ROYAL CANADIAN AIR FORCE

STRUCTURAL REPAIR MANUAL EXPEDITOR

REVISION
NOTICE

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15 FEB 54
Revised 29 Mar 68

LIST OF RCAF REVISIONS

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13 Aug 62	62		
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NOTES TO USERS

1 The contents of the text in this EO includes information relative to the following marks: Expeditors 3N, 3NM, 3T and 3TM.

2 In the text, words written in capital letters and quotations indicate actual markings on the controls concerned.

3 A record of Revisions is on page A. The holder of this book is to ensure that revisions which have been promulgated are incorporated in the book.

4 Comments and suggestions should be forwarded through the usual channels to Air Force Headquarters.

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PART 1

GENERAL INFORMATION

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TYPE OF CONSTRUCTION

1 The Expeditor 3 series aircraft, Figure 1-16, employ a semi-monocoque construction, wherein stresses are carried by both the skin and the stiffener members. Due to this interrelationship, it is necessary that adequate stress connection be maintained at all times, wherever one part is bolted or riveted to another, to insure the proper distribution of loads. Loads are both introduced and distributed by bulkheads, spars, and stringers. This results occasionally in local stress concentrations in the skin, which must be carefully dispersed. Examination of rivet patterns at any structural joint (including skin splices) will provide indication of the extent of stress concentration at that point, and will serve as a guide when replacing damaged portions of the structure.

2 The fuselage framework of the aircraft consists of bulkheads and longitudinal stringers to which the outside skin of the airplane is riveted. A highly heat-treated welded tubular steel truss carries the main wing spar stresses and also provides supporting structure for the engines. The wing stubs are constructed integrally with the fuselage and are not demountable.

REPAIR INSTRUCTIONS

3 General — In investigating the extent of damage, especially damage from shock, it is necessary to make an extensive inspection of the structure. A severe shock can be transmitted from one structural member to another and may result in damage or cause distortion of members remote from the point of impact. Wrinkled skin or fabric, distorted rivets, and elongated or damaged bolt or rivet holes are all indications of damage to adjacent structure.

CLASSIFICATION OF DAMAGE

4 Negligible Damage — This includes damage not endangering the strength or functioning of the area. Location will determine to a large extent whether or not the damage is negligible. Nicks, dents and scratches generally are considered negligible damage, except on certain highly stressed members; i.e., landing gear, where they would require replacement.

5 Damage Repairable by Patching — This is usually a puncture of a unit, such as a skin or extrusion puncture. Repair is made by the addition of similar material to the damaged area.

6 Damage Repairable by Insertion — This type of damage is of such an extent that the damaged area must be removed, but the part as a unit need not be replaced. The damaged portion removed is replaced by material of similar composition, shape, and size, and is secured in place by splices or patches which may cover the complete insert and overlap the original area.

7 Damage Necessitating Replacement of Parts — Replacement of parts shall be used only when other methods of repair are unsatisfactory or reasons for not repairing are adequate, such as: the damaged part is too small for repair; the area is inaccessible; the type of material of the damaged part makes repair difficult; tools and material for proper repair are not available; the damaged portion of the part is so situated that repair of the part would weaken that area.

8 When determining the type of repair, decide whether it will be more practical to replace the part, or to attempt a repair. This decision depends upon the part's location, accessibility, and function in the aircraft, as well as methods of repair which may be used. It may be preferable to repair, rather than replace, even though the damage is comparatively great; difficult removal of interfering structure may dictate repair to avoid prolonged grounding of the aircraft while a replacement is undertaken.

9 Before actual dismantling of a damaged member begins, confirm that the member definitely is not repairable. This may save needless replacement work which at first glance seemed unavoidable. Nevertheless, even though a repair could be achieved, it may be more desirable to make a replacement because of conditions set forth below.

10 The damage may be such that the function for which the part was intended cannot be restored by repairs. This may be true for some highly stressed parts which have peculiarities such as a high degree of heat-treatment or special tolerances.

11 Certain factors favor replacement, including the probability that the part will fit more exactly into its place. Furthermore, parts fabricated in the field generally cannot match the quality of a factory-manufactured part.

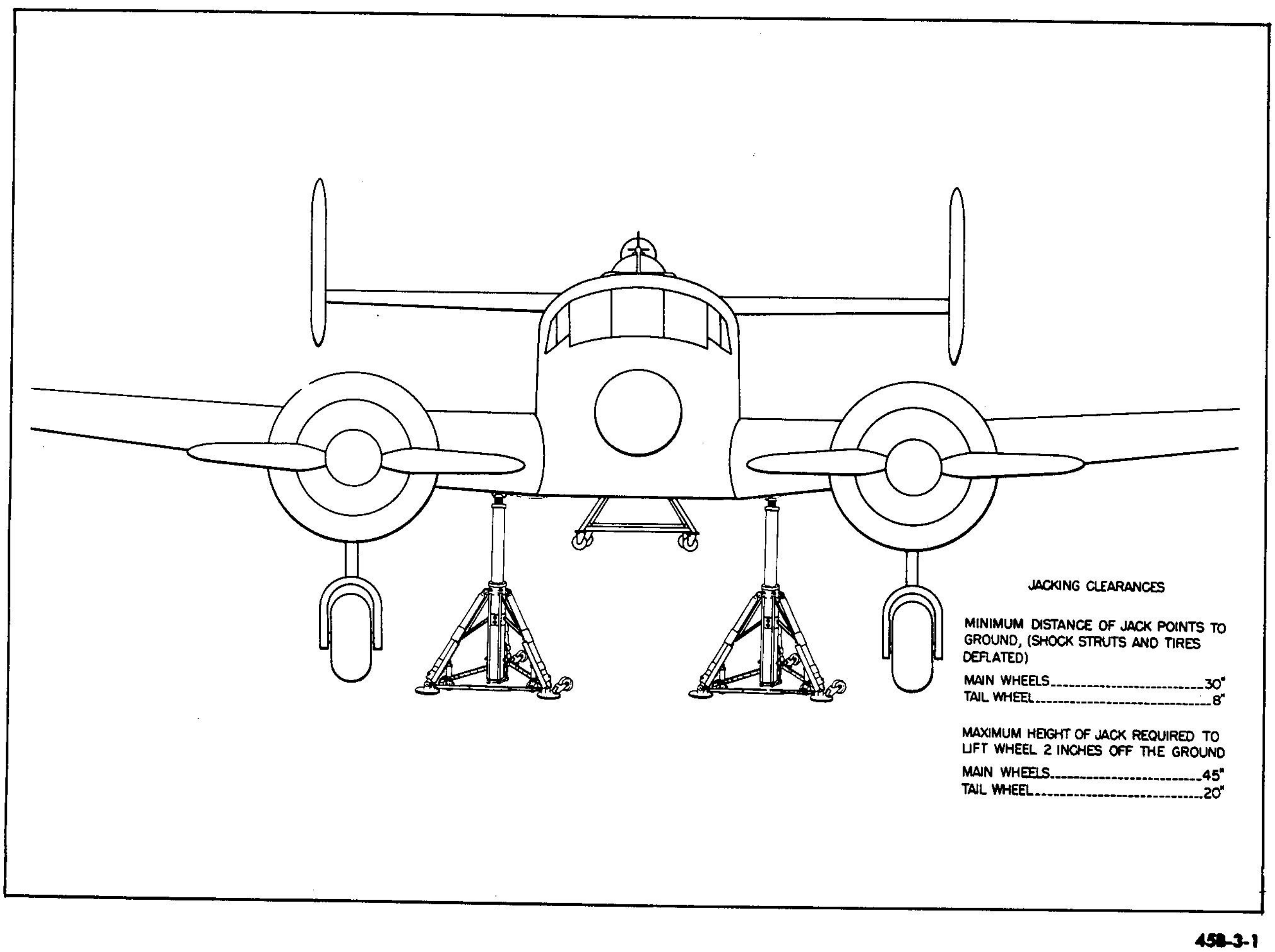


Figure 1-1 Jacking Aircraft

12 Unavailability of replacement parts, however, may preclude their use, in which case substitutions or repairs made in accordance with the recommended procedure of this handbook, may restore adequate strength.

13 When a new repair involves an area immediately adjacent to or within several inches of an already existing repair, it is better to remove the old repair and include the entire area in the new one.

PREPARING DAMAGED AREAS FOR REPAIR

14 After examining and classifying a damage, it must be prepared (cleaned up) for repair. This includes the removal of ragged edges, bends, tears, cracks, punctures, and similar injuries. All this should be cut away with a file, hack saw, or snips making certain that all of the tears, nicks, and cracks are included. Edges of the removed area should be parallel to the unit edges when they are rectangular in shape. The corners of rectangular areas must be circular in shape. Smooth out all abrasions and dents.

SUPPORT OF STRUCTURE DURING REPAIR

15 During repair it is important that the aircraft be adequately supported in order that distortion or injury will not result. It is essential that the area to be repaired is supported solidly to maintain a firm and correct position with the surrounding area during repair. Measurements made from outstanding points near the damaged area before and after repair provide a simple means of checking for distortion. Fuel and oil tanks should be emptied before supporting the aircraft for major repairs. The aircraft will be supported by jacks, hoists, supports, or jigs.

CAUTION

Often a major weight section (the engine or tail group, etc.) is removed in order that a repair or replacement can be accomplished. When this is done, the center of gravity changes and the load is redistributed to the support points. In certain cases this may lead to serious damage unless additional supports are provided. For example, failure to support the tail or sandbag the aft fuselage when removing the tail group, will allow the center of gravity to shift forward and upset the aircraft. See Figure 1-2.

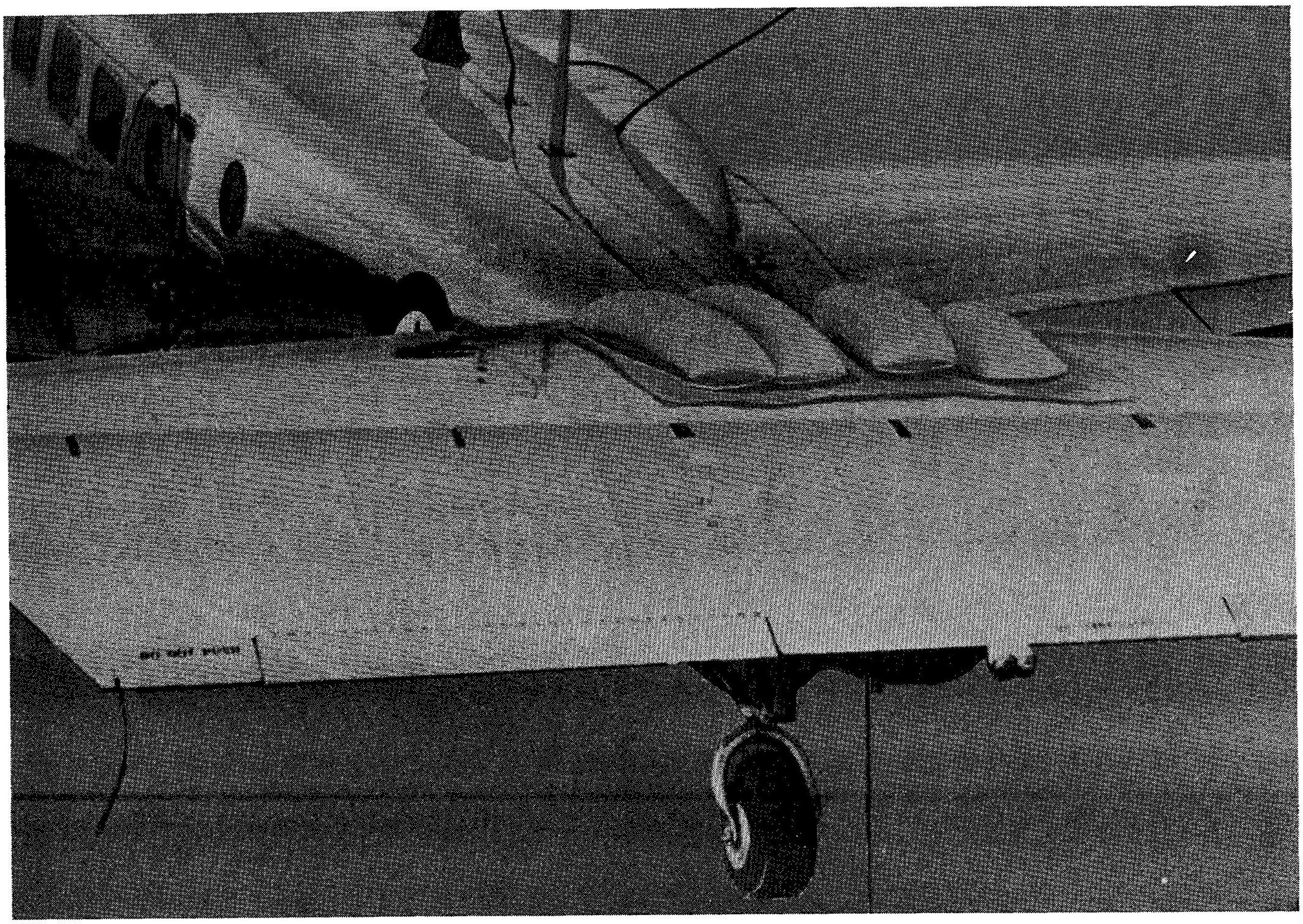
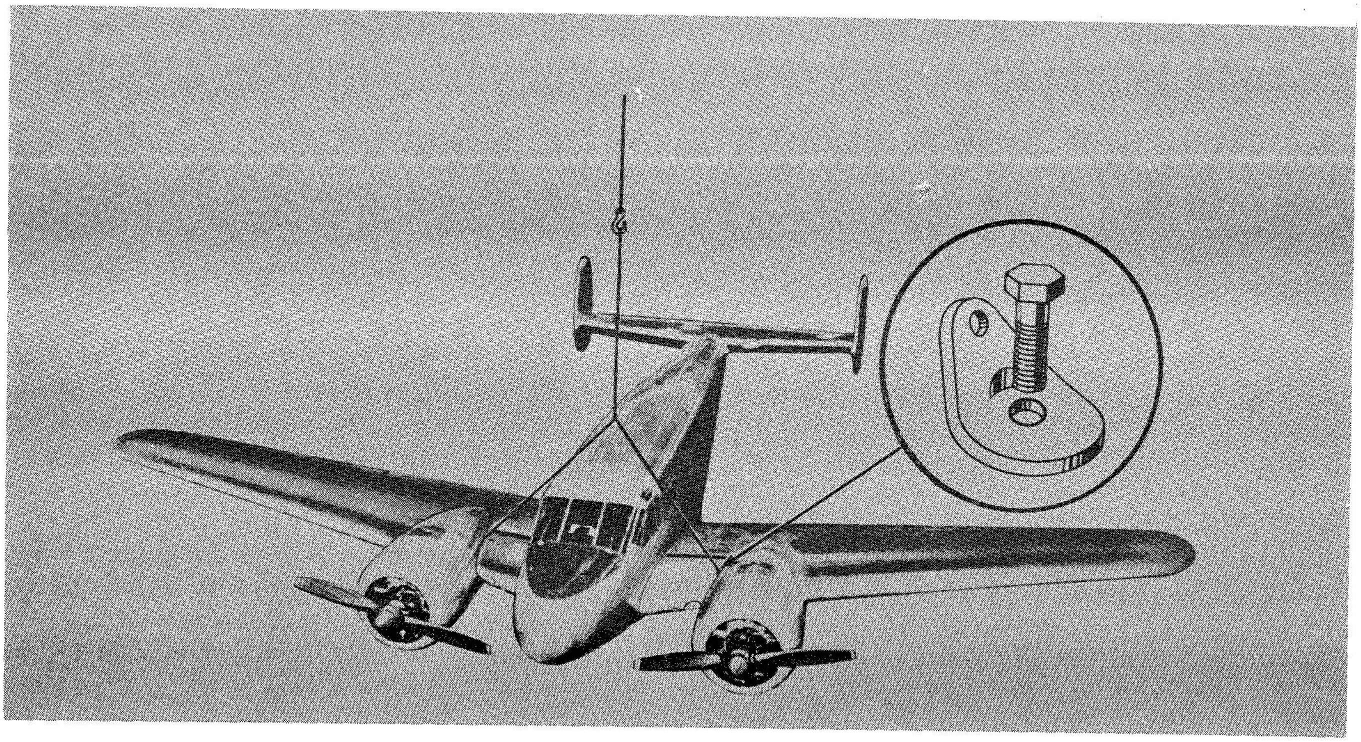


Figure 1-2 Tail Ballast for Hoisting or Jacking



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NOTE: Cables from lift lugs to hoist should clear cabin about 2 inches to pull off at correct angle.

Figure 1-3 Hoisting Aircraft with Single Hoist

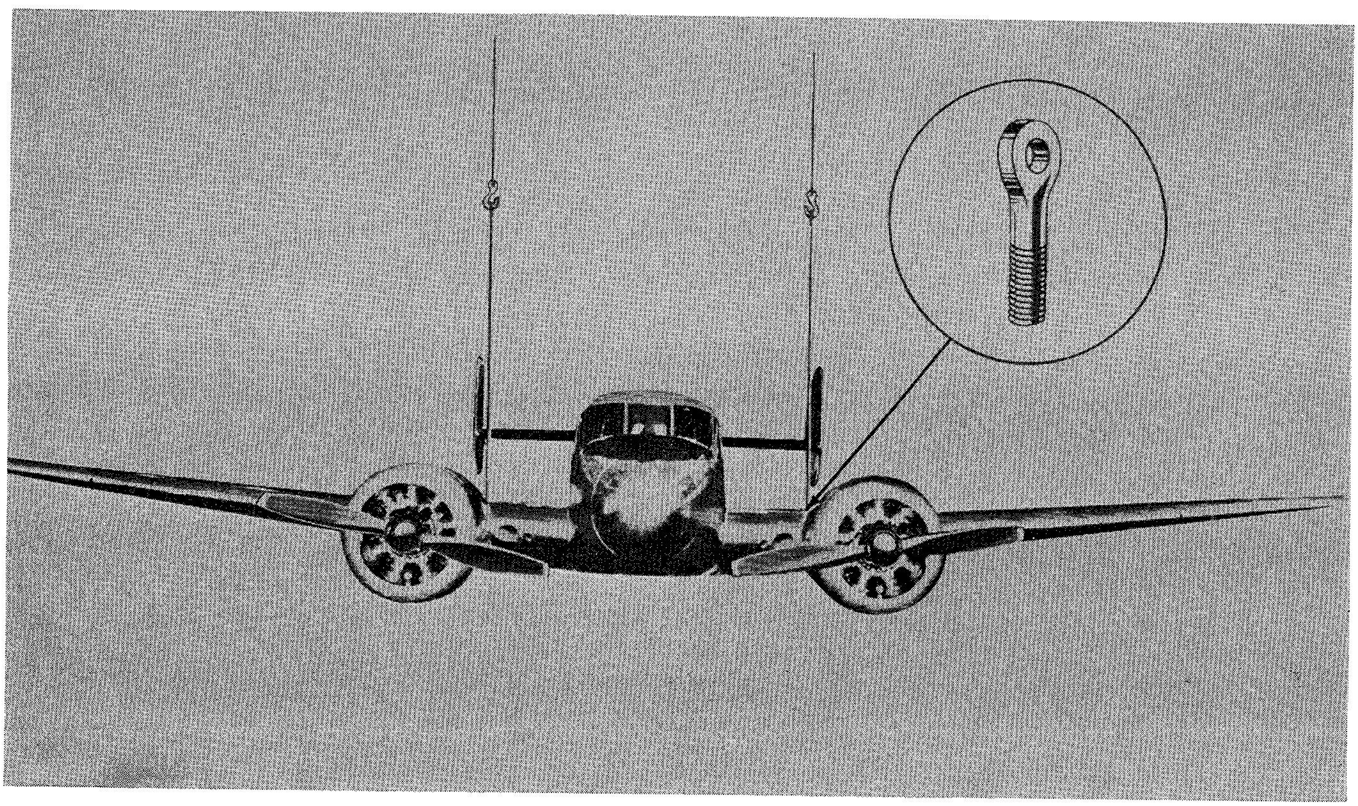

Figure 1-4 Hoisting Aircraft with Two Hoists

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Supporting

16 The repair of many injuries requires that the aircraft be raised off the ground. The main jack points are located on the underside of the wing center section between the fuselage and each nacelle. Three rubber Ford plugs must be removed and jack pads (Part 84-180930) installed. These pads are supplied with the aircraft. Individual wheel jack points are provided on the inboard side of each main landing gear fork. The tail jack point is located just aft of the tail wheel.

NOTE

A jack should never be used near a damaged area when further injury might result. Never leave equipment (ladders, benches, jigs, etc.) that is not being used under a jacked aircraft. This precaution may prevent damage in case a jack slips or fails.

Hoisting

17 It is sometimes necessary to hoist an aircraft for repairs. Hoisting is necessary, also, to place a section in jig or cradle support. Fittings are provided on the center section spar for hoisting. Access to these fittings may be gained by removing the doped fabric patch in the upper wing stub skin just inboard of the upper rear nacelle. Hoisting eyebolts and offset lugs are provided to hoist the aircraft. Install eyebolts and lugs in the fittings on the center section spar as shown in Figures 1-3 and 1-4. Turn the eyebolts well down into the fitting before hoisting. If one hoist (of at least 5-ton capacity) is used, bolt the attaching brackets to the truss. The chains and cables used in single point suspension should clear the cabin approximately 2 inches so that a direct pull will be placed on the lugs. This will prevent the lugs from being bent. If two hoists (of at least 3-ton capacity) are used, the vertical lift eyebolts are to be used. See Figure 1-4. When hoisting, approximately 200 pounds of weight must be applied to the tail to keep the aircraft from nosing over. Offset lugs and their attaching bolts are to be used for single point suspension hoisting. See Figure 1-3.

18 Provision is made for lifting the tail by inserting a steel bar (maximum diameter ¾ inch) through the "lift" holes located in the fuselage just aft of Bulkhead 15 below the forward edge of the horizontal stabilizer.

CAUTION

Do not attempt to raise the tail of the aircraft by lifting against the horizontal stabilizer as the ribs and stringers may be seriously damaged.

The tail may also be hoisted by placing a piece of webbing under the fuselage immediately forward of the horizontal

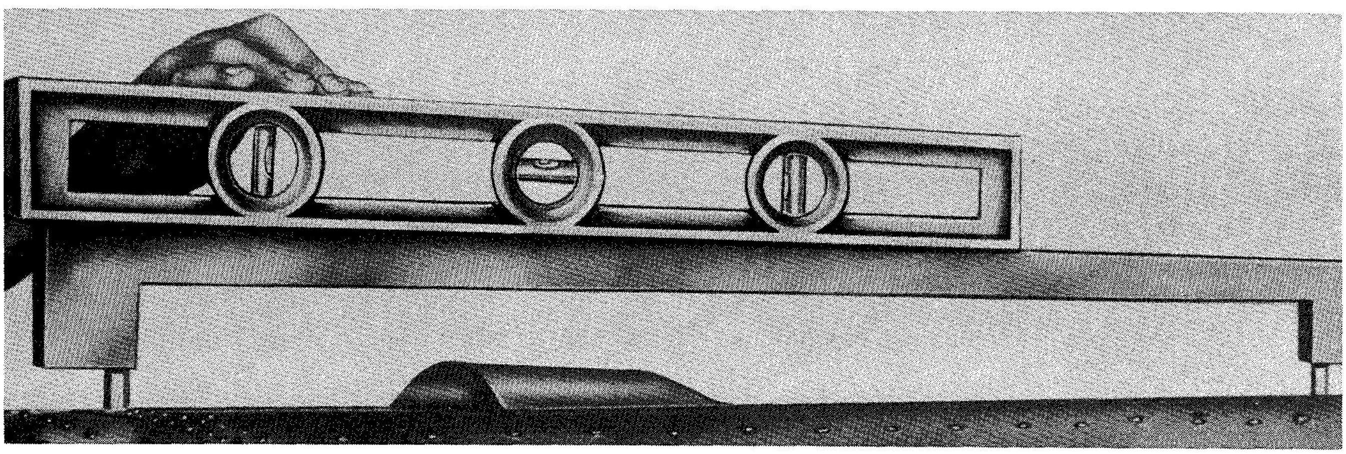


Figure 1-5 Longitudinal Leveling

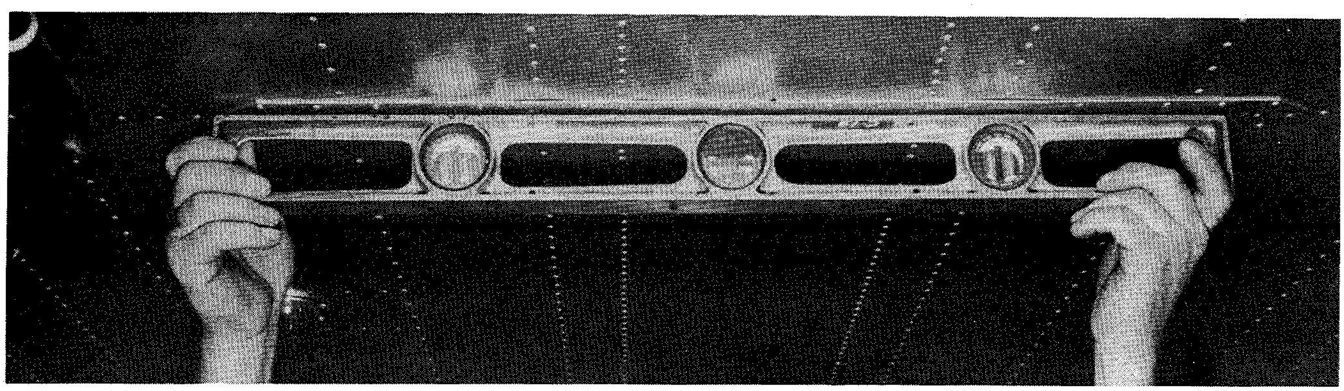


Figure 1-6 Lateral Leveling

stabilizer. Attach the web sling to a hoist and raise as desired for weighing, leveling, etc.

LOCATION OF LEVELING POINTS

19 Leveling points are located on the top of the fuselage for leveling the aircraft on its longitudinal axis. A straightedge may be placed on the leveling points and the aircraft leveled, as shown in Figure 1-5. To level the ship on its lateral axis, place a straightedge across the leveling points on the cabin belly as shown in Figure 1-6.

TYPES OF REPAIR

20 Repairs to the Expeditor 3 series aircraft consist largely of repairs to sheet-metal structures. The tubular steel frames which are the primary structures are, in most instances, heat treated to give the necessary strength. Indiscriminate welding on a frame, therefore, is prohibited. In the several parts of this EO, the steel tube structures which may be welded, and the procedures to be followed are given in detail. Strict observation of these procedures will result in satisfactory repairs. The use of wood in these aircraft is limited to non-structural members, such as floorboards, upholstery tacking strips and furnishings.

CONTROL SURFACE REBALANCING DATA

21 The ailerons and rudders of this aircraft were carefully balanced at the time of manufacture to obtain adequate dynamic and static balance. This involves the addition of lead ballast weights within the nose section of each surface.

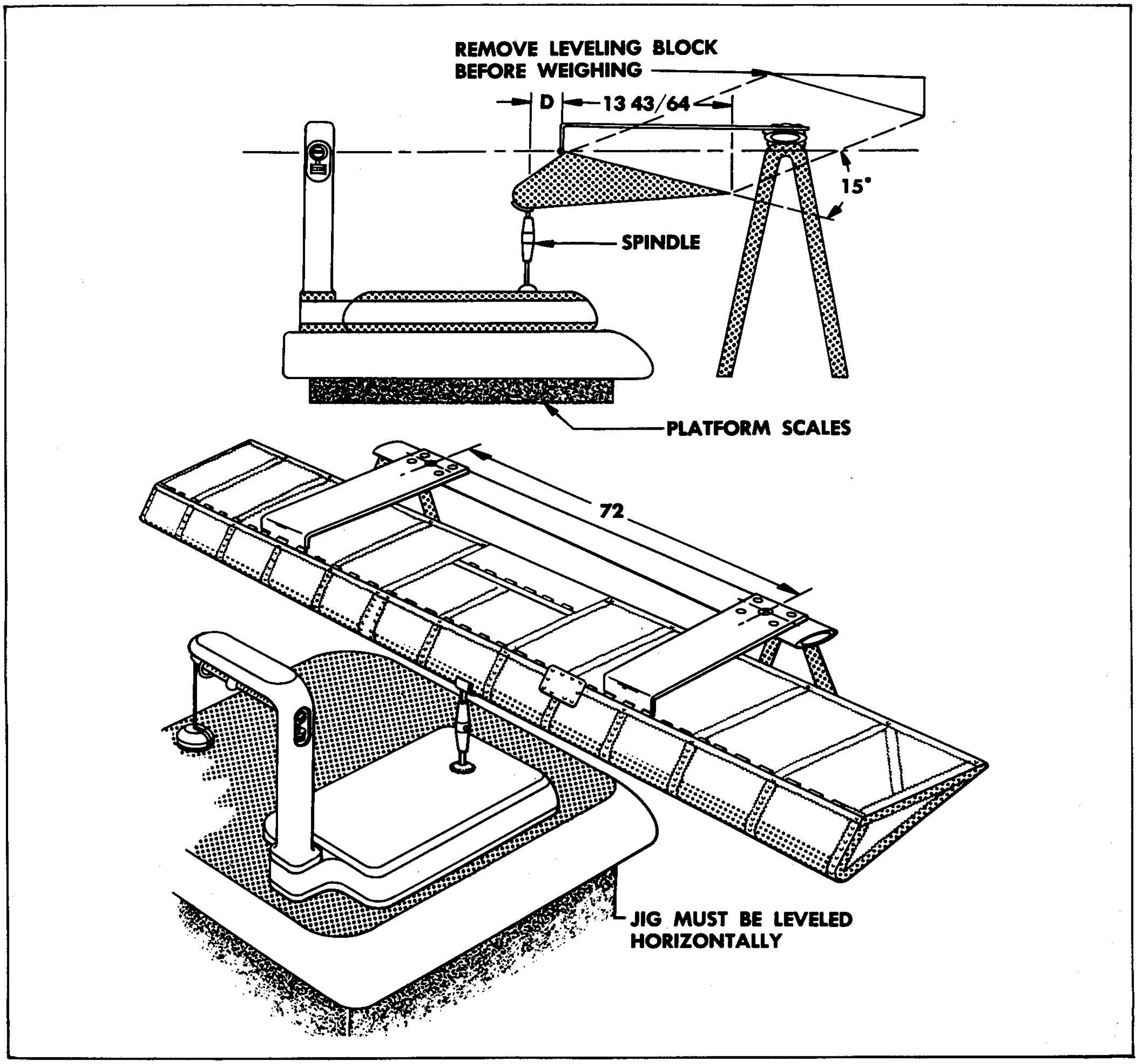


Figure 1-7 Balancing Ailerons

Balancing Ailerons

22 The minimum overbalance of left aileron is 1.6 inch-pounds. The minimum overbalance of right aileron is 1.9 inch-pounds.

23 To balance an aileron, it is necessary to place it on a jig similar to the one shown in Figure 1-7. Place a small platform scale under the leading edge and support it with a spindle. The chord line of aileron must be horizontal at time of weighing. This can be determined by placing a triangular block of wood with 15 degree, 75 degree and 90 degree angles on the aileron as shown in Figure 1-7, with a level on the flat surface of the block. Adjust the spindle to align the bubble in the level. Remove the leveling block and the level and note the scale reading. To determine the amount of static overbalance, use the equation given below:

STATIC OVERBALANCE (nose heaviness) = D (W-S) when D = Distance forward of hinge line that weight reading was taken in inches. W = Scale reading on platform scale in pounds. S = Weight of spindle used to support the leading edge of surface on the scale, in pounds.

24 If the value obtained from the preceding equation is smaller than 1.6 inch-pounds on the left aileron and 1.9 inch-pounds on the right aileron, it will be necessary to add balance weight to the aileron. Add lead washers (Beech Part 183809) inside of the nose of the inboard rib until proper balance is obtained. A maximum of 7 washers may be used. Washers may be attached to the rib by

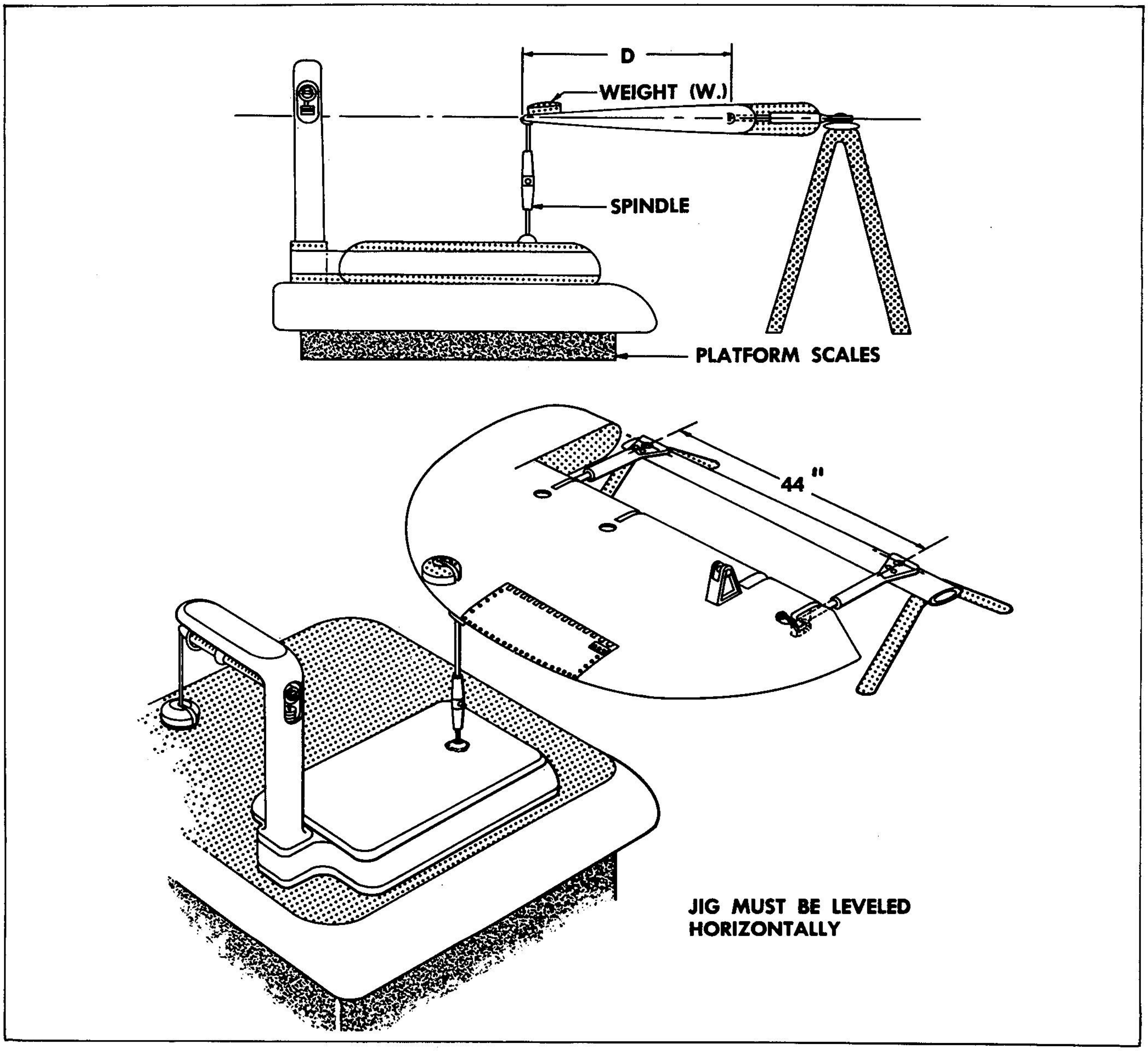


Figure 1-8 Balancing Rudders

an AN526-10-18 screw, AN365-1032 nut, and two AN970-3 washers. Lead washers may be fabricated locally, if manufactured parts are not available, from $\frac{1}{16}$-inch sheet lead. Make in form of a flat washer $1\frac{1}{2}$ inches in diameter, with a No. 12 hole drilled in the center.

Balancing Rudders

25 The maximum static underbalance of each rudder must not exceed 1.4 inch-pounds.

26 To balance the rudder, set up a jig similar to that in Figure 1-8. Weigh on a small platform scale, as described for the aileron and use the following equation to determine the underbalance. The jig must be leveled horizontally and the chord line must be horizontal at time of weight reading. The weight shown on the rudder in Figure 1-8 is used merely to give a larger reading on the scale for ease in computation. The value of the weight is subtracted from the scale reading.

STATIC UNDERBALANCE (tail heaviness) — D (W-S) when D = Distance aft of hinge line that weight reading was taken in inches.

W = Scale reading on platform scales in pounds.

S = Weight of spindle used to support trailing edge of surface on the scale and the value of the weight placed on the rudder.

27 The elevator is balanced dynamically by lead weights installed inside the leading edge. Required static balance is obtained when the center of gravity of the complete elevator is not more than three inches aft of the hinge center line. To balance the elevator, it is necessary to place it in a jig similar to the one shown in Figure 1-8. Use the following equation to determine the center of gravity:

$$CG = \frac{(Ws) \quad (X)}{W}$$

Ws = Scale reading minus weight of spindle.

X = Distance from hinge line to spindle.

W = Total weight of complete elevator.

The CG must be less than 3 inches.

If the value obtained from the preceding equation is greater than 3 inches, the situation must be corrected as follows: Ream a one-inch hole in either outboard rib. Secure a lead balance weight (Beech Part No. 186132). This weight will require forming to fit the leading edge. Drill a No. 10 hole through the leading edge of the elevator and the formed lead weight. Countersink the hole and install an AN510-10-24 screw, an AN970-3 washer and an AN365-1032 nut. To determine the amount of lead weight needed, use the following equation:

$$W1 = \frac{Ws\ (x) \ - \ 3W}{3 + L}$$

W1 = Minimum weight of lead to obtain static balance.

Ws = Scale reading minus weight of spindle.

W = Total weight of complete elevator.

L = Distance from most forward portion of leading edge to hinge center line.

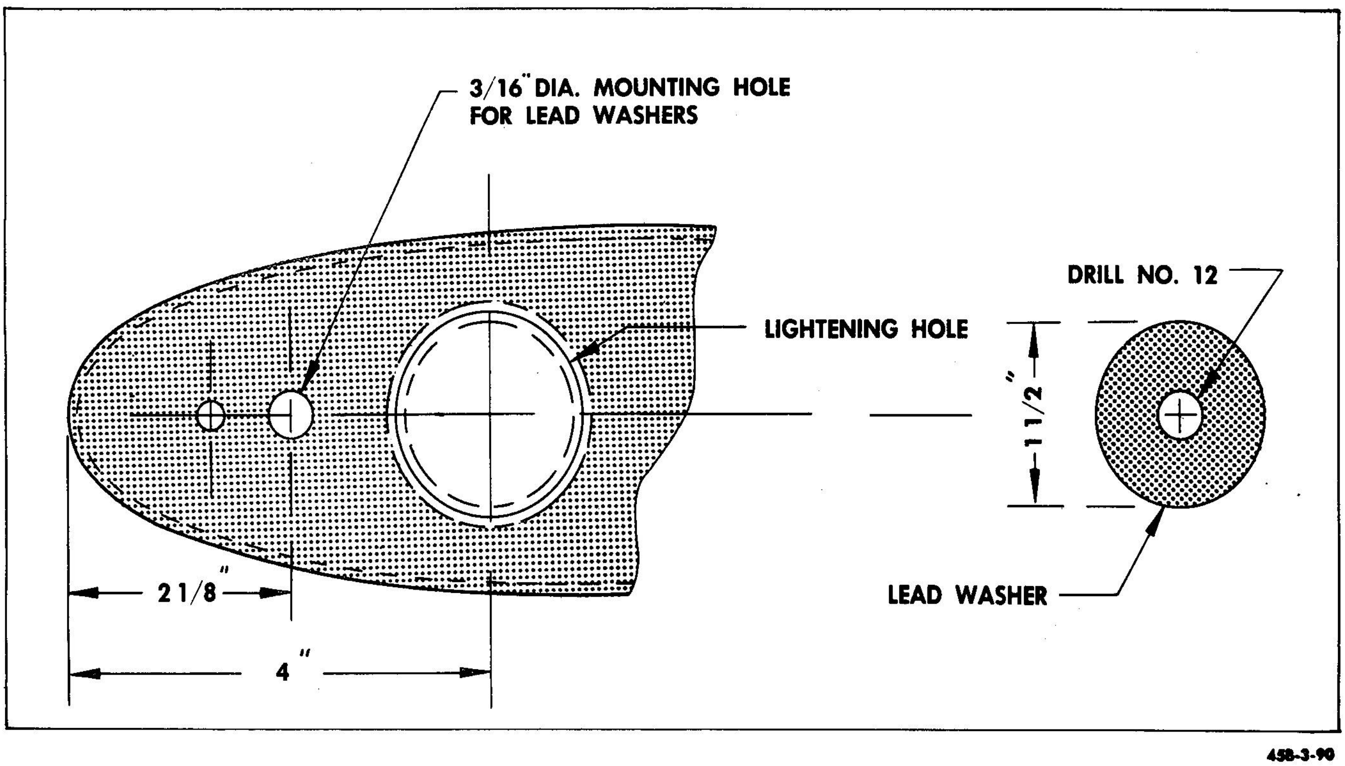


Figure 1-9 Installation of Lead Balance Weights

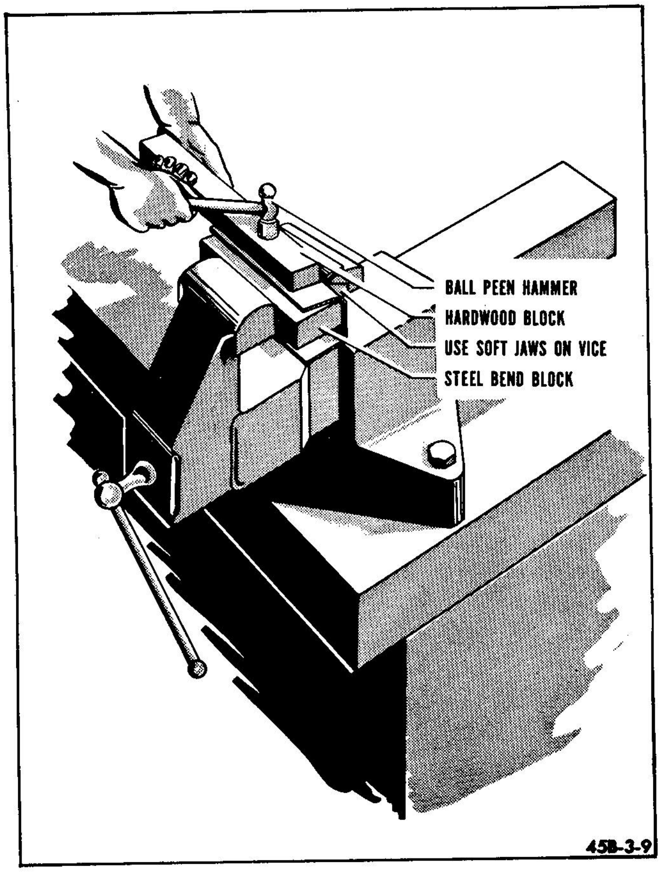


Figure 1-10 Forming U-Section of Sheet Metal

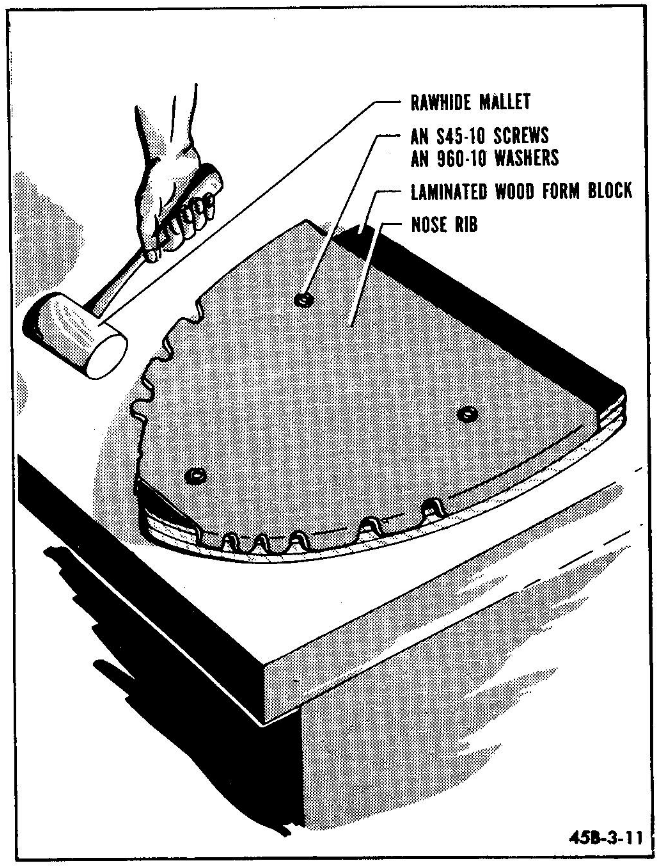


Figure 1-12 Forming Nose Ribs

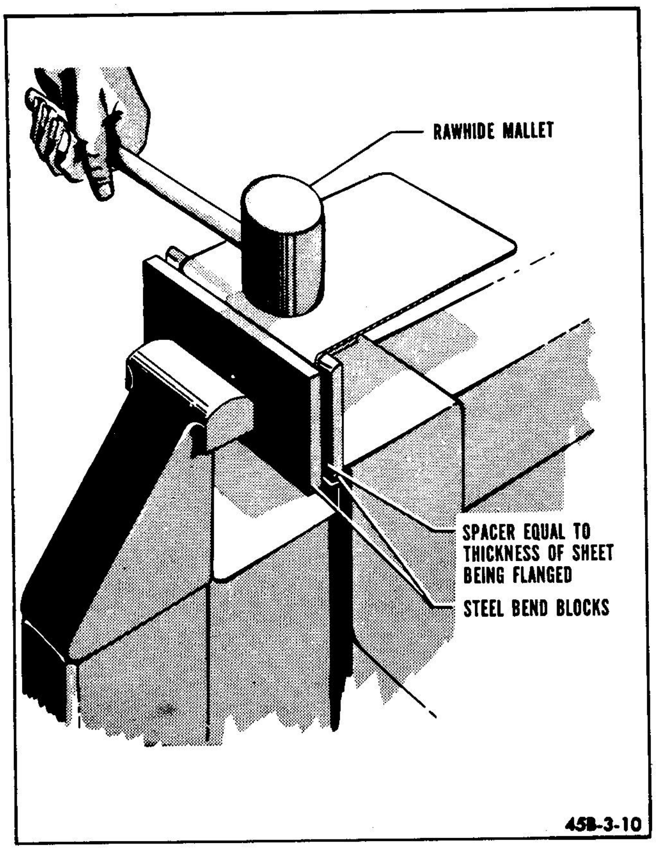


Figure 1-11 Forming Angle in Sheet Metal

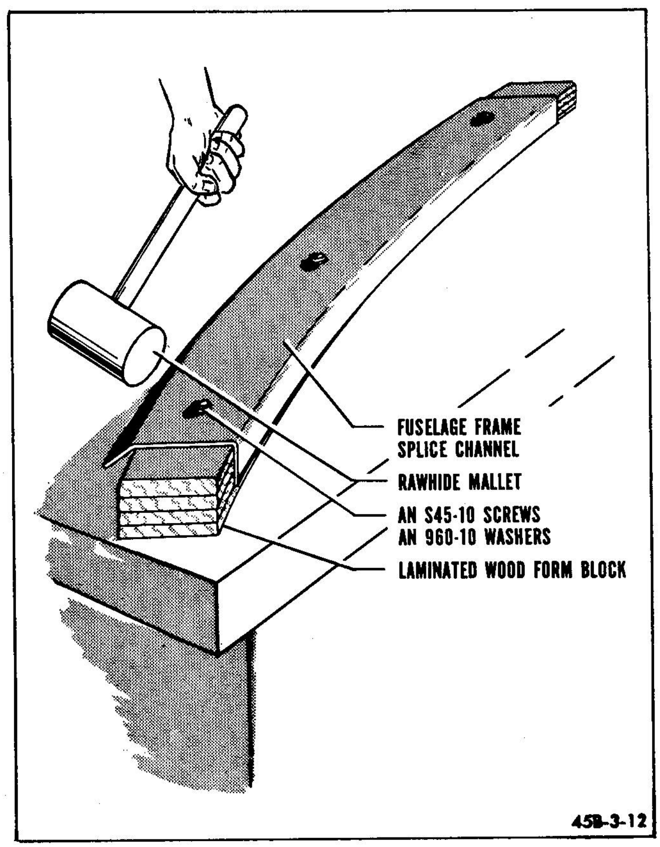


Figure 1-13 Forming Bulkhead Splice Section

REBALANCING CONTROL SURFACES BY COMPUTATION

28 The following method should be followed to determine the amount of weight necessary to restore correct balance requirements if facilities are not at hand to balance the surfaces by actual test.

(a) Accurately determine the weight of the part or parts removed, if any. Measure the distance aft of the hinge centerline and note the location of the approximate center of gravity of the parts removed.

(b) Accurately weigh the replacement parts and measure their location with reference to the hinge centerline.

(c) With the data from the above procedure, substitute the proper values in Equation I to determine the necessary amount of additional balance weight required to properly rebalance the surface.

(d) The additional lead ballast weight must be located inside the leading edge of the surface as far forward as possible and at least as far outboard as the repair.

(e) Equation 1

$$B = \frac{Wdr}{dl}$$

Where B = Ballast necessary at chosen location

W = Weight increase due to repair

dr = Distance of repair aft of hinge centerline

dl = Distance of ballast lead forward of hinge centerline

(f) The flaps are not dynamically balanced and need not be rebalanced after repairs.

FORMING SHEET STOCK

29 Since many of the repairs described in this handbook involve forming of sheet aluminum stock, a short description of the methods used in forming sheet stock will be included here. Patches should be of the same type metal and the next gauge heavier. In order to form the heat-treatable alloys, it will be necessary to form them in the annealed or "O" condition and heat-treat them to the "T" condition after forming and before the patch is installed on the aircraft. Refer to Figures 1-10, 1-11, 1-12, and 1-13 for information on methods of forming aluminum sheet material.

(a) High strength rolled sheet is used for stressed skin and corrugations; formed sheet for the bulkheads and ribs. The material in all replacements or reinforcements will be chosen on the same basis as the material in the original structure. If it is necessary to substitute an alloy weaker than the original, a larger gauge must be used to give equivalent cross-section strength. However, the reverse is not a safe practice. Never use a smaller cross section even when using a stronger metal. All contacting surfaces, regardless of the composition of the materials, must be prepared and all corrosion removed before permanent installation.

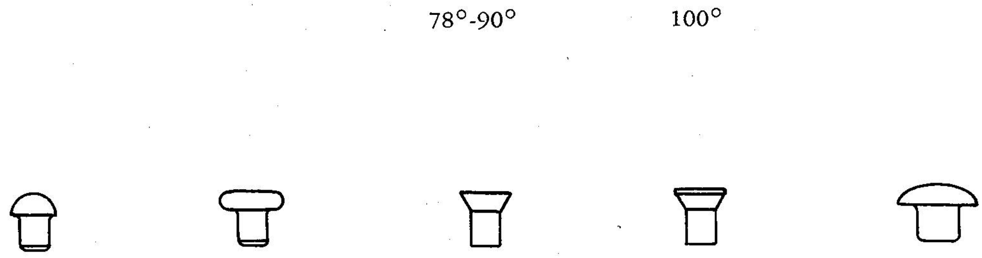
(b) Particular care should be taken when selecting the material to be used when forming is required. The heat-treated and cold worked alloys will stand a very small amount of bending without cracking. The soft alloys, while they are easily formed, are without sufficient strength to be used for primary structures. The strong alloys can be formed in the best manner while in their annealed condition and then, after they are formed, heat-treated to develop their strength before their installation or assembly. In some cases where a soft alloy or annealed metal is not available, it is possible to heat the metal, quench it according to regular heat-treating practices, and then form it before the age hardening sets in. The forming must be completed within one half hour after quenching or the material will become too hard to work. If it is necessary to use a brake to form sections, place a thin piece of soft metal over the brake jaws. This will help in preventing scraping, scratches and damage to the surface of the sheet of material. It has been found that cold-rolling and forming operations, which can be made on steel without injuring the sheet, will sometimes, in the case of aluminum-alloy sheet, cause the metal to flow away from the point of maximum pressure, thus resulting in a sheet of material which is thinner at certain points.

NOTE

Bend lines must be drawn in pencil on aluminum alloy and not scratched in.

Wherever possible the bends should be across the grain of the metal.

(c) The use of tapped plates is justifiable only in the event that a larger number of bolts is required in a space too small to allow necessary working clearance. If the use of a tapped plate is found to be necessary, the physical properties of the plate shall develop the required bolt strength.



AN430	AN442	AN425	AN426	AN455 AN456	AN470
Round Head	Flat Head	Counter-sunk Head	Counter-sunk Head	Brazier Head	Universal Head

Head Markings	Material	AN Std. Rivet Material 425	426	430	442	455	456	470	AN Material Code	Condition	Heat Treat Before Using
Plain	2S	X		X	X			X	A	As Fabricated	No
Raised Cross	56S		X	X				X	B	As Fabricated	No
Dimpled	A17ST	X	X	X	X	X	X	X	AD	(T) Heat Treated	No
Raised Double Dash	24ST	X	X	X	X	X		X	DD	(T) Heat Treated	Yes

Rivet Number Code:
AN430-AD5-12

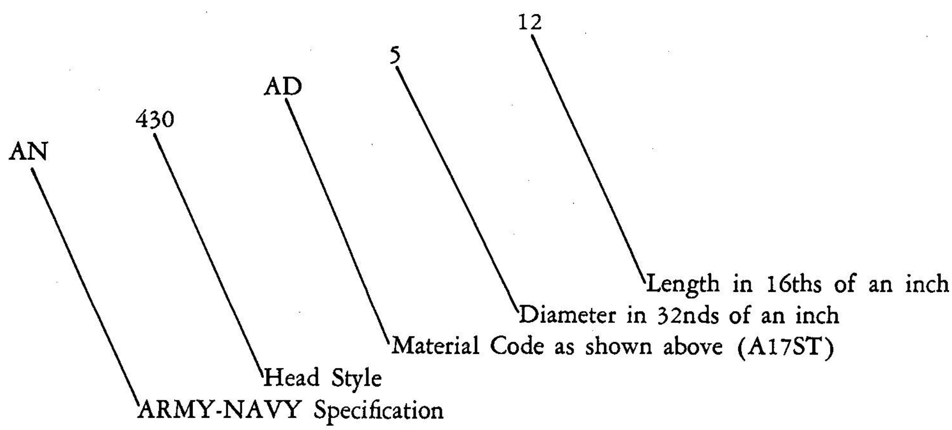


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Figure 1-14 Rivet Identification and Dash Numbers

RIVETS AND RIVETING

30 Standard Solid Shank Rivets — Standard solid shank rivets are generally used in aircraft construction. They are fabricated in the following head styles: roundhead, flathead, countersunk-head, and brazier-head. Roundhead rivets are generally used in the interior of the aircraft except where clearance is required for adjacent members. Flathead rivets are generally used in the interior of the aircraft where head clearance is required. Countersunk-head rivets are used on the exterior surfaces of the aircraft to minimize turbulent air flow. Brazier-head rivets are used on the exterior surfaces of the aircraft where strength requirements necessitate a stronger rivet head than that of a countersunk-head rivet. Both the brazier-head and countersunk-head rivets are used in the interior of the aircraft where head clearance is required.

31 Standard AN Rivets — Standard AN rivets are identified in Figure 1-14. The 2S rivet is made of pure aluminum and is used only in riveting non-structural parts fabricated from the softer aluminum alloys such as 2S (any temper) and 52SO. The A17ST rivet is in general use throughout aircraft structures for riveting parts fabricated from the heat-treatable aluminum alloys. The 24ST rivets are used where their higher strength properties are more desirable than those of the A17ST rivet.

BLIND RIVETS

32 Blind rivets (MS 20600 and MS 20601) are used, where strength requirements permit, when one side of the structure is inaccessible making it impossible or impractical to drive solid shank rivets. Blind rivets have higher defection rates in shear than standard solid rivets. For this reason it is not advisable to replace any sizable number of solid rivets with blind rivets in a given joint, to do so might result in over-stressing the remaining solid rivets. The following specific instructions apply:

(a) Hollow blind rivets shall not be used.

(b) The blind rivet used shall be of the same strength or greater strength and one size larger than the rivet it replaces. Blind rivets may be replaced size for size.

	RIVET DIAMETER							
E/D=1.5	1/16	3/32	1/8	5/32	3/16	1/4	5/16	3/8
SHEET THICKNESS* .016	83							
.018	94	135						
.020	105	150						
.025	131	187	250					
.032	167	239	321	397				
.036	188	270	361	446	537			
.040	209	300	401	496	596			
.045	236	337	451	558	671			
.051	267	382	511	633	760	1022		
.064	341	488	653	811	970	1304	1646	
.072	383	549	735	906	1089	1471	1852	2210
.081	432	619	827	1026	1232	1654	2083	2488
.091	485	695	930	1153	1383	1860	2337	2790
.102	543	778	1041	1288	1518	2083	2616	3132
.128	682	978	1304	1614	1916	2616	3283	3927
.156	835	1193	1598	1972	2369	3188	4007	4794
.188	994	1431	1916	2369	2846	3832	4818	5756
.250	1328	1908	2552	3156	3792	5104	6416	

*Values for Clad 24S-T3 aluminum sheet are equal to or greater than those listed in this table.

E = Edge Distance

D = Hole Diameter

Table 1 Bearing Strength of Rivets on Clad 24S-T4 Aluminum Sheet
* (Heat-Treated by User)

(c) When possible, the exposed end of each clipped plug shall be coated with a 10-percent chromic acid solution or with chromate primer.

(d) If blind fasteners other than blind rivets are encountered, it is recommended that replacements be made by either a blind or a standard rivet.

33 Standard Holes for Rivets — The following table specifies the size hole to drill for the application of various sizes of rivets.

Rivet Diameter	Drill Size
3/32	No. 41
1/8	No. 30
5/32	No. 21
3/16	No. 11
1/4	No. F
5/16	No. P
3/8	No. W

Rivet Requirements

34 To compute the number of rivets to be used in a patch, use the following procedure:

(a) First, determine the allowable ultimate tensile strength of the material and compute the design load, using the following formula:

Design Load = Length of crack x X x gauge of skin, X being the allowable ultimate tensile strength of the material being repaired.

For example, assume a crack 2½ inches long in a piece of 24ST aluminum sheet, .032 thick. Aluminum alloy 24ST sheet has an ultimate tensile strength of 60,000 pounds per square inch. See table V. Thus:

Design Load = 2.5 x 60,000 x .032 = 4800 pounds.

(b) It is possible to use rivets of several different sizes in making a repair. Good design practice is to make a joint which has approximately equal strength in shear and bearing, with the bearing strength slightly higher, if possible.

	RIVET DIAMETER								
SHEET THICKNESS* E/D=2.0	1/16	3/32	1/8	5/32	3/16	1/4	5/16	3/8
.016	95							
.018	107	153						
.020	119	170						
.025	149	212	284					
.032	189	272	364	450				
.036	213	306	410	506	609			
.040	237	340	455	563	676			
.045	267	382	512	634	761			
.051	303	434	580	718	862	1159		
.064	393	562	752	933	1116	1501	1894	
.072	441	632	846	1043	1254	1693	2132	2544
.081	497	712	952	1180	1418	1903	2397	2864
.091	558	800	1071	1327	1592	2141	2690	3212
.102	625	896	1199	1482	1748	2397	3010	3605
.128	785	1125	1501	1857	2205	3010	3779	4520
.156	961	1373	1839	2269	2727	3699	4612	5517
.188	1144	1647	2205	2727	3276	4410	5545	6625
.250	1528	2196	2937	3633	4365	5874	7384	

*Values for Clad 24S-T4 aluminum sheet will be equal to or greater than those listed in this chart.

E = Edge Distance

D = Hole Diameter

Table 2 Bearing Strength of Rivets of Clad 24S-T4 Aluminum Sheet
* (Heat-Treated by User)

SHEET THICKNESS*	RIVET DIAMETER							
	1/16	3/32	1/8	5/32	3/16	1/4	5/16	3/8
.016	102							
.018	104							
.020	106							
.025		211						
.032		217	374					
.036			380					
.040			386	575				
.045			388	584				
.051				594	838			
.064				596	862	1494		
.072						1519	2371	
.081						1544	2396	
.091						1550	2421	
.102							2450	3412
.128							2460	3510
.156								
.188								
.250								

*Thickness of Finished Sheets

Table 3 Shear Strength of Protruding Head A17S-T3 Aluminum Rivets (Single Shear)

SHEET THICKNESS*	RIVET DIAMETER							
	1/16	3/32	1/8	5/32	3/16	1/4	5/16	3/8
.016	146							
.018	160							
.020	168							
.025	184	310						
.032	198	355	534					
.036	206	372	574					
.040	209	389	615	820				
.045	212	400	645	882				
.051		417	675	944	1231			
.064		434	726	1053	1410	2133		
.072			756	1095	1477	2294		
.081			776	1130	1545	2455	3385	
.091				1161	1590	2576	3705	
.102				1192	1657	2697	3897	5012
.128					1724	2899	4344	5742
.156						3060	4600	6199
.188						3100	4792	6564
.250							4920	7020

*Sheet thickness is that of middle sheet.

Table 4 Shear Strength of Protruding Head A17S-T3 Aluminum Rivets (Double Shear)

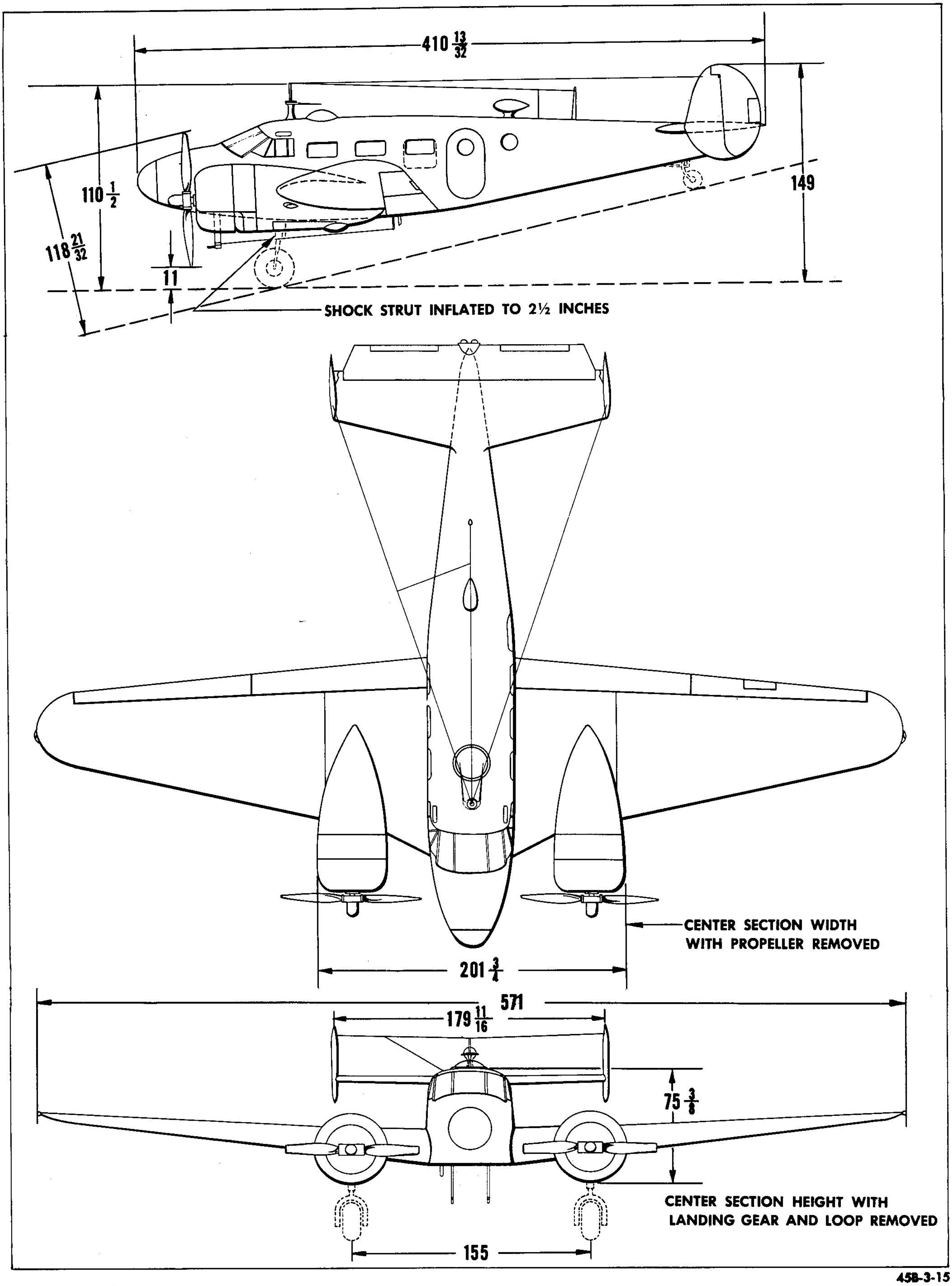

Figure 1-15 Rigging Dimensions

A general rule for selecting rivets of the proper diameter to join aluminum-alloy sheets is to select a size having a diameter approximately three times the thickness of the heavier sheet in the patch. An A17ST rivet with a diameter of 1/8 inch has been selected for this example. The allowable shear and combinations of rivet diameter, sheet material, and gauge thickness are given in Tables 3 and 4. The permissible bearing load per rivet must be based on the thinner material where different gauges of material are used in the repair. The allowable load for one A17ST rivet 1/8 inch in diameter, as given in the table are: Allowable shear load = 374 pounds; allowable bearing load = 364 pounds. The smaller of these values must be used as the allowable load per rivet; in this example, 364 pounds.

(c) The ratio between the diameter of the rivet hole and the distance from the hole to the edge of the material is a critical factor in the bearing strength of rivets. In the tables, ratios of 1.5 and 2.0 have been used; i.e. in Table 1, the calculations were based on the edge distance being 1.5 times the hole diameter and in Table 2, the edge distance is twice the hole diameter. In using the tables, these ratios must be observed; wherever possible, they should be maintained or exceeded in making repairs. The 1.5 ratio is generally accepted as a minimum in good aircraft practice.

(d) The number of rivets required on each side of the crack may now be determined:

$$\text{Number of rivets required} = \frac{\text{Design Load}}{\text{Allowable load per rivet}}$$

or

$$\text{Number of rivets required} = \frac{4800}{364} = 13.2 \text{ (use 14)}$$

1. Hamilton Standard Hydromatic Propeller
2. Lower Cowling
3. Upper Cowling
4. Wrapper Sheets
5. Carburetor Air Intake
6. R985-AN14B Pratt & Whitney Engine
7. Carburetor Air Heater Valve
8. Exhaust Collector Ring
9. Inner Cowling
10. Tail Pipe
11. Engine Mount
12. Former Ring
13. Firewall
14. Spar Assembly — Center Section
15. Main Landing Gear Doors
16. Main Landing Gear
17. Outboard Wing
18. Wing Tip
19. Navigation Light
20. Aileron
21. Aileron Tab
22. Flap
23. Center Section Wing
24. Cabin
25. Cabin Door
26. Tail Wheel Slide Tube
27. Tail Landing Gear
28. Tail Wheel Shock Strut
29. Horizontal Stabilizer
30. Vertical Stabilizer
31. Rudder
32. Rudder Tab
33. Elevator
34. Elevator Tab
35. Tail Cowling
36. Aft Fuselage
37. Loop Antenna
38. Astrodome
39. Pilot's Cabin
40. Antenna Mast
41. Fuselage Nose
42. Nose Door
43. Pitot Mast

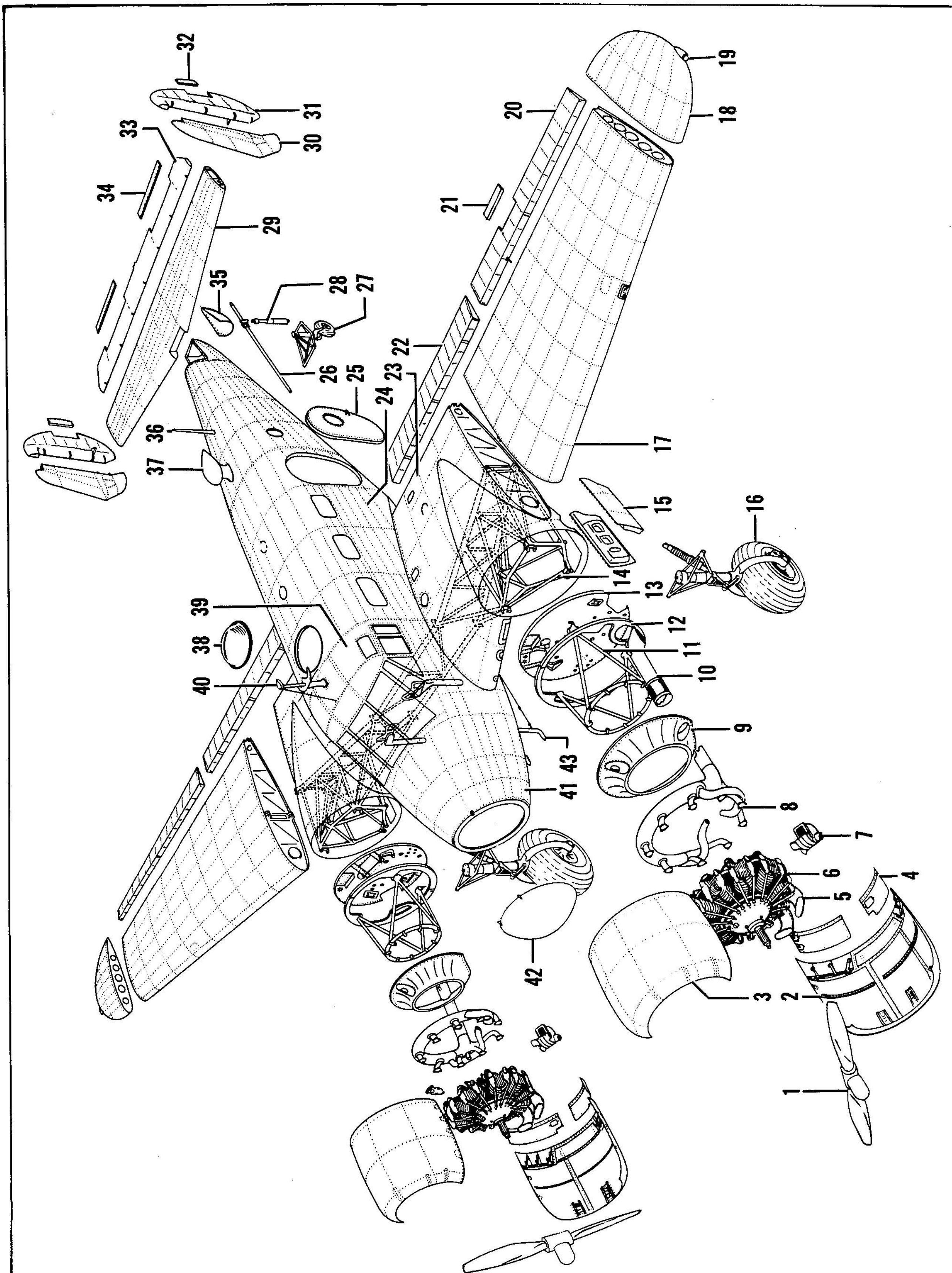

Figure 1-16 Three-Quarter View Exploded into Major Assemblies

45B-3-14

PART 2
WING GROUP

TABLE OF CONTENTS

DESCRIPTION

1 The wing is an all metal, cantilever type composed of three sections; center section wing, outboard wing and wing tip. The spar of the outboard wing attaches to the center section truss at the upper and lower spar fittings with specially tapered spar bolts and nuts. A special nut and bolt also secure the outboard wing to the rear spar of the center section wing stub. The wing is of the same general construction as the outboard wing. It is attached by a hinge wire through the front spar and by machine screws through the skin of the wing panel and wing tip.

CENTER SECTION WING

2 The primary structure of the center section consists of a single, welded, heat-treated, tubular steel truss. This truss carries the fittings for the engine mounts, landing gear and outer wing panel main spar. Recesses are provided in the center section for the installation of four fuel tanks: one 63 Imperial gallon and one 21 Imperial gallon on each side. Also provided are recesses to house two batteries, one on each side. The remainder of the center section structure consists of aluminum alloy ribs, bulkheads, stringers and a smooth skin covering. The rear spar is a shear beam which supports the center and inboard flap hinges. Removable panels are provided over the fuel tanks and battery box openings.

REPAIR LIMITS OF CENTER SECTION TRUSS

Preparation for Repair of Welded Truss

3 Prior to making any type of a weld repair thoroughly inspect the damaged area to ascertain that it does not extend beyond the limits shown in the illustration pertaining to the tube or cluster to be repaired.

(a) Cut the tube to fit as shown in the illustration.

(b) Obtain material for sleeves and cut to size as shown in the illustration. The closest possible fit must be maintained between the sleeve and tube. If it is necessary to ream the sleeve, do not remove more than .010 inch of material from the tube wall.

(c) Pack the area immediately adjacent to the repair with asbestos mud to minimize the heat transfer.

WARNING

Drain and purge or remove all fuel tanks and remove vent plugs from the tubes being welded. Failure to do so may result in an explosion.

Procedure for Repair of Welded Structures

4 The equipment recommended for weld repairs is the electric arc and welding rod Spec MIL-E6843. Since the centre section is a heat treated assembly, all welds must be of the highest quality and should be accomplished by Class A welders in accordance with Proc 101-12 who are thoroughly familiar with this type of weld repair. Make all welds in still air under temperature condition which will not allow the weld to cool too rapidly. Magnaflux all welds; if possible, the repair weld should be magnafluxed the day following welding. Carefully examine the results of the magnaflux inspection, since major and minor defects will be revealed. In case of doubt, reject a weld rather than risk a failure in service. Welds, of inferior quality, constitute a potential hazard to the aircraft and occupants. Make sure the finished weld is of the highest quality.

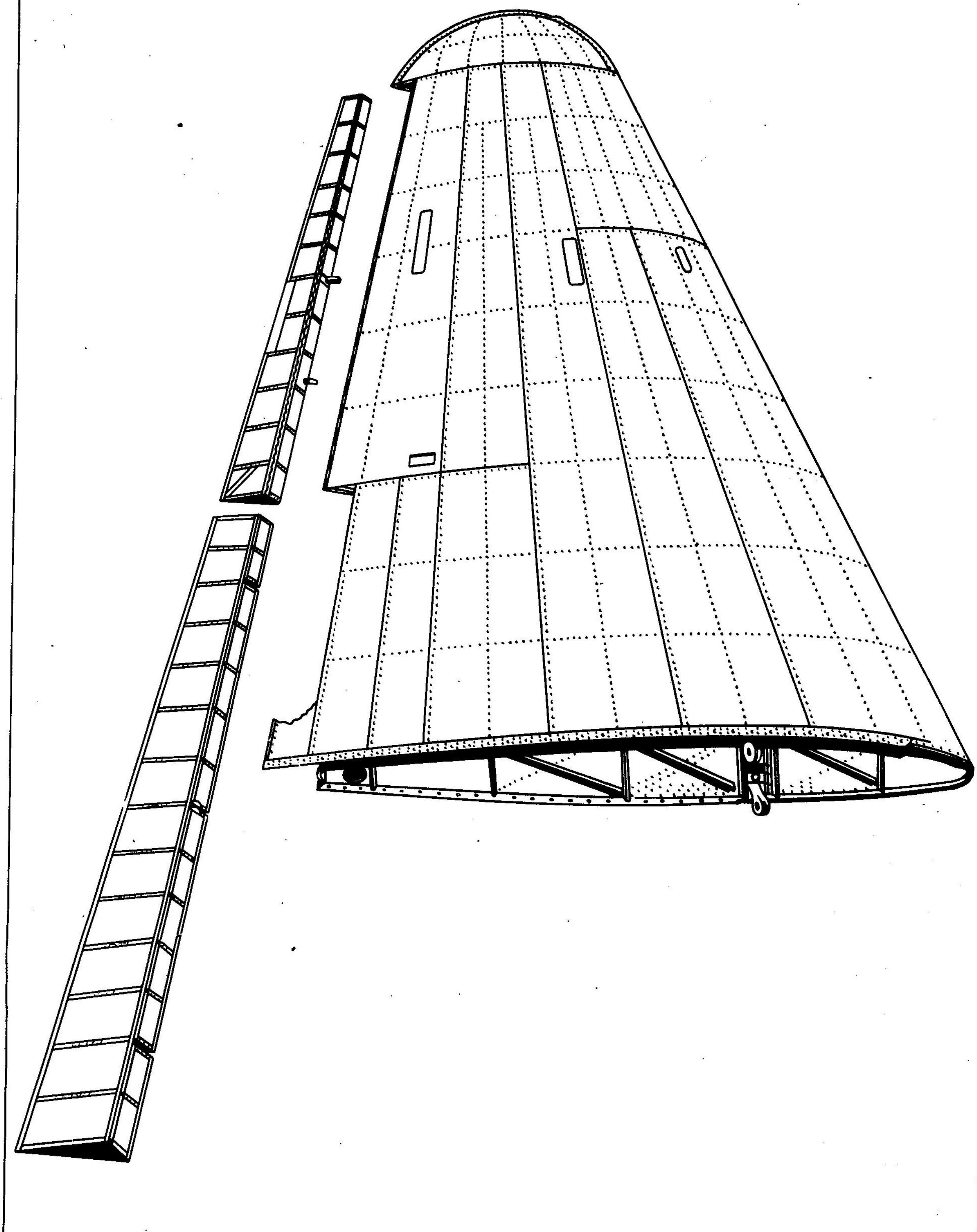

Figure 2-1 Wing Group Exploded View

45B-3-16

(a) The "Tungsten Inert Gas" welding process may be used for structural repairs to Expeditor aircraft as an alternate to the electric arc process. A DC tungsten inert gas machine is to be used with 2% thoriated tungsten electrode of the appropriate size, and suitable argon flow. Filler material to be MIL Spec. R5632, Class 2. Welding to be carried out by Class A welders thoroughly familiar with the TIG process.

(1) In the repair of cracked welds all paint is to be removed from the immediate area, grind out excess weld metal flush to surface of parent metal.

(2) In new welds, installation of inserts or reinforcements, mating surfaces shall be thoroughly cleaned and bevelled as required.

(3) Pre-heat weld zone with oxy-acetylene torch to 375° F, determine temperature by use of a tempelstik.

(4) Where feasible the weld should be completed in one pass, if subsequent passes are required it is mandatory that the previous pass be completely cleaned by using a wire brush.

(5) Post heat weld zone with oxy-acetylene torch to 900° F reducing heat to 300° F over a period of 15 minutes. Determine temperatures by use of tempelstik.

Procedure for Repair of Cracked Areas

5 Cracks in the center section truss fittings may be repaired only to the extent shown in Figures 2-4, 2-5, and 2-7. Use the following procedure:

(a) Grind out or vee cracks to a minimum of one half the thickness of the structure wall or web, using a 1/8-inch rotary file. Grind sufficiently to insure complete weld penetration.

(b) Isolate the repair area by packing asbestos mud immediately adjacent to the cracked area so as not to preheat the adjoining areas.

(c) Preheat with a No. 22 tip (Smith orifice) using a neutral flame directed on the crack alone or on the bottom of the ground-out area. Do not play the flame over the adjoining area.

NOTE

The No. 22 tip is a Smith designation tip, having an orifice size of .030 (the size of a 68 drill).

(d) Continue preheating until the point directly below the cone of the flame attains black heat or purple oxide rings extending 1/4-inch from the crack. This will indicate sufficient preheating of the area.

(e) Arc weld immediately, using the method described in paragraph 4, part 2. After the red heat disappears, peen the bead with a ball peen hammer which has a 1/8-inch head radius.

(f) Before the weld has cooled below 350° F (light straw color), post-heat by concentrating the flame from a No. 22 tip (Smith orfice) along the center of the new bead. Do not play the flame on the adjoining area.

(g) Continue post heating until the bead reaches black heat (950/1000° F) or purple oxide rings extend 1/4-inch from the bead (500° F).

(h) Allow the repair to cool in still air.

(j) Magnaflux after the repair has cooled.

Replacement and Repair of Welded Clusters

6 Repair to the several welded clusters may be made only within the limits prescribed in the following paragraphs. Those clusters which are replaceable may be replaced with clusters from a salvage truss, as directed in the individual paragraphs and illustrations. In all cases, however, care must be taken to remove the damaged cluster and the cluster from the salvage truss, in exactly the same manner.

LOWER SLIDE TUBE CLUSTER

7 This cluster is not replaceable and is repairable only to the extent shown in Figure 2-4 and within the following limits: cracks on the bottom of the -7 tube may be repaired within the limits given on the top side of the tube (Figure 2-4) except that only one repair may be made in any given section; i.e., repairs must be staggered at least one inch.

Wing Spar Bolt Fitting Clusters

8 These clusters are not replaceable and are repairable only within the limits shown in Figure 2-5. The ends of the wing outboard panel spar caps, where the wing hinge bolt forgings are welded in, are filled with solder. Linoil seepage at these points will require very careful inspection to determine whether the weld or tube is cracked or the solder merely has parted from the joint. All solder should be removed before welding and replaced when weld is finished. Temperature of the fitting during soldering must not exceed 204° C (400° F).

9 Weld repairs may be made to cracks appearing in the outboard wing panel front spar, where the spar bolt fitting is welded to the spar cap, if they are no longer than 1 1/2 inches and run along the weld; however, only one weld of this length is permitted on any one fitting. All other welds must be 3/4 inch or less. Cracks along welds on either fore or aft forgings on top bottom sides, may be repaired, but only two welds may be made on one forging or a total of four on any one fitting assembly. Repairs to the fitting and their attachments must be made in accordance with instructions shown in Figure 2-6.

ENGINE MOUNT FITTINGS

10 Cracks in engine mount fittings may be repaired only to the extent shown in Figure 2-7 and within the following limits:

WARNING

When repairing the heat-treated tubes by welding, a partial destruction of the strength occurs. Therefore, only those clusters or tubes on which repairs are approved will be discussed. It may be considered that any tube or cluster not covered is not repairable. Do not exceed limits set forth for each repair.

(a) Cracks in the bends of the fitting center piece may be welded entirely across the center piece. See 1, Figure 2-7.

(b) Cracks between the fitting and tubes may be welded when crack is transverse. Tube may be welded to an extent of 5/8 inch. See 2, Figure 2-7.

(c) Cracks between the fitting lug piece and the fitting center piece may be welded to the extent of 5/8 inch, see 3, Figure 2-7.

(d) Cracks between fittings or gussets and tubes may be welded when the crack is parallel to the center line of the tube and is not more than one inch long. See 4, Figure 2-7.

NOTE

A second weld in the same fitting should not be made until the first weld has cooled to minimize heat transfer.

(e) Upon the discovery of a crack, either by visual inspection or magnaflux, grind to determine the extent of the crack. Use a rotary file with a ⅛-inch radius, being careful not to exceed limits prescribed for repair. If crack continues beyond repair limit, replacement of tube or cluster may be necessary. Careful distinction must be made between a crack and an actual void at the end or bottom of a weld, where the weld has not penetrated. If possible, repair weld should set overnight before magnafluxing.

UPPER SLIDE TUBE CLUSTER

11 Replacement of damaged upper slide tube cluster requires the cutting and splicing of tubes -32, -33, -34, and -35. See Figure 2-9. Use the following procedure:

(a) The slide tube must be removed. Remove the bolts in the fitting at each end of the slide tube and slide the tube through the top fitting.

NOTE

In most cases where the upper slide cluster is damaged, the slide tube will be damaged beyond repair. In such cases, removal of the tube will be simplified by sawing it in half.

(b) Locate the position for cutting the tube by referring to Figure 2-9.

(c) Place the splice tubes on the tubes in the truss and slide down past cut off ends.

(d) Install the replacement fitting and slide the splice tubes equidistantly over the joints. With the fitting thus held in position by the sleeves, install a slide tube and bolt into place.

(e) After tacking the fitting in place, weld the ends of the splice sleeves, making but one weld at a time on each sleeve. Magnaflux after welding.

(f) Install the landing gear. Check travel for complete retraction of gear.

(g) If necessary, dress off the upper slide tube fitting to allow full upward travel of the slide, or tack a spacer on the fitting to limit upward travel.

Lower Engine Mount Fitting Cluster

12 The lower engine mount fitting cluster may be replaced. To do so, proceed as follows:

(a) Obtain a replacement fitting from a salvage truss being careful to remove it and the damaged cluster in identical manner.

(b) Removal of the cluster will require cutting tubes -36, -37 and -38. See Figure 2-10 for location of the cuts on -38 and Figure 2-8 for -36 and -37.

(c) Splicing of the -38 tube depends on the extent of the damage. If the tube has been buckled due to damage of the lower engine mount fitting, the tube should be cut at AA and BB and spliced with a long splice tube as shown in Figure 2-10. If tube is not damaged, cut at BB and splice with a short splice tube.

(d) With the damaged fitting removed and a replacement fitting ready to install, slide the splice tubes for -36, -37 and -38 on their respective stubs on the fitting.

(e) Move the fitting into its correct position and slide splice tube equidistantly over the tube cuts.

(f) Install a mount to assist in locating and steadying the position of the lower fitting.

(g) Obtain the fore and aft locations. This is done by measuring from an axis through the center of the 7/16-inch bolt hole and the landing gear hinge fitting. This measurement is centered as shown in Figure 2-11. The true dimension is 13 and 9/64 inches, plus 1/32 inch. This can be obtained by inserting a one-inch round bar through the landing gear hinge fitting, measuring between the bar and the 7/16-inch bolt and adding the sum of the radii of the bar and bolt.

(h) When the fitting is properly located, tack weld to hold it in position.

(j) Remove engine mount and one-inch bar. Weld ends of splice tubes, making but one weld at a time on each sleeve. Magnaflux after welding.

NOTE

If the lower bushing in the engine mount is worn to the extent that bolt will not center in the bushing, replace it before using the mount as a jig.

Inboard Landing Gear Hinge Fitting Cluster

13 To remove a damaged inboard landing gear cluster, proceed as follows:

(a) Remove the cluster from the aircraft and from a salvage truss. See Paragraph 6, Part 2.

(b) Removal of the inboard landing gear hinge fitting requires cutting the -23, -24, -34 and -36 tubes. The location for cutting the -23 at AA is shown in Figure 2-15, for -24 at BB, Figure 2-13, for -34 at BB, Figure 2-14 and -36, Figure 2-8.

(c) Obtain material for splice tubes and cut them as shown in their respective illustrations.

(d) Mark splice tubes for proper location of splice gap. Also mark tubes to properly locate sleeves.

(e) Cut the splice tubes for the -23, -24, -34 and -36 splice tubes as shown in their respective illustrations.

(f) Place the -23, -24 and -34 splice tubes on the replacement cluster. The -36 splice tube must be placed on the truss portion of the tube.

(g) Position the replacement cluster and slide the splice sleeve into place, aligning with marks made in step (d). With the cluster now loosely installed, install an engine mount to keep the lower mount fitting in place.

(h) Install the landing gear. If the landing gear bushings are worn, install new ones.

(j) Adjust wheels for "O" caster and camber. When hinge joint cluster is properly located, tack weld the joints in the following order: -34, -24, -23 and -36.

(k) Remove landing gear and engine mount. Weld splice in the following order: -23, -24, -36 and -34.

Outboard Landing Gear Hinge Joint Cluster

14 To replace a damaged outboard landing gear hinge joint cluster proceed as follows:

(a) Obtain a salvage cluster and remove damaged cluster. See Paragraph 6, Part 2. This will require cutting tubes -28, -29, -35 and -37. Cut tubes -28 at BB Figure 2-16, -29 at BB Figure 2-13, -35 at BB Figure 2-14 and -37 as in Figure 2-8.

(b) Cut and mark splice sleeves and mark tubes for sleeve location.

(c) If landing gear bushings are worn replace them. Install landing gear to provide means for aligning cluster. Adjust wheels for "O" caster and camber, moving free hinge point to obtain proper alignment.

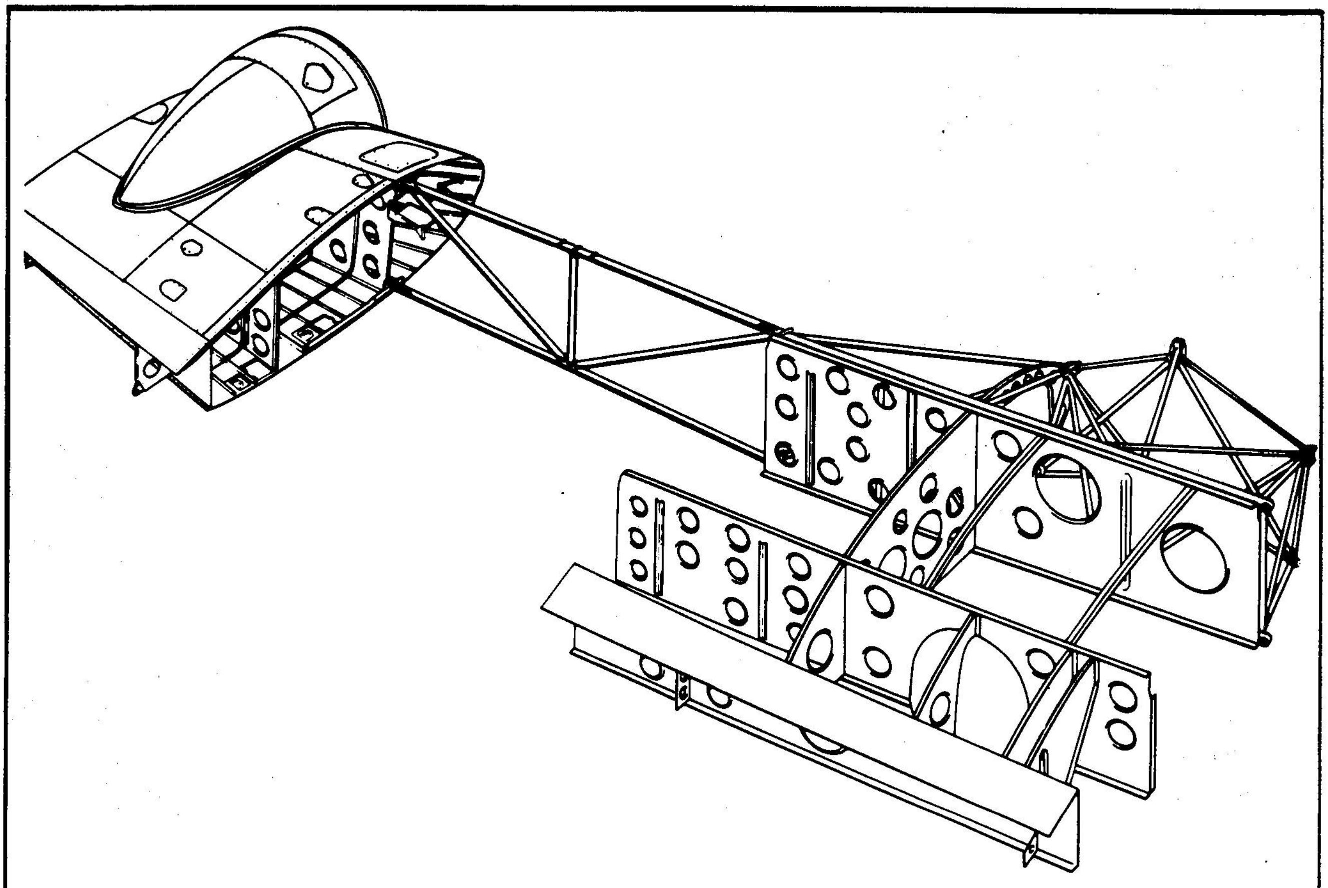

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Figure 2-2 Center Section Wing

CAUTION

While aligning the landing gear, be sure that aircraft is completely supported on the jacks and that both gears are fully extended.

(d) Tack weld the hinge point after it is properly aligned with respect to caster and camber. Tubes should be tacked in the following order: -35, -29, -28 and -37.

(e) Remove landing gear.

CAUTION

Remove vent plug on tubes being welded. Failure to do so may result in an explosion while welding.

(f) Make final weld on tubes in the following order: -28, -29, -37, and -35. Make but one weld at a time on each tube. Before making second weld on tube, allow it to cool. After completion of weld, magnaflux.

(g) Replace vent plug.

Repair Instructions for Replacing Truss Assembly Center Spar Outboard

15 To accomplish this repair it will be necessary to either drain and purge all fuel tanks, or drain and remove all fuel tanks. Then proceed as follows:

(a) Remove batteries.

(b) Drill out rivets and remove bottom leading edge of inboard wing. Install jack pads and place aircraft on jacks capable of supporting the aircraft in level position.

(c) Remove propellers, cowling, and engines.

(d) Disconnect all wiring, plumbing, and cables from the wing that is to be removed.

(e) Remove wing flap and outboard wing. Place adjustable support under the outboard end of the opposite wing.

(f) Remove main landing gear and landing gear doors on the side to be repaired.

(g) Remove firewall attaching clamps and oil tank cover.

(h) Remove all engine controls, plumbing, and electrical wiring from firewall and leading edge wing section forward of truss. Cap all exposed plumbing.

(j) Drill out rivets and remove lower inboard and outboard nacelle skin and firewall. (Oil tank need not be removed.) See Figure 2-12.

(k) Remove inboard upper leading edge skin, Nose Rib 2, and battery stand.

(l) Remove Nose Rib 2 and electrical junction box. Secure engine controls and wiring away from the field of operation.

NOTE

Remove liquidometer wires from Nose Rib 2 electrical junction box before removing the junction box from the aircraft.

(m) Remove flap shaft and nacelle gearbox.

(n) Remove gear shaft, chain, lower chain sprocket and associated parts from the nacelle and truss assembly.

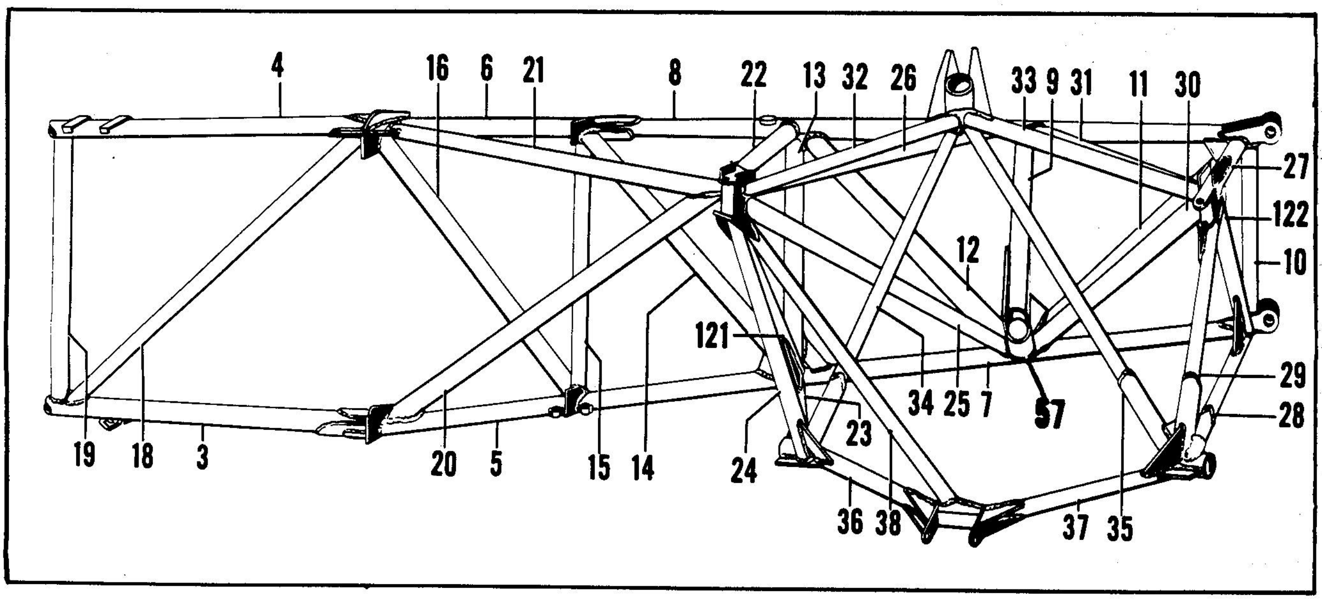


Figure 2-3 (Issue 1) Truss Tube Members, Numbered

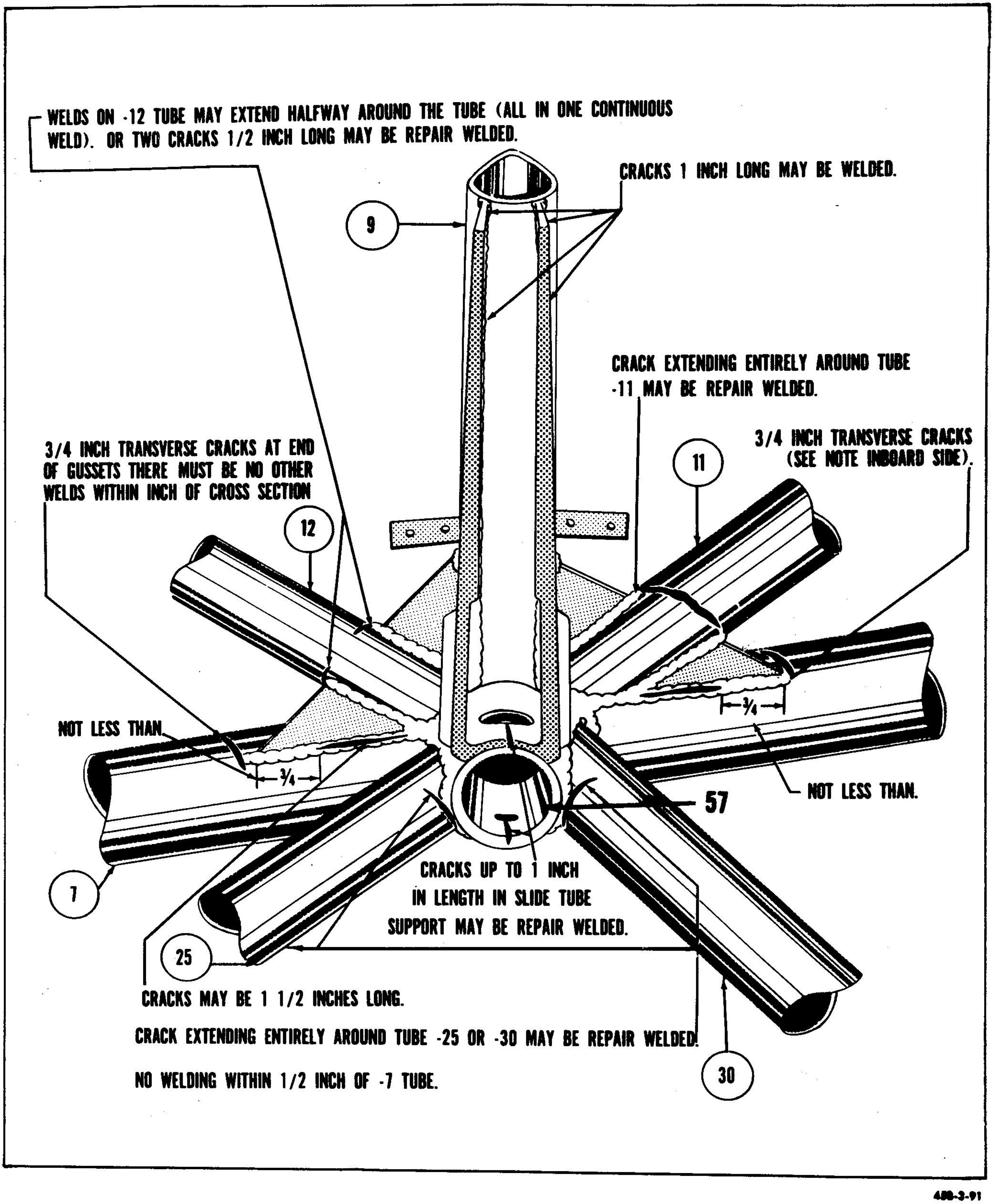
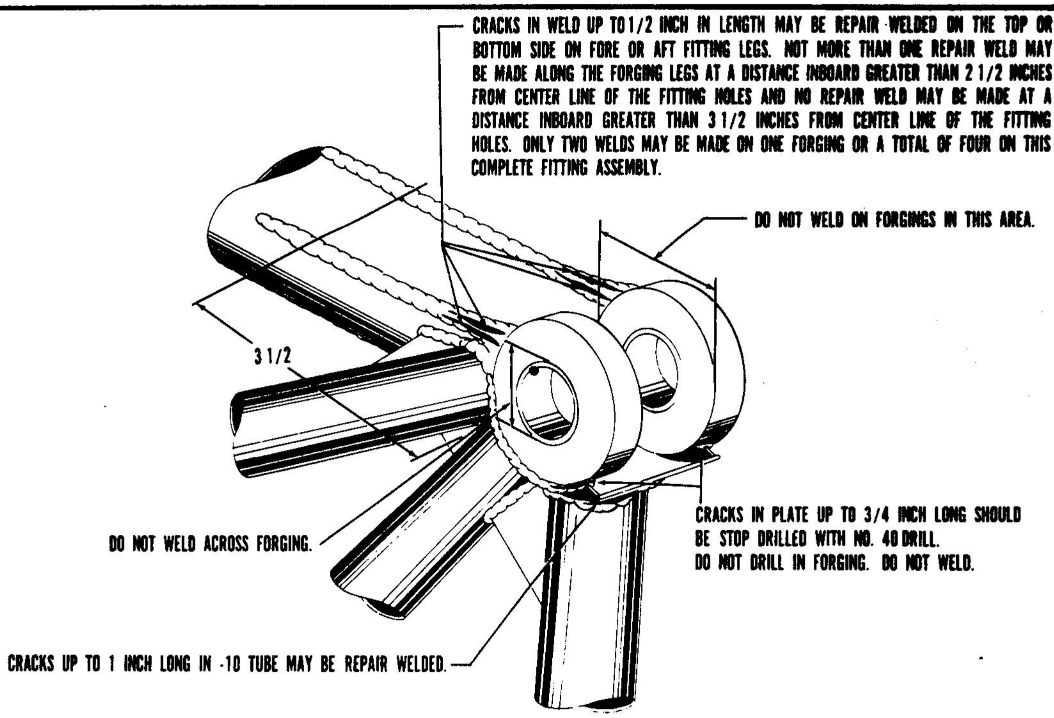
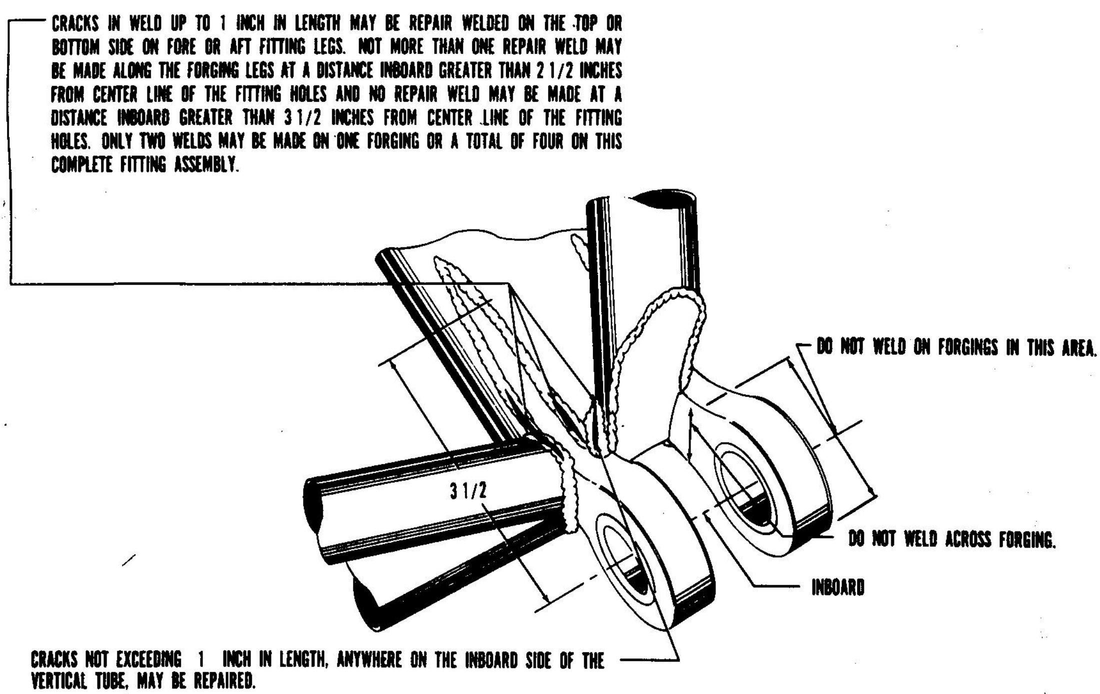


Figure 2-4 (Issue 1) Lower Slide Tube Cluster



NOTE: A SECOND WELD IN THE SAME FITTING SHOULD NOT BE MADE UNTIL FIRST WELD HAS COOLED



NOTE: CARE MUST BE EXERCISED IN GRINDING OUT CRACKS TO AVOID EXCEEDING CRACK EXTENT AND GRINDING INTO VOID. A SECOND WELD IN THE SAME FITTING SHOULD NOT BE MADE UNTIL FIRST WELD HAS COOLED

Figure 2-5 Wing Spar Bolt Fitting Clusters

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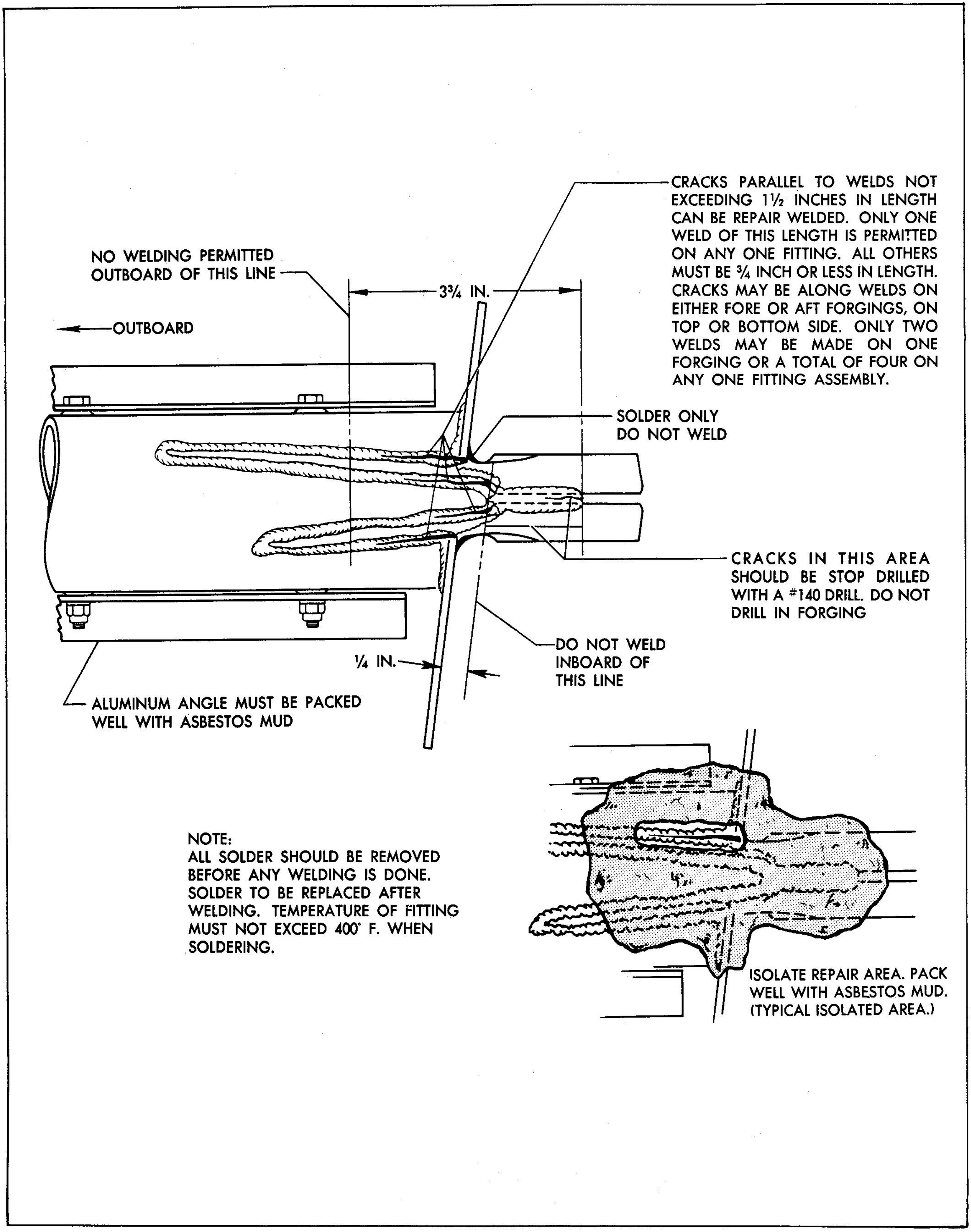

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Figure 2-6 Outer Wing Panel Spar Fitting

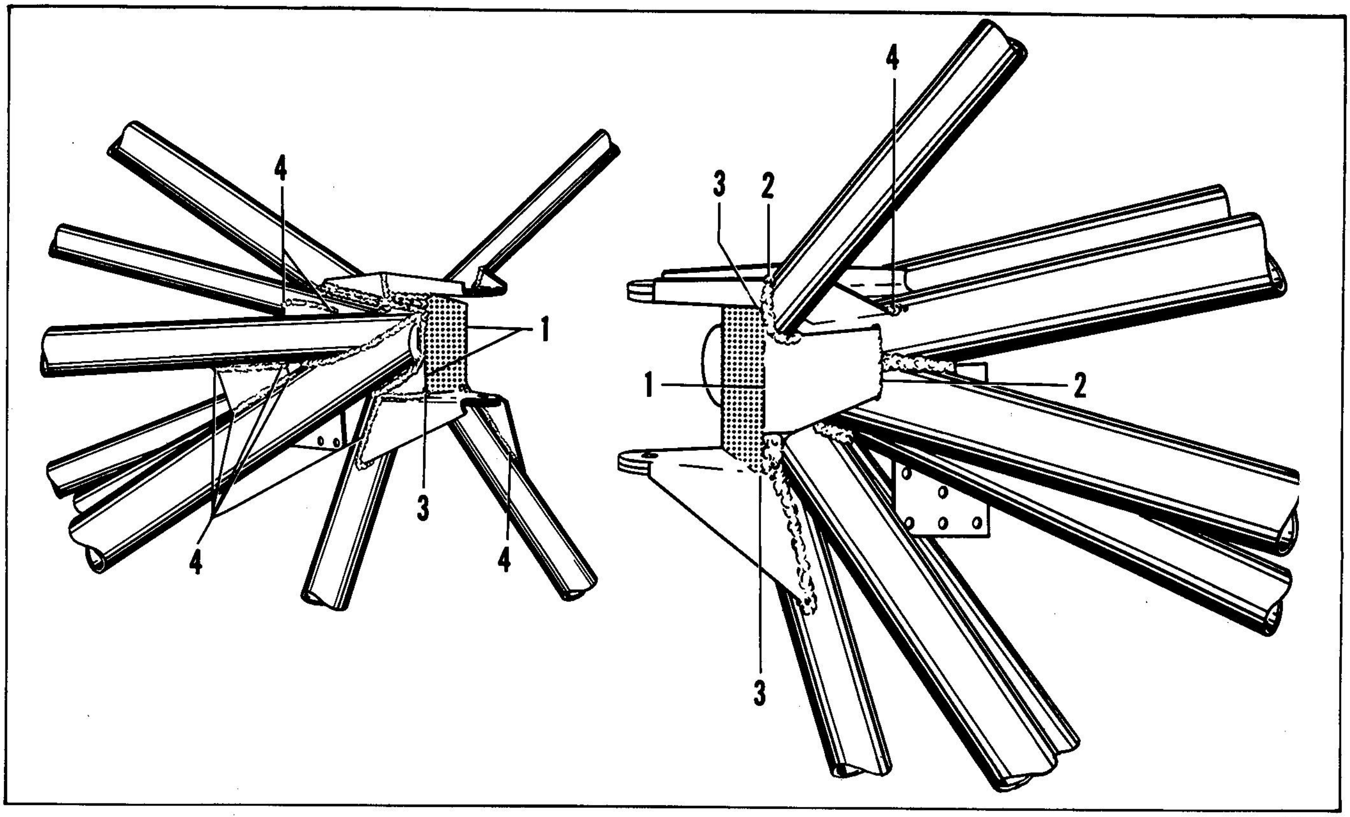
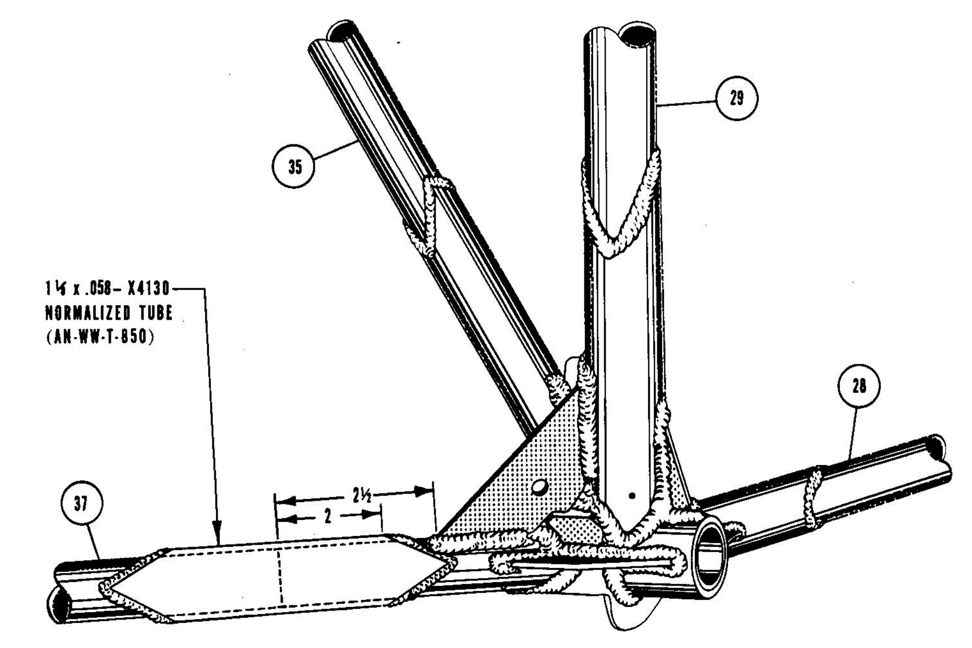


Figure 2-7 Engine Mount Fitting Repairs



NOTE: THIS SPLICE IS GOOD FOR BOTH -36 AND -37 TUBES AND CAN BE MADE ON EITHER END OF THE TUBE. IN SPLICING AT THE END NEXT TO THE ENGINE MOUNT FITTING, THE 2½" DIMENSION WILL BE FROM THE FARTHEST POINT UP WHERE THE WELD ATTACHES THE GUSSET TO THE TUBE.

Figure 2-8 Splicing -36 and -37 Tubes

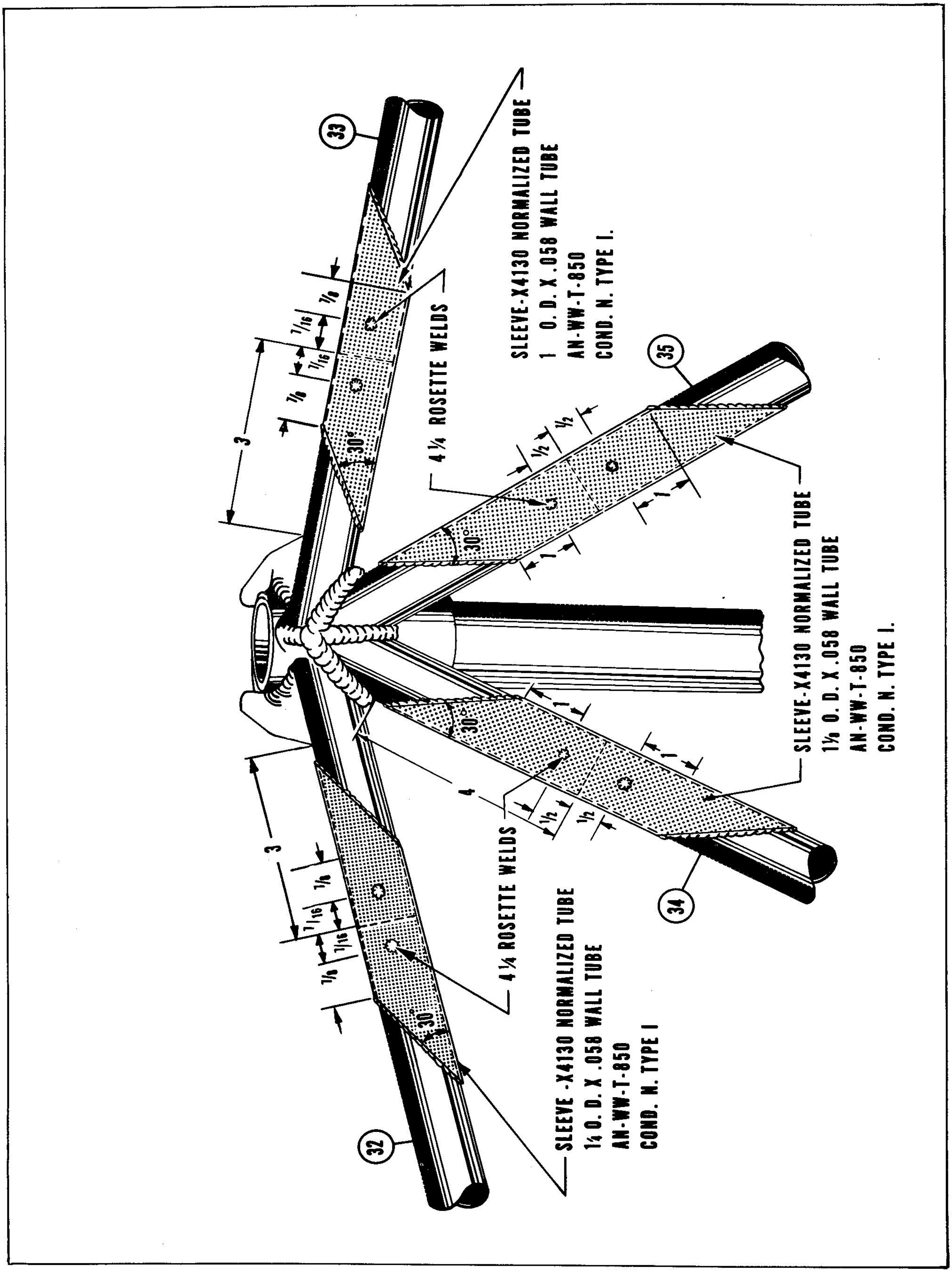


Figure 2-9 Upper Slide Tube Cluster

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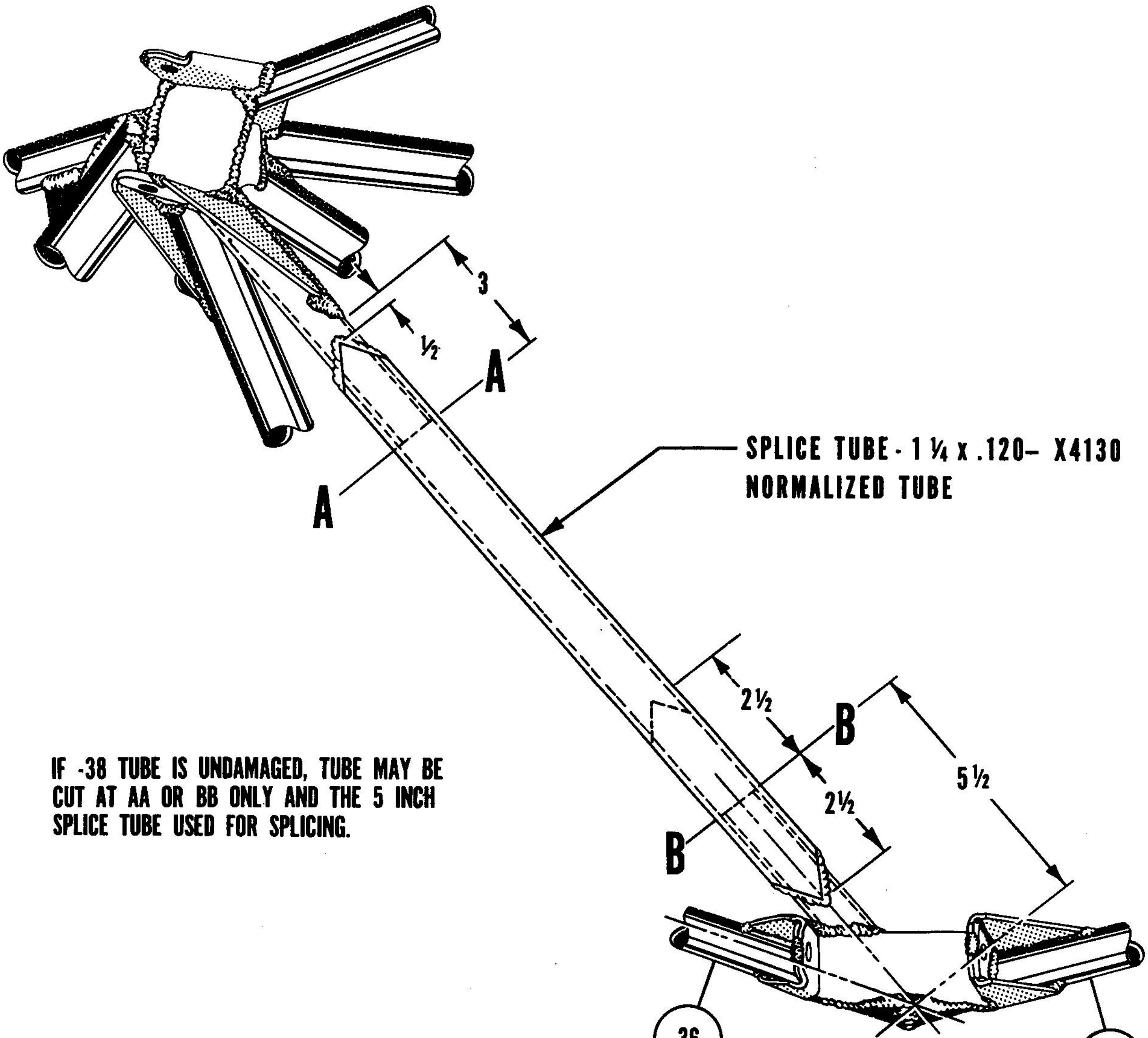

IF -38 TUBE IS UNDAMAGED, TUBE MAY BE CUT AT AA OR BB ONLY AND THE 5 INCH SPLICE TUBE USED FOR SPLICING.

NOTE: CUT –38 TUBE AT A-A AND B-B.

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Figure 2-10 Splicing -38 Tube

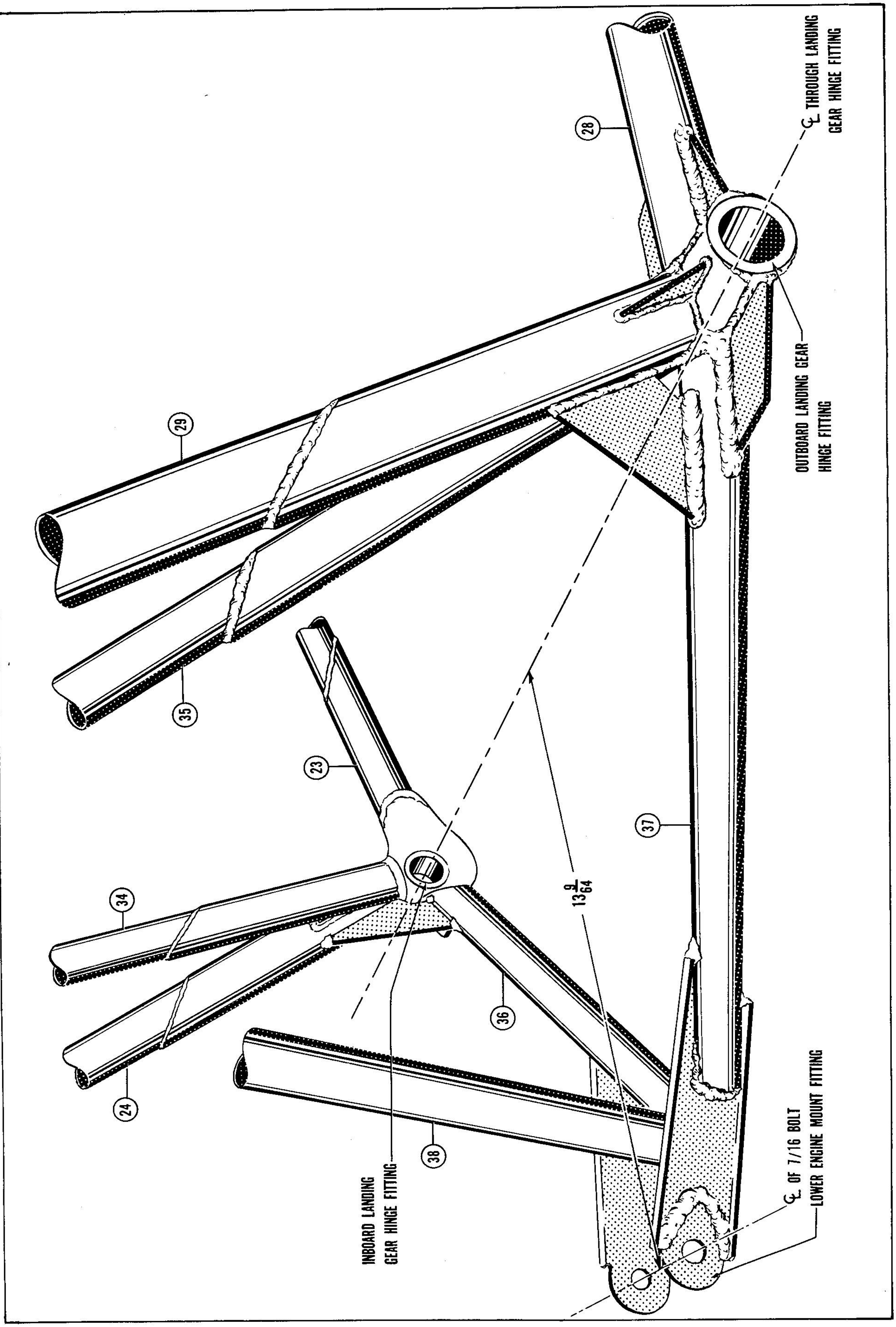

Figure 2-11 Locating Lower Engine Mount Clusters

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(p) Remove front and rear fuel tanks, rear fuel tank fuel line, and front fuel tank compartment bulkhead located at front of the fuel tank compartment on side to be repaired.

(q) Remove magnetic compass, and pilot compartment upholstery between Bulkheads 3 and 5 on side to be repaired.

(r) Remove cabin center aisle floorboard, chairs, and main floorboard on the side to be repaired.

(s) Remove front cabin window frame and glass; remove upholstery between Bulkheads 5 and 6. See Figure 2-18.

(t) Cut out a section of the fuselage skin as shown in Figure 2-17.

(u) Remove sufficient skin and cut away a portion of Bulkhead 5 as shown in Figure 2-18.

(v) Place support under Bulkhead 6 with aircraft in level position. Remove jack from side of aircraft to be repaired.

(w) With the aircraft in level position, install suitable tooling or jig to establish and hold reference points, thereby enabling the new truss member to be installed identically to the original installation. For best results, suspend the plumb-bob in a can of SAE 30 motor oil. See Figure 2-19.

(x) Check jig, or tooling for FINAL DIMENSIONS AND ALIGNMENT; provide support for the inboard wing section and drill out the rivets in the truss gussets that secure the truss to the remaining aft structure of Nose Rib 2.

(y) Saw through truss drag tube four inches aft of splice weld.

(z) With a support beneath the section of truss to be removed, saw off both main truss members as close to the cabin fittings as possible.

(aa) Grind off remaining portions of the outboard truss members and plate flush with the cabin fittings. See Figure 2-17.

(ab) Grind off the weld and the outboard truss section gussets from upper and lower center section elliptical tubes. See Figure 2-18. Drill six small holes (drilling first with a No. 40 drill, then following up with a No. 30 drill or No. 30 reamer) along the upper and lower outboard truss attaching gussets parallel to the attaching gussets. This will allow a saw blade to be started above and below the outboard attaching gussets. Saw the attaching gussets loose from the center section of the center section truss, and remove plates from center section elliptical tubes.

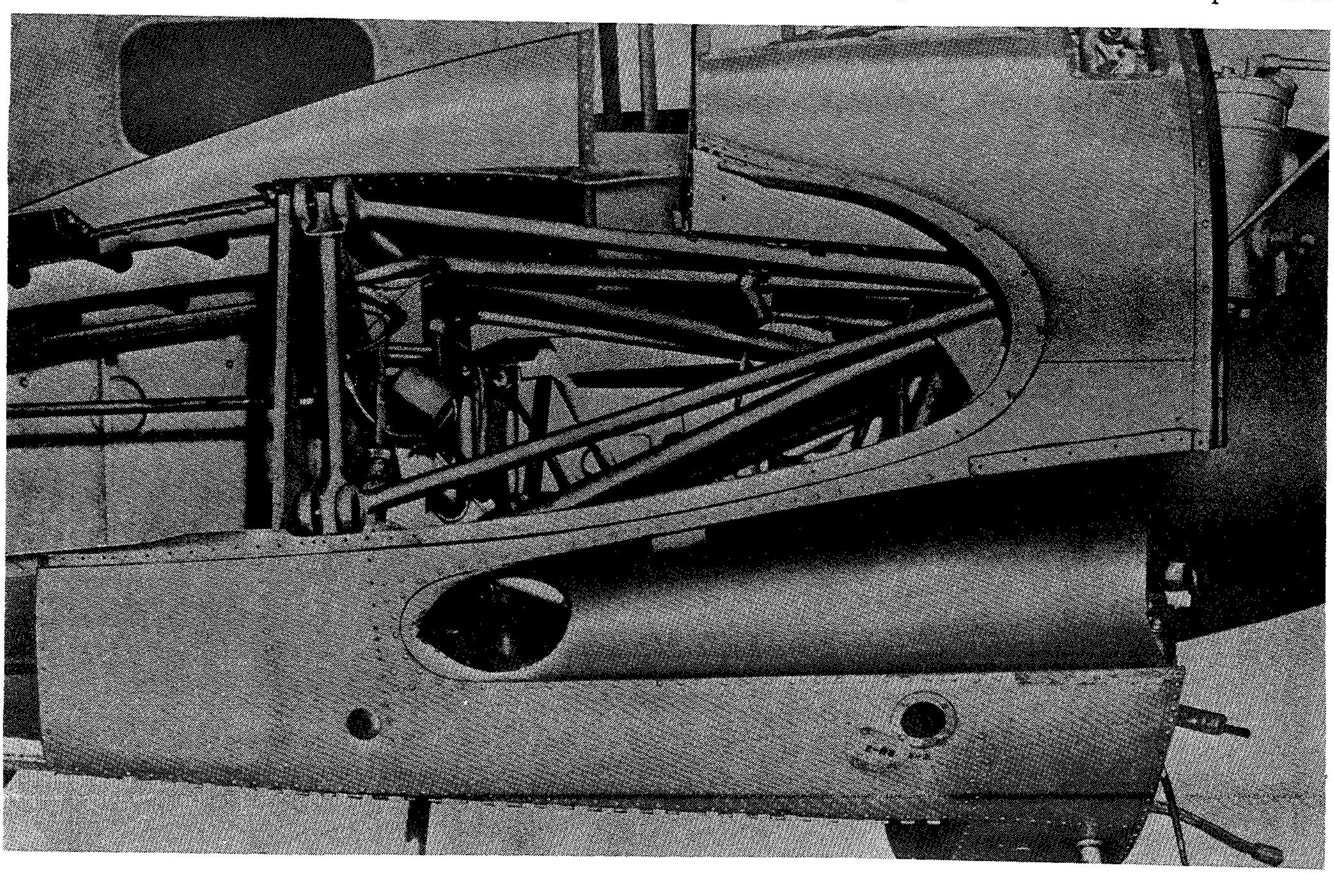

Figure 2-12 Removal of Nacelle Skin and Firewall

45B-3-39

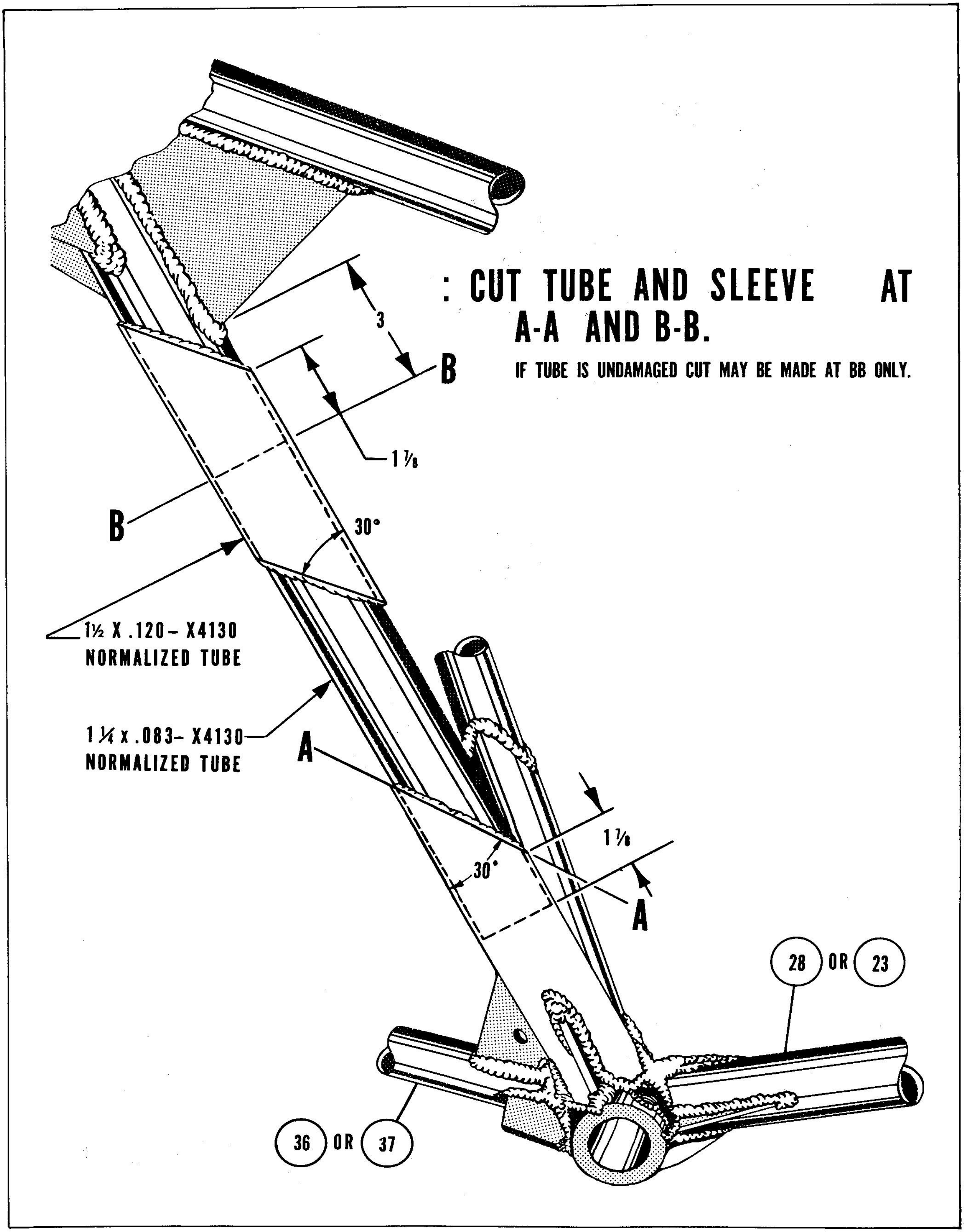

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Figure 2-13 Splicing -24 and -29 Tubes

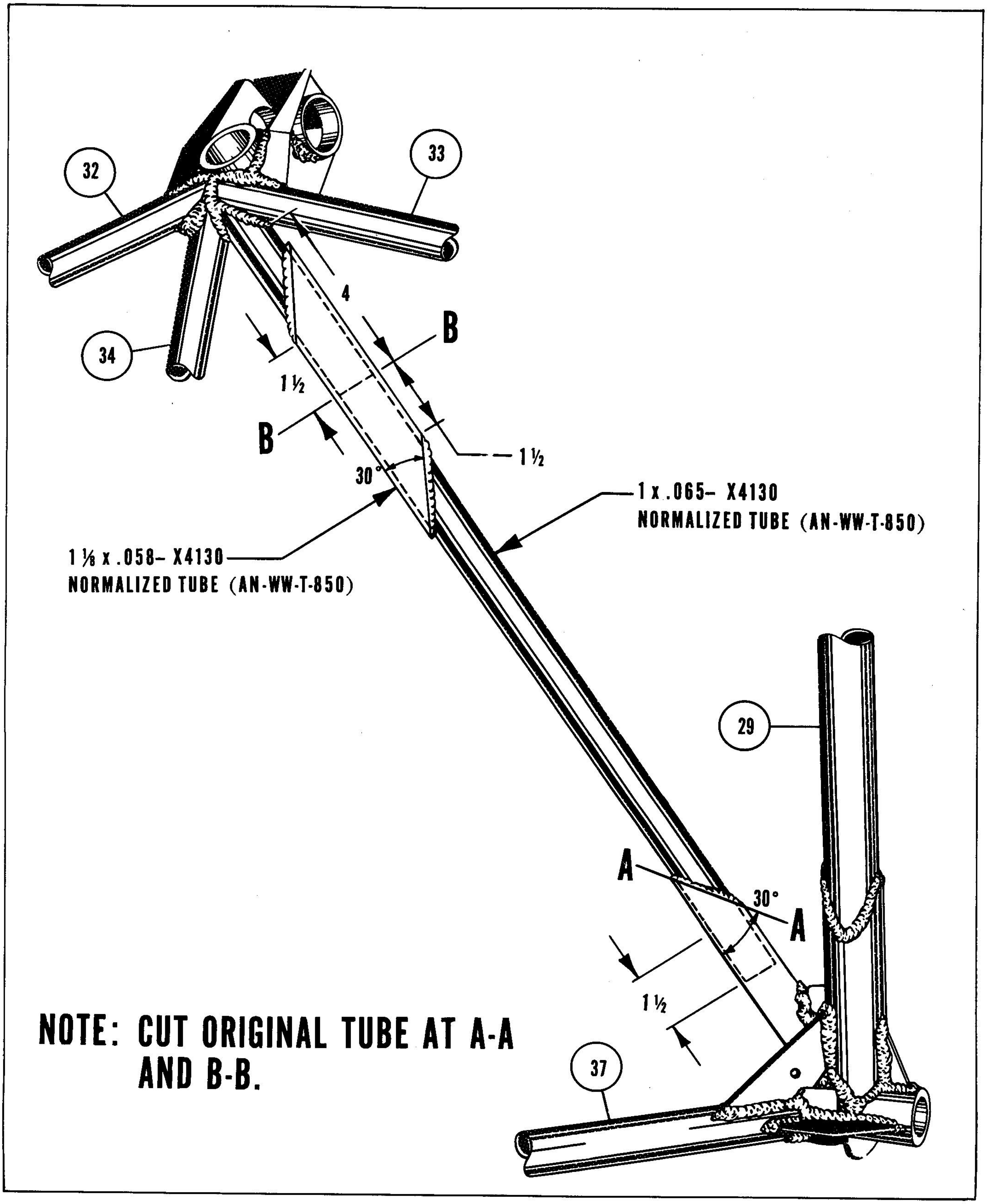

Figure 2-14 Splicing -24 and -35 Tubes

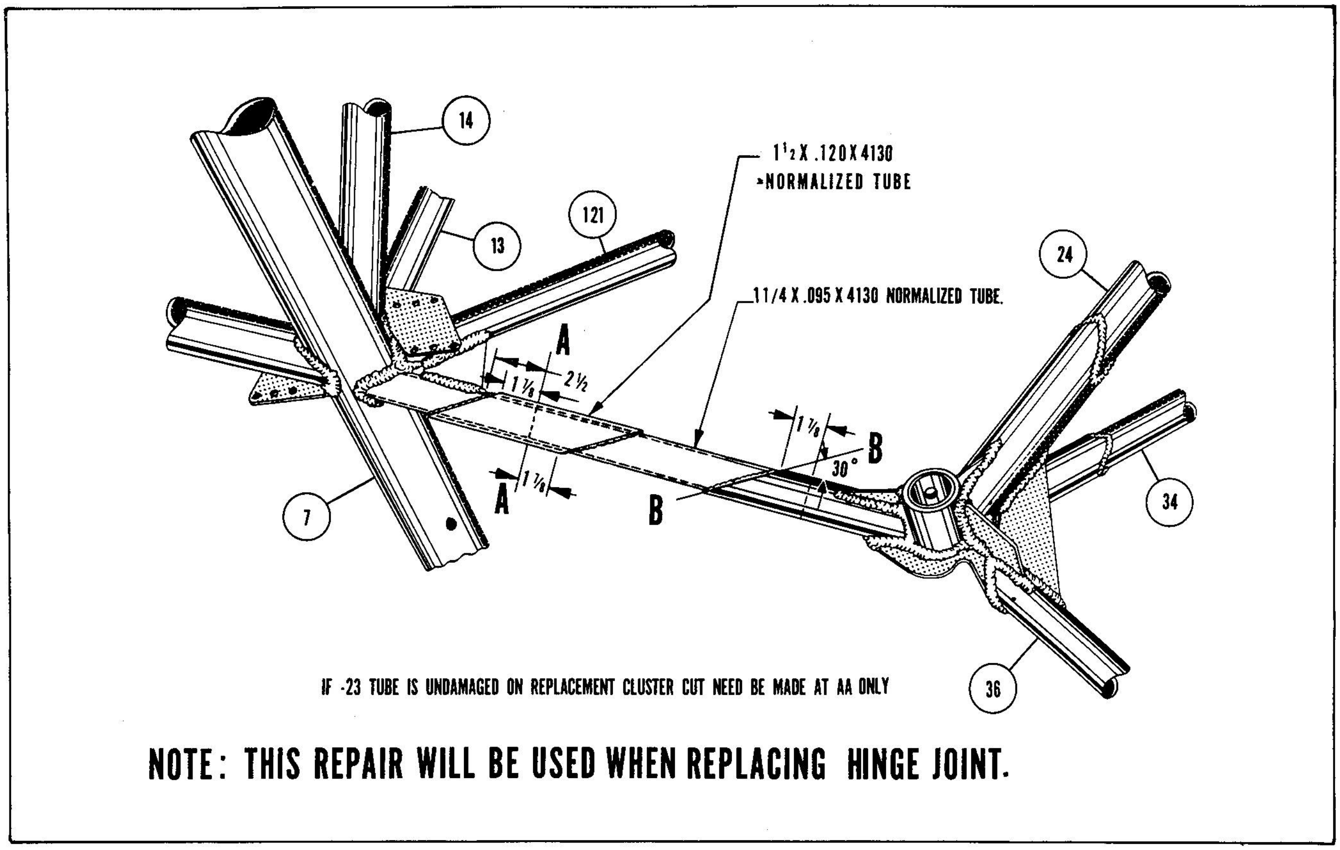

Figure 2-15 Splicing -23 and -28 Tubes

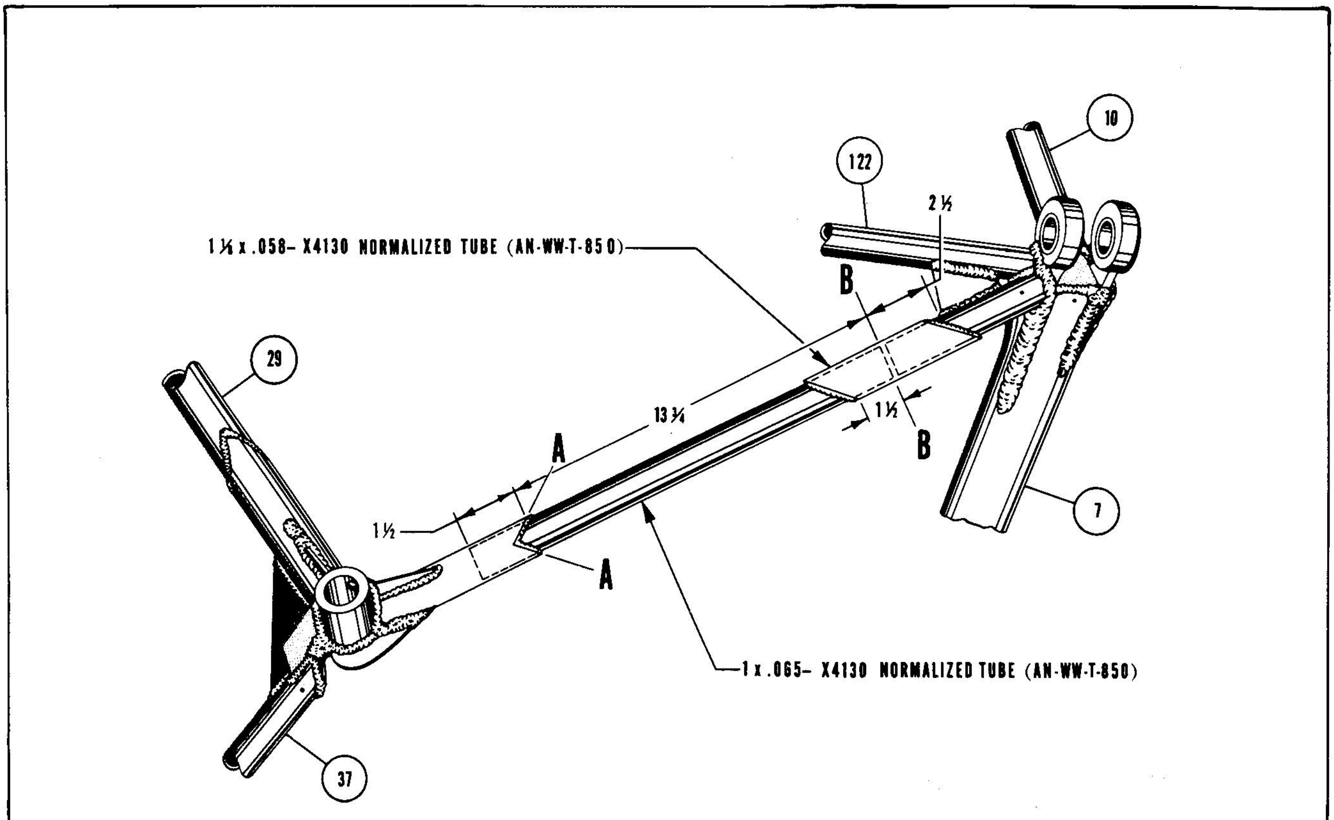

Figure 2-16 Splicing -28 Tube

(ac) Remove slide tube, and all clamps and fittings from the truss section just removed, and install all parts on the new truss assembly.

(ad) Fabricate a splice section of tubing from 1½-inch diameter chrome molybdenum steel tubing, .049 wall thickness, approximately 11 inches long. Cut both ends of this section of tubing on the same angle as the drag tube fitting on the new truss assembly. See Figure 2-20. Slide this splice section of tubing over the original truss drag tube where it will temporarily remain.

(ae) Cut a section from 1⅜-inch diameter chrome molybdenum steel tubing, .065 wall thickness, and approximately 9 inches in length. Insert one end of this section of tubing into the truss drag tube fitting on the new truss assembly. (When the new truss is in place this tube will butt against the original truss drag tube.) The actual correct length of this tube will be determined when the new truss is in place, and it may vary slightly from the specified 9 inches.

(af) Install the straight edge between the upper and lower wing fittings on the new truss assembly. Locate the new truss assembly in place determined by the jig or tooling, and support the new truss assembly in this position. See Figure 2-19.

(ag) Tack weld the upper and lower main truss members both fore and aft. Recheck truss assembly for alignment.

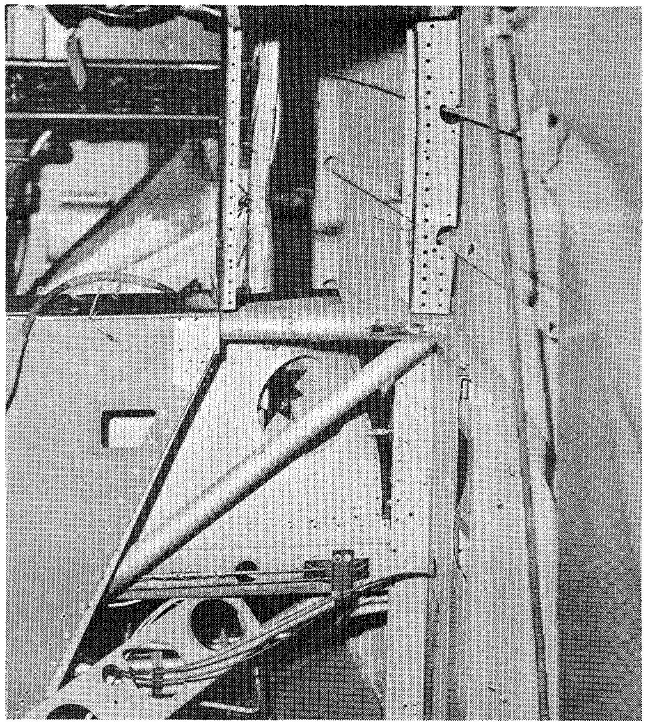

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Figure 2-18 Removal of Cabin Window and Upholstery

(ah) With the truss in proper alignment, install vertical brace between upper and lower cabin fitting while welding is being done. Start welding the outboard truss section gussets to the center section elliptical tubes, weld-

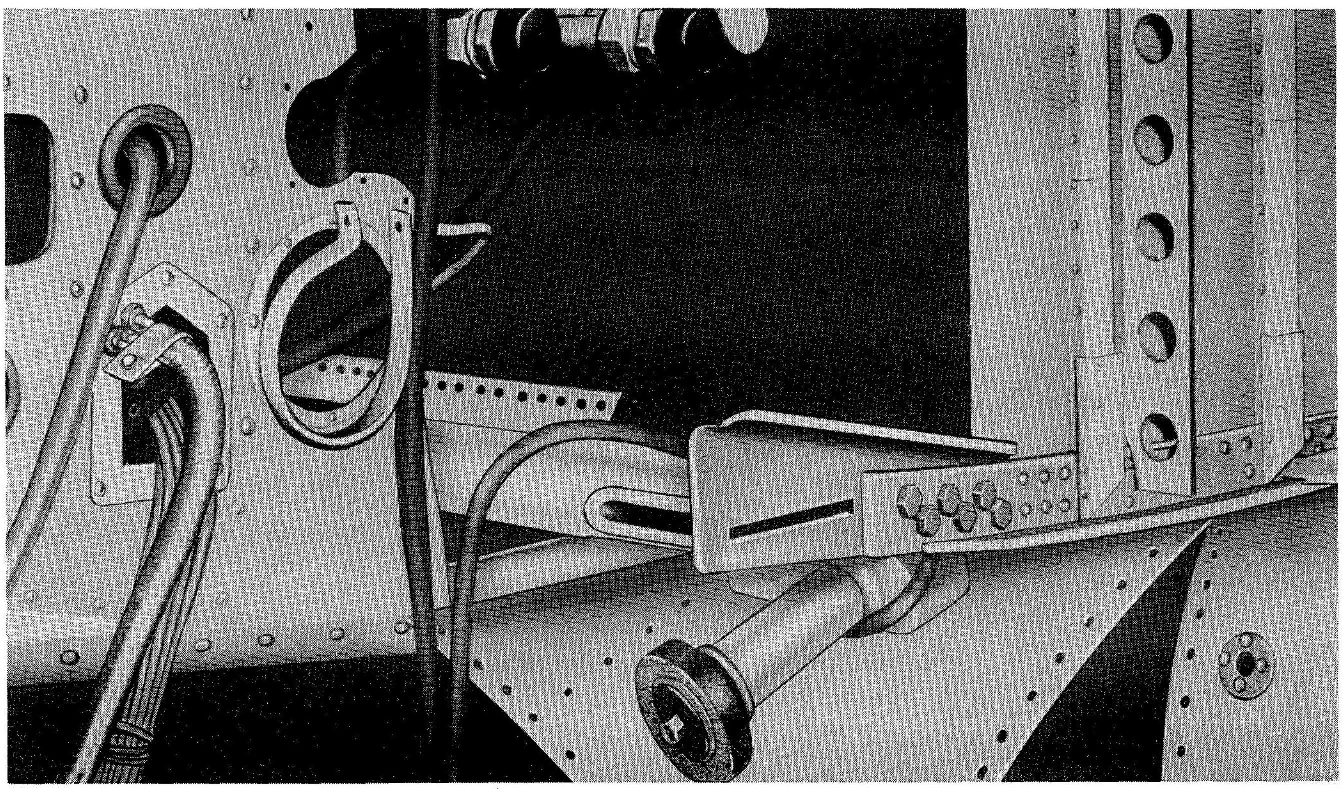

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Figure 2-17 Grinding Outboard Truss Members ing alternately from one side to the other. Constantly check the alignment of the outboard truss section to the jig in order to hold shrinkage and distortion to a minimum. See Figure 2-21.

NOTE

It is essential that one man constantly check the alignment of the new truss assembly and jig, advising the welder when to alternate the welding.

After the outboard truss gussets have been welded to the center section elliptical tubes, weld the elliptical tubes to the cabin truss plate, terminating the weld 3/8-inch from the aft root rib angle. With the weld terminated at this point, remove the bolts from the cabin truss plate, and spring the truss forward as far as possible, which will be from 1/8 to 3/16 inch. Place a sheet of asbestos between the cabin truss plate and the fuselage root rib angle. Pack the remainder of the weld area with wet asbestos mud, and complete the weld.

(aj) Slide the tube referred to in Paragraph (ae) back against the original truss drag tube. Butt weld this tube to the original drag tube. Recheck the truss alignment and tack weld the forward end of this tube to the truss drag tube fitting.

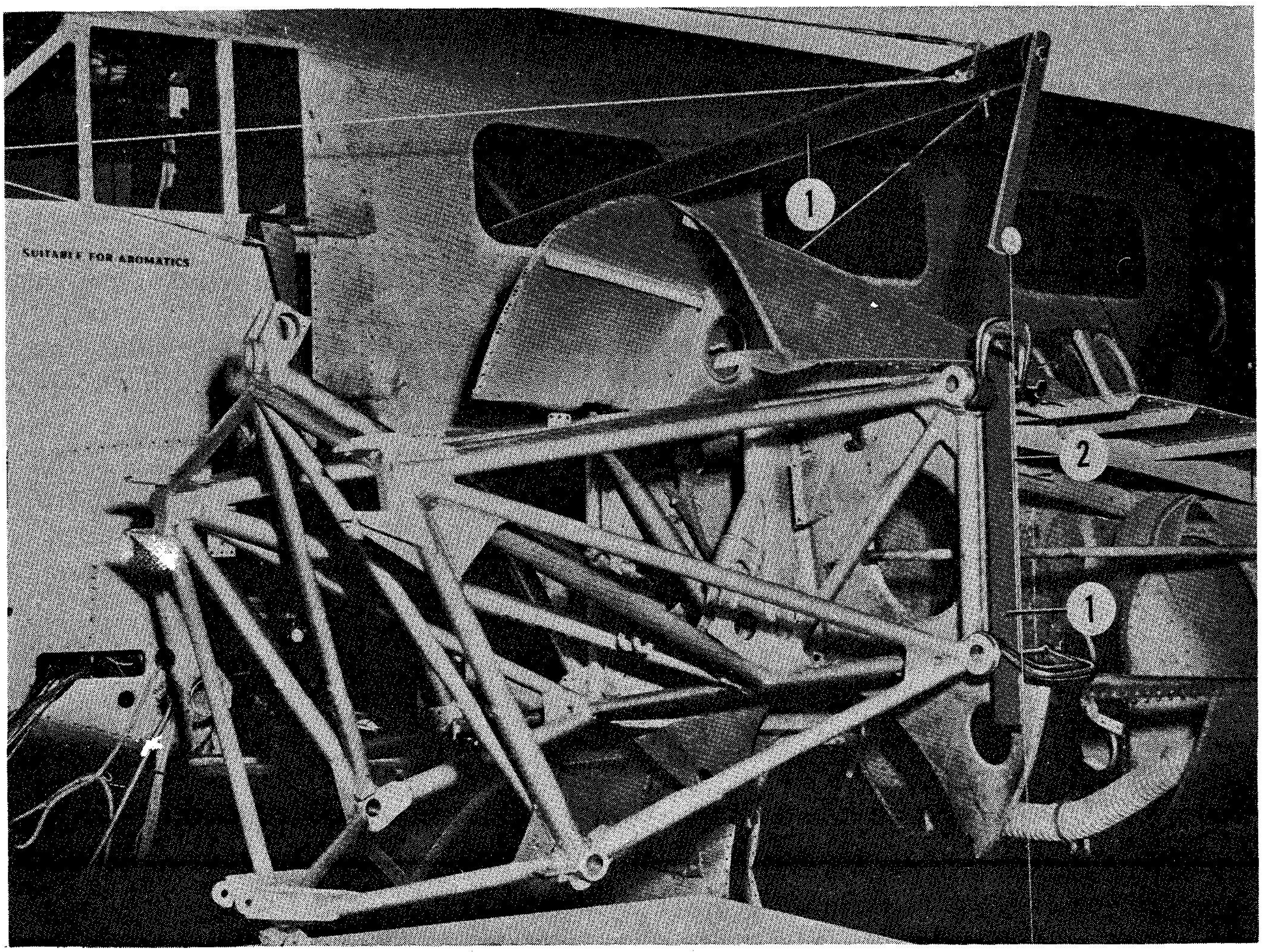
(ak) Grind off sufficient butt weld, to allow the splice tube referred to in Paragraph (ad) to slide forward over the butt weld and up to the truss drag tube fitting, allowing approximately 3/16-inch clearance between the two for welding. Weld both ends of the splice tube including the truss drag tube fitting in the forward weld, see Figure 2-20.

(al) Magnaflux all welds.

(am) Lionoil all weldments and welded sections, clean with wire brush, prime and paint.

(an) Reassemble, using the reverse of the above procedure, except as follows:

(1) Splice the root rib skin just aft of the truss cabin fittings using .051 clad 24S-T3 AL sheet approximately 14x24.



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1 Tooling 2 Plumb Line

Figure 2-19 Alignment Jig

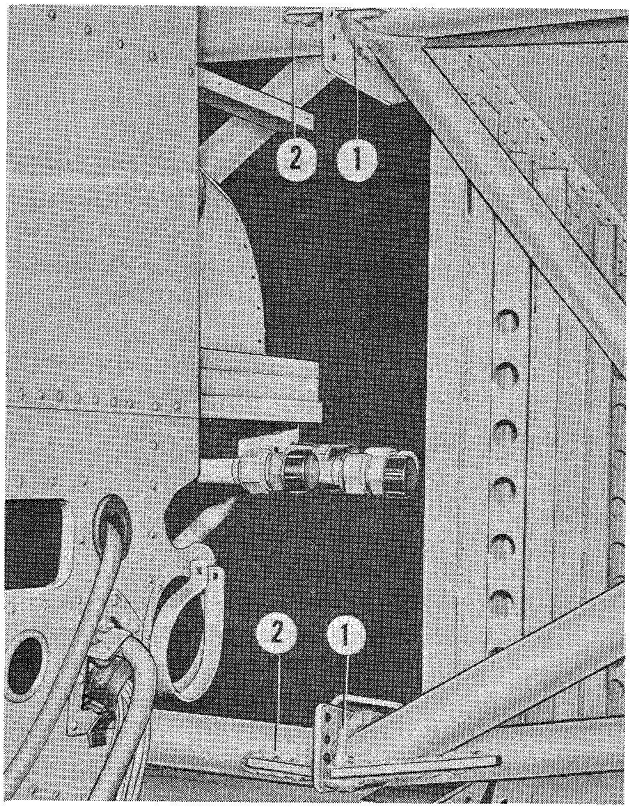

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Figure 2-20 Drag Tube Fitting Splice

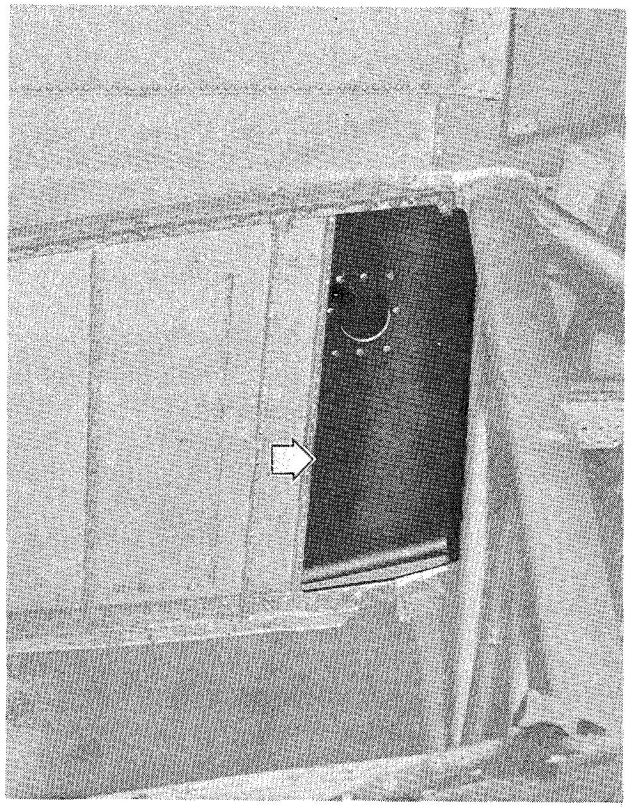
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Figure 2-22 Root Rib Skin Splice

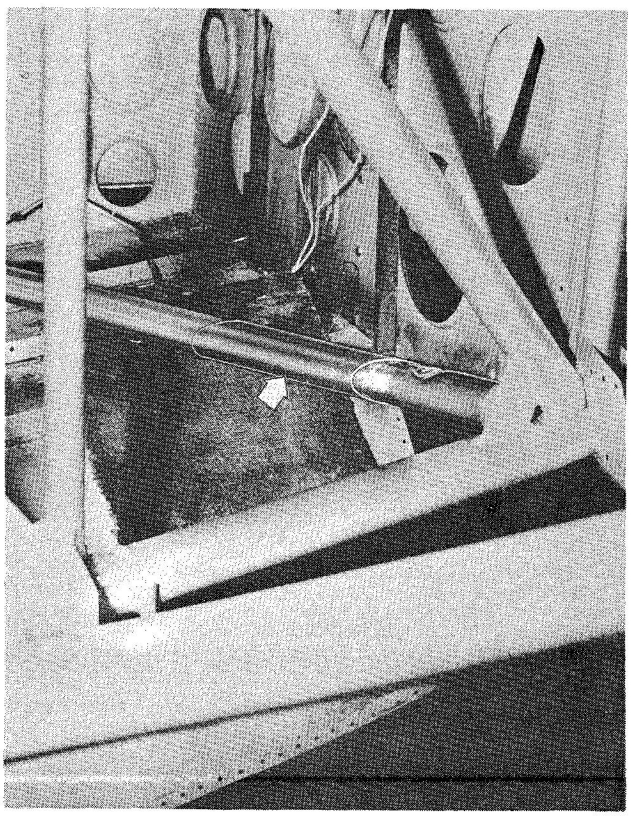
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Figure 2-21 Alternate Welding, Outboard Section Gussets to Center Section

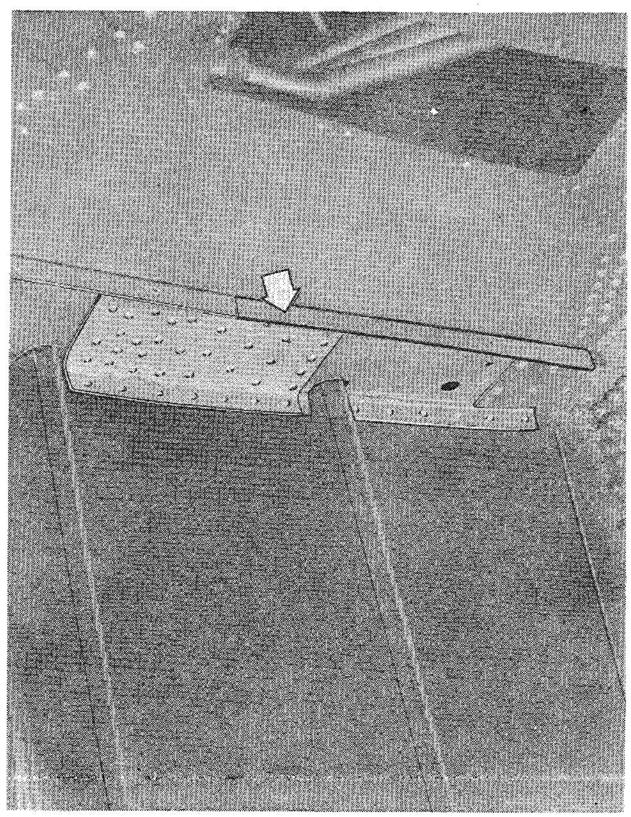
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Figure 2-23 Lower Splice, Bulkhead 5

inches. Use two rows of rivets ¾ inch apart, ¾-inch rivet spacing, adding a ½ x ⅞ x .051 bulb angle reinforcement. Use AN470AD4 rivets of sufficient length. See Figure 2-22.

(2) Splice stringers under cabin floorboards with a standard fuselage butt splice, using AN470AD4 rivets; eight rivets installed in each end of the splice.

(3) Splice new section on lower end of Bulkhead 5 using a section of .040 clad 24S-T3 AL sheet made up to fit inside of Bulkhead 5, and approximately 4 inches long, using AN470AD4 rivets. See Figure 2-23.

(4) Splice the upright stringer above the main spar at Bulkhead 5 with ⅝ x 1 inch, .065 clad 24S-T3 AL angle clip, approximately 6 inches long. Pick up rivets through the web using AN470AD4 rivets. See Figure 2-24.

CAUTION

Reassemble all of leading edge skin before installing lower nacelle and firewall assembly.

NOTE

When ordering a truss assembly — center spar outboard, it is necessary to state the type of aircraft, the serial number, and specify right or left.

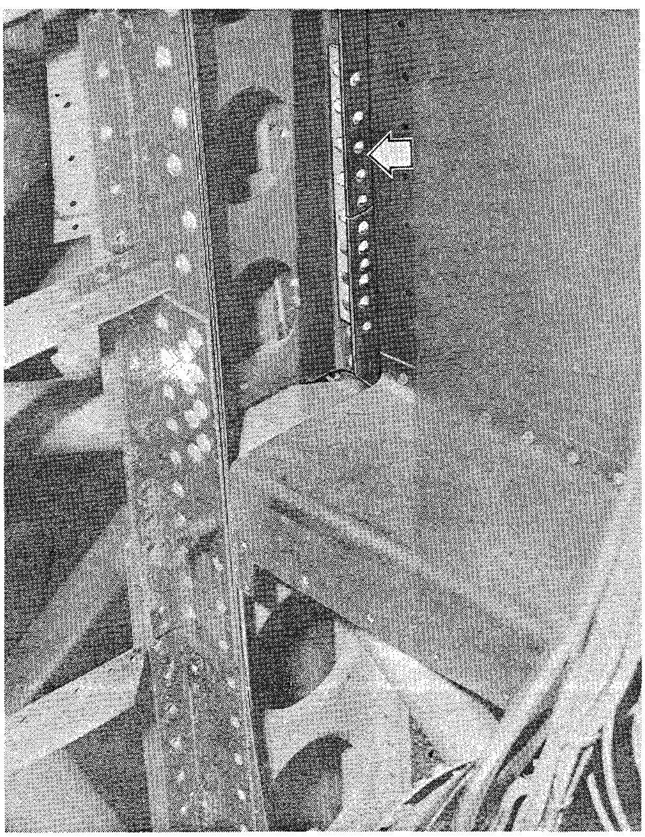


Figure 2-24 Splice, Upright Stringer, Bulkhead 5 45B-3-47

OUTBOARD WING

16 The structure of the outboard wing consists of front and rear spar and formed ribs to which stringers of extruded aluminum sections are riveted. See Figure 2-1. The front spar is of welded, tubular, heat-treated, chrome molybdenum steel from Rib 1 outboard to Rib 5. From Rib 5 to Rib 10, the spar is constructed of riveted aluminum alloy. The wing is covered with aluminum-alloy skin designed to share the structural load with ribs, stringers, and spars. See Figure 2-25.

17 Wing Tip — The shape of the wing tip skin is maintained by a single rib, paralleling the outboard wing, and intersecting bulkheads.

18 Aileron — The fabric-covered aileron is constructed of aluminum-alloy main and nose ribs attached to a spar. A metal nose plate forms the leading edge and the trailing edge is made of a standard Alcoa K-1508 rolled section. The aileron is attached to the outboard wing by a piano-type hinge extending the full length of the aileron.

19 Flap — The fabric-covered flap construction is fundamentally the same as the aileron. See Figure 2-1. It is attached to the center section wing and inboard part of the outboard wing by three bearing-type hinges. The under surface of the flap is protected from exhaust and wheel blast by a metal shield attached to the flap ribs by rivnuts.

DEFINITION OF DAMAGE

20 Damage may be defined as follows:

(a) Negligible Damage — Damage that will not affect the airworthiness of the wing assembly and usually does not require immediate attention.

(b) Damage Repairable by Patching — Damage that may be repaired by covering or reinforcing a portion of the wing skin or structure.

(c) Damage Repairable by Insertion — Damage that requires the removal and replacement of a portion of the wing skin or structure.

(d) Damage Necessitating Replacement of Parts — Damage unrepairable by patching or insertion, but which may be repaired by installing a new part. Damage requiring replacement, but which cannot be replaced because of structural design, will necessitate replacement of the entire assembly.

PROCEDURE FOR REPAIR OF DAMAGE

21 Negligible Damage — Damage of this classification shall be limited for the entire wing assembly to surface

dents in the skin. These dents should not substantially change the contour of the airfoil and must be carefully investigated for indications of structural damage.

Damage Repairable by Patching

22 Skin — Small holes, cracks, or breaks in the metal skin covering of the wing assembly may be patched in different ways. It is advisable to use a flush-type patch, see Figures A-3 and A-5, in patching a leading edge section of wing. This section, that part forward of the front spar, must be maintained in smooth condition so as not to interrupt the flow of air. Other sections of the wing may be repaired with surface patches of the following types:

(a) Round holes up to 1 inch in diameter may be reinforced by a washer installed as shown in Figure A-4. Reinforcing the hole rather than covering it permits the use of a bucking bar in setting the rivets. If blind rivets are used, a disc may be substituted for washer.

(b) Small breaks or punctures in the skin may be repaired as shown in Figures A-2 and A-3. The ragged edges should be cut away, as shown by the dotted lines, so that no sharp corners remain. To compute rivet size and spacing, refer to Paragraph 34, Part 1.

(c) To repair cracks in the skin, first drill stop-holes at each end or sharp corner of the crack. See Figure A-1. The patch plate should be cut large enough to clear all parts of the crack by ⅞ inch. Blind rivets if available may be substituted for standard rivets.

23 Stringers — Cracks in the stringers of the wing assembly may be repaired by reinforcing the damaged member with an extruded section or a hand-formed splice angle as follows:

(a) An extrusion of the same cross section as the original stringer may be used as patch material. The reinforcement must fit smoothly into the stringer; if necessary, the bulb angle and corner radius of the patch extrusion may be

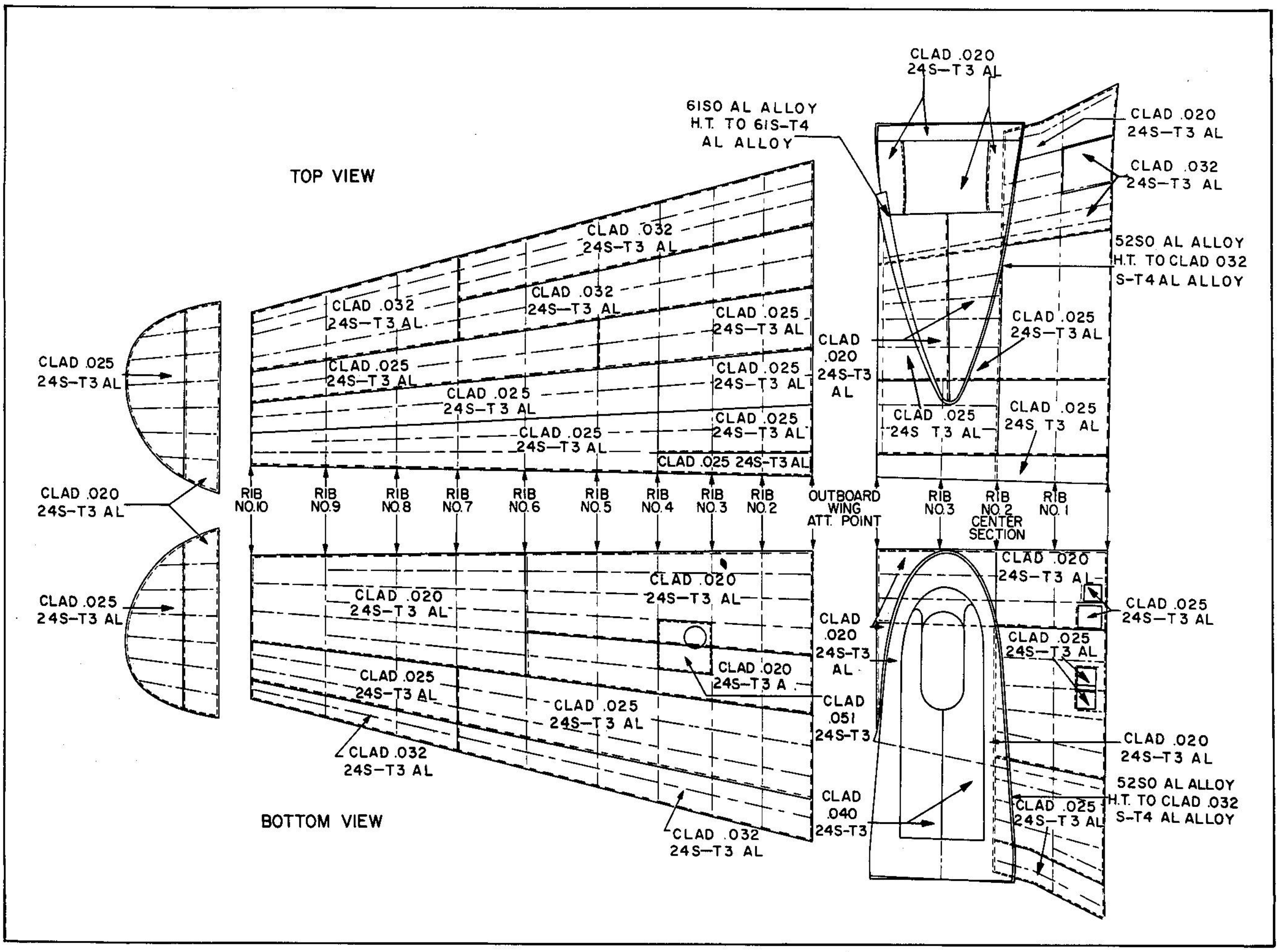


Figure 2-25 Wing Skin Plating Diagram

filed. See Figure A-11. It is also permissible to attach the reinforcement on the opposite side of the stringer.

(b) The hand-formed splice angle should be made of .064 24ST sheet and installed as shown in Figure A-10. Radius of bend for this angle should be 3/16 inch.

(c) If necessary to splice more than one stringer, splices should be staggered in such a manner that no two splices fall at the same station. See Figure A-12.

24 Ribs — Rib structure of all components of the wing assembly are essentially the same and repair methods will apply to all ribs. Repair as follows:

(a) Small cracks or breaks, entirely within the rib web and where space allows, may be repaired by methods described for skin patches in Paragraph 22, Part 2.

(b) Damage in formed flanges, in the flange and extending down into the web, or in ribs too small for a skin-type patch, will require a patch formed to the flange of the rib. See Figures A-13 and A-14. The crack or break must be covered with a patch of at least ¾-inch edge margin. Stop-holes should be drilled at the end of cracks and breaks should be properly trimmed to prevent spreading. In riveting wing rib patch to rib flange, skin rivets may be used with an additional rivet between the original rivet holes. Rivets must not be spaced closer than ⅜ inch.

25 Spars — Wing rear spar sections and flight control surface spars may be patched as illustrated in Figure A-15. All cracks or breaks in spar members shall be reinforced with a patch plate extending across the full cross section of the spar. A patch on the wing rear spar may be riveted to the wing skin, either by drilling for and using a first-size larger rivet in the old rivet holes or spacing new rivets midway between the old rivet holes.

26 Bulkheads — Bulkheads in the center section and wing tip are suited to repair methods similar to those for wing skin patching. Refer to Paragraph 22, Part 2.

27 Trailing Edge Repairs — The trailing edges of the aileron and flap form the wing assembly trailing edge. Cracks and small breaks between rib members may be repaired by a reinforcing patch as shown in Figure A-23. Care must be exercised in inserting the splice-block, to avoid further damage to the edge member. A minimum of three rivets must be used on each side of the break.

28 Supporting Structure — Due to the size and type of construction of supporting members such as flap hinges and flight control pulley brackets, damage of these parts will necessitate replacement. Other supporting structures, such as battery support and ribs can be repaired. The battery support structure consists of a frame of channel sections, riveted to the fuselage at one end, and to Rib 1 of the center section wing at the other. Cracks or breaks in the channel sections may be patched as shown in Figures A-18 and A-19.

Damage Repairable by Insertion

29 Skin — When damage to the skin of the wing assembly is too extensive to be repaired by a reinforcing patch, the skin should be cut back to a supporting structure such as a rib or stringer. A new section of skin should be fitted into place and riveted to the structure. When determining the amount of skin to remove, avoid making a new joint on a structural member that will be a continuation of an original skin joint. It is also undesirable to make a skin joint on the upper and lower surface on the same rib or stringer. It is better to extend the replacement skin to the next member rather than to make such joints as described.

30 The replacement skin should be of the next greater thickness than the damaged skin and of 24ST material.

31 Skin joints may be classified as longitudinal or transverse:

(a) The longitudinal skin joints lie along stringers or spars. If the new joint is made along a member where there was an old skin joint, the same rivet spacing may be employed. If there was no joint previously, the rivets should be spaced only half as far apart as the old rivets as shown in Figure A-9.

(b) The transverse skin joints lie along the ribs and the skin is attached as shown in Figure A-8. The original rivet spacing may be used if the joint is made at the previous joint, but if there has been no previous joint, the replacement skin should be cut to lap over the rib by ½ inch. It should be riveted with a staggered row of rivets with spacing equal to the original. The ½-inch lap may be made on either side of the rib.

32 Stringers — Damage requiring removal of a portion of the stringer may be repaired by cutting out the damaged portion and inserting a new extruded section. This section may be spliced into place by methods described in Paragraph 23(b), Part 2.

33 Ribs — Serious damage to a rib member may require replacement of a portion of the rib. The damaged part of the rib should be removed by making a straight cut across the rib. A new portion may then be made, using material of equal or greater strength and thickness. This new part should be spliced to the rib by using a splice plate of the same material as the rib and at least 2 inches wide. There should be a double row of ⅛-inch rivets on either side of the joint. The splice-plate used should be formed to extend inside of the rib flange to rivet through the flange to the skin. See Figure A-14.

34 Spars — Damage to the wing rear spar and the aileron or flap spars, may be repaired by cutting away the damaged portion and forming a new section to replace it. The new section may be spliced to the original spar as shown in Figure A-15. Rivet the wing skin to the spar by either drilling a size larger hole through the old rivet holes of the skin, and using a size larger rivet, or space new rivets midway between the old rivet holes.

35 Trailing Edge Repairs — To repair a damaged trailing edge of the flap or aileron, cut out the damaged section and replace it with a new piece. The splice should be made as shown in Figure A-23. It is usually most convenient to make the extremities of the cut center between the trailing edge ribs. This permits the splice block (for attaching the new section) to be installed more easily. The splice block may be of 52SH or any stronger aluminum alloy. A minimum of three rivets on each side of the cut will be necessary.

Damage Necessitating Replacement of Parts

36 Skin — If more than 50 percent of a skin panel is damaged, it is usually advisable to replace the complete panel. Use material of the next greater thickness and the same alloy strength.

37 Stringers — It is possible to replace the stringers in the wing assembly, but because of the amount of skin that would have to be removed, it is not practical. All repairs should be adequately made, either by patching or insertion.

38 Ribs — Replace ribs as follows:

(a) Wing Ribs — Because of the integral construction of the ribs with front spar, it is impractical to put in an entire new rib. However, a new nose section can be installed by splicing to the rib just forward of the front spar, and similarly, an aft rib section can be replaced by splicing into the rib immediately behind the front spar. The same procedure applies as for repairing by insertion as described in Paragraph 33, Part 2. This is a difficult process because so much skin must be removed, but it can be accomplished satisfactorily.

(b) Aileron and Flap Ribs — Extensive damage to these members is cause for replacement. Nose and tail sections of the rib are separated by the spar and are replaced as individual parts. If new parts are not available, replacements can be hand-formed. Refer to Part 1.

39 Spars — Replace spars as follows:

(a) Wing Front Spar — The wing front spar is a heat-treated member and is constructed integrally with the wing ribs; therefore, its removal and reinstallation is a complex and critical procedure. Detailed instructions are given in Paragraph 42 and in the six sheets of Figure 2-26. When attempting this repair, these instructions must be followed exactly.

(b) Wing Rear Spar — The outboard wing spar consists of the inboard and outboard assembly spliced together at Rib 4. The rear spar on the center section wing is joined to the outboard wing spar by a special bolt. Replacement of any of these spar sections will be difficult, but may be accomplished.

(c) Flap and Aileron Spars — Extensive damage to these spars will necessitate replacement of the entire assembly.

40 Wing Tip — Damage to the leading edge or extensive structural damage will necessitate replacement of the wing tip, due to difficulties of repair.

41 Supporting Structures — Due to the size and type of construction of supporting members such as flap hinges and flight control pulley brackets, damage incurred will necessitate replacement of the parts.

REPLACEMENT OF OUTER WING PANEL MAIN SPAR

42 The single outer wing panel front spar of heat-treated, welded steel tube is sufficiently stressed to withstand normal service loads. The general construction, manufacturing data, defect tolerances and repair schemes for the main spar are outlined in RCAF Drawing C64D00064. When the spar requires replacements the following procedure must be used:

(a) Remove the outer wing panel and place it on a suitable fixture which will support it rigidly and at the same time provide a convenient working location.

(b) With wing properly supported, follow the detail disassembly and reassembly procedure given in Figure 2-26, sheets 1 through 6.

CAUTION

Take care at all times that the aerodynamic design of the wing is not altered.

FUEL TANKS

43 To repair cracks or breaks in a fuel tank, proceed as follows:

(a) Immerse tank completely in a hot (82° to 88° C) (180° to 190° F) cleaner solution made from a concentration of Oakite No. 64 (8 to 10 ounces per gallon), Kelite No. 60 (4 ounces per gallon) or Turco 3266 (6 to 7 ounces per gallon).

NOTE

Excessively greasy or oily tanks should be rinsed inside and out with a suitable solvent (trichlorethylene or solvent, Federal Specification P-S-661a) before immersion.

(b) Leave immersed as necessary to clean, up to a maximum of four hours. Slightly agitate the solution within the tank to speed removal of the flushing film.

(c) When inspection shows all film has been dissi-

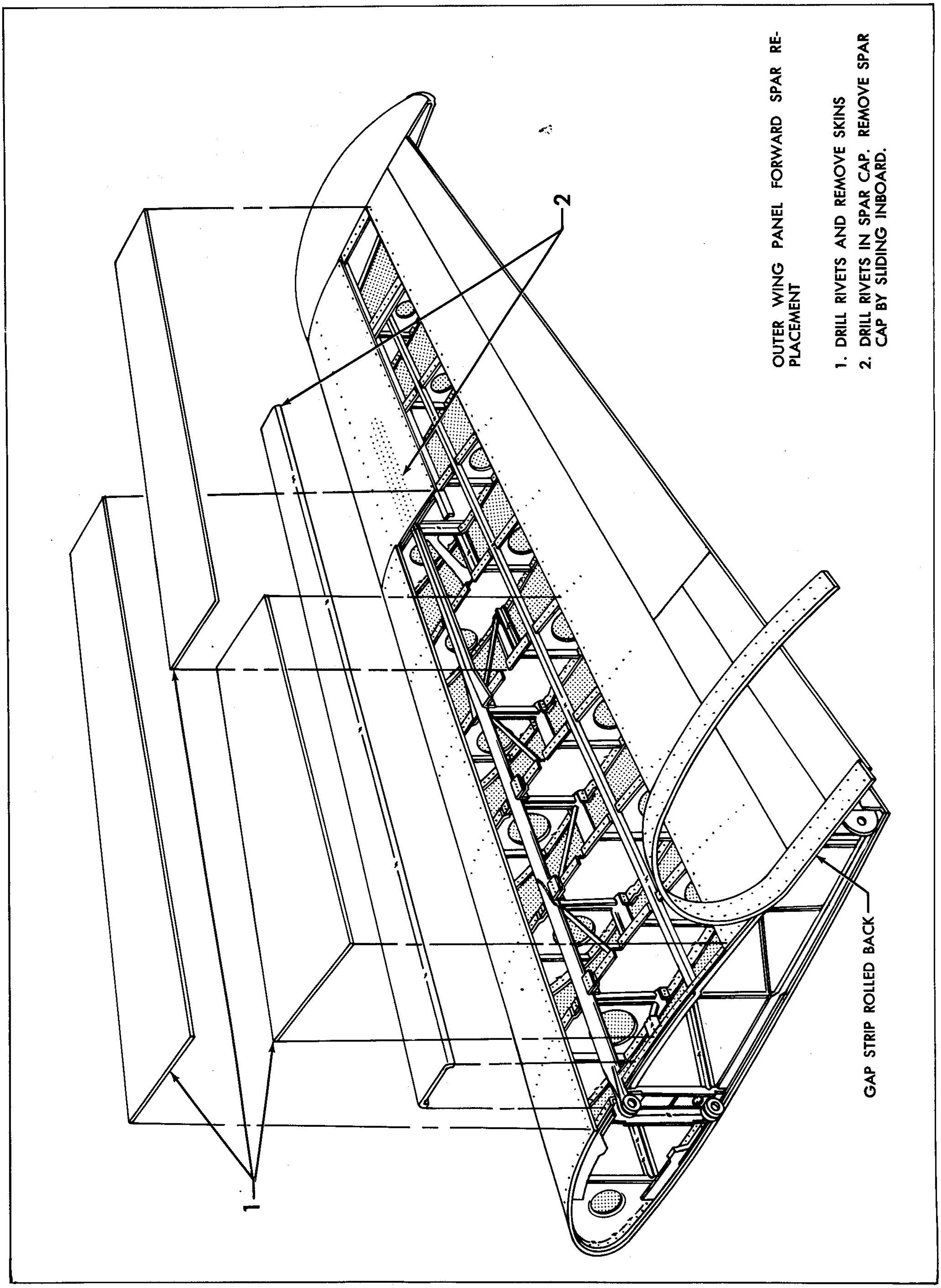
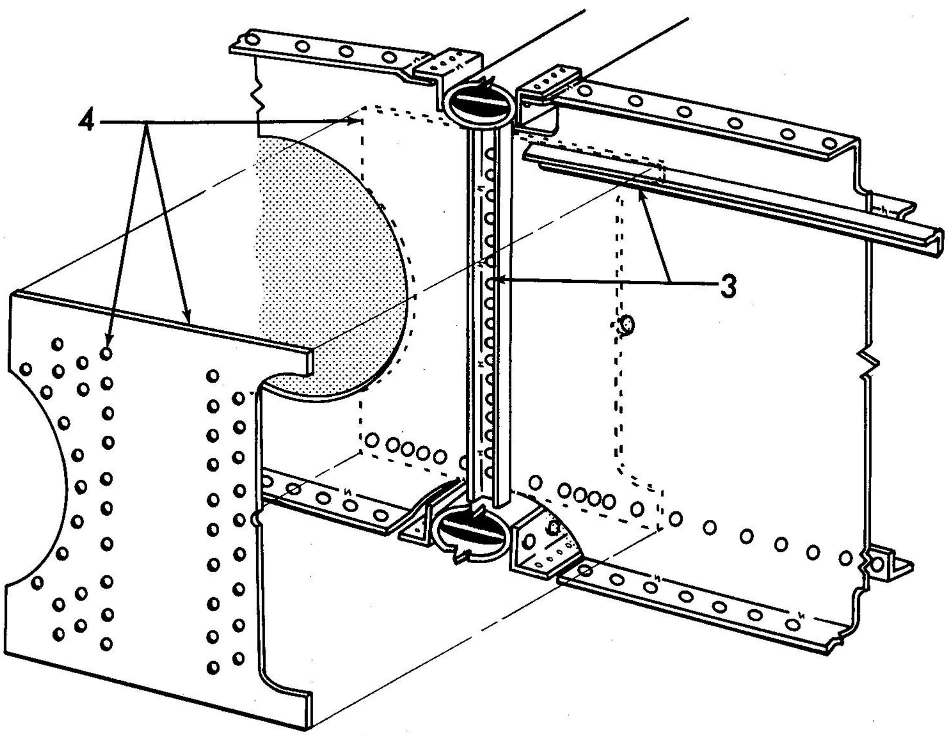


Figure 2-26 Outer Wing Panel Front Spar Replacement (Sheet 1 of 6 Sheets)

CAUTION: DRILL SPLICE PLATE RIVET PATTERN BEFORE RIBS ARE CUT.

3. DRILL RIVETS IN U-CHANNEL AND REMOVE ANGLE SO SPLICE PLATES CAN BE LOCATED ON RIBS. (INDICATIVE -2 SPLICE PLATE ON NUMBER 2 RIB; -4 SPLICE PLATE ON NUMBER 3 RIB; -6 SPLICE PLATE ON NUMBER 4 RIB AND -8 SPLICE PLATE ON NUMBER 5 RIB) (SEE PAGE 41.)
4. LOCATE SPLICE PLATES ON RIBS AND DRILL IN RIVET PATTERNS ON RIBS. TRIM SPLICE PLATES TO CLEAR DE-ICER TUBING.



5. FILLERS (MADE OF .040 SHEET OR STRIP CLAD 24ST-3 AL F.E.D. QQ-A-362 COND. T3) TO BE INSTALLED AT INSTALLATION OF SPLICE PLATES. (SEE PAGE 37, STEP 5)
6. REINSTALL ANGLE STIFFENERS AND RIVET TO SPLICE PLATES AFTER SPLICE PLATES ARE INSTALLED. (SEE PAGE 40, STEP 16)

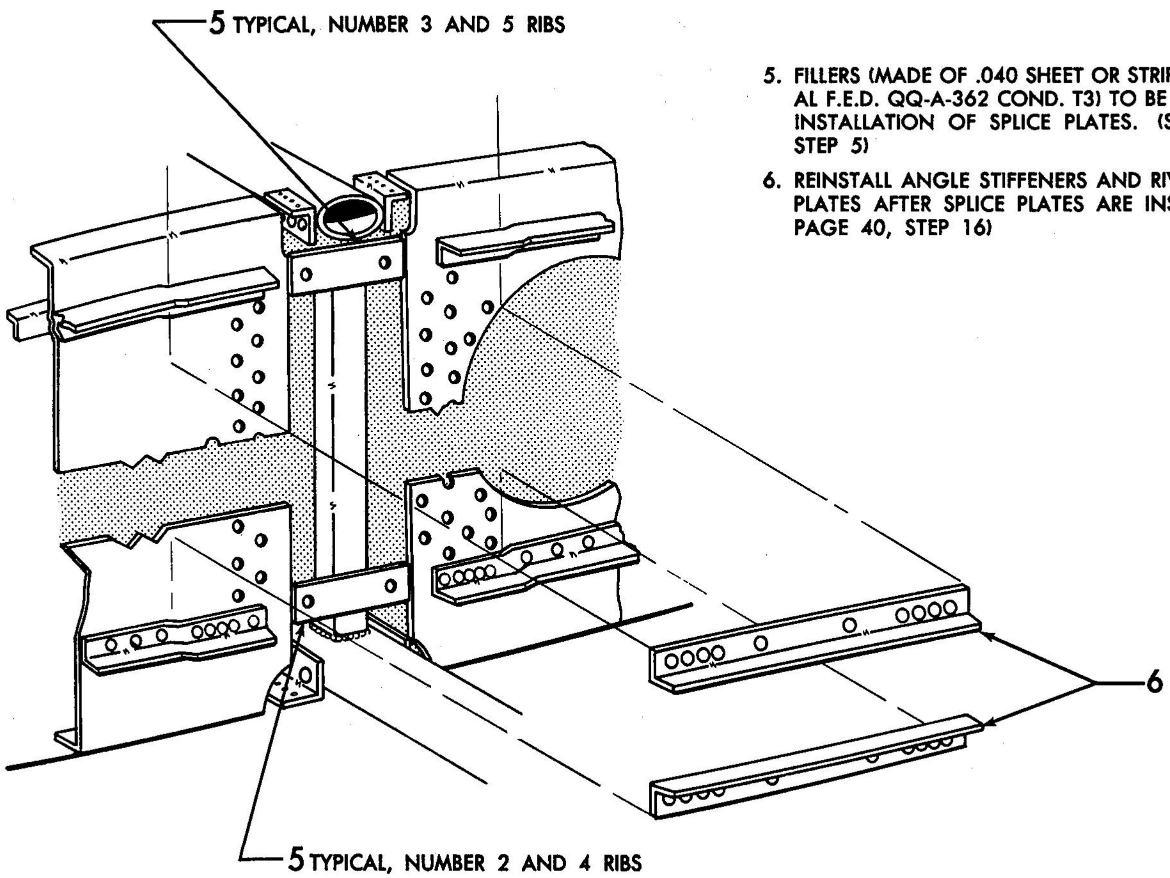


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Figure 2-26 Outer Wing Panel Front Spar Replacement (Sheet 2 of 6 Sheets)

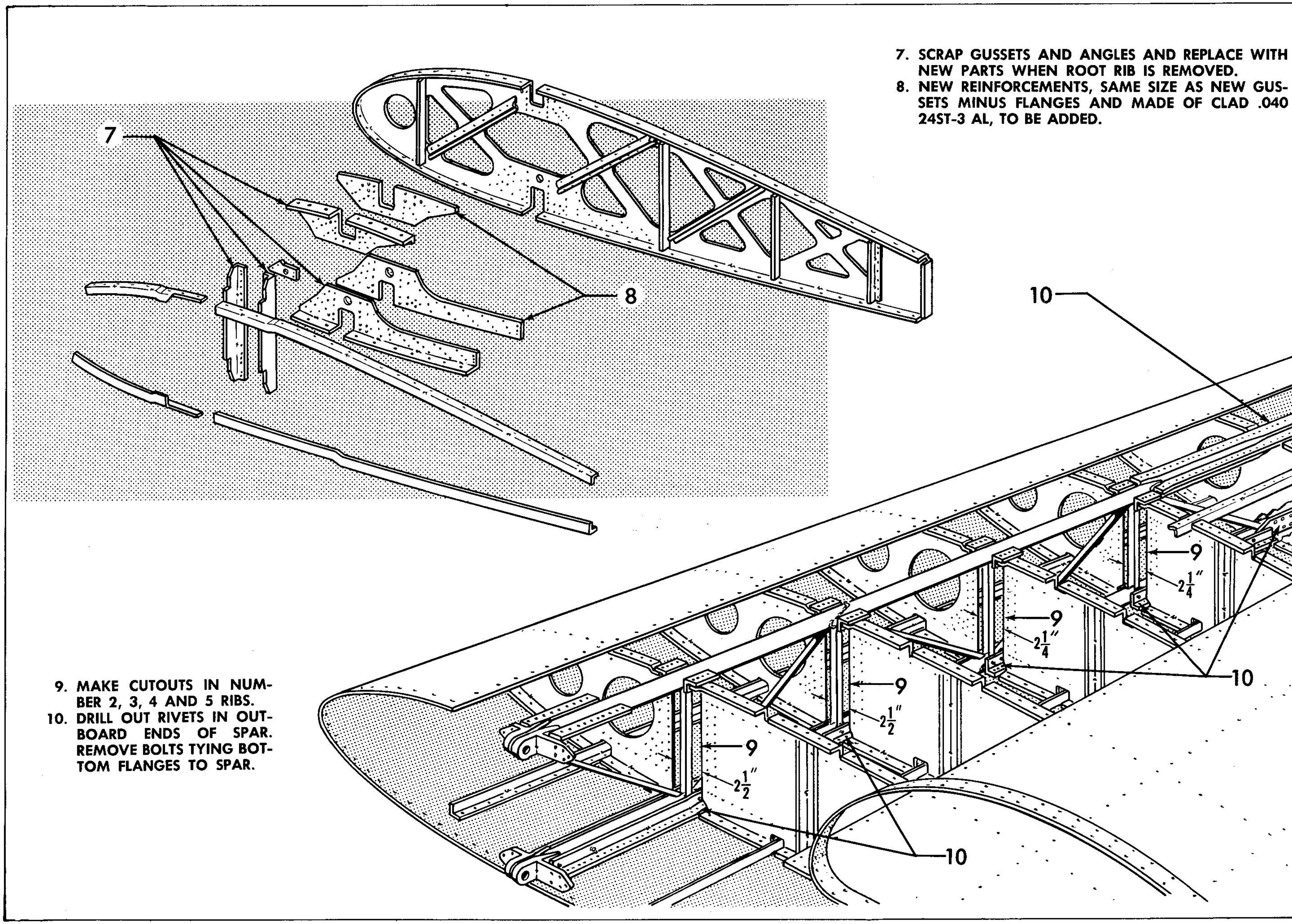

Figure 2-26 Outer Wing Panel Front Spar Replacement (Sheet 3 of 6 Sheets)

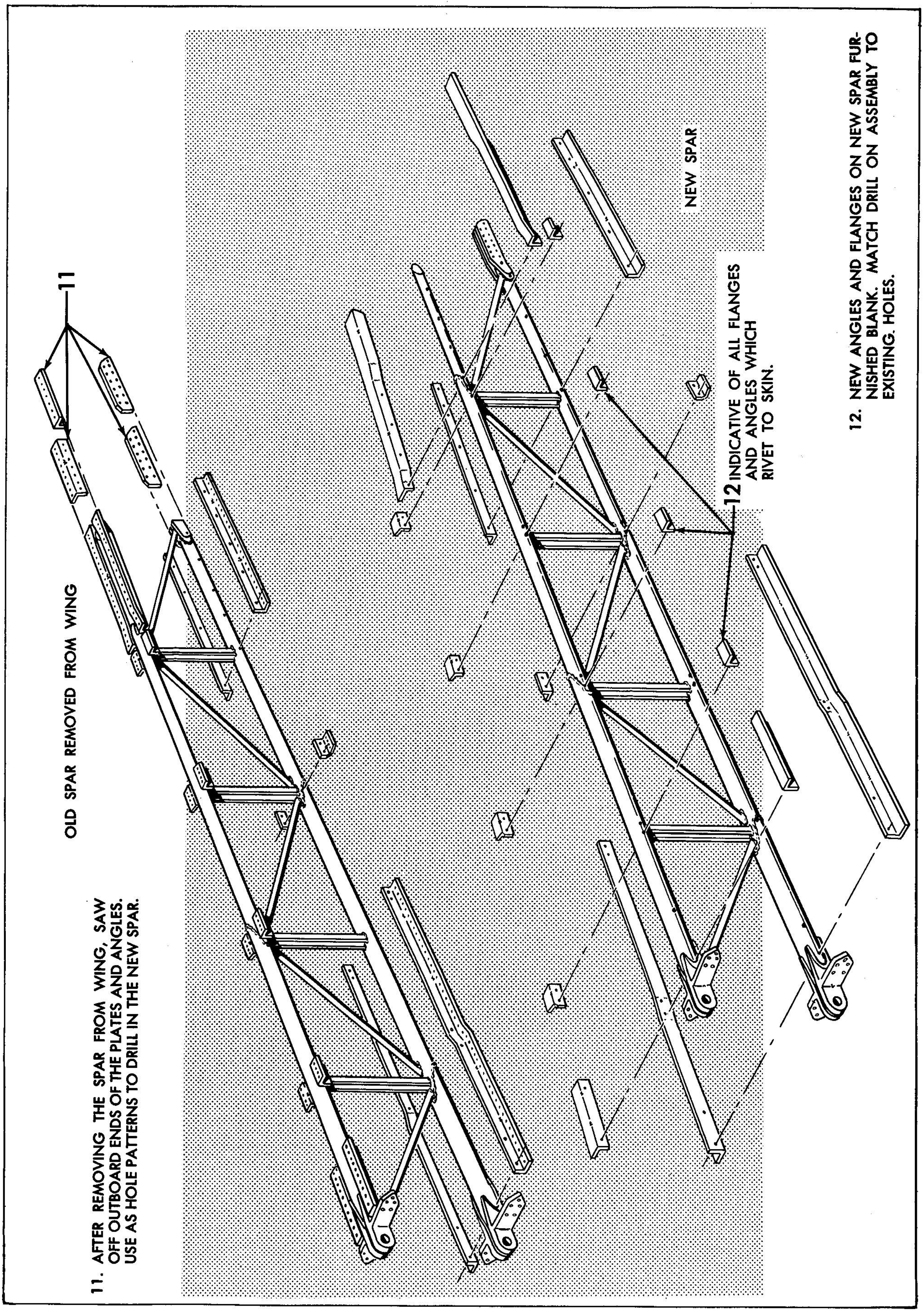

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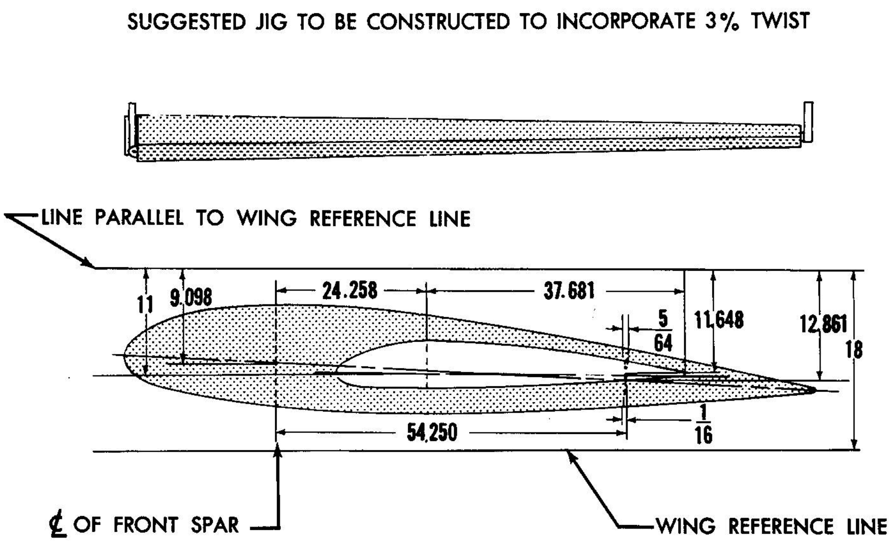
Figure 2-26 Outer Wing Panel Front Spar Replacement (Sheet 4 of 6 Sheets)

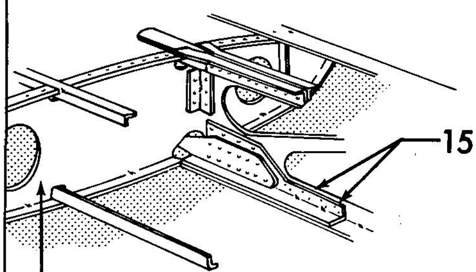
13. INSTALL NEW SPAR IN WING. INSTALL ROOT RIB. BUTTON DOWN ALL RIVETS IN ROOT RIB AND SKIN.
CAUTION: LEVELING JIG MUST BE INSTALLED BEFORE PROCEEDING WITH FOLLOWING STEPS.

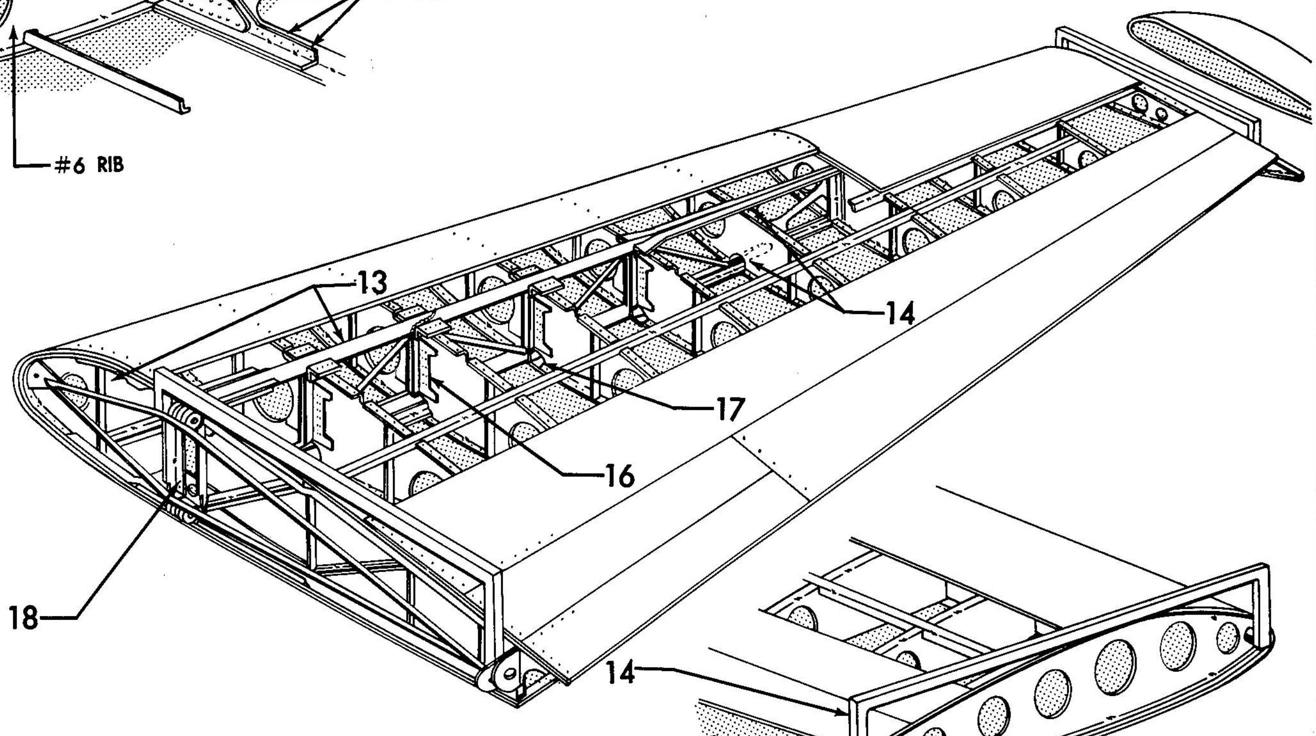
14. PUT WING IN JIG FOR MATING INBOARD AND OUTBOARD SPARS. USE HOLEFINDER FOR LOCATING TWO HOLES IN PLATES AND ANGLES AT OUTBOARD END OF NEW SPAR. REMAINDER OF HOLES TO BE DRILLED FROM OLD PLATES AND ANGLES.

15. ANGLES (FWD. AND AFT SIDES) ARE USED ONLY WHEN HOLES IN LOWER PLATES MISALIGN WITH EXISTING HOLES IN OUTER FRONT SPAR. AD6 RIVETS USED IN PLACE OF AD5 RIVETS IN CASE OF SLIGHT MISALIGNMENT.



16. INSTALL SPLICE PLATES ON RIBS
-2 SPLICE PLATE ON #2 RIB
-4 SPLICE PLATE ON #3 RIB
-6 SPLICE PLATE ON #4 RIB
-8 SPLICE PLATE ON #5 RIB
ALIGN RIBS WITH SPAR AND MATCH DRILL SPLICE PLATE TO U-CHANNEL ON SPAR AND RIVET.





17. MATCH DRILL BOTTOM ANGLES TO HOLES IN BOTTOM SKIN AND SPAR CAP AND RIVET. LOCATE TOP SPAR CAP AND ALL TOP SKINS. AN470 RIVETS MAY BE REPLACED WITH NEXT SIZE LARGER IF NECESSARY. DO NOT REDIMPLE DIMPLED SKINS TO NEXT LARGER SIZE. BACK DRILL TOP ANGLES ON SPAR TO MATCH EXISTING HOLES IN SKIN AND SPAR CAP.

18. BACK DRILL ROOT RIB TO SPAR AND INSTALL BOLTS.

Figure 2-26 Outer Wing Panel Front Spar Replacement (Sheet 5 of 6 Sheets)

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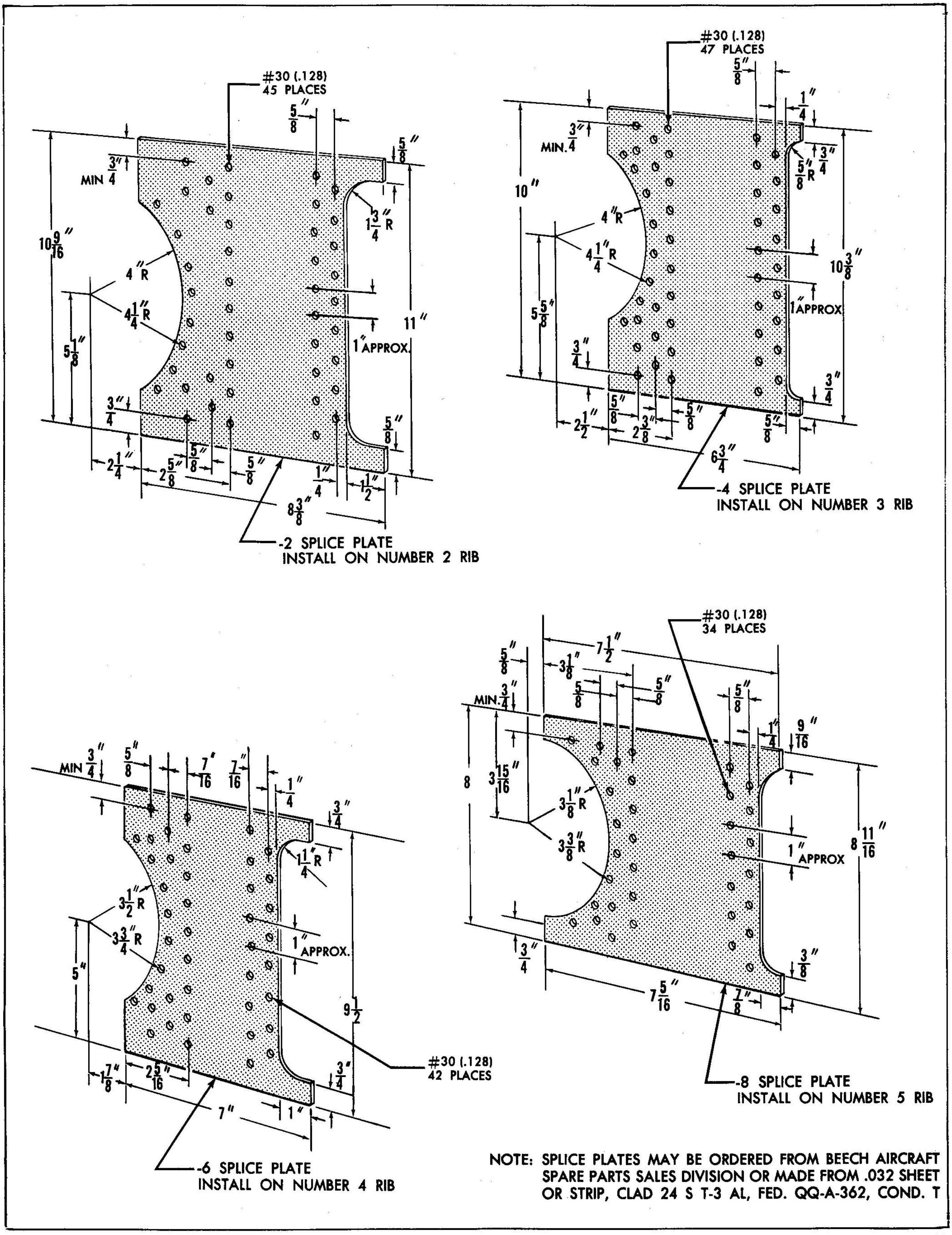

NOTE: SPLICE PLATES MAY BE ORDERED FROM BEECH AIRCRAFT SPARE PARTS SALES DIVISION OR MADE FROM .032 SHEET OR STRIP, CLAD 24 S T-3 AL, FED. QQ-A-362, COND. T

Figure 2-26 Outer Wing Panel Front Spar Replacement (Sheet 6 of 6 Sheets)

pated, drain solution from tank, wash and rinse thoroughly with cold running water.

(d) Acidize by immersing in a water solution of Oakite 84A (8 to 10 ounces per gallon) for 5 to 10 minutes at room temperature (21° to 32° C) (70° to 90° F).

(e) Drain tank for a few minutes, then wash thoroughly with clean cold water.

(f) Follow with a dip in clean hot water to facilitate drying. Use air blast to remove last traces of water from between joining surfaces. Tank is now ready for repair.

44 After repair or alterations have been made on the tank by welding, remove welding flux as follows:

(a) Immerse in a solution of Oakite No. 84A (8 to 10 ounces per gallon) at room temperature (21° to 32° C) (70° to 90° F) for 15 to 30 minutes (or until all flux dissolves).

(b) Rinse with clean, cold running water before neutralizing. Thorough rinsing is essential.

(c) Neutralize by immersing tank in a hot solution (82° to 88° C) (180° to 190° F) of Oakite No. 61 (8 to 10 ounces per gallon) for 15 to 30 minutes.

(d) Rinse thoroughly in cold running water.

(e) Rinse in hot water to facilitate drying. Dry, using dry, compressed air.

45 To refinish the interior of the tank, complete the foregoing process and then proceed as follows:

(a) Seal all openings and air test at 5 psi.

(b) Remove seal from one opening and pour about five gallons of slushing compound (MIL-L-6047) into the tank and seal opening.

(c) Rotate tank on a diagonal axis in order to get complete surface coverage.

(d) Drain slushing compound. Place in a position which will permit complete drainage. Allow to drain for 20 minutes or until dripping has stopped.

(e) Dry for 48 hours at room temperature with all openings uncovered or room dry for 30 minutes, then using a heat run, raise the temperature to a minimum of 82° C (180° F).

46 For refinishing the exterior of the fuel tank, proceed as follows: Remove any paint left on the tank and sandpaper any rough spots. Flush with water and permit to dry. When completely dry, prime with one coat of zinc chromate primer, then spray with two coats of lacquer (DTD 754 aluminized).

PART 3
TAIL GROUP

TABLE OF CONTENTS

DESCRIPTION

1 General — The horizontal stabilizer, elevator, two vertical stabilizers, and two rudders compose the empennage parts. Two trim tabs are attached to the elevator and one to each rudder. Angle of incidence of horizontal stabilizer to centerline of the fuselage is negative two degrees.

2 Horizontal Stabilizer — The horizontal stabilizer is a stressed-skin panel of all aluminum-alloy construction. The ribs are attached to front and rear spars and are supported along this span by extruded angle stringers. The stabilizer is attached to the fuselage in fixed alignment by attaching brackets bolted to the fuselage and machine screws through the support angles on fuselage Bulkheads 13 and 15. See Figure 3-1.

3 Vertical Stabilizer — Two vertical stabilizers are attached to the outer ends of the horizontal stabilizer by means of standard AN machine screws through angles riveted to the horizontal stabilizer covering. They are stressed-skin panels of aluminum-alloy construction. The ribs are attached to front and rear spars and are supported along this span by stringers made from .032 sheet material. See Figure 3-1.

4 Elevator — The elevator is a fabric-covered, aluminum-alloy structure, similar in construction to other control surfaces. It is hinged to the horizontal stazilizer at five points on prelubricated bearings mounted in cast aluminum alloy brackets which are bolted to the horizontal stabilizer. The elevator is shaped by 18 ribs attached to a spar. The trailing edge is made of Alcoa F-1508, and the nose is of metal skin supported by 22 nose ribs. Four balancing weights, two on each side, are fastened to the inside of the nose skin to give static and dynamic balance. Two trim tabs, hinged to bulkheads attached to the ribs, are fitted into the trailing edge of the elevator, one on each side of the center line. See Figure 3-1.

5 Rudder — A rudder is attached to the rear spar of each vertical stabilizer. The rudders are fabric-covered control surfaces of similar construction to the ailerons, flaps, and elevator. Each rudder is shaped by seven ribs fastened to a spar and reinforced by diagonal braces and bulkheads. The nose section of the rudder is made of metal skin supported by 10 nose ribs, and the trailing edge is made of Alcoa Streamline Tube Section T-535. See Figure 3-1. A balancing weight is built into the upper front part of each rudder to give static and dynamic balance. Trim tabs are fitted on the trailing edge of both rudders. Each rudder is hinged on four pre-lubricated bearings mounted in cast aluminum-alloy brackets which are bolted to the rear spars of the vertical stabilizers.

DEFINITION OF DAMAGE

6 Damage may be defined as follows:

(a) Negligible Damage — Damage that will not affect the airworthiness of the tail group and usually does not require immediate attention.

(b) Damage Repairable by Patching — Damage that may be repaired by covering or reinforcing without removal, other than trimming, of a portion of the skin or structure.

(c) Damage Repairable by Insertion — Damage requiring the removal and replacement of a portion of the tail group skin or structure.

(d) Damage Repairable by Replacement — Damage that is unrepairable by patching or insertion, but that may be repaired by installing a new part. Damage requiring replacement, but which cannot be replaced because of structural design, will necessitate replacement of the entire damaged assembly.

PROCEDURE FOR REPAIR OF DAMAGE

7 Negligible Damage — Damage of this classification shall be limited for the entire tail group to surface dents and scratches in the skin. The dents must not substantially change the contour of the airfoil and must be carefully investigated for indications of structural damage.

Damage Repairable by Patching

8 Skin — Small holes, cracks, or breaks in the metal skin covering of the horizontal or vertical stabilizers may be patched, with the exception of those occurring in the leading edge skin. The leading edge skin must maintain a strictly smooth contour, necessitating a flush-type patch. It would be extremely difficult to form a patch to fit this contour properly; therefore, repair by insertion is recommended. Other sections of the stabilizers may be repaired with surface patches of the following types:

(a) Round holes up to 1 inch in diameter may be reinforced by a washer installed as shown in Figure A-4. Reinforcing, rather than covering, the hole permits the use of a bucking bar in setting the rivets. If blind rivets are used, a disc may be substituted for the washer.

(b) Small breaks or punctures in the skin may be repaired as shown in Figures A-2 and A-3. The ragged edges should be cut away, as shown by the dotted lines, so that no sharp corners remain. To calculate the minimum number of rivets to be used, multiply the length of the hole, after trimming, by eight. As an example, assume the length of the hole is 2.5 inches, 8 x 2.5 = 20 rivets. Therefore, a minimum of 20 rivets must be used on each side of the hole, or 40 rivets for the entire patch.

(c) To repair cracks in the skin, first drill stop-holes at each end or sharp corner of the crack. See Figure A-1. The patch plate should be cut large enough to clear all parts of the crack by 7/8 inch. Blind rivets, if available, may be substituted for the standard rivets.

9 Stringers — Cracks in stringers of the tail group may be repaired by reinforcing the damaged member with an extruded section or a hand-formed splice angle, as follows:

(a) An extrusion of the same cross section as the original stringer may be used as patch material. The reinforcement must fit smoothly into the stringer. In some cases it is necessary to remove the bulb and radius corners of the patch extrusion. See Figure A-11.

(b) The hand-formed splice angle should be made of .064, 24ST sheet, and attached as shown in Figure A-10. If the flange on the extrusion or stringer to be repaired is under 3/4 inch, the radius of bend for the splice angle should be 1/8 inch, and if the flange is over 3/4 inch, the radius of bend for the splice angle should be 3/16 inch. The splice angle should be formed on a brake machine if one is available.

10 Ribs — Damage to the structure of all ribs of the tail group can be repaired as follows:

(a) Small cracks or breaks, entirely within the rib web, may be repaired by methods described for skin patches in Paragraph 22, Part 2, if space permits.

(b) Damage to the formed flanges extending down into the web, or in ribs that are too small for a skin-type patch, will require a patch formed to fit the flange of the rib. See Figures A-13 and A-14. The crack or break must be covered with a patch which will extend at least

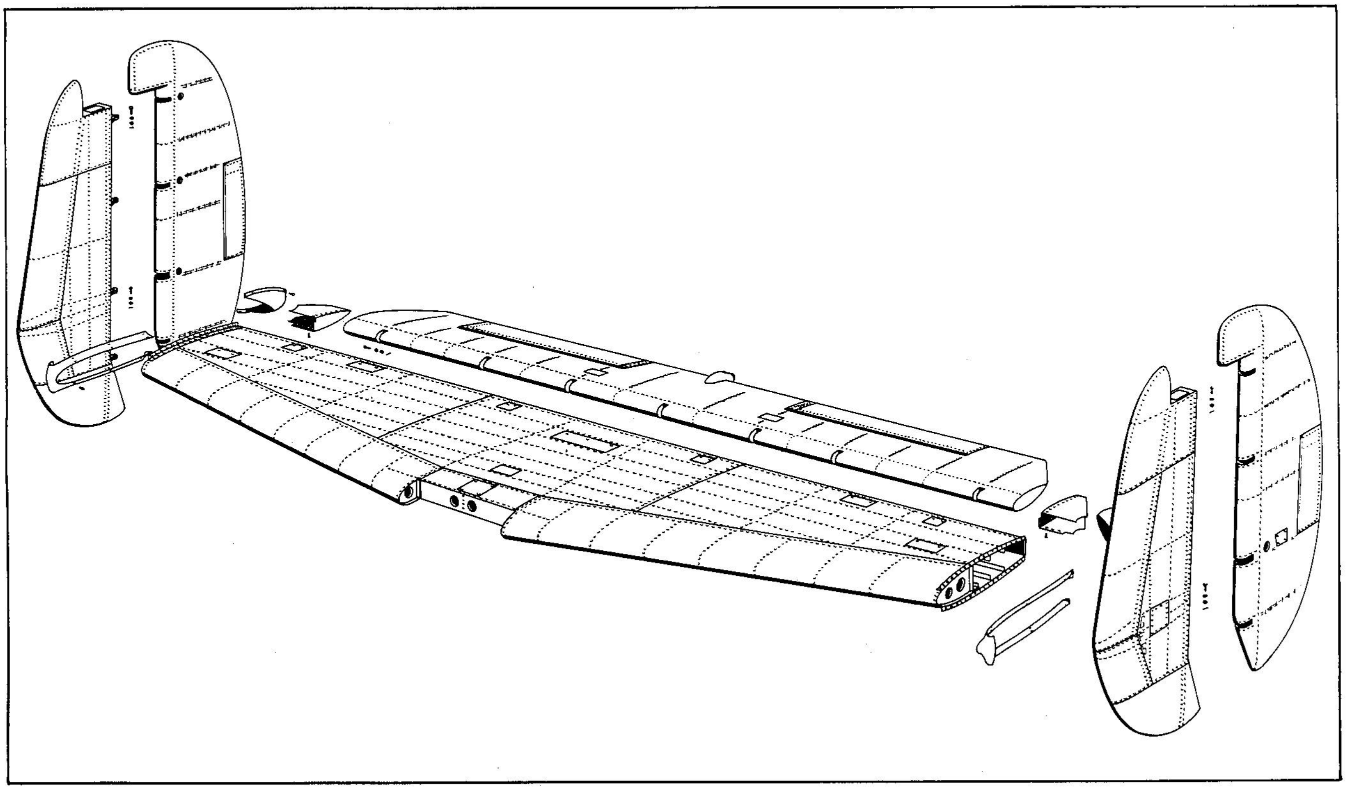

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Figure 3-1 Exploded View, Tail Group

¾ inch each way from the edge of the crack. Stop-holes should be drilled at the ends of cracks, and breaks should be properly trimmed to prevent spreading. In riveting the rib patch to the rib flange, the skin rivets may be used with an additional rivet between the original skin rivets. Rivets must not be spaced closer than ⅜ inch.

11 Spars — All cracks or breaks in spar members shall be reinforced with a patch-plate extending across the full cross section of the spar. The patch should be flanged to fit inside the spar flanges, and should be attached to the spar flanges, using the original rivet holes in the spar and skin, and spacing new rivets midway between the old rivet holes. A double row of rivets, staggered, with ½-inch spacing, should extend the full length of each side of the patch across the face of the spar. If the patch falls on a lightening hole, the patch should be formed to fit the lightening hole flanges. Patches of this type are more easily formed from 24SO AL Alclad, heat-treated after forming to 24ST AL Alclad. Repair material must be the next greater gauge than the spar to be repaired.

12 Trailing Edge Repairs — Cracks or small breaks between rib members may be repaired by a reinforcing patch as shown in Figure A-23. Care must be exercised in inserting the splice block to avoid further damage, especially in the case of the rudder trailing edge which is formed of streamlined tubing. A minimum of three rivets must be used on each side of the break. See Figure A-22.

Damage Repairable by Insertion

13 Skin — When damage to the skin of the tail group is too extensive to be repaired by patching, the skin should be cut back to the surrounding stringers and ribs, and a new piece of skin inserted. The new piece of skin should be the next greater thickness than the damaged piece and of the same material. A minimum spacing of ⅜ inch between rivets must be maintained.

14 Skin joints may be classified as longitudinal or transversal.

(a) The longitudinal skin joints lie along stringers and spars, with the skin attached as shown in Figure A-9. Skin joints, wherever possible, are made at points where loads are less; therefore, if the new joint is made at the site of an old joint, the same rivet spacing may be employed. However, due to the possibility of higher loads in that area, a skin joint where no joint existed previously should be made with twice the number of rivets used to attach the skin to the frame member at that point.

(b) The transverse skin joints lie along the ribs and the skin is attached as shown in Figure A-8. The original rivet spacing may be used if the joint is made at an original skin joint; otherwise, the replacement skin should be cut to lap over the rib by ½ inch, riveted with a staggered row of rivets, and with spacing equal to the original rivet spacing in the rib.

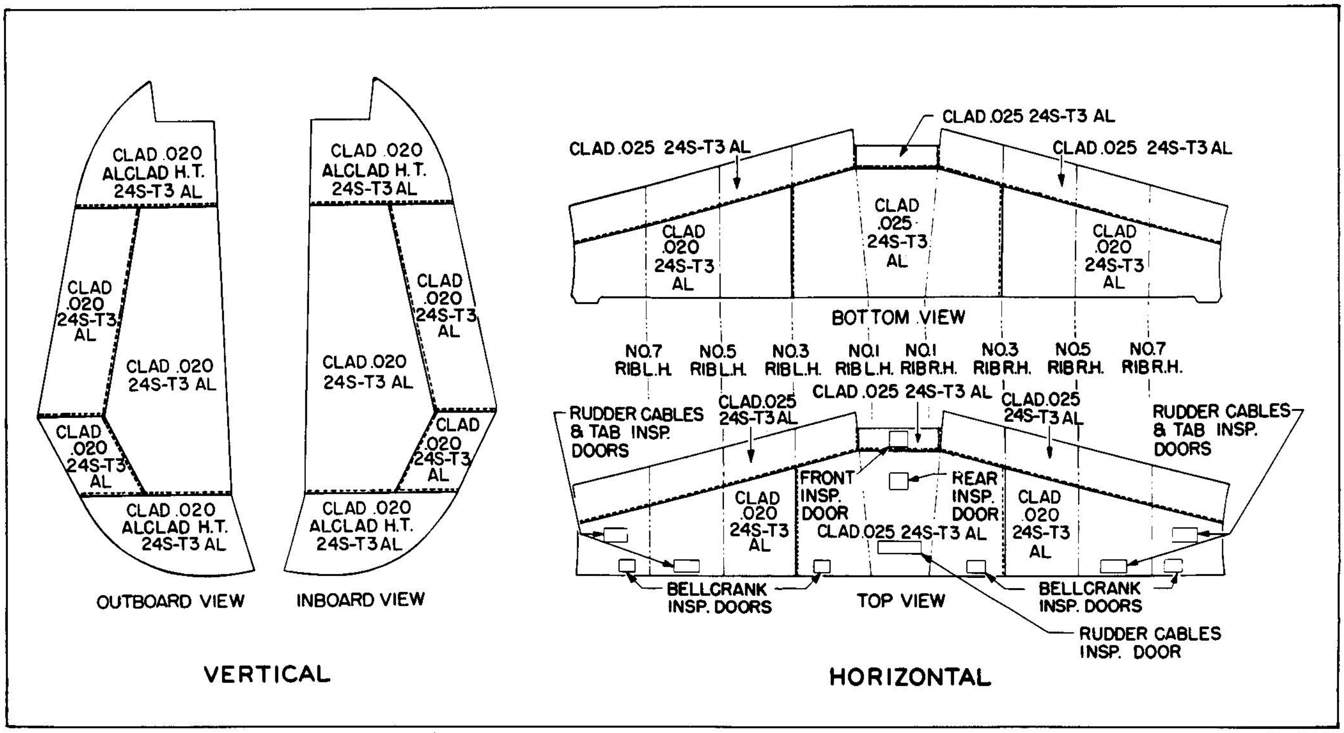

Figure 3-2 Empennage Skin Plating Diagram

15 Stringers — Damage requiring removal of a portion of a stringer may be repaired by cutting out the damaged portion and inserting a new extruded section. This section may be held in place with two splices, installed as in Paragraph 23(b), Part 2. See Figures A-11 and A-12.

16 Ribs — Serious damage to a rib may require replacement of a portion of the rib. Remove the damaged part by making a straight cut across the rib. Form a new portion the same size as the damaged portion which was removed using material of the next greater thickness and the same alloy. This new part may be spliced to the rib by using the same procedure as that used in patching ribs described in Paragraphs 19(a) and 24(b), Part 2. See Figures A-13 and A-14. There should be a staggered double row of rivets on each side of each joint.

17 Spars — Damage to the spars of the tail group may be repaired by cutting away the damaged portion and forming a new section to replace it. This repair may be made by following the procedure outlined for the repair of ribs in Paragraph 16 above.

18 Trailing Edge Repairs — To replace a damaged trailing edge of the elevator or rudders, cut out the damaged section and replace it with a new piece. The new section should be spliced in as shown in Figures A-22 and A-23. A splice should never be made at a rib, due to the difficulty of installing a splice block directly at a rib. It is usually most convenient to make extremities of the cut center between the trailing edge ribs. The splice block may be made of 52SH or any stronger aluminum alloy. A minimum of three rivets on each side of the cut will be necessary.

Damage Repairable by Replacement

19 Skin — If more than 50 percent of a sheet of skin is damaged, the entire sheet should be replaced. Use material of same thickness and equal strength.

20 Stringers — If damage to a stringer is so extensive that repair by insertion or patching is impractical, the entire stringer should be removed and replaced. In some cases this may necessitate the removal of skin in the area of the damaged stringer.

21 Ribs — Replace ribs as follows:

(a) Stabilizer Ribs

(1) To remove a rib in the stabilizers, it will be necessary to remove the top skin in the area of the damaged rib. This should cause no undue inconvenience since any occurrence that would damage a rib, subsequently would damage the surrounding skin so that extensive patching or replacement would be necessary. If 50 percent of a rib is damaged, the entire rib should be replaced.

(b) Elevator and Rudder Ribs

(1) These ribs may be replaced by slitting the fabric in the vicinity of the damage and pulling it back away from the damaged ribs. If 50 percent of the rib is damaged, the rib should be replaced. The new rib should be formed of the same material as the old rib.

22 Spars — Replace spars as follows:

(a) Stabilizer Spars

(1) The stabilizer spars are built in sections and one or more damaged sections may be replaced. However, the repair will be very difficult. If it is necessary to replace a stabilizer spar, the complete stabilizer assembly should be replaced.

(b) Elevator and Rudder Spars

(1) Extensive damage to these spars will necessitate replacement of the entire assembly.

PART 4
BODY GROUP

TABLE OF CONTENTS

DESCRIPTION

1 General — The fuselage is a semi-monocoque, all-metal structure with stressed-metal skin covering. The structure, Figure 4-1, consists of stringers running fore and aft through the fuselage and attached to the bulkheads. The flooring in cabin and pilots' compartment is supported by a structure of intersecting channels attached to the bulkheads and skin. The skin covering is riveted to the stringers and bulkheads.

DEFINITION OF DAMAGE

2 Damage may be defined as follows:

(a) Negligible Damage — Damage that will not affect the airworthiness of the fuselage structure and usually does not require immediate attention.

(b) Damage Repairable by Patching — Damage that may be repaired by covering or reinforcing a portion of the fuselage skin or structure.

(c) Damage Repairable by Insertion — Damage requiring the removal and replacement of a portion of the fuselage skin or structure.

(d) Damage Repairable by Replacement — Damage unrepairable (or too extensive to repair) by patching or insertion but that may be repaired by replacing the part.

PROCEDURE FOR REPAIR OF DAMAGE

Negligible Damage

3 General — Negligible damage to the aircraft frequently may be caused by flying rocks, missiles, accidental abrasion, or inadvertent actions of personnel. Shallow dents, small, clean-edged holes, minor scratches, and bruises may be considered as negligible when not occurring in highly stressed portions of webs, angles, or skin. Cracks and tears must be checked or corrected to prevent spreading. A 3/32 to 1/8-inch hole, drilled at the end of a crack, is a temporary means of checking its extension. Care must be taken that the hole is actually drilled in the end of the crack, since an improperly checked crack may easily continue to extend. Web damage in bulkheads must be carefully considered, as the same injury which could be accounted negligible in one locality may be detrimental in another. Dents or holes in the hydro-pressed parts should not be allowed to remain. However, dents or holes in the thin sheet sections of some of the bulkheads are not critical and fairly large damaged areas may be considered negligible.

4 Floor Channels — Floor channels have quite heavy loads imposed upon them by the cabin seats and cargo and care must be taken that they develop maximum strength. Small holes will be allowed in the webs provided they have ample edge distance and the edges are smoothed so that there is no chance for cracks to elongate. However, holes or cracks in flanges will not be allowed, but must be repaired. Slight bends of fairly large radii may be straightened. Any damage to the floor supports adjacent to the control column, torque tube, or landing gear and flap motors must be carefully considered, since distortion may cause faulty operation.

5 Hat Sections — The hat sections are quite heavily stressed and any damage to them must be carefully considered, especially in the formed portions. Small holes, having ample edge distance and which do not occur in the radius of a bend and which do not have any rough corners, may be disregarded if the radius is large, but holes or dents in the formed portions will require repair.

6 Skin — Small clean holes and small dents may be considered negligible damage to the skin. Jagged holes should be cleaned out and sharp dents smoothed out where possible, as sharp dents or jagged holes are likely to develop cracks which could spread. Stop-drill cracks with a 3/32-inch drill at the extreme end of the crack to curtail spreading. However, it is recommended that holes be patched as soon as possible to avoid annoying airstream whistles. A temporary nonstructural patch may be made by doping fabric over the hole. Although the damage to the skin may be considered negligible from a structural standpoint, it may destroy the outer corrosion-protective coating.

7 Supporting Structures — Small dents in the radio rack and navigation table brackets will be considered negligible; however, since they are easily repaired, dents should

be smoothed out as soon as possible. Small clean holes will also be considered negligible if they do not occur in a flange and have ample edge distance.

8 Door and Window Frames — The door and window frames are quite heavily stressed parts. Small holes in the cabin door and baggage door frame may be considered negligible if they occur in the web and have ample edge distance.

Damage Repairable by Patching

9 Bulkheads — Cracks in bulkheads or holes which occur near the flanges of the formed sections should be repaired immediately as they weaken the structure considerably. Repair may be made by forming a patch of 24S aluminum-alloy material of the next gauge heavier than the part being repaired. Usually it will be necessary to form the patch in the annealed or "O" condition, after which it will be necessary to heat-treat the patch to the "T" condition before installation on the part to be repaired. Refer to Figure A-17 for details of the repair. Holes or cracks in the flat portions of the thin web of some of the bulkheads may be patched as shown in Figures A-1 and A-2.

10 Stringers — Patch stringers as follows:

(a) Cracks in the stringers may be repaired by reinforcing the damaged member with an extruded section or a hand-formed splice angle.

(b) An extrusion of the same cross section as the original stringer may be used as patch material. The reinforcement must fit smoothly into the stringer, even if it is necessary to file the bulb angle and corner radius of the patch extrusion. Refer to Figures A-10 and A-11 for details of the patch.

(c) In the event a hand-formed splice angle is used, the angle should be made of 24ST or 17ST sheet, .064-inch thick. Radius of bend for this angle should be 3/16 inch.

(d) If it is necessary to splice more than one stringer, stagger the splices in such a manner that no two splices fall at the same station. See Figure A-12.

11 Floor Channels — Cracks in floor channels may be patched by inserting a patch of the next gauge heavier material. If the crack or damaged portion occurs in the flange, it will be necessary to form the patch to fit the inside contour of the channel. Either 17ST or 24ST material should be used for patch material. See Figure A-20.

12 Hat Sections — Damage to hat sections may be repaired by the addition of a splice plate of 17ST or 24ST material, formed to fit over the top of the hat section. It will be necessary to form this patch in the annealed or "O" condition and heat-treat to the "T" condition before installation. See Figure A-16.

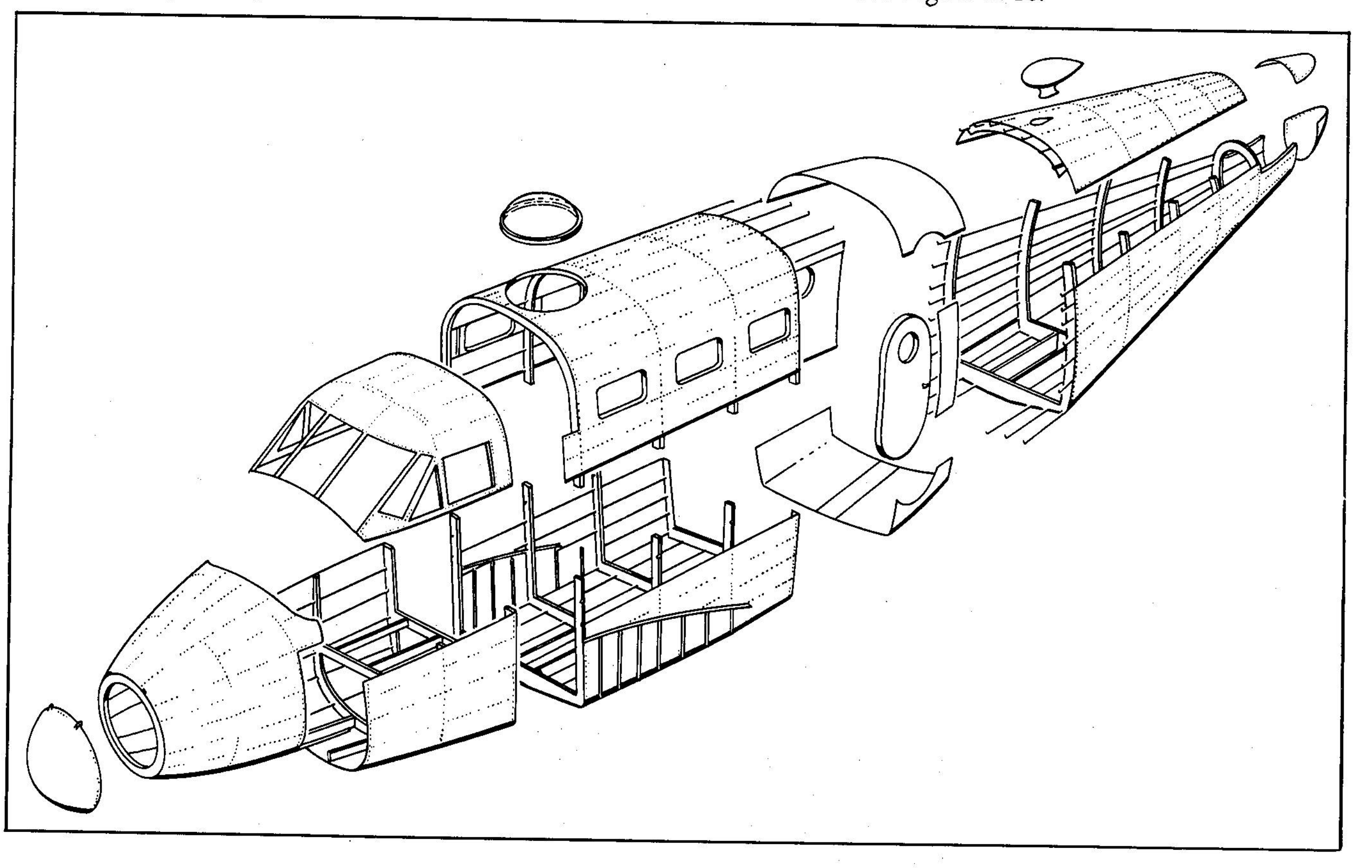

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Figure 4-1 Exploded View, Fuselage

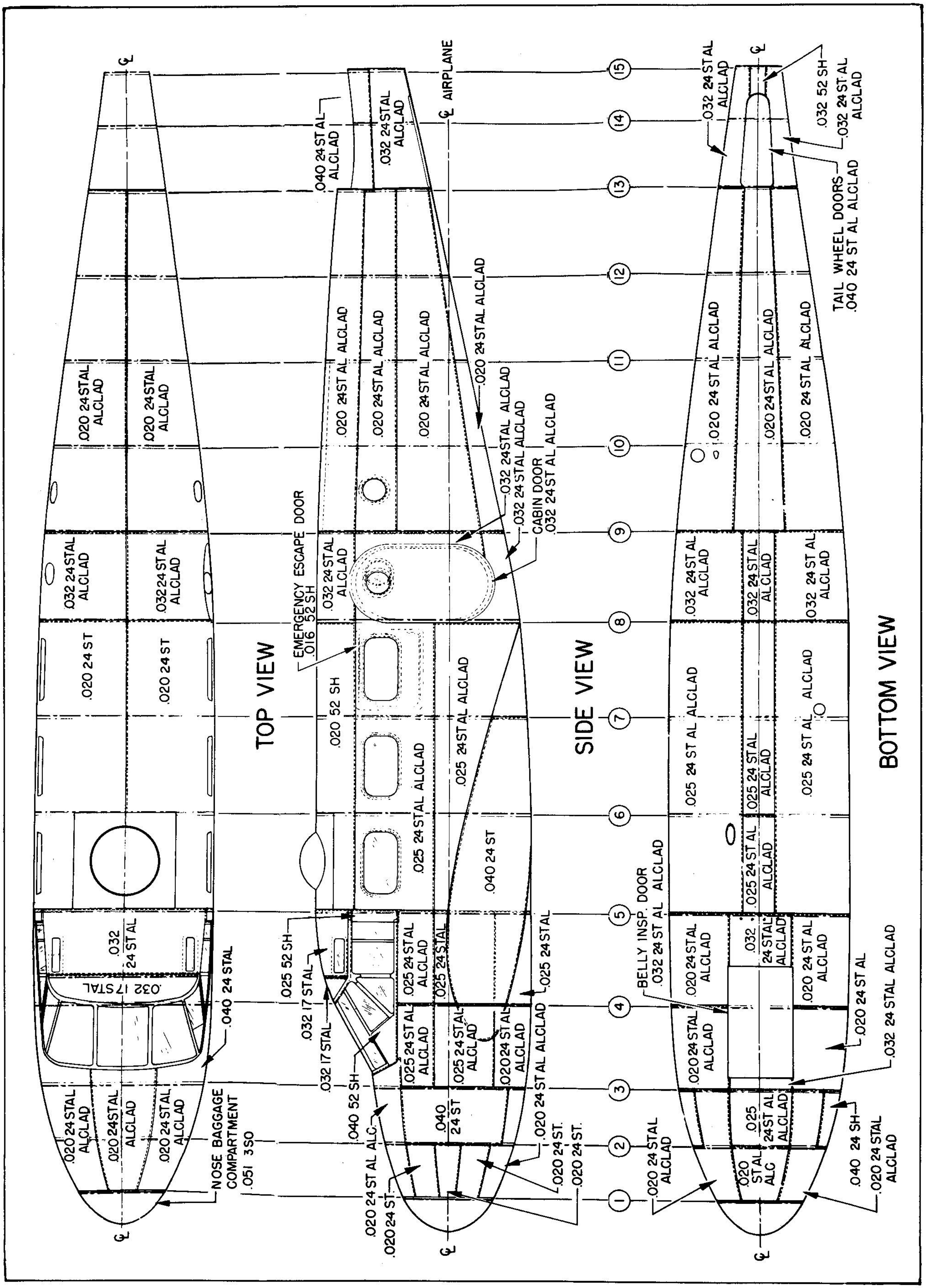

Figure 4-2 Fuselage Skin Plating Diagram

13 Skin — Patch skin as follows:

(a) Various sizes of damaged areas in the skin will require different types of patches. Either a flush-type patch, Figure A-3, or the external-type patch, Figure A-2, may be used.

(b) Round holes up to 1 inch in diameter may be reinforced by a washer of the same thickness and material as the original. See Figure A-4. In the event it is impossible to buck the rivets, some form of blind riveting device may be used.

(c) Small breaks or punctures in the skin may be repaired as shown in Figures A-2 and A-3. The ragged edges should be cut away, as shown by the dotted lines, so that no sharp corners remain.

14 Supporting Structures — Cracks and holes in the supporting structures may be repaired by forming a patch to fit the contour of the supporting structure in the case of flanged channels. See Figure A-18. Cracks or holes in flat sections of supporting structure may be repaired by inserting a reinforcing patch over the cracks or holes (see Figures A-2 and A-4).

15 Door and Window Frames — Damage to the hat sections, which constitute the cabin window frames, may be repaired by forming a sheet of the same material and of the next gauge thicker than the hat section being repaired, installing it as shown in Figure A-16. The cabin door frame is made of a flanged section of sheet metal and is quite heavily stressed. The left-hand side of Bulkhead No. 8 acts as the front side of the cabin door frame. Patches may be made to the cabin door frame in the same manner as patches on bulkheads. See Figure A-18. The baggage door frame, located on the right side of the fuselage, is of similar construction and requires a similar repair.

Damage Repairable by Insertion

16 Bulkheads — Damage to bulkheads which requires insertion should be very carefully considered, as some of the bulkheads are built of relatively small sections. In many cases it will be much easier to replace a section than to attempt to form and insert part of a damaged bulkhead. However, from a structural standpoint there is no objection to splicing in an insertion to replace the damaged portion. An insertion may be made to the bulkhead by trimming out the damaged area and inserting a formed section which duplicates the damaged portion removed. If a replacement or salvaged bulkhead is available, it will be more satisfactory to cut a section from the other bulkhead which duplicates the damaged portion removed. However, if a replacement insertion is not available, one may be formed from SO material and heat-treated to the ST condition after forming. Secure insert into bulkhead by means of a splint-patch. See Figure A-18.

17 Stringers — Damage to stringers may be very easily repaired by trimming out the damaged area and inserting an extrusion of the same type to replace the trimmed-away portion. The replacement insertion will be attached to the original stringer, as shown in Figures A-10 and A-11.

18 Floor Channels — Insertions may be made to floor channels by cutting away the damaged portion and inserting the necessary length of channel. The channel inserted should be identical to the original and may be spliced to the original, as shown in Figure A-20.

19 Hat Sections — Damaged hat sections which are not repairable by patching may be repaired by trimming away the damaged areas and INSERTING a section of hat section. Splices at each end of the insertion may be made as shown in Figure A-16.

20 Skin — Skin damage which is too large to be repaired by patching, must be repaired by trimming the skin back to structural members and inserting a section of skin. The skin in the adjacent panels will be allowed a minimum of 5/8-inch edge distance beyond the center line of the rivets bounding the respective panels. Replacement skin must be of the same material as original, or stronger, and must be of a thickness equal to or a gauge heavier than the original. Rivet spacing should duplicate the original.

21 Supporting Structures — In the event of damage to supporting structure which is too large to be restored by a patch, form a replacement insertion of material equal to the original and rivet into place, as described under "PATCHING."

22 Door and Window Frames — The cabin window frame work is made of hat sections and insertions may be made in the same manner as described for hat sections. The cabin and baggage door frames are of a construction similar to the bulkheads and may be repaired in the same manner.

Damage Repairable by Replacement

23 Bulkheads — Damage to bulkheads must be very carefully considered. Many of the bulkheads are built in sections and replacement of damaged sections is relatively easy. However, some of the bulkheads are very hard to replace and require the removal of a great deal of equipment to accomplish the replacement. In general, ease of replacement will determine to a large extent whether to repair or replace damaged members.

24 Stringers — Unless the complete stringer is damaged, there is no need to replace the stringer, as patch and insertion repairs may be made easily and are just as satisfactory.

25 Floor Channels — In event of extensive damage to the floor channels, it will be more satisfactory to replace them than to attempt a repair. The cross member of Bulkhead No. 4, Beech part 804-184047, Figure 4-3, is a very highly stressed member constructed of chrome-molybdenum steel, either .063 sheet or .065 strip, Specification No. AN-QQ-S-685. Replacement of this member is recommended, if it is damaged.

26 Hat Sections — Replacement of hat sections will be determined by the amount of work necessary to replace them. If a complete hat section can be replaced with a slight amount of additional work, it will be better to replace the damaged part.

27 Skin — In sections of skin in which the area of damage is relatively large, the section of skin affected should be replaced. However, before removing the skin, determine whether or not the rivets can be bucked on the replacement skin. In event rivets cannot be bucked, in many cases it will be better to make an insertion repair.

28 Supporting Structure — Replacement will depend upon the extent of damage and availability of replacement parts. If replacement parts are available, it will be better to replace damaged parts than to attempt a repair, even though the damaged area is small, as replacement will make a better-appearing repair and will not add weight to the aircraft.

29 Door and Window Frames — Damage to the pilots' compartment window and windshield frames will require replacement because of possible interference with nearby structure or window operation.

WINDSHIELD AND WINDOWS

30 Removal

(a) Remove screws holding lower gusset, outside "T" frame and upper strip.

NOTE

Access to the elastic stop nuts is obtained through the nose baggage compartment and the pilot's compartment.

(b) Using a sharp knife to loosen sealer, carefully remove lower gusset, outside "T" frame and upper strip.

(c) Remove glass and clean all sealer from channels and surfaces.

31 Installation

(a) Install sealant, using sealer MIL Spec. S7502C, Class A 1/2 with NSN 8030-21-805-9873 along lower surface of inside T frame and lower channel.

(b) Install glass in place leaving ⅛-inch clearance between edge of glass and channels; press down firmly.

(c) Install sealer MIL Spec. S7502C, Class A 1/2 with NSN 8030-21-805-9873 on outboard side of the glass near the edge of all edges.

(d) Install outside "T" frame, lower gusset and upper strip with screws and tighten securely but do not overtighten. Trim off excess sealer and clean glass.

NOTE

Screws in the glass frame are to contact the fiber in the stop nuts at least two threads and are not to protrude through fiber more than one thread.

PART 5
LANDING GEAR

TABLE OF CONTENTS

DESCRIPTION

1 Main Landing Gear — The main landing gear is an air-oleo shock strut, having a yoke-type lower end clamped rigidly to the axle of the wheel. At the upper and lower ends of the upper cylinder, the strut is attached to a "Y" brace pivoting on bolts through bushing-bearings mounted in the center section steel truss. See Figure 5-1. Hinged to the rear side of the lower end of the upper cylinder is an oleo drag strut running aft and upward. The upper end is hinged to a slide operating on a slide tube which runs forward and upward in approximately the center of the engine nacelle, from the bottom of the center section truss to a point near the top of the firewall. Attached to the slide is a chain which, when operated by the landing-gear motor or emergency hand crank through the retraction mechanism, pulls the slide forward and up the slide tube, retracting the landing gear aft and up into the bottom of the nacelle.

2 Tail Gear — The tail gear consists of a fork, swivel housing, air-oleo shock absorbing unit, wheel, tire, retracting mechanism, and locking mechanism, Figure 5-2, essentially as follows:

(a) The fork, which holds the wheel assembly, swivels in the swivel housing which is hinged for retraction of the front end in fittings provided on a fuselage bulkhead.

(b) The rear end of the swivel housing is bolted to the lower end of the shock strut.

(c) The upper end of the shock strut is bolted to a slide operating on a fore-and-aft tube. When the landing gear is retracted the slide is pulled forward on the slide tube, retracting the tail gear aft and up into the fuselage.

(d) The fork is of welded steel tubing-and-gusset construction. The tail wheel mounts between the forks.

(e) The swivel housing is also of welded steel tubing-and-gusset construction. It houses the swivel end of the fork and is hinged at the front end on a special bolt through fittings attached to a fuselage bulkhead.

DEFINITION OF DAMAGE

3 Damage may be defined as follows:

(a) Negligible Damage — Damage that will not affect the airworthiness of the main landing gear or the tail wheel gear, and does not require immediate attention.

(b) Damage Repairable by Patching — Damage that may be repaired by covering or reinforcing, without removal of a portion of the main landing gear or tail wheel gear structure.

(c) Damage Repairable by Insertion — Damage requiring the removal and replacement of a portion of the main alighting gear or tail wheel gear structure.

(d) Damage Repairable by Replacement — Damage unrepairable by patching or insertion, but that may be repaired by installing a new part.

PROCEDURE FOR REPAIR OF DAMAGE

Negligible Damage

4 Main Landing Gear — Negligible damage may consist of one, or both, of the following conditions:

(a) SCRATCHES, not exceeding 1/32 inch in depth, and not more than five of them occurring in 1 square inch of surface.

(b) DENTS, not exceeding 1/32 inch in depth, having no more than 3/32 inch radii, and no more than four of them occurring in 1 square inch of surface. THE METAL SURFACE MUST NOT BE CRACKED OR FRACTURED.

NOTE

Damage of the above nature does not require immediate attention; however, it is recommended that scratches be kept free of sharp, rough edges and that they be painted.

5 Tail Wheel Gear — Negligible damage to this structure may take the form of slight indentations, scratches, or

minor bowing. Smooth dents not exceeding one-twentieth of the tube diameter in depth without cracks, fractures, or sharp corners, and clear of the middle third of the length of the member may be disregarded except to satisfy appearance. Tubular members should be carefully examined for the presence of sharp nicks and deep scratches because these nicks and scratches produce stress concentrations that may cause failure of the part. Care must be taken to smooth out all sharp nicks and deep scratches. When this is accomplished, high concentrations of stress disappear.

Damage Repairable by Patching

6 Main Landing Gear — The structural members comprising the main landing gear are heat-treated and highly stressed; therefore, repairs by welding are prohibited.

7 Tail Wheel Gear — The tail wheel swivel housing assembly may be repaired by patching. Since the tail wheel swivel housing assembly is a normalized structure, this is recommended as a temporary repair only and the damaged assembly should be replaced as soon as possible.

Damage Repairable by Insertion

8 Main Landing Gear — Repair of any damage in excess of that listed as Negligible Damage, Paragraph 4, Part 5, is prohibited.

9 Tail Wheel Gear — The tail wheel swivel housing assembly may be repaired by splicing or partial replacement

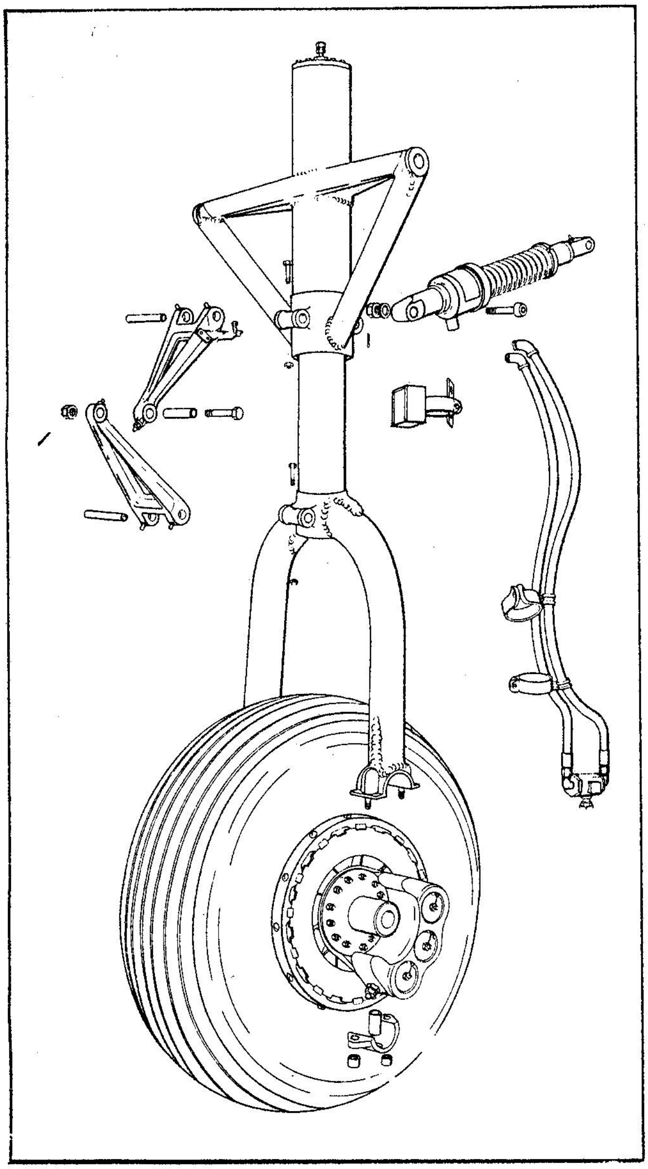

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Figure 5-1 (Issue 1) Exploded View, Main Landing-Gear

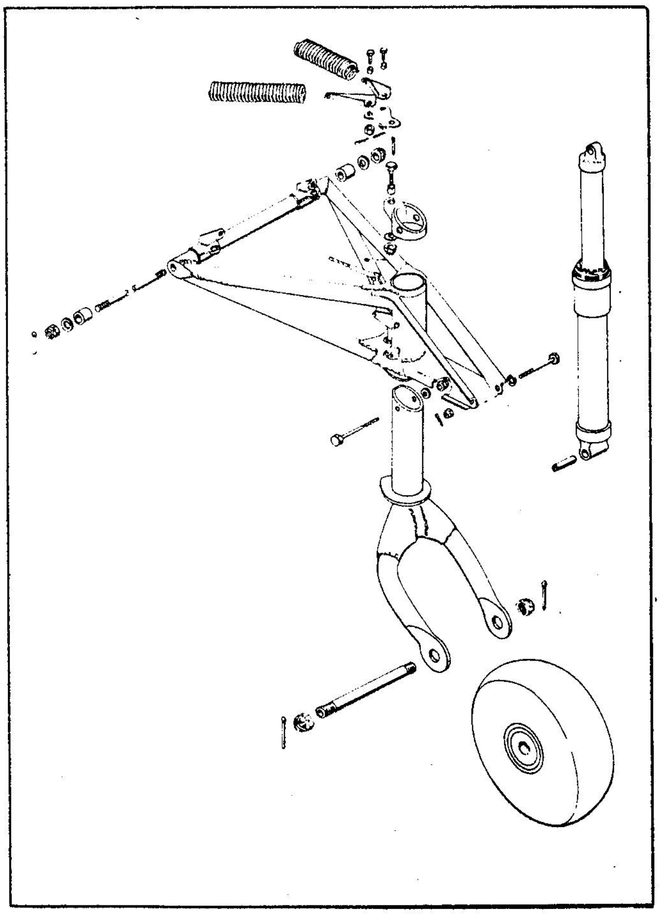

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Figure 5-2 Exploded View, Tail Gear

of the tubular structure. Good judgment must be used in making the repair, to see that the function of moving parts will not be hampered.

Damage Repairable by Replacement

10 Main Landing Gear - Any damage sustained in excess of that listed as Damage Repairable by Patching in Paragraph 6, Part 5, will necessitate replacement of the damaged part.

11 Tail Wheel Gear - Any damage sustained by the tail wheel fork assembly other than that described in Paragraphs, 5, 7, and 9, Part 5, will necessitate replacement of the fork assembly. This assembly consists of the fork to which the tail wheel is mounted and the barrel, or swivel, which is the upper part of the fork and which turns in the swivel housing. This fork assembly is constructed of highly stressed, heat-treated steel tubing, and cannot be repaired because any bending or welding would greatly reduce its strength.

Tail Wheel Locking Pin Hole Repair - Fork Assembly

12 Worn holes for the tail wheel locking pin in the tail wheel fork assembly may be repaired by inserting a bushing as follows:

(a) Drill out existing hole to .687" + .0005, - .0000 diameter.

(b) Spot face upper surface to .750" diameter, 1/16" deep as shown in Figure 5-3.

(c) Manufacture bushing, refer to Figure 5-3.

(d) Install bushing with wet zinc chromate primer ensuring that the upper surface is flush with the bearing surface on the fork.

(e) Ream .500" ± .0005 diameter on installation.

NOTE

Part 404-188699 plate may be used as a jig for locating reamed hole. Fork assemblies Part 404-188675 will have the hole in the bushing drilled to .483" diameter in place of reaming. 1/2" diameter reaming is required on installation.

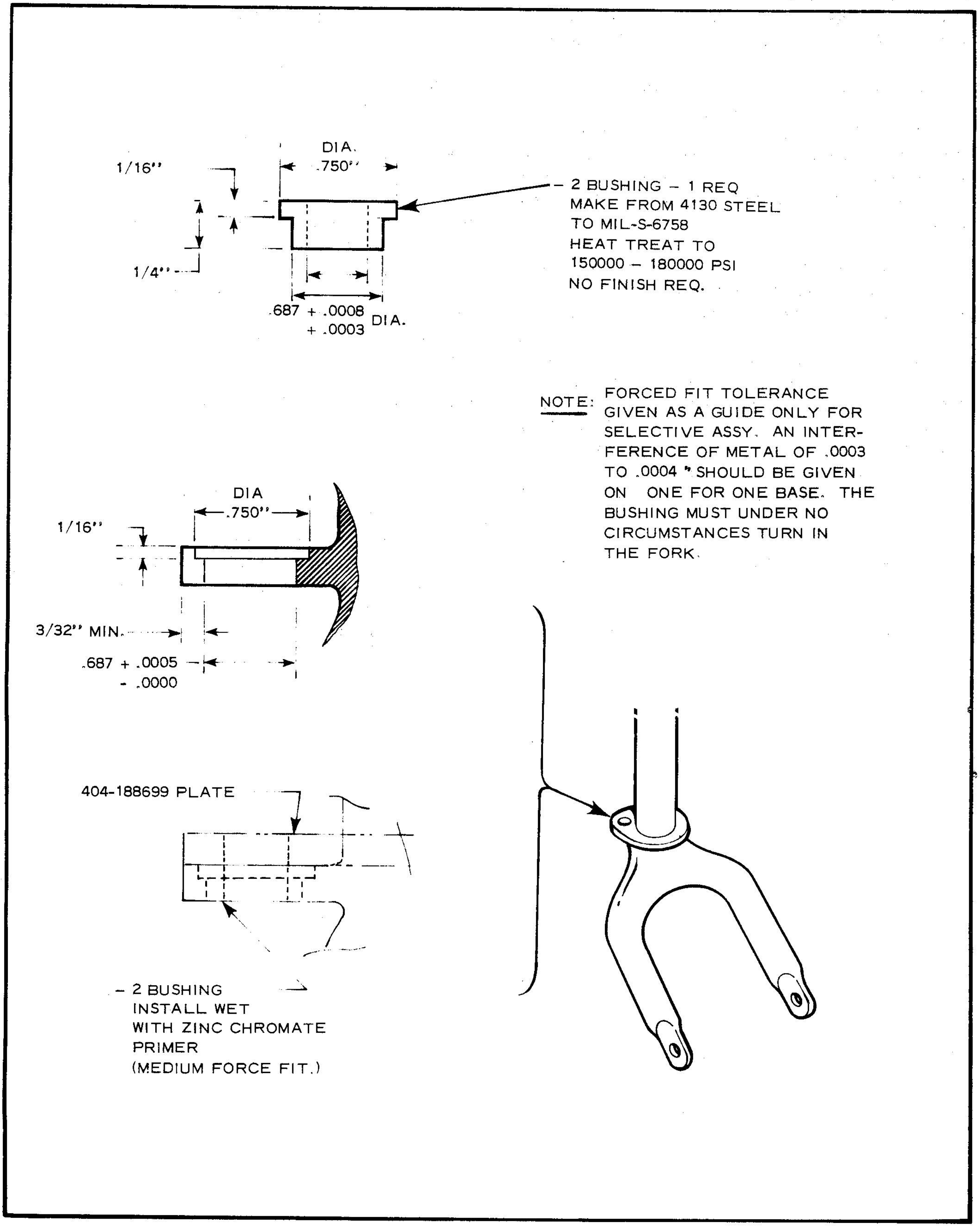

Figure 5-3 Tail Wheel Locking Pin Hole Repair

PART 6
NACELLE GROUP

TABLE OF CONTENTS

DESCRIPTION

1 The nacelle is built integrally with center-section wing and truss. See Figure 6-1. The aft portion of the nacelle, which provides fairing for the engine and enclosure for landing gear and oil supply tank, is a skin-covered, bulkhead-supported structure. The lower side is enclosed by hinged landing-gear doors.

2 Firewall — The forward bulkhead of the nacelle is a stainless steel firewall, separating the aft nacelle section from the engine section.

3 Engine Mount — The primary structure of the engine section is the welded tubular engine mount of chrome molybdenum steel. See Figure 6-1. It attaches, by three Lord-type shock mounts, to fittings on the center-section truss. The fittings extend through the firewall. The engine is bolted to nine lugs on the ring of the engine mount structure.

4 Cowlings — The accessory compartment of the engine section is separated from the engine by an inner cowl and the entire section is enclosed by a removable cowling. This cowling consists of upper and lower ring sections, with two wrapper sheets for enclosing the lower part of the accessory compartment. Three separate, overlapping cowl flaps are fitted to the trailing edge of the lower section of the ring cowl, on each side of the engine. They are hinged at the forward edge and interconnected so they operate as a unit. The cowling is supported by brackets on the engine cylinders, lugs at the inner cowling, and a former ring at the firewall. Dzus-type strap fasteners hold the sections in assembly.

5 Air Ducts — Ducts are provided for the carburetor air intake and the oil cooling radiator. The carburetor ducts are supported by brackets bolted to the engine cylinders. The oil cooling air duct is attached to the aft side of the firewall in the nacelle.

DEFINITION OF DAMAGE

6 Damage may be defined as follows:

(a) Negligible Damage — Damage not affecting the airworthiness of the nacelle group; it usually does not require immediate attention other than investigation.

(b) Damage Repairable by Patching — Damage repairable by covering or reinforcing any of the component parts of the nacelle group.

(c) Damage Repairable by Insertion — Damage requiring the removal and replacement of a portion of any of the component parts of the nacelle group.

(d) Damage Repairable by Replacement — Damage requiring the replacement of component parts or assemblies.

PROCEDURE FOR REPAIR OF DAMAGE

7 Negligible Damage — Small holes and dents in the skin, bulkhead structures, landing-gear door channels, cowlings, or ducts may be considered negligible if not located so as to weaken a structural part. Dents should be thoroughly investigated for indication of structural damage. Holes must not be over ½ inch in diameter, must be rounded, and free from ragged edges. It is safer practice to patch or reinforce all holes. Slight indentations, scratches, and smooth dents in the engine mount, not exceeding one-twentieth of the tube diameter in depth and without cracks, fractures, or sharp corners, may be considered negligible. Tubular members should be carefully examined for the presence of sharp nicks and deep scratches which produce stress concentrations that may cause failure of the part. Care must be taken to smooth out all sharp nicks and deep scratches with a fine file. When this is done, high concentrations of stress disappear.

Damage Repairable by Patching

8 Skin — Small holes, breaks, or cracks in the skin covering and landing-gear doors may be repaired by the following methods:

(a) Round holes up to 1 inch in diameter may be patched by covering with a disc, as shown in Figure A-4. If the rivets are not accessible for bucking, a washer may be substituted for the disc, or blind rivets used with the disc patch.

(b) Small breaks or punctures may be patched as shown in Figures A-2 and A-3. The ragged edges should be trimmed, as shown by the dotted lines, so that no sharp corners remain.

(c) Small cracks should have stop-holes drilled at each end and sharp corner before patching. See Figure A-1. The patch plate should be cut large enough to clear all dimensions of the crack by at least ¾ inch. Blind rivets may be substituted for the standard rivets only in areas where it is impossible to buck standard rivets.

9 Bulkheads — Small holes, breaks, or cracks may be repaired by methods described for skin patches in the preceding paragraph. Damage in the formed flange (or in the flange and extending down into the web) will require a patch formed to the flange of the bulkhead, similar to the rib repair shown in Figure A-14. The crack or break must be covered with a patch of at least ¾-inch edge margin. Stop-holes should be drilled at the ends of cracks, and breaks should be carefully trimmed to prevent spreading.

10 Firewall — Repairs to the firewall will be made similarly to the skin patches in Paragraph 8 of this Part. Material for the patches should be of corrosion-resistant steel. Use AN430-AD4 rivets and wet with zinc-chromate primer before driving, to minimize corrosion between the aluminum rivets and the steel firewall.

11 Landing-Gear Door Channels — Small holes, cracks, and breaks in door channels may be repaired by forming a splice-plate patch of similar material and cross section as the original channel. Use AN430-AD4 rivets with ⅜-inch spacing.

12 Engine Mount — If a crack appears in a length of steel tube, usually as the result of previously straightening the tube, first drill a No. 40 (.098) hole at each end of the crack and then rub the area with steel wool to remove the finish around the tube for distance of approximately three inches on each side of the damage. If the damage is in the form of a sharp dent which cannot be removed by any of

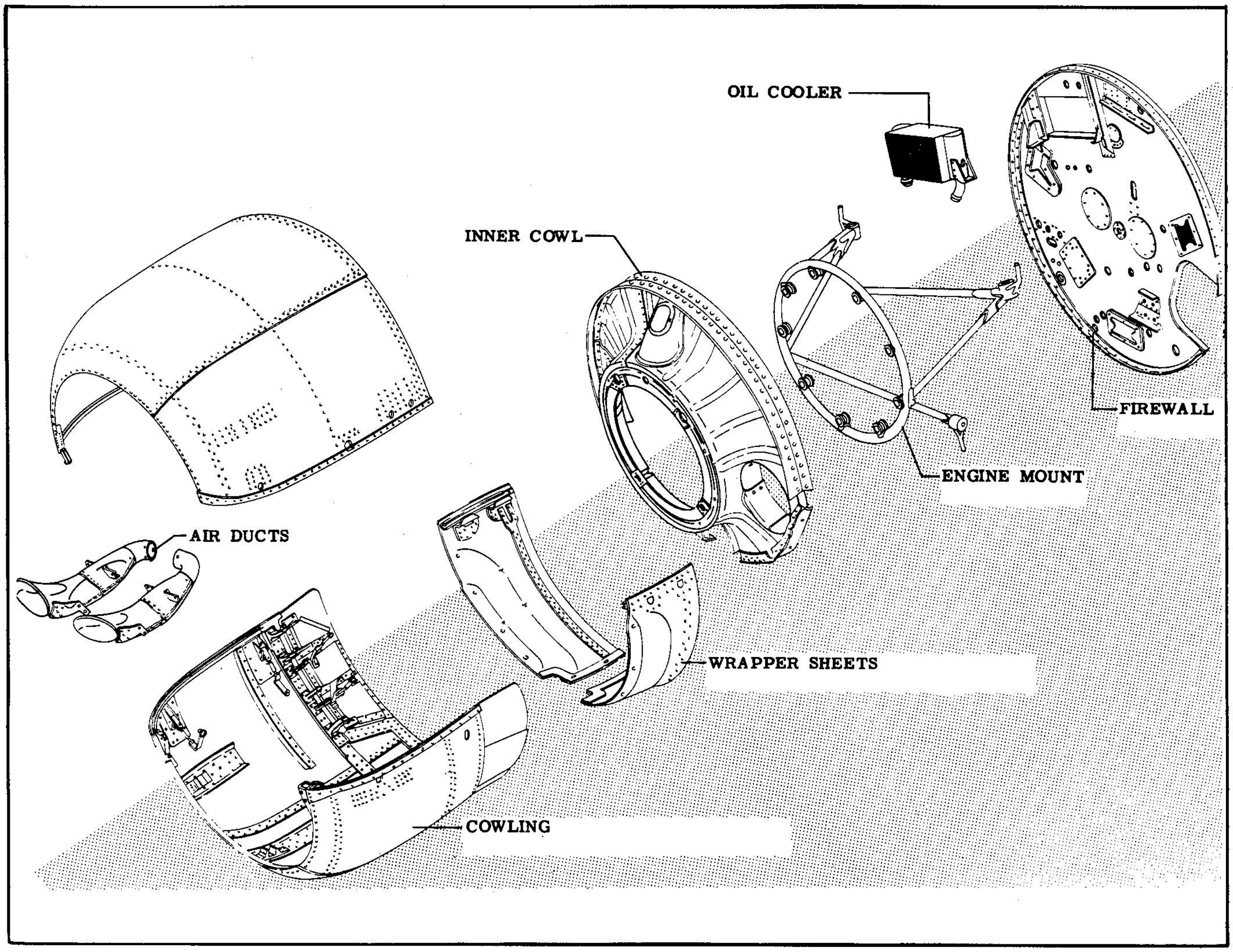

Figure 6-1 Exploded View, Nacelle Group

the methods previously outlined, remove the finish in the same manner. In order to reinforce the dented or cracked area, select a length of spare steel tube sleeve having an inside diameter approximately equal to the outside diameter of the damaged tube and the same wall thickness. Diagonally cut the steel sleeve reinforcement at a 30-degree angle on both ends so that the distance of the sleeve from the edge of the crack or dent is not less than 1½ times the diameter of the damaged tube, see Figure 6-2. Cut through the entire length of the reinforcement sleeve and separate the half section of the sleeve. Clamp the two sleeve sections to the proper position on the affected areas of the original steel tube. Weld the reinforcing sleeve along the length of the two sides, and weld both ends of the sleeve to the damaged steel tube as shown.

CAUTION

Make no splice by butt-welding member between station points.

13 Cowling — Holes and cracks in the cowling assemblies may be repaired by patching procedures similar to those used on the wings and fuselage, except that fewer rivets are required due to reduced loads. (All holes should be trimmed and cracks stop-drilled to prevent spreading.) Patches to the outer sections of the cowling should be of the flush type, as shown in Figure A-3.

14 Air Ducts — Holes and cracks in the duct assemblies may be patched by any method to cover the damage. Holes should be trimmed and cracks stop-drilled to prevent spreading, since the ducts are subject to intense vibration from the engine.

DAMAGE REPAIRABLE BY INSERTION

15 Skin — Insertion repairs to the nacelle skin are not practical. The panels are of such size that replacement would be preferred if the damage was too extensive to be repaired by patching procedure.

16 Bulkheads — Insertion repairs may be made to these members by trimming away the damaged portions and splicing in new sections. New sections may be hand-formed from SO material of the next thicker gauge and of alloy equal to the original, then heat-treated to ST condition. If the new section is very large or in the curved portions of the bulkhead, it probably will be easier to obtain the portion needed from a new or salvaged part. The splice-plate should be equal to the original material in strength and the next higher gauge in thickness. The plate should be at least 2 inches wide with rivets arranged in two rows and spaced according to procedure in Part 1.

17 Firewall — Repairs for the firewall may be made similarly to those for bulkheads. Insertions and splice-plates will be of corrosion-resistant steel. Rivets must be dipped in zinc chromate primer before driving.

18 Landing-Gear Door Channels — New sections of these channels may be inserted after trimming away the damaged portion. The required portion of channel may be obtained from a new or salvaged part, or short lengths of the channel may be hand-formed from SO material and heat-treated to ST. The splice-plate should be of material equal in strength and of the next higher gauge in thickness. For rivet arrangement of channel splices, see Figure A-18.

19 Engine Mount — Insertions may be made to the engine mount structure by welding methods. Splices should not be made in the ring tubing or within 3 inches of a welded joint.

20 Cowling — Large holes or dents in the cowling may be repaired by removing the damaged material and inserting new skin. Use SO material of strength and gauge equal to the original. Joints, originally spot-welded, may be made by riveting the parts.

Damage Repairable by Replacement

21 Skin — Extensive damage to a skin panel is best repaired by replacement. Select material of original strength and the next gauge heavier. Cut and shape as necessary. Follow original rivet pattern in attaching skin panels.

22 Bulkheads — If the nacelle bulkheads have incurred as much as 50 percent damage, usually it is advisable to replace the bulkhead with a new part. Follow original rivet pattern when installing bulkheads.

23 Firewall — Replacement of the firewall will be unusual and dependent on the nature of damage and facilities for repair. If it is to be replaced, it will be necessary to remove engine, engine mount, and all connections. Remove rivets attaching front flange of firewall to nacelle skin and Curtis-type clamps holding firewall to truss structure. Follow original rivet pattern when installing new part.

24 Landing-Gear Door Channels — Extensive damage to these channels will necessitate replacements in order to maintain proper alignment and operation of the landing-gear doors.

25 Engine Mount — Extensive damage to the ring member of the engine mount, damage too close to a welded joint to permit splice repairs, or misalignment of the structure will necessitate replacement of the entire mount assembly.

26 Cowling — Damage to any section of the cowling assembly, so extensive that original contour cannot be restored or security of attachment is endangered, will necessitate replacement of that section.

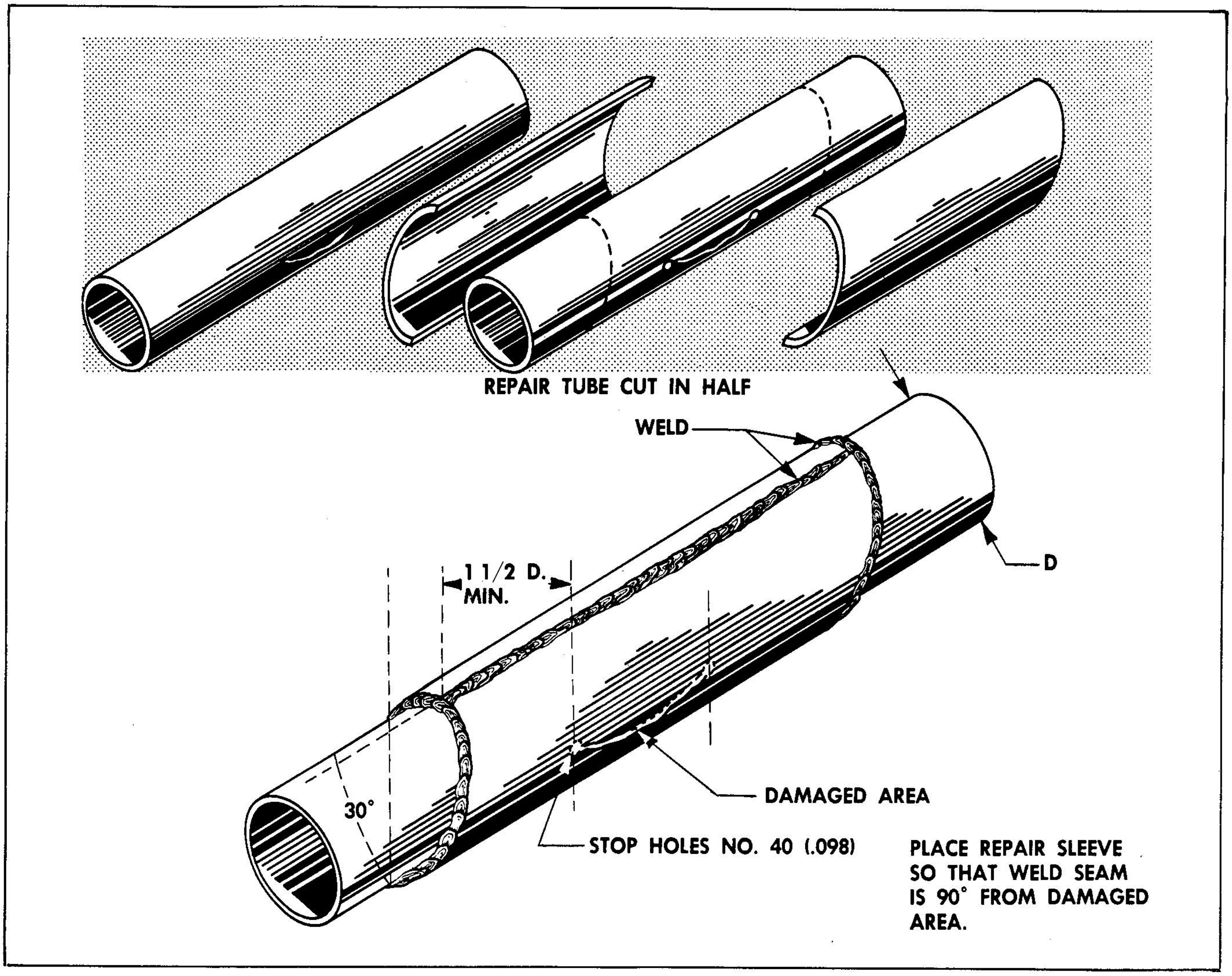

Figure 6-2 Engine Mount Tube Repairs

PART 7
FABRIC REPAIR AND ATTACHMENT

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DESCRIPTION

1 The flight control surface, except the trim tabs, are fabric covered. The envelope method of covering is used and the attachment procedure used is the same on all surfaces. The envelope method of covering is accomplished by machine sewing together precut widths of fabric which are specific dimension, to form an envelope. When sewn, the envelope is turned inside out to put the seams on the inside and the envelope is then drawn over the framework of the control surface. The open ends of the envelope then are hand sewn.

DEFINITION OF DAMAGE

2 Damage may be defined as follows:

(a) Negligible Damage — Damage that will not affect the airworthiness of the fabric and does not require immediate repair.

(b) Damage Repairable by Patching — Damage that may be repaired by covering or reinforcing, without removal, other than trimming off a portion of the fabric.

(c) Damage Repairable by Insertion — Damage necessitating removal and replacement of a section of fabric.

(d) Damage Repairable by Replacement — Damage necessitating complete recovering of the control surface.

PROCEDURE FOR REPAIR OF DAMAGE

3 Negligible Damage — Any damage sustained by a fabric covering should be repaired, however slight it may seem. Damage such as missing drain grommets and loose fabric patches, checks and cracks in doped surfaces, and loose tape edges, are not in themselves serious, and could be considered negligible damage; however, continued use of the aircraft without repair would tend to aggravate the damage and a more serious condition might develop. It is recommended that all fabric damage, however slight it may seem, be repaired at the earliest possible time.

4 Damage Repairable by Patching — Damage repairable by patching, such as small holes and tears in the fabric, may be corrected by accepted fabric repair methods.

5 Damage Repairable by Insertion — If an entire fabric section between ribs is damaged to such an extent that the patch will exceed one-half the surface area, or that repair patches will overlap, the fabric between ribs should be replaced.

6 Damage Repairable by Replacement — In the event a fabric covering is damaged to such an extent that repairs by patching would be impractical, or in the event the fabric loses its tautness and elasticity due to age or numerous repairs, it should be removed and the frame recovered. The envelope method of covering is accomplished by sewing together fabric conforming to Specification AN-C-121, cut in lengths sufficient to pass completely around the frame, starting at and returning to the trailing edge.

7 All sharp metal edges as lightening holes and flanges which are likely to come in contact with the rib lacing must be covered with one-fourth inch cellulose tape at such contacting points.

8 Fabric covering on the airfoil is applied so that the warp threads (threads running parallel to the selvage edges) are parallel to the line of flight.

9 If the covering of a component cannot be accomplished without pinning the fabric in place preparatory to hand sewing, one or two wraps of friction tape around the metal part at 1 or 2 foot intervals will give a surface for pinning to hold the fabric in position for hand sewing.

10 Design and sew all coverings so that there will be proper and equal tension over all parts of the surface when the envelope is drawn in position for doping. In order to divide tension among each system of threads in the fabric, apply equal tension in all directions.

11 Hand sew at a point where machine sewing or uncut fabric is reached. Lock hand sewing at intervals of 6 inches and finish seams with a lock stitch. At the point where hand sewing is necessary, cut the fabric so that it can be doubled under before sewing. In hand sewing, maintain a minimum of 4 stitches per inch. See Figure 7-1.

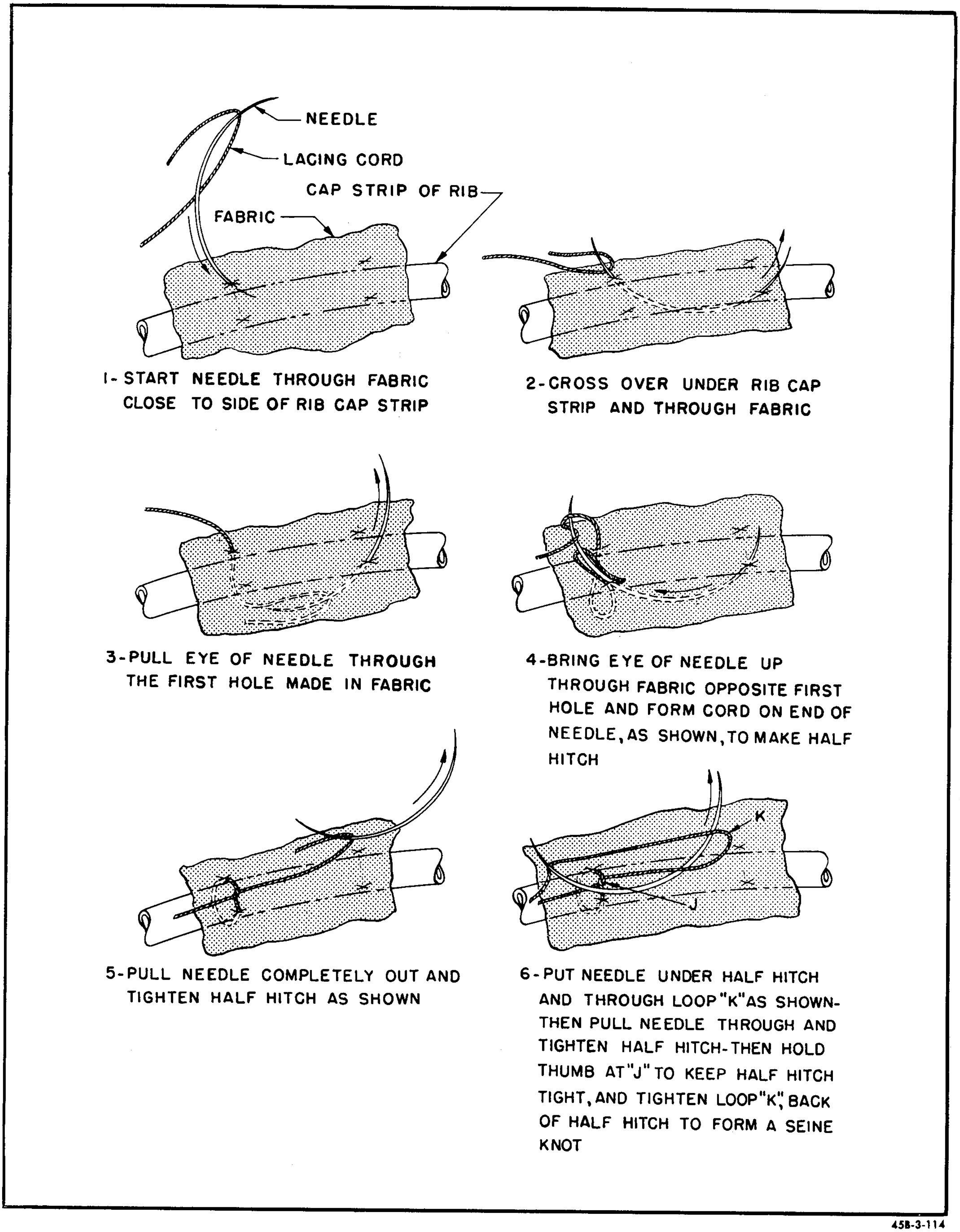
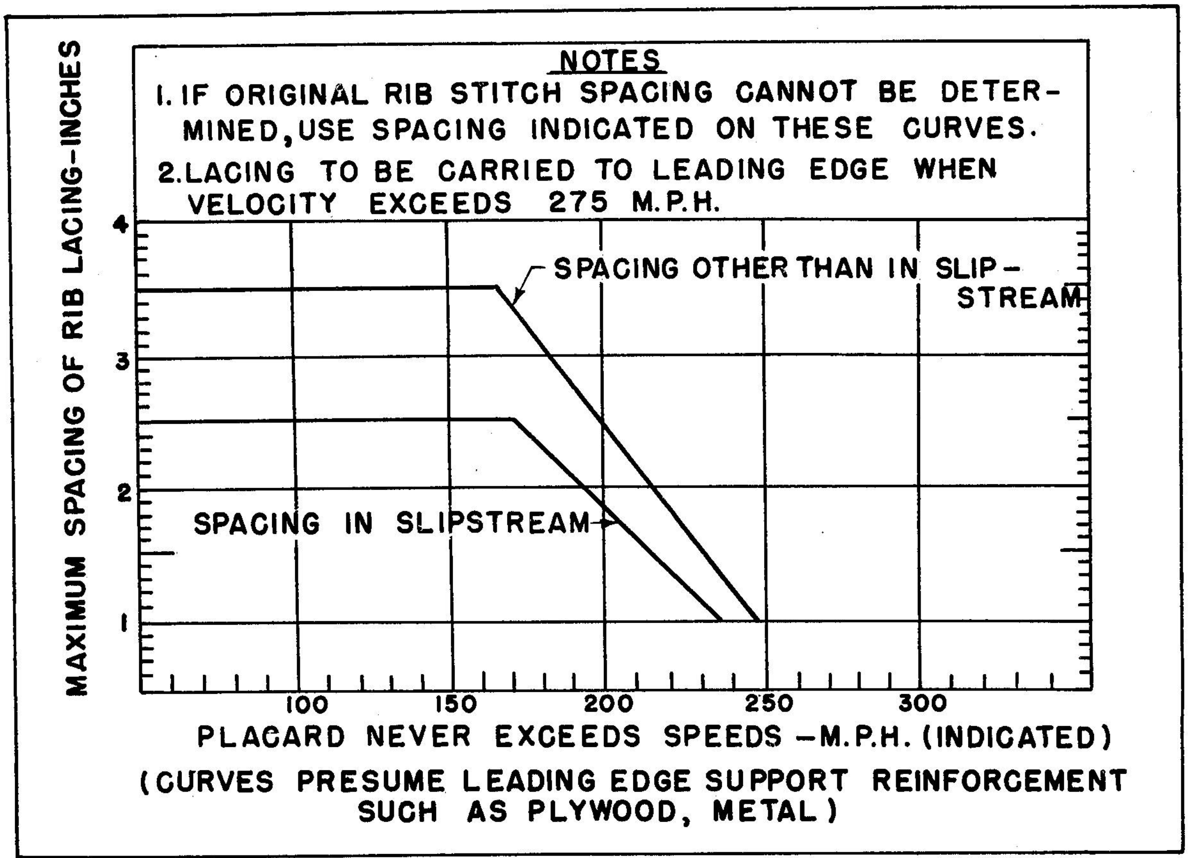


Figure 7-1 Rib Lacing



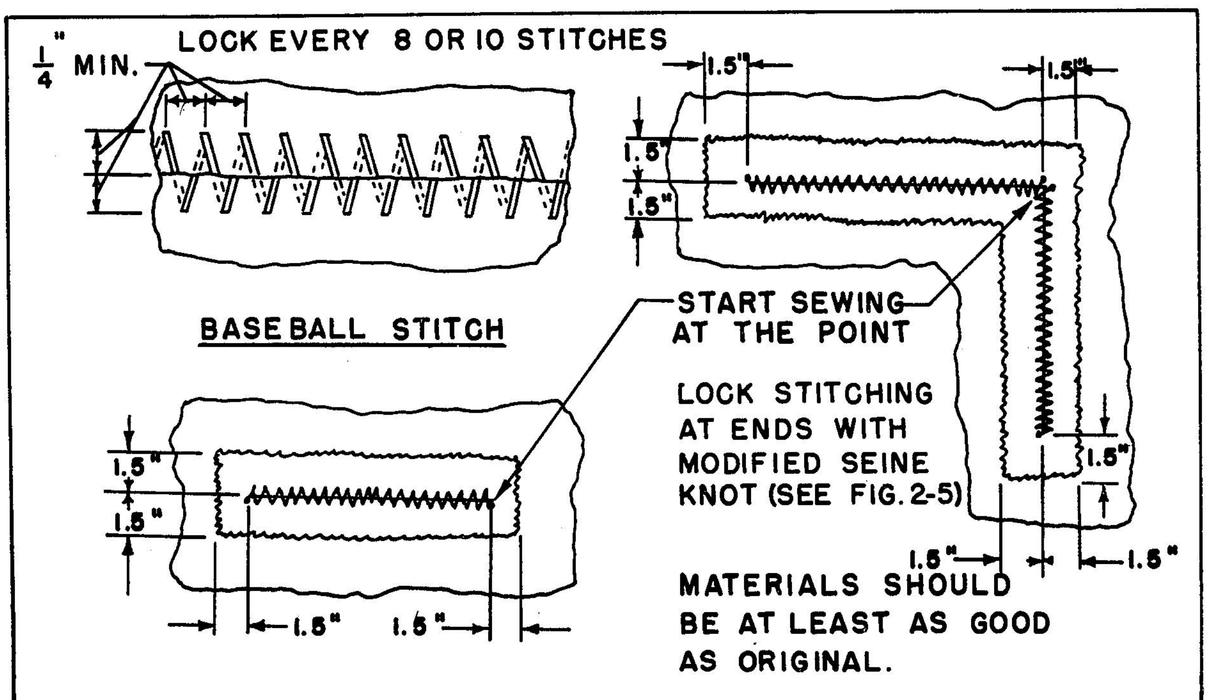


Figure 7-2 Sewing Fabric

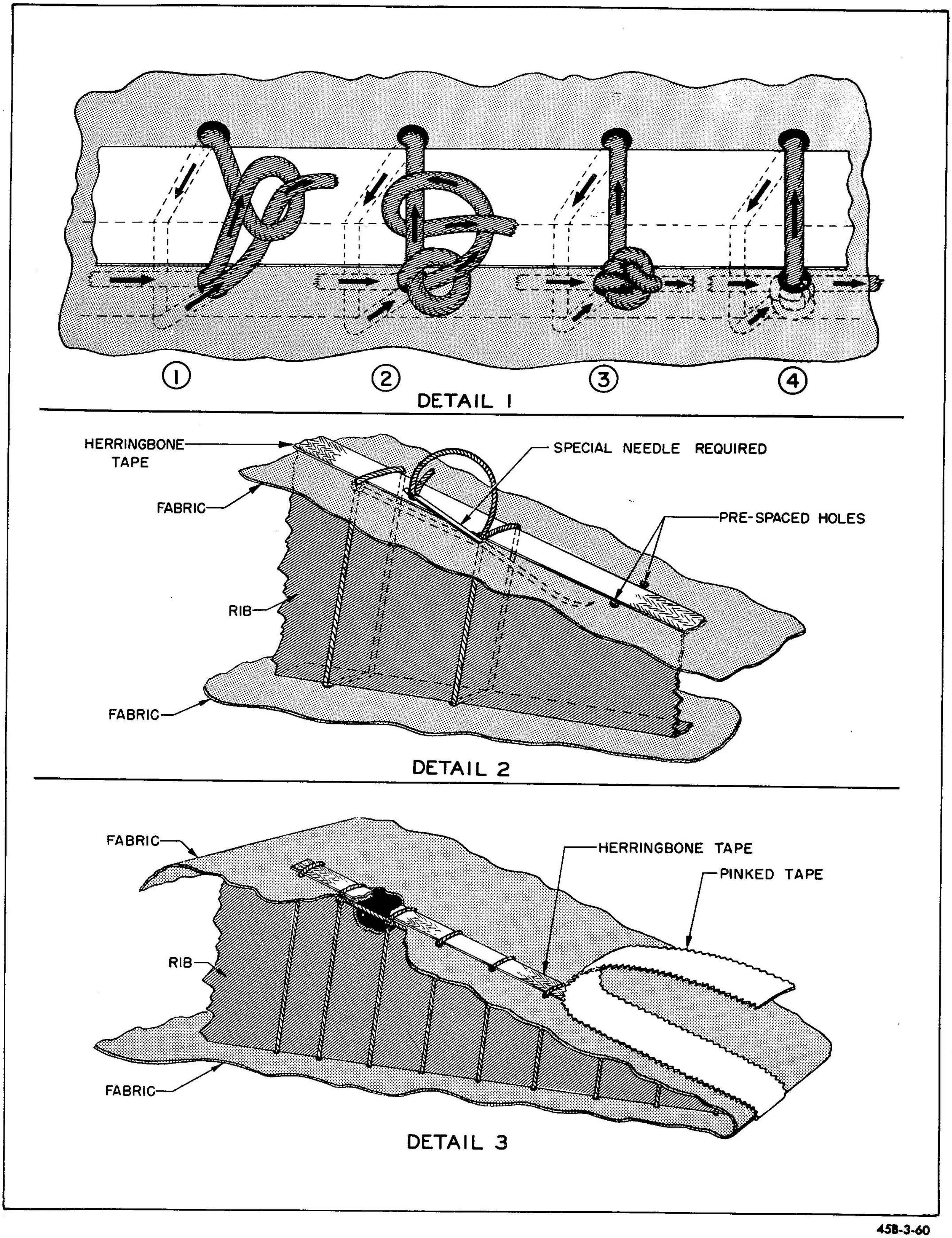


Figure 7-3 Fabric Sewing Procedure

12 Seams — On all seams, use plain lap or folded flat fell seams machine stitched in accordance with Type LSC-2, and a three loop stitch or double locked stitch Type 301 and 401 in accordance with Specification DDD-S-751. Stitch seams, using eight to ten stitches per inch. Sew the row of stitches nearest each folded edge each seam 1/8 to 1/4 inch from the edge of the fold and the rows of stitches 1/4 to 3/8 inch apart.

13 Place all longitudinal (fore and aft) seams parallel to the line of flight. Make certain that seams will not cover a rib or be so placed that the lacing will be through or over a seam. In the case of a tapered section, place the seams so as to cross the fewest number of ribs consistent with efficient cutting of the pattern.

14 The only permissible seams extending the span of the control surface (laterally) in the envelope, either hand sewed or machine sewed, is the seam at the trailing edge, except in case of a tapered section, where an additional seam is allowed on a tapered portion at the leading edge. In all cases, cover this seam with a strip of 3 3/4-inch surface tape, Specification 6-62.

15 Reinforcement — In cases where the fabric is attached by lacing, apply reinforcing tape, Specification AN DDD-T-91 under all lacing, see Figure 7-2. Securely attach tape under moderate tension at the forward and rear ends of the fabric covered portion. Where the attachment of the fabric is made by self-tapping screws, bolt or other mechanical devices, other type of reinforcements may be used as shown in Figure 7-3.

16 Fabric Attachment — Attach the fabric using the flush type attachment as shown in Figure 7-3. Use lacing cord and reinforcing tape or mechanical devices as described in Paragraph 21, Part 7, provided they are countersunk in grooves of the supporting structure or ribs.

17 Lacing — When lacing thin sections, pass the lace completely around the rib, fabric and reinforcing tape as shown in Figure 7-4. Tie all knots on the upper surface of the air foil. Apply enough tension on lacing to remove all slack.

18 When lacing thick sections, and the rib is designed for lacing, pass the lacing around each upper and lower rib member, fabric and reinforcing tape as shown in Figures 7-2 and 7-3. Lace as close as practicable to the rib upper and lower members and tie over the center or edge of the member.

19 Tie a slip knot at the first point of lacing, then carry the cord to the next point of lacing at which, and at all subsequent points, the lacing should be secured by seine knots. Secure the cord at the finish of the lacing by a double or lock knot.

20 Finishing Tape — After the first coat of dope has dried, apply a second coat of dope freely over lacing, reinforcing tape and that portion of the fabric to be covered by finishing tape. Next lay the finishing tape over the doped surface and bring into proper position, then dope freely over the finishing tape.

21 Reinforce all portions of fabric that are pierced by wires, bolts or other material after the first coat of dope has dried. To make a reinforcement, dope on an angle patch of fabric. Either pink the patch or fray out all four sides not less than 3/16-inch. Omit this type of patch where other reinforcements are specified. At points where wear or friction is induced by a moving part of fitting, install a cotton duck patch by first sewing the cotton duct to a fabric patch then doping in position.

22 Provisions are made for openings to permit inspection and repair of internal structures and equipment. Metallic frames are used for this purpose with metal inspection doors attached to the frame.

23 Install drainage grommets in each fabric covered component. Place the grommet on the under side at the trailing edge and as close to the rib as practicable. Place a drainage grommet on each side of the rib to insure good drainage. The grommets are made of celluloid and are doped directly to the main covering, after the first coat of dope.

24 Finishing — To finish a fabric covered surface proceed as follows:

(a) Apply clear dope, Specification AN-TT-D-554. This is applied either by spraying two cross coats or by applying two spray coats.

NOTE

Dope may be thinned as necessary, but every coat must produce a definite film over the previous one.

(b) Apply the pigmented dope in such an amount that a solid covering is obtained and the finish has a smooth appearance and feel. Two coats are normally required, thoroughly wet spraying the last cross coat.

NOTE

Use thinners, Specification AN-TT-T-256 or Specification AN-TT-T-258, as applicable.

25 If necessary to produce a smooth finish, sand after the second clear coat and/or after the first pigmented coat, using No. 320 grit sandpaper.

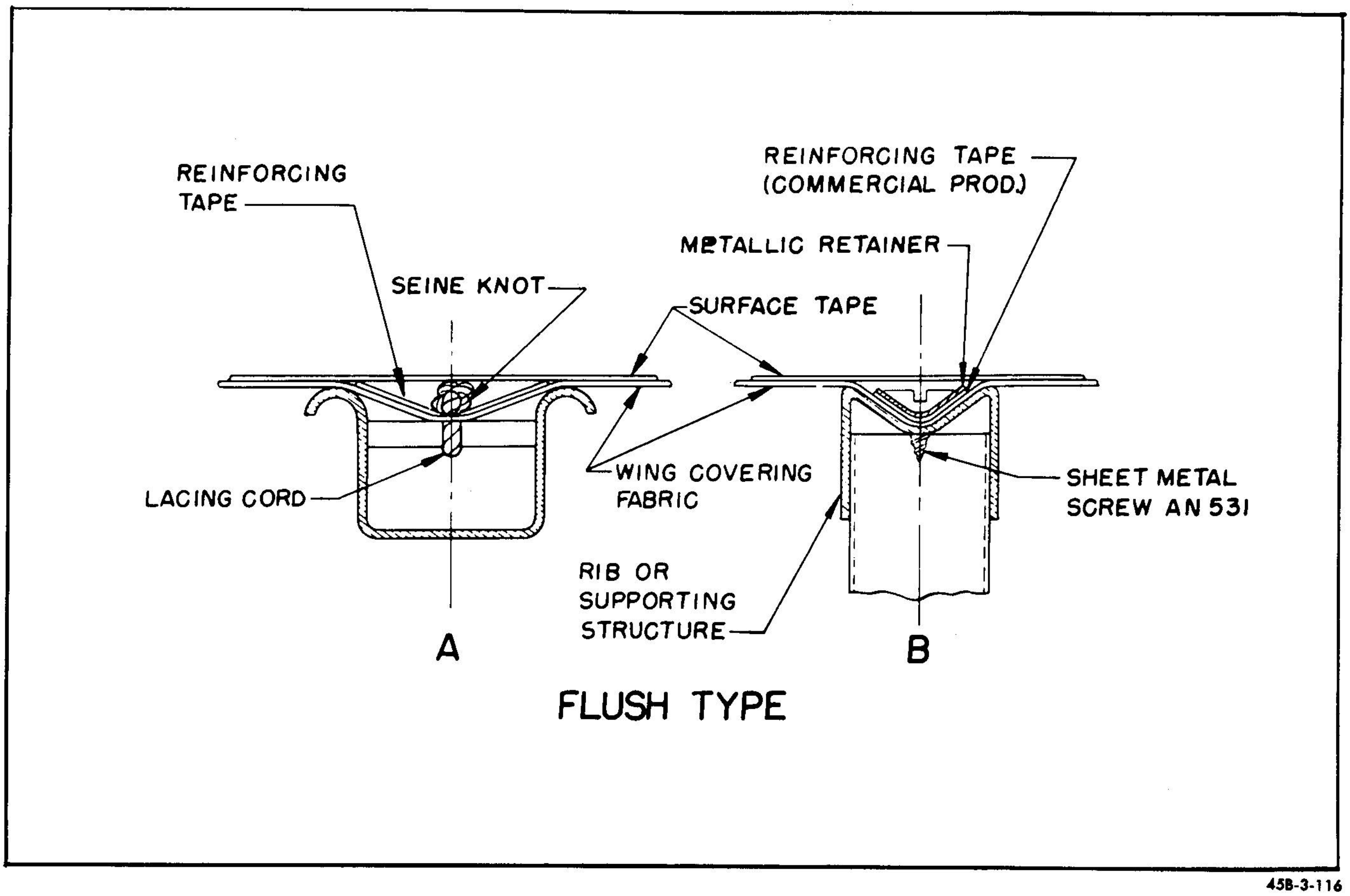
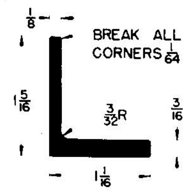


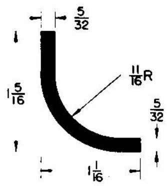
Figure 7-4 Flush Type Fabric Attachment

PART 8

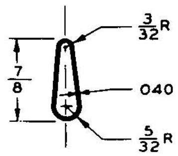
EXTRUSION CHART



17S ALUM. ALLOY
BOHN ALUM. CO.
DIE 86S4
SPEC FED. QQ-A-351
CONDITION T
BEECH DWG. NO. 101161



101161 SUBSTITUTE
24S ALUM. ALLOY
5/32 + 1.877 + LENGTH OF SHEET
CONDITION T



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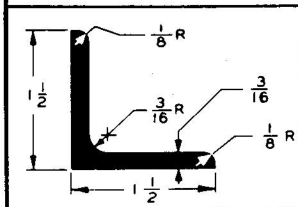

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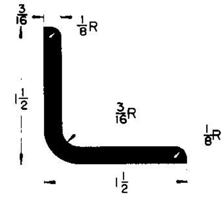

101635 SUBSTITUTE
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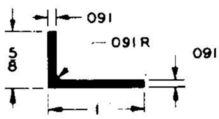
3/16 + 2.676 + LENGTH OF SHEET



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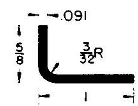

101636 SUBSTITUTE
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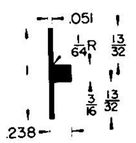
.091 + 1.469 + LENGTH OF SHEET



63ST EXTRUSION
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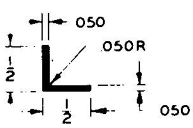
101637 NO SUBSTITUTE



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SPEC FED. QQ-A-354
CONDITION T
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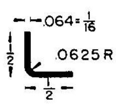

101639 SUBSTITUTE
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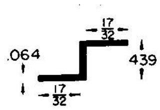
.064 + .89 + LENGTH OF SHEET
CONDITION T



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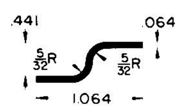

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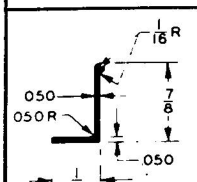
.064 + 1.3655 + LENGTH OF SHEET



24S ALUM. ALLOY
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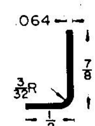
SPEC FED. QQ-A-354
BEECH DWG. NO. 101641



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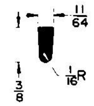
45B-3-117

Figure 8-1 Extrusion Chart (Sheet 1 of 4 Sheets)



63ST EXTRUSION
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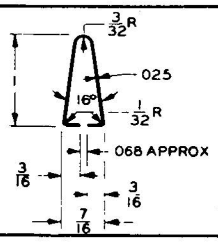
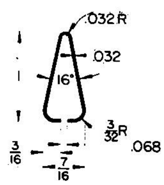
ALCOA DIE K 16822
BEECH DWG. NO. 101644

101644 NO SUBSTITUTE



24 STAL ALCLAD
ALCOA DIE K-1508
CONDITION T
BEECH DWG. NO. 101925



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24S ALUM. ALCLAD
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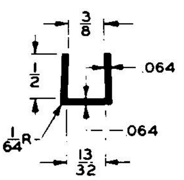
SHEET
CONDITION T



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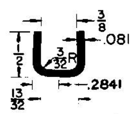
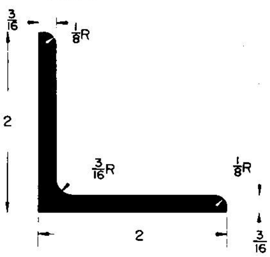
ALCOA DIE NO. 875
SPEC FED. QQ-A-354
BEECH DWG. NO. 102718



102718 SUBSTITUTE
17SO ALUM. ALLOY
.018 + 1.70 + LENGTH OF
SHEET



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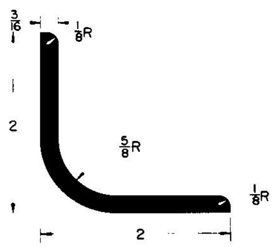
ALCOA DIE 77S
SPEC FED. QQ-A-351
CONDITION T
BEECH DWG. NO. 103287



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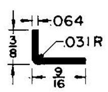
3/16 + 3.486 + LENGTH OF
ANGLE
CONDITION T



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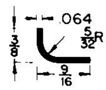
ALCOA DIE K-206B
SPEC FED. QQ-A-351
BEECH DWG. NO. 104521



104521 SUBSTITUTE
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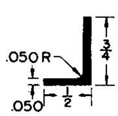
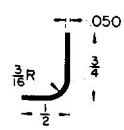
SHEET
CONDITION T



24S ALUM. ALLOY
REYNOLDS METAL CO. DIE E-1213
SPEC FED. QQ-A-351
BEECH DWG. NO. 104588



104588 SUBSTITUTE
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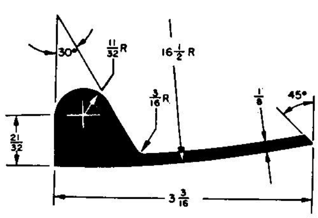
SHEET
CONDITION T

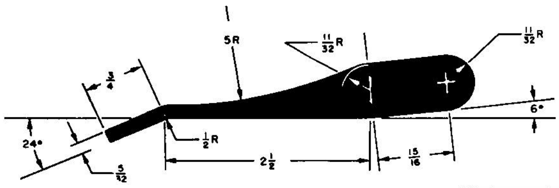
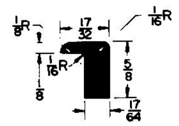
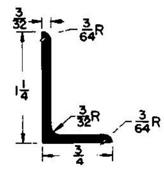
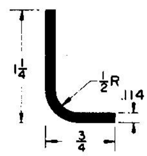
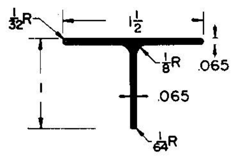
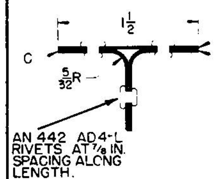
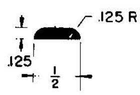
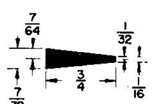
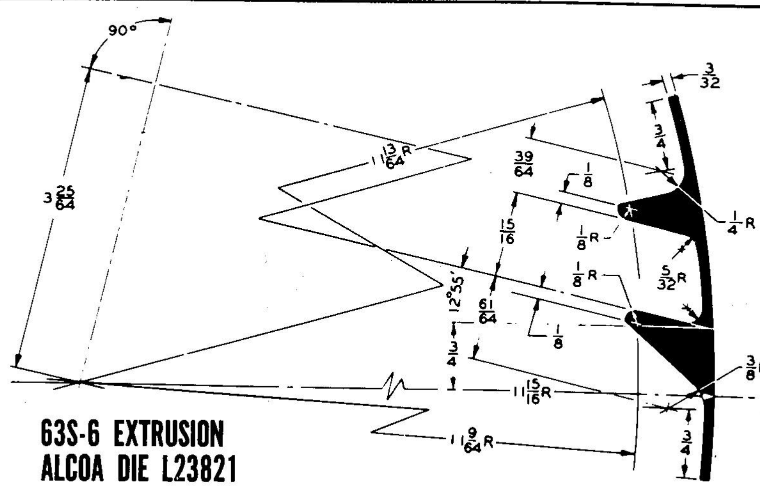


24ST ALUM. ALLOY
BOHN ALUM. & BRASS CORP.
DIE 10013
SPEC FED. QQ-A-354
BEECH DWG. 105410

105410 NO SUBSTITUTE

453-3-118

Figure 8-1 Extrusion Chart (Sheet 2 of 4 Sheets)

	24ST ALUM. ALLOY ALCOA DIE B10014 SPEC FED. QQ-A-354 BEECH DWG. NO. 105411	105411 NO SUBSTITUTE
	53S ALUM. ALLOY SPEC FED. QQ-A-331 CONDITION F BEECH DWG. NO. 106237	106237 NO SUBSTITUTE
	24S ALUM. ALLOY ALCOA DIE 734FF SPEC FED. QQ-A-354 BEECH DWG. NO. 110205	 110205 SUBSTITUTE 24S ALUM. ALLOY .114 + 1.637 + LENGTH OF SHEET CONDITION T
	24ST ALUM. ALLOY ALCOA DIE 22008 SPEC FED. QQ-A-354 BEECH DWG. NO. 111164	 111164 SUBSTITUTE A — 24ST ALUM. ALLOY .036 + 1.5 + LENGTH OF SHEET B AND C — 24ST ALUM. ALLOY .036 + 1.3755 + LENGTH OF SHEET
	61S ALUM. ALLOY ALCOA DIE NO. 30319 SPEC FED. QQ-A-325 BEECH DWG. NO. 112139	112139 NO SUBSTITUTE
	53ST EXTRUSION ALCOA DIE D20030 SPEC FED. QQ-A-331 BEECH DWG. NO. 186258	
	63S-6 EXTRUSION ALCOA DIE L23821 SPEC FED. QQ-A-331 CONDITION T BEECH DWG. NO. S-160	S-160 NO SUBSTITUTE

45B-3-119

Figure 8-1 Extrusion Chart (Sheet 3 of 4 Sheets)

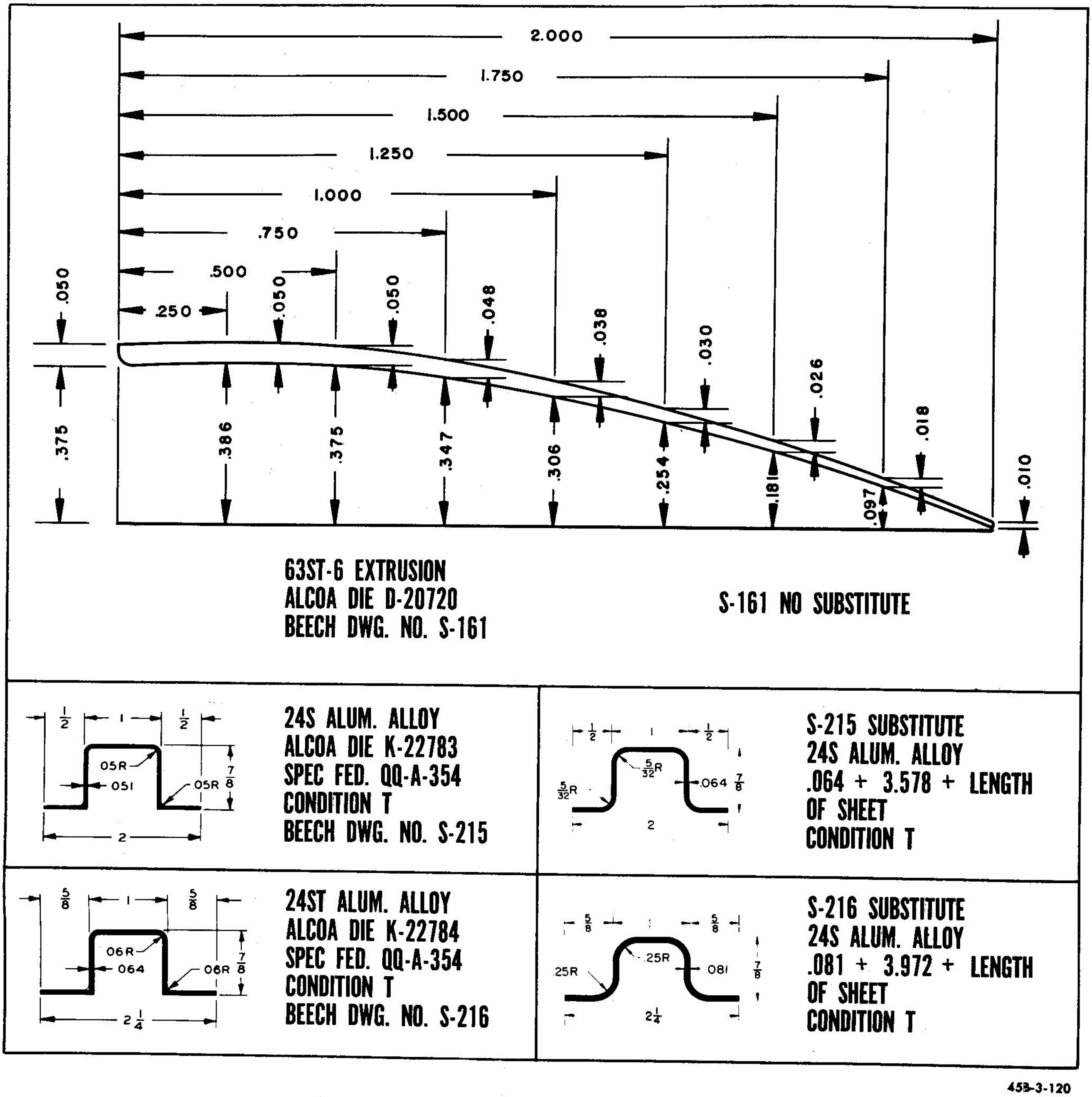


Figure 8-1 Extrusion Chart (Sheet 4 of 4 Sheets)

APPENDIX A

EMERGENCY REPAIRS

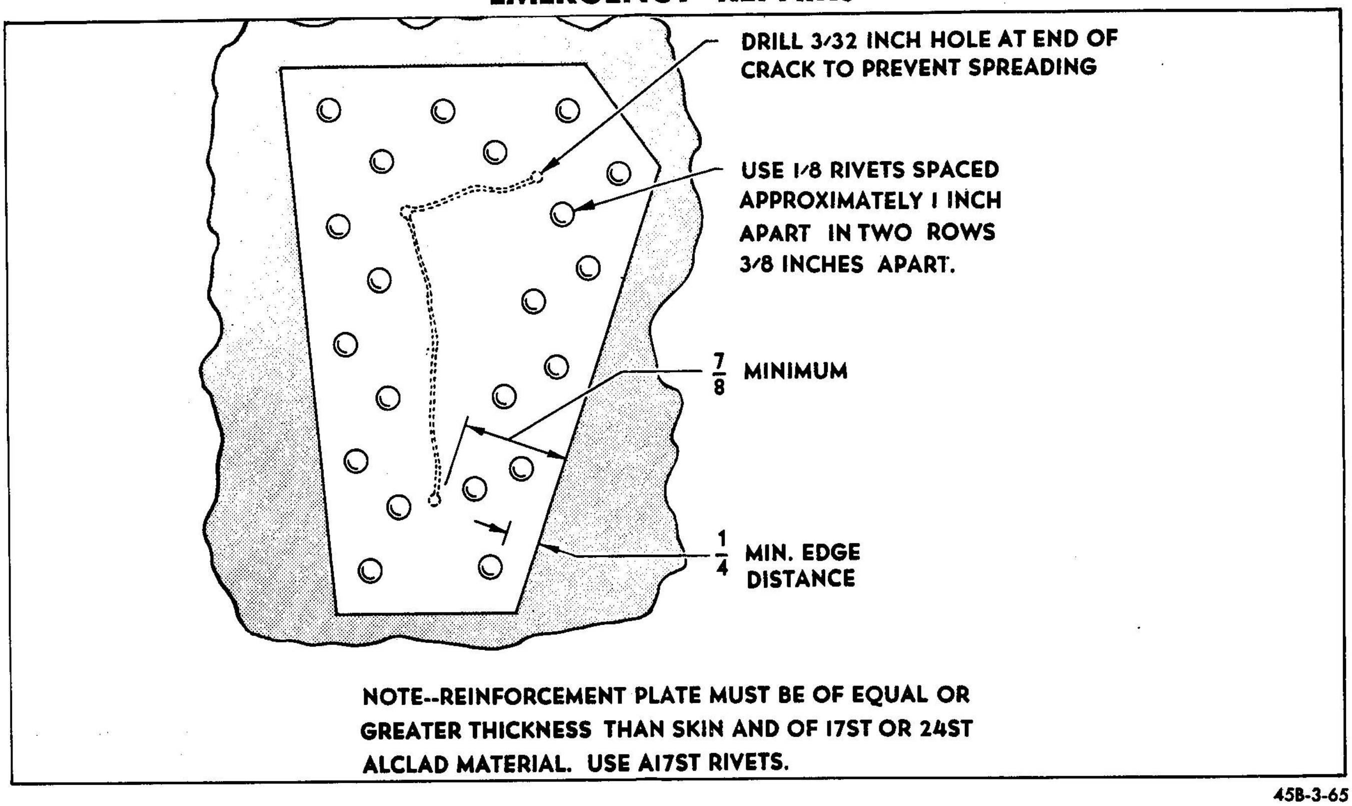


Figure A-1 Crack Repair

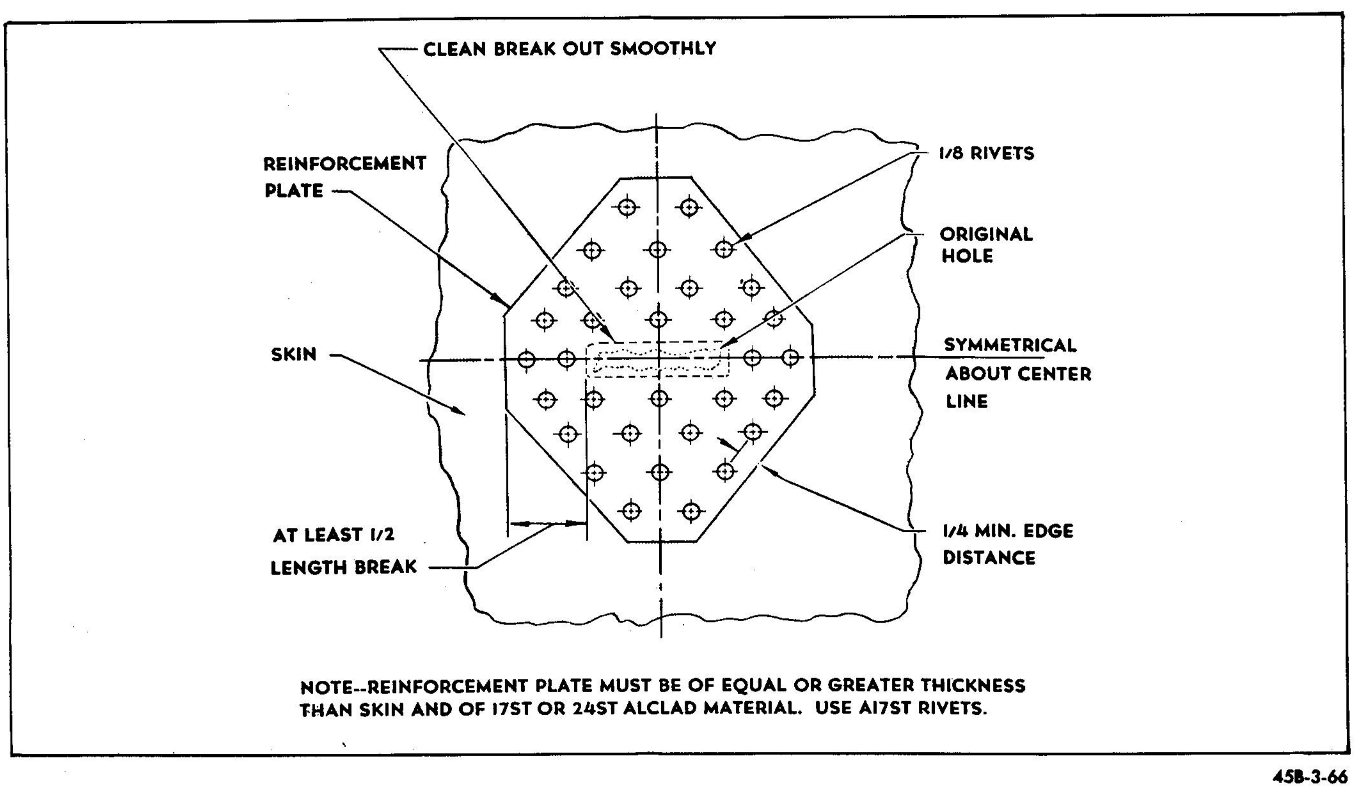


Figure A-2 External Patch

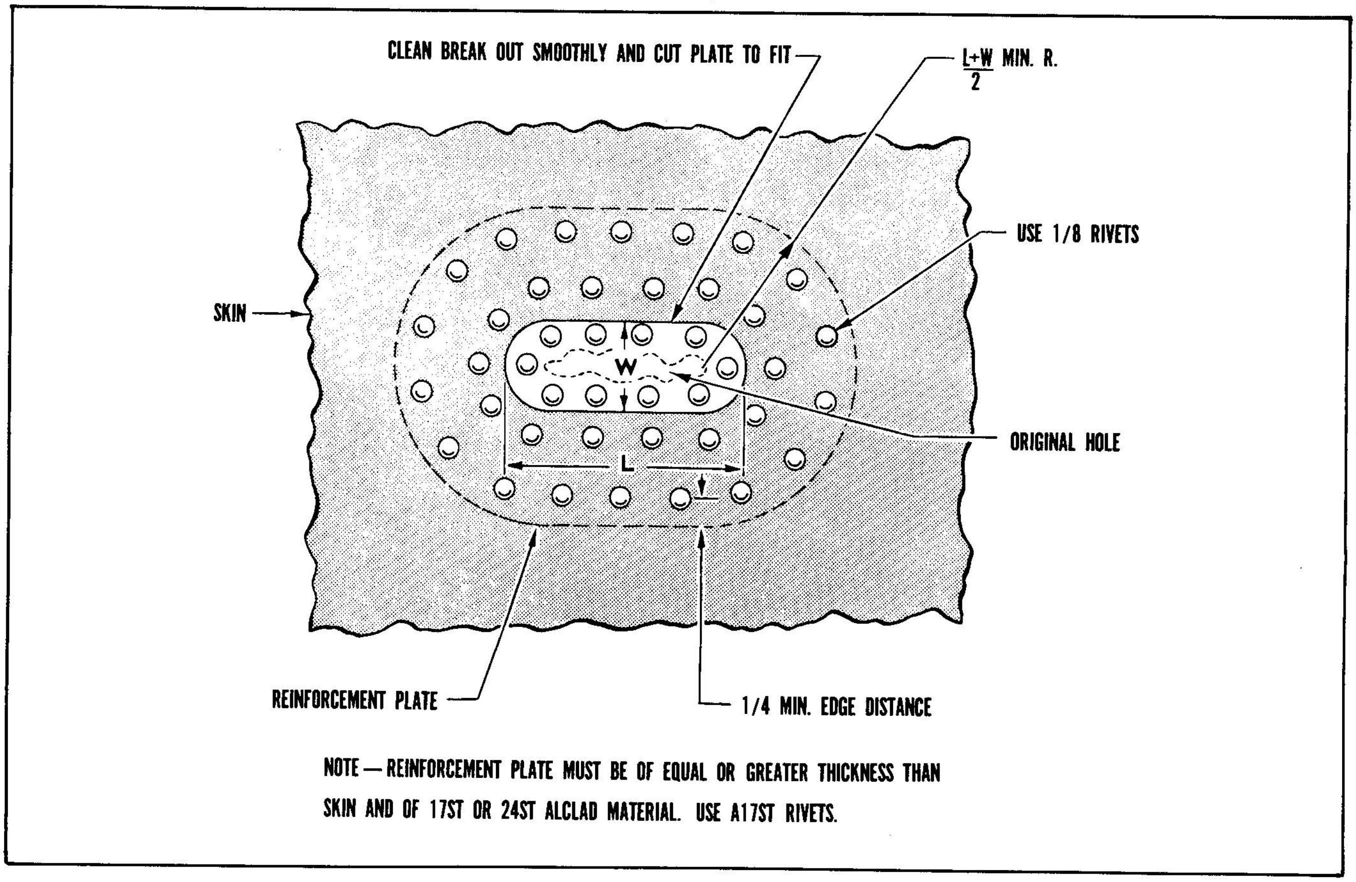


Figure A-3 Flush Patch

45B-3-67

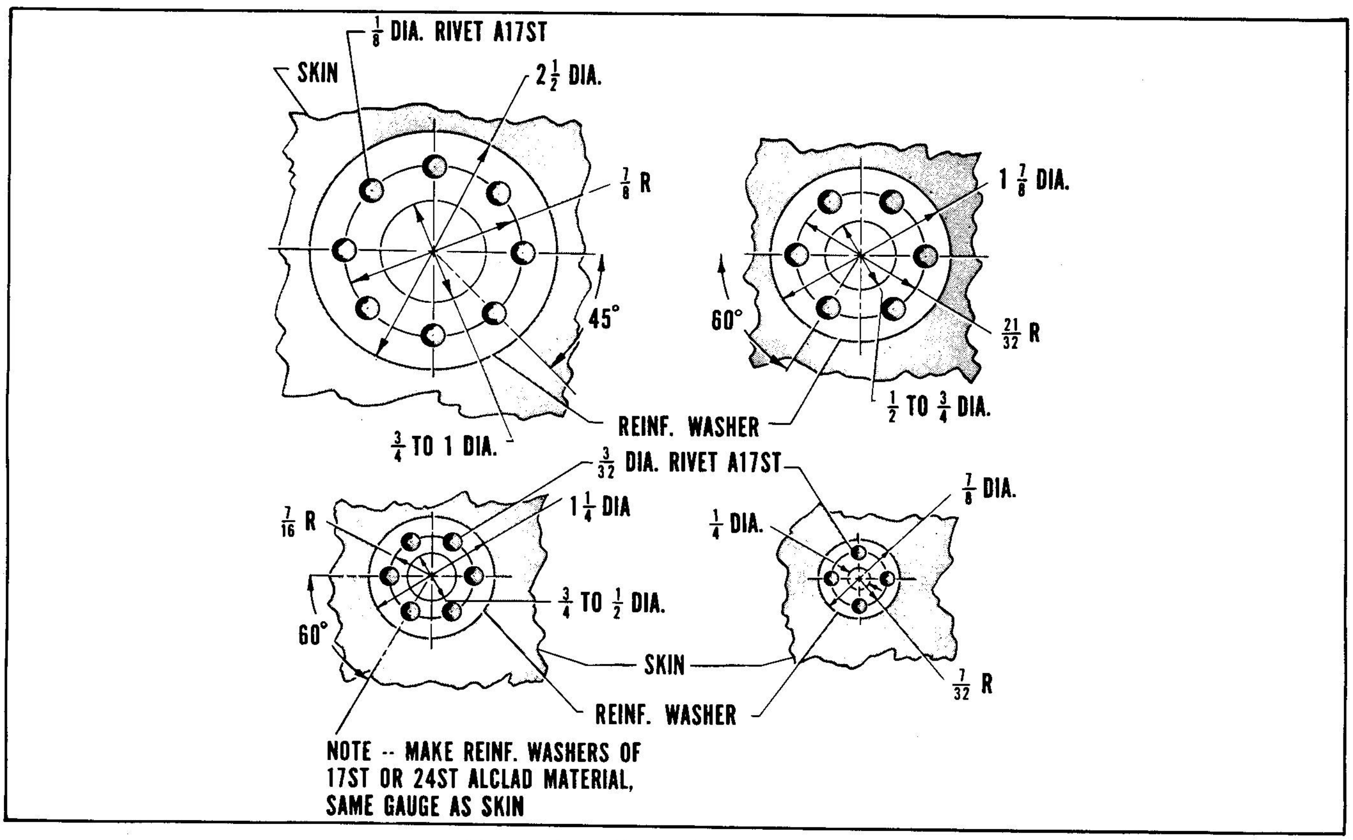


Figure A-4 External Circular Patch

45B-3-68

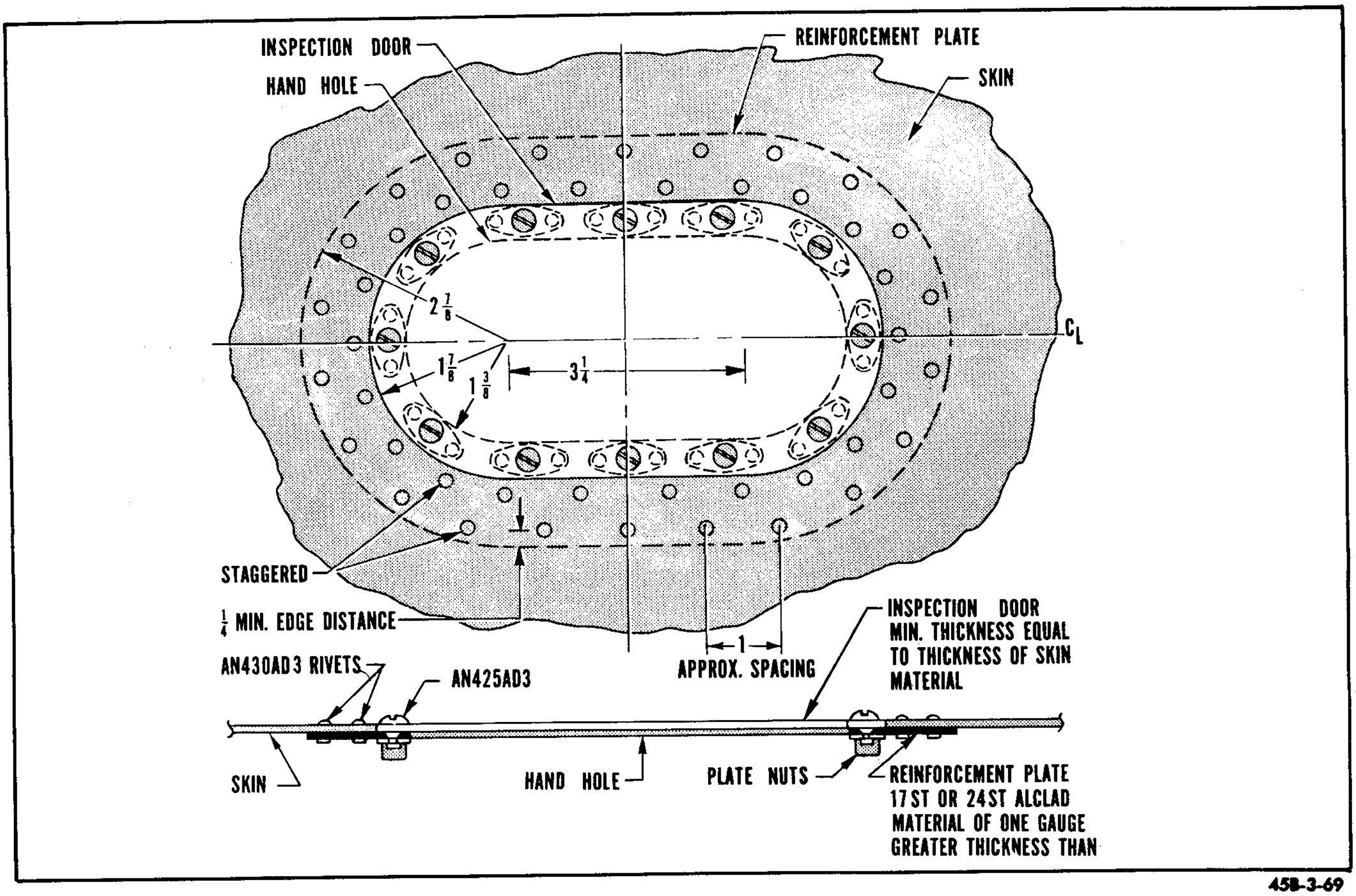


Figure A-5 Flush Access Hole

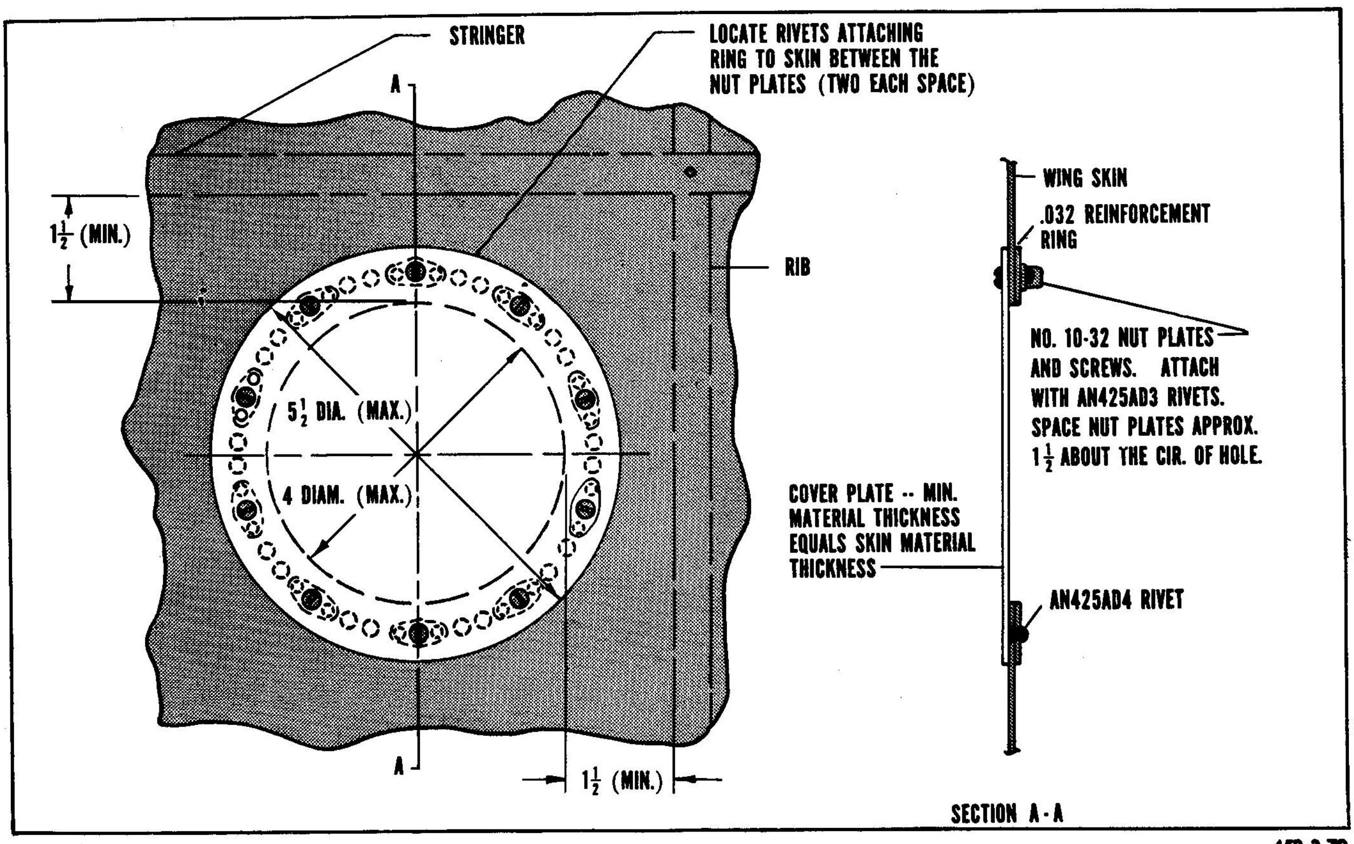


Figure A-6 External Access Hole

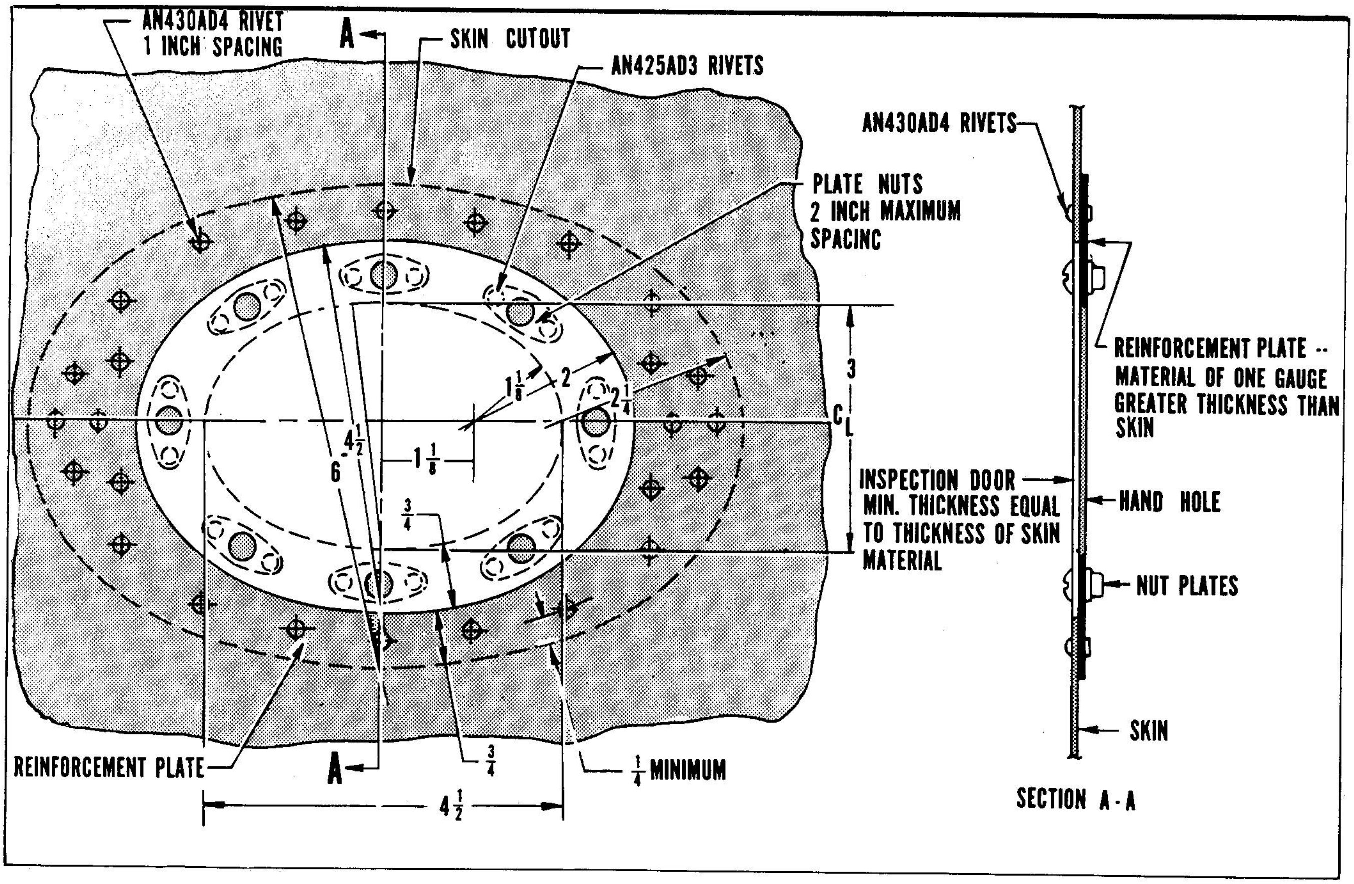


Figure A-7 Oval Flush Access Hole

45B-3-71

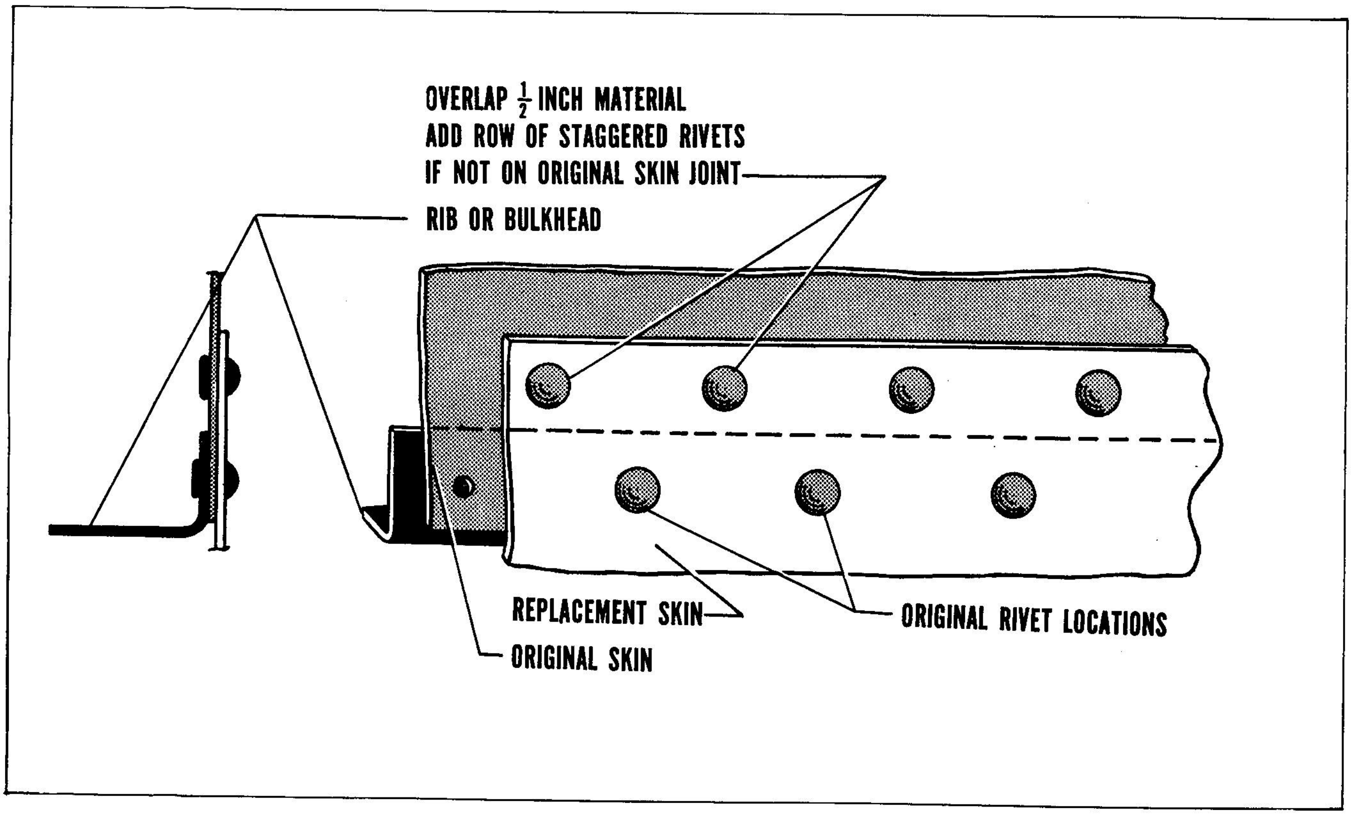
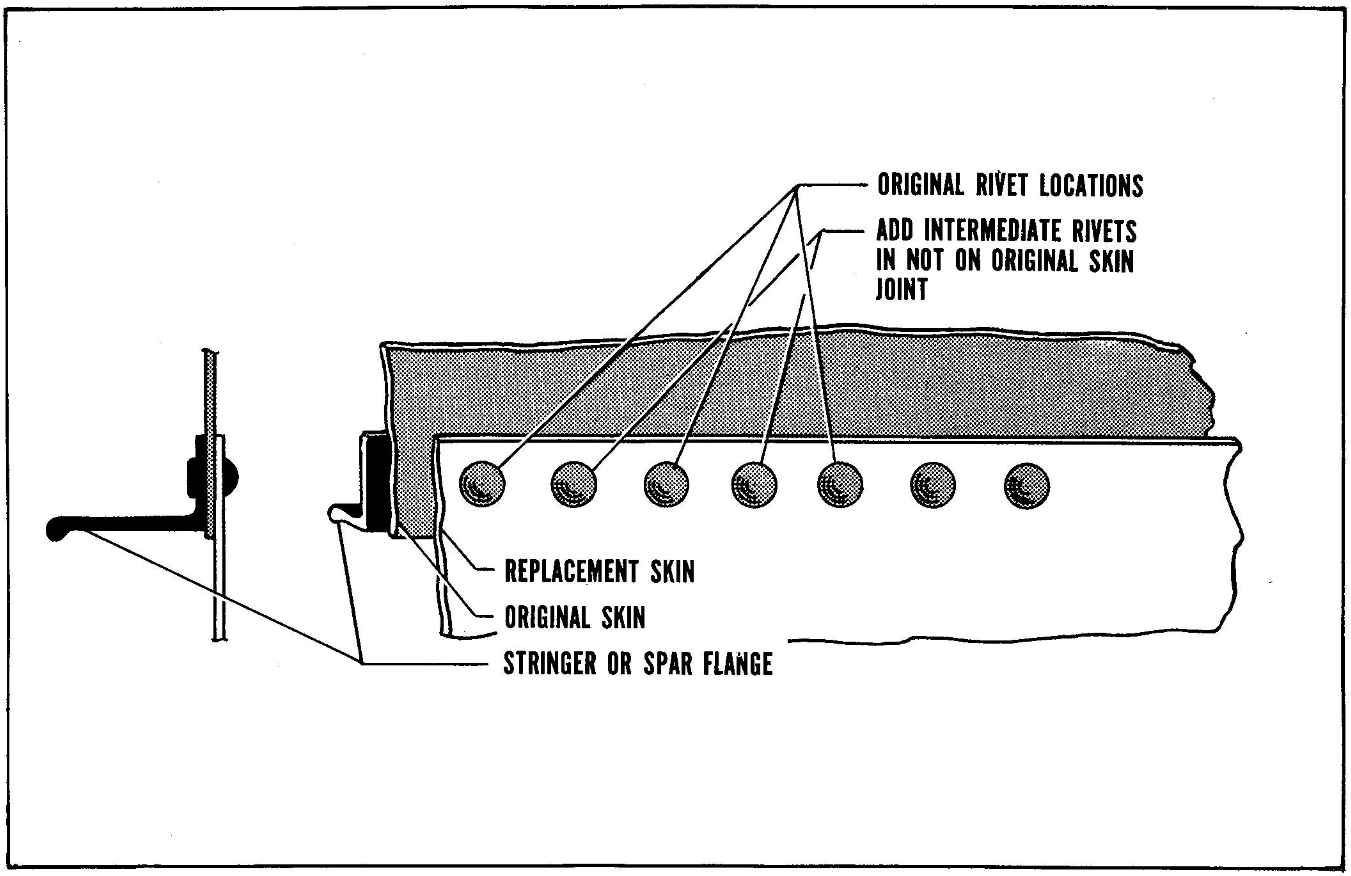


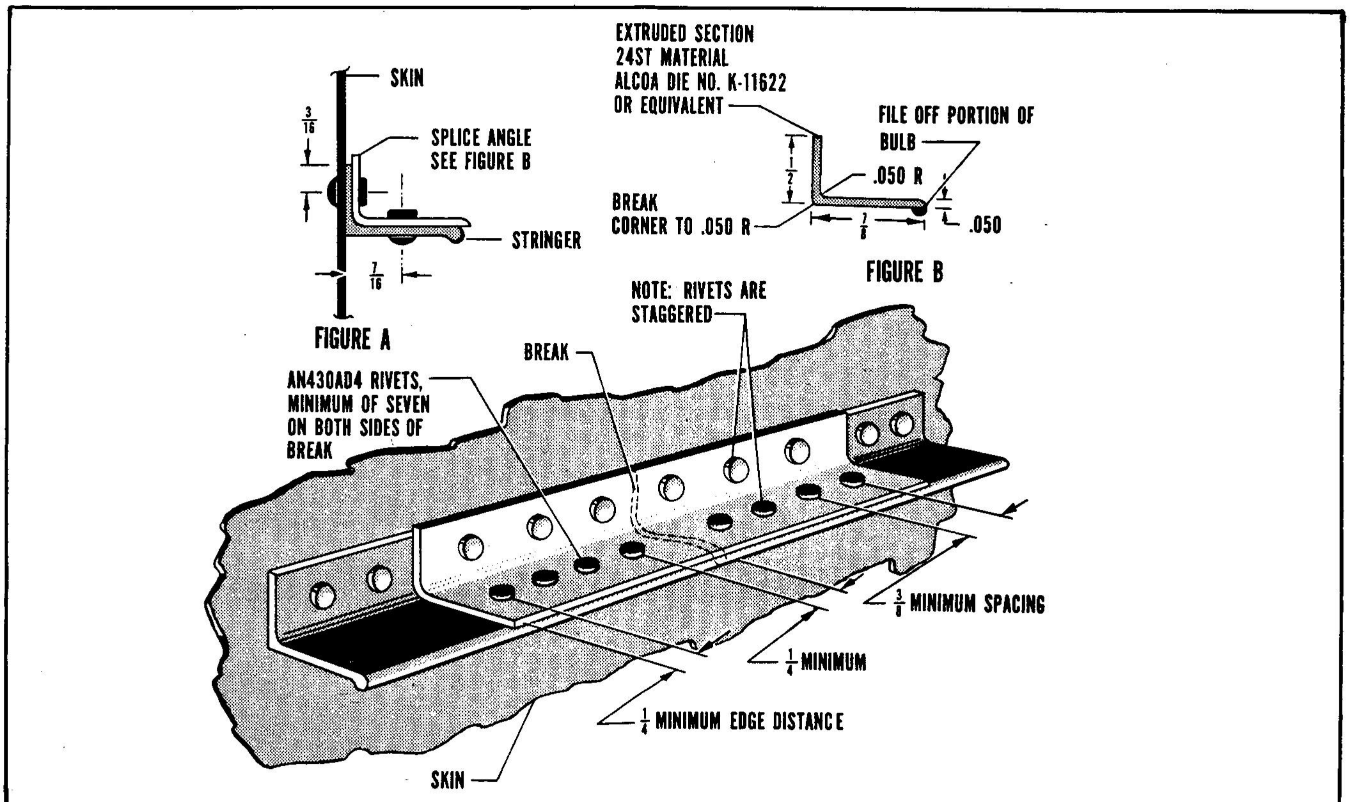
Figure A-8 Transverse Skin Joints

45B-3-72



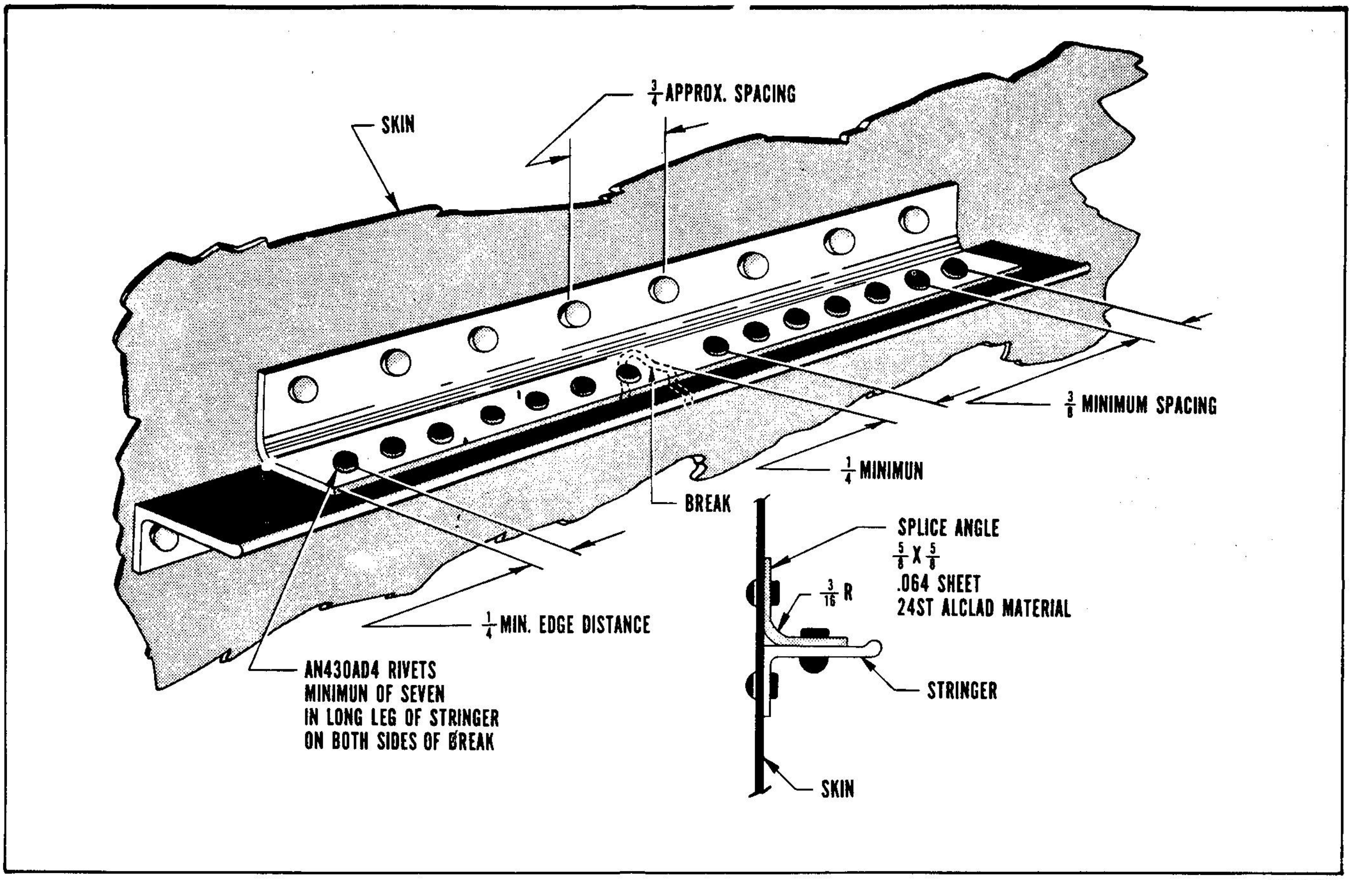
45B-3-73

Figure A-9 Longitudinal Skin Joint



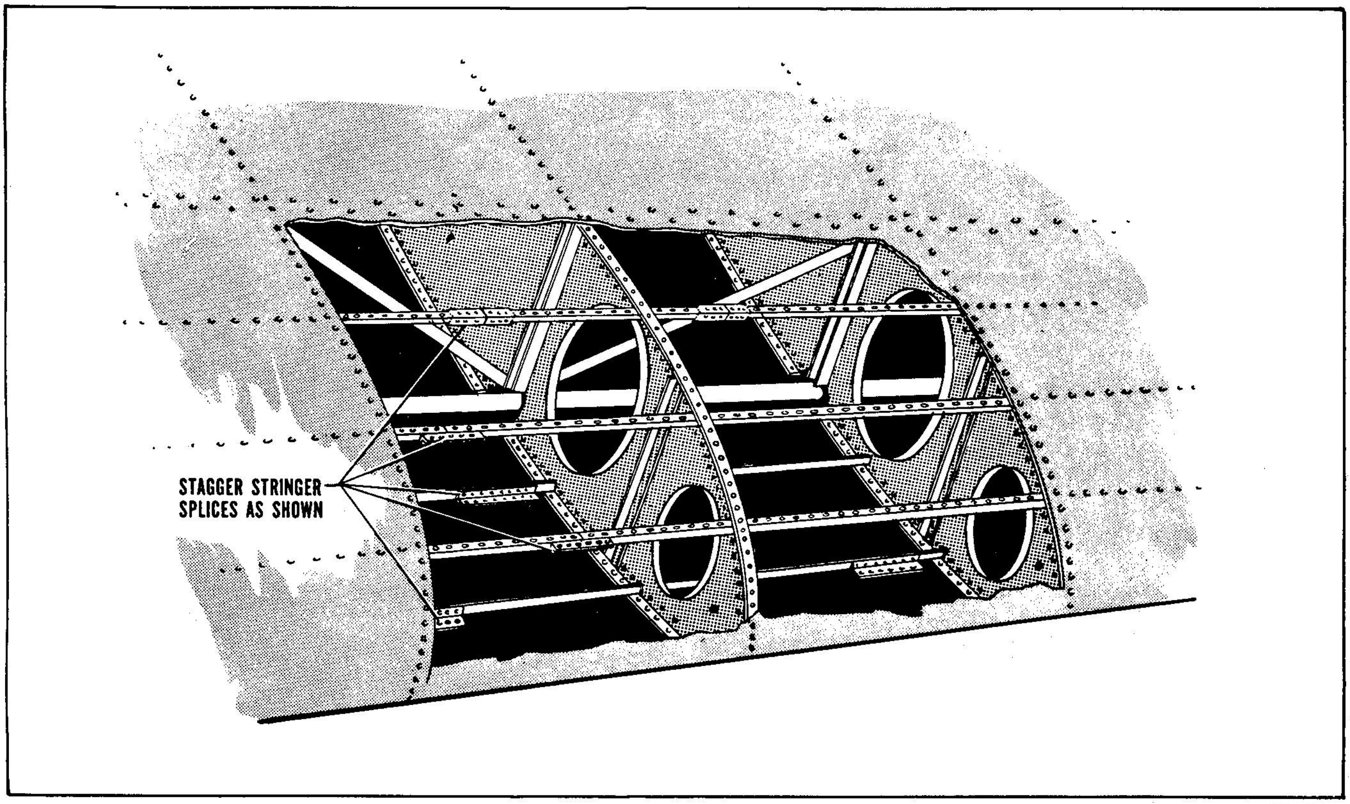
45B-3-74

Figure A-10 Formed Angle Stringer



45B-3-75

Figure A-11 Extruded Stringer



45B-3-76

Figure A-12 Stringer Splices

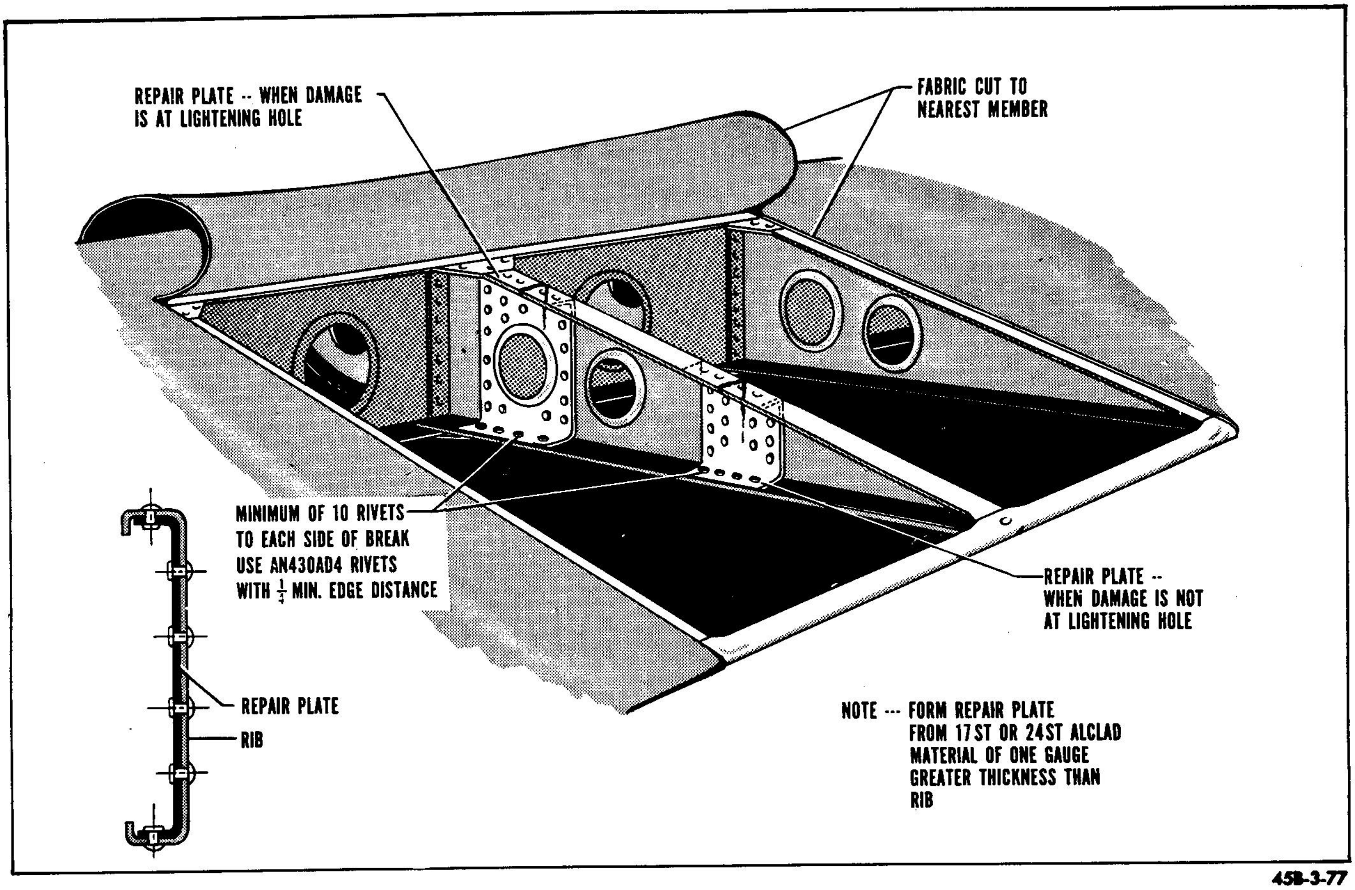


Figure A-13 Control Surface Rib

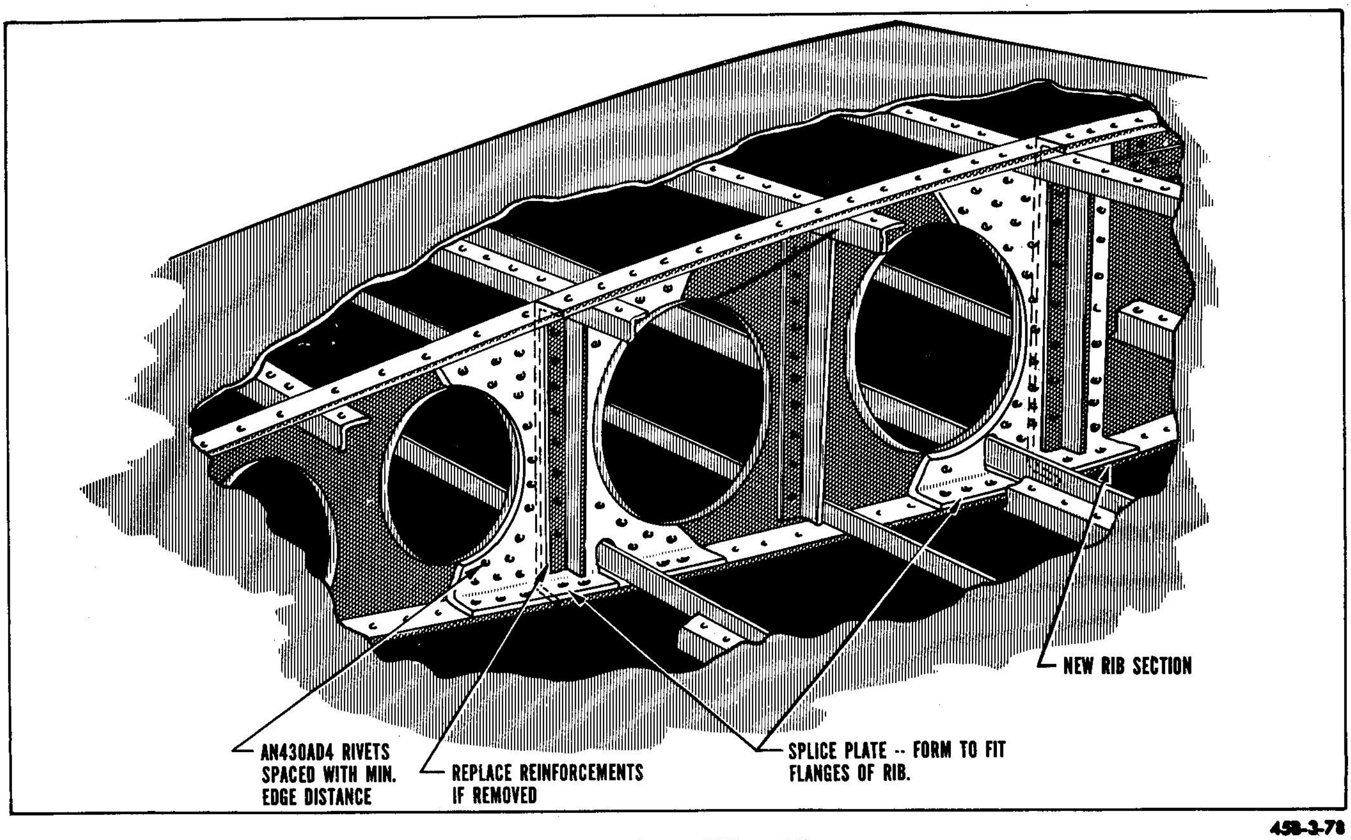


Figure A-14 Wing Rib

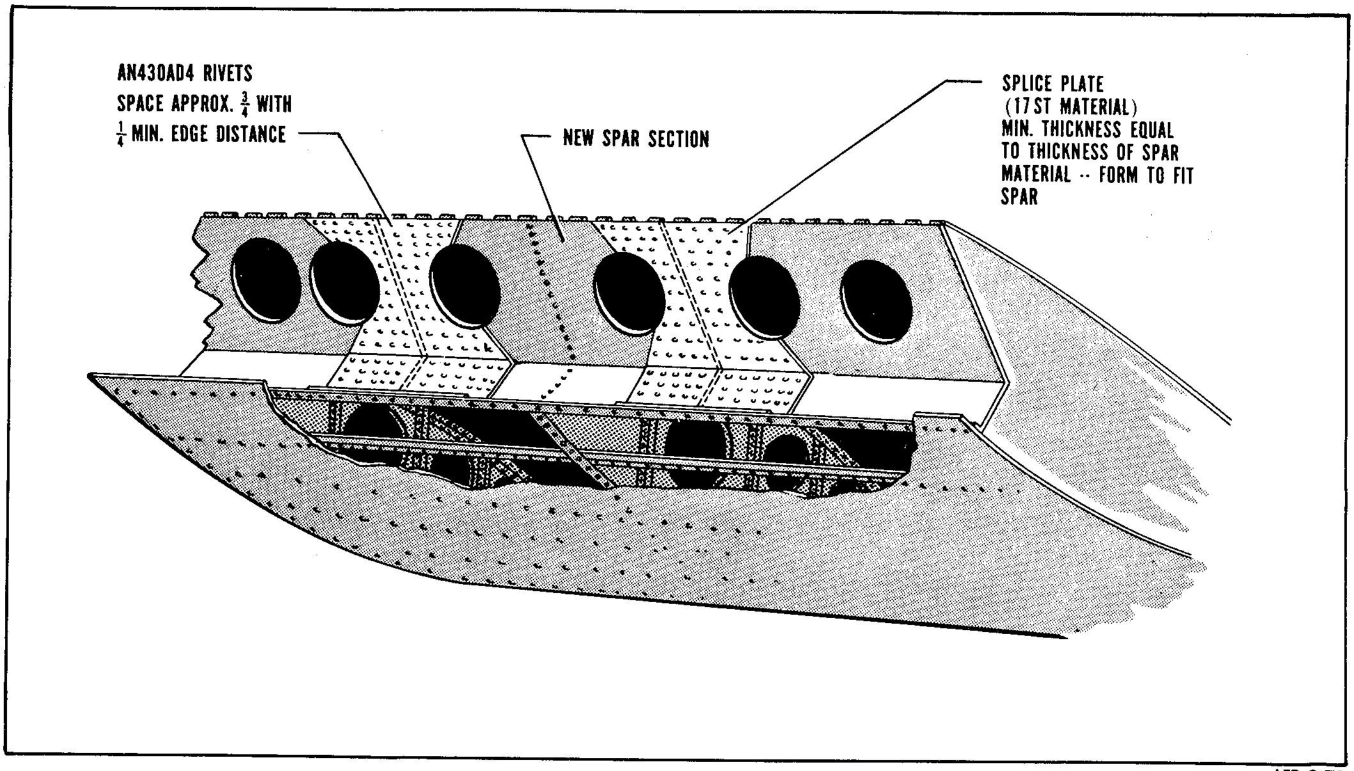


Figure A-15 Spar Repair

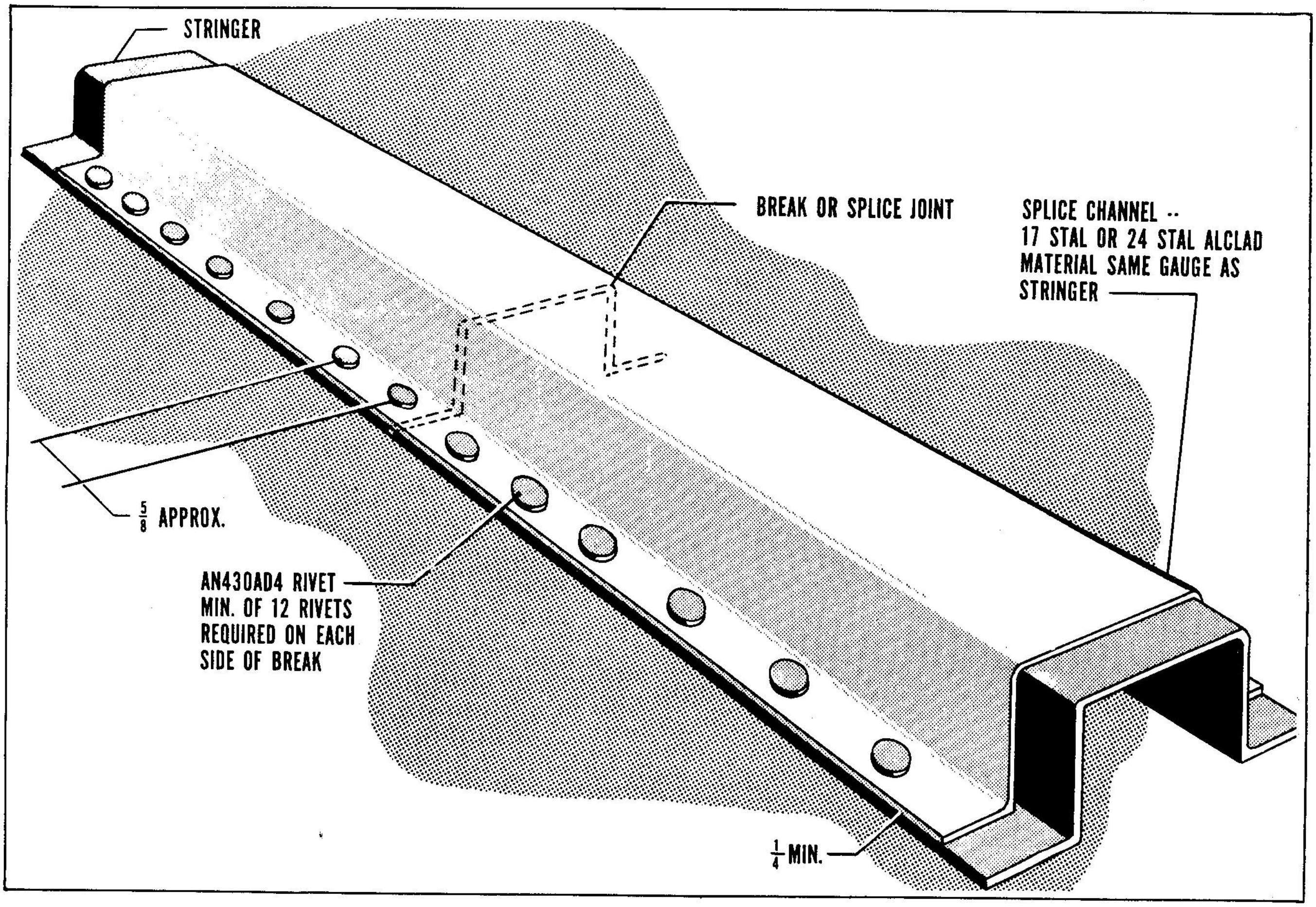


Figure A-16 Hat Section Repair

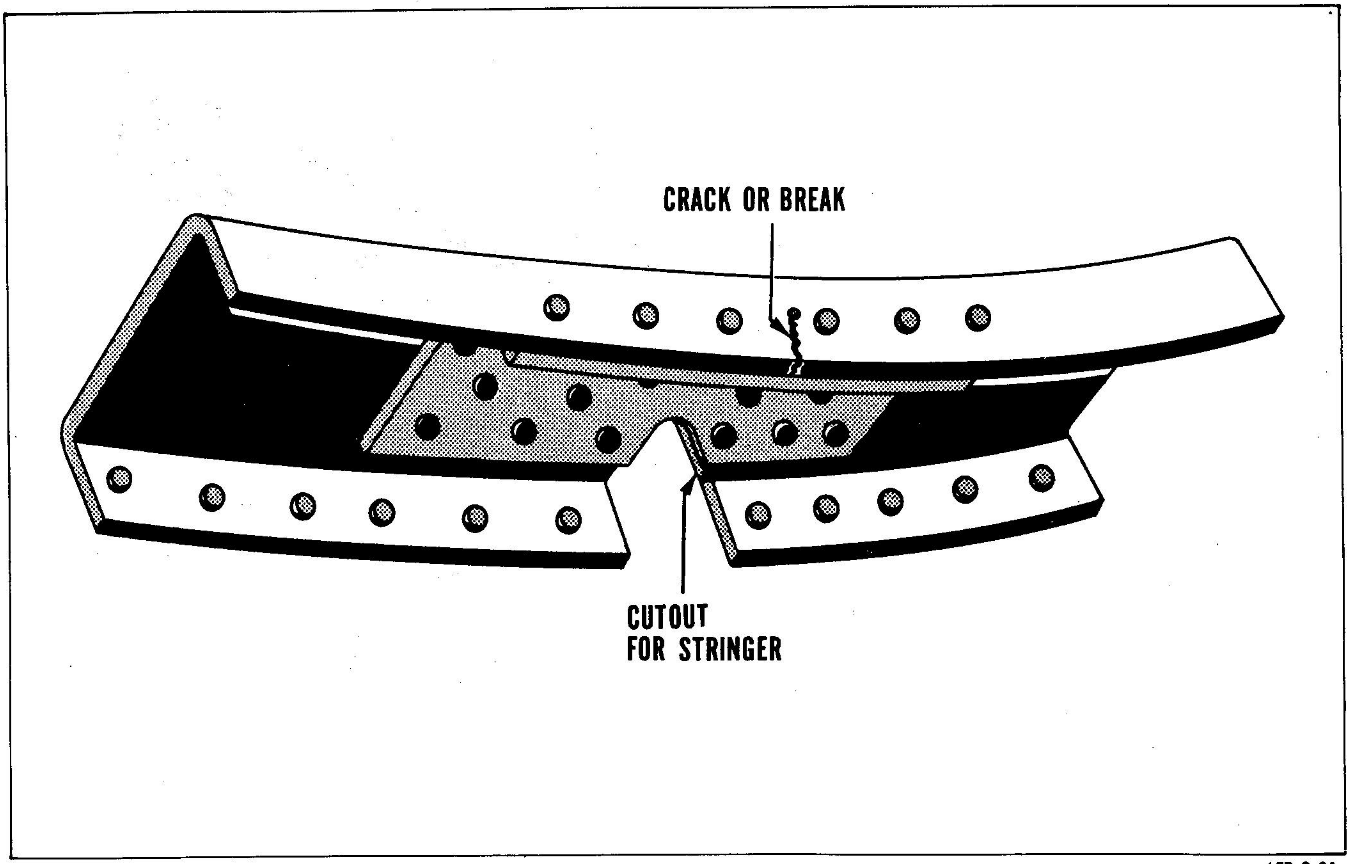


Figure A-17 Bulkhead Repair at Stringer Cutout

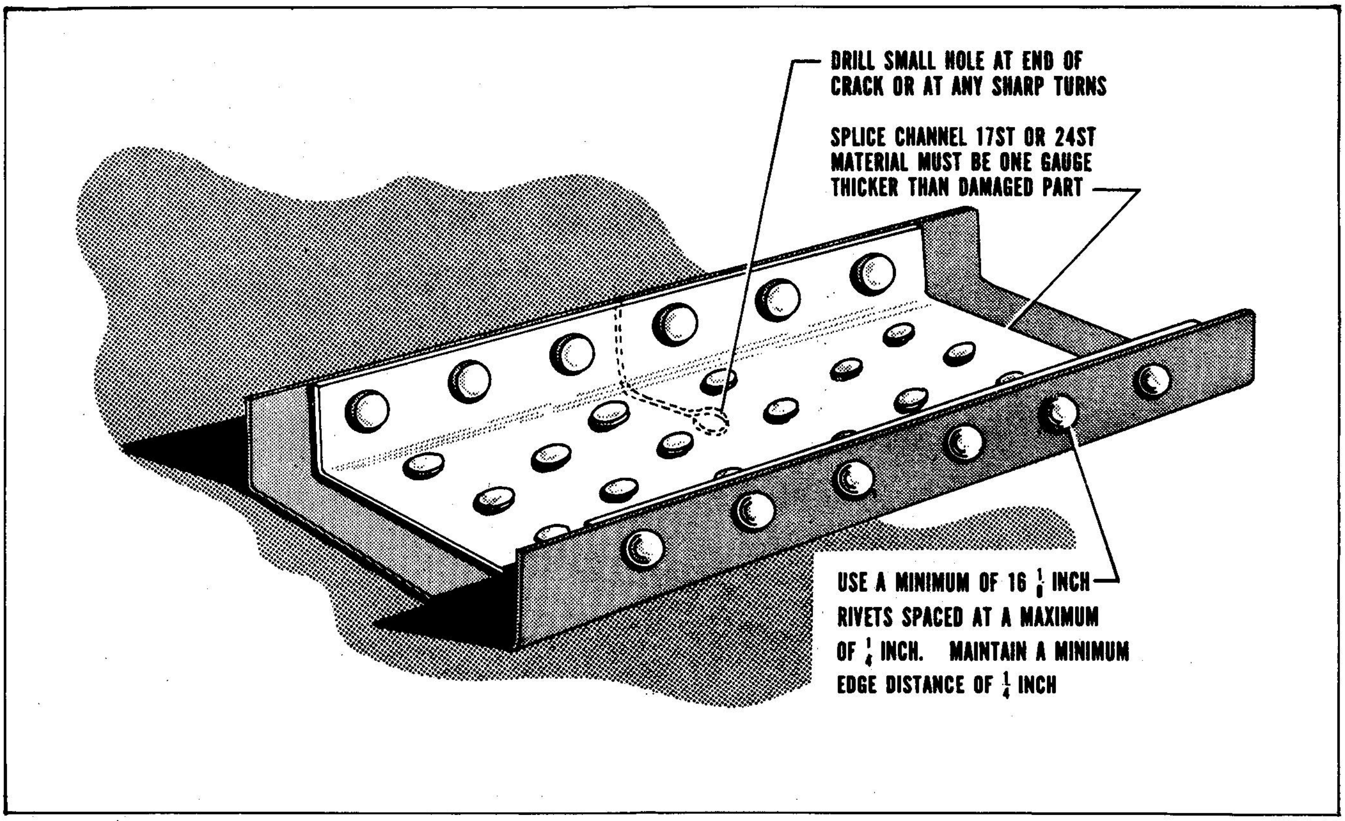
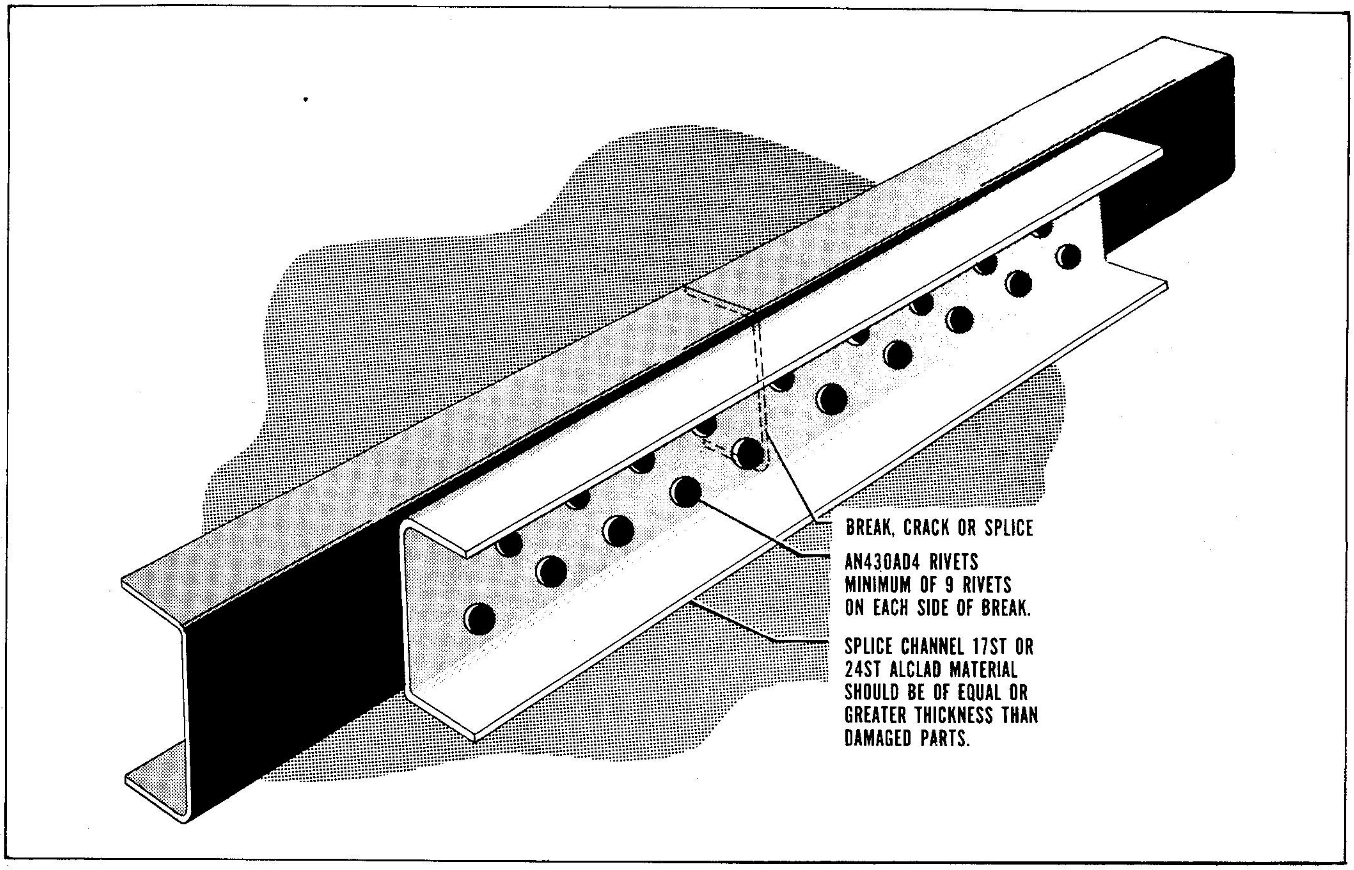
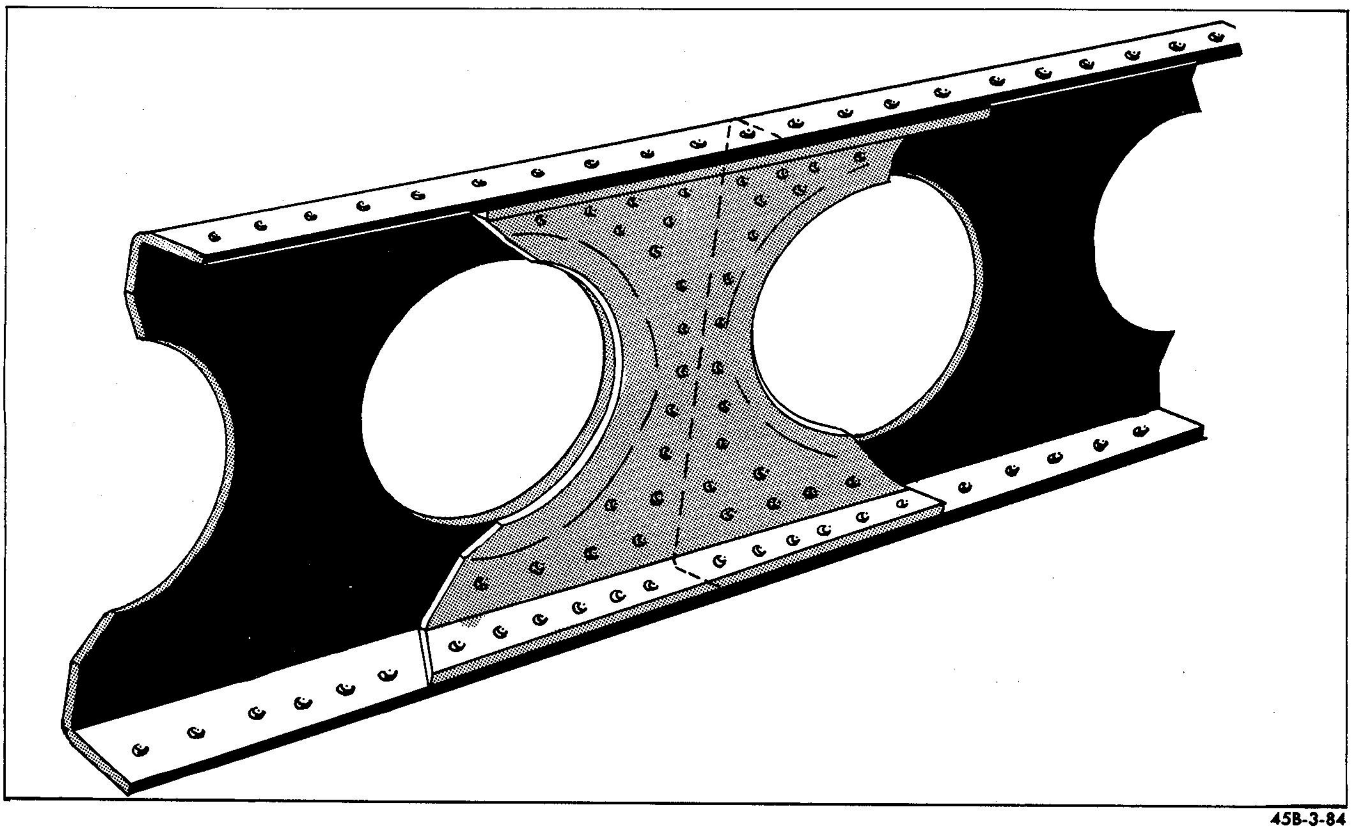


Figure A-18 Internal Splice, Bulkhead or U-Section



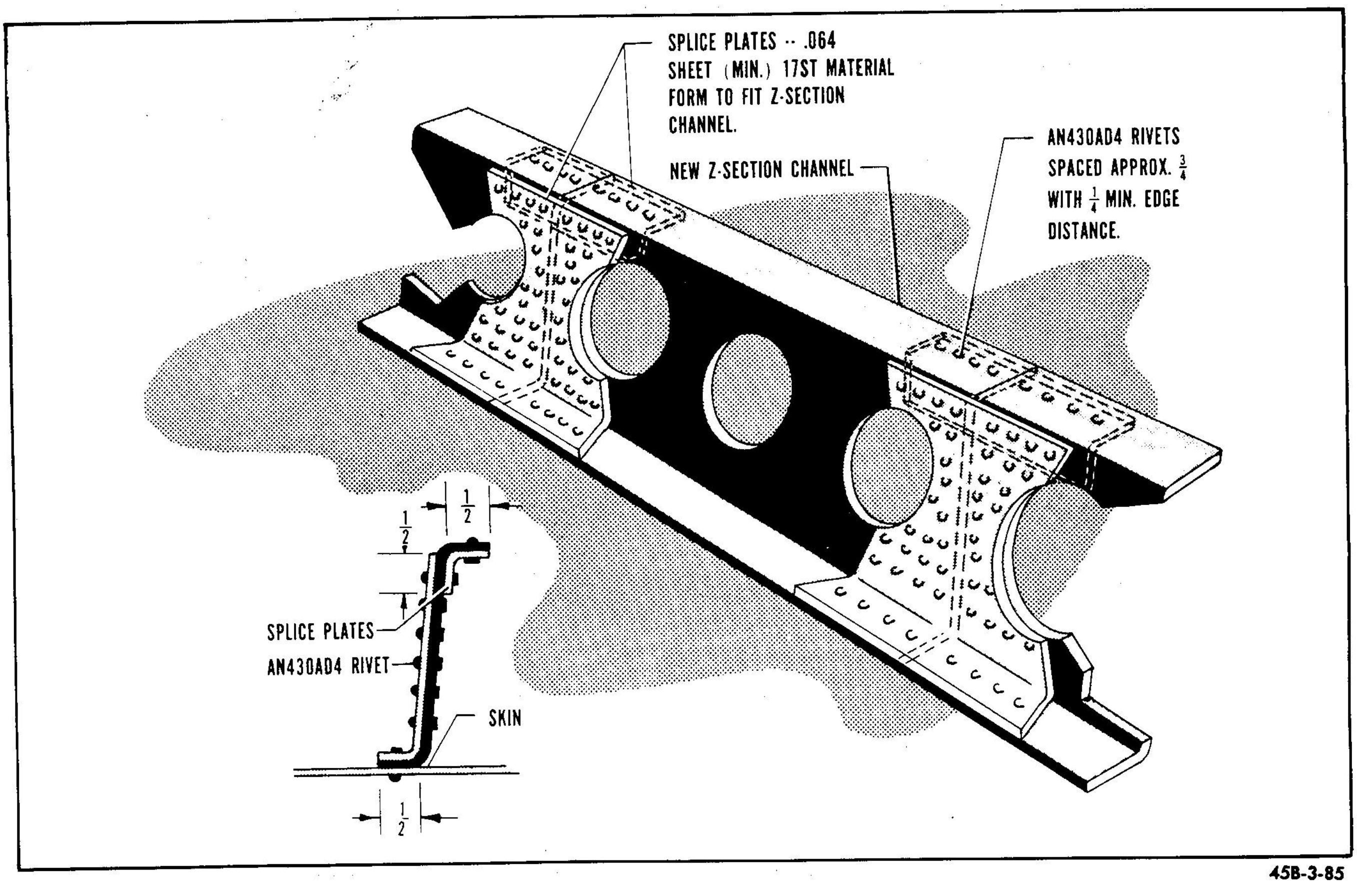
45B-3-83

Figure A-19 External Splice, U-Section or Bulkhead



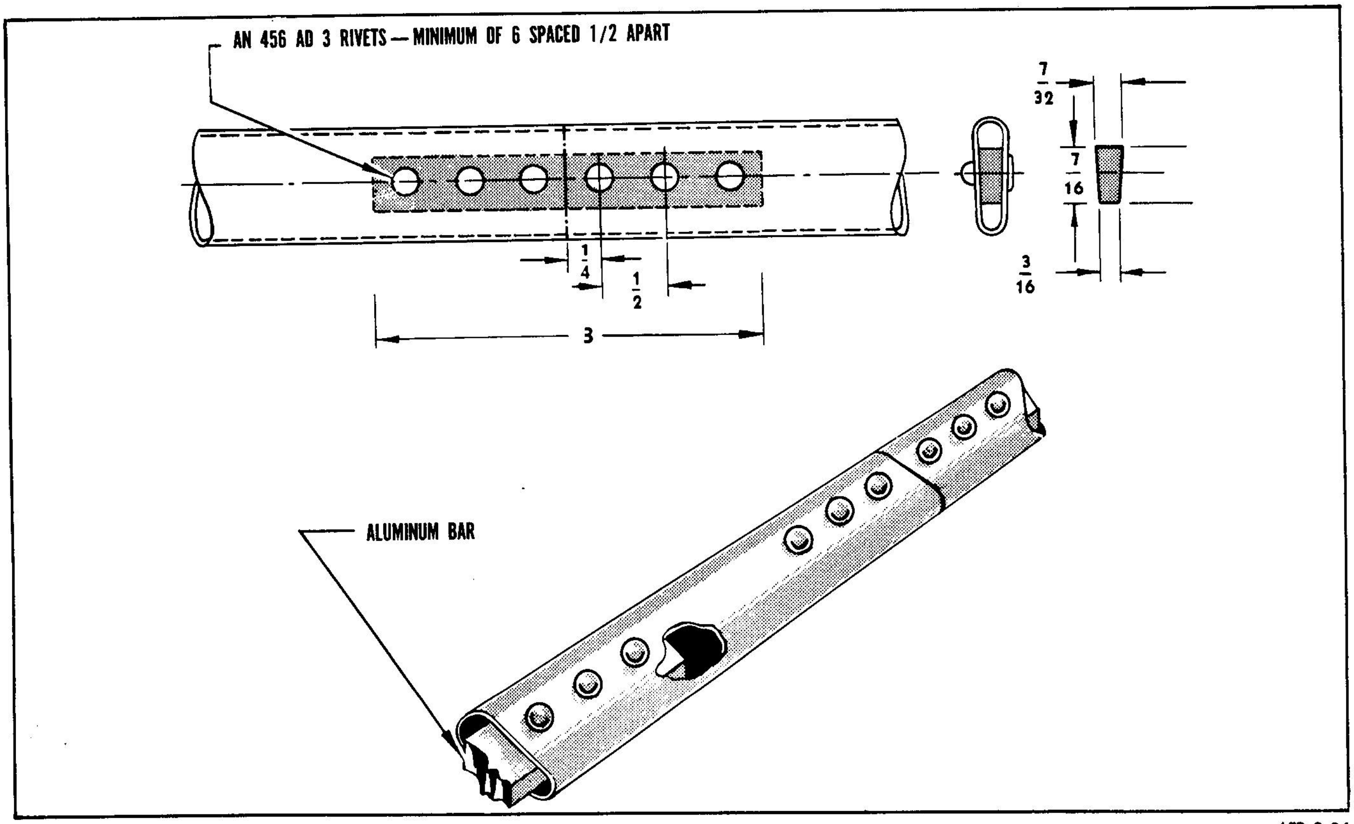
45B-3-84

Figure A-20 Floor Channel



45B-3-85

Figure A-21 Z-Channel Repair



45B-3-86

Figure A-22 Rudder Trailing Edge

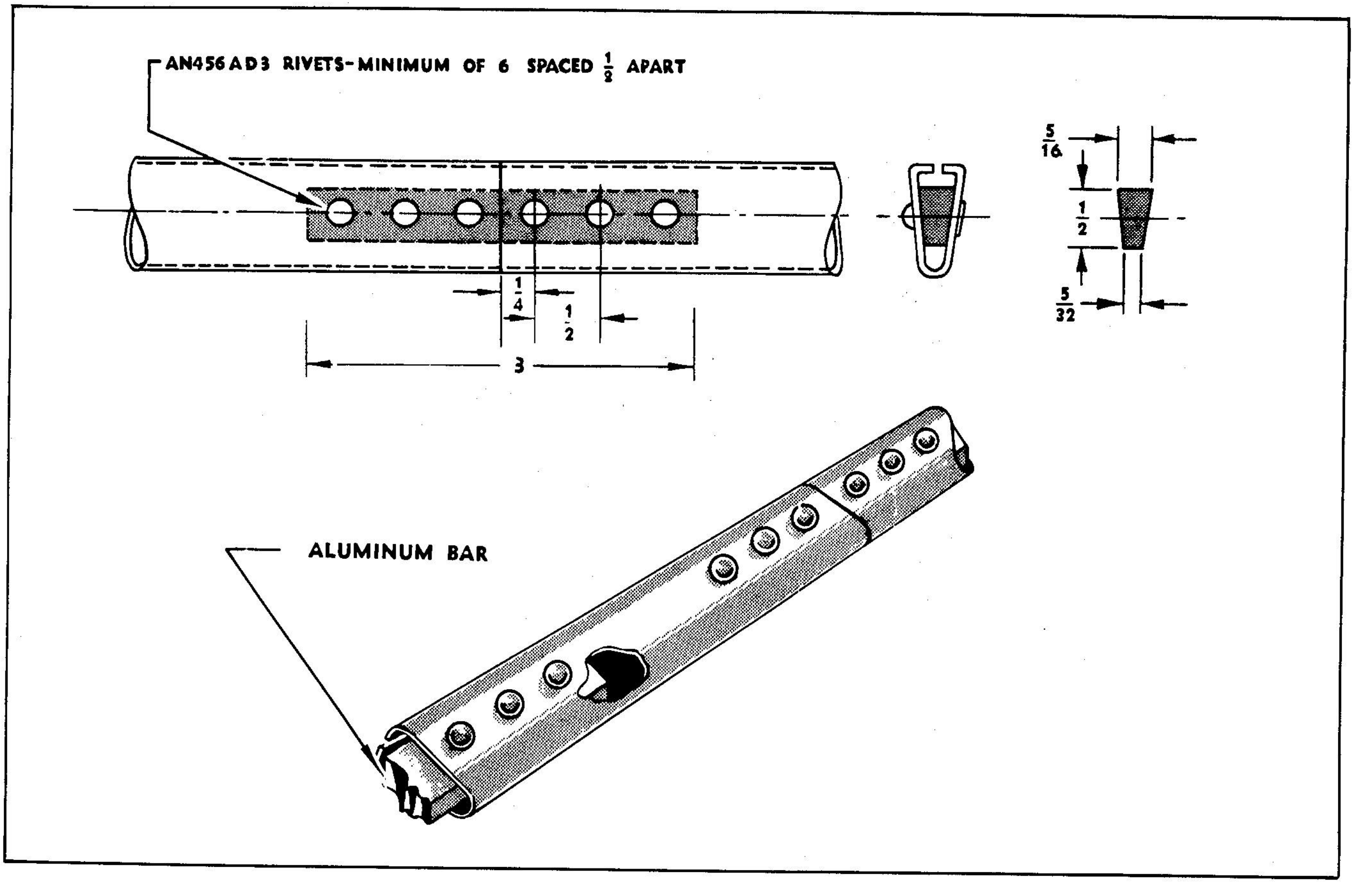


Figure A-23 Trailing Edge

45B-3-87