Shank Rivets (Refer to Figure 1).
 - (1) When it becomes necessary to replace a rivet, extreme care should be taken in its removal so that the rivet hole will retain its original size and replacement with a larger size rivet will not be necessary. If the rivet is not removed properly, the strength of the joint may be weakened and the replacement of rivets made more difficult.
 - (2) When removing a rivet, work on the manufactured head. It is more symmetrical about the shank than the shop head, and there will be less chance of damaging the rivet hole or the material around it. To remove rivets, use hand tools, a power drill or a combination of both. The preferred method is to drill through the rivet head and drive out the remainder of the rivet with a drift punch. First, file a flat area on the head of any round or brazier head rivet, and center punch the flat surface for drilling. On thin metal, back up the rivet on the shop head when center punching to avoid depressing the metal. The dimple in 2117-T3 rivets usually eliminates the necessity of filing and center punching the rivet.
 - (3) Select a drill one size smaller than the rivet shank and drill out the rivet head. When using a power drill, set the drill on the rivet and rotate the chuck several revolutions by hand before turning on the power. This procedure helps the drill cut a good starting spot and eliminates the chance of the drill slipping off and tracking across the metal. While holding the drill at a 90° angle, drill the rivet to the depth of its head. Be careful not to drill too deep because the rivet

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shank will turn with the drill and cause a tear. The rivet head will often break away and climb the drill, which is a good signal to withdraw the drill. If the rivet head does not come lose of its own accord, insert a drift punch into the hole and twist slightly to either side until the head comes off.

- (4) Drive out the shank of the rivet with a drift punch slightly smaller than the diameter of the shank. On thin metal or unsupported structures, support the sheet with a bucking bar while driving out the shank. If the shank is exceptionally tight after the rivet head is removed, drill the rivet about two-thirds of the way through the thickness of the material and then drive out the remainder of the rivet with a drift punch.
- (5) The removal of flush rivets is the same as that just described except that no filing of the manufactured head is required before center punching. Be very careful to avoid elongation of the dimpled or the countersunk holes. The rivet head should be drilled to approximately one-half the thickness of the top sheet.

Table 1. Approved Replacement Fasteners Chart

REPLACE	Inch thickness (or thicker)	WITH
MS20470AD3	0.025	NAS1398B4, NAS1398D4
	0.020	NAS1738B4, NAS1738D4
MS20470AD4	0.050	NAS1398B4, NAS1398D5
	0.040	NAS1398B5, NAS1398D5, NAS9301B5, NAS1738B4, NAS1738E4, NAS1738D4, NAS9301B4
	0.032	NAS1738B5, NAS1738E5, NAS1738D5, NAS9301B5
MS20470AD5	0.063	NAS1398B5, NAS1398D5
	0.050	NAS1398B6, NAS1398D6, NAS1738B5, NAS1738E5, CR3213-5
	0.040	NAS1738B6, NAS1738E6, NAS1738D5, CR3213-6
MS20470AD6	0.080	NAS1398B6, NAS1398D6
	0.071	NAS1398D6
	0.063	NAS1738B6, NAS1738E6, NAS1738D, CR3213-6
MS20426AD3 (Countersunk) (Refer to Note 1)	0.063	NAS1398B4, NAS1399D4
	0.040	NAS1739D4
MS20426AD4 (Countersunk)	0.080	NAS1399B4, NAS1399D4, CR3213-4
	0.050	NAS1739D4
MS20426AD4 (Dimpled)	0.063	NAS1739B4, NAS1739E4

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Table 1. Approved Replacement Fasteners Chart (continued)

REPLACE	Inch thickness (or thicker)	WITH
MS20426AD5 (Countersunk)	0.063	NAS1739D5, NAS1739B5, NAS1739E5
	0.050	CR3242-5
MS20426AD5 (Dimpled)	0.071	NAS1739B5, NAS1739E5

NOTE 1: Rework Required. Countersink oversize to accommodate oversize rivet.

NOTE 2: GENERAL NOTE: Do not use blind rivets in any portion of the engine air induction system structure.

Table 2. Approved Fastener Substitutions

Fastener	Collar	DIAMETER	Fastener	Collar
REPLACE			WITH	
NAS178	NAS179	(Refer to Notes 1, 2, 6, 7)	HL18	HL70, HL82
		(Refer to Notes 1, 4)	NAS1054	NAS179, NAS528
		(Refer to Notes 1, 4)	NAS14XX	NAS1080C, NAS1080E, NAS1080G, NAS1080AG
		(Refer to Notes 1, 3, 4)	NAS529	NAS528, NAS179
		(Refer to Notes 1, 2, 5)	NAS1146	NAS1080C, NAS1080E, NAS1080G, NAS1080AG
		(Refer to Notes 1, 5)	NAS7034	NAS1080K
		(Refer to Notes 1, 6)	NAS464	MIL-S-7742
		(Refer to Notes 1, 6)	NAS1103- NAS1116	MIL-S-7742
		(Refer to Notes 1, 6)	NAS1303- NAS1316	MIL-S-7742
		(Refer to Notes 1, 6)	NAS6203- NAS6216	MIL-S-7742
		(Refer to Notes 1, 6)	NAS6603- NAS6616	MIL-S-7742
		(Refer to Notes 1, 6)	AN173	AN305, MS20305, MS21044, MS21045
NAS1054	NAS179, NAS528	(Refer to Notes 1, 4)	NAS14XX	NAS1080C, NAS1080E, NAS1080G, NAS1080AG
		(Refer to Notes 1, 3, 4)	NAS529	NAS528, NAS179
		(Refer to Notes 1, 2, 5)	NAS1446	NAS1080C, NAS1080E, NAS1080G, NAS1080AG

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Table 2. Approved Fastener Substitutions (continued)

Fastener REPLACE	Collar	DIAMETER	Fastener WITH	Collar
		(Refer to Notes 1, 5)	NAS7034	NAS1080K
		(Refer to Notes 1, 6)	NAS464	(Refer to Note 8)
		(Refer to Notes 1, 6)	NAS1103- NAS1106	(Refer to Note 8)
		(Refer to Notes 1, 6)	NAS1303- NAS1306	(Refer to Note 8)
		(Refer to Notes 1, 6)	NAS6203- NAS6206	(Refer to Note 8)
		(Refer to Notes 1, 6)	NAS6603- NAS6606	(Refer to Note 8)

NOTE 1: Refer to appropriate tables for nominal diameters available.

NOTE 2: Available in oversize for repair of elongated holes. Ream holes to provide a 0.001 inch interference fit.

NOTE 3: NAS529-4 thru -12 take NAS528 same dash number. NAS529-14 thru -20 take NAS179.

NOTE 4: Steel shank fastener designated for drive-on collars. Choose protruding head only.

NOTE 5: Steel shank fastener designated for squeeze-on collars. Installation requires sufficient space for the tool and extended shank of the fastener. Choose protruding head only.

NOTE 6: Threaded fastener.

NOTE 7: Preferred substitute fastener.

NOTE 8: When you substitute a threaded fastener for a high strength steel shank rivet, use one of these steel nuts: AN365/MS20365, MS17825, MS21044, MS21045, MS51943 or NAS1079. Approval of the use of these nuts in this application does not constitute a general approval to use these nut on high strength bolts.

NOTE 9: GENERAL NOTE: These fastener substitutions address shear strength and hole tolerances only. The specific application may not allow all of these substitutions because of space considerations.

B. The United States Department of Defense no longer maintains MS and NAS standards. Identical parts may have MS, NASM or AIA/NAS part numbers.

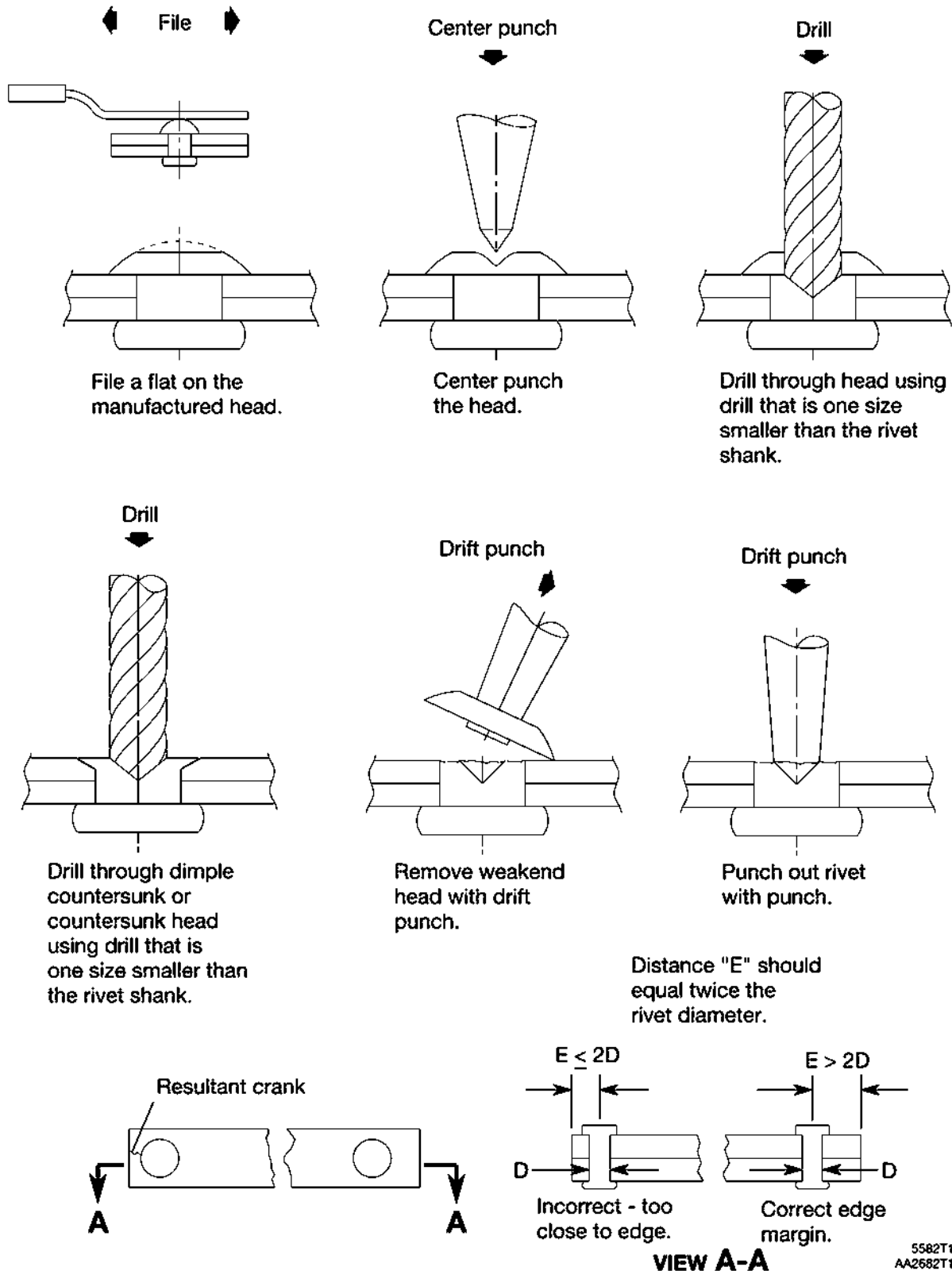
EXAMPLE: MS20470AD4-6 rivets may also be identified as NASM20470AD4-6. NAS1738M4-4 rivets may be identified as AIA/NAS1738M4-4.

C. Installation of Solid Shank Rivets.

(1) A large percentage of riveting of airplane structure is accomplished on thin gauge aluminum alloy, and the work must be accomplished without distorting or damaging the material with hammer blows or riveting tools. All airplane power riveting is accomplished by upsetting the rivets against a bucking bar instead of striking the shank with a hammer. To prevent deforming the rivet head, a rivet set must be selected to fit each type of rivet. The depth of this set must not touch material being riveted. Parts requiring heat treatment should be heat treated before riveting, since heat

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Rivet Removal and Rivet Edge Distance
 Figure 1 (Sheet 1)

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treating process after rivet installation causes warping. Assemblies that require heat treatment in a salt bath must be treated prior to assembly, as the salt cannot be entirely washed out of the joints.

- (2) The use of hollow rivets in joining highly stressed parts is not permitted. To determine if blind rivets may be substituted, refer to Tables 1 and 2. Selection of the proper rivet and the proper number of rivets is very important. Rivets must be of the proper length for the total thickness of the parts being riveted. Ordinarily, from 1-1/2 to 2 times the diameter of the rivet is the correct amount for the rivet shank to protrude through the material to form the head. For heavy material, such as plates or fittings, from 2 to 2-1/2 times the rivet diameter may be used. The rivet should not be excessively loose in the hole, as this condition will cause the rivet to bend over while being driven, and the shank will not be sufficiently expanded to completely fill the hole. A drill from 0.002 inch to 0.004 inch larger than the rivet shank should be used for sheet and plate riveting. Parts should be held firmly together by clamps, screws, or bolts while they are being drilled or riveted. The bucking bar is to be held against the end of the rivet shank. Exercise care while accomplishing this operation to prevent unseating the rivet by too much pressure. For the first few blows, the bucking bar should be held lightly against the rivet shank so it will receive the impact of the blow through the rivet. The bucking bar must be held square with the rivet to produce uniform upsets. As few blows as possible should be struck to properly upset rivet. Blows must be as uniform as possible.

D. Loose Or Working Solid Shank Rivets.

- (1) Rivets which appear to be loose shall be checked with a 0.002 inch feeler gauge by inserting the gauge around the head of the rivet in question. If the feeler gauge can be inserted to the shank of the rivet, it shall be classified as a loose rivet and it shall be replaced. If the feeler gauge can be inserted approximately halfway to the shank for less than 30 percent of the circumference of the rivet head, it shall not be classified as a loose rivet. The feeler gauge shall be used to check the shear section between the riveted members (such as skin to spar or different sections of skins) in a similar manner to that used around the rivet head. If the skin around the brazier head or countersunk rivet can be moved by depressing the skin with finger pressure around the rivet, the rivet shall be replaced. If a rivet is found which turns by applying a rotating load to the head of the rivet, it should be replaced.
- (2) In areas where exterior paint has been applied to rivet heads, the paint may harden due to aging processes and show hairline cracks around the edge of the rivet heads. This should not be used as a basis for determining whether or not the rivet is loose. The hardened paint may crack at times and collect dirt or exhaust fumes which will appear as discoloration. It is not possible to detect loose rivets visually. Replacement rivets should be of like size and type. In some instances, however, it will be necessary to use the next size larger diameter. For general repair practices, the spacing between the centerlines of adjacent rivet holes shall be four diameters or greater. In some areas where the spacing between rivets prohibits the use of the next larger rivets, special repair instructions and procedures shall be followed. Contact Cessna Single Engine Support.

8. Blind Rivets

A. General.

- (1) Blind rivets are intended for use where access is available to only one side of the work.
- (2) Replacement of solid rivets with blind rivets should only be accomplished within the guidelines of Table 1, when the installation of a solid shank rivet is not possible. Blind rivets do not have the same resistance to corrosion and fatigue as solid shank rivets, and should not be considered a universal replacement for solid shank rivets.

B. Removal of Blind Rivets.

CAUTION: Do not drill completely through the rivet sleeve. This method of removing a rivet will tend to enlarge the hole.

- (1) Use a small center drill to provide a guide for a larger drill on top of the rivet stem, and drill away the tapered portion of the stem to destroy the lock.
- (2) Pry the remainder of the locking collar out of the rivet head with a drift punch.

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- (3) Drill nearly through the head of the rivet using a drill the same size as the rivet shank.
- (4) Break off rivet head, using drift pin inserted into the drilled hole as a pry.
- (5) Drive out remaining rivet shank with a pin having a diameter equal to the rivet shank.

C. Installation of Blind Rivets.

- (1) Refer to Figure 2, for an illustration of installation procedures.
- (2) Check that rivet hole size and rivet are compatible.
- (3) Check that proper pulling head is installed on rivet gun.
- (4) Adjustment of pulling head must be made in accordance with manufacturers instructions.
- (5) Check that proper operating air pressure is available to rivet gun.

NOTE: Blind rivets may be installed using pneumatic or mechanical guns, whichever is available.

- (6) Check that holes in parts to be fastened are properly aligned.
- (7) In blind clearance applications, check the minimum blind clearance (BK) dimension if the manufactured head of blind rivet is protruding above the top sheet. The rivet will pull down the sheet as the stem is pulled if the BK dimension is met or exceeded.
- (8) The minimum blind clearance is the BK dimension, and is listed in the manufacturers standard sheets.

NOTE: When installing a blind rivet (pull-type rivet) in a hole where the previous blind rivet was removed by drilling and punching the rivet out, inspect the drilled hole to assure all metal sheets are in place and not separated prior to pulling rivet. It may be necessary to insert a stiff wire in adjacent hole to hold metal in position while pulling rivet.

- (9) When placing pulling head on rivet stem, hold riveter and pulling head in line with axis of rivet while holding tool in a light and flexible manner.
- (10) When tool is actuated, pulling head will pull down and seat against rivet head.
- (11) Clamping action will pull sheets together and seat rivet when tool is actuated.
- (12) When tool is actuated, action of rivet will automatically assist in bringing tool and pulling head into proper alignment with rivet axis.

NOTE: Pressing down with force will not allow rivet and tool to align themselves with hole and could limit head setting of rivet, however, enough force to seat the head against the skin is necessary.

- (13) Hold tool in line with rivet as accurately as possible, and allow a steady but light pressure; pull trigger and let the rivet align itself.
- (14) When rivet is completely installed, release trigger and pulling head will eject pulling portion of stem through forward end.
- (15) Rivet must break within these limits.

Fastener	Dash number	Stem Flushness
NAS1738 or NAS1739	All	+0.010 or -0.020 inch
Cherry Max	-4	+0.010 or -0.015 inch
Cherry Max	-5, -6	+0.010 or -0.020 inch

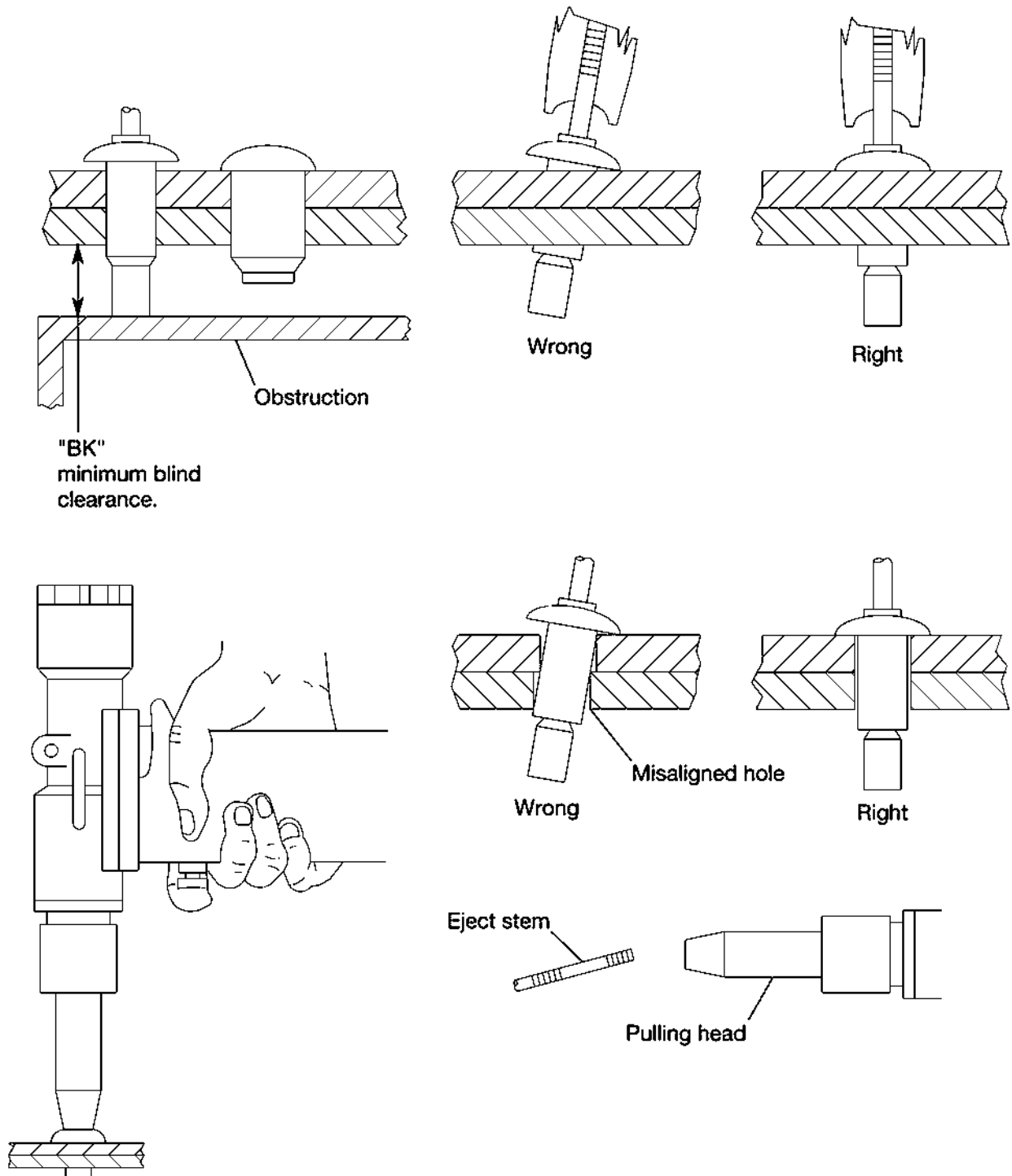
- (16) Protruding stems usually indicate incorrect grip length or oversize holes.

D. Loose or Working Blind Rivets.

- (1) Blind rivets which are found to be loose or show evidence of working must be replaced with rivets of like size and type. In some instances, it may be necessary to use the next larger size rivet. Loose fasteners may be indicated by the following situation:
 - (a) The fastened material moves relative to the fastener. Skin deflection is evident.

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Installation of Blind Rivets
Figure 2 (Sheet 1)

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- (b) Tipping of the fastener head may indicate its looseness or slippage. Rivet head periphery rolled upward also indicates looseness.
- (c) A black or dark gray stain is found adjacent to or around the fastener head. Generally, it takes the form of a dirt or oily streak aft of the loose rivet.
- (d) Mark a red line across the fastener head and the adjacent material. Check the line at the next inspection. Any loosening of the fastener will break the line as indicated in Figure 3.

9. Spacing Of Rivets

- A. There are no specific rules which are applicable to every case or type of riveting. There are, however, certain general rules which should be understood and followed. Edge distance of rivets should not be less than two diameters of the rivet, measured from the edge of the sheet or plate to the center of the rivet hole. Spacing between rivets, when in rows, depends upon several factors, principally the thickness of the sheet, the diameter of the rivets, and the manner in which the sheet will be stressed. This spacing is seldom less than four diameters of the rivet, measured between the centers of the rivet holes. Rivets, spaced four diameters apart, are found in certain seams of semimonocoque fuselages, webs or built up spars, and various plates or fittings. Where there are two rows of rivets, they are usually staggered. The transverse pitch or distance between rows should be slightly less than the pitch of the rivets, with 75 percent of the rivet pitch being the usual practice. An average spacing or pitch of rivets in the cover or skin of most structures, except at highly stressed points, will be from 6 to 12 diameters of the rivet. The best practice in repair is to make pitch of rivets equal to those in the original structure.

10. Threaded Fasteners Bolt Torques

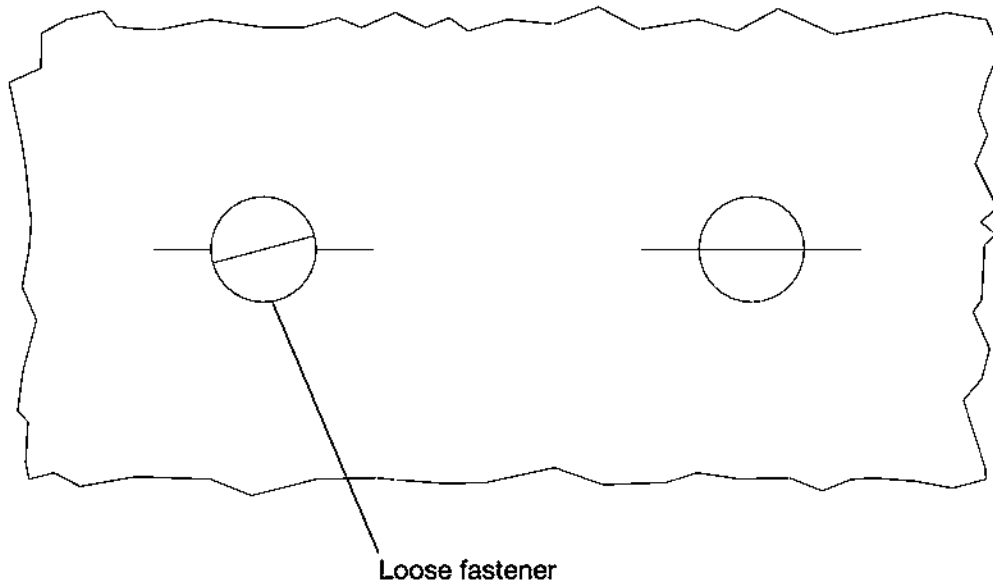
- A. The importance of correct application cannot be overemphasized. Refer to appropriate Maintenance Manual, Chapter 20, Torque Data - Maintenance Practices, for additional information covering torque values. Under torque can result in unnecessary wear of nuts and bolts as well as parts they are holding together. When insufficient pressures are applied, uneven loads will be transmitted throughout assembly, which may result in excessive wear or premature failure due to fatigue. Over torque can be equally damaging because of failure of a bolt or nut from overstressing threaded areas. There are a few simple, but very important, procedures that should be followed to assure that correct torque is applied:
 - (1) Calibrate torque wrench periodically to assure accuracy, and recheck frequently.
 - (2) Be sure that bolt and nut threads are clean and dry unless otherwise specified.
 - (3) Run nut down to near contact with washer or bearing surface and check friction drag torque required to turn nut.
 - (4) Add friction drag torque to desired torque recommended. Refer to appropriate Maintenance Manual, Chapter 20, Torque Data - Maintenance Practices to obtain complete torque calculating procedures. This is referred to as final torque which should register on indicator or setting for a snap over-type wrench.
 - (5) Apply a smooth even pull when applying torque pressure. If chattering or a jerking motion occurs during final torque, back off and re-torque.
 - (6) When installing a castellated nut, start alignment with cotter pin hole at minimum recommended torque plus friction drag torque, and do not exceed maximum torque plus friction drag. If hole and nut castellations do not align, change washers or nut and try again. Exceeding maximum recommended torque is not recommended unless specifically allowed or recommended for that particular installation.

11. Rivets for Plastic or Composite Parts

- A. Unlike rivets in metallic joints, blind rivets are often the rivet of choice for riveting non-metallic materials because they may be installed without the hammering necessary to install solid rivets. If the tail end of the rivet is adjacent to the non-metal side, install a washer over the shank to prevent the "hole filling" action built into blind rivets from overloading the non-metal hole. The hole in the washer should match the specified installation hole for the fastener. If the tail end of the rivet is installed through metal substructure, the washer is not necessary.

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Red Lining of Fasteners
Figure 3 (Sheet 1)

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- B. Soft ("A" 1100 aluminum shank rivets or "B" 5056 aluminum shank) rivets are also used to install non-metallic parts. Original equipment soft rivets will be either red or green colored under the paint. If the butt or driven end of the rivet is adjacent to the non-metallic part, it is preferable to install a washer over the shank to prevent the rivet shank, which swells during driving, from overloading the non-metallic hole. The hole in the washer should match the specified installation hole for the fastener. If the tail end of the rivet is installed through metal substructure, the washer is not necessary. Take care when driving rivets through non-metal to not overdrive the rivet. If the rivet is overdriven, the shank will swell even with the washer in place. The rivet butt should be driven to no more than necessary to retain the part, never more than 1.4 times the shank diameter.
- C. If the original equipment rivet provided connection between metal parts as well as non-metallic parts, it may be a standard (AD) rivet. Original equipment AD rivets are colored gold or uncolored. Replace original equipment AD rivets with AD rivets.

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FLIGHT CONTROL SURFACE BALANCING

1. General

- A. This section applies to the balancing of the ailerons, elevators, and rudder. Control surface balance must be verified after repair or painting.
- B. Proper balance of control surfaces is critical to prevent flutter during normal operating conditions.

2. Tools and Equipment

NAME	NUMBER	MANUFACTURER	USE
Control Surface Balance Fixture Kit	5180002-1	Cessna Aircraft Co. Cessna Part Distribution 5800 E. Pawnee P.O. Box 1521 Wichita, KS 67218	Balance elevator and aileron.
Scale 0-10 Pounds in 0.01 Pound increments		Commercially Available	Balance rudder

3. Procedures for Balancing Control Surfaces

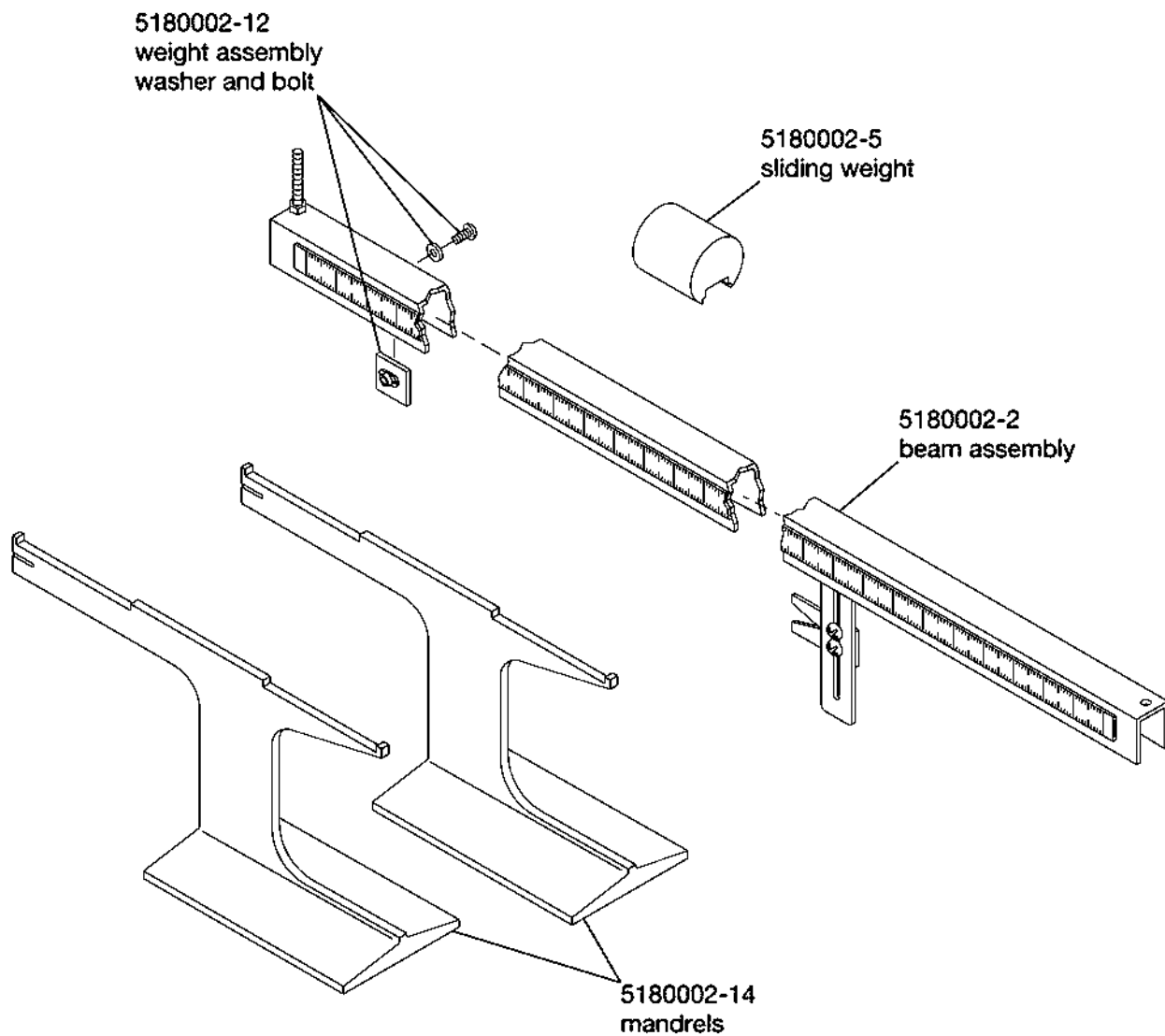
- A. The flight control surface balancing fixture kit (part number 5180002-1) is shown in Figure 1.
 - (1) Balance of control surfaces must be accomplished in a draft free room or area.
 - (2) Place hinge bolts through control surface hinges and position on knife edge balancing mandrels, refer to Figure 2 for positioning of balancing control surfaces.
 - (3) Make sure all control surfaces are in their approved flight configuration; painted (if applicable), trim tabs installed, static wicks, and all tips installed.
 - (4) Place balancing mandrels on a table or other suitable flat surface.
 - (5) Adjust trailing edge support to fit control surface being balanced while center of balancing beam is directly over hinge line. Remove balancing beam and balance the beam itself by adding washers or nuts required at end opposite the trailing edge support.
 - (6) When positioning balancing beam on control surface, avoid rivets to provide a smooth surface for the beam and keep the beam 90 degrees to the hinge line of control surface.
 - (7) Paint is a considerable weight factor. In order to keep balance weight to a minimum, it is recommended that existing paint be removed before adding paint to a control surface. Increase in balance weight will also be limited by the amount of space available and clearance with adjacent parts. Good workmanship and standard repair practices should not result in unreasonable balance weight.
 - (8) The approximate amount of weight needed may be determined by taping loose weight at the balance weight area.
 - (9) Lighten balance weight by drilling off part of weight.
 - (10) Make balance weight heavier by fusing bar stock solder to weight after removal from control surface. The ailerons should have balance weight increased by ordering additional weight and gang channel, listed in applicable Parts Catalog, and installing next to existing inboard weight the minimum length necessary for correct balance, except that a length which contains at least two attaching screws must be used. If necessary, lighten new weight or existing weights for correct balance.

4. Balancing Definitions

- A. Overbalance (refer to Figure 3) is defined as the condition that exists when surface is leading edge heavy and is defined by symbol (-). If the balance beam uses a sliding weight, the weight must be on the trailing edge side of the hinge line (to balance the control surface), the control surface is considered to be overbalanced.

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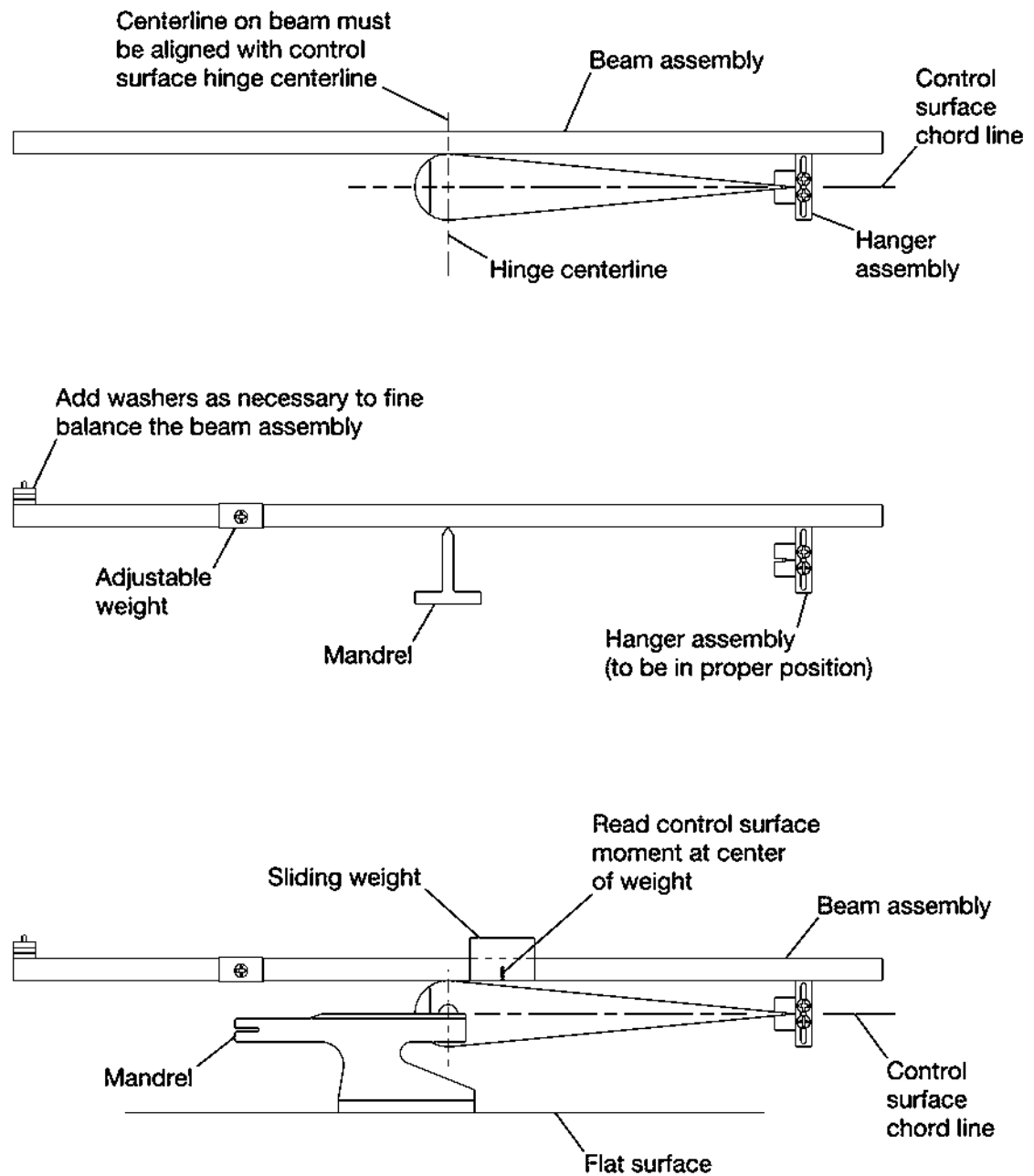
NOTE: Included in 5180002-1 flight control surface balancing fixture kit.

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Flight Control Surface Balancing Fixture Kit
Figure 1 (Sheet 1)

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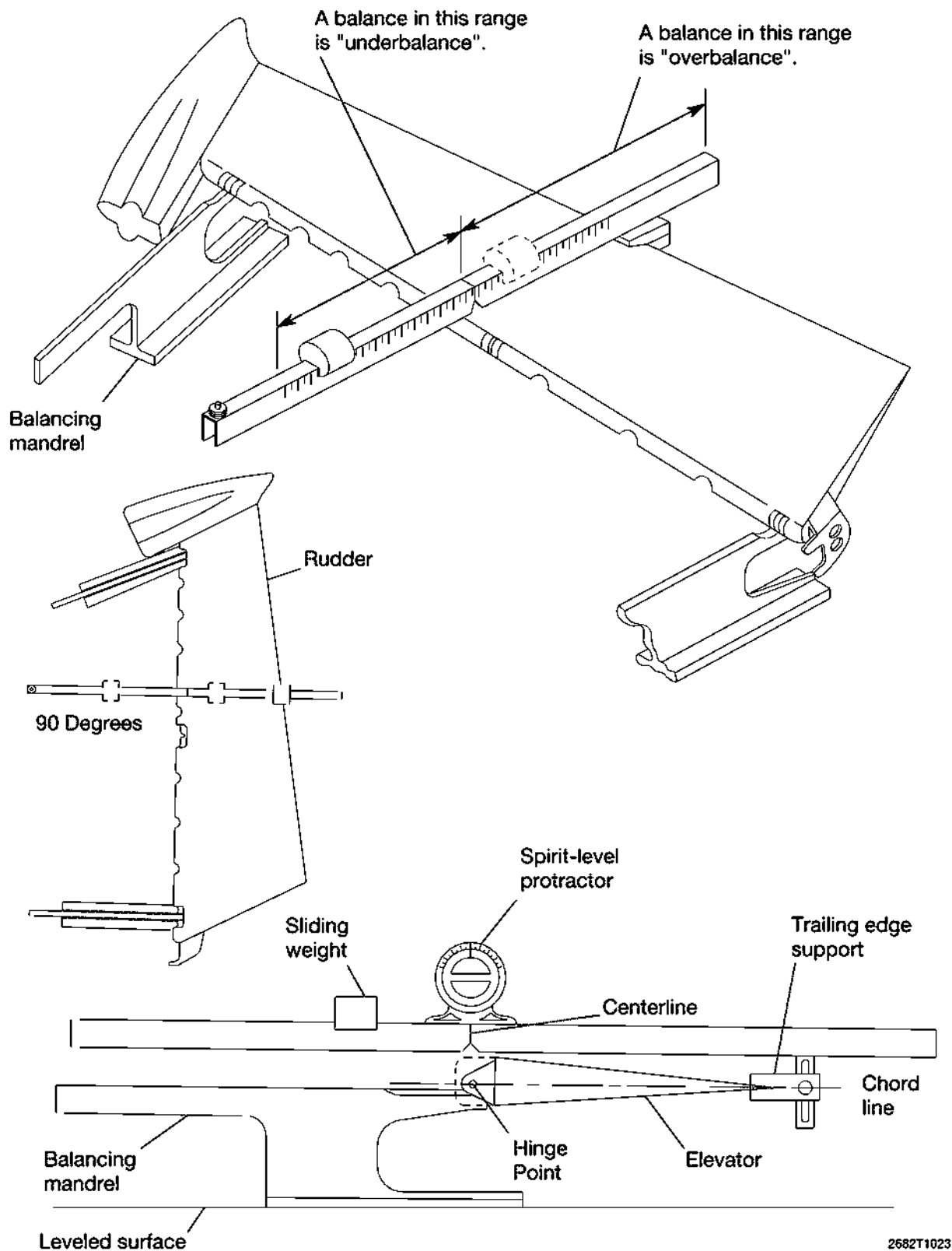


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Balancing Control Surfaces
Figure 2 (Sheet 1)

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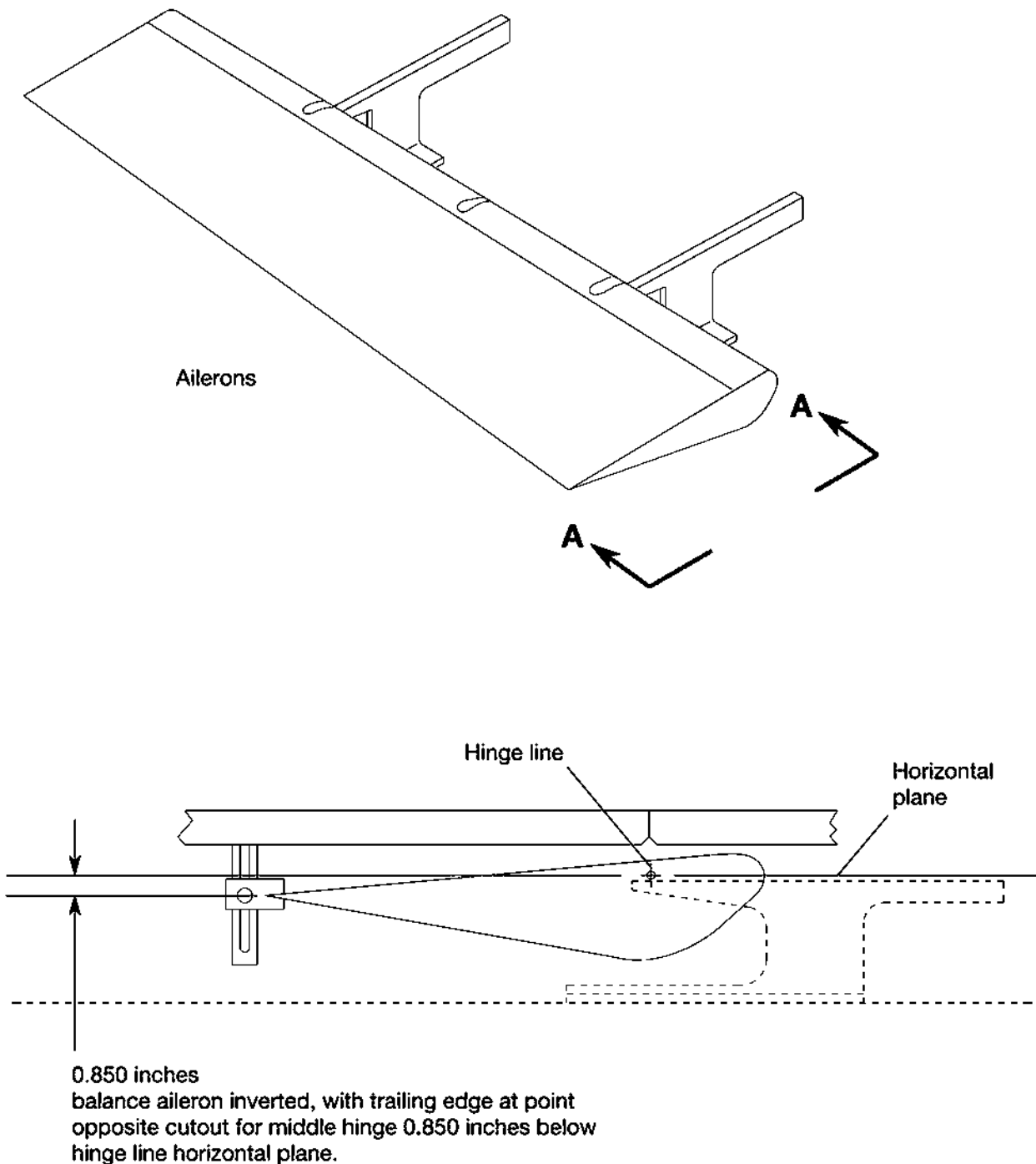


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Balancing Control Surfaces
 Figure 2 (Sheet 2)

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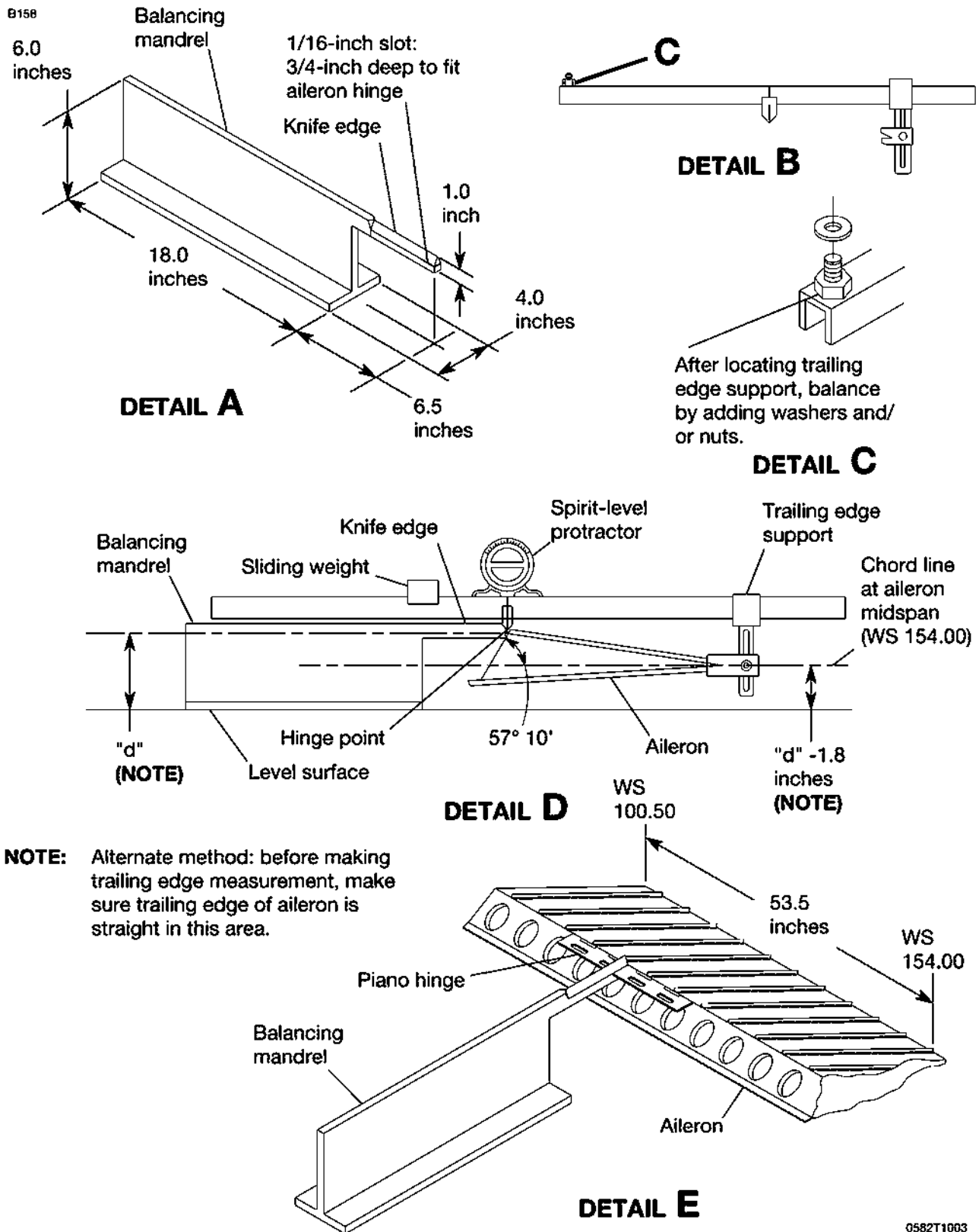


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Balancing Control Surfaces
Figure 2 (Sheet 3)

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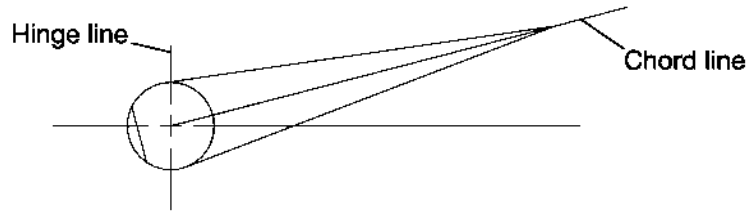


Balancing Control Surfaces
 Figure 2 (Sheet 4)

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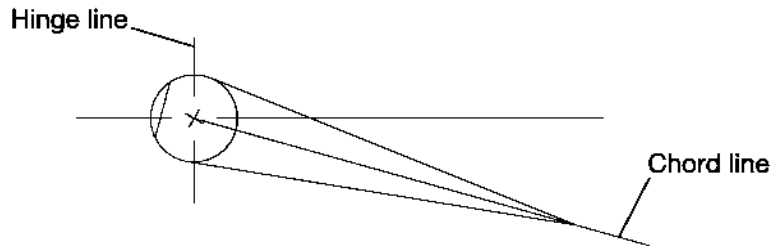
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Control Surface Overbalance (-)
 Figure 3

- B. Underbalance (refer to Figure 4) is defined as the condition that exists when surface is trailing edge heavy and is defined by symbol (+). If the balance beam uses a sliding weight, the weight must be on the leading edge side of the hinge line (to balance the control surface), is considered to be under balanced.

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Control Surface Underbalance (+)
 Figure 4

5. Control Surface Balance Requirements

NOTE: "Approved Flight" must never be exceeded when the surface is in its final configuration for flight.

- A. Refer to Tables 1, 2 and 3 for balance limits of the various airplane control surfaces. These approved flight limits must take into account all items which may be attached and/or applied to the various control surfaces (static wicks, trim tabs, paint, decorative trim stripes, and so forth).

Table 1. Model 172 Static Balance Limits.

CONTROL SURFACE	STATIC BALANCE LIMITS APPROVED FOR FLIGHT CONFIGURATION (INCH-LBS).
AILERON	0.0 TO +11.31
RUDDER	0.0 TO +9.0
LEFT ELEVATOR	0.0 TO +18.5
RIGHT ELEVATOR	0.0 TO +24.5

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Table 2. Model 182 Static Balance Limits.

CONTROL SURFACE	STATIC BALANCE LIMITS APPROVED FOR FLIGHT CONFIGURATION (INCH-LBS).
AILERON	0.0 TO +9.64
RUDDER	0.0 TO +6.0
LEFT ELEVATOR	0.0 TO +20.47
RIGHT ELEVATOR	0.0 TO +20.47

Table 3. Model 206 Static Balance Limits.

CONTROL SURFACE	STATIC BALANCE LIMITS APPROVED FOR FLIGHT CONFIGURATION (INCH-LBS).
AILERON	0.0 TO +3.0
RUDDER (Landplane)	-4.0 TO +3.0
LEFT ELEVATOR	0.0 TO +12.1
RIGHT ELEVATOR	0.0 TO +12.1

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STRUCTURAL REPAIR MANUAL

REPAIRS - GENERAL

1. Introduction

- A. Many components of the airframe structure are similar in design and fabrication. Examples of such items are sheet metal webs, formed structural shapes and extrusions.
- B. Typical repairs to these and other items have been compiled in this section to eliminate the duplication of repairs under each applicable component. Repairs in this section apply to the member shown, regardless of location on the airplane structure (except as limited), and will include only those parts or members necessary to show the typical situation.

2. Usage

- A. Typical repairs may be accomplished individually, or combined with other repairs for a major repair. Technique and material variation is permissible only so far as to facilitate fabrication and ensure the original strength and usefulness of the affected component.

3. Preparation for Repair

- A. The airplane should be located in an area where, once positioned, minimum movement or relocation is required. The airplane should be leveled and supported as necessary. Refer to appropriate Maintenance Manual, Chapter 7, Jacking - Maintenance Practices and Chapter 8, Leveling - Maintenance Practices.

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RIVETED ALUMINUM STRUCTURE REPAIR

1. Preparing Riveted Aluminum Structure For Repair

- A. To prepare an area for repair, examine and classify the damage. Make a thorough check before beginning repairs. In some cases, a damaged part may be classified as needing replacement; however, after removal, closer inspection indicates the part may be repaired.
- (1) Remove all ragged edges, dents, tears, cracks, punctures, and similar damages.
 - (2) Stop-drill all cracks using a No. 30 (0.128 inch) drill.
 - (3) Leave edges, after removal of damaged area, parallel to any square or rectangular edges of the unit.
 - (4) Round all corners
 - (5) Smooth out abrasions and dents
 - (6) Deburr all edges of repair and ensure that no nicks or scratches remain
 - (7) Brush all aluminum parts having rough edges with a solution of Iridite or alodine mixed in a ratio of one ounce of Iridite or alodine to one gallon of water, and rinse thoroughly.
 - (8) To restore original paint and corrosion protectant properties to factory standards, refer to appropriate Maintenance Manual, Chapter 20, Exterior Finish - Cleaning/Painting for refinishing procedures and required materials.

NOTE: Damage adjacent to a previous repair requires removal of the old repair and inclusion of the entire area in the new repair.

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GLASS FABRIC REPAIR

1. General

A. The following procedures are for parts which are constructed of epoxy prepreg glass fabric.

2. Tools and Materials

NOTE: Equivalent substitutes may be used for the following:

NAME	NUMBER	MANUFACTURER	USE
Fiberglass	181 weight	Hexcel	Repair composite structures.
Polyethylene sheet		Commercially available	Cover patches while curing.
Adhesive	EA9394	Loctite Aerospace Bay Point, CA 94565	Adhesive resin.
Adhesive	EA9396	Loctite Aerospace	Adhesive resin.
Adhesive	Epon 815	Loctite Aerospace	Adhesive resin.
Methyl Propyl Ketone		Commercially available	Cleaning solvent.
Sandpaper	Various grits	Commercially available	Abrading, smoothing.
Rubber sheet		Commercially available	Cover patches when applying pressure.

3. Repair Of Glass Fabric Parts

A. The procedures listed below are for repairing of glass fabric parts. Refer to Figure 801 for an illustration of a typical glass fabric repair.

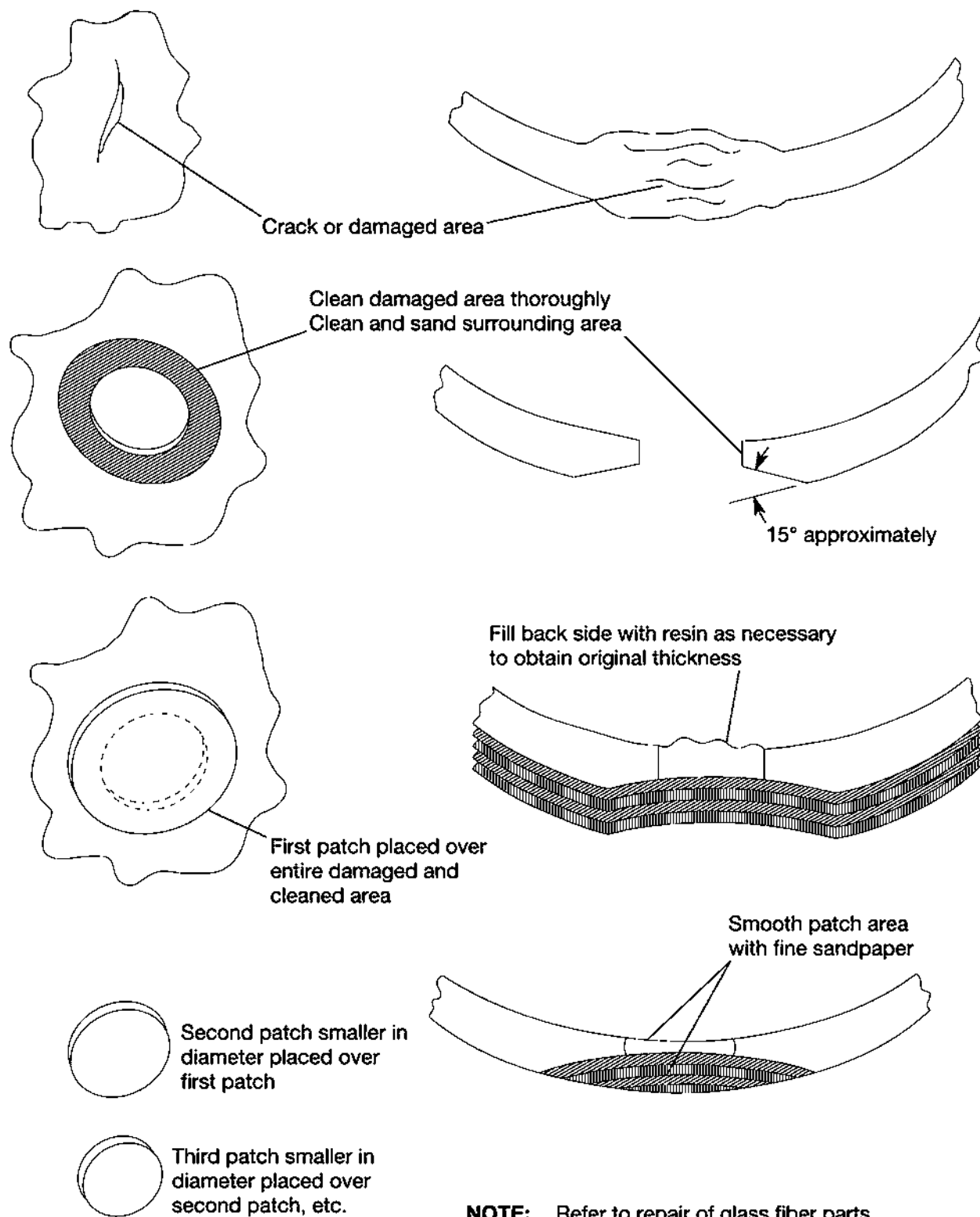
- (1) Cut and trim area immediately beyond damage. If parts were painted, remove paint and sand clean an area at least 1-1/2 inches larger in diameter than the cut out section.
- (2) Prepare necessary size and number of patches of glass fabric style No. 181.

WARNING: Always follow manufacturer's mixing instructions carefully to ensure proper cure and prevent a spontaneous fire.

- (3) Mix sufficient amount of resin in accordance with manufacturers instructions.
- (4) Ensure that hands are free from oil, grease, and dirt, and apply an even coat of resin on sanded area.
- (5) Impregnate all the glass fabric patches by laying them on a polyethylene sheet and working the resin through the glass fabric with a small brush.
- (6) Place larger patch over cutout area, working out all air bubbles and wrinkles.
- (7) If cutout is large enough to cause the patch to sag, place a suitable support behind repair area.
- (8) Apply a second patch over the first patch, working out all wrinkles and air bubbles.
- (9) After all patches have been applied, brush the area with an even coat of resin and allow to cure. Curing time is 24 hours at 77°F.
- (10) Smooth patched area with 600-grit sandpaper until desired finish is obtained.
- (11) Repaint finished area with matching paint. Refer to the applicable Maintenance Manual, Chapter 20, Exterior Finish - Cleaning/Painting for painting procedures.

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NOTE: Refer to repair of glass fiber parts before attempting glass fiber repair.

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Typical Glass Fiber Panel Repair
 Figure 801 (Sheet 1)

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REPAIR OF THERMO-FORMED THERMO PLASTIC COMPONENTS

1. Thermo-formed Thermo Plastic Repair

- A. Repair of puncture or holes in thermo-formed plastics can be made by trimming out the damaged area, removing any paint in the area, and installing an overlapping, beveled, or flush patch of identical material. Doublers may be installed behind the patch where additional strength is desired. MPK, or any commercially available solvent that will soften and dissolve the plastic, may be used as the bonding agent. Dissolving some of the plastic shavings in the solvent will furnish additional working time. Moderate pressure is recommended for best results. Curing time will vary with the agent used, but repairs should not be strained until fully cured. Cracks can be repaired by saturating the crack itself with the solvent, then filling with an epoxy filler or a paste made of the plastic shavings and the solvent. Again, the crack may be reinforced with a doubler on the back side for additional strength. After the repair has been made, the area may be sanded smooth and painted. Parts that are extensively damaged should be replaced instead of repaired.

2. Temporary Repairs

A. Crack Repair

- (1) It is permissible to stop drill crack(s) that originate at the edge of a fairing if the crack is less than 2 inches (50 mm) in length.
- (a) Stop drill the crack with a Number 30 (0.128 inch diameter) drill bit.
 - (b) A crack may be stop drilled only once.

NOTE: A crack that passes through a fastener hole and does not extend to the edge of the part, may be stop drilled at both ends of the crack.

- (c) Any fairing that has a crack that progresses past a stop drilled hole must be repaired or replaced.
 - (d) A fairing that has any of the following conditions must have a repair made as soon as practical:
 - 1 A crack that is longer than 2 inches (50 mm).
 - 2 Cracks in more than 10 percent of the attach fastener locations per fairing.
- (2) Fairings, with a stop drilled crack that does not extend past the stop drilled hole, may remain in service until the next 100 hour or equivalent inspection.

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TYPICAL SKIN REPAIRS

1. General

- A. Damage which would involve a typical skin repair can be described as damage that requires modification, such as material replacement or patching. Skin damage in the form of dents, scratches, or punctures requires a patch. Refer to Figure 801, for an illustration of typical skin repairs. Refer to Figure 802 for corrugated skin repairs.

2. Guidelines for Corrugated Skin Crack Repairs

A. Corrugated Aileron Skin Repair:

- (1) It is permissible to stop drill crack(s) that originate at the trailing edge of the control surface provided the crack(s) is(are) not more than 2 inches in length.
- (2) Stop drill crack(s) using a Number 30 (0.128 inch diameter) drill.
- (3) A crack may only be stop drilled once.

NOTE: A crack that passes through a trailing edge rivet and does not extend to the trailing edge of the skin may be stop drilled at both ends of the crack.

- (4) Any control surface that has a crack that progresses past a stop drilled hole shall be repaired or replaced.
- (5) A control surface that has any of the following conditions shall have a repair made as soon as practical:
 - (a) A crack that is longer than 2 inches.
 - (b) A crack that does not originate from the trailing edge or a trailing edge rivet.
 - (c) Cracks in more than six trailing edge rivet locations per skin.
- (6) Affected control surfaces with corrugated skins and having a stop drilled crack that does not extend past the stop drilled hole, may remain in service without additional repair.
- (7) Refer to Figure 802 as applicable for repair information.

B. Corrugated Flap Skin Repair:

- (1) It is permissible to stop drill crack(s) that originate at the trailing edge of the control surface provided the crack(s) is(are) not more than 2 inches in length.
- (2) Stop drill crack(s) using a Number 30 (0.128 inch diameter) drill.
- (3) A crack may only be stop drilled once.

NOTE: A crack that passes through a trailing edge rivet and does not extend to the trailing edge of the skin may be stop drilled at both ends of the crack.

- (4) Any control surface that has a crack that progresses past a stop drilled hole shall be repaired or replaced.
- (5) A control surface that has any of the following conditions shall have a repair made as soon as practical:
 - (a) A crack that is longer than 2 inches.
 - (b) A crack that does not originate from the trailing edge or a trailing edge rivet.
 - (c) Cracks in more than six trailing edge rivet locations per skin.
- (6) Affected control surfaces with corrugated skins and having a stop drilled crack that does not extend past the stop drilled hole, may remain in service without additional repair.
- (7) Refer to Figure 802 as applicable for repair information.

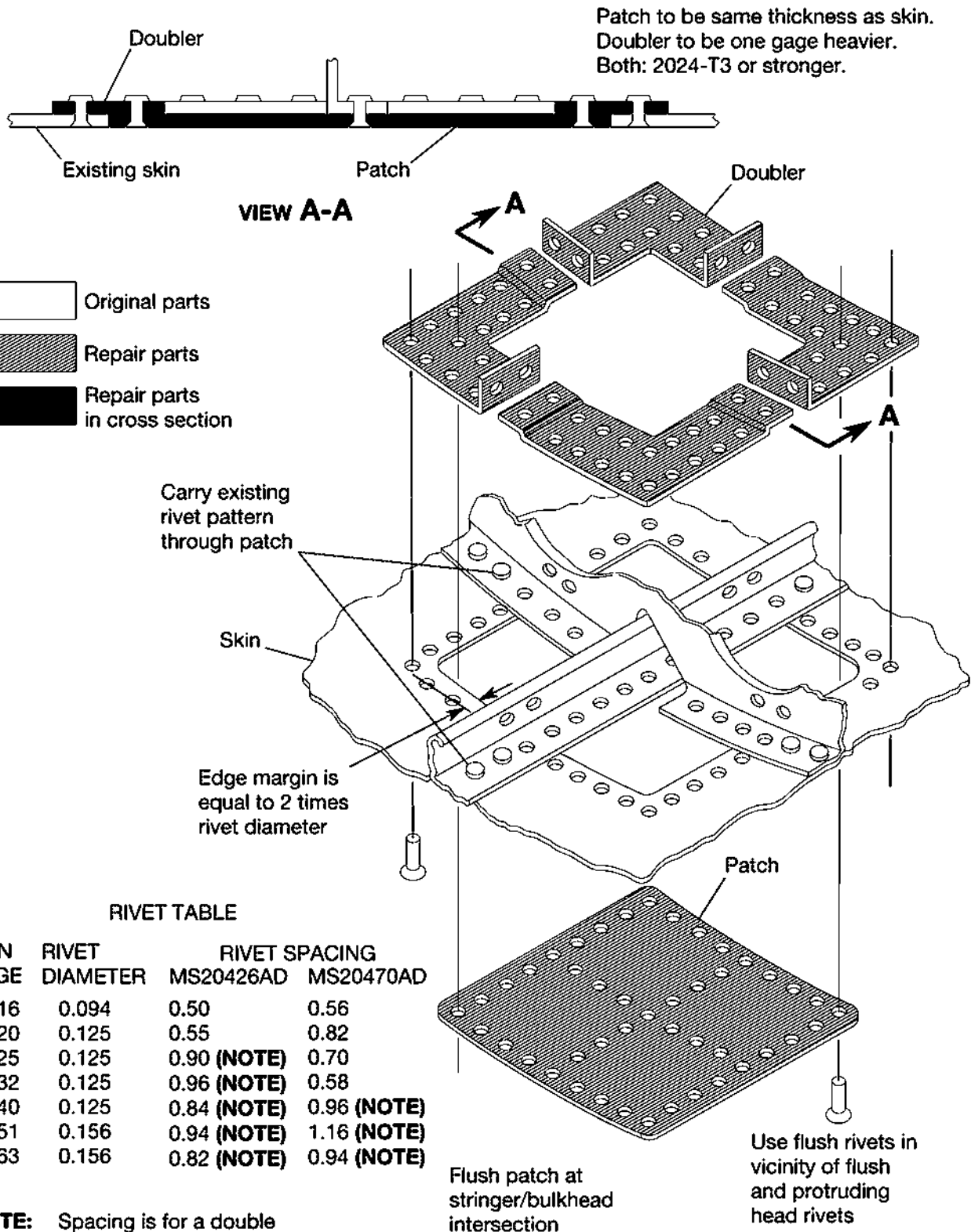
C. Corrugated Elevator Skin Repair:

- (1) It is permissible to stop drill crack(s) that originate at the trailing edge of the control surface provided the crack(s) is(are) not more than 2 inches in length.
- (2) Stop drill crack(s) using a Number 30 (0.128 inch diameter) drill.
- (3) A crack may only be stop drilled once.

NOTE: A crack that passes through a trailing edge rivet and does not extend to the trailing edge of the skin may be stop drilled at both ends of the crack.

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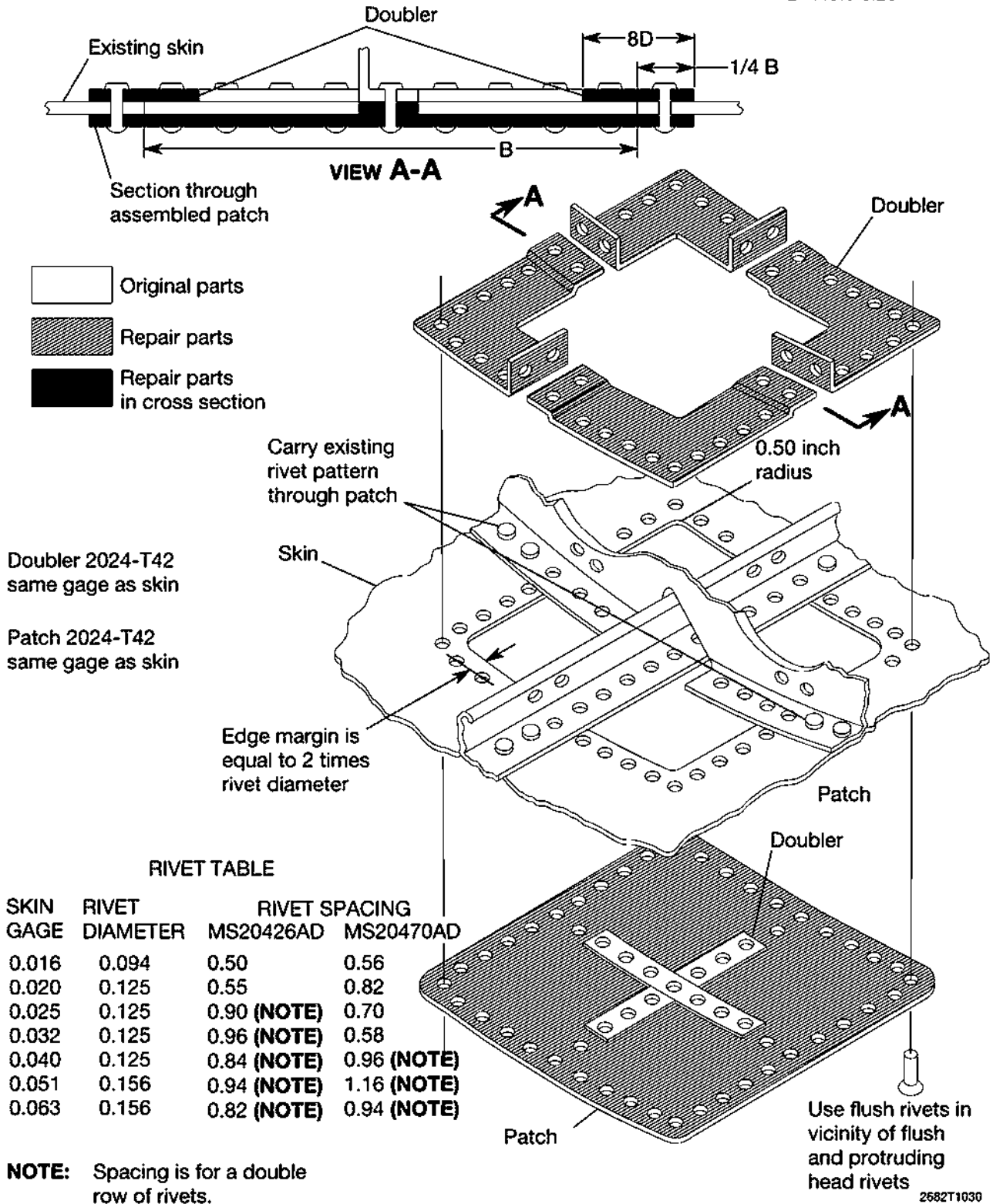
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Skin Repair
 Figure 801 (Sheet 1)

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D=Rivet diameter
 B=Hole size



Skin Repair
 Figure 801 (Sheet 2)

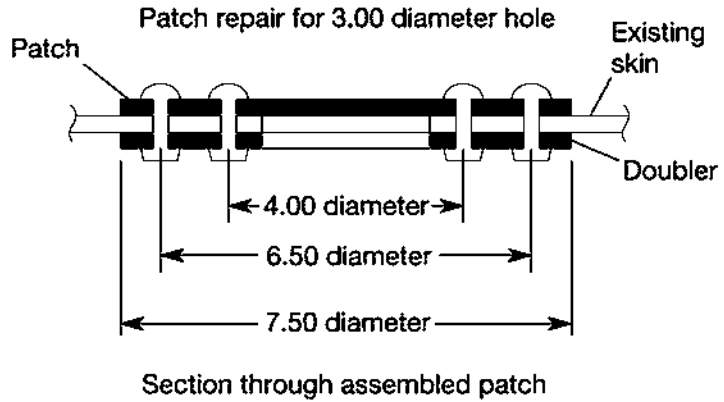
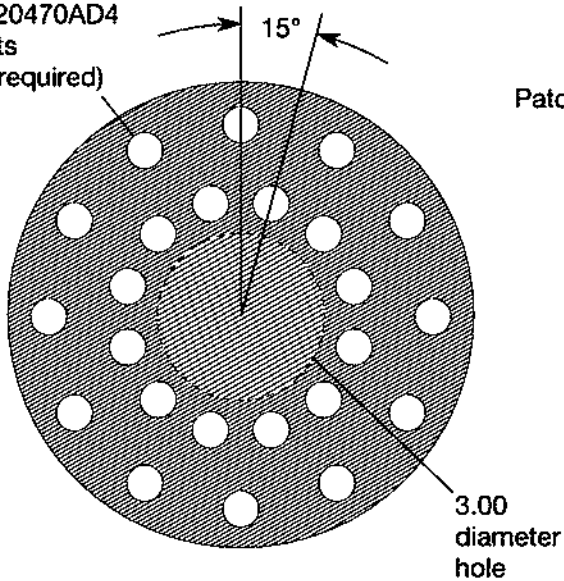
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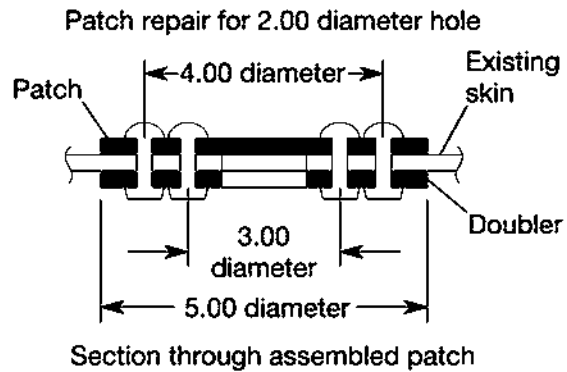
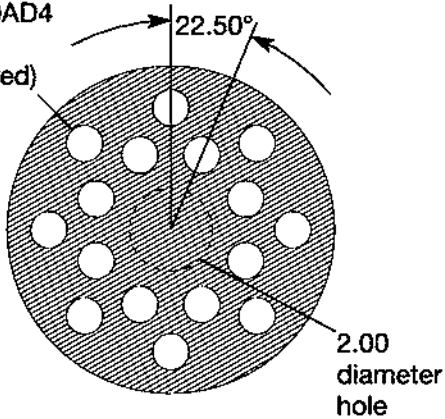
NOTE: All dimensions are in inches unless otherwise noted.

Patch and doubler 2024-T4 same gage as skin

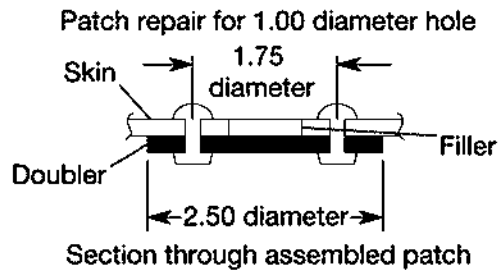
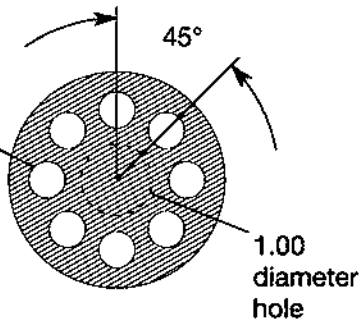
MS20470AD4
 rivets
 (24 required)



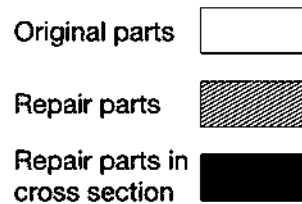
MS20470AD4
 rivets
 (16 required)



MS20470AD4
 rivets
 (8 required)



Overlapping circular patch

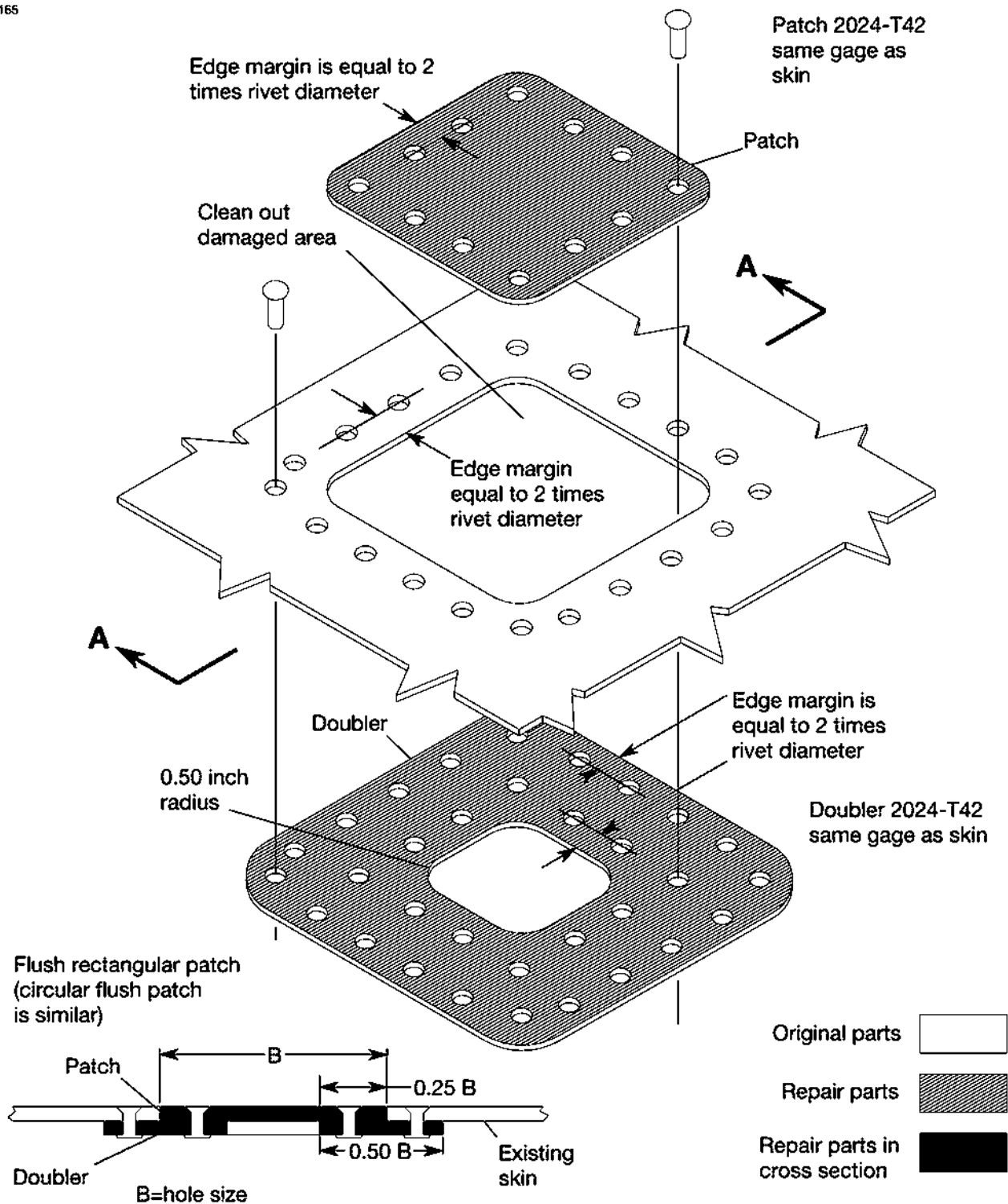


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Skin Repair
 Figure 801 (Sheet 3)

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 STRUCTURAL REPAIR MANUAL

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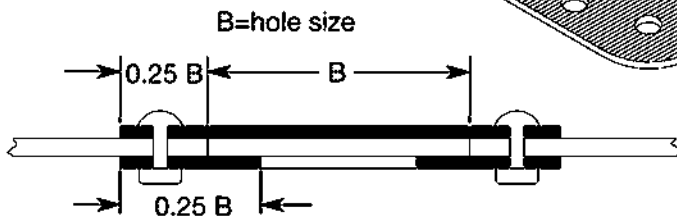
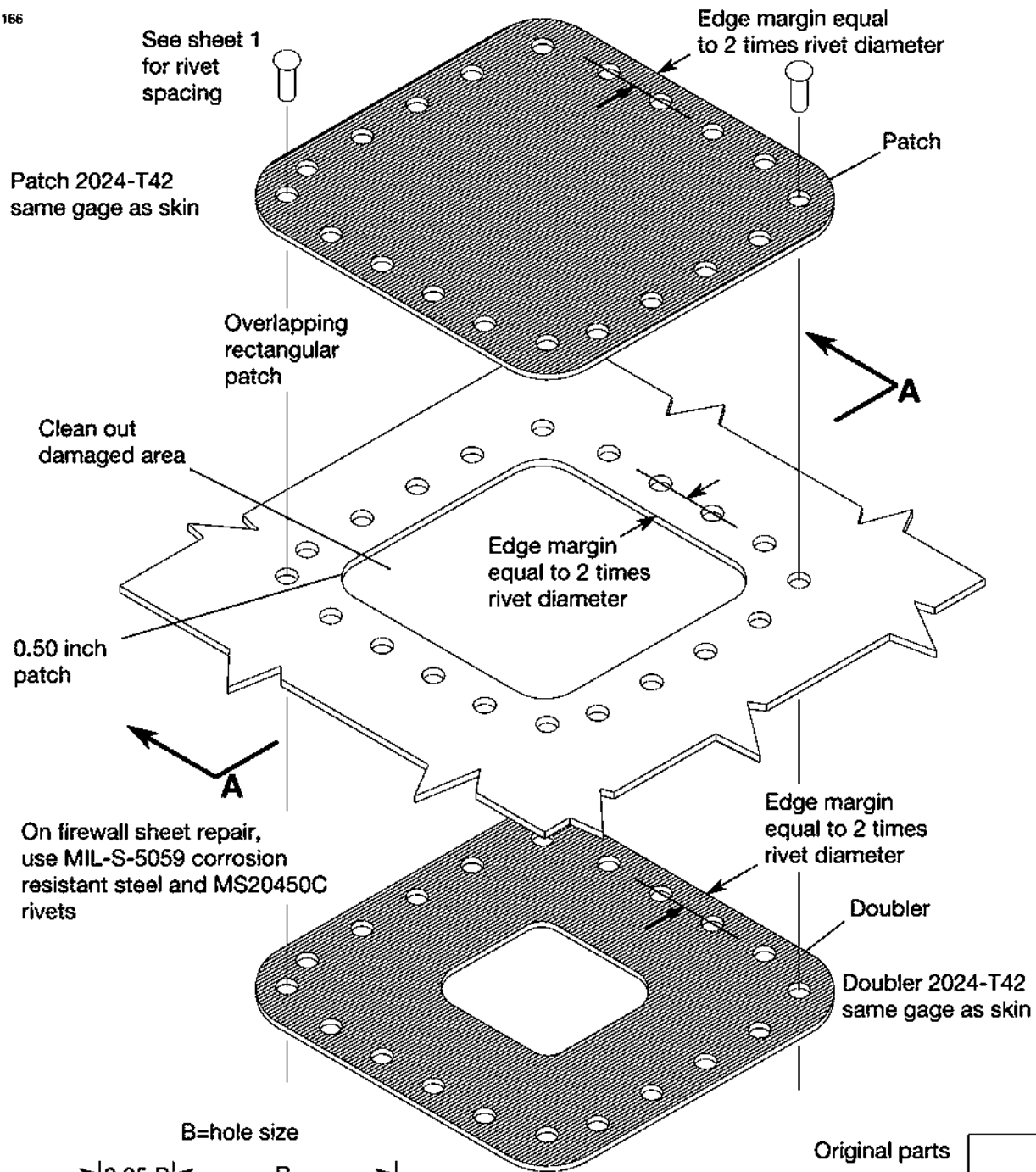


Skin Repair
 Figure 801 (Sheet 4)

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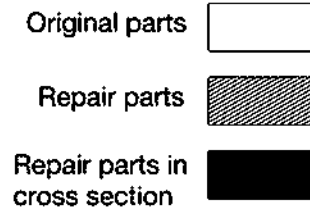
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VIEW A-A

Section through assembled patch

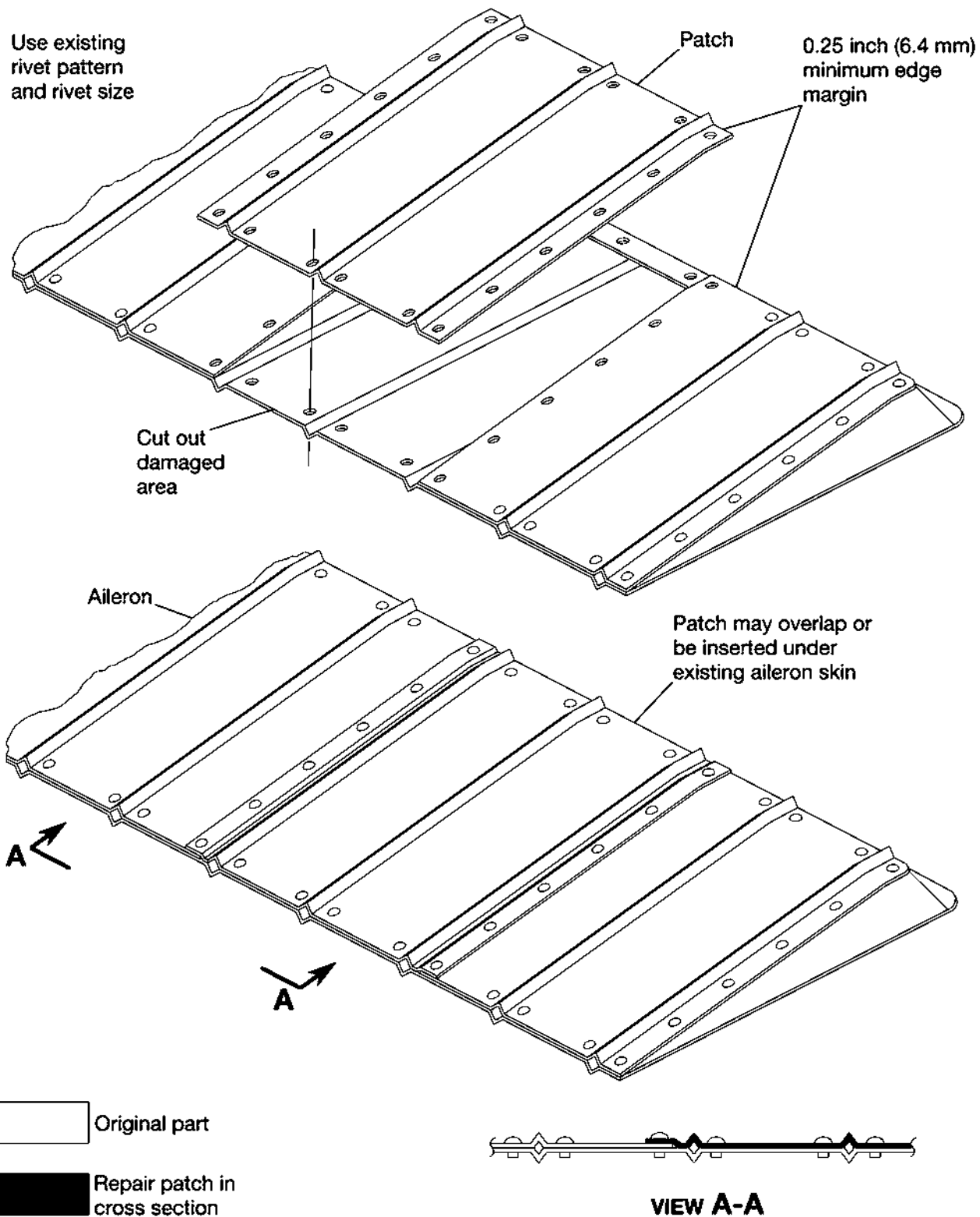


Skin Repair
 Figure 801 (Sheet 5)

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Corrugated Skin Repair
Figure 802 (Sheet 1)

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- (4) Any control surface that has a crack that progresses past a stop drilled hole shall be repaired or replaced.
- (5) A control surface that has any of the following conditions shall have a repair made as soon as practical:
 - (a) A crack that is longer than 2 inches.
 - (b) A crack that does not originate from the trailing edge or a trailing edge rivet.
 - (c) Cracks in more than six trailing edge rivet locations per skin.
- (6) Affected control surfaces with corrugated skins and having a stop drilled crack that does not extend past the stop drilled hole, may remain in service without additional repair.
- (7) Refer to Figure 802 as applicable for repair information.

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CONTROL SURFACE REPAIR

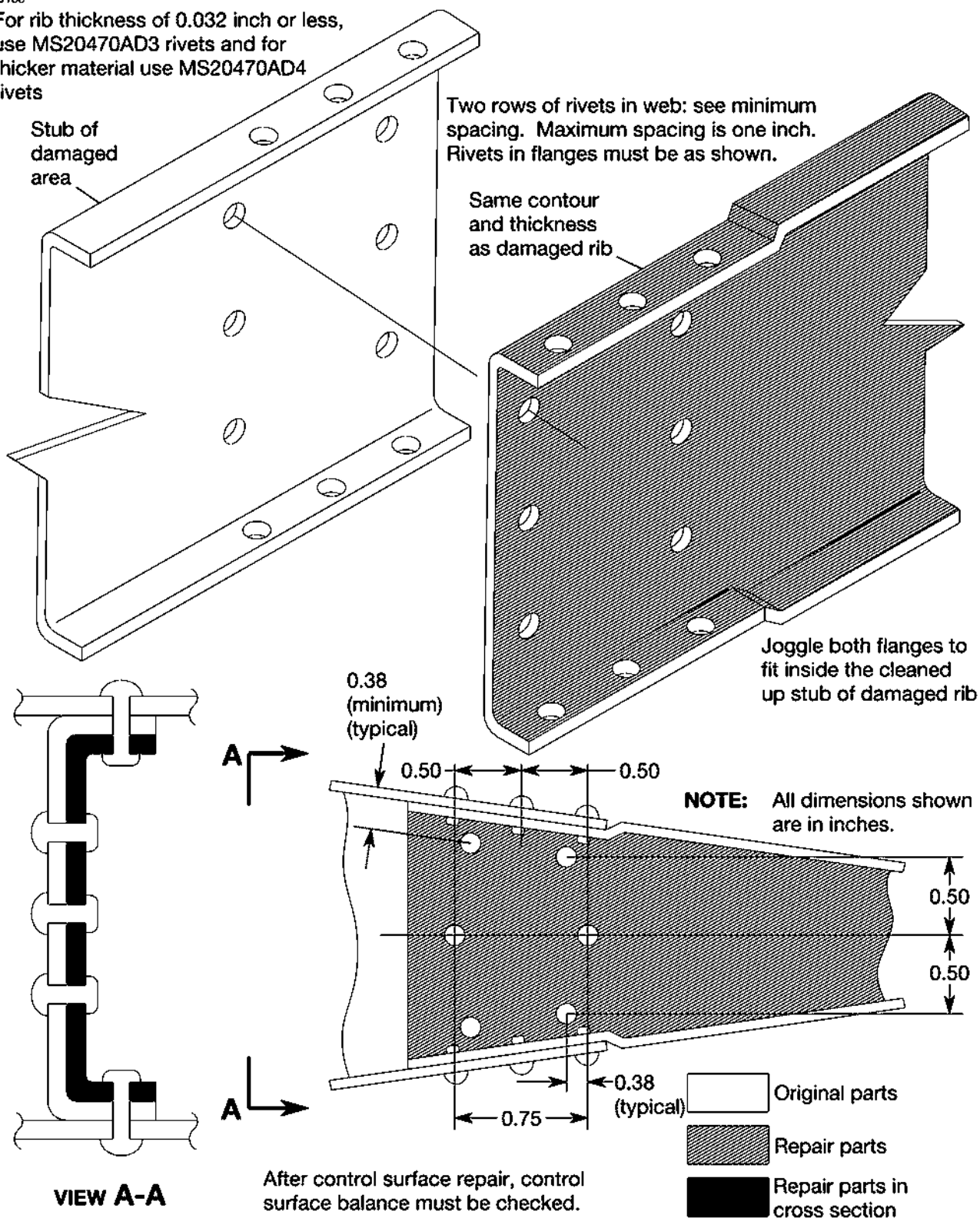
1. General

- A. Damage which would involve a control surface repair: After the repair is completed, the control surface balance must be checked as described in Flight Control Surface Balancing. Refer to Figures 801 and 802 which illustrate typical control surface repairs.

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For rib thickness of 0.032 inch or less,
 use MS20470AD3 rivets and for
 thicker material use MS20470AD4
 rivets

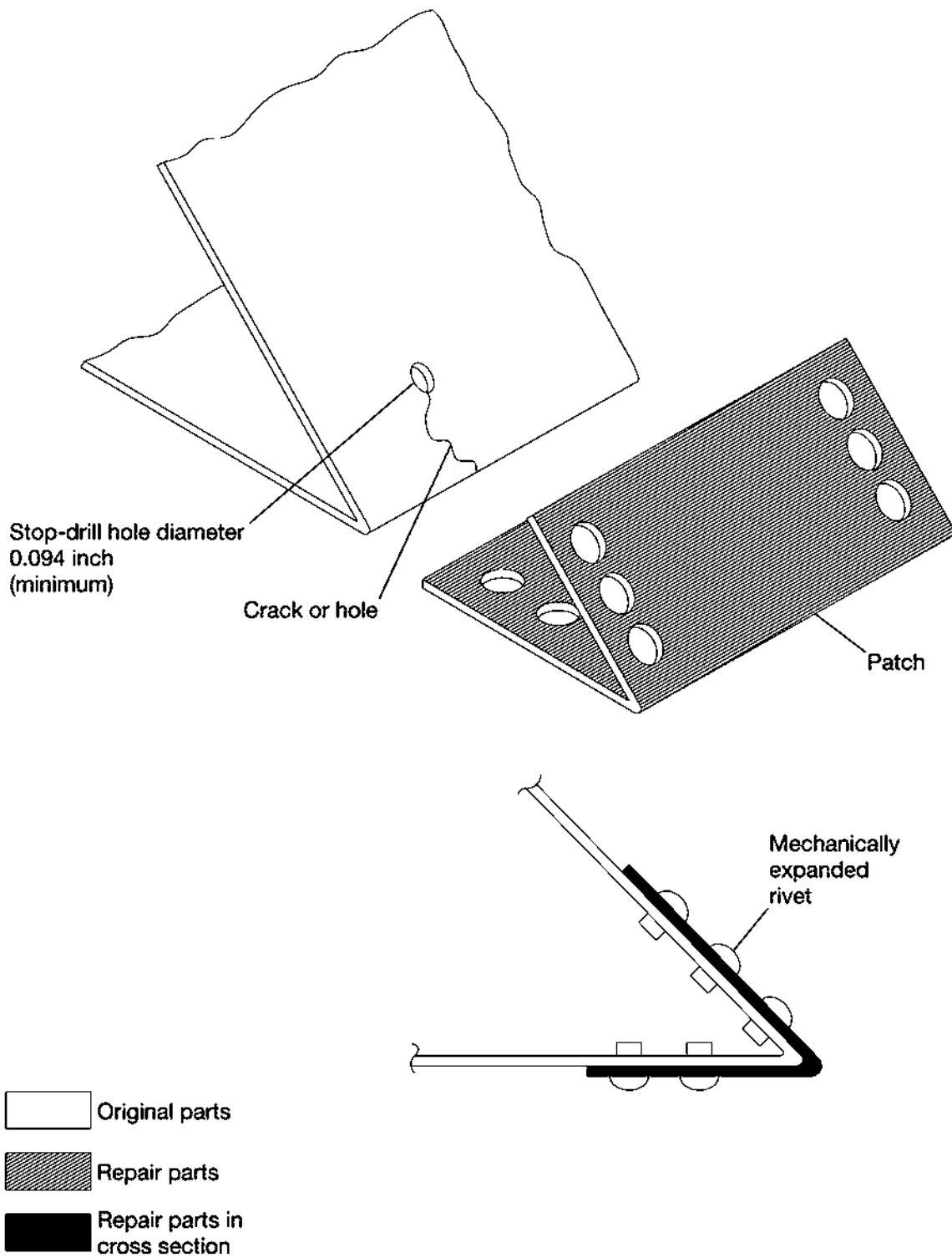


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Typical Control Surface Rib Repair
 Figure 801 (Sheet 1)

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STRUCTURAL REPAIR MANUAL

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2682T1026

Typical Control Surface Trailing Edge Repair
Figure 802 (Sheet 1)

CHAPTER

52

DOORS

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SINGLE ENGINE
STRUCTURAL REPAIR MANUAL

LIST OF EFFECTIVE PAGES

CHAPTER-SECTION-SUBJECT	PAGE	DATE
52-Title		
52-List of Effective Pages		
52-Record of Temporary Revisions		
52-Table of Contents		
52-00-00	Page 1	Jun 1/2005
52-10-00	Page 101	Jun 1/2005

RECORD OF TEMPORARY REVISIONS

[illegible]

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General	52-00-00 Page 1
DOOR DAMAGE CLASSIFICATION	52-10-00 Page 101
Repairable Damage	52-10-00 Page 101

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DOORS - GENERAL

1. General

- A. Chapter 52 describes general repair practices, materials and procedures which are applicable to the doors and door structure.
- B. If questions arise concerning approved repairs or for repairs not shown in this section, contact Cessna Propeller Aircraft Product Support.

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DOOR DAMAGE CLASSIFICATION

1. Repairable Damage

- A. Bonded doors may be repaired by the same methods used for riveted structure. Rivets are a satisfactory substitute for bonded seams on these assemblies. The strength of the bonded seams in doors may be replaced by a single 3/32, 2117-AD rivet per running inch of bond seam. The standard repair procedures outlined in AC43.13-1b are also applicable to bonded doors.

CHAPTER

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FUSELAGE

CESSNA AIRCRAFT COMPANY
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LIST OF EFFECTIVE PAGES

CHAPTER-SECTION-SUBJECT	PAGE	DATE
53-Title		
53-List of Effective Pages		
53-Record of Temporary Revisions		
53-Table of Contents		
53-00-00	Pages 1-3	Jun 1/2005
53-10-00	Pages 1-2	Jun 1/2005
53-20-00	Pages 801-805	Jun 1/2005
53-30-00	Pages 801-806	Jun 1/2005
53-40-00	Pages 801-803	Jun 1/2005

RECORD OF TEMPORARY REVISIONS

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FUSELAGE DAMAGE CLASSIFICATION	53-10-00 Page 1
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CABIN BULKHEAD REPAIR	53-20-00 Page 801
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Repair of Webs or Flanges	53-20-00 Page 801
Repair of Channels	53-20-00 Page 801
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Repairing the Firewall Assembly	53-40-00 Page 801

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FUSELAGE - GENERAL

1. General

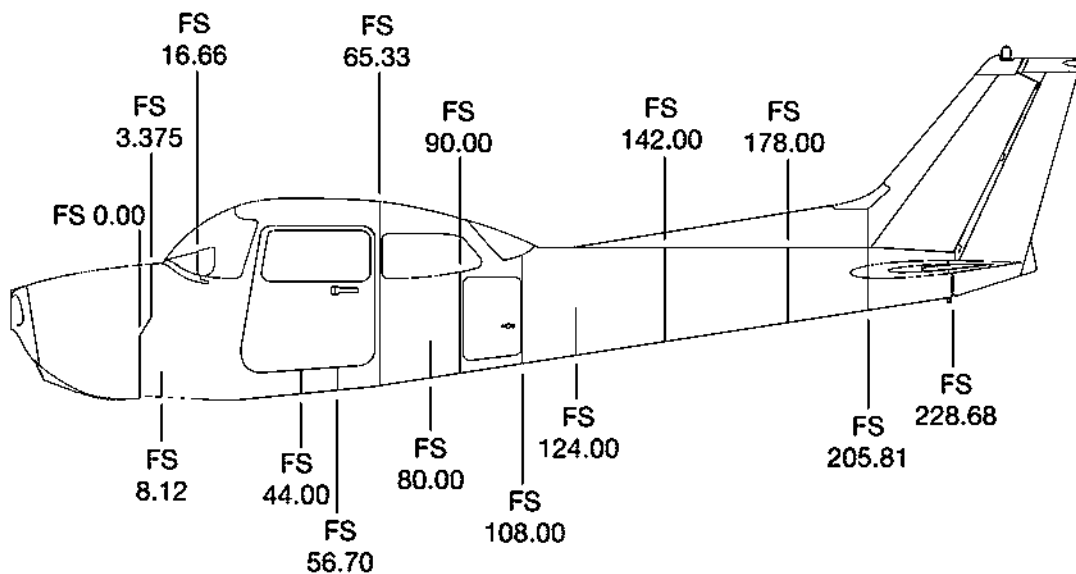
- A. Chapter 53 describes general repair practices, materials and procedures which are applicable to the Fuselage and Fuselage Structure. Refer to Figure 1 for illustrations of fuselage stations.
- B. For repairs beyond the scope of this chapter, refer to Chapter 51, Typical Skin Repairs.

2. Fuselage

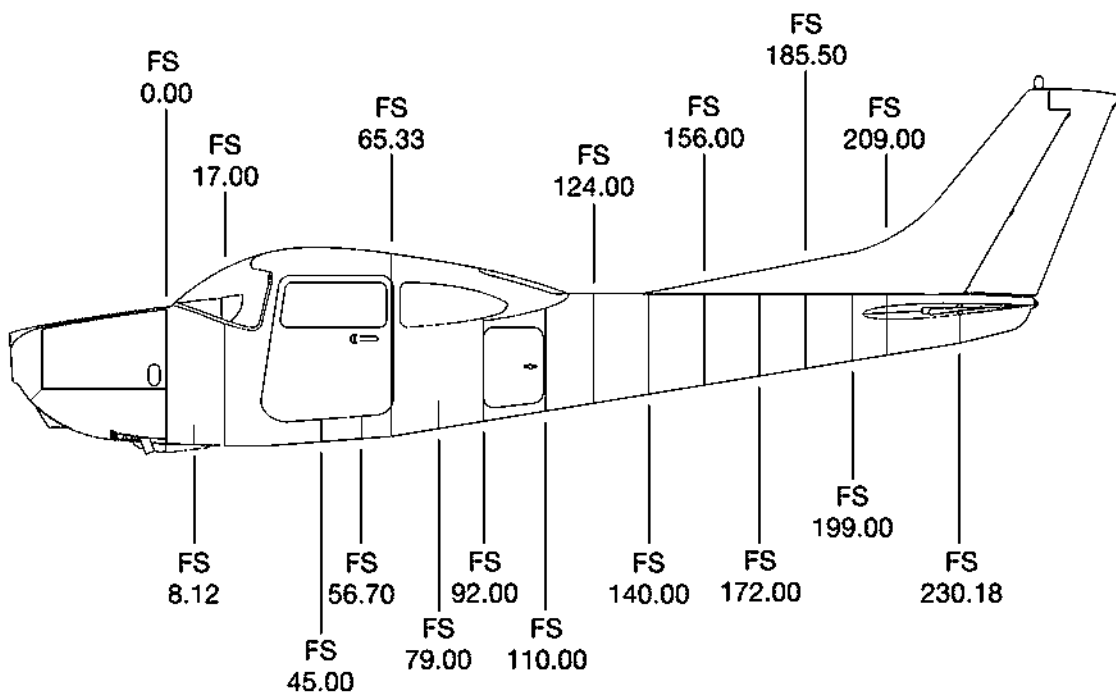
- A. The fuselage is of semimonocoque construction and consists of formed bulkheads, longitudinal stringers, reinforcing channels and skin panels.
- B. If questions arise concerning approved repairs or for repairs not shown in this section, contact Cessna Propeller Aircraft Product Support.

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MODEL 172R/172S FUSELAGE



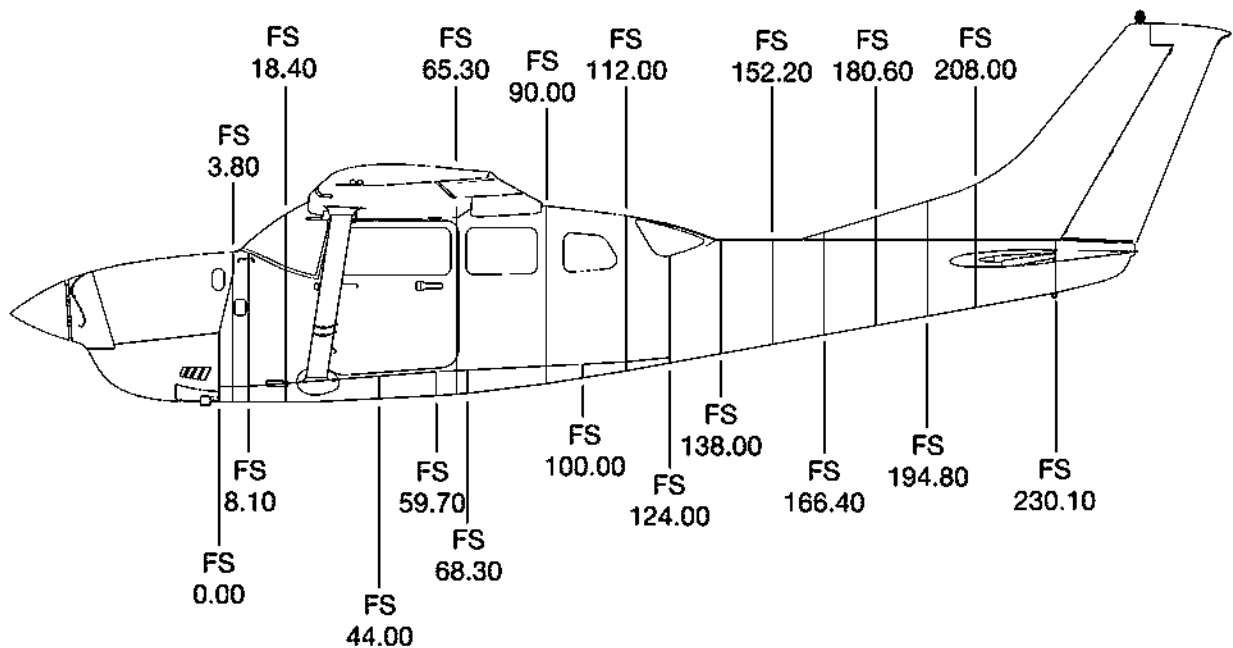
MODEL 182S/182T/T182T FUSELAGE

Fuselage Stations
 Figure 1 (Sheet 1)

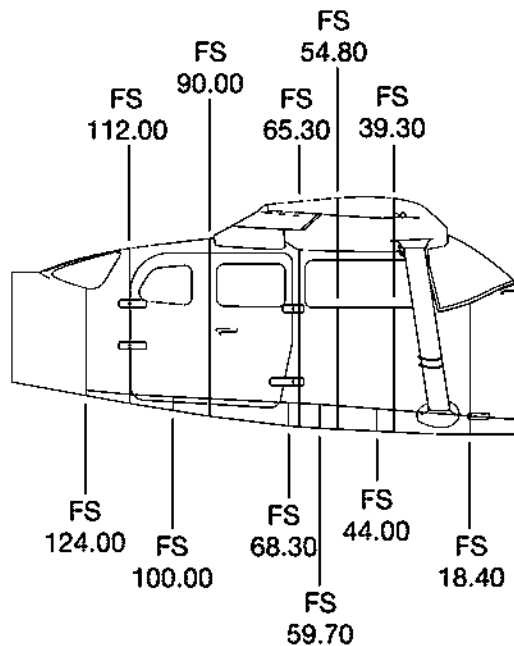
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MODEL 206H/T206H FUSELAGE



CARGO DOORS
 (RIGHT SIDE ONLY)
 (MODEL 206H/T206H)

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 1210T1007

Fuselage Stations
 Figure 1 (Sheet 2)

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STRUCTURAL REPAIR MANUAL

FUSELAGE DAMAGE CLASSIFICATION

1. General

- A. Damage to the fuselage can be divided into three major categories; negligible damage, repairable damage, and major replacement damage. The categories are provided to assist in determining the extent and criticalness of any damage.

2. Negligible Damage

- A. Any smooth dents in the fuselage skin that are free from cracks, abrasions, and sharp corners, and which are not stress wrinkles and do not interfere with any internal structure or mechanism, may be considered as negligible damage. In areas of low stress intensity, cracks, deep scratches, or deep, sharp dents - which after trimming or stop-drilling can be enclosed by a two-inch circle - can be considered negligible if the damaged area is at least one diameter of the enclosing circle away from all existing rivet lines and material edges. Stop drilling is considered a temporary repair and a permanent repair must be made as soon as practical.
- B. Mild corrosion appearing upon clad aluminum surfaces does not necessarily indicate incipient failure of the base metal. However, corrosion of all types must be carefully considered, and approved remedial action taken.
- C. Small cans appear in the skin structure of all metal airplanes and should not necessarily be a cause for concern. However, it is strongly recommended that wrinkles which appear to have originated from other sources, or which do not follow the general appearance of the remainder of the skin panels, be thoroughly investigated. Except in the landing gear bulkhead areas, wrinkles occurring over stringers which disappear when the rivet pattern is removed, may be considered negligible. However, the stringer rivet holes may not align perfectly with skin holes because of a permanent "set" in the stringer. If this is apparent, replacement of the stringer will usually restore the original strength characteristics of the area.

NOTE: Wrinkles occurring in the skin of the main landing gear bulkhead areas must not be considered negligible. The skin panel must be opened sufficiently to permit a thorough examination of the lower portion of the landing gear bulkhead and its tie-in structure.

- D. Wrinkles occurring in open areas which disappear when the rivets at the edge of the sheet are removed, or a wrinkle which is hand removable, may often be repaired by a 1/2 inch x 1/2 inch x 0.050 inch 2024-T42 extruded angle or a heavy "J" section. The angle should be inserted fore and aft across the center of the wrinkle and should extend to within 1/16 inch to 1/8 inch of the fuselage bulkheads comprising the end of the bay. Rivet pattern should be similar to existing manufactured seam at edge of sheet.
- E. Negligible damage to stringers, formed skin flanges, bulkhead channel and like parts is similar to that for the wing skin. Refer to Chapter 57, Wing Damage Classification for a definition of negligible damage to these components.

3. Repairable Damage

- A. If a skin is badly damaged, repair must be made by replacing an entire skin panel, from one structural member to the next. Repair seams must be made to lie along structural members and each seam must be made exactly the same in regard to rivet size, spacing and pattern as the manufactured seams at the edges of the original sheet. If the manufactured seams are different, the stronger must be copied. If the repair ends at a structural member where no seam is used, enough repair panel must be used to allow an extra row of staggered rivets, with sufficient edge margin to be installed.
- B. Typical methods of repair for skins, bulkheads, stringers, and channels are illustrated in Chapter 51, Typical Skin Repairs. Before repairs are attempted, all cracks or deep scratches must be stop-drilled with a No. 30 (0.128 inch) drill and all sharp corners and ragged edges must be trimmed away and deburred.

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4. Replacement Damage

- A. All forgings and castings of any material and structural parts made of steel must be replaced if damaged. Structural members of a complicated nature that have been distorted or wrenched should be replaced. Seat rails serve as structural parts of the fuselage and must be replaced if damaged.

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CABIN BULKHEAD REPAIR

1. General

- A. Bulkheads are comprised of formed "C" channel sections. The principal material of construction is 2024-0 Alclad aluminum alloy which, after forming, is heat-treated to a 2024-T42 condition. All bulkheads in the fuselage are of the formed sheet metal or the reinforced formed sheet metal type.

2. Repair of Webs or Flanges

- A. The following procedures are for the repair of cracked bulkhead webs or flanges.
- (1) Acceptable methods of repairing various types of cracks occurring in service are shown in Figures 801 and 802.
 - (2) Stop-drill No. 30 (0.128 inch) minimum holes at extreme ends of cracks to prevent further cracking.
 - (3) Reinforcements should be added to carry stresses across damaged portion and stiffen the joints.

NOTE: The condition causing such cracks to develop at a particular point may be stress concentration at that point, in conjunction with repetition of stress (such as produced by vibration of the structure). The stress concentration may be due to defects such as nicks, scratches, tool marks, and initial stresses or cracks from forming or heat-treating operations. An increase in sheet thickness alone is usually beneficial but does not necessarily remedy the condition leading to the cracking. Patch-type repairs are generally employed and are usually satisfactory in restoring the original material strength characteristics.

3. Repair of Channels

- A. The following procedures are for the repair of severely bent, kinked, or torn channels.
- (1) If practical, severely bent, kinked, or torn portions of bulkheads should be removed and replacement sections installed and joined at the original splice joint.
 - (2) If the procedure outlined in the preceding step is not justified, cutting away the damaged portion and inserting a trimmed portion of the original section, adequately reinforced by splice plates or doublers, will prove satisfactory. This is known as an insertion-type patch.

4. Landing Gear Bulkheads

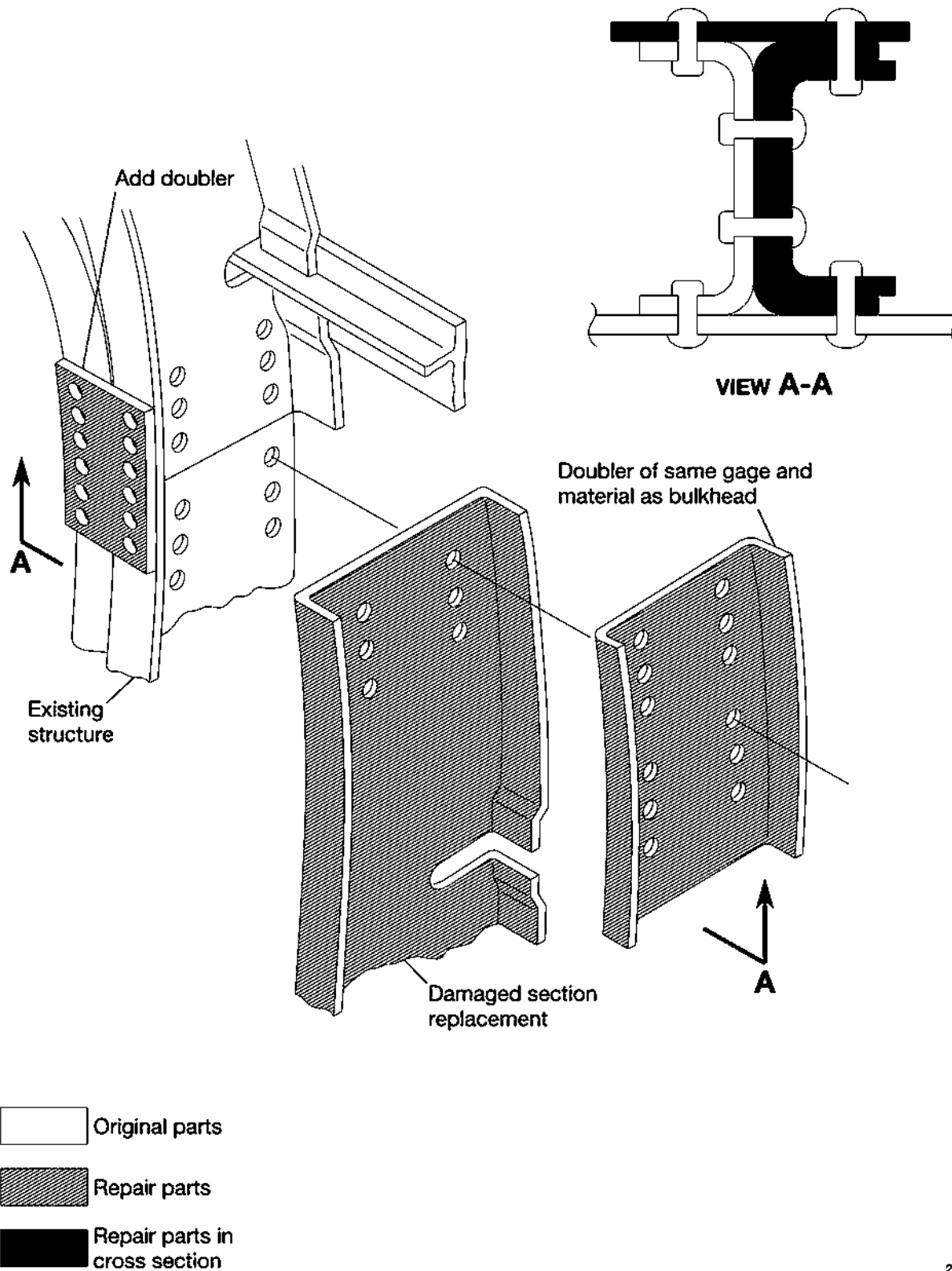
- A. Landing gear bulkheads are highly stressed members, irregularly formed to provide clearance for control cables, fuel and brake lines. Patch type repairs on these bulkheads are, for the most part, impractical. Minor damage, consisting of small nicks or scratches, may be repaired by dressing out the damaged area, or by replacement of fasteners. Any other damage must be repaired by replacing the landing gear support assembly as an aligned unit.

5. Repair After Hard Landing

- A. Buckled skin or floor boards, and loose or sheared rivets in the area of the main gear support are indications of damage to structure from an extremely hard landing. When such evidence is present, the entire support structure must be examined and all support forgings must be checked for cracks.
- (1) Use fluorescent dye penetrant and magnification to examine for cracks.
- B. Bulkheads in the damaged area must be checked for alignment. Deformation of bulkhead webs must be checked using a straightedge.
- C. Damaged support structure, buckled floorboards and skins, and damaged or questionable forgings must be replaced.

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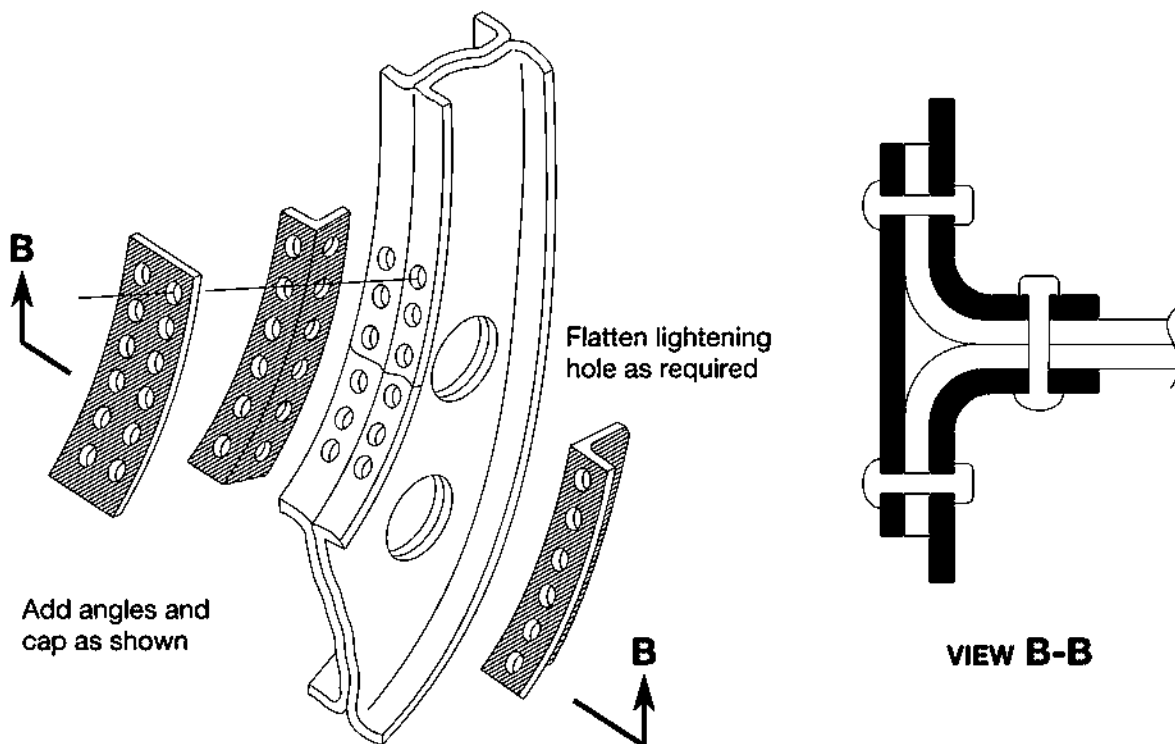


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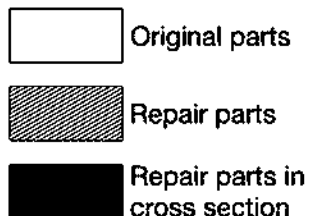
Typical Cabin Bulkhead Repair
 Figure 801 (Sheet 1)

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 STRUCTURAL REPAIR MANUAL

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Repair of cracked bulkhead



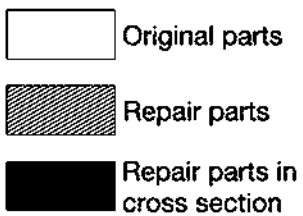
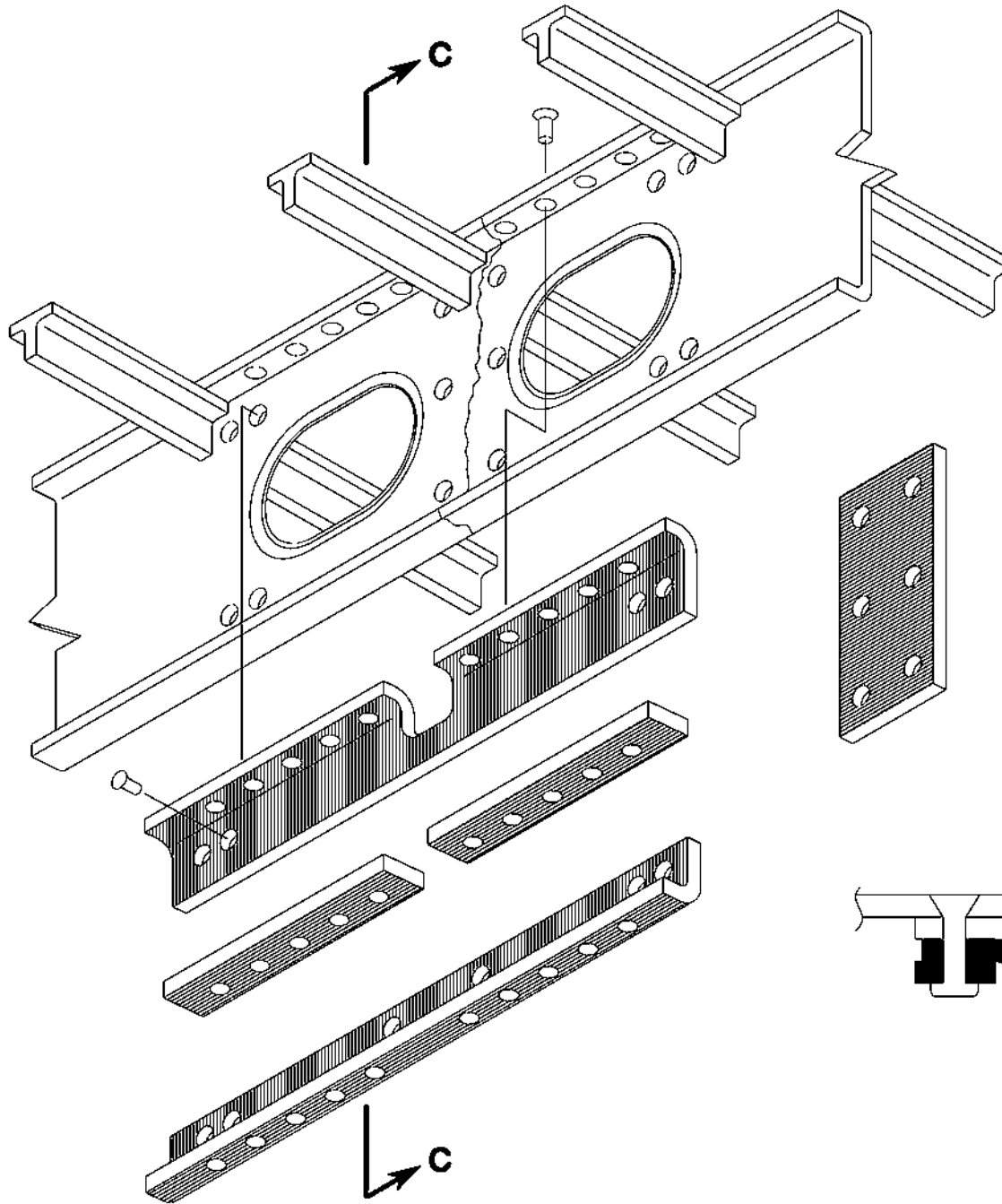
NOTE: Add repair parts of next larger gage material. Refer to FAA advisory circular AC43.13-1A, Figure 2.28 for required gage thickness and number of rivets.

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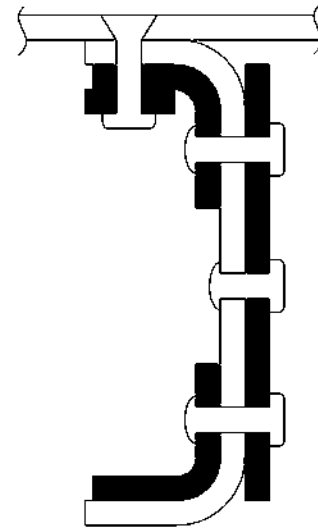
Typical Cabin Bulkhead Repair
 Figure 801 (Sheet 2)

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NOTE: Add bulkhead segment length to extend to adjacent stringer or approximately seven inches each side of defect. Make from bulkhead section with center section removed.



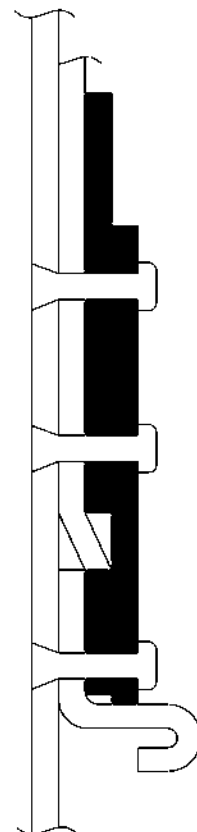
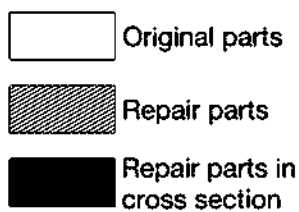
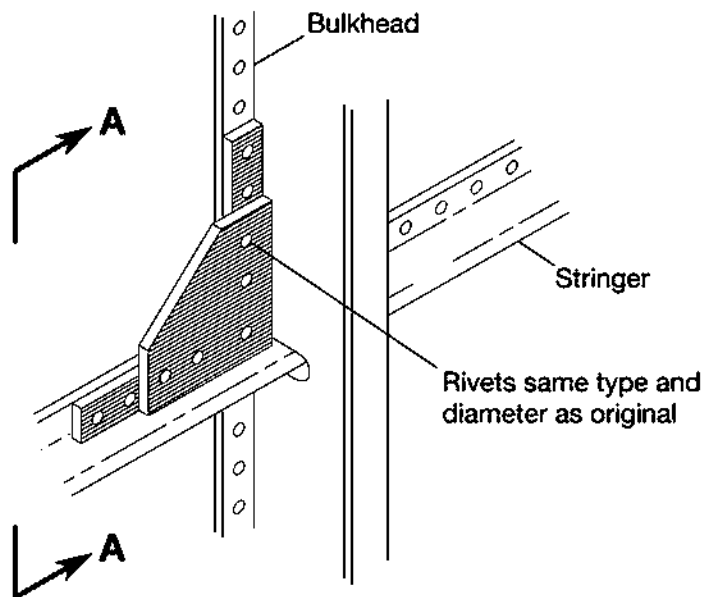
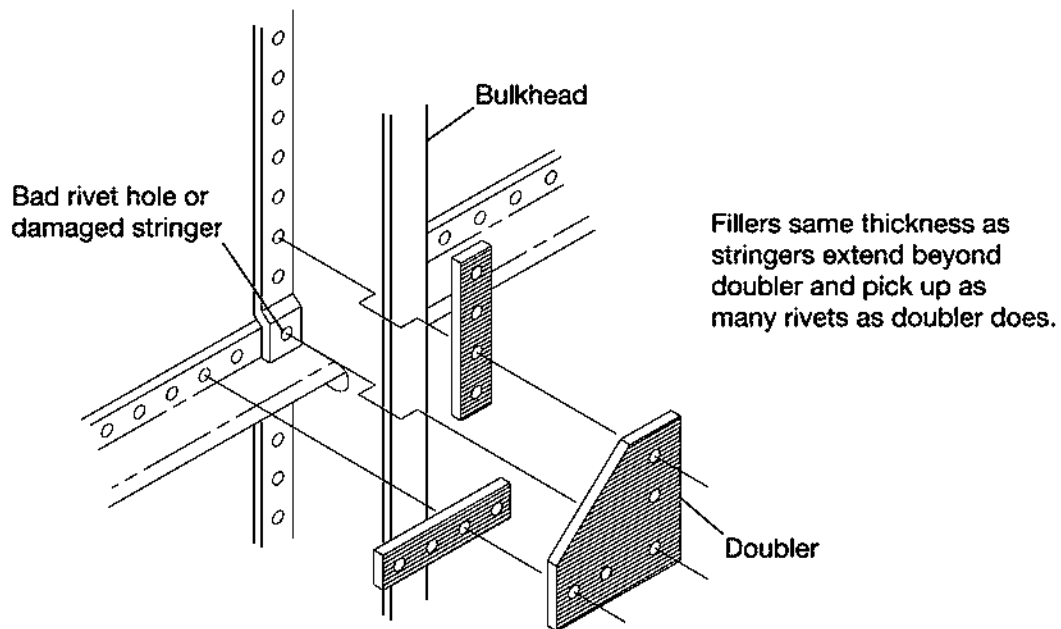
VIEW C-C

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Typical Cabin Bulkhead Repair
 Figure 801 (Sheet 3)

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VIEW A-A

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Typical Rib Repair
 Figure 802 (Sheet 1)

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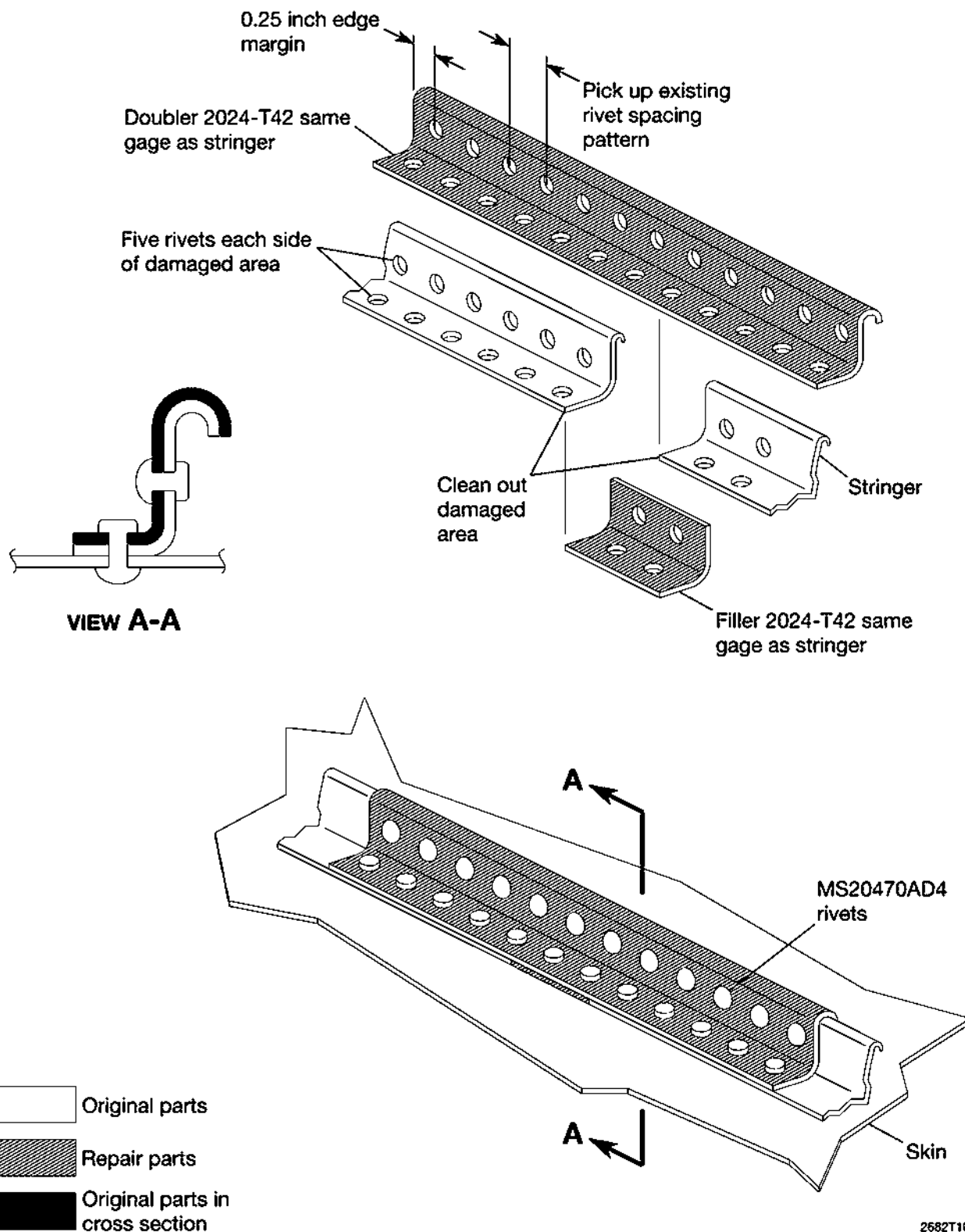
STRINGER AND CHANNEL REPAIR

1. General

- A. Damage to the stringers or channels can be repairable. Refer to Figure 801 for an illustration of typical stringer and channel repairs.

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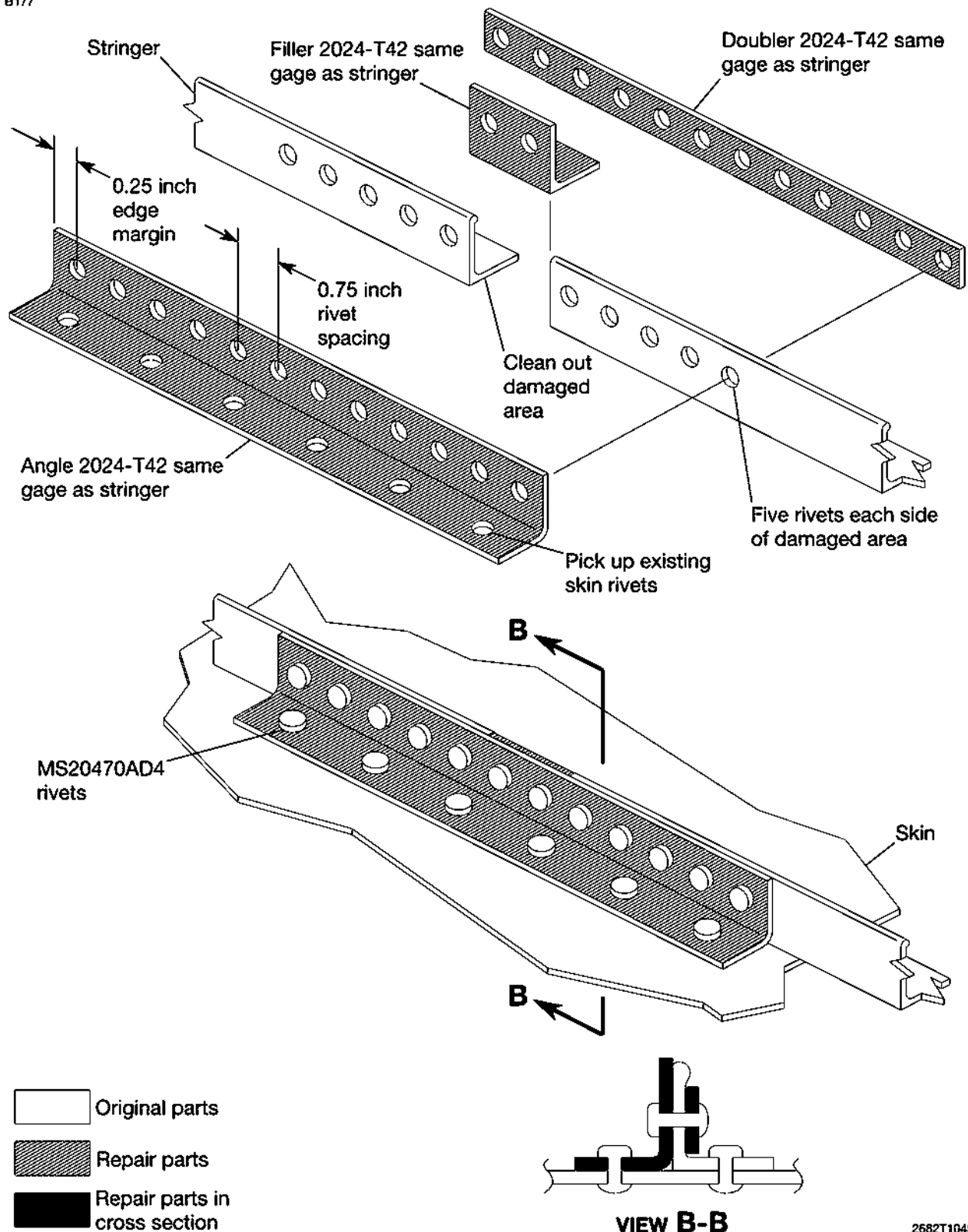
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Typical Stringer and Channel Repair
 Figure 801 (Sheet 1)

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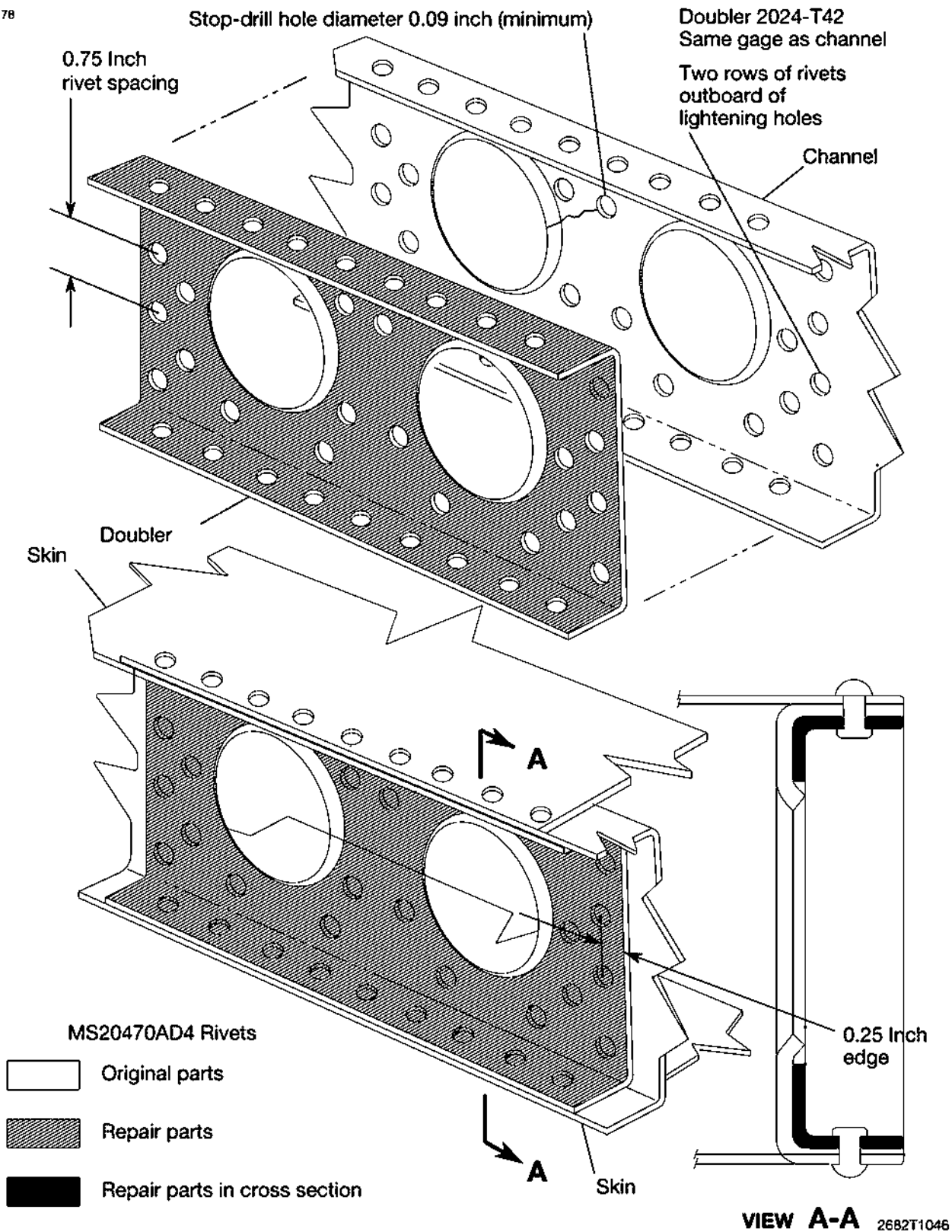


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Typical Stringer and Channel Repair
 Figure 801 (Sheet 2)

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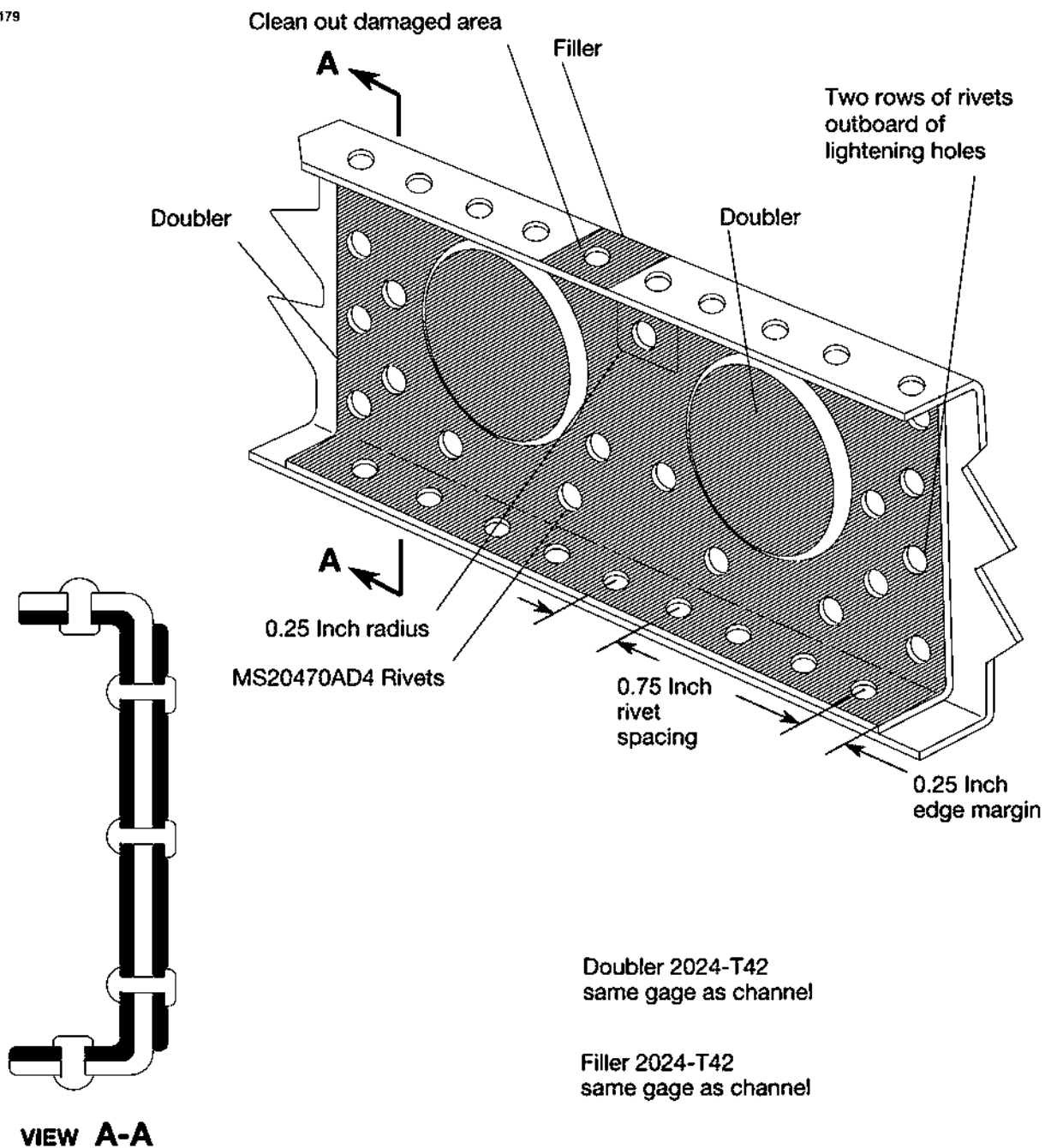
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Typical Stringer and Channel Repair
 Figure 801 (Sheet 3)

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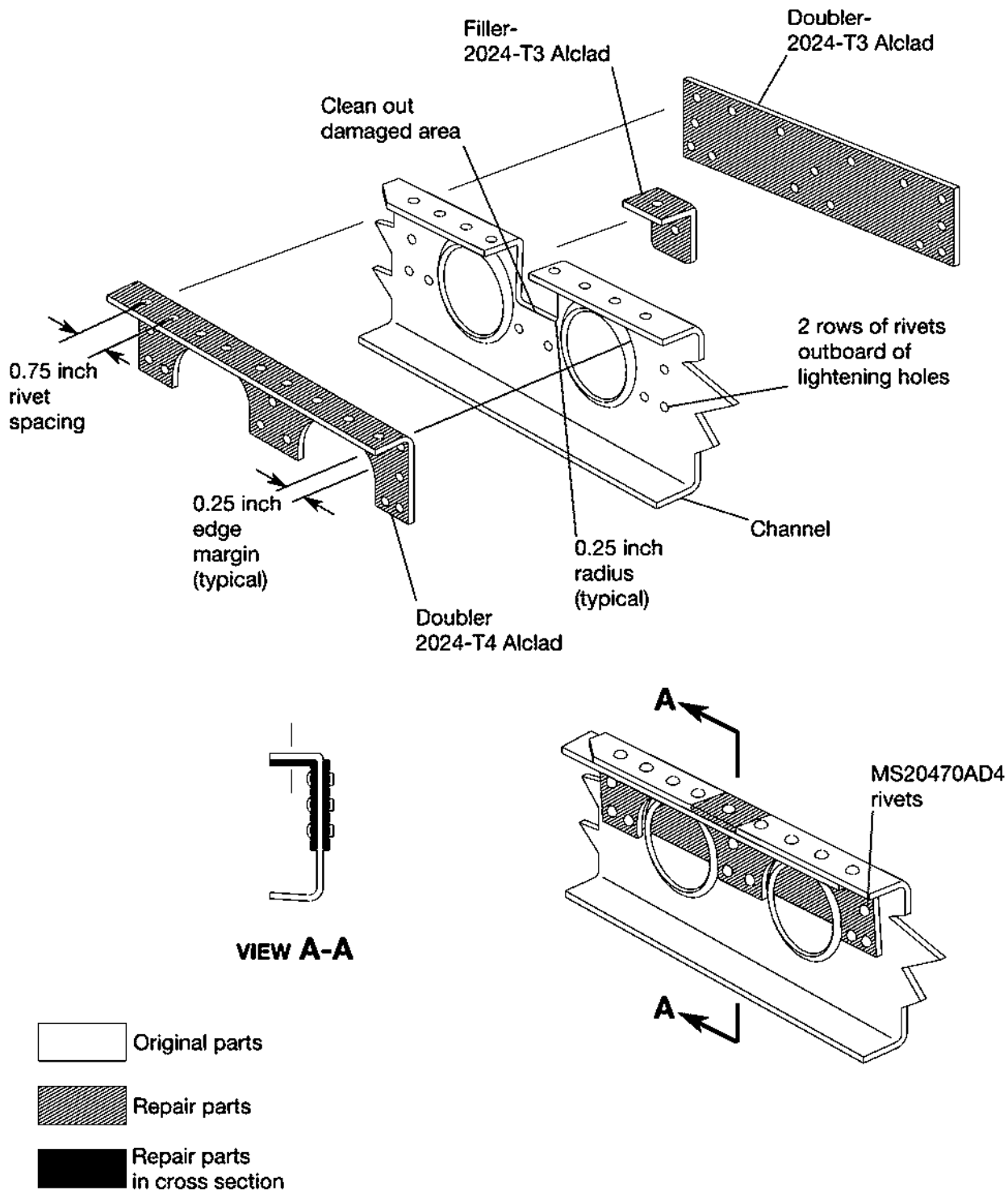


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Typical Stringer and Channel Repair
 Figure 801 (Sheet 4)

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Typical Stringer and Channel Repair
 Figure 801 (Sheet 5)

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FIREWALL REPAIR

1. General

- A. The firewall is constructed of 0.016 inch, 18-8 corrosion resistant, annealed stainless steel sheet.
- (1) A typical firewall patch is illustrated in Figure 801.
 - (2) A typical repair to the interior firewall angle is illustrated in Figure 802.

2. Material

NAME	NUMBER	MANUFACTURER	USE
Firewall Sealant AMS 3374	Pro-Seal #700-A	Loctite Aerospace Bay Point, CA 94565	Firewall sealant

3. Repairing the Firewall Assembly

- A. Firewall sheets may be repaired by removing damaged material and splicing in a new section. The splice must be lapped over the old material, sealed and secured with steel rivets.
- (1) Patches, splices and joints must be repaired using MS20450 steel rivets.
- B. Following any repair to the firewall assembly, seal the damaged areas as follows:
- (1) Clean area on surface to be sealed with methyl propyl ketone.
 - (2) Mix one part of catalyst thoroughly with 100 parts of Pro-Seal No. 700 base.

NOTE: Sealant should be mixed by weight. It is important that accelerator be completely and uniformly dispersed throughout the base compound.

- (3) Using a spatula, caulking gun, or flow gun, apply a fillet of sealer along cracks, seams, joints, and rows of rivets.

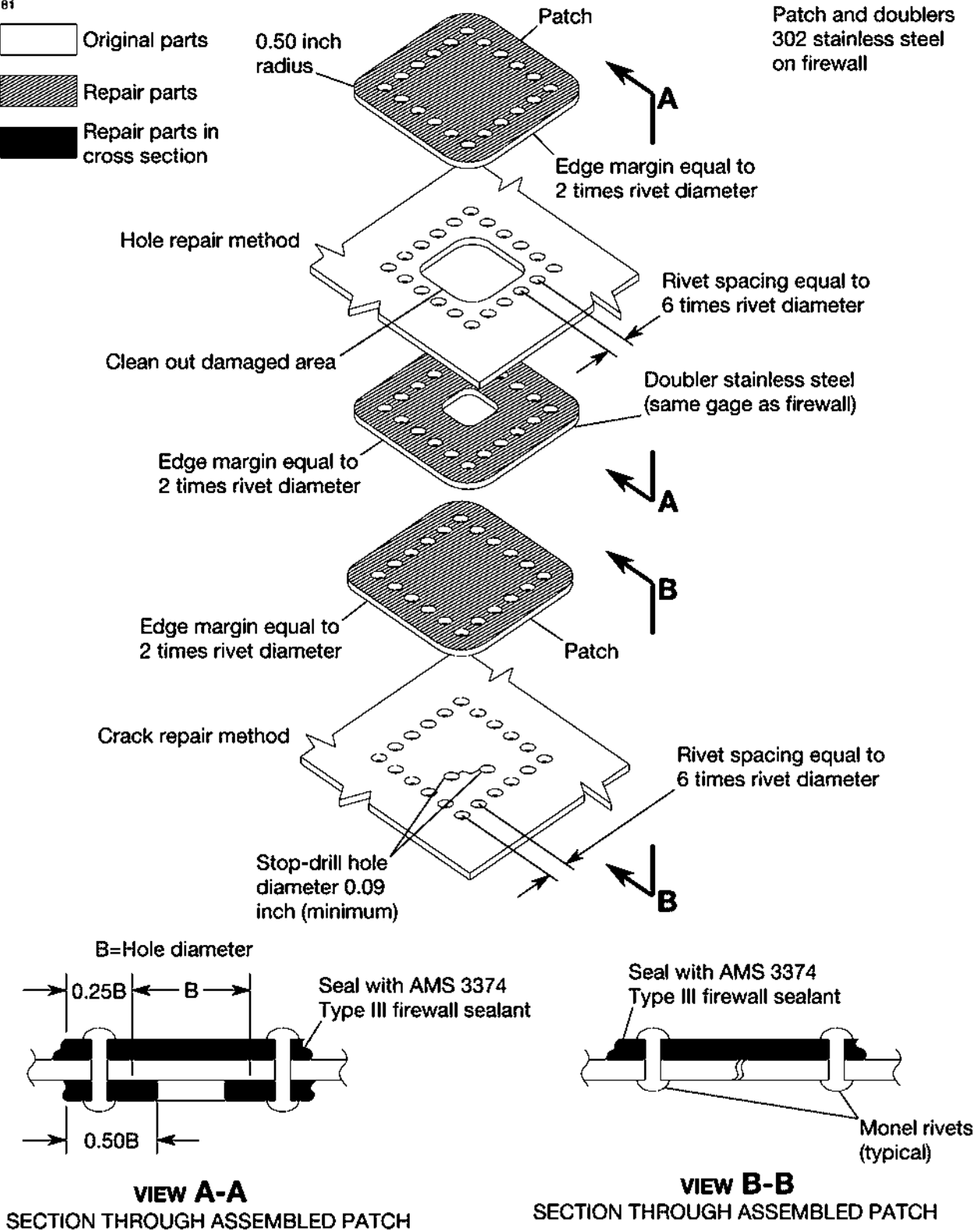
NOTE: If the sealant is applied before the parts are mated, use enough sealing compound to completely fill the joint, and wipe away excess after parts are mated.

NOTE: If the sealant is applied with a brush or a brush flow gun, more than one coat of sealant will be necessary on very porous material. Sealant should be allowed to air-dry 10 minutes between coats.

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-  Original parts
-  Repair parts
-  Repair parts in cross section

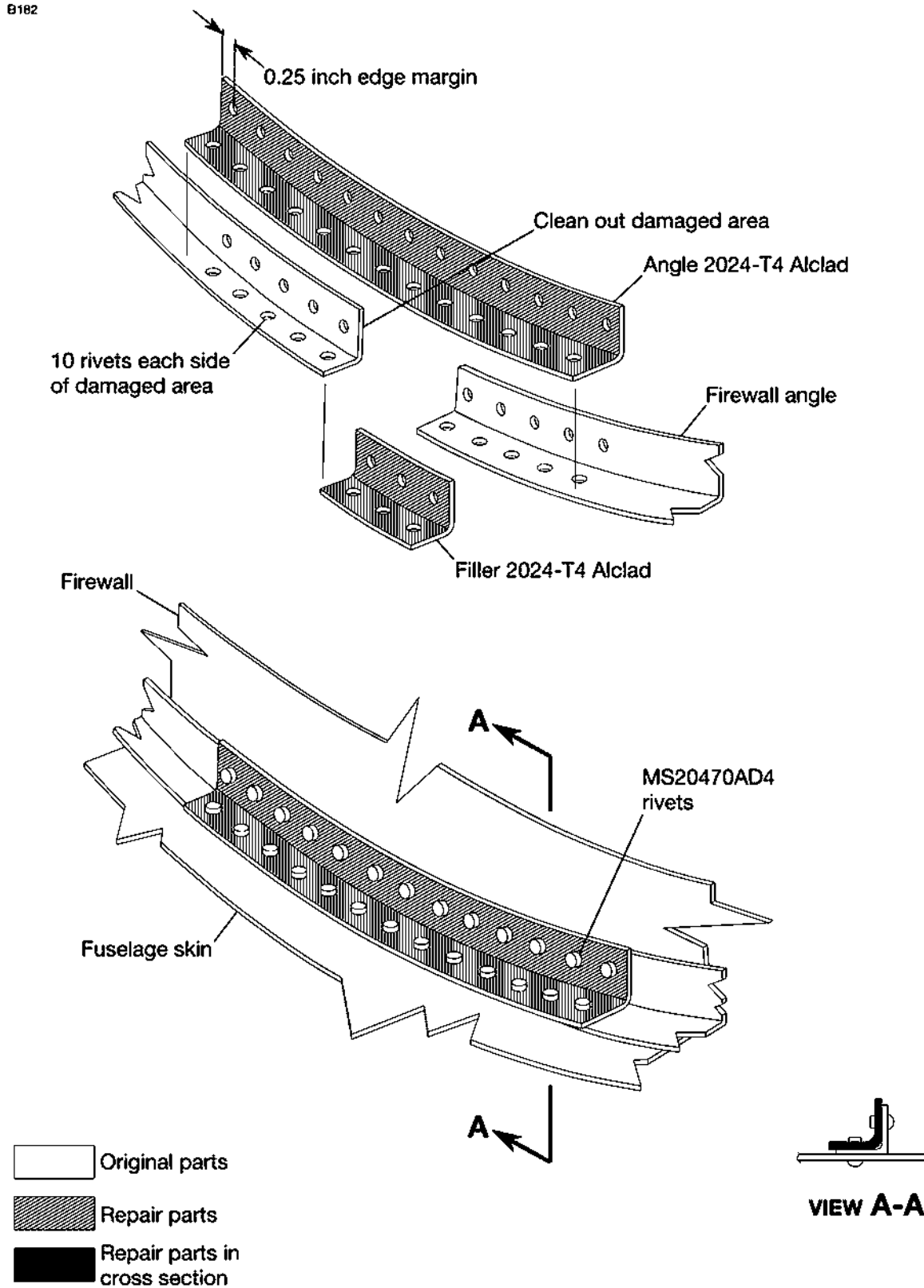


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Typical Firewall Repair
 Figure 801 (Sheet 1)

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Firewall Angle Repair
 Figure 802 (Sheet 1)

CHAPTER

55

STABILIZERS

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HORIZONTAL AND VERTICAL STABILIZERS

1. General

- A. Chapter 55 describes general repair practices, materials and procedures which are applicable to the Horizontal and Vertical Stabilizers.
- B. The horizontal and vertical stabilizers are of all metal, fully cantilever, semimonocoque design, consisting of spars, stringers, ribs, and skins. Skins are riveted to supporting structure with conventional MS20470AD rivets.
- C. If questions arise concerning approved repairs or for repairs not shown in this section, contact Cessna Propeller Aircraft Product Support.

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HORIZONTAL STABILIZER

1. Horizontal Stabilizer

- A. The horizontal stabilizer is constructed from spars, ribs, stringers, doublers and skins. Refer to applicable Maintenance Manual, Chapter 6, Dimensions and Areas, for horizontal stabilizer station diagram.

2. Negligible Damage

- A. The same criteria which is used to define "negligible damage" to the fuselage may be applied to the horizontal stabilizer. Refer to Chapter 53, Fuselage Damage Classification for a complete description of negligible damage.

3. Repairable Damage

- A. Skin patches may be used to repair skin damage. These patches are illustrated in Chapter 51, Typical Skin Repairs, Figure 801. For skin damage which includes corrugations, Refer to Chapter 51, Typical Skin Repairs, Figure 802.
- B. Access to the internal stabilizer structure may be gained by removing a portion of the rivets along the rear spar and ribs and springing back the skin. By using the proper bucking bars through holes in spar web, skins may be closed with a minimum of blind rivets.

4. Replacement Damage

- A. If the damaged area would require a repair which could not be made between adjacent ribs, or the repair would be located in an area with compound curves, complete skin panels must be replaced. Ribs and spars may be repaired, but replacement is generally preferable. Where damage is extensive, replacement of the entire assembly is recommended.

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ELEVATOR

1. General

- A. The elevator assembly consists of a left and right section bolted together near the airplane centerline by torque tubes. Each section consists of a front and a rear spar, ribs, skins, and a trim tab assembly. A balance weight is bolted to the outboard tip leading edge.

2. Negligible Damage

- A. Any smooth skin dents that are free from cracks, abrasions, and sharp corners, and which are not stress wrinkles and do not interfere with any internal structure or mechanism, may be considered as negligible damage. Exception to negligible damage on elevator surfaces is the front spar, cracks appearing in web of hinge fitting or in tip rib which supports overhanging balance weight. Cracks in overhanging tip rib, in the area at the front spar intersection with web of the rib, also cannot be considered negligible.

3. Repairable Damage

- A. Skin patches may be used to repair skin damage. These patches are illustrated in Chapter 51, Typical Skin Repairs, Figure 801. For skin damage which includes corrugations, refer to Chapter 51, Typical Skin Repairs, Figure 802.
- B. Flight control surfaces must be balanced after repair or painting, in accordance with balancing procedures outlined in Chapter 51, Flight Control Surface Balancing.

4. Replacement Damage

- A. Warped and cracked skin, ribs, and hinge brackets are replaceable items. Where damage is extensive, replacement of the entire assembly is recommended.

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VERTICAL STABILIZER

1. General

- A. The vertical stabilizer is of conventional aluminum construction utilizing spars, ribs, and skins.

2. Vertical Stabilizer and Dorsal

- A. The vertical stabilizer and dorsal are constructed jointly to form a single unit.

3. Negligible Damage

- A. The same criteria which is used to define "negligible damage" to the fuselage may be applied to the vertical stabilizer. Refer to Chapter 53, Fuselage Damage Classification for a complete description of negligible damage.

4. Repairable Damage

- A. Skin damage exceeding that considered negligible that can be repaired as illustrated in Chapter 51, Typical Skin Repairs, Figure 801. For skin damage which includes corrugations, Refer to Chapter 51, Typical Skin Repairs, Figure 802. Access to the internal fin structure is best gained by removing skin attaching rivets on one side of the rear spar and ribs, and springing back the skin. Access to the stabilizer may be gained by removing skin attaching rivets on one side and springing back the skin. If the damaged area would require a repair which could not be made between adjacent ribs, or a repair would be located in an area with compound curves, replacement of parts is recommended.

5. Replacement Damage

- A. Hinge brackets and small ribs should be replaced rather than repaired. In general, where parts are available, the easiest and most satisfactory repairs can be accomplished by replacing the damaged parts.
- B. If the damaged area would require a repair which would not be made between adjacent ribs, or the repair would be located in an area with compound curves, complete skin panels must be replaced. Ribs and spars may be repaired, but replacement is generally preferable. Where damage is extensive, replacement of the entire assembly is recommended.

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RUDDER

1. Rudder

- A. The rudder is constructed of a spar, ribs, and skin. A torque tube, incorporating a lower hinge bracket, is attached to the lower leading edge. A balance weight is bolted to the upper tip leading edge.

2. Negligible Damage

- A. Minor skin dents and nicks are considered negligible and should be worked out by burnishing.

3. Repairable Damage

- A. Skin damage exceeding that considered negligible damage, can be repaired by patching. Typical repairs are illustrated in Chapter 51, Typical Skin Repair and Control Surface Repair.
- B. A flight control surface which has been repaired or replaced must be balanced in accordance with the procedures outlined in Chapter 51, Flight Control Surface Balancing.

4. Replacement Damage

- A. Assemblies that have been twisted or warped beyond usable limits and parts with extensive corrosion damage are considered replaceable. Small parts which may be easily fabricated from materials available locally should be replaced.

CHAPTER

56

WINDOWS

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WINDOWS - GENERAL

1. General

- A. This chapter provides repair information applicable to windshields and windows used on the 1996 and On single engine airplanes. These repairs may be utilized without removing components from the airplane.
- B. For windshield/window removal or replacement, refer to the various model Maintenance Manuals, Chapter 56 - Windows.

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PLASTIC WINDOW SURFACE REPAIR

1. Repair of Plastic Window Surfaces

- A. Damaged window panels and the windshield on the airplane are normally removed and replaced if the damage is extensive. However, certain repairs as described in the following paragraphs can be accomplished without removing the damaged part from the airplane. Three types of temporary repairs for cracked plastic are possible. No repairs of any kind are recommended on highly stressed or compound curves or where the repair would be likely to affect the pilots or copilot's field of vision during normal flight or landing operations. Curved areas are more difficult to repair than flat areas, and any repaired area is both structurally and optically inferior to the original surface. Refer to Figure 801 for an illustration of typical windshield and window repair.

NOTE: If temporary repairs are made, operations should be kept to a minimum until replacement of window can be made.

2. Tools and Materials

NAME	NUMBER	MANUFACTURER	USE
Novus 1		Novus Co. Minneapolis, MN 55435	To polish scratches out of windows.
Novus 2		Novus Co.	To polish scratches out of windows.
Methylene Chloride		Commercially Available	Solvent for repair of windows.

3. Stop-Drilling

- A. The following procedure should be used when stop-drilling.
- (1) When a crack appears in a panel, drill a hole at the end of the crack to prevent further spreading. The hole should be approximately 1/8 inch in diameter, depending on the length of the crack and the thickness of the material. This is a temporary repair.

NOTE: If temporary repairs are made, operations should be kept to a minimum until replacement of window or windshield can be made.

4. Surface Patch

- A. The following procedure should be used when preparing a surface patch.
- (1) Trim away damaged area and round all corners.
 - (2) Cut a piece of plastic of sufficient size to cover the damaged area and extend 3/4 inch on each side of crack or hole.
 - (3) Bevel edges as shown in Figure 801.

NOTE: If section to be repaired is curved, shape surface patch to the same contour by heating it in an oil bath at a temperature of 248°F to 302°F, or it may be heated on a hotplate until soft. Boiling water should not be used for heating.

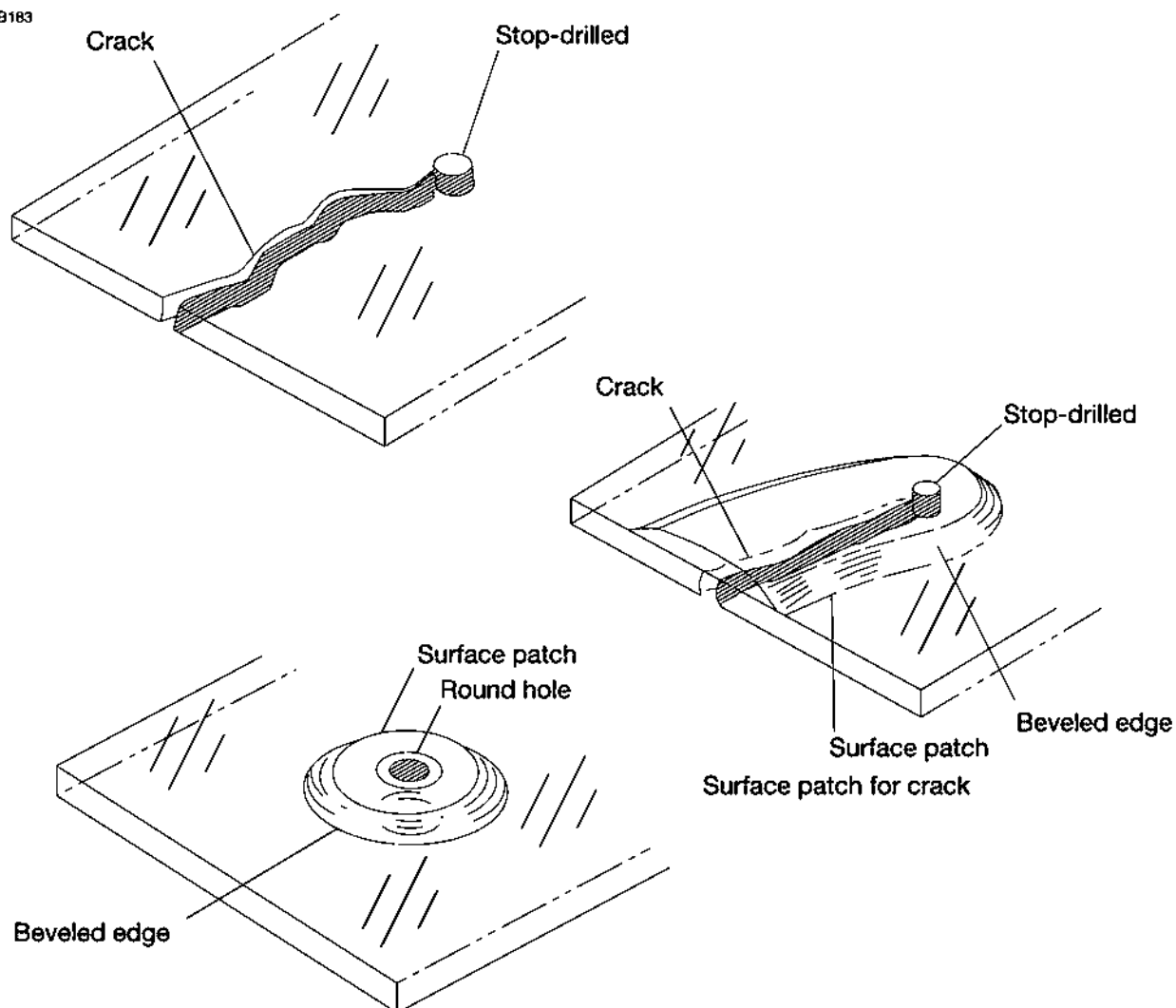
- (4) Coat surfaces to be bonded evenly with plastic solvent adhesive (acrylic chips dissolved in methylene chloride) and place immediately over the hole.
- (5) Maintain a uniform pressure of 5 to 10 pounds per square inch on the surface patch for a minimum of 3 hours. Allow surface to dry 24 to 36 hours before sanding or polishing is attempted.

5. Insert (Plug) Patch

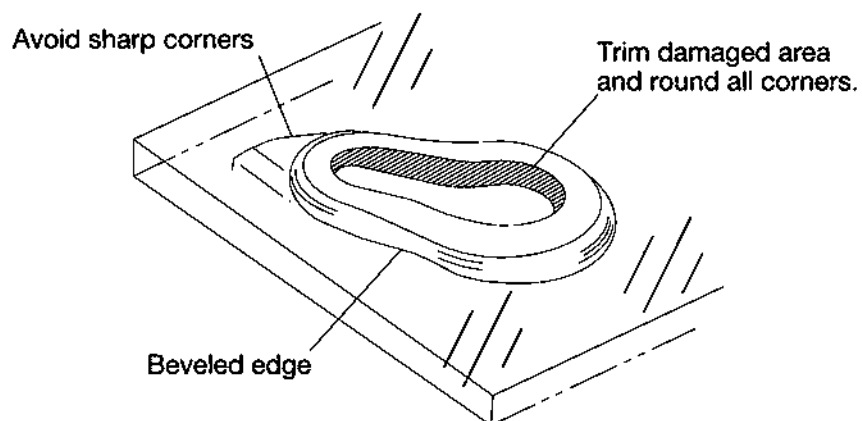
- A. The following procedure should be used when preparing a plug patch.
- (1) Trim hole to a perfect circle or oval and bevel edges slightly.

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Surface patch for round holes



Surface patch for irregular shaped damage

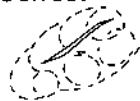
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Typical Windshield and Windows Repair
Figure 801 (Sheet 1)

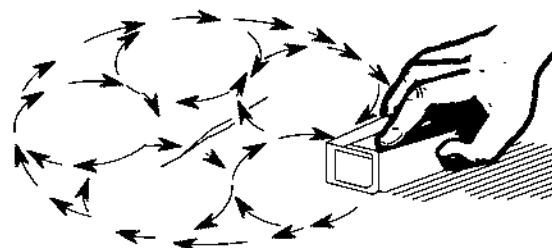
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Correct

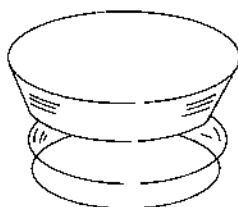


Incorrect



Sanding repair

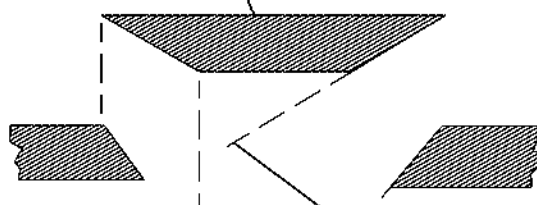
Patches



Patch and hole
should be trimmed
with tapered edges

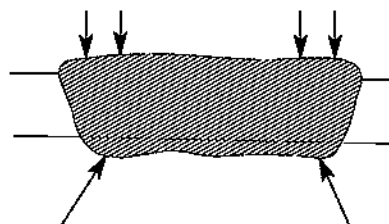
Heat edges of patch
until soft and force
it into hole. Hold it in
place until cool and
hard to assure perfect
fit. Then remove
patch for cementing
bath.

Patch should
be thicker



Patch tapered
on sharper angle
than material

During cementing, pressure
need be applied only on
top surface. Taper assures
equal pressure on all sides.



After cement has hardened,
sand or file edges level
with surfaces.

2682T1043

Typical Windshield and Windows Repair
 Figure 801 (Sheet 2)

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- (2) Make plug patch slightly thicker than the material being repaired, and similarly bevel the edges.
- (3) Install plug patch as illustrated in Figure 801.
- (4) Heat plug patch until it is soft, press into the hole without plastic solvent adhesive, and allow to cool to make a perfect fit.
- (5) Remove plug patch, coat surfaces to be bonded with plastic solvent (acrylic chips dissolved in methylene chloride), and insert plug patch in the hole.
- (6) Maintain a firm, light pressure until the plastic solvent adhesive has set.
- (7) Sand or file edges level with surface; buff and polish. Do not attempt hand polishing until surface is clean. A soft, open-type cotton wheel is suggested.

NOTE: Acrylic and cellulose plastics are thermoplastic. Friction created by buffing or polishing for too long a time in one spot can generate sufficient heat to soften the surface. This will produce visual distortion and is to be guarded against.

6. Minor Scratches

- A. The following procedure should be used when repairing minor scratches.
- (1) Remove minor scratches by vigorously rubbing the affected area by hand, using a soft, clean cloth dampened with Novus 2 plastic polish, and finish by polishing with Novus 1. Remove polish with a soft dry cloth.

NOTE: Plastics should not be rubbed with a dry cloth, since this is likely to cause scratches, and also builds up an electrostatic charge which attracts dust particles to the surface. If, after removing dirt and grease, no great amount of scratching is visible, finish the plastic with a good grade of commercial wax. Apply the wax in a thin, even coat, and bring to a high polish by rubbing lightly with a soft cloth.

7. Cleaning Plastic

- A. The following procedure is the recommended method for cleaning plastic windows.
- (1) Clean the plastic by washing with plenty of water and mild soap, using a clean, soft, grit free cloth, sponge, or bare hands.

CAUTION: Do not use gasoline, alcohol, benzene, acetone, carbon tetrachloride, fire extinguisher or deicing fluids, lacquer thinners, or window cleaning sprays because they will soften the plastic and cause crazing.

CHAPTER

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WINGS

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WINGS - GENERAL

1. General

A. Description of Wing Assemblies:

- (1) The wing assemblies are a semicantilever type, employing semimonocoque type of structure.
- (2) The internal structure consists of a built-up front spar, a formed inboard front fuel spar, a rear spar, and a formed auxiliary spar assembly in the aileron attach area.
- (3) Ribs are formed sheet metal, and consist of nose, intermediate and trailing edge assemblies.
- (4) On the 172 series airplanes, stressed skin is riveted to the rib and spar assemblies to complete the rigid structure. On 182 and 206 series airplanes, the skin is bonded to the leading edge ribs and riveted at other locations.
- (5) The inboard section of the wing is sealed to form an integral fuel cell. The sealed area runs from the wing root outboard toward the strut attach; and from the front fuel spar to the rear spar.

NOTE: On the 172 series airplanes, the fuel closeout rib is located approximately 7 inches outboard from the wing root.

- (6) Access openings (hand holes with removable cover plates) are located in the wing. These openings afford access to flap and aileron bellcranks and control systems, the flap actuator in the left hand wing, electrical wiring and wiring disconnect points, the wing portion of the ventilation system, strut attach fittings, and the inside of the fuel cell.

B. Refer to applicable Maintenance Manual, Chapter 6, Dimensions and Areas, for wing station diagrams.

C. If questions arise concerning approved repairs, or for repairs not shown in this section, contact Cessna Propeller Aircraft Product Support, Box 7706, Wichita, KS 67277. (316) 517-5800, Facsimile (316) 942-9006.

2. Tools, Equipment and Materials

A. Refer to Figure 1 for an illustration of wing and fuselage support stands which may be fabricated locally and used during structural repair.

3. Installation of Access Holes

NOTE: In some instances, it may be advantageous to create access holes in the wing skin to facilitate wing repair. Refer to the following steps and Figure 2 for an illustration of access holes.

WARNING: The following procedures are not applicable to the integral fuel cell skins.

A. Precautions and Notes.

- (1) Add the minimum number of access holes necessary.
- (2) Any circular or rectangular access hole which is used with approved optional equipment installations may be added in lieu of the access hole illustrated.
- (3) Do not add access holes at outboard end of wing: remove wing tip instead.
- (4) Locate new access holes near the center of a bay (spanwise).
- (5) Locate new access holes forward of the front spars as close to the front spar as practical.
- (6) Locate new access holes aft of the front spar between the first and second stringers aft of the spar. When installing the doubler, rotate it so the two straight edges are closest to the stringers.
- (7) Alternate bays, with new access holes staggered forward and aft of the front spar, are preferable.
- (8) A maximum of five new access holes in each wing is permissible. If more are required, contact Cessna Propeller Aircraft Product Support.

B. Access Hole Installation. (Refer to Figure 2)

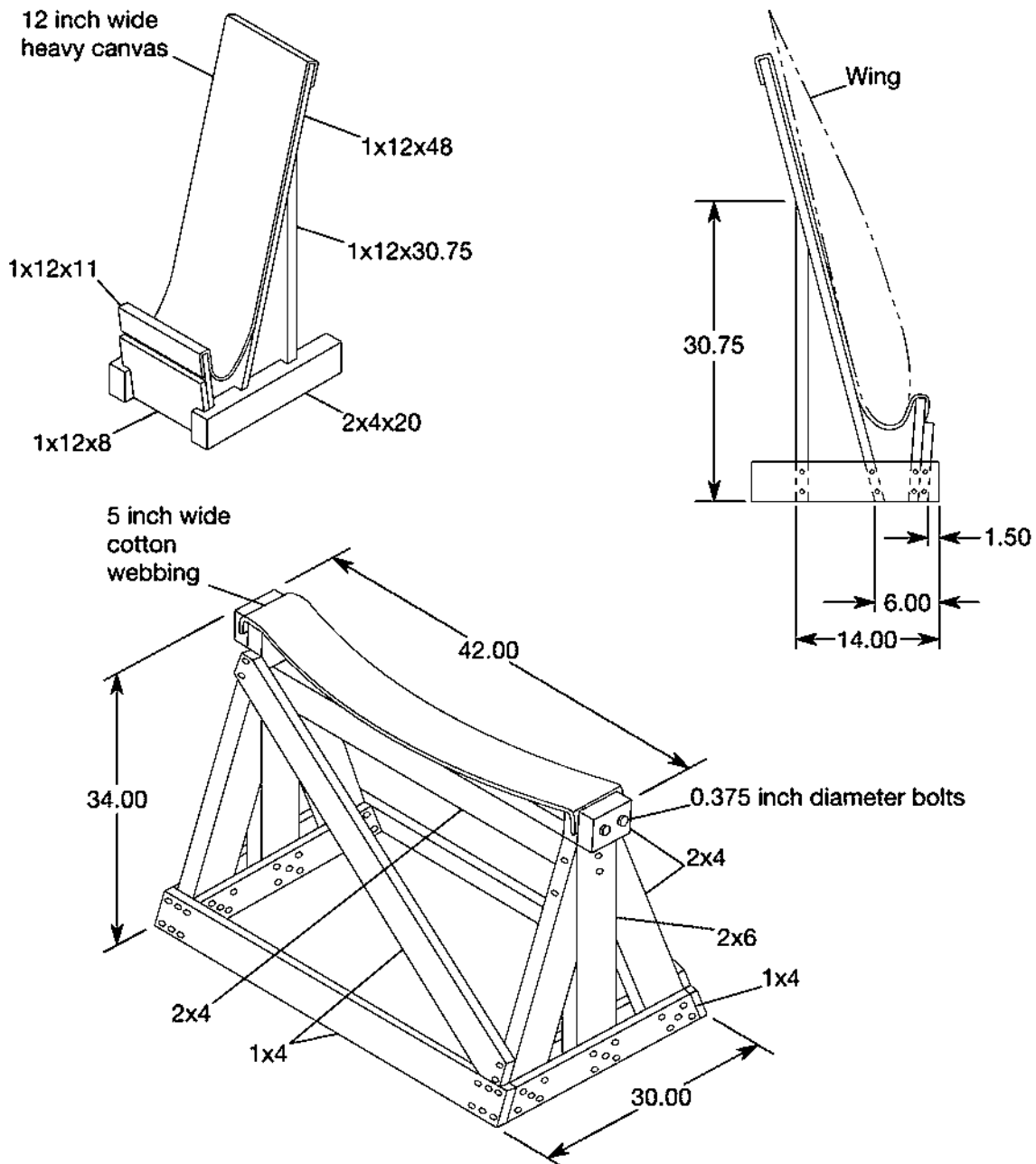
- (1) Establish exact location for inspection cover and inscribe centerlines.
- (2) Determine position of doubler on wing skin and center over centerlines. Mark the ten rivet hole locations and drill to size shown.

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- (3) Cut out access hole, using dimension shown.
- (4) Flex doubler and insert through access hole, and rivet in place.
- (5) Position cover and secure, using screws as shown.

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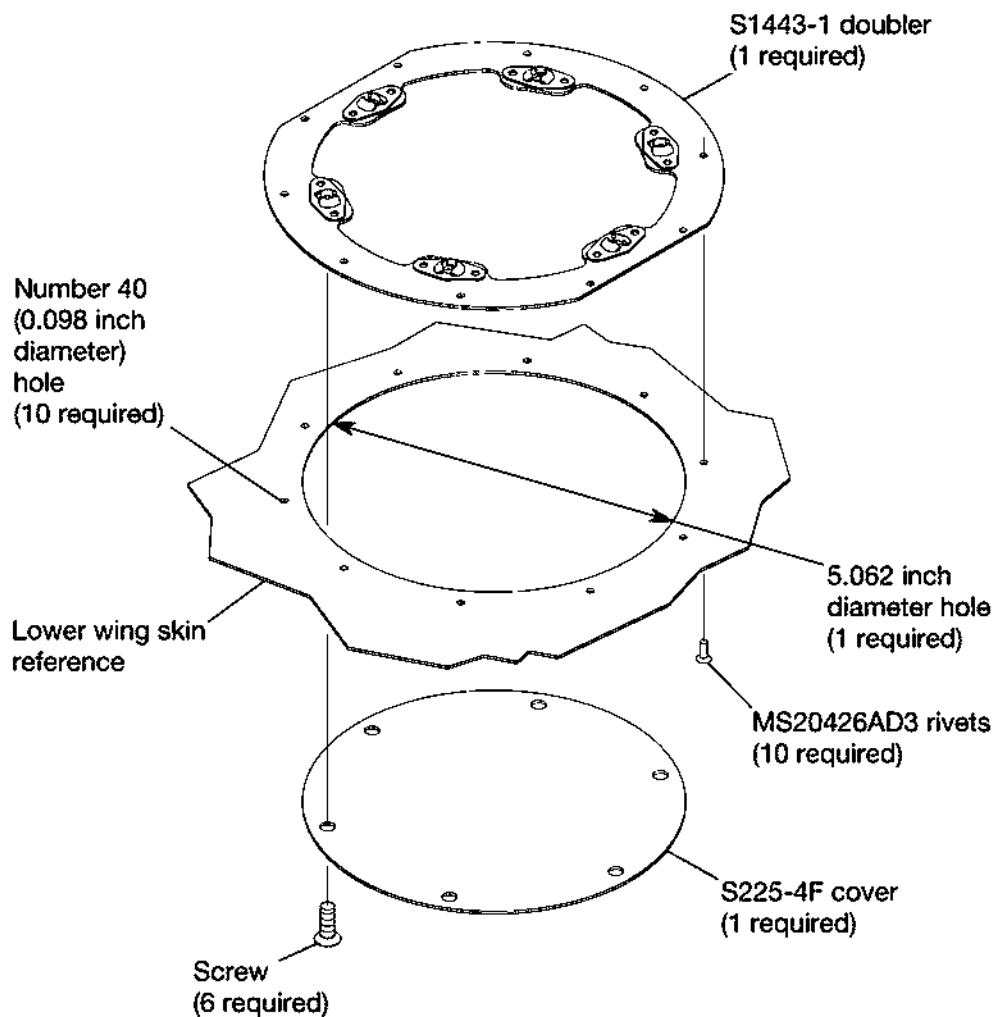
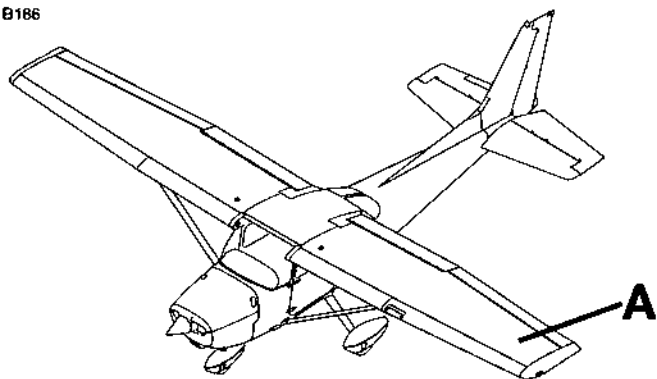
NOTE: All dimensions shown are in inches or nominal lumber size.

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Wing and Fuselage Support Stands
 Figure 1 (Sheet 1)

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DETAIL A

View looking down
 from inside wing at
 top of skin

Access Hole Installation
 Figure 2 (Sheet 1)

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WING DAMAGE CLASSIFICATION

1. Damage Classification

- A. Damage to the wing and its component assemblies can be divided into three major categories: negligible damage, repairable damage, and damage necessitating replacement of parts. These categories are intended to provide the mechanic with some general guidelines to use in determining the extent and criticalness of any damage. Obviously, there will be some overlapping between categories, and common sense should be used in determining the final action to be taken with regard to any damage.
- B. For an illustration of various wing component repairs, refer to applicable sections within this chapter.

2. Wing Skin Damage Criteria

- A. Negligible damage: Any smooth dents in the wing skin that are not more than 0.030 inch below contour and can be circumscribed with a 2 inch diameter circle that have no evidence of skin tears, cracks, or skin penetrations - which are not stress wrinkles and do not interfere with internal structure of mechanism - constitute negligible damage; and rework is considered cosmetic.
- B. Repairable damage: Dents or dings deeper and/or larger than specified above must be repaired. Skin tears, cracks or penetrations must be repaired. Dings that include understructure (ribs, frames and spars) must be repaired by reforming or removal and replacement of the damaged member or damaged are. Reevaluation of the skin after repair of the understructure will determine if the skin damage is negligible, repairable or requires replacement.
- C. Damage Necessitating Replacement Of Parts: If a skin is badly damaged, repair must be made by replacing an entire skin panel from one structural member to the next. Repair seams must be made to lie along structural members and each seam must be made exactly the same in regard to rivet size, spacing and pattern as the manufactured seams at the edges of the original sheet. If the manufactured seams are different, the stronger must be copied. If the repair ends at a structural member where no seam is used, enough repair panel must be used to allow an extra row of staggered rivets, with sufficient edge margin, to be installed.

3. Wing Stringer Damage Criteria

- A. Negligible Damage: Minor Scratches or abrasions are the only form of damage considered negligible to wing stringers.
- B. Repairable damage: Dents or bends in a stringer may be repaired by reforming or by replacing a section of the stringer. Since aluminum work hardens, it is much more likely to crack when reformed and should be carefully inspected for such cracks after rework. Removal and replacement of damaged stringers is preferred to reformation.
- C. Damage Necessitating Replacement Of Parts: If a stringer is so badly damaged that more than one section must be spliced, replacement is recommended.

4. Wing Auxiliary Spar Damage Criteria

- A. Negligible damage: Minor scratches or abrasions are the only form of damage considered negligible to wing auxiliary spars.
- B. Repairable damage: Dents or bends in an auxiliary spar may be repaired by reforming or by replacing a section of the auxiliary spar. Since aluminum work hardens, it is much more likely to crack when reformed and should be carefully inspected for such cracks after rework. Removal and replacement of a damaged section to the auxiliary spar is preferred to reformation.
- C. Damage necessitating Replacement Of Parts: If damage to an auxiliary spar would require a repair which could not be made between adjacent ribs, the auxiliary spar must be replaced.

5. Wing Rib Damage Criteria

- A. Negligible damage: None, other than minor scratches or abrasions.

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- B. Repairable damage: Dents or bends in a rib may be repaired by reforming or by replacing a section of the rib. Since aluminum work hardens, it is much more likely to crack when reformed and should be carefully inspected for such cracks after rework. Removal and replacement of a damaged section to the rib is preferred to reformation.
- C. Damage Necessitating Replacement Of Parts: Leading and trailing edge ribs that are extensively damaged can be replaced. However, due to the necessity of unfastening an excessive amount of skin in order to replace the rib, they should be repaired if practical. Center ribs, between the front and rear spar, should always be repaired if practical.

6. Wing Spar Damage Criteria

- A. Negligible damage: Due to the stress which wing spars encounter, very little damage can be considered negligible. All cracks, stress wrinkles, deep scratches, and sharp dents must be repaired. Smooth dents, light scratches and abrasions may be considered negligible.
- B. Repairable damage: While it is possible to repair the spar channel by reforming a section of the spar, replacement is preferred. A service kit (SK172-68) is available for replacement of the inboard end of the rear spar for damage that typically occurs with impact on the outboard leading edge.
- C. Damage Necessitating Replacement of Parts: Damage so extensive that repair is not practical requires replacement of complete wing spar.

7. Wing Fuel Bay Spars/Rib Damage Criteria

- A. Negligible damage: Any smooth dents in the wing fuel spar and ribs that have no evidence of tears, cracks or penetrations - which are not stress wrinkles and do not change (Oil can, or pop in and out) with internal pressure - are considered negligible damage.
- B. Repairable damage: Dents or bends in the wing fuel spar and ribs may be repaired by reforming or by replacing a section of the structure. Since aluminum work hardens, it is much more likely to crack when reformed and should be carefully inspected for such cracks after rework. Removal and replacement of a damaged section is preferred to reformation.
- C. Damage Necessitating Replacement Of Parts: Due to the amount of fuel bay sealant which must be removed from fuel bay components to facilitate repair, individual parts are not available to replace fuel bay spars or ribs. The entire fuel bay area must be replaced as a unit.

8. Wing Leading Edge Damage Criteria

- A. Negligible damage: Any smooth dents in the wing leading edge skin that are not more than 0.030 inch (0.76 mm) below contour and circumscribable with not more than a 1.5 inch (38 mm) diameter circle that has no evidence of skin tears, cracks, or skin penetrations - which are not stress wrinkles and do not interfere with internal structure - constitute negligible damage. However, because of the critical nature of the wing leading edge, this cosmetic repair should be completed.
- B. Repairable damage: Dents or dings deeper and/or larger than specified above must be repaired. Skin tears, cracks or penetrations must be repaired. Dings that include ribs must be repaired by reforming or removal and replacement of the rib. Reevaluation of the skin after the repair of the understructure will determine if the skin damage is negligible, repairable or requires replacement.
- C. Damage Necessitating Replacement Of Parts: Where extreme damage has occurred, complete leading edge skin panels should be replaced.

9. Bonded Leading Edge Damage Criteria

- A. Negligible damage: Any smooth dents in the wing leading edge skin that are not more than 0.030 inch (0.76 mm) below contour and circumscribable with not more than a 1.5 inch (38 mm) diameter circle that has no evidence of skin tears, cracks, or skin penetrations - which are not stress wrinkles and do not interfere with internal structure - constitute negligible damage. However, because of the critical nature of the wing leading edge, this cosmetic repair should be completed.

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- B. Repairable damage: Dents or dings deeper and/or larger than specified above must be repaired. Skin tears, cracks or penetrations must be repaired. Dings that include ribs must be repaired by reforming or removal and replacement of the rib. Reevaluation of the skin after the repair of the understructure will determine if the skin damage is negligible, repairable or requires replacement. Bonded ribs may be removed by applying heat to the damaged area using a heat gun. Replacement ribs may be installed using protruding head or dimpled flush rivets.
- C. Damage Necessitating Replacement Of Parts: Where extreme damage has occurred, complete leading edge skin panels should be replaced.

10. Wing Strut Damage Criteria

- A. Negligible damage: Any smooth dents in the strut that are not more than 0.090 inch (2.03 mm) below contour and circumscribable with not more than a 3.0 inch (76.2 mm) diameter circle is negligible damage. Minor scratches which do not involve removal or displacement of strut material is negligible damage. Because of the critical nature of the strut, any non-cosmetic scratches must be reworked.
- B. Repairable damage: For grooves in the strut caused by fairings, strut may be repaired if groove is less than 0.020 inch and is more than 0.75 inch from a rivet center. For lower trailing edge strut damage (typically caused by door hitting strut), strut may be repaired if groove depth is less than 50% of original material thickness.
- C. Damage Necessitating Replacement Of Parts: For grooves in the strut caused by fairings, strut must be replaced if groove exceeds 0.010 inch in depth and is less than 0.75 inch from a rivet center AND/OR if groove exceeds 0.020 inch in depth and is more than 0.75 inch from a rivet center. For lower trailing edge strut damage (typically caused by door hitting strut), strut must be replaced if groove is deeper than 50% of the original material thickness.

11. Aileron Damage Criteria (Corrugated Skin Aileron)

- A. Negligible damage: Any smooth dents in the aileron skin that are not more than 0.050 inch (1.27 mm) below contour and circumscribable with not more than a 1.5 inch (38.1 mm) diameter circle - that have no evidence of skin tears, cracks or skin penetrations and which do not include a corrugation - constitute negligible damage.
- B. Repairable damage: Dents or dings deeper and/or larger than specified must be repaired. Skin tears, cracks or penetrations must be repaired. Dings that include corrugations are unlikely to be reworkable, but may be repaired by replacing the damaged area. Corrugated skin material is available from Cessna. Special care must be taken to minimize added weight since the surface must be rebalanced after rework.
- C. Damage Necessitating Replacement Of Parts: Because of the balance requirements, multiple areas of damage may require replacement of skins to allow balance limits to be attained.

12. Aileron Damage Criteria (Model 206 Aileron)

- A. Negligible damage: Any smooth dents in the aileron skin that are not more than 0.030 inch (0.76 mm) below contour and circumscribable with not more than a 1.5 inch (38.1 mm) diameter circle - that have no evidence of skin tears, cracks or skin penetrations which are not stress wrinkles and do not interfere with internal structure - constitute negligible damage.
- B. Repairable damage: Dents or dings deeper and/or larger than specified must be repaired. Skin tears, cracks or penetrations must be repaired. Dings that include understructure (ribs) must be repaired by reforming or removal and replacement of the rib. Reevaluation of the skin after the repair of the understructure will determine if the skin damage is negligible, repairable or replacement damage. Special care must be taken to minimize added weight since the surface must be rebalanced after rework.
- C. Damage Necessitating Replacement Of Parts: Because of the balance requirements, multiple areas of damage may require replacement of skins to allow balance limits to be attained.

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13. Wing Flap Damage Criteria (Corrugated Skin Flap)

- A. Negligible damage: Any smooth dents in the flap skin that are not more than 0.050 inch (1.27 mm) below contour and circumscribable with not more than a 1.5 inch (38.1 mm) diameter circle - that have no evidence of skin tears, cracks or skin penetrations and which do not include corrugations - constitute negligible damage.
- B. Repairable damage: Dents or dings deeper and/or larger than specified may be repaired. Skin tears, cracks or penetration must be repaired. Dings that include corrugations are unlikely to be reworkable, but may be repaired by replacing the damaged area. Corrugated skin material is available from Cessna.
- C. Damage Necessitating Replacement Of Parts: Multiple repairs to the same area must not be made, but a larger repair incorporating both repairs may be made. Decisions regarding replacement of parts should be made based on the feasibility of repair verses complete replacement of the skin

14. Wing Flap Damage Criteria (Model 206 Flap)

- A. Negligible damage: Any smooth dents in the flap skin that are not more than 0.030 inch (0.76 mm) below contour and circumscribable with not more than a 1.5 inch (38.1 mm) diameter circle - that have no evidence of skin tears, cracks or skin penetrations and which do not include corrugations - constitute negligible damage.
- B. Repairable damage: Dents or dings deeper and/or larger than specified may be repaired. Skin tears, cracks or penetration must be repaired. Dings that include understructure (ribs) must be repaired by reforming or removal and replacement of the rib. Reevaluation of the skin after the repair of the understructure will determine if the skin damage is negligible, repairable or replacement damage.
- C. Damage Necessitating Replacement Of Parts: Multiple repairs to the same area must not be made, but a larger repair incorporating both repairs may be made. Skins must be replaced if damage extends across more than one rib.

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WING FUEL BAY REPAIRS

1. Preparing Damaged Area In Wing Fuel Bay for Repair

- A. Before performing any maintenance in fuel bay area, it will be necessary to defuel and purge the fuel bay. To defuel and purge the fuel bay, proceed as follows:

WARNING: During all fuel system servicing procedures, fire fighting equipment must be available.

WARNING: Always ground airplane prior to performing any maintenance of the fuel system.

WARNING: Avoid drainage from residual fuel held in disconnected fuel lines; this accumulation constitutes a fire hazard.

WARNING: Use NS-40 (RAS-4) (Snap-On Tools Corp., Kenosha, Wisconsin), MIL-T-83483 (thread compound, anti-seize, graphite petrolatum), or engine oil as a thread lubricant or to seal leaking connections. Apply sparingly to all but first two threads of male fittings, being careful not to allow entry of compound into fuel system.

NOTE: Covers or caps should be installed on lines and fittings to prevent entry of foreign material, and to prevent damage to threads.

- (1) Ground airplane to a suitable ground stake.
- (2) Ensure airplane battery switch is in OFF position.
- (3) Turn fuel selector valves to OFF position
- (4) Remove fuel filler cap on bay that is to be defueled; insert defueling nozzle.
- (5) Remove as much fuel as possible through filler opening.
- (6) Remove drain valves from bottom side of fuel bay and drain remaining fuel into a clean, open container. Use defueling nozzle to remove fuel from container.
- (7) If necessary, repeat procedures for opposite wing.

WARNING: Purge fuel bays with an inert gas (argon or carbon dioxide) prior to repairing fuel leaks to preclude possibility of explosions.

- (8) Insert inert gas supply hose into fuel filler opening.
- (9) Allow gas to flow into bay for several minutes to remove all fuel vapors. Since argon or carbon dioxide are heavier than air, these gasses will remain in bay during repair. Non-sparking tools shall be used to make repairs (air motors, plastic scrapers, etc.).

NOTE: Portable vapor detectors are available to determine presence of explosive mixtures and are calibrated for leaded fuel. The detectors can be used to determine when it is safe to make repairs.

NOTE: During structural repair, parts must be predrilled, countersunk or dimpled, and cleaned before being sealed and positioned for final installation.

- (10) Remove all existing sealant from area to be sealed, leaving a taper to the remaining sealant. The taper will allow a scarf bond and a continuous seal when the new sealant is applied.

NOTE: The best method of removing sealant is with a chisel-like tool made of hard fiber or plexiglass. Remaining sealant can be removed with aluminum wool. Steel wool or sandpaper must not be used.

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- (11) Stop drill cracks using a No. 30 (0.128 inch) drill.
- (12) Remove all ragged edges, dents, tears, cracks, and punctures.
- (13) After removal of damaged area, leave edges parallel to any square or rectangular edge of the unit.

NOTE: Damage adjacent to a previous repair requires removal of old repair and inclusion of the entire area in the new repair.

- (14) Round all corners.
- (15) Smooth out abrasions.
- (16) Vacuum thoroughly to remove all chips, filings, dirt, etc., from bay area.
- (17) All surfaces to be sealed after repair should be thoroughly cleaned by wiping with a clean cloth dampened with methyl propyl ketone (MPK), acetone or similar solvent, and dried with a clean cloth before allowing solvent to evaporate. Always pour the solvent on the cloth to prevent contaminating solvent. Do not allow cloth to drip. Never use contaminated solvent.
- (18) Any repair that breaks the fuel bay seal will require resealing that bay area, refer to applicable Maintenance Manual, Chapter 28, Fuel Tank Sealing - Maintenance Practices for sealing materials and procedures.

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FUEL BAY SEALING DURING STRUCTURAL REPAIR

1. General

- A. Any repair that breaks the fuel bay seal will necessitate resealing that bay area. Repair parts that need sealing must be installed during the sealing operations. All joints within the boundary of the bay, but which do not provide a direct fuel path out of the bay (such as fuel spar flanges and rib flanges), must be fay-surface-sealed and fillet sealed on the fuel side. Fay surface sealing is applying sealant to one mating part before assembly. Enough sealant must be applied so it will squeeze out completely around joint when the parts are fastened together. The fillet seal is applied after the joint is fay-surface-sealed and fastened. Sealer is (fillet) applied to the edge of all riveted joints, joggles, bend reliefs, voids, rivets, or fasteners. All boundaries and any other place that could become a fuel leak are sealed. The fay sealant need not be cured before applying the fillet sealer; however, the fay sealant must be free of dirt or other contaminants before applying fillet seal. Fillets laid on intersecting joints shall be joined together to produce a continuous seal. Sealant must be pressed into the joint to displace any entrapped air bubbles. Use an extrusion gun to lay a bead along joint, and work out all entrapped air with a small paddle to eliminate bubbles.

2. Integral Fuel Bay Sealant

- A. Two types of sealants are used, one to seal the bay and the other to seal access doors, fuel quantity transmitters, fuel inlet assemblies, and fuel test receptacle. The access door sealant is more pliable, and will not adhere to metal as firmly as the bay sealant. This permits access doors, fuel quantity transmitter, etc., to be removed without damage. Service Kit SK210-56, available from Cessna Parts Distribution, contains Type I Class B-2 and Type VIII Class B-2 (access) sealants with Cessna Parts Distribution, contains Type I Class B-1/2 and Type VIII Class B-12 (access) sealants with the proper quantity of accelerator for each sealant.

WARNING: The accelerators contain heavy metal peroxides. Keep them away from heat and flame. Use only in well-ventilated areas. Avoid skin and eye contact. Wear eye shields. In case of eye contact, flush generously with water and get prompt medical attention.

3. Mixing Sealant

- A. Use all the accelerator and sealant in the container when mixing to ensure the proper ratio of accelerator to sealant. Stir the accelerator to absorb all floating liquid before it is mixed with the sealant. The accelerator can then be poured into the container of sealant for mixing; otherwise, a wax-free container must be used. Stir accelerator and sealant until they become a uniform mixture. Do not stir air into mixture so it forms bubbles; if bubbles appear, they must be removed.

CAUTION: Protect drain holes and fuel outlet screens when applying sealants.

NOTE: Work life of sealants contained in SK210-56 is 2 hours from the start of mixing. Work life of sealants contained in SK210-101 is one-half hour from the start of mixing. This is based on a standard condition of 77°F (25°C) and 50 percent relative humidity. An increase in either temperature or humidity will shorten the work life of the sealants.

4. Applying Sealant

- A. Use the following procedures as the best method for applying sealant.
(1) Apply fay surface sealant to one mating part, and install rivets or fasteners while sealant is still within its work life.

NOTE: During sealing, the supply of mixed sealant must be monitored to be certain it has not exceeded the normal work life. To check, use a small wooden paddle, or tongue depressor, to gather a small amount of sealant. Touch this sealant to a piece of clean sheet metal. If it adheres, sealant can still be used, if it doesn't adhere, then the sealant has exceeded the allowable work life, and must not be used.

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- (2) Apply a fillet seal to the repaired area on the inside of the bay.
- (3) Apply a fay surface seal to access doors, fuel quantity transmitters, etc., if removed, and install.
- (4) Allow sealant to cure; refer to Curing Time, for time requirements.
- (5) Clean stains on outer surface.
- (6) Test fuel bay for leaks as described in Testing Integral Fuel Bay.

5. Sealing Fuel Leaks

- A. First determine the source of the fuel leak. Fuel can flow along a seam or structure of the wing for several inches, making the leak source difficult to find. A stained area is an indication of the leak source. Fuel leaks can be found by testing the complete bay as described in Testing Integral Fuel Bay. Another method of detecting the source of a fuel leak is to remove access doors and blow with an air nozzle from the inside of the bay in the area of the leak while soap bubble solution is applied to the outside of the bay. After the leak source has been found, proceed as follows:
 - (1) Remove existing sealant in the area of the leak as described in Chapter 57, Wing Fuel Bay Repairs.
 - (2) Clean the area and apply a fillet seal. Press sealant into leaking area with a small paddle, working out all air bubbles.
 - (3) If leakage occurs around a rivet or bolt, restrike the rivet or loosen bolt, retorque, and reseal around nutplate.
 - (4) Apply fay surface door sealant to access doors, fuel quantity transmitters, etc., if removed, and install.
 - (5) Test fuel bay for leakage as outlined in Testing Integral Fuel Bay.

6. Curing Time

- A. Class B-2 sealant has a maximum tack free time of 40 hours and a maximum cure time of 72 hours. These values are based on a standard condition of 77°F (25°C) and 50 percent relative humidity.
- B. Class B-1/2 sealant has a maximum tack free time of 10 hours and a maximum cure time of 30 hours. These values are based on a standard condition of 77°F (25°C) and 50 percent relative humidity.
- C. The cure of sealants can be accelerated by an increase in temperature and/or relative humidity. Warm circulating air at a temperature not to exceed 140°F (60°C) may be used to accelerate cure. Heat lamps may be used if the surface temperature of the sealant does not exceed 140°F (60°C). At temperatures above 120°F (49°C), the relative humidity will normally be so low (below 40 percent) that sealant curing will be retarded. If necessary, the relative humidity may be increased by the use of water containing less than 100 parts per million total solids and less than 10 parts per million chlorides.

7. Testing Integral Fuel Bay

- A. The fuel system consists of two vented, integral fuel tanks (one in each wing). The following procedures are for testing integral fuel bay.
 - (1) Remove vent line from vent fitting and cap fitting.
 - (2) Disconnect fuel lines from bay.
 - (3) To one of the bay fittings, attach a water manometer capable of measuring 20 inches of water.
 - (4) To the other bay fitting, connect a well-regulated supply of air (1/2 psi maximum, or 13.8 inches of water). Nitrogen may be used where the bay might be exposed to temperature changes while testing.
 - (5) Make sure filler cap is installed and sealed.

CAUTION: Do not attempt to apply pressure to the bay without a good regulator and a positive shutoff in the supply line. Do not pressurize the fuel bay to more than one-half psi or damage may occur.

- (6) Apply pressure slowly until one-half psi is obtained.
- (7) Apply a soap solution as required.
- (8) Allow 15 to 30 minutes for pressure to stabilize.
- (9) If bay holds for 15 minutes, without pressure loss, bay is acceptable.

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(10) Reseal and retest if any leaks are found.

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WING RIB

1. General

- A. Flanged upper and lower edges of all ribs serve as cap strips in addition to providing rigidity to the rib. The skin riveted or bonded directly to each rib flange provides the cellular strength for each successive rib bay. The nose, center, and trailing rib segments are riveted together through the front and rear spars to form the basic airfoil section. Spanwise, Alclad stringers stiffen the skin between ribs.

2. Wing Rib Damage Classification

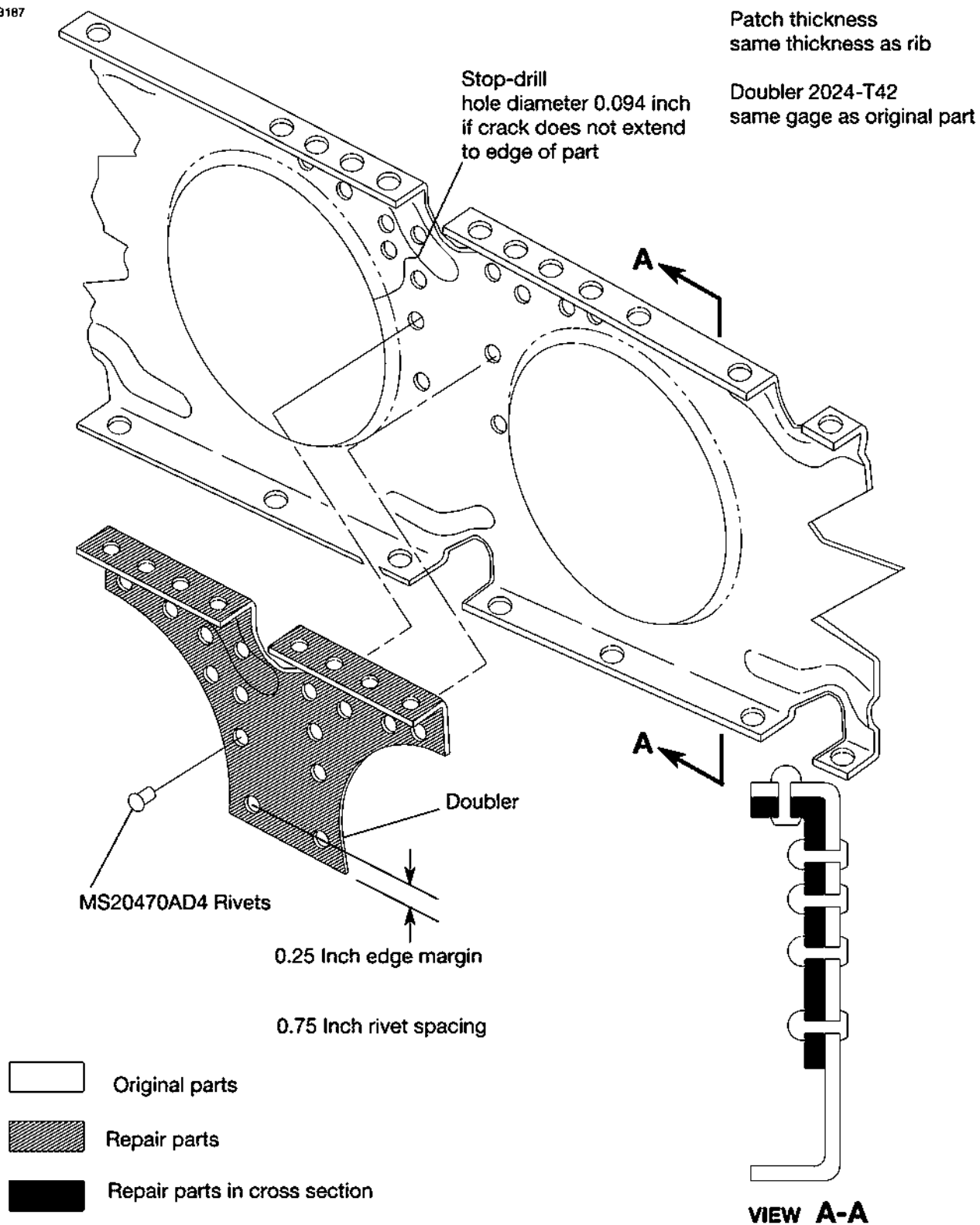
- A. Damage to the wing rib can be divided into three major categories and is detailed in Wing Damage Classification.

3. Wing Rib Repair

- A. Repairs to the wing rib are illustrated in Figure 801.

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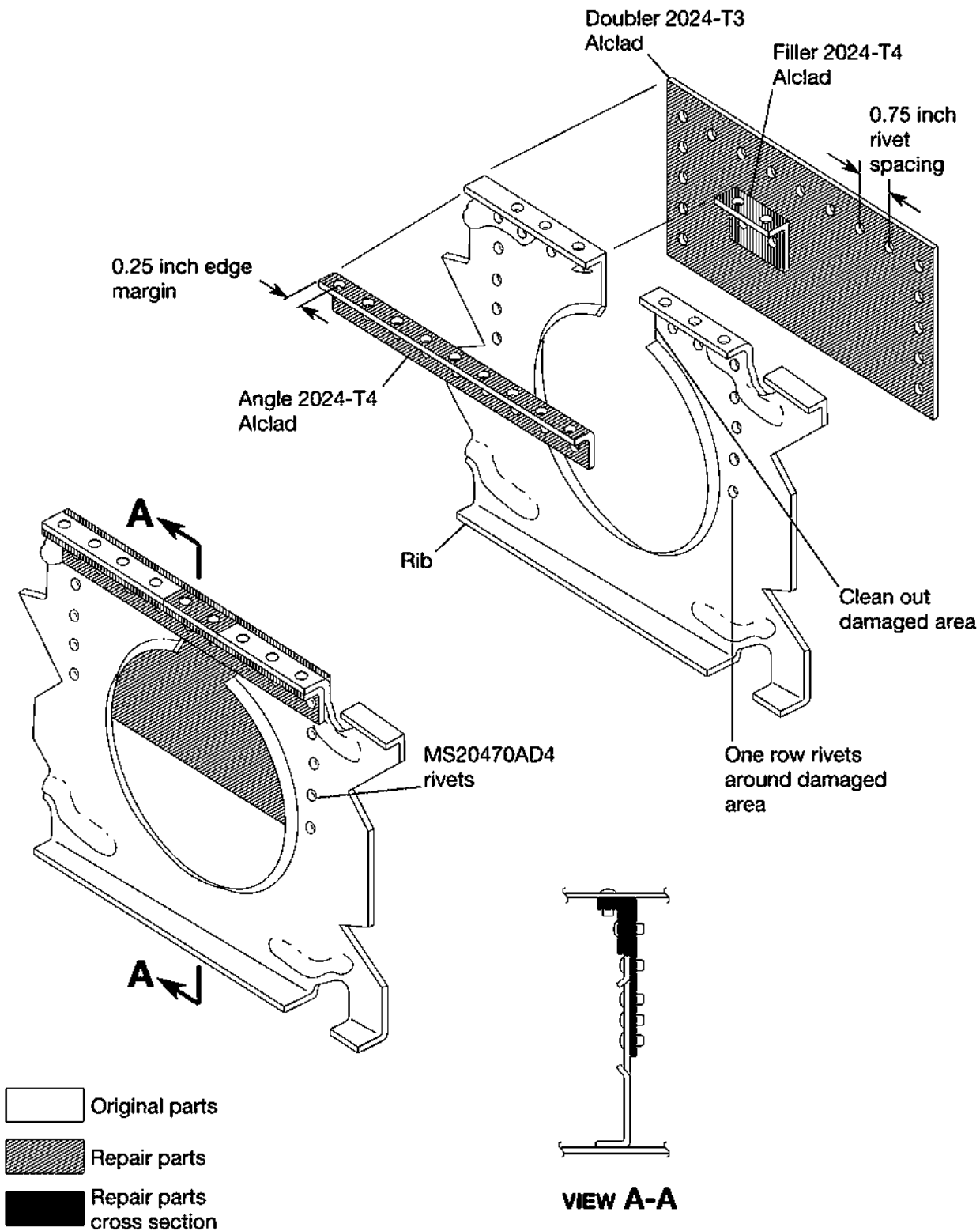


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Typical Rib Repair
 Figure 801 (Sheet 1)

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Typical Rib Repair
 Figure 801 (Sheet 2)

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WING SPARS

1. General

A. Front and rear spars are of riveted construction.

2. Damage Classification

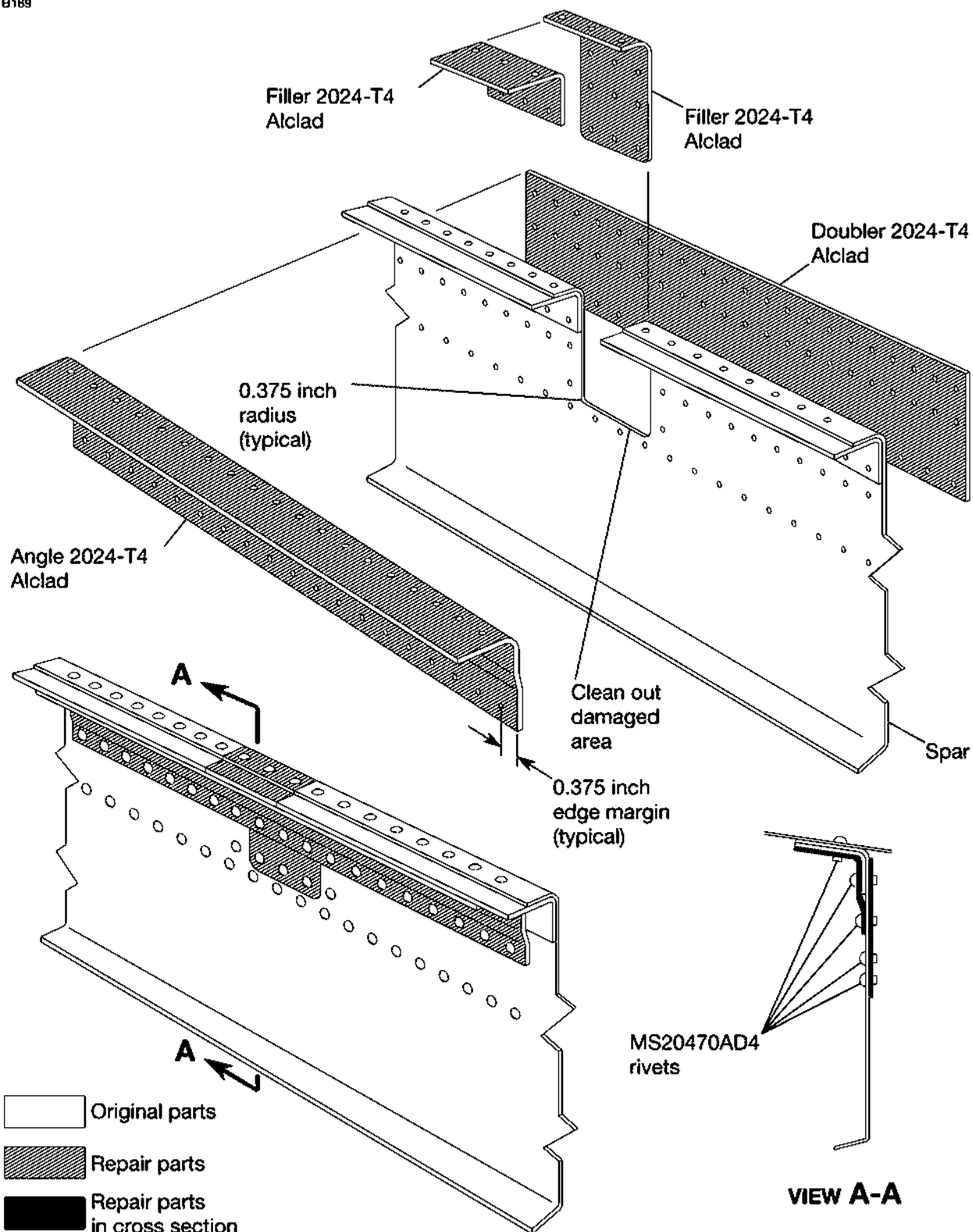
A. Damage to the wing spar can be divided into three major categories and is detailed in Wing Damage Classification.

3. Spar Repair

A. Repairs to the wing spar are illustrated in Figure 801.

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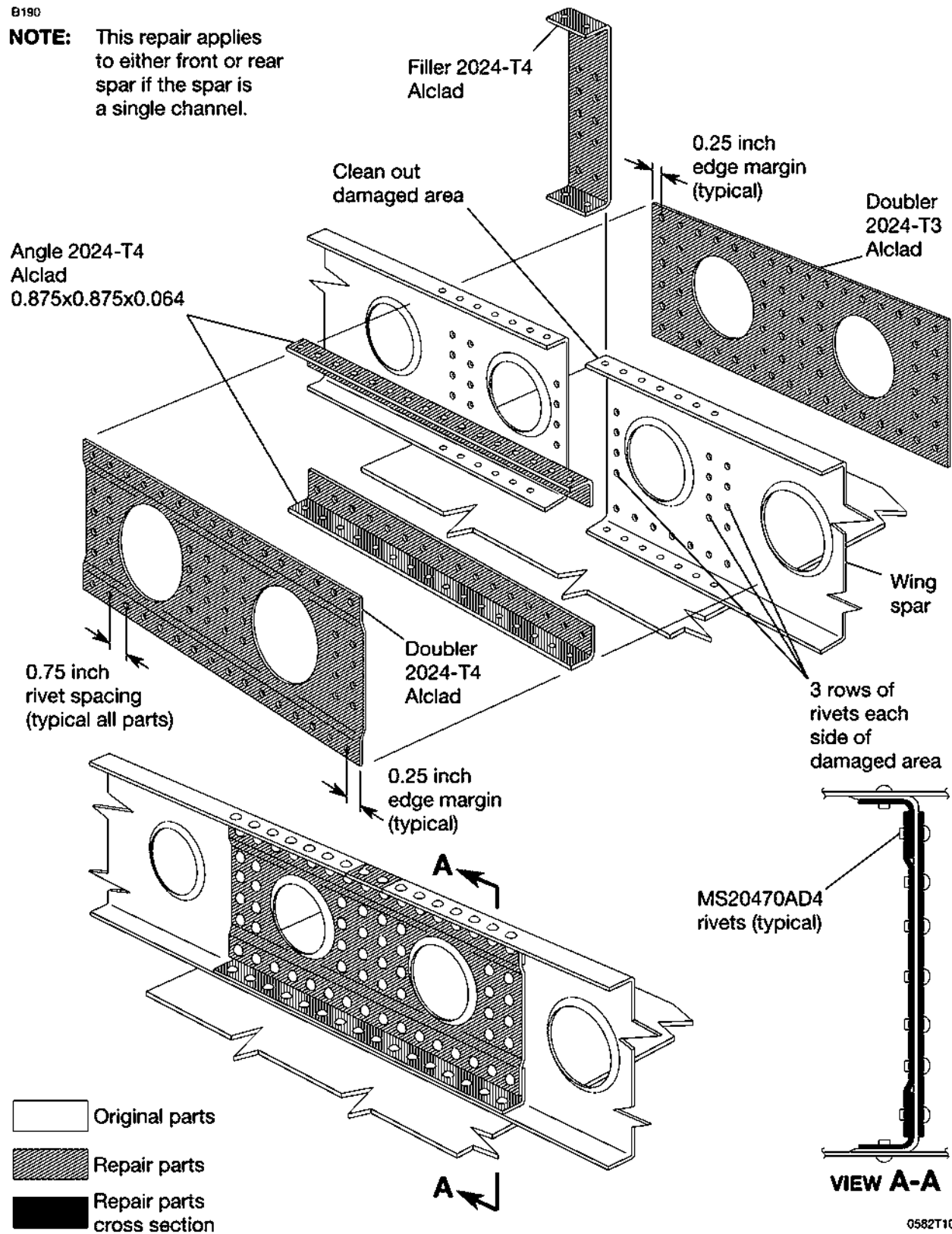
0582T1008

Wing Spar Repair
 Figure 801 (Sheet 1)

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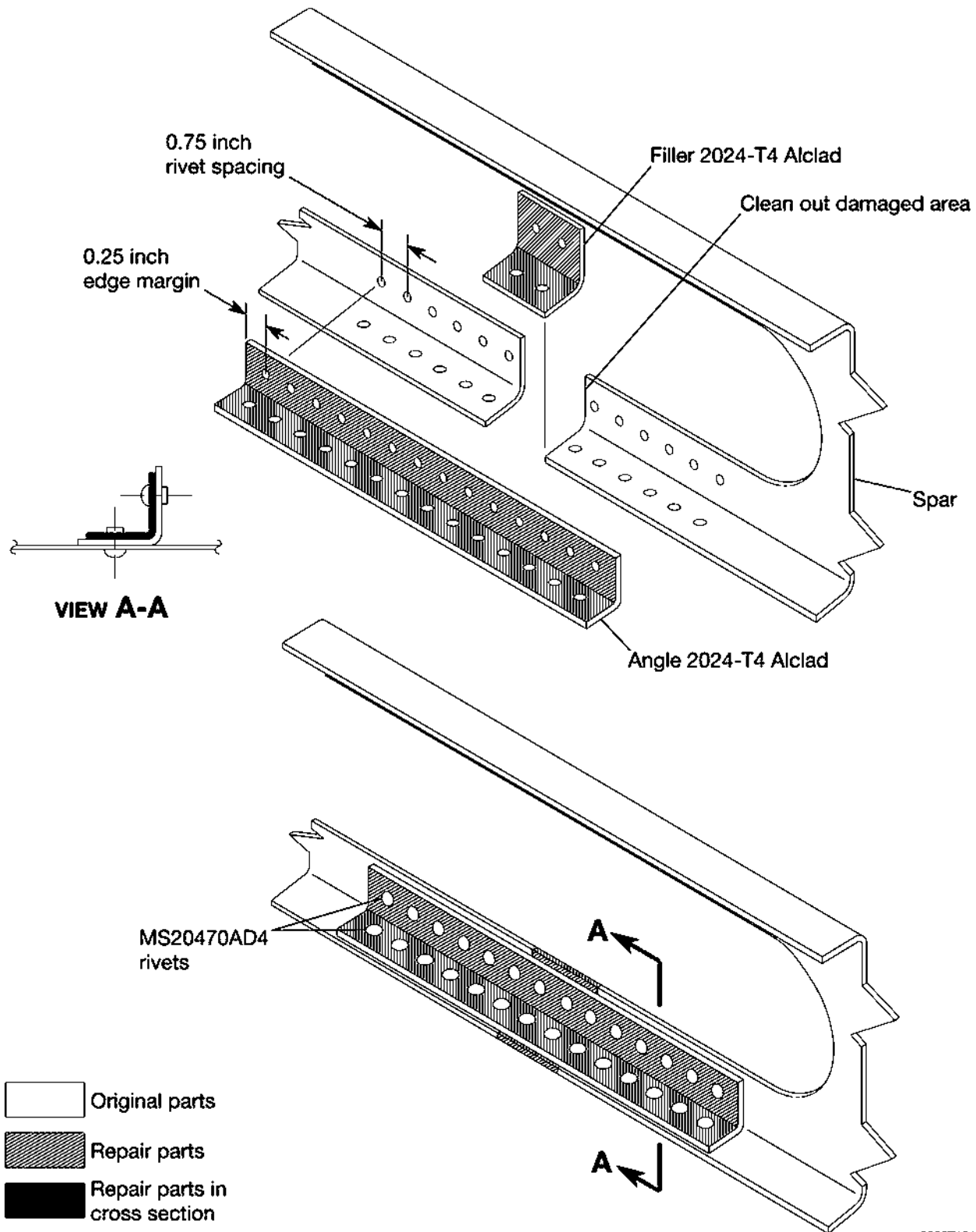
NOTE: This repair applies to either front or rear spar if the spar is a single channel.



Wing Spar Repair
 Figure 801 (Sheet 2)

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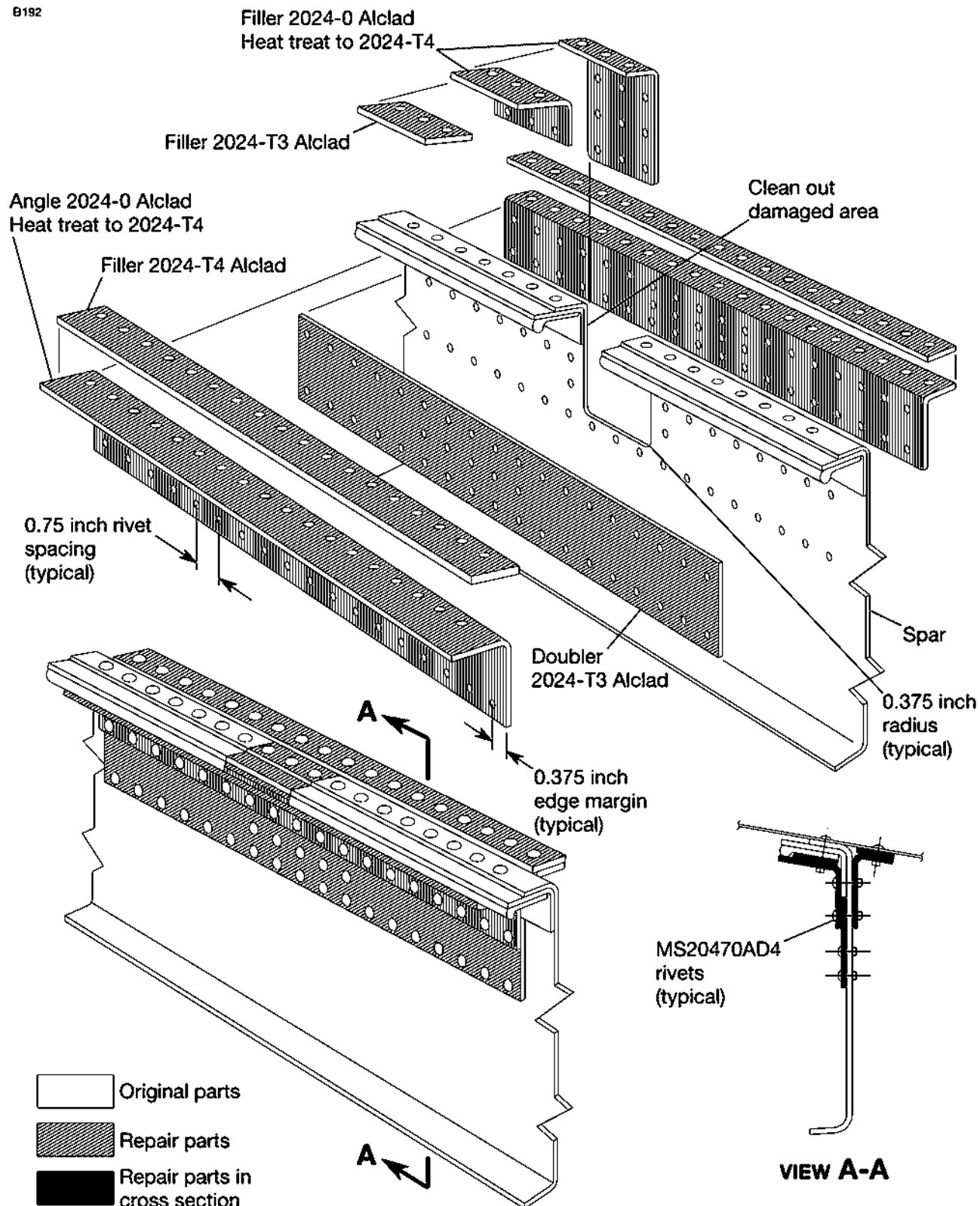
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Wing Spar Repair
 Figure 801 (Sheet 3)

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0582T1011

Wing Spar Repair
 Figure 801 (Sheet 4)

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MEASURING WING TWIST - INSPECTION/CHECK

1. General

- A. This section applies to the procedures required to perform a wing twist check and is applicable to both wing. If damage has occurred to a wing, it is advisable to check the wing twist (washout).
- B. Wing twist (washout) for the Model 172, 182/T182 and 206/T206 airplanes is 3° 37'.

2. Tools, Equipment and Materials

- A. The following equipment is required to accomplish the wing twist check procedure:

NAME	NUMBER	MANUFACTURER	USE
32 Inch Straightedge		Commercially Available	Used to aid in determining wing twist.
Protractor Head with Bubble Level		Commercially Available	To ensure wings are level.
Bolts Machined to Specific Lengths		Fabricate Locally	Used to determine wing twist.

3. Model 172 Series Wing Twist Check Procedure

- A. Mark Wing Station Reference Points (Refer to Figure 601)
 - (1) Locate WS 39.00. Make a mark, with a felt tip pen, approximately 0.50 inch aft of lateral row of rivets in wing leading edge spar flange.
 - (2) Locate WS 100.50. Make a mark, with a felt tip pen, approximately 0.50 inch aft of lateral row of rivets in wing leading edge spar flange.
 - (3) Locate outboard WS 207.00. Make a mark, with a felt tip pen, approximately 0.50 inch aft of lateral row of rivets in wing leading edge spar flange.
- B. Measure Wing Twist at Each Wing Station (Refer to Figure 601)

NOTE: While performing the following procedure, stay as far away as possible from the "canned" areas of the wing.

- (1) At WS 39.00:
 - (a) Grind bolt "A" to a dimension of 2.00 inches. Grind bolt "B" to a dimension of 1.00 inch. Place these bolts 29.50 inches from each other on the upper edge of the straightedge and secure using tape.
 - (b) Secure protractor to bottom of the straightedge.
 - (c) Hold straightedge parallel to wing station and place bolt "A" on mark.
 - (d) Set bubble in protractor to center, and lock protractor to hold this reading.
- (2) At WS 100.50:
 - (a) Hold straightedge parallel to wing station.
 - (b) Place bolt "A" on mark, set protractor head against lower edge of straightedge and verify bubble in protractor head indicates level.
- (3) At WS 207.00:
 - (a) Remove bolt "A" from straightedge. Grind another bolt "A" to a dimension of 0.45 inch. Place this bolt 24.00 inches from bolt "B" and secure to straightedge.
 - (b) Hold straightedge parallel to wing station and place bolt "A" on mark.
 - (c) Check to assure that protractor bubble is still centered. If proper twist is present, the protractor readings will be the same (parallel).

NOTE: Forward or aft bolt may be lowered from wing 0.10 inch (maximum) to attain level indication.

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4. Model 182 Series Wing Twist Check Procedure

- A. Mark Wing Station Reference Points (Refer to Figure 602)
- (1) Locate WS 39.00. Make a mark, with a felt tip pen, approximately 0.50inch aft of lateral row of rivets in wing leading edge spar flange.
 - (2) Locate WS 100.50. Make a mark, with a felt tip pen, approximately 0.50 inch aft of lateral row of rivets in wing leading edge spar flange.
 - (3) Locate outboard WS 207.00. Make a mark, with a felt tip pen, approximately 0.50 inch aft of lateral row of rivets in wing leading edge spar flange.
- B. Measure Wing Twist at Each Wing Station (Refer to Figure 602)

NOTE: While performing the following procedure, stay as far away as possible from the "canned" areas of the wing.

- (1) At WS 39.00:
 - (a) Grind bolt "A" to a dimension of 2.00 inches. Grind bolt "B" to a dimension of 1.00 inch. Place these bolts 29.50 inches from each other on the upper edge of the straightedge and secure using tape.
 - (b) Secure protractor to bottom of the straightedge.
 - (c) Hold straightedge parallel to wing station and place bolt "A" on mark.
 - (d) Set bubble in protractor to center, and lock protractor to hold this reading.
- (2) At WS 100.50:
 - (a) Hold straightedge parallel to wing station.
 - (b) Place bolt "A" on mark, set protractor head against lower edge of straightedge and verify bubble in protractor head indicates level.
- (3) At WS 207.00:
 - (a) Remove bolt "A" from straightedge. Grind another bolt "A" to a dimension of 0.45 inch. Place this bolt 24.00 inches from bolt "B" and secure to straightedge.
 - (b) Hold straightedge parallel to wing station and place bolt "A" on mark.
 - (c) Check to assure that protractor bubble is still centered. If proper twist is present, the protractor readings will be the same (parallel).

NOTE: Forward or aft bolt may be lowered from wing 0.10 inch (maximum) to attain level indication.

5. Model 206/T206 Series Wing Twist Check Procedure

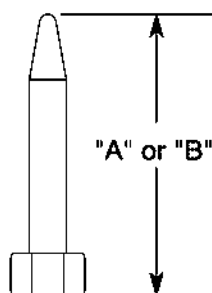
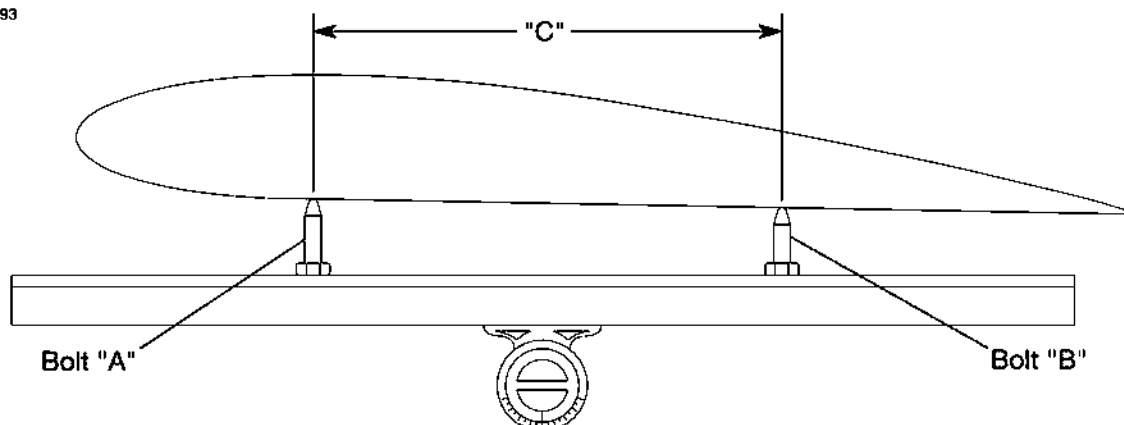
- A. Mark wing Station Reference Points (Refer to Figure 603)
- (1) Locate WS 39.00. Make a mark, with a felt tip pen, approximately 0.50inch aft of lateral row of rivets in wing leading edge spar flange.
 - (2) Locate WS 100.00. Make a mark, with a felt tip pen, approximately 0.50inch aft of lateral row of rivets in wing leading edge spar flange.
 - (3) Locate outboard WS 207.00. Make a mark, with a felt tip pen, approximately 0.50inch aft of lateral row of rivets in wing leading edge spar flange.
- B. Measure Wing Twist at Each Wing Station (Refer to Figure 603)

NOTE: While performing the following procedure, stay as far away as possible from the "canned" areas of the wing.

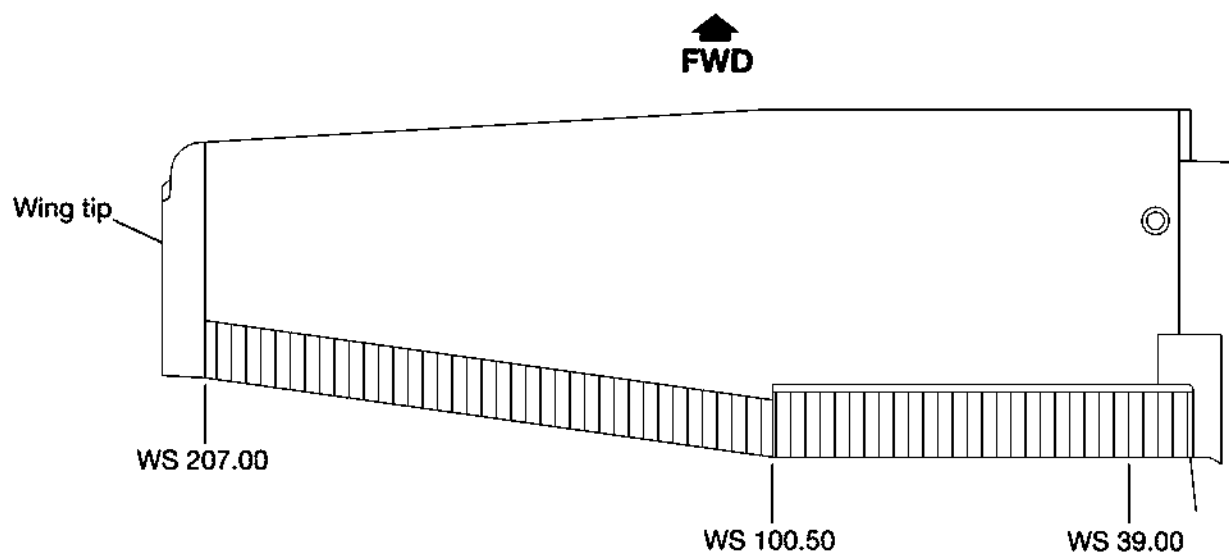
- (1) At WS 39.00:
 - (a) Grind bolt "A" to a dimension of 2.00 inches. Grind bolt "B" to a dimension of 1.00 inch. Place these bolts 29.50 inches from each other on the upper edge of the straightedge and secure using tape.
 - (b) Secure protractor to bottom of the straightedge.
 - (c) Hold straightedge parallel to wing station and place bolt "A" on mark.
 - (d) Set bubble in protractor to center, and lock protractor to hold this reading.

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Bolt "A" dimension (inches)	Bolt "B" dimension (inches)	"C" dimension (inches)	Wing station
2.00	1.00	29.50	39.00
2.00	1.00	29.50	100.50
0.45	1.00	24.00	207.00



NOTE: All wing twist occurs between WS 100.50 and the tip rib.

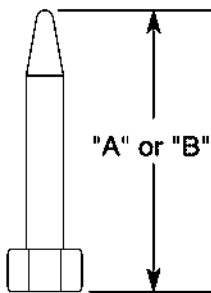
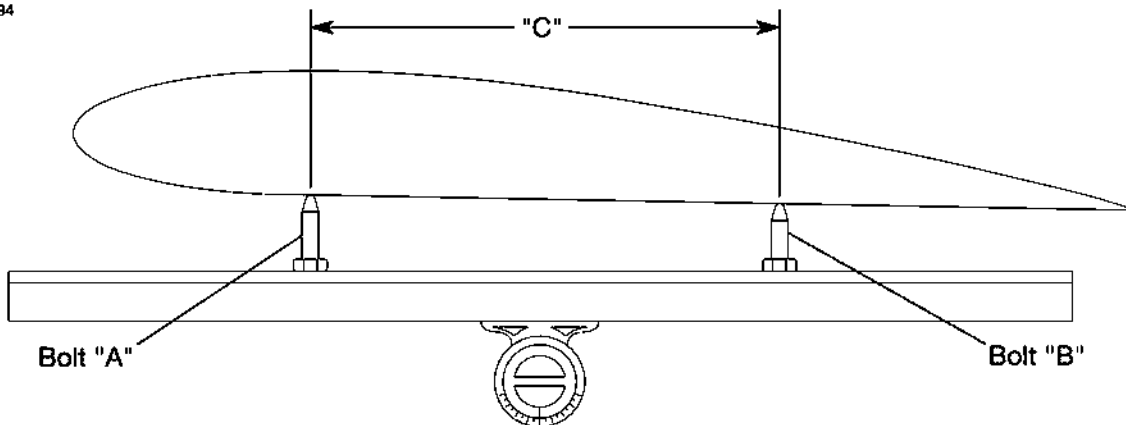
View looking down on wing

2682T1041

Measuring Model 172 Series Wing Twist
 Figure 601 (Sheet 1)

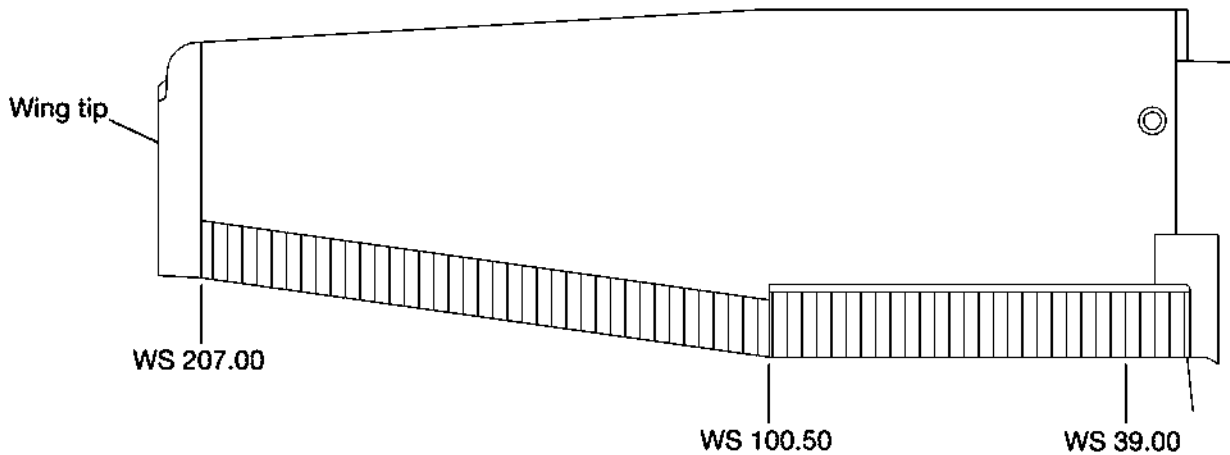
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Bolt "A" dimension (inches)	Bolt "B" dimension (inches)	"C" dimension (inches)	Wing station
2.00	1.00	29.50	39.00
2.00	1.00	29.50	100.50
0.45	1.00	24.00	207.00

FWD



NOTE: All wing twist occurs between WS 100.50 and the tip rib.

View looking down on wing

2682T1041

Measuring Model 182 Series Wing Twist
 Figure 602 (Sheet 1)

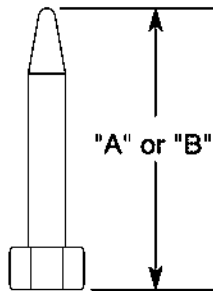
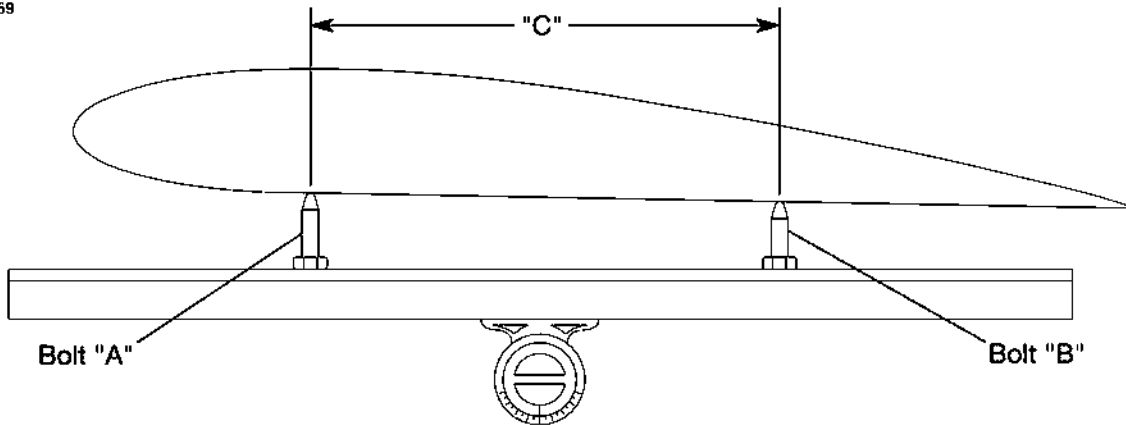
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- (2) At WS 100.00:
 - (a) Hold straightedge parallel to wing station.
 - (b) Place bolt "A" on mark, set protractor head against lower edge of straightedge and verify bubble in protractor head indicates level.
- (3) At WS 207.00:
 - (a) Remove bolt "A" from straightedge. Grind another bolt "A" to a dimension of 0.66 inch. Place this bolt 20.00 inches from bolt "B" and secure to straightedge.
 - (b) Hold straightedge parallel to wing station and place bolt "A" on mark.
 - (c) Check to assure that protractor bubble is still centered. If proper twist is present, the protractor readings will be the same (parallel).

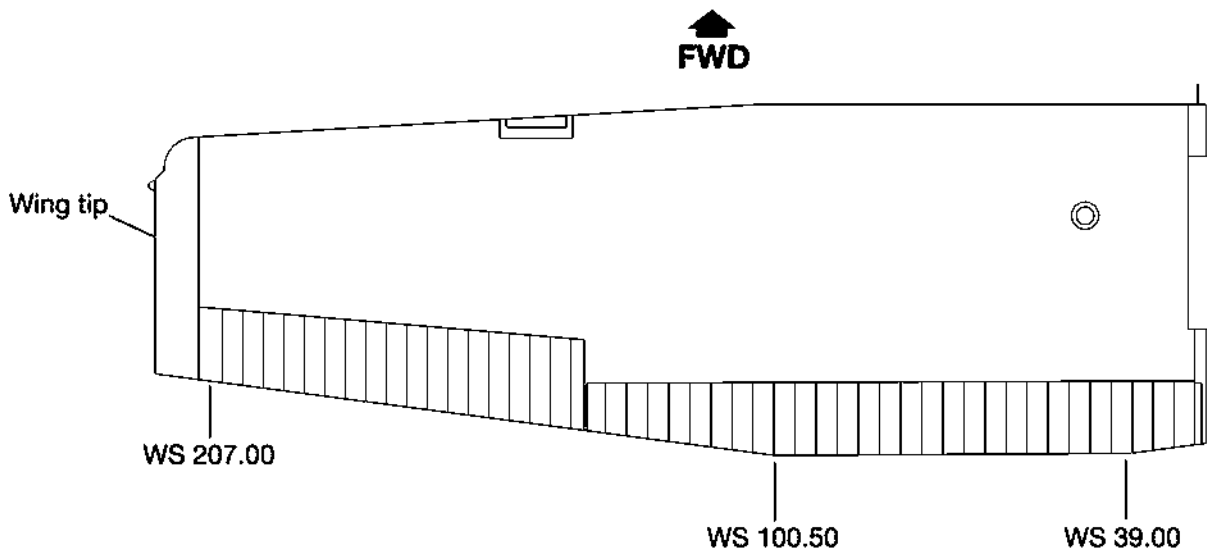
NOTE: Forward or aft bolt may be lowered from wing 0.10 inch (maximum) to attain level indication.

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Bolt "A" dimension (inches)	Bolt "B" dimension (inches)	"C" dimension (inches)	Wing station
2.00	1.00	29.50	39.00
2.00	1.00	29.50	100.00
0.66	1.00	20.00	207.00



NOTE: All wing twist occurs between WS 100.50 and the tip rib.

View looking down on wing

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Measuring Model 206/T206 Series Wing Twist
 Figure 603 (Sheet 1)

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WING STRINGER REPAIRS

1. Stringer Damage Classification

- A. Damage to the wing stringers can be divided into three major categories and is detailed in Wing Damage Classification.

2. Stringer Repair

- A. Repairs to wing stringer are similar to repairs to fuselage stringers. Refer to Chapter 52, Stringer and Channel Repair, Figure 801 for repair illustrations.

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AUXILIARY SPAR REPAIRS

1. General

- A. The auxiliary spar is constructed of formed sheet metal, and is behind the trailing edge ribs from approximately WS 100.50 to 208.00. The auxiliary spar is attached to upper skins, lower skins and other wing structure using rivets.

2. Auxiliary Spar Damage

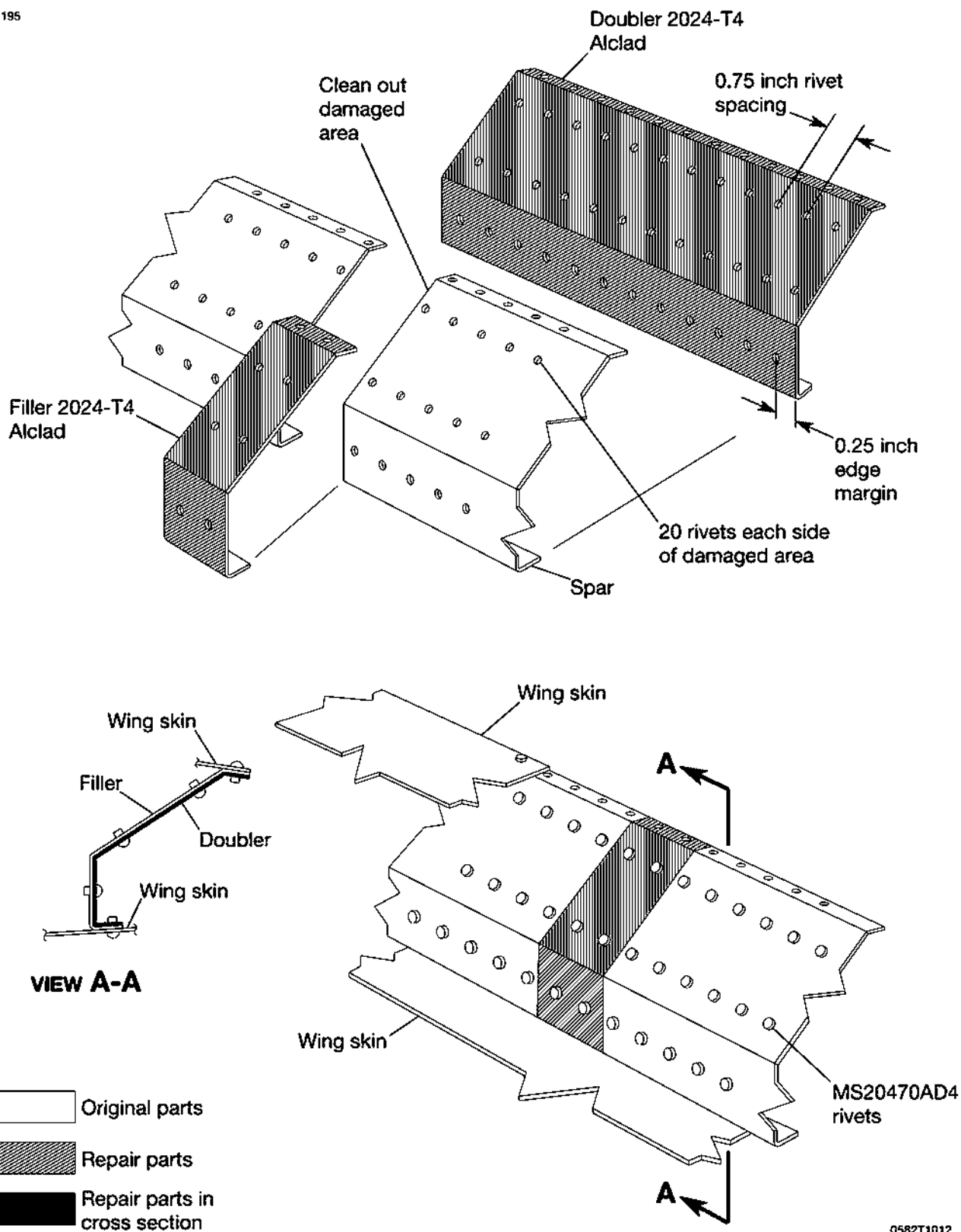
- A. Damage to the auxiliary spar can be divided into three major categories and is detailed in Wing Damage Classification.

3. Auxiliary Spar Repair

- A. Repairs to the auxiliary spar are illustrated in Figure 801.

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Auxiliary Spar Repair
 Figure 801 (Sheet 1)

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LEADING EDGE REPAIRS

1. Leading Edge Damage Classification

- A. Damage to the leading edge can be divided into three major categories and is detailed in Wing Damage Classification.

2. Leading Edge Repairs

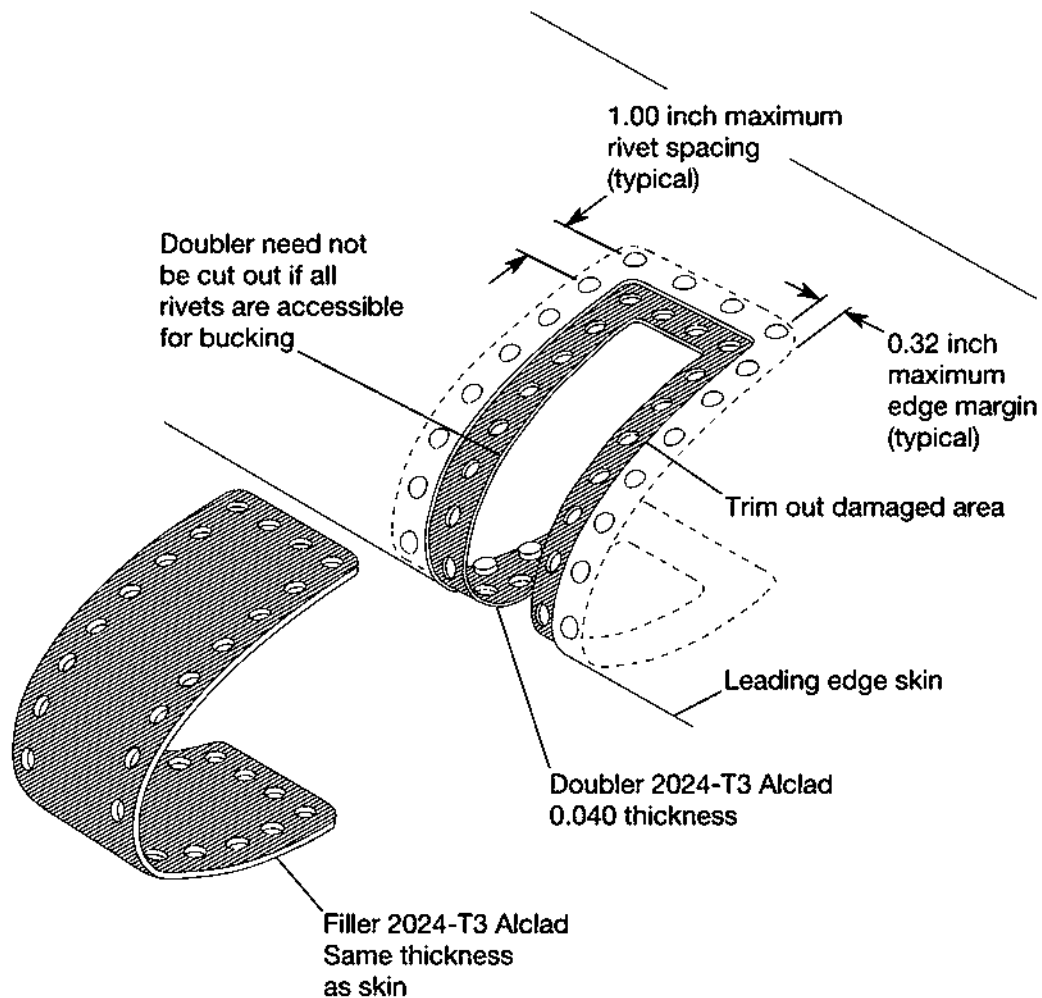
- A. Repairs to the leading edge are illustrated in Figure 801.

3. Notes and Repair Limits

- A. The following notes and repair limits are applicable to leading edge repairs:
- (1) Dimple leading edge skin and filler material, counter sink the doubler.
 - (2) Use MS20426AD4 rivets to install filler except where bucking is impossible. Use blind rivets where regular rivets cannot be bucked.
 - (3) Contour must be maintained. After repair has been completed, use epoxy filler as necessary and sand smooth before painting.
 - (4) Vertical size of patch is limited by ability to install doubler clear of front spar.
 - (5) Lateral size is limited to seven inches across trimmed out area.
 - (6) Number of repairs is limited to one per bay.

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Leading Edge Repair
Figure 801 (Sheet 1)

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BONDED LEADING EDGE REPAIR

1. General

- A. Bonded leading edges are used on the Model 182 and Model 206/T206 series of airplanes. The following repairs apply to these airplanes only.

2. Bonded Leading Edge Damage Classification

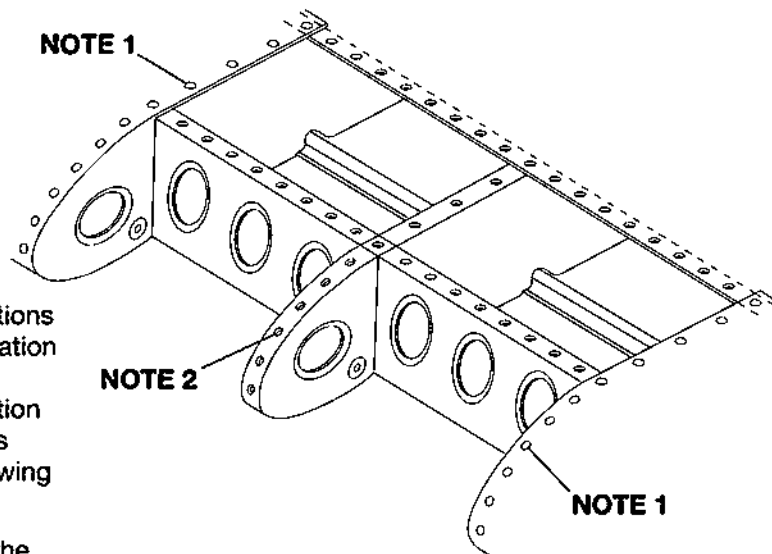
- A. Damage to the bonded leading edge can be divided into three major categories and is detailed in Wing Damage Classification.

3. Bonded Leading Edge Repair

- A. Repairs to the bonded leading edge are illustrated in Figure 801.

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NOTE 1: Use rivet pattern at wing stations 23.65 for repair from wing station 23.65 to wing station 85.87. Use rivet pattern at wing station 100.50 for lap splice patterns from wing station 100.50 to wing station 190.00.

NOTE 2: Use rivet spacing similar to the pattern at wing station 100.50 at leading edge ribs between lap splices.

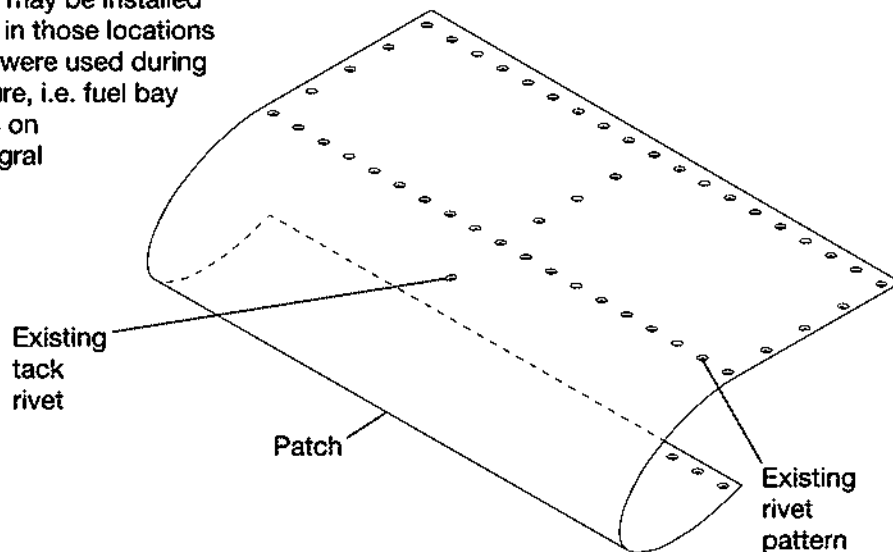
Select number of flush rivets to be used at each wing station leading edge rib from table.

Ribs and stringers: Blind rivets may be substituted for solid rivets in proportionally increased numbers in accordance with the table.

Spars: Blind rivets may be installed in wing spars only in those locations where blind rivets were used during original manufacture, i.e. fuel bay area of front spars on airplanes with integral fuel bays.

Number of flush rivets in dimpled skin required in replacement leading edge skin

Wing station rib	Solid MS20426-4	Blind CR2248-4
118	18	22
136	15	18
154	11	13
172	10	12
190	10	12



Typical leading edge section

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Bonded Leading Edge Repair
 Figure 801 (Sheet 1)

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FLAP LEADING EDGE REPAIR

1. Flap Leading Edge Damage Classification

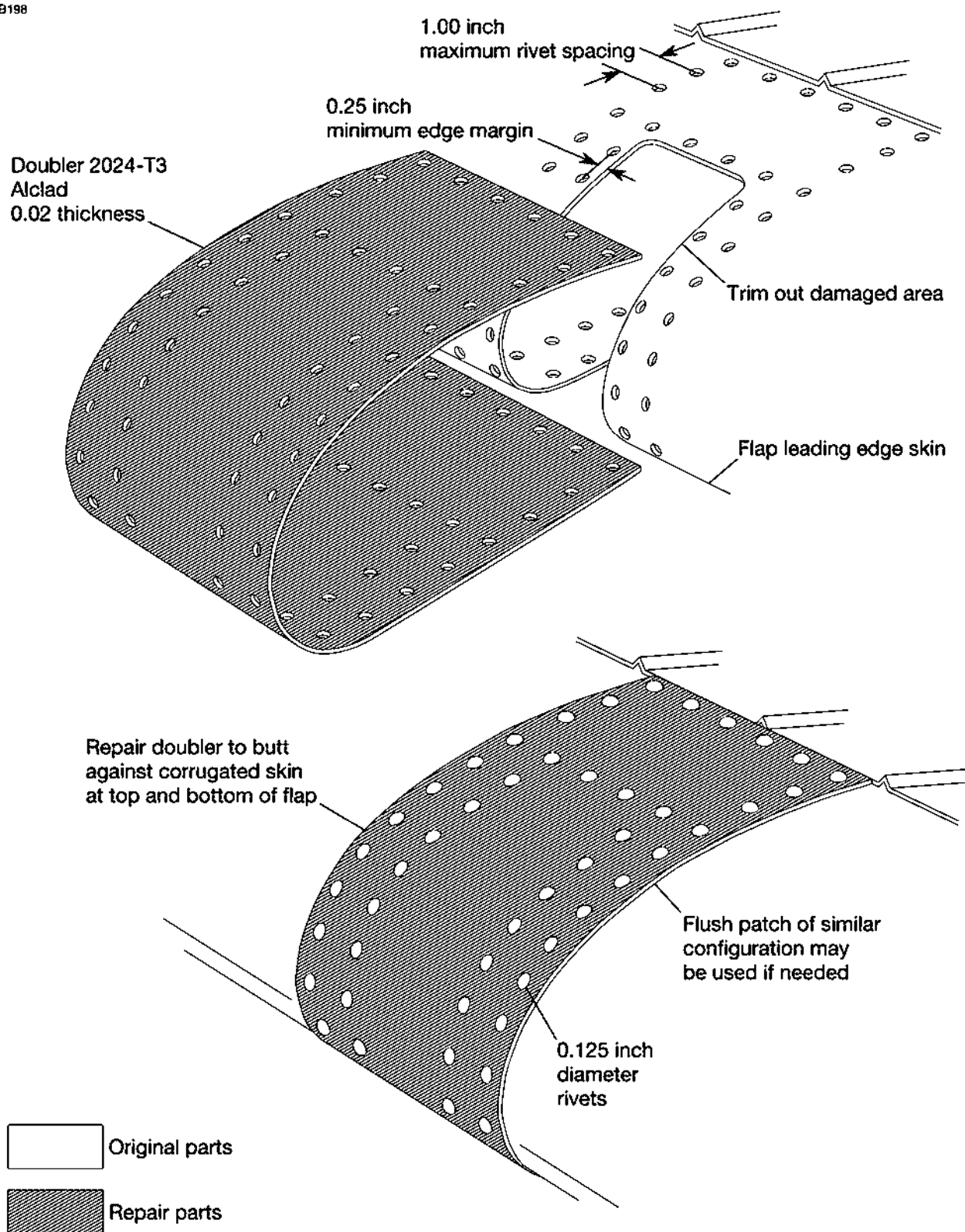
- A. Damage to the wing flap can be divided into three major categories and is detailed in Wing Damage Classification.

2. Flap Repairs

- A. Repairs to the flap leading edge are illustrated in Figure 801. Repairs to the corrugated skin are illustrated in Chapter 51, Typical Skin Repairs, Figure 802.

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Flap Leading Edge Repair
 Figure 801 (Sheet 1)

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FLAPS AND AILERONS

1. General

- A. Each wing flap assembly is constructed of a spar, ribs, upper and lower skins and leading edge skin.
- B. Each aileron assembly is constructed of a single spar, ribs, upper and lower skin. Balance weights are installed in the lower inboard leading edge and are retained with screws.
- C. Flight control surfaces which have been repaired or replaced must be balanced in accordance with procedures outlined in Chapter 51, Flight Control Surface Balancing.

2. Damage Criteria

- A. Damage to the flaps and ailerons can be divided into three major categories and is detailed in Wing Damage Classification.

3. Flap and Aileron Repair

- A. Skin damage, exceeding that considered negligible, that can be repaired with minor patches can be considered repairable. Flush skin patches are illustrated in Chapter 51, Typical Skin Repairs, Figure 801. A typical rib repair is illustrated in Chapter 51, Control Surface Repair, Figure 801, trailing edge repair in Chapter 51, Control Surface Repair, Figure 802, are typical flap and aileron repairs.
- B. Flight control surfaces which have been repaired or replaced must be balanced in accordance with procedures outlined in Chapter 51, Flight Control Surface Balancing.

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WING LIFT STRUTS

1. General

- A. The wing lift struts consist of 6061-T6 tube stock formed into an aerodynamic shape. Attach fittings are machined from 7075-T73 bar stock and attached to the strut tubes.

2. Wing Strut Damage Classification

- A. Damage to the wing lift strut can be divided into three major categories and is detailed in Wing Damage Classification.

CHAPTER

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POWER PLANT

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LIST OF EFFECTIVE PAGES

CHAPTER-SECTION-SUBJECT	PAGE	DATE
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71-List of Effective Pages		
71-Record of Temporary Revisions		
71-Table of Contents		
71-00-00	Page 1	Jun 1/2005
71-10-00	Page 801	Jun 1/2005
71-20-00	Pages 801-804	Jun 1/2005

RECORD OF TEMPORARY REVISIONS

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DYNAFOCAL-TYPE ENGINE MOUNT REPAIRS	71-20-00 Page 801
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POWERPLANT - GENERAL

1. General

- A. Single engine airplanes produced from 1996 and On use Lycoming powerplants. These powerplants are attached to the fuselage by dynafocal mounts (172R, 172S, 182S, 182T and T182T) or by sheet metal bed mounts (206H and T206H).
- B. This chapter covers structural repair to the cowlings (172R, 172S, 182S, 182T and T182T), and structural repair to the welded engine mounts (172R, 172S, 182S, 182T and T182T). For repair information not covered in this manual, contact Cessna Propeller Aircraft Product Support, P.O. Box 7706, Wichita, KS 67277. Telephone(316) 517-5800 or Facsimile (316) 942-9006.

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ENGINE COWLING REPAIRS

1. General

- A. This section provides repair procedures for the cowl skins and reinforcement angles.

2. Repair of Cowling Skins

- A. Cowl halves are made of formed aluminum skin. If extensively damaged, complete sections of cowling must be replaced. Standard insert-type skin patches, however, may be used if repair parts are formed to fit. Small cracks may be stop drilled and dents straightened if they are reinforced on the inner side with a doubler of the same material.

3. Repair of Reinforcement Angles

- A. Due to their small size, cowl reinforcement angles should be replaced (rather than repaired) if they become damaged.

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DYNAFOCAL-TYPE ENGINE MOUNT REPAIRS

1. General

- A. The engine mount is fabricated from 4130 chrome-molybdenum steel tubing. The mount attaches to the firewall at four points and to the engine using rubber isolation mounts at four points.

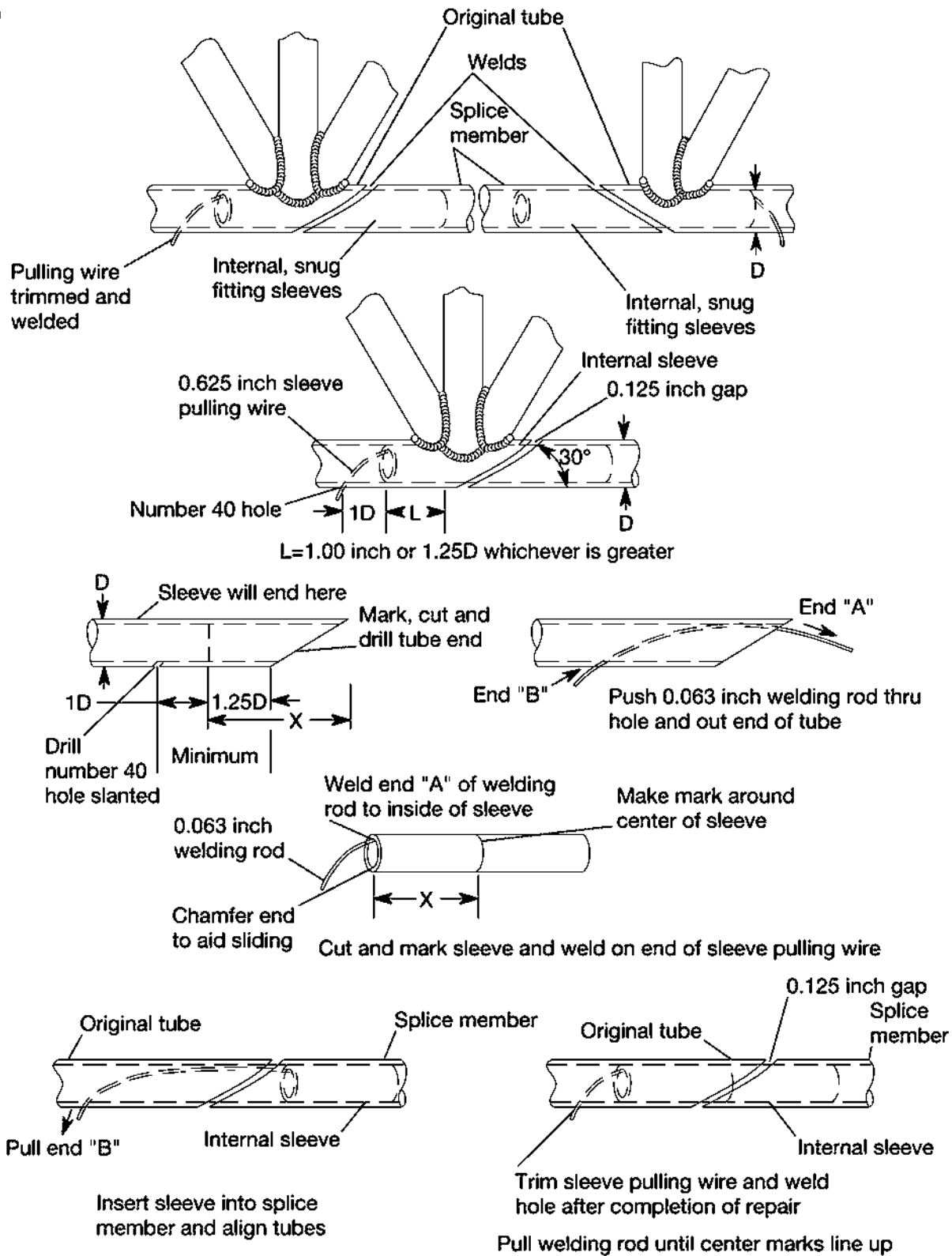
NOTE: Repair by gas welding is acceptable.

2. Engine Mount Repairs

- A. The following procedures are to be used when making repairs to the engine mount. Refer to Figure 801.
- (1) All welding on the engine mounts should be of the highest quality, since the tendency of vibration will accentuate any minor defect present and cause fatigue cracks. Engine mount members are preferably repaired by using larger diameter replacement tube welds. However, reinforced 30-degree scarf welds in place of the fishmouth welds are considered satisfactory for engine mount repair work.
 - (2) Minor damage, such as a crack adjacent to an engine attaching lug, may be repaired by rewelding the tube and extending a gusset past the damaged area. Extensively damaged parts must be replaced.
 - (3) Engine mounting lugs and engine mount-to-fuselage attach fittings should be replaced, not repaired.
 - (4) For information on damage beyond the scope of these repairs, consult Cessna Propeller Aircraft Product Support, P.O. Box 7706, Wichita, KS 67277 USA, Telephone (316) 517-5800 or Facsimile (316) 942-9006.

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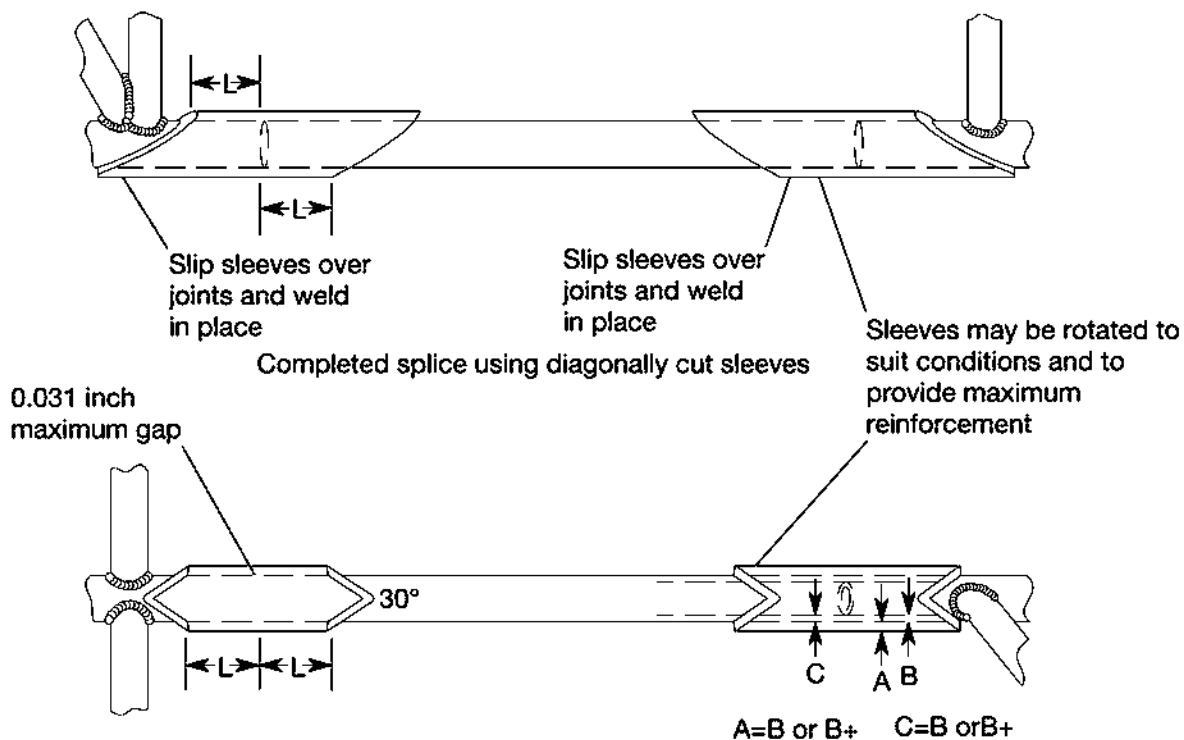
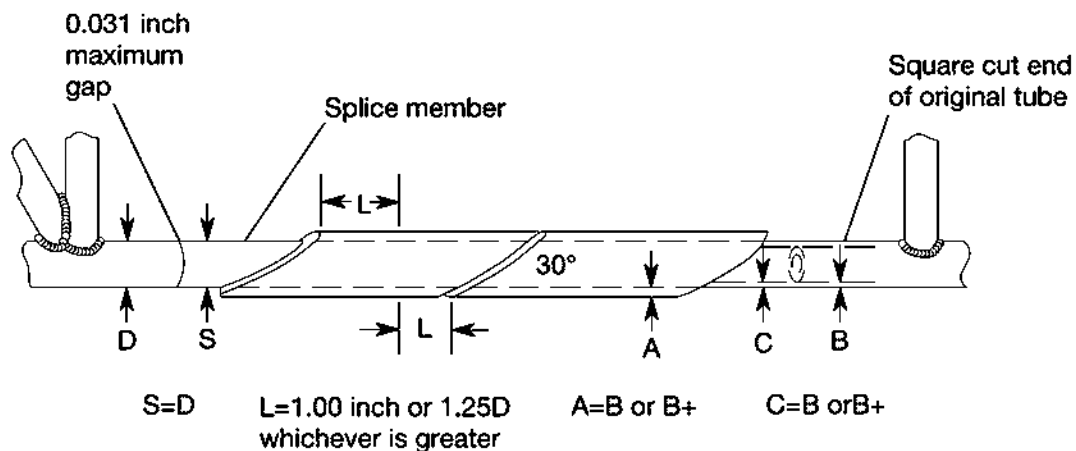


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Typical Engine Mount Repairs
 Figure 801 (Sheet 1)

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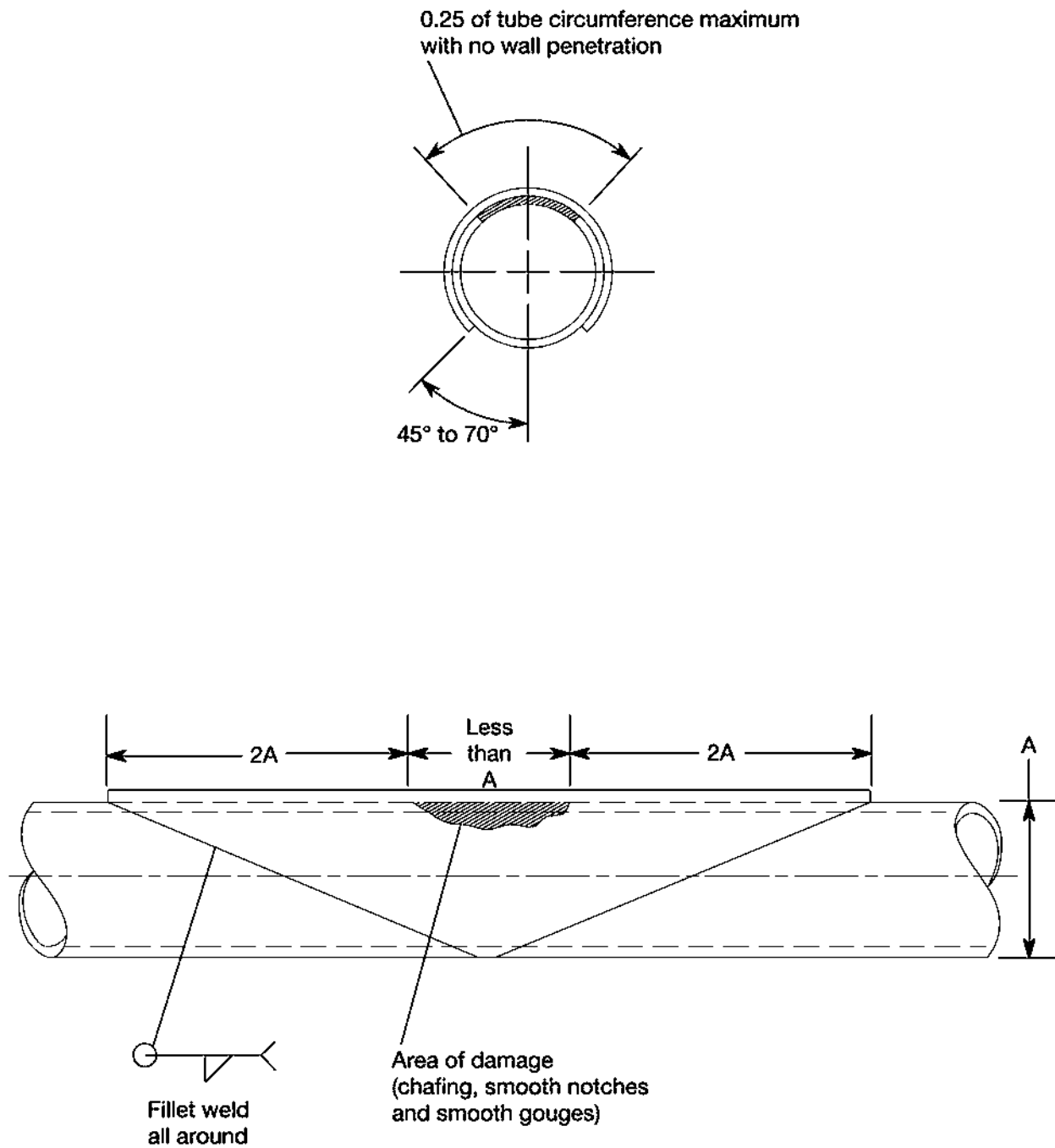
Completed splice using fishmouth cut sleeves

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Typical Engine Mount Repairs
 Figure 801 (Sheet 2)

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2682T1053

Typical Engine Mount Repairs
Figure 801 (Sheet 3)