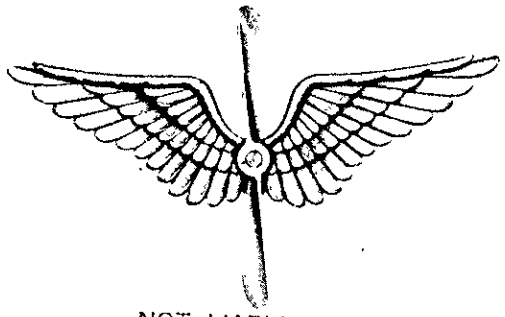
RESTRICTED
FILE: FO

TECHNICAL ORDER NO. 01-25C-3

P-40D, E, E-1 and F AIRPLANES

•

STRUCTURAL REPAIR INSTRUCTIONS



NOTE: This Technical Order Replaces T. O. No. 01-25C-3 Dated May 15, 1942

NOTICE: This document contains information affecting the National Defense of the United States within the meaning of the Espionage Act, 50 U. S. C., 31 and 32, as amended. Its transmission or the revelation of its contents in any manner to an unauthorized person is prohibited by law.

PUBLISHED BY AUTHORITY OF THE COMMANDING GENERAL,
ARMY AIR FORCES, BY THE HEADQUARTERS,
AIR SERVICE COMMAND, PATTERSON FIELD, FAIRFIELD, OHIO

The Drury Ptg. Co. 2-17-43—16M

JANUARY 30, 1943

Paragraph 5.d. of Army Regulation 380-5 relative to the handling of printed matter which has been classified as "Restricted" is quoted for the information of all concerned.

"d. Dissemination of restricted matter. - The information contained in restricted documents and the essential characteristics of restricted material may be given to any person known to be in the service of the United States and to persons of undoubted loyalty and discretion who are cooperating in Government work, but will not be communicated to the public or to the press except by authorized military public relations agencies."

TABLE OF CONTENTS

SECTION I

INTRODUCTION

1. Type of Construction.

The P-40 Airplane is of all metal construction, consisting of a semimonocoque fuselage and full cantilever wing and empennage, manufactured by Curtiss-Wright Corporation, Buffalo, New York. The main structure is a network of bulkheads, spars, and stringers, which are covered with a thin stressed aluminum-alloy skin. The ailerons, rudder, and elevators are of metal structure which is fabric-covered. The engine mount is a welded and bolted tubular structure of X-4130 steel and is detachable from the fuselage. See figures 1 and 2 for major disassemblies.

2. Types of Repair.

a. General.

(1) Due to the construction of the airplane, it is important that any repair to the skin, stringers, and bulkheads be given careful consideration. Simple operations, such as repairs to dents, small skin holes, and exterior injuries may be accomplished readily and easily; however, internal structures must be repaired by means of patches, inserts, or by splicing to reinforce the damaged sections or areas before the outer skin is attached. Caution must be exercised to maintain the original contour and to eliminate excessive increases in weight.

(2) A simple procedure to follow for all repairs is: Analyze the extent of the damage to the part before proceeding to repair it, devise several methods for its repair by referring to the repair schemes in the back of the test, and with the aid of the illustrations and the book, proceed to use the most convenient and easiest method.

(3) Where a specific repair is not given it is generally permissible to assume that either the member in question or its attachment has been designed to a zero margin. Due consideration must, however, be given to the probable types of loading to which the member is to be subjected and to the eccentricities of the applied loads. Repairs for the most part consist of replacing the damaged material with material of equal strength and section properties. Attach this material with the same type of attachment as used for the damaged piece or with sufficient attachment to permit the new piece to take its full allowable load. Care must be taken in attaching repair pieces to arrange the attachment so as not to reduce the structural efficiency of the member to which the repair piece is attached.

b. Classification. - Damages have been divided into four groups to facilitate the classification of repair methods. The classification and general description of the various damages is as follows:

(1) Negligible Damage. - Small dents, holes, or cracks in the sheet material requiring no addition of material or reinforcement. The dents must be bumped out, cracks stopped by a 1/8-inch hole at each end, and small holes rounded out to a 1/4-inch radius to prevent formation of cracks.

(2) Damage Reparable by Patching. - Holes and cracks which impair the strength of the structure but which may be repaired by the use of sheet reinforcements attached by a specified number and arrangement of rivets or bolts. Patches must be shaped and arranged in such a manner as to permit the required rivet or bolt pattern to extend completely around the damage or to the edges of the original stock. Where fittings or other structure is near the damaged area, the patches may have to be extended beyond these in order to obtain the required attachment. In many cases the damaged material must be replaced to give support to the patch and to other parts of the structure, or to obtain continuity, as in repair of the fuselage skin, this added material is designated as a filler or insert.

(3) Damage Reparable by Insertion. - Extensive damage requiring large inserts which may be attached by means of splices. When the damage is extensive or the presence of fittings and other structures make it difficult to use patches, the damaged material must be removed and replaced by formed inserts of the same or equivalent material, gage, and shape. Where practical, the inserts should be made to extend to the edges of the original sheet and should be attached by using the original rivet or bolt pattern. In cases where complete replacements are impractical, splices may be effected by using patches. Patches used in splicing must be continuous along the length of the splice and of sufficient width to take the rivet or bolt pattern specified for patching on each side of the cut. Continuous patches for splices that are not straight, that is, for angles, rectangles or circles, are designated as frames. Frames are frequently used in repairing small sections of damaged fuselage skin. Where continuity is not essential, splices may be effected by overlapping the insert and undamaged material. The attachment for an overlap should be the same in pattern as that used on one side of a patch splice.

(4) Damage Necessitating Replacement. - Damage to fittings, highly stressed material, and small pieces such as clips and gussets which may be easily replaced. Fittings which are cracked, sprung, or nicked must be replaced. Certain portions of the sheet structure are highly stressed and cannot be successfully repaired. These must be replaced. Small sheet fittings, gussets, clips, brackets, etc., are easily duplicated and should be replaced if damaged or stretched out of shape.

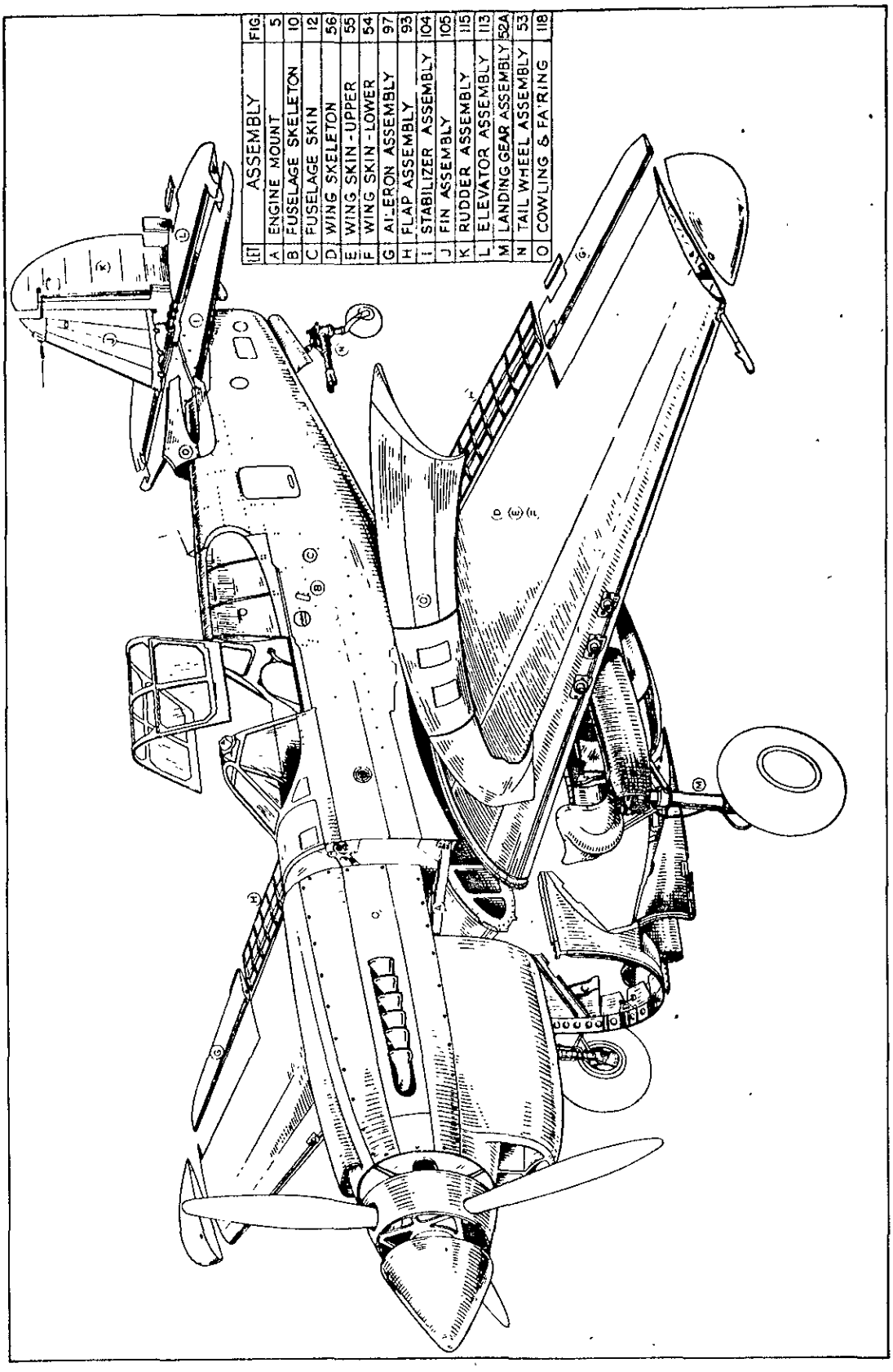


Figure 1 - Major Disassembly P-40E

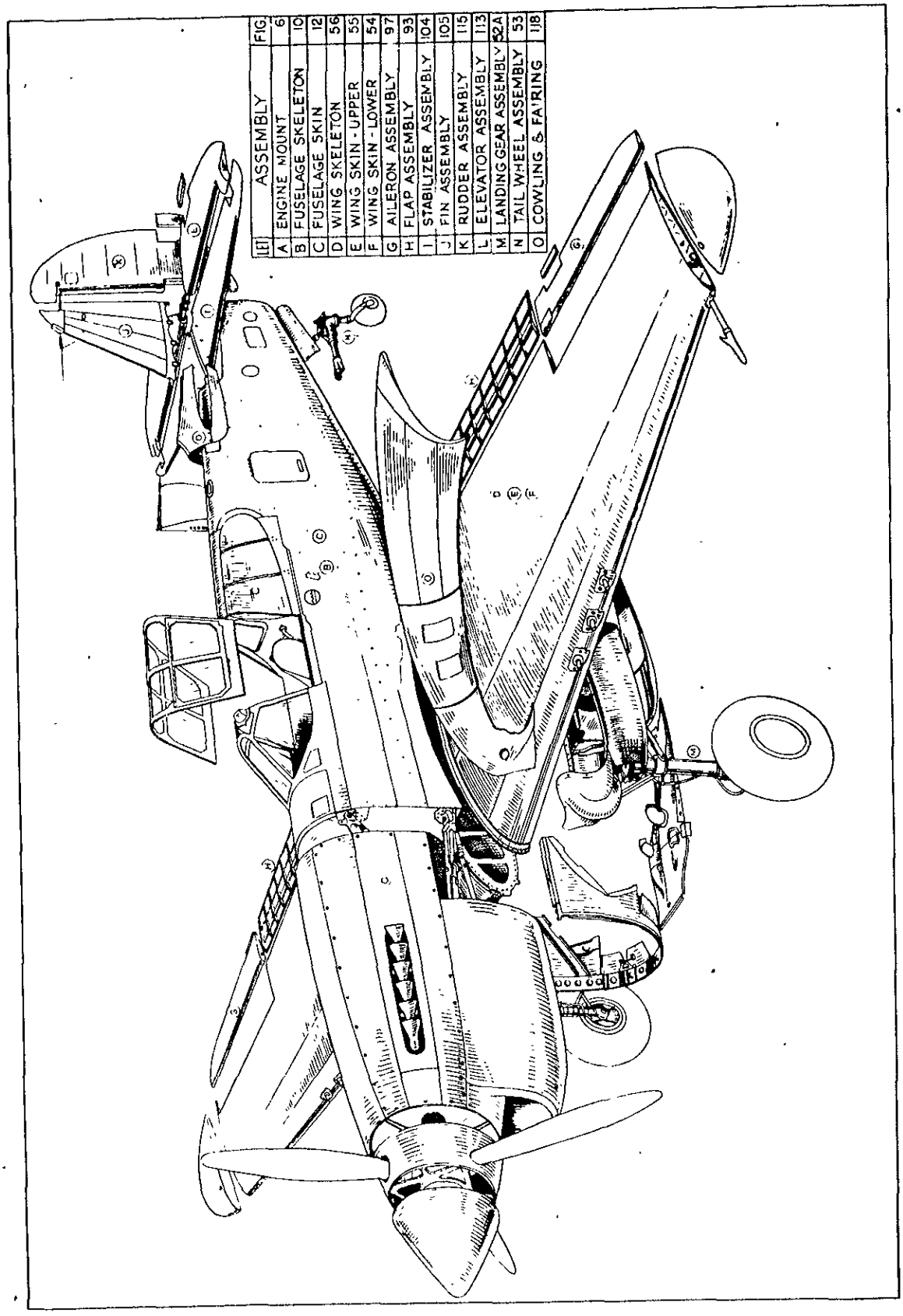


Figure 2 - Major Disassembly P-40F

3. Extent of Damage.

The extent of damage must be carefully ascertained. Determine the path taken by every missile which enters the wings, fuselage, or control surfaces and examine the attachment of every item which has been struck. Look for damage caused by the travel of shock loads along large members. If necessary form semi-structural doors in the skin, (section VI, paragraph 3.a.(2)) to facilitate inspection. Check particularly for the following: Dents and cracks in extrusions and fittings; elongated rivet and bolt holes, cracks and sharp cornered dents or wrinkles, and corrosion in sheet materials; and rivets which are stretched or sheared leaving their heads intact.

4. Support of Structure During Repair.

When repair operations are being performed which necessitate the removal of structural material, care must be taken not to overload other parts of the structure. A fixture of some type must be used to brace or hold that portion of the structure being worked upon. It is essential that the damaged structure be suitably and firmly supported against distortion.

5. Heat Treatment.

The material used in the construction of the airplane is almost entirely aluminum alloy. High strength rolled sheet is used for the stressed skin, and formed sheet is used for the spars, webs, bulkheads and ribs, and extrusions for the stringers and cap strips. All replacement or reinforcement material used must have the same structural characteristics as the damaged part for which it is used. Repair stock for the assembly covered in each section is listed in a table at the end of the respective section. A list of the commonly used heat-treat specifications, along with a brief description of each is given at the end of this section.

The heat-treated and cold worked alloys, 17SRT and 24SRT, can stand very little bending without cracking. The strong alloys of 17S and 24S can be formed in their annealed temper and heat-treated to develop the required strength before assembly. In cases where the annealed metal is not available, it is possible to heat the metal and quench it according to regular heat-treating practice and then form it before the age hardening sets in. The forming must be completed in 1 hour on "17S" and 20 minutes on "24S" after quenching or the material will become too hard to work. Heat treating the strong alloys of 17S and 24S consists of heating to a temperature ranging from $504.44^{\circ} \pm 5.5^{\circ}C$ ($940^{\circ} \pm 10^{\circ}F$) for "17S" material; and $493.33^{\circ} \pm 5.5^{\circ}C$ ($920^{\circ} \pm 10^{\circ}F$) for "24S." Hold at the required temperature until the piece is uniformly heated throughout and quench it immediately in cold water or oil. Thus, all strong aluminum-alloy bar, sheet and tube used for the airplane parts must be in the fully heat-treated condition upon final fabrication. It is only in this condition that the material develops its maximum physical properties and resistance to corrosion. Aluminum forgings, castings, and fittings must be replaced, as reheat treat weakens the tensile strength of the part.

All structural steel fittings are also heat-treated. These fittings must be replaced because of their respective structural and tensile strength value.

6. Welding.

a. Welded Aluminum Tanks and Fuel Bag Shells. - Repair welded aluminum tanks and fuel bag shells according to regular welding procedure. There are several ways and means of accomplishing good lasting welds if the following precautions are adhered to. However, when effecting repairs, care must be taken to eliminate a combination of slag and gas as they produce defects that have a very definite bearing on the strength and pliancy of the weld, and depending on their size and location can seriously endanger any welded joint. The elimination of slag and gas in the weld metal is dependent largely upon proper welding procedure and a good welding operator. Nevertheless, some slag will be formed and this must be removed with emery paper.

b. Welding Directions. - When performing welds on the fuel tanks and fuel bag shells, the tip size and gas pressure for oxyhydrogen welding should be according to the thickness of the metal. For metal 0.050 inch - 0.064 inch, the diameter of the orifice should be 0.065 inch. The oxygen pressure should be 2 and the hydrogen pressure should be 1 pound per square inch. For metal 1/8 inch - 3/16 inch, the diameter of the orifice should be 0.095 inch, the oxygen pressure 3 and the hydrogen pressure 2 pounds per square inch.

c. Weldable Parts. - Only parts which were welded during manufacture may be repaired or replaced by welding. When repairing the engine mount, reference should be made to the Caution note contained in section II, paragraph 1.b. All welded repairs must be similar to those made on the original part; for instance tack welding should be replaced by tack welding.

7. Bowed Tubes.

Engine mount tubes bowed in excess of 1/600 of their length must be replaced.

8. Solid Rivets.

Removal of formed rivets: When removing old rivets the following precautions should be observed. Use No. 30 (.128-inch) drill for 1/8-inch rivets, 5/32-inch drill for a 5/32-inch rivet and 3/16-inch drill for a 3/16-inch rivet. On round-head rivets, a flat should be filed on the head before drilling. Drill to a depth equal to the depth of the rivet head or slightly beyond the head and drive the rivet out with a punch. If the rivet will not come out and the drill hole is centered in the rivet, the drill may be run partly into

the shank. Care should be exercised not to elongate the rivet hole. See this section, paragraph 19., for information concerning enlarged rivet holes. After the removal of the rivet, inspect the hole to see that particles of metal are not lodged between the sheets holding them apart.

9. Removal of Countersunk Head Rivets.

The same procedure as followed in this section, paragraph 8., is a good method, except that a center mark should be made on the center of the rivet head before proceeding to drill. Use a drill of the same size or slightly smaller than the rivet shank. Drill into the head of the rivet to half the thickness of the nearest plate or sheet. The head should come away on the drill in the form of a washer. If this does not happen the remainder of the rivet may be punched out with a flat-ended pin punch small enough to pass through the hole.

10. Fitting Solid Rivets.

a. Replacing Solid Rivets. - Solid rivets may be replaced by several methods. Press countersunk 100-degree rivets are used extensively on skin gage .051 inch and under. For skin over .051 inch, drill countersunk 100-degree rivets are used. Drill countersunk rivets should never be used on sheets under .051 inch. All rivets should be a good fit in their holes. When press countersinking the sheet for a 5/32-inch rivet first drill with an 1/8-inch drill and then form with a male and female steel die. The hole is then redrilled using a No. 22 (.157-inch) drill and the rivet is inserted and driven by hand with a moderate weight hammer.

b. Skin Countersinking. - Drill countersinking of the sheet offers less support against shearing of the rivet than does the press countersunk sheet. In the fabrication of drill countersunk rivets, care must be taken to be sure that the head of the rivet is flush with the surface. If the drill countersink is allowed to go too deep, the joint is weakened.

c. Riveting Operations. - For rivet operations, insert the rivet from the outside, place the heading tool on the rivet head, and drive the rivet. The blow should be shocked on the inside by a dolly whose distance from the member will become less as the body of the rivet becomes shorter. The counterblock of the dolly should be adjusted during clinching and head forming. Uniform and straight driving of the rivet and its body will be difficult unless the dolly is in the exact center of the rivet. Caution should be taken that the rivet does not fit too tightly as it will cause the plates to bulge, and when the rivet is not pulled tight, clinches will be formed between the plates. Also avoid closing the head too flat. Avoid material bucklings of the skin due to an apparent "bulge" between the press countersinks. See figure 3, for flush riveting tools.

d. Effecting Repairs on Wing Skin. - When effecting repairs on the wing skin, flush-type doors are recommended, because of structural value and also for access in locating any future damage that may occur in or around the vicinity. (See section VI, paragraph 3.a.(2).)

11. Rivet Allowance - Modified Brazier Head Rivet (671-D).

For 1/8-inch diameter rivet: The formed head thickness should be .047 inch; the diameter of the formed head should be .156 inch; the extruded length of the rivet, after insertion, should be 5/32 inch.

For 5/32-inch diameter rivet: The formed head thickness should be .063 inch; the diameter of the formed head should be .203 inch; the extruded length of the rivet, after insertion should be 5/32 inch.

For 3/16-inch diameter rivet: The formed head thickness should be .078 inch; the diameter of the formed head should be .234 inch; the extruded length of the rivet, after insertion, should be 3/16 inch. (See figure 4.)

12. Countersunk 78-Degree Rivet (673-D).

For 1/8-inch diameter rivet: The formed head thickness should be .064 inch; the diameter of the formed head should be .188 inch; the extruded length of the rivet, after insertion, should be 3/16 inch; the protrusion due to the press countersinking of the metal sheets should be 1/32 inch.

For 5/32-inch diameter rivet: The formed head thickness should be .063 inch; the diameter of the formed head should be .234 inch; the extruded length of the rivet, after insertion, should be 3/16 inch; the protrusion due to the press countersinking of the metal sheets should be 3/64 inch.

For 3/16-inch diameter rivet: The formed head thickness should be .078 inch; the diameter of the formed head should be .281 inch; the extruded length of the rivet, after insertion, should be 3/16 inch; the protrusion due to the press countersinking of the metal sheets should be 1/16 inch. (See figure 4.)

13. Countersunk 100-Degree Rivet (AN426).

For 1/8-inch diameter rivet: The formed head thickness should be .063 inch; the diameter of the formed head should be .188 inch; the extruded length of the rivet, after insertion, should be 3/16 inch.

For 5/32-inch diameter rivet: The formed head thickness should be .078 inch; the diameter of the formed head should be .234 inch; the extruded length of the rivet, after insertion, should be 15/64 inch.

For 3/16-inch diameter rivet: The formed head thickness should be .094 inch; the diameter of the formed head should be .281 inch; the extruded length of the rivet, after insertion, should be 9/32 inch.

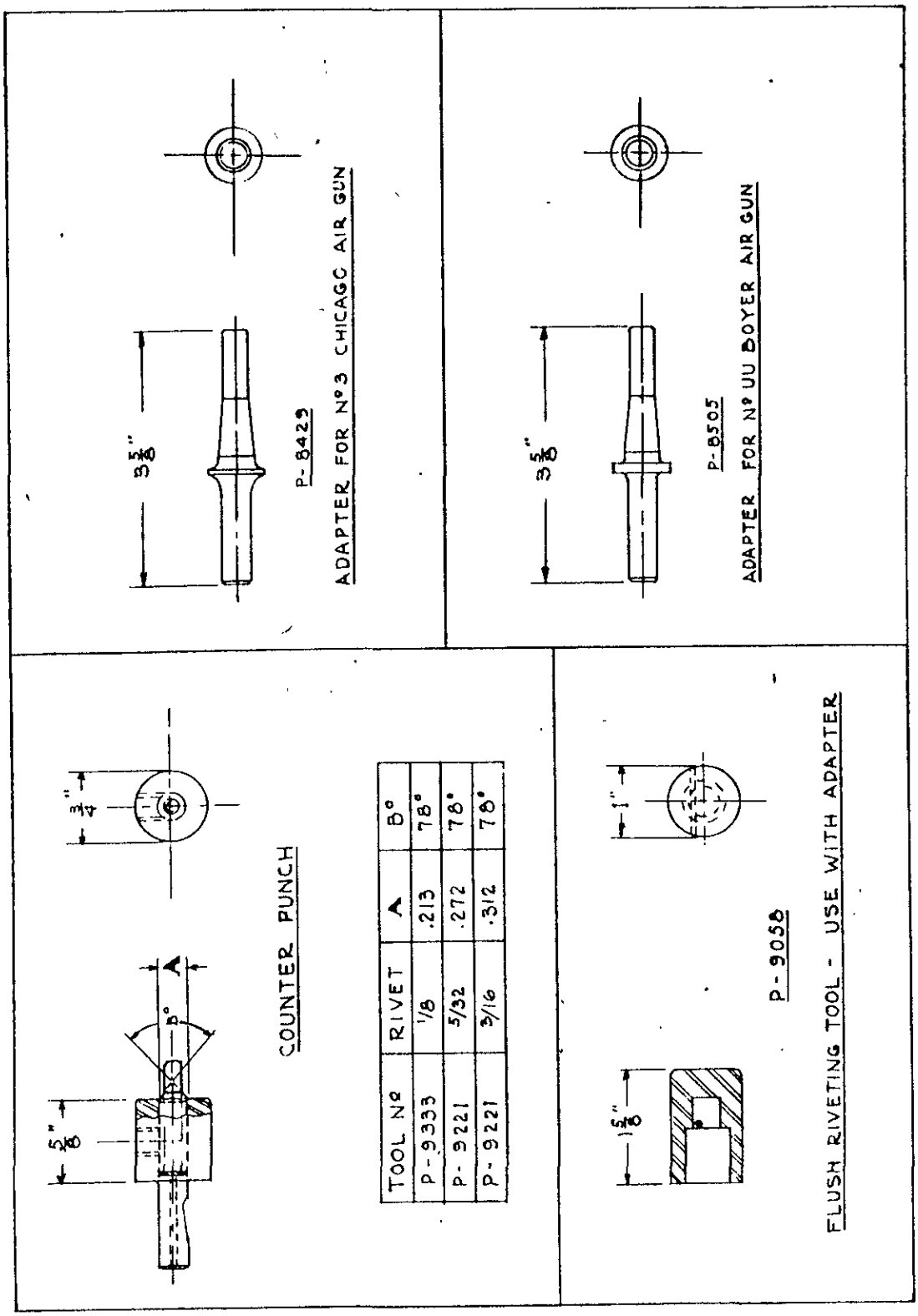
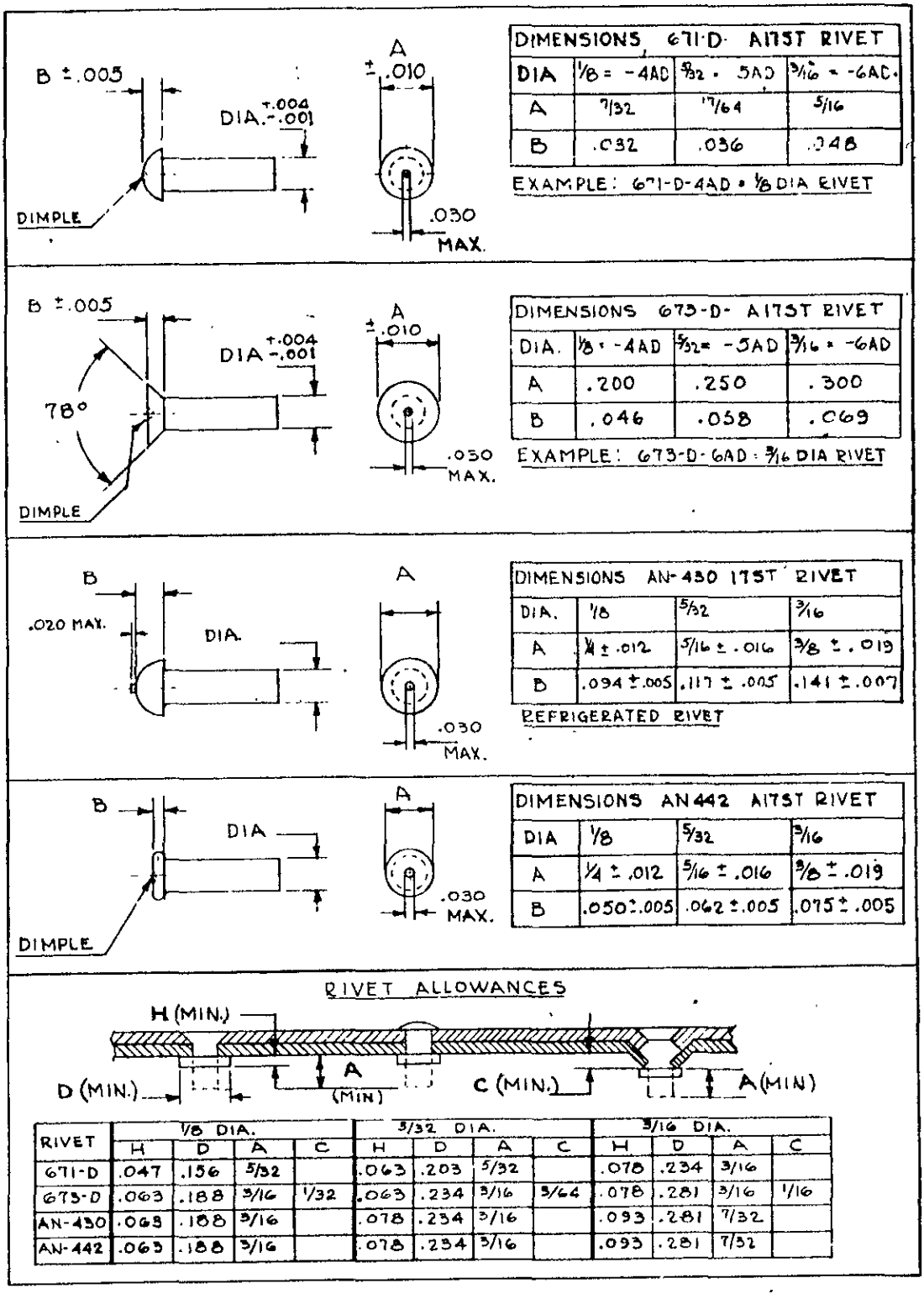


Figure 3 - Flush Riveting Tools



DIMENSIONS 671-D AI7ST RIVET

DIA	1/8 = -4AD	5/32 = -5AD	3/16 = -6AD
A	7/32	17/64	5/16
B	.032	.036	.048

EXAMPLE: 671-D-4AD = 1/8 DIA RIVET

DIMENSIONS 673-D- AI7ST RIVET

DIA.	1/8 = -4AD	5/32 = -5AD	3/16 = -6AD
A	.200	.250	.300
B	.046	.058	.069

EXAMPLE: 673-D-6AD = 3/16 DIA RIVET

DIMENSIONS AN-430 I7ST RIVET

DIA.	1/8	5/32	3/16
A	1/4 ± .012	5/16 ± .016	3/8 ± .019
B	.094 ± .005	.117 ± .005	.141 ± .007

REFRIGERATED RIVET

DIMENSIONS AN442 AI7ST RIVET

DIA	1/8	5/32	3/16
A	1/4 ± .012	5/16 ± .016	3/8 ± .019
B	.050 ± .005	.062 ± .005	.075 ± .005

RIVET ALLOWANCES

RIVET	1/8 DIA.				5/32 DIA.				3/16 DIA.			
	H	D	A	C	H	D	A	C	H	D	A	C
671-D	.047	.156	5/32		.063	.203	5/32		.078	.234	3/16	
673-D	.063	.188	3/16	1/32	.063	.234	3/16	3/64	.078	.281	3/16	1/16
AN-430	.063	.188	3/16		.078	.234	3/16		.093	.281	7/32	
AN-442	.063	.188	3/16		.078	.234	3/16		.093	.281	7/32	

Figure 4 - Rivet Reference Chart

14. Round-head Rivet (AN430).

For 1/8-inch diameter rivet: The formed head thickness should be .063 inch; the diameter of the formed head should be .188 inch; the extruded length of the rivet, after insertion, should be 3/16 inch.

For 5/32-inch diameter rivet: The formed head thickness should be .078 inch; the diameter of the formed head should be .234 inch; the extruded length of the rivet, after insertion, should be 3/16 inch.

For 3/16-inch diameter rivet: The formed head thickness should be .093 inch; the diameter of the formed head should be .281 inch; the extruded length of the rivet after insertion, should be 7/32 inch. (See figure 4.)

15. Flathead Rivet (AN442).

Same allowance as used for round-head rivet (AN430). (See this section, paragraph 14., figure 4.)

16. Rivet Clearance.

For minimum clearances for rivet holes use the proper drill size. For example, on a 1/16-inch rivet size use a No. 52 (.0635 inch); 3/32-inch rivet use No. 41 (.096 inch); 1/8-inch rivet size use No. 30 (.1285 inch); 5/32-inch rivet use No. 22 (.157 inch); 3/16-inch rivet size use No. 12 (.189 inch); 1/4-inch rivet size use 1/4 size drill, etc. When aligning holes of different parts, it is essential that they be dimensioned by the same method and from a corresponding datum point.

17. Operation of Cherry Blind Riveter.

The method of operating the Cherry blind riveter is given in A.P. 1464/D.76. Read note given in section VI, paragraph 3.a.(2).

18. Fitting Bolts.

No steel bolts smaller than 3/16 inch shall be used. No commercial machine screws or bolts shall be substituted for aircraft bolts. The condition, to be obtained with standard bolts employing washers under the nuts where necessary, is that the threaded portion of a bolt must not be used to take a shear load. When replacing a bolt, the plain portion of the shank of the new bolt must be identical in length with that of the old bolt. All bolts must be suitably locked. Wherever lock wire is used, the wire must fit the hole. Care must be taken to ensure that the nuts are locked in the same manner as the original.

19. Enlarged Holes.

Enlarged or elongated rivet holes should be drilled for the next larger diameter rivet. Slightly elongated holes can in some cases be filled by using a longer rivet of the original diameter. Elongated holes in fittings or extrusions must not be redrilled because of the limited edge distances provided in manufacture.

20. Detecting the Presence of Cracks.

When effecting repairs, great care must be exercised at all times to ensure that no cracks in the immediate structure remain undetected. Fine hair-size cracks in fractured sheets if undetected will open and spread under vibration. Minute cracks caused by bullet impacts should be cut away when cleaning up fractured areas for repair. However, if any doubt exists as to the presence of a crack, the part or area should be soaked in paraffin and thoroughly dried. The application of a whiting water or whiting methylated spirit paste to the surface will on drying disclose the presence of a crack by a discolored mark.

21. Marking-Off.

When making up new part replacements of important members or fittings, care must be taken that the correct dimensions given on the drawing be marked off with crayon or soft marking pencil on the surface plate. Prevent heavy marking of the material, as deep markings or scratches may seriously weaken the material and may develop into fine hair-like cracks.

22. Prevention of Corrosion.

All damaged surfaces should be immediately coated to prevent corrosion. Examine the metal under cracked or blistered paint. Use particular care in repairing internal structure which cannot be periodically inspected for corrosion.

With the exception of Alclad aluminum, aluminum-covered sheets, all aluminum-alloy parts are anodically treated. Steel parts, other than those made of noncorrodible sheet or stainless steel are cadmium plated. However, in addition to these primary protective treatments, one coat of zinc chromate primer and one coat of aluminized zinc chromate primer before assembly are applied to everything except the conduit system. The elevators, ailerons, and rudder are coated with dope-resisting paint and all parts which are liable to come in contact with acid are given two coats of acid-resisting paint. Open-ended tubular and hollow parts are given a coat of primer either by filling or dipping. Closed or sealed metal tubular and hollow parts are coated with raw linseed oil forced into the parts by pressure.

All cuts, files, or badly scratched surfaces can be treated with a zinc chromate paste, type II. Also when insulating dissimilar metals, insulate parts with a thin layer approximately 1/32 inch thick of zinc chromate paste, type II. Excess should be squeezed out before riveting, or on tightening the assembled parts. Form a small fillet at the edges of the joint unless this fillet is exposed to the air stream.

For tail surfaces, a quick drying, clear cellulose nitrate dope may be used for emergency patches on fabric-covered airfoils. This dope is applied in the same manner as semipigmented dope, but in drying

imparts more tension to the fabric and thus requires a lesser number of coats. Cover with a semipigmented dope as soon as practicable to match surrounding finish. However, patches applied with this material are to be used in emergency only. Semipigmented dope should be used when initial time saving is not essential.

23. Treatment of Parts.

a. Re-used Steel Parts. - Steel parts which are removed and are to be re-used should be treated as follows:

(1) Remove all paint, grease, and oil by immersing in 20 percent sodium hydroxide (NaOH) 80 percent water solution. This may be performed at room temperature, or in a warm solution (faster), and in general should not require much more than 10 to 15 minutes.

(2) Remove cadmium, rust and corrosion with a 60 percent hydrochloric acid (muriatic) 40 percent water solution. This must be watched to prevent overpickling. In many cases a single momentary dip will suffice.

(3) Replace with .0005-inch minimum thickness, using standard cadmium plating practice.

(4) Cadmium plated parts (and also unplated parts), which require painting shall be chromic acid dipped for 2 to 5 minutes in a water solution at room temperature, containing 3 to 5 percent chromic acid, rinsed and dried.

(5) Paint.

b. New Steel Parts. - New steel parts should be treated as follows:

(1) Clean with any approved alkali cleaner either in hot or cold solution and rinse in water.

(2) Pickling to prepare for plating may proceed in a 25 percent hydrochloric (muriatic) acid bath for 5 to 10 minutes. Steel springs shall never receive more than a momentary dip.

(3) Plate with .005-inch minimum thickness, using standard cadmium plating practices.

(4) Cadmium plated parts (and also unplated parts) which require painting, shall be chromic acid dipped for 2 to 5 minutes in a water solution, at room temperature, containing 3 to 5 percent chromic acid, rinsed and dried.

(5) Paint.

c. Aluminum-Alloy Parts. - Aluminum-alloy parts should be treated as follows:

(1) Remove paint, grease, and oil by dipping in a suitable approved inhibited mild alkali cleaner, and rinse in fresh water. Cleaning may be aided by hand scrubbing. Parts excessively oily or greasy may be given a standard degrease before this alkali cleaning.

(2) Dip for 2 to 5 minutes in a water solution, at room temperature, containing 3 to 5 percent chromic acid, rinse and dry. After this treatment, and before painting, parts should be handled as little as possible.

(3) Paint.

d. Magnesium-Alloy Parts. - Magnesium-alloy parts should be treated as follows:

(1) Rough sand castings or other parts which are excessively dirty or which contain imbedded bold sand etc., may be cleaned by dipping for 5 minutes in a 15 to 20 percent hydrofluoric acid (HF) 80 percent water solution. A satisfactory bath can be prepared by diluting one volume of technical grade 48 to 52 percent (HF) with two volumes of water. Wash thoroughly in cold water.

(2) Boil casting for 45 minutes in a water solution containing 10 percent by weight of sodium dichromate ($Na_2Cr_2O_7$). This solution can be readily prepared by dissolving technical sodium dichromate in water in the ratio of 3/4 pound per gallon.

(3) Depletion of the 10 percent sodium dichromate solution will be indicated by nonuniformity of coating. It can be crudely revivified by adding 1.3 percent or less of chromic acid. More positive control can be accomplished by adding sufficient chromic acid to bring the pH value of the bath to 4.2.

(4) Dry in an oven and paint immediately.

SPECIFICATIONS OF MATERIALS USED FOR REPAIR

*Superseded specification
**Current specification

MATERIAL	SPECIFICATIONS	RECEIVED PHYSICAL COND. AND TENSILE STRENGTHS	REMARKS
ALUMINUM Sheet 2S 1/2 H	QQ-A-561 ** 57-151-1 *	Half Hard (AN) 16,000 lb/sq in.	For general use in forming operations.
Tubing 2S 1/2 H	WW-T-783 ** 57-186-1 *	Half Hard (AN) 16,000 lb/sq in.	For electrical conduit and tube attached by welding such as filler necks.
ALUMINUM ALLOY Bars & Rods 17ST	QQ-A-351 (T) ** 57-152-4 (T) *	Heat Treated (AN) 55,000 lb/sq in.	Used for stressed fittings, bolts, screws and other lightweight stressed parts.
Bars & Rods, Extruded Shapes 24ST	QQ-A-354 (T) ** 57-152-5 (T) *	Heat Treated (AN) 62,000 lb/sq in. Bar & Rod (AN) 57,000 lb/sq in. Ext.	Used for highest stressed aluminum-alloy structural fittings. Readily machined. Extrusion used for stringers.
Extruded Shapes - 24SO	QQ-A-354 (T) ** 57-152-5 (A) *	Annealed (AN) 35,000 lb/sq in. As H.T. (AN) 57,000 lb/sq in.	Use only where necessary because of extreme bends not possible with 24ST.
Bars, Rods, Shapes & Wires 53ST	QQ-A-331 (T)	Heat Treated (AN) 32,000 lb/sq in.	May be welded.
Forgings 14ST	QQ-A-367-GR.5 ** 57-153-GR.5 *	Heat Treated (AN) 65,000 lb/sq in.	Used wherever possible to take advantage of superior strength. For structural fittings and other forgings where maximum tensile strength, yield strength, and hardness are desired.
Forgings A51ST	QQ-A-367-GR.3 ** 57-153-GR.3 *	Heat Treated (AN) 44,000 lb/sq in.	Aircraft engine parts, etc. Good alumiliting characteristics. Used for lightly stressed forging requirements.
Casting, Sand Alcoa 43	AN-QQ-A-405 ** 57-72-GR.1 * 11311	As Cast (AN) 17,000 lb/sq in.	For welded tank fittings and low strength parts. Has good welding and corrosion-resistant properties. Capable of withstanding high fluid pressures.
Sheet 3S 1/2 H	QQ-A-359	Half Hard (AN) 19,500 lb/sq in.	For general use in forming operations. Harder and stronger than aluminum. Equal corrosion resistance. Forming properties slightly inferior. Good welding properties, suitable for tanks, junction boxes, etc.
Sheet 24SO	QQ-A-355 (A) ** 57-152-6 (1) *	Annealed (AN)35,000 lb/sq in. Max As H.T. (AN) 62,000 lb/sq in.	24SO material must be heat-treated. For structural parts requiring forming. May be resistant welded. Do not torch weld.
Sheet 24ST	QQ-A-355 (T) ** 57-152-6 (11) *	Heat Treated (AN) 62,000 lb/sq in.	For structural parts not formed too greatly. May be resistant welded. Do not torch weld.
Sheet - Alclad 24SO	QQ-A-362 (A) ** 11067 (1) *	Annealed (AN) 32,00 lb/sq in. Max As H.T. (AN) 56,000 lb/sq in.	For structural parts that require forming more severe than that possible with 24ST Alclad. 24SO material must be heat treated. Pure aluminum coating on both sides gives maximum resistance to corrosion. Do not torch weld.
Tubing 24ST	10235 Cond. B	Heat Treated (AN) 62,000 lb/sq in.	Anneal and heat treat if necessary for severe forming. For structural applications. Do not weld.
Tubing 52SO	WW-T-787 ** 57-187-3 * Temp. A	Annealed (AN) 32,000 lb/sq in. Max	For nonstructural parts; fuel, oil, instrument, hydraulic vacuum, and other lines. Do not torch weld when wall thicknesses are in excess of 1/8 inch. Do not anneal after forming.
BRASS Bar & Rod - Leaded Brass	QQ-B-611	Half Hard (AN) None Required	Free cutting material for machined parts, knobs, bushings, leaded bearings, etc.

SPECIFICATIONS OF MATERIALS USED FOR REPAIR

*Superseded specification
**Current specification

MATERIAL	SPECIFICATIONS	RECEIVED PHYSICAL COND. AND TENSILE STRENGTHS	REMARKS
Sheet and Strip - Low Brass	57-160	Annealed (AN) 40,000 lb/sq in.	For use on radiator plates and shells only.
Tubing, Seamless	WW-T-791	Semiannealed (AN) None Required	Used for spacers, bushings, and tubing that requires strength and corrosion resistance.
BRONZE Casting - Gun Metal Type I, Comp. G	QQ-B-691	As Cast (AN) 40,000 lb/sq in.	High tensile structural bronze. Used for special fittings, nuts, bushings, bearings, etc., where a combination of strength casting properties and corrosion resistance is necessary.
COPPER Tubing, Seamless	WW-T-799	Annealed (AN) None Required	For fuel, water, oil, and air lines, in connection with solder or flared-type fittings.
Tube, Cu - Si - Bronze	57-192-1	Soft Annealed (AN) 50,000 lb/sq in.	Used for oil, water, fuel, and air lines.
CLOTH Cotton - Grade A	AN-CCC-C-399	80 lb breaking strength	For covering wings, fuselage, control surfaces, etc.
RUBBER PRODUCTS Hose - Synthetic rubber	20-103	----------	Used in fuel, oil, and coolant liquid lines in engine installations.
STEEL Carbon, low SAE 1112	None	Annealed 75,000 lb/sq in. As case Hardened 150,000 lb/sq in.	For machined parts carrying no load. Excellent machinability. Unsafe for vital parts.
Chrome - Moly SAE X-4140	AN-QQ-S-752	Annealed (AN) 55,000 lb/sq in. to 65,000 lb/sq in. As H.T. (AN) 125,000 lb/sq in.	Used for all steel forgings and fittings where bar stock is required. Can be welded. Heat treats well and can be used for forgings with wide thickness variations.
Nickel Carbon, Medium SAE 2330	57-107-17	Annealed (AN) 65,000 lb/sq in. As H.T. (AN) 125,000 lb/sq in.	For bolts and threaded parts, fittings, bomb rack parts. Do not weld. Not for carburizing.
Chrome - Moly, Medium Carbon SAE 4130	57-136-8	Normalized (AN) 90,000 lb/sq in. As H.T. (AN) 150,000 lb/sq in.	Used for all stressed steel fittings and parts such as gussets, straps, plates, clamps, etc. Easily welded.
Corrosion Resisting, stainless, chrome-nickel	AN-QQ-S-772** 11068 GR.A * 1/2 H	Half Hard (AN) 150,000 lb/sq in.	Is slightly magnetic. For structural parts where only slight forming is necessary. For fire walls and armament spot welded parts. Do not torch weld. Not to be heat-treated.
Chrome - Moly (Round) Medium Carbon X-4130	AN-WW-T-850** 57-180-2 *	Normalized (AN) 95,000 lb/sq in. As H.T. (AN) 125,000 to 180,000 lb/sq in.	For all structural steel tubing parts Easily welded and heat-treated.
Sheet and Strip Carbon, Low SAE 1010	Commercial	Annealed 45,000 lb/sq in.	Extra soft low carbon for deep drawing and nonstructural parts. May be gas, arc, or spot welded.
TAPE Surface Tape, Cotton Pinked	6-62	----------	Used on airfoil coverings over ribs, leading edges, trailing edges, etc.

SECTION II

ENGINE MOUNT

1. General.

a. Primary Structure. - The primary structure of the engine mount is constructed of X-4130 chrome-molybdenum steel tubes which have been heat-treated to a high tensile strength. The upper tube assemblies and the horizontal bearer tubes are heat-treated to 150,000 pounds per square inch tensile strength. The upper tube assemblies have steel fittings welded at the ends to form the joints. The horizontal bearer tubes have bolted fittings which facilitate their replacement. The lower diagonal tubes are X-4130 steel tubes heat-treated to 95,000 pounds per square inch tensile strength with fittings bolted to the tubes to permit quick disassembly. The engine mount truss and sway brace link assemblies are aluminum-alloy 14ST forgings which are heat-treated to 65,000 pounds per square inch tensile strength.

b. Nature of Design. - The engine mount was originally designed for extremely accurate jigging and close hole tolerances in order to eliminate vibration. The design of the engine mount is of such a nature that it may be easily disassembled into small units and subassemblies for quick replacements. Figures 5 and 6 show the complete disassembly of the engine mounts and call out the subassemblies in order to assist in quick identification of parts.

CAUTION: Do not, under any circumstances, apply torch heat to the engine mount tubes as the heat impairs the tensile strength of the material. When heat is required for a replacement, the assembly must be reheat-treated to the original tensile strength specified for the member. (See this section, paragraph 1.a.)

c. Replacement of Damaged Parts. - Any damage to the engine mount, however slight, necessitates replacement of the damaged member. All center line of holes must be within 1/32 inch of the center line of the forgings and tubular members. See the Engine Mount Charts and figures 5 and 6 for replacement of parts.

2. Engine Mount Bushings.

Bushed holes of the engine mount make it possible to maintain the desired tolerance and close fits. However, when replacing a subassembly of the engine mount, replace bushings, only when absolutely necessary. Because of the close hole tolerances, it is improbable that any appreciable wear will develop in the bushings.

3. Elongated Holes.

If any bushed hole is slightly elongated or damaged replace the bushing and bolt according to the Engine Mount Material Chart.

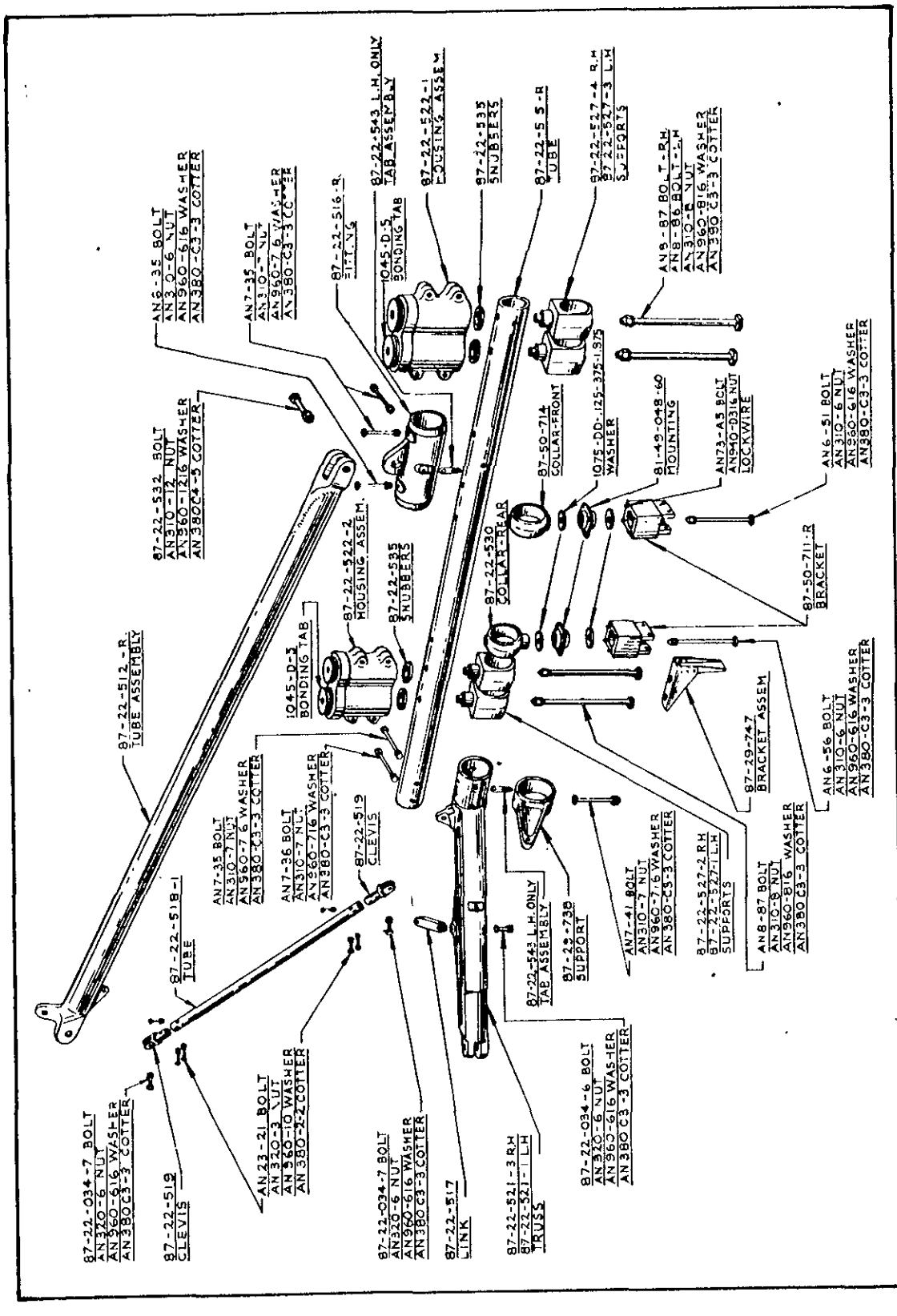


Figure 5 - Engine Mount Disassembly P-40D, P-40E, P-40E-1

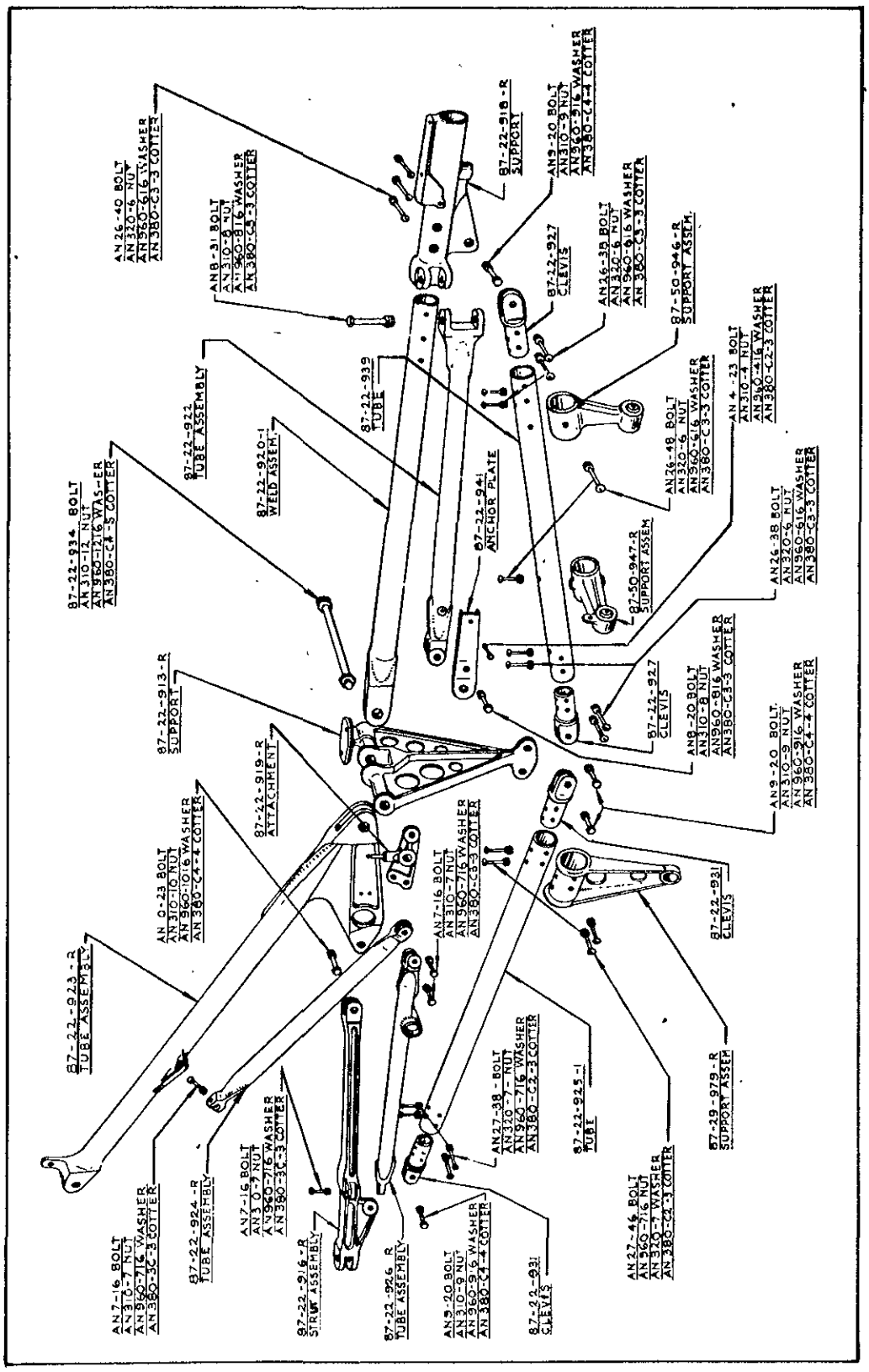


Figure 6 - Engine Mount Disassembly P-40F

ENGINE MOUNT (87-22-501) MATERIAL CHART FOR ALLISON V-1710-F3R

PART NO.	MATERIAL		SIZE	REMARKS
	SPEC NO.	TITLE		
87-22-531 L/R		Horizontal Bearer Tube Assembly		46-5/8 in. long
87-22-515	X-4130 Steel	Tube	Stock - 2.525 in. OD x 2.046 in. ID	Coarse thread
AN73-A5	Steel	Bolt	5/8 in. long; shank 1/8 in.	
AN7-35	Steel	Bolt	3-5/8 in. long; shank 3-1/16 in.	
AN6-51	Steel	Bolt	5-1/8 in. long; shank 4-9/16 in.	
87-22-530	Al. Al. 14ST	Collar - Oil cooler and prestone radiator support	Bore - 2.501 in. +.002 −.000	
87-22-516	4340 Steel	Fitting	ID 2.502 in. +.002 −.000	Forging
87-29-738	Al. Al. 14ST	Support - Cowling to engine mount		Forging
87-22-512 L/R		Upper Bearer Tube Assembly		Forging
87-22-513	4140 Steel	Fitting		Forging
87-22-514	4140 Steel	Fitting	ID .375 in.; OD .5015 in.	.374 in. long
1001D-6-.374	4140 Steel	Bushing	ID .75 in.; OD .8765 in.	.525 in. long
1001D-12-.525	X-4130	Bushing	2-1/2 in. OD x .095 in. x 56-1/2 in.	Weld fittings at ends
87-22-512-1		Tube		
87-22-521		Truss - Engine mount lower		Forging
87-22-520	Al. Al. 14ST	Truss	Dia. 5/16 in.; 1-1/4 in. long	Coarse thread
626-D-5/16-1 1/4	2330 Steel	Stud	Dia. 5/16 in.; 1-3/8 in. long	Coarse thread
626-D-5/16-1 3/8	2330 Steel	Stud	ID .375 in.; OD .5015 in.	.370 in. long
1001-D-6-.370	4140 Steel	Bushing	ID .375 in.; OD .5015 in.	.495 in. long
1001-D-6-.495	4140 Steel	Bushing	ID .750 in.; OD .8765 in.	.625 in. long
1001-D-12-.625	4140 Steel	Bushing		
87-22-518		Tube Assembly - Lower diagonal		
87-22-518-1	X-4130 Steel	Tube	1 in. OD x .065 in. x 20-3/4	
AN23-21	Spec 29-59	Bolt	1-5/16 in. long; shank 1 in.	
AN320-3	Steel	Nut	No. 10-32	
AN960-10	1010 Steel	Washer	13/64 in. ID; 7/16 in. OD	1/16 in. thick
AN-380-2-2	Spec (42P7D)	Cotter	1/2 in. long; 1/16 in. dia.	
87-22-519	Al. Al. 24ST	Clevis	1-1/8 in. dia. x 3-3/16 in. Bar	
87-22-519-2	4140 Steel	Bushing - Clevis	.375 in. ID; .5015 in. OD	1001-D-6-.187
87-22-517	Al. Al. 14ST	Link - Lower truss to fire wall	11.019 in. ±.003 long	
1001-D-6-.250	4140 Steel	Bushing	.375 in. ID; .5015 in. OD	.250 in. long
AN960-816	1010 Steel	Washer	33/64 in. ID; 7/8 in. OD	1/16 in. thick
AN320-6	Steel	Nut	3/8 in. dia. of tap x 24 thd	
AN310-12	Steel	Nut	3/4 in. dia. of tap x 16 thd	
AN310-8	Steel	Nut	1/2 in. dia. of tap x 20 thd	
AN8-87	Steel	Bolt	Shank dia. .499 +.0000 −.0035	8-7/8 in. long
AN8-86	Steel	Bolt	Shank dia. .499 +.0000 −.0035	8-3/4 in. long
87-22-034-7	2330 Steel	Bolt	9/16 in. hex x 1-17/32 in.	
87-22-034-6	2330 Steel	Bolt	9/16 in. hex x 1-25/32 in.	
87-22-535	No. 14 Fabreeka	Snubber	1-5/16 in. ID; 1-7/8 in. OD	.234 in. ± .004 thick
87-22-534	No. 14 Fabreeka	Snubber	1-1/2 in ID; 1-15/16 in. OD	.234 in. ± .004 thick
87-22-533-2	4140 Steel	Stop	Ream .500 in.; 2-3/8 in. dia.	
87-22-533-1	4140 Steel	Stop	2-3/8 in. dia. x 1-1/8 in. Bar	
87-22-542-1	4140 Steel	Stop	Ream .500 in.; 2-3/8 in. dia.	
87-22-532	2330 Steel	Bolt	1-1/16 in. hex x 3-3/8 in.	3/4 in. dia.- special

ENGINE MOUNT (87-22-901) MATERIAL CHART FOR ROLLS ROYCE MERLIN XX V-1650-1

PART NO.	MATERIAL		SIZE	REMARKS
	SPEC NO.	TITLE		
87-22-913		Support - Engine mount - rear		
87-22-912	X-4340 Steel	Support		Forging
1001-D-9-.620	4140 Steel	Bushing	ID .5625 in.; OD .6890 in.	.620 in. long
87-22-916		Strut Assembly - Engine mount bearer tube to fire wall		
87-22-915	X-4340 Steel	Strut		Forging
1001-D-10-.406	4140 Steel	Bushing	ID .6250 in.; OD .7515 in.	.406 in. long
1001-D-7-.250	4140 Steel	Bushing	ID .4375 in.; OD .5640 in.	.250 in. long
1001-D-9-.620	4140 Steel	Bushing	ID .5625 in.; OD .6890 in.	.620 in. long
1001-D-12-.468	4140 Steel	Bushing	ID .7500 in.; OD .8765 in.	.468 in. long
625-D-1/4-7/8A	2330 Steel	Stud	Dia. 1/4 in.; 7/8 in. long	Fine thread
87-22-919	4340 Steel	Attachment - Engine mount side tubes		Forging
1001-D-7-.495	4140 Steel	Bushing	ID .4375 in.; OD .5640 in.	.495 in. long
1001-D-8-.495	4140 Steel	Bushing	ID .5000 in.; OD .6265 in.	.495 in. long
1001-D-12-.812	4140 Steel	Bushing	ID .7500 in.; OD .8765 in.	.812 in. long
625-D-3/8-1	2330 Steel	Stud	Dia. 3/8 in.; 1 in. long	Fine thread
87-22-920-2	X-4130 Steel	Tube Assembly - Engine bearer	1-3/4 in. OD x .120 in. x 29-1/4in.	
87-22-928	X-4140 Steel	Fitting		Forging
87-22-918	X-4340 Steel	Support		Forging
1001-D-9-.620	4140 Steel	Bushing	ID .5625 in.; OD .6890 in.	.620 in. long
1001-D-8-1.745	4140 Steel	Bushing	ID .5000 in.; OD .6265 in.	1.745 in. long
625-D-1/4-1 3/4	2330 Steel	Stud	Dia. 1/4 in.; 1-3/4 in. long	Fine thread
AN26-40	Steel	Bolt	Shank dia. .373 +.000 -.002	2-1/2 in. long
AN320-6	Steel	Nut	3/8 in. dia. of tap x 24 thd	
AN380-C3-3	Spec No. (42P7D)	Cotter	3/4 in. long; 3/32 in. dia.	
AN960-616	1010 Steel	Washer	25-64 in. ID; 5/8 in. OD	1/16 in. thick
1001-D-12-.620	4140 Steel	Bushing	ID .7500 in.; OD .8765 in.	.620 in. long
87-22-940		Tube Assembly - Engine mount forward lower		
87-22-927	X-4140 Steel	Clevis	2 in. dia. x 5-1/8 in. bar	
1001-D-9-.312	4140 Steel	Bushing	ID .5625 in.; ID .6890 in.	.312 in. long
87-22-939	X-4130 Steel	Tube	2 in. OD x .120 in. x 24-29/32 in.	24-29/32in. long
87-50-946 H-3004	Al. Al. 14ST	Support Rubber Mounting		Forging Lord Mfg Co.
87-50-947 H-3004	Al. Al. 14ST	Support Rubber Mounting		Forging Lord Mfg Co.
AN320-6	Steel	Nut	3/8 in. dia. of tap x 24 thd	
AN27-38	Steel	Clevis Bolt	Shank dia. .436 +.000 -.002	2-3/8 in. long
AN26-48	Steel	Clevis Bolt	Shank dia. .373 +.000 -.002	2-1/2 in. long
AN320-7	Steel	Nut	7/16 in. dia. of tap x 20 thd	
AN960-716	1010 Steel	Washer	25/64 in. ID; 3/4 in. OD	1/16 in. thick
87-22-942	Steel Sheet	Tab	.063 in. x 3/4 in. x 2-3/16 in.	
AN380-C3-3	Spec No. (42P7D)	Cotter	3/4 in long; 3/32 in. dia.	
87-22-922	X-4130 Steel	Tube Assembly - Engine mount forward side	1/2 in. OD x .065 in. wall x 21-1/4 in.	
87-22-922-4	X-4140 Steel	Spacer	1/2 in. dia. x 2 in.	
87-22-929	4140 Steel	Fitting		Forging
87-22-930	4140 Steel	Fitting		Forging
1001-D-8-.312	4140 Steel	Bushing	ID .5000 in.; OD .6265 in.	.312 in. long
87-22-923-2	X-4130 Steel	Tube Assembly - Engine mount upper rear	2-1/4 in. OD x .120 in x 40 in.	
87-22-914	4140 Steel	Fitting		Forging
87-22-917	4140 Steel	Fitting		Forging
87-22-933	X-4140 Steel	Lug		Forging
87-22-923-4	X-4130 Steel	Spacer	1/2 in. dia. x 2.75 in.	
1001-D-7-.495	4140 Steel	Bushing	ID .4375 in.; OD .5640 in.	.495 in. long
1001-D-10-.745	4140 Steel	Bushing	ID .6250 in.; OD .7515 in.	.745 in. long
1001-D-12-.437	4140 Steel	Bushing	ID .7500 in.; OD .8765 in	.437 in. long
1001-D-12-.500	4140 Steel	Bushing	ID .7500 in.; OD .8765 in.	.500 in. long

ENGINE MOUNT (87-22-901) MATERIAL CHART FOR ROLLS ROYCE MERLIN XX V-1650-1 Contd

PART NO.	MATERIAL		SIZE	REMARKS
	SPEC NO.	TITLE		
87-22-924-2	X-4130 Steel	Tube Assembly - Engine mount upper side	1-1/2 in. OD x .065 in. wall x 22-3/4 in.	
87-22-929	4140 Steel	Fitting		Forging
1001-D-7-.312	4140 Steel	Bushing	ID .4375 in.; OD .5640 in.	.312 in. long
87-22-925	X-4130 Steel	Tube Assembly - Engine mount lower rear	2 in. OD x .065 in.wall x 31-3/16 in.	
87-22-931	X-4140 Steel	Clevis	2 in. dia. x 5-1/8 in. bar	
1001-D-9-.312	4140 Steel	Bushing	ID .5625 in.; OD .6890 in.	.312 in. long
87-29-279	Al. Al. A51ST	Support		Forging
87-29-821	Bronze	Bushing	ID 1.186 in.; OD 1.376 in. x .875 in.	Flanged end
1637		Lubrication Fitting		Alemite
AN27-38	Steel	Bolt	Shank dia. .373 in. +.000 -.002	2-3/8 in. long
AN27-46	Steel	Bolt	Shank dia. .373 in. +.000 -.002	2.7/8 in. long
AN320-7	Steel	Nut	7/16 in. dia. of tap x 20 thd	
AN380-C2-3	Spec No.(42P7D)	Cotter	1/2 in. long; 3/32 in. dia.	
AN960-716	1010 Steel	Washer	25/64 in. ID; 3/4 in. OD	1/16 in. thick
AN27-48	Steel	Bolt	Shank dia. .436 in. +.000 -.002	3 in. long
87-22-926-2	X-4130 Steel	Tube Assembly - Engine mount lower side	1-1/2 in. OD x .065 in. wall x 26-1/4 in.	
87-22-929	4140 Steel	Fitting		Forging
87-22-932	4140 Steel	Fitting		Forging
1001-D-7-.312	4140 Steel	Bushing	ID .4375 in.; OD .5640 in.	.312 in. long
1001-D-7-.620	4140 Steel	Bushing	ID .4375 in.; OD .5640 in.	.620 in. long
87-22-926-3	X-4130 Steel	Tube	1-3/4 in. OD x .250 in. wall x 2 in.	
87-22-926-4	X-4130 Steel	Gusset	.156 in. x 1 3/16 in. x 4-3/4 in.	
87-43-912	Bronze	Bushing	1-1/2 in. dia. x 5/8 in.bar	
AN4-23	Steel	Bolt	Shank dia. .249 in. +.000 -.003	2-3/8 in. long
AN7-16	Steel	Bolt	Shank dia. .436 in. +.0000 -.0035	1-3/4 in. long
AN8-20	Steel	Bolt	Shank dia. .499 in. +.0000 -.0035	2 in. long
AN8-31	Steel	Bolt	Shank dia. .499 in. +.0000 -.0035	3-1/8 in. long
AN9-20	Steel	Bolt	Shank dia. .5615 in. +.000 -.004	2 in. long
AN10-23	Steel	Bolt	Shank dia. .624 in. +.000 -.004	2-3/8 in. long
AN310-4	Steel	Nut	1/4 in. dia. of tap x 28 thd	
AN310-7	Steel	Nut	7/16 in. dia. of tap x 20 thd	
AN310-8	Steel	Nut	1/2 in. dia. of tap x 20 thd	
AN310-9	Steel	Nut	9/16 in. dia. of tap x 18 thd	
AN310-10	Steel	Nut	5/8 in. dia. of tap x 18 thd	
AN310-12	Steel	Nut	3/4 in. dia. of tap x 16 thd	
AN380-C2-3	Spec No.(42P7D)	Cotter	3/4 in. long; 1/16 in. dia.	
AN380-C3-3	Spec No.(42P7D)	Cotter	3/4 in. long; 3/32 in. dia.	
AN380-C4-4	Spec No.(42P7D)	Cotter	1 in. long; 1/8 in. dia.	
AN380-C4-5	Spec No.(42P7D)	Cotter	1-1/4 in. long; 1/8 in. dia.	
AN960-416	1010 Steel	Washer	17/64 in. ID; 1/2 in.OD	1/16 in. thick
AN960-716	1010 Steel	Washer	25/64 in. ID; 3/4 in. OD	1/16 in. thick
AN960-816	1010 Steel	Washer	33/64 in. ID; 7/8 in. OD	1/16 in. thick
AN960-916	1010 Steel	Washer	37/64 in. ID; 1-1/16 in. OD	1/16 in. thick
AN960-1016	1010 Steel	Washer	41/64 in. ID; 1-3/16 in. OD	1/16 in. thick
AN960-1216	1010 Steel	Washer	49/64 in. ID; 1-5/16 in. OD	3/32 in. thick
87-22-934	2330 Steel Bar	Bolt - Engine mount special	1-1/8 in. hex x 11-1/8 in. shank	
87-22-941	4130 Steel Sheet	Anchor Plate - Motor mount	1/8 in. x 2-1/2 in. x 6-7/8 in.	
87-66-854	Phosphor Bronze	Tab - Engine grounding	.069 in. x 2-5/8 in. x 1-1/2 in.	Type 5

SECTION III

FUEL, OIL, HYDRAULIC, AND COOLING SYSTEMS

1. Tanks.

a. General.

(1) Fuel Tanks. - The fuel tanks consisting of a fuselage tank and two wing tanks are fuel-tight, self-sealing bags which are snugly fitted into pressed aluminum containers. (See figure 7.) Also see figure 8 for wing tank installation tools. The fuel bags are fabricated by employing several layers of material which consist of an inner lining of neoprene balloon fabric, a second layer of split steer hide, third layer of uncured Latex sheet, fourth layer of sponge rubber, fifth layer of uncured Latex sheet and an outer covering of chrome-tanned steer hide. The inner lining of neoprene balloon fabric consists of balloon cloth impregnated with Thiokol and cemented together with neoprene cement to form a two-ply sheet .017 inch thick. The self-sealing element consists of two .015-inch sheets of Latex gum on either side of a .250-inch sponge rubber sheet. The Latex sheets are protected on the outside by a .078-inch sheet of grained steer-hide leather and on the inside by a .060-inch sheet of split steer hide. Bostick M-40 cement is used to attach the split steer hide to the layer, while neoprene cement is used to attach the successive layers of the Latex gum, sponge rubber and leather. The neoprene cement is applied to both surfaces and allowed to dry for 20 to 30 minutes. The pipe fittings, filler neck, gage fittings and inspection hole fittings are all made of molded neoprene and have flanges which are cemented to the inside of the self-sealing bag and covered with a patch of balloon cloth. The baffles are of rubberized webbing with neoprene flanges molded on and consist of five layers, two of duck and three of neoprene, center and outsides. Each self-sealing bag is provided with inspection holes so as to facilitate repair. The fuselage bag has one inspection hole; whereas the front wing bag is equipped with three inspection holes and the rear wing bag has four inspection holes. The capacity of the fuel tanks is 148 U.S. gallons (123.3 Imperial gallons). The individual capacities are as follows: The fuselage self-sealing bag, 62.5 U.S. gallons (52.06 Imperial gallons); the front wing self-sealing bag, 35 U.S. gallons (29.16 Imperial gallons) and the rear wing self-sealing bag, 50.5 U.S. gallons (42.07 Imperial gallons). All fuel bags have a 3 percent expansion space and are vented to the atmosphere.

(2) Oil and Coolant Expansion Tank. - The oil and coolant expansion tank are welded aluminum-alloy (3S) structure. The externally Linatex-covered oil tank has an expansion space of 1.5 U.S. gallons (1.25 Imperial gallons); a normal tank capacity of 13 U.S. gallons (10.83 Imperial gallons) and an overload capacity of 16 U.S. gallons (13.33 Imperial gallons).

The coolant expansion tank on the P-40F is in the form of a header tank and is a soldered brass structure being made from .032-inch sheet brass. This tank must withstand a test pressure of 40 pounds per square inch.

(3) Reserve Hydraulic Tank. - The reserve hydraulic tank, located forward of the fuselage access door, is a magnesium-alloy casting (Alcoa AM-260T6). The auxiliary hydraulic tank located on the forward side of the fire wall is an aluminum-alloy (3S) welded structure. The ends are castings (Alcoa No. 43).

b. Damage.

(1) Classification of Damage. - When determining the type of damage to any of the tanks, the repair must be classified as one of the following:

(a) Negligible damage.

(b) Reparable damage.

(c) Damage necessitating replacement.

(2) Negligible Damage. - When effecting slight repairs to a fuel tank, it is not necessary that the tank be steamed and washed before the repair is made; however, it must be kept away from heat or fire. It is necessary that the surfaces of the self-sealing bags and aluminum shells be free from grease, oil or fuel. All surface scratches, small cuts, or rips on the self-sealing bags can be repaired readily by roughing up the outside steer hide and patching with strips of leather using two coats of M-40 Bostick cement and rolling down smoothly with a roller. The bag shells must be free from cracks, abrasions, and sharp corners, and all small dents must be restored to shape, taking care not to stretch or crack the shell. File all sharp corners smooth.

(3) Reparable Damage. - Self-sealing bags and shells that are damaged and necessitate repairs should be replaced and the damaged bag and shell sent to a repair depot where repairs should be effected by the following method.

c. Fuel Bags.

(1) Removal of a Self-sealing Fuel Bag. - Remove the fuel bag from the aluminum shell container. The containers or shells of the fuselage and wing tanks are (2S1/2H) aluminum and can be repaired by welding. The wing tank shells are pressed sections consisting of an upper and lower assembly which are held together to form the complete shell by means of straps. The fuselage container or shell consists of pressed sections with a bolted forward end and a riveted aft end.

The shell sections are bolted together with the leather covering of the fuel bag fastened between its flanges. (See figure 7.) The fuselage container or shell is reinforced by means of straps.

(2) Repair of Fuel Bag on the Side Which the Bullet Enters. - A small clean hole, which would usually result from a bullet entering a tank, may be repaired as follows:

(a) Clean the neoprene balloon cloth lining around the bullet hole with ethyl acetate solution to remove the zinc chromite slushing compound. Allow to dry and buff lightly where the patch will fit. Use two coats of Bostick M-40 cement on both the neoprene fabric patch and the liner of the bag. The patch should extend at least 1 inch beyond the damaged area in all directions.

(b) Brush on TL-284 zinc chromite slushing compound so that the repaired area is completely covered.

(c) Rough up the steer-hide leather on the outside of the bag with card cloth around the damaged area. Cement the leather surface with two coats of M-40 cement and allow to dry 15 minutes.

(d) Prepare a patch by cementing the flesh side of the steer-hide leather with two coats of M-40 cement. Allow to dry, and apply the leather patch to the prepared area and hand roll thoroughly. (See figure 9.)

(3) Repair of Fuel Bag on the Side from Which the Bullet Emerges. - Any extensive damage or large tear in the bag may be repaired as follows:

(a) Repair the inner neoprene lining in the same manner as detailed above.

(b) On the outside leather surface draw a circle around the damaged area so that no part of the circle will fall closer than 2 inches to any part of the damaged area. Remove this section of the steer-hide leather using benzol and a knife.

(c) Remove the outer layer of Latex and sponge from a concentric circle having a 1/2-inch smaller radius than the previously removed steer hide.

NOTE: The Latex and sponge are removed simultaneously over an equal area. (See figure 9.)

(d) Remove the inner layer of Latex from a concentric circle having a 1-inch smaller radius than the previously removed steer hide or a 1/2-inch smaller radius than the previously removed Latex and sponge.

(e) Remove any loose particles of the split steer hide.

(f) Cut patches of steer hide, Latex sheet, sponge and split steer hide. These patches should be large enough to make a lap joint on each step of this repair except in the case of the sponge patch where a butt joint should be used instead of a lap joint. Each lap is 1/2 inch except the outer layer of steer hide which should lap 1 inch. (See figure 9.) Use two coats of Bostick M-40 cement on each surface.

(g) The bag layers should be repaired as soon as possible after damage, because the Latex gum swells at the rate of 2000 percent in 48 hours when saturated with 100 octane fuel. The area affected will spread rapidly and unless repaired immediately, the fuel bag may have to be scrapped.

(h) Emergency temporary repairs made by merely patching the inside of the inner lining would prove effective where the tear does not exceed 4 inches, provided the aluminum shell is hammered back into shape to support the self-sealing element where it is damaged.

(i) Bostick M-40 cement should be used to repair self-sealing fuel bags. This is a self-vulcanizing cement and tends to deteriorate if stored for long periods. It is, therefore, advisable to order supplies in small quantities as it is necessary to mix the cement with a curing fluid before use and once mixed, it starts to vulcanize rapidly. Therefore, mix only sufficient cement to do the job on hand. Never use previously mixed M-40 Bostick cement. Benzol or Toluol may be used as a cement thinner. Toluol is used in the M-40 Bostick cement.

NOTE: Both benzol and Toluol have severe toxic effects and, consequently, must be used only in a location that will afford ample ventilation to protect the repair personnel from any ill effects.

(4) Repair Around Fittings. - Leaking or damaged pipe fittings may be easily repaired. Loosen the defective fitting by pouring benzol or Toluol down the outside of the pipe so that it seeps between the flange of the fitting and the balloon cloth. The fitting when loosened, may be pushed into the bag and removed through the inspection hole. The jointing surfaces must be cleared of the zinc chromite slushing compound before applying the Bostick M-40 cement. A balloon patch should be cemented to the flange before the fitting is cemented inside the bag. Care should be exercised to work from the center out when attaching the fittings or patches so that no air will be trapped between the surfaces.

(5) Repair Materials.

(a) Neoprene synthetic rubber fabric liner, Specification No. 16112-A.

(b) Benzol or Toluol cement thinner.

(c) Uncured Latex sheet gum, Specification No. 26568.

(d) Cellular sponge, Specification No. 26556.

(e) Chrome-tanned steer hide, types 1 and 2, Specification No. 12028.

(f) M-40 neoprene cement with liquid accelerator.

(g) TL-284 Fuller's slushing compound.

(6) Tools for Repair Kit.

(a) One set of No. 50 emery paper.

(b) One bevel stitcher, 2 inches x 2-1/2 inches x 1/4 inch.

(c) One hand roller, 2 inches.

(d) One round handled turn-over knife.

(e) One steel knife for cutting rubber, type 1 inch x 4 inches.

(f) Several 1-inch brushes for cement and slushing compound.

d. Repair of Fuel Bag Shells. - Failures in the fuel tank shells can usually be repaired by welding provided a smooth interior surface is obtained that will not injure the fuel bag. Remove the paint coatings from around the damaged area with paint remover and thoroughly wash off the surface with hot water before proceeding to repair the shell. See section I, paragraphs 6.a. and 6.b., and this section, paragraph 1.h. Shells must be free from dirt, oil, grease, etc., before proceeding with welding operation.

e. Oil Tanks.

(1) Application of Linatex Covering to the Oil Tank. - Remove the Linatex covering of the aluminum oil tank when effecting repairs by welding. Replace the Linatex covering of the oil tank according to the following procedure:

(a) Tanks shall have one coat of primer before covering with Linatex.

(b) Clean tank with solvent (naphtha, benzol, etc.) to remove oil, grease, and dirt.

(c) Apply one coat of primer C-10. Allow to dry 1/2 hour (minimum).

(d) Apply one coat of cement L-110. Allow to dry 10 to 15 minutes. Tanks may stand for 1 to 2 days after cementing if necessary.

(e) Clean Linatex coat (one side) with solvent to remove dirt, oil, and grease.

(f) Brush in well one coat Solufix No. 1. Only mix sufficient Solufix No. 1 for one day's use, as it jells rapidly on exposure to the air. Solufix No. 1 is 50 percent No. 1A and 50 percent Solufix No. 1B. Allow to dry 10 to 15 minutes.

(g) Apply one coat Solufix No. 1 to tank and allow to dry 10 to 15 minutes.

(h) Cement on Linatex covering, working from center of sheet outward. No air should be trapped under the coating.

(i) At joints lap 1-inch minimum, and clean with solvent. Brush both surfaces with Solufix No. 1, allow to dry 10 to 15 minutes; then roll down, beginning at the edge of the lap, using the thin roller along the lapped edge first.

IMPORTANT: Each layer must be hand-rolled immediately after applying to the tank. Care should be taken to work from the center outward and no air shall be trapped between the layers.

(j) Clean the first coat of Linatex with solvent. Brush in one coat of Solufix No. 1 and allow to dry 15 minutes.

(k) Clean the layers of Linatex for the second covering with solvent. Brush in one coat of Solufix No. 1, and allow it to dry 15 minutes.

(l) Apply the second coat of Linatex over the first, and work it down as before. No air shall be trapped between layers. Roll down the surface after application of the second coat.

(m) Clean the Linatex covering and the (16-3/4 ounces) duck on its proofed side. Apply to each, one coat of Solufix No. 1 and allow to dry 10 to 15 minutes.

(n) Apply the duck covering over the Linatex layers, pulling down hard. Work should be from the center outward.

(o) Apply one coat of cement L-110 to the joints of duck and allow to dry 15 to 20 minutes; then one coat Solufix No. 1 and allow to dry 15 minutes. All lap joints must then be rolled down, working from the edge of the under layer out.

(p) The edges of all lapped joints and edges of openings for clips and fittings must be coated with cement L-110.

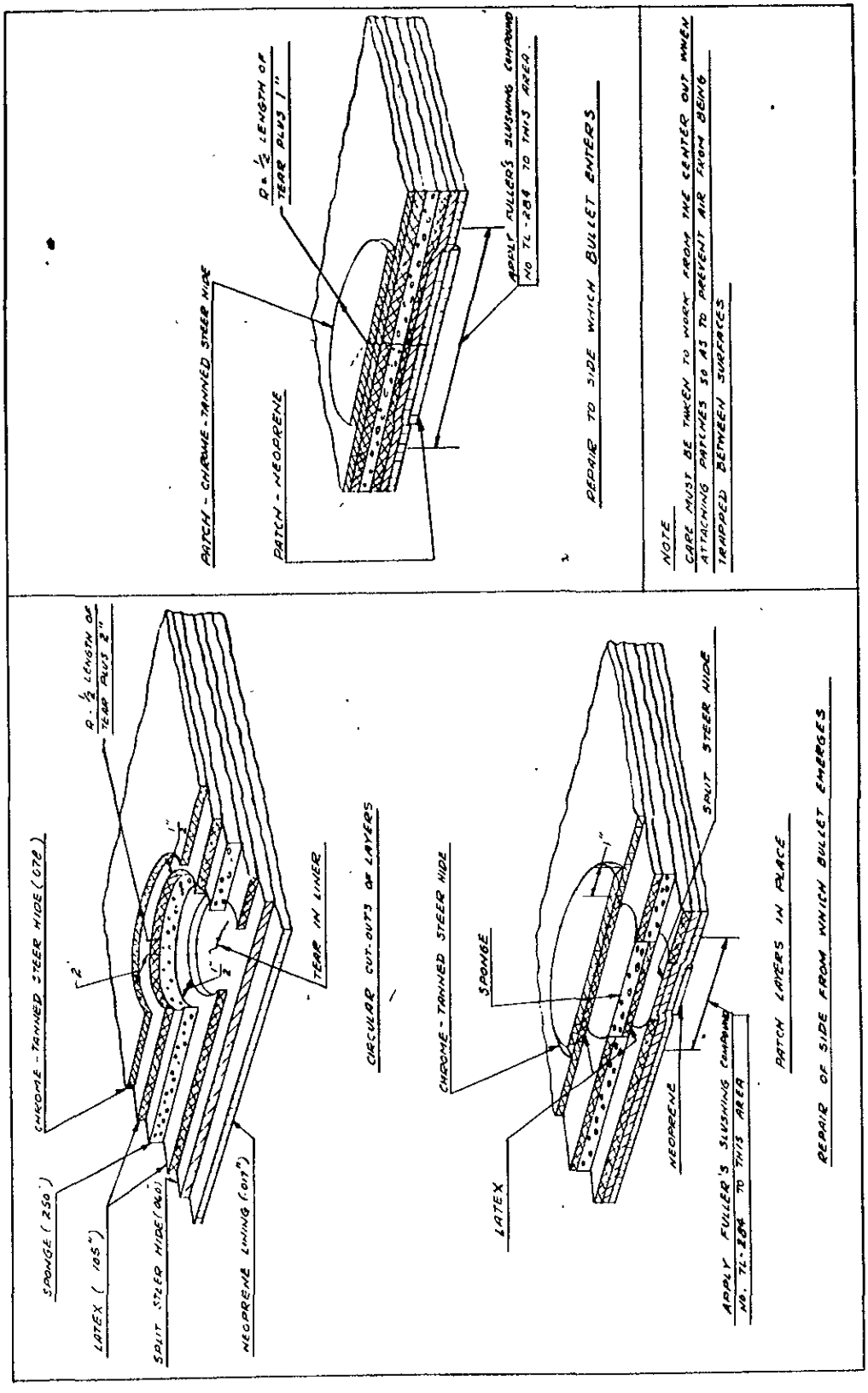


Figure 9 - Fuel Cell Liner - Repair

(2) Finishing Method.

(a) As the second coat of Linatex is applied, care should be taken in lapping the applied pieces so that the laps made in the first and second coverings are staggered. This gives a maximum thickness of three layers of Linatex in any one spot, and keeps irregularities in the contour at a minimum.

(b) In applying the cements and primer, spraying may be used for applying primer C-10. The coat of cement L-120 may be applied by a dipping operation. Solufix No. 1 is best handled by brushing and gives the desired thin, smooth coats. Spraying of Solufix No. 1 is not recommended as the cement must penetrate the surface of the Linatex in order to form good joints.

(c) Butt joints formed by cementing the clean edges of sheets with Solufix No. 1 have nearly the full strength of the material. It is suggested, in order to conserve material, that large scrap pieces of the Linatex be butt jointed together to procure large sheets for use as covering. These butt joints may be formed by coating each clean edge with Solufix No. 1, allowing to dry 10 to 15 minutes, then placing the edges approximately 1/32 inch apart on a flat surface, and hammering the joint starting from one end and working toward the other. The Linatex expands sidewise upon impact and cements, pulling the joint together. The edges must be trimmed true to match before cementing.

(d) The duck used for the finishing coat over the Linatex is (16-3/4 ounces) cotton duck proofed on one side only with masticated or uncured rubber in order to allow cementing over Linatex with Solufix No. 1 cement. When doping this duck, light coats should be applied to avoid excessive strain on the fabric and the cemented joints. The tanks should stand 2 days after covering before doping to allow the cements to dry and cure properly.

(3) Tools and Materials Required. - Linatex is used in conjunction with special cements developed for use with this product. Two tools are used in rolling down the layers after applying to the oil tank. The first, a stitcher is used in rolling down the edges of lapped joints to form a secure joint without trapped air bubbles. The second is a small roller used on the entire surface to roll down the Linatex driving out the trapped air and insuring good contact between the cemented layers.

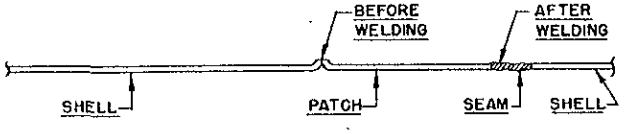
f. Repair of Aluminum Tanks and Shells. - The coolant expansion tank, oil tank and the auxiliary hydraulic tank are of aluminum-alloy (3S) construction and can be repaired by welding. Before proceeding with welding operations, the tank must be free from dirt, oil, paint, etc. and all fittings must be removed. Run a constant stream of boiling hot water entering at the bottom of the tank and letting it overflow at the top for at least 1 hour. Blow compressed air into the tank until all odors have been expelled.

g. Repair of Coolant Header Tank P-40F.

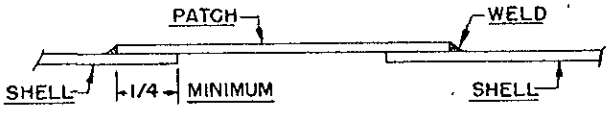
(1) Minor Repairs. - Repairs such as small leaks, leaks around rivets, leaks around thermometer adapter housings and external reinforcing rings may be accomplished with a class 1 silver solder, Army Specification No. QQ-S-561C. The melting point of this solder is 675°C (1250°F) and the flow point is 745°C (1370°F).

(2) Major Repairs. - Repairs to larger holes requiring the application of a patch may be made as follows: Smooth the damaged area by filing off the rough edges with a file and then using emery cloth. Avoid as much as possible the bits of brass and filings falling into the header tank. The repair patch should be of the same gage as the tank skin and should be of sufficient area to overlap the damage a minimum of 3/8 inch. In soldering the patch to the skin use a class 1 silver solder, Army Specification No. QQ-S-561C. Before soldering, all surfaces must be thoroughly cleaned. A flux coat is then applied to the patch and to the header tank at the point of repair to protect against oxidation and to aid the flow of the solder. Powered borax mixed with water to form a thick paste is a good flux. Great care should be taken in applying the torch to the tank so as not to burn the metal. Use a gentle flame to heat the work to the required temperature before applying the solder. When the solder is brought under the flame of the torch it should melt and flow rapidly along the joint. After repairing, test the tank to a pressure of 40 pounds per square inch for leakage and strength of repair.

h. Welding Procedure. - When welding aluminum tanks or shells, use oxyhydrogen flame according to instructions given in section I, paragraph 6.b. A 5 percent silicon rod, or equivalent, should be used with Flux No. 22, manufactured by the United States Aluminum Company. The flux is mixed with water to a thin paste condition and is applied on the area to be welded and also for dipping the rod. Cut all fractures round or elliptical and when these openings are closed, the tank edges should be bumped up about 1/2 inch and the patch to be inserted should also have upturned edges to fit snugly into the tank opening. The patch can then be tacked and welded in place as shown in the following sketch.



If the tank thickness of the metal is .050 inch or over, a lap weld patch as shown, may be used, provided there is room for the repair.



i. Pressure Test for Tanks. - Repaired tanks must pass the following internal pressure tests before being returned to service.

Wing (reserve) fuel bag	1 lb/sq in. - unrestrained
Wing (main) fuel bag	1 lb/sq in. - unrestrained
Fuselage fuel bag	1 lb/sq in. - unrestrained
Oil tank	5 lb/sq in.
Coolant expansion tank	20 lb/sq in.
Coolant expansion tank - P-40F	40 lb/sq in.
Reserve hydraulic tank (magnesium-alloy casting)	5 lb/sq in. - pressure test without valve

j. Damage Necessitating Replacement. - Cracking or perforation of the bag shell or tank due to corrosion, or damage which by its extent or location renders the success of the repair uncertain, necessitates replacement of the tank or shell. Damage beyond repair of the self-sealing bags due to fuel saturation should also be replaced.

2. Radiators.

a. Coolant - P-40D, P-40E, P-40E-1. - The coolant radiators are constructed with a core frontal area of 1.11 square feet, a cooling surface area of 147 square feet and a free air area in the core of .715 square foot having a minimum flow of 120 U.S. gallons (100 Imperial gallons) per minute with 7-1/2 pounds per square inch inlet pressure and 0 pounds per square inch outlet pressure.

b. Coolant - P-40F. - The coolant radiator is constructed with a core frontal area of 1.75 square feet, a cooling surface area of 383 square feet, having a flow of 200 U.S. gallons (166.6 Imperial gallons) per minute with 10 pounds per square inch inlet pressure and 0 pounds per square inch outlet pressure.

c. Oil - P-40D, P-40E, P-40E-1. - The oil cooler, United Aircraft product U-3385-D8S type "11" is constructed with a frontal area of 95 square inches and a cooling surface of 86 square feet and weighs 44.5 pounds.

d. Oil - P-40F. - The oil cooler, United Aircraft product U-6507-D8 is constructed with a frontal area of 38.5 square inches and a cooling surface of 35.1 square feet and weighs 18.25 pounds.

e. Construction.

(1) Coolant Radiator. - The coolant radiator consists of copper tubes (.006 inch x .230 inch OD x 12 inches). The brass header bulkhead flanges are turned for attachment to the shell and riveted. All rivet heads or external surfaces are sealed with silver solder which is a lead base containing from 5 percent to 6 percent silver, developing a high shearing strength and having a melting point of 304° to 370°C (581° to 698°F).

(2) Oil Cooler. - The inner and outer brass shells and the valve flange casting of the oil cooler are assembled by silver soldering. The core tubes are held together, one tube to all its adjacent tubes, and the core assembly complete to the shell by means of a lead tin solder. Tubes used are .210-inch diameter x .250-inch hex.

f. Cleaning Before Repair.

(1) Oil Cooler. - In all cases where any type of repair work is to be done the cooler must first be drained of oil and then thoroughly cleaned. Carbon tetrachloride or trichlor ethylene are the best solvents for cleaning oil coolers and should be used at elevated temperatures, approximately at the boiling points of the liquids. However, in the absence of any heating means, these solvents at room temperature will perform a satisfactory cleaning job. A 50-50 mixture of carbon tetrachloride and naphtha or a mixture of carbon tetrachloride and Sunoco spirits may be used if desired. The solvent should be mixed as required in quantities sufficient to meet daily requirements. It is recommended that the liquid be pumped through the cooler. A hand fuel pump, transfer pump, or a power-driven pump may be used. The liquid should be strained as it leaves the cooler to catch any particles of hard carbon, metal, etc. If bearing metal particles are found, the cooler should be scrapped. The interior of the cooler, after cleaning should be flushed with hot running water and steamed for not less than 1/2 hour. The steam should pass downward into the internal passages with the regulator so placed that the condensate will drain freely from the bottom.

(2) Coolant Radiators. - A solution consisting of 1 to 2 pounds of concentrated soap to 40 gallons of water makes a satisfactory cleaning solvent. After thoroughly washing the radiator, remove the soap solution and flush the exterior and interior with clean hot running water. After rinsing, steam the interior of the radiator for not less than 1/2 hour. The steam should pass downward into the internal passages with the radiator so placed that the condensates will drain freely from the bottom.

g. Testing for Leaks.

(1) Oil Cooler. - After cleaning as described above, locate leaks by submerging the cooler in clean warm water with all openings closed and an air pressure of not more than 75 pounds per square inch applied. The pressure is to be applied and released slowly to prevent any strain or shock. Then mark

each point where bubbles appear with a wire clip. If there is a leak in the tube, remove it as described in this section, paragraph 2.i.(1), and insert a new one by soldering it in place as described in this section, paragraph 2.i.(2). If the leak appears around the jacket, or the core face, the leak can usually be soldered without disturbing any of the assembled parts.

The same test should be made after any repairs are completed.

(2) Coolant Radiators. - The leak test for the coolant radiators should be conducted in the same manner as for the oil cooler except that an air pressure of not more than 10 pounds per square inch is to be applied.

h. Repair Equipment Required. - The following equipment is required for the complete repair work of oil coolers and coolant radiators in accordance with this prospectus:

(1) Oxyacetylene torch, oxygen-acetylene tanks, and pressure regulator with several sizes of torch tips.

(2) Small gas-fired furnace for heating copper soldering irons.

(3) At least two large gas-heated soldering irons.

(4) At least four special tube pulling irons. (See figure below.)

(5) Silver solder wire approximately 1/16 inch in diameter; soft tin lead solder wire approximately 1/8 inch in diameter.

(6) Zinc chloride flux for the soft solder and also flux for the silver solder.

SQUARE OFF END OF PLAIN SOLDERING IRON (AT LEAST A 3-POUND IRON). DRILL 3/8-INCH HOLE IN SQUARED END 1-1/4 INCHES DEEP. INSERT COPPER POINT AND SILVER SOLDER TO IRON.

BE SURE TO SWEAT SOLDER FULL LENGTH OF HOLE.

i. Repairs.

(1) Removing Single Tubes. - Collapsed tubes usually will not leak but should be removed because of their effect on the heat dissipation. Instruction for repair and replacement of collapsed tubes also applies to the repair and replacement of a leaking tube. The procedure is as follows: Heat the special tube pulling irons in the gas furnace. While the irons are heating, clean the original soldered ends of the tubes to be pulled, with concentrated hydrochloric acid and swab with zinc chloride flux. The cleaning and fluxing should be done with a small hair brush or swab. With the irons hot, insert the tip of one iron into one end of the tube and the tip of the other iron into the opposite end of the tube, making sure they are in the same tube. Corresponding tube ends can be identified easily by pushing a wire through the tube and as the wire is withdrawn from the tube, insert one iron in the end from which the wire has been withdrawn and then as the wire is withdrawn from the other end, insert the other iron in that end. Then applying a pushing pressure directed toward the core face with one iron, hold the other iron against the tube with just enough pressure to keep it in place and apply a slight oscillating motion of 10 or 15 degrees to both irons. If the irons are hot enough the solder bond between the tube to be removed and the adjacent tubes will loosen almost immediately and the hex tube ends will assume a round shape and will break loose from their position in the core. Then the irons may be removed from both ends of the tube. Using a pair of pliers, pull the protruding end of the tube out through the core.

(2) Replacing New Tubes. - To replace the new tube, first flux each end of the new tube and tin it with a lead tin solder on the hex ends only. Then take the special tube pulling iron and round up the opening in the core where the old tube was removed so that the new tube may be easily inserted in case there are any lumps of solder adhering to the opening. Next flux the openings in the core where the old tube has been removed and insert the new tube. Use a pair of sharp-nosed pliers and re-form the hexagons of the tubes adjacent to the new tubes. After refluxing use the standard soldering iron and solder over the face of the core with a back-and-forth motion of the iron.

(3) Removing Large Sections of Core. - The above procedure applies to removing one tube or several tubes. However, if a large section of the core must be removed, it is safe to use an oxyacetylene flame on both ends of the core to melt out large sections at one time.

(4) Repair of Core Surface Leaks. - Core surface leaks may be repaired by fluxing the surface of the core at the point of leakage with a zinc chloride flux, and then using a hot iron apply a back-and-forth motion, and solder over the point of leak.

(5) Repair of Surface Leaks Between the Core and Shell Assembly. - Flux at the point of leak with zinc chloride flux and either apply an iron directly to the solder bond, and resolder at the point of leak, or use a flame on the outside surface of the shell to apply heat to the brass and using the solder wire feed the solder between the periphery of the core and the inside of the shell.

(6) Leaks Through Silver Solder Bond of the Shell Assembly. - These leaks may be repaired by the application of soft solder, using either a flame or an iron after first fluxing the point of leak.

(7) Dents in Shell. - Large dents in the shell may be corrected by applying an air pressure of 30 to 40

pounds to the inside of the cooler and using oxyacetylene flame, apply heat carefully to the dent, allowing the heating of the metal with its consequent decrease in hardness to form out to the proper radius under the action of air pressure on the inside. Sharp dents can sometimes be pulled out by soldering the end of the silver solder wire to the point of the dent and pulling the shell into position.

(8) Bullet Holes in Shell. - Small holes, that is, anything corresponding to 1/4 inch in diameter or under, may be patched using a piece of .040-inch or .050-inch thick brass and soft soldering over the hole. Large holes in the shell may be repaired by silver soldering provided the core is properly protected from excessive heating by the use of wet cloths. Holes in the inside shell are extremely difficult to repair and it is doubtful if the cooler can be salvaged in such cases. These remarks in regard to the holes in the cooler and the repair thereof apply only to the holes in the outside shell. However, in the hands of a skillful workman it is quite possible that bullet holes in the inside shell can be repaired. This will require considerable familiarity with cooler construction and repair work and is not recommended.

(9) Bullet Holes in Core. - If a large portion of the core has been damaged, that damaged section may be removed by using an oxyacetylene torch as previously described under "Collapsed Tubes" and "Tube Leaks."

i. Cleaning After Repair.

(1) Oil Cooler. - After repairing and testing, any cooler should be thoroughly flushed inside and out with hot water and steamed as specified in this section, paragraph 2.f.(1). However, any steaming operation may be omitted in case the cooler is to be installed for immediate use, but in this case it will be first thoroughly dried either by immersing in hot oil, as outlined below, or by baking it in an oven at a temperature from 121° to 135°C (250° to 275°F) for approximately 1 hour, or until all evidence of moisture has been removed. If the regulator is to be placed in stock, apply the hot oil treatment to remove the moisture and cover the internal surfaces with a protective coating. This is accomplished by completely immersing the cooler in a tank of clean, light engine oil, approximately SAE 20, maintained at a temperature of 121°C (250°F) plus or minus 10°. The cooler should be agitated thoroughly until all bubbling ceases, which will indicate that the water is evaporated and the interior of the cooler is completely coated. It should then be drained and the openings closed for storage.

(2) Coolant Radiator. - After repairing and testing, any radiator should be thoroughly flushed inside and out with hot running water and steamed as specified in this section, paragraph 2.f.(2). However, any steaming operation may be omitted in case the radiator is to be installed for immediate use.

k. Fuel, Oil, and Hydraulic Tubes. - The copper and aluminum tubes of the fuel, oil and hydraulic systems must be replaced if damaged in any way with the same type tubes as originally used.

l. Fuel System - Self-sealing Lines (Tubes). - On the P-40 airplane, AK-721 and subsequent, all fuel lines are gunfire protected self-sealing tubes. These lines are made up of a seamless compounded inner tube, layers of self-sealing material, plies of reinforcement and a compound cover. The hose will seal completely within 4 minutes after damage at a temperature of -20°F (-29°C). These lines must be replaced if damaged in any way with the same type tubes as originally used. Care must be exercised when tightening clamps that they are not too tight, because the outer compound cover may be pierced and thus damage the tube.

MATERIAL FOR REPAIR OF FUEL BAG SHELLS, RADIATORS AND PIPING

PART NO.	MATERIAL		SIZE	REMARKS
	SPEC NO.	TITLE		
87-45-501-8	QQ-A-561 (1/2H)	Shell - Upper - Al. sheet (2S-1/2H)	.125 in. x 20 in. x 36-3/8 in.	Fuselage shell
87-45-501-2	QQ-A-561 (1/2H)	Shell - Lower - Al. sheet (2S-1/2H)	.125 in. x 36-3/8 in . 66 in.	Fuselage shell
87-45-501-7	QQ-A-561	Shell - End - front - Al. sheet (2S0)	.125 in. x 27 in. x 29 in.	Fuselage shell
87-45-501-3	QQ-A-561	Shell - End - rear - Al. sheet (2S0)	.125 in. x 27 in. x 29 in.	Fuselage shell
87-45-501-4	QQ-A-561 (1/2H)	Sump housing - Al. sheet (2S-1/2H)	.125 in. x 5 in. x 20 in.	Fuselage shell
AN5108-416-12	QQ-B-611	Screws - Brass - flathead		Fuselage shell
AN3-5	29-59 Mfg	Bolt - Steel	5/8 in. long, shank 1/4 in.	Fuselage shell
365-1032	25527 Mfg	Nut - Self-locking - steel	15/64 in.x 3/8 in.	Fuselage shell
87-45-501-9	QQ-A-561 (1/2H)	Flange Head - Al. sheet (2S-1/2H)	.125 in. x 7 in. x 7 in.	Fuselage shell
87-45-525-37	QQ-A-561 (1/2H)	Shell - Lower - forward - Al. sheet (2S-1/2H)	.125 in. x 30 in. x 16 in.	Wing shell - rear
87-45-525-31	QQ-A-561 (1/2H)	Shell - Lower - aft - Al. sheet (2S-1/2H)	.125 in. x 30 in. x 22 in.	Wing shell - rear
87-45-525-46	QQ-A-561 (1/2H)	End - Al. sheet (2S-1/2H)	.125 in. x 43 in. x 14-1/4 in.	Wing shell - rear
87-45-525-45	QQ-A-561 (1/2H)	Shell - Al. sheet (2S-1/2H)	.125 in. x 22-3/4 in. x 48 in.	Wing shell - rear
87-45-525-51	QQ-A-561 (1/2H)	Plate - Al. sheet (2S-1/2H)	.187 in. x 3-1/2 in. x 7 in.	Wing shell - rear
87-45-525-52	QQ-A-561 (1/2H)	Plate - Al. sheet (2S-1/2H)	.187 in. x 5-3/4 in. x 4-1/4 in.	Wing shell - rear
87-45-525-43	QQ-A-561 (1/2H)	End - Al. sheet (2S-1/2H)	.125 in. x 43 in. x 14-1/4 in.	Wing shell - rear
87-45-525-42	QQ-A-561 (1/2H)	Plate - Al. sheet (2S-1/2H)	.125 in. x 5-1/4 in. x 6-1/2 in.	Wing shell - rear
87-45-525-41	QQ-A-561 (1/2H)	Shell - Al. sheet (2S-1/2H)	.125 in. x 22-3/4 in. x 48 in.	Wing shell - rear
673-D-6-8	A-17ST	Rivet - 78° countersunk head	3/16 in. dia. x 1/2 in. long	Wing shell - rear
87-45-525-35	QQ-A-561 (1/2H)	Angle - Shell - lower - aft	.125 in. x 1-1/8 in. x 4-1/2 in.	Wing shell - rear
87-45-524-33	QQ-A-561 (1/2H)	Shell - Lower - aft - Al. sheet (2S-1/2H)	.125 in. thickness	Wing shell - front
87-45-524-31	QQ-A-561 (1/2H)	Shell - Lower - forward - Al. sheet (2S-1/2H)	.125 in. thickness	Wing shell - front
87-45-524-41	QQ-A-561 (1/2H)	End - Upper - RH - Al. sheet (2S-1/2H)	.125 in. thickness	Weld and rivet assembly
87-45-524-40	QQ-A-561 (1/2H)	Shell - Upper - RH - Al. sheet (2S-1/2H)	.125 in. thickness	Weld and rivet assembly
87-45-524-46	QQ-A-561 (1/2H)	Plate - Upper - LH - Al. sheet (2S-1/2H)	.187 in. x 3-1/2 in. x 8-1/4 in.	Weld and rivet assembly
87-45-524-38	QQ-A-561 (1/2H)	End - Upper - LH - Al. sheet (2S-1/2H)	.125 in. x 12 in. x 35 in.	Weld and rivet assembly
87-45-524-37	QQ-A-561 (1/2H)	Plate - Upper - LH - Al. sheet (2S-1/2H)	.125 in. x 6-1/8 in. x 7-3/8 in.	Weld and rivet assembly
87-45-524-36	QQ-A-561 (1/2H)	Shell - Upper - LH - Al. sheet (2S-1/2H)	.125 in. x 24 in. x 38 in.	Weld and rivet assembly
		Note: RH = Right Hand;	LH = Left Hand	
87-45-097-1	57-136-8	Fuselage - Fuel shell - front - strap	.063 in. x 1 in. x 27-5/8 in.	Cr moly steel
87-44-569-1	QQ-A-35-(T)	Wing - Rear shell - aft - inboard strap	.081 in. x 1-1/2 in. x 15-9/16 in.	Al. Al. 24ST
87-44-059-1	57-136-8	Wing - Forward shell - aft - outboard strap	.064 in. x 2-7/16 in. x 18-7/8 in.	Steel sheet X-4130
87-44-058-1	AN-QQ-S-685	Wing - Forward shell - aft - inboard strap	.064 in. x 2-1/2 in. x 20-1/4 in.	Steel sheet X-4130
87-44-568-1	57-152-6 (11)	Wing - Rear shell - aft - outboard strap	.081 in. x 1-1/2 in. x 14-7/16 in.	Al. Al. 24ST
87-44-567-1	57-152-6 (11)	Wing - Rear shell - (front) strap	.081 in. x 1-1/2 in. x 8-3/16 in.	Al. Al. 24ST
87-50-015	57-160	Header Bulkheads - Brass	.040 in. thickness	Radiator-coolant system
87-50-015-9	QQ-B-691-(5)	Flange - (Bronze casting)	2 in. dia. x 5/16 in.	Radiator-coolant system

MATERIAL FOR REPAIR OF FUEL BAG SHELLS, RADIATORS AND PIPING Contd

PART NO.	MATERIAL		SIZE	REMARKS
	SPEC NO.	TITLE		
87-50-015-2	WW-T-799	Tubes - Copper	.006 in. x .230 in. OD x 12 in.	Radiator-coolant system
AN435-C4-4		Rivet - Round-head - copper	1/8 in. dia.; 1/4 in. long	Radiator-coolant system
AN420-C4-4		Rivet - 90° countersunk head - copper	1/8 in. dia.; 1/4 in. long	Radiator-coolant system
87-50-015-1	57-160	Shell - Brass	.040 in. x 12-1/2 in. x 48 in.	Radiator-coolant system
		Note: different OD's required.		
87-33-501-11	57-192-1A	Tube - Hydraulic system - Everdur	1/2 in. OD x .035 in. x 25 in.	Cu.,Si.,Br., Tube
87-33-501-13	57-192-1A	Tube - Hydraulic system - Everdur	3/8 in. OD x .035 in. x 10 in.	Cu.,Si.,Br., Tube
87-33-501-21	57-192-1A	Tube - Hydraulic system - Everdur	1/4 in. OD x .035 in. x 46-5/8 in.	Cu.,Si.,Br., Tube
87-33-901-21	57-192-1A	Tube - Hydraulic system - Everdur P-40F	3/8 in. OD x .035 in. x 40 in.	Cu.,Si.,Br., Tube
87-33-501-53	57-192-1A	Tube - Hydraulic system -	5/16 in. OD x .035 in. x 8-1/2 in.	Cu.,Si.,Br., Tube
87-47-501-11	QQ-A-359 (1/2H)	Fin - Al. sheet (3S)	.040 in. x 1-1/2 in. x 6-1/4 in.	Oil Tank-Linatex covered
87-47-501-10	QQ-A-359 (1/2H)	Cone - Al. sheet (3S)	.040 in. x 7 in. x 16 in.	Oil Tank-Linatex covered
87-47-501-9	WW-T-783 (1/2H)	Tube - Aluminum (2S)	OD 2-1/2 in. x .049 in. x 8-1/4 in.	Oil Tank-Linatex covered
87-47-501-8	QQ-A-359 (1/2H)	Cylinder (Weld Assembly)-Al. (3S)	.040 in. x 15-3/4 in. x 13 in.	Oil Tank-Linatex covered
87-47-501-6	WW-T-783 (1/2H)	Tube - Aluminum (2S)	.049 in. x 2-1/2 in. OD x 20-1/4 in.	Oil Tank-Linatex covered
87-47-501-4	QQ-A-359 (1/2H)	Baffle - Aluminum alloy (3S)	.040 in. x 12 in. x 22-1/4 in.	Oil Tank-Linatex covered
87-47-501-3	QQ-A-359 (1/2H)	Cover - Aluminum alloy (3S)	.051 in. x 16 in. x 48-1/2 in.	Oil Tank-Linatex covered
87-47-501-2	QQ-A-359 (1/2H)	Shell - (Welded assemblies)	.040 in. x 16-5/8 in. x 54-1/2 in.	Oil Tank-Linatex covered
87-50-911-11	57-160 (GR. LOW)	Tank - Brass sheet P-40F	.032 in. thickness	Header Tank - Expansion
87-50-502-8	QQ-A-359 (1/2H)	End - Aluminum alloy (3S)	.015 in. x 10-3/8 in. x 10-3/8 in.	Coolant Tank - Expansion
87-50-502-7	QQ-A-359 (1/2H)	Center - Upper - aluminum alloy (3S)	.051 in. x 12-3/8 in. x 14-1/2 in.	Coolant Tank - Expansion
87-50-502-6	QQ-A-359 (1/2H)	End - Aluminum alloy (3S)	.051 in. x 10-3/8 in. x 10-3/8 in.	Coolant Tank - Expansion
87-50-502-5	QQ-A-359 (1/2H)	Center - Lower - aluminum alloy (3S)	.051 in. x 12-3/8 in. x 14-1/2 in.	Coolant Tank - Expansion
87-50-502-9	QQ-A-359 (1/2H)	Reinforcement - Al. Al. (3S)	.051 in. x 4-7/8 in. x 4-7/8 in.	Coolant Tank - Expansion
87-50-502-11	WW-T-791	Tube - Brass tube	5/8 in. OD x .035 in. x 8 in.	Coolant Tank - Expansion
AN505-8-6	FF-S-91 Mfg	Screw - Flathead - steel - coarse thread	3/8 in. long	Coolant Tank - Expansion
503-8-8	FF-S-91 Mfg	Screw - Coarse thread (steel)	1/2 in. long	Coolant Tank - Expansion
501A-10-10	FF-S-91 Mfg	Screw - Drilled carbon steel - fine thread	5/8 in. long	Coolant Tank - Expansion
AN442-6-6	25526 Mfg	Rivet - Flathead - aluminum	3/16 in. dia.; 3/8 in. long	Coolant Tank - Expansion
AN960-8-8	1010 Steel	Washer - Plain	ID 11/64 in.; OD 3/8 in.	Note: Do not heat treat before using. Coolant Tank - Expansion

MATERIAL FOR REPAIR OF FUEL BAG SHELLS, RADIATORS AND PIPING Contd

PART NO.	MATERIAL		SIZE	REMARKS
	SPEC NO.	TITLE		
87-33-011		Tank - Reservoir - hydraulic - casting		Magnesium Alloy - Alcoa AM-260T6
87-33-525-1	QQ-A-359	Tank - Aux hydraulic - welded	.051 in. x 8-15/32 in. x 16 in.	Aluminum Alloy (3S)
87-33-536	11311	Tank - End - aux hydraulic		Casting - Alcoa No. 43
AN520-416-8	FF-S-91 Mfg	Screw - Oil system	1/2 in. long	Round-head - Fine thread
365-524	255-27 Mfg	Nut - Oil system - steel	11/32 in. x 1/2 in.	Self-locking
AN-310-4	29-26 Mfg	Nut - Oil system - castle	1/4 in. dia, 7/16 in. x 9/32 in.	
AN960-416	1010 Steel	Washer - Oil system - plain	17/64 in. ID, 1/2 in. OD	
		NOTE: Bead all tube ends, see section 3 for radii bend on oil lines.		
87-44-506-6	57-187-3	Tube - Fuel system P-40F	1/2 in. OD x .042 in. x 42 in.	(52SO) Aluminum Alloy
87-44-506-16	57-187-3	Tube - Fuel system P-40F	1/4 in. OD x .032 in. x 76-3/4 in.	(52SO) Aluminum Alloy
87-44-901-16	WW-T-787	Tube - Fuel system P-40F	1/4 in. OD x .035 in. x 76-3/4 in.	(52SO) Aluminum Alloy
87-44-935		Tube - Fuel system P-40F		
87-44-935		Tube - Fuel system P-40F		
882-4-10	20-103	Hose - Fuel system	1/4 in. ID x 2-1/2 in. long	Hose Clamp - 745-1B
882-6-10	20-103	Hose - Fuel system	3/8 in. ID x 2-1/2 in. long	Hose Clamp - 745-1A
882-8-10	20-103	Hose - Fuel system	1/2 in. ID x 2-1/2 in. long	Hose Clamp - 745-2A
882-12-12	20-103	Hose - Fuel system	3/4 in. ID x 3 in. long	Hose Clamp - 745-3A
811-T-4CS		Sleeve - Fuel system - solderless	11/16 in. long	Tube Fitting
811-BT-4D		Nut - Fuel system	9/16 in. x 37/64 in.	Tube Fitting
		NOTE: Avoid beaded ends, and flare tube ends according to figure and table in section 3.		
365-832	25527 Mfg	Nut - Self-locking - coarse thread	15/64 in. x 3/8 in.	
365-1032	25527 Mfg	Nut - Self-locking - fine thread	15/64 in. x 3/8 in.	
AN520-10-8	FF-S-91 Mfg	Screw - Round-head - fine thread	1/2 in. long	Carbon Steel
AN960-10	1010 Steel	Washer - Plain	13/64 in. ID x 7/16 in. OD	
	NOTE: Stainless steel tubing Spec No. 57-180-3 may be used in place of Everdur. All tube ends must be flared. See table and diagram in the text. Section III.			
87-46-507-1	57-187-3	Tube - Oil system	1 in. OD x .049 in. x 24-1/2 in.	52SO Aluminum Alloy
87-46-507-32	57-187-3	Tube - Oil system	1-1/2 in. OD x .049 in. x 52 in.	52SO Aluminum Alloy
87-46-507-10	57-187-3	Tube - Oil system	3/4 in. OD x .049 in. x 22 in.	52SO Aluminum Alloy
87-46-507-11	57-187-3	Tube - Oil system	1/2 in. OD x .042 in. x 28 in.	52SO Aluminum Alloy
882-24-18	20-103	Hose - Oil system	1-1/2 in. ID x 4-1/2 in. long	Hose Clamp - 745-5A
882-16-20	20-103	Hose - Oil system	1 in. ID x 5 in. long	Hose Clamp - 745-3A
882-12-14	20-103	Hose - Oil system	3/4 in. ID x 3-1/2 in. long	Hose Clamp - 745-3A
882-8-8	20-103	Hose - Oil system	1/2 in. ID x 2 in. long	Hose Clamp - 745-2A
882-6-8	20-103	Hose - Oil system	3/8 in. ID x 2 in. long	Hose Clamp - 745-1A
882-4-9	20-103	Hose - Oil system	1/4 in. ID x 2-1/4 in. long	Hose Clamp - 745-1B
GT-1		Clamp - Oil system		
GT-14		Clamp - Oil system		
AN3-20A	29-59 Mfg	Bolt - Oil system (without cotter pin)	2 in. Long - Shank 1-5/8 in.	Use with self-locking nut

MATERIAL FOR REPAIR OF FUEL BAG SHELLS, RADIATORS AND PIPING Contd

PART NO.	MATERIAL		SIZE	REMARKS
	SPEC NO.	TITLE		
87-46-901-62	57-187-3	Tube - Oil system	1-1/4 in. OD x .049 in. x 22 in.	52S0 Al. Al.
87-46-901-64	57-187-3	Tube - Oil system	1 in. OD x .049 in. x 47 in.	52S0 Al. Al.
87-46-901-7	57-187-3	Tube - Oil system	3/4 in. OD x .049 in. x 44 in.	52S0 Al. Al.
87-46-901-10	WW-T-787	Tube - Oil system	3/8 in. OD x .035 in. x 20 in.	52S0 Al. Al.
87-46-901-51	57-187-3	Tube - Oil system	1/2 in. OD x .042 in. x 40 in.	52S0 Al. Al.
87-46-901-13	WW-T-799	Tube - Oil system	1/4 in. OD x .035 in. x 65 in.	Copper
884-4-12	20-103	Hose - Oil system	1/4 in. ID x 3 in. long	Hose Clamp - 745-1B
884-6-10	20-103	Hose - Oil system	3/8 in. ID x 2-1/2 in. long	Hose Clamp - 745-1A
884-8-10	20-103	Hose - Oil system	1/2 in. ID x 2-1/2 in. long	Hose Clamp - 745-2A
884-12-12	20-103	Hose - Oil system	3/4 in. ID x 3 in. long	Hose Clamp - 745-3A
884-16-12	20-103	Hose - Oil system	1 in. ID x 3 in. long	Hose Clamp - 745-3A
884-20-16	20-103	Hose - Oil system	1-1/4 in. ID x 4 in. long	Hose Clamp - 745-4A
NOTE: These parts are for the P-40F model only				

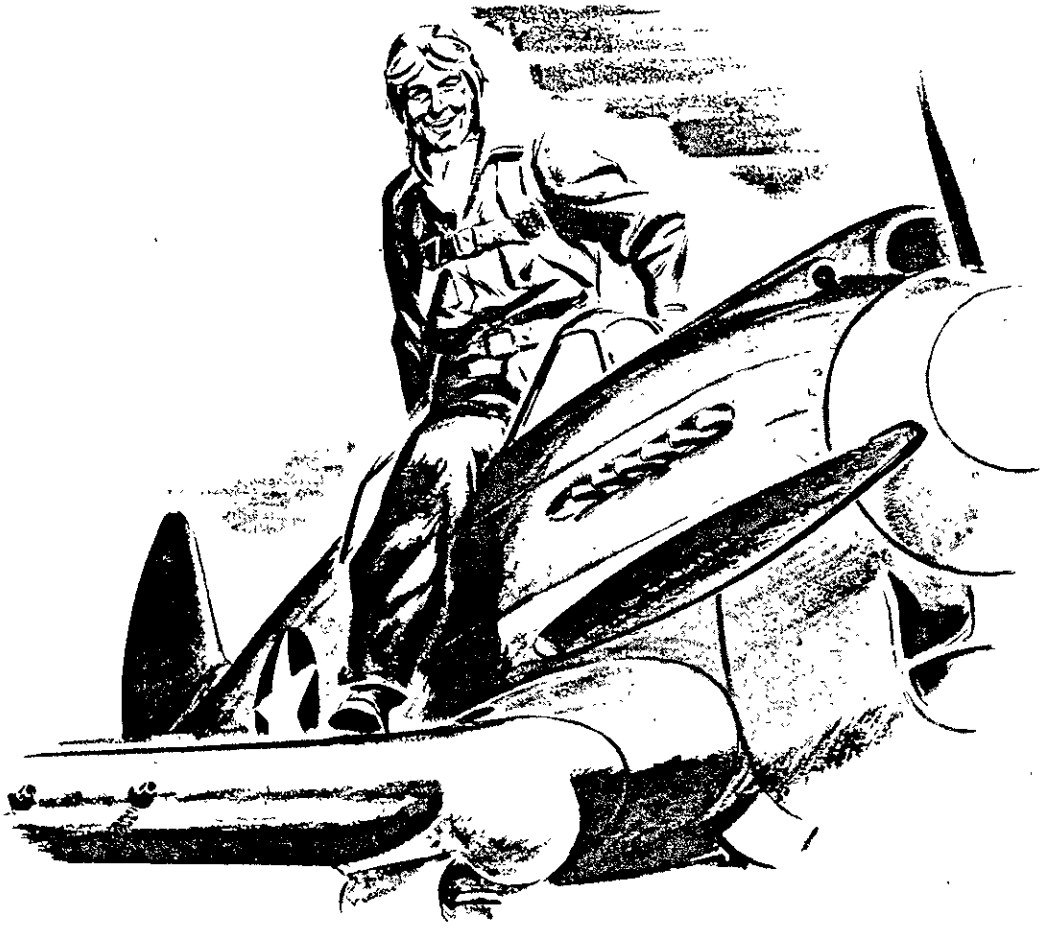
SECTION IV

FUSELAGE

1. General Discussion.

a. Description of Fuselage. - The fuselage is a semimonocoque structure consisting of 24ST aluminum-alloy stressed skin reinforced longitudinally by bulb angle stringers and laterally by traverse bulkhead rings. The skin and all bulkheads are spliced at the horizontal center line. The forward portion of the fuselage which forms the pilot's cockpit is reinforced with heavy upper and lower longerons. (See figure 10.) Bulkhead No. 5 immediately aft of the pilot is so designed that with the armor plate installed it will support the fuselage in the event of a turn-over. The bulkheads aft of station 12 are reinforced sufficiently to enable them to take concentrated tail wheel and empennage loads.

b. Wing and Tail Fillets. - Fillets are provided at the intersections of the wing and empennage with the fuselage. The wing-fuselage fillet is constructed of aluminum-alloy sheets (24ST) which are spot-welded together and attached by means of screws. The tail fillets are composed of four sections of Alclad 24ST and are also attached by means of screws. When effecting repairs to the wing-fuselage fillet, it is important to maintain the original contour. Flush patches must be used to prevent formation of eddies in the airflow.



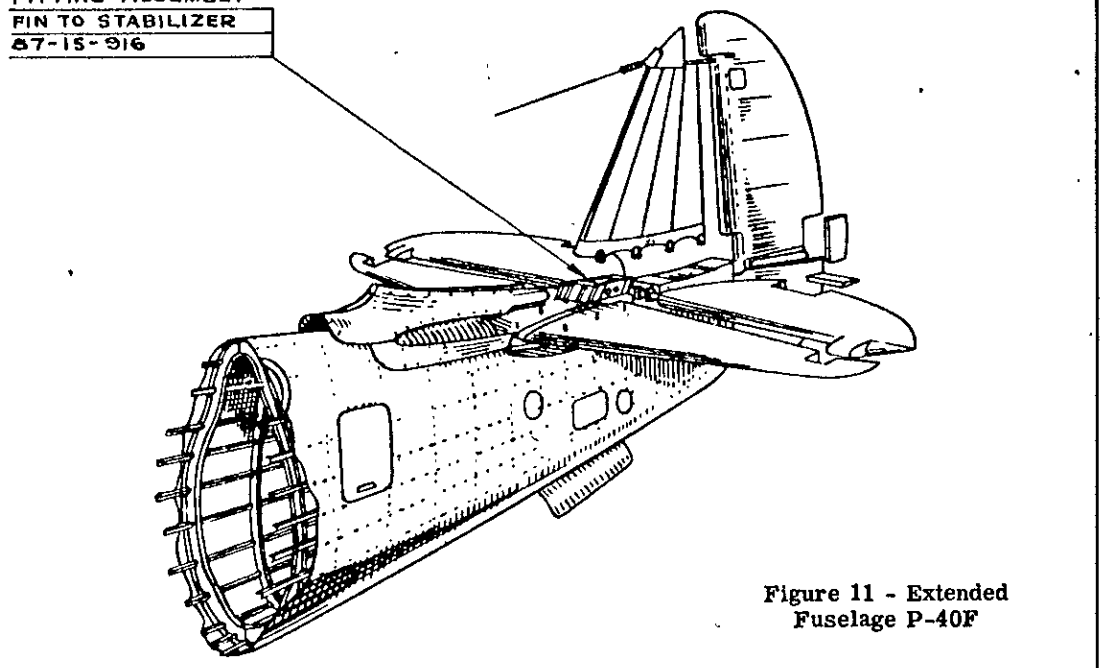


Figure 11 - Extended Fuselage P-40F

c. Fuselage Extension. - On the P-40F model, ship No. 701 and up, there is an extended fuselage. This extension is made up of 24ST aluminum-alloy stressed skin reinforced by stringers and vertical bulkheads. This extension is so designed that only the fin and rudder are moved aft. An illustration of this extension is shown in figure 11.

2. Classification of Damage. - When effecting any repairs on the fuselage structure, carefully examine the extent of the damage and determine a method of repair by classifying it as one of the following:

a. Negligible damage.

b. Damage reparable by patching.

c. Damage reparable by insertion.

d. Damage necessitating replacement.

3. Skin.

a. General. - Aluminum-alloy stressed skin is used to cover the fuselage. Since the skin gages at the various stations have been carefully selected to give the required strength with a minimum of material, it is necessary, when effecting repairs to make all patches, inserts and splice plates of the same gage stock as the sheet being repaired. (See figure 12.) The rivets and rivet patterns to be used for each attachment or around a damaged area should be the same as in the nearest parallel skin splice or skin overlap.

b. Negligible Damage. - Small dents free from cracks, abrasions, and sharp corners may be neglected provided the adjacent structural members are not damaged and the rivets are undisturbed. Care must be exercised when bumping out dents that the skin is not stretched or buckled otherwise it will have to be reinforced with a patch of the same gage skin or removed and repaired by an insert.

c. Damage Reparable by Patching.

(1) Skin Repair. - Large dents, cracks, holes and skin abrasions are reparable by patching or splicing as illustrated in figures 13, 14, 15, 16, 17, and 18. When effecting skin repairs, note the gage of the skin used in the damaged area by referring to figure 5. Figures 19 and 20 illustrate methods of repairing damages to the free areas of the skin between stringers and bulkheads. The damaged skin area should be cut away to leave a square or rectangular hole with 1/2-inch radii in the corners and a flush insert should be fitted in the hole and secured by an internal frame as shown in figure 10 or by a patch as in figure 19.

(2) Skin Repair Over Stringer. - Skin patch repair over stringers should be repaired by the method shown in figures 13, 21, 17, and 19. The repair is similar to that described in this section, paragraph 3.c.(1) except that the repair to the stringer is effected by splicing (this section, paragraphs 3.b. and 4.c.) and the internal frame must be inserted about the stringer having a 1/32-inch clearance at the stringer. The in-

sert is neatly fitted in the hole and flush riveted by countersunk rivets.

(3) Skin Repair Over Bulkhead. - Skin patch repair over a bulkhead is illustrated in figures 13, 22, and 14. Remove the skin to enable the damaged area of the bulkhead to be cut away and splice in the new section of the bulkhead. Place the reinforcing frame about the bulkhead as described in this section, paragraph 3.c.(2) and fit it so that it will clear the edge of the bulkhead approximately 1/32 inch. The existing countersunk holes in the bulkhead should be used as a pattern when attaching the flush patch which must be counterpunched. Avoid damaging the bulkhead when effecting repairs of this type.

d. Damage Reparable by Insertion. - When effecting an extensive repair to the skin necessitating the insertion of all or a large part of the skin, the damaged portion of the fuselage should be supported so that the removal of the skin will not place a strain on the adjacent structure. Remove the necessary rivets taking care not to elongate or damage the rivet holes. (See section I, paragraphs 9. and 10.a..) Repair any damage to the internal structure and add splice plates where the skin sheet has been cut. Splice plates should be of the same gage and material as the damaged sheet and twice the width of the lap at the nearest parallel edge of this sheet. This type of repair is illustrated in figure 23. Form the insert and drill the rivet holes to match the original holes in the fuselage and fittings. Remove all burrs caused by drilling and rivet the insert in place. Attach each splice plate with the same rivet pattern and rivets on each side of the cut as originally used in attaching the nearest parallel edge of the sheet. When inserting a complete skin section remove the damaged section and attach the new insert using the original rivet pattern.

4. Stringers.

a. Negligible Damage. - Smooth isolated dents free from cracks, abrasions, and sharp corners which can be removed without excessive hammering, may be considered negligible damage. Small cracks running longitudinally and not exceeding 1 inch should be stopped by drilling 1/8-inch diameter holes at their ends to prevent spreading. File all nicks in the stringer until smooth. Nicks on the legs of the stringer should not exceed 1/4 inch in depth after clean-up.

b. Damage Reparable by Patching. - Use the methods shown in figure 24 provided the cross section of the damaged area does not exceed one-half of the total cross section of the stringer. Repair damage to the leg attaching the stringer to the skin, as shown in the upper section of figure 24. Use a filler of .068 inch to pick up the skin rivets in the damaged area and a formed channel of .040-inch 24ST of ample length to take four 1/8-inch rivets at 1/2-inch spacing in the free leg of the stringer on each side of the damaged portion in addition to the corresponding rivets in the skin. For damage to the free leg of the angle use .051-inch plate as shown in the lower section of figure 24 with four 1/8-inch rivets on each side of the damage. A filler plate is unnecessary unless damage after cleaning up exceeds 1-1/2 inches in length, if so it should be formed from .064-inch sheet and attached with 1/8-inch rivets at 1/2-inch spacing.

c. Damage Reparable by Insertion. - If the damage occurs at a bulkhead or destroys more than one-half of the stringer cross section, remove the rivets which attach the damaged section of the stringer to the skin. Remove the damaged portion of the stringer by cutting it off at each end at a point midway between two of the existing rivet holes and proceed to splice the new section. (See figure 25.) The insert material should be cut from stock of the same cross-sectional area as the original stringer. The length should be sufficient to leave a maximum clearance at each end of the insert of 1/32 inch. Use the same stock and cut two splice pieces of ample length to take the necessary number of rivets. Attach the splice pieces to the original member and the insert with an equal length on each side of the cut and with a clearance of 1/32 inch between the splice piece and the skin. Rivet the splice piece in place with 5-5/32 inch or 8-1/8 inch rivets spaced at 1/2 inch on each side of the insertion joint as illustrated in figure 25. Use the existing skin rivet holes as a pattern to drill the holes in the inserted stock. Attach the skin to the inserted stock using the existing skin rivet holes.

5. Longerons.

a. General. - The fuselage is reinforced between the fire wall and bulkhead No. 8 with upper and lower longerons. (See figures 5 and 12.) The upper longeron is a formed channel with flanged legs which is reinforced with an added channel between the fire wall and bulkhead No. 3 and added angles which extend from bulkhead No. 3 to bulkhead No. 6. The cabin track running from bulkhead No. 3 to bulkhead No. 8 is attached to the back of the upper longeron. The lower longeron consists of an extruded angle and an extruded "T" section (figure 26) which form the wing-fuselage attachment plus the heavy gusset straps which extend from the fire wall completely around the edge of the lower fuselage opening. The skin on each side of the fuselage acts as a diagonal tension web between the longerons and the bulkheads in this region act as stiffeners to keep the longerons apart. The longerons are subjected to heavy axial and bending loads and should in general be replaced if damaged.

b. Repair of Upper Longeron. - The upper longeron may be spliced between stations 2 and 3, 4 and 5, or 6 and 7, (figures 12, 15, and 27) by the methods shown in figures 28, 29, and 30. Minor damages to the legs or flanges of this longeron may be reinforced by attaching .102-inch gage 24ST aluminum-alloy patches with 3/16-inch diameter rivets, providing there is room to use the required number of rivets. The number of rivets to be used at each end of the damage, between the fire wall and bulkhead No. 5, is one for each

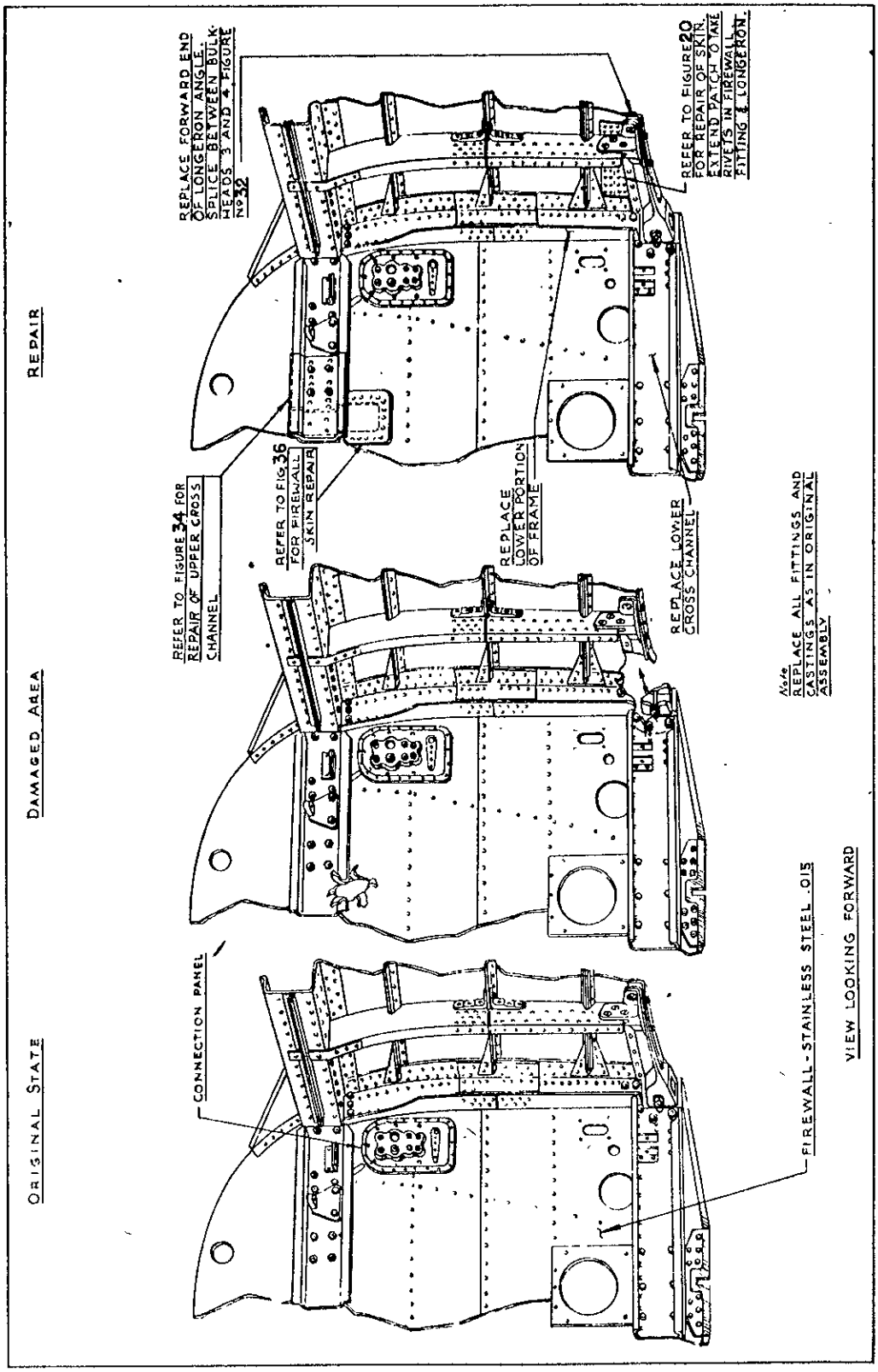


Figure 14 - Fuselage - Skin and Fire Wall Damage Sta No. 1

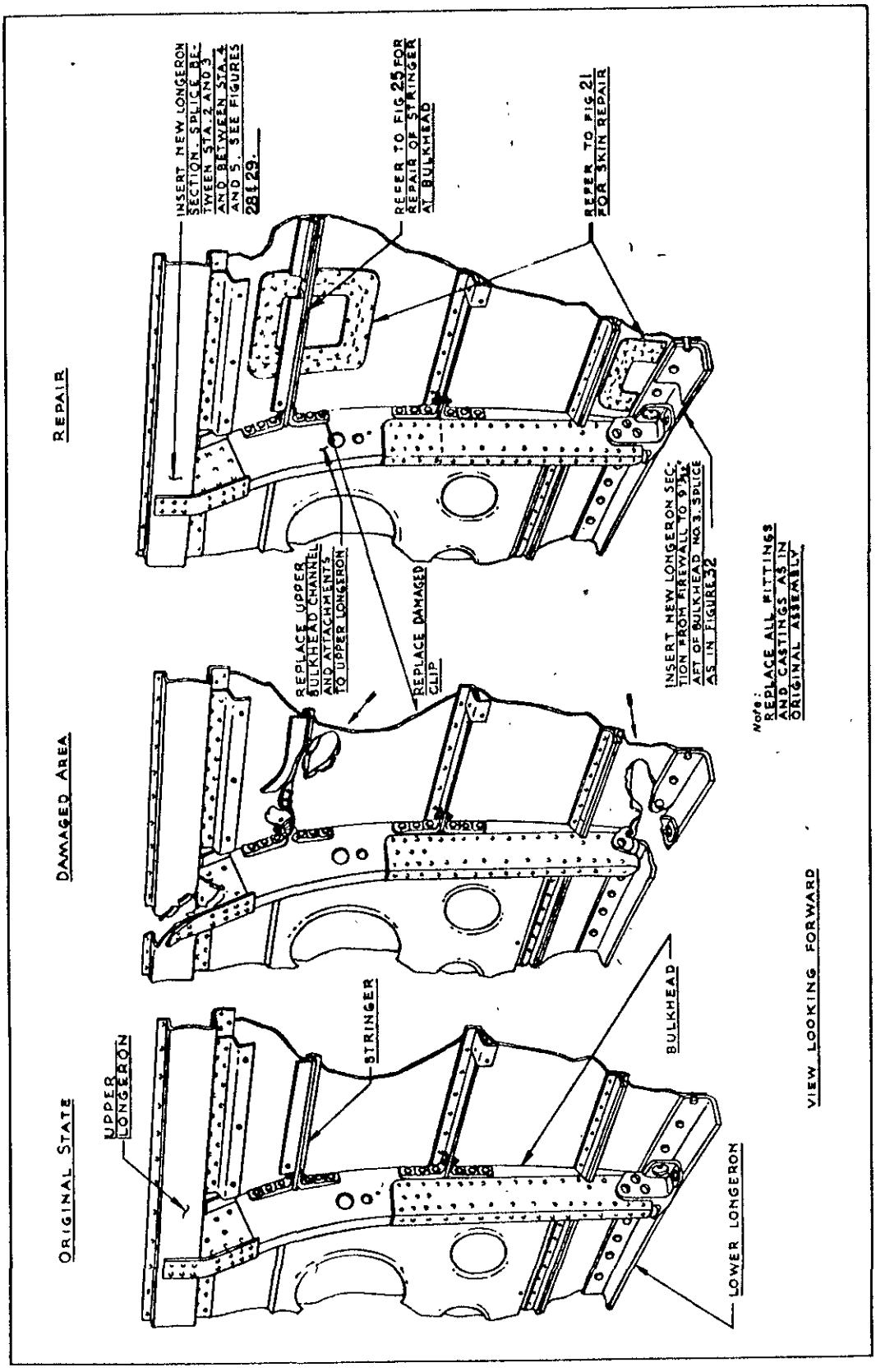


Figure 15 - Fuselage - Stringer, Bulkhead and Longeron Damage Sta No. 3

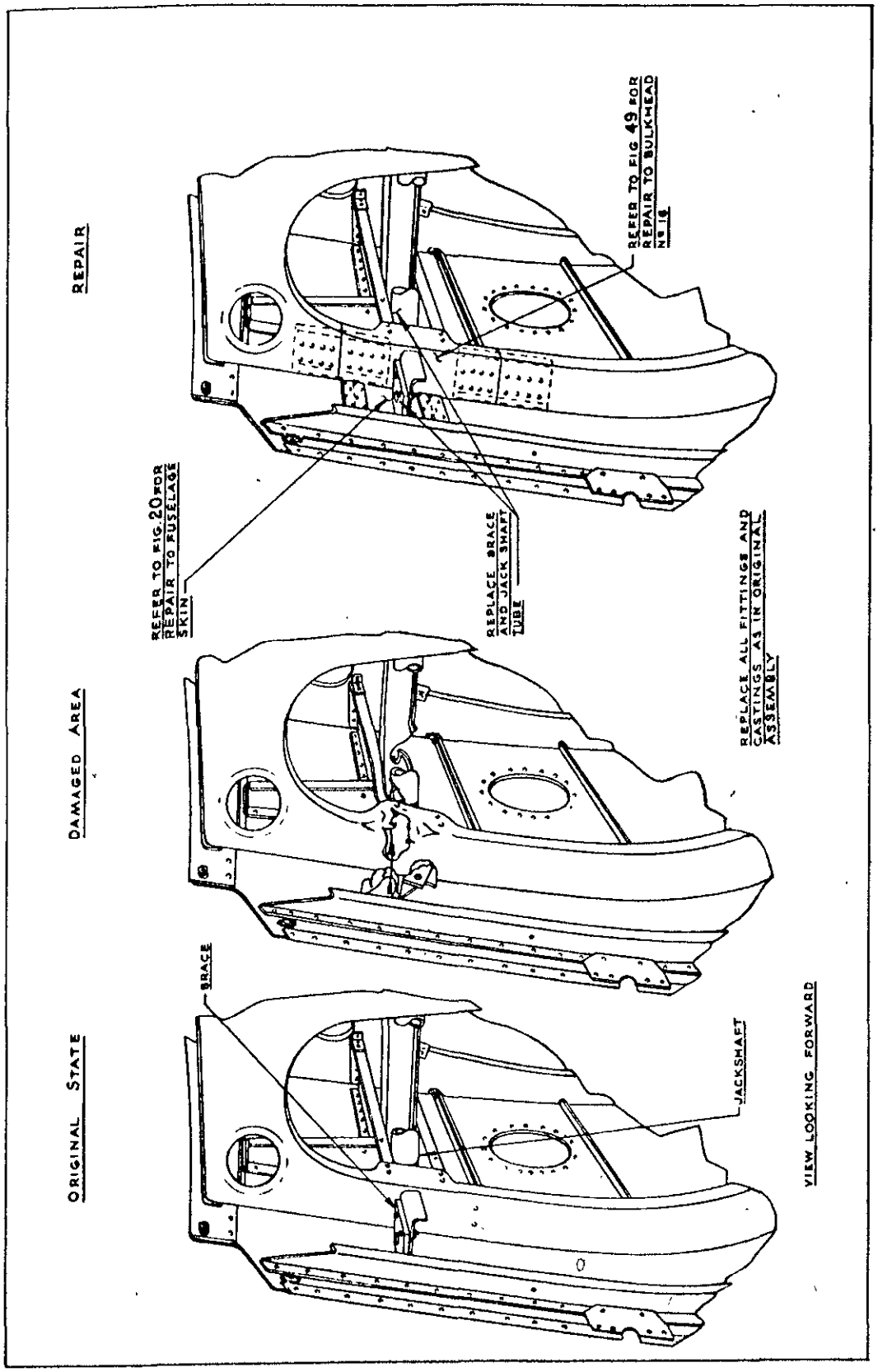


Figure 18 - Fuselage - Bulkhead Damage - Station No. 16

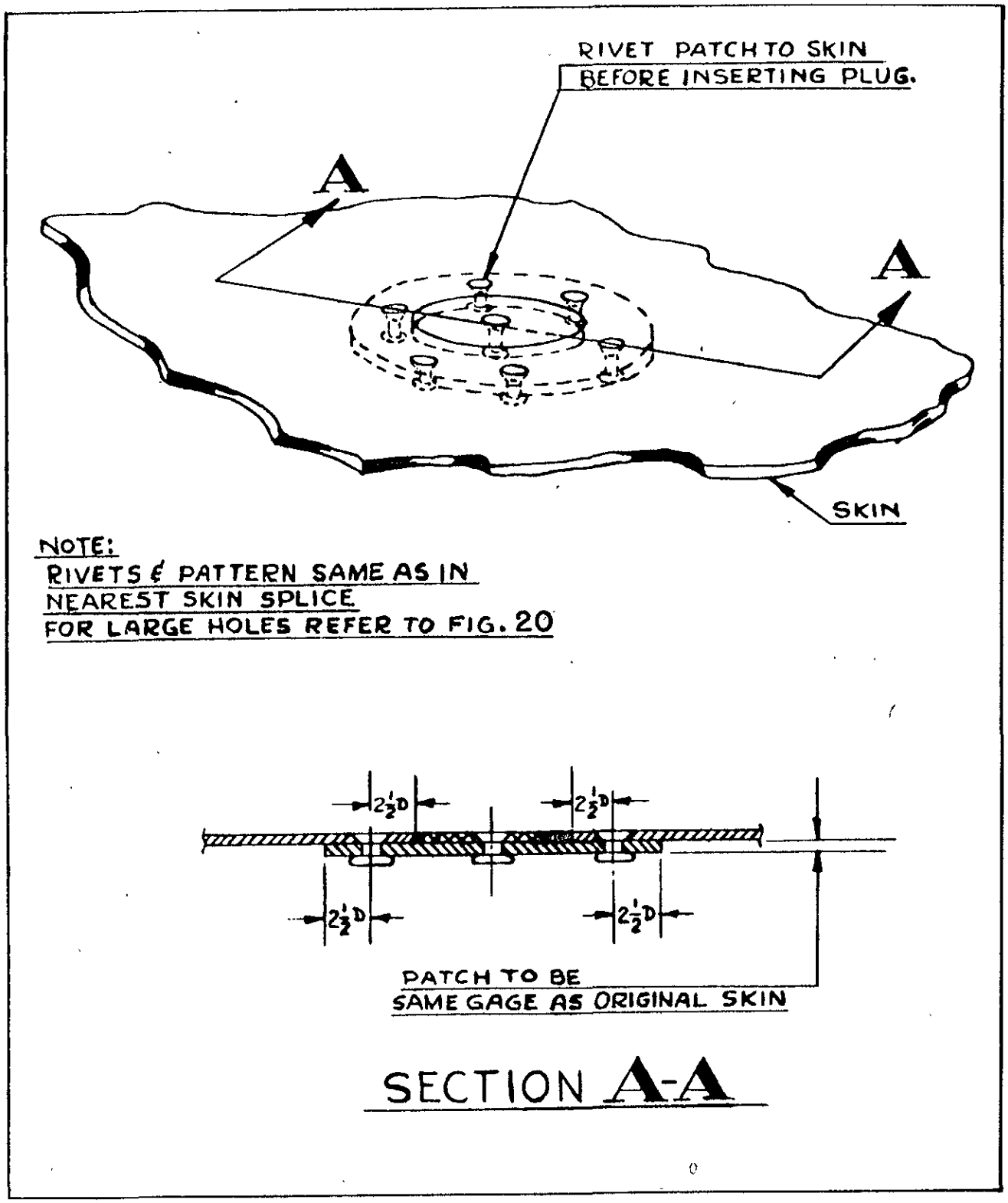


Figure 19 - Fuselage Skin - Small Patch

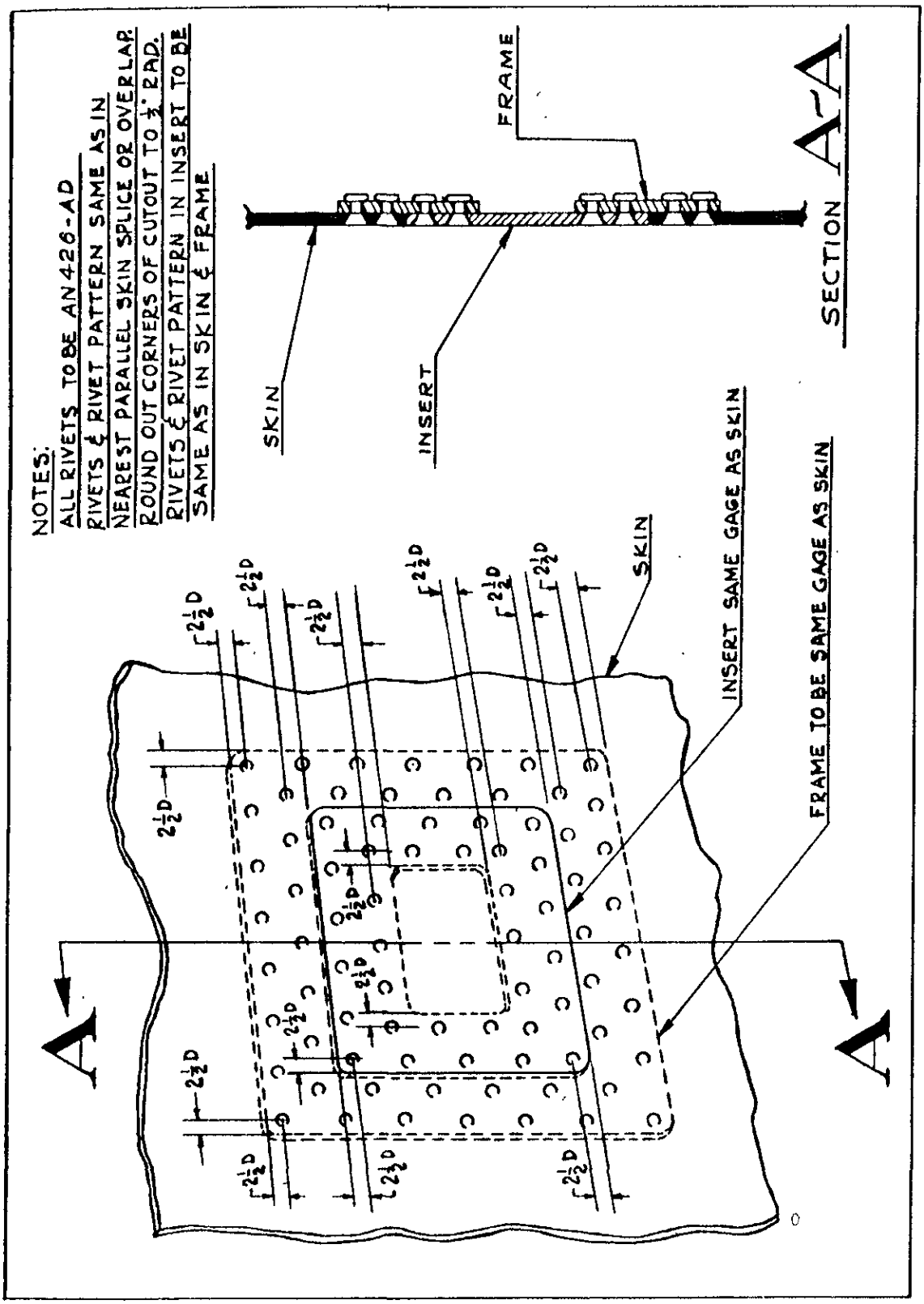


Figure 20 - Fuselage Skin Insert

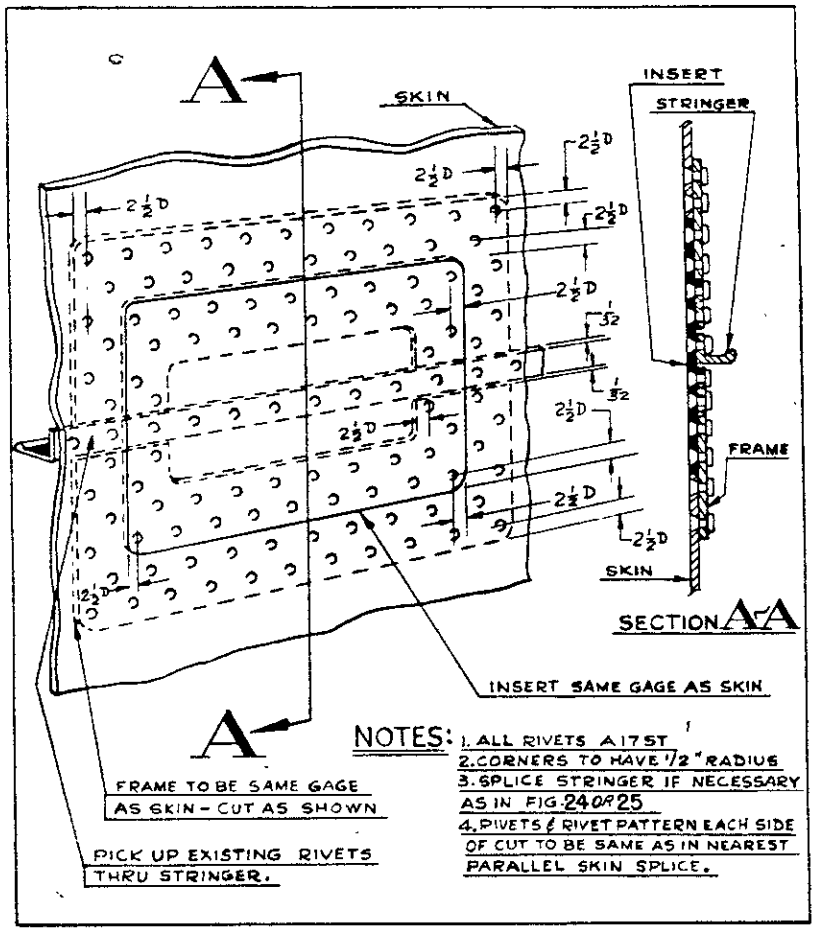


Figure 21 - Fuselage - Flush Skin Patch at Stringer

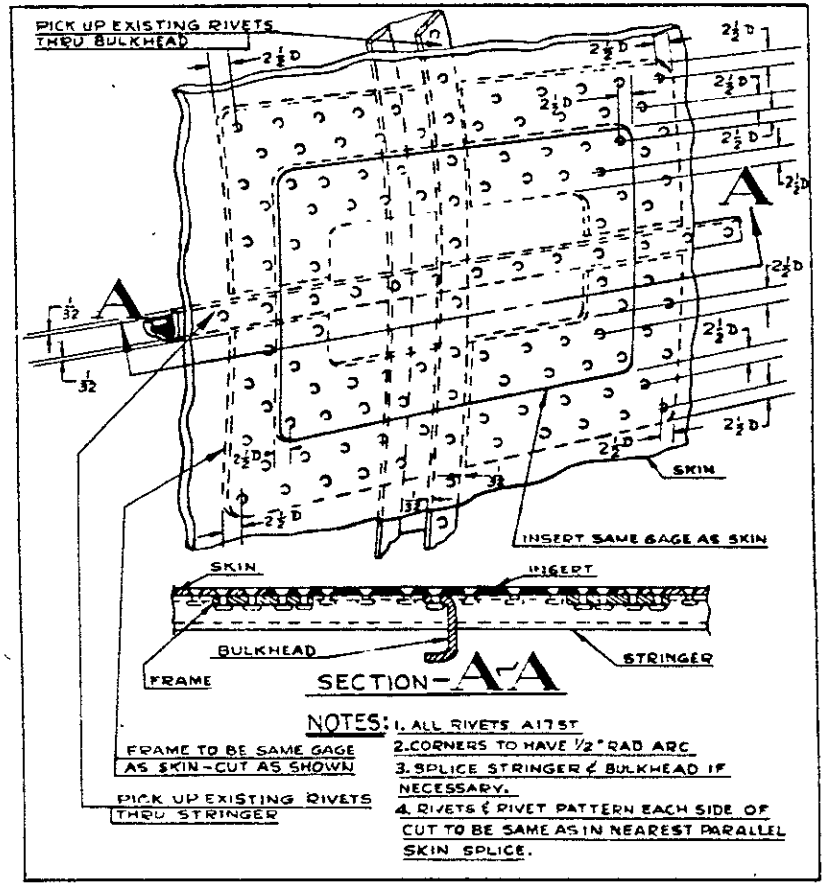
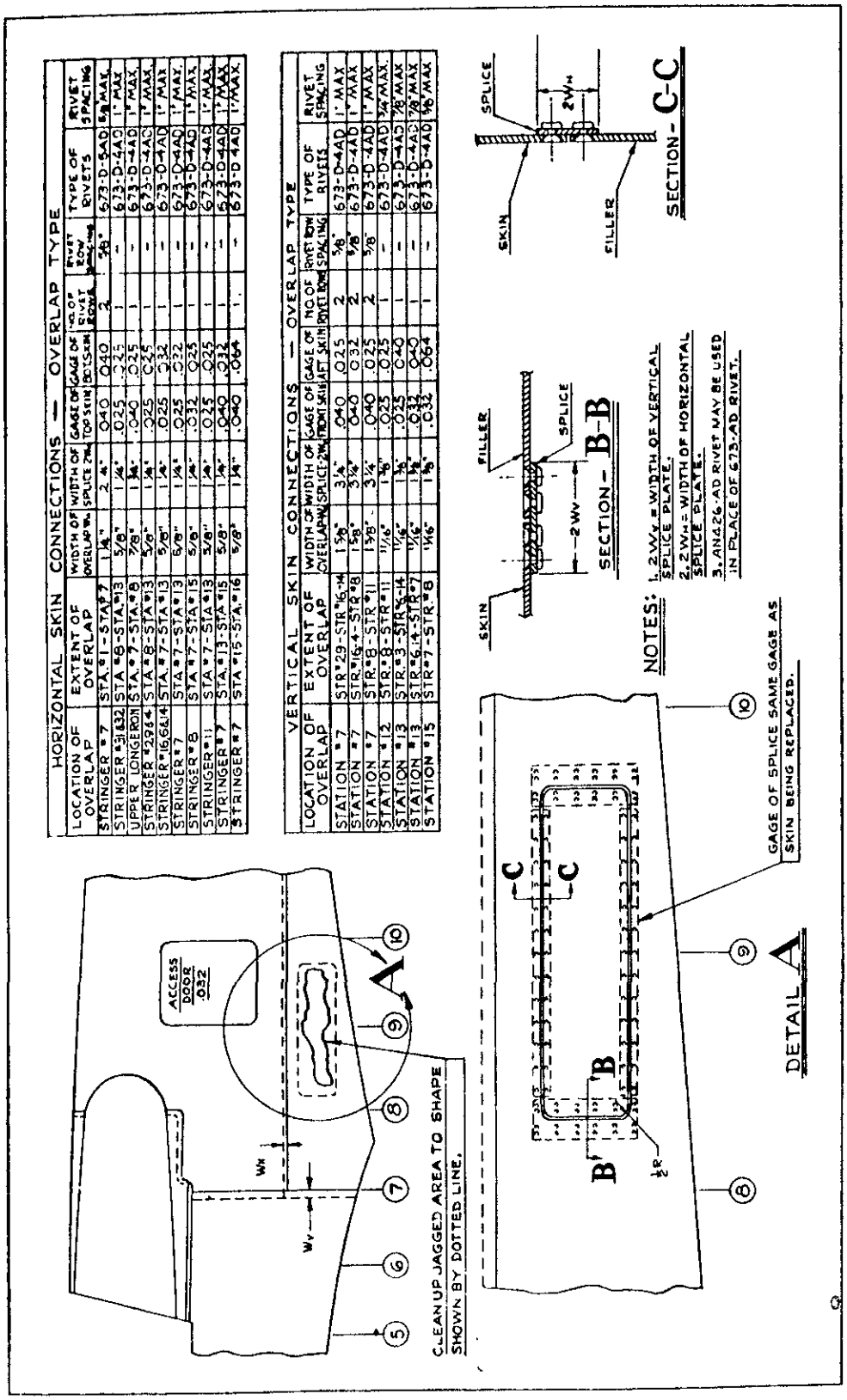


Figure 22 - Fuselage - Flush Skin Patch at Bulkhead



HORIZONTAL SKIN CONNECTIONS — OVERLAP TYPE

LOCATION OF OVERLAP	EXTENT OF OVERLAP	WIDTH OF OVERLAP "W"	WIDTH OF SPLICE "W"	GAGE OF TOP SKIN	GAGE OF BOTTOM SKIN	NO. OF RIVET ROWS	RIVET SPACING	TYPE OF RIVETS	RIVET SPACING
STRINGER "7	STA "1 - STA "7	1 1/4"	2 4"	.040	.040	2	5/8"	673-D-5AD	5/8" MAX.
STRINGER "3832	STA "8 - STA "13	5/8"	1 1/4"	.025	.025	1	-	673-D-4AD	1" MAX.
UPPER LONGERON	STA "7 - STA "8	7/8"	1 3/4"	.040	.025	1	-	673-D-4AD	1" MAX.
STRINGER "2944	STA "8 - STA "13	5/8"	1 1/4"	.025	.025	1	-	673-D-4AD	1" MAX.
STRINGER "6644	STA "7 - STA "13	5/8"	1 1/4"	.025	.032	1	-	673-D-4AD	1" MAX.
STRINGER "7	STA "7 - STA "13	5/8"	1 1/4"	.025	.032	1	-	673-D-4AD	1" MAX.
STRINGER "8	STA "7 - STA "15	5/8"	1 1/4"	.032	.025	1	-	673-D-4AD	1" MAX.
STRINGER "11	STA "7 - STA "13	5/8"	1 1/4"	.025	.025	1	-	673-D-4AD	1" MAX.
STRINGER "7	STA "13 - STA "15	5/8"	1 1/4"	.040	.032	1	-	673-D-4AD	1" MAX.
STRINGER "7	STA "15 - STA "16	5/8"	1 1/4"	.040	.064	1	-	673-D-4AD	1" MAX.

VERTICAL SKIN CONNECTIONS — OVERLAP TYPE

LOCATION OF OVERLAP	EXTENT OF OVERLAP	WIDTH OF OVERLAP	WIDTH OF SPLICE "W"	GAGE OF FROM SKIN	GAGE OF SPLICE "W" SKIN	NO. OF RIVET ROWS	RIVET SPACING	TYPE OF RIVETS	RIVET SPACING
STATION "7	STR "29 - STR "16.4	1 5/8"	3 1/4"	.040	.025	2	5/8"	673-D-4AD	1" MAX
STATION "7	STR "16.4 - STR "8	1 5/8"	3 1/4"	.040	.032	2	5/8"	673-D-4AD	1" MAX
STATION "7	STR "8 - STR "11	1 5/8"	3 1/4"	.040	.025	2	5/8"	673-D-4AD	1" MAX
STATION "12	STR "8 - STR "11	1 1/16"	1 5/8"	.025	.025	1	-	673-D-4AD	1/4" MAX.
STATION "13	STR "3 - STR "14	1 1/16"	1 1/8"	.025	.040	1	-	673-D-4A5	7/8" MAX
STATION "13	STR "6.14 - STR "7	1 1/16"	1 1/8"	.032	.040	1	-	673-D-4A5	7/8" MAX
STATION "15	STR "7 - STR "8	1 1/16"	1 1/8"	.032	.064	1	-	673-D-4A0	1/16" MAX

Figure 23 - Fuselage - Skin Repair - Large Insertion

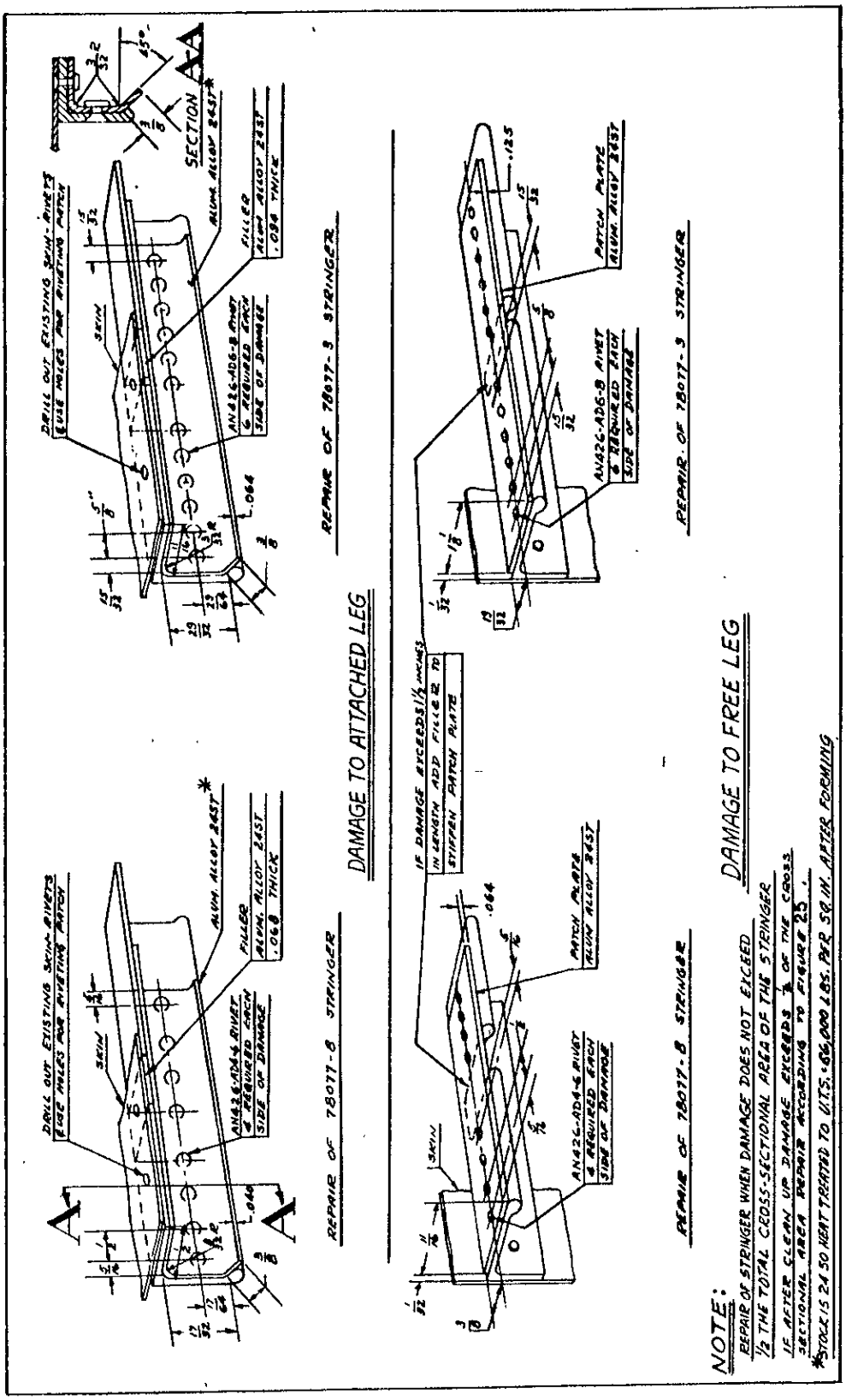


Figure 24 - Fuselage Stringers - Patches

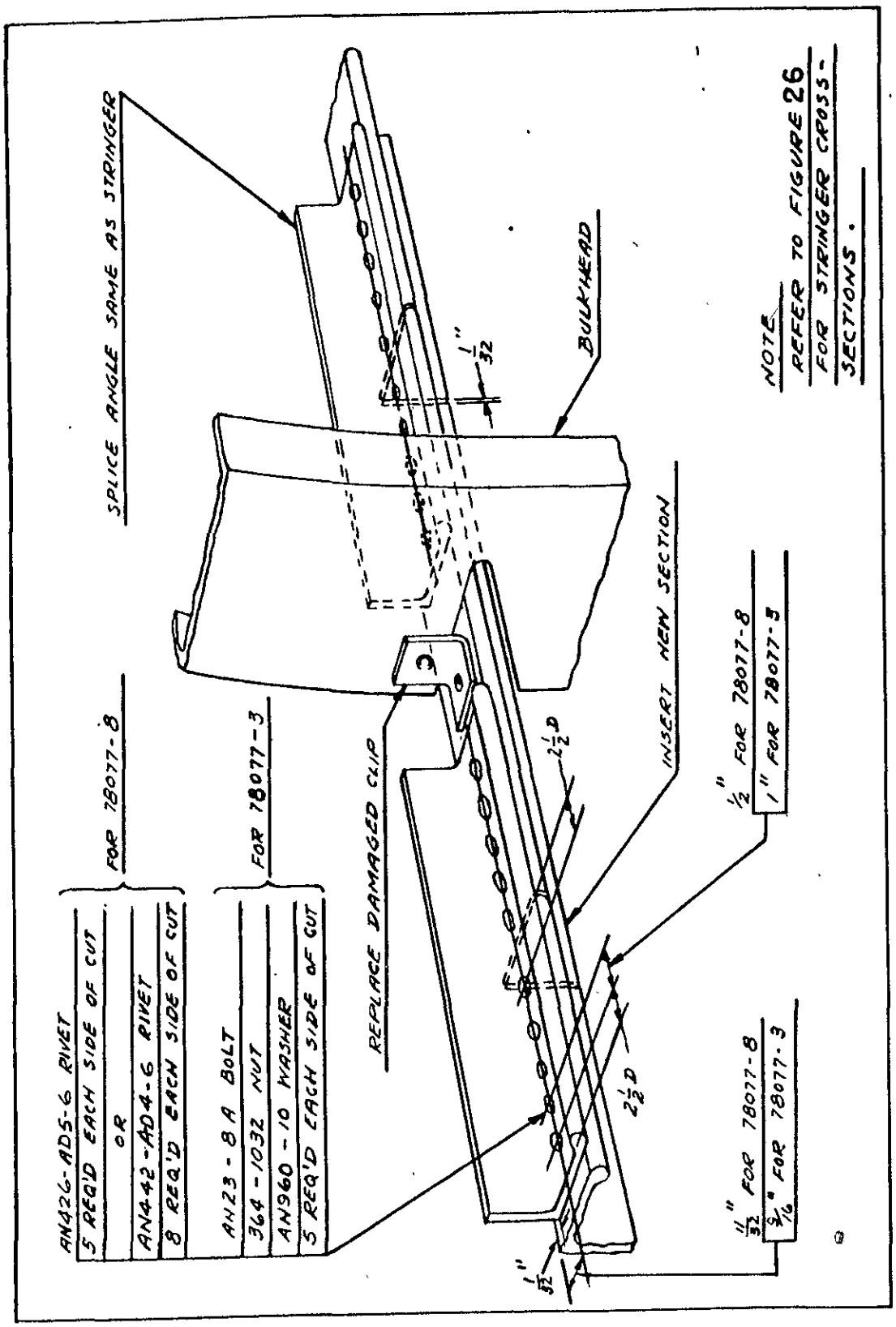


Figure 25 - Fuselage - Stringer Insert at Bulkhead

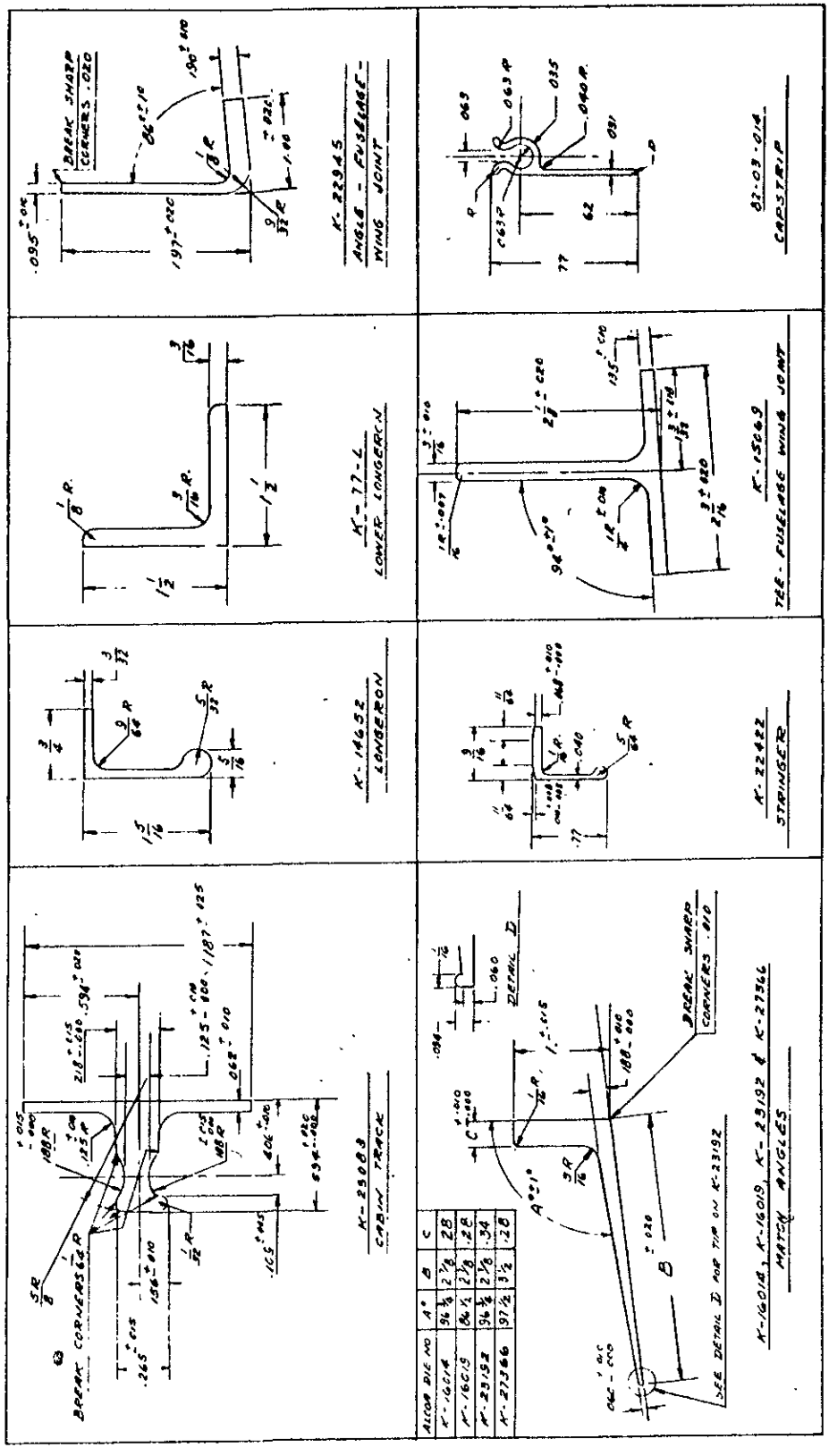


Figure 26 - Extruded Cross Sections

1/8 inch of the length of the damage as seen in a vertical cross section of the longerons. For sections aft of bulkhead No. 5 use one for each 5/16 inch of damage. The width of the patch should be at least 25 percent greater than the cross-sectional length of the damage and should be formed with a flange if a corner or bent part of the longeron is damaged. Rivet the flange of the patch to the longeron.

Small damages to the back of the longeron may be neglected if after cutting away the damaged material the adjacent corners or legs are undamaged. Replace any damaged reinforcements, fittings, and gussets and use the rivet patterns given in figure 31 to attach new sections of the cabin track.

c. Repair of Lower Longeron. - The extruded angle which is attached to the lower edge of the fuselage may be spliced between stations 3 and 4 as shown in figures 15 and 32. Minor damages to this member may be patched or reinforced with 3/16-inch 24ST sheet stock attached by one 3/16-inch A17ST rivet at each end of the damage for each 1/8-inch length of damage as seen in a vertical cross section. The cross section of each patch should be at least 25 percent greater than the maximum cross section of the damage.

The extruded "T" section which is attached to the upper surface of the wing cannot be repaired. Any damage which exceeds that caused by the bolt and rivet holes in adjacent cross sections will necessitate complete replacement of this extrusion.

Any damage to the gusset straps which reinforce the lower edges of the skin above the wing should be repaired by patching with 24ST sheet of the same gage as the damaged gusset using one 3/16-inch A17ST rivet for each 5/16 inch of damage measured along the cross section of the gusset or three rows of 3/16-inch rivets at 1-inch spacing around the damage.

6. Bulkheads.

a. General. - All bulkheads are designated by numbers counting aft from the fire wall. (See figure 10.) Each bulkhead is spliced on the horizontal reference line. The outer flange face of the bulkheads is cut out so as to clear the stringers. Due to the variation of design, the bulkheads or formed channels are individually paragraphed. When effecting a repair to the bulkheads, follow the procedure outlined for each specific case. In general the bulkheads are accessible. However, in some cases, the location of the damage may necessitate the dismantling of surrounding fittings and the stripping of the structure. All damaged fittings, clips, gussets, etc., should be replaced. Bulkhead patches and splice plates should be formed from sheet stock of the same gage and material as the damaged bulkhead. Splice plates should be formed with flanges as channels and inserted into the bulkhead. Rivet or bolt patterns are given for each bulkhead in the paragraphs which follow. A distinction is maintained between attachment to webs and attachment to flanges.

b. Types of Damage.

(1) Negligible Damage. - Small smooth isolated dents may be neglected provided the dents are free from cracks, abrasions, and sharp corners, and the adjacent rivets and bolts are not disturbed. Small holes in webs which after clean-up do not exceed an inch in diameter and are at least 1/2 inch from the nearest hole, edge of sheet, or inside flange may be neglected except in bulkhead sections which are reinforced.

(2) Cracks. - All cracks located in any part of the bulkhead structure must be drilled at the ends to prevent them from spreading. Use a 1/8-inch drill, whether the crack is considered negligible or otherwise. Cracks up to 1 inch in length and 1/2 inch from the inside flange or nearest rivet hole may be neglected.

c. Bulkhead No. 1.

(1) Bulkhead Frame. - The channel sections which form the frame around this bulkhead (figure 32A), should in general be replaced if damaged because of the low design margins and the difficulty of attaching repair material. (See figure 14.)

(2) Vertical Channels. - Minor repairs to the vertical channels may be effected in some cases by adding 24ST patches of the same gage as the damaged material. The design stresses in the flanges and in the bent material at the corners between the flanges and the back of the channels is such that the patch material must be attached with at least one 3/16-inch A17ST rivet above and below the damage for each 1/8 inch of damage measured horizontally after the damaged material has been cleaned away. For damage to the back of a channel use one 3/16-inch rivet above and below for each 3/16 inch of damage. The patching material should have at least 25 percent more cross-sectional area than the horizontal cross section of the damaged material and should be formed with a flange if the corner of the channel is damaged. Use the original rivet spacing and where possible the original rivet holes in attaching all reinforcing material.

(3) Lower Cross Member. - Minor repairs to either leg or to the back of the lower cross channel may be made using the data given in figure 33. For more extensive damage or damage requiring the use of more than two such patches the channel should be replaced as in figure 14.

(4) Upper Cross Member. - The hat section forming the upper cross member may be spliced as shown in figure 34 to facilitate the insertion of a new section. Minor damage to a leg or flange may be patched with an .081-inch 24ST angle attached with sixteen 3/16-inch A17ST rivets or four in each leg at each end of the damage plus those which are necessary in the damaged area. Use the existing rivet spacing.

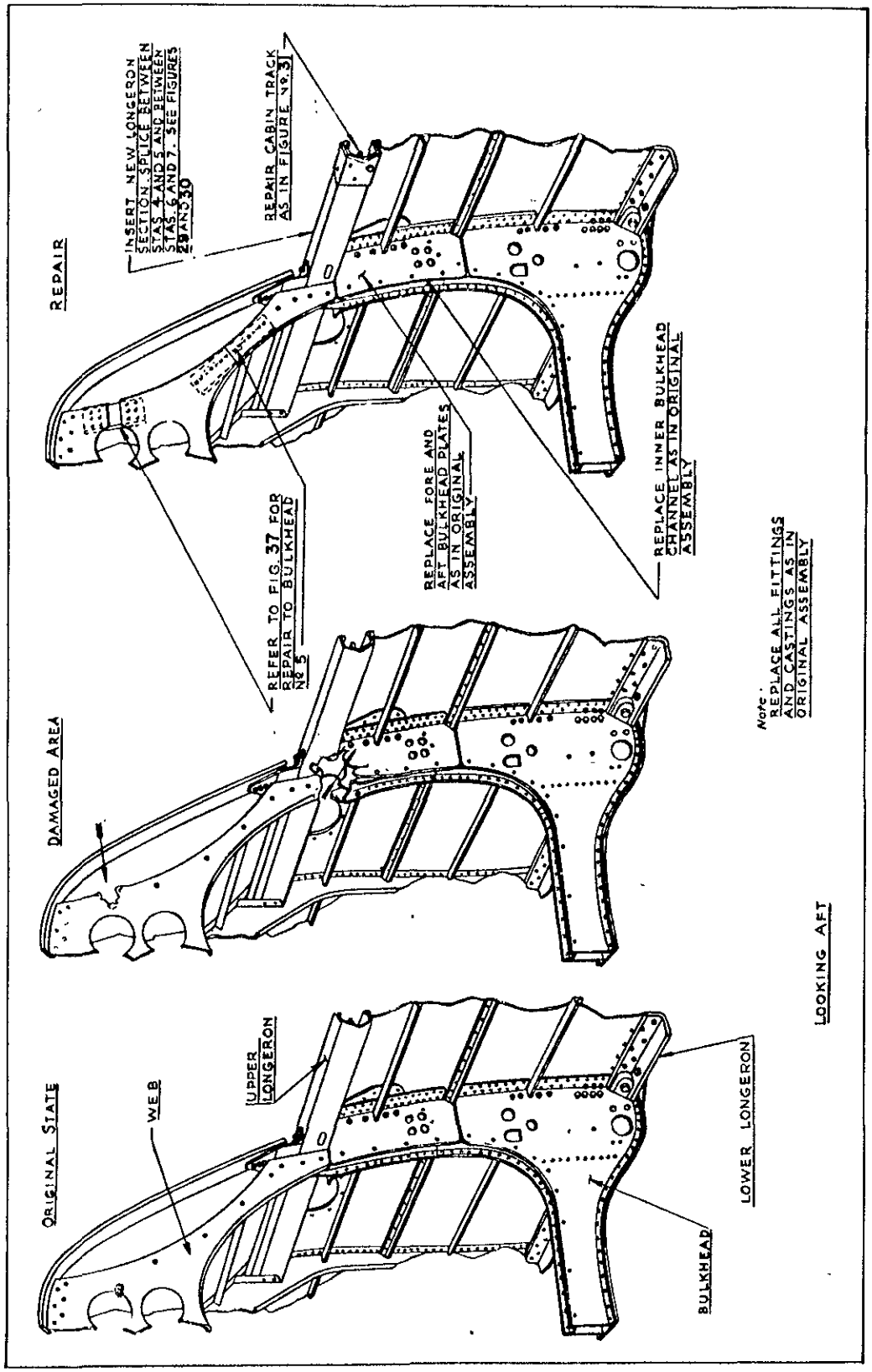


Figure 27 - Fuselage - Bulkhead and Longeron Damage Sta No. 5

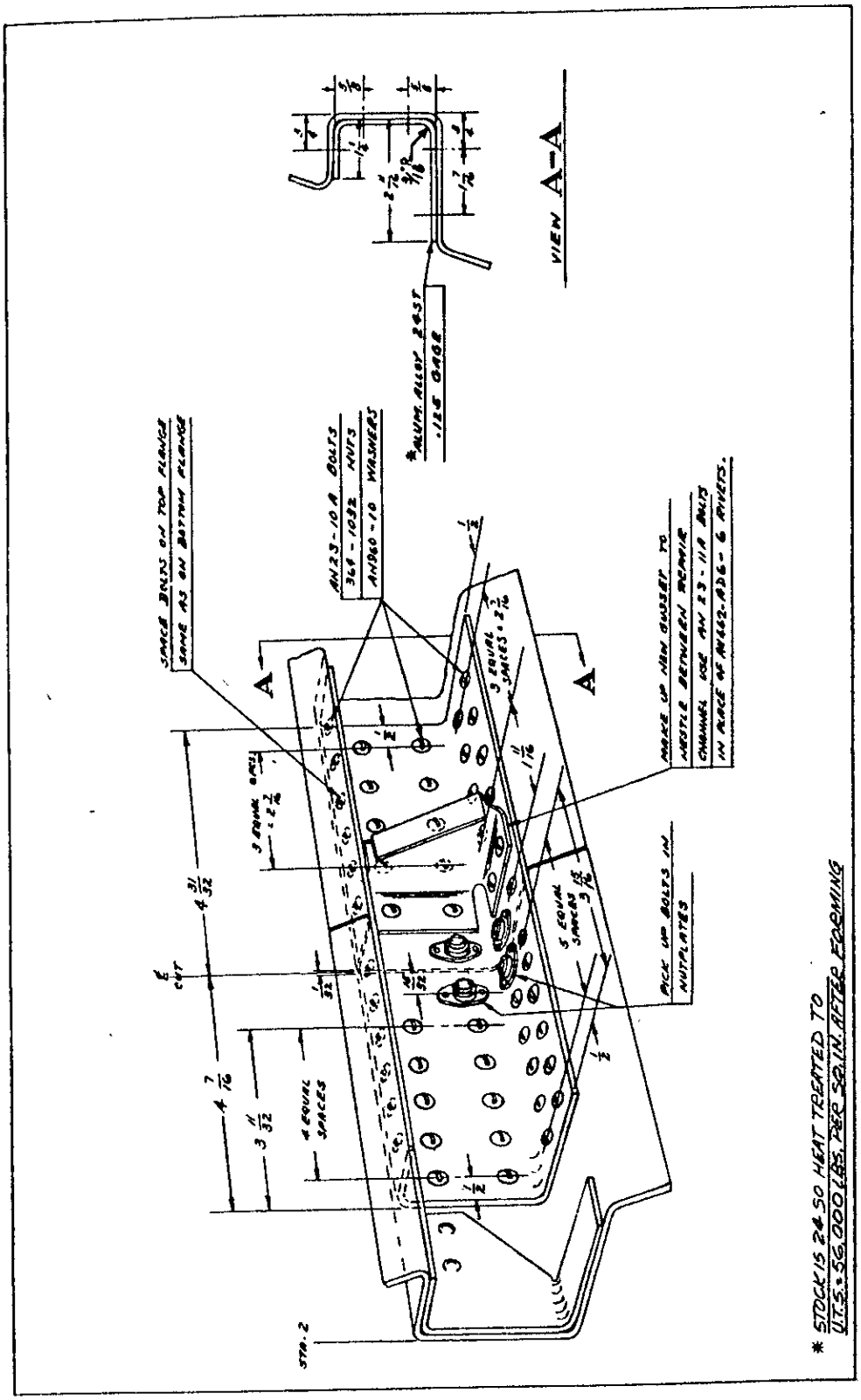


Figure 28 - Upper Longeron Splice - Sta 2 to 3

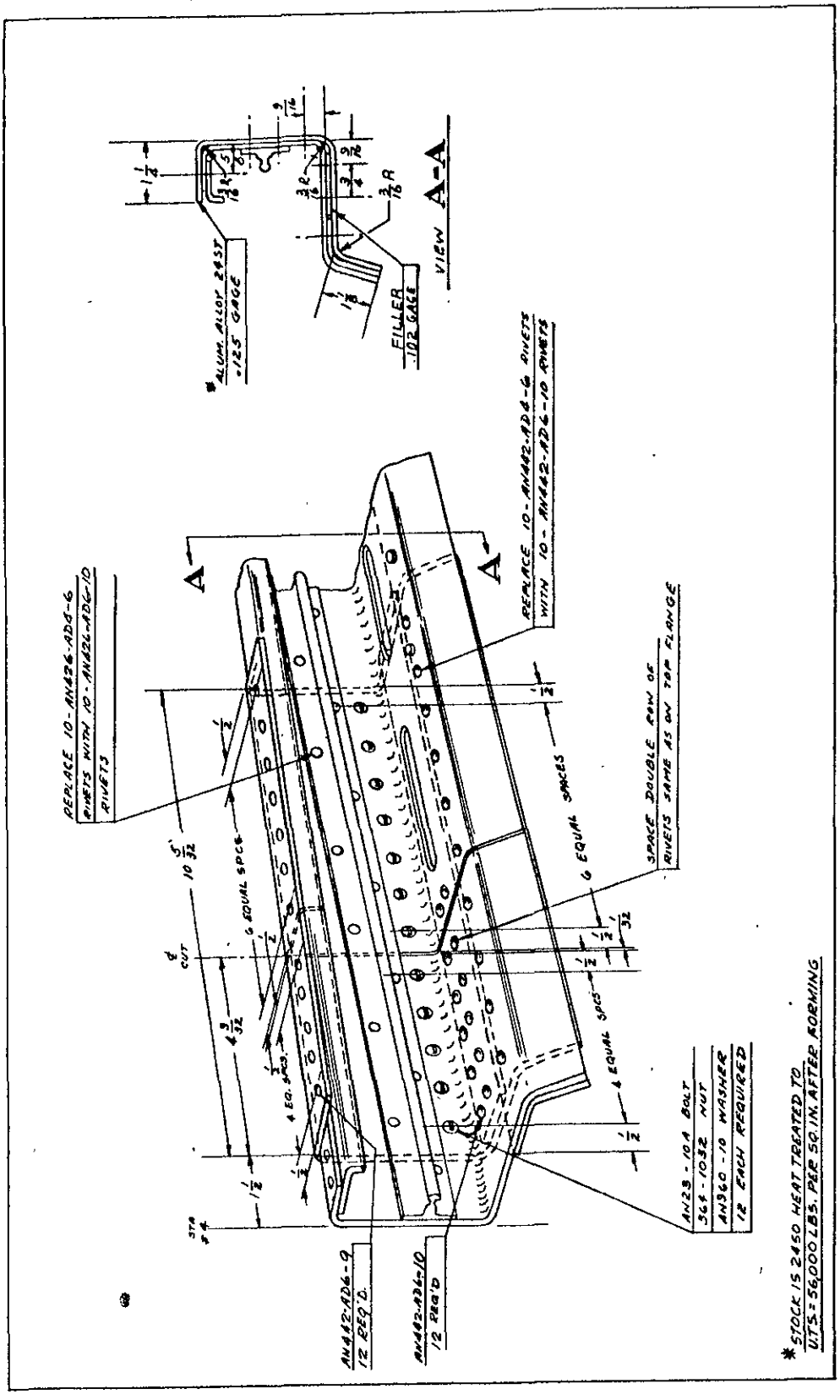


Figure 29 - Upper Longeron Splice - Sta 4 to 5

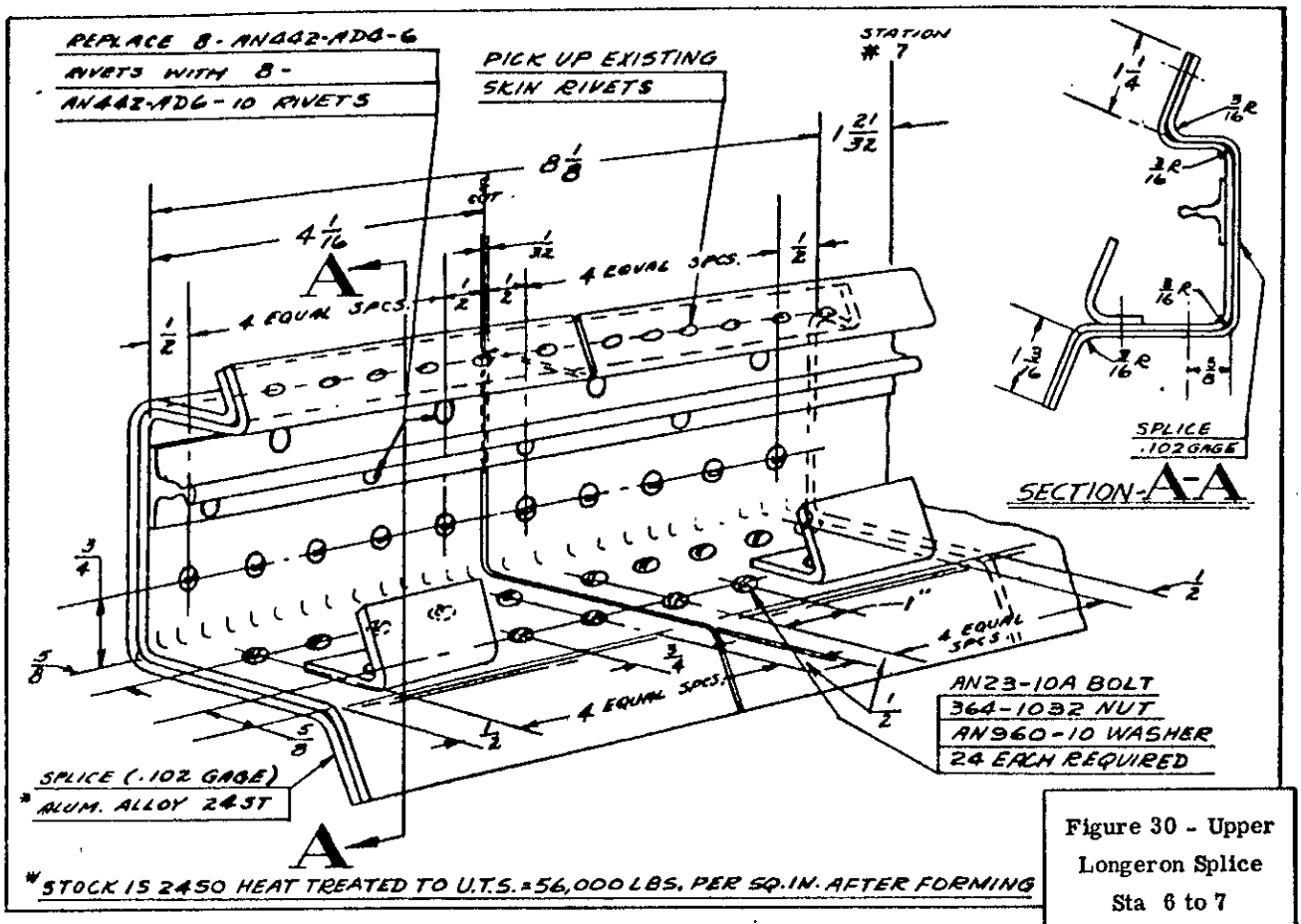
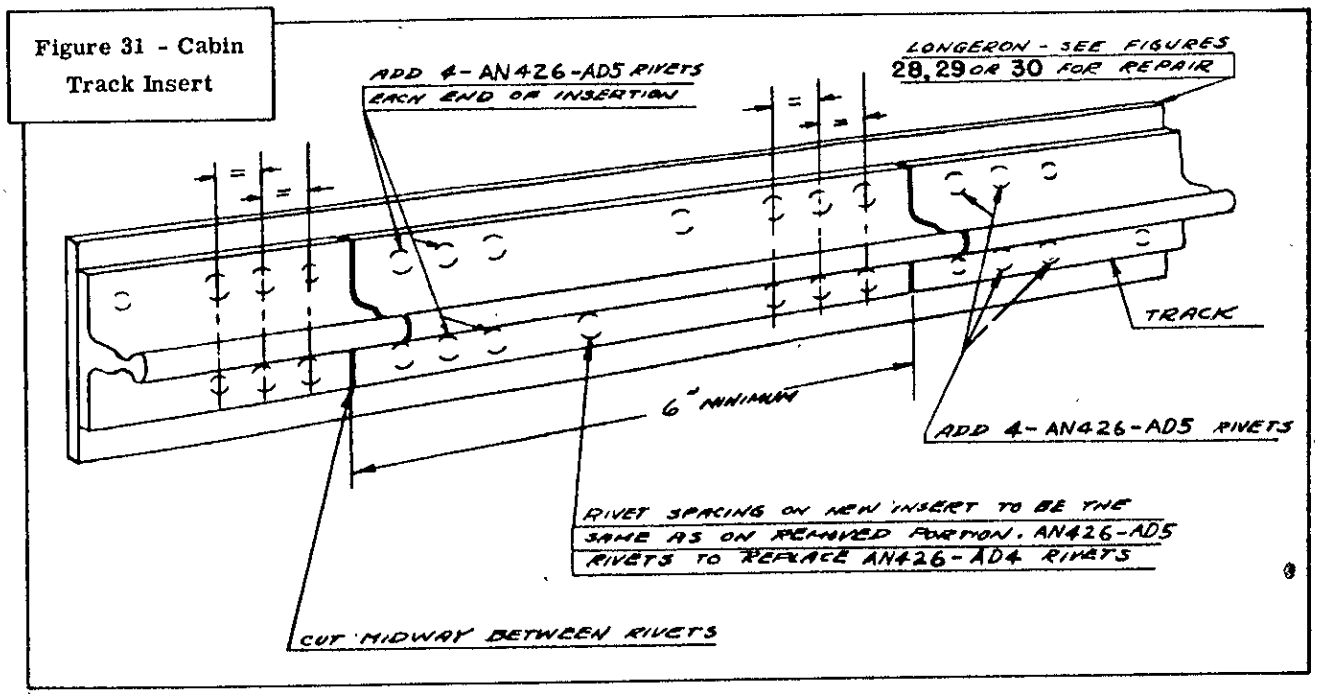


Figure 30 - Upper Longeron Splice Sta 6 to 7

Figure 31 - Cabin Track Insert



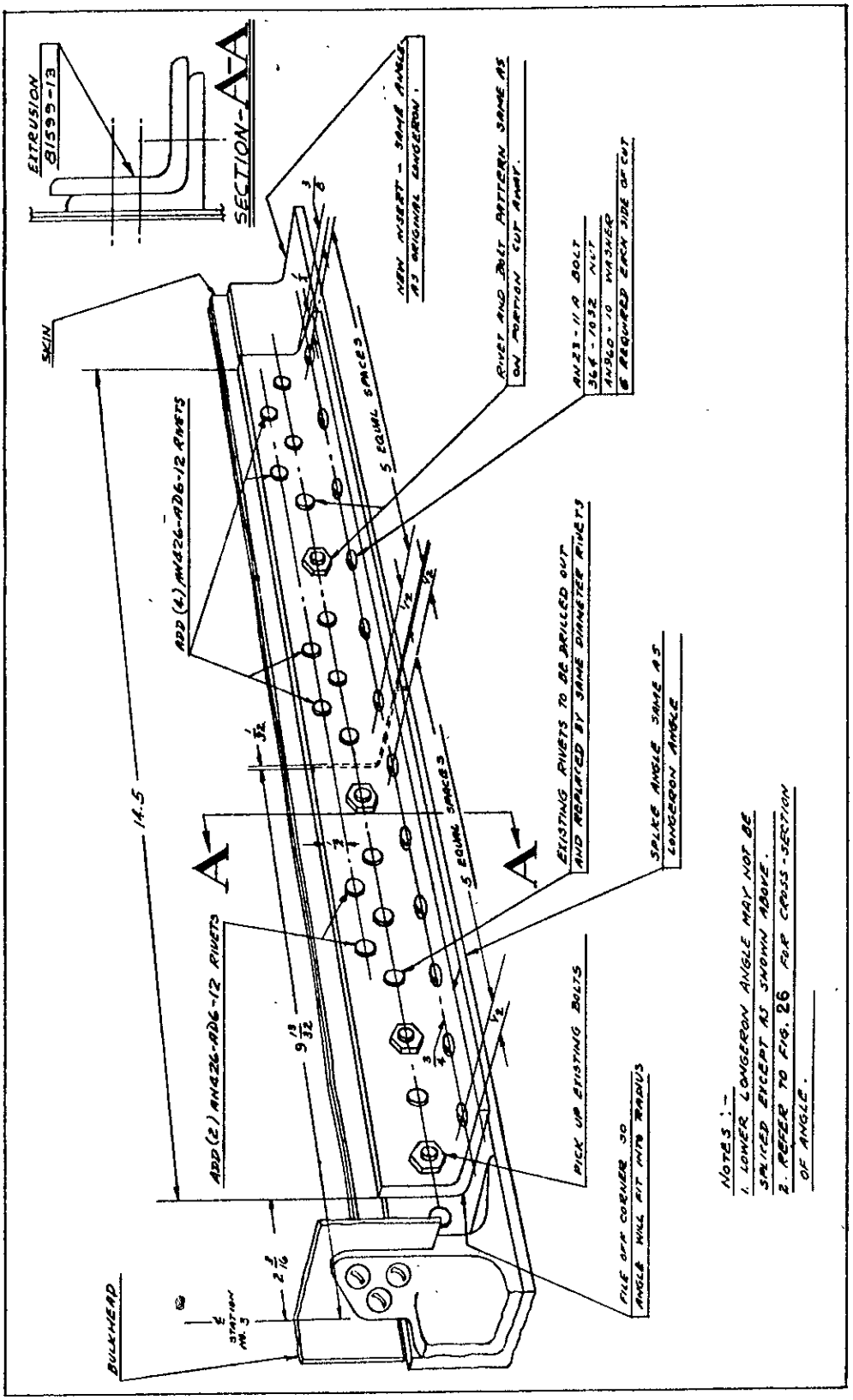


Figure 32 - Lower Longeron Splice - Sta 3 to 4

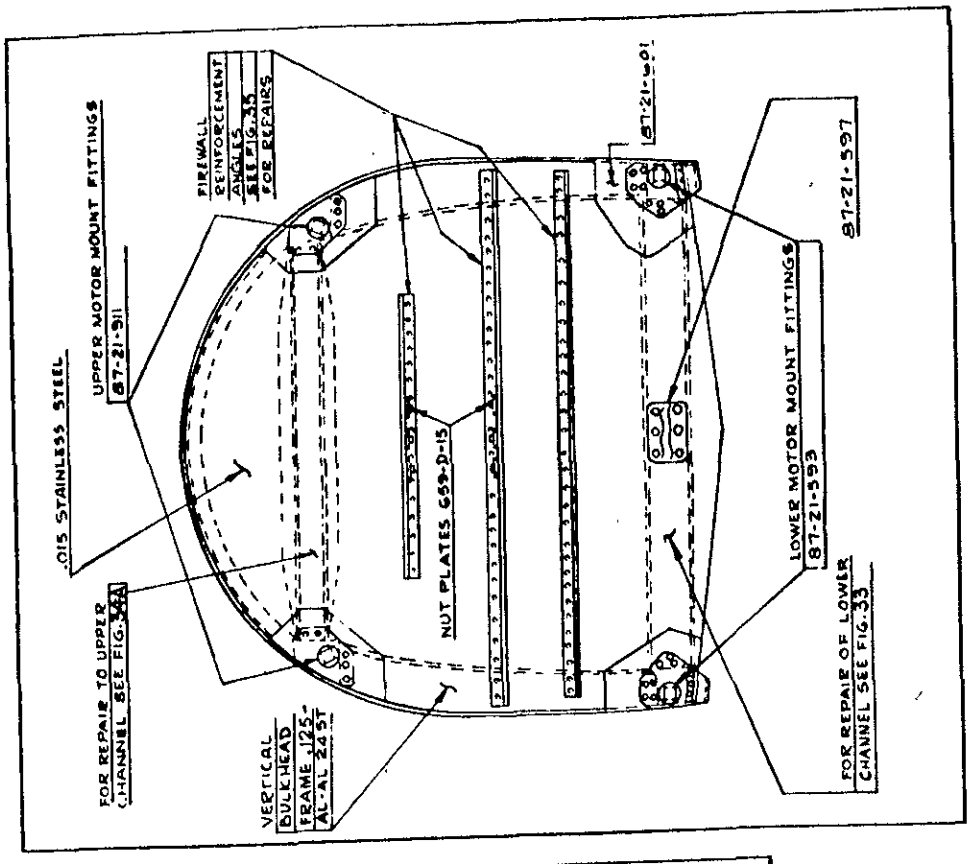


Figure 32B - Fuselage Fire Wall P-40F

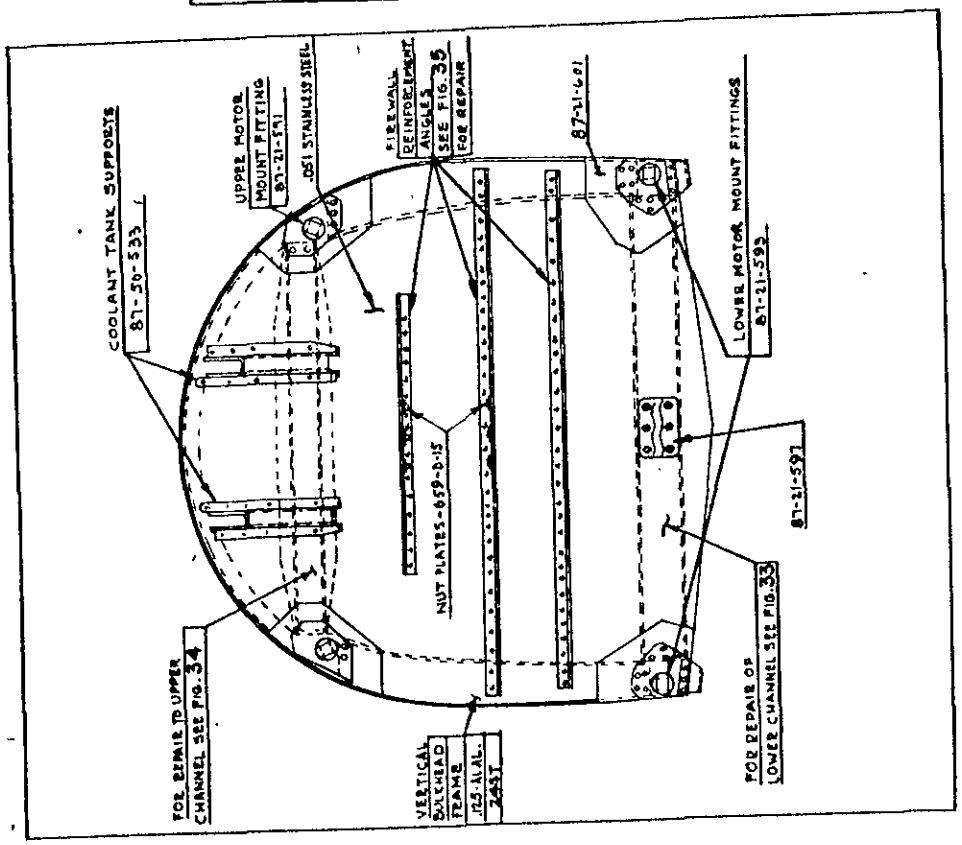


Figure 32A - Fuselage Fire Wall
P-40D, E, E-1

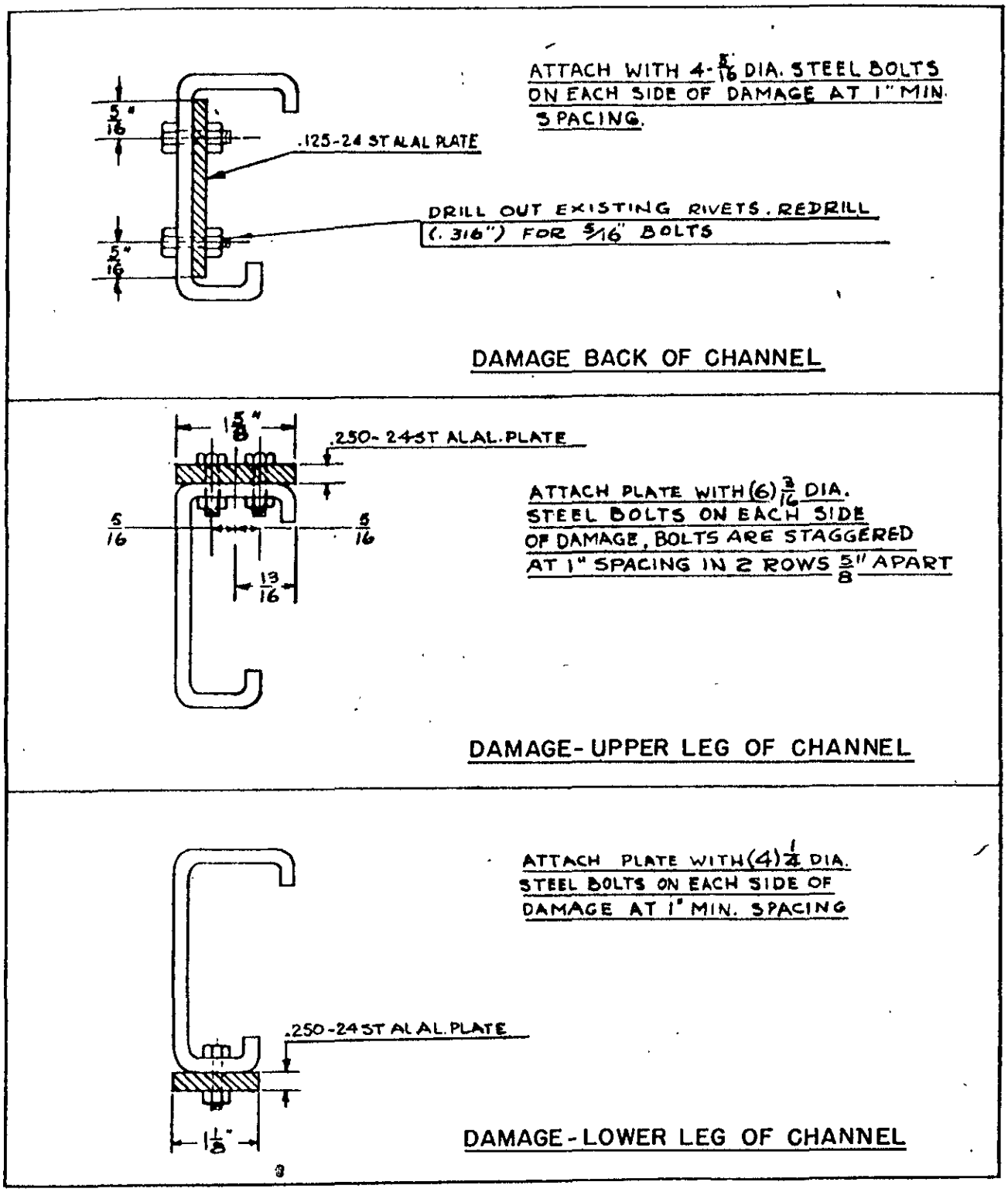


Figure 33 - Minor Repairs - Lower Channel Fire Wall

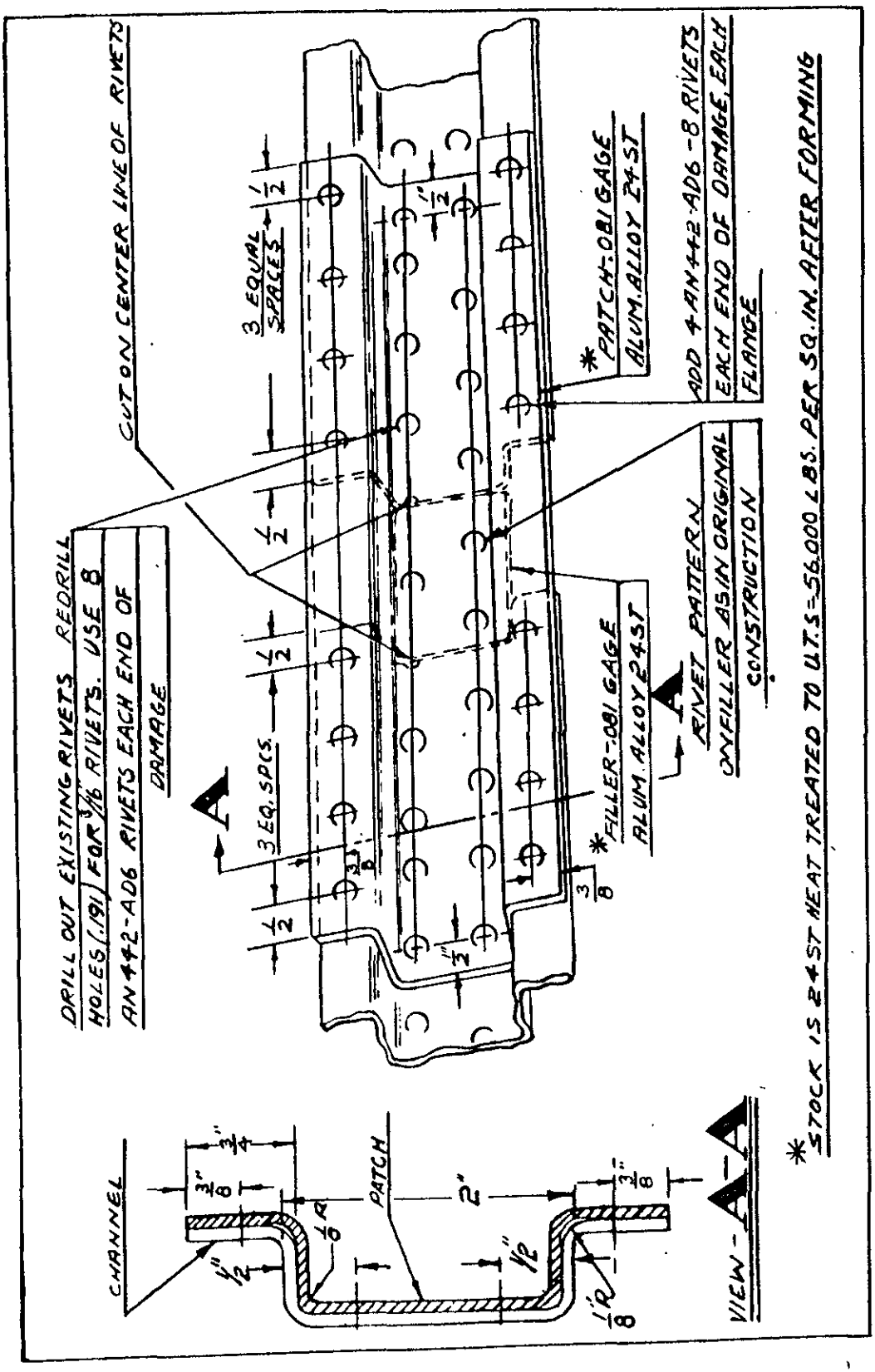


Figure 34 - Fire Wall - Upper Cross Channel Patch P-40D, E, E-1

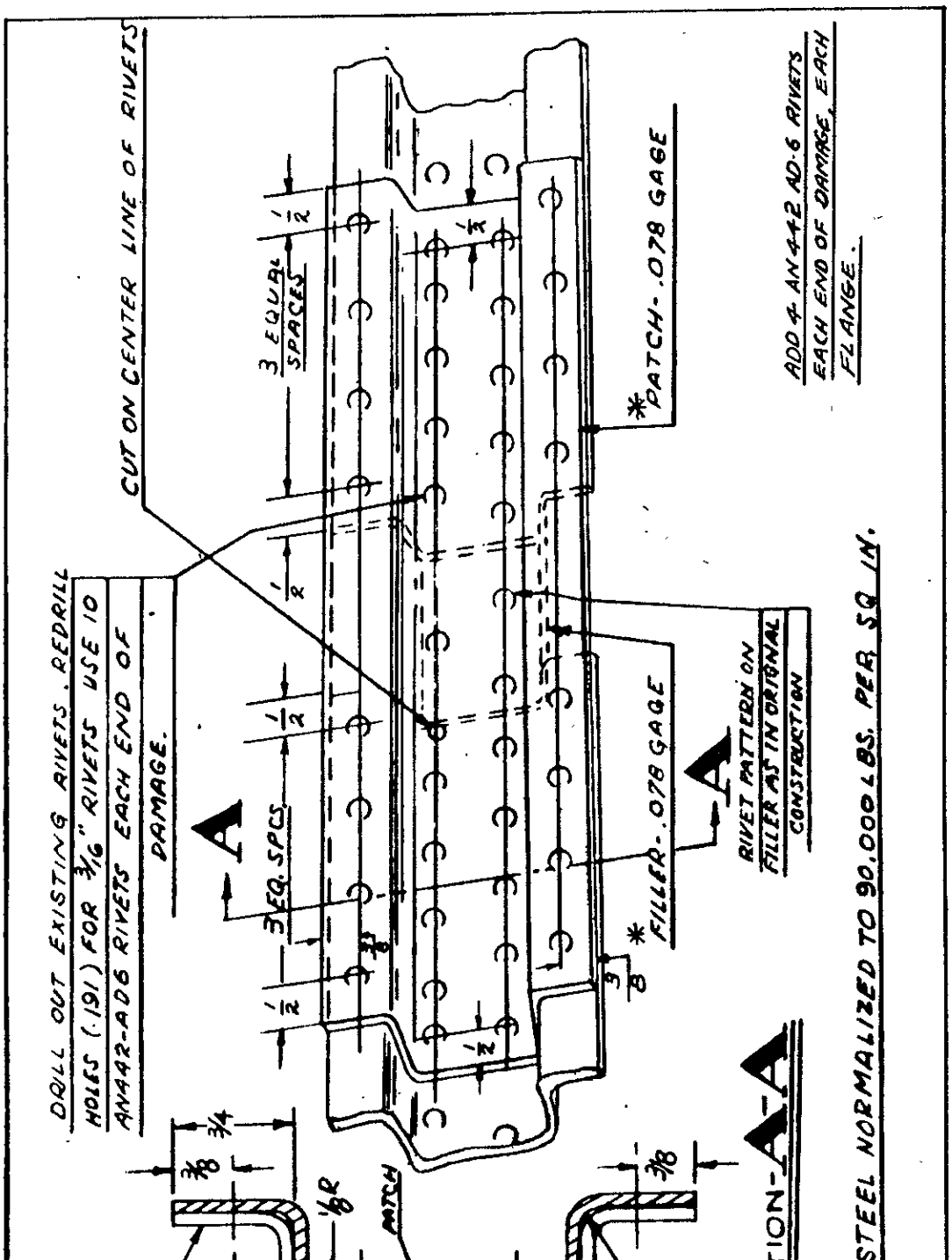


Figure 34A - Fire Wall - Upper Cross Channel Patch P-40F

(5) Fire Wall Stiffeners. - Figure 35 shows a typical repair which may be used for damage to the bulb angle stiffeners in the center of the bulkhead.

(6) Fire Wall. - The stainless steel fire wall sheet should be patched with .015-inch gage stock of the same material using two rows of AN442AD-4 rivets at 3/4-inch spacing completely around the damage for areas within the bulkhead frame and one row at 3/4-inch spacing for the area above the upper cross member. If the required rivet pattern cannot be obtained extend the patch to the edge of the original sheet or use inserts with conveniently located splices or frames of the same material. (See figure 36.)

(7) Fittings. - All fittings and gussets on the firewall and also the engine mount and coolant tank supports must be replaced if either they or their attachments are damaged.

d. Bulkheads Nos. 1A, 2, 3, and 4. - These bulkheads carry heavy axial loads caused by the diagonal tension in the skin between the upper and lower longerons and distribution of the loads from the wing to the fuselage. These bulkheads are heavily reinforced and, consequently, cannot be readily repaired. (See figure 15.) Due to their inherently low margins of safety, damage to these bulkheads or to their attachments cannot be neglected. In those cases where it appears feasible to repair minor damages instead of replacing the damaged parts, the table which follows may be used to determine the number of 3/16-inch A17ST rivets or 3/16-inch steel bolts to be used above and below the damaged area. In this table data is given separately for the back and for the inside flange of each upper channel, each lower channel and each flanged reinforcement. The data for the backs of the channels applies also to the flange which is next to the skin and the data for the flanges applies to the corner or bent material at the junction of the inner flange and the back. Repair each damage with 24ST sheet of the same gage as the original. Divide the width of the damage, measured horizontally after clean-up by the correct fraction of an inch as given in the table to determine the number of rivets or bolts to be used above and below the damage in attaching the repair material. Rivets should be used in preference to bolts where the number required is not excessive. If both the lower channel and reinforcement are damaged, each rivet or bolt may be used to attach the patches for both by placing the patches on opposite sides so as to load the rivets or bolts in double shear.

BULKHEAD		No. 1A		No. 2		No. 3		No. 4	
3/16 Rivets or Bolts		R*	B*	R	B	R	B	R	B
Lower Channel	Back	3/16	3/8	11/32	5/8	7/32	13/32	7/32	7/16
	Flange	1/16	1/8	1/8	7/32	1/32	1/16	3/32	3/16
Flanged Reinforcement	Back	5/32	3/8	5/16	5/8	7/32	13/32		
	Flange	1/16	1/8	1/8	1/4	1/32	1/16		
Upper Channel	Back	5/16	1/2	15/32	3/4	5/16	15/32	9/32	9/16
	Flange	5/32	1/4	7/32	11/32	5/32	7/32	1/8	7/32

*R=Rivet Data B=Bolt Data

Use existing holes or a minimum spacing of 3/4 inch for the above attachments. The stringer cut-outs are reinforced by the stringer clips which are designed to reinforce the bulkheads at the cut-outs. These fittings and their attachments as well as the fittings at the upper and lower ends of the bulkheads must be replaced if damaged.

e. Bulkhead No. 5.

(1) General. - This bulkhead is designed to support the fuselage in the event of a "Turn-over." The fitting at the top of the bulkhead transmits the load to the skin and stringers at the top of the fuselage aft of the bulkhead and to the armor plate which is attached to this bulkhead. The armor plate through its attachment at each side and along the bottom transmits the loads into the bulkheads which in turn transmits the loads to the fuselage skin and longerons.

(2) Upper Section. - Damage to the upper part of the bulkhead should be patched or reinforced with .064-inch gage 24ST aluminum-alloy stock attached with 1/8-inch A17ST rivets as shown in figures 16 and 37. Form a flange on the patch if an inside bulkhead flange is damaged. For extensive damage insert a new section or splice a new material as shown in the drawing. Damages which do not injure the flanges or the armor plate attachments may be neglected.

(3) Lower Section. - Damage to any of the lower sections of the bulkhead will in general necessitate replacing the damaged parts. (See figure 17.) Splices which may be used at the bottom of the bulkhead are shown in figure 38. Any damage which injures a bulkhead flange, splice, armor plate attachment or any fitting to the bulkhead must be repaired using equivalent material and method of attachment. Minor dents in the armor plate may be neglected. Do not, however, neglect large horizontal buckles as these will cause the bulkhead to collapse should the airplane turn over. The bolts attaching the armor plate to the bulkhead have a low margin of safety; consequently, any damaged bolts should be replaced or new bolts should be added on each side of each damaged bolt.

(4) Turn-Over Fitting. - The attachment of the large fitting at the top of the bulkhead to the fuselage has a low margin of safety. If the fuselage skin is damaged directly aft of this fitting, add a .040-inch gage 24ST patch large enough to take three rows of 3/16-inch A17ST rivets at 1-inch spacing around the damage plus all of the rivets and bolts in the fitting which are directly forward of the damage. Arrange the rivet pattern so as to use the original holes. Do not drill any additional holes in the fuselage skin immediately aft of this fitting. The stringer at the top of the fuselage which attaches to the bulkhead fitting should be spliced if damaged with a similiar stringer section and at least six 3/16-inch A17ST rivets on each side of the splice cut.

f. Bulkhead Nos. 6 to 12.

(1) Narrow Section. - In general any portion of these bulkheads which is not over 2-1/2 inches wide between flanges may be patched or spliced by adding a flanged plate as shown in figures 17 and 39. The plate should be of the same gage and material as the damaged portion of the bulkhead and should be shaped to fit the outer edge of the bulkhead. The flange on the inner edge should be the same as the inner flange on the bulkhead but may be formed straight. To attach the patch or splice use six 5/32-inch A17ST rivets for a .040-inch bulkhead or six 3/16-inch rivets for a .064-inch bulkhead spaced at 1-inch minimum in the channel web on each side of the damage or cut.

(2) Wide Sections. - Minor damage to the wider portions of these bulkheads may in general be repaired by patching with a sheet of the same gage and material and two rows of 5/32-inch A17ST rivets completely around the damage. (See figure 40.) Extensive damage may be repaired by the use of insert; use two rows of 5/32-inch rivets along each side of the line of cut as illustrated in figure 42. For .040-inch bulkheads use a maximum spacing of 1 inch for the rivets and on the .064-inch bulkheads use a maximum spacing of 3/4 inch.

(3) Lower Sections. - Nos. 6 and 7 have reinforcing angles at the bottom. (See figure 17.) These angles may be spliced or patched by nestling a similar angle into the damaged angle and attaching with AN442AD-5 rivets in both flanges. The required number of rivets per flange on each side of the damage is five minus one-fifth the number of rivets in one flange of the angle between the damage and the vertical center line of the bulkhead.

(4) Special Repairs. - Exceptions to the preceding general rules are as follows:

(a) Bulkhead No. 8. - Any splice below stringer 10 requires a minimum of eight 3/16-inch rivets at 3/4-inch spacing on each side of a splice cut.

(b) Bulkhead No. 9. - Use two rows of 5/32-inch rivets at 3/4-inch spacing around any damage below stringer 11. For a splice in this region use eight 5/32-inch rivets at 3/4-inch to 1-inch spacing on each side of splice cut.

(c) Bulkhead No. 10. - Use three rows of 1/8-inch rivets at 1-inch spacing around any damage below stringer 11. For a splice in this region use nine 1/8-inch rivets at 3/4-inch to 1-inch spacing on each side of splice cut.

(5) Structural Clips. - Stringer 10 is attached to bulkheads Nos. 7 and 8 by structural clips. Any damage to the attachment of these clips will require reinforcement or replacement of the damaged portion of the bulkhead.

All damaged gussets, clips, splices, etc., must be replaced.

g. Bulkhead No. 13.

(1) Upper Section. - Minor damage to the upper half of this bulkhead may be repaired with .064-inch 24ST sheet attached by two rows of 1/8-inch rivets at 5/8-inch spacing completely around the damage.

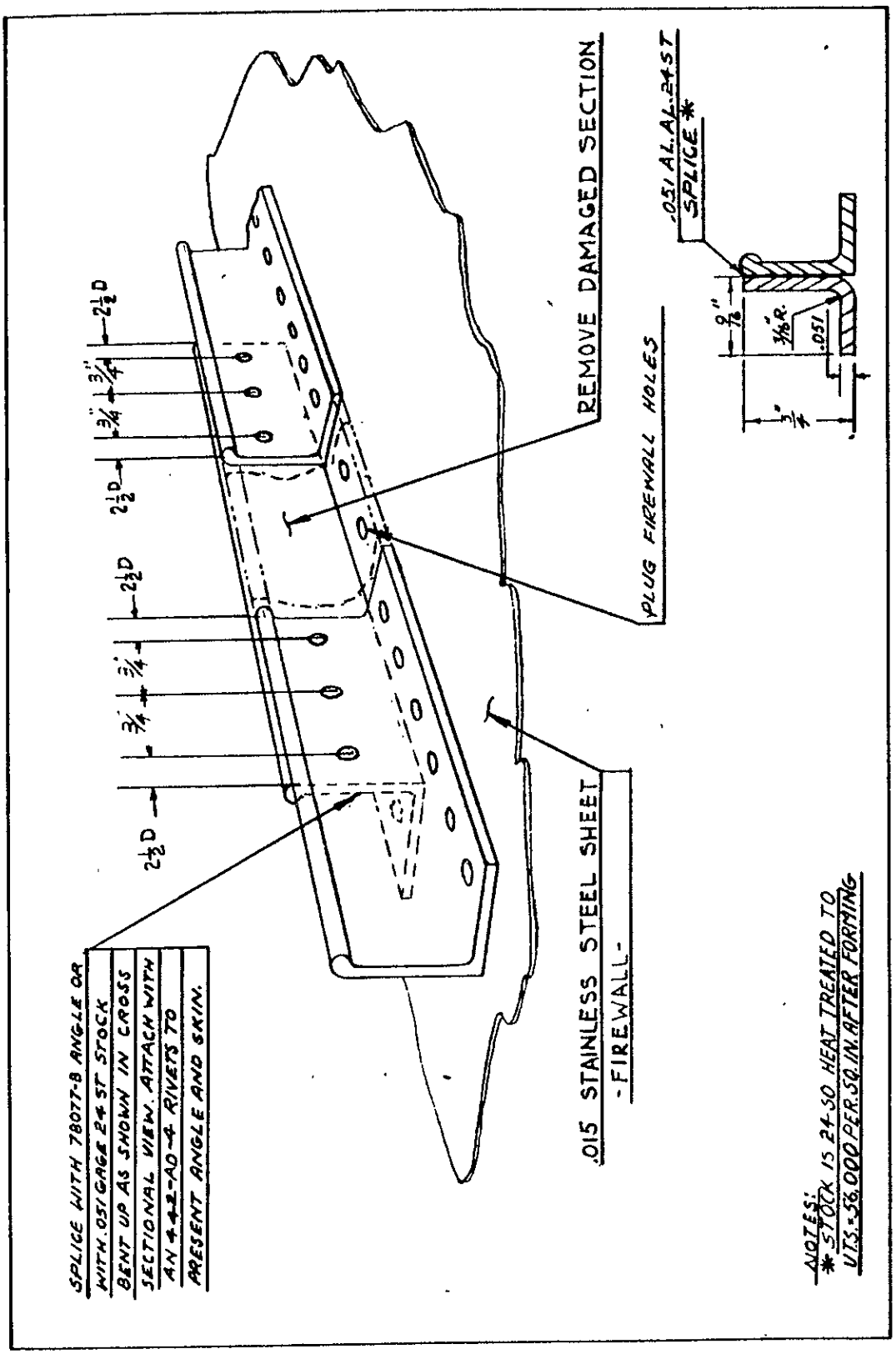


Figure 35 - Fire Wall Reinforcement Patch

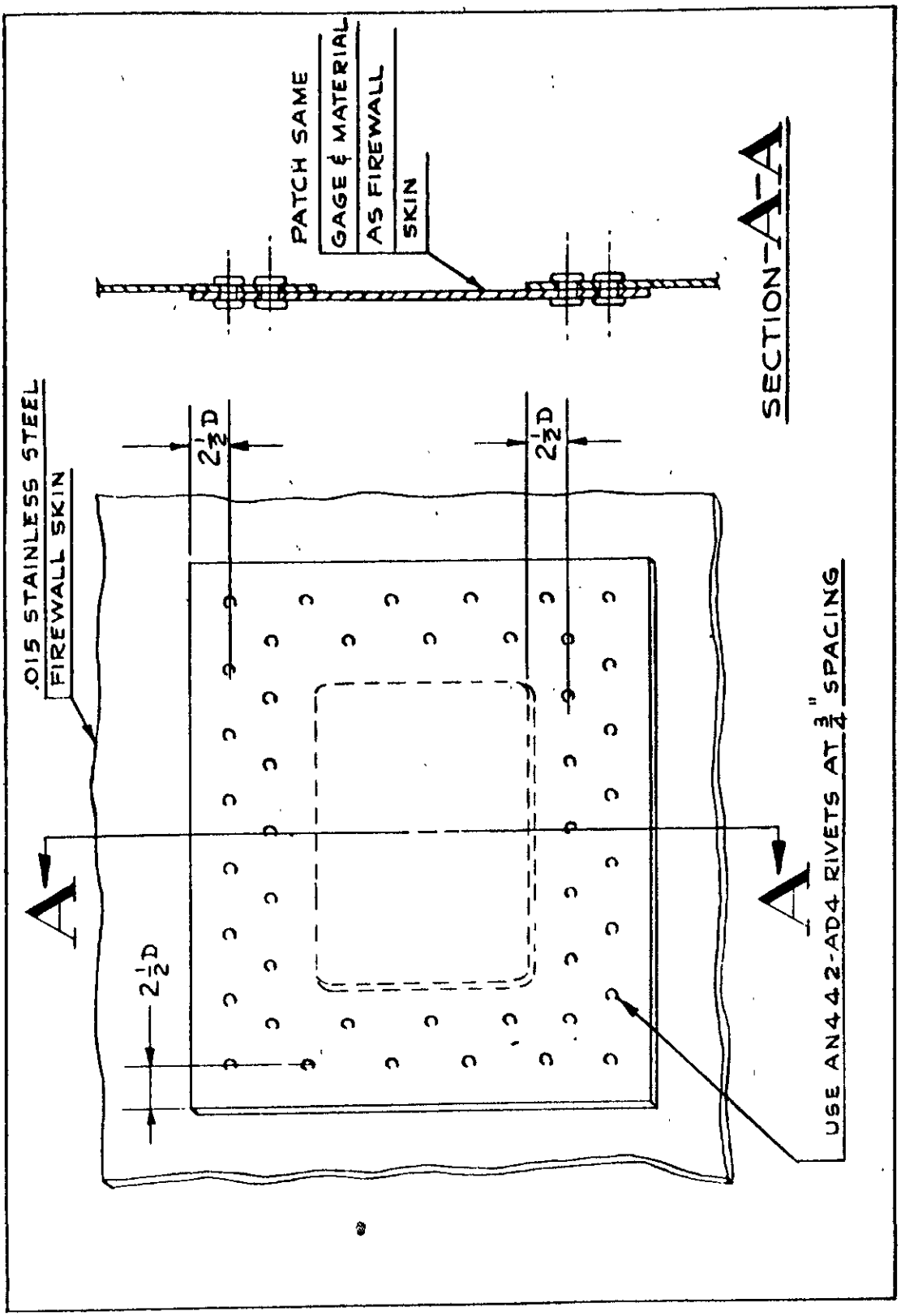


Figure 36 - Fire Wall Skin Repair

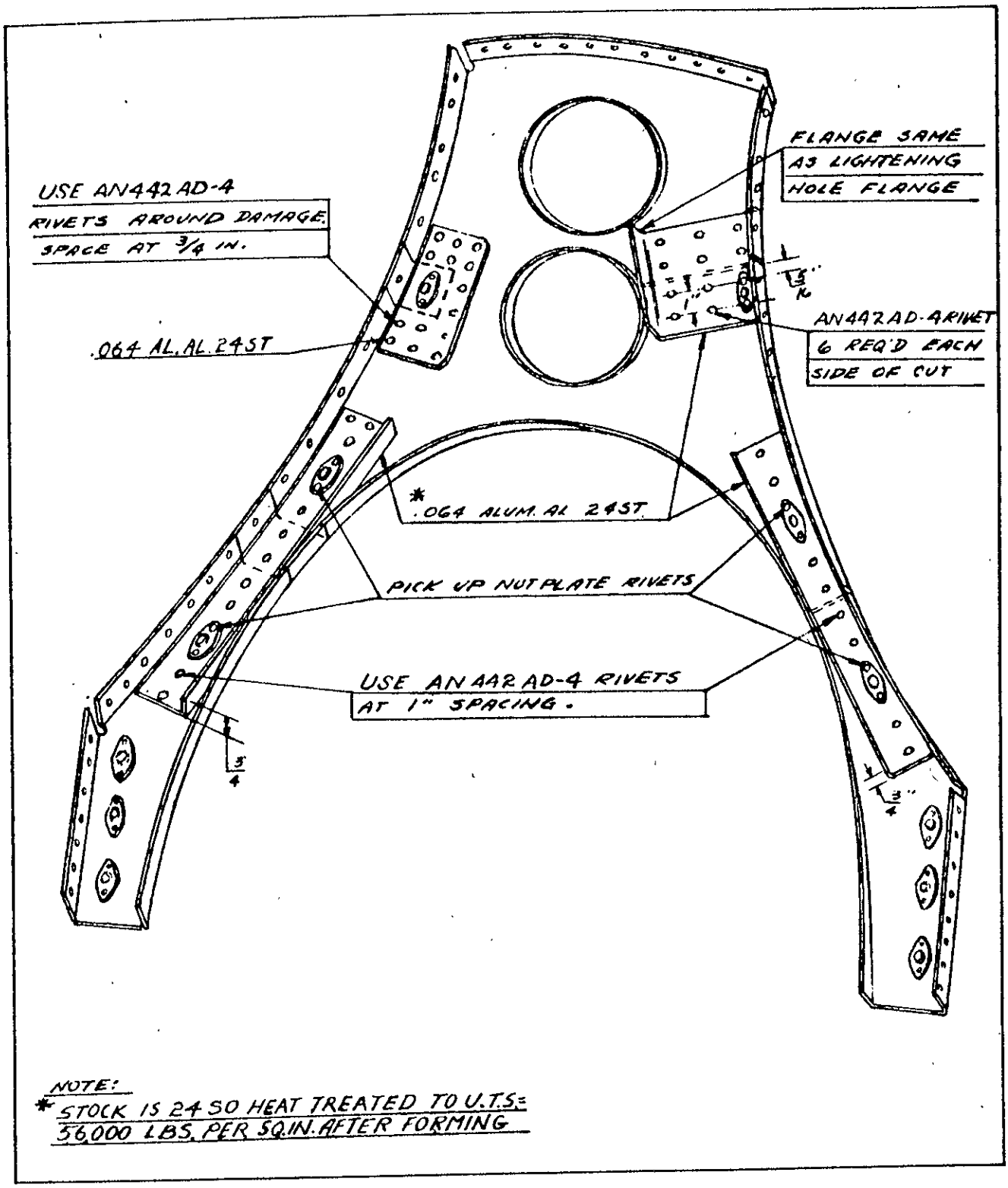


Figure 37 - Bulkhead No. 5 - Upper Splices and Patches

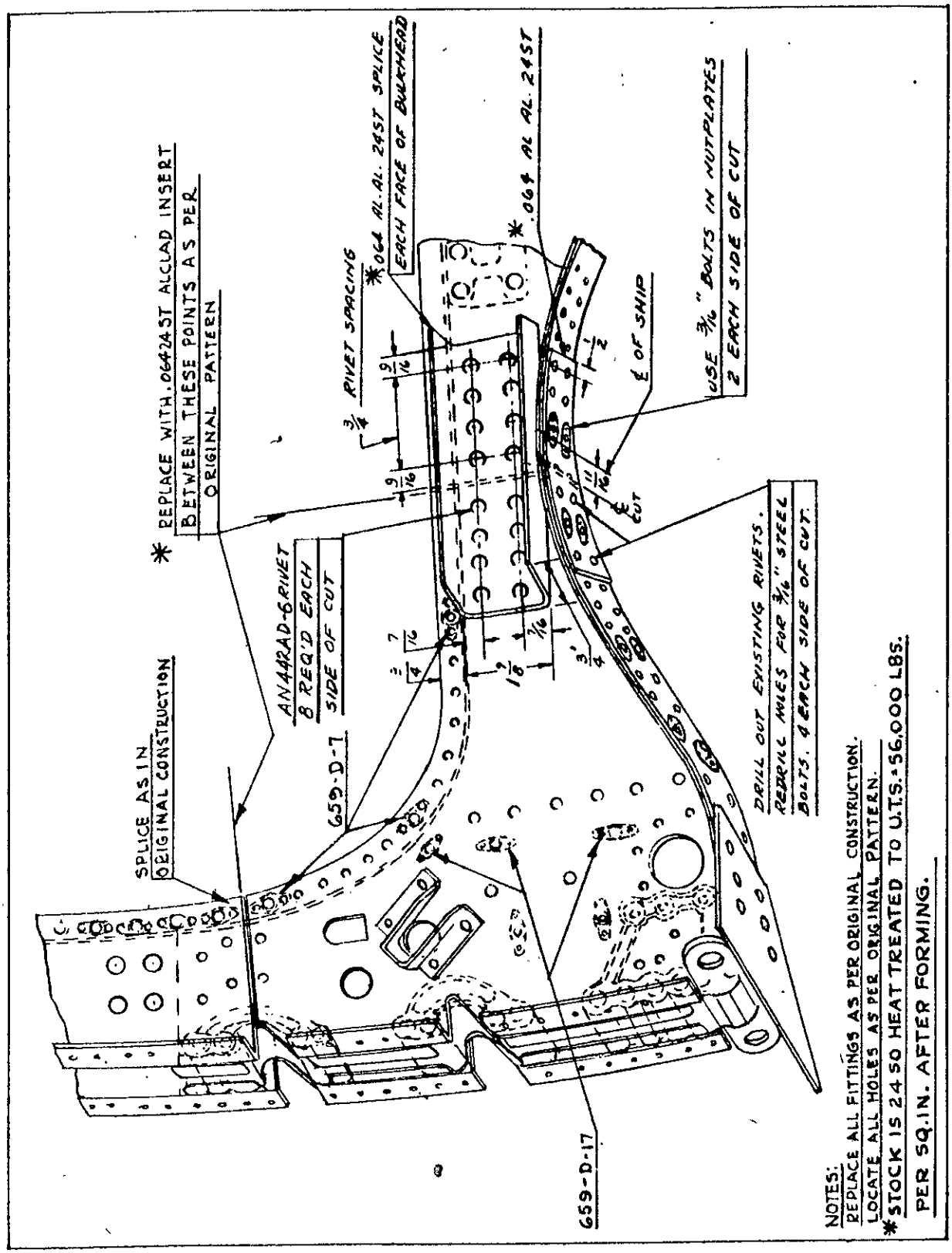


Figure 38 - Bulkhead No. 5 - Lower - Splice

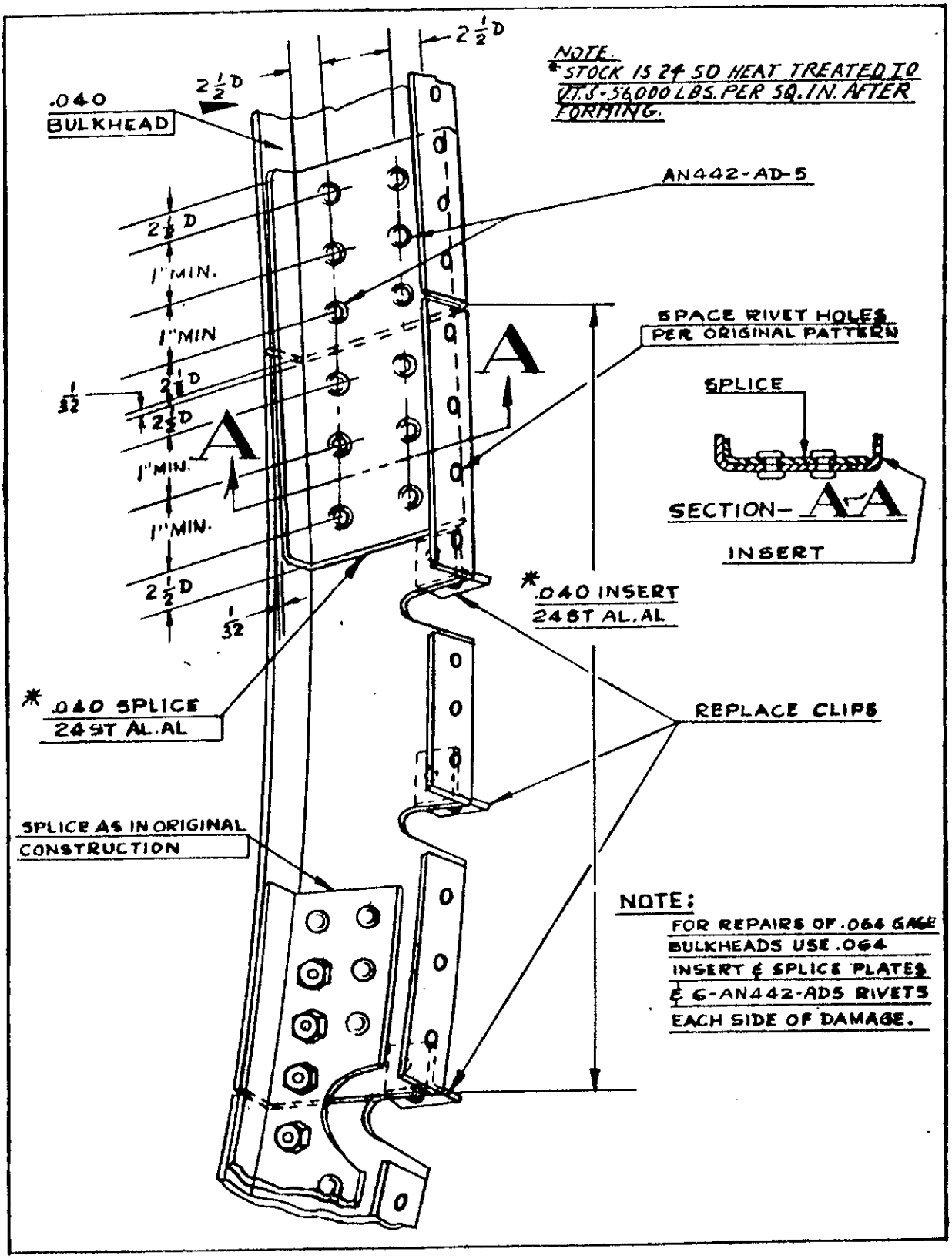


Figure 39 - Fuselage Bulkheads 6 to 12

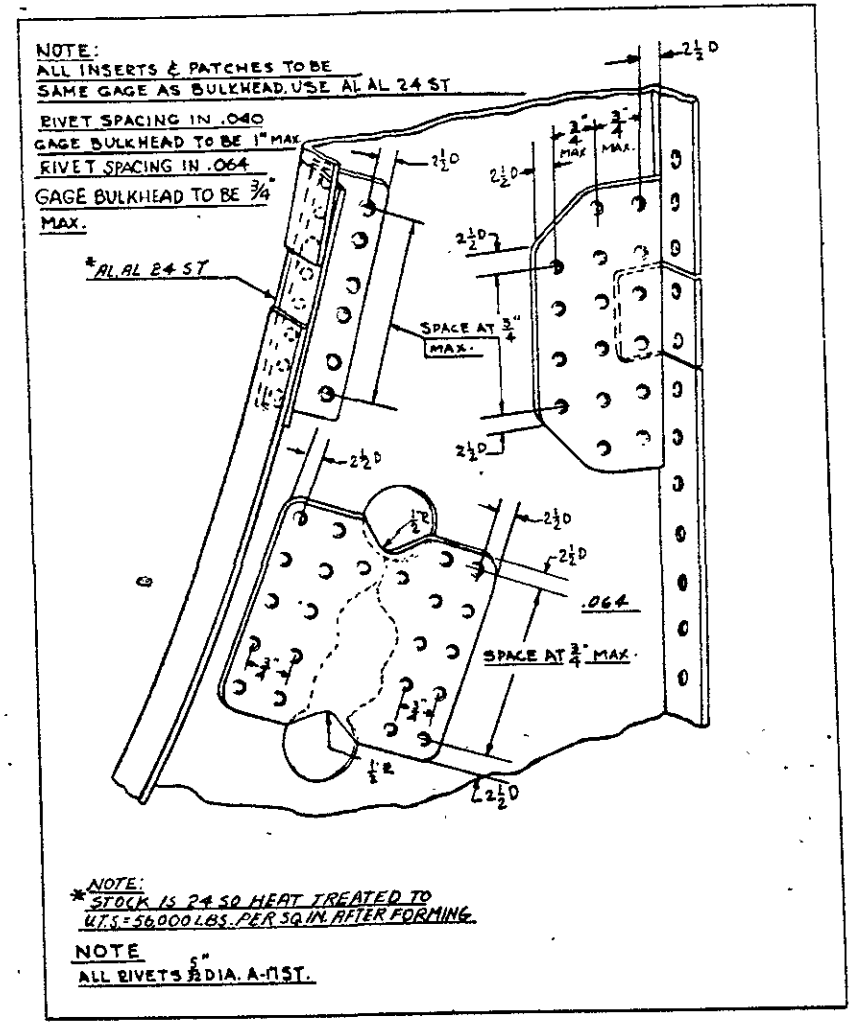


Figure 40 - Fuselage Bulkheads 6 to 12

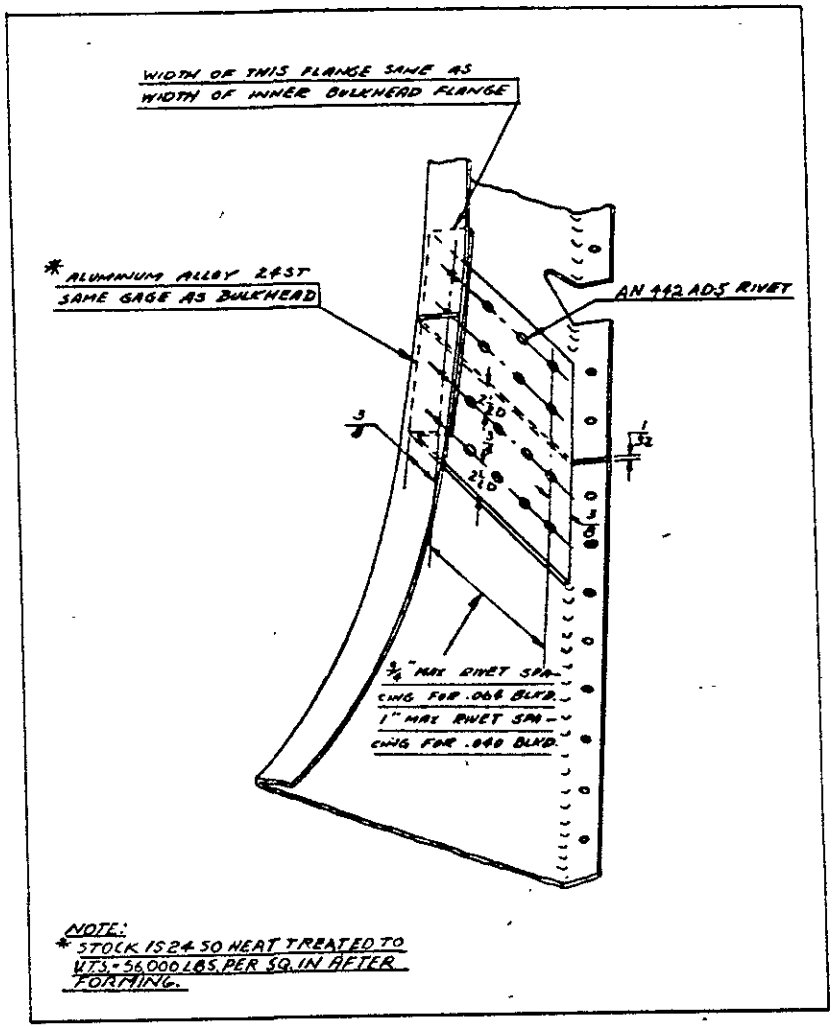


Figure 40A - Fuselage Bulkheads 6 to 12

If the damage is near an inside flange, add an equal flange to the patch plate, as shown in figures 19, 41, and 42. A damaged inside flange may be reinforced by attaching an angle of .064-inch 24ST sheet to the web of the bulkhead by two rows of 1/8-inch rivets at 5/8-inch spacing around the damage.

(2) Lower Section. - Due to the number of fittings and reinforcements attached to the lower half of this bulkhead, any damage will in general require complete replacement of this section of the bulkhead. Figures 43 and 44 illustrate this type of repair. Any damaged channels, clips, reinforcements, or fittings must be replaced.

h. Horizontal Bulkhead. - The horizontal bulkhead aft of bulkhead No. 13 (figure 21) should be patched, if damaged, with .032-inch 24ST aluminum-alloy sheet attached with two rows of AN442AD-4 rivets at 1-inch spacing around the damage. Add a flange to the patch material if a lightening hole flange is damaged. Replace the bulb angle stiffeners and the fitting reinforcements if either they or their attachments are damaged.

i. Bulkhead No. 14. - This bulkhead is heavily loaded and will in general require replacement if damaged. Figures 45 and 46 give data for a splice which may be used below the upper stringer cut-out. Patches of .040-inch 24ST aluminum-alloy sheet may be used if there is room to attach the repair stock with two rows of AN442AD-5 rivets at 1-inch spacing at each end of the damage. (See figure 46.)

j. Bulkhead No. 15. - This bulkhead may be patched or spliced at any point with a flanged plate of .032-inch 24ST aluminum-alloy sheet and two rows of 1/8-inch rivets at 1-inch spacing at each end of the damage. (See figure 47.) Use a minimum of six AN442AD-4 rivets on each side of the cut in splicing this bulkhead.

k. Bulkhead No. 16. - This bulkhead must be spliced or patched with .064-inch channels of 24ST aluminum-alloy sheet formed to fit in the bulkhead channel. (See figures 48 and 18.) Attach the repair stock with eight AN442AD-5 rivets on each side of the damage if it is in the upper ring of the bulkhead or use eight AN442AD-6 rivets at 3/4-inch spacing if the damage is on the lower ring. The lower ring should be replaced if damaged extensively. (See figure 49.)

l. Horizontal Shear Deck. - The horizontal shear deck is aft of station 16. If the damaged area after clean-up is not less than 1-1/4 inches from the flange or 3/4 inch from the edge of a bead it may be repaired with a .032-inch 24ST aluminum-Alclad sheet attached with two rows of AN442AD-4 rivets at 1-inch spacing or two rows of 5/32-inch Cherry blind rivets at 1-inch spacing. If a bead is damaged repair as shown on sketch figure 50. Replace all fitting reinforcements.

m. Bulkhead No. 17. - Above the shear deck, cracks and holes may be repaired by a .064-inch patch with two rows of 1/8-inch rivets at 1-1/4 inch spacing as shown in figure 51. If a lightening hole is damaged, the repair sheet must be flanged. If damage is done to the flange of the bulkhead above the shear deck, repair should be made by means of a channel formed from .064-inch Alclad sheet with a minimum of six 5/32-inch rivets on each side of the damage. (See figure 51.) Below the shear deck use a .040-inch channel with six 5/32-inch rivets each side of splice. (See figure 51.)

n. Bulkhead No. 18. - At any point below the shear deck, the bulkhead must be spliced or patched with a .064-inch channel formed to fit the bulkhead channel. (See figure 51A.) Use a minimum of eight AN442AD-6 rivets spaced at 3/4 inch on each side of the splice. Above the shear deck damage to the flange must be repaired by a 1-inch x 1-1/2 inch x .064 inch angle with six AN442AD-6 rivets in a double row as shown in figure 51A. For damage to the web of the bulkhead see figure 51A.

MATERIAL FOR REPAIR OF FUSELAGE, SKIN AND LONGERONS

PART NO.	MATERIAL		SIZE	REMARKS
	SPEC NO.	TITLE		
87-21-706	Alcoa die K-22422	Fuselage Skeleton - Stringers etc. (78077-8)	.770 in. x 9/16 in.	Fuselage - Extrusion
87-21-706-17	Alcoa die K-14652	Fuselage Skeleton - Stringer longeron (78077-3)	1-5/16 in. x 3/4 in.	Fuselage - Extrusion
75-03-291		Fuselage Skeleton - Nut plate		Mfg. by Elastic Stop Nut Corp.
81-21-274	11067 (11)	Fuselage Skeleton - Splice plate - channel	.064 in. x 3-3/8 in. x 4 in.	Alclad 24ST
87-21-552	57-152-6 (1)	Fuselage Skeleton - Channel - support tab control	.064 in. x 5-5/8 in. x 9-5/16 in.	Al. Al. Sheet 24S0
87-21-562	QQ-A-355-(A)	Fuselage Skeleton - Splice plates stringers 2, 3, and 4 - sta 8	.064 in. x 2-1/8 in. x 10-5/8 in. .051 in. x 2-7/16 in. x 13-5/16 in. .81 in. x 2-1/8 in. x 11 in.	Al. Al. Sheet 24S0
AN24-10	29-59 Mfg.	Fuselage Skeleton - Bolt	5/8 in. long, shank 5/16 in.	
AN4-6	"	Fuselage Skeleton - Bolt	3/4 in. long, shank 5/16 in.	
AN3-5	"	Fuselage Skeleton - Bolt	5/8 in. long, shank 1/4 in.	
AN5-27	29-59 Mfg.	Fuselage Skeleton - Bolt	2-7/8 in. long, shank 2-7/16 in.	
364-428	25527 Mfg.	Fuselage Skeleton - Nut - self-locking	13/64 in. x 7/16 in.	Thin
365-524	25527 Mfg.	Fuselage Skeleton - Nut - self-locking	11/32 in. x 1/2 in.	
671-D-4AD-4	A17ST	Fuselage Skeleton - Rivet - solid	1/8 in. dia. x 1/4 in. long	Modified brazier head
AN960-10	1010 Steel	Fuselage Skeleton - Washer - plain	13/64 in. ID x 7/16 in. OD	
87-21-530-1	11067-(1)	Longeron - Upper	.102 in. x 11 in. x 105 in.	Alclad 24S0
87-21-530-3	QQ-A-355-(A)	Longeron - Channel - upper	.125 in. x 6-1/2 in. x 15-13/16 in.	Al. Al. 24S0
87-21-530-4	QQ-A-355-(A)	Longeron - Gussets - upper	.051 in. x 4 in. 4-1/2 in.	Al. Al. 24S0
87-21-530-11	QQ-A-355-(A)	Longeron - Clip angle - upper	.125 in. x 1-21/32 in. x 2-3/4 in.	Al. Al. 24S0
87-21-530-8	QQ-A-355-(A)	Longeron - Angle - upper	.102 in. x 2-1/2 in. x 41-3/4 in.	Al. Al. 24S0
671-D-6AD-7	A17ST	Longeron - Rivet - solid - upper	3/16 in. dia. x 7/16 in. long	Aluminum
673-D-4-6	A17ST	Longeron - Rivet - 78° countersunk upper	1/8 in. dia. x 3/16 in. long	Aluminum
659-D-2	AN-QQ-P-421	Longeron - Fasteners - nut plate - upper	25/64 in. x 1/4 in.	1112 Steel
87-25-037-63	57-152-5-(T)	Longeron - Track - upper	Alcoa die No. K-23083	Al. Al. 24ST
87-21-705-5	QQ-A-355-(T)	Fuselage - Skin	.032 in. x 17-1/4 in. x 40-1/4 in.	Al. Al. 24ST
87-21-705-6	QQ-A-355-(T)	Fuselage - Skin	.040 in. x 15-3/4 in. x 90-5/8 in.	Al. Al. 24ST
87-21-705-11	QQ-A-355-(T)	Fuselage - Skin	.025 in. x 14-1/2 in. x 84 in.	Al. Al. 24ST
87-21-705-20	QQ-A-355-(T)	Fuselage - Skin	.064 in. x 24-5/8 in. x 28-1/8 in.	Al. Al. 24ST
87-21-705-25	QQ-A-355-(T)	Fuselage - Splice plate	.051 in. x 5-5/8 in. x 5-5/8 in.	Al. Al. 24ST
11030-S-4	2330 Steel	Fuselage - Bolt - recessed head	1/2 in. long	100° Countersunk recessed type head
1120-D-8	2330 Steel	Fuselage - Screw - modified - brazier	1/2 in. long	
AN23-8	29-59 Mfg.	Fuselage - Bolt	9/16 in. long; 1/4 in. shank	
AN960-8	1010 Steel	Fuselage - Washer - plain	ID 11/64 in.; 3/8 in. OD	
364-428	25527 Mfg.	Fuselage - Nut - self-locking	13/64 in. x 7/16 in.	
673-D-4-4 1/2	A17ST	Fuselage - Rivet - 78° countersunk	1/8 in. dia. x 9/32 in. long	
671-D-6AD-6	A17ST	Fuselage - Rivet - modified brazier head	3/16 in. dia. x 3/8 in. long	
87-21-705-65	Neoprene	Fuselage - Strip - durometer 40-45	1/16 in. x 1-5/16 in. x 37-1/2 in.	
87-21-568	11067 (1)	Fuselage - Skin - rear vision	.032 in. x 24 in. x 36 in.	Alclad 24S0
S5-325		Fuselage - Dzus spring		
87-21-623	QQ-A-355-(T)	Fuselage - Reinforcement - skin - fuel line	.032 in. x 3-1/2 in. x 3-9/16 in.	Al. Al. 24ST
87-21-640	57-152-6 (1)	Fuselage - Reinforcement - upper access door	.040 in. x 7 in. x 6-5/8 in.	Tail wheel oleo Safety
915-D-00-5	Brass	Fuselage - Chain	5 in. long	
AN230-B10	Brass	Fuselage - Grommet - plain	1/4 in. ID; 9/16 in. OD	
87-21-643	57-152-6 (11)	Fuselage - Shim	.051 in. x 1 in. x 1-1/2 in.	Al. Al. 24ST
87-21-596-4	QQ-A-355-(A)	Fuselage - Channel - doubler plate	.094 in. x 4-1/2 in. x 12-3/4 in.	Al. Al. Sheet 24S0
87-21-596-3	QQ-A-355-(A)	Fuselage - Doubler plate	.081 in. x 4 in. x 44 in.	Al. Al. Sheet 24S0
87-21-596-2	QQ-A-355-(A)	Fuselage - Doubler plate	.051 in. x 5 in. x 45 in.	Al. Al. Sheet 24S0
87-21-596-1	QQ-A-355-(A)	Fuselage - Doubler plate	.064 in. x 9 in. x 60 in.	Al. Al. Sheet 24S0

MATERIALS FOR REPAIR OF FUSELAGE BULKHEADS AND FRAMES

PART NO.	MATERIALS		SIZE	REMARKS
	SPEC. NO.	TITLE		
87-21-601-5	11068 (1/2H)	Sta No. 1 - Sheet - fire wall	.015 in. x 15 in. x 38 in.	Steel sheet
87-21-601-6	11068 (1/2H)	Sta No. 1 - Reinforcement strip	.040 in. x 31/32 in. x 12 in.	Steel sheet
87-21-601-11	QQ-A-355 (A)	Sta No. 1 - Channel	.125 in. x 7-3/8 in. x 32-15/16 in.	Al. Al. 24S0
87-21-601-12	QQ-A-355 (T)	Sta No. 1 - Gusset	.081 in. x 6-1/2 in. x 7-1/2 in.	Al. Al. 24ST
670-D-4-12	AN-QQ-P-421	Sta No. 1 - Rivet - hollow - steel	1/8 in. dia. x 3/8 in. long	Thomson
671-D-4AD-6	A17ST	Sta No. 1 - Rivet - modified brazier head	1/8 in. dia. x 3/16 in. long	
673-D-4-5	A17ST	Sta No. 1 - Rivet - 78° countersunk	1/8 in. dia. x 5/32 in. long	
87-21-601-53	QQ-A-355 (T)	Sta No. 1 - Plate	.064 in. x 3-3/4 in. x 5-5/8 in.	Al. Al. 24ST
87-21-910-53	QQ-A-355 (T)	Sta No. 1 - Plate P-40F	.064 in. x 3-9/16 in. x 5-3/4 in.	Al. Al. 24ST
87-21-601-30	QQ-A-355 (A)	Sta No. 1 - Rivet strip	.051 in. x 5/8 in. x 14 in.	Al. Al. 24S0
87-21-601-32	Neoprene	Sta No. 1 - Sealing strip	3/16 in. x 7/8 in. x 14-1/4 in.	Black Sponge
87-21-602-5	QQ-A-355 (A)	Sta No. 2 - Upper frame	.081 in. x 12-1/8 in. x 5-1/2 in.	Al. Al. 24S0
87-21-602-8	QQ-A-355 (A)	Sta No. 2 - Lower frame	.094 in. x 8-5/8 in. x 4-3/8 in.	Al. Al. 24S0
87-21-602-9	QQ-A-355 (A)	Sta No. 2 - Splice plate	.102 in. x 11-1/4 in. x 3-3/4 in.	Al. Al. 24S0
AN25-15	29-59 Mfg.	Sta No. 2 - Bolt	15/16 in. long; shank 5/8 in.	Same for sta 3
AN23-11	29-59 Mfg.	Sta No. 2 - Bolt	11/16 in. long; shank 3/8 in.	Same for sta 3 & 4
364-1032	25527 Mfg.	Sta No. 2 - Nut - self-locking - thin	11/64 in. x 3/8 in.	Same for sta 3 & 4
87-21-603-5	QQ-A-355 (A)	Sta No. 3 - Upper frame	.081 in. x 12-1/4 in. x 4-7/8 in.	Al. Al. 24S0
87-21-603-8	QQ-A-355 (A)	Sta No. 3 - Lower frame	.094 in. x 8-7/8 in. x 3-3/4 in.	Al. Al. 24S0
87-21-603-9	QQ-A-355 (A)	Sta No. 3 - Splice plate	.102 in. x 11-1/2 in. x 3-7/8 in.	Al. Al. 24S0
87-21-604-5	QQ-A-355 (A)	Sta No. 4 - Upper frame	.094 in. x 12-1/4 in. x 5-3/8 in.	Al. Al. 24S0
87-21-604-8	QQ-A-355 (A)	Sta No. 4 - Lower frame	.102 in. x 10-1/4 in. x 4-3/4 in.	Al. Al. 24S0
87-21-604-9	QQ-A-355 (A)	Sta No. 4 Splice Plate	.125 in. x 6-1/16 in. x 2-13/16 in.	Al. Al. 24S0
87-21-604-7	QQ-A-355 (A)	Sta No. 4 Gusset	.094 in. x 4-7/8 in. x 4-1/4 in.	Al. Al. 24S0
87-21-605-9	QQ-A-355 (A)	Sta No. 5 - Channel - upper	.064 in. x 3-11/16 in. x 12-3/4 in.	Al. Al. 24S0
AN442-5AD-6	25526 Mfg.	Sta No. 5 - Rivet - flathead	5/32 in. dia. x 3/8 in. long	Do not heat treat before using.
AN24-27	29-59 Mfg.	Sta No. 5 - Bolt	1-11/16 in. long; 1-3/8 in. shank	
87-21-605-11	QQ-A-355 (A)	Sta No. 5 - Web	.064 in. x 6 in. x 12 in.	Al. Al. 24S0
87-21-605-21	QQ-A-355 (A)	Sta No. 5 - Channel - lower	.064 in. x 2-3/4 in. x 11 in.	Al. Al. 24S0
659-D-15	1112 Steel	Sta No. 5 - Nut plate - Elastic nut type	1/4 in. high x 25/64 in. wide	No. 8-32 threads
87-21-581	QQ-A-367	Sta No. 5 - Reinforcement - forging	3.687 .005 in. x 3/4 in.	14ST Al. Al.
87-21-606-4	QQ-A-355 (A)	Sta No. 6 - Frame - lower	.064 in. x 13-1/2 in. x 25 in.	Al. Al. 24S0
87-21-606-5	QQ-A-355 (A)	Sta No. 6 - Reinforcement	.102 in. x 1-1/4 in. x 23 in.	Al. Al. 24S0
87-21-606-3	QQ-A-355 (A)	Sta No. 6 - Frame - upper	.064 in. x 11 in. x 40 in.	Al. Al. 24S0
87-21-653	10235 (B)	Sta No. 6 - Spacer - aluminum	.035 in. x 3/16 in. OD 3/16 in. long	Same for sta 7
87-21-607-4	QQ-A-355 (A)	Sta No. 7 - Frame - lower	.064 in. x 14 in. x 27 in.	Al. Al. 24S0
87-21-607-6	QQ-A-355 (A)	Sta No. 7 - Reinforcement	.125 in. x 1-1/4 in. x 23 in.	Al. Al. 24S0
87-21-607-7	QQ-A-355 (T)	Sta No. 7 - Reinforcement	.102 in. x 1-1/2 in. x 27-1/8 in.	Al. Al. 24ST
87-21-607-3	QQ-A-355 (A)	Sta No. 7 - Frame - upper	.040 in. x 8 in. x 40 in.	Al. Al. 24S0
87-21-608-3	QQ-A-355 (A)	Sta No. 8 - Frame - lower	.040 in. x 10-3/4 in. x 28-1/2 in.	Al. Al. 24S0
87-21-608-5	QQ-A-355 (A)	Sta No. 8 - Splice plate	.081 in. x 2-5/64 in. x 5-15/16 in.	Al. Al. 24S0
87-21-608-4	QQ-A-355 (A)	Sta No. 8 - Frame - upper	.040 in. x 7 in. x 42 in.	Al. Al. 24S0
87-21-131	57-153 (GR.5)	Sta No. 8 - Clip - forging	5/8 in. x 1-15/16 in.	Al. Al. 14ST
75-21-186-3	57-152-6 (11)	Sta No. 8 - Clip	.040 in. x 1/2 in. x 1-5/16 in.	Al. Al. 24ST
87-21-577	57-152-6 (1)	Sta No. 8 - Clip	.081 in. x 2-3/16 in. x 2-3/4 in.	Al. Al. 24S0
87-21-609-3	QQ-A-355 (A)	Sta No. 9 - Channel - upper	.040 in. x 7 in. x 37 in.	Al. Al. 24S0
87-21-609-4	QQ-A-355 (A)	Sta No. 9 - Channel - lower	.040 in. x 11 in. x 26 in.	Al. Al. 24S0
87-66-582	QQ-A-355 (T)	Sta No. 9 - Bracket - pull box - hydraulic pump	.051 in. x 4-1/4 in. x 8-7/8 in.	Al. Al. 24ST
87-21-572	57-152-6 (1)	Sta No. 9 - Splice plate - lower	.040 in. x 6 in. x 11-1/2 in.	Al. Al. 24S0
87-21-610-3	QQ-A-355 (A)	Sta No. 10 - Channel - upper	.040 in. x 6-3/8 in. x 34-1/8 in.	Al. Al. 24S0
87-21-610-6	QQ-A-355 (T)	Sta No. 10 - Channel - upper	.040 in. x 4 in. x 4-9/16 in.	Al. Al. 24ST
87-21-610-4	QQ-A-355 (A)	Sta No. 10 - Channel - lower	.040 in. x 8-3/4 in. x 24 in.	Al. Al. 24S0

MATERIALS FOR REPAIR OF FUSELAGE BULKHEADS AND FRAMES

PART NO.	MATERIALS		SIZE	REMARKS
	SPEC. NO.	TITLE		
87-21-611-3	QQ-A-355 (A)	Sta No. 11 - Channel - upper	.040 in. x 7 in. x 33 in.	Al. Al. 24SO
87-21-611-4	QQ-A-355 (A)	Sta No. 11 - Channel - lower	.040 in. x 7-1/2 in. x 20 in.	Al. Al. 24SO
87-21-612-3	QQ-A-355 (A)	Sta No. 12 - Channel - upper	.040 in. x 7 in. x 30 in.	Al. Al. 24SO
87-21-612-4	QQ-A-355 (A)	Sta No. 12 - Channel - lower	.040 in. x 6-1/4 in. x 18 in.	Al. Al. 24SO
87-21-613-2	QQ-A-355 (A)	Sta No. 13 - Ring - upper	.064 in. x 20-1/2 in. x 26-1/8 in.	Al. Al. 24SO
87-21-613-5	QQ-A-355 (A)	Sta No. 13 - Channel - upper	.125 in. x 5-1/4 in. x 10 in.	Al. Al. 24SO
87-21-613-6	QQ-A-355 (T)	Sta No. 13 - Plate - upper	.102 in. x 3-1/2 in. x 5 in.	Al. Al. 24ST
87-21-613-4	QQ-A-355 (A)	Sta No. 13 - Ring - lower	.064 in. x 12-1/2 in. x 20-1/2 in.	Al. Al. 24SO
87-21-613-9	QQ-A-355 (A)	Sta No. 13 - Plate - lower	.064 in. x 6-7/16 in. x 16 in.	Al. Al. 24SO
87-21-613-8	QQ-A-355 (A)	Sta No. 13 - Splice plate	.064 in. x 5-1/4 in. x 10-1/8 in.	Al. Al. 24SO
87-21-613-10	QQ-A-355 (T)	Sta No. 13 - Doubler plate	.064 in. x 4-1/4 in. x 10-1/8 in.	Al. Al. 24ST
87-21-614-2	QQ-A-355 (A)	Sta No. 14 - Frame - upper	.040 in. x 16 in. x 17 in.	Al. Al. 24SO
87-21-614-4	QQ-A-355 (A)	Sta No. 14 - Frame - lower	.040 in. x 5 in. x 6 in.	Al. Al. 24SO
87-21-615-3	QQ-A-355 (A)	Sta No. 15 - Frame - upper	.032 in. x 14 in. x 16 in.	Al. Al. 24SO
87-21-615-4	QQ-A-355 (A)	Sta No. 15 - Frame - lower	.032 in. x 3-1/4 in. x 5 in.	Al. Al. 24SO
87-21-188-1	57-152-6 (1)	Sta No. 15 - Splice plate	.040 in. x 1-1/2 in. x 4-3/4 in.	Al. Al. 24SO
87-21-190-1	57-152-6 (1)	Sta No. 15 - Reinforcement bracket	.040 in. x 2 in. x 2 in.	Al. Al. 24SO
87-21-191-1	QQ-A-355 (A)	Sta No. 15 - Pulley bracket	.051 in. x 2-3/4 in. x 4-3/4 in.	Al. Al. 24SO
87-21-616-2	QQ-A-355 (A)	Sta No. 16 - Ring upper	.064 in. x 10-3/4 in. x 15-1/2 in.	Al. Al. 24SO
87-21-616-4	QQ-A-355 (A)	Sta No. 16 - Ring lower	.064 in. x 7-3/4 in. x 11 in.	Al. Al. 24SO

MATERIALS FOR REPAIR OF EXTENDED SECTION OF FUSELAGE P-40F

PART NO.	MATERIAL		SIZE	REMARKS
	SPEC NO.	TITLE		
87-21-903-1	QQ-A-355 (T)	Fuselage - Skin - top	.040 in. x 25 in. x 25-3/4 in.	Al. Al. 24ST
87-21-903-2	QQ-A-355 (T)	Fuselage - Skin - bottom	.040 in. x 19 in. x 26 in.	Al. Al. 24ST
87-21-903-3,-12	Alcoa die K-14652	Fuselage - Stringers (78077-8	.770 in. x 9/16 in. x 20-3/16 in.	Fuselage - extrusion
87-21-903-4	QQ-A-362 (T)	Fuselage - Reinforcement - angle	.032 in. x 1-5/16 in. x 18-1/2 in.	Alc. 24ST
87-21-903-5	QQ-A-362 (A)	Fuselage - Reinforcement - angle	.032 in. x 1-5/16 in. x 18-3/4 in.	Alc. 24SO
87-21-903-8	QQ-A-362 (T)	Fuselage - Splice plate	.040 in. x 4-7/8 in. x 5 in.	Alc. 24ST
87-29-903-11	QQ-A-362 (A)	Fuselage - Clip	.040 in. x 2-1/16 in. x 2-1/2 in.	Alc. 24SO
87-29-903-17	QQ-A-362 (A)	Fuselage - Reinforcement - angle	.032 in. x 1-5/16 in. x 11-1/4 in.	Alc. 24SO
AN3-6A	29-59 Mfg.	Fuselage Skeleton - Bolt	3/4 in. long, shank 3/8 in.	
AN24-9A	29-59 Mfg.	Fuselage Skeleton - Bolt	9/16 in. long, shank 1/4 in.	
364-1032	25527 Mfg.	Fuselage Skeleton - Nut - self-locking	11/64 in. x 3/8 in.	Thin
364-428	25527 Mfg.	Fuselage Skeleton - Nut - self-locking	13/64 in. x 7/16 in.	Thin
AN960-10	1010 steel	Fuselage Skeleton - Washer - plain	13/64 in. ID x 7/16 in. OD	
AN960-416	1010 steel	Fuselage Skeleton - Washer - plain	17/64 in. ID x 1/2 in. OD	
87-21-951-1	QQ-A-362 (A)	Sta No. 18 - Bulkhead	.064 in. x 9-5/8 in. x 29-1/2 in.	Alc. SH. 24SO
87-21-951-3	QQ-A-362 (A)	Sta No. 18 - Angle	.064 in. x 2-7/16 in. x 3-1/8 in.	Alc. SH. 24SO
87-21-951-4	71-484 (1)	Sta No. 18 Fibre plate	1/8 in. x 2-3/8 in. x 2-3/4 in.	Phenol fibre
87-21-951-5	QQ-A-362 (A)	Sta No. 18 - Bracket	.040 in. x 4-3/4 in. x 5-1/8 in.	Alc. SH. 24SO
87-21-952-1	QQ-A-362 (A)	Sta No. 17 - Bulkhead	.040 in. x 19-3/4 in. x 19-5/8 in.	Alc. SH. 24SO
87-21-952-3	QQ-A-362 (A)	Sta No. 17 - Bulkhead	.064 in. x 8-3/4 in. x 12-13/16 in.	Alc. SH. 24SO
87-21-954-2	QQ-A-362 (A)	Sta 16 - 18 - bulkhead - horizontal	.032 in. x 8-1/8 in. x 21-3/4 in.	Alc. 24SO
87-21-954-3	QQ-A-362 (T)	Horizontal Bulkhead - Gusset	.032 in. x 1-1/2 in. x 2-7/8 in.	Alc. 24ST
87-21-955	QQ-A-362 (A)	Sta 17 - 18 - deck	.025 in. x 5-5/8 in. x 13 in.	Alc. SH. 24SO
87-21-957	QQ-A-362 (A)	Aft. Sta 18 - Riblet	.032 in. x 5-3/4 in. x 5-3/4 in.	Alc. 24SO
87-21-958	QQ-A-362 (A)	Aft. Sta 18 - Deck	.032 in. x 4-1/4 in. x 7-7/16 in.	Alc. 24SO

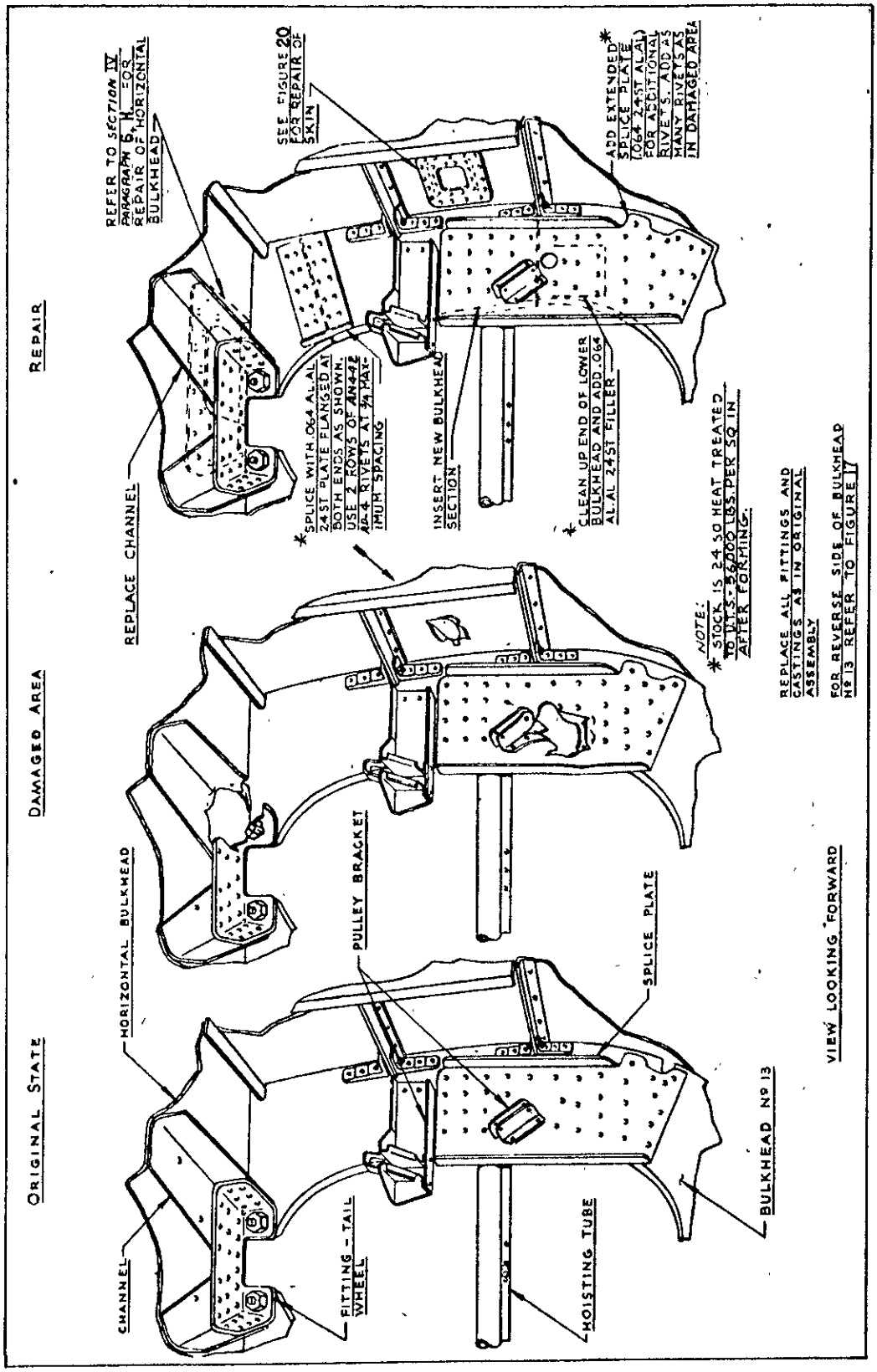


Figure 41 - Fuselage - Bulkhead and Skin Damage Sta. No. 13

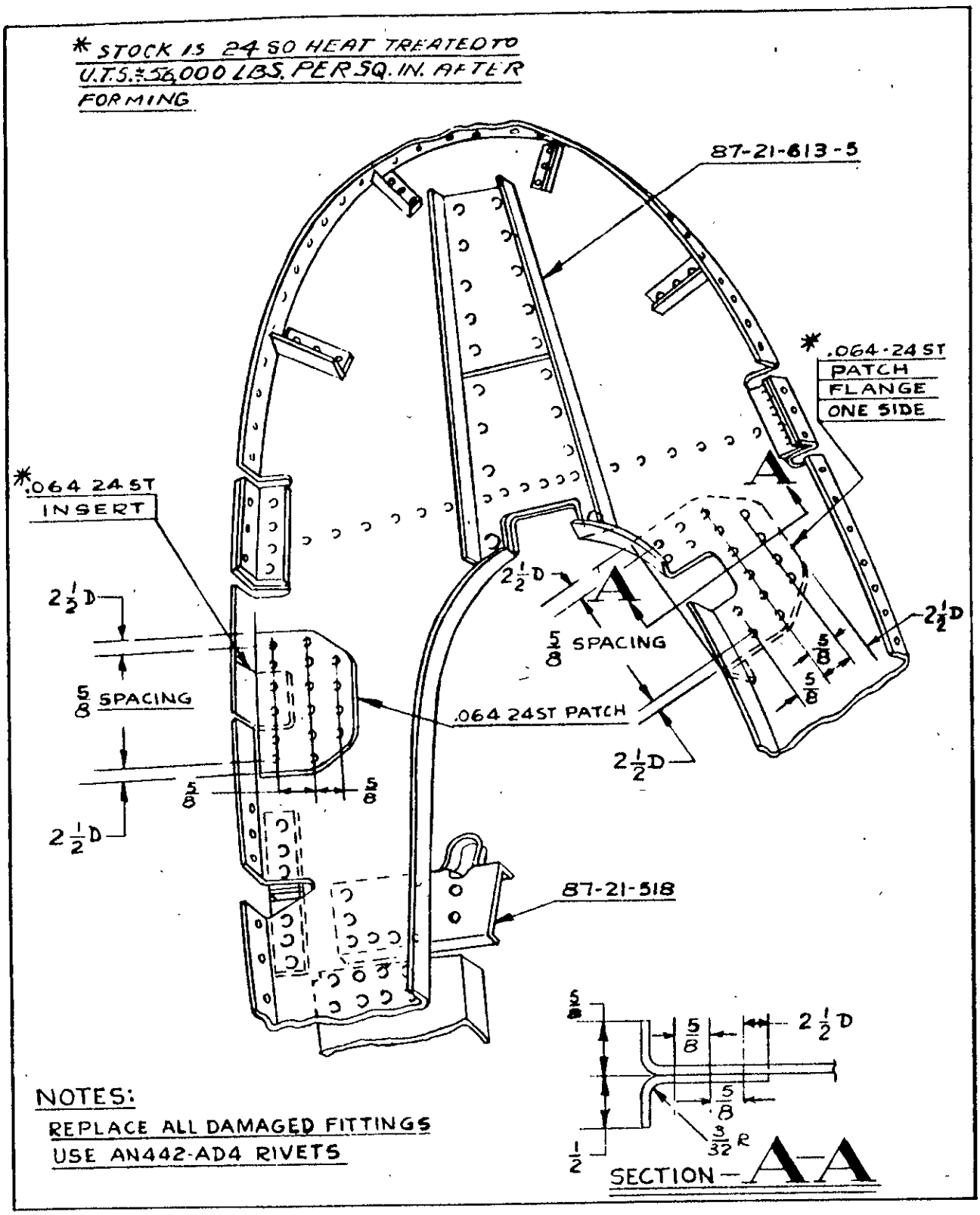


Figure 42 - Fuselage Bulkhead No. 13

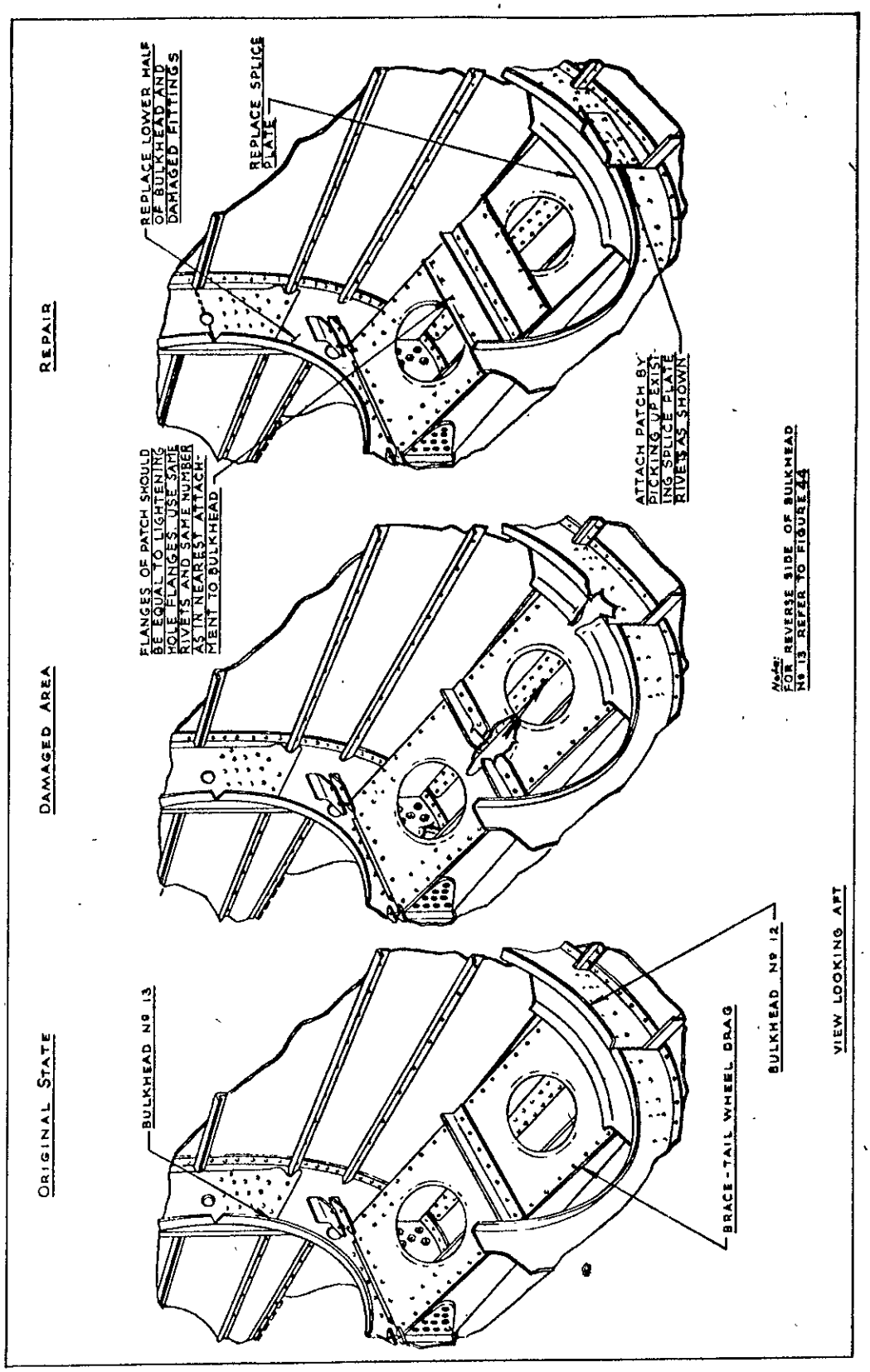


Figure 43 - Fuselage - Bulkheads and Tail Wheel Brace Damage Sta No. 12 and 13

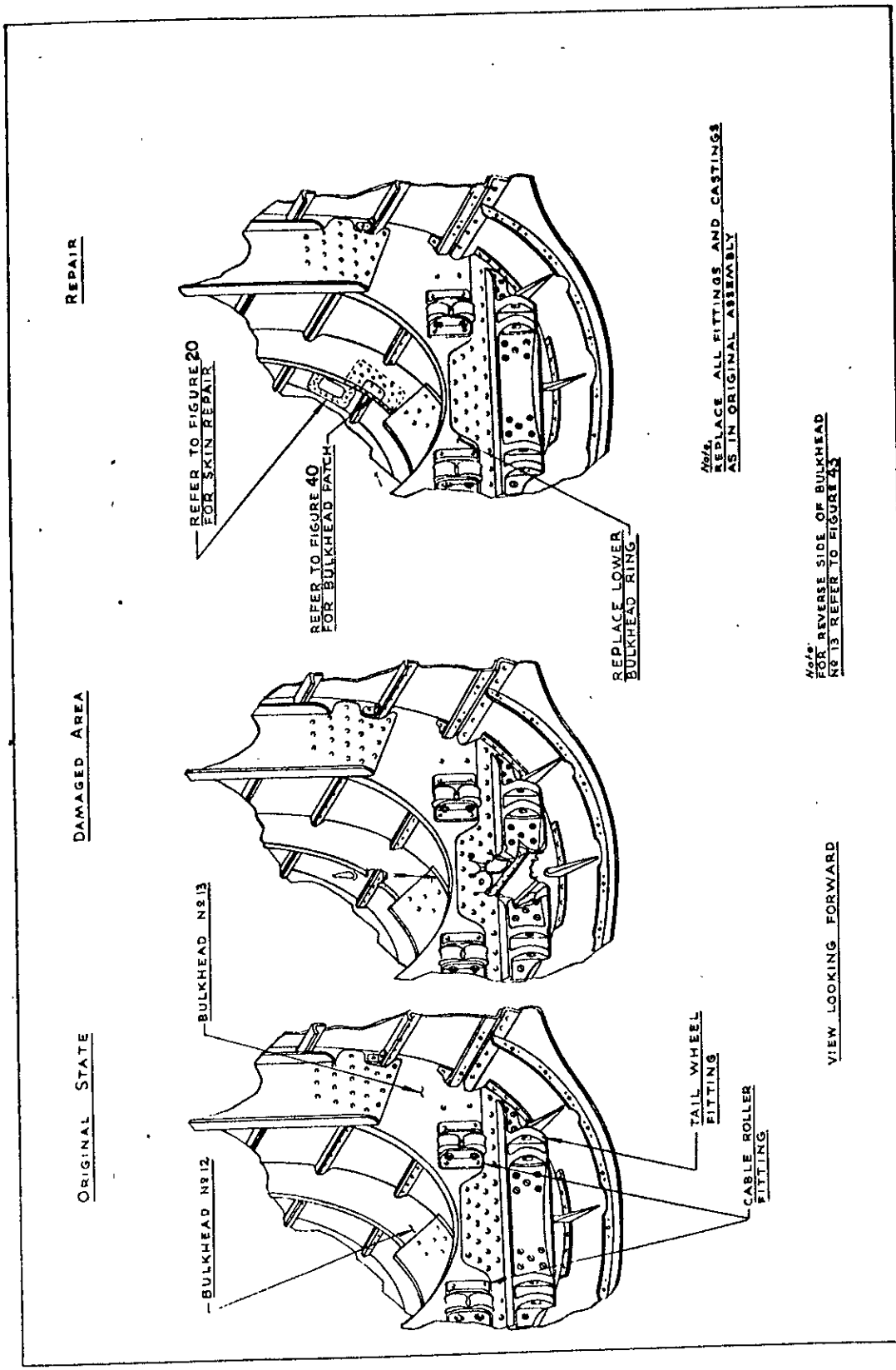


Figure 44 - Fuselage - Bulkhead and Tail Wheel Fitting Damage Sta. No. 13

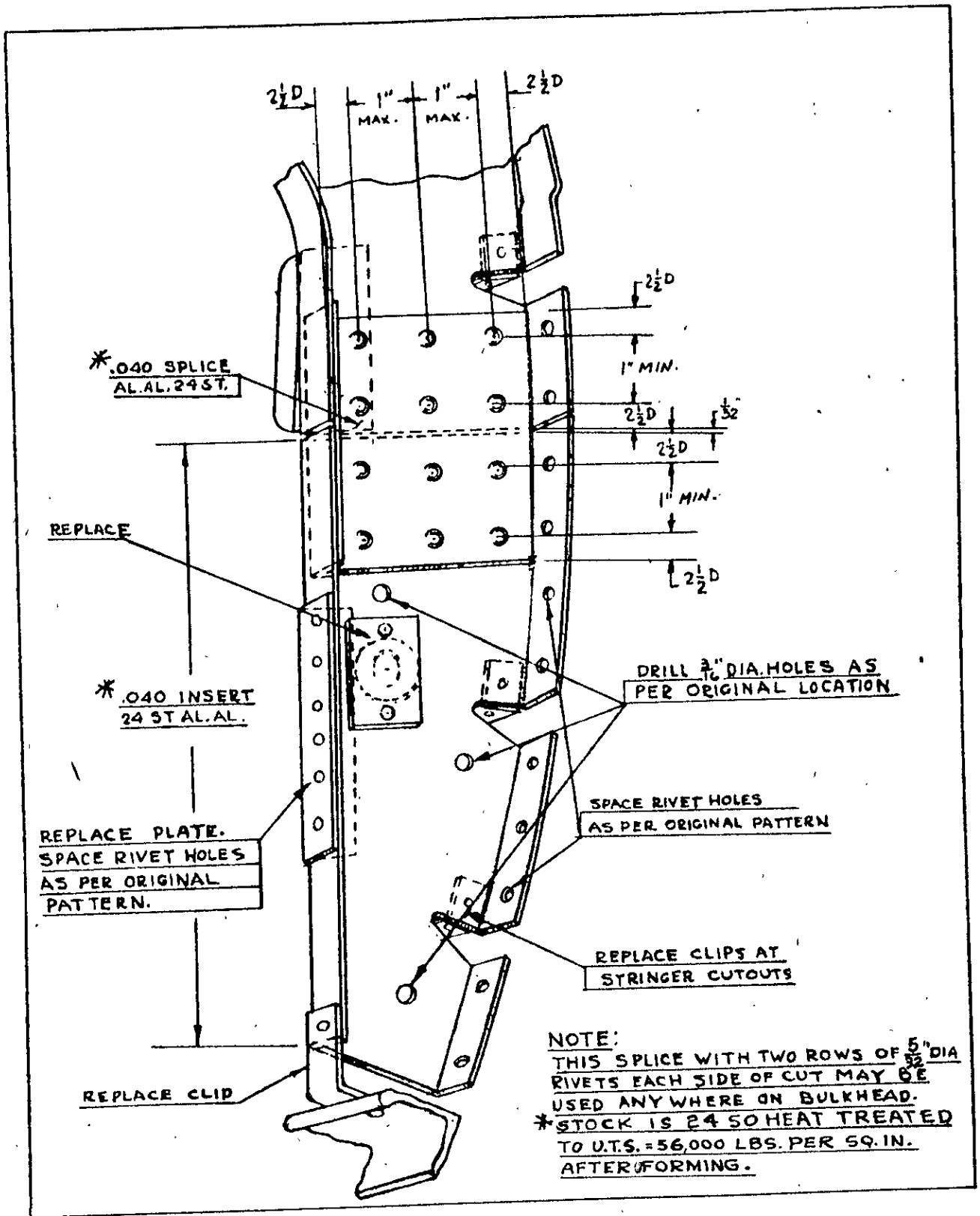


Figure 45 - Fuselage - Bulkhead No. 14

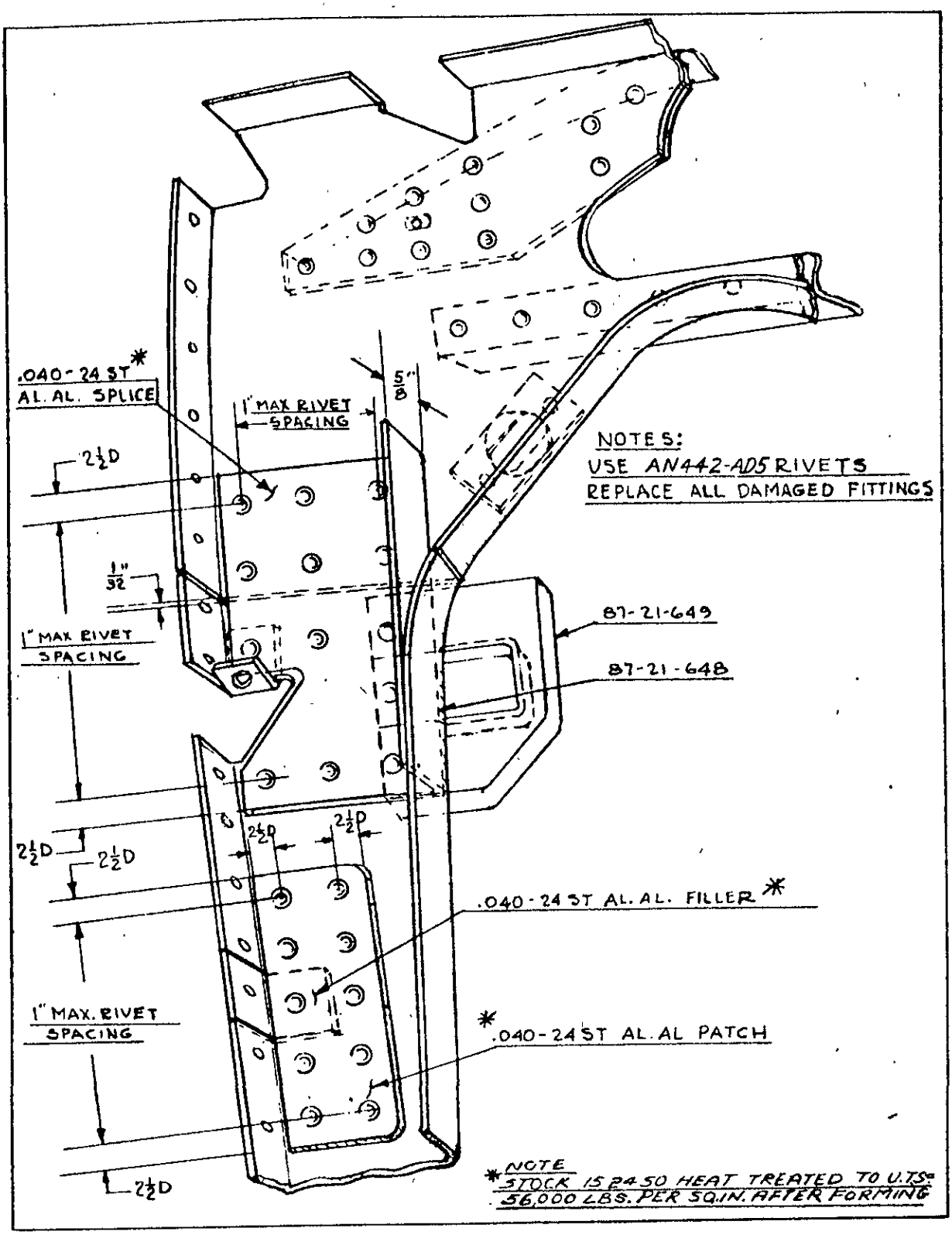


Figure 46 - Fuselage - Bulkhead No. 14

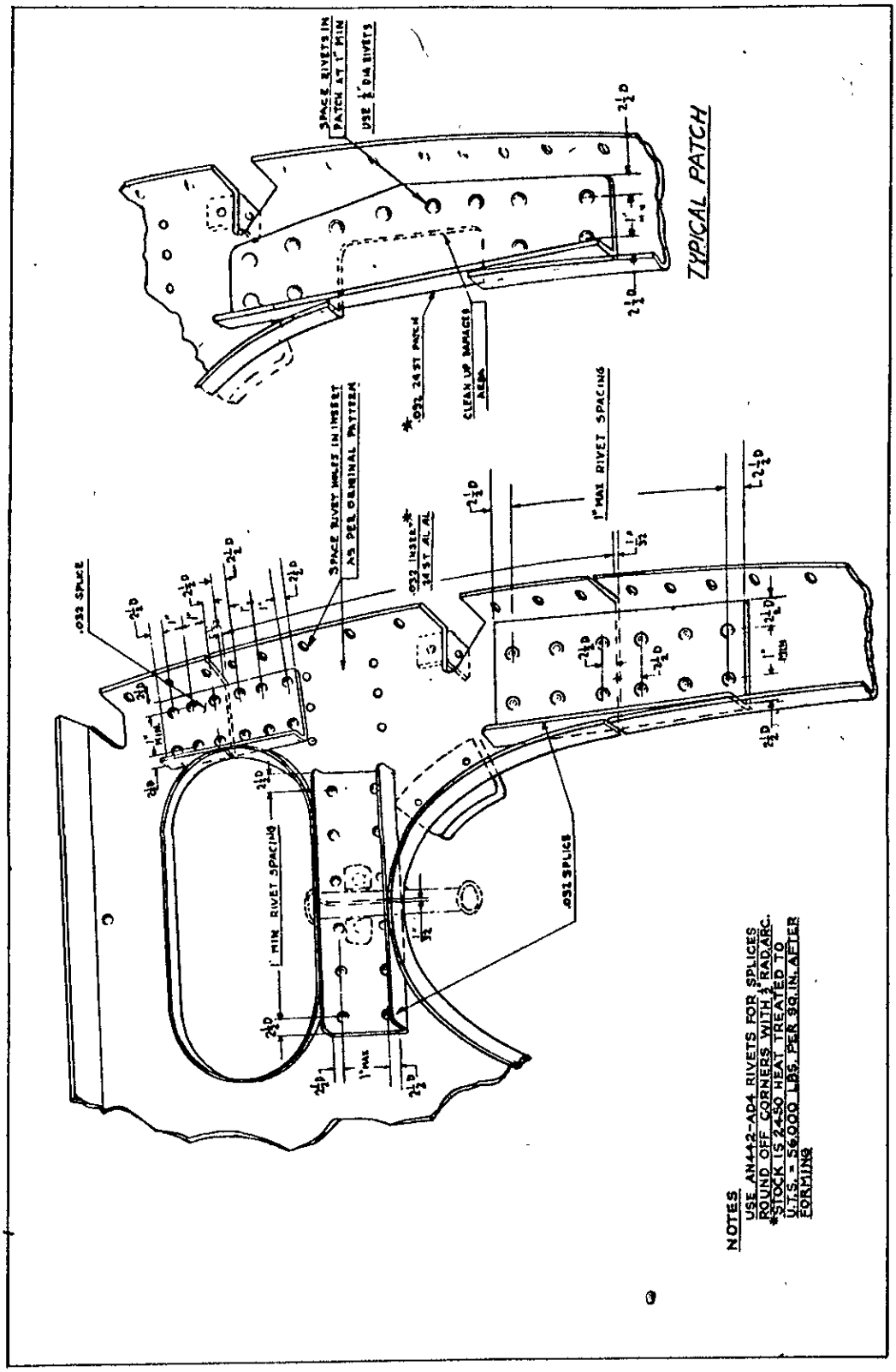


Figure 47 - Fuselage - Bulkhead No. 15

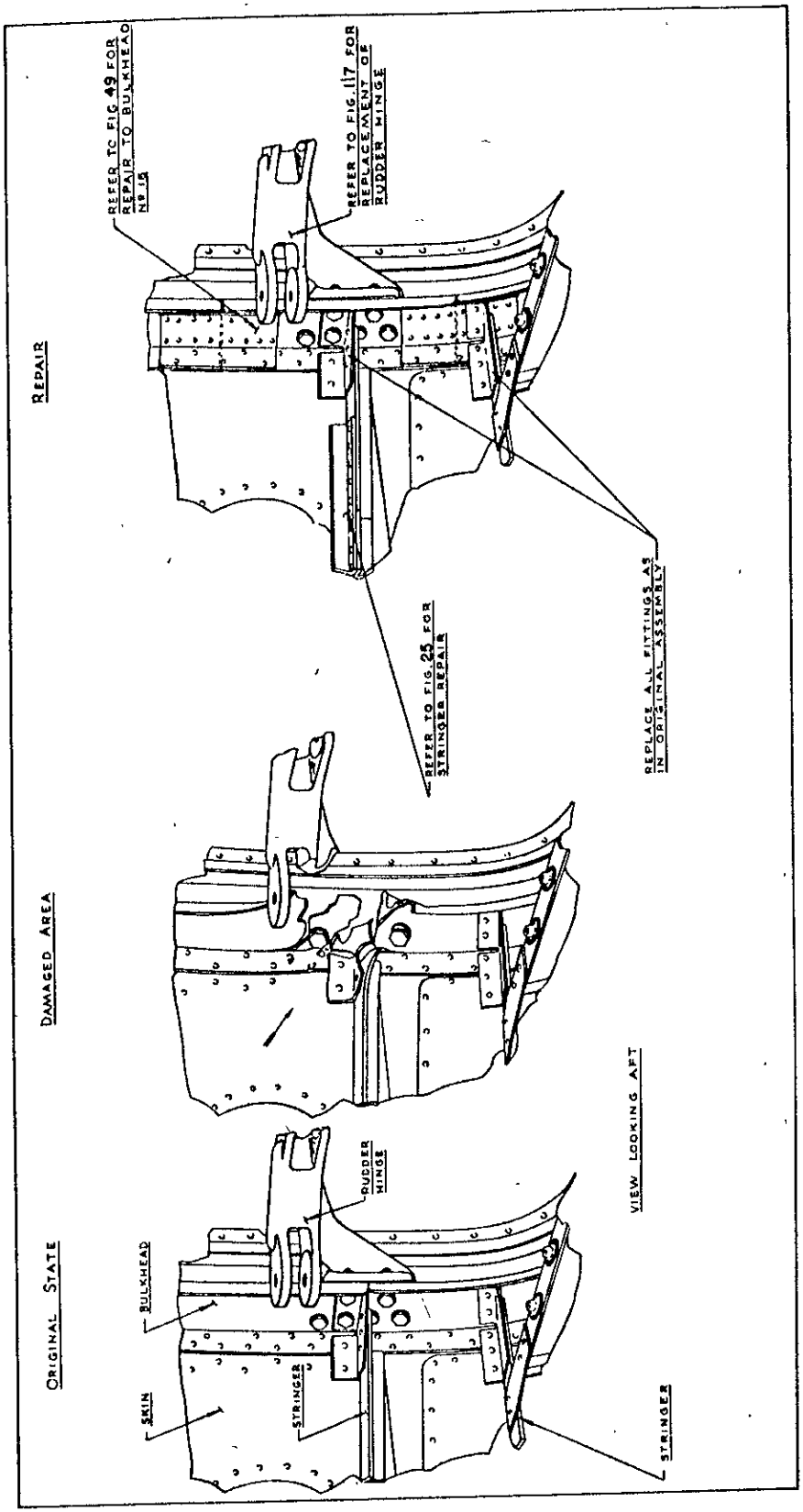


Figure 48 - Fuselage - Bulkhead and Rudder Hinge Damage Sta No. 16

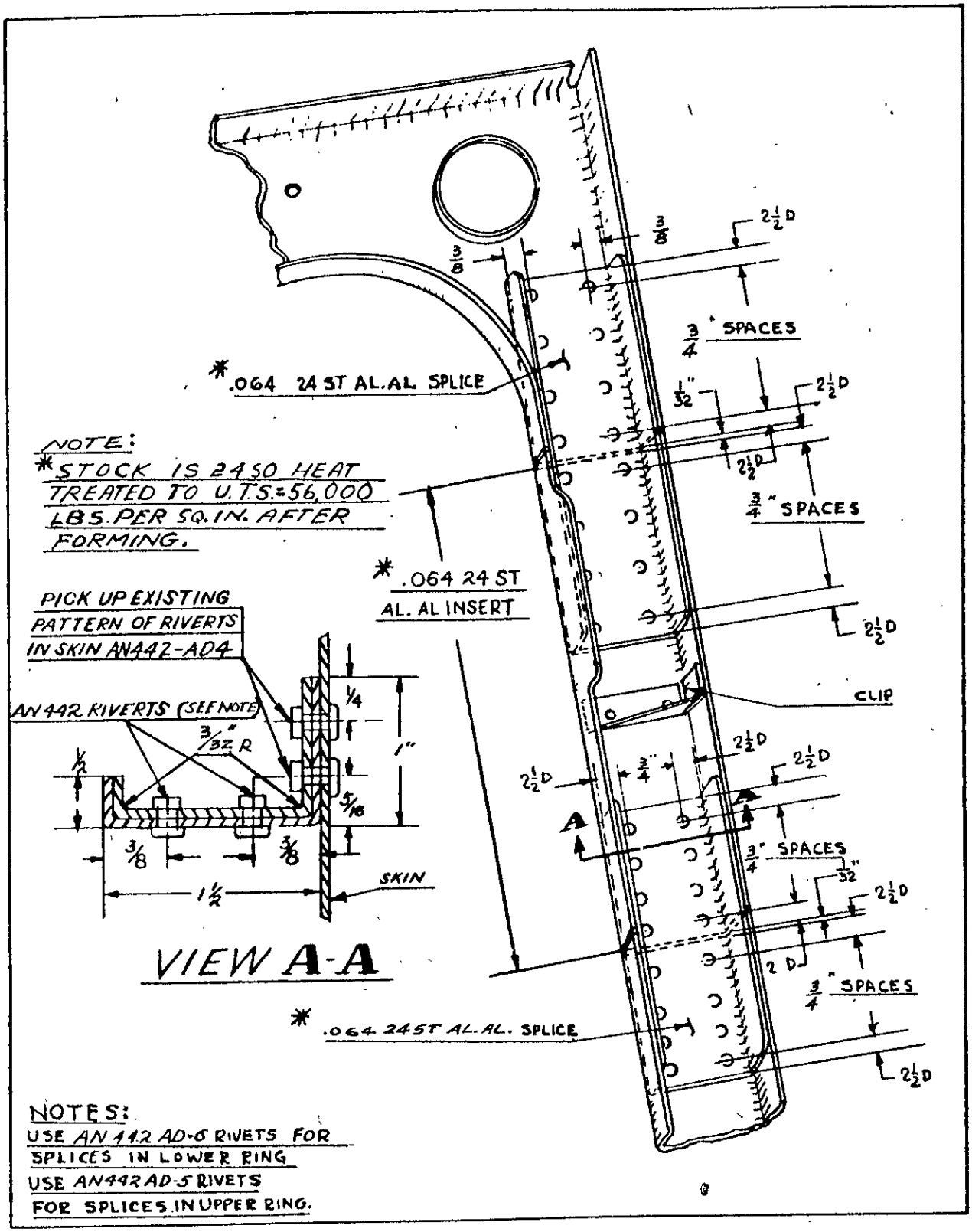


Figure 49 - Fuselage - Bulkhead No. 16

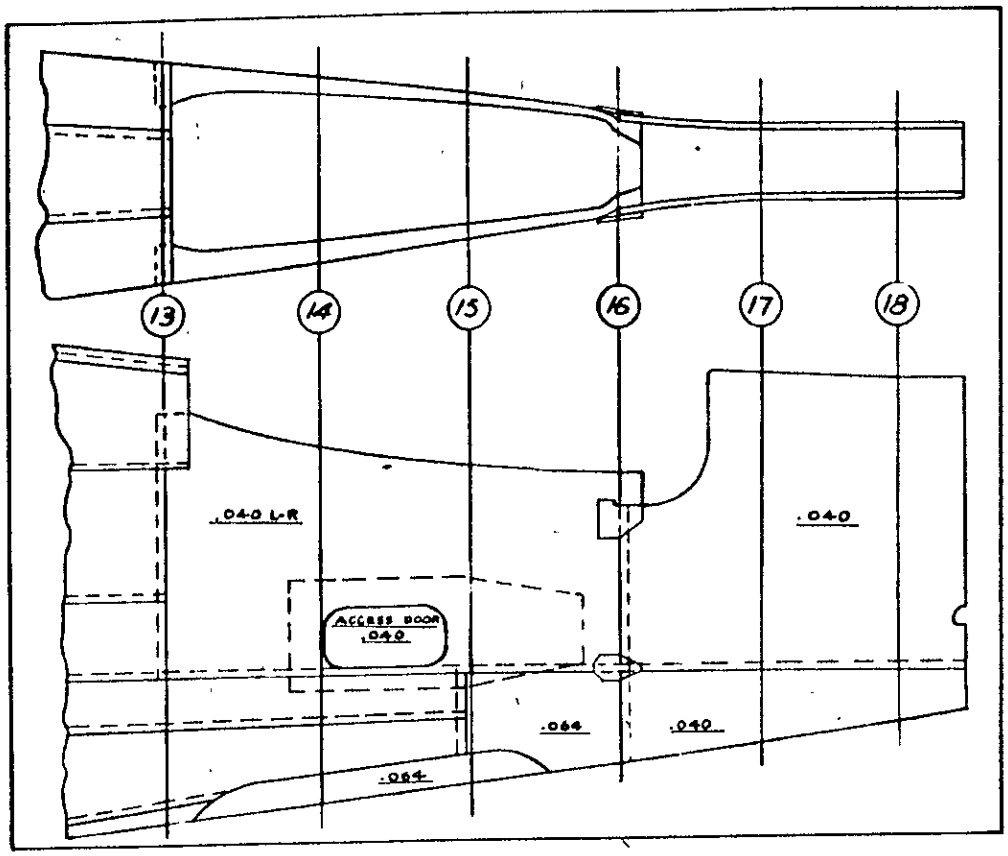


Figure 49A - Fuselage Extension - Skin

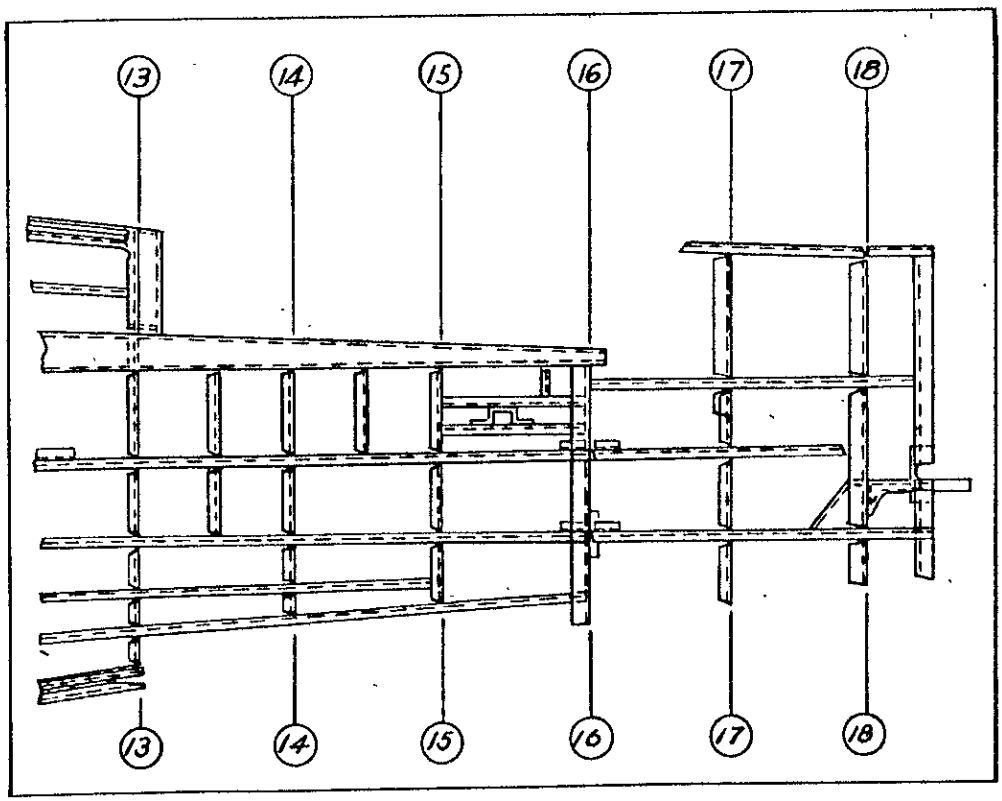


Figure 49B - Fuselage Extension - Skeleton

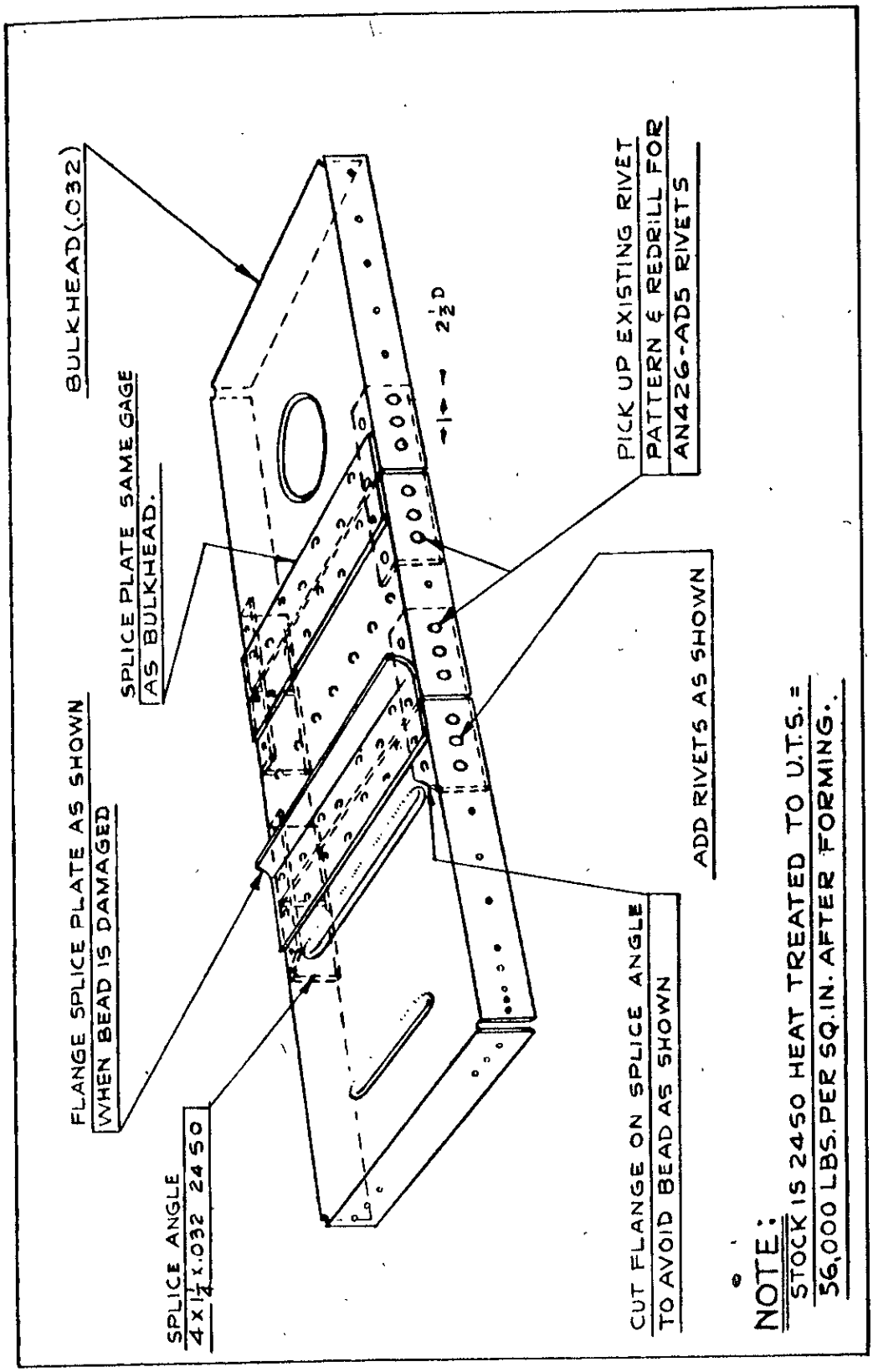


Figure 50 - Horizontal Shear Deck Repair

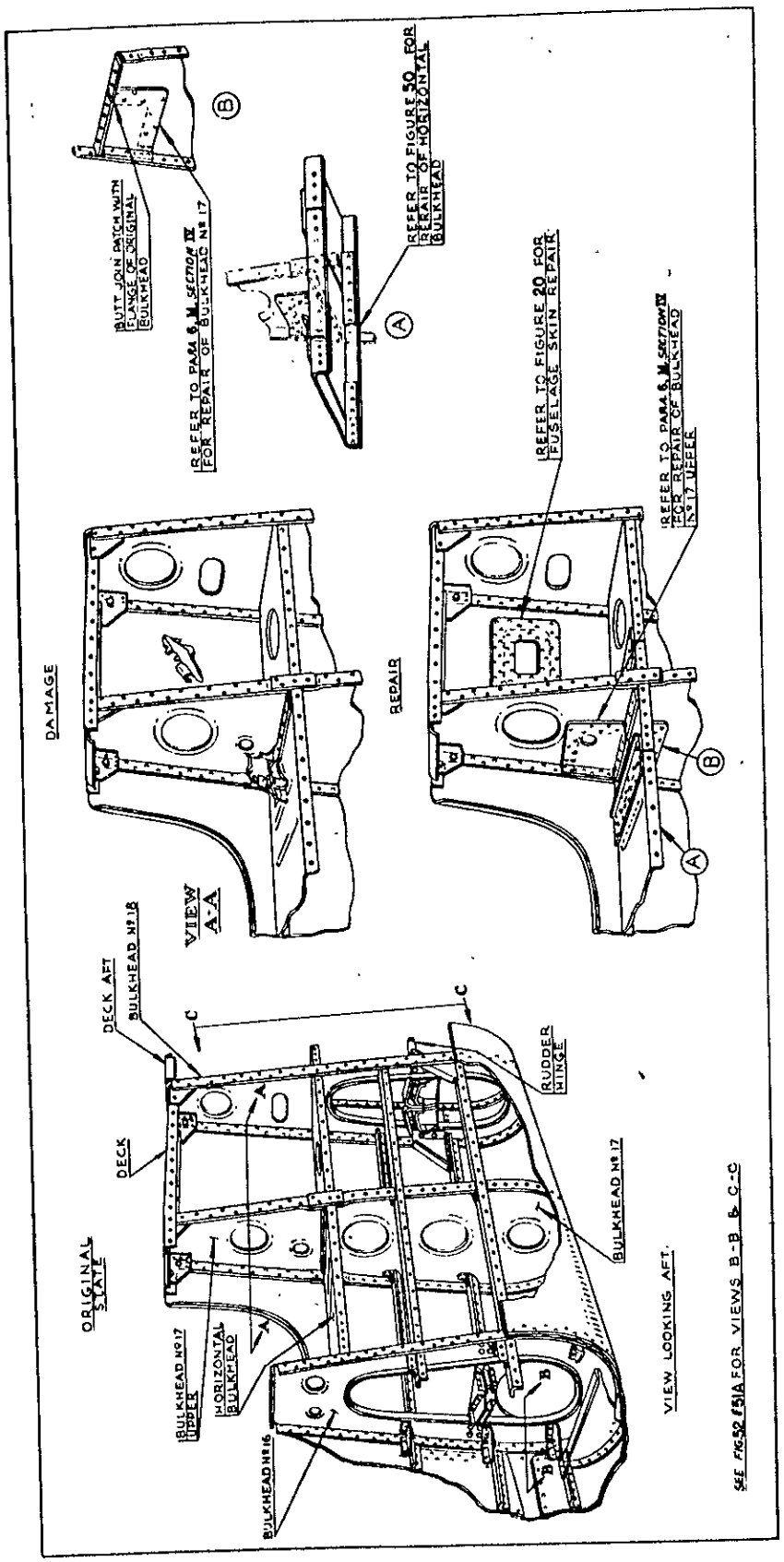


Figure 51 - Fuselage - Extension Repair

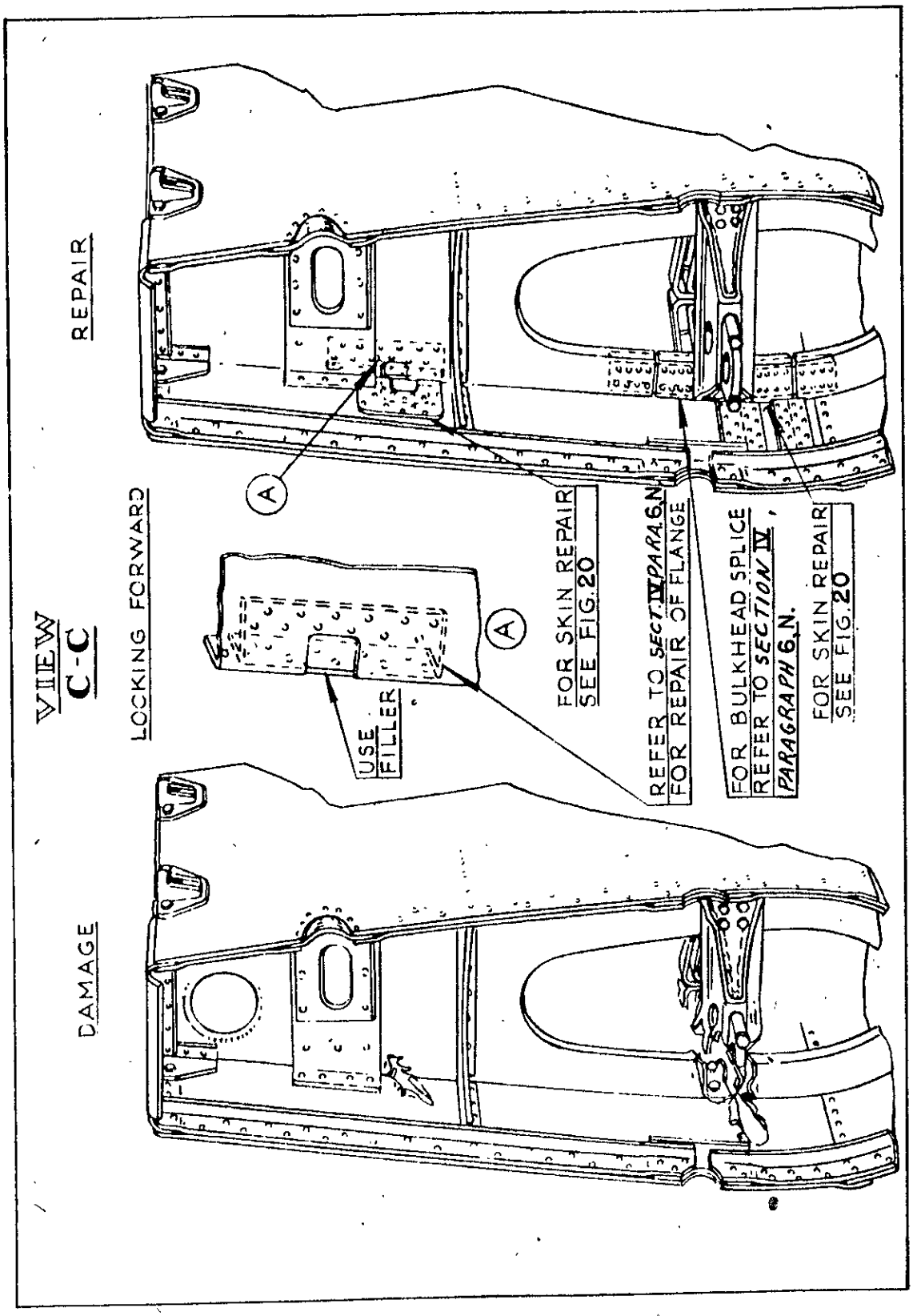


Figure 51A - Fuselage - Skin and Bulkhead Repair Sta. No. 18

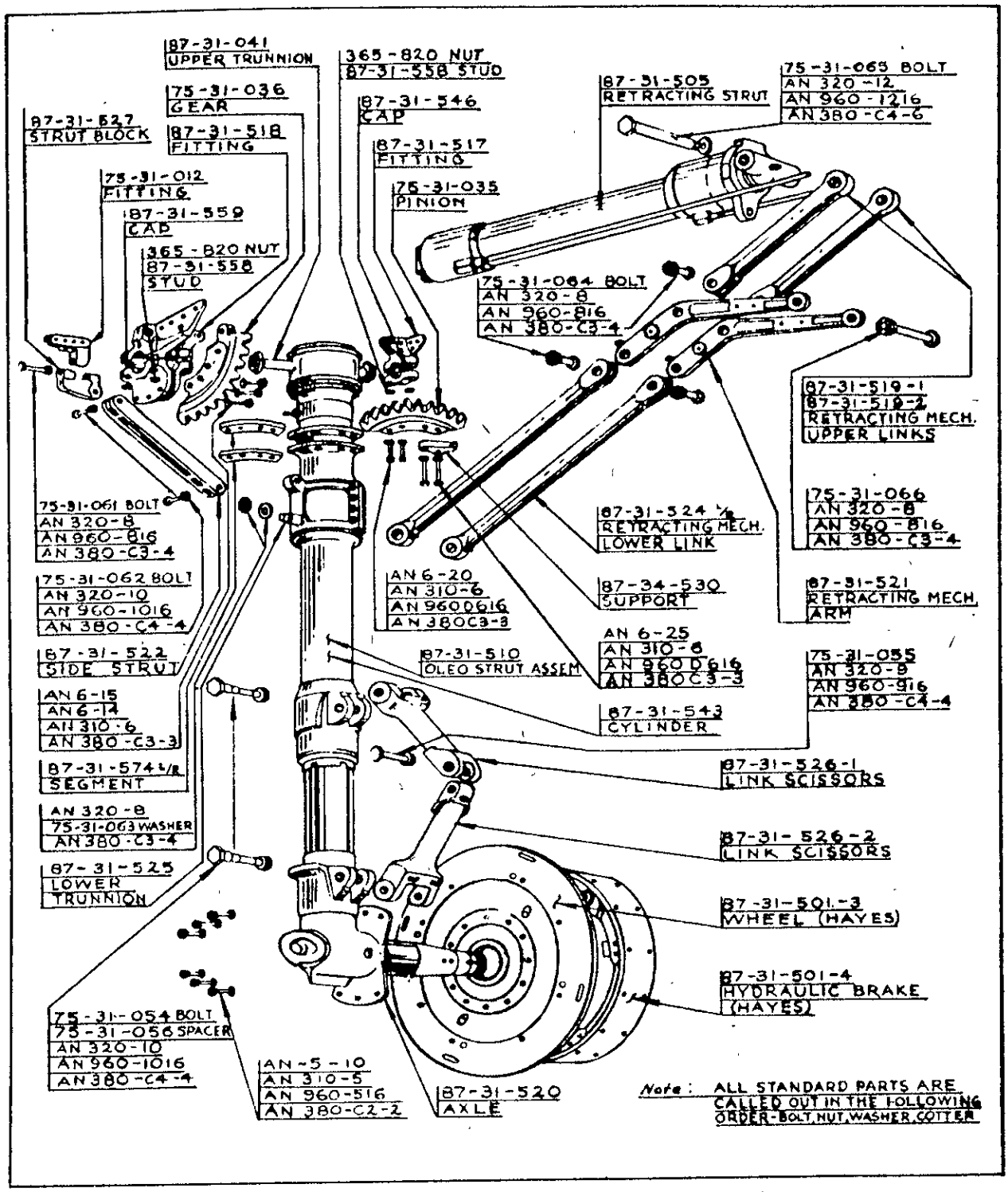


Figure 51B - Landing Gear Disassembly P-40D

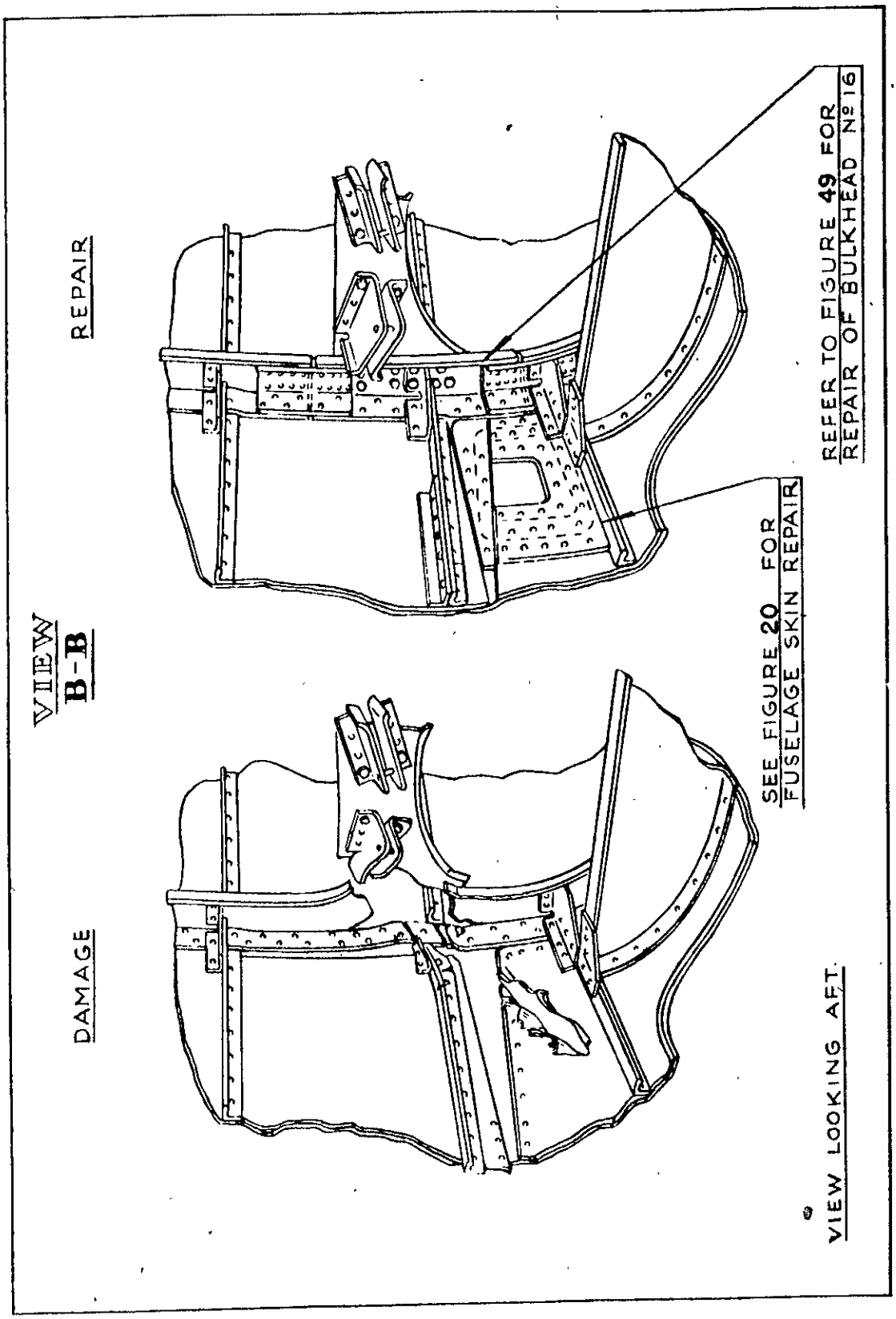


Figure 52 - Fuselage - Skin and Bulkhead Repair Sta. No. 16

SECTION V

LANDING GEAR

1. General.

No repairs are permitted to any part of the landing gear or tail wheel units, consequently all damaged parts must be replaced by standard spares. The replacement of parts may be facilitated by the use of the disassembly drawings of the landing gear and tail wheel. These drawings, figures 52A and 53 contain call-outs of all subassemblies.

2. Bushing.

With regard to bushed holes in the landing gear and the tail wheel units, wear should occur only inside of the bushing and, consequently, only the bushing will have to be replaced. Most bushings are replaceable with standard parts and do not require rereaming after installation. If the bushing is used with a shaft where a special tolerance between the shaft and the bushing must be held, it will be necessary to control the shaft diameter to suit the design requirements.

Oilite bushings cannot be reamed after installation; however, the hole may be burnished for close control of inside diameter when the condition warrants.

In hand reaming, for diameters up to 1 inch, a tolerance of 0.001 inch should be maintained; for diameters above 1 inch, the tolerance should be 0.002 inch.

For machine reaming, the tolerance of diameters up to 1/2 inch should be 0.005 inch; for diameters of 1/2 inch to 1 inch, 0.001 inch, and for diameters above 1 inch, ± 0.0015 inch.

A rule to use for circular fits, such as shafts in bearings, or bushings in fittings is as follows: Compare the maximum dimension of the hole with the minimum dimension of the shaft and the minimum dimension of the hole with the maximum dimension of the shaft.

For example:

Hole	Shaft
.875 inch ± .0015 inch – .001 inch	.873 inch ± .000 inch – .002 inch
.8765 inch – .871 inch	.0055 inch clearance, max
.874 inch – .873 inch	.001 inch clearance, minm

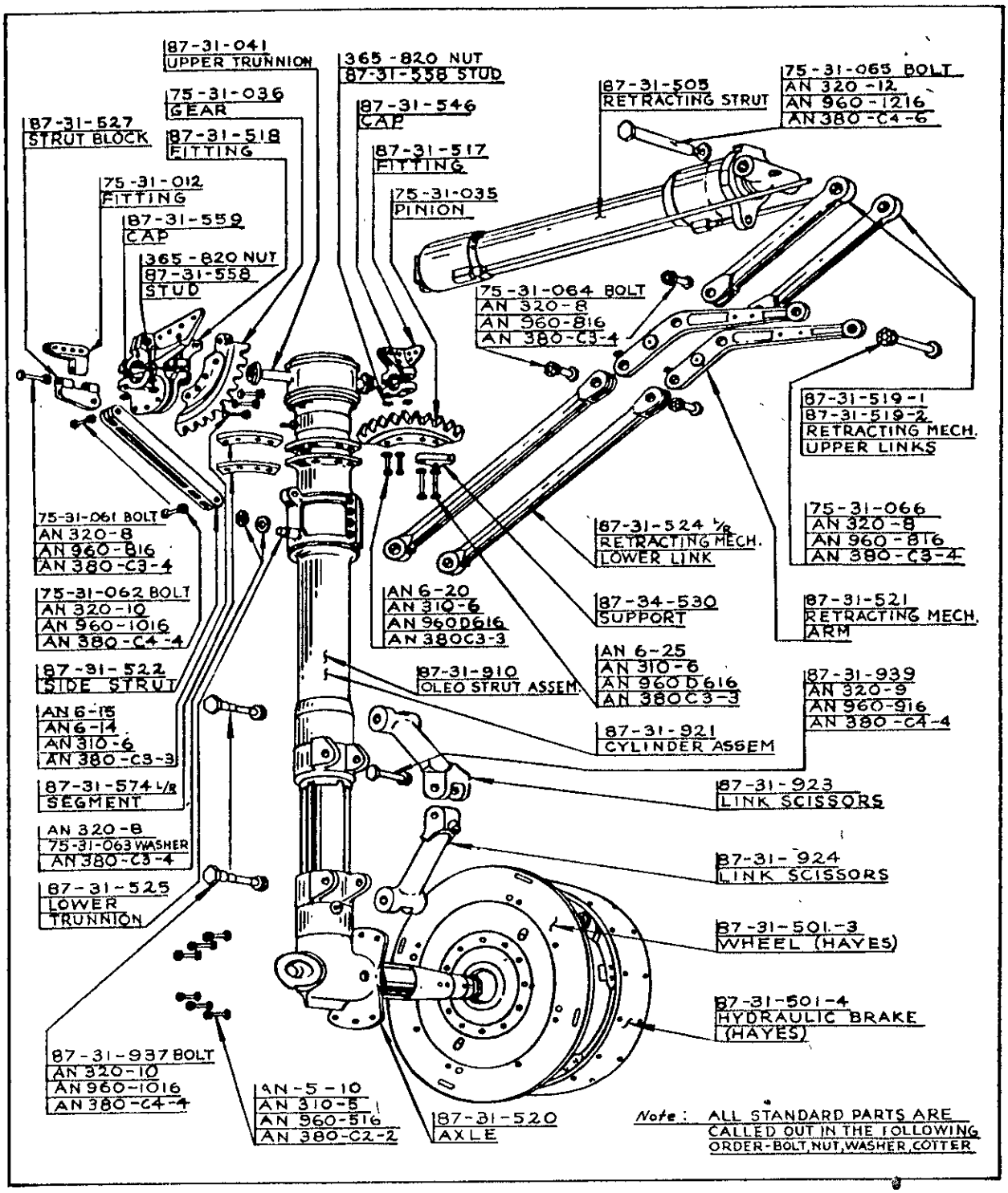


Figure 52A - Landing Gear Disassembly P-40E, E-1, F

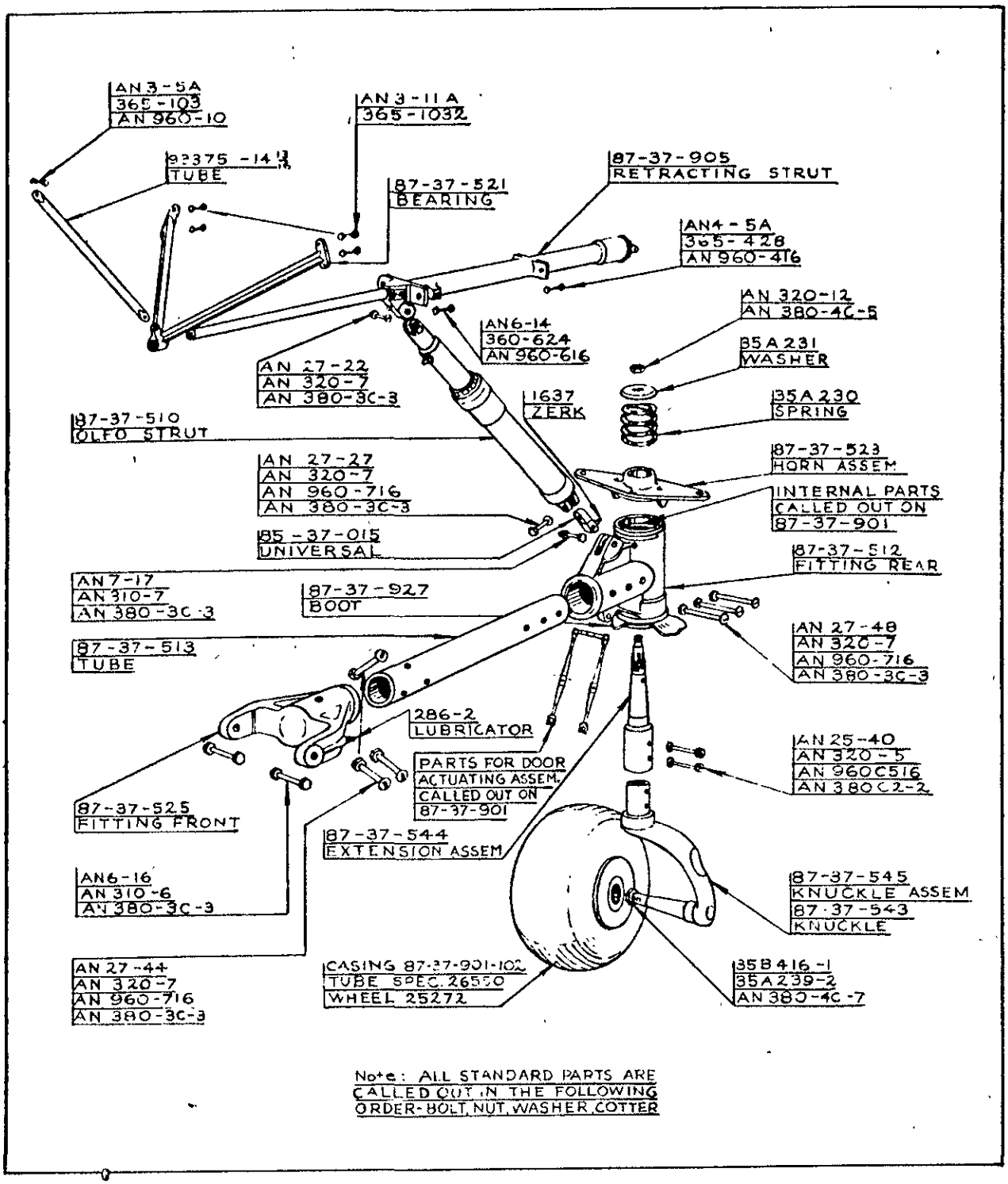


Figure 53 - Tail Wheel Disassembly

SECTION VI

WING

1. General.

The wing is of all metal construction consisting of a network of spars, ribs, and stringers which are covered with a thin highly stressed aluminum-alloy skin. (See figures 54, 55, and 56.)

The wing has a multispar arrangement and consists of two sections which are jointed at the center line of the airplane. The wing tips are detachable. The skin gages vary from .020 inch to .064 inch, as shown on figures 54 and 55. The split trailing edge type flaps are of all metal construction, whereas the ailerons have a metal frame which is fabric covered.

a. Types of Riveting. - Three types of riveting are used in the fabrication of the wing. These are:

(1) Machine countersunk type where the upper sheet is machine countersunk. For repairs do not machine countersink below .051-inch sheet.

(2) Press machine countersunk type which consists of machine countersinking the lower sheet or stringer and dimpling the upper sheet by squeezing or vibrating separately.

(3) Press countersinking where both the upper and lower sheets or the stringer are dimpled separately.

(4) In all cases, the parts are together when drilled for the rivets, and all rivets are driven by vibration.

b. Types of Rivets. - All rivets exposed to the airstream are of the 78-degree countersunk, A17ST type (Curtiss Standard 673-D-AD) or of the 100-degree countersunk (Army Navy Standard AN426-AD). Internal rivets are of the modified brazier head A17ST type (Curtiss Standard 671-D-AD) or of the flathead type (AN442-AD).

2. Classification of Damage.

When classifying any damage on the wing, carefully examine the extent and nature of the damage before placing it in one of the following:

a. Negligible damage.

b. Damage reparable by patching.

c. Damage reparable by insertion.

d. Damage necessitating replacement.

3. Wing Skin.

a. General. - The wing skin is supported by five spars, ribs between the spars, and closely spaced stringers which lie between the spars and are attached to the ribs. All areas of the skin are designed to take heavy tension and compression loads. It is essential, therefore, to adequately reinforce any area of the skin which becomes damaged.

(1) Splice Plates. - Table I, figure 57, specifies the required numbers of rivets or bolts to be used at the inboard and outboard edges of any patch or splice plate used to reinforce a damaged area. Columns 1, 2, and 3 specify the areas to which the data applies. Stations are measured in inches outboard from the center line of the airplane as shown by the encircled numbers on figures 54 and 55. Column 4 gives the rivet diameter, number of rows and the spacing between the rivets to be used at each end of a given patch; along the edges which are parallel to the ribs. The same data applies to the attachment on each side of a chordwise splice. The attachment for the edges of a patch which are parallel to the spars and for spanwise splices should be the same as in the nearest attachment of the damaged skin to a spar cap strip. When, as illustrated in figure 58, splices are made with frames which are discontinuous at the stringers or spars, the required number of rivets inboard and outboard of the chordwise cuts should be determined from column 5 of table I on the basis of the over-all chordwise length of the skin cut. Arrange the rivets at the spacing given in column 4 adding an extra row on each side of the cut to take the extra rivets. Count only those rivets which attach the frame within the chordwise length of the cut.

(2) Structural Doors. - Flush type structural or semistructural doors may be formed in the skin to facilitate skin repair* and permit future inspection of internal repairs. A structural door may be formed by substituting bolts for the rivets used in attaching a skin insert to a frame or splice plates. (See figure 58.) Flush steel bolts No. 1101-D which fit countersunk holes are used. These screw into self-locking nut plates No. 659-D each of which is riveted to the underside of the frame with two AN426AD-4 flush type rivets. The bolt patterns to be used for the chordwise

*Data available at the time of this writing does not substantiate the use of blind rivets in highly stressed portions of the airplane. The deflection of blind rivets, even when used in the ratio of two for one standard rivet and even when pinned or formed with a solid shank, is considerably in excess of that for the standard machine formed or vibrated solid rivets. Their use produces dangerous stress concentrations due to the redistribution of loads.

attachments are given in columns 6 and 7 of table I, figure 57, while the patterns for the spanwise attachments consist of one bolt for every two rivets in the nearest attachment of the skin to a spar capstrip. Openings which do not extend beyond two adjacent stringers may be closed with semistructural doors requiring approximately one-half the number of bolts for their attachment. The frame for a semistructural door should be made from stock one gage heavier than the sheet being repaired and should be cut to the shape illustrated in figure 57. The width of the frame on each side of the opening should equal one-half the width of the opening, and the length should be such as to take the required number of rivets given in column 5 of table I, figure 57, at the spacing given in column 4, all of these required end rivets to be placed in the two stringers and in the skin between these stringers. The washer head type of bolt No. 525-10 which is not countersunk may be used on semistructural doors except in areas near the leading edge where their drag would be detrimental. The nut plates No. 659-D contain a fibre washer which automatically locks the screws into place. Attachment of the nut plates to stock of gage .040 inch or lighter, where the material must be dimpled, or press countersunk to obtain flush riveteads on the outer surface requires the use of a countersunk shim plate No. 1066-D-1 or a .064-inch gage strap laid along the line of bolt holes between the nut plates and the frame. This shim strap is drilled and machine countersunk for each rivet and bolt, the frame is drilled and dimpled to match, and the door is countersunk for the bolts.

b. Negligible Damage.

(1) Dents. - Skin dents, free from cracks, abrasions, and sharp corners may be neglected. These dents should be restored to shape wherever possible to prevent their developing into cracks, using care, however, not to stretch or crack the skin in the process. Inspect all rivets near the damage to see that they have not been loosened or sheared.

(2) Holes and Cracks. - Holes and cracks which can be cleaned up to a 1-inch circle are considered negligible if in .040 inch or lighter skin and if the edge of the cleaned-up hole is at least 1 inch from the nearest rivet or cut-out and at least 2 inches measured along the span to the nearest skin splice rivets. Two such holes within 10 inches of each other measured chordwise and 5 inches measured spanwise, however, may not be neglected. Negligible holes must be cleaned up to prevent the spread of cracks and should be plugged as in figure 58.

c. Damage Reparable by Patching. - Minor damage not considered negligible may in general be cleaned up and patched by attaching a 24ST sheet of the same gage under the skin using the required number of rivets and rivet spacing as given in figure 57. It is preferable to place patches under the skin so that the damaged area may be inspected for the formation of cracks. For aerodynamic reasons the damaged material which is cleaned away should be replaced with a filler sheet. The original contour may be maintained by making patches discontinuous at stringers and bulkheads; care must be taken to use the total required number of rivets per inch of chordwise damage. On the other hand, continuous patches which pass over and are attached to the stringers require less rivets and are structurally superior. Existing rivets which interfere with the attachment of a patch should be carefully drilled out and the resulting holes used in arranging the new required rivet pattern.

Damage near reinforced sections of the skin, particularly in the area between stations 27 and 65 of the lower surface, may be patched only when sufficient attachment can be obtained by using the original rivet or bolt holes. Do not drill additional holes in any reinforced area because these areas have only the minimum required margins of safety.

Damage to the skin of the gas tank doors may be patched by using a sheet of the same gage 24ST stock which is large enough to take four rows of 3/16-inch rivets at 3/4-inch spacing along the inboard and outboard ends of the damaged area plus one row of 5/32-inch rivets at 1-inch spacing on the other two sides. Clean up the damaged area giving all corners a minimum radius of half an inch to prevent the formation of cracks and remove enough rivets to permit placing the patch between the skin and the stiffeners. Patches or splice plates must be made continuous across the stringers and should take 3/16-inch rivets in both legs of each stiffener. A filler sheet should be added to preserve the contour if the damage is located in an unfaired section of the door. The filler should be attached to the patch with a single row of 1/8-inch rivets at 1-1/4 inch spacing.

d. Damage Reparable by Insertion. - Damage to areas which cannot be effectively patched due either to their location or to their extent may be repaired by the use of inserts. The required insert should be cut from 24ST stock of the same gage as the damaged skin. The insert should be sufficiently large to extend to the edges of the damaged sheet or to areas in which the necessary splice plates or frames may be used (figures 58 and 59) and its corners should be rounded off to a half inch or larger radius. Use the insert as a template in cutting away the damaged material. Make up the necessary splice plates or frames and rivet these to the skin using the data in figure 57.

e. Damage Necessitating Replacement. - Damaged reinforcement plates and extensively damaged sheets of skin should be replaced with equal gage 24ST stock cut and drilled to match the damaged part. Use care in drilling out the existing rivets. (Refer to section I, paragraph 9.)

4. Ribs.

a. Negligible Damage. - Cracks or holes which after clean-up have not reduced the length of the ma-

terial along every cross section of the rib by more than 10 percent and which are not within half an inch of any web hole flange, structural bead, or fitting attachment may in general be considered negligible. Small, isolated dents which are at least half an inch from the nearest web hole flange or structural bead may be neglected. Sharp cornered holes should be rounded out and all dents should be bumped out and examined for cracks. All cracks should be stopped by drilling 1/8-inch holes at their ends.

Do not neglect any cracks, nicks, or holes in the landing gear attachment ribs or in the leading and trailing edge portions of the center line rib.

b. Damage Reparable by Patching.

(1) Minor Damage. - Minor damage not considered negligible may in general be cleaned up and patched with 24ST stock of the same gage. (Refer to figures 60 to 64.) In all areas except those directly above or below a lightening hole, use the same rivets or bolts and the same spacing as in the nearest attachment of the rib to the spar web, and run this pattern either completely around the damage or to the edges of the undamaged portion of the rib. In patching damaged areas above or below a lightening hole use the same gage patch with twice as many rows of the same rivets or bolts and the same spacing as in the nearest web attachment.

(2) Lightening Hole Flange. - If the damage after clean-up is in the flange of a lightening hole or within half an inch of this flange, form a flange on the patch equal to the lightening hole flange and add an additional rivet at each end of the patch flange near the undamaged rib hole flange. (See figure 65.)

(3) Structural Beads. - If the damage is within half an inch of a structural bead or extends across the bead, form an equal bead in the patch and add two additional rivets each side of the damage, one each side of the bead.

(4) Landing Gear Ribs. - The landing gear ribs should not be patched unless the rivets or bolts used for the patch, see nearest attachment of rib to spar web, can be placed around the damage without their being closer than 1 inch to the nearest fitting attachments. If a landing gear rib or any of its fittings are in any way damaged, inspect the whole landing gear attachment structure for damage to the attachments, cracks in the fittings, and misalignment of parts.

c. Damage Reparable by Insertion. - Damage to areas supporting fittings, to areas around which sufficient attachment cannot be obtained for patches, and to areas extensively damaged should be repaired by the use of inserts of the same gage 24ST stock. The design requirements for splice plates and their attachments or for overlap splices are the same as for patch plates, as given in this section, paragraphs 4.b.(1) to 4.b.(4). Equal legged angles of the same gage 24ST stock 5/8 inch x 5/8 inch may be attached to an insert along the line of an original bead in lieu of forming a bead. The same angle should be used as a vertical stiffener across a space where it is undesirable to reform a flanged lightening hole. (See figures 61 and 66.) Attach the angle with the same rivets and pattern used for the splices.

d. Damage Necessitating Replacement. - Damaged rib reinforcements and fittings and extensively damaged rib sections should be replaced. Use care in drilling out the existing rivets. (Refer to section I, paragraph 8.)

5. Spars.

a. Negligible Damage. - Small holes in the spar webs which can be circumscribed by a 3/4-inch diameter circle need not be patched provided the perifery of the circle is not less than 1 inch from the nearest lightening hole or cap strip. The hole should be drilled or reamed to make the edges smooth.

b. Damage Reparable by Patching.

(1) Minor Damage. - Minor damage not considered negligible should be cleaned up and patched provided there is sufficient room to use the required rivet pattern as given in tables A and D of figure 67 around the damage. Patches should be made from the same gage 24ST stock as the damaged spar web. The spar web gages are as follows:

Spar No. 1	.051 in. from sta ℄ to sta 89
	.040 in. from sta 89 to sta 205
Spar No. 2	.040 in. from sta ℄ to sta 133
	.032 in. from sta 133 to sta 205
Spar No. 3	.051 in. from sta ℄ to sta 205
Spar No. 4	.040 in. from sta ℄ to sta 57
Spar No. 5	.040 in. from sta ℄ to sta 205

(2) Web Lightening Hole. - When damage is near a web lightening hole, as in figures 57 and 59, extend the patch beyond the edge of the hole, run the required rivet pattern around the damage of the edge of the hole, and add an extra rivet at each end of the pattern near the edge of the hole. If the web hole is flanged, add an equal flange to the patch and add two extra rivets at the ends of the rivet pattern near the flanges. The flange on the patch may be formed straight and should be opposite to the web hole flange. Damaged lightening hole reinforcement rings must be replaced. Large reinforcement plates may be patched with 24ST stock of the same gage as the original member, using the same method as employed for web repair. Where both web and reinforcement are damaged, place the required patches on opposite sides and rivet through the four sheets with the required rivets and pattern. Use a filler between the patches and replace all rivets which were originally in the damaged area. (See figures 60 and 61.) A single patch equal in gage to the web plus its reinforcement as in figure 68 may be used, providing the next larger size of rivets is used

and the spacing is reduced to the minimum in table D of figure 67. When damage occurs near a web flange or cap strip and prevents running the required rivet pattern around the damage, extend the patch to the edge of the web and use the required number of rivets as given in table B of figure 67 for the attachment to the cap strip, at each end of the damage. Run the required rivet pattern, table A, around the damage and up to the cap strip or flange. (See figures 68 and 69.)

c. Damage Reparable by Insertion. - Extensive damage should be repaired by splicing in new sections of the same gage 24ST stock. Splice plates for attaching the inserts to the undamaged parts of the web should also be of the same gage 24ST stock. The rivet pattern requirements are in general the same as for patches. Table C, figure 67 gives the minimum number of rivets to be used on each side of the cut between the cap strips. Figures 70 to 73 give cap strip and web flange repairs which are equal in strength to cap strip material including the web material in the cap strip region. When these repairs are made at a cut in the web, the web splice plate does not need to be attached to the cap strip. If, however, the cap strip or web flange is not repaired according to figures 80 to 83, the splice plate should overlap the cap strip and should be attached with the number of rivets specified in table B on each side of the cut. (See figure 67.) Table D gives the minimum allowable spacing for rivets and should be considered in arranging all rivet patterns. Various examples of repairs to spar webs are given in figures 67 to 69 and 74 to 81.

d. Damage Requiring Replacement. - Damaged fittings, small gussets and reinforcements must be replaced. Also all rivets or bolts removed in making repairs must be replaced.

6. Stringers.

a. General. - Several types of stringers are used in reinforcing the wing skin. Cross-sectional views are shown in figures 82 and 83. Figure 82 shows extruded stringers with their Alcoa die numbers. Figure 83 shows formed "Z" stringers and an extruded "Z" stringer with its Alcoa die number. For reference purposes each stringer is given a number as shown in figures 54 and 55.

b. Negligible Damage. - Small isolated dents, free from cracks, abrasions, and sharp corners may be neglected provided no two adjacent stringers are damaged and the skin to which the stringers are attached is not affected. All stringers should be kept as straight as possible in order to withstand compression loads.

c. Damage Reparable by Patching. - Do not neglect any nicks or cracks in the stringers. Damage which after clean up affects less than one half of the cross-sectional area may be reinforced by using the required patch plates and rivets as given in figures 85, 86, 87, and 88. Damage affecting more than one-half of the cross section should be repaired according to figures 84, 89, 90, and 91. As shown in these figures an angle may be attached to the skin next to a stringer to reinforce any damaged area located near the outboard end of the stringer. Filler pieces should be added wherever needed for the attachment of the skin or fittings.

d. Damage Reparable by Insertion. - Extensive damage should be repaired by cutting away the damaged portion of the stringer and replacing this with an insert of the same section and material. Details for the splices to be used in attaching the insert are given in figures 84, 89, 90, and 91 for the various sections.

e. Damage Necessitating Replacement. - Damaged stringer reinforcements and splice plates should be replaced.

The short stringers supporting the lower surface of the ammunition compartment should be replaced if damaged or may be reinforced by attaching a section of similar stringers to the skin next to the damaged portion using AN442AD-4 rivets at 1-inch spacing and at least four rivets at each end of the damage.

f. Gas Tank Door Stringers. - Any damaged gas tank door stringers should be replaced or patched with .051-inch gage 24ST sheet formed to fit over the damaged stringer and long enough to take at least four 3/16-inch rivets at each end through each flange or a total of eight 3/16-inch rivets at each end plus the original 1/8-inch rivets along the length of the damage.

7. Spar Cap Strips.

a. General. - There are four types of cap strips: An extruded angle, an extruded "J" section, an extruded bulb angle and a formed "J" section. Each type requires a special arrangement of patch material and is covered separately in figures 70 to 73. The number of bolts or rivets for each repair is given on the figures according to spar number and spanwise location. Cross-sectional views with Alcoa die numbers for each are shown in figure 92.

b. Negligible Damage. - Small isolated dents, free from cracks, abrasions, and sharp corners may be neglected.

c. Damage Reparable by Patching.

(1) Nicks and Cracks. - Do not neglect any nicks or cracks in the cap strips. Clean up the damaged area, by rounding out the sharp corners and stopping cracks with an 1/8-inch drilled hole and then reinforce or patch the cap strip according to the data given in figures 70 to 73.

(2) Drilling Bolt Holes. - Care must be exercised to use the correct drill sizes when enlarging rivet holes to take the required bolts. Any looseness of the bolts will throw excessive loads on the nearby rivets,

thus loosening the rivets and making them ineffective. All bolt and rivet patterns should be arranged to make use of the original holes. Do not drill additional holes or change the pattern unless the change is justified by a similar change inboard of the section in question.

(3) Cap Strip Patches. - Due to the fact that reinforcements bolted to a cap strip cannot be made as efficient as the original continuous material any partially damaged section will take its ultimate allowable load before the reinforcements or patches are loaded up. This action will inevitably cause complete failure of the cap strip at the damaged section during service. To avoid a failure of this nature, all cap strip patches and their attachments at each end of the damage, must, therefore, be made equal in strength to the strength of the original undamaged section. The repairs given in figures 70 to 73 are designed to include the strength of the web material that acts with the cap strips.

d. Damage Reparable by Insertion. - Extensive damage or damage which due to its location cannot be repaired by patching should be repaired by the use of an insert. Details for the splicing in of cap strip inserts are given in figures 70 to 73.

e. Damage Requiring Replacement. - All damaged cap strip reinforcements should be replaced.

8. Flap.

a. General. - The skeleton aluminum-alloy framework of the split trailing edge flaps is covered with .025-inch aluminum-alloy 24ST sheet. (See figure 93.)

b. Skin. - Any damage to the skin should be repaired with a flush insert of .025-inch gage 24ST stock attached by a patch or frame of .032-inch gage 24ST stock. Use a single row of AN426AD-4 press countersunk rivets at 1-inch spacing for the attachment. Patches and frames may be discontinuous at the ribs or beam.

c. Rib. - Random holes in the web of any rib which when cleaned up can be circumscribed by a circle of diameter less than one-half of the depth of the rib at the damaged section may be considered negligible providing:

(1) The center of the hole is not above the center of the rib web.

(2) The lower edge of the hole does run into the lower bend radius.

(3) The edge of the hole is not closer than 1 inch in a chordwise direction, to the nearest structural hole.

For damage in excess of the above see figure 94.

d. Stringer. - Any damage to the stringers should be reinforced by adding a .040-inch gage 24ST "Z" section as shown in figure 95. This same reinforcement may be used as a splice when replacing sections of a damaged stringer.

e. Channel Beam. - The channel forming the main beam of the flap is heavily loaded and has low margins at the sections where the operating links are attached as well as at the ribs. All repairs are to be made with .051-inch gage 24ST stock fitted to the channel as shown in figure 96 and the specified arrangement of AN442AD-4 rivets. For minor damages to the beam use portions of the reinforcement illustrated in figure 96 as follows:

(1) Damage to the Flange Only. - Attach an angle with three rivets in the flange and three in the leg of the channel at each end of the damage.

(2) Damage to the Leg Only. - Attach a "Z" section with three rivets in the flange of the channel, six rivets in the leg and three rivets in the back of the channel at each end of the damage.

(3) Damage to the Back of the Channel Only. - Attach a channel with seven rivets through the back and three through each of the legs of the channel at each end of the damage.

For extensive damage or damage occurring in the sections which cover bearing blocks for the operative links insert new sections of channel making the splices (figure 96) between ribs in the sections where there are no bearing blocks. Replace all damaged fittings, etc.

f. Hinge. - Minor local damage to the flap hinge between the ribs may be cleaned up and neglected. Damage within 2 inches of any rib should be repaired by cutting away the damaged portion of the hinge and replacing it with a new section of standard hinge. Arrange the new insert so that its ends are at least 2 inches from the nearest flap rib.

9. Ailerons.

a. General. - The ailerons are light alloy, fabric-covered structures. (See figure 97.) To prevent their flutter at high speeds the static balance of each about its hinge axis is adjusted in manufacture by attaching a lead filled tube within the leading edge near the outboard end. Any repair which decreases the static balance; that is, makes the trailing edge fall, by more than 0.3 inch-pounds measured at the hinge axis should be compensated for by adding lead sheet to the leading edge directly in front of the repair. Use 1/8-inch or thinner, lead sheet extending to within 1 inch of the upper and lower row of rivets in the nose beam flanges and attach with 1/8-inch countersunk blind rivets at 1-inch spacing and 1/2-inch edge distance along the top and bottom edges. (See figure 114.) Cover the lead with well doped fabric extending at least 2 inches beyond its edges.

b. Mass Balancing. - The procedure for checking static balance should consist of prebalancing the aileron on its end bearings in an inverted horizontal position by attaching a small weight, in a manner similar to that employed for the elevator. (See figure 98.) After completing the repairs replace the balancing weight at the same point, in the same manner as the original attachment and add sufficient lead sheet to the leading edge to bring the trailing edge up to its original prebalance position.

c. Negligible Damage. - Smooth dents, free from cracks, abrasion and sharp corners may be neglected provided the adjacent rivets and internal structure are intact. Do not neglect dents in the nose skin which tend to buckle when the aileron is twisted or warped by hand. Where accessible, negligible dents should be restored to shape taking care to avoid the formation of cracks.

d. Reparable Damage.

(1) Nose Skin. - The nose skin may be repaired or reinforced by using external patches which extend to the upper and lower edges of the nose skin as shown in figure 99. The patch must cover the damage and extend to the nearest ribs. Use .025-inch 24ST stock for the patch and attach it with 1/8-inch solid rivets in the beam flanges and 1/8-inch blind rivets in the rib flanges. Use rivet spacing as illustrated in figure 99. Damage to the skin aft of the beam web should be reinforced with .025-inch 24ST sheet of sufficient size to take one row of 1/8-inch blind rivets at 1/2-inch spacing around the damage forward of the beam plus at least three of the original AN442AD-4 rivets in the beam flange at each end of the damage. Use a .025-inch shim between the reinforcement and beam flange where the skin patches should be well rounded to prevent their cutting through the fabric.

(2) Nose Ribs. - Damaged nose ribs should be replaced using the same size rivets and pattern where accessible. If blind rivets must be used, use two of the same diameter for each original solid rivet.

(3) Nose Beam Web. - The nose beam web may be patched with .032-inch gage 24ST stock attached by two rows of 1/8-inch blind rivets arranged around the damage at 1-inch spacing between rivets and 3/4 inch between rows. (See figure 100.) If the damage is too near a flange to obtain the required rivet pattern, form a 3/4-inch flange on the patch which is long enough to take the existing 1/8-inch rivets in the flange, next to the damage, plus two additional rivets at each end of the damage. If only the flange is damaged reinforce it with a .032-inch gage 3/4-inch by 3/4-inch 24ST angle long enough to take four of the original 1/8-inch rivets in the beam flange at each end of the damage plus four 1/8-inch blind rivets in the back of the channel. To splice the beam use a nestled channel of .032-inch 24ST stock with 3/4-inch flanges approximately 5 inches long and attach this splice channel with four AN442AD-4 rivets in each flange on each side of the cut plus three 1/8-inch blind rivets on each side of the cut in the web of the beam and three 1/8-inch rivets at each end of the splice in the web of the channel. (See figure 100.)

(4) Rib Webs. - Damage to the web of any rib aft of the main beam should be patched with .025-inch gage 24ST sheet using one row of AN442AD-4 rivets at 3/4-inch spacing around the damage. If the damage extends into the radius of either flange add a flange to the patch and use at least two AN442AD-4 rivets in the rib cap strip at each end of the damage. Damage to the rib flange alone should be reinforced with a .025-inch gage 24ST angle formed to fit into the flange of the rib and pick up the cap strip rivets. (See figure 101.) Use at least two AN442AD-5 rivets through the cap strip approximately 1/2 inch apart at each end of the damage plus any existing intermediate rivets. To splice the rib use a nestled channel (figure 101) of .025-inch gage 24ST aluminum alloy attached with eight AN442AD-5 rivets, four in each cap strip, two on each side of the cut. If the cap strip is damaged replace or insert a new section and splice with a strip of .032-inch gage 24ST using two AN442AD-5 rivets on each side of the cut at 1/2-inch minimum spacing.

(5) Tab Mechanism. - The tab mechanism must be rigidly supported. Any damaged parts should be replaced, and any damaged supporting structure must be carefully reinforced to prevent flutter of the aileron in flight.

(6) Trailing Edge. - For general repair of the trailing edge see figure 102.

10. Wing Tip.

Each wing tip is attached by screws and can be easily removed. (See figures 56 and 64.) Wing tips should generally be replaced if damaged. Minor repairs may be effected using blind rivets and following the procedures outlined for repair of the fin and stabilizer. For aerodynamic reasons patches forward of spar No. 3 should be made flush with the skin. For a general repair to the wing tip joint see figure 103.

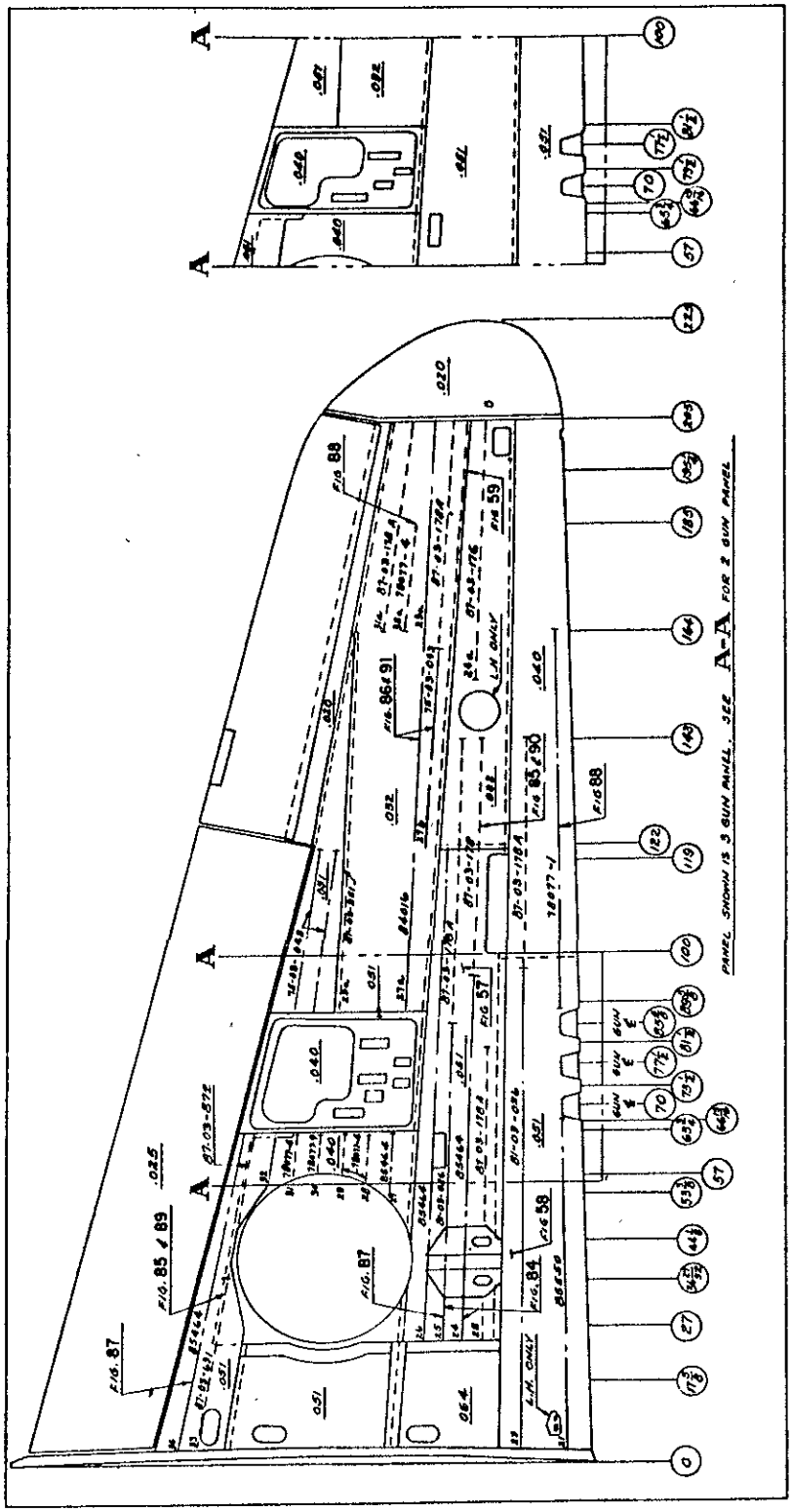


Figure 54 - Wing Skin - Lower

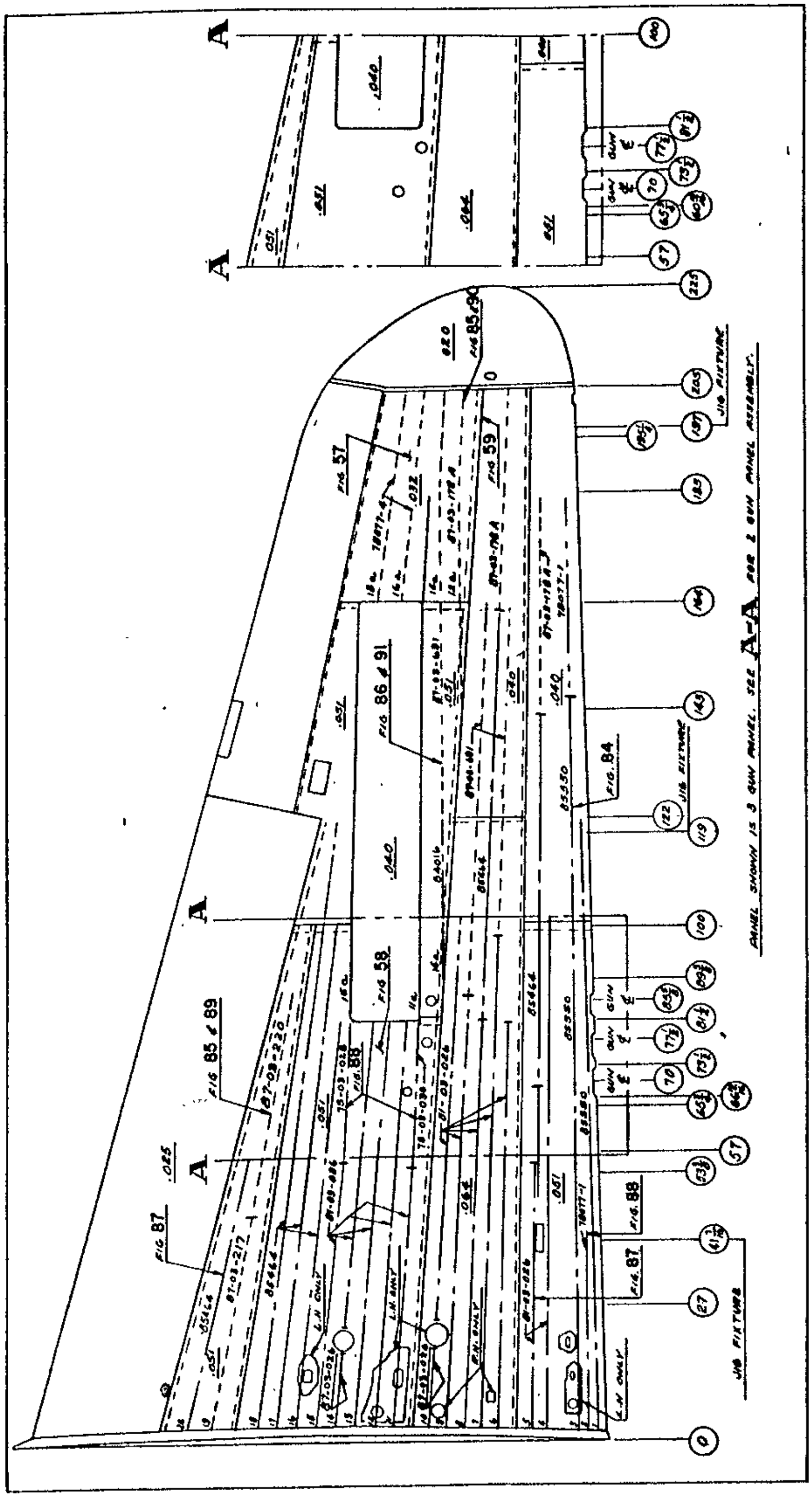


Figure 55 - Wing Skin - Upper

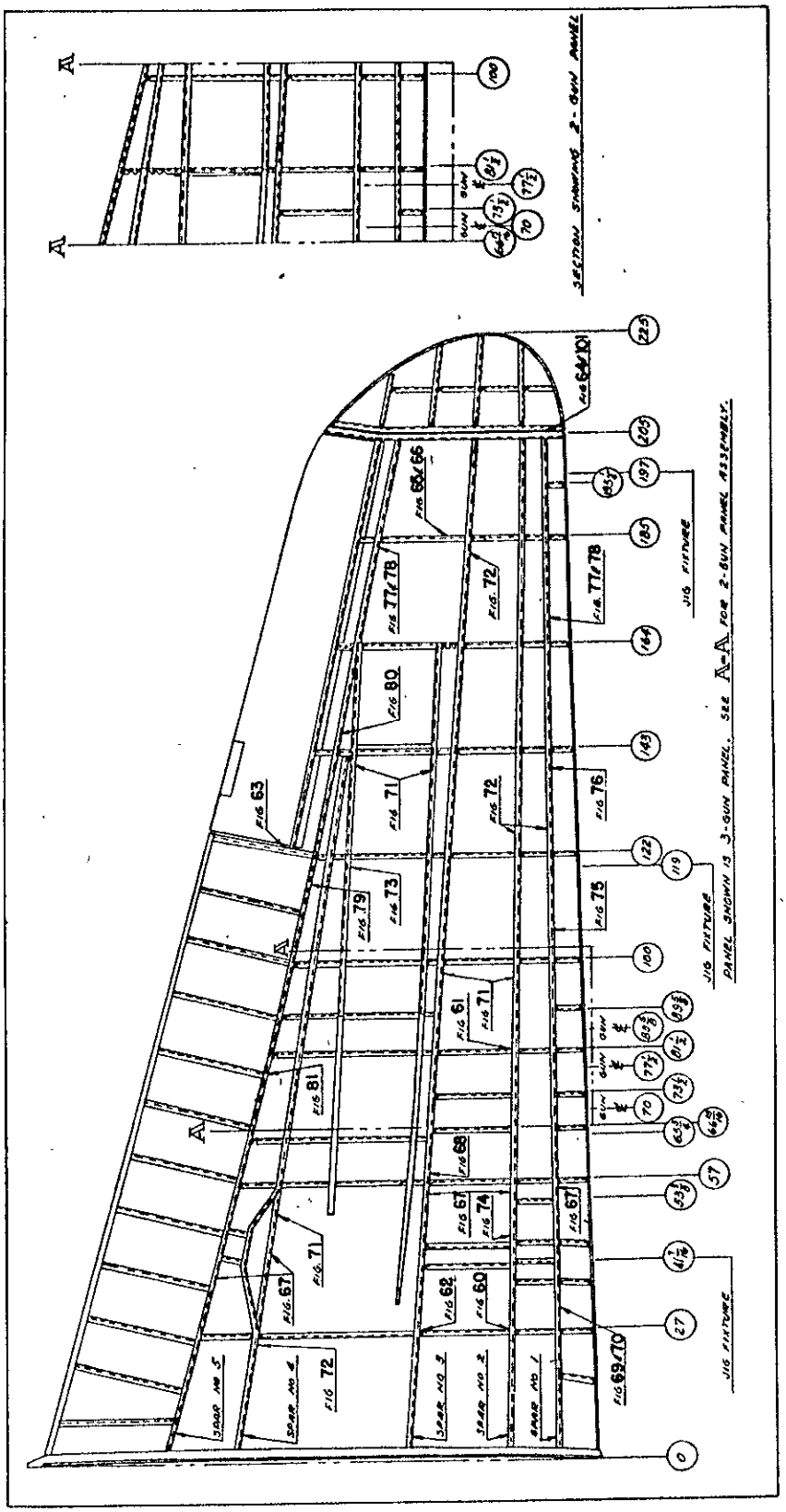
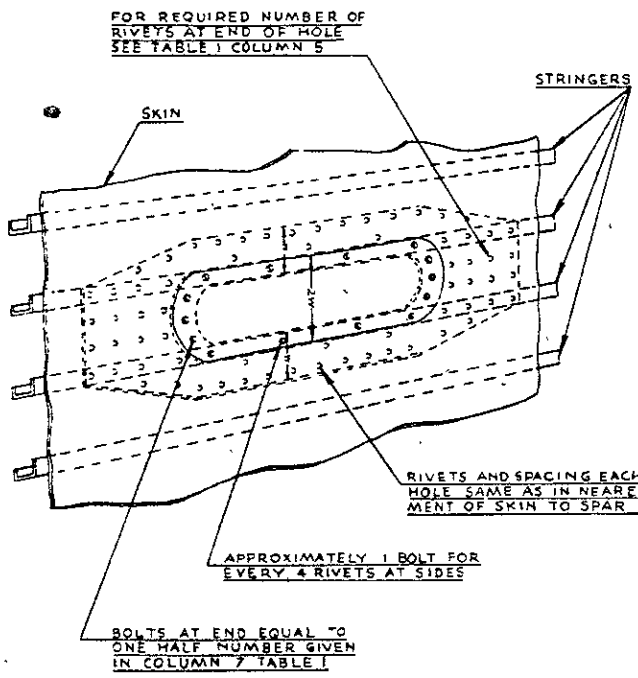


Figure 56 - Wing Skeleton



EXAMPLE ABOVE SHOWS SEMI-STRUCTURAL DOOR OF .051 GAGE STOCK IN UPPER SKIN BETWEEN ℄ AND STATION 100

FOR SPANWISE ATTACHMENTS-USE SAME RIVETS AND PATTERN AS IN NEAREST ATTACHMENT OF THE SKIN TO A SPAR CAPSTRIP
FOR STRUCTURAL DOOR USE ONE BOLT FOR EACH TWO RIVETS
FOR SEMI-STRUCTURAL DOOR USE ONE BOLT FOR EACH FOUR RIVETS

FOR CHORDWISE ATTACHMENTS-USE FOLLOWING DATA:

TABLE I
SKIN REPAIR

SKIN	STATION	GAGE	RIVET DIAM. NO OF ROWS & SPACING D	Rows	S	MINIMUM NUMBER PER INCH OF CUTOUT	*1100-D BOLTS (C'SK.) OR 525-10 BOLTS (WASHER) BOLTS AND MAX. SPACING	MINIMUM NO. PER IN. CUTOUT
1	2	3	4			5	6	7
UPPER	℄ TO 81½	.051	5/32	3	5/8	5	3 AT 3/4	4
		.064	3/16	3	5/8	5	3 AT 5/8	5
	81½ TO 100	.040	1/8	3	5/8	5	2 AT 3/4	2 3/4
		.051	5/32	3	5/8	5	2 AT 5/8	3
		.064	3/16	3	3/4	4	3 AT 3/4	4
	100 TO 164	.040	1/8	3	5/8	5	2 AT 3/4	2 3/4
		.051	5/32	3	3/4	4	2 AT 5/8	3
		.064	3/16	3	3/4	4	3 AT 3/4	4
	164 TO 205	.040	1/8	2	3/4	3	1 AT 7/8	1 3/4
LOWER	℄ TO 81½	.040	5/32	3	5/8	4	2 AT 5/8	3
		.051	3/16	3	5/8	5	3 AT 5/8	4
	81½ TO 100	.032	5/32	3	5/8	4	2 AT 3/4	3
		.051	3/16	3	5/8	5	3 AT 5/8	5
	100 TO 164	.020	1/8	2	7/8	2	1 AT 3/4	1 1/2
		.032	1/8	2	5/8	4	2 AT 1	2
		.040	1/8	3	3/4	4	2 AT 7/8	2 1/4
		.051	5/32	3	5/8	5	2 AT 5/8	3 1/2
	164 TO 205	.020	1/8	1	3/4	2	1 AT 1 1/4	1
		.032	1/8	2	1 1/8	2	1 AT 1	1
		.040	1/8	2	7/8	2	1 AT 3/4	1 1/2

* USE ELASTIC STOP NUT PLATES Nº 650-D-2 WITH BOLTS. EACH NUT PLATE IS ATTACHED WITH TWO AN426-AD-4 FLUSH RIVETS. TO ATTACH NUT PLATES TO .051 OR .064 GAGE STOCK, MACHINE COUNTERSINK SHEET FOR RIVETS TO ATTACH NUT PLATE TO .040 GAGE OR LIGHTER STOCK PRESS COUNTERSINK AND USE COUNTERSINK PLATE NO 1066-D-1 FOR RIVETS. USE Nº 1101-D BOLTS FOR STRUCTURAL DOORS AND NEAR LEADING EDGE OF WING.

Figure 57 - Wing Skin Repair Data

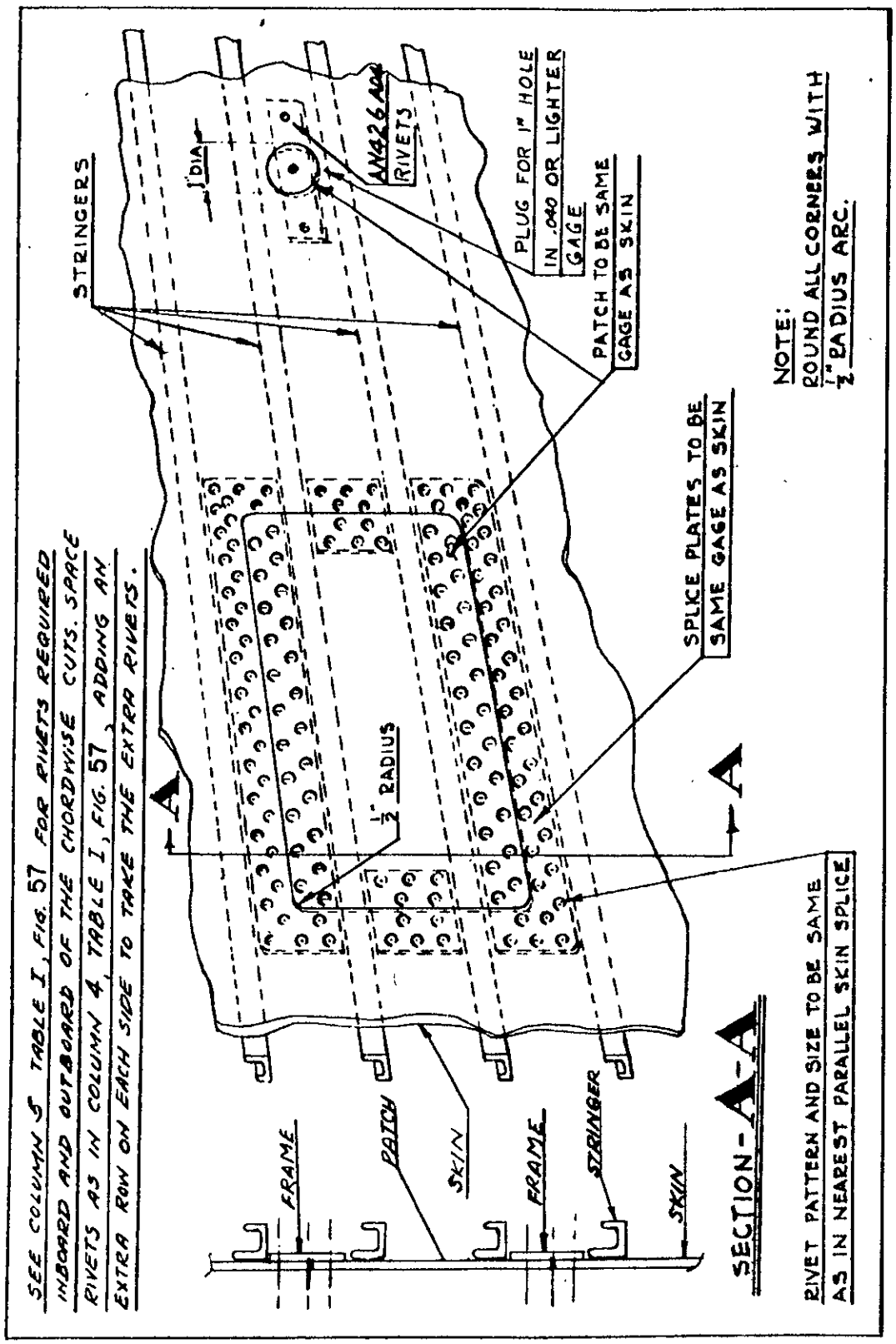


Figure 58 - Wing - Flush Skin Patch

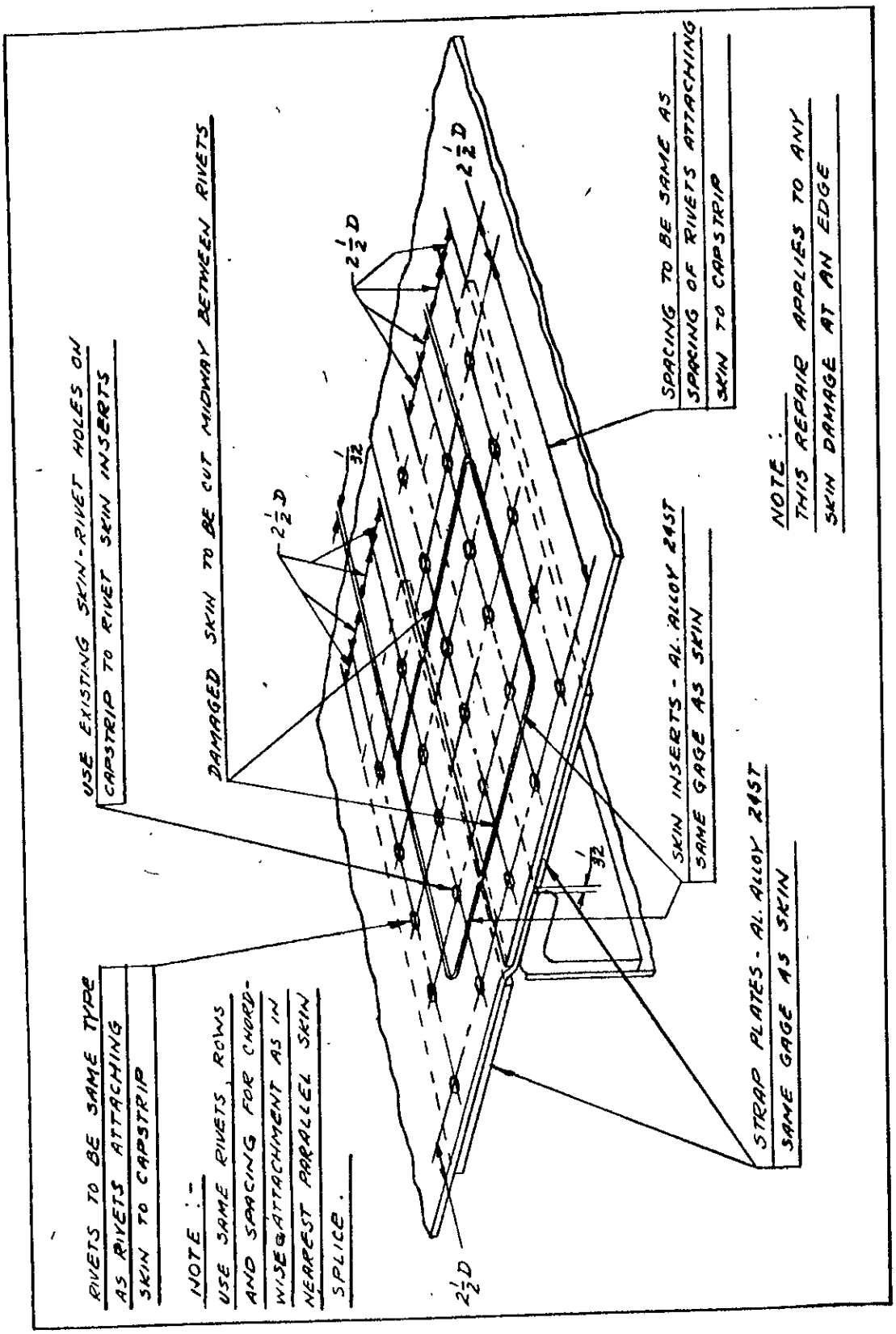


Figure 59 - Flush Skin Patch at Overlap

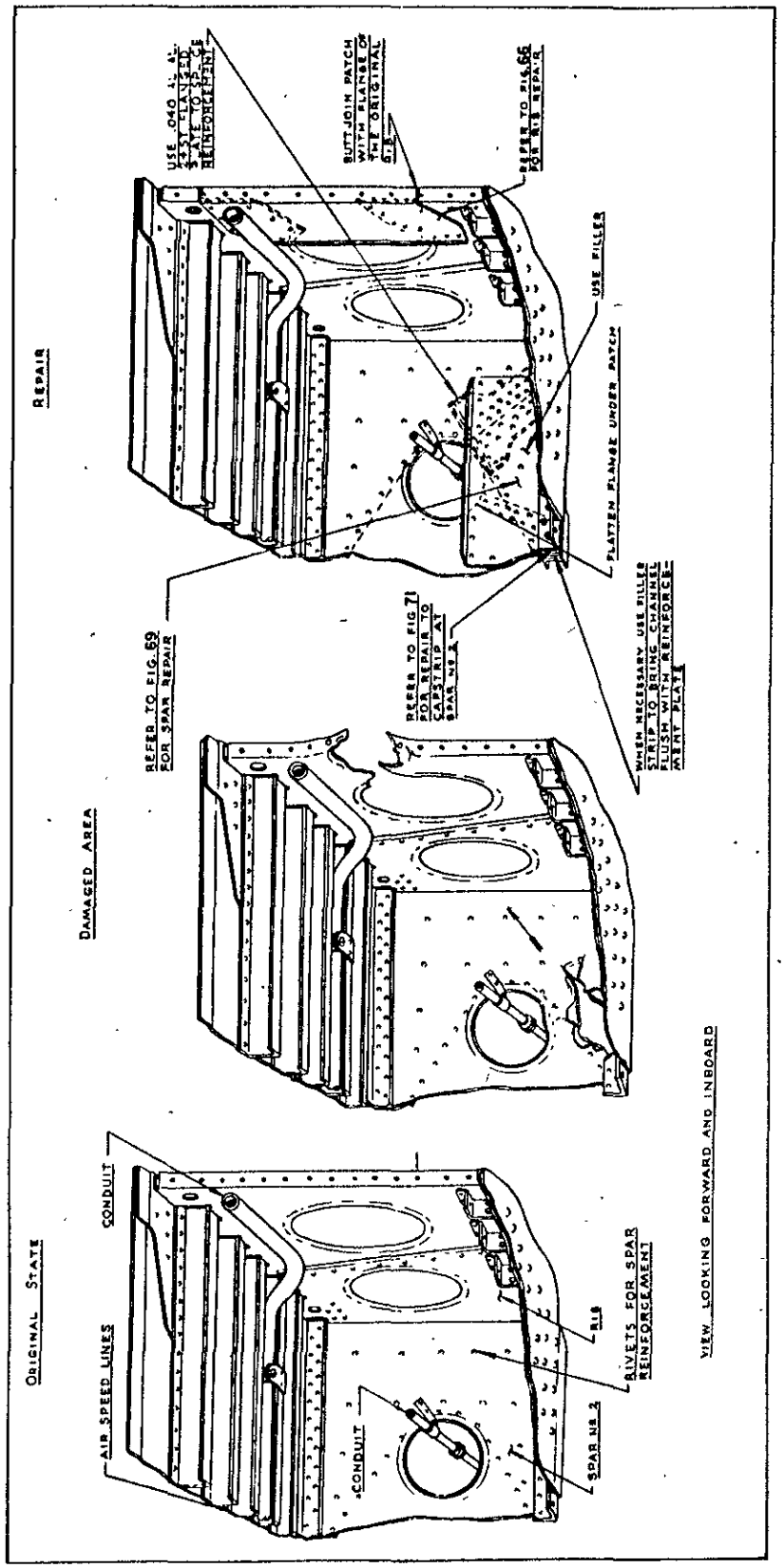


Figure 60 - Wing - Rib and Spar No. 2 Sta No. 27

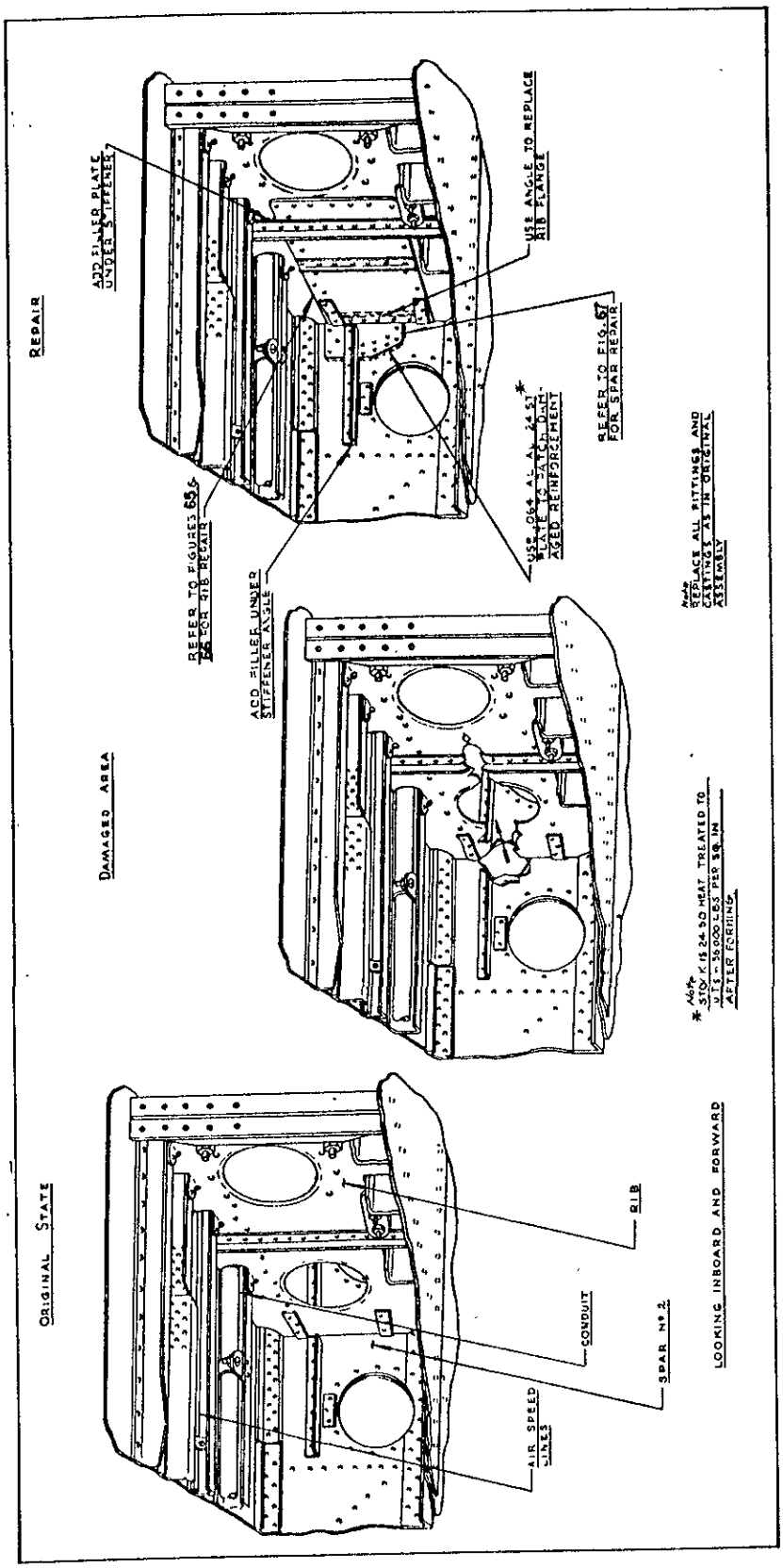


Figure 61 - Wing - Rib and Spar No. 2 Sta No. 81-1/2

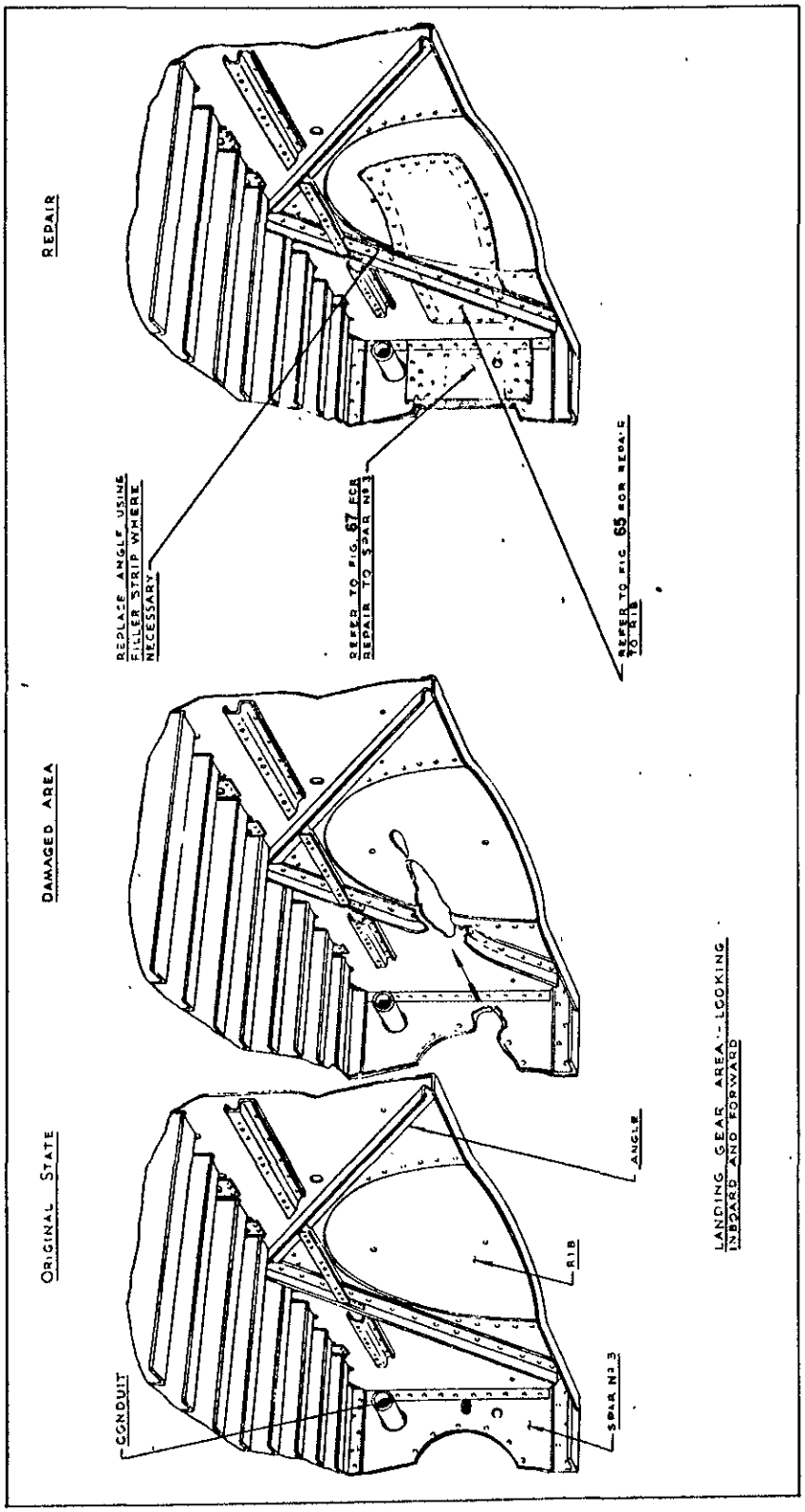


Figure 62 - Wing - Rib and Spar No. 3 Damage - Sta No. 27

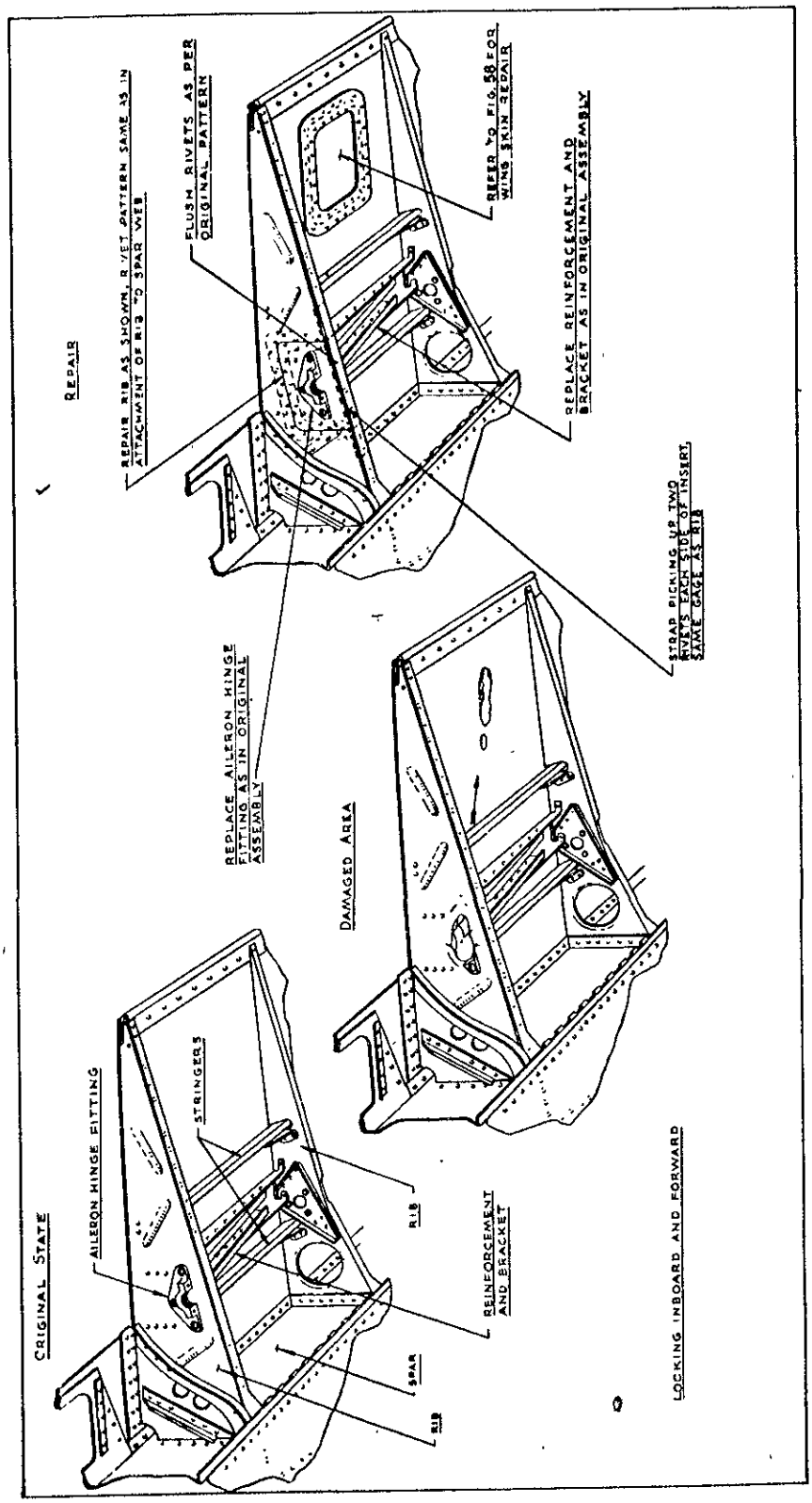


Figure 63 - Aileron - Rib and Fitting - Sta No. 122

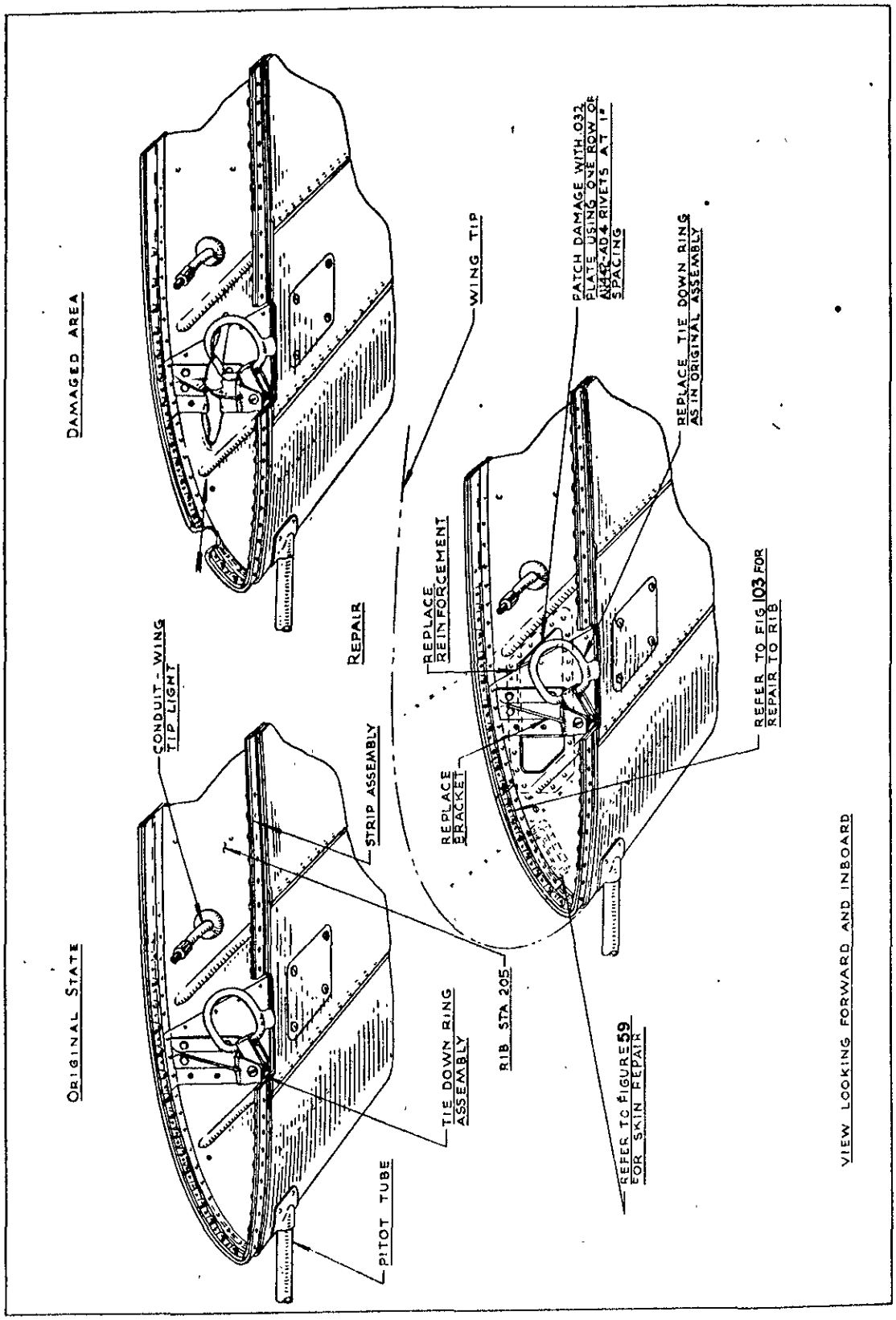


Figure 64 - Wing - Skin and Rib Damage - Sta 205

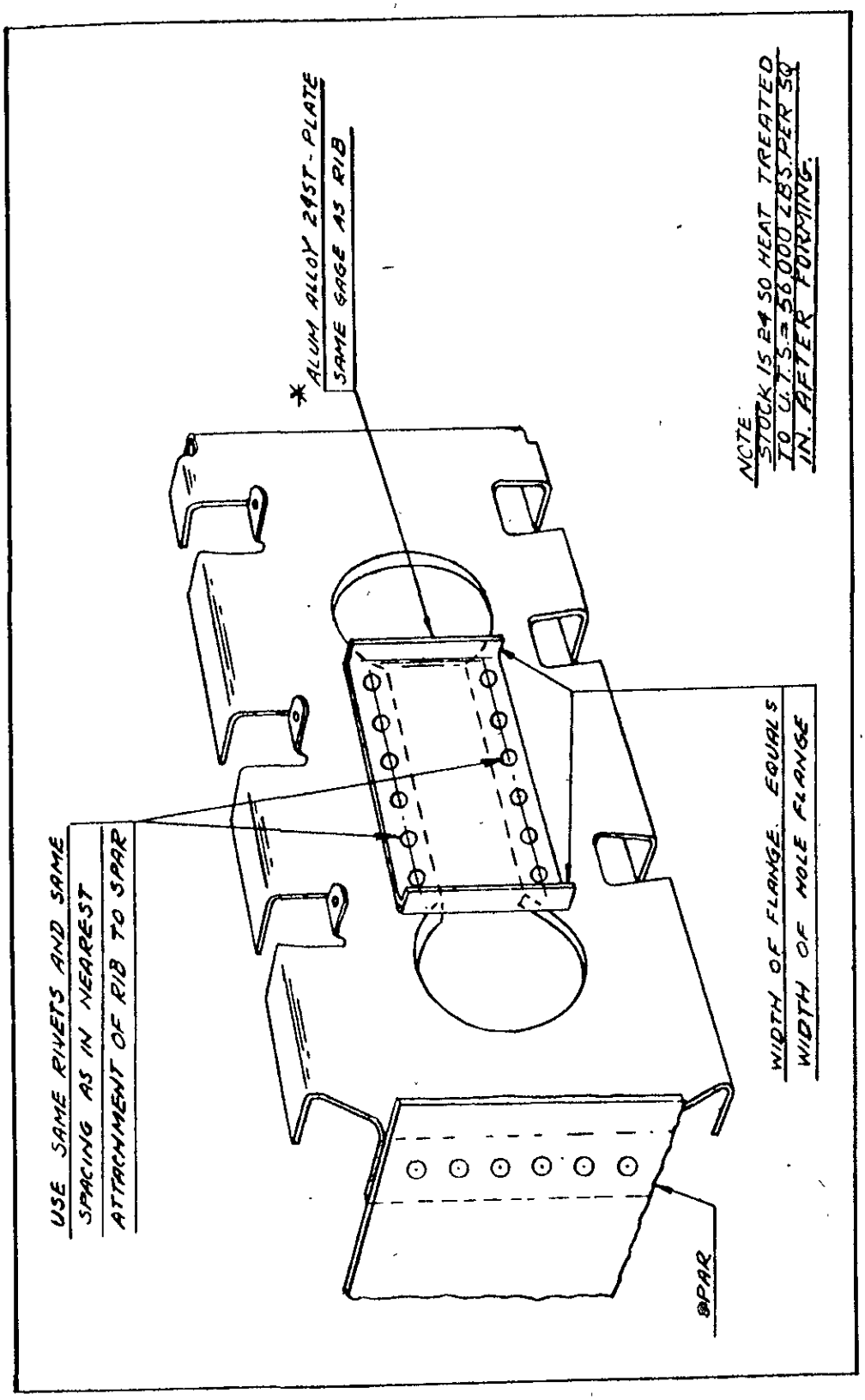


Figure 65 - Wing - Rib Patch

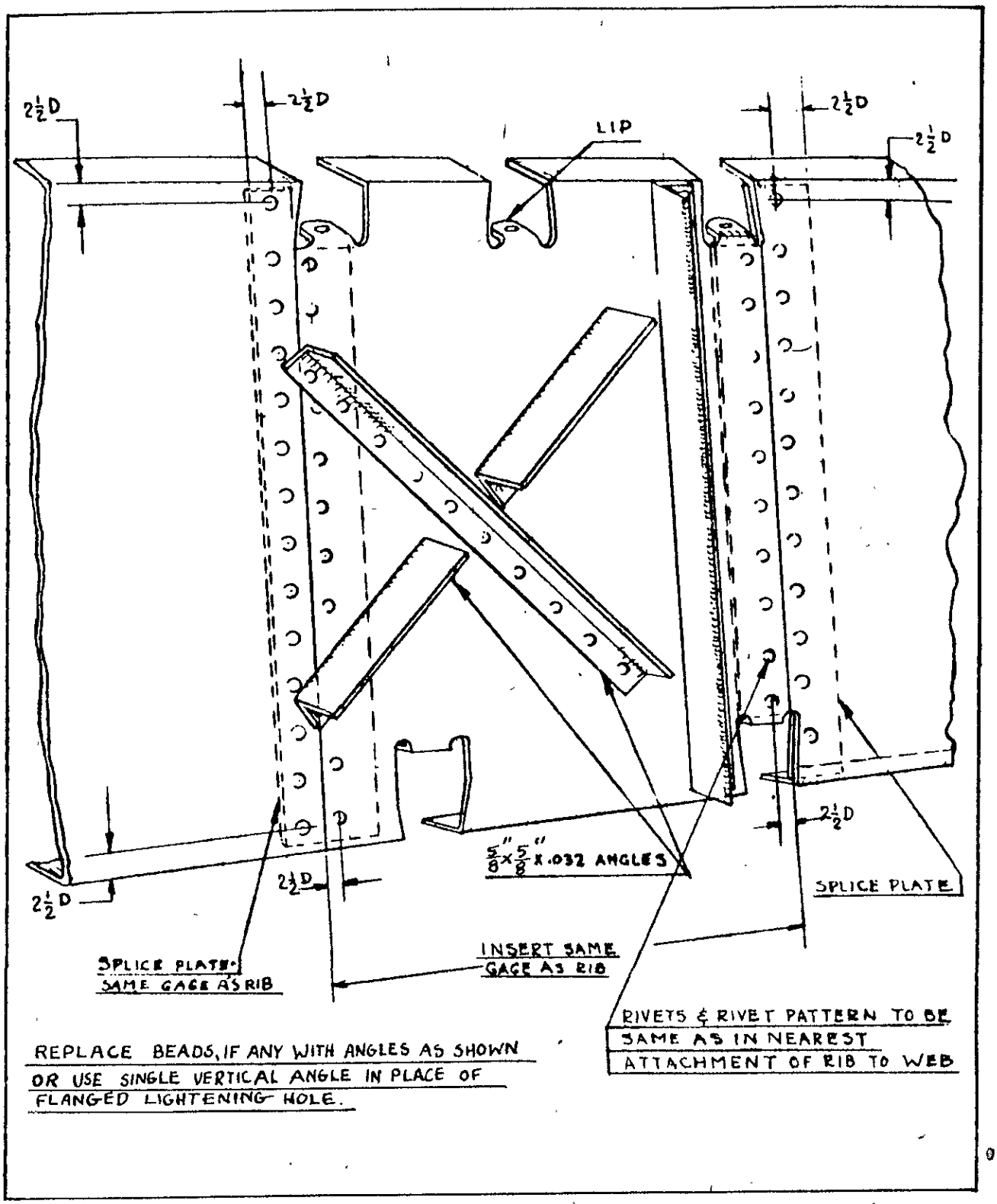


Figure 66 - Wing - Rib Insertion

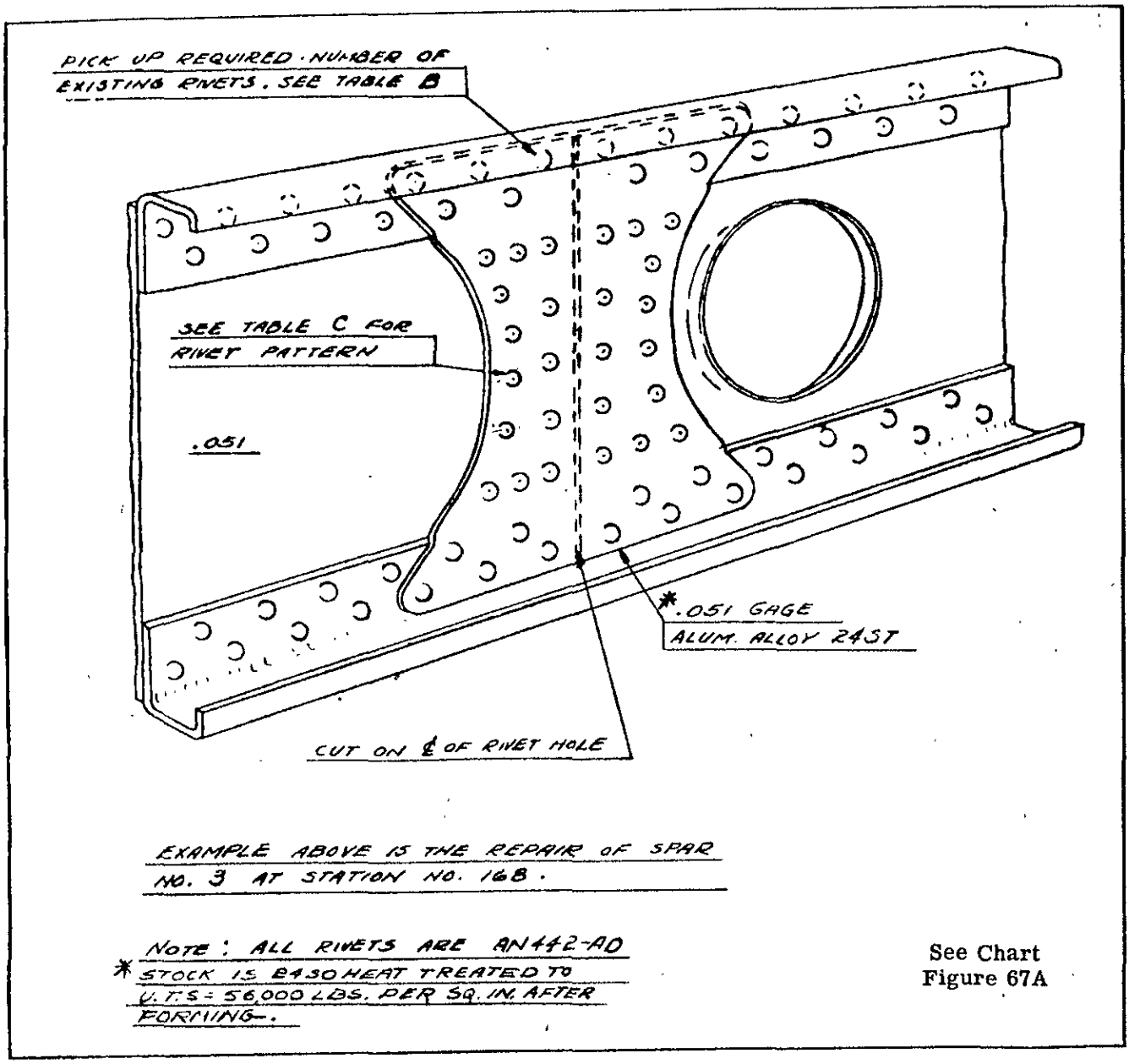


Figure 67 - Wing - Spar Repair Data

A. ATTACHMENT OF PATCHES TO SPAR BETWEEN CAPSTRIPS - RIVET DIAMETER, NUMBER OF ROWS AND SPACING IN ROWS TO USE AROUND DAMAGE. FOR SPACING OF ROWS USE MINIMUM RIVET SPACING GIVEN BELOW.

STATION	SPAR NO. 1	SPAR NO. 2	SPAR NO. 3	SPAR NO. 4	SPAR NO. 5	AUX. BEAMS
℄ - 18	1/8 - 2 @ 3/4	1/8 - 2 @ 5/8	1/8 - 2 @ 5/8	1/8 - 2 @ 7/8	1/8 - 2 @ 1 3/4	———
18 - 45	3/16 - 2 @ 3/4	5/32 - 2 @ 7/8	5/32 - 2 @ 3/4	1/8 - 2 @ 1	1/8 - 2 @ 1	———
45 - 64	1/8 - 2 @ 1	5/32 - 2 @ 7/8	1/8 - 2 @ 5/8	1/8 - 2 @ 1	1/8 - 2 @ 1	———
64 - 90	1/8 - 2 @ 1	5/32 - 2 @ 7/8	5/32 - 2 @ 3/4	———	1/8 - 2 @ 1	1/8 - 2 @ 3/4
90 - 205	1/8 - 2 @ 1	1/8 - 2 @ 5/8	5/32 - 2 @ 3/4	———	1/8 - 2 @ 1	1/8 - 2 @ 3/4

B. ATTACHMENT OF PATCHES OR SPLICE PLATES TO CAPSTRIPS - NUMBER OF RIVETS REQUIRED AT EACH END OF DAMAGE. USE SAME SPACING AND RIVET DIAMETER AS IN CAPSTRIP OR SPAR FLANGE.

STATION	SPAR NO. 1	SPAR NO. 2	SPAR NO. 3	SPAR NO. 4	SPAR NO. 5	AUX. BEAMS
℄ TO 90	8	6	11	6	7	6
90 TO 205	6	4	6	—	6	6

C ATTACHMENT OF SPLICE PLATES TO SPAR BETWEEN CAPSTRIPS - MINIMUM NUMBER OF RIVETS REQUIRED EACH SIDE OF CUT. DO NOT COUNT RIVETS IN CAPSTRIPS.

SPAR NO.	1			2			3			4		5		AUX. FRONT		AUX. RER	
RIVET DIAM.	1/8	5/32	3/16	1/8	5/32	3/16	1/8	5/32	3/16	1/8	5/32	1/8	5/32	1/8	5/32	1/8	5/32
℄ TO 18		40	28	20	13	9		24	17	9	6	4					
18 TO 45		40	28	22	14	10		24	17	9	6	4					
45 TO 80	8	6		21	14	10	28	18	13	8	5	7	5				
80 TO 100	7	4		20	13	9	25	15	10			11	7	10	7	7	5
100 TO 122	6	4		15	10	7	23	15	10			11	7	10	7	7	5
122 TO 143	5			13	9		19	12	9			7	5	9	6	5	3
143 TO 164	3			8	6		17	11	8			5		9	6	5	3
164 TO 185	3			7	5		13	8				3					
185 TO 205	3			6	4		12	7				3					

D. REQUIRED MINIMUM SPACING OF RIVETS AND RIVET ROWS TO PREVENT FAILURE OF SHEET BETWEEN RIVETS AND FAILURE OF RIVETS DUE TO ECCENTRIC LOADS ON RIVET PATTERNS. SPACING IS MEASURED BETWEEN RIVET CENTERS. SHEET GAGE REFERS TO GAGE OF THINNEST SHEET IN ATTACHMENT.

SHEET GAGE	.032			.040			.051			.102		
RIVET DIAM.	1/8	5/32	3/16	1/8	5/32	3/16	1/8	5/32	3/16	1/8	5/32	3/16
1 ROW	1/2	3/8	7/8	3/8	1/2	7/8	3/8	1/2	3/4	3/8	1/2	3/8
2 ROWS	3/4	1	1 3/8	3/8	7/8	1 3/8	1/2	3/4	1 1/4	3/8	1/2	3/4
3 ROWS	1	1 3/8	1 3/4	7/8	1 1/4	1 3/4	3/8	1	1 5/8	3/8	5/8	1
4 ROWS	1 3/8	1 3/4		1 1/8	1 5/8		7/8	1 1/4	2	1/2	3/4	1 1/2

Figure 67A - Wing - Spar Repair Data

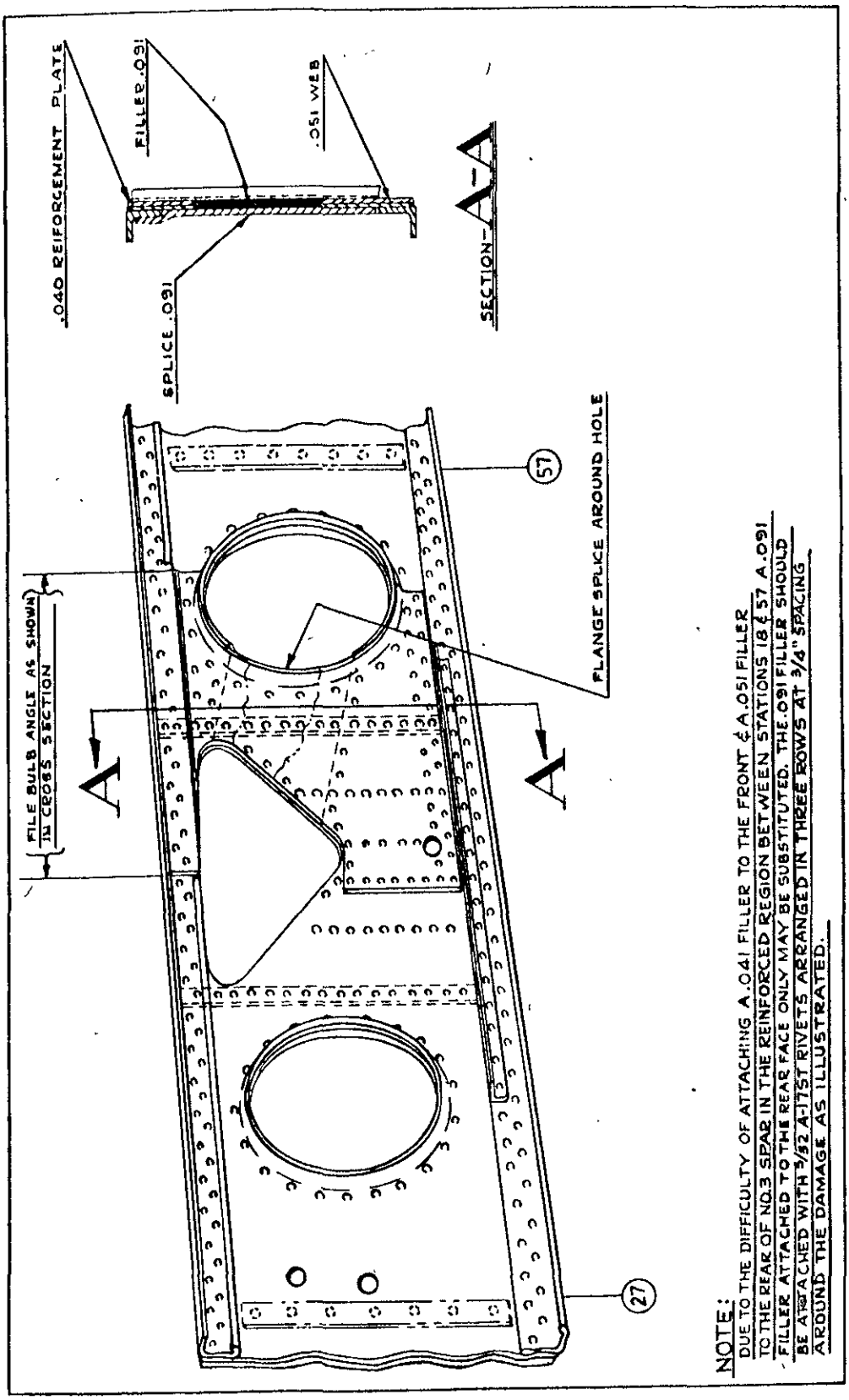


Figure 68 - Wing - Spar 3 Web Patch - Sta 27 to 57

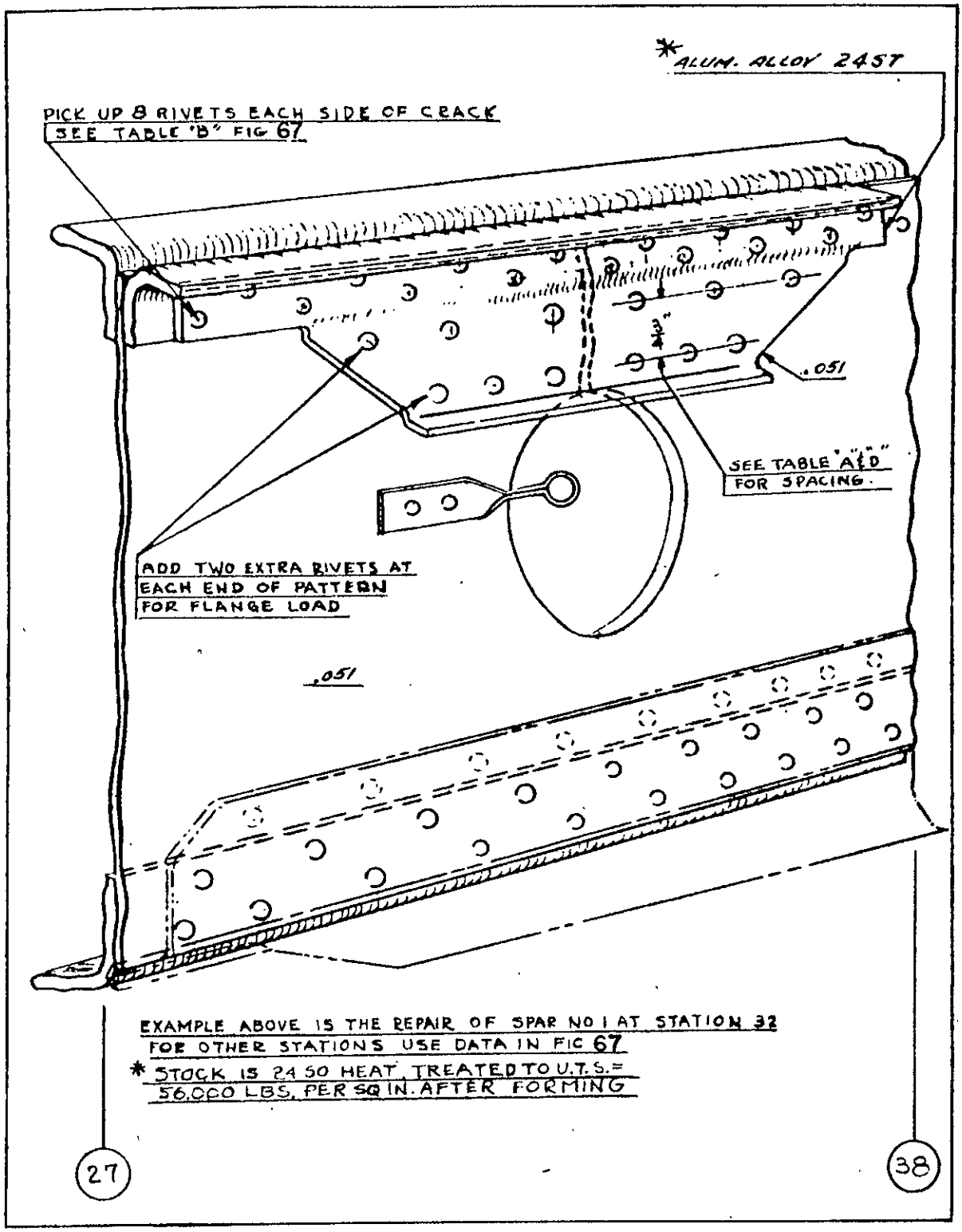


Figure 69 - Wing - Spar Patch Near Cap Strip

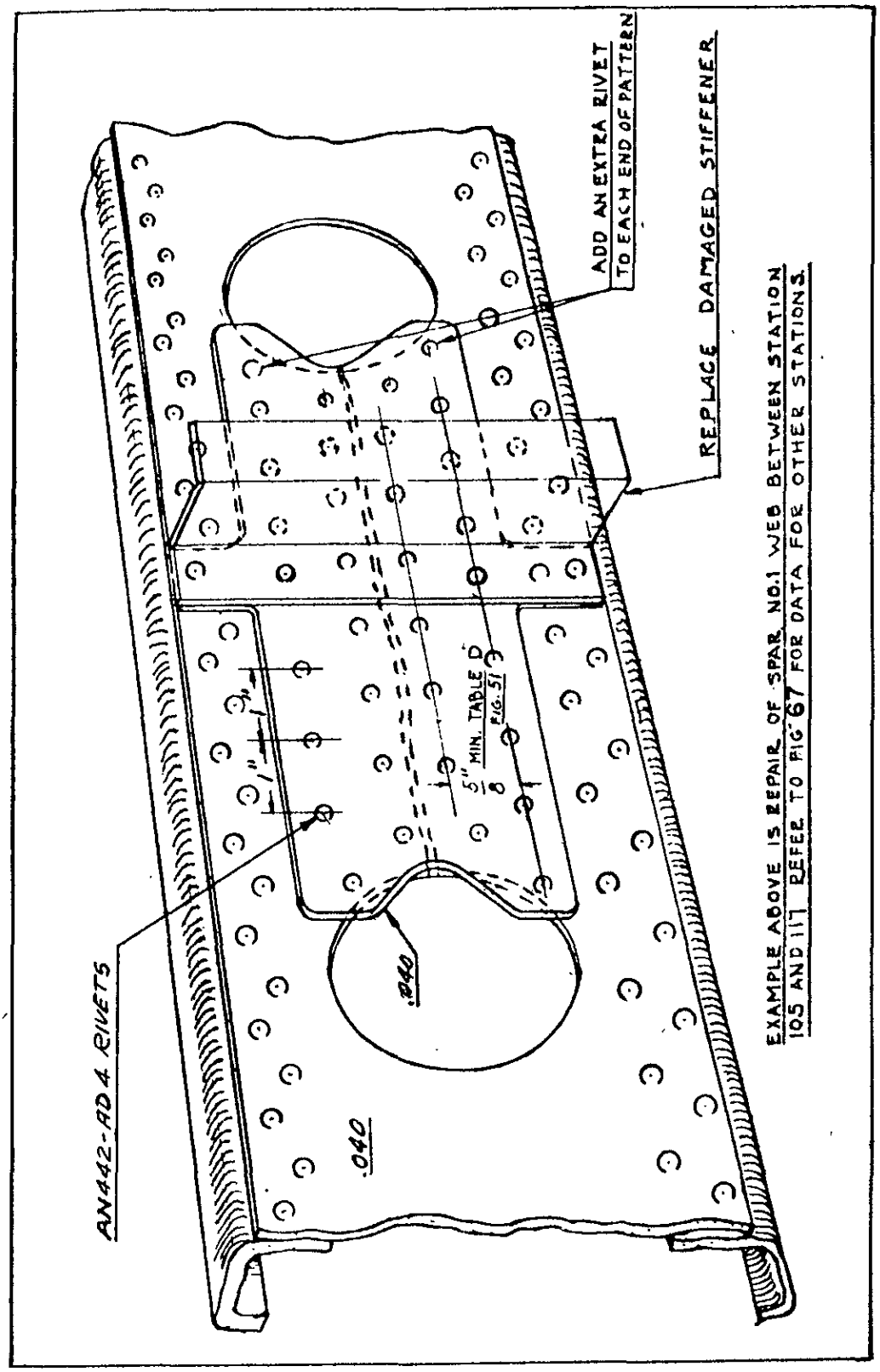


Figure 75 - Wing - Spar Fracture Between Lightening Holes

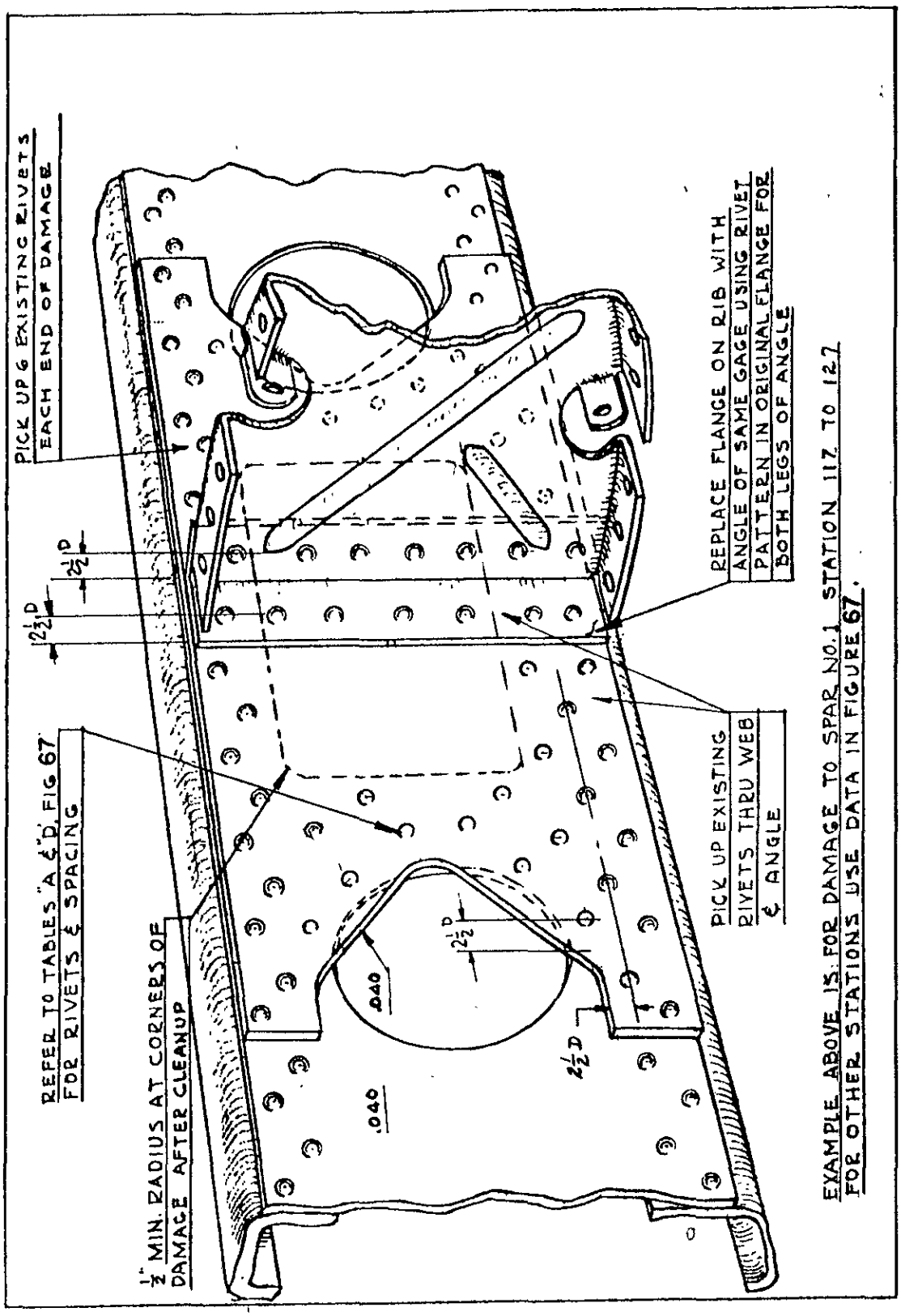


Figure 76 - Wing - Spar Web Patch at Rib

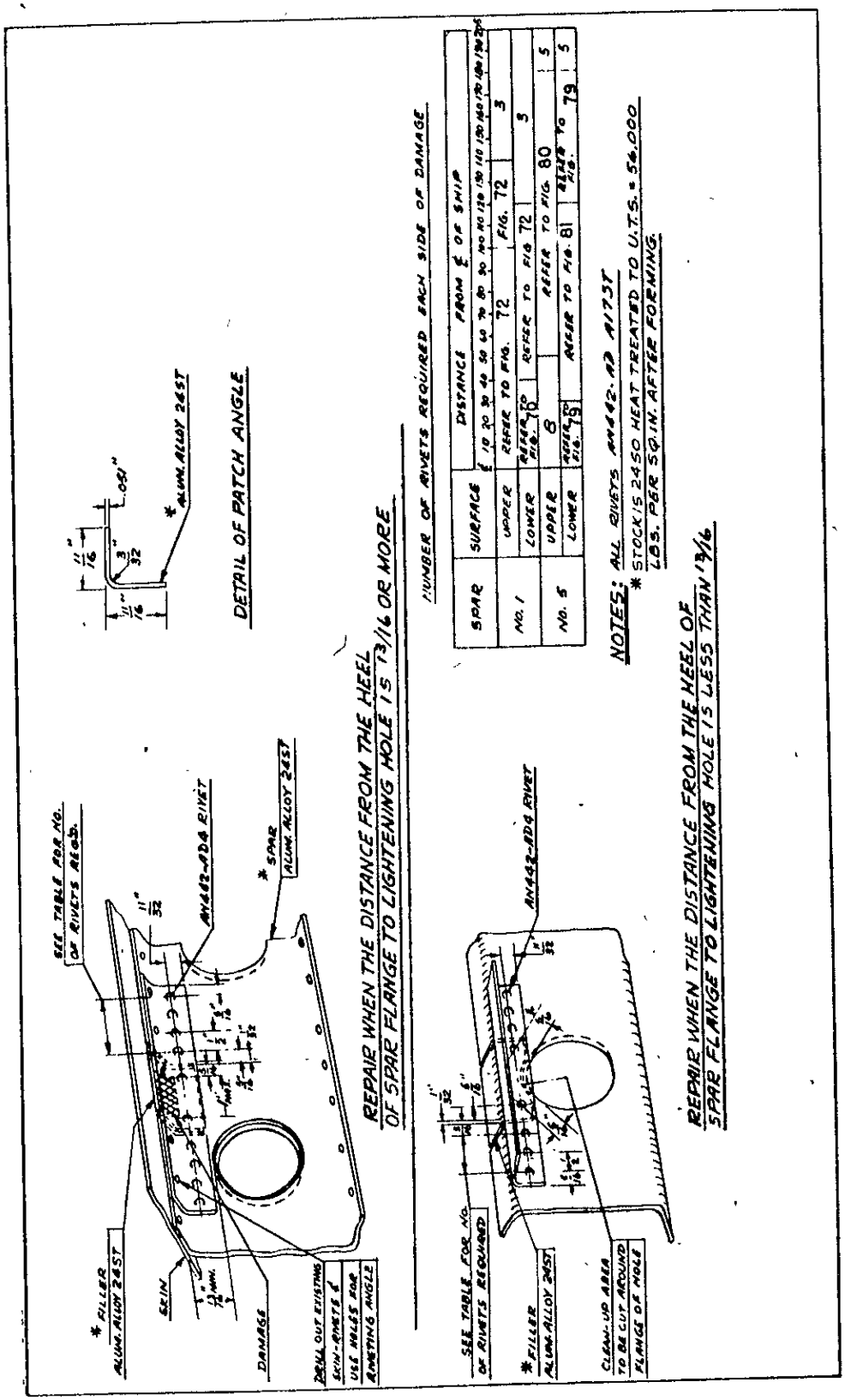


Figure 77 - Wing - Spar - Flange Patch

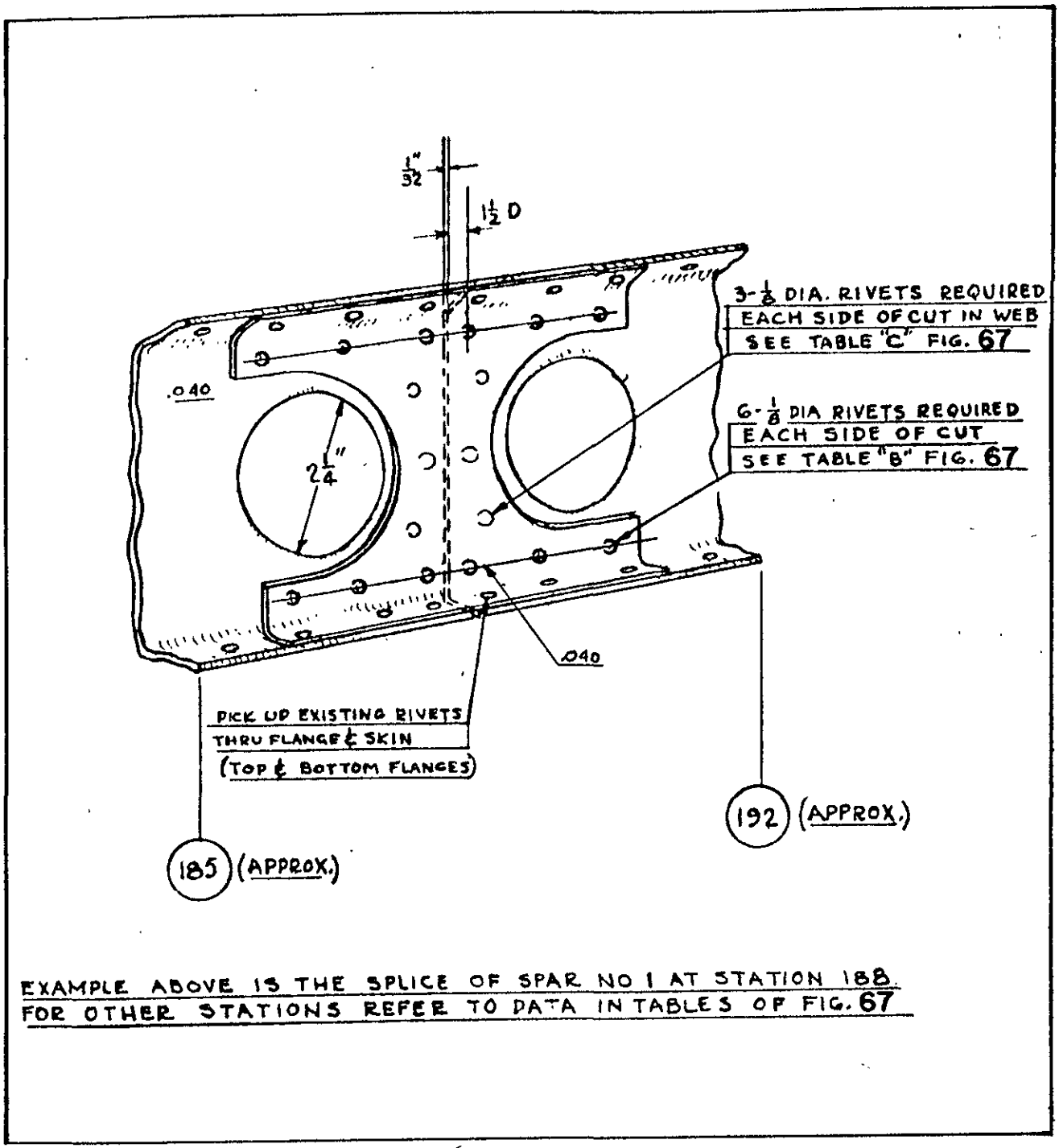


Figure 78 - Wing - Spar - Web Splice - Outboard End

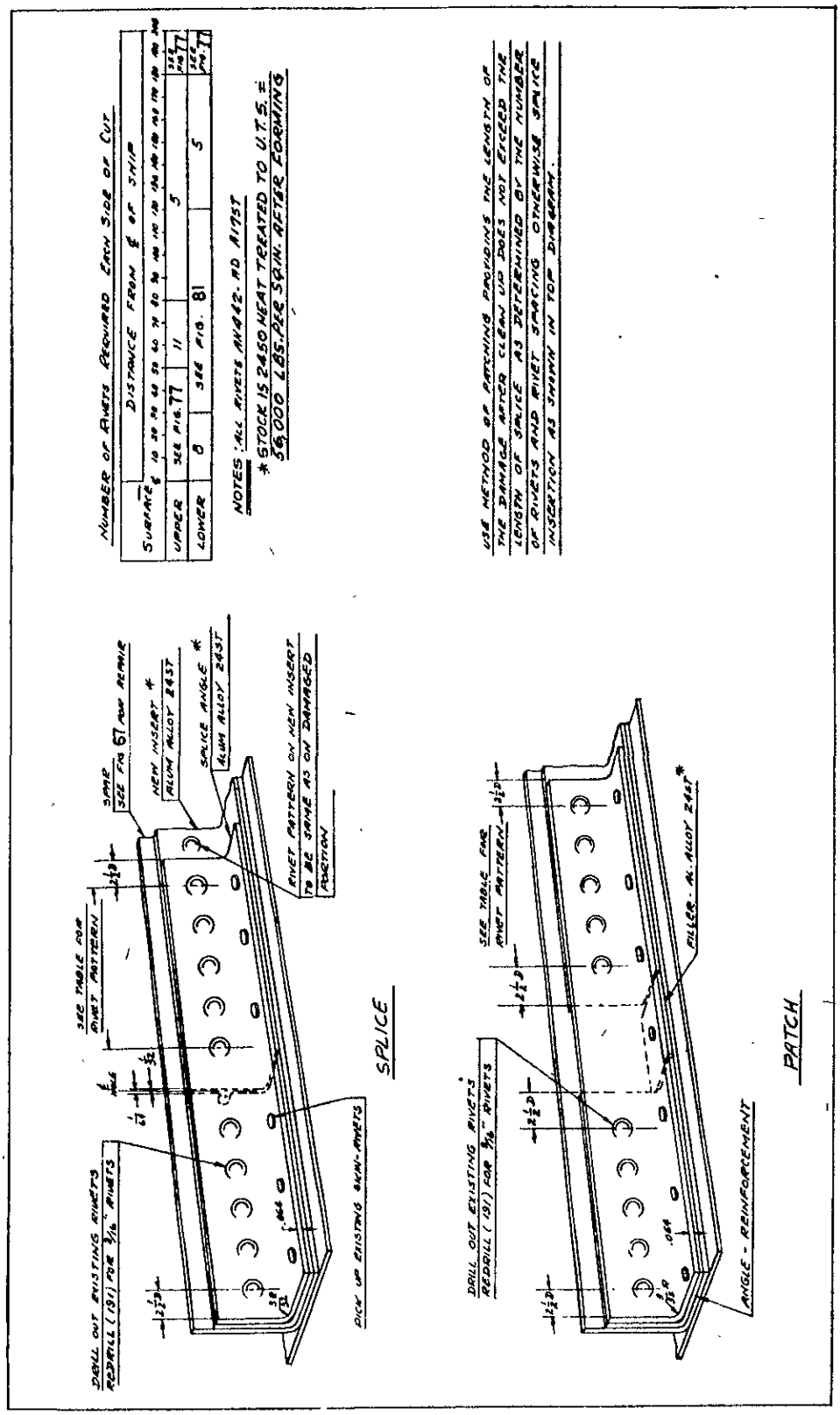


Figure 79 - Spar No. 5 - Angle - Reinforcement Splice and Patch

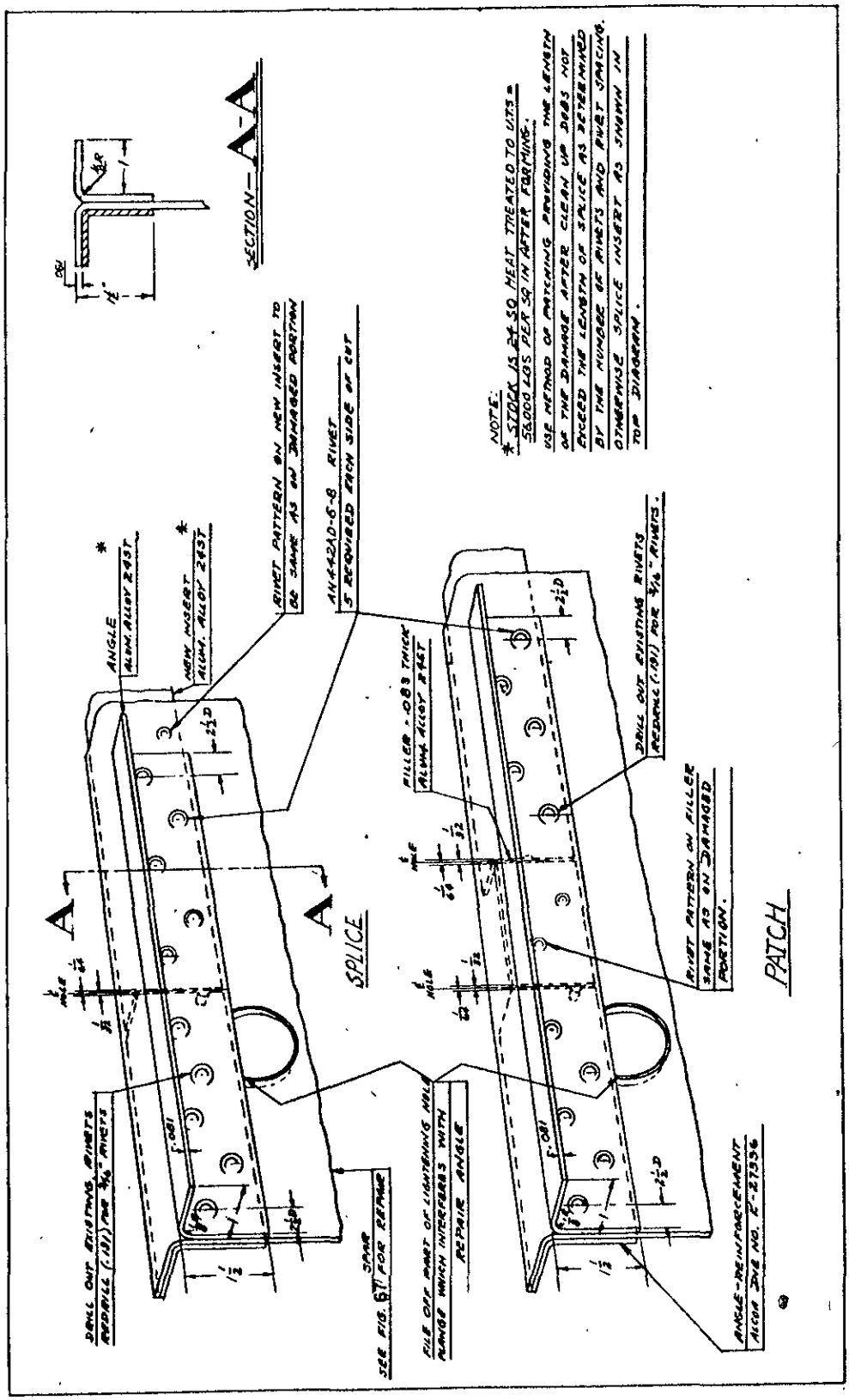


Figure 80 - Spar No. 5 - Upper Surface - Sta 139 to 179 - Angle - Reinforcement Splice

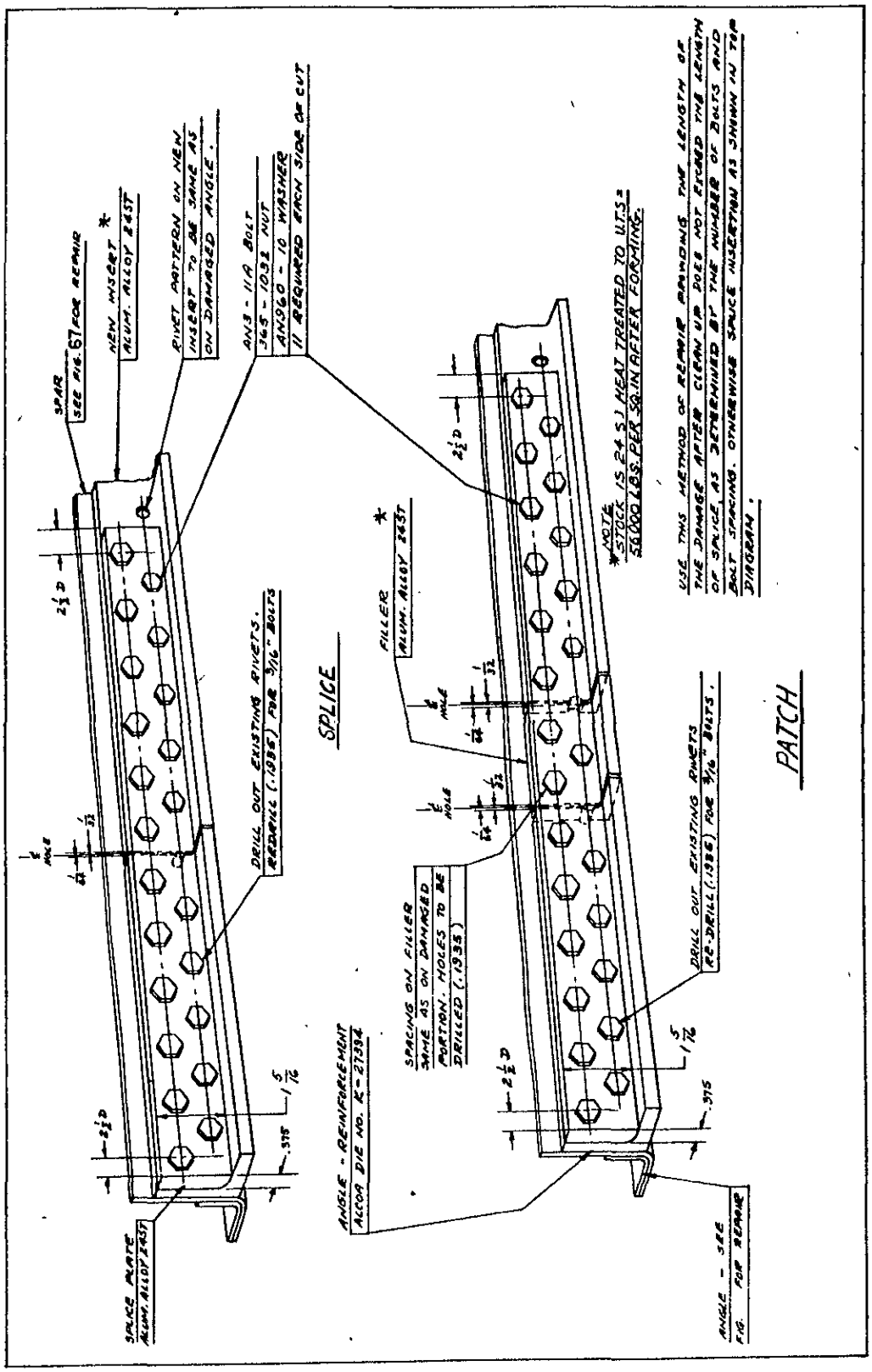


Figure 81 - Spar No. 5 - Lower Surface - Angle - Reinforcement Splice

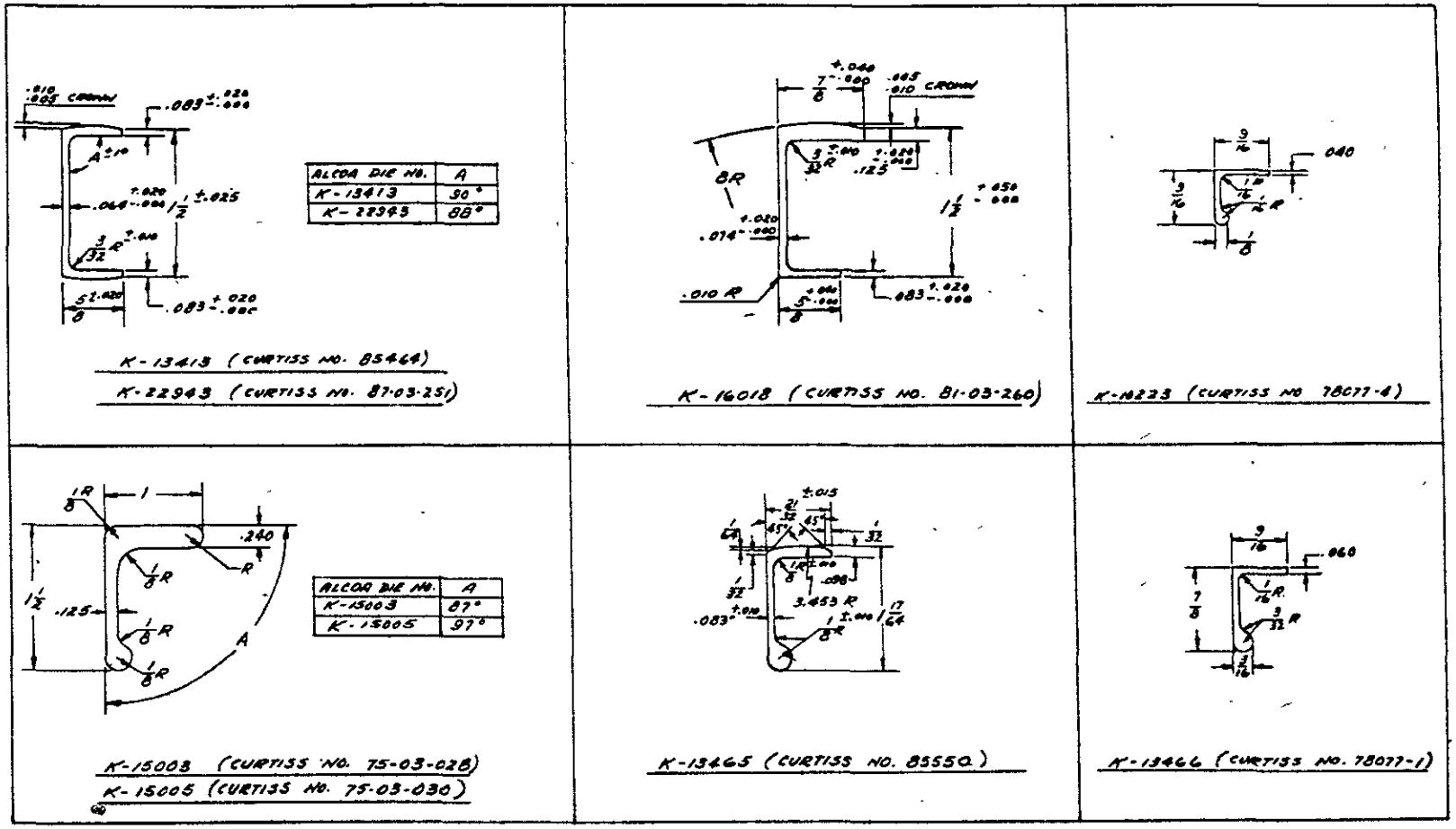
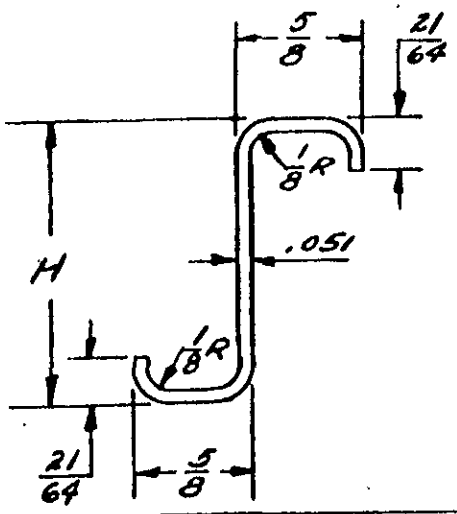
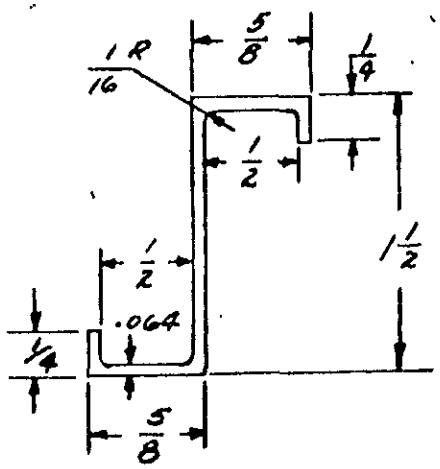


Figure 82 - Wing Stringers - Extrusions



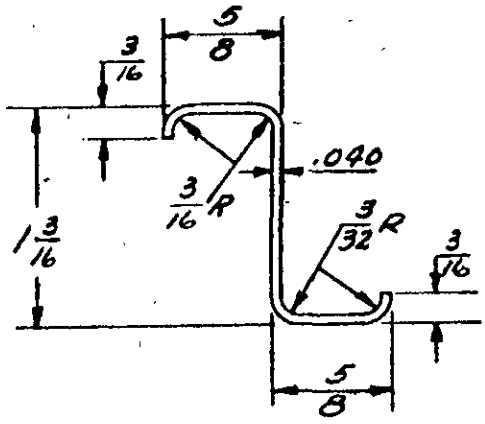
STRINGER TAPERS FROM H1 TO H2 IN LENGTH INDICATED.

STRINGER	H1	H2	L
87-03-691	1 1/2	11/16	88
87-03-217	1 1/2	1 5/32	40 1/8
87-03-220	1 3/32	11/16	40 6/8
87-03-872	1 3/64	57/64	16 1/8



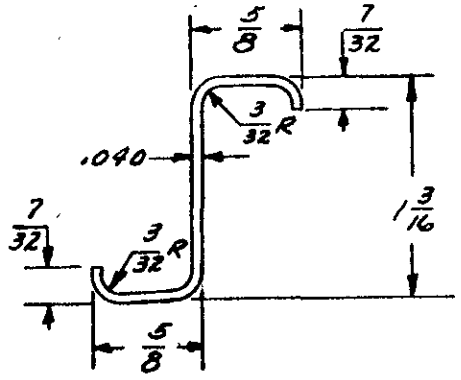
K-10274

CURTISS NO. 84016



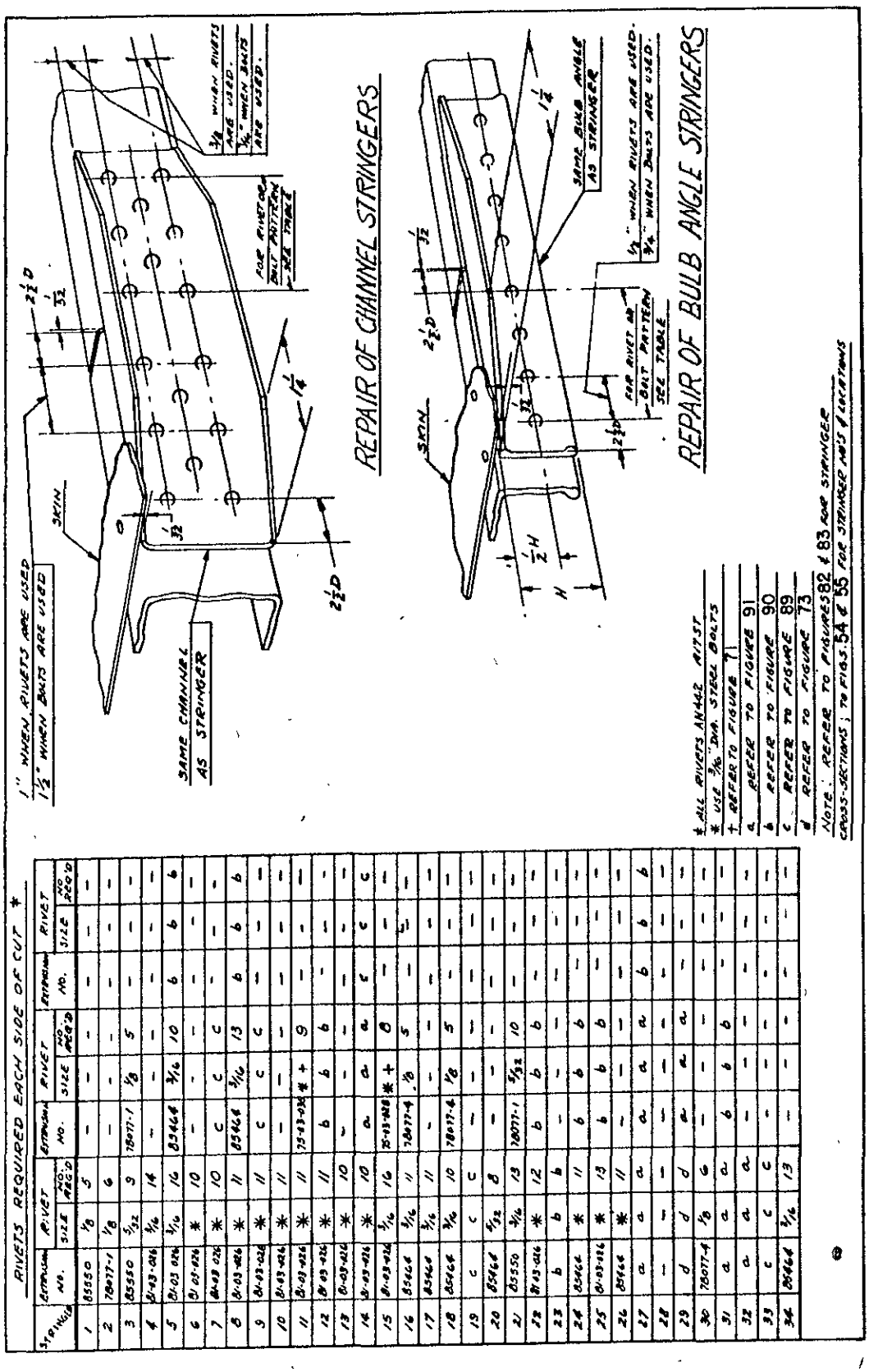
THIS STRINGER TAPERS FROM 1 3/16" TO 3/8" IN 65"

87-03-178A



75-03-043

Figure 83 - Wing Stringers - "Z" Section



RIVETS REQUIRED EACH SIDE OF CUT *

STRINGER	EITHER SIDE NO.	RIVET SIZE	RIVET NO. REQ'D	EITHER SIDE NO.	RIVET SIZE	RIVET NO. REQ'D	EITHER SIDE NO.	RIVET SIZE	RIVET NO. REQ'D
1	85550	1/8	5	-	-	-	-	-	-
2	78077-1	1/8	6	-	-	-	-	-	-
3	85550	5/32	9	78077-1	1/8	5	-	-	-
4	B-03-026	3/16	14	-	-	-	-	-	-
5	B-03-026	3/16	16	B5464	3/16	10	b	b	b
6	B-03-026	*	10	-	-	-	-	-	-
7	B-03-026	*	10	c	c	c	-	-	-
8	B-03-026	*	11	B5464	3/16	13	b	b	b
9	B-03-026	*	11	c	c	c	-	-	-
10	B-03-026	*	11	-	-	-	-	-	-
11	B-03-026	*	11	75-03-026	* +	9	-	-	-
12	B-03-026	*	11	b	b	b	-	-	-
13	B-03-026	*	10	-	-	-	-	-	-
14	B-03-026	*	10	a	a	a	c	c	c
15	B-03-026	3/16	16	25-03-026	* +	8	-	-	-
16	B5464	3/16	11	78077-4	1/8	5	-	-	-
17	B5464	3/16	11	-	-	-	-	-	-
18	B5464	3/16	10	78077-4	1/8	5	-	-	-
19	c	c	c	-	-	-	-	-	-
20	B5464	5/32	8	-	-	-	-	-	-
21	B5550	3/16	13	78077-1	5/32	10	-	-	-
22	B-03-026	*	12	b	b	b	-	-	-
23	b	b	b	-	-	-	-	-	-
24	B5464	*	11	b	b	b	-	-	-
25	B-03-026	*	13	b	b	b	-	-	-
26	B5464	*	11	-	-	-	-	-	-
27	a	a	a	a	a	a	b	b	b
28	-	-	-	-	-	-	-	-	-
29	d	d	d	a	a	a	-	-	-
30	78077-4	1/8	6	-	-	-	-	-	-
31	a	a	a	b	b	b	-	-	-
32	a	a	a	-	-	-	-	-	-
33	c	c	c	-	-	-	-	-	-
34	B5464	3/16	13	-	-	-	-	-	-

Figure 84 - Wing Stringers - Angle and Channel - Splice

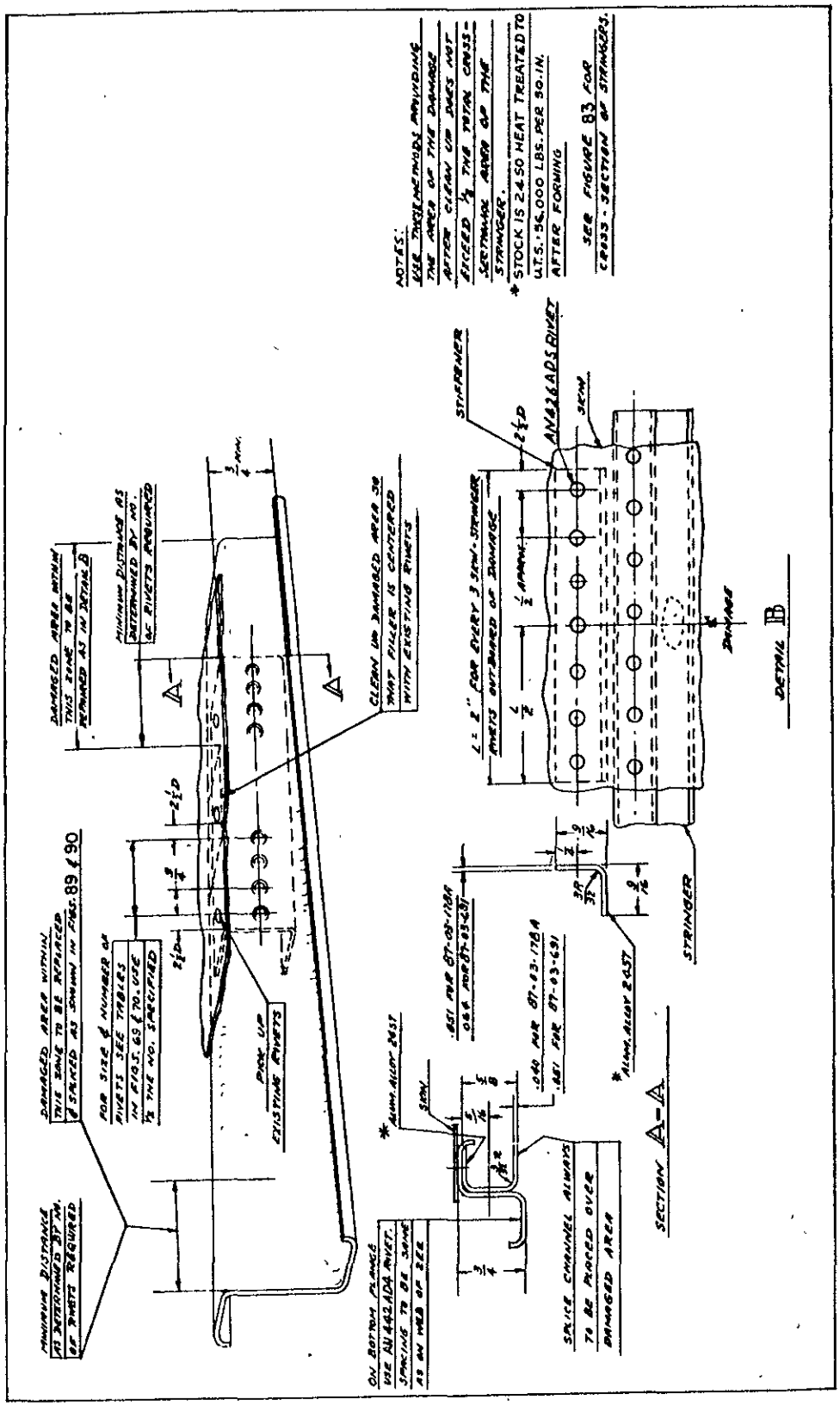


Figure 85 - Wing Stringers - 87-03-691 and 87-03-178A - "Z" - Minor Damage

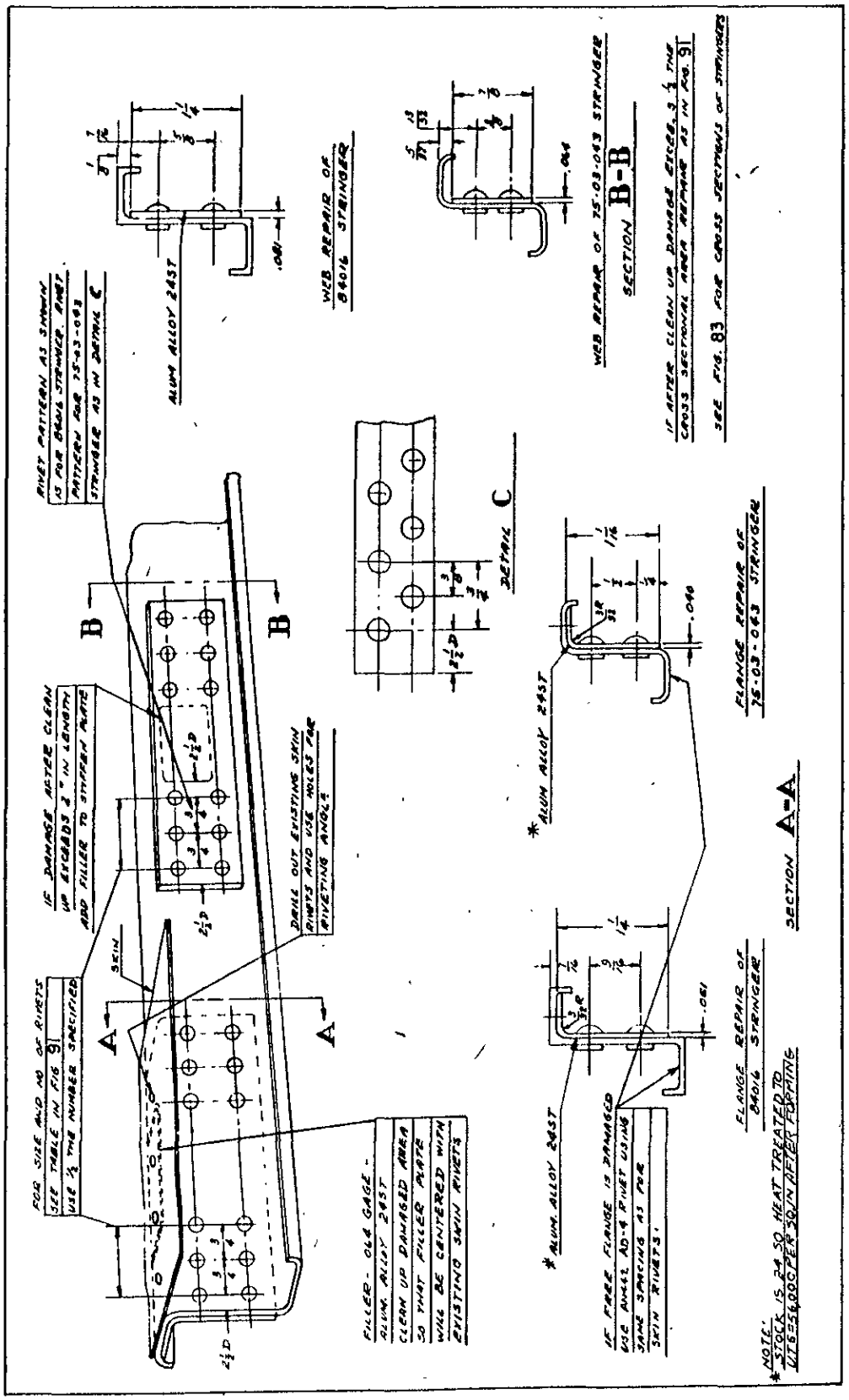


Figure 86 - Wing Stringers - 84016 and 75-03-043 - Minor Damage

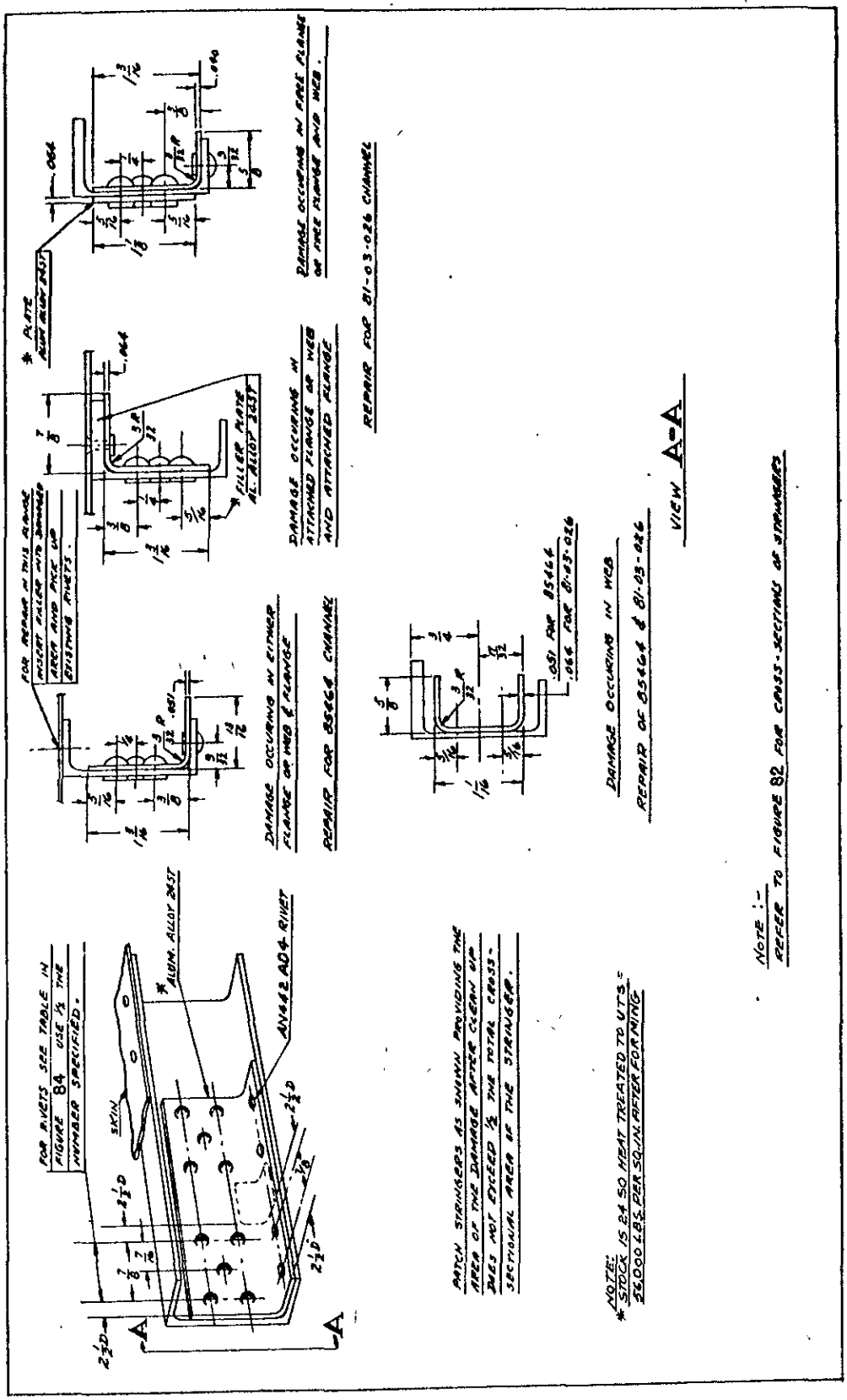


Figure 87 - Wing Stringers - Channel Minor Damage

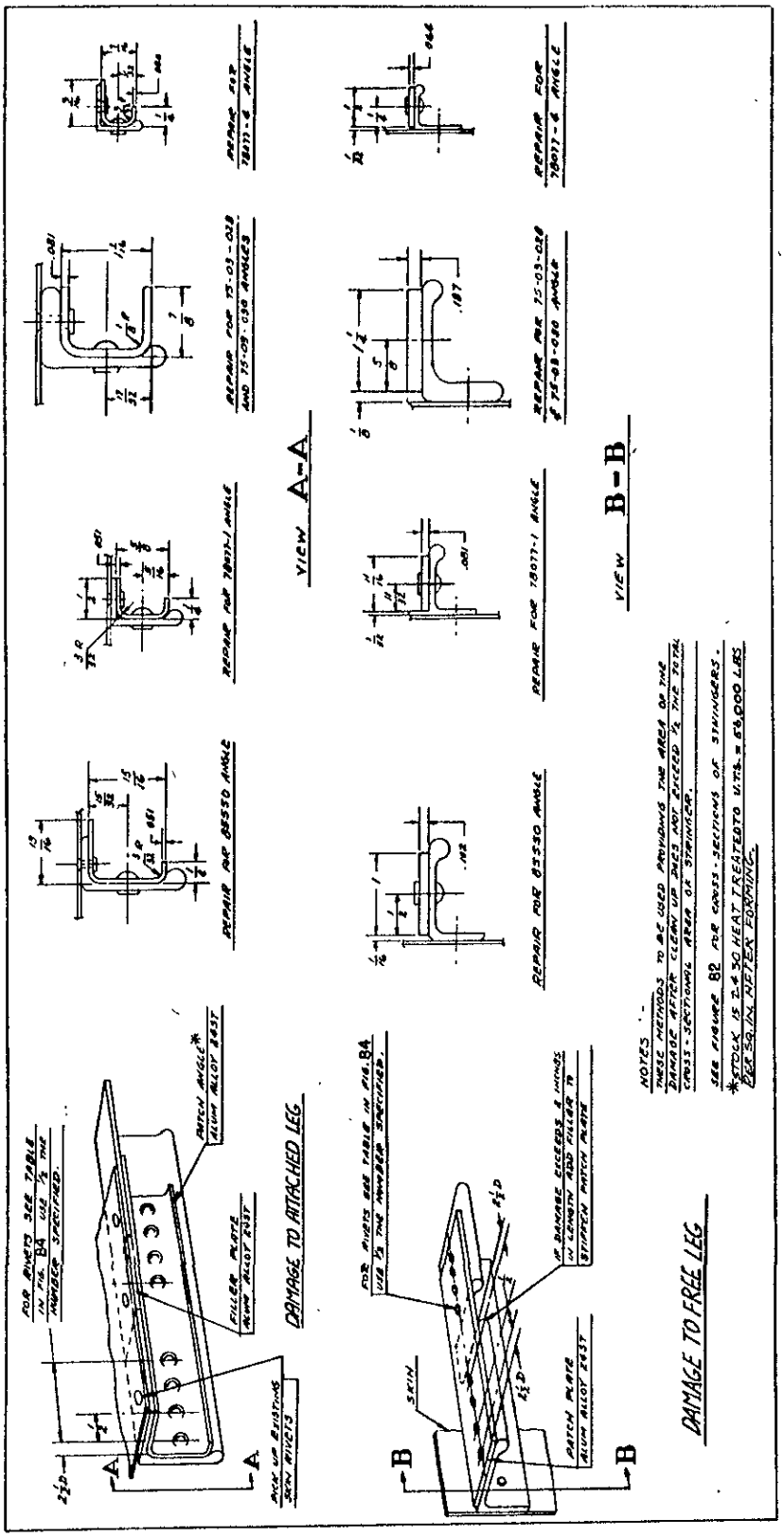


Figure 88 - Wing Stringers - Bulb Angle - Minor Damage

Figure 91 - Wing Stringers - "Z" - 84016 and 75-03-043 - Splice

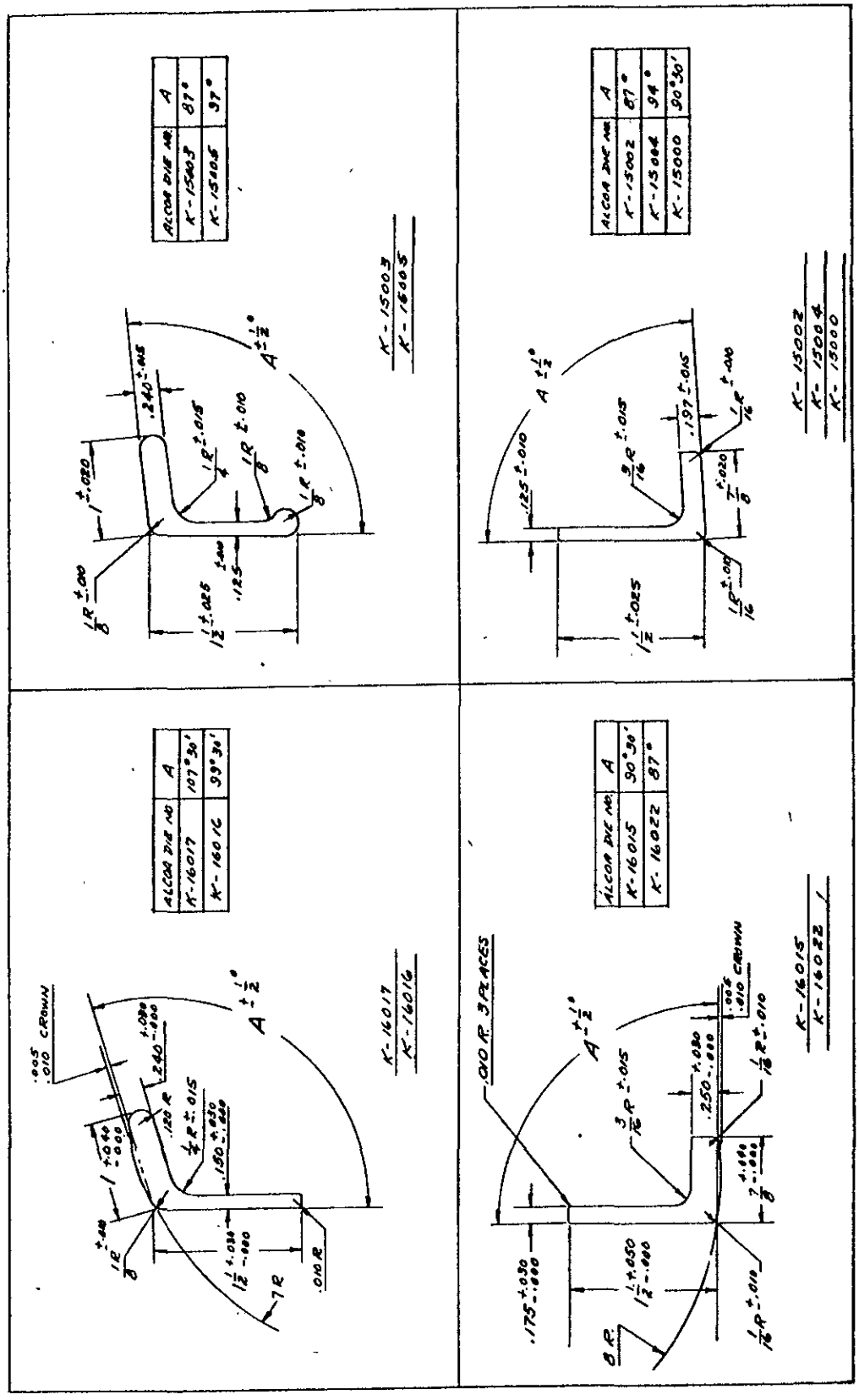


Figure 92 - Wing Cap Strips Extruded Cross Sections

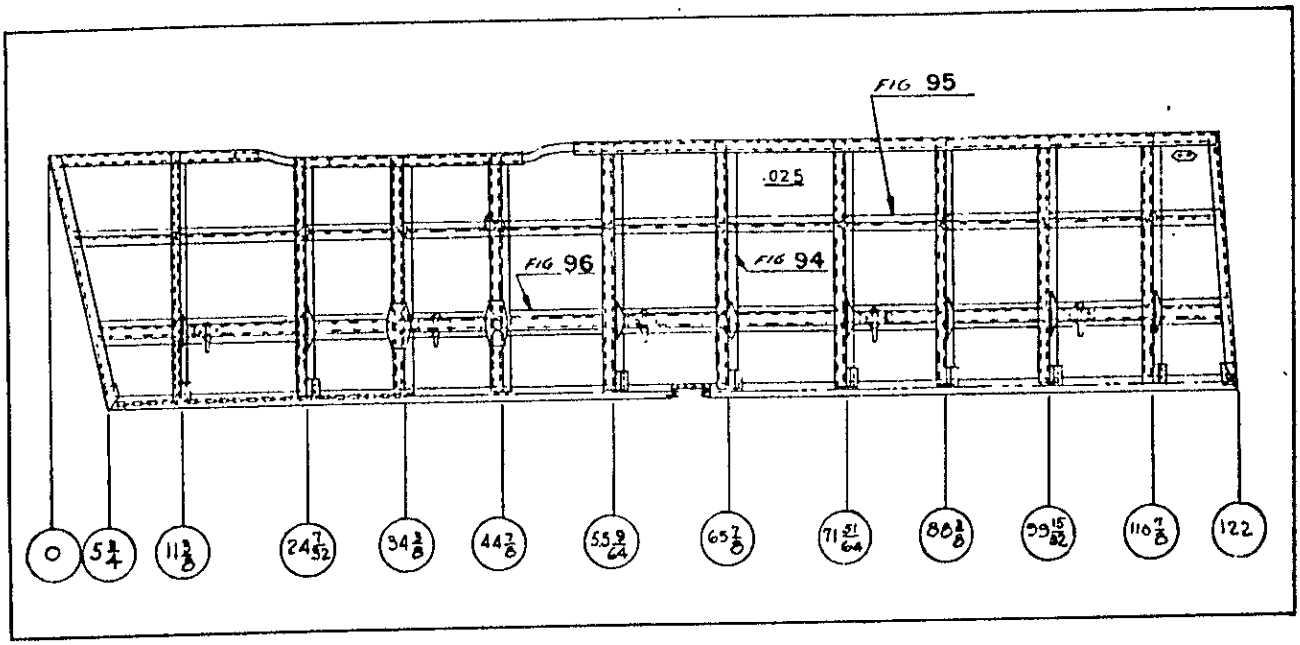


Figure 93 - Flap Assembly

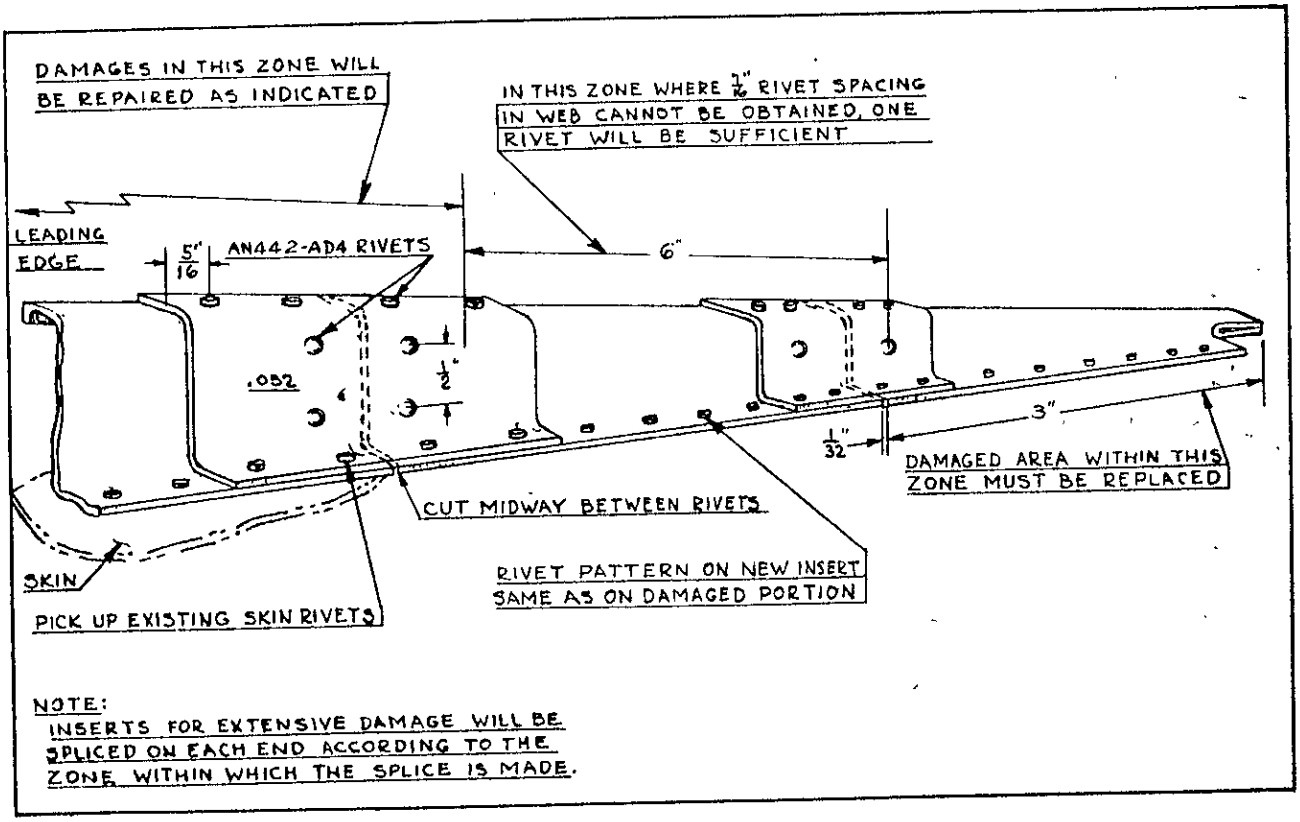


Figure 94 - Flap - Rib Splice

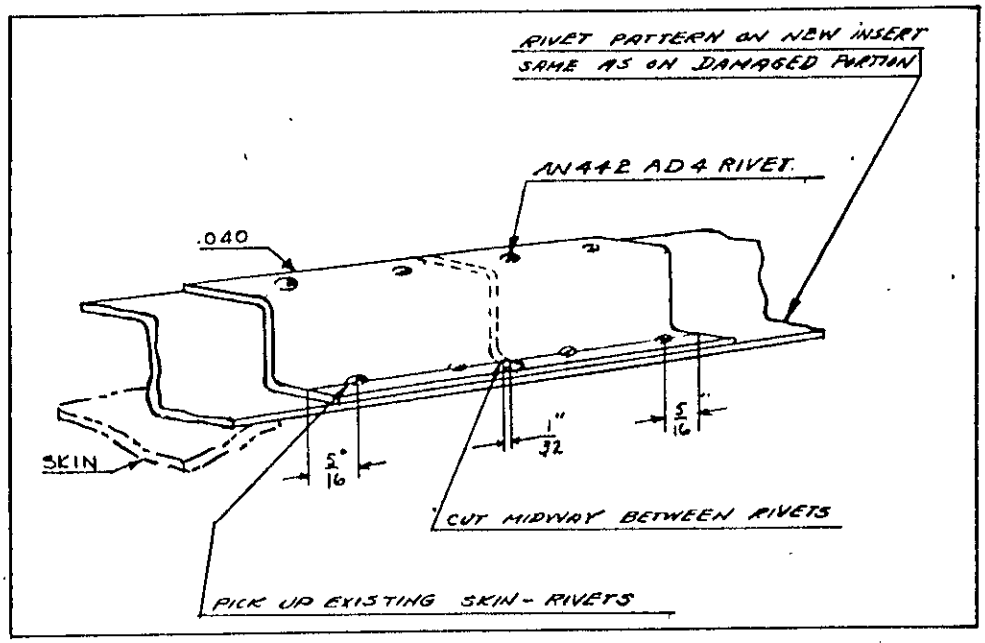


Figure 95 - Flap - Stringer Splice

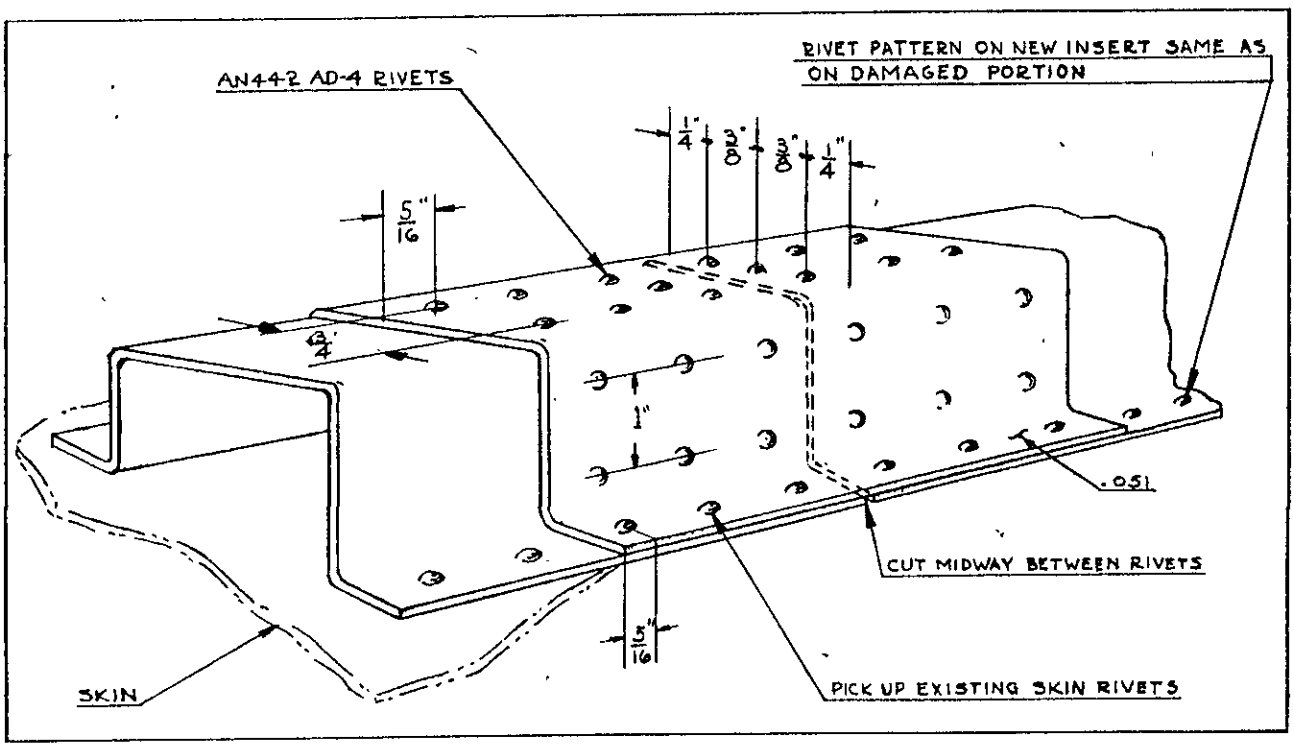


Figure 96 - Flap - Channel Beam Splice

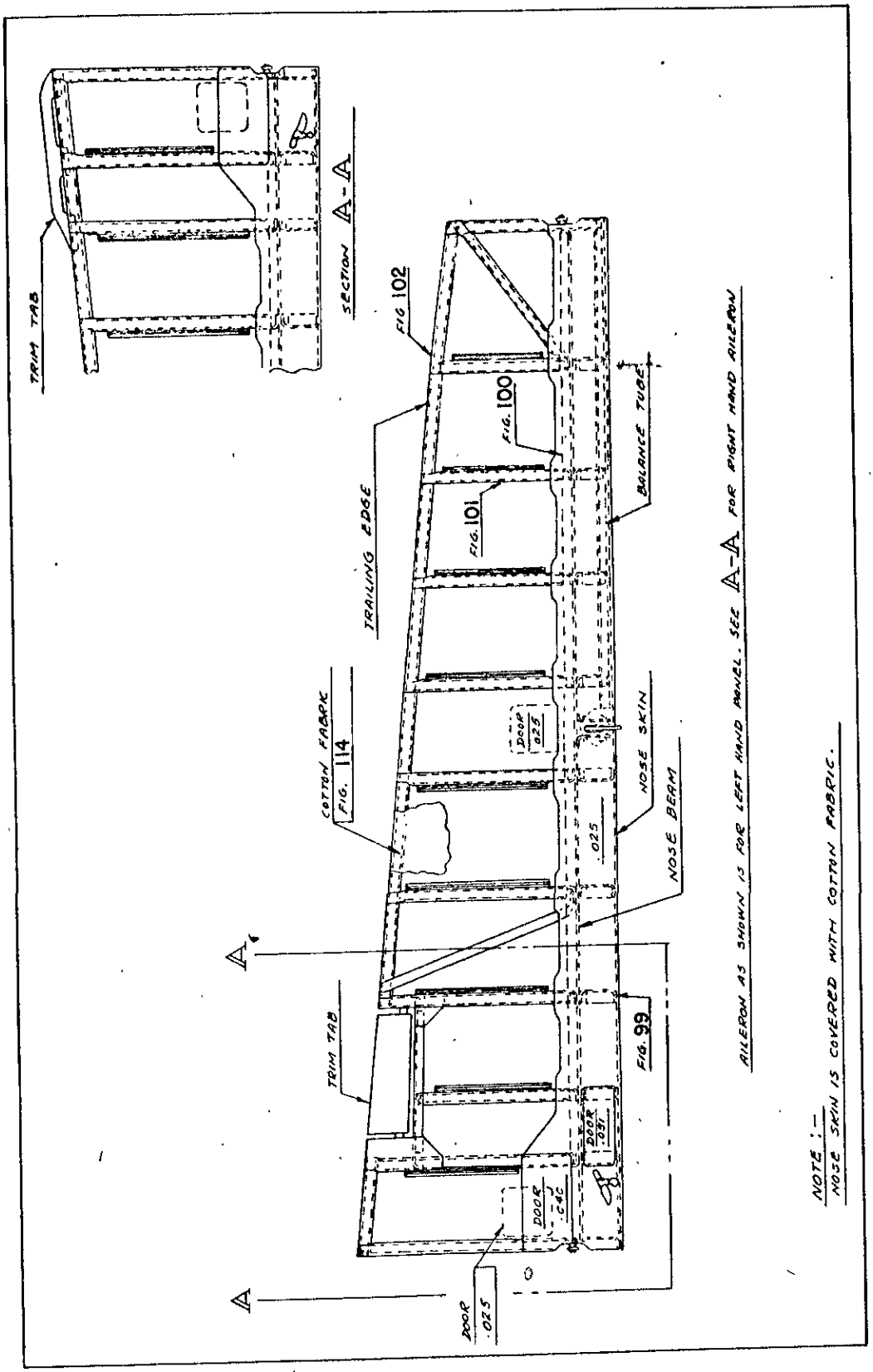


Figure 97 - Aileron Assembly

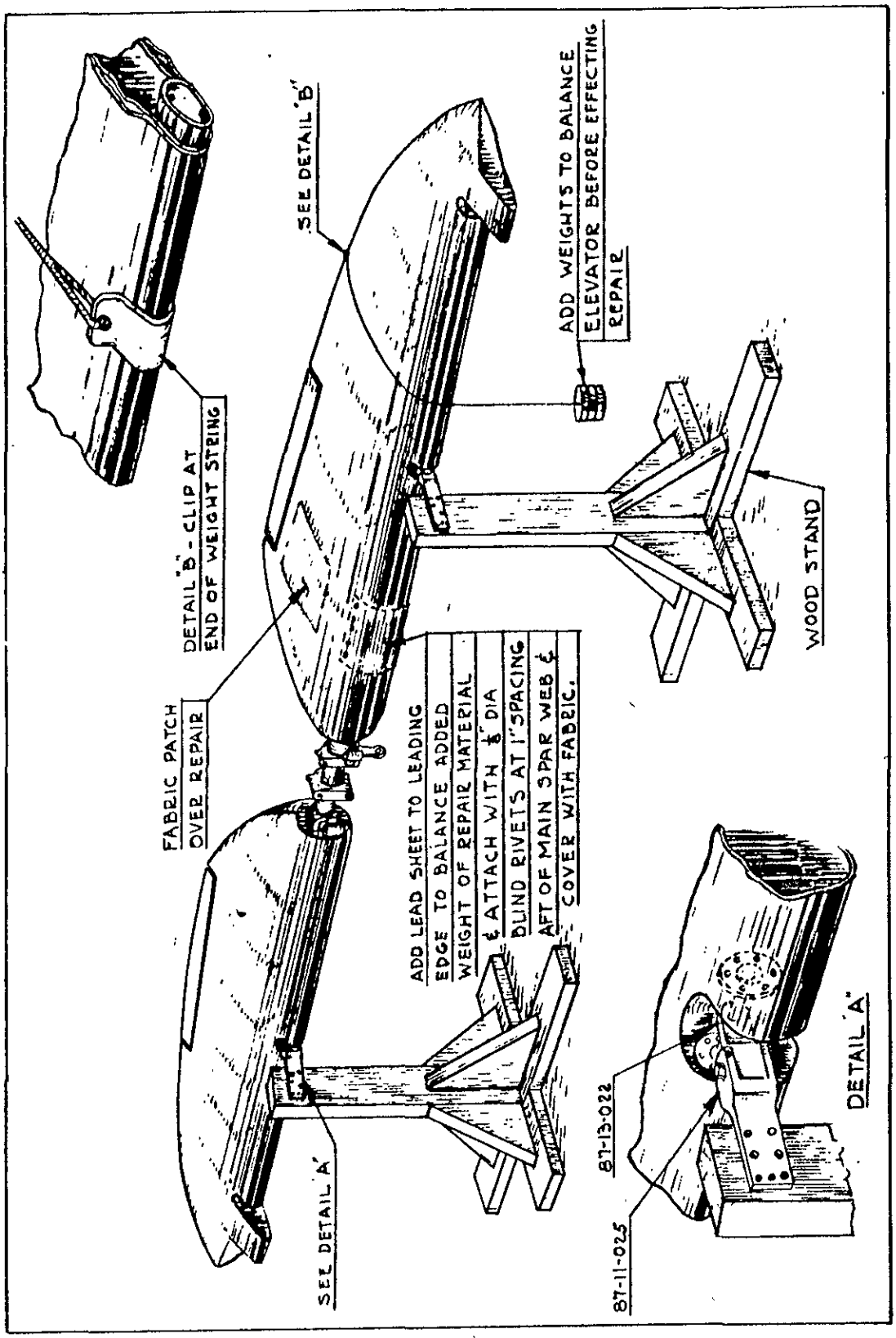


Figure 98 - Elevator - Mass Balance Diagram

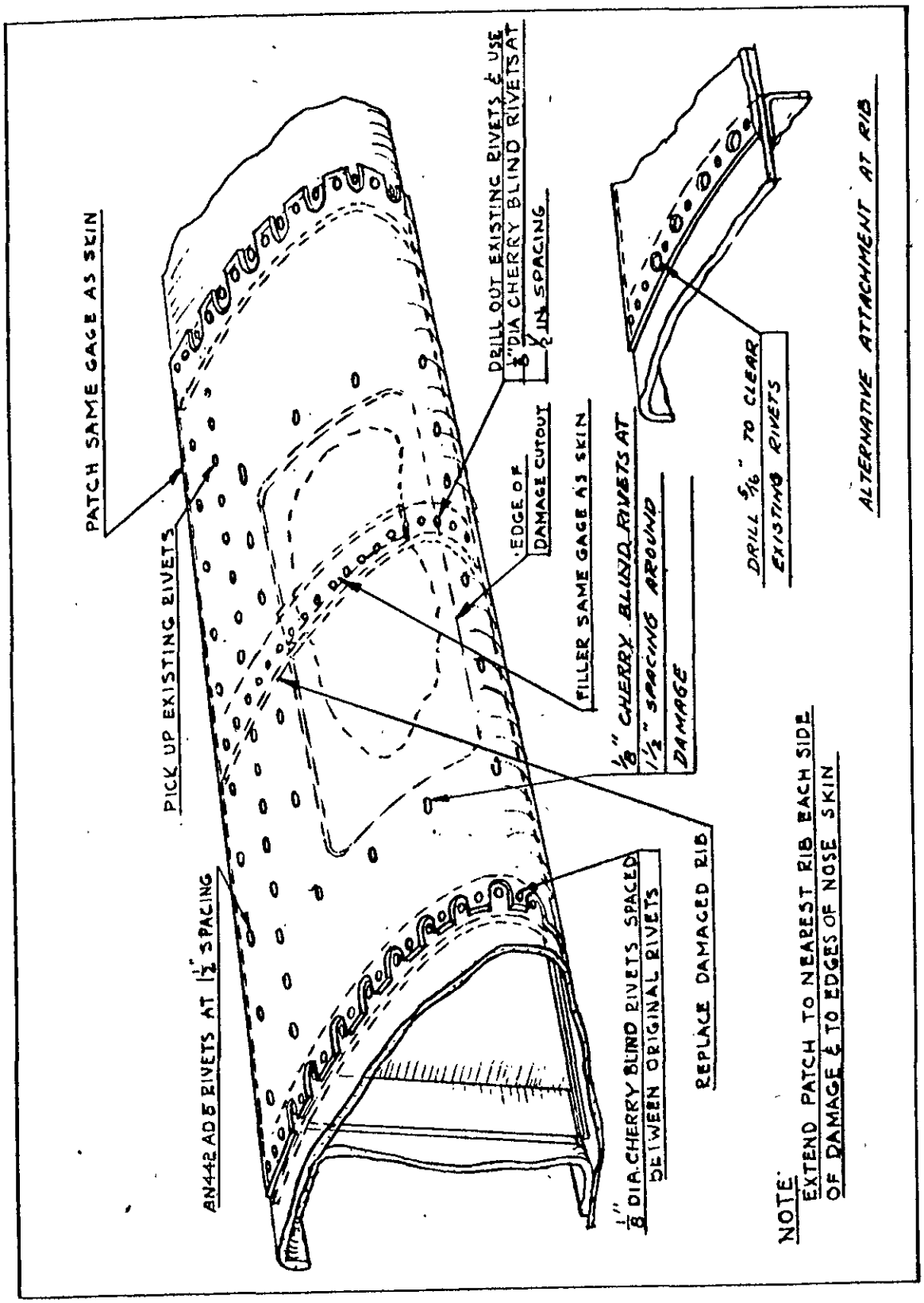


Figure 99 - Aileron - Nose Skin Patch

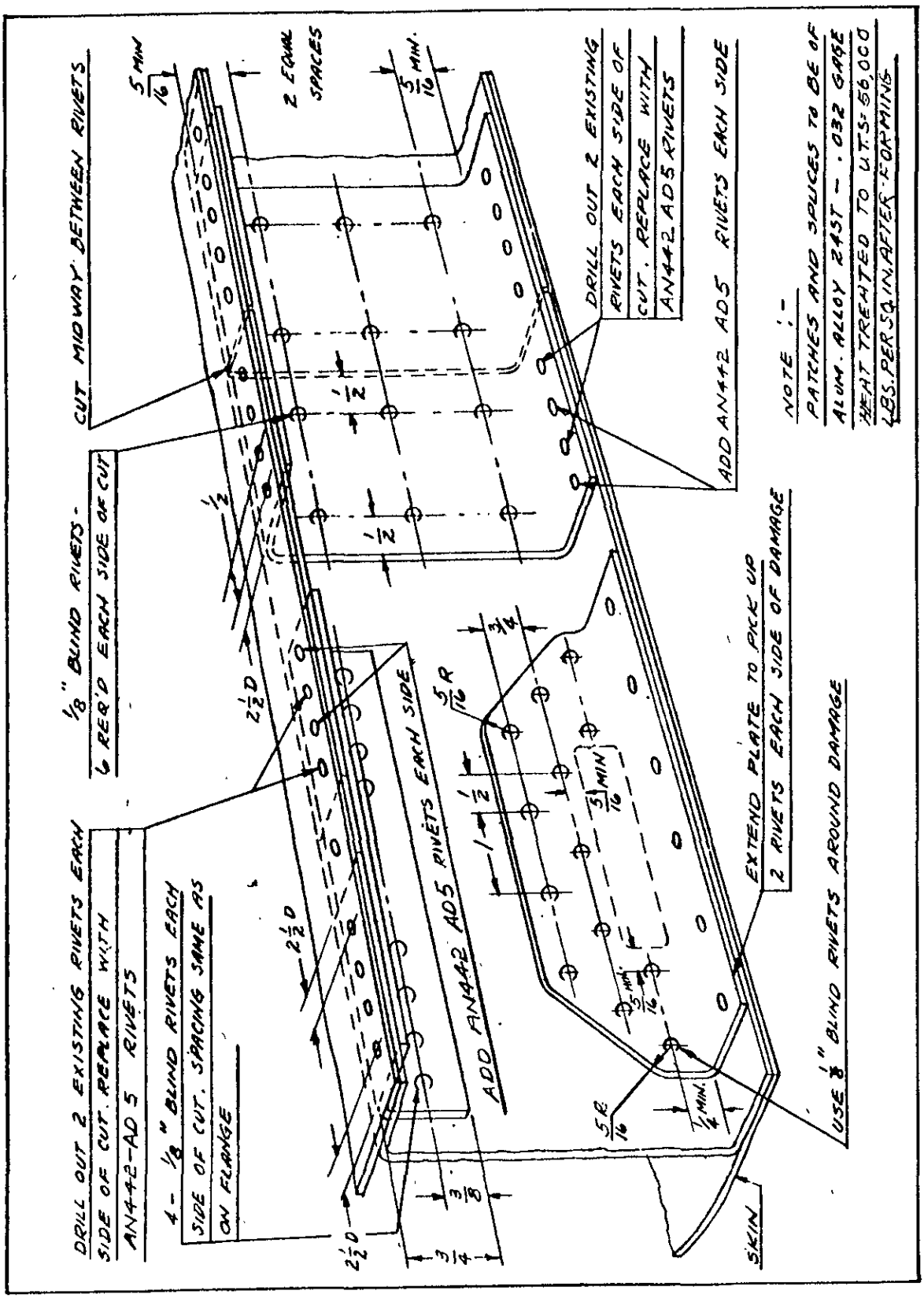


Figure 100 - Aileron - Beam Splice and Patches

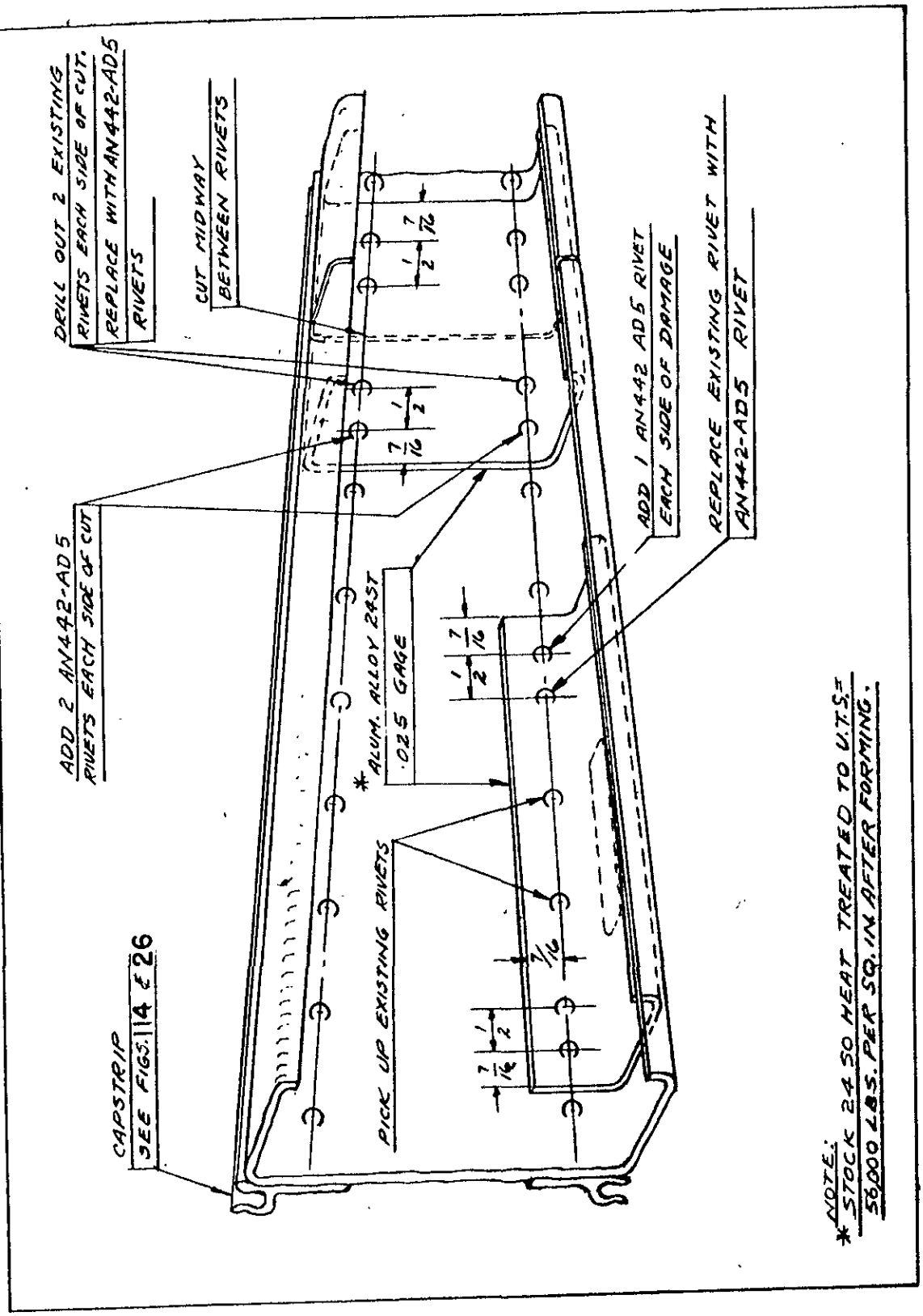


Figure 101 - Aileron - Rib Splice and Patch

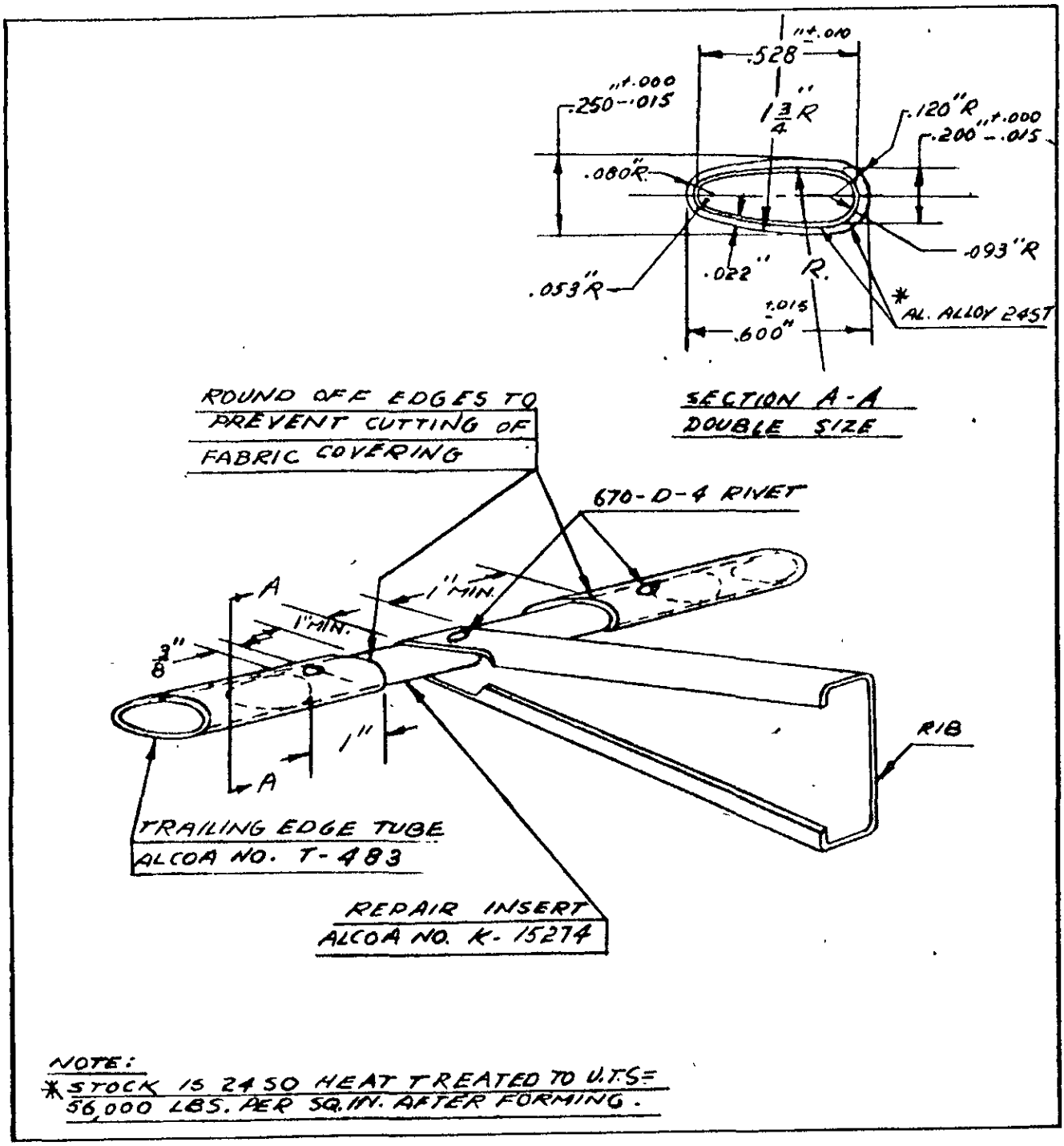


Figure 102 - Control Surfaces - Trailing Edge Insert

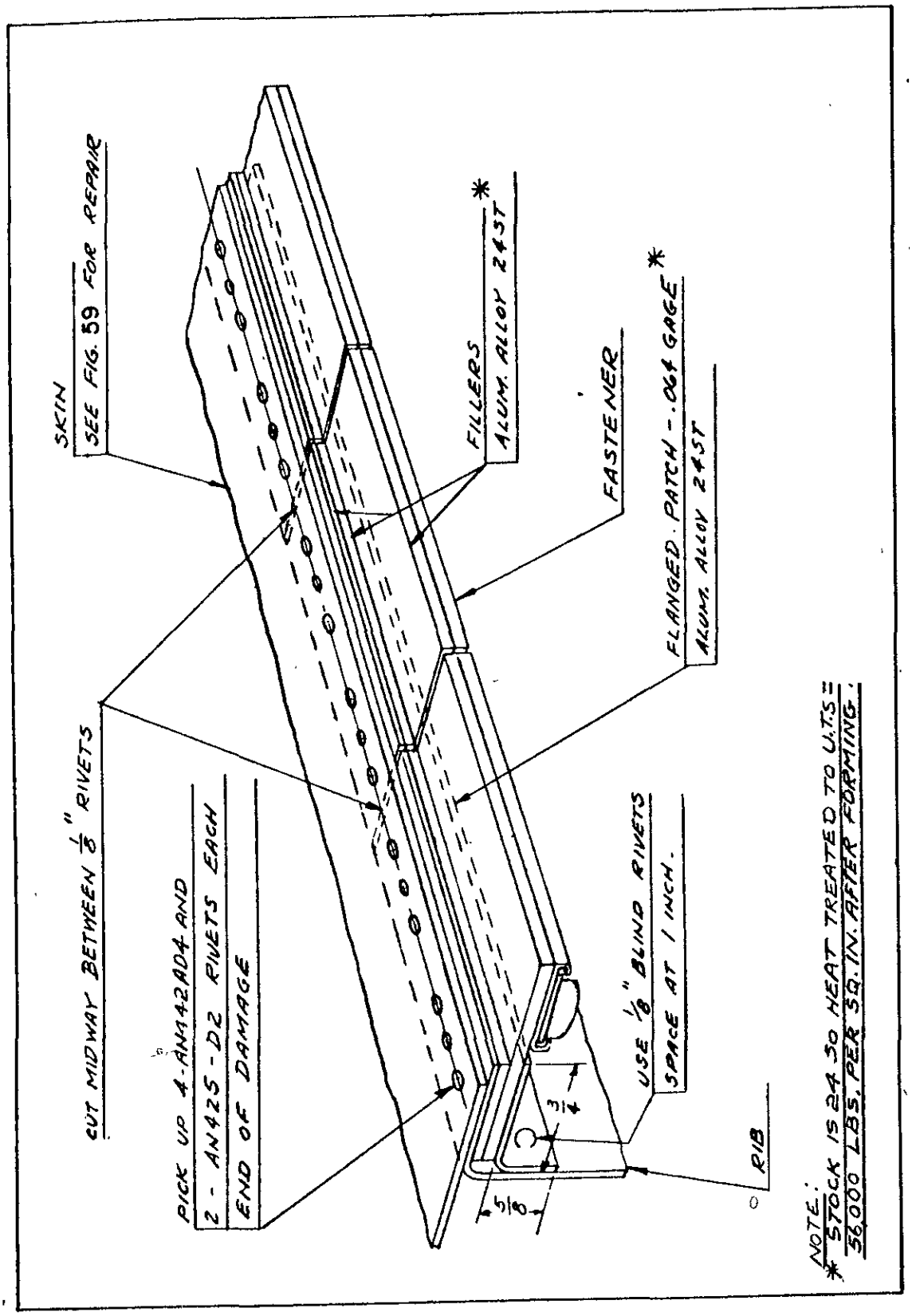


Figure 103 - Rib - Wing Tip Joint - Patch

MATERIALS FOR REPAIR OF WING SKIN, SPARS, RIBS AND TRAILING EDGE

PART NO.	MATERIAL		SIZE	REMARKS
	SPEC NO.	TITLE		
87-03-521-7	QQ-A-355 (A)	Rib - Angles - wing attachment	.081 in. thickness x 1-3/4 in. x 2-5/8 in.	Spars 4 and 5
87-03-521	QQ-A-355 (T)	Rib - Al. Al. 24ST	.064 in. x 12-1/4 in. x 14 in.	Spars 4 and 5
671-D-6AD-6	A17ST	Rib - Rivets - brazier head	3/16 in. dia. x 3/8 in. long	Spars 4 and 5
81599-3-7		Rib - Angle (K-78-K)	3/4 in. x 1/16 in. thick	Spars 4 and 5
81599-4-8 7/8 and 8 15/16 in.		Rib - Angle (K-78-J)	1 in. x 1/16 in. thick	Spars 4 and 5
87-03-529-1	QQ-A-355 (T)	Rib - Sta 27 - spars 2 and 3	.040 in. x 16 in. x 19-1/2 in.	Al. Al. 24ST
87-03-529-3	57-152-6 (I)	Rib - Sta 27 - spars 2 and 3 reinforcement	.051 in. x 2-7/8 in. x 3-3/4 in.	Al. Al. 24SO
AN931-6-10		Rib - Sta 27 - spars 2 and 3 grommet	ID 3/8 in. x OD 7/8 in.	Neoprene
87-03-530-1	QQ-A-355 (T)	Rib - Sta 26 - spars 3 and 4	.040 in. x 15 in. x 32-3/4 in.	Al. Al. 24ST
87-03-530-2	QQ-A-355 (A)	Rib - Angle	.051 in. x 1-3/4 in. x 32 in.	Al. Al. 24SO
81599-1-17 1/8 and 19 3/8 in.		Rib - Angles	3/4 in. x 3/32 in. thickness	Alcoa die No. (K-78-C)
87-03-530-5	QQ-A-355 (T)	Rib - Reinforcement	.064 in. x 2-5/8 in. x 2-5/8 in.	Al. Al. 24ST
87-03-530-16	QQ-A-354 (J)	Rib - Reinforcement	3/16 in. x 5/8 in. x 12-7/8 in.	Al. Al. 24ST
87-03-031-11	QQ-A-355 (T)	Rib - Sta 27 - spars 4 and 5	.040 in. x 11 in. x 13-5/16 in.	Al. Al. 24ST
87-03-535-1	QQ-A-355 (T)	Sheet - Chassis support - inner spars 2 and 3	.128 in. x 13-15/16 in. x 17-1/2 in.	Al. Al. 24ST
659-D-15	1112	Anchor Nut - Chassis support - inner spars 2 and 3	25/64 in. x 11/32 in. x 1/4 in. high	Steel
525-10-10	57-107-17	Screws - Chassis support - inner spars 2 and 3	5/8 in. long; 7/32 in. shank	Washer head
365-1032	25527 Mfg.	Nuts - Chassis support - inner spars 2 and 3	15/64 in. x 3/8 in.	Fine thread
AN3-5	57-152-5	Bolts - Chassis support - inner spars 2 and 3	5/8 in. long; x 1/4 in. shank	
87-03-541-1	QQ-A-356 (T)	Sheet - Chassis support - outer spars 2 and 3	.128 in. x 13-15/16 in. x 17-15/16 in.	Al. Al. 24ST
87-03-920-1	57-152-6 (11)	Sheet - Chassis support - outer spars 2 and 3 P-40F	.128 in. x 13-15/16 in. x 17-15/16 in.	Al. Al. 24ST
81599-1		Angles - Chassis support - outer - spars 2 and 3	3/4 in. x 3/32 in. thickness	Alcoa die No. (K-78-C)
81599-3		Angles - Chassis support - outer - spars 2 and 3	3/4 in. x 1/16 in. thickness	Alcoa die No. (K-78-K)
81599-6		Angle - Chassis support - outer spars 2 and 3	1 in. x 1/8 in. thickness	Alcoa die No. (K-77-B)
81599-2		Angle - Chassis support - outer spars 2 and 3	3/4 in. x 1/8 in.	Alcoa die No. (K-77-A)
AN960-10		Washers - Chassis support - outer - spars 2 and 3	13/64 in. ID; 7/16 in. OD	Plain
87-03-618-1	QQ-A-355 (T)	Rib - Inboard wheel pocket - spars 4 and 5	.040 in. x 7-5/8 in. x 9-3/4 in.	Alclad 24ST
87-03-619-1	QQ-A-355 (T)	Rib - Outboard wheel pocket - spars 4 to 5	.040 in. x 7-7/8 in. x 9-5/8 in.	Al. Al. 24ST
87-03-559-1	QQ-A-355 (T)	Rib - Sta 57 - spars 2 to 3	.040 in. x 14-1/32 in. x 17-1/8 in.	Al. Al. 24ST
87-03-559-3	57-152-6 (11)	Rib - Sta 57 - spars 2 to 3 - stiffener	.040 in. x 2-1/4 in. x 1-3/8 in.	Al. Al. 24ST
87-03-560-1	QQ-A-355 (T)	Rib - Sta 57 - spars 3 to 5	.051 in. x 14-1/8 in. x 38-1/2 in.	Al. Al. 24ST
87-03-560-2	QQ-A-355 (A)	Rib - Sta 57 - spars 3 to 5 reinforcements	.064 in. x 2-15/16 in. x 3-3/8 in.	Al. Al. 24SO
87-03-560-3 to 17	QQ-A-355 (T)	Rib - Sta 57 - spars 3 to 5 - plates	.032 in. thickness	Al. Al. 24ST

MATERIALS FOR REPAIR OF WING SKIN, SPARS, RIBS AND TRAILING EDGE

PART NO.	MATERIAL		SIZE	REMARKS
	SPEC NO.	TITLE		
87-03-560-22	QQ-A-355 (T)	Rib - Sta 57 - spars 3 to 5 - collar	.064 in. x 4-7/16 in. x 4 7/16 in.	Al. Al. 24ST
87-03-569	QQ-A-362	Rib - Sta 65 - spars 3 to 5	.051 in. x 4-3/8 in. x 35-3/4 in.	Alclad sheet 24ST
87-03-568-1	QQ-A-362 (T)	Rib - Sta 66-15/16 - spars 2 to 3	.040 in. x 14 in. x 17-1/2 in.	Alclad sheet 24ST
87-03-568-3	QQ-A-355 (A)	Rib - Sta 66-15/16 - spars 2 to 3 - reinforcements	.051 in. x 3-1/16 in. x 5-7/16 in.	Al. Al. 24S0
87-03-574-1	QQ-A-355 (A)	Rib - Sta 73-1/2 - spars 2 to 3	.040 in. x 13-1/4 in. x 17-5/16 in.	Al. Al. 24S0
87-03-044-2		Rib - Angles - 78077-4 - Alcoa die No. K-10223	11-9/16 in. x 9/16 in x .040 in. thickness	Area .056 sq in.
87-69-539	QQ-A-354 (T)	Rib - Angles - Alcoa die No. K-27369	1.5 in. x 1.188 in. x 11-1/2 in. long	Al. Al. 24ST
87-03-843-1	QQ-A-355 (T)	Rib - Sta 81-1/2 - spars 2 to 3	.051 in. x 16 in. x 12-7/8 in.	Al. Al. 24ST
87-03-843-4	QQ-A-355 (A)	Rib - Sta 81-1/2 - spars 2 to 3 clips	.064 in. x 1 in. x 3-1/2 in.	Al. Al. 24S0
87-03-843-6	QQ-A-355 (T)	Rib - Sta 81-1/2 - spars 2 to 3 plates	.081 in. x 2-9/16 in. x 4-1/2 in.	Al. Al. 24ST
AN-4-7	57-152-5	Rib - Sta 81-1/2 - spars 2 to 3 bolts	7/8 in. long; 7/16 in. shank	Steel
365-428	25527 Mfg.	Rib - Sta 81-1/2 - spars 2 to 3 nuts	5/16 in. x 7/16 in.	Self-locking
87-03-844-2	QQ-A-355 (T)	Rib - Sta 81-1/2 - spars 3 to 5	.040 in. x 12-15/16 in. x 35-3/32 in.	Al. Al. 24ST
87-03-844-13	QQ-A-355 (T)	Rib - Sta 81-1/2 - spars 3 to 5 filler	.125 in. x 1-13/16 in. x 2-9/16 in.	Al. A2. 24ST
559-D-15	1112	Rib - Sta 81-1/2 - spars 3 to 5 nut plate	25/64 in. x 11/32 in. x 1/4 in. high	Steel
AN24-11	29-59 Mfg.	Rib - Sta 81-1/2 - spars 3 to 5 screws	11/16 in. long; 3/8 in. shank	
364-428	25527 Mfg.	Rib - Sta 81-1/2 - spars 3 to 5 nuts	13/64 in. x 7/16 in.	Self-locking-thin
87-03-851-1	QQ-A-355 (T)	Rib - Sta 100 - spars 2 to 3	.032 in. x 11-9/16 in. x 15-5/8 in.	Al. Al. 24ST
87-03-851-3	QQ-A-355 (T)	Rib - Sta 100 - spars 2 to 3 - angle	.040 in. x 1-1/4 in. x 2-11/16 in.	Al. Al. 24ST
87-03-852-1	QQ-A-355 (T)	Rib - Sta 100 - spar 3 to aux spar	.040 in. x 6 in. x 11-1/2 in.	Al. Al. 24ST
87-03-853-1	QQ-A-355 (T)	Rib - Sta 100 - aux spar to aux spar	.040 in. x 6-3/4 in. x 13-1/2 in.	Al. Al. 24ST
87-03-854-1	QQ-A-355 (T)	Rib - Sta 100 - aux spar to aux spar	.040 in. x 9-21/32 in. x 14-3/16 in.	Al. Al. 24ST
87-03-624-1	QQ-A-355 (T)	Rib - Sta 122 - spars 2 to 3	.025 in. x 10-3/8 in. x 14-1/2 in.	Al. Al. 24ST
87-03-624-2	57-152-6-(11)	Rib - Sta 122 - spars 2 to 3 - angle	.040 in. x 1-1/4 in. x 2-11/16 in.	Al. Al. 24ST
87-03-858-1	QQ-A-355 (T)	Rib - Sta 122 - spars 3 to aux spar	.040 in. x 7-17/32 in. x 10-1/4 in.	Al. Al. 24ST
87-03-859-1	QQ-A-355 (T)	Rib - Sta 122 - aux spar to aux spar	.040 in. x 6-9/16 in. x 13-3/8 in.	Al. Al. 24ST
87-03-860-1	QQ-A-355 (T)	Rib - Sta 122 - aux spar to spar No. 5	.040 in. x 5-15/32 in. x 8-5/8 in.	Al. Al. 24ST

MATERIALS FOR REPAIR OF WING SKIN, SPARS, RIBS AND TRAILING EDGE

PART NO.	MATERIAL		SIZE	REMARKS
	SPEC NO.	TITLE		
87-03-788-1	QQ-A-355 (T)	Rib - Reinforcement - aileron drum support	.040 in. x 8-1/8 in. x 7-1/8 in.	Al. Al. 24ST
87-03-788-2	57-152-6-(11)	Filler	.051 in. x 3/4 in. x 3-9/16 in.	Al. Al. 24ST
87-03-788-3	57-152-6-(11)	Angle	.040 in. x 2-1/16 in. x 5-5/16 in.	Al. Al. 24ST
87-03-645-1	QQ-A-355 (T)	Rib - Sta 143 - spars 2 to 3	.025 in. x 9-1/8 in. x 13-1/2 in.	Al. Al. 24ST
87-03-646	QQ-A-355 (T)	Rib - Sta 143 - spars 3 to aux spar	.040 in. x 9-1/16 in. x 9-1/16 in.	Al. Al. 24ST
87-03-647-1	QQ-A-355 (T)	Rib - Sta 143 - aux spar to aux spar	.040 in. x 5-3/16 in. x 13-7/32 in.	Al. Al. 24ST
87-03-647-6	QQ-A-355-(T)	Strap	.102 in. x 1 in. x 5-3/8 in.	Al. Al. 24ST
87-03-648-1	QQ-A-355-(T)	Rib - Sta 143 - aux spar to spar 5	.032 in. x 5-3/16 in. x 6-11/16 in.	Al. Al. 24ST
87-03-649	QQ-A-355 (A)	Rib - Sta 143 - aft of spar 5	.025 in. x 6-5/16 in. x 6-1/2 in.	Al. Al. 24S0
87-03-666	QQ-A-355 (T)	Rib - Sta 164 - spar 2 to spar 3	.025 in. x 8 in. x 12-5/8 in.	Al. Al. 24ST
87-03-667-1	QQ-A-362 (T)	Rib - Sta 164 - spars 3 to 5	.032 in. x 8 in. x 23-1/2 in.	Alclad 24ST
87-03-667-4	QQ-A-355-(T)	Rib - Sta 164 - spars 3 to 5 - angle	.040 in. x 2-1/8 in. x 3-13/16 in.	Al. Al. 24ST
87-03-667-6	QQ-A-355-(A)	Rib - Sta 164 - spars 3 to 5 - angle	.064 in. x 1-15/16 in. x 3-5/8 in.	Al. Al. 24S0
87-03-687	QQ-A-355(T)	Rib - Sta 185 - spars 2 to 3	.025 in. x 7 in. x 11-5/8 in.	Al. Al. 24ST
87-03-688-1	QQ-A-355(T)	Rib - Sta 185 - spars 3 to 5	.032 in. x 6-7/8 in. x 21-1/4 in.	Al. Al. 24ST
87-03-306	11067-(1)	Ribs - Sta 185 - aft of spar 5	.025 in. x 5 in. x 5-1/4 in.	Al. Al. 24S0
87-03-848-1	QQ-A-355 (T)	Rib - Sta 90 - spars 3 to 5	.040 in. x 11-15/16 in. x 39-1/2 in.	Al. Al. 24ST
87-03-705-1	11067-(1)	Rib - Sta 205 - leading edge to trailing edge	.032 in. x 6-1/2 in. x 50 in.	Alclad 24S0
87-03-705-2	QQ-A-355 (A)	Rib - Angle - sta 205 - leading edge to trailing edge	.032 in. x 1-3/8 in. x 3-1/2 in.	Al. Al. 24S0
75-03-162-1	57-152-6-(11)	Rib - Plate - sta 205 - leading edge to trailing edge	.051 in. x 1-13/16 in. x 3 in.	Al. Al. 24ST
75-03-187-1	QQ-A-355 (T)	Rib - Reinforcement - sta 205 - leading edge to trailing edge	.040 in. x 5 in. x 5-9/32 in.	Al. Al. 24ST
87-03-811-2	QQ-A-355 (A)	Spar No. 1 - Inner	.051 in. x 11-1/2 in. x 92-3/4 in.	Al. Al. 24ST
87-03-911-2	QQ-A-355 (T)	Spar No. 1 - Inner P-40F	.051 in. x 11-1/2 in. x 92-3/4 in.	Al. Al. 24ST
87-03-811-3	QQ-A-355 (A)	Spar No. 1 - Outer	.040 in. x 8-1/2 in. x 113-3/8 in.	Al. Al. 24ST
87-03-911-3	QQ-A-355 (T)	Spar No. 1 - Outer P-40F	.040 in. x 8-1/2 in. x 113-3/8 in.	Al. Al. 24ST
87-03-811-13	QQ-A-355 (A)	Spar No. 1 - Reinforcement	.064 in. x 5-3/8 in. x 5-3/8 in.	Al. Al. 24ST
87-03-911-13	QQ-A-355 (T)	Spar No. 1 - Plate P-40F	.064 in. x 5-3/8 in. x 5-3/8 in.	Al. Al. 24ST
87-03-811-5	QQ-A-355 (A)	Spar No. 1 - Angle	.081 in. x 2-1/4 in. x 29-1/16 in.	Al. Al. 24S0
87-03-839	57-152-5-(T)	Spar No. 1 - Flange - lower - outboard	Alcoa die No. (K-27290)	Al. Al. 24ST
81-03-027	57-152-5-(T)	Spar No. 1 - Flange - upper - intermediate	Alcoa die No. (K-16017)	Alclad 24ST
87-03-551	57-152-5 (T)	Spar No. 1 - Flange - lower - inboard	Alcoa die No. (K-16016)	Al. Al. 24ST
87-03-694	57-152-5 (T)	Spar No. 1 - Flange - upper - outboard	Alcoa die No. (K-27291)	Al. Al. 24ST
81-03-027	57-152-5 (T)	Spar No. 1 - Flange - upper - inboard	Alcoa die No. (K-16017)	Al. Al. 24ST
87-03-812-1	QQ-A-355-(T)	Spar No. 2 - Inboard	.040 in. x 14-1/4 in. x 133-1/2 in.	Al. Al. 24ST
87-03-812-2	QQ-A-355-(T)	Spar No. 2 - Outboard	.032 in. x 7-1/2 in. x 72 in.	Al. Al. 24ST
87-03-812-5	QQ-A-355-(T)	Spar No. 2 - Plate	.040 in. x 4-7/8 in. x 9-15/16 in.	Al. Al. 24ST

MATERIALS FOR REPAIR OF WING SKIN, SPARS, RIBS AND TRAILING EDGE

PART NO.	MATERIAL		SIZE	REMARKS
	SPEC NO.	TITLE		
87-03-812-5	QQ-A-355-(A)	Spar No. 2 - Stiffener P-40F	.051 in. x 1-1/8 in. x 12-1/4 in.	Al. Al. 24S0
87-03-812-12	QQ-A-355-(T)	Spar No. 2 - Plate	.064 in. x 11-3/16 in. x 37-1/2 in.	Al. Al. 24ST
87-03-812-15	QQ-A-355-(A)	Spar No. 2 - Angle splice	.081 in. x 2-3/16 in. x 12 in.	Al. Al. 24S0
87-03-812-22	QQ-A-355-(T)	Spar No. 2 - Filler	.051 in. x 15/16 in.x 2-9/16 in.	Al. Al. 24ST
87-03-733	57-152-5-(T)	Spar No. 2 - Flange - Upper - outboard	Alcoa die No. (K-27383)	Al. Al. 24ST
87-03-812-24	QQ-A-354-(T)	Spar No. 2 - Flange - lower - inboard	Alcoa die No. (K-15004)	Al. Al. 24ST
87-03-813-2	QQ-A-355-(T)	Spar No. 3 - Inboard	.051 in. x 15-3/4 in. x 111-1/2 in.	Al. Al. 24ST
87-03-813-3	QQ-A-355-(T)	Spar No. 3 - Outboard	.051 in. x 10-1/2 in. x 95-5/16 in.	
87-03-813-20	QQ-A-355-(T)	Spar No. 3 - Reinforcement - sta 180	.040 in. x 6 in. x 6 in.	
87-03-813-12	QQ-A-355-(T)	Spar No. 3 - Filler plate	.125 in. x 1 in. x 3-11/16 in.	Al. Al. 24ST
87-03-813-26	QQ-A-355-(T)	Spar No. 3 - Filler plate	.093 in. x 1 in. x 3-11/16 in.	Al. Al. 24S0
87-03-813-23	QQ-A-355-(A)	Spar No. 3 - Stiffener	.032 in. x 3-1/4 in. x 11-5/8 in.	
87-03-814-5	QQ-A-355 (T)	Spar No. 4 - Web sheet	.040 in. x 10-3/4 in. x 57-11/16 in.	Al. Al. 24ST
87-03-814-6	QQ-A-355 (A)	Spar No. 4 - Top channel - middle	.072 in. x 3-1/2 in. x 28-1/2 in.	Al. Al. 24S0
87-03-814-7	QQ-A-355 (A)	Spar No. 4 - Top channel - inner	.064 in. x 3 in. x 25-3/8 in.	
87-03-814-8	QQ-A-355 (A)	Spar No. 4 - Channel	.064 in. x 2-5/8 in. x 10 in.	Al. Al. 24ST
87-03-814-33	QQ-A-354 (T)	Spar No. 4 - Angle	92126 - 2 - 33-1/2 in.	Al. Al. 24ST
87-03-814-15	QQ-A-355 (T)	Spar No. 4 - Filler	.040 in. x 1-5/16 in. x 3-1/2 in.	Al. Al. 24ST
87-03-814-16	QQ-A-355 (T)	Spar No. 4 - Reinforcement	.051 in. x 10-5/16 in. x 12-9/16 in.	Al. Al. 24ST
87-03-747	57-152-5 (T)	Spar No. 4 - Lower - inner	Alcoa die No. (K-16022)	
87-03-815-1	QQ-A-355 (T)	Spar No. 5 - Web	.040 in. x 9-1/8 in. x 126-1/8 in.	Al. Al. 24ST
87-03-815-2	QQ-A-355 (T)	Spar No. 5 - Web	.040 in. x 7-7/16 in. x 85 in.	Al. Al. 24ST
87-03-815-5	QQ-A-355 (A)	Spar No. 5 - Angle	.040 in. x 1-3/8 in. x 6-7/8 in.	Al. Al. 24S0
87-03-815-10	QQ-A-355 (A)	Spar No. 5 - Angle	.040 in. x 1-1/4 in. x 48-5/8 in.	Al. Al. 24S0
87-03-552	57-152-5-(T)	Spar No. 5 - Lower - extrusion	Alcoa die No. (K-27394)	Al. Al. 24ST
87-03-817-1	QQ-A-355-(T)	Auxiliary Spar - Rear	.051 in. x 9-9/16 in. x 74-1/2 in.	Al. Al. 24ST
87-03-817-5	QQ-A-355-(A)	Auxiliary Spar - Reinforcement angle	.125 in. x 1-3/8 in. x 12-3/4 in.	Al. Al. 24S0
87-03-816-4	QQ-A-355 (T)	Auxiliary Spar - Front	.051 in. x 10-5/16 in. x 74-1/4 in.	Al. Al. 24ST
671-D-4AD-	A-17ST	Rivet - Same for lower - brazier head	1/8 in. dia.	Upper main plane
673-D-5-	A-17ST	Rivet - Same for lower - 78° countersunk	5/32 in. dia.	Upper main plane
AN442-AD-4-	A-17ST	Rivet - Same for lower - flathead	1/8 in. dia.	Upper main plane
AN430D-6-	A-17ST	Rivet - Roundhead	3/16 in. dia.	Lower main plane
AN425D6-	A-17ST	Rivet - Countersunk 78°	3/16 in. dia.	Lower main plane
AN23-12A	29-59 Mfg.	Bolts - Without cotter pin hole	3/4 in. long x 7/16 in. shank	Lower main plane
365-1032	25527 Mfg.	Nuts - Self-locking - fine	15/64 in. x 3/8 in.	Lower main plane
AN960-10	1010 Steel	Washers - Plain	13/64 in. ID x 7/16 in. OD	Lower main plane
525-10-10	57-107-17	Screws - Washer head	5/8 in. long, 7/32 in. shank	Lower main plane
87-03-820-1	QQ-A-355 (T)	Wing Skin - Upper - inboard - spars 2 to 3	.064 in. x 20-1/2 in. x 122-1/2 in.	Al. Al. 24ST
87-03-820-2	QQ-A-355 (T)	Wing Skin - Upper - outboard	.040 in. x 14-3/8 in. x 85-1/2 in.	Al. Al. 24ST

MATERIALS FOR REPAIR OF WING SKIN, SPARS, RIBS AND TRAILING EDGE

PART NO.	MATERIAL		SIZE	REMARKS
	SPEC NO.	TITLE		
87-03-822-1	QQ-A-355-(T)	Wing Skin - Upper - spars 3 to 4	.051 in. x 35 in. x 108 in.	Al. Al. 24ST
87-03-822-4	QQ-A-355-(T)	Wing Skin - Upper - spars 3 to 4	.032 in. x 32 in. x 44 in.	Al. Al. 24ST
87-03-822-29	QQ-A-355-(T)	Wing Skin - Reinforcement LH only	.051 in. x 4 in. x 7-3/4 in.	Al. Al. 24ST
87-03-822-30	QQ-A-355-(T)	Wing Skin - Patch - LH only	.040 in. x 6-1/2 in. x 12-1/2 in.	Al. Al. 24ST
87-03-824-1	QQ-A-355-(T)	Wing Skin - Upper - spars	.051 in. x 15-5/8 in. x 105 in.	Al. Al. 24ST
87-03-823-2	QQ-A-355-(T)	Wing Skin - Lower - inboard - spars 3 to 4	.040 in. x 37 in. x 43 in.	Al. Al. Sheet 24ST
87-03-823-3	QQ-A-355-(T)	Wing Skin - Lower - inboard - spars 3 to 4 - reinforcement	.040 in. x 10-3/4 in. x 12-3/16 in.	Al. Al. Sheet 24ST
87-03-823-13	QQ-A-355-(T)	Wing Skin - Lower - inboard - spars 4 to 5	.051 in. x 15-1/2 in. x 70 in.	Al. Al. Sheet 24ST
659-D-2	1112 steel	Wing Skin - Lower - inboard - spars 4 to 5 - fastener	25/64 in. x 11/32 in. x 1/4 in. high	Nut plate
81-03-049-1	57-152-6-11	Wing Skin - Lower - inboard - spars 4 to 5 - gusset - RH	.064 in.x 2-5/16 in. x 6-1/4 in.	Al. Al. 24ST
75-03-816-2	57-152-6-11	Wing Skin - Lower - inboard - spars 4 to 5 - reinforcement	.051 in. x 5-5/8 in. x 12 in.	Al. Al. 24ST
87-03-823-18	QQ-A-355 (T)	Wing Skin - Lower - outboard - spars 3 - 5	.051 in. x 18 in. x 74 in.	Al. Al. 24ST
87-03-823-19	QQ-A-355 (T)	Wing skin - Lower - outboard - spars 3 - 5	.032 in. x 23 in. x 116 in.	Al. Al. 24ST
87-03-823-31	QQ-A-355 (T)	Wing Skin - Lower - inboard - spars 3 - 5 - reinforcement	.032 in. x 4-3/4 in. x 9-3/8 in.	Al. Al. 24ST
87-03-821-1	57-152-6-11	Wing Skin - Lower - spars	.051 in. x 20 in. x 97-1/2 in.	Al. Al. 24ST
87-03-921-1	QQ-A-355-(T)	Wing Skin - Lower - spars 2 to 3 - inboard P-40F	.051 in. x 20 in. x 97-1/2 in.	Al. Al. 24ST
87-03-821-2	57-152-6-11	Wing Skin - Lower - spars 2 to 3 - outboard	.032 in. x 14-1/16 in. x 93-1/4 in.	Al. Al. 24ST
87-03-921-2	QQ-A--355-(T)	Wing Skin - Lower - spars 2 to 3 - outboard P-40F	.032 in. x 14-1/16 in. x 93-1/4 in.	Al. Al. 24ST
1100-D-S-7	1115 steel	Wing Skin - Lower - screw	7/16 in. long	100° countersunk
87-03-229-1	57-152-6-1	Wing Skin - Lower - reinforcement - LH	.051 in. x 7-1/32 in. x 18 in.	Al. Al. 24ST
87-03-588	QQ-A-355-(T)	Wing Skin - Lower - reinforcement - LH	.040 in. x 3-3/4 in. x 22 in.	Al. Al. 24ST
87-03-181-1	57-152-6-11	Wing Skin - Lower - plate	.032 in. x 12-9/32 in. x 20 in.	Al. Al. 24ST
87-03-779	QQ-A-355-(A)	Wing Skin - Lower - channel splice - RH	.051 in. x 2-1/4 in. x 5-1/4 in.	Al. Al. 24SO
87-03-795-1	QQ-A-355-(T)	Wing Skin - Lower - frame	.032 in. x 5-9/16 in. x 7-9/16 in.	Al. Al. 24ST
75-03-367-1	57-152-6-1	Wing Skin - Lower - channel splice - RH	.051 in. x 2-5/16 in. x 5-1/2 in.	Al. Al. 24SO
87-03-810-1	QQ-A-355-(T)	Wing - Nose skin - inboard	.051 in. x 42 in. x 101 in.	Al. Al. 24ST
87-03-810-2	QQ-A-355-(T)	Wing - Nose skin - outboard	.040 in. x 31-1/2 in. x 106-7/8 in.	Al. Al. 24ST
365-428	25527 Mfg.	Wing - Nose skin - nuts - fine	5/16 in. x 7/16 in.	Self-locking
365-1032		Wing - Nose skin - nuts - fine	15/64 in. x 3/8 in.	Self-locking
87-03-810-6	QQ-A-355-(T)	Wing - Nose skin - shim	.040 in. x 3/4 in. x 6 in.	Al. Al. 24ST
87-03-810-18	QQ-A-355-(T)	Wing - Nose skin - reinforcement	.051 in. x 16 in. x 33-1/8 in.	Al. Al. 24ST
87-03-810-19	QQ-A-355-(T)	Wing - Nose skin - reinforcement	.102 in. x 3-5/8 in. x 3-14 in.	Al. Al. 24ST
659-D-7	1112 steel	Wing - Nose skin - nut - plate - RH	1/2 in. x 1/2 in. x 9/32 in. high	Elastic nut type
87-03-826-1	QQ-A-355-(T)	Trailing Edge - Inboard- skin - upper	.025 in. x 22-3/4 in. x 131-7/16 in.	Al. Al. 24ST
87-03-826-2	QQ-A-355-(T)	Trailing Edge - Inboard - skin - lower	.025 in. x 21-15/16 in. x 22-1/2 in.	Al. Al. 24ST

MATERIALS FOR REPAIR OF WING SKIN, SPARS, RIBS AND TRAILING EDGE

PART NO.	MATERIAL		SIZE	REMARKS
	SPEC NO.	TITLE		
87-03-826-3	QQ-A-355-(T)	Trailing Edge - Inboard - skin - inner	.032 in. x 8-1/4 in. x 25-3/4 in.	Al. Al. 24ST
87-03-826-5	QQ-A-355-(T)	Trailing Edge - Inboard - skin - reinforcement	.125 in. x 27/32 in. x 21-29/32 in.	Al. Al. 24ST
87-03-826-6	QQ-A-355-(T)	Trailing Edge - Inboard - skin - plate	.040 in. x 1/2 in. x 2-1/4 in.	Al. Al. 24ST
87-03-826-7	QQ-A-355-(T)	Trailing Edge - Inboard - skin - filler	.032 in. x 1-1/4 in. x 2-1/4 in.	Al. Al. 24ST
AN3-5	57-152-5	Trailing Edge - Inboard - bolts	5/8 in. long x 1/4 in. shank	Steel
1126-D-2	1060 Steel	Trailing Edge - Inboard - nut - plate	.469 in. x 31/64 in.	Flat anchor type
87-03-826-4	QQ-A-355-(T)	Trailing Edge - Inboard - door	.032 in. x 5-1/2 in. x 10-5/8 in.	Al. Al. 24ST
87-03-639	57-152-6-(1)	Ribs - Aileron - center hinge	.032 in. x 5-17/32 in. x 5-15/16 in.	Al. Al. 24SO
87-03-532-1	QQ-A-355-(T)	Wing Tip - Skin - upper	.020 in. x 21 in. x 54 in.	Al. Al. 24ST
87-03-532-2	QQ-A-355-(T)	Wing Tip - Skin - lower	.020 in. x 22 in. x 54 in.	Al. Al. 24ST
87-03-532-3	QQ-A-355-(A)	Wing TTp - Spar No. 2	.020 in. x 5-5/16 in. x 17 in.	Al. Al. 24SO
87-03-532-4	QQ-A-355-(A)	Wing Tip - Spar No. 3	.020 in. x 5-5/8 in. x 18-3/4 in.	Al. Al. 24SO
87-03-532-5	QQ-A-355-(A)	Wing Tip - Spar No. 4	.020 in. x 5-3/16 in. x 17-7/8 in.	Al. Al. 24SO
87-03-532-6	QQ-A-355-(A)	Wing Tip - Spar No. 5	.020 in. x 4 in. x 14-7/8 in.	Al. Al. 24SO
87-03-532-7	QQ-A-355-(A)	Wing Tip - Rib	.020 in. x 4-3/8 in. x 6-1/4 in.	Al. Al. 24SO
87-03-532-8	QQ-A-355-(A)	Wing Tip - Rib	.020 in. x 4-3/4 in. x 10-1/8 in.	Al. Al. 24SO
87-03-532-9	QQ-A-355-(A)	Wing Tip - Rib	.020 in. x 4-3/4 in. x 10 in.	Al. Al. 24SO
87-03-532-10	QQ-A-355-(A)	Wing Tip - Rib	.020 in. x 4-1/8 in. x 9-7/8 in.	Al. Al. 24SO
87-03-532-12	QQ-A-355-(T)	Wing Tip - Spacer - top	.051 in. x 19/32 in. x 36 in.	Al. Al. 24ST
87-03-532-16	QQ-A-355-(A)	Wing Tip - Leading edge	.025 in. x 1-5/8 in. x 32 in.	Al. Al. 24SO
75-03-148	57-72-GR-(1)	Wing Tip - Trailing edge	"casting"	Al. Alloy
87-03-532-17; 18	QQ-A-355-(T)	Wing Tip - Spacer - top and bottom	.051 in. x 19/32 in. x 10-5/8 in.	Al. Al. 24ST
87-03-532-14	11067-F	Wing Tip - Rib - sta 206-1/2	.032 in. x 5-11/16 in. x 48 in.	Alclad 24SO
670-D-4D-4	17ST	Wing Tip - Rivet - hollow - Thomson	1/8 in. dia. x 1/8 in. long	Aluminum Alloy
75-03-203-1	57-152-6-(1)	Wing Tip - Clamp	.040 in. x 7/8 in. x 2-5/16 in.	Al. Al. 24SO
87-08-501-1	57-152-6-(1)	Flap - Skin	.025 in. x 22 in. x 125 in.	Al. Al. 24ST
87-08-501	57-152-6-(1)	Flap - Ribs - all	.024 in. thickness	Al. Al. 24SO
87-08-501	57-152-6-(1)	Flap - Stringers - all	.040 in. x 1-3/4 in.	Al. Al. 24SO
87-08-501-20	57-152-6-(1)	Flap - Reinforcement	.064 in. x 1-1/8 in. x 4-1/2 in.	Al. Al. 24SO
87-08-501-21	57-152-6-(1)	Flap - Filler	.081 in. x 1/2 in. x 118 in.	Al. Al. 24SO
87-08-501	57-152-6-(1)	Flap - Angles - all	.025 in. thickness	Al. Al. 24SO
87-08-501-26	57-152-6-(1)	Flap - Beam	.040 in. x 5-1/2 in. x 120 in.	Al. Al. 24ST
87-08-501-27	57-152-6-(1)	Flap - Reinforcement	.040 in. x 1-3/4 in. x 2-5/8 in.	Al. Al. 24SO
1018-D-72 13/32 in.		Flap - Trailing edge - also 20-5/8 in. long	11/16 in. x 3/16 in. x .035 in.	Alcoa die No. T-608
1019-D-22 7/8 in.		Flap - Trailing edge - walk-away	43/64 in. x 3/16 in. x .035 in.	Alcoa die No. T-609
75-08-024-6	57-152-6-(11)	Flap - Hinge - outboard	1092-DB-2-57 in.	Al. Al. 24ST
75-08-011	QQ-A-367-Gr.3	Flap - Splice - trailing edge	"Forging" - Ends 43/64 in. x 3/16 in. and 11/16 in. x 1/8 in.	Al. Al. 51ST
75-08-024-5	57-152-6-(11)	Flap - Hinge - inboard	1092-DB-2-57 1/8 in.	Al. Al. 24ST
75-08-013	57-107-17	Flap - Trunnion	5/8 in. dia. x 2-13/16 in.	Steel bar
87-05-501-200	QQ-A-355-(A)	Aileron - Nose ribs - all except -18 and -113	.025 in. thickness	Al. Al. 24SO
87-05-501-18	QQ-A-355-(A)	Aileron - Nose rib - also -113 L/R	.040 in. x 4-23/32 in. x 4-1/2 in.	Al. Al. 24SO
87-05-501-3	QQ-A-355-(T)	Aileron - Nose beam - L/R	.032 in. x 5-1/8 in. x 84-1/16 in.	Al. Al. 24ST
87-05-501-4	QQ-A-355-(T)	Aileron - Nose skin - L/R	.025 in.x. 14-7/8 in. x 83-3/4 in.	Al. Al. 24ST
87-05-501-16	QQ-A-355-(A)	Aileron - Brace - L/R	.020 in. x 3-15/32 in. x 14-13/32 in.	Al. Al. 24SO
87-05-501	QQ-A-355-(A)	Aileron - Ribs - L/R	.025 in. and .020 in. thickness	Al. Al. 24SO
87-05-501-40	QQ-A-359	Aileron - Trim tab - RH	.051 in. x 2 in. x 13-1/2 in.	Al. sheet 3S1/2H
87-05-501-90	QQ-A-355-(A)	Aileron - Reinforcement L/R	.040 in. x 4-5/8 in. x 4-3/4 in.	Al. Al. 24SO

MATERIALS FOR REPAIR OF WING SKIN, SPARS, RIBS AND TRAILING EDGE

PART NO.	MATERIAL		SIZE	REMARKS
	SPEC NO.	TITLE		
911-0-	QQ-A-355-(A)	Aileron - Trailing edge L/R	.6 in. x .25 in. x .022 in.	Alcoa die No. T-483
82-03-014	QQ-A-331 (T)	Aileron - Cap Strip - Upper and lower L/R	"Y" Shape .77 in. x .031 in. thick	Al. Al. 53ST
87-05-017	57-180-2	Aileron - Balance tube - total weight 6. .1 lb. .0	3/4 in. OD x .035 in. x 39-1/2 in.	Steel
87-05-504	QQ-A-355 (T)	Aileron - Trim tab - ribs - LH	.020 in. thickness	Al. Al. 24ST
87-05-504-3	QQ-A-355 (T)	Aileron - Trim tab - beam - LH	.025 in. x 2-1/8 in. x 11-1/4 in.	Al. Al. 24ST
87-05-504-2	QQ-A-355 (T)	Aileron - Trim tab - skin - LH	.016 in. x 6-1/2 in. x 11-1/4 in.	Al. Al. 24ST
87-05-504-12	QQ-A-355 (T)	Aileron - Trim tab - angles - LH	.051 in. x 3/4 in. x 3-1/4 in.	Al. Al. 24ST
87-05-504-12	QQ-A-355 (T)	Aileron - Trim tab - reinforcement - LH	.040 in. x 3/4 in. x 1-1/2 in.	Al. Al. 24ST
87-05-501-131	QQ-A-355 (T)	Aileron - Tapping plate - LH	1/8 in. x 7/16 in. x 3-1/4 in.	Al. Al. 24ST
87-05-501-137	QQ-A-355 (T)	Aileron - Angle - LH	.064 in. x 2 in. x 2-7/16 in.	Al. Al. 24ST
87-05-501-87	QQ-A-355 (T)	Aileron - Gusset - LH	.020 in. x 1-1/2 in. x 1-1/2 in.	Al. Al. 24ST

SECTION VII

STABILIZER AND FIN

1. General.

The stabilizer and fin are of aluminum-alloy construction consisting of spars, stringers, and intercostal ribs which are covered with an aluminum-alloy highly stressed skin. (See figures 104 and 105.)

2. Stabilizer.

a. Negligible Damage. - Smooth dents free from cracks, abrasions, and sharp corners may be neglected provided the adjacent rivets are intact, and there is good reason for assuming that the damage has not affected the internal structure. Wherever possible these dents should be restored to shape taking care to avoid cracks.

b. Damage Reparable by Patching.

(1) Nose Skin. - The method of repairing the nose skin is shown in figure 106. Attach the .051-inch splice plates to the undamaged skin with 1/8-inch solid rivets. The .051-inch 24ST aluminum-alloy skin insert may be attached with Cherry blind rivets after the plates are in position.

(2) Main Skin. - Repair to the stabilizer skin may be effected as shown in figure 107. For attaching the strap plates to the .020-inch skin use AN426AD-4-4 rivets spaced at 3/4 inch. For the .025-inch skin use AN426AD-4-4 rivets at 1-inch spacing in two staggered rows as shown in figure 107. For attaching a .020-inch skin patch to a strap plate use two rows of Cherry blind - 1/8-inch diameter countersunk rivets. For attaching a .025-inch skin patch, use two staggered rows of Cherry blind 5/32-inch diameter countersunk rivets.

(3) Flanges and Webs. - For flange and web repair of the spar, see figure 108. When effecting repairs, refer to the chart on figure 10 for the number and spacing of rivets. Use the existing rivet holes for the skin rivet pattern.

(4) Stiffening Beads. - For repair over a stiffening bead of the spar use the same material, one gage higher than the damaged member, using AN442AD-4 rivets as shown in figure 109.

(5) Spars Containing Lightening Holes. - For repair of a spar section where there are lightening holes use 24ST aluminum-alloy material of the next higher gage and attach with AN442AD-4 rivets as shown in figure 109.

(6) Reinforced Spar Sections. - Damage to reinforced sections of the spars should be repaired by splicing in new sections or by adding two pieces of stock, one on each side of the web and doubler. The total thickness of these two repair plates is to be equal to the total thickness of the web and doubler. The required number of rivets is the same as given in figure 108.

(7) Rib Flanges. - For damage to any flange of the rib patch by a bent-up angle attached to the web by a minimum of three 1/8-inch rivets on each side of the damaged area as specified in the chart. (See figure 110.)

(8) "V" Stringers. - For repair of a "V" stringer, see figure 110. Drill and punch out the necessary skin rivets according to section I, paragraph 9. Cut away and clean the damaged area of the stringer. Insert a filler plate of the same gage material (24ST) and rivet the section as shown in the figure using three rows of 1/8-inch rivets on each side of the damage.

c. Damage Reparable by Insertion. - For a "V" stringer insertion splice, see figure 110. Drill and punch out the skin rivets, cut away and clean the damaged area and insert a new section of Alclad 24ST, leaving a 1/32-inch clearance at each end. Splice the new section ends, using three rows of rivets on each side of the cut, leaving a rivet edge distance of 2-1/2 diameters.

d. Damage Necessitating Replacement. - Sections of the spars between the fin and fuselage attachment fittings should generally be replaced if damaged. The webs should be spliced at least 3 inches outboard of the fuselage fittings. Replace all damaged gussets, fittings, etc.

3. Fin.

a. Spars.

(1) Webs and Flanges. - Web and flange damage should be repaired according to data given in figure 108.

(2) Reinforcement Angles. - Reinforcement angles on spars No. 1, 3, and 4 should be either replaced if damaged or repaired by attaching a .025-inch 24ST angle over the damaged section with 1/8-inch rivets. Use at least 4-1/8 inch rivets, two in each leg of the angle, at each end of the damage.

b. Ribs. - For web damage a minimum of two 1/8-inch rivets are necessary on each side of the damage. The flange repair should be the same as used on the stabilizer as in this section, paragraph 1.b.(3). (See figure 108.)

c. Stringers. - Patch the damage with four rivets on each side of the damage, same as the tail plane repair. (See figure 110.)

d. Skin Patches. - Use 1/8-inch rivets at 3/4-inch spacing around the damaged area of .020-inch skin;

use 1/8-inch rivets at 1-inch spacing in two staggered rows for .025-inch skin. (See figures 106 and 107.) For repair of the running light, see figure 111. Cut away and clean the damaged area. Redrill existing holes with a No. 20 drill and use D.T.D 327 - 5/32-inch diameter countersunk rivets. Replace aluminum-alloy 24ST, .020-inch plate and lamp assembly.

e. P-40E Dorsal Fin. - The original P-40E fin is the same in all details as the P-40D fin. To expedite production of the new fin, a fin overlay was designed to fit over the original fin construction. (See figure 112.)

f. Attachment - Fin to Stabilizer. - This fitting is built of X4130 steel that is heat-treated to a tensile strength of 90,000 pounds per square inch. Repair to this fitting is not practical because the shock from the impact of shell fire would misalign the channels. These channels have to be parallel within a tolerance of ± .015 inch.

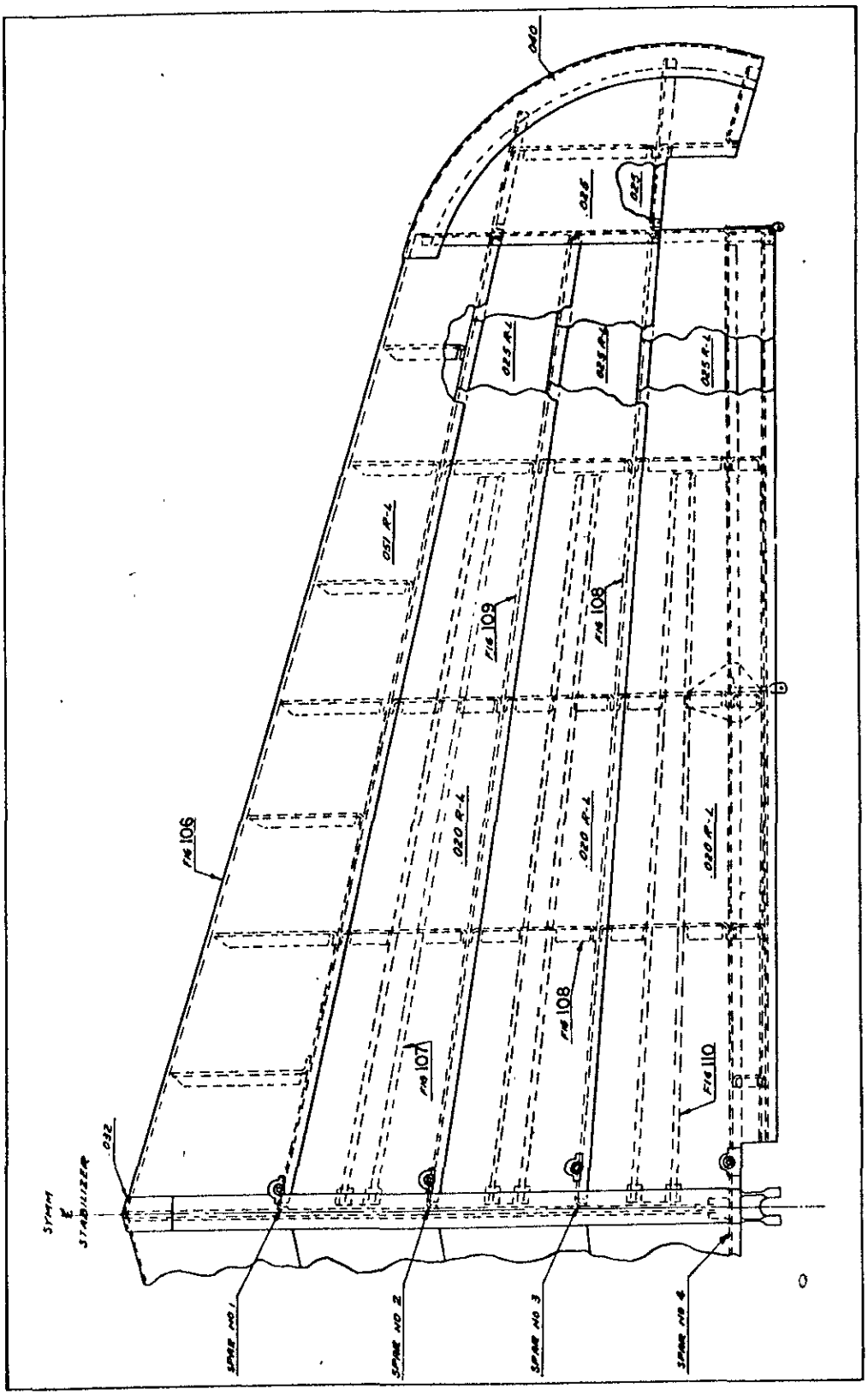


Figure 104 - Stabilizer Assembly and Skin

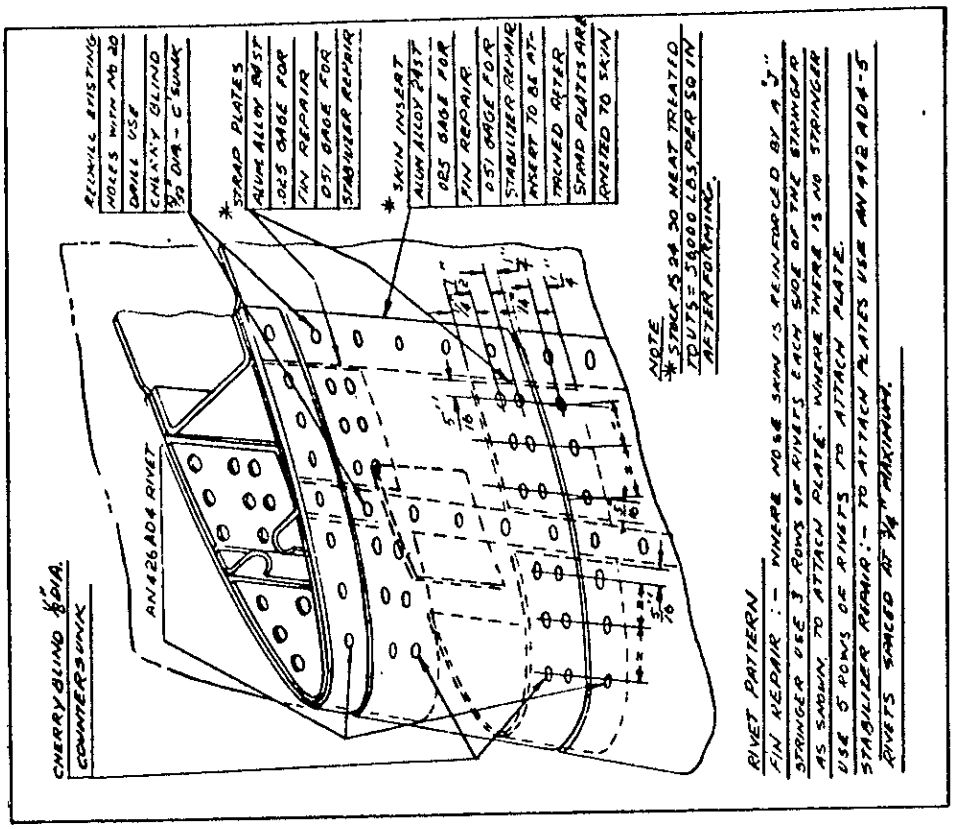


Figure 106 - Stabilizer and Fin - Nose Skin - Flush Patch

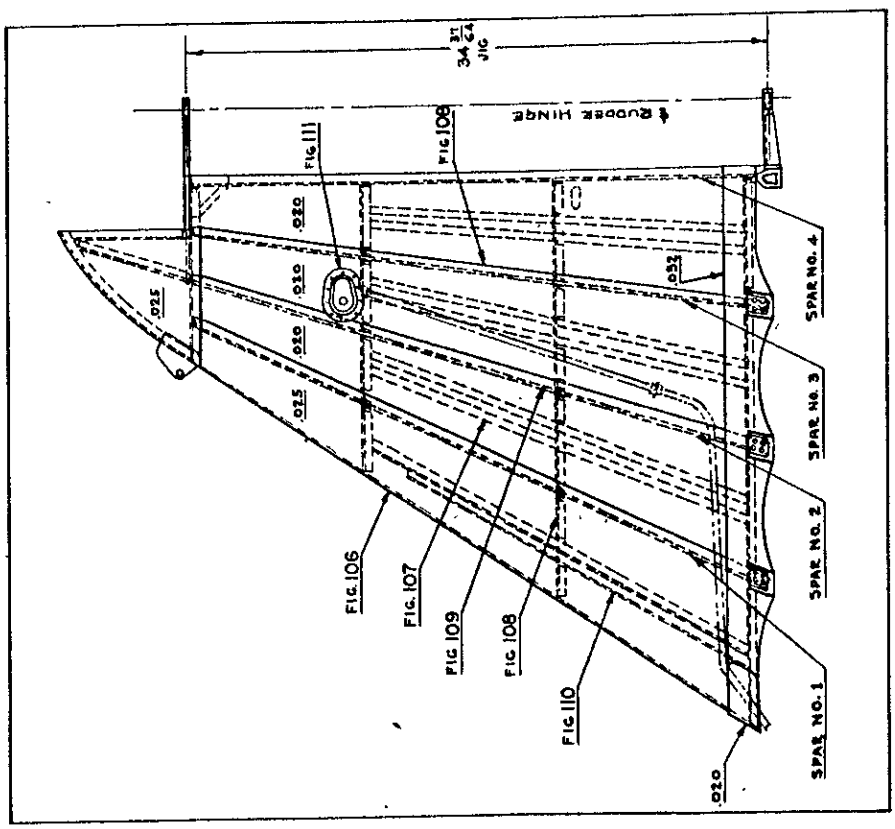


Figure 105 - Fin Assembly

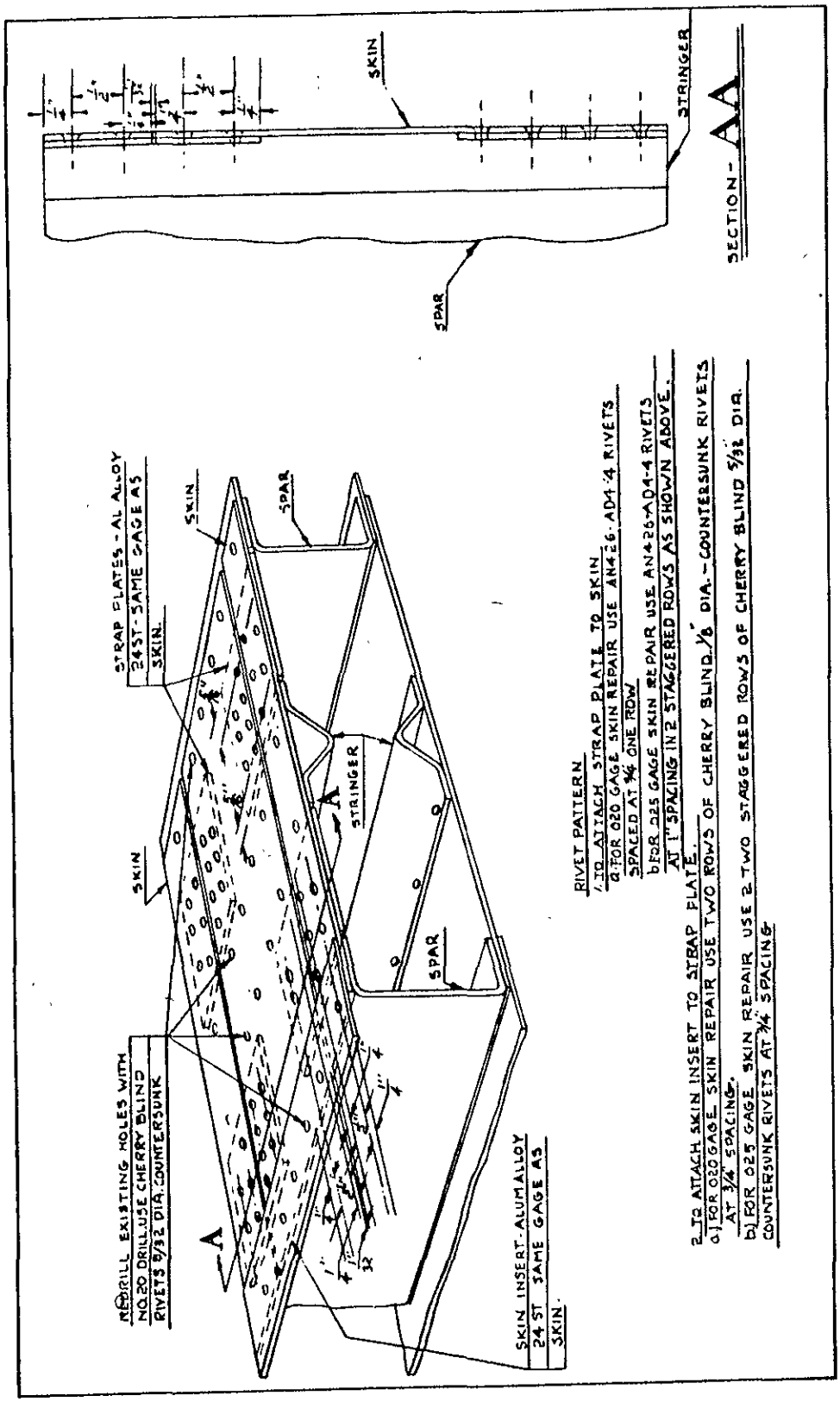


Figure 107 - Stabilizer and Fin - Flush Skin Patch

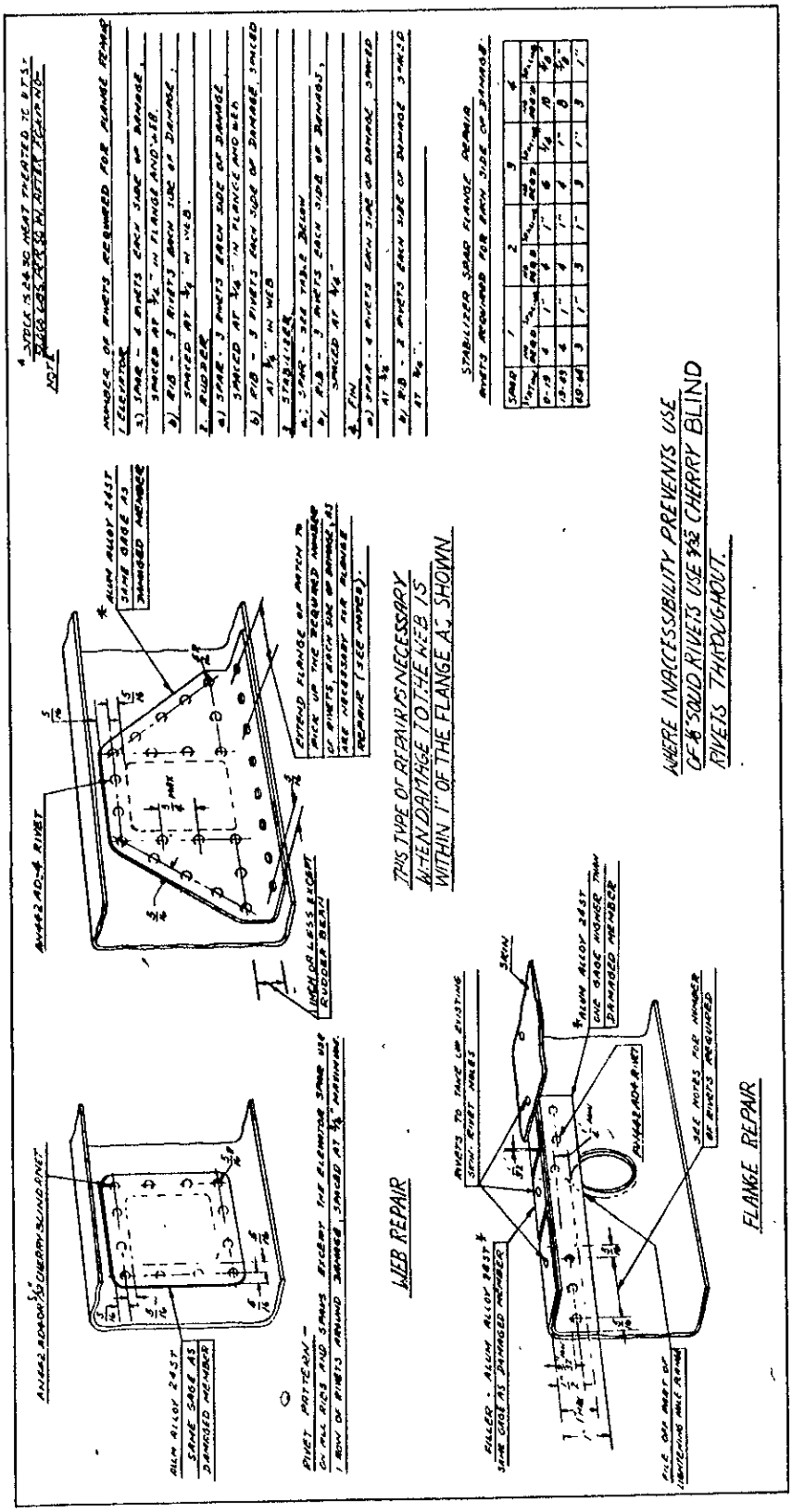


Figure 108 - Empennage - Rib and Spar - Web and Flange Patches

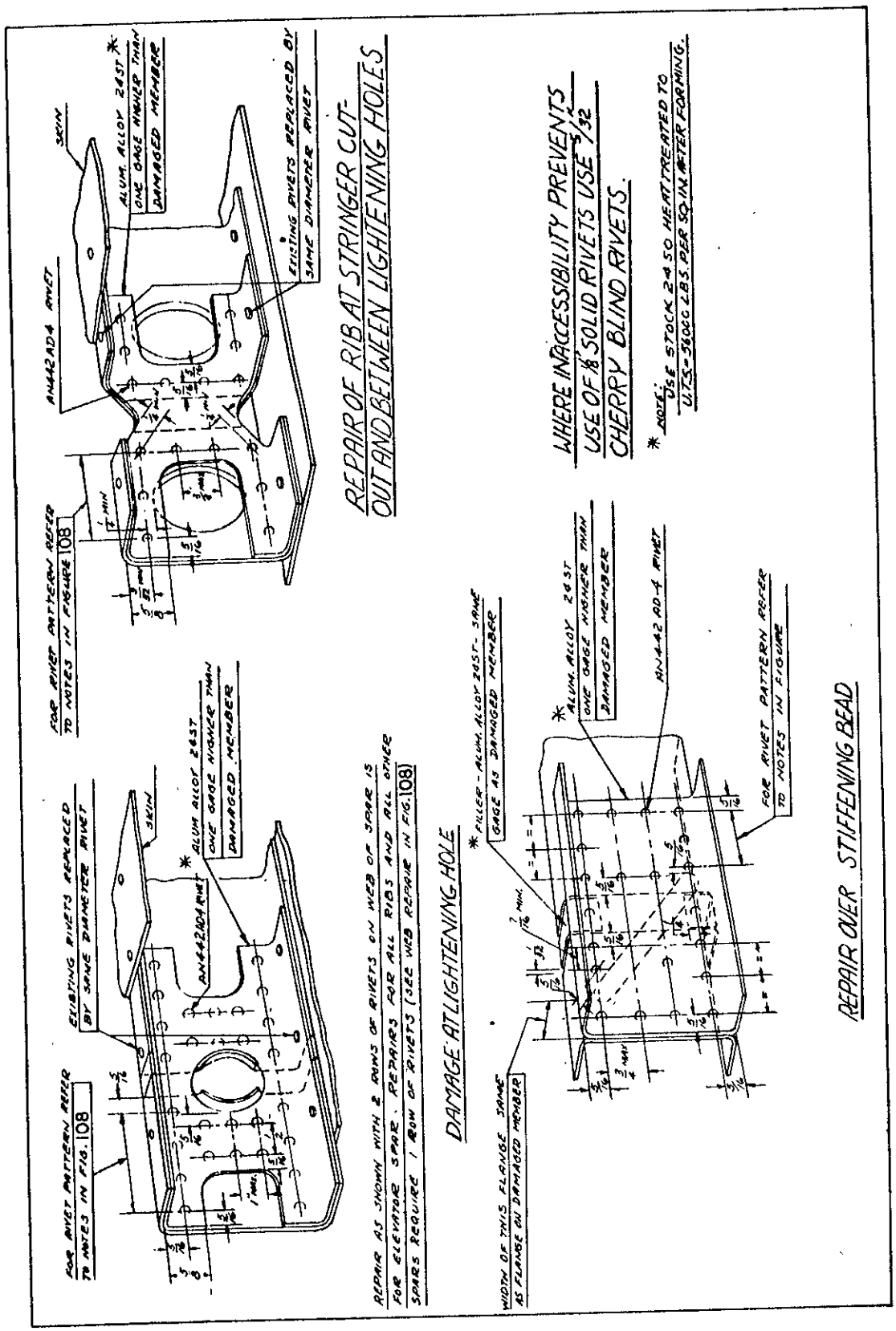


Figure 109 - Empennage - Rib and Spar Patches

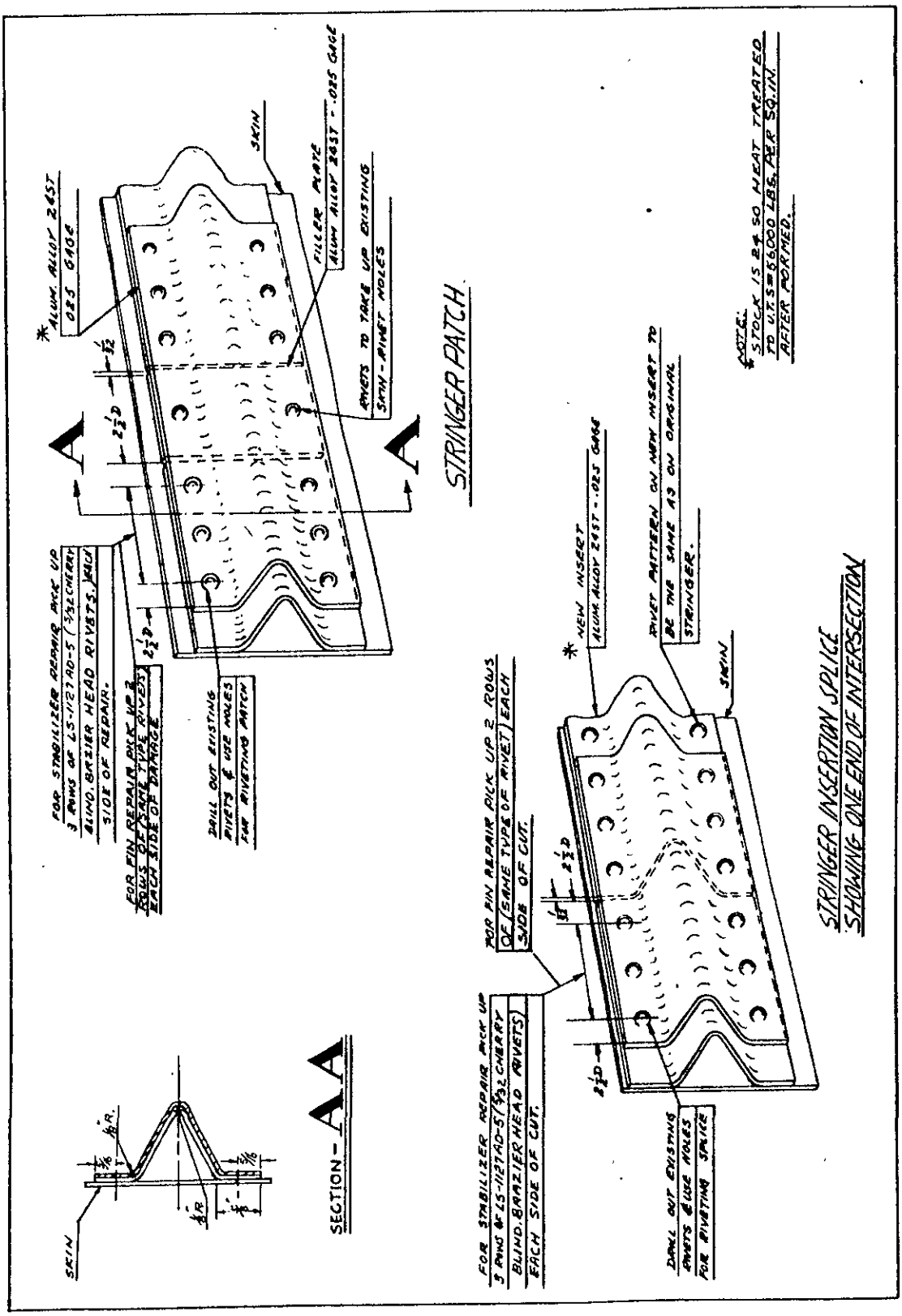


Figure 110 - Empennage "V" Stringer - Splice and Patch

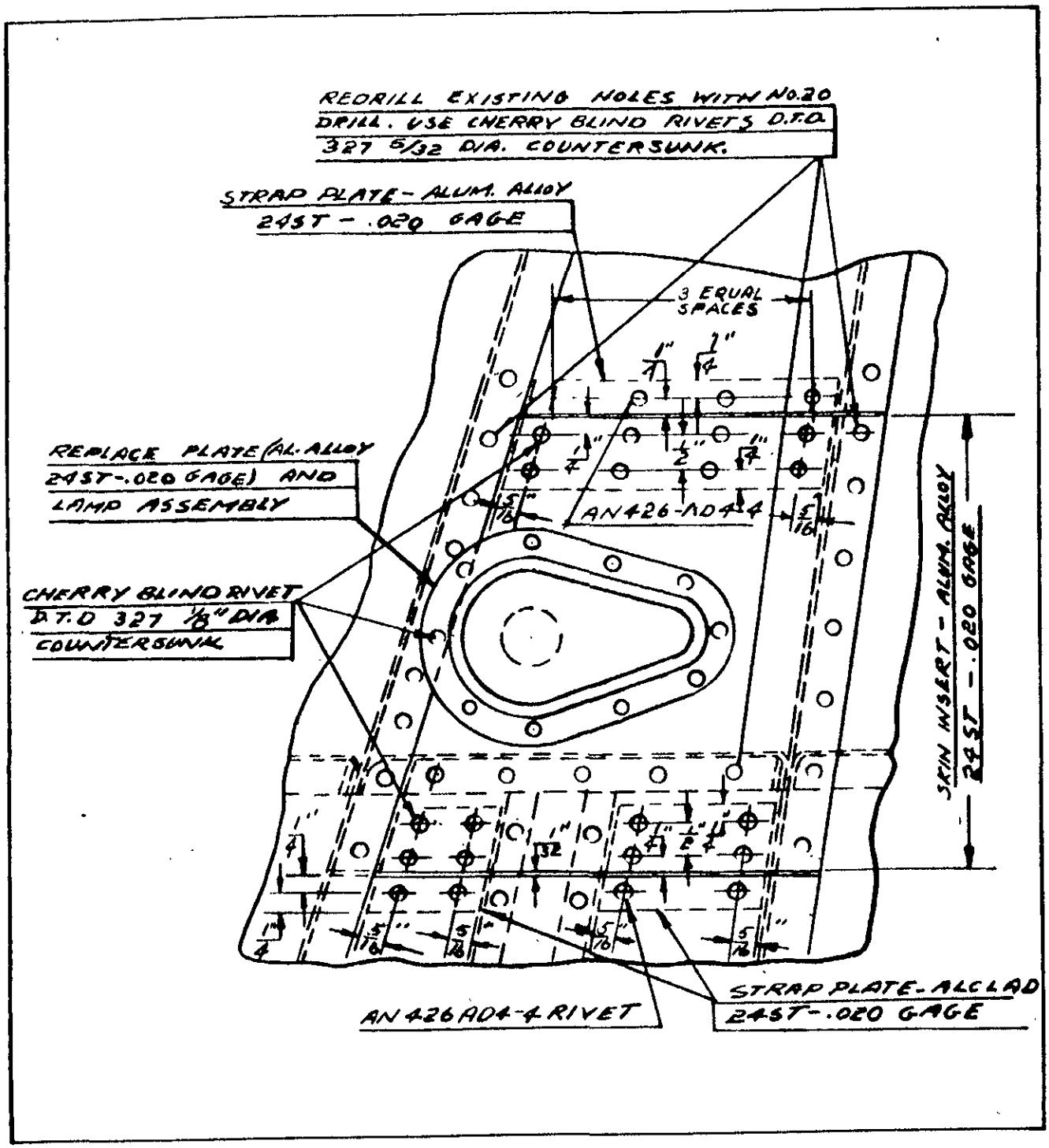


Figure 111 - Fin - Running Light Damage

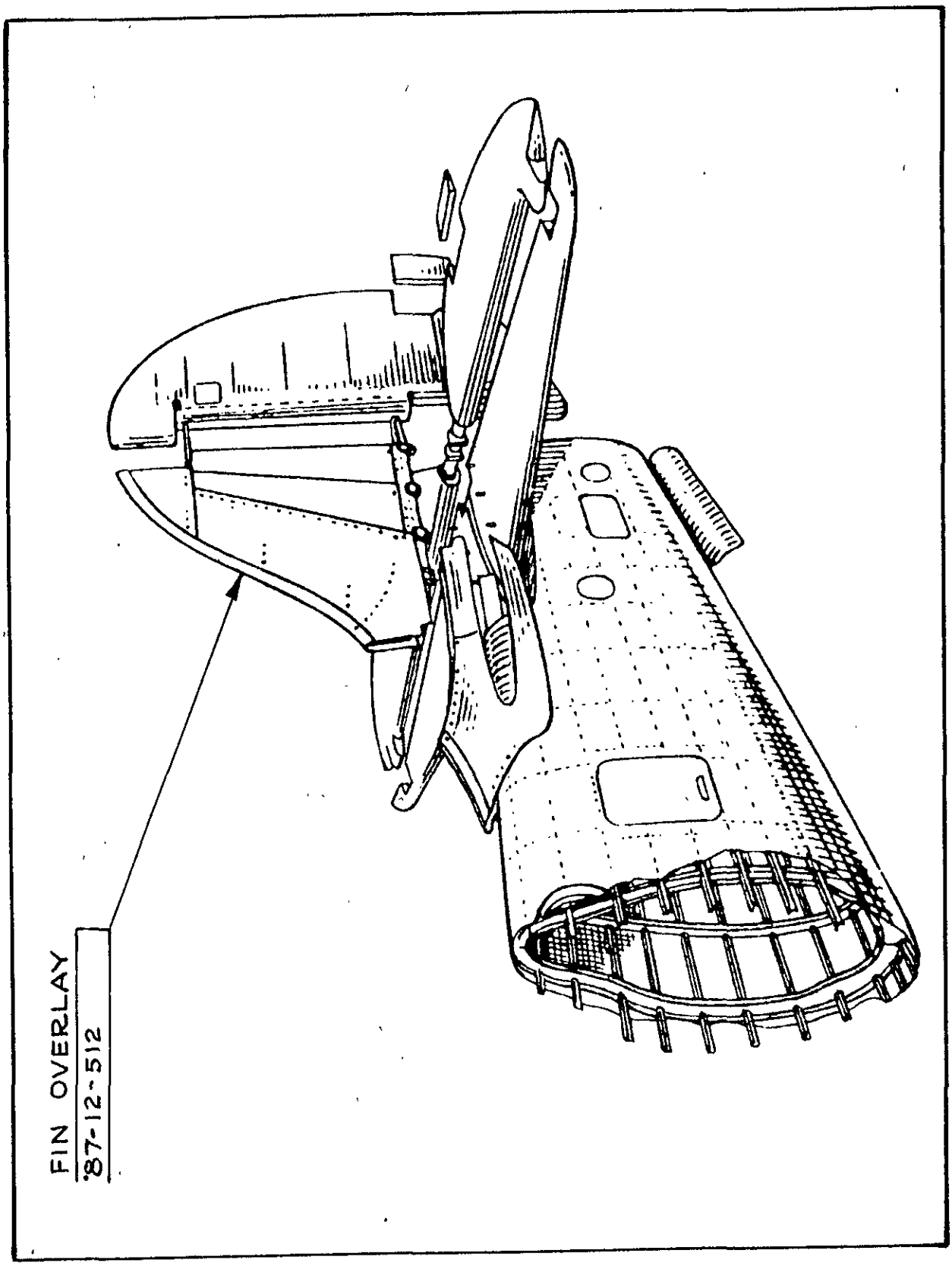


Figure 112 - Empennage - P-40E and P-40E-1

MATERIAL FOR REPAIR OF THE STABILIZER

PART NO.	MATERIAL		SIZE	REMARKS
	SPEC NO.	TITLE		
87-11-501-1	11067-(1)	Stabilizer - Nose skin	.051 in. x 20-5/16 in. x 68-5/8 in.	Alclad 24S0
87-11-501-2	57-152-6-(11)	Stabilizer - Bottom skin	.025 in. x 10-1/8 in. x 66-5/16 in.	Al. Al. 24ST
87-11-501-3	57-152-6-(11)	Stabilizer - Top skin	.020 in. x 10-7/8 in. x 66-5/16 in.	Al. Al. 24ST
87-11-501-18	57-152-6-(11)	Stabilizer - Angle	.032 in. x 7/8 in. x 3 in.	Al. Al. 24ST
87-11-501-19	57-156-6-(11)	Stabilizer - Angle	.040 in. x 7/8 in. x 3 in.	Al. Al. 24ST
673-D-4-4	A17ST	Stabilizer - Rivet - 78° countersunk	1/8 in. dia. x 1/4 in. long	
671-D-5AD-3	A17ST	Stabilizer - Rivet - modified brazier head	5/32 in. dia. x 3/16 in. long	
AN442AD-4-3 1/2		Stabilizer - Rivet - flathead	1/8 in. dia. x 3-5/16 in. long	
87-11-512-2	57-152-6-(1)	Stabilizer - Rib	.020 in. x 5-1/2 in. x 9-3/16 in.	Al. Al. 24SB
87-11-512-8	57-152-6-(1)	Stabilizer - Rib	.032 in. x 4-15/16 in. x 7-15/16 in.	Al. Al. 24S0
87-11-512-9	57-152-6-(1)	Stabilizer - Rib	.025 in. x 3-3/8 in. x 6-1/4 in.	Al. Al. 24S0
87-11-512-19	57-152-6-(1)	Stabilizer - Nose	.025 in. x 4-1/6 in. x 8-3/4 in.	Al. Al. 24S0
87-11-515-36	57-152-6-(11)	Stabilizer - Spar	.040 in. x 6-3/16 in. x 64-5/8 in.	Al. Al. 24ST
87-11-515-14	57-152-6-(11)	Stabilizer - Spar - reinforcement	.040 in. x 4-5/8 in. x 15-1/16 in.	Al. Al. 24ST
87-11-515-33	57-152-6-(11)	Stabilizer - Spar - channel	.040 in. x 2-3/4 in. x 5-1/2 in.	Al. Al. 24ST
87-11-515-32	57-152-6-(11)	Stabilizer - Spar - angle	.040 in. x 1-9/16 in. x 65-7/16 in.	Al. Al. 24ST
87-11-515-11	57-152-6-(11)	Stabilizer - Spar	.032 in. x 6-9/16 in. x 64-5/8 in.	Al. Al. 24ST
87-11-515-15	57-152-6-(1)	Stabilizer - Spar - reinforcement	.032 in. x 7-5/8 in. x 18-1/4 in.	Al. Al. 24S0
87-11-515-22	57-152-6-(11)	Stabilizer - Spar - channel	.040 in. x 2-3/4 in. x 8-1/2 in.	Al. Al. 24ST
87-11-515-16	11067	Stabilizer - Spar - reinforcement	.025 in. x 7-7/16 in. x 12-5/8 in.	Alclad 24S0
AN23-8A		Stabilizer - Spar - bolt	1/2 in. long x 3/16 in. shank	Without cotter pin hole
365-1032		Stabilizer - Spar - nut - self-locking	15/64 in. x 3/8 in.	Fine thread
AN960-10	Steel	Stabilizer - Spar - washer	13/64 in. ID x 7/16 in. OD	1/16 in. thick
75-11-011	AN-QQ-S-762	Stabilizer - Stud	7/8 in. screw - 3/32 in. thickness	Forging
87-11-024-2	57-152-6-(11)	Stabilizer - Reinforcement - rear	.025 in. x 1-3/4 in. x 1-3/4 in.	Al. Al. 24ST
75-11-027	11067-(1)	Stabilizer - Stringer - "V" section	.025 in. x 3-17/32 in. x 49-17/32 in.	Alclad 24S0
87-11-019-2	57-152-6-(11)	Stabilizer - Reinforcement - front	.025 in. x 1-3/4 in. x 2-1/8 in.	Al. Al. 24ST

NOTE: Tail Plane - 670 - D steel rivets or 671D-AD- rivets may be substituted for AN442AD- rivets to facilitate fabrication where machine riveting is used.

MATERIAL FOR REPAIR OF FIN

PART NO.	MATERIAL		SIZE	REMARKS
	SPEC NO.	TITLE		
87-12-501-2	57-152-6-(11)	Fin - Skin	.025 in. x 16-5/8 in. x 42-1/2 in.	Al. Al. 24ST
87-12-501-5	57-152-6-(11)	Fin - Skin	.020 in. x 9-7/8 in. x 34-3/4 in.	Al. Al. 24ST
87-12-501-6	57-152-6-(11)	Fin - Reinforcement	.032 in. x 3-1/4 in. x 37-1/4 in.	Al. Al. 24ST
87-12-501-7	57-152-6-(1)	Fin - Reinforcement - (59036-12-12-3/4)	.025 in. x 1-9/16 in. x 12-3/4 in.	Al. Al. 24SO
87-12-501-11	WW-T-783	Fin - Conduit - tube	3/8 in. OD x .022 in. x 18 in.	
87-12-501-12	57-152-6-(11)	Fin - Nosepiece - L.E.	.020 in. x 3-7/8 in. x 5-13/16 in.	Al. Al. 24ST
87-12-501-14		Fin - Angles - (81599-1-1-5/8)	3/4 in. x 3/32 in. thickness	Alcoa die No. K. 78-C
87-12-501-16	57-152-6-(11)	Fin - Filler	.020 in. x 3/4 in. x 1 in.	Al. Al. 24ST
75-12-011-16	57-152-6-(1)	Fin - Rib	.032 in. x 4-1/4 in. x 9-1/4 in.	Al. Al. 24SO
75-12-011-17	57-152-6-(1)	Fin - Rib	.020 in. x 5-7/16 in. x 10-7/16 in.	Al. Al. 24SO
75-12-011-29	57-152-6-(1)	Fin - Reinforcement	.040 in. x 2-1/16 in. x 8-1/8 in.	Al. Al. 24SO
75-12-016-21	QQ-A-355-(T)	Fin - Spar	.025 in. x 4-1/2 in. x 39-1/16 in.	Al. Al. 24ST
75-12-016-22	QQ-A-355-(T)	Fin - Spar - reinforcement	.025 in. x 1-3/8 in. x 12-1/2 in.	Al. Al. 24ST
75-12-016-31	QQ-A-355-(T)	Fin - Spar	.032 in. x 5-1/4 in. x 36 in.	Al. Al. 24ST
75-12-016-30	57-152-6-(1)	Fin - Spar - reinforcement	.064 in. x 5-1/2 in. x 5-1/8 in.	Al. Al. 24SO
87-12-501-25	57-152-6-(11)	Fin - Gusset - plate	.040 in. x 2-5/8 in. x 2-3/4 in.	Al. Al. 24ST
87-03-596-3	57-152-6-(1)	Fin - Light - plate	.020 in. x 3-3/4 in. x 5 in.	Al. Al. 24SO
87-03-596-4	57-152-6-(1)	Fin - Light - channel	.020 in. x 5-1/2 in. x 11 in.	Al. Al. 24SO
87-12-517-1	QQ-A-355-(A)	Fin - Tip - spar	.032 in. x 3 in. x 9-15/16 in.	Al. Al. 24SO
87-12-517-3	QQ-A-355-(A)	Fin - Tip - skin	.025 in. x 11-3/8 in. x 11-3/8 in.	Al. Al. 24SO
87-12-517-5	QQ-A-355-(A)	Fin - Tip - plate	.040 in. x 2-1/4 in. x 4-3/8 in.	Al. Al. 24SO
673-D-4-4	A17ST	Fin - Rivet - 78° countersunk	1/8 in. dia. x 1/4 in. long	
671-D-4AD-4	A17ST	Fin - Rivet - modified brazier head	1/8 in. dia. x 1/4 in. long	
AN442AD-4-4		Fin - Rivet - flathead	1/8 in. dia. x 1/4 in. long	
AN3-6A	29-59 Mfg.	Fin - Bolt	3/4 in. long; 3/8 in. shank	Without cotter pin hole
365-428	25527 Mfg.	Fin - Nut	5/16 in. x 7/16 in.	Fine thread
AN515-8-8	FF-S-91 Mfg.	Fin - Screw - roundhead	1/2 in. long	Coarse thread
AN3-5A	29-59 Mfg.	Fin - Bolt	5/8 in. long; 1/4 in. shank	Without cotter pin hole
AN960-10	1010 steel	Fin - Washer - plain	13/64 in. ID; 7/16 in. OD	
365-1032	25527 Mfg.	Fin - Nut - self-locking	15/64 in. x 3/8 in.	Fine thread

MATERIAL FOR REPAIR OF FIN OVERLAY

87-12-512-2	11067-(11)	Fin Overlay - Skin	.032 in. x 34 in. x 34 in.	Al. Al. 24ST
87-12-512-3	11067-(11)	Fin Overlay - Skin	.032 in. x 34 in. x 34 in.	Al. Al. 24ST
87-12-512-4	11067-(1)	Fin Overlay - Leading edge - upper	.032 in. x 4-1/4 in. x 60 in.	Al. Al. 24SO
87-12-512-5	11067-(1)	Fin Overlay - Filler rib	.032 in. x 2-3/4 in. x 8 in.	Al. Al. 24SO
87-12-512-11	11067-(1)	Fin Overlay - Filler rib	.032 in. x 3-1/2 in. x 8-1/2 in.	Al. Al. 24SO
87-12-512-6	11067-(1)	Fin Overlay - Bulkhead	.032 in. x 5-1/4 in. x 8-1/2 in.	Al. Al. 24SO
87-12-512-7	11067-(1)	Fin Overlay - Nose rib	.032 in. x 5 in. x 18-1/2 in.	Al. Al. 24SO
87-12-512-8	11067-(1)	Fin Overlay - Nose rib	.032 in. x 4 in. x 11-1/2 in.	Al. Al. 24SO
87-12-512-9	11067-(1)	Fin Overlay - Nose rib	.032 in. x 2.5 in. x 9 in.	Al. Al. 24SO
87-12-512-10	11067-(1)	Fin Overlay - Tip skin	.032 in. x 12 in. x 16-1/2 in.	Al. Al. 24SO
87-12-512-12	11067-(1)	Fin Overlay - Filler rib	.032 in. x 2-1/4 in. x 5-3/4 in.	Al. Al. 24SO
87-12-512-13	11067-(1)	Fin Overlay - Filler rib	.032 in. x 2-1/2 in. x 5-3/4 in.	Al. Al. 24SO
87-12-512-15	11067-(1)	Fin Overlay - Bulkhead	.032 in. x 5-1/2 in. x 5-1/2 in.	Al. Al. 24SO
87-12-512-21	11067-(1)	Fin Overlay - Rib	.032 in. x 2-3/8 in. x 12 in.	Al. Al. 24SO
87-12-512-24	11067-(1)	Fin Overlay - Gang channel	6861-02-7	5 nuts
87-12-512-29	11067-(1)	Fin Overlay - Rib	.032 in. x 2-1/2 in. x 7-3/8 in.	Al. Al. 24SO
87-12-512-36	11067-(1)	Fin Overlay - Rib	.032 in. x 2-1/2 in. x 6-1/2 in.	Al. Al. 24SO
87-12-512-41	11067-(1)	Fin Overlay - Fillet - left same for right	.032 in. x 20 in. x 41 in.	Al. Al. 24SO
87-12-512-43	11067-(1)	Fin Overlay - Leading edge - lower	.040 in. x 4-1/4 in. x 27 in.	Al. Al. 24SO
525-10-8	AN-QQ-S-689	Fin Overlay - Screw	1/2 in. long, shank 1/8 in.	Steel - Washer head
22A21-02		Fin Overlay - Basket nuts		

SECTION VIII

ELEVATOR AND RUDDER

1. Mass Balancing.

The elevator and rudder are aluminum-alloy, fabric-covered structures. The static balance of each about its hinge line is adjusted in manufacture by the addition of lead weights near the leading edge. The weights added in each case are the minimum that will give satisfactory flutter control. It is important, therefore, in effecting repairs aft of the hinge line, to compensate for any addition of weight. This may be easily accomplished as follows: Set the surface on its hinge bearings. Attach a sufficient length of cord to the trailing edge of the surface so that it may extend along the top part of the surface, and over the leading edge. Attach weights to the free end of the cord until the top surface assumes a horizontal position. Remove the cord and make the necessary repairs. When the repairs are complete replace the cord and weight in the same position as the original prebalanced attachment. Add sufficient lead sheet to the leading edge to return the surface to its horizontal prebalanced position. Attach the lead sheet and cover with fabric as described in section VI, paragraph 9.a. (See figure 98.)

2. Elevator.

a. General. - The elevator contains one counterweight which is installed inside of the paddle at the outboard end, forward of the center line of the hinge. This counterweight is a 2-inch OD x .058-inch x 5-1/8 inch tube filled with 3.607 pounds of lead. It is welded to webs which are riveted to the ribs. (See figure 113.) This weight is not accessible.

b. Negligible Damage. - One inch holes at the center of the rib webs which are at least 1/2 inch from any other holes or the flanges may be neglected if there are no cracks.

c. Main Beam.

(1) Flanges. - Repair flange damage, when injury does not extend more than 1 inch into the web, by patching with 5/8-inch x 1-inch x .032-inch 24ST aluminum-alloy angle long enough to take two AN442AD-4 rivets in the beam web plus two of the skin rivets at each end of the damage as shown in figure 108, or use a repair similar to that shown in figure 100 with the .032-inch angle long enough to take four AN442AD-4 rivets through the beam flange plus at least two 1/8-inch Cherry blind rivets through the beam web near the flange at each end of the damage.

(2) Webs. - Damage that is confined to the web of the beam should be patched with .032-inch 24ST aluminum-alloy sheet attached with one row of 5/32-inch Cherry blind rivets at 3/4-inch spacing around the damage. If accessible use AN442AD-4 rivets at 3/4-inch spacing.

(3) Webs and Flanges. - For complete cross-section damage, patch the member with an equivalent section as shown in figure 109. Use the next heavier gage if lightening holes or beads are damaged. If the section is inaccessible for riveting the web of the beam use four AN442AD-4 rivets in each flange on each side of the cut plus four 1/8-inch Cherry blind rivets, two near each flange in the web, on each side of the cut similar to repair illustrated in figure 100.

d. Nose Skin. - Repair is the same as for the aileron, use an external patch extending to the nearest ribs and to the edges of the nose skin. (See figure 99.)

e. Trailing Edge. - Repair as illustrated in figure 102.

f. Torque Tube. - Replace the entire damaged section of the tube.

g. Ribs.

(1) Webs. - Rib web damage may be repaired by patching with 24ST stock of the same gage as the original material. Attach the stock with one row of AN442AD-4 rivets at 3/4-inch spacing around the damage.

(2) Flanges. - Flange damage repairs should be effected by replacing the area and using three AN442AD-4 rivets in the web near the flange at each end of the damage to attach the patch piece in place as illustrated in figure 108.

(3) Extrusions. - Any damage to the extrusion, (figure 114) by which the fabric is attached, should be repaired by inserting a new section long enough to take at least two 1/8-inch rivets at a 1-inch minimum spacing. Splice with a .032-inch x 1/2-inch 24ST plate long enough to take two 1/8-inch rivets on each side of each cut.

(4) Special Rib Flanges. - Rib flanges that attach the ribs to the beam web if damaged should be replaced by a 5/8-inch x 5/8-inch angle of the same gage material. The angle should be attached to the rib by the same number of rivets as used to attach the rib to the beam web. (See figure 113.)

3. Rudder.

a. General. - The rudder contains two counterweights inside of the leading edge. One, made of steel bar, is welded to plates which are in turn bolted to the first and second ribs above the intermediate center

line of the hinge. The other, an assembly consisting of lead, three nose ribs, and a channel is located above the top center line of the hinge. This assembly is integral with, and cannot be removed from, the rudder structure. (See figure 115.)

b. Main Beam.

(1) Webs. - Damage confined to the web and at least 5/8 inch from the flanges may be repaired according to figure 108, using AN442AD-4 or 5/32-inch Cherry blind rivets at 3/4-inch spacing around the damage.

(2) Flanges. - Flange damage should be repaired by patching with an equivalent area and the same gage material, using three AN442AD-4 rivets each side of the damage. (See figure 108.)

c. Ribs. - Repairs for the rudder ribs should be the same as used for the elevator rib repairs, which are discussed in paragraph 2.g.(1),(2), and (3).

d. Nose Skin. - Repair on the same manner as an aileron; use an external patch extending to the nearest ribs and to the edges of the nose skin. (See figure 99.)

e. Brace Tube. - This tube may be repaired by insertion of a 7/16-inch diameter aluminum rod attached with 1/8-inch rivets as in figure 116.

f. Rudder Assembly Locating Fixture. - See figure 117 for the rudder assembly locating fixture.

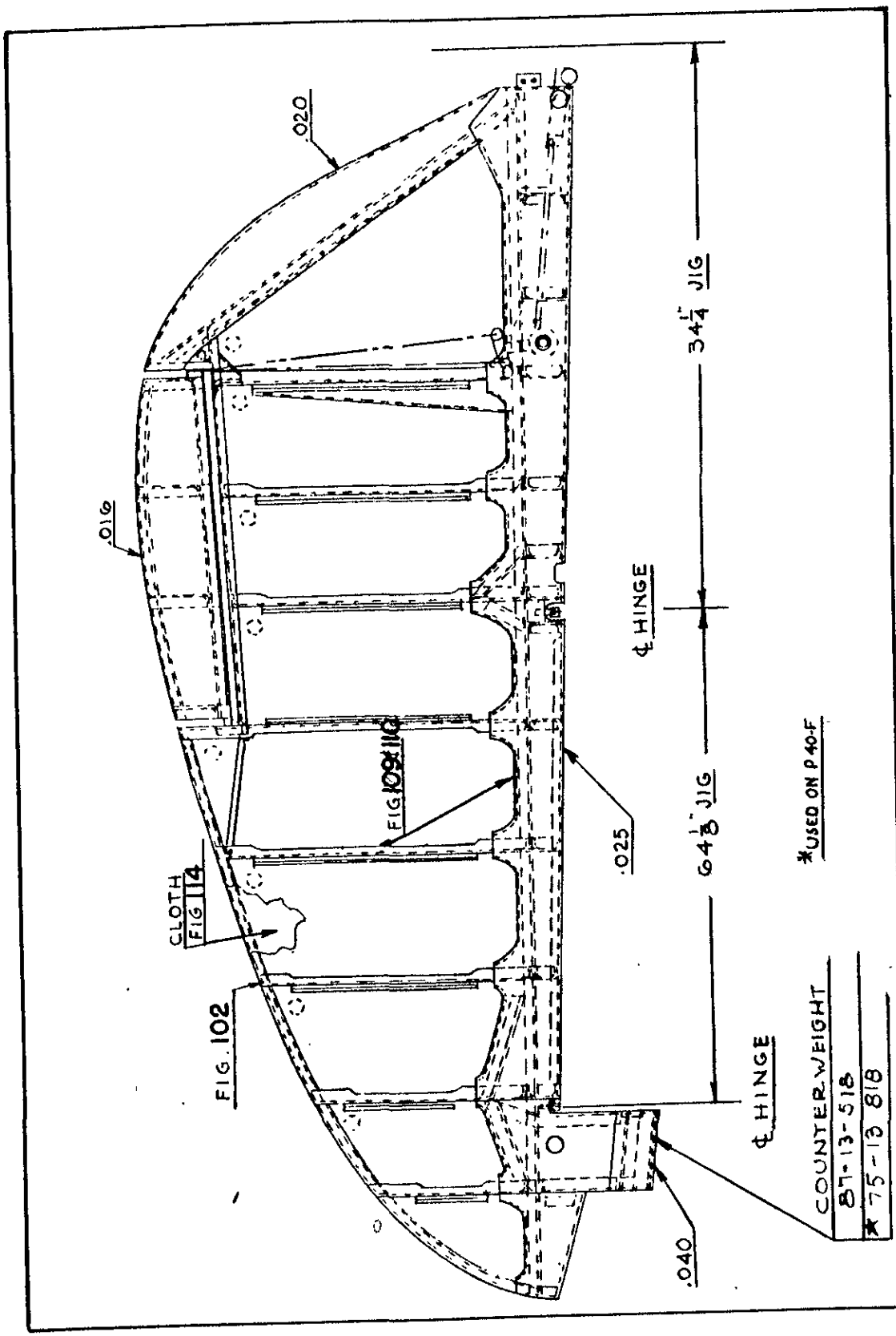


Figure 113 - Elevator Assembly

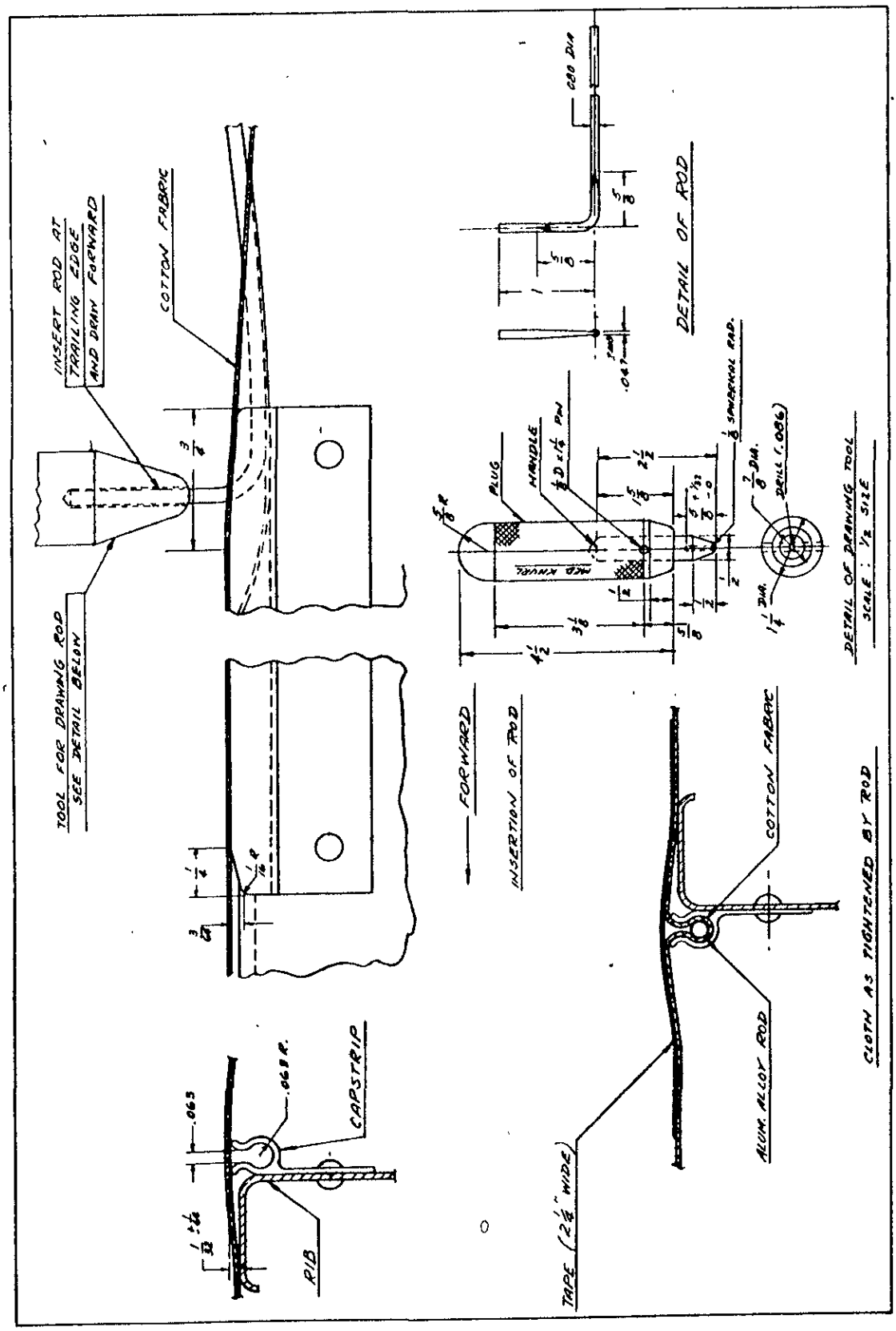


Figure 114 - Cloth Tightening Method - Control Surfaces

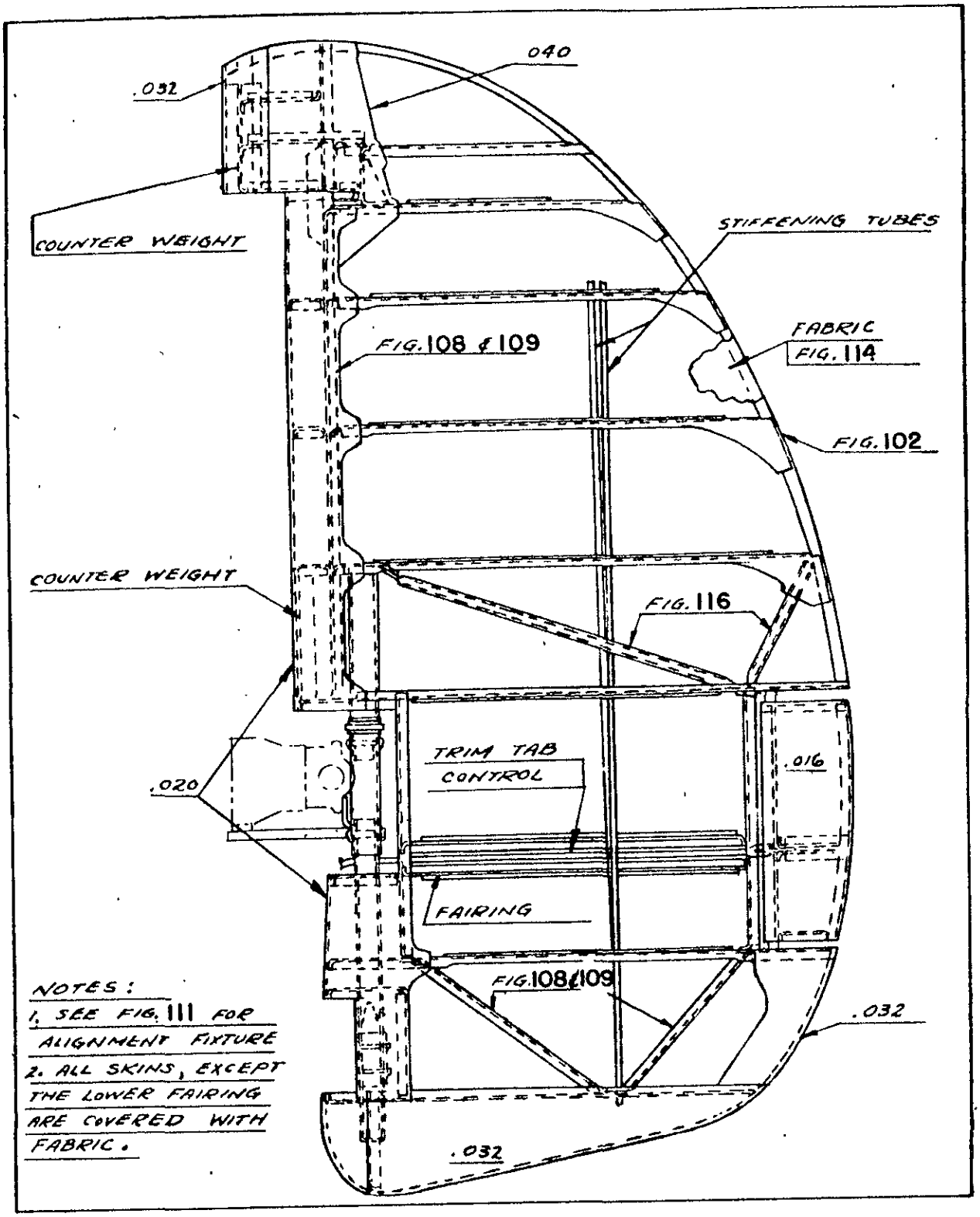


Figure 115 - Rudder Assembly

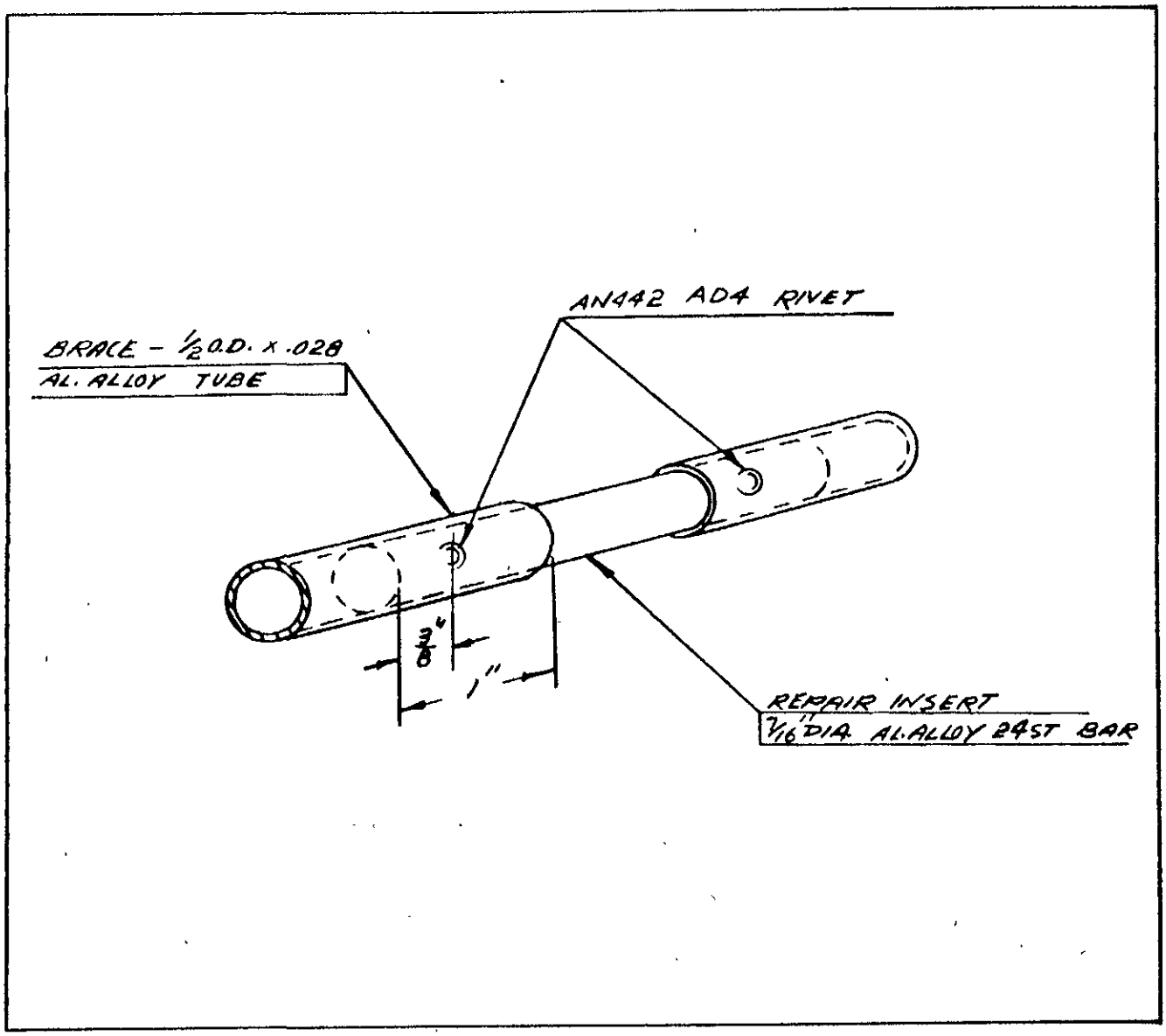


Figure 116 - Rudder Brace Tube Insert

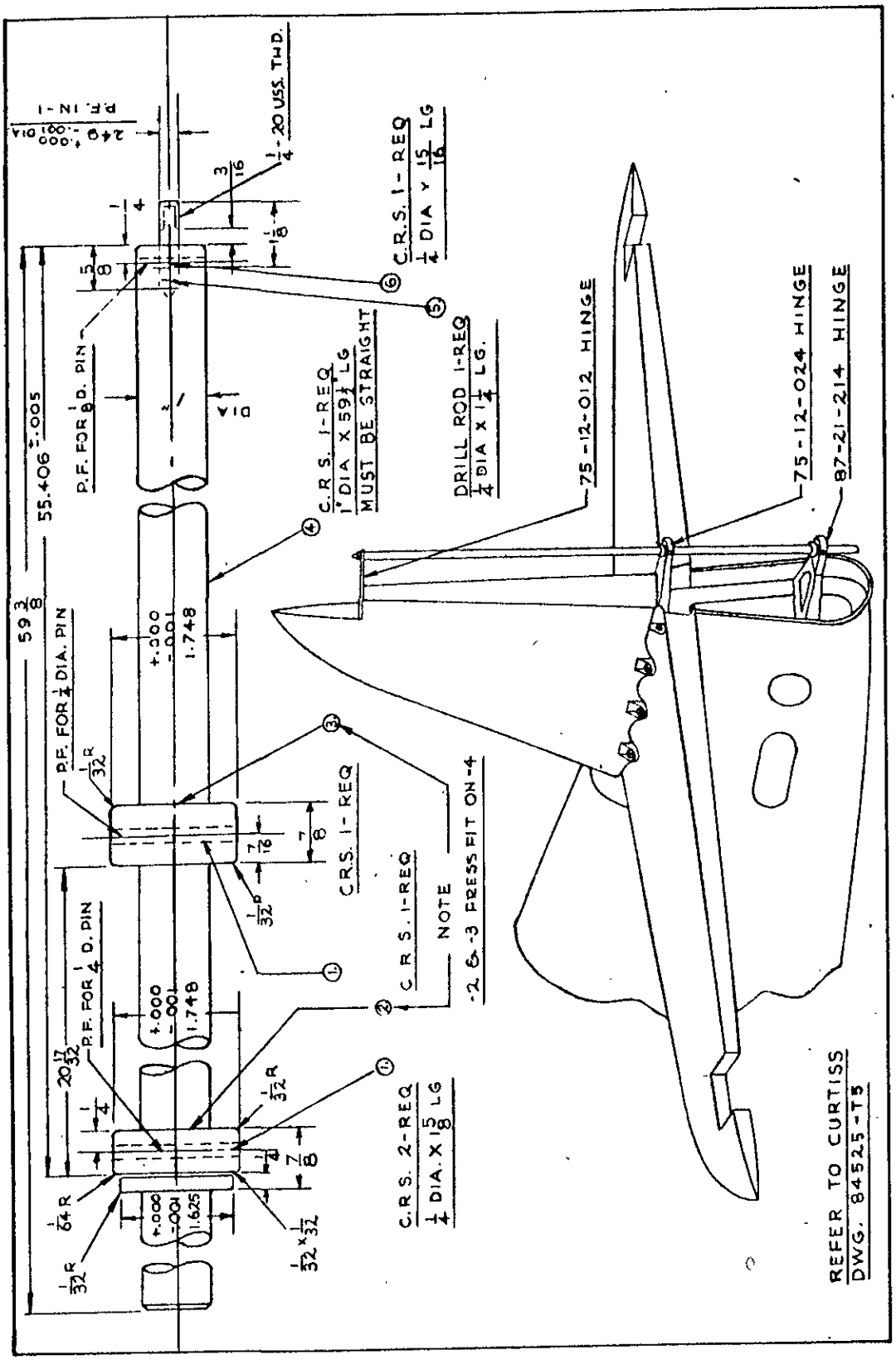


Figure 117 - Rudder Assembly Locating Fixture

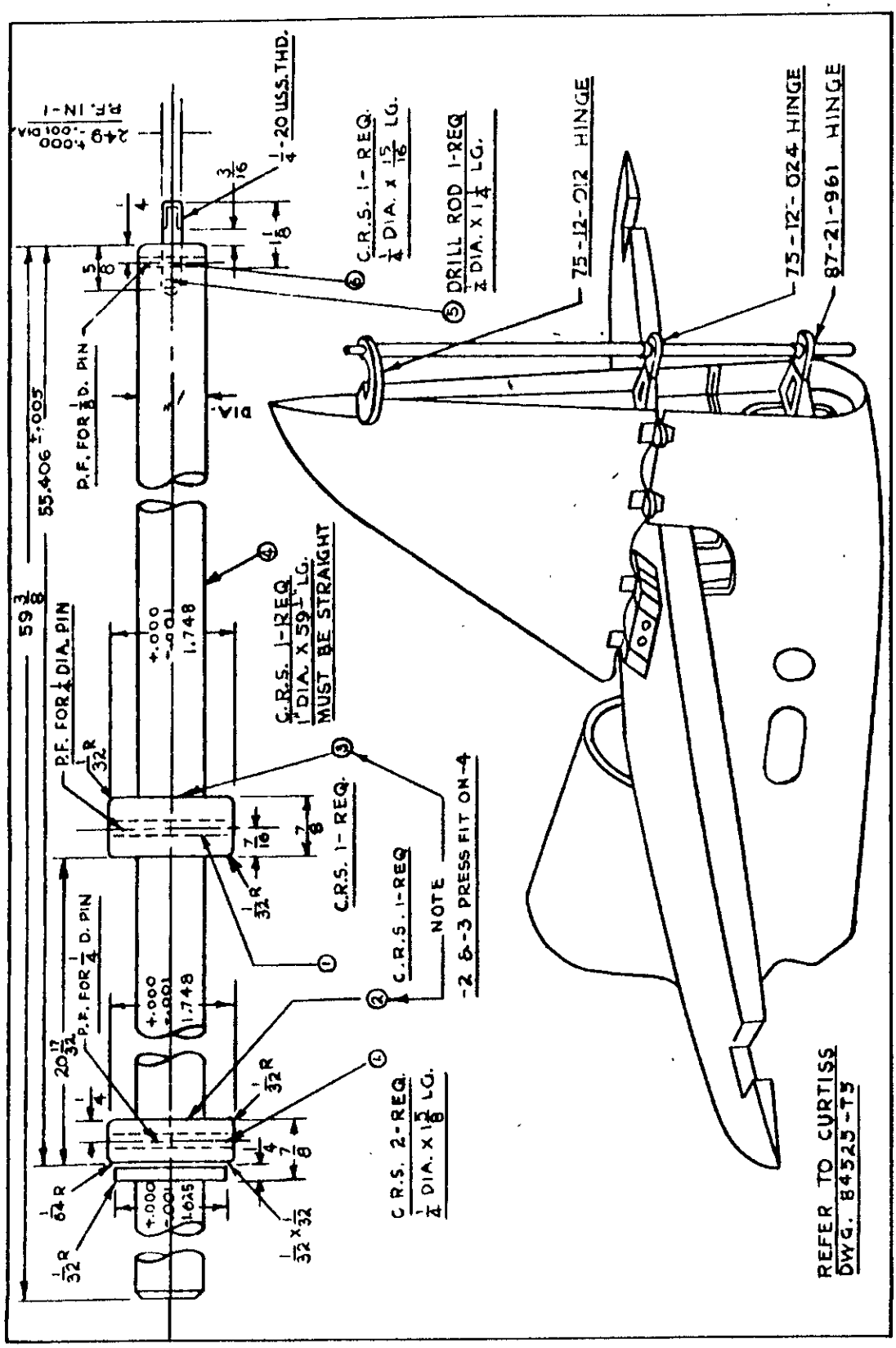


Figure 117A - Rudder Assembly Locating Fixture - Extended Fuselage

MATERIAL FOR REPAIR OF THE ELEVATOR

PART NO.	MATERIAL		SIZE	REMARKS
	SPEC.NO.	TITLE		
6710-4AD-4	A17ST	Elevator - Rivet - brazier head	1/8 in. dia. x 1/4 in. long	
AN442AD-4-4		Elevator - Rivet - flathead	1/8 in. dial x 1/4 in. long	
1045-D-6	57-136-8	Elevator - Bonding tab	Dia. .1285 in. x dia. .113 in.	X4130 steel sheet
AN73A3		Elevator - Bolt	3/8 in. long	
87-13-036	11067-(1)	Elevator - Beam ribs	.025 in. thickness	Al. Al. 24S0
67-13-034	11067-(1)	Elevator - Spar - inboard end	.020 in. x 5-5/8 in. x 22-3/4 in.	Al. Al. 24S0
87-13-033	11067-(1)	Elevator - Fairing - inboard end	.020 in. x 8 in. x 24 in.	Al. Al. 24S0
87-13-032-21	QQ-A-355-(A)	Elevator - Rib	.051 in. x 4-1/2 in. x 7 in.	Al. Al. 24S0
87-13-032-22	QQ-A-355-(A)	Elevator - Rib	.020 in. x 5 in. x 6 in.	Al. Al. 24S0
87-13-032-26	QQ-A-355-(A)	Elevator - Rib	.040 in. x 5 in. x 3-7/8 in.	Al. Al. 24S0
87-13-032-31	QQ-A-355-(T)	Elevator - Tapping plate for-32 rib	.187 in. x 3/8 in. x 1-7/8 in.	Al. Al. 24ST
87-13-026	11067-(1)	Elevator - Skin - tip	.025 in. x 7-1/2 in. x 10-1/4 in.	Al. Al. 24S0
87-13-025-1	57-152-6-(1)	Elevator - Shoe - elevator end	.051 in. x 7-1/8 in. x 7-3/4 in.	Al. Al. 24S0
87-13-021-1	57-152-6-(1)	Elevator - Skin - elevator balance	.040 in. x 5-1/4 in. x 7-1/2 in	Al. Al. 24S0
87-13-020	57-107-17	Elevator - Bolt - trimtab control	5/16 in. hex x 1-1/32 in.	Steel bar
87-13-018-1	57-152-6-(11)	Elevator - Skin - nose	.025 in. x 15 in.x 60 in.	Al. Al. 24ST
87-13-016-12	57-152-6-(11)	Elevator - Beam - main	.032 in. x 3-3/4 in x 13 in.	Al. Al. 24ST
87-13-015	11067-(1)	Elevator - Beam - false	.025 in. x 3 in. x.27-3/8 in.	Alclad sheet 24S0
87-13-014-1	57-152-5-(T)	Elevator - Plate - tapping	3/16 in. x 5/8 in. x 3-5/8 in.	Dural bar
87-13-013-3	57-152-6-(11)	Elevator - Angles - trim tab bearing attachment	.040 in. x.1 in. x 1-3/8 in.	Al. Al. 24ST
87-13-012-1	57-152-6-(11)	Elevator - Channel - false beam reinforcement	.025 in. x 1-19/64 in. x 2-1/8 in.	Al. Al. 24ST
75-13-037	QQ-A-354-(T)	Elevator - Spacer	.311 in. x 5/16 in. x 1-1/16 in.	Al. Al. bar 24ST
75-13-025	10235	Elevator - Brace - flap false beam - trailing edge	3/8 in. OD x .035 in. x 8-11/16 in.	Al. Al. tube 24ST
75-13-018-1	57-152-6-(11)	Elevator - Gusset - flap beam - inner hinge	.025 in. x 1-5/8 in. x 2 in.	Al. Al. 24ST
87-13-517-3	57-152-6-(1)	Elevator - Rib	.025 in. x 6 in. x 15-7/8 in.	Al. Al. 24S0
87-13-517-5	57-152-6-(1)	Elevator - Rib	.020 in. x 5-1/2 in. x 15 in.	Al. Al. 24S0
MATERIAL FOR REPAIR OF THE RUDDER				
671-D-4AD-4	A17ST	Rudder - Rivet - brazier head	1/8 in. dia. x 1/4 in. long	
87-14-021	11067-(11)	Rudder - Skin - tip - RH	.040 in. x 10-1/8 in. x 18-3/8 in.	Alclad sheet 24ST
87-14-013	11067-(11)	Rudder - Beam - tip - rear	.040 in. x 4 in. x 6-1/2 in.	Alclad sheet 24ST
87-14-022	11067-(11)	Rudder - Skin - tip - LH	.040 in. x 10-1/8 in. x 13-3/4 in.	Alclad sheet 24ST
87-14-025	11067-(11)	Rudder - Nose cover - lower	.020 in. x 9-1/2 in. x 17-3/4 in.	Alclad sheet 24ST
87-14-016	11067-(1)	Rudder - Skin - trailing edge	.032 in. x 10 in. x 13 in.	Alclad sheet 24S0
75-14-034	11067-(1)	Rudder - Fairing - lower	.032 in. x 8-1/2 in. x 21 in.	Alclad sheet 24S0
75-14-015-19	11067-(1)	Rudder - Rib - diagn	.020 in. x 5-7/8 in. x 13-3/4 in.	Alclad sheet 24S0
75-14-015-11	11067-(1)	Rudder - Rib - upper	.040 in. x 2-1/4 in x 3-9/16 in.	Alclad sheet 24S0
75-14-015-60	11067-(1)	Rudder - Splice - main beam	.040 in. x 3-17/32 in. x 14-1/16 in.	Alclad sheet 24S0
75-14-015-1	11067-(1)	Rudder - Rib - sta 9	.040 in. x 2-1/4 in. x 16-7/8 in.	Alclad sheet 24S0
75-14-015-13	11067-(1)	Rudder - Rib - nose	.020 in. x 3-1/4 in. x 4-1/4 in.	Alclad sheet 24S0
87-14-030-17	11067-(1)	Rudder - Rib web - sta 4	.040 in x 5-1/8 in. x 31 in.	Alclad sheet 24S0
87-14-030-15	11067-(1)	Rudder - Rib - sta 2	.020 in. x 7-3/4 in. x 31-3/4 in.	Alclad sheet 24S0
87-14-017-1	11067-(1)	Rudder - Beam - lower	.020 in. x 5-5/16 in. x 7-5/8 in.	Alclad 24S0
75-14-015-26	11067-(1)	Rudder - Beam - tip	.040 in. x 2 in. x 8-1/4 in.	Alclad sheet 24S0
87-14-003-8	11067-(11)	Rudder - Beam - inter	.020 in. x 2-3/8 in. x 16-5/8 in.	Alclad sheet 24ST

MATERIAL FOR REPAIR OF THE RUDDER

PART NO.	MATERIAL		SIZE	REMARKS
	SPEC NO.	TITLE		
87-14-023	11067-(1)	Rudder - Beam - lower main	.051 in. x 7-1/4 in. x 16-5/8 in.	Alclad sheet 24SD
87-14-024	11067-(11)	Rudder - Beam - main	.025 in. x 5 in. x 26-5/16 in.	Alclad sheet 24ST
87-14-603-3	57-136-8	Rudder - Channel - counter-weight	.063 in. x 5 in. x 9-5/8 in.	Steel sheet
87-14-603-2	Comm.	Rudder - Lead weight		Lead
87-14-604-2	AN-CCC-C-399	Rudder - Covering - cotton (GR. A)	42 in. x 4-1/4 yds	
87-14-604-3	6-62	Rudder - Covering - tape surface	2-1/4 in. x 26 yds.	
AN503-8-6	FF-S-91 Mfg.	Rudder - Screw - coarse thread	3/8 in. long	
365-832	25527 Mfg.	Rudder - Nut - self-locking	15/64 in. x 3/8 in.	Coarse thread Al. Al. 24ST
87-14-601-3	10235-(8)	Rudder - Trailing edge (911-D-58)	.022 in. thickness of tube	
87-14-601-4	10235-(8)	Rudder - Tube	3/16 in. OD x .022 in. x 50 in. (APP)	Al. Al. tube

SECTION IX

MISCELLANEOUS REPAIR

1. Engine Cowl.

a. General. - The engine cowl consists of several sections, which are of spot-welded and riveted aluminum-alloy construction, except for those portions of the cowl adjacent to the exhaust stacks which are stainless steel. The engine cowl sections are reinforced by formers which are supported by numerous fittings attached to the engine mount. The forward ends of the cowling are supported by a bulkhead which is attached to the bosses on the engine reduction gear housing. That portion of the cowl which must be frequently removed for servicing is attached with Dzus fasteners. Access doors are provided for the coolant expansion tank and starter crank.

b. Negligible Damage. - All small dents, free from cracks, abrasions and sharp corners, may be neglected. Larger dents should be restored to shape taking care to avoid cracking when effecting the repair.

c. Damage Reparable by Patching. - For damage in excess of that in paragraph 1.b. above, use the repair data given in figure 118. Cut away all damaged area leaving a smooth-edged, regular-shaped hole with at least a 1/2-inch radius in the corners. Patches must be of the same gage and material as the original construction.

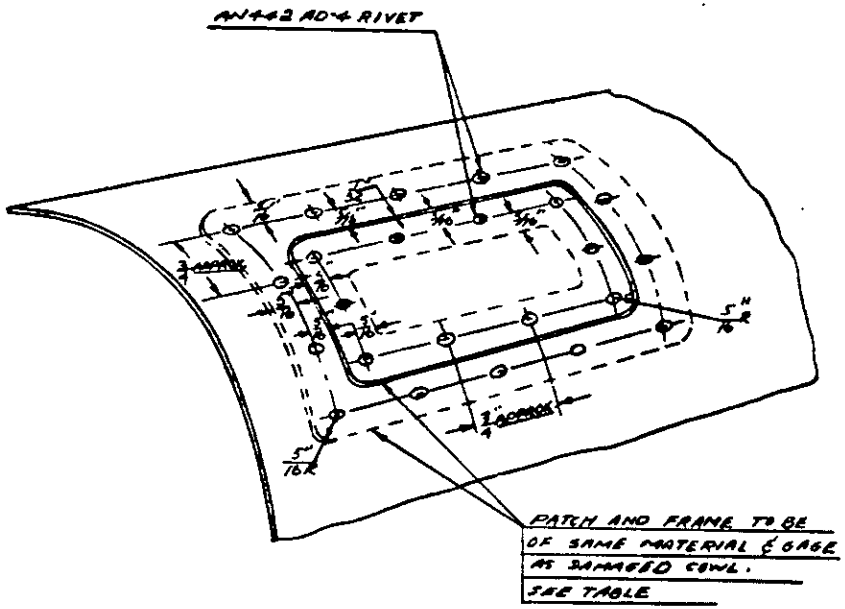
d. Damage Necessitating Replacement. - Any damaged section of the cowl which, due to its extent or location makes a repair impracticable, should be replaced.

2. Surface Controls.

a. General. - No repairs should be made to the control mechanisms and cables. Replace if damaged in any way by standard spares. All cables must be of the corrosion-resisting type and must be replaced if frayed, see the Cable Chart of the section for replacement. If cloth is replaced on any of the control surfaces it should be attached to the ribs as shown by diagrams in figure 114.

b. Pulleys. - Check all pulleys for proper alignment and signs of excessive wear and replace when necessary. All control pulleys are of the antifriction bearing type and replacements must be of the same nature.

PART	MATERIAL	GAGE
1- ENGINE COWL P-40D,E,E-1.		
COWL FLAPS	ALUM ALLOY 24ST	.040
COWL - TOP		
a. SKIN	ALCAD 24ST	.040
b. DUCT - TOP & BOTTOM	ALCAD 24ST	.051
c. DUCT INSERT	ALUM. ALLOY 24ST	.064
COWL - SIDE	ALCLAD 24 ST	.032
COWL - SIDE - REAR	ALCLAD 24 ST	.032
COWL - BOTTOM - FORWARD		
a. COWL SKIN	ALCLAD 24ST	.032
b SCOOPS	ALCLAD 24ST	.032
DUCT - COOLER EXIT	ALUM. ALLOY 24ST	.051
2-ENGINE COWL P-40F		
COWL FLAPS		
COWL TOP-SKIN	ALC. SHT. 24ST	.032
COWL - SIDE	ALCLAD 24ST	.032
COWL SIDE-REAR	ALCLAD 24ST	.040
COWL-BOTTOM FORWARD SKIN	ALCLAD 24ST	.032
DUCT-COOLER EXIT	ALCLAD 24ST	040
DUCT-CARB-COLD AIR	ALCLAD 24ST	.064
3-WING FILLET-ALL P40 SERIES		
FORWARD	ALUM. ALLOY 24ST	.040
INTERMEDIATE	ALUM. ALLOY 24ST	.032
REAR		
a FORWARD SKINS		
1. TOP	ALUM. ALLOY 24ST	.025
2. CENTER	ALUM. ALLOY 24ST	.025
3. BOTTOM	ALUM. ALLOY 24ST	.025
b AFT SKINS		
1. BOTTOM	ALUM. ALLOY 24ST	.025
2. TOP	ALCLAD 24ST	.032
4-FAIRING KEEL-ALL P40 SERIES		
REAR	ALCLAD 24ST	.032
INTERMEDIATE	ALCLAD 24ST	.032
FORWARD	ALCLAD 24ST	.032
5-FAIRING-FUSELAGE/STABLIZER	ALCLAD 24ST	.032
6-LANDING GEAR COWL		
a. SKIN	ALCLAD 24ST	.040
b. MAIN DOOR	ALCLAD 24ST	.040
c. INNER DOOR	ALCLAD 24ST	.051



ALL STOCK IS 24S0 HEAT TREATED TO U.T.S. = 58,000 LBS. PER SQ IN. AFTER FORMING.

Figure 118 - Cowl Skin - Flush Patch

MATERIAL FOR MISCELLANEOUS REPAIRS P-40 D, E, AND E-1

PART NO.	MATERIAL		SIZE	REMARKS
	SPEC NO.	TITLE		
1101-D-S-10	57-107-17	Cowl - Screw - 100° countersunk	5/8 in. long	2330 steel
365-1032	25527 Mfg.	Cowl - Nut - self-locking	15/64 in. x 3/8 in.	Fine thread
AN960-D-10	Steel	Cowl - Washer	13/64 in. ID x 7/16 in. OD	1/16 in. thick
AN6-21	29-59 Mfg.	Cowl - Bolt	2-1/8 in. long; 1-9/16 in. shank	
AN350-6	Steel	Cowl - Nut-wing	1-3/8 in.; 23/32 in.	
87-29-749-7	QQ-A-355-(A)	Cowl - Former - channel - side - rear - lower	.064 in. x 5-1/2 in. x 13-3/4 in.	Al. Al. 24S0
87-29-749	QQ-A-355-(A)	Cowl - Former - channel - side - rear -lower	.064 in. x 4-1/2 in. x 13-3/4 in.	Al. Al. 24S0
87-29-748-5	QQ-A-355-(A)	Cowl - Former - channel - side - rear - middle	.064 in. x 4-1/2 in. x 27-3/4 in.	Al. Al. 24S0
87-29-748-8	QQ-A-355-(A)	Cowl - Former - angle - side side - rear - middle	.081 in. x 2-5/8 in. x 1-3/8 in.	Al. Al. 24S0
87-29-748-7	QQ-A-355-(A)	Cowl - Former - spacer - side - rear - middle	.032 in. x 7/8 in. x 1-3/4 in.	Al. Al. 24S0
87-29-818	QQ-A-355-(A)	Cowl - Duct - center and front	.051 in. thickness	Al. Al. 24S0
87-29-818	QQ-A-355-(A)	Cowl - Duct - angles	.064 in. thickness	Al. Al. 24S0
87-29-818-21	QQ-A-355-(T)	Cowl - Strip	.040 in. x 1/2 in. x 14 in.	Al. Al. 24ST
87-29-818-24	QQ-A-355-(A)	Cowl - Duct - aft	.051 in. x 23 in. x 34 in.	Al. Al. 24S0
87-29-818-26	QQ-A-355-(A)	Cowl - Door	.051 in. x 4-3/4 in. x 8-1/2 in.	Al. Al. 24S0
87-29-816	11067-(1)	Cowl - Skin - side - bottom - nose	.032 in. thickness	Al. Al. 24S0
87-29-715-10	11067-(1)	Cowl - Skin - LH - weld assembly - side - rear	.032 in. x 22 in. x 25-7/8 in.	Al. Al. 24S0
87-29-715	11067-(1)	Cowl - Skin - reinforcements - all	.040 in. thickness	Al. Al. 24S0
87-29-706-2	QQ-A-355-(HT)	Cowl - Duct - rear exit - trough	.032 in. x 4-5/8 in. x 6 in.	Al. Al. 24ST
87-29-706-3	QQ-A-355-(HT)	Cowl - Duct - rear exit - angle	.032 in. x 1-1/4 in. x 3-1/8 in.	Al. Al. 24ST
87-29-502-2	57-187-3-(A)	Cooling Tube - Fuel pump	1-1/2 in. OD x .049 in. x 47-1/2 in.	Al. Al. 52S0
87-29-502-1	57-187-3-(A)	Cooling Tube - Spark plug manifold	1-3/4 in. OD x .065 in. x 16 in.	Al. Al. 52S0
671-D-4AD-	A17ST	Cowl - Rivets - brazier head	1/8 in. dia-	
673-D-4AD-	A17ST	Cowl - Rivets - 78° countersunk head	1/8 in. dia-	
670-D-4AD-	A17ST	Cowl - Rivets - hollow	1/8 in. dia-	

MATERIALS FOR MISCELLANEOUS REPAIRS P-40 F

1101-D-S-10	57-107-17	Cowl - Screw - 100° countersunk	5/8 in. long	2330 steel
365-1032	25527 Mfg.	Cowl - Nut - self-locking	15/64 in. x 3/8 in.	Fine thread
AN960-D-10	Steel	Cowl - Washer	13/64 in. ID x 7/16 in. OD	1/16 in. thick
AN350-6	Steel	Cowl - Nut - wing	1-3/8 in.; 23/32 in.	
AN6-21	29-59 Mfg.	Cowl - Bolt	2-1/8 in. long; 1-9/16 in. shank	
87-29-939	11067-(1)	Cowl - Former - channel - side - rear - upper	.032 in. x 5-7/8 in. x 36-5/16 in.	Al. Al. 24S0
87-29-940	11067-(1)	Cowl - Former - channel - side - rear - lower	.064 in. x 3-1/4 in. x 17-3/8 in.	Al. Al. 24S0
87-29-941	11067-(1)	Cowl - Former - channel - side - rear - vertical	.064 in. x 4-7/8 in. x 21-3/16 in.	Al. Al. 24S0
87-29-918	11067-(1)	Cowl - Duct - skin	.040 in. thickness	Al. Al. 24S0
87-29-918	11067-(1)	Cowl - Duct - angles	.040 in. thickness	Al. Al. 24S0
87-29-918	11067-(1)	Cowl - Duct - strips	.040 in. thickness	Al. Al. 24ST
87-29-918-54	11067-(1)	Cowl - Door	.040 in. x 5-1/2 in. x 5-1/2 in.	Al. Al. 24S0
87-29-916	11067-(1)	Cowl - Skin - bottom - forward section	.032 in. thickness	Al. Al. 24S0
87-29-915-9	11067-(1)	Cowl - Skin - RH - side - rear	.040 in. x 19-1/2 in. x 24-1/2 in.	Al. Al. 24S0
87-29-915	QQ-A-362-(T)	Cowl - Skin - reinforcements - all	.040 in. thickness	Al. Al. 24ST
87-29-929	QQ-A-355-(A)	Cowl - Duct plates - radiator to cowl seal	.040 in. thickness	Al. Al. 24S0
87-29-928	QQ-A-355-(A)	Cowl - Duct - skin - oil coolers (forward)	.032 in. x 12 in. x 25 in.	Al. Al. 24S0
87-29-930-3	WW-T-787	Cooling Tube - Spark plug manifold	1-3/4 in. OD x .049 in. x 33-1/2 in.	Al. Al. 52S0
87-29-930-5	WW-T-787	Cooling Tube - Inlet to spark plug manifold	1-3/4 in. OD x .049 in. x 15-3/4 in.	Al. Al. 52S0
87-29-930-27	57-187-3-(A)	Cooling Tube - Fuel pump	1-1/2 in. OD x .049 in. x 18-1/2 in.	Al. Al. 52S0
671-D-4AD	A17ST	Cowl - Rivets - brazier head	1/8 in. dia.	
673-D-4AD	A17ST	Cowl - Rivets - 78° countersunk head	1/8 in. dia.	
670-D-4AD	A17ST	Cowl - Rivets - hollow	1/8 in. dia.	

FLEXIBLE CABLES

PART NO.	TITLE	END FITTINGS	LENGTH (INCHES)	MATERIAL AND SPEC	DIA.	END FITTING TYPE AND PART NO.
85731	Rudder Control Cable	Spliced and Wrapped	60.0	Ex. Flex. Cable (AN-RR-C-43)	5/32	Bushing AN111-5
85731	Rudder Control Cable	Spliced and Wrapped	132.625	Ex. Flex. Cable (AN-RR-C-43)	5/32	Bushing AN111-5
85731	Rudder Control Cable	Spliced and Wrapped	118.625	Ex. Flex. Cable (AN-RR-C-43)	5/32	Bushing AN111-5
85731	Rudder Control Cable	Spliced and Wrapped	19.093	Ex. Flex. Cable (AN-RR-C-43)	5/32	Bushing AN111-5
85731	Steerable Tail Wheel Cable	Spliced and Wrapped	55.5	Ex. Flex. Cable (AN-RR-C-43)	5/32	Bushing AN111-5
85731	Steerable Tail Wheel Cable	Spliced and Wrapped	30.500	Ex. Flex. Cable (AN-RR-C-43)	5/32	Bushing AN111-5
85731	Elevator Control Cable	Spliced and Wrapped	59.875	Ex. Flex. Cable (AN-RR-C-43)	5/32	Bushing AN111-5
85731	Elevator Control Cable	Spliced and Wrapped	99.875	Ex. Flex. Cable (AN-RR-C-43)	5/32	Bushing AN111-5
85731	Elevator Control Cable	Spliced and Wrapped	62.125	Ex. Flex. Cable (AN-RR-C-43)	5/32	Bushing AN111-5
87-64-047-1	Aileron Control Cable	Spliced and Wrapped	24.0	Ex. Flex. Cable (AN-RR-C-43)	5/32	Bushing AN111-5 Bushing 75-64-055
87-64-047-2	Aileron Control Cable	Spliced and Wrapped	115.688	Ex. Flex. Cable (AN-RR-C-43)	5/32	Bushing AN111-5
75-64-056-1	Aileron Control Cable	Spliced and Wrapped	111.0	Ex. Flex. Cable (AN-RR-C-43)	5/32	Bushing AN111-5 Bushing 75-64-055
75-64-056-5	Aileron Control Cable	Spliced and Wrapped	27.5	Ex. Flex. Cable (AN-RR-C-43)	5/32	Bushing AN111-5
87-64-052-5	Rudder Tab Control Cable	Soldered	109.375	Flexible Cable (AN-RR-C-43)	1/16	Link 84907
87-64-052-9	Rudder Tab Control Cable	Soldered	109.0	Flexible Cable (AN-RR-C-43)	1/16	Link 84907 Turnbuckle 75-54-110 Link 84907 Turnbuckle 75-54-110 Link 84907
87-64-052-16	Rudder Tab Control Chain	Riveted	90.5			
87-64-052-13	Rudder Tab Control Chain	Riveted	79.75			
87-64-052-6	Elevator Tab Control Cable	Soldered	110.5	Flexible Cable (AN-RR-C-43)	1/16	Link 84907
87-64-052-10	Elevator Tab Control Cable	Soldered	108.25	Flexible Cable (AN-RR-C-43)	1/16	Link 84907 Turnbuckle 75-64-110 Link 84907 Turnbuckle 75-64-110 Link 84907
87-64-052-4	Elevator Tab Control Chain	Riveted	86.0			
87-64-052-19	Elevator Tab Control Chain	Riveted	79.5			