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HANDBOOK OF INSTRUCTIONS
STRUCTURAL REPAIR

for

MODELS

JRF-1, 2, 3, 4, 5 and 6B

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Air Service Caravan Co., Inc.

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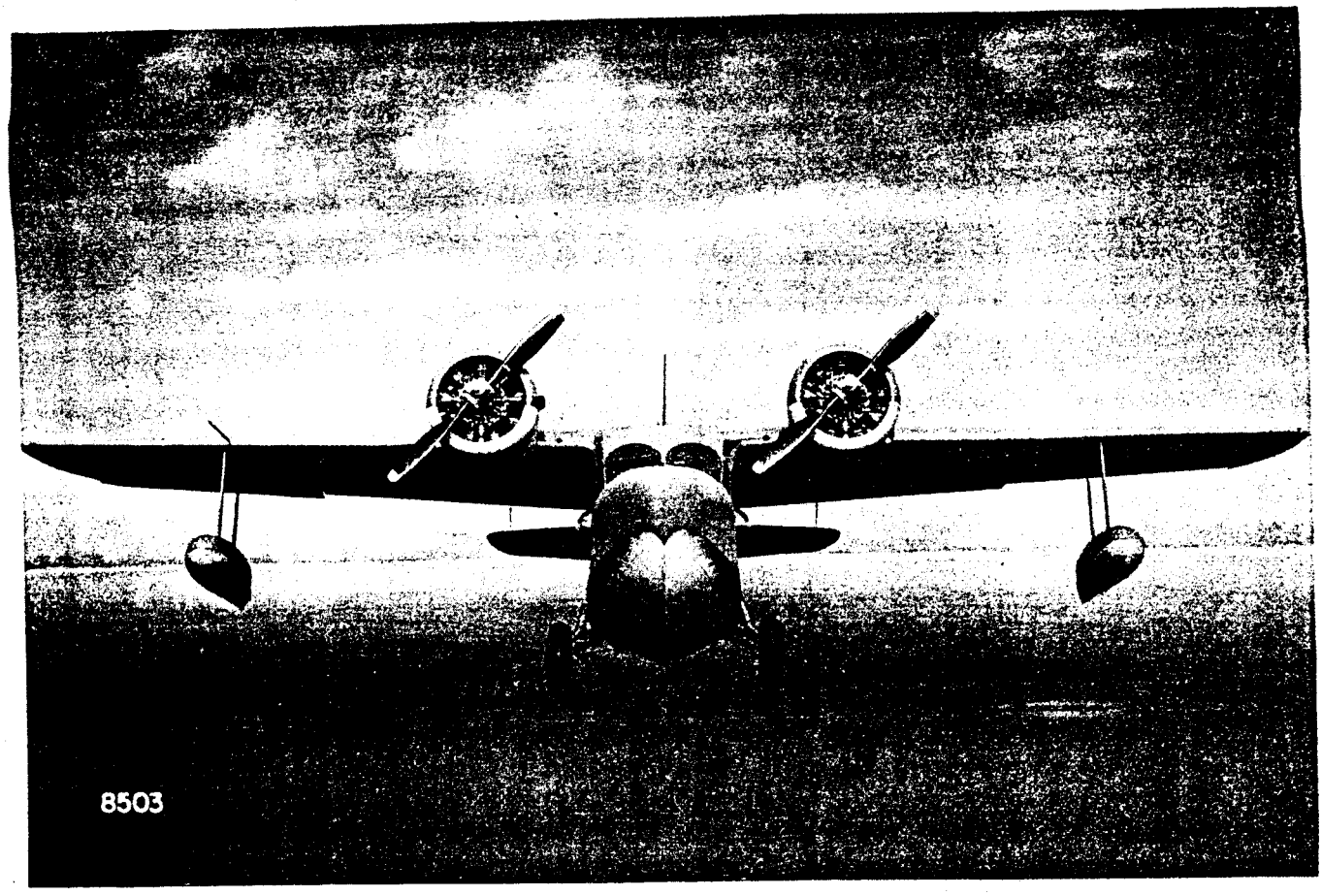
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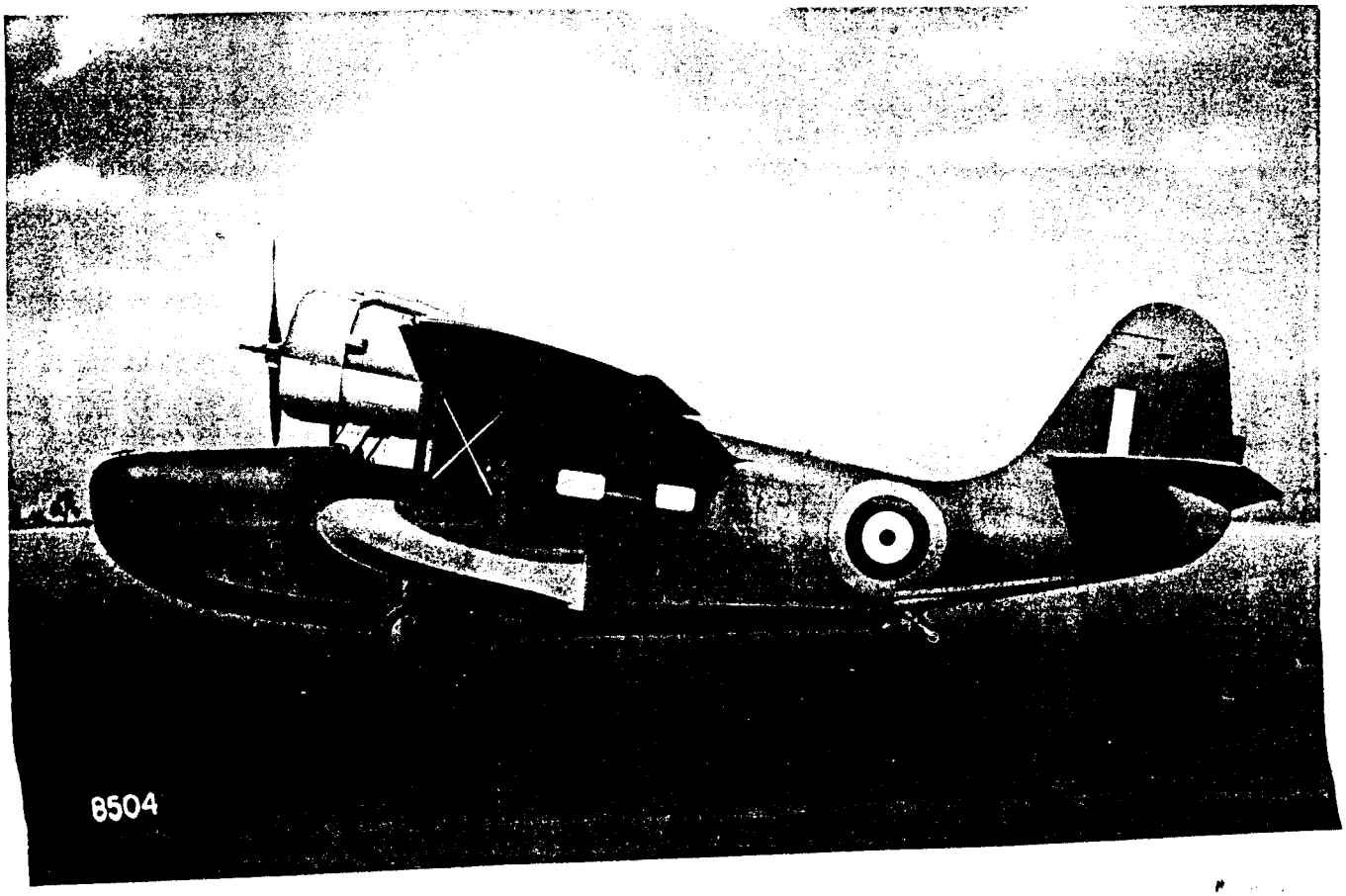
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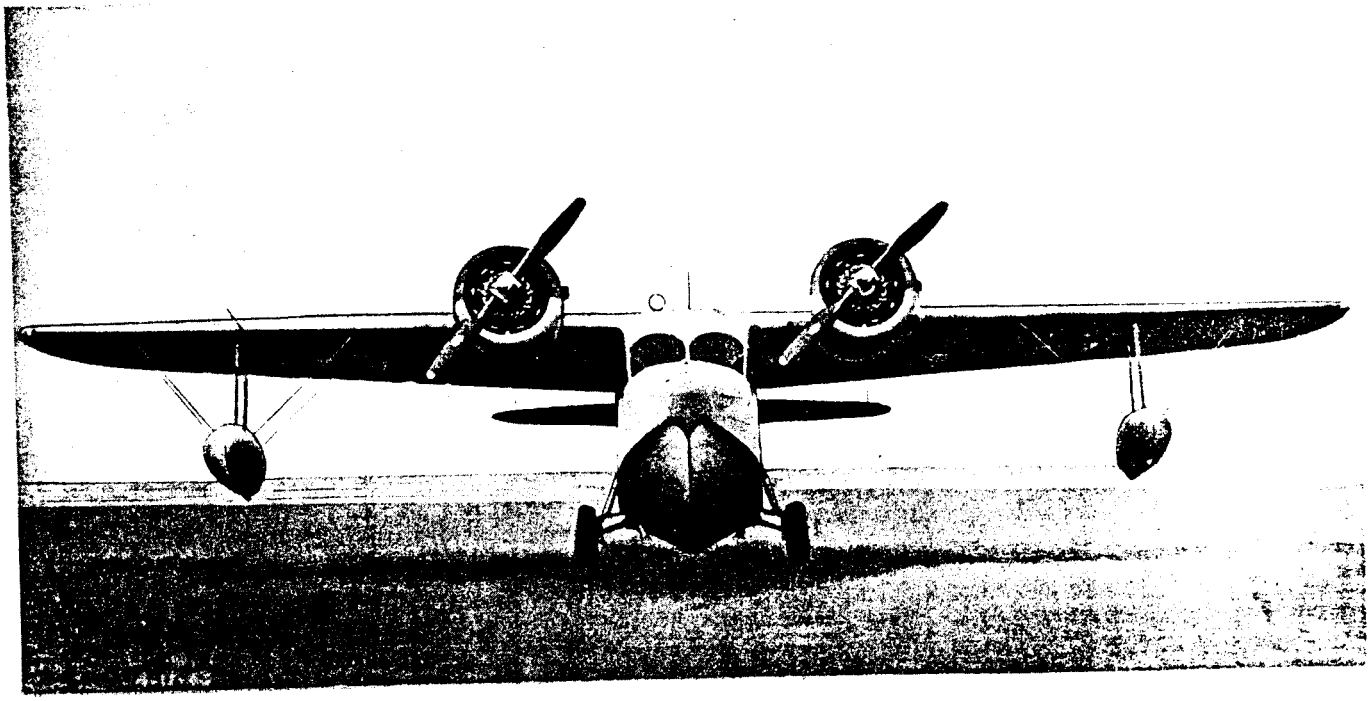

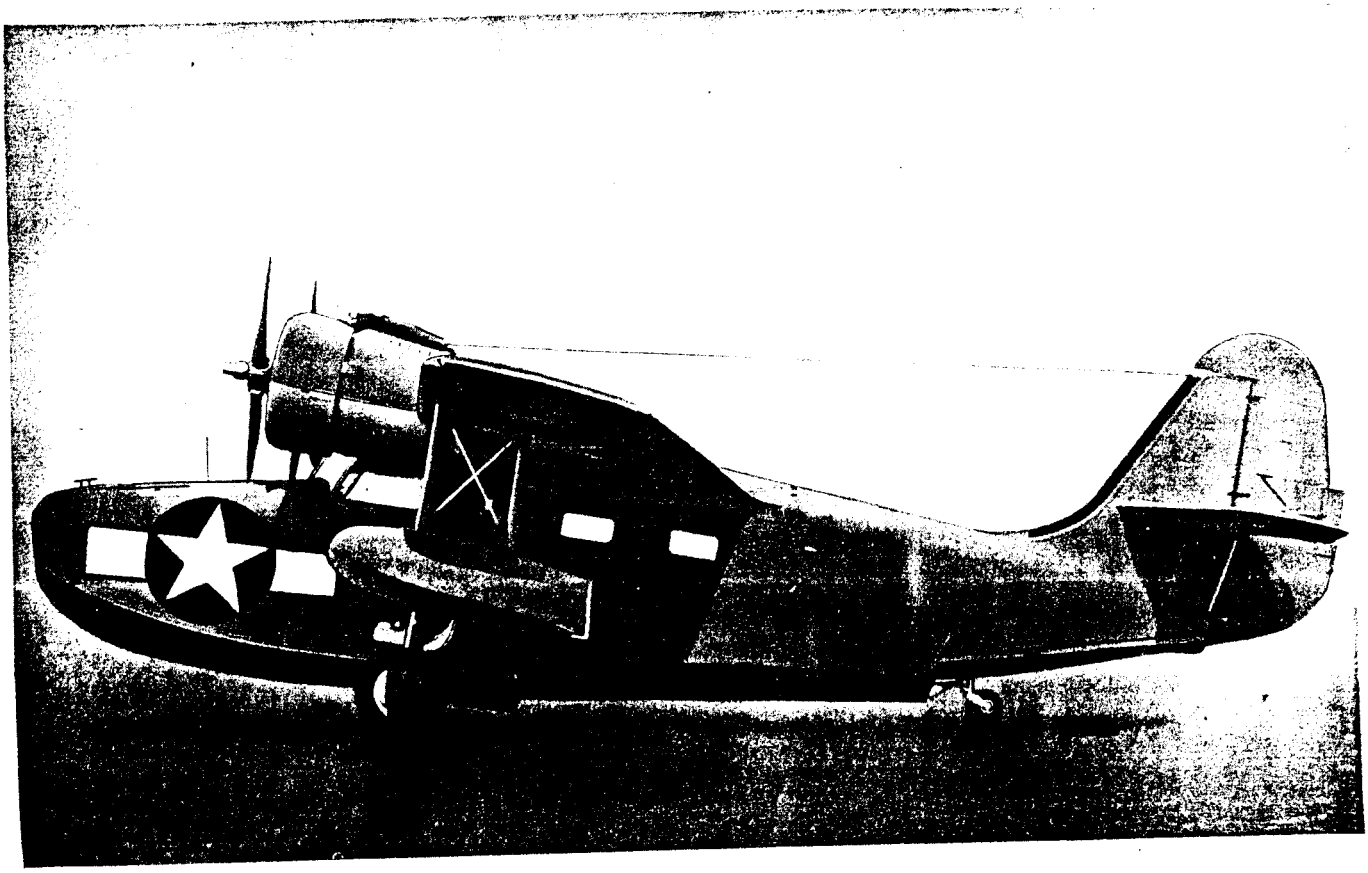

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SECTION 1
GENERAL

1. USE OF REPAIR MANUAL.

a. This Handbook of Instructions for structural repair of the JRF Series Airplane includes instructions for typical repair of the airplane in the field where major overhaul facilities and experienced repair personnel may not be available. For standard practice on repairs, refer to General Manual for Structural Repair, AN-01-1A-1, AP2600A.

2. TYPE OF CONSTRUCTION.

a. The airplane is a twin engine, six place, dual control, fixed high wing cantilever monoplane amphibian. It is designed for utility, patrol and observation use and particularly as a navigators or radio operator's training airplane.

b. The hull is an integral part of the body. The wing center section is permanently bolted to the top of the body, and includes in its construction the engine nacelles and "built in" fuel tanks. The wing flaps are of the split balanced type. The aft portion of the wing and the control surfaces are of fabric covered metal frame construction. The wing tip floats are of standard lines and construction and 760 lbs. displacement each. They are attached to an outer panel by two fixed length vertical struts, incidence and transverse bracing tie rods.

c. Plexiglas windows are provided in the pilot's compartment side windows and in the cabin.

d. The wings, of stressed skin construction, are the full cantilever type with a single box beam and consists of one separate center section and two outer panels. The outer wing panel surface aft of the box beam together with all movable control surfaces with the exception of the wing flaps, are fabric covered.

3. MATERIALS OF CONSTRUCTION.

a. In general the airplane is constructed of 24ST aluminum alloy sheet, tube, extruded and rolled sections. Oil tank material is 3S½H aluminum alloy sheet. Electric conduit is 2S0 aluminum alloy tubing and all other piping is constructed of 52S0 aluminum alloy tubing. Wherever 24S0 material is used to fabricate a part, such part is heat treated to give 24ST properties before installation. Exhaust stacks and collectors are constructed of corrosion and heat resistant steel. For heat treated parts list, See Table I.

4. REPAIR MATERIALS.

a. Materials used for repair should be the equivalent of the original structure. Most repairable structural and non-structural parts of the airplane can be repaired by patches, splice plates, insertions or replacements which are chiefly 24ST aluminum alloy sheet, extrusion, bar or tubing.

b. Patches other than the flush skin type and splice plates should be of the next heavier gage than the material being repaired.

c. Rivets used for repair should be of the same type, size and strength as those in the original construction in the vicinity of the repair.

d. Alclad may be substituted for aluminum alloy as outlined in Paragraph 12b(2) below.

e. Aluminum alloy parts are installed in the airplane in the heat treated condition (24ST) and repairs or replacements should conform with the heat treated properties of the original structure as outlined.

f. Bent up 24ST aluminum alloy of equal cross sectional area may be substituted for 24ST aluminum alloy extrusions.

5. INVESTIGATING DAMAGE.

a. Structural parts should be inspected for dents, cracks, holes, scratches, breaks, sharp corners and abrasions, loose, sheared or otherwise damaged rivet, elongated rivet holes, bowing, distortion, worn spots and corrosion. Dents and wrinkling in skin sheets should be inspected to insure that they are not stress wrinkles caused by failure of vital structure. Fabric surfaces should be checked for holes and tears.

6. CLASSIFICATION OF DAMAGE.

a. GENERAL.

(1) Damage to any of the component members of the airplane must be subjected to a careful examination to decide in which of the following categories it should be placed:

(a) Negligible Damage.
(b) Damage Repairable by Patching.
(c) Damage Repairable by Insertion.
(d) Damage Necessitating Replacement.

(2) In estimating the extent of damage especially when caused by shock, the surrounding parts must be carefully examined to insure that no damage remains unnoticed.

(3) The transmission of a severe force from one end of a strut or frame to the opposite end, for example, may cause a bolt or rivet hole to be distorted, plates to be bent, or rivets sheared even though they are a considerable distance from the point of impact.

b. DAMAGED RIVETS.-It is particularly important to check rivets closely. A rivet may be strained or its head sheared off, and the damage not be apparent. Rivets may stretch or fail, leaving the head intact. For instance, after straightening a bent member, all of the structure adjacent to it should be inspected for loose rivets. Always use a feeler gage when inspecting for damaged rivets. Also check carefully for elongated rivet holes.

c. EXCESSIVE PATCHING.-The fact that invisible hair size cracks in the skin will open up under vibration makes the patch repair of panels a procedure to be followed with extreme care and only after rigid inspection of the damage and the surrounding material. This type of repair, while one of the most common in the field where adequate repair facilities are not always available, should be resorted to except when required by the dictates of speed or economy. The damaged section should be replaced for best performance.

d. CORROSION.-Corrosion can not always be detected by visual examination, and any case in which the paint or enamel flakes off the parts when pressed should be immediately investigated. Corrosion is the resulting chemical reaction of metal when exposed to moisture. Corrosive action is aided by the presence of high temperature and humidity. Aluminum corrosion is detected by a white crystalline deposit, and will attack exposed material regardless of thickness. Dry aluminum will not corrode, and therefore a daily inspection of the lowest edges of the entire airplane should be made for moisture that has not drained away. (See General Manual for Structural Repair).

7. INSPECTION AFTER REPAIR.

a. Inspection should be made during each stage of repair before it becomes inaccessible. The repairs should be checked against the removed damaged section or duplicate structure.

b. Rigging check measurements with allowable tolerances against which the airplane should be checked after repairs are shown on Figure 127.

8. SUPPORT OF STRUCTURE DURING REPAIR.

a. The structure should be suitably and firmly supported during the repair of any major structural member so that repair work will not cause misalignment or distortion. If special trestles are not available, temporary supports such as wooden trestles or jigs should be made up for that purpose. Jig dimensions for the major structural assemblies are shown in conjunction with the various Sections of this Manual describing typical repairs.

b. Leveling lugs are located in the pilot's compartment. The lateral lugs are at the center of the rear bulkhead of the compartment and the longitudinal lugs are on the right hand wall near the floor. (See Figure 127).

9. REPAIR PROCEDURES.

a. GENERAL.-Repair personnel should be familiar with the following general procedures, in addition to the specific instructions for typical repairs to each of the component members of the airplane, as described in this Manual. The following instructions should apply to the repair of all damage:

(1) Smooth out all dents.
(2) Smooth out all shallow abrasions.
(3) Clean out all holes with 1/4 inch minimum radii in all corners.
(4) Cut out all jagged tears to form a smooth outline.
(5) Remove a minimum of material.
(6) Drill #40 (.098 inch) diameter holes at the ends of all cracks.
(7) Butt joints should fit snugly. A maximum of 1/64 (.0156 inch) is recommended.
(8) Repair material in contact with fabric doping should be protected by two coats of zinc chromate primer.

10. RIVETING.

a. IDENTIFICATION OF RIVETS.-The rivets used in this airplane are 17ST aluminum alloy (designation "D") identified by a raised tit on the center of the head. In making repairs, the A17ST aluminum alloy rivet (designation "AD") identified by a depression on the manufactured head, may be substituted for the 17ST in accordance with Paragraph 10b(3) below.

b. REPAIR RIVETS.

(1) When making repairs the same type of rivet should be used as in the surrounding structure.

(2) The type of rivets commonly used are:

(a) AN-425 (countersunk flat head).
(b) AN-430 (round head).
(c) AN-455 (mushroom - Brazier-head).
(d) G-29 (special Brazier - Grumman Standard).
(e) G-73 (countersunk - Grumman Standard).
(f) NAF-210988 (oval countersunk).

(3) SUBSTITUTION OF RIVETS.-A17ST rivets ("AD"), which can be driven as purchased without heat treatment, may be substituted for 17ST rivets ("D"), which require heat treatment before driving, for all repair rivets of 3/16 inch diameter or less. All repair rivets of 1/4 inch diameter or more, 17ST ("D"), must be heat treated before driving.

(4) BLIND RIVETS.-Pierced rivets may be used for the repair of lightly stressed parts where the interior is not readily accessible. Goodrich "Rivnuts" plugged with a steel plug, or equivalent may be used. Repairs which require blind rivets may be made on lightly stressed parts such as fairings and wing tip structure with these "Rivnuts" (3/16 inch dia.) or equivalent blind rivets. Wherever possible, it is recommended that some other method of repair be used, either making a removable patch (See Figure 110) or removing a sufficient portion of skin to permit access.

(5) RIVET SPACING.

(a) HULL.-The spacing of the hull rivets in the original construction is as follows and should be observed in making repairs:

1. Front Bottom - W.T. 3/4 O.C. 3/16" Dia. Rivets.

2. Front Bottom - N.W.T. 1-1/2 O.C. 3/16" Dia. Rivets.

3. Rear Bottom - W.T. 5/8 O.C. 5/32" Dia. Rivets.

4. Rear Bottom - N.W.T. 1-1/2 O.C. 5/32" Dia. Rivets.

5. Sides & Top - W.T. 1/2 O.C. 1/8" Dia. Rivets.

6. Skin Joints - Sides & Top 1/2 O.C. 1/8" Dia. Rivets.

7. Sides & Top - N.W.T. No Skin Joint 1 O.C. 1/8" Dia. Rivets.

NOTE

W.T. Watertight joints.
N.W.T. Non-watertight joints.

11. HEAT TREATMENT.

a. ALUMINUM ALLOY.-The 24ST aluminum alloy in the airplane is in a definite physical condition and will be adversely affected by the application of heat in making repairs. While aluminum alloy parts are installed in the heat treated condition, some are worked in the "O" or soft tempered condition when considerable forming is required. When 24ST aluminum alloy is available, replacements can be readily made if considerable forming is not required. If considerable forming is required, 24SO should be used and then heat treated to 24ST before installation. If 24SO is not available, 24ST can be annealed to the "O" or soft tempered conditions and then re-heat treated to the required strength (24ST). Refer to General Manual for Structural Repair, Section 5.

b. STEEL.-Most steel parts are heat treated. A list of these parts appears under Table I. All welded steel parts must be normalized.

c. RIVETS.-Heat treatment of 17ST (D) aluminum alloy rivets shall be in accordance with standard practice. (See General Manual for Structural Repair, Sections 5 and 6). They must be kept in a refrigerated state before driving. The A17ST(AD) rivets are in the hard temper condition and are driven cold.

12. WORKING METALS.

For additional data on working metals, See General Manual for Structural Repair.

a. ALUMINUM ALLOY.

(1) Aluminum alloy should be shaped with a soft hammer over hardwood forms.

(2) When shaping aluminum alloy by hammering or bending, the shape of the bend should be closely checked. A smaller radii than those recommended in General Manual for Structural Repair risks a possible crack in the material. The bend lines should not be pricked, punched or scratched into the surface of the sheet. Marring the sheet in such a manner makes early fatigue cracking possible.

(3) In marking aluminum alloy, a soft lead pencil should be used instead of tools such as a scratch-awl. Aluminum alloy surfaces should never be scratched or scraped except for bond clamps. Aluminum alloy parts should never be clamped in a vise without using aluminum or lead false jaws and the surface of the part and jaws should be cleaned before clamping in a vise.

(4) All of the adjacent structure should be inspected for loose rivets after straightening a

bent member.

b. ALCLAD.

(1) The instructions for working aluminum alloy (see above) in general apply to the working of Alclad. Note the warning against using a torch flame -- this deteriorates the aluminum protective coating of Alclad aluminum alloy by fusing it into the base metal and renders it susceptible to corrosion and reduces strength. Protection may be obtained by the use of asbestos when such structure is subject to heat conditions.

(2) If 24ST Alclad is substituted for 24ST aluminum alloy, use a thickness 20 percent greater. If 17ST Alclad is substituted for 17ST aluminum alloy, use thickness 10 percent greater.

(3) For heat treatment before or after forming, see Paragraph 11 above.

c. STAINLESS STEEL.-The straightening of stainless steel is aided by the use of a torch if the material is not heated beyond the dark red stage.

CAUTION

Protect adjacent aluminum structure from heat created by this procedure. Use asbestos; it is best to remove part during operation, if possible.

d. EXTRUDED SECTIONS.-For typical extruded sections, see Figure 106, showing dimensions and part numbers. If an extruded section is not available, a similar bent up section should be used.

13. WELDING.

a. GENERAL.-When making weld repairs, only those structural parts which were welded during manufacture should be repaired by welding. All welding should be done by experienced personnel in accordance with standard practice, and the welds should be similar to those originally made. All chrome molybdenum steel parts should be normalized after welding and heat treated as required. Welding repairs cannot be made unless qualified personnel and at least portable equipment is available; if not, re-welding should await servicing at a regularly equipped depot, or replacement should be made if available. Welded parts can sometimes be salvaged from other airplanes, and, if not damaged, can be used to replace a damaged welded section on the airplane being repaired.

b. SPOT WELDED STRUCTURE.

(1) GENERAL.

(a) In making repairs involving spot welds reference should be made to General Manual for Structural Repair.

(b) Spot welding is done by passing a very low voltage, high amperage current through two sheets of metal at a point where two specially formed, pointed electrodes (or irons) press the sheets together. The heat produced by the current flowing between the sheets of metal is sufficient to melt a portion of both sheets at the point of contact. This point of welded contact is known as the nugget. Figure 133 very clearly illustrates the shape and size relative to sheet metal thickness. The nugget reacts against shear loads in the same manner as a rivet.

(c) REMOVAL OF SPOT WELDS.-The removal of spot welded surfaces can be accomplished in the following procedures: Figure 131 illustrates the method used for shearing spot welds (or the nugget) between two pieces of metal. Note that instead of drilling holes the full size of the nugget, a clearance hole is drilled for the rivet size which would ordinarily be used. This does not completely remove the spot weld nugget as shown in operation No. 2, but if a chisel (see Figure 130) is used, and is inserted between the two sheets on the center line of the spot weld nugget and struck lightly with a hammer, the remainder of the nugget bond will break. This procedure permits all sheared spot welds to be riveted back as would normally be done for rivets.

NOTE

It has been found, if the chisel as shown in Figure 130 is not available, that a pocket jack-knife used in the same manner as for the chisel will shear a spot weld, but the rivet hole must be drilled first. Figure 132 illustrates the method to adopt in cases where the skin is to be discarded and at the same time save the under structure, which may be of lighter gage, from fracture. The spot weld is drilled the same as for the first method, except that a counterbore should be used with a depth gage as shown in Figure 132 operation No. 3, which will completely shear the nugget area, and thereby remove the spot weld bond between the two sheets. Refer to Figure 133 for proper bore size.

(d) SPOT WELD FAILURES.-In cases where spot weld fails and the skin separates from the structure leaving a button (or the nugget portion of the skin) on the framing member, the button should be milled off with the use of a counterbore as shown

in Figure 133. Then prepare a spacer of same gage as skin and install as shown in Figure 134. A washer should then be prepared; it should be at least six diameters of the rivet size with beveled edges and countersunk for rivet, all as shown and illustrated in Figure 134. If there are more than two spot weld failures at the same spot, or the breaks exceeding 3/8 inch diameter, the area in question should be prepared in the same manner as a complete break, using a flush patch procedure. In cases where spot welds fail or shear and there are no cracks or breaks visible on the spot weld dimples, the area of skin should be tapped with a hammer until the two surfaces have been brought solidly together. Figure 134 gives the necessary steps for riveting. If the area of sheared spot welds cannot be brought down so that the skin lays flat, the portion of skin should be removed and repaired in the same manner as for a complete skin break, using a flush patch procedure.

14. BONDING REPAIRS.

a. When replacing worn bondings, the proper treatment of the surface is of prime importance. At bonding connections, except where self-tapping screws are used, paint and anodic film should be removed in order to assure a metal-to-metal contact. No greater area should be bared than is essential for contact. However, the protective finish shall never be removed from any vital structural part of the airplane for bonding purposes; instead self-tapping screws should be used. In using these screws, the protective coating finish and/or anodize should not be removed from any surface, and no special preparation is necessary before bonding with these screws.

b. Copper bonding jumpers are used when it is necessary to attach the bonding jumper by soldering.

c. Bearing bolts are not used as connections for bonding jumpers since they might not be tight enough during normal surface operations to provide a good electrical connection. Self-tapping screws are not used where subject to frequent removal and replacement

15. REPLACEMENTS (STANDARD PARTS).

a. GENERAL.-All bolts, screws, bushings, fittings, castings and forgings should be replaced if damaged or bent unless otherwise noted. Reference should be made to Figure 135.

b. REPLACEMENT OF BOLTS.

(1) Bolts must be well fitted, and care must be taken to insure that the thread of any bolt is not in the bearing. For this reason, the unthreaded length of a replacement bolt must be the same length as that of the original bolt. When a bolt is used in conjunction with a bushing and no bearing load occurs on the bolt, the length of the unthreaded portion is not so important.

(2) Before replacing parts which are secured by bolts, examine the holes for elongations. Enlarged holes necessitate reaming for oversize bolts. If edge distance becomes critical, replacement is necessary.

c. REPLACEMENT OF NUTS, COTTERS.-If it is necessary to remove a nut which was originally locked by butting over the bolt end, the bolt must be replaced by a bolt of the same specification and diameter. When replacing bolts, care must be taken to insure that the nuts are locked in the same manner as the original bolt. Cotter pins should not be used twice.

d. REPLACEMENT OF SHEAR BUSHINGS.-Original shear bushings should not be used again after repair work.

16. FINISHES - REPAIR MATERIALS.

a. Repair material should be protected against corrosion. Aluminum alloy parts should be anodized if equipment is available, and then covered with one coat of zinc chromate primer as soon as possible. It is recommended that the parts be finished with two coats of primer and two coats of aluminized lacquer or equivalent to match surrounding structure.

b. Closed tubular or hollow steel parts should be filled with Par-al-ketone (See Appendix II) and drained.

c. Open tubular or hollow parts should be protected against corrosion by one coat of zinc chromate primer by filling and draining or by dipping.

17. MASS-BALANCING PROCEDURE.

a. In order to retain the proper mass-balance of the ailerons, elevators and rudder it is necessary to use the following procedure:

(1) The repair patches together with all rivets and fastenings should be weighed and the weight, correct to .01 lb. should be recorded in the log book. If any parts are removed, the net weight change should be recorded and marked as such.

(2) The distance in inches from the hinge line to the repair should be recorded in the log book as the "B" dimension. This will be either positive or negative as shown by the illustration.

(3) For each repair the product of the Weight times dimension "B" (in pound inches) should be

recorded in the log book.

(4) Only positive products as made in Paragraph (3) above necessitate a change in the leading edge weight. To calculate the weight to be added, divide the sum of the products found in Paragraph (3) above by the distance from the hinge line of the movable surface to the center of gravity of the weight to be added. In most cases the weight should be added as close to the leading edge of the surface as possible.

Typical mass-balance calculation:

Weight of patch and rivets	+.08#
Weight of material removed	-.01#
New weight added	+.07#
Weight of leading edge repair	+.02#
Weight of material removed	-.01#
Net weight added	+.01#

Now assume that the trailing edge repair was 12 inches aft (positive) of the hinge center line, and assume that the leading edge repair, was made three inches forward (negative) of the hinge center line.

Obtaining our moments by multiplying the net weight change by the arm to the hinge line we get:

$$+.07 \times 12 = +0.84$$
$$+.01 \times -3 = -0.03$$
$$+0.81 \text{ inch - pound}$$

Assume the weight is to be added six inches forward of the hinge center line. Then, weight to be added =

$$\text{Added weight} = \frac{0.81}{6} = .14 \text{ lb.}$$

NOTE

For mass-balancing diagram of ailerons, see Figure 118; elevators, Figure 119, and rudder, Figure 120.

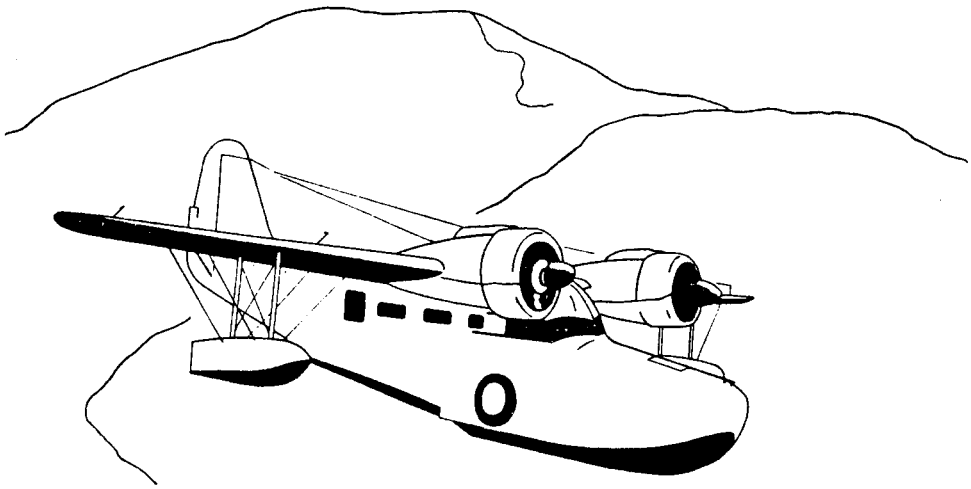

TABLE I

HEAT TREATED PARTS LIST

Part No.	Name	H. T. #/Sq. In.	Material
5332	Axle & Bushings - Tail Wheel	125,000	C.M. Steel
9602	Link - L. G. Lower Drag	150,000	C.M. Steel
9603	Link - L. G. Upper Drag	150,000	C.M. Steel
9607	Support Tube - L.G. Compression	200,000	C.M. Steel
9613-1	Pin - L.G. Counter-Balance	180,000	C.M. Steel
9613-4	Hinge Fitting - L.G. Counter-Balance	150,000	C.M. Steel
9613-7	Hinge Plate - L.G. Counter-Balance	150,000	C.M. Steel
9613-11	Tie Rod - L.G. Counter-Balance	150,000	C.M. Steel
12055	Bolt - Wing Attaching	150,000	Nickel Steel
12080	Fitting - Hull Sta. #11 - L.G. Drag Link	150,000	C.M. Steel
12081	Fitting - Hull Sta. #13 - L.G. Drag Link	150,000	C.M. Steel
12082	Fitting - Hull Sta. #13 - Front Wing Beam	125,000	C.M. Steel
12083	Fitting - Hull Sta. #16 - Rear Wing Beam	125,000	C.M. Steel
12096	Fitting - Sta. R.S. Weld.Assem. Sta. #36	125,000	C.M. Steel
12306-6	Fitting - Wing Gas Tank Rib	125,000	C.M. Steel
12307-1	Fitting - Bulkhead Sta. #30¼	125,000	Carbon Steel
12307-2	Fitting - Bulkhead Sta. #30¼	125,000	Carbon Steel
12308-1	Fitting - Bulkhead Sta. #85	125,000	Carbon Steel
12308-2	Fitting - Bulkhead Sta. #85	125,000	Carbon Steel
12317-9	Angle Splice Beam Wing	125,000	C.M. Steel
12317-10	Angle Splice Beam Wing	125,000	C.M. Steel
12317-11	Angle Splice Beam Wing	125,000	C.M. Steel
12317-12	Angle Splice Beam Wing	125,000	C.M. Steel
12351	Fitting - Wing Hoisting Sling	125,000	C.M. Steel
12361	Fittings - Nacelle Engine Mount	125,000	C.M. Steel
12458-11	Torque Stop - Ring Cowl	125,000	C.M. Steel
12458-13	Expansion Clip - Ring Cowl	65,000	C.M. Steel
12479	Clip - Engine Ring Cowl	125,000	C.M. Steel
12552	Fitting - Stabilizer Beam Attachment	125,000	C.M. Steel
12553	Reinforcement - Stab. Strut	125,000	C.M. Steel
12554	Fitting - Stab. Strut	125,000	C.M. Steel
12561-3	Strut End Stabilizer	125,000	C.M. Steel
12604	Link - Landing Gear Compression	150,000	C.M. Steel
12605	Torque Tube - Landing Gear	150,000	C.M. Steel
12633-1	Worm Gear - L.G. Retracting	125,000	C.M. Steel
12635	Bellcrank - Tail Wheel Ret. Mech.	125,000	C.M. Steel
12639	Link - Tail Wheel Ret. Mech.	125,000	C.M. Steel
12651	Caster - Tail Wheel	180,000	C.M. Steel
12652	Drag Link - Tail Wheel	125,000	C.M. Steel
12668	Plunger & Sleeve - T.W. Caster Lock	150,000	C.M. Steel
12713	Arm - Rudder Pedal Torque	125,000	C.M. Steel
12731-3	Trunnion - Control Wheel Shaft	125,000	C.M. Steel
12776-2	Stud - Drum Details	125,000	C.M. Steel
12776-3	Stud - Drum Details	125,000	C.M. Steel
12984	Shackle - Hoisting Sling	125,000	C.M. Steel
13605	Pull Rod - L.G. Handcrank Unit	150,000	C.M. Steel
13624	Pawl - Lg. Handcrank Unit	180,000	C.M. Steel
13625	Roller - Lg. Handcrank Unit	180,000	C.M. Steel
13633	Bolt - Lg. Handcrank Unit	125,000	C.M. Steel
13639	Stub Axle - Landing Gear	180,000	C.M. Steel
13640	Axle - Landing Gear (Machined)	165,000	C.M. Steel
13658	Ratchet - L.G. Handcrank	150,000	C.M. Steel
13660	Control Lever - L.G. Handcrank	125,000	C.M. Steel
13796	Fork - Wing Flap Cylinder	125,000	C.M. Steel

TABLE II

SEALANTS

Title	Navy Spec.	Manufacturer	Remarks
Vulcatex	Comm. 7204	A.C. Horn. Long Island City New York	Sealant, cabin and windshield.
Bostick	Comm. 292	B.B. Chemical Co. Cambridge, Mass.	Sealant, cabin and windshield.
PAW Tape		DuPont Fairfield, Conn.	A rubberized fabric tape used as a seal between riveted seams on amphibian hulls.
PAW Cement (Neoprene)	See Fairprene or Duprene	DuPont	A synthetic rubber cement used in conjunction with PAW Tape to seal cracks and seams; recommended for gas tight areas.
PAW Cement (Fairprene)	Comm. LC264		
PAW Cement (Duprene)	Comm. LC2696	DuPont	A synthetic rubber cement used in conjunction with PAW Tape to seal cracks and seams; recommended for watertight areas.
Zinc Chromate Compound - Type I	S-142, Class A Type I		A heavy putty-like compound used for sealing seams and openings over 1/8 inch in integral fuel tanks; hand applied. (Alt. extruded tape).
Zinc Chromate Compound - Type II	S-142, Class A Type II		Similar to Type I but lighter in consistency. Applied with a putty gun to seal cracks under 1/8 inch. (Alt. extruded tape).
Chromseal	Comm. LF19050	Pittsburg Plate Glass	A firm extruded zinc chromate tape used for sealing fuel tanks; .015, .032, .064 and 1/8. Gas tight and watertight.
Zinc Chromate Impregnated Tape	S-142, Class C Type VI		
Zinc Chromate Paste	Comm. Fuller's No. T-3908		Gas tight and watertight.
Zinc Chromate Slushing Compound	Fuller's No. T-L284-T-3864		Sealant for tanks.
Cotton Wicking	Comm.		Use with Neoprene cement, float watertight joints.
FINISH REMOVERS			
Lacquer Thinner Stripper	Comm.		For removing tank paint before welding.
Carbon-tetrachloride	Comm.		Tanks tinted primer remover; use before welding.

REF. NO	GRUMMAN PART NO	TITLE	SECTION
(1)	12001	HULL FRAMING ASSEM.	IV
(2)	12600	LANDING GEAR INSTAL.	V
(3)	12302	WING OUTER PANEL ASSEM.	II
(4)	13000	WING TIP FLOAT INSTAL.	II
(5)	12430	AILERON ASSEM.	II
(6)	12440	FLAP ASSEM.	II
(7)	12650	TAIL WHEEL INSTAL.	V
(8)	12532	STABILIZER ASSEM.	III
(9)	12301	WING CENTER SECTION ASSEM.	II
(10)	12360	WING CENTER SECTION NACELLE STRUCTURE	VI
(11)	12330	WING TO HULL CONNECTION ASSEM.	
(12)	12531	RUDDER ASSEM.	III
(13)	13557	RUDDER TAB ASSEM.	
(14)	12556	ELEVATOR TAB ASSEM.	
(15)	12530	ELEVATOR ASSEM.	II
(16)	—	PROPELLER	
(17)	12458	RING COWL	VI
(18)	13459	ENGINE EXHAUST MANIFOLD INSTAL.	VI
(19)	12270	ENGINE COWLING COMPARTMENT	VI
(20)	12455	ENGINE MOUNT ASSEM.	VI
(21)	12271	WING NACELLE REAR ASSEM.	VI

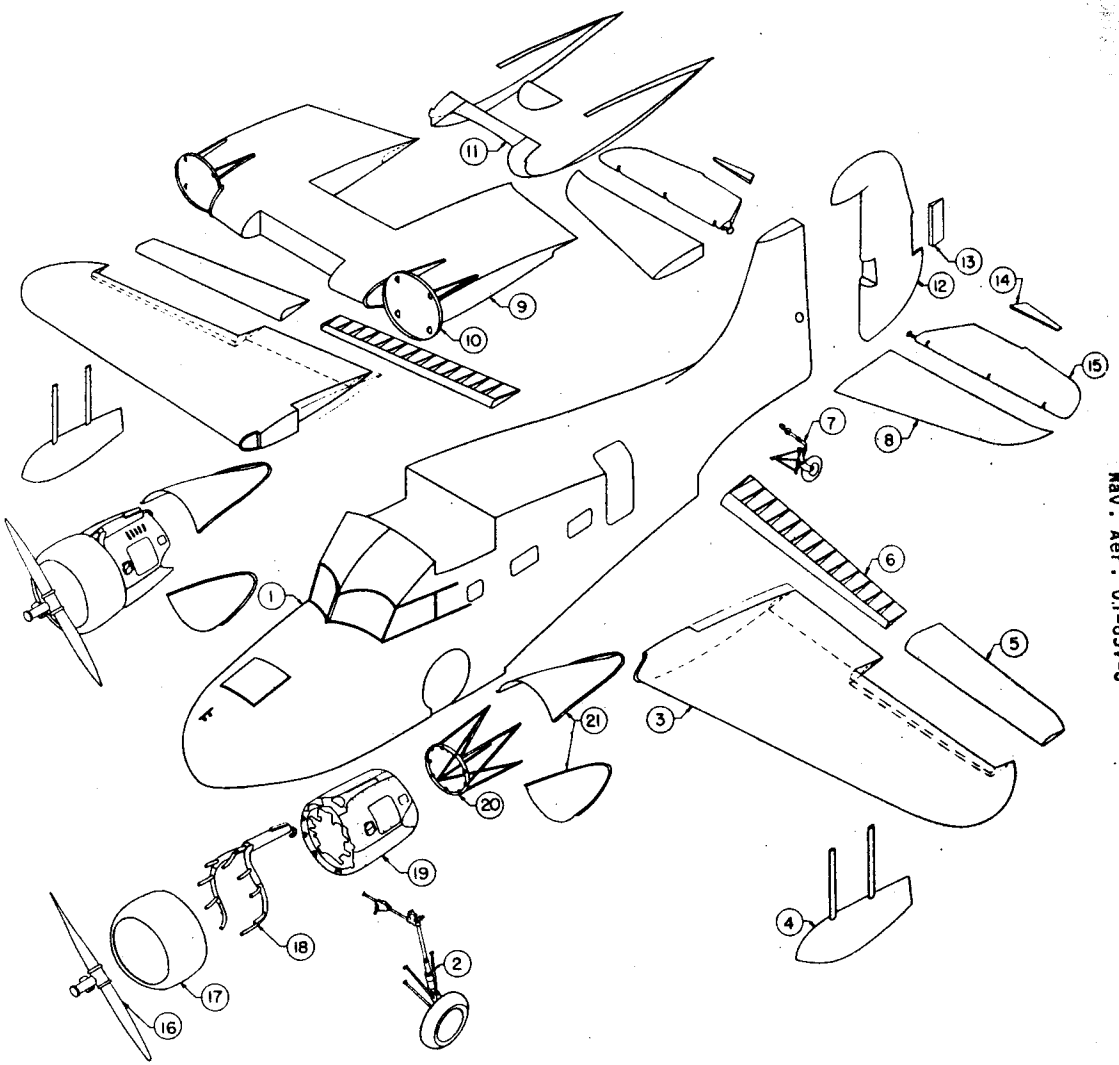

Figure 2 - Exploded View of Airplane

REF. NO	GRUMMAN PART NO	TITLE	SECTION
(1)	12001	HULL FRAMING ASSEM.	IV
(2)	12600	LANDING GEAR INSTAL.	V
(3)	12302	WING OUTER PANEL ASSEM.	II
(4)	13000	WING TIP FLOAT INSTAL.	II
(5)	12430	AILERON ASSEM.	II
(6)	12440	FLAP ASSEM.	II
(7)	12650	TAIL WHEEL INSTAL.	V
(8)	12532	STABILIZER ASSEM.	III
(9)	12301	WING CENTER SECTION ASSEM.	II
(10)	12360	WING CENTER SECTION NACELLE STRUCTURE	VI
(11)	12330	WING TO HULL CONNECTION ASSEM.	
(12)	12531	RUDDER ASSEM.	III
(13)	13557	RUDDER TAB ASSEM.	
(14)	12556	ELEVATOR TAB ASSEM.	
(15)	12530	ELEVATOR ASSEM.	II
(16)	—	PROPELLER	
(17)	12458	RING COWL	VI
(18)	13459	ENGINE EXHAUST MANIFOLD INSTAL.	VI
(19)	12270	ENGINE COWLING COMPARTMENT	VI
(20)	12455	ENGINE MOUNT ASSEM.	VI
(21)	12271	WING NACELLE REAR ASSEM.	VI

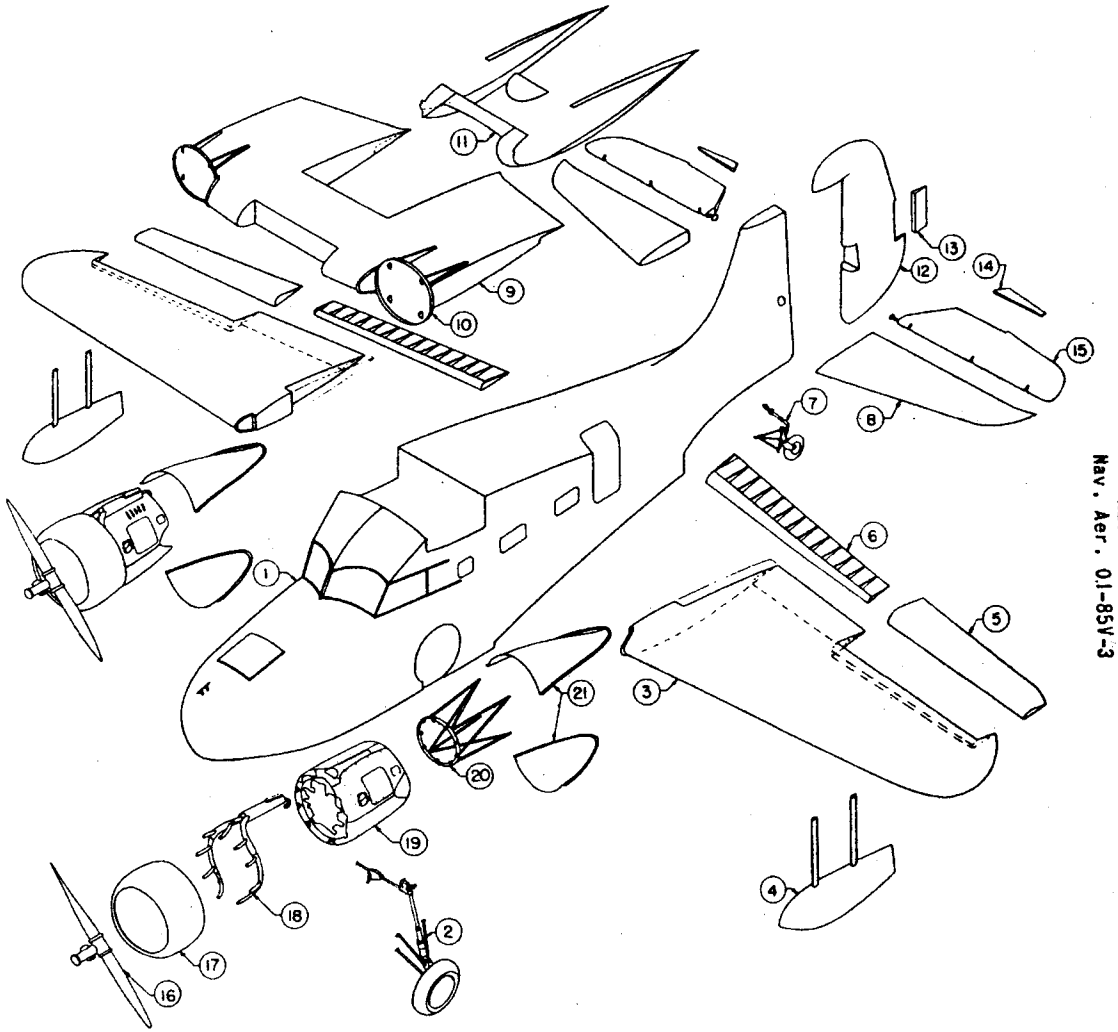

Figure 2 – Exploded View of Airplane

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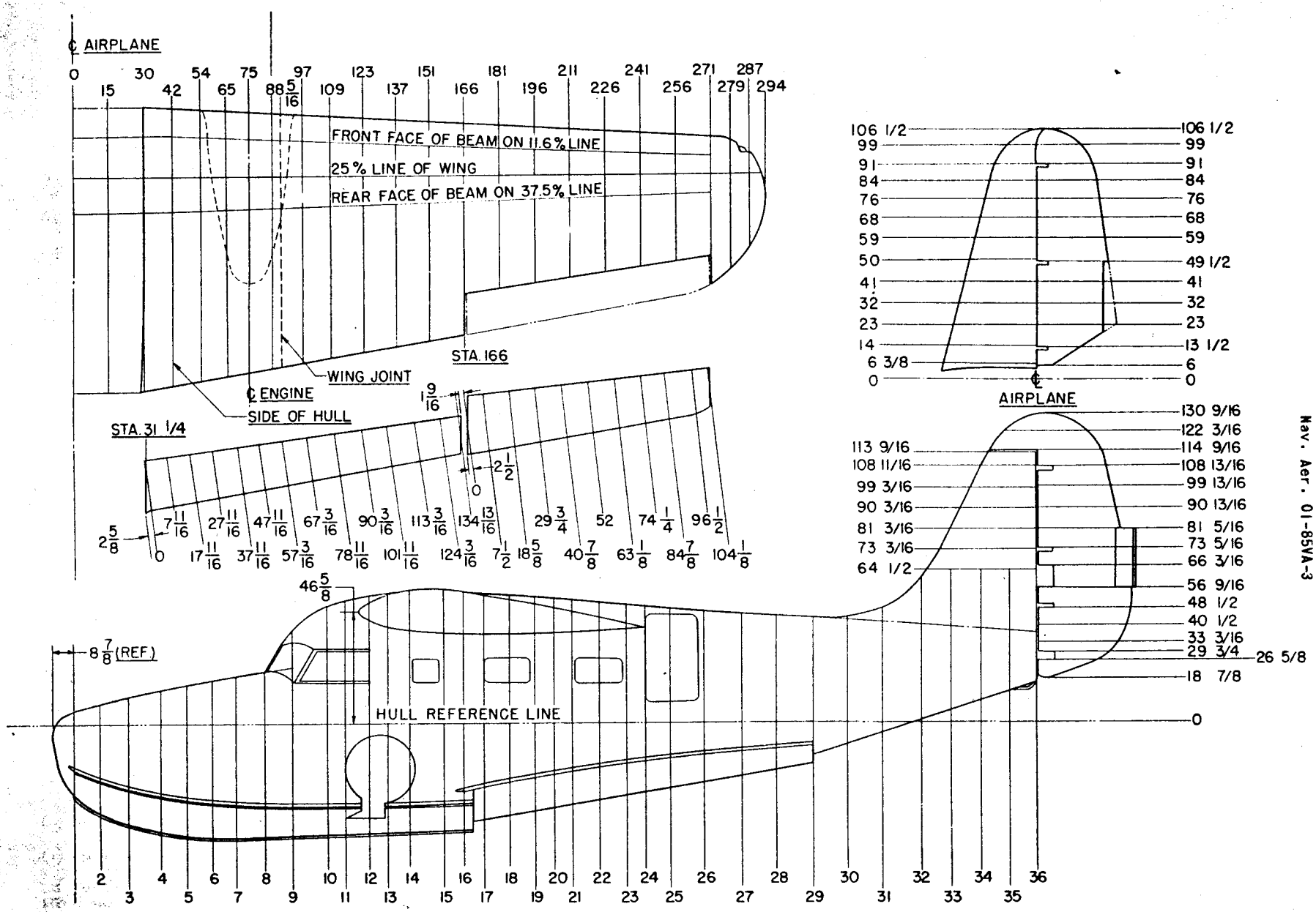

Figure 3 - Stations Diagram

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SECTION 2
WING GROUP

1. GENERAL.

a. The wing structure consists of two outer panels to which are attached the wing tip floats; the center section (which carries the engine nacelles and contains the built in fuel tanks) and the wing flaps and ailerons. The outer panels are covered with 24ST aluminum alloy sheets and fabric; the center section skin is 24ST aluminum alloy and includes gas tight joints in the fuel tank area.

b. The center section is attached at the box beam by eight vertically installed large diameter bolts at the points of intersection of the box beam sides and sides of the hull. The portions fore and aft of the box beam are permanently riveted to the hull by means of angle brackets and gap bands.

c. The outer wing panels are attached to the center section at the box beam by a series of vertically installed clevis bolts and horizontally installed hex head bolts and at the aileron support beam by a series of hex head bolts. The joint between the outer panel and the center section is covered by plates fastened in place by clevis bolts at the box beam and AN526 screws aft of the box beam. The center section and outer panels are built around a box beam.

d. The outer wing panel box beam jig is shown in Figure 12 and the center section box beam jig in Figure 23. The entire wing structure may be assembled and aligned as shown in Figure 24.

2. CLASSIFICATION OF DAMAGE.-Damage to any part of the wing structure should be carefully inspected to determine in which of the following categories it should be placed:

a. Negligible Damage.
b. Damage Repairable by Patching.
c. Damage Repairable by Insertion.
d. Damage Necessitating Replacement.

NOTE

If a slightly distorted structural member has been restored to shape and no cracks or abrasions have occurred, it should be reinforced the same as a damaged section repairable by patching, as material which has been distorted may not retain its original strength after being restored to shape even though there are no cracks or abrasions.

CAUTION

Special attention should be given inspection and repair of damage to structural members in areas at outer panel to C.S. and wing to fuselage attachment points, and in general, to box beams, fuel tanks and entire wing center section. Check carefully for misalignment. When extensive repairs or replacements are necessary, a jig may be required to assure alignment. To check alignment, refer to Figure 127.

WING CENTER SECTION.

3. GENERAL.-The wing center section is a box beam structure and includes nose, intermediate and trailing edge sections, made up of skin panels, web and truss type ribs, front and rear beams of the box beam structure, solid bulkheads and bulkheads with flanged lightening holes some of which serve as fuel tank baffle plates. See Figures 5 and 32. Special attention required for the repair of the gas tight fuel tank structure is described in Paragraph 92 below.

NOTE

Erection of the wing center section is ordinarily a factory job. If this section is extensively damaged, replacement with a spare section is advised. Repairs can be made readily if they are of a minor nature, and major repairs may be made with adequate equipment and experienced personnel available. Access to the interior for inspection and repair is usually most convenient by working from the bottom. If access is difficult, it may be possible to remove some damaged members for repair or replacement and then reinstall without impairing alignment of the section as described for these individual members below.

SKIN.

4. GENERAL.-The center section skin panels are noted in Figure 4.

5. NEGLIGIBLE DAMAGE.-Small, smooth isolated dents less than 1/16 inch deep, free from cracks,

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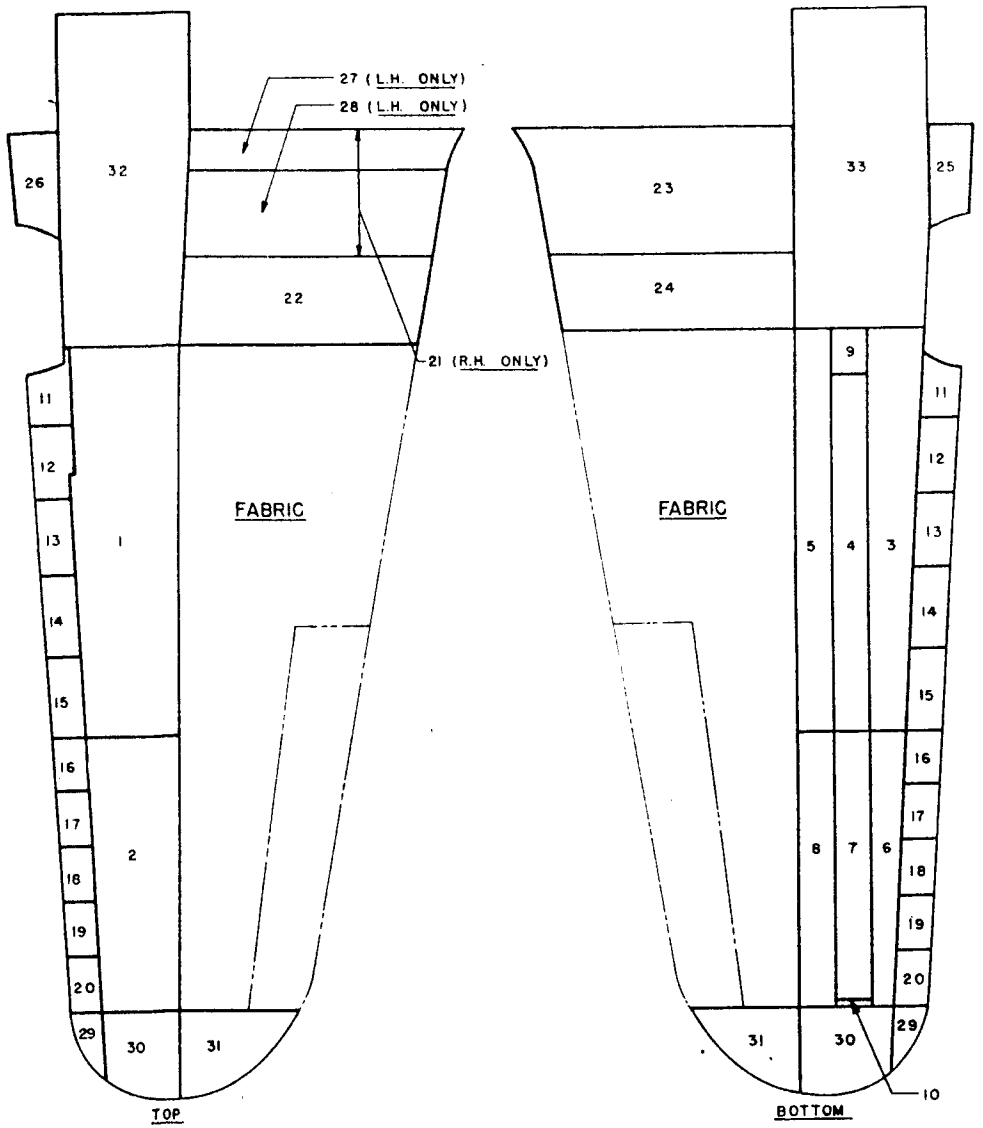

REF. NO.	NUMBER REQ'D	DESCRIPTION	THICK-NESS	SIZE
1	1L-1R	COVER-TOP OUTER	.051	32 X 110
2	1L-1R	COVER-TOP INBOARD	.040	26 X 80
3	1L-1R	COVER-BOT. INBOARD AFT	.051	14 X 110
4	1L-1R	COVER-BOT. INBOARD CENTER	.051	10 X 90
5	1L-1R	COVER-BOT. INBOARD REAR	.051	14 X 110
6	1L-1R	COVER-BOT. OUTBOARD FRONT	.040	14 X 80
7	1L-1R	COVER-BOT. OUTBOARD CENTER	.040	8 X 80
8	1L-1R	COVER-BOT. OUTBOARD REAR	.040	14 X 80
9	1L-1R	COVER-BOT. INBOARD END REAR	.051	10 X 24
10	1L-1R	COVER-BOT. OUTBOARD END REAR	.040	1 1/2 X 8
11	1L-1R	SKIN-NOSE	.028	24 X 30
12	1L-1R	SKIN-NOSE	.028	24 X 28
13	1L-1R	SKIN-NOSE	.028	24 X 25
14	1L-1R	SKIN-NOSE	.028	24 X 24
15	1L-1R	SKIN-NOSE	.028	24 X 23
16	1L-1R	SKIN-NOSE	.028	18 X 21
17	1L-1R	SKIN-NOSE	.028	18 X 20
18	1L-1R	SKIN-NOSE	.028	18 X 19
19	1L-1R	SKIN-NOSE	.028	18 X 18
20	1L-1R	SKIN-NOSE	.028	18 X 17
21	1R	COVER-INB. TOP	.028	36 X 80
22	1L-1R	COVER-OUT TOP	.028	22 X 72
23	1L-1R	COVER-INB. BOT	.020	36 X 56
24	1L-1R	COVER-OUT BOT.	.020	22 X 51
25	1L-1R	COVER-NOSE BOT.	.028	25 X 32
26	1L-1R	COVER-NOSE TOP	.028	15 X 32
27	1L	COVER-INB. TOP	.040	11 1/2 X 79
28	1L	COVER-INB. TOP	.028	23 5/8 X 77
29*	1L-1R	COVER-PIECE	.040	10 X 20
30*	1L-1R	COVER-PIECE	.040	20 X 26
31*	1L-1R	COVER-PIECE	.040	9 1/2 X 26
32	1	COVER-TOP	.064	35 X 178
33	1	COVER-BOTTOM	.064	35 X 180

NOTE:

ALL MATERIAL 24ST AL. ALLOY SHEET EXCEPT AS NOTED

*REF. NO. 29 - 52 S 1/4 H

*REF. NO. 30 - 52 S 1/4 H

*REF. NO. 31 - 52 S 1/4 H

Figure 4 - Wing Skin Plating Diagram

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sharp corners and abrasions may be neglected provided adjacent riveting is undisturbed and the damage has not affected the internal structure. Cracks outside the fuel tank covering may be neglected as noted in Figure 135.

6. DAMAGE REPAIRABLE BY PATCHING.-The center section skin outside the fuel tank structure may be repaired by patching as described in Paragraphs 99 - 103 below. Repair of the fuel tank skin is described in Paragraphs 88 - 93 below.

7. DAMAGE REPAIRABLE BY INSERTION.-The center section skin outside the fuel tank structure may be repaired by cutting out the damaged section, when the damage is too extensive to be repaired by patching, and inserting a new equivalent section of skin as shown in Figure 7. Insertion repair of fuel tank skin is described in Paragraph 89 below and shown in Figure 7. No insertion repair is recommended for the leading edge skin. (See next Paragraph below).

8. DAMAGE NECESSITATING REPLACEMENT.-Damaged panels not repairable as described above necessitate replacement with an equivalent undamaged section. If the fuel tank skin is involved, special reference should be made to Paragraphs 88 - 90 below.

BULKHEADS, SOLID AND BAFFLE PLATE TYPE.

9. GENERAL. - These members are part of the box beam structure and extend between the front and rear beams.

SOLID BULKHEADS.

10. GENERAL. - There are four solid gas tight bulkheads, one at each end of the box beam, Station #85 and two center ones spaced to divide the section into three compartments, (Station #31-1/4) the two outboard compartments being the left and right hand fuel tanks. The bulkhead web plating is riveted to a steel angle framework to which the box beam stringer attachment fittings are welded. The two outboard bulkheads form the outboard ends of the fuel tanks and support the outboard section of the engine nacelles.

NOTE

These bulkheads should be inspected for leaks, dents, cracks, holes and distortion. Serious damage may result from collision or abnormal landing; for example, if the outer panel strikes an object the center section end bulkheads may be distorted or otherwise damaged. The stringer attachment fittings welded to the frame should be checked for cracks and breaks.

WEB.

11. NEGLIGIBLE DAMAGE.-Dents less than 1/16 inch deep may be neglected as noted in Figure 135.

12. DAMAGE REPAIRABLE BY PATCHING.-The web may be repaired by cutting out the damaged area for damage more than negligible and riveting an outside patch of 24ST aluminum alloy sheet of the next heavier gage over the damaged area as shown in Figure 114. This patch must be sealed with zinc chromate paste. Patches should be placed on the side opposite the web stiffeners if damage to the web is in the way of these stiffeners. A single crack may be repaired by drilling a #40 (.098) hole at each end and covering with a similar patch as shown in Figures 8 and 114 while a severely cracked area should be cut out and patched as shown on these diagrams. Loose rivets should be drilled out and replaced by a rivet of the next larger diameter and of equivalent strength. A small hole up to 1/4 inch after smoothing out may be repaired by inserting a rivet. Coat all rivets before insertion with zinc chromate paste.

13. DAMAGE REPAIRABLE BY INSERTION.- Repair of the web by insertion is not recommended.

14. DAMAGE NECESSITATING REPLACEMENT.-Damage to the web not repairable by patching necessitates replacement with an equivalent undamaged section, riveting and installing gas tight joints as described in Paragraph 92 below.

ANGLES, STIFFENERS.

15. GENERAL.-The solid bulkheads are stiffened by attached sections as noted in Figures 8 and 10.

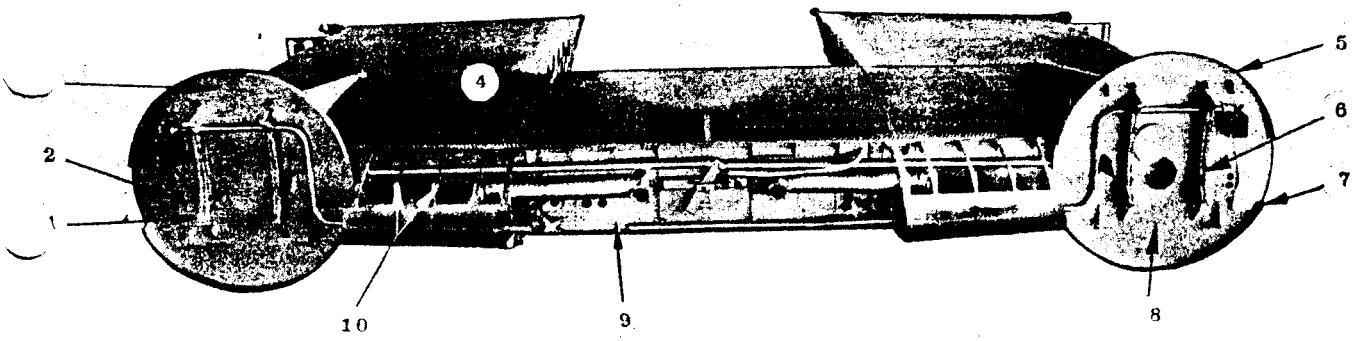
16. NEGLIGIBLE DAMAGE. - Dents, nicks and in general cleaned up damage less than 1/3 the depth of either leg as noted in Figure 135 may be classified as negligible, if the radius is not included in the damage.

17. DAMAGE NECESSITATING REPLACEMENT.-Stiffeners damaged more than negligible should be replaced by equivalent undamaged sections, observing gas tight precautions as described in Paragraph 92 below.

ANGLES - FRAME.

18. GENERAL. - The solid bulkheads include a mild carbon steel frame as noted in Figures 8 and 10.

19. NEGLIGIBLE DAMAGE.-Isolated nicks less than 1/8 inch deep should be smoothed out and may then be neglected if adjacent riveting is undisturbed and the cleaned out area is not less than one diameter from the adjacent rivets.



Ref. #	Grumman Part #	Description	Material	Thickness
1	12163	Cradle - Oil Tank Assembly		
	12463-7	Cradle	24ST Al. Alloy Sht.	.057
2	12360-32-33	Angle	24ST Al. Alloy Ext. #1288	.070
3	12360-14	Firewall	24ST Al. Alloy	.040
4		See Figures 4 & 6 for Skin Covering		
5	12360-22	Flange	52S½H Al. Alloy Sht.	.040
6	12360-19-20	Angle	24ST Al. Alloy Ext. #1288	.070
7	12360-21	Flange	52S½H Al. Alloy Sht.	.040
8	12360-18	Angle (rear side of firewall)	24ST Al. Alloy Ext. #472	
9		Box Beam	See Figure 10	
10		Nose Ribs	See Figure 10	

NOTE: All extrusions Alcoa.

Figure 5 - Wing Center Section Structure - Front View

20. DAMAGE REPAIRABLE BY WELDING.-Repair of the frame must be approached with caution. Cracks may be repaired by welding up the crack *provided the bulkhead is removed from the airplane, and the frame removed from the web.* A section of the frame damaged more than negligible can be cut out and a new equivalent piece welded in. Reheat the frame if any torch welding is done, or if the arc weld repair is more than 5/8 inch in length (125,000 p.s.i.).

21. DAMAGE NECESSITATING REPLACEMENT.-For damage more than negligible which cannot be repaired by welding as above, replacement of the frame with a spare is advised, observing precautions for gas tight joints as described in Paragraph 92 below.

When a solid bulkhead is removed for repair or replacement difficulty may be encountered in realigning it properly if the entire box beam structure has not been carefully aligned. (See Figure 12). Reinstall carefully and make sure the skin joints are secure, sealed and properly riveted. Skin repairs involved with these bulkheads are described in Paragraphs 88 - 90 below.

FITTINGS.

22. GENERAL.-The fittings by means of which the stringers are attached to the solid bulkheads are noted in Figures 8 and 10.

23. NEGLIGIBLE DAMAGE.-See Figure 135.

24. DAMAGE NECESSITATING REPLACEMENT.-These members should be replaced with undamaged equivalents if damaged more than negligible.

NOTE

Welding of cracks is not recommended.

LIGHTENING HOLE BULKHEADS.

25. GENERAL.-In general, there are two types of bulkheads with lightening holes both types being part of the fuel tank structure in which they serve as baffle plates. One type has bent up flanges notched for the stringers; one each is located in each tank and serves to support the engine nacelles, while one is located in the center compartment. These members are riveted to the skin and the stringers. The other type bulkhead is attached to the stringers and does not come in contact with the skin.

NOTE

These members should be inspected for leaks, dents, cracks, holes distortion and loose rivets. Damage to the skin will usually be involved in damage to flanges of the bulkheads to which the skin is riveted; damage to the stringers will usually be involved in damage to the attached angles of the other bulkheads. Damage to the web will usually involve the lightening holes.

WEB AND FLANGE.

26. NEGLIGIBLE DAMAGE.-Dents less than 1/16 inch deep and cracks may be neglected in accord-

ance with Figure 135; also isolated holes in the web less than one inch in diameter after cleaning out may be neglected if more than one inch from a lightening hole, stiffener or radius, and provided such holes are more than four diameters on centers from any similar hole. Isolated nicks in the free edges of the flanges less than 1/8 inch deep may be neglected after smoothing out if riveting is undisturbed and no other damage is involved.

27. DAMAGE REPAIRABLE BY PATCHING.-Damage to bent up flanges may be repaired by a flat plate for damage up to 1/2 the width of the flange and for damage more than 1/2 the width by an angle patch of bent up 24ST aluminum alloy sheet of the next heavier gage as shown in Figure 9. Damage to the web may be repaired by cutting out the damaged area and riveting a patch as noted in Figure 9. A cracked lightening hole may be repaired by drilling a #40 (.098) hole at the end of the crack and patching as shown in Figure 115. Patches should be placed on the side most convenient for fitting the patch. The lightening holes must not be covered with a patch that fills up the hole in the baffle plates. Combined damage to the flange and web may be repaired by a bent up angle patch as shown in Figure 9. If the damage is confined to the web and is in the way of a lightening hole a flat patch may be used as shown. Damage to the web not in the way of a lightening hole may be patched as noted in Figure 9 and shown in Figure 114. Skin joints must be gas tight as outlined in Paragraph 92 below.

28. DAMAGE REPAIRABLE BY INSERTION.-Damage to the web and/or flange which cannot be repaired by patching may be repaired by cutting off the damaged section and inserting a new equivalent section, using a splice plate as shown in Figure 9. The butt joint should be made between lightening holes so that the splice plate will not be in their way. Skin must be watertight as outlined in Paragraph 92 below.

29. DAMAGE NECESSITATING REPLACEMENT.-Damage not repairable as above necessitates replacement of the bulkhead with an equivalent undamaged section observing gas tight precautions as noted in Paragraph 92 below.

NOTE

Damage to the partial bulkheads in the center compartment may be repaired the same as the other bulkheads except that lightening holes will not be involved.

STIFFENERS.

30. GENERAL.-These bulkheads are stiffened by vertical and horizontal angles as noted in Figures 9 and 10.

31. NEGLIGIBLE DAMAGE.-Isolated nicks less than 1/8 inch deep after smoothing out may be neglected if riveting is undisturbed as noted in Figure 135.

32. DAMAGE REPAIRABLE BY PATCHING.-Damage up to 1/2 the width of the free leg may be repaired by a flat plate and up to the full width by a bent up angle patch as noted in Figure 9 provided the damage is so located as to permit room for a patch repair.

33. DAMAGE NECESSITATING REPLACEMENT.-If the damage is not repairable by patching replacement with an equivalent undamaged member is recommended. If the attached leg is damaged more than negligible, the member can be more readily replaced than patched.

CENTER SECTION BOX BEAM.

34. GENERAL.-The center section box beam structure is built up of front and rear beam plates, bulkheads and stringers. (See Figure 10). The plates are stiffened by top and bottom Alcoa extruded angles, (capstrips or corner angles) and vertical stiffeners. The plates form the forward and aft walls of the fuel tanks. Repair of the skin, bulkheads and stringers is described under the appropriate paragraph headings in this Section.

NOTE

The beam should be checked for leaks in the fuel tank area, disturbed riveting, cracks, dents, holes, breaks and distortion. In general, damage can be classified as minor, such as leaks, cracks and perforations; and major damage such as distortion, holes and complete fractures. In repair of the beam, it must be assured that the gas tight qualities are maintained, and reference should be made to Paragraph 92 below.

When access can be gained, repairs to the beam may be made with the center section installed if the beam is not disturbed. Extensive damage will probably involve extensive damage to the box beam or entire center section, in which case rebuilding of the section involving the use of jigs or replacement with a spare is indicated.

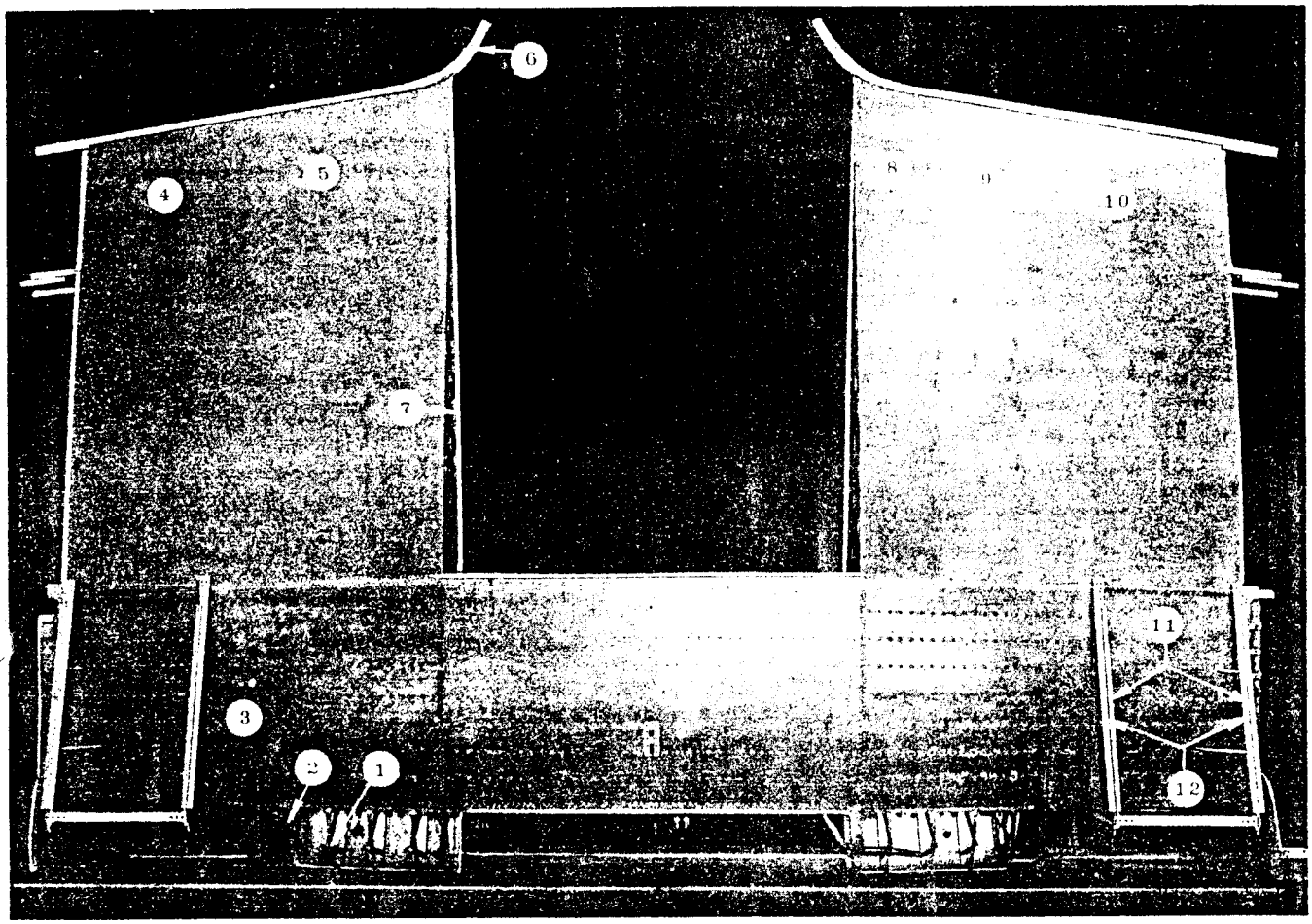
WEB.

35. NEGLIGIBLE DAMAGE.-Isolated dents less than 1/16 inch deep free from cracks, sharp corners and abrasions may be neglected if riveting is undisturbed, the section is not distorted and no other damage other than scores exists as noted on Figure 135.

36. DAMAGE REPAIRABLE BY PATCHING.

a. Damage up to 1/2 the width of the web can be repaired by cutting out the damaged area, and patching with a circular 24ST aluminum alloy plate of the next heavier gage as shown in Figure 13, provided there is room to fit the patch over the trimmed area. Patch plates may be placed on either side of the web, depending on convenience, using packing strips when required as noted in Figure 13. Patches should be sealed.

b. Vertical stiffeners in way of the patch should be removed and if undamaged or damaged a neg-



Ref. #	Grumman Part #	Description	Material	Thickness
1	12321-1	Nose Rib	24ST Al. Alloy Sht.	.051
2	12327	Nose Rib	24ST Al. Alloy Sht.	.051
3	12303-29	Cover Top	24ST Al. Alloy Sht.	.064
4	12301-2	Cover - Outb'd Top	24ST Al. Alloy Sht.	.028
5	12301-1	Cover Top	24ST Al. Alloy Sht.	.028
6	385-1	Trailing Edge	24ST Al. Alloy Ext. K-14403	
7	12321	Rib Intermediate Assembly		
	12321-1	Rib	24ST Al. Alloy Sht.	.028
	12321-2 to -6	Vertical Stiffeners	24ST Al. Alloy Sht.	.051
	12321-9	Bottom Sheet Angle	24ST Al. Alloy Ext. 5456	
8	12301-50	Cover Top	24ST Al. Alloy Sht.	.040
9	12301-51	Cover Top	24ST Al. Alloy Sht.	.028
10	12301-2	Cover Top	24ST Al. Alloy Sht.	.020
	12301-4	Cover Bot.	24ST Al. Alloy Sht.	.020
11	12360-3-4	Reinforcement	24ST Al. Alloy Sht.	.064
12	12360-1-2	"Z" Member	24ST Al. Alloy Sht.	.064

NOTE: All extrusions Alcoa.

Figure 6 - Wing Center Section Structure - Top View

ligible amount as noted in Paragraph 40 below, reinstalled after the web is repaired.

37. DAMAGE REPAIRABLE BY INSERTION.-If a patch cannot be fitted or if the damage is more than 1/2 the width of the web, an insertion repair may be made. The damaged section of the web should be cut off between ribs and a new equivalent section should be inserted, using splice plates at the butt joint and riveting in accordance with Figure 13. The splice plate should be placed on the inside of the web and should be sealed. Web sections must follow the contours of the original structure as shown in Figure 15.

38. DAMAGE NECESSITATING REPLACEMENT.-If the web cannot be repaired as described above, it must be replaced with an equivalent undamaged section and should follow the contours of the original structure as shown in Figure 15.

STIFFENERS.

39. GENERAL.-The web is stiffened by attached angles. (See Figures 10 and 13).

40. NEGLIGIBLE DAMAGE.-Isolated nicks as shown in Figure 135 may be neglected.

41. DAMAGE NECESSITATING REPLACEMENT.-For damage more than negligible it is recommended that these stiffeners be replaced with equivalent undamaged members.

CORNER ANGLES (CAPSTRIPS).

42. GENERAL.-The box beam webs are stiffened by top and bottom angles, or capstrips, as shown in Figures 10 and 14.

43. NEGLIGIBLE DAMAGE.-Isolated nicks and scores may be neglected as noted in Figure 135 if no other damage exists.

44. DAMAGE REPAIRABLE BY PATCHING.-Damage up to 1/2 the cross sectional area of these members may be repaired by cutting out the damaged area between bulkheads and repairing by patching as shown in Figure 14. Note that joints must be sealed.

45. DAMAGE REPAIRABLE BY INSERTION.-Damage which cannot be repaired by patching may be repaired by cutting out the damaged area and inserting a new equivalent section as shown in Figure 14. Note that joints must be sealed.

46. DAMAGE NECESSITATING REPLACEMENT.-The capstrip must be replaced with an equivalent undamaged member if damage cannot be repaired as above, and must be gas tight as in the original construction.

STRINGERS - BOX BEAM.

47. GENERAL.-The box beam is stiffened longitudinally by Alcoa extruded "Zee" section stringers. The stringers are attached to the bulkheads by means of angles riveted to the stringers and bulkhead webs. (See Figures 10 and 11). The skin is riveted to the stringers, using NAF210988-6 rivets.

48. NEGLIGIBLE DAMAGE.-Isolated nicks less than 1/8 inch deep after smoothing out in the free edges of the flanges and scores confined to a single face of a section may be neglected as noted in Figure 135, if adjacent riveting is undisturbed and no other damage is involved.

49. DAMAGE REPAIRABLE BY PATCHING.

a. Broken, cracked or otherwise damaged areas should be cut away, keeping 1/4 inch minimum radius. Damaged areas should be straightened if necessary to allow the patch to seat properly. These members must be kept straight as in the original construction. Unless the box beam structure is severely distorted, individual stringers may be repaired in the airplane, or removed for repair and reinstalled, depending on convenience of access. A patch repair in an undistorted structure may generally be made conveniently in the airplane.

b. Damage to the skin or bulkheads will generally be involved in damage to the stringers.

c. Damage up to 1/2 the cross sectional area may be repaired by cleaning out the damaged area and patching with a 24ST aluminum alloy repair plate as shown in Figure 17. Patches generally can be fitted either between bulkhead attachments or in the way of these attachments except at the solid bulkheads as shown in Figure 17. If the damage is too close to the end of a stringer to permit fitting a patch, the stringer should be cut off at a point far enough to permit an insertion repair splice plate as described below.

d. Repairs must be gas tight as noted in Figure 17.

50. DAMAGE REPAIRABLE BY INSERTION.-Damage more extensive than that repairable by patching may be repaired by cutting out the damaged area between bulkheads, leaving clean, smooth edges, and inserting a new equivalent section which must fit snugly against the adjacent undamaged section. The repair plates should be the length, shape and riveted as shown in Figure 17.

51. DAMAGE NECESSITATING REPLACEMENT.-Damage not repairable as described above necessitates replacement with an equivalent undamaged member

which must be gas tight as in the original construction.

STRINGERS.

AFT OF BEAM.

52. GENERAL.-The stringers in the intermediate section just aft of the box beam are channel sections as noted in Figure 18. The trailing edge section stringers are short "Zee" sections attached to the tail ribs by means of small angle clips. (See Figure 18).

53. NEGLIGIBLE DAMAGE.-Small smooth isolated dents in the web less than 1/16 inch deep may be neglected as noted in Figure 135, and smoothed out holes whose diameter is less than 1/4 the width of the web may be neglected if less than four diameters on centers from any similar hole and do not involve the radius of the flange. Isolated nicks in the free edges of the flanges less than 1/8 inch deep after smoothing out may be neglected as noted in Figure 135 if riveting is undisturbed;cracks may be neglected as noted in Figure 135.

54. DAMAGE REPAIRABLE BY PATCHING.-Damage up to 1/2 the cross sectional area of the channel sections may be repaired by a patch shaped in accordance with Figure 83, Sheet 5, and riveted in accordance with Figure 83, Sheet 6, provided there is room to fit the patch. Damage up to 1/2 the cross sectional area of the "Zee" section stringer may be repaired by a patch shaped in accordance with Figure 83, Sheet 2, and riveted according to Figure 83, Sheet 6, if there is room to fit the patch.

55. DAMAGE NECESSITATING REPLACEMENT.-If the channel or "Zee" stringers cannot be repaired by patching they should be replaced with equivalent undamaged members.

NOSE RIBS.

56. GENERAL.-The nose ribs of the center section are truss and web type as shown in Figure 32.

57. NEGLIGIBLE DAMAGE.-See Paragraph 141 below.

58. METHOD OF REPAIR.- See Paragraphs 142 and 143 below.

TRUSS TYPE RIBS.

59. GENERAL. - The intermediate structure of the center section includes truss type ribs comprising angle section diagonals and capstrips. (See Figures 18 and 32). They are attached to the rear box beam plate and the wing flap support beam. The skin is riveted to the upper and lower members.

60. NEGLIGIBLE DAMAGE.-Isolated nicks in the capstrips and diagonals less than 1/8 inch after smoothing out, and dents less than 1/16 inch may be neglected if riveting is not disturbed, the section is undistorted and no other damage such as cracks or abrasions exists. Damage up to 1/3 the width of either leg of the diagonals may be neglected after smoothing out if such damage occurs in isolated instances. (See Figure 135).

61. DAMAGE REPAIRABLE BY PATCHING. - Damage to the capstrips, diagonals or braces up to 1/2 the cross sectional area may be repaired by patching as shown in Figure 19, if there is room to fit the patch.

62. DAMAGE REPAIRABLE BY INSERTION. - For damage to the capstrips more extensive than that repairable by patching, a new equivalent section may be inserted to replace a removed damaged portion, using splice plate as shown on Figure 19. No repair by insertion is recommended for diagonals or vertical braces.

63. DAMAGE NECESSITATING REPLACEMENT.-Damage not repairable as described above necessitates replacement with an equivalent undamaged member.

WEB TYPE RIBS.

64. GENERAL.-There are four web type ribs stiffened by flanged lightening holes in the intermediate section of the wing center section. They extend from the rear box beam plate to which they are attached, two aft to the trailing edge and two aft to the wing flap support beam. (See Figures 18 and 32).

65. NEGLIGIBLE DAMAGE.-Small smooth isolated dents less than 1/16 inch deep, and smoothed out nicks in the bent up flanges less than 1/8 inch deep after cleaning out may be neglected provided adjacent riveting is undisturbed and the section is not distorted and no other damage exists. Isolated holes up to 1/2 inch in diameter after smoothing out may be neglected if more than one inch from a lightening hole, stiffeners or radius of the flange and more than four diameters on centers from any similar hole. Isolated nicks in either leg of attached stiffeners less than 1/8 inch deep after smoothing out may be neglected. Cracks may be neglected after drilling in accordance with Figure 135.

66. DAMAGE REPAIRABLE BY PATCHING.-If a cracked lightening hole is involved, reference should be made to Figure 115. For more than negligible damage a small angle patch as shown in Figure 20 may be used to repair damage to the flange and web and a larger patch may be used for more extensive damage extending into the web. Web patches in the way

of lightening holes either should be trimmed to suit the hole, or the lightening hole flange removed and a stiffener riveted over the patch as shown in Figure 20. The patch should be placed on the side most convenient for fitting the patch. It is recommended that the small angle patch for damage to the flange be placed on the rib as shown in Figure 20 and web patches on the opposite side as shown.

67. DAMAGE REPAIRABLE BY INSERTION.-If the damage cannot be repaired by patching as described above, the damaged area may be cut out and a new equivalent section inserted, using a splice plate as shown in Figure 20 and observing the same procedure for the installation of a web patch as described above.

68. DAMAGE NECESSITATING REPLACEMENT.-If the damage cannot be repaired by patching or insertion the damaged rib should be replaced with an equivalent undamaged member.

TAIL RIBS.

69. GENERAL.-The tail ribs are the solid web type and extend from the wing flap support beam aft to the trailing edge. They are similar to the tail ribs in the outer panel.

70. NEGLIGIBLE DAMAGE.-See Paragraph 145 below.

71. DAMAGE REPAIRABLE BY PATCHING.-See Paragraph 146 below.

72. DAMAGE REPAIRABLE BY INSERTION.-See Paragraph 147 below.

73. DAMAGE NECESSITATING REPLACEMENT.-See Paragraph 148 below.

WING FLAP SUPPORT BEAM.

74. GENERAL.-This structure forms the aft portion of the wing center section intermediate section and is spliced to a similar beam extending into the outer panel.

75. NEGLIGIBLE DAMAGE.-See Paragraph 155 below.

76. DAMAGE REPAIRABLE BY PATCHING.-See Paragraph 156 below.

77. DAMAGE REPAIRABLE BY INSERTION.- See Paragraph 157 below.

78. DAMAGE NECESSITATING REPLACEMENT.-See Paragraph 158 below.

TRAILING EDGE.

79. NEGLIGIBLE DAMAGE.-See Paragraph 150 below.

80. DAMAGE REPAIRABLE BY PATCHING.-See Paragraph 151 below.

81. DAMAGE REPAIRABLE BY INSERTION.-See Paragraph 152 below.

82. DAMAGE NECESSITATING REPLACEMENT.-See Paragraph 153 below.

FUEL TANKS.

83. GENERAL.-The left and right fuel tanks are an integral part of the wing center section. The structure includes the box beam, bulkheads, baffle plates, stringers and skin (See Figures 5, 7 and 10). All joints in the fuel tank structure are sealed gas tight with Fairprene tape and Fairprene cement. (See Table II and Figure 107).

CAUTION

No repairs should be made to the fuel tank structure unless the tanks have been drained of fuel and fuel vapors removed to prevent explosion and damage to the tanks and possible injury to personnel.

84. ESTIMATION OF DAMAGE.-The fuel tank structure should be inspected for leaks, dents, cracks, holes, loose rivets, and distortion. Negligible damage to the individual members of the fuel tank structure is described under the appropriate Paragraph headings above in this Section.

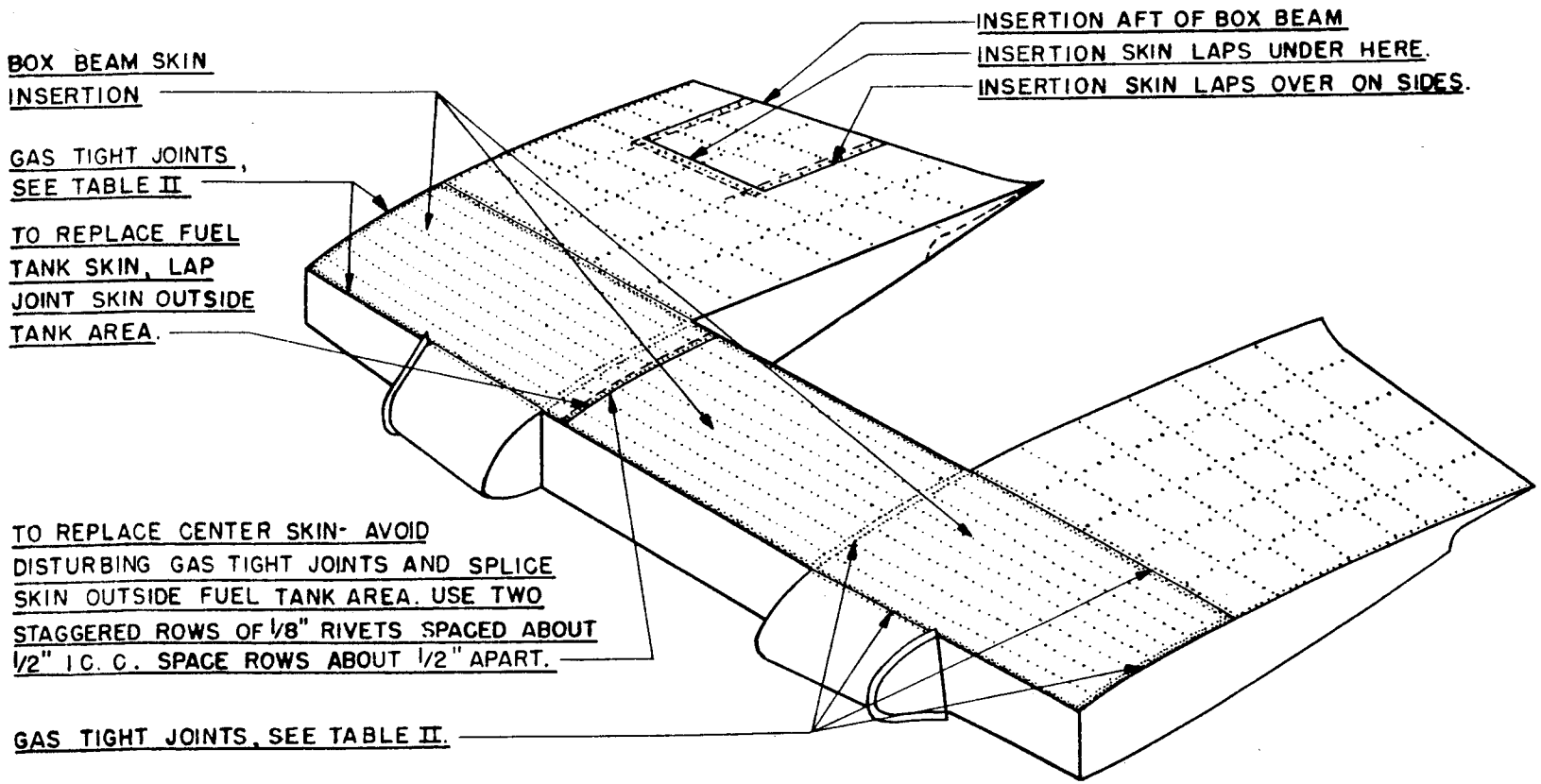
85. TESTING FOR LEAKS.-To test for leaks, the fuel tanks must be pressure tested, using three and one-half to four p.s.i. If the tanks are empty, the fuel outlets must be plugged. When repairs have been made, the outside of the repaired area should be covered with soap suds and inspected for leaks. If the pressure drops and no leaks are apparent in the repaired area, soap suds should be applied over the entire tank. All the seams on the skin surface should be soaped and the pressure reapplied. If a small leak is prevalent, a large soap bubble will appear at the point of a break in the seam. A large leak will be indicated by the soap bubbles being forced along the surface.

86. METHOD OF REPAIR.

NOTE

Before the fuel tank structure is repaired, the tanks must be drained and purged of fuel vapors as described in Paragraph 93 below. All repairs to the fuel tank structure must be gas tight as in the original construction. (See Paragraphs 91 and 92 below).

a. GENERAL.-The repair of the individual members of the fuel tank structure is described under the appropriate Paragraph headings above in



NOTE:

FOR SKIN PATCH REPAIR - SEE FIG. 108, 109, 111 & 112.

Figure 7 - Wing Center Section Skin Insertion Repair

.0937
.0810
.1747

.081 + 3/32 .0937

12306

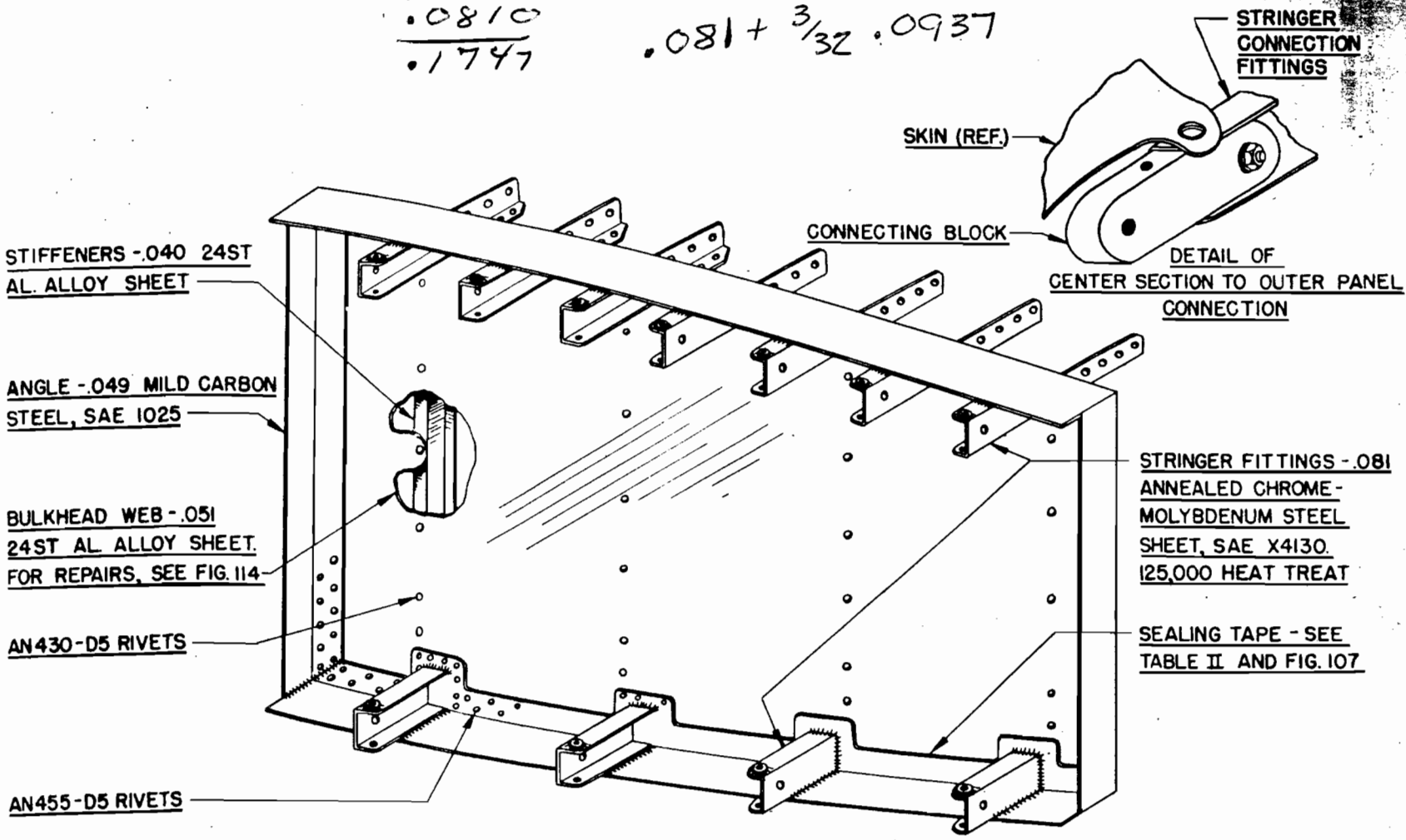


Figure 8 - Wing Center Section Solid Bulkhead Repairs

this Section, with the exception of the fuel tank skin which is described in Paragraphs 87 to 90 below, and patching of the skin outside the fuel tank area, which is described in Paragraph 101 below.

b. LEAKS.

(1) For other than extensive damage, repair of the fuel tanks will be concerned generally with testing and repairing leaks. If the structure is misaligned, leaks will result; for example, if the tank bulkheads are misaligned, a strain on the structure will loosen joints with resultant leakage. When skin rivets are not treated as described in Paragraph 88a below, leaks may be encountered. Metal particles which become entrapped in joints as a result of drilling may seriously affect the leak-proof qualities of the fuel tank structure.

(2) In general, when a leak develops around a rivet, the rivet should be drilled out and a new equivalent rivet thoroughly covered with leak-proof cement inserted. When a leak develops along a joint, the rivets must be drilled out and a new piece of leak-proof tape covered with cement should be inserted in the joints and new equivalent rivets with shanks covered with cement as in the original construction should be inserted (See Paragraph 92 below).

SKIN.

87. NEGLIGIBLE DAMAGE.-See Paragraph 5 above.

88. DAMAGE REPAIRABLE BY PATCHING.

a. Isolated cracks up to one inch in length may be repaired by drilling a #40 (.098) hole at the ends and patching with a sealed patch as described below in this Paragraph. Cracked areas may be cut out and repaired with a sealed patch as shown in Figure 112. Holes in the skin 1/4 inch in diameter or less after cleaning out may be repaired by inserting a rivet treated with leak-proof cement into the hole.

b. Larger holes may be repaired by cutting out the damaged area and making a patch repair. A flush type or an outside patch may be used. Preparation of these patches is described in Paragraph 101 below, and shown in Figures 108, 109, 111. When using the flush type patch it may be necessary to insert the frame between the stringers and the patch. This may disturb the adjacent riveting and result in leaks; therefore, unless this can be avoided, an outside patch may be more convenient for this repair of the fuel tank skin. Patches must be sealed gas tight.

89. DAMAGE REPAIRABLE BY INSERTION.-If the fuel tank skin cannot be repaired by patching as described above, a partial panel may be inserted by removing the entire fuel tank panel all the way to the skin outside the fuel tank area as noted in Figure 7, and making a lap skin joint outside the fuel tank area.

90. DAMAGE NECESSITATING REPLACEMENT.-Since the fuel tank skin must be entirely removed to adjacent skin, the insertion repair described in the Paragraph above constitutes replacement of the fuel tank skin.

NOTE

When patching or replacing fuel tank skin panels, care should be taken not to disturb riveting. Special care must be taken with the double row of skin rivets at the fuel tank bulkheads. If it is necessary to drill out these rivets, first drill out every fourth rivet and insert screws to hold the skin down.

CAUTION

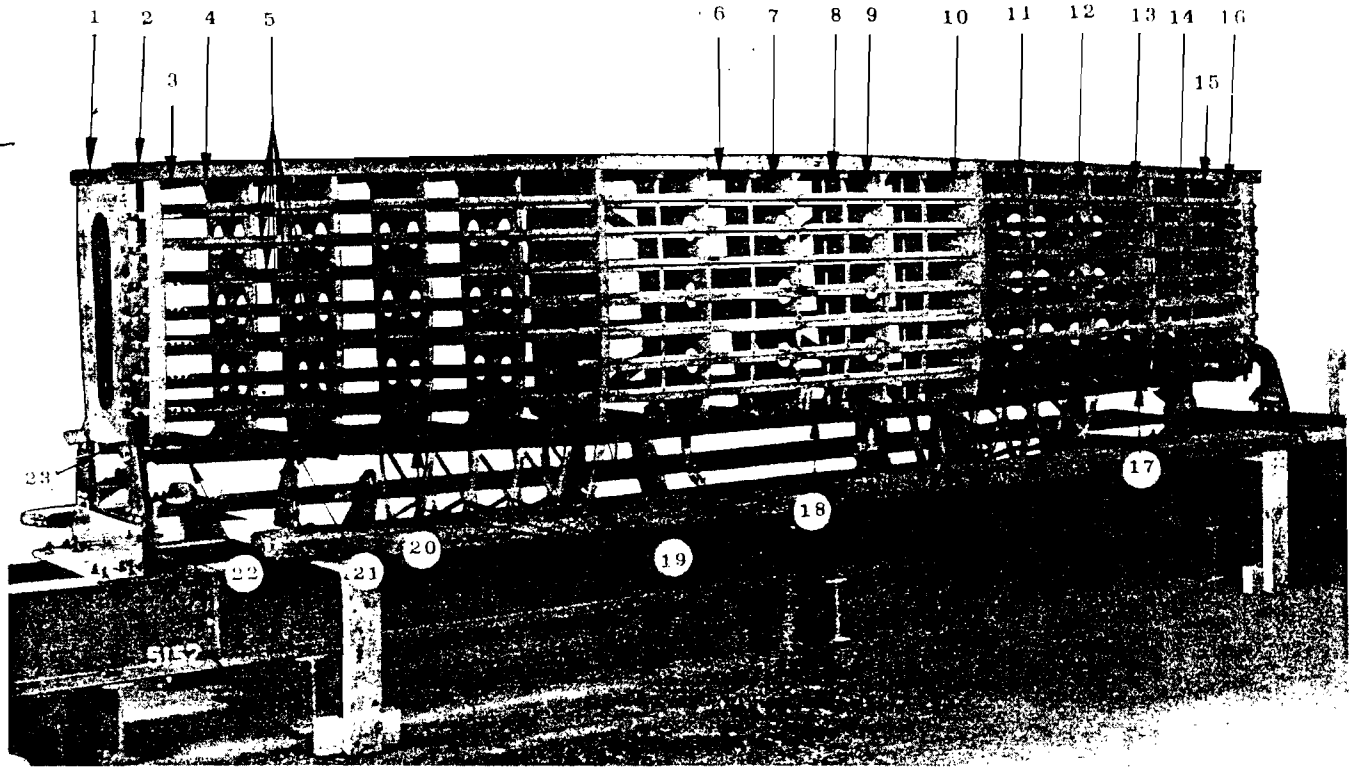
Be sure the skin is held down tight at these joints while inserting new riveting. This will prevent distortion of the skin with resultant leakage and help to guard against metal chips getting underneath. The top and bottom angles at the bulkhead are mild steel. Rivets must be driven through these members absolutely straight or the rivet holes will become enlarged with resultant leaks. All rivet rows must be absolutely straight as in the original construction. Avoid excessive patching to an extent which interferes with the flexibility of this structure, which must be maintained.

GAS TIGHT JOINTS.

91. GENERAL.-If it is necessary to repair skin sheet or other structure in gas tight areas the following instructions must be carefully followed:

92. REPAIR PROCEDURE.

a. In order to eliminate all possibilities of metal chips being trapped in a joint or seam, the drilling should be done wherever possible before the parts are assembled with the sealing cement and tape. Whenever this cannot be done, all metal chips that have been entrapped should be removed. Enough cement should be applied to the parts so that when the assembly is made, the excess cement will be forced out at the edges. The cement can



Ref. No.	Grumman Part No.	Description	Material	Thickness
1	12303-26	Corner Angle - Lower Rear	24ST Aluminum Alloy Ext. Alcoa 734-TT	
2	12303-25	Corner Angle - Upper Rear	24ST Aluminum Alloy Ext. Alcoa 734-TT	
3	12305-4	Beam Plate Rear Outboard - Right	24ST Aluminum Alloy Sheet	.051
4	12303-19	Stiffening Angle Rear	24ST Aluminum Alloy Ext. Alcoa 1594	
	12303-20	Stiffening Angle Rear	24ST Aluminum Alloy Ext. Alcoa 78C	
	12303-21	Stiffening Angle Rear	24ST Aluminum Alloy Ext. Alcoa 78C	
	12303-22	Stiffening Angle Rear	24ST Aluminum Alloy Ext. Alcoa 78C	
	12303-23	Stiffening Angle Rear	24ST Aluminum Alloy Ext. Alcoa 78C	
	12303-24	Stiffening Angle Rear	24ST Aluminum Alloy Ext. Alcoa 78C	
5	12303-1 to -12	Z Stringers	24ST Aluminum Alloy Ext. Alcoa 1060	
6	12305-3	Beam Plate - Rear Center	24ST Aluminum Alloy Sheet	.040
7	12314	Bulkhead Sta. #0		
	12314-1	Bulkhead Sheet	24ST Aluminum Alloy Sheet	.051
	12314-2	Doubling Plate	24ST Aluminum Alloy Sheet	.051
	12314-3	Stiffener	24ST Aluminum Alloy Sheet	.051
	12314-4,-5,-6, -7,-9	Stiffener Angle	24ST Aluminum Alloy Ext. Alcoa K-734	
	12314-8	Corner Angle	24ST Aluminum Alloy Ext. Alcoa K-734	
8	12353	Partial Bulkhead		
	12353-1	Z Member	24ST Aluminum Alloy Sheet	.051
9	12316	Bulkhead Sta. #15		
	12316-1	Angle Top	24ST Aluminum Alloy Ext. Alcoa 78C	

Figure 10 - Wing Center Section Box Beam Structure

KEY TO FIGURE 10 (CONT.)

Ref. No.	Grumman Part No.	Description	Material	Thickness
	12316-2	Angle Bottom	24ST Aluminum Alloy Ext. Alcoa 78K	
	12316-3	Plate	24ST Aluminum Alloy Sheet	.020
	12316-4	Angle Front	24ST Aluminum Alloy Sheet	.064
	12316-5	Angle Reinf.	24ST Aluminum Alloy Sheet.	.064
	12316-6 to -9	Angle Reinf.	24ST Aluminum Alloy Sheet	.040
10	12307	Wing Fuel Tank Bulkhead Sta. #30½ Similar to Bulkhead Part No.12308 in extrusions and gage. Refer to Ref. No. 16		
11	12310	Wing Fuel Tank Bulkhead Sta. #42 Similar to Part No. 12313 in extrusions and gage. Refer to Ref. No. 14		
	13303	NOTE: Fuel Tank Compartment Baffle Plate (Between Reference Numbers 10 and 11).		
	13303-1	Partial Baffle Plate	24ST Aluminum Alloy	.064
	13303-2	Partial Baffle Plate	24ST Aluminum Alloy	.028
12	12311	Wing Gas Tank Compartment Bulkhead Sta. #54		
	12311-1	Angle Top	24ST Aluminum Alloy Ext. Alcoa 22220	
	12311-2	Angle Bottom	24ST Aluminum Alloy Ext. Alcoa 22220	
	12311-3	Plate	24ST Aluminum Alloy	.020
	12311-4	Angle Front	24ST Aluminum Alloy Sheet	.064
	12311-5	Angle Rear	24ST Aluminum Alloy Sheet	.064
13	12312	Wing Gas Tank Compt. Bulkhead Sta. #65		
	12312-1	Angle Top	24ST Aluminum Alloy Ext. Alcoa 9823	
	12312-2	Angle Bottom	24ST Aluminum Alloy Ext. Alcoa 9823	
	12312-3	Sheet	24ST Aluminum Alloy Sheet	.051
	12312-4 to -7	Angles - Reinforcement	24ST Aluminum Alloy Sheet	.040
14	12313	Wing Gas Tank Compartment	Bulkhead Sta. #75	
	12313-1	Angle Top	24ST Aluminum Alloy Ext. Alcoa 9823	
	12313-2	Angle Bottom	24ST Aluminum Alloy Ext. Alcoa 9823	
	12313-3	Plate	24ST Aluminum Alloy Sheet	.020
	12313-4 & -5	Angles	24ST Aluminum Alloy Sheet	.064
	12313-6 to -9	Angles	24ST Aluminum Alloy Sheet	.040
15	12305-4	Beam Plate - Rear Outboard Left	24ST Aluminum Alloy Sheet	.051
16	12308	Wing Fuel Tank Bulkhead Sta. #85		
	12308-5	Plate Web	24ST Aluminum Alloy Sheet	.051
	12308-1 to -4	Angles	Mild Carbon Steel Sheet (S.A.E. 1025)	.049
17	12305-2	Beam Plate Front Left	24ST Aluminum Alloy Sheet	.064
18	12305-1	Beam Plate Front Center	24ST Aluminum Alloy Sheet	.064
	12328			
19	12329	Nose Ribs	24ST Aluminum Alloy Sheet	.051
	12331			
	12332			
20	12305-2	Beam Plate - Front Right	24ST Aluminum Alloy Sheet	.064
21		Stiffening Angles - Front		
	12303-13	Stiffening Angle	24ST Aluminum Alloy Ext. Alcoa 1594	
	12303-14 to-18	Stiffening Angle	24ST Aluminum Alloy Ext. Alcoa 78C	
22	12303-27	Corner Angle - Upper Front	24ST Aluminum Alloy Ext. Alcoa K-13864	
23	12303-28	Corner Angle - Lower Front	24ST Aluminum Alloy Ext. Alcoa K-13864	

be removed from the surfaces around a joint by wetting it with gasoline and wiping off with a soft rag.

CAUTION

Avoid gasoline seeping inside a joint as this may cause the cement to soften and remain in a jelly-like state, impaired as a sealant.

b. Whenever flat surfaces are brought together in a gas tight joint, the assembly should be treated as specified below for seams. Any appreciable opening should be packed with Fairprene tape (See Table II) soaked in carbon-tetrachloride and packed with Fairprene cement or equivalent. (See Table II). The Fairprene cement should be thinned down to a workable consistancy with carbon-tetrachloride. The cement has no adhering property until the activator is added in the proportion of one ounce to each pint of Fairprene cement and must then be used within 12 hours or discarded. A recommended substitute for Fairprene cement is zinc chromate paste.

NOTE

Angles used as stiffeners need not be gas tight. When gas proofing seams, the parts should be coated with cement and the assembly completed as soon as possible. Under no circumstances should a sub-assembly whose surfaces have been coated with adhesive, remain incomplete for more than 30 minutes unless the coated surfaces are brought in contact by sheet metal screws inserted in every fourth hole. Whenever sheet metal screws are used, the assembly may remain as is for approximately one hour before inserting the rivets. Whenever the skin laps at a longitudinal, the small crevice formed by such an assembly should be packed with cement. Joints at or around extrusions should be sealed by the use of metal plates. The plates should be drilled and fitted before the application of the sealing compound. After riveting in place, both sides of the entire joint should then be sealed with a fillet of undiluted adhesive as shown in Figure 107. After repairing and allowing the cement to dry overnight, the seal should be tested as described in Paragraph 85 above.

93. DRAINING AND PURGING.

a. PROCEDURE.-Use the following procedure to remove fuel vapors:

(1) Drain out all fuel and leave outlets open.

(2) Run water through the tanks for 1/2 hour.

(3) Blow compressed air at low pressure with all vents open long enough to hasten drying and cause the odor of gasoline to disappear completely.

CAUTION

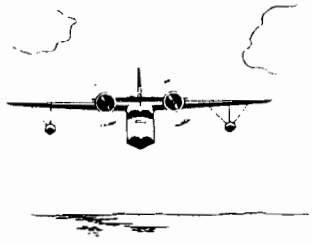
Do not purge the fuel tanks of vapor by the use of steam as it is detrimental to the tank sealing compound and might cause leaks.

FUEL LINES.

94. GENERAL.-The fuel lines are 52SO aluminum alloy tubing.

95. ESTIMATION OF DAMAGE.-Fuel lines should be inspected for scratches, holes, breaks and deformities. Lines must be carefully removed and cleaned thoroughly for an adequate inspection, being tagged with location given as an aid to assembly. Flared ends of fuel lines should be checked, especially under the sleeves. In cases where a slight scratch appears, it may be burnished out by using a burnishing tool. The burnishing should be finished with a crocus cloth and oil to leave a clean smooth surface.

96. DAMAGE NECESSITATING REPLACEMENT.-Any damage to the fuel lines necessitates replacement with equivalent undamaged lines. If a full length of tubing is not available, the damaged section may be cut out and a length of tubing inserted, using standard fuel line fittings.



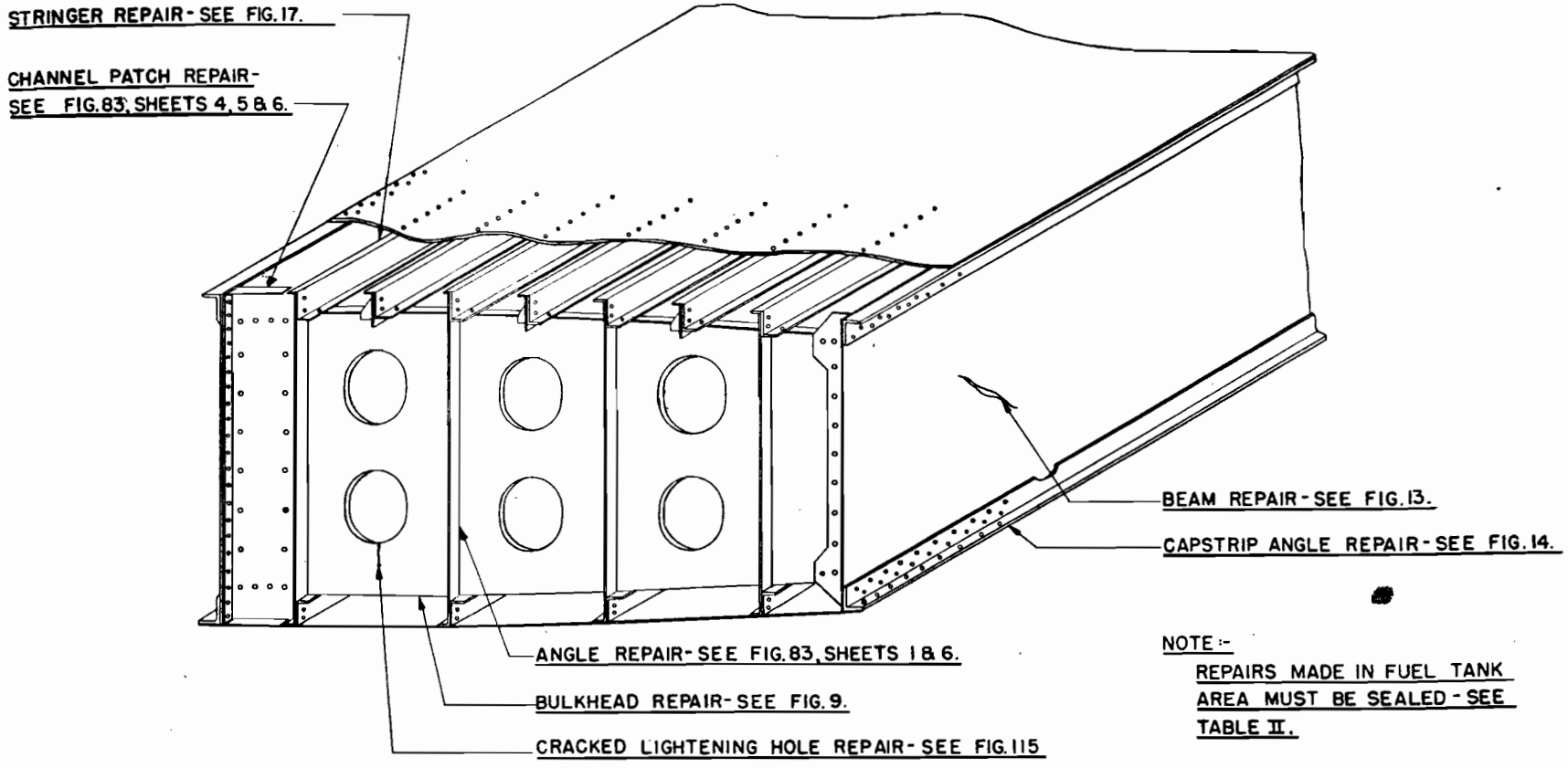


Figure 11 - Wing Center Section Box Beam Repair Reference Diagram

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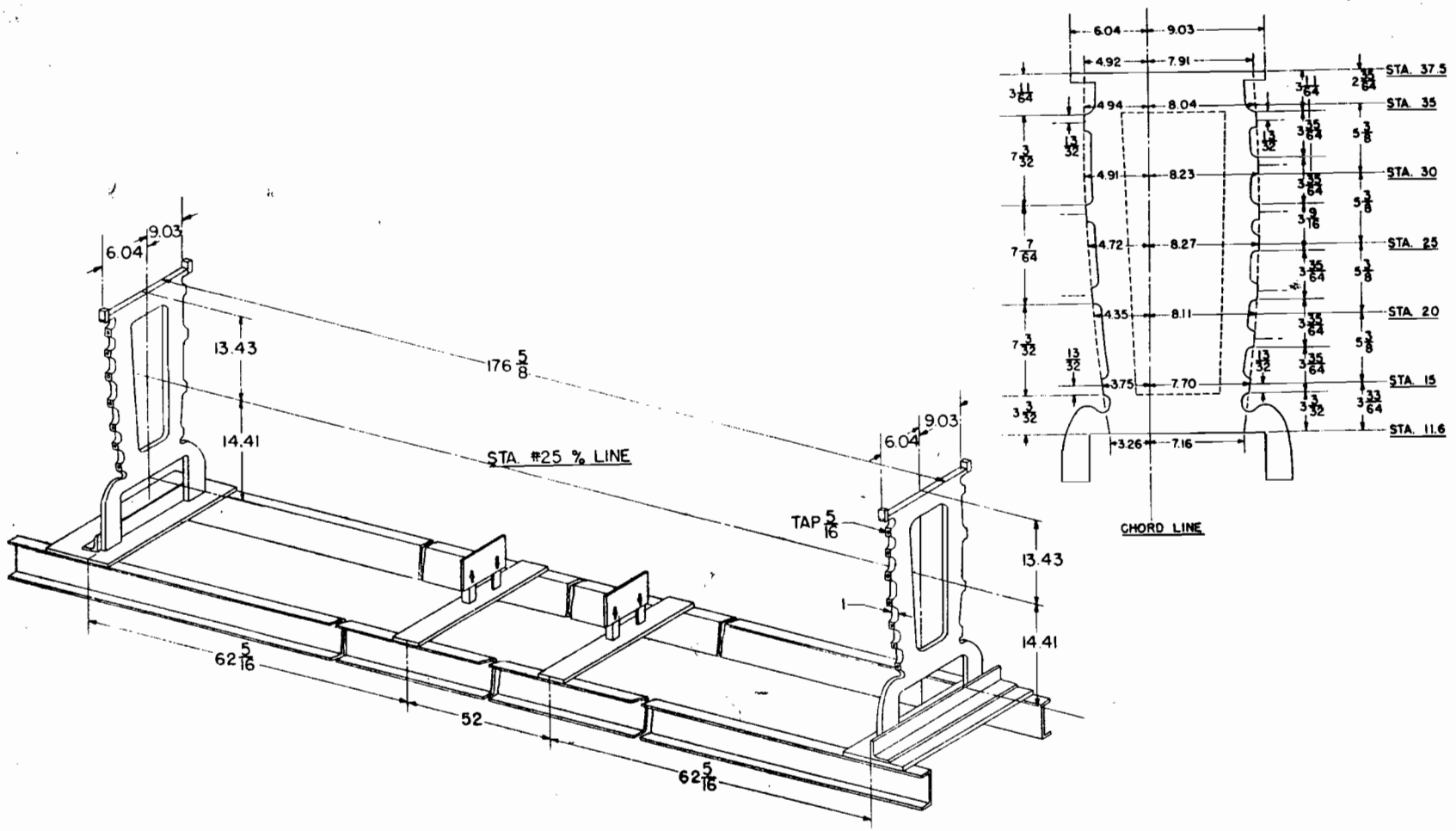

Figure 12 - Wing Center Section Box Beam Jig

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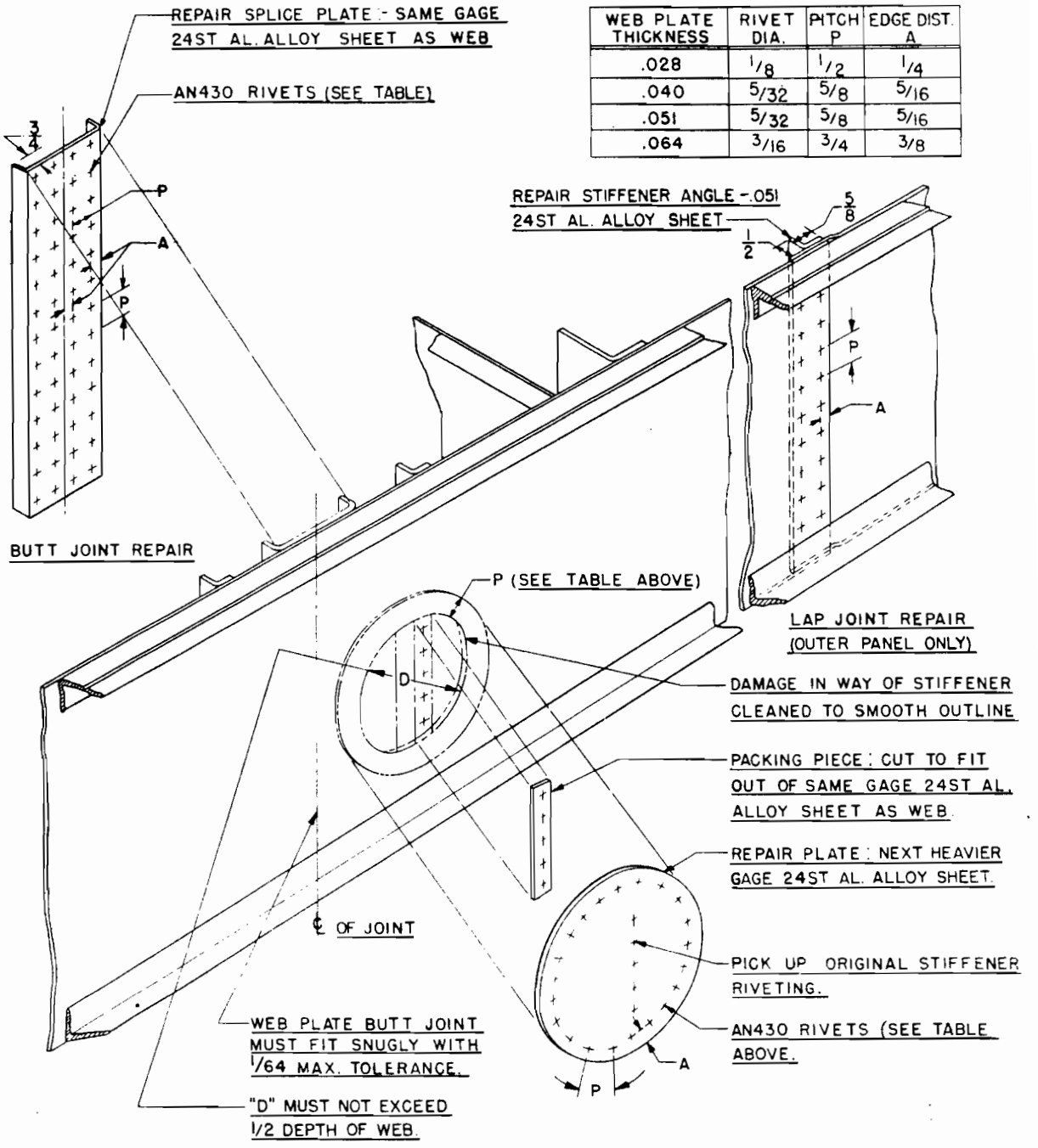
WEB PLATE THICKNESS	RIVET DIA.	PITCH P	EDGE DIST. A
.028	1/8	1/2	1/4
.040	5/32	5/8	5/16
.051	5/32	5/8	5/16
.064	3/16	3/4	3/8

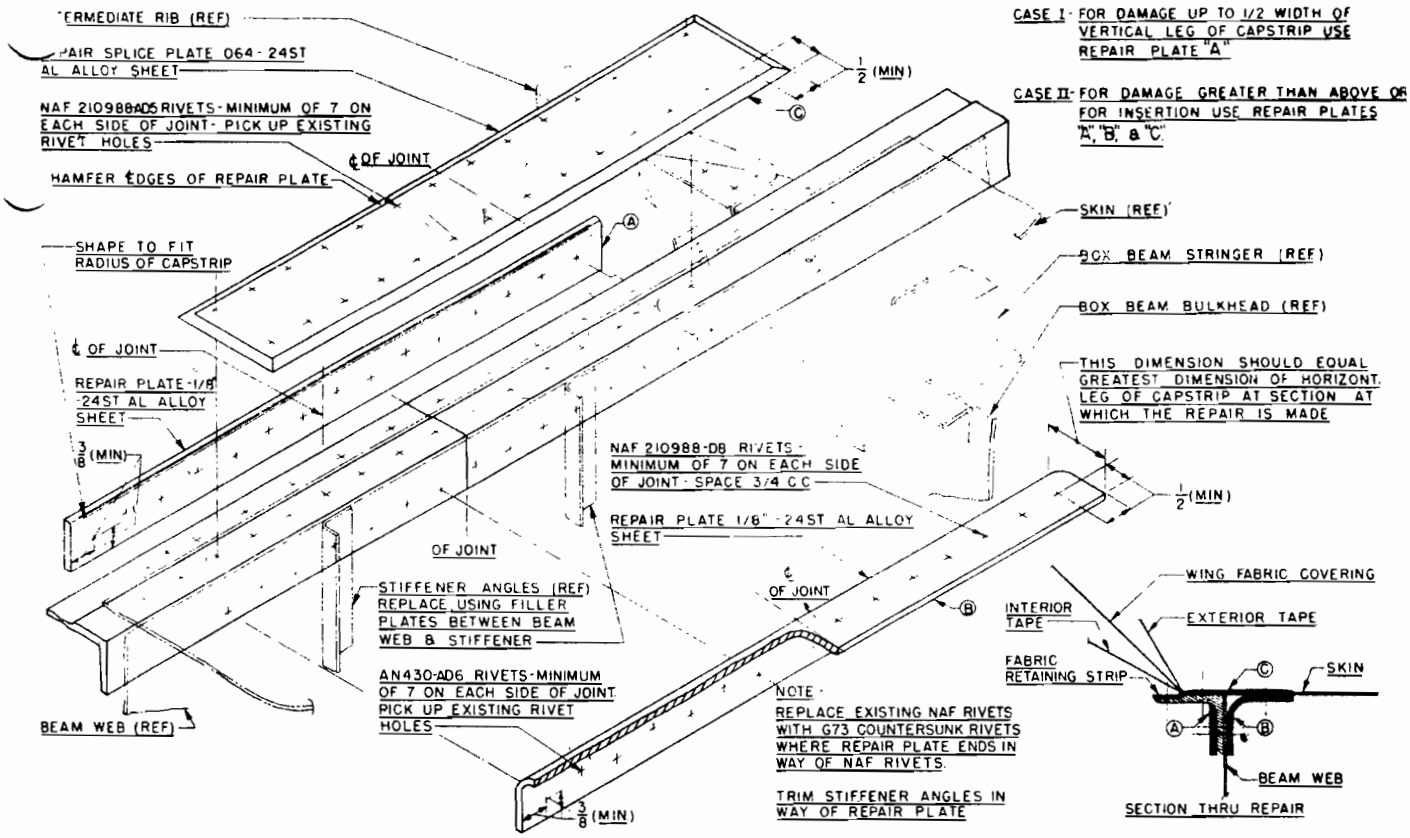


NOTE :-

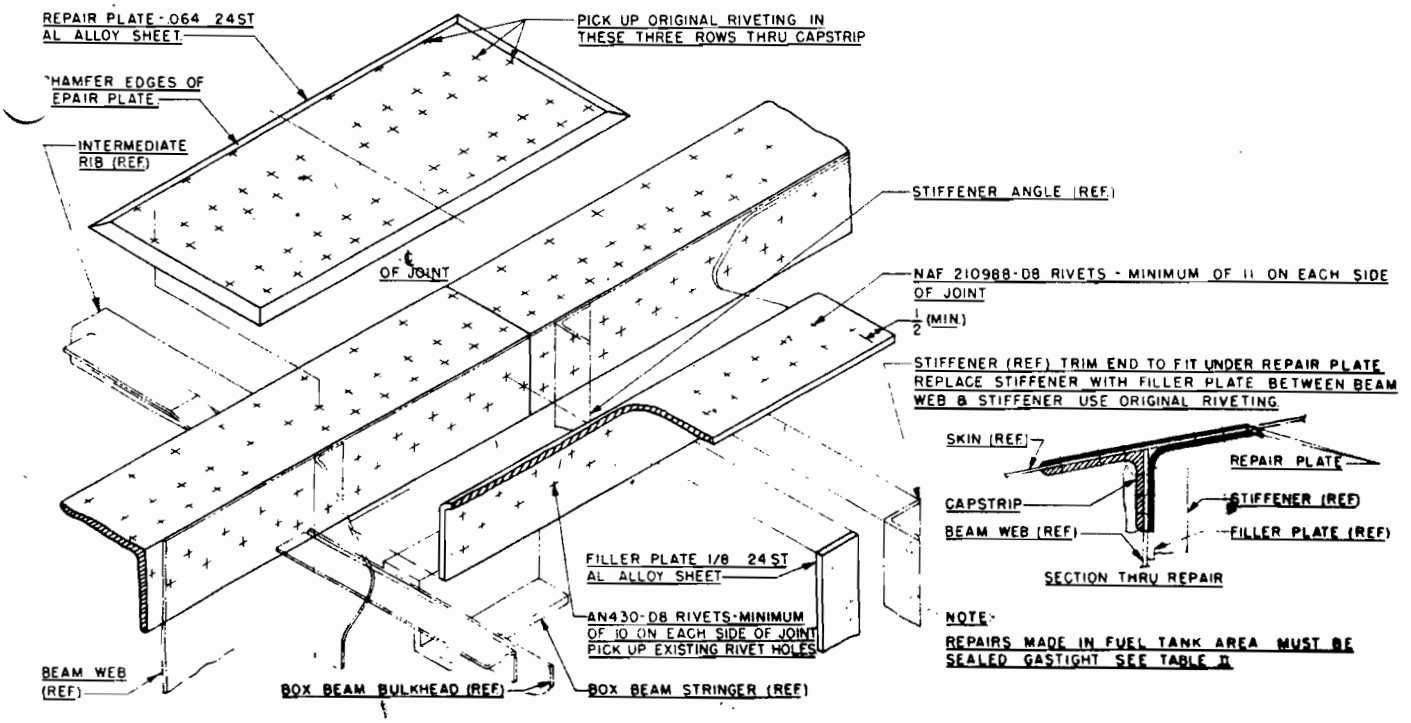
EITHER A BUTT JOINT OR A LAP JOINT WEB REPAIR MAY BE USED.

REPAIRS MUST BE GASPROOF IN FUEL TANK AREA - SEE FIG. 107

Figure 13 - Wing Box Beam Web Repairs



OUTER PANEL BOX BEAM CAPSTRIP REPAIR



CENTER SECTION BOX BEAM CAPSTRIP INSERTION REPAIR

Figure 14 - Wing Box Beam Capstrip Repairs

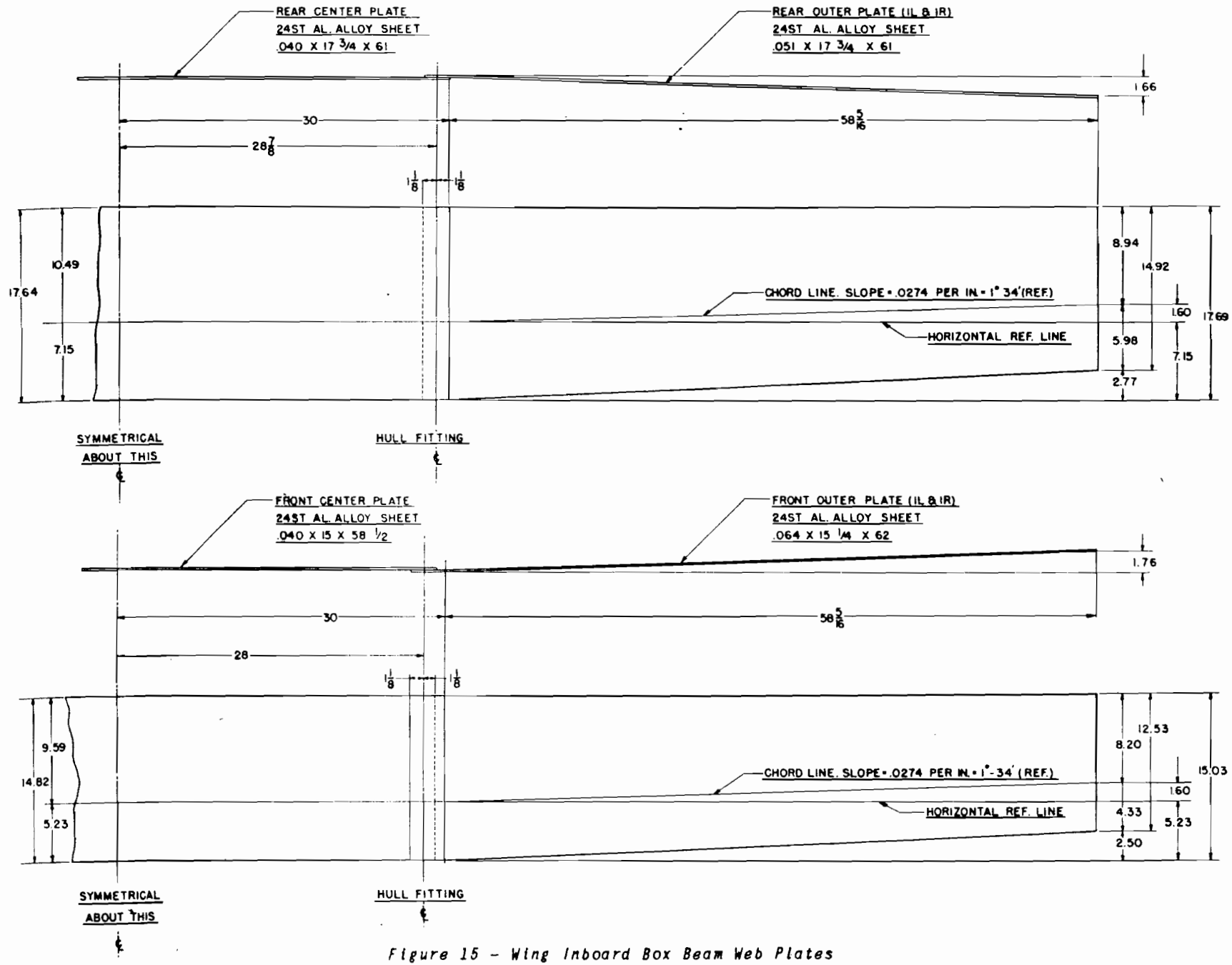


Figure 15 - Wing Inboard Box Beam Web Plates

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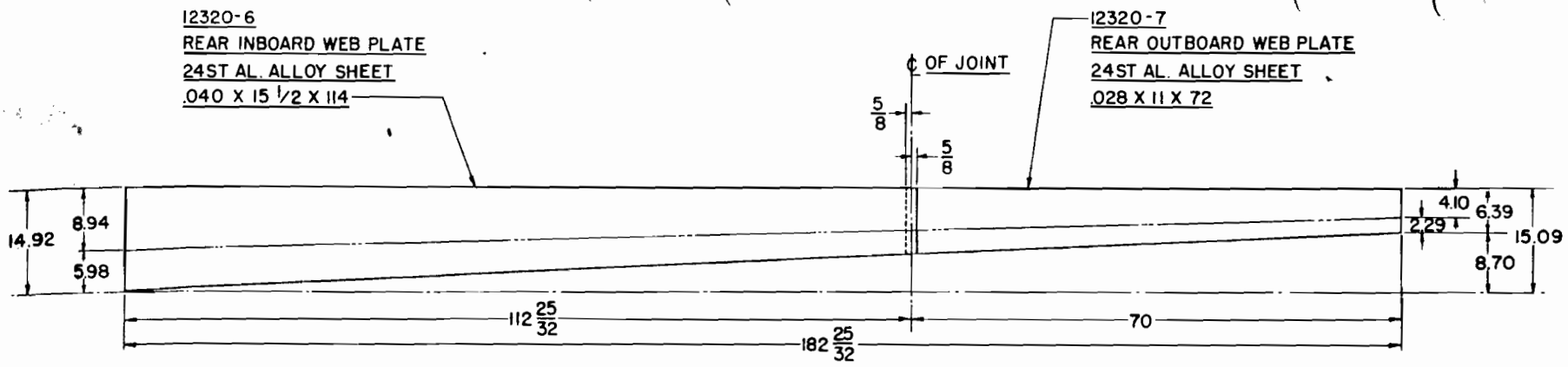
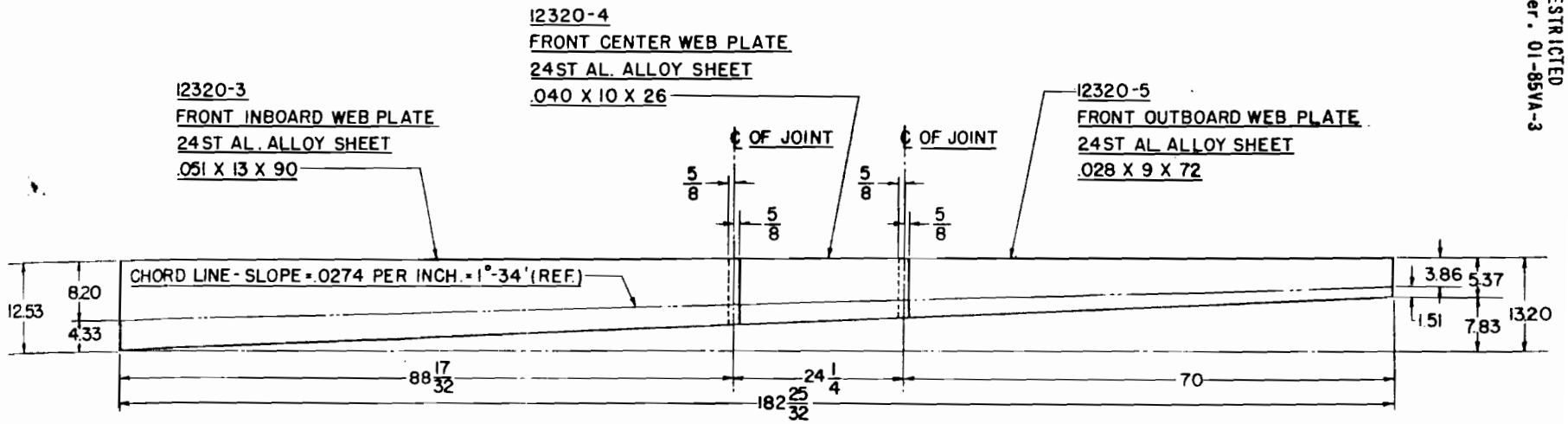


REAR BEAM WEB PLATE



FRONT BEAM WEB PLATE

Figure 16 - Wing Outboard Box Beam Web Plates

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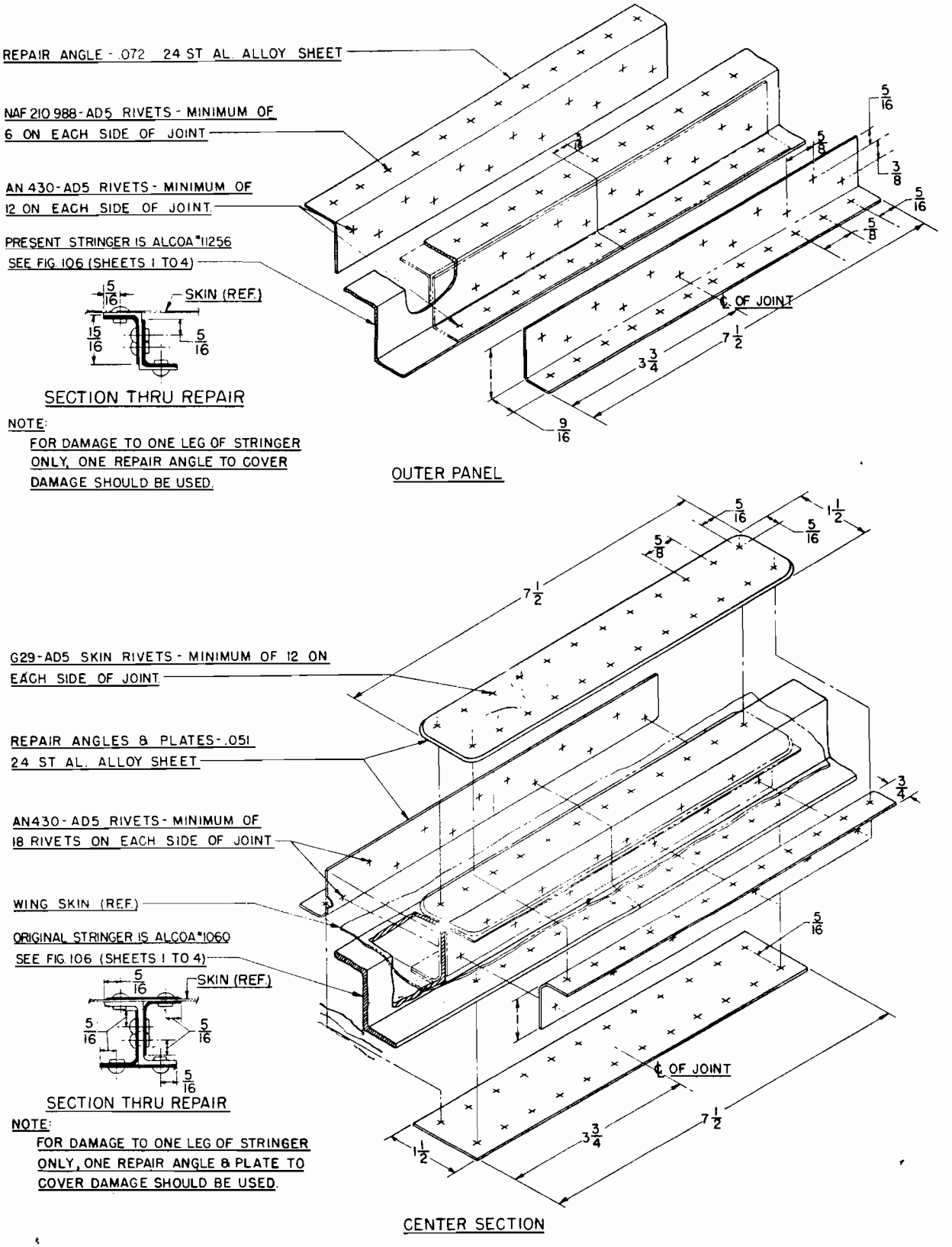


Figure 17 - Wing Box Beam Stringer Repairs

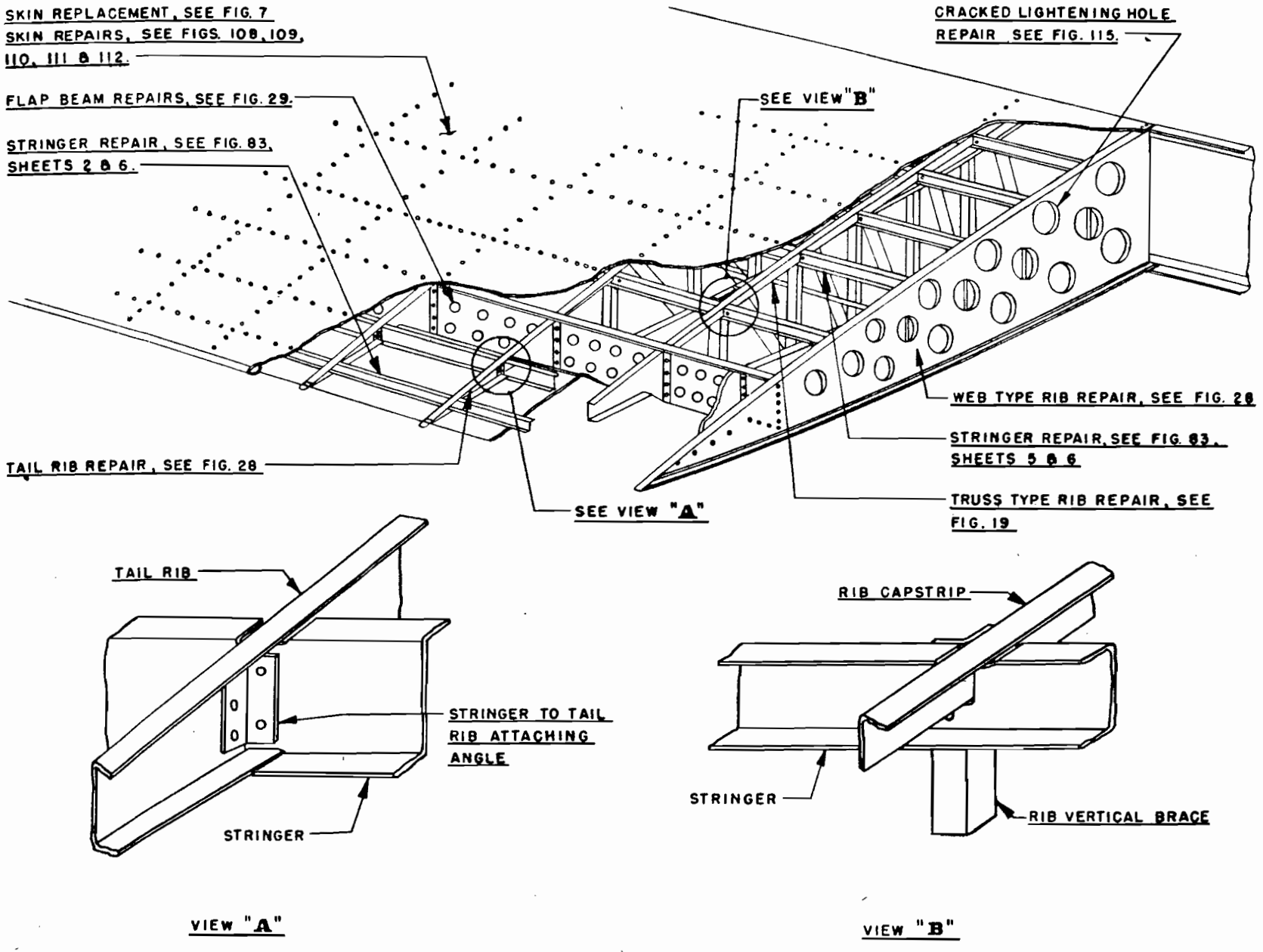


Figure 18 - Wing Center Section Trailing Edge Section Repair Reference Diagram

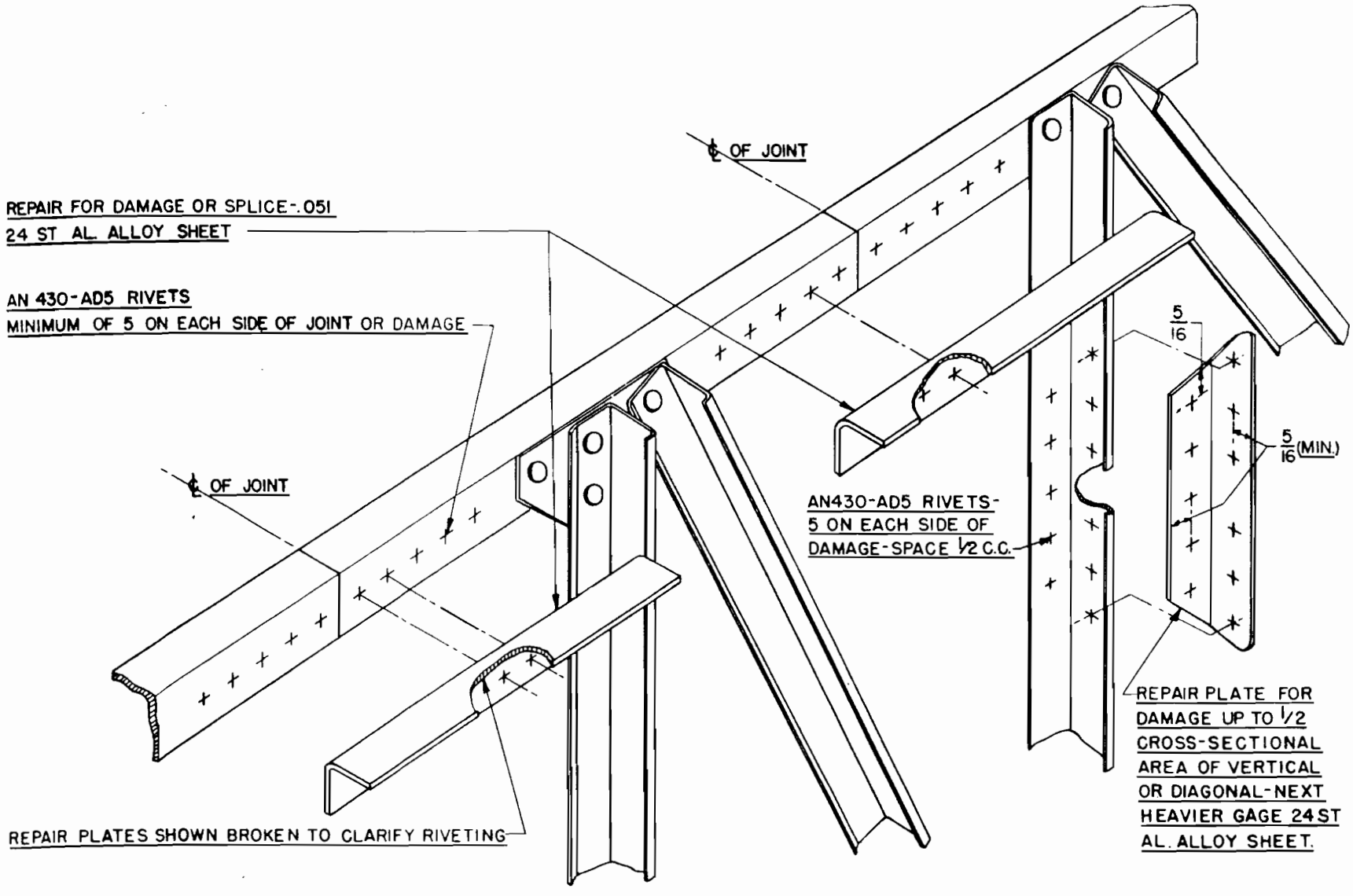
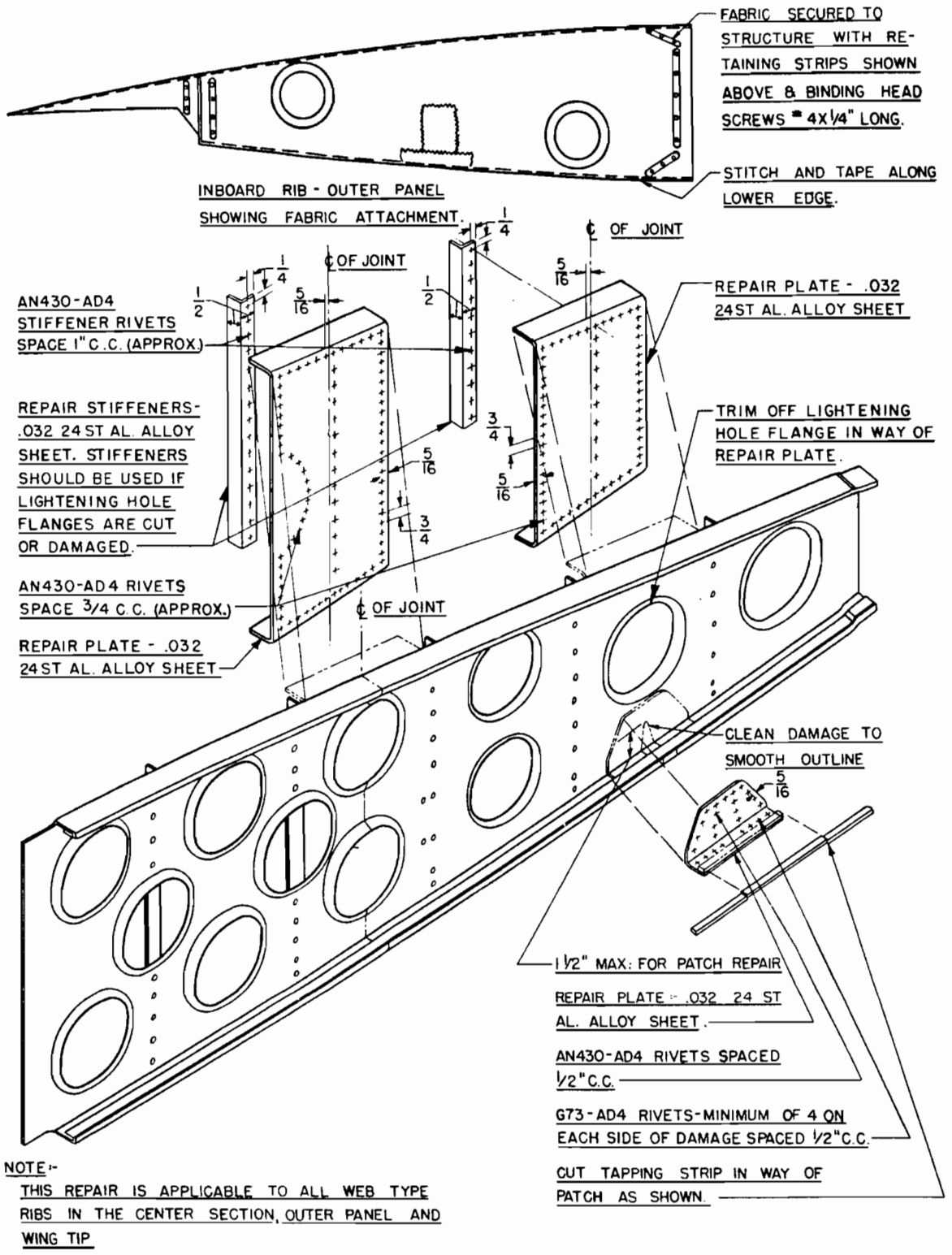


Figure 19 - Wing Center Section Truss Type Rib Repairs



NOTE:-
THIS REPAIR IS APPLICABLE TO ALL WEB TYPE RIBS IN THE CENTER SECTION, OUTER PANEL AND WING TIP

Figure 20 - Web Type Rib Repairs

WING OUTER PANEL.

97. GENERAL. - The two outer panels are each built around a box beam, and include nose section, box beam structure, and intermediate or trailing edge section. The internal structure is comprised of web and truss type ribs, bulkheads, stringers, front and rear box beam web plates, wing flaps and aileron support beams, trailing edge and wing tip structure. (See Figure 22).

SKIN.

98. GENERAL.-The outer panels are covered with 24ST aluminum alloy aft to rear box beam plate, and with fabric aft to the trailing edge as noted in Figures 4 and 129.

NOTE

The repair of fabric is described in Section 8.

The skin panels should be inspected for dents, cracks, holes, loose rivets and distortion. Inspect all dents to insure that they are not stress wrinkles caused by failure of vital structure.

99. REPAIR OF DENTS, PERFORATIONS.-Dents more than negligible should be hammered out and may then be neglected provided no damage has resulted from this treatment, adjacent riveting is not disturbed and damage has not affected the internal structure. In smoothing the surface after the dent has been removed, emery cloth may be used to remove surface roughness. Small holes up to 1/4 inch in diameter after smoothing out may be repaired by inserting a rivet, or doping on a piece of fabric.

100. NEGLIGIBLE DAMAGE.-Small, smooth isolated dents less than 1/16 inch deep and free from cracks, sharp corners and abrasions may be neglected if riveting is undisturbed and internal structure is undamaged. Isolated cracks up to 1-1/2 inches may be neglected as indicated in Figure 135.

101. DAMAGE REPAIRABLE BY PATCHING.

a. GENERAL.

(1) Holes in open areas not larger than 1-1/2 inches in diameter after smoothing out and not closer than four diameters on centers may be repaired by doping on a piece of fabric. It is recommended that the fabric be replaced as soon as possible by a metal patch of 24ST aluminum alloy, the same gage as the damaged skin as described below in this Paragraph.

NOTE

This repair may be used on all aluminum alloy skin in the outer panel and the wing center section, aft of the center section box beam.

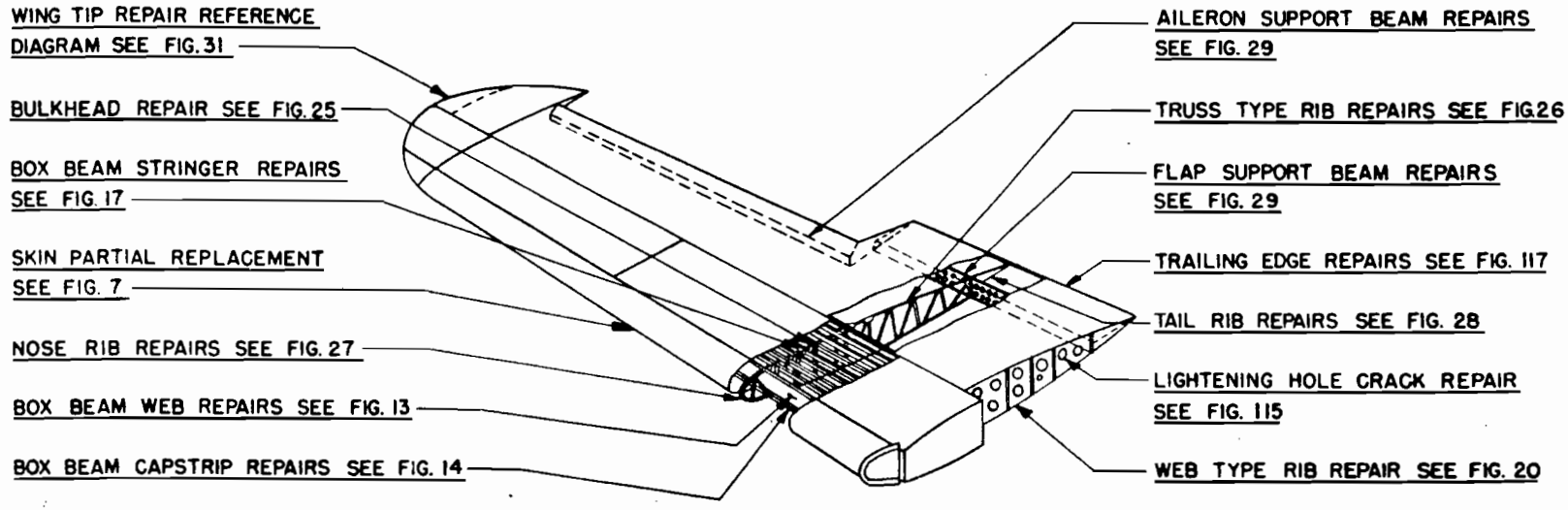
(2) Holes, cracked or otherwise damaged areas may be repaired by patching, unless insertion or replacement of a panel is required as described below. In general, damage in open areas between adjacent internal structure, or damage in the way of these members may be repaired by patching. Any section of the skin may be patched. The damaged area should be cut away and trimmed to a smooth contour, using 1/4 inch minimum radii, and leaving preferably a round or oval hole. Care should be taken not to cut away more skin than is necessary to remove the damaged portion. Either a flush or an outside patch may be used. The flush patch is recommended if it can be conveniently prepared and installed without affecting adjacent riveting.

NOTE

Sufficient areas of skin should be removed so that the rivets securing the edges of the patch will be clear of stringers or other internal structure in all cases where the patch is in the way of these members. Where damage extends across adjacent panels of different skin thickness, the patch should be the same as the heavier skin. If a large patch is used in open areas, a stiffener may be placed under the patch as an additional reinforcement.

b. FLUSH TYPE PATCH.-The flush type patch insures a smooth contour of the skin surface. It may be either round (See Figure 108) or square (See Figure 109). The internal frame and patch should be cut from 24ST aluminum alloy sheet of the same thickness as the damaged skin and of the size noted on the repair diagrams. The patch should be cut oversize and then trimmed to insure a tight fit. To facilitate insertion of the frame, it may be cut along the middle into two pieces and butted. The joint should run spanwise. The patch should then be fitted over the frame and hole and then riveted as in Figures 108 or 109. Where the flush type patch extends over one or more stringers or other internal structure, the frame should be inserted through the trimmed damaged hole and placed between the stringer and the skin.

c. OUTSIDE PATCH.-The outside patch for repair of the wings should be cut from a piece of 24ST aluminum alloy sheet of the same gage as the damaged panel being repaired. The edges should be chamfered. The patch should be large enough to cover



NOTE:

MATERIALS OF CONSTRUCTION, SEE FIG. 22

SKIN PLATING DIAGRAM, SEE FIG. 4.

SKIN PATCH REPAIRS, SEE FIGS. 108, 109, 110, 111 & 112.

FABRIC REPAIR, SEE FIG. 116

Figure 21 - Wing Outer Panel Repair Reference Diagram

the cleaned out damaged area and riveted as shown in Figure 111. Where the outside patch extends over one or more stringers or other internal structure, a packing strip should be inserted between the stringer and the patch.

NOTE

While the outside patch may be used on the leading edge, it should be noted that even slight protuberances such as the spanwise edges of the outside patch have a tendency to disturb the normal airflow. For this reason, caution should be used in applying the outside patch to the wings and while it is permissible, excessive outside patching should be avoided.

d. REMOVABLE PATCH.-If access cannot be gained conveniently through hand holes provided for this purpose in the original construction, additional hand holes for inspection and repair may be cut in the skin and covered with a removable plate as shown in Figure 110.

102. DAMAGE REPAIRABLE BY INSERTION.-Damage to the outer wing panels (except the leading edge) which cannot be repaired by patching may be repaired by the insertion of a partial panel. The new skin may be inserted by cutting out the damaged area along adjacent internal structure and inserting an equivalent undamaged partial panel, following the same procedure as in the case of the wing center section skin as noted in Figure 7. Note that the new section may be lap jointed. The spanwise laps should be made by inserting the new skin under the adjacent original skin on the forward edge, and over the adjacent original skin at the aft edge.

103. DAMAGE NECESSITATING REPLACEMENT.

a. If the leading edge skin panels cannot be repaired by patching, the panel should be replaced by an equivalent undamaged section, riveted and jointed as in the original construction. If the skin outside the leading edge panels cannot be repaired by patching or insertion, the damaged panel should be replaced with an equivalent undamaged panel, riveted and jointed as in the original construction.

b. When installing new skin panels, the position of the rivet holes to match the holes in the interior structure over which the skin is to be riveted can be determined by means of a special "Rivet Hole Locating" or "Marking Off" tool. (See Figure 124).

c. After the holes are located and drilled, the new skin should be riveted from the outside.

d. When installing a new wing leading edge skin panel, the piece may be held in place by means of screws, or shock cord. The cord will assist in holding skin panels to the proper contour of the leading edge. Screws or clamps may be used after the new rivet holes are drilled in the new panel.

OUTER PANEL BOX BEAM.

104. GENERAL.-The outer panel box beam structure is built up of front and rear web plates, bulkheads and stringers. (See Figure 22). The plates are stiffened by top and bottom Alcoa extruded angles (capstrips or corner angles) and vertical stiffeners and taper in width toward the wing tip. Repair of the skin is described in Paragraphs 98 to 103 above.

NOTE

The beam web plating should be inspected for cracks, dents, holes, breaks, distortion and disturbed riveting.

WEB.

105. NEGLIGIBLE DAMAGE.-Isolated dents less than 1/16 inch deep, free from cracks, sharp corners and abrasions may be neglected if riveting is undisturbed, and the section is not distorted. Smoothed out holes less than one inch in diameter may be neglected provided they are more than four diameters on centers from any similar hole, two diameters from the capstrips, ends of the beam web and one diameter from attached stiffeners. Scores and cracks may be neglected as noted in Figure 135.

106. DAMAGE REPAIRABLE BY PATCHING.

a. Damage up to 1/2 the depth of the web may be repaired by cutting out the damaged area and patching with a circular 24ST aluminum alloy plate of the next heavier gage as shown in Figure 13, provided there is room to fit the patch over the trimmed damaged area. In general, the patch may be placed on either side of the web depending on convenience, using fillers when required on the inside of the web. If the damage is in the way of bulkhead attachments or stiffeners, fillers should be used where necessary as noted in Figure 13.

b. Vertical stiffeners in the way of a repair should be removed and reinstalled after the web is repaired, if not damaged more than negligible as noted in Paragraph 110 below.

c. If damage is in the way of the attachments of the struts, and/or brace wires, it is recommended that an insertion repair be made as described in the next Paragraph immediately below. When the damage is in the way of the web type rib attached

to the rear web plating the rib must be trimmed to accomodate the patch if it is placed on the outside of the beam web plating.

107. DAMAGE REPAIRABLE BY INSERTION.

a. Damage not repairable by patching may be repaired by cutting out the damaged area of the web between bulkheads for the entire width and inserting a new equivalent portion with repair plates of the shape and size and riveted as shown in Figure 13. The repair plates should be placed on the inside of the beam web plating. Two repair plates will be necessary for an insertion repair if two butt joints are required for the insertion piece. If the outer portion of the beam is damaged to an extent not repairable by patching, it may be advantageous to cut off the damaged end of the web and splice on a new equivalent section, in which case only one splice plate will be necessary.

b. Web sections must follow the contours of the original section as shown in Figure 16.

c. As an alternate repair, the insertion may be made by means of a lap joint as in the original construction. (See repair diagram, Figure 13, and also Figure 16).

NOTE

To repair the web plating, the fabric may have to be cut or removed to provide access, in which case reference should be made to Section 8.

108. DAMAGE NECESSITATING REPLACEMENT.-If the web cannot be repaired as described above, it must be replaced with an equivalent undamaged section and should follow the contours of the original structure as shown in Figure 16.

STIFFENERS.

109. GENERAL.-The web is stiffened by attached angles. (See Figure 22).

110. NEGLIGIBLE DAMAGE.-Isolated nicks as shown in Figure 135 may be neglected.

111. DAMAGE NECESSITATING REPLACEMENT.-For damage more than negligible, it is recommended that these stiffeners be replaced with equivalent undamaged members.

CORNER ANGLES (CAPSTRIPS).

112. GENERAL.-The box beam webs are stiffened by top and bottom angles, or capstrips, as shown in Figures 14 and 22.

113. NEGLIGIBLE DAMAGE.-Isolated nicks and scores may be neglected as shown in Figure 135 if no other damage exists.

114. DAMAGE REPAIRABLE BY PATCHING.-Damage up to 1/2 the cross sectional area may be repaired by cutting out the damaged area between bulkheads and patching as shown in Figure 14. Refer to NOTE in next Paragraph below.

115. DAMAGE REPAIRABLE BY INSERTION.-Damage which cannot be repaired by patching may be repaired by cutting out the damaged area and inserting a new equivalent section as shown in Figure 14.

NOTE

Repairs may necessitate removal of fabric in the way of the damage. Repair material coming in contact with fabric must be protected against dope by two coats of zinc chromate primer. All sharp edges and rivets in contact with the fabric shall be covered with cellophane tape. (Reference should be made to Section 8).

116. DAMAGE NECESSITATING REPLACEMENT.-The capstrip must be replaced with an equivalent undamaged member if damage cannot be repaired as above and must be protected as outlined in NOTE in the Paragraph immediately above.

STRINGERS - "ZEE".

117. GENERAL.-The box beam is stiffened longitudinally by "Zee" section stringers which are Alcoa extruded angles. The stringers are attached to the bulkheads by means of angles riveted to the stringers and bulkhead webs.

118. NEGLIGIBLE DAMAGE.-Damage to the outer panel box beam stringers is defined the same as damage to the center section stringers as outlined in Paragraph 48 above.

119. DAMAGE REPAIRABLE BY PATCHING.-These members are repaired the same as the center section stringers as outlined in Paragraph 49 above and shown in Figure 17, with the following exceptions:

a. The outer panel stringers do not require gas tight joints.

b. Fabric will be involved in the case of the outer panels. (See NOTE in Paragraph 115 above).

120. DAMAGE REPAIRABLE BY INSERTION.-See Paragraph 50 above, with the exceptions noted in Paragraphs 119a and 119b above.

121. DAMAGE NECESSITATING REPLACEMENT.-Refer to Paragraph 51 above, with the exceptions as noted in Paragraphs 119a and 119b above.

BULKHEADS.

WEB.

122. GENERAL.-The bulkheads in the outer panel box beam are lightening holed members stiffened with angles, channels and flanged lightening holes. The bulkheads at the inboard end have two rows of lightening holes and a single row toward the outboard section, decreasing in size as the wing tapers towards the tip.

NOTE

These members should be inspected for dents, cracks, holes, distortion and disturbed riveting.

123. NEGLIGIBLE DAMAGE.-Dents less than 1/16 inch deep and cracks may be neglected in accordance with Figure 135; also isolated holes in the web up to one inch in diameter after cleaning out may be neglected if more than one inch from a lightening hole or stiffener and provided such holes are more than four diameters on centers from any similar hole.

124. DAMAGE REPAIRABLE BY PATCHING.-Damage to the web may be repaired by cutting out the damaged area and riveting a patch in accordance with Figure 25. A cracked lightening hole may be repaired by drilling a #40 (.098) hole at the end of the crack and patching as shown in Figure 115. Patches should be placed on the side most convenient in making the repair. It is recommended that web patches in the way of lightening holes be cut out and flanged to suit the lightening holes; however, if this equipment is not available, the patch may cover the lightening hole as shown in Figure 25.

125. DAMAGE NECESSITATING REPLACEMENT.-If the damage cannot be repaired by patching it is recommended that the web be replaced with an equivalent undamaged section.

STIFFENERS.

126. GENERAL.-These members are stiffened by small vertical and horizontal members.

127. NEGLIGIBLE DAMAGE.

a. Dents, nicks and in general cleaned up damage less than 1/3 the depth of either leg of the vertical stiffeners may be classified as negligible as noted in Figure 135 provided the radius is not included in the damage.

b. In the horizontal stiffeners, isolated nicks less than 1/8 inch deep may be neglected if riveting is undisturbed as noted in Figure 135.

128. DAMAGE REPAIRABLE BY PATCHING.-The horizontal stiffeners may be repaired by patching as noted in Figure 25 if there is room to fit the patch.

129. DAMAGE NECESSITATING REPLACEMENT.-If the vertical stiffeners are damaged more than negligible, replacement is recommended. If the horizontal stiffeners cannot be repaired by patching as noted above, replacement is recommended.

TRUSS TYPE RIBS.

130. GENERAL.-The outer panel structure aft of the rear box beam plate includes tubular truss type ribs covered with fabric. They are attached to the box beam rear plate and aileron and flap support beams by means of small angle clips.

NOTE

Check for dents, cracks, holes, breaks, distortion and disturbed riveting.

131. NEGLIGIBLE DAMAGE.- Small isolated nicks less than 1/8 inch deep after smoothing out, and isolated dents less than 1/16 inch deep, may be neglected as noted in Figure 135.

132. DAMAGE REPAIRABLE BY PATCHING.-The upper or lower tubular members of these ribs may be repaired by patching in accordance with Figure 26; a piece of material equivalent to the diagonals may be inserted inside the tubular section, as shown, or a piece of 24ST aluminum alloy bar may be used. (See NOTE in the next Paragraph below).

133. DAMAGE REPAIRABLE BY INSERTION.-A damaged section may be removed and an equivalent undamaged section inserted, using splice plates the same as a patch as shown in Figure 26.

NOTE

Aluminum alloy coming in contact with fabric must be protected against dope. Refer to NOTE in Paragraph 115 above.

134. DAMAGE NECESSITATING REPLACEMENT.-For damage more than negligible to the diagonals it is recommended that these members be replaced. If the tubular members cannot be repaired as described above, replacement is required. (Refer to NOTE in the Paragraph immediately above).

WEB TYPE RIBS.

135. GENERAL.-The web type ribs in the outer panels have flanged lightening holes either one or two rows, and are attached to the rear box beam plating and aileron and flaps support beams.

136. NEGLIGIBLE DAMAGE.-Negligible damage is defined the same as damage to similar ribs in the

center section as described in Paragraph 65 above.

137. DAMAGE REPAIRABLE BY PATCHING.-The web type ribs in the outer wing panels may be repaired by patching the same as the similar ribs in the wing center section as described in Paragraph 66 above, except that in the outer panel aluminum alloy coming in contact with fabric must be protected against dope. Refer to NOTE in Paragraph 115 above.

138. DAMAGE REPAIRABLE BY INSERTION.-See Paragraph 67 above and NOTE in Paragraph 115 above.

139. DAMAGE NECESSITATING REPLACEMENT.-See Paragraph 68 above and NOTE in Paragraph 115 above.

NOSE RIBS.

140. GENERAL.-The truss type nose ribs of the outer panels and center section are bent up angle capstrips reinforced by bent up angle diagonals. (See Figure 32). The ribs are made from a flat piece of 24S0 aluminum alloy; after forming they are heat treated to 24ST. In forming, the flat piece is cut to size by using a template. It is then secured firmly between two forming plates and the flange is hammered over, conforming to the outline of the forming plates. Other nose ribs are web type similarly made, except that a web plating is attached to the capstrip and has small holes for lines.

NOTE

Inspect for dents, nicks, holes, cracks, distortion and disturbed riveting.

141. NEGLIGIBLE DAMAGE.-Isolated dents less than 1/16 inch deep, and nicks in the edges of the capstrips or diagonals less than 1/8 inch after cleaning out may be neglected if riveting is undisturbed as noted in Figure 135.

142. DAMAGE REPAIRABLE BY PATCHING.-Damage to the capstrips or diagonals more than negligible should be repaired by cutting out the damaged area and patching with a 24ST aluminum alloy patch as noted in Figure 27, provided the damage is so located that there is room to fit the patch. The web type rib capstrips may be similarly repaired and the web may be patched if the patch can be fitted and does not interfere with the passage of conduits. (See Figure 27).

CAUTION

It is important to maintain the contour of the nose ribs. Distortion of the leading edge will otherwise result with consequent disturbance of the aerodynamics of the wing.

143. DAMAGE NECESSITATING REPLACEMENT.-If the damage cannot be repaired by patching, replacement of the damaged member should be made.

TAIL RIBS.

144. GENERAL.-The tail ribs of the outer panel are solid web type similar to the tail ribs in the wing center section except that the former are fabric covered while the latter are covered with 24ST aluminum alloy skin plating on top and are attached to adjacent stringers. (See Figure 18). The nose of these ribs is attached to the wing flaps support beam and the aft section to the trailing edge.

NOTE

These members should be inspected for dents, cracks, nicks, holes, disturbed riveting and distortion.

145. NEGLIGIBLE DAMAGE.-Isolated dents in the web and flanges less than 1/16 inch deep and nicks in the free edges of the flanges less than 1/8 inch deep after smoothing out, and cracks may be neglected as noted in Figure 135. Cleaned out holes in the web with a diameter less than 1/4 the width of the web (or 1/2 inch maximum diameter if this is smaller) and not in the way of the radius or attachments may be neglected provided they are more than two inches between centers from any similar hole as noted in Figure 135.

146. DAMAGE REPAIRABLE BY PATCHING.-Damage to the flange may be repaired by a patch as shown in Figure 28. More extensive damage up to 1/2 the width of the web requires a larger patch as shown in Figure 28.

NOTE

When repairing the center section tail ribs the damage may be in the way of stringer attachments, in which case the stringer may be trimmed as shown in Figure 28. When repairing the outer wing panel tail ribs, fabric may be involved in which case reference should be made to NOTE in Paragraph 115 above.

147. DAMAGE REPAIRABLE BY INSERTION.-If damage is too extensive to repair by patching, a damaged section of the rib may be removed and a new equivalent section inserted, using the largest type patch for a splice plate as shown in Figure 28. Refer to NOTE in the Paragraph immediately above.

148. DAMAGE NECESSITATING REPLACEMENT.-A rib which cannot be repaired by patching or insertion should be replaced with an equivalent undamaged rib. Refer to NOTE in Paragraph 146 above.

TRAILING EDGE.

149. GENERAL.-The trailing edge of the outer panel and wing center section is an Alcoa section. The skin of the center section is riveted to the trailing edge, while the fabric of the outer panels covers the trailing edge. A chordwise inspection plate where the center section and outer panel join is attached to a portion of the trailing edge by screws. (See Figure 39).

NOTE

The trailing edge should be inspected for dents, nicks, holes, breaks, cracks, distortion and disturbed riveting.

150. NEGLIGIBLE DAMAGE.-Small, smooth, isolated dents, free from cracks, sharp corners and abrasions may be neglected provided they are less than 1/16 inch deep, adjacent riveting is undisturbed and the section is not distorted. Isolated nicks in the free edges of the section less than 1/8 inch deep after smoothing out may be neglected.

151. DAMAGE REPAIRABLE BY PATCHING.-Damage up to 1/2 the width of the section should be repaired by patching. The patch should be 24ST aluminum alloy sheet riveted over the trailing edge in conjunction with a 24ST aluminum alloy filler block in accordance with Figure 117. (Reference should be made to NOTE in Paragraph 153 below).

152. DAMAGE REPAIRABLE BY INSERTION.-Damage more than 1/2 the width of the section may be repaired by insertion. The damaged section should be cut out between rib attachments and replaced by a new equivalent length of trailing edge secured at the butt joint the same as a patch repair as shown in Figure 117. (See NOTE in Paragraph 153 below).

153. DAMAGE NECESSITATING REPLACEMENT.-Damage which cannot be repaired as above necessitates replacement of the trailing edge.

NOTE

The alignment of the trailing edge should be checked during repairs. This may be done by stringing a wire or straight edge across the trailing edge. It may be necessary to check the alignment of the entire trailing edge section in which case reference should be made to Figure 24. Fabric repairs will be involved in damage to the outer wing panel trailing edge. Fabric in the way of the damage should first be removed. After the repair plates are installed the fabric should be replaced over the patch. Repair material should be protected against dope as described in NOTE, Paragraph 115 above.

WING FLAP SUPPORT BEAM.

154. GENERAL.

a. The wing flap support beam is built in two sections, inboard and outboard, in each wing. The inboard portion is located in the aft structure of the wing center section as shown in Figure 18, and is spliced to the outboard portion which extends into the aft structure of the outer panel as shown in Figure 22. The inboard portion of the beam is covered with 24ST aluminum alloy skin riveted to the top and bottom flanges, the lower skin extending over the aft face of the beam across the rear lower portion of the tail ribs.

b. The outboard portion of the beam is covered with fabric extending over the upper and lower flanges and across the aft face of the beam as shown in Figure 29.

c. The flanges are bent up forming a "Zee" section and the web has a double row of lightening holes throughout its length. The intermediate ribs are attached to the forward face of the inboard and outboard portions, and the tail ribs to the aft face.

NOTE

Check for dents, holes, cracks, nicks, distortion and disturbed riveting.

155. NEGLIGIBLE DAMAGE.-Small smooth isolated dents less than 1/16 inch deep, isolated nicks less than 1/8 inch deep after smoothing out, cracks and smoothed out holes less than 1/2 inch in diameter may be neglected in accordance with Figure 135.

156. DAMAGE REPAIRABLE BY PATCHING.

a. Damage more than negligible may be repaired by patching.

NOTE

If the damage is in the outboard portion of the beam, the fabric in the way of the damage should first be removed and repaired or replaced after the repair is completed. New repair material should be protected against dope. Reference should be made to NOTE in Paragraph 115 above and Section 8. If the damage is in the inboard portion of the beam, the aluminum alloy skin in the way of the damage should first be removed and repaired or replaced after the repair is completed.

Care should be taken to assure that repairs do not interfere with movement of the wing flaps.

b. Damage to either flange more than negligible may be repaired by cutting out the damaged area and repairing with a 24ST aluminum alloy bent gle patch of the next heavier gage as shown in gure 29. Damage to the flange involving the web, or damage to the web only may be repaired as shown in Figure 29.

c. It is not necessary to cut out repair plates to suit the lightening holes in the original construction. Patches may be placed on either side of the beam depending on convenience and the location of the damage.

d. Damage in the way of rib or hinge fittings may be repaired as shown in Figure 29; however, if this repair is difficult, it is recommended that the damaged section be cut out and an insertion repair made. Attachment fittings in the way of damage should be removed, repaired or replaced and reinstalled.

e. A cracked lightening hole may be repaired in accordance with Figure 115 except that flanged edges are not involved.

157. DAMAGE REPAIRABLE BY INSERTION.-If the dame cannot be repaired by patching, the damaged portion may be cut out between ribs through lightening holes and a new equivalent length of beam inserted, using the splice plate shown in Figure 29, and observing the same general instructions for e installation of patches described in the Paragraph immediately above.

158. DAMAGE NECESSITATING REPLACEMENT.-Damage not repairable by patching or insertion as described above necessitates replacement of the beam with an undamaged equivalent. Special reference should be made to NOTE in Paragraph 156 above.

AILERON SUPPORT BEAM.

159. GENERAL.-The aileron support beam, left and right, is a lightening hole "Zee" section with bent up flanges similar to the wing flap support beam. The beam is covered with a fairing attached by means of blind rivets, and fabric which extends over the fairing and across the lower flange as shown in Figure 29.

160. NEGLIGIBLE DAMAGE.-Negligible damage is defined the same as damage to the wing flap beam as described in Paragraph 155 above.

161. DAMAGE REPAIRABLE BY PATCHING.-Damage more an negligible may be repaired by patching in accordance with Paragraph 156 above and Figure 29, taking special note that damage to the aileron beam may involve damage to the fairing and fabric covering and that repair material in contact with fabric dope should be treated in accordance with NOTE in Paragraph 115 above.

162. DAMAGE REPAIRABLE BY INSERTION.-See Paragraph 157 above with special reference to NOTE in Paragraph 115 above. If the outer portion of the beam is damaged, it may be preferable to cut off the damaged end and splice on a new equivalent section in which case only one butt joint with splice plates will be required.

163. DAMAGE NECESSITATING REPLACEMENT.-See Paragraph 158 above.

WING TIP.

164. GENERAL.-The wing tip structure is a separate jigged assembly consisting of a framework of spanwise and chordwise web type ribs and bent up trailing edge as shown in Figure 30. The structure is covered with 52S½H aluminum alloy panels, the top and bottom plating welded together around the tip of the structure. The skin is covered with fabric except on the forward portion. The wing tip is non-structural.

NOTE

Inspect for dents, holes, cracks, distortion and disturbed riveting.

SKIN.

165. REPAIR OF DENTS, PERFORATIONS.-See Paragraph 99 above.

166. NEGLIGIBLE DAMAGE.-See Paragraph 100 above.

167. DAMAGE REPAIRABLE BY PATCHING.

a. Damage more than negligible may be repaired by patching as described in this paragraph.

NOTE

Repair may necessitate removal of fabric over the skin, in which case the fabric should be repaired as required and reinstalled after the metal skin is repaired. Repair material in contact with fabric should be protected against dope. Reference should be made to NOTE in Paragraph 115 above and Section 8.

b. Holes in open areas may be repaired by fabric as described in Paragraph 101a (1) above.

c. The skin outside the spot welded seam at the tip may be repaired with a flush or outside

patch as described in Paragraphs 101a (2), 101b and 101c above, except that the patch may be 52S½H aluminum alloy.

d. Damage to the spot welded seams at the tip may be repaired by an angle patch of 52S½H aluminum alloy bent up to fit over the edge and riveted to the top and bottom plates. (See Figure 31). Reference should be made to spot weld repairs in the next Paragraph below.

168. DAMAGE REPAIRABLE BY INSERTION.-A damaged portion of the skin too large to make a patch repair practical, may be repaired by cutting out the damaged area along adjacent internal structure and making lap joints by inserting equivalent new skin similar to the method shown in Figure 7. Special reference should be made to NOTE in Paragraph 167 immediately above. If the seam at the tip is involved, spot welding may be replaced by riveting as described in Section 1, Paragraph 13b and shown in Figures 130 to 134, inclusive.

169. DAMAGE NECESSITATING REPLACEMENT.-Damage not repairable as described above necessitates replacement of the skin as in the original construction except that spot welding may be repaired by riveting as noted in Paragraph 168 above; special reference should be made to NOTE in Paragraph 167 above.

RIBS.

170. GENERAL.-The ribs which comprise the internal structure of the wing tip section are lightening hole members similar to the web type ribs of the wing center section and outer panels.

171. NEGLIGIBLE DAMAGE.-Negligible damage is defined the same as damage to similar members in the wings as outlined in Paragraph 65 above.

172. DAMAGE REPAIRABLE BY PATCHING.-See Paragraph 66 above.

173. DAMAGE REPAIRABLE BY INSERTION.-See Paragraph 67 above.

174. DAMAGE NECESSITATING REPLACEMENT.-See Paragraph 68 above.

TRAILING EDGE.

175. GENERAL.-The trailing edge is a bent up "V" section.

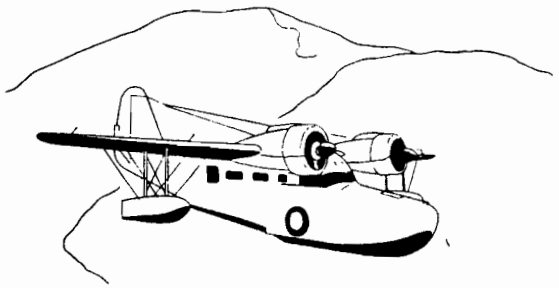
176. NEGLIGIBLE DAMAGE.-See Paragraph 235 below.

177. DAMAGE REPAIRABLE BY PATCHING.-The wing tip trailing edge, a short curved member, may be repaired by patching as described in Paragraph 236 below and shown in Figure 117 provided there is room to fit the patch and it conforms with the proper curvature.

178. DAMAGE NECESSITATING REPLACEMENT.-Due to the short length of this piece, for damage not repairable by patching replacement of the member is recommended.

NOTE

The tubular members attaching the trailing edge to the aft ribs should be replaced if distorted or if damage includes nicks or dents over 1/16 inch deep, or cracks longer than one inch. For fabric involved in damage to the trailing edge, reference should be made to Section 8.



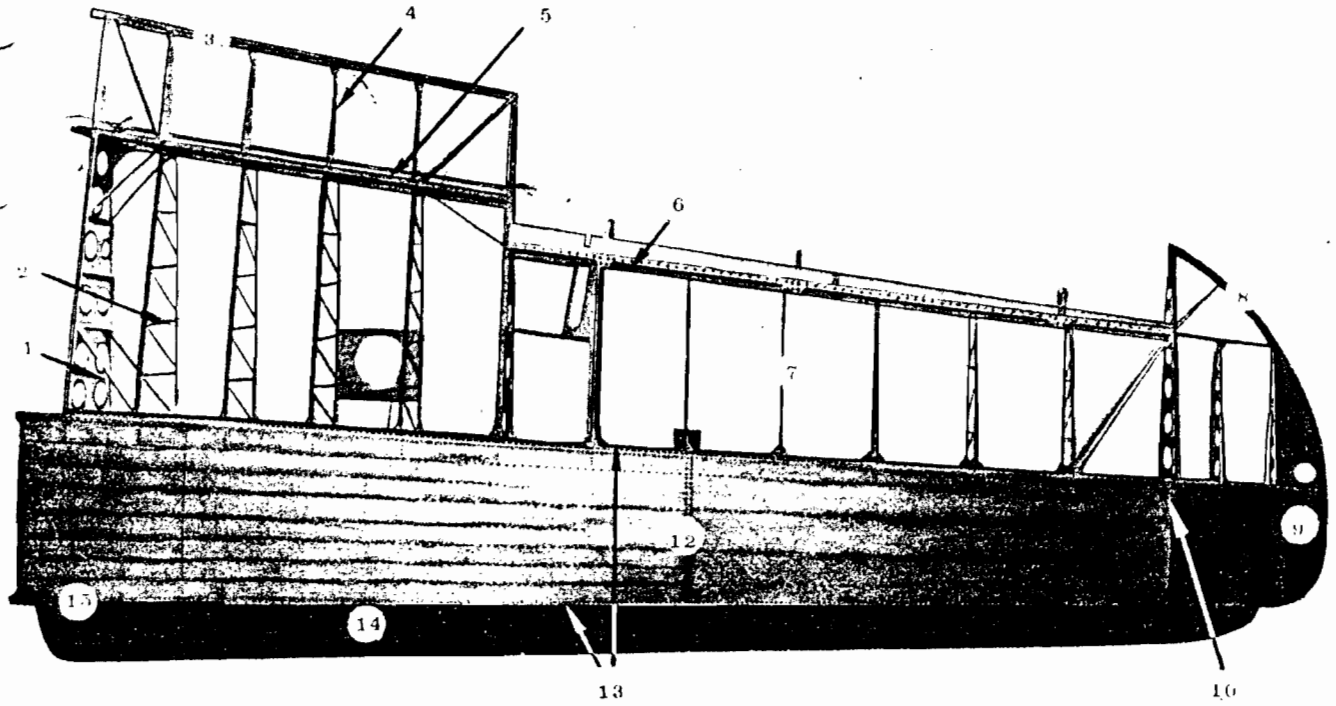


Photo Ref. No.	Part No.	Sta.	Description	Material	Thickness
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	12383-5		Angle - Stiffener	24ST Aluminum Alloy Ext. Alcoa #98	
	12383-10		Tapping Strip	24ST Aluminum Alloy Sheet	.091
2	12384	109	Intermediate Rib See Ref. No. 7		
	12387	151	Intermediate Rib See Ref. No. 7		
3	385		Trailing Edge	24ST Aluminum Alloy Ext. Alcoa K-14403	
4			Tail Ribs		
	12365	137	Typical Tail Rib		
	12365-1		Rib Sheet	24ST Aluminum Alloy Sheet	.028
	12365-5,6		Tapping Strips	24ST Aluminum Alloy Sheet	.091
	12368	97	Similar to 12365		
5	12340		Wing Flap		
			Beam Assembly		
	12340-3		Beam - Inboard	24ST Aluminum Alloy Sheet	.064
	12340-4		Beam - Outboard	24ST Aluminum Alloy Sheet	.064
6	12356		Aileron Beam Assembly		
	12356-1		Beam - Inner	24ST Aluminum Alloy Sheet	.064
	12356-2		Beam - Outer	24ST Aluminum Alloy Sheet	.064
7	12390	196	Intermediate Rib		
	12390-1		Capstrip - Upper	24ST Aluminum Alloy Sheet	.026
	12390-2		Capstrip - Lower	24ST Aluminum Alloy Sheet	.026
8	12420-13		Trailing Edge	24ST Aluminum Alloy Sheet	.028

Figure 22 - Wing Outer Panel Structure

KEY TO FIGURE 22 (CONT.)

Photo Ref. No.	Part No.	Sta.	Description	Material	Thickness
9	12420		Wing Tip		
10	12382	271	End Bulkhead (Web extends from nose to trailing edge)		
	12382-3		Plate	24ST Aluminum Alloy Sheet	.028
11			Skin Paneling		
12			Bulkheads		
	12370	97			
	12370-1		Angle - Top	24ST Aluminum Alloy Ext. Alcoa K-22220	
	12370-2		Angle - Bottom	24ST Aluminum Alloy Ext. Alcoa K-22220	
	12370-3		Plate	24ST Aluminum Alloy Sheet	.020
	12375	166			
	12375-1		Angle - Top	24ST Aluminum Alloy Ext. Alcoa K-22220	
	12375-2		Angle - Bottom	24ST Aluminum Alloy Ext. Alcoa K-22220	
	12375-3		Plate	24ST Aluminum Alloy Sheet	.020
	12376	181			
	12376-1		Angle - Top	24ST Aluminum Alloy Ext. Alcoa K-22220	
	12376-2		Angle - Bottom	24ST Aluminum Alloy Ext. Alcoa K-22220	
	12376-3		Plate	24ST Aluminum Alloy Sheet	.020
	12378	211			
	12378-1		Angle Top	24ST Aluminum Alloy Sheet	.040
	12378-2		Angle Bottom	24ST Aluminum Alloy Sheet	.040
	12378-3		Plate	24ST Aluminum Alloy Sheet	.020
			Box Beam		
13	12320		(Front & Rear)		
	12320-3		Plate - Inboard	24ST Aluminum Alloy Sheet	.051
	12320-4		Plate - Center	24ST Aluminum Alloy Sheet	.040
	12320-5		Plate - Outboard	24ST Aluminum Alloy Sheet	.028
	12320-6		Plate - Inboard	24ST Aluminum Alloy Sheet	.040
	12320-8		Cor. Angle Top Front	24ST Aluminum Alloy Ext. Alcoa #439-2	1/8 gage
	12320-9		Cor. Angle Bot. Front	24ST Aluminum Alloy Ext. Alcoa #439-2	1/8 gage
	12320-38		Cor. Angle Top Rear	24ST Aluminum Alloy Ext. Alcoa #734TT	
	12320-39		Cor. Angle Bot. Rear	24ST Aluminum Alloy Ext. Alcoa #734TT	
14	12302-1 to 9 & 20		Nose Skin		
15	12396	97	Nose Rib		

RESTRICTED

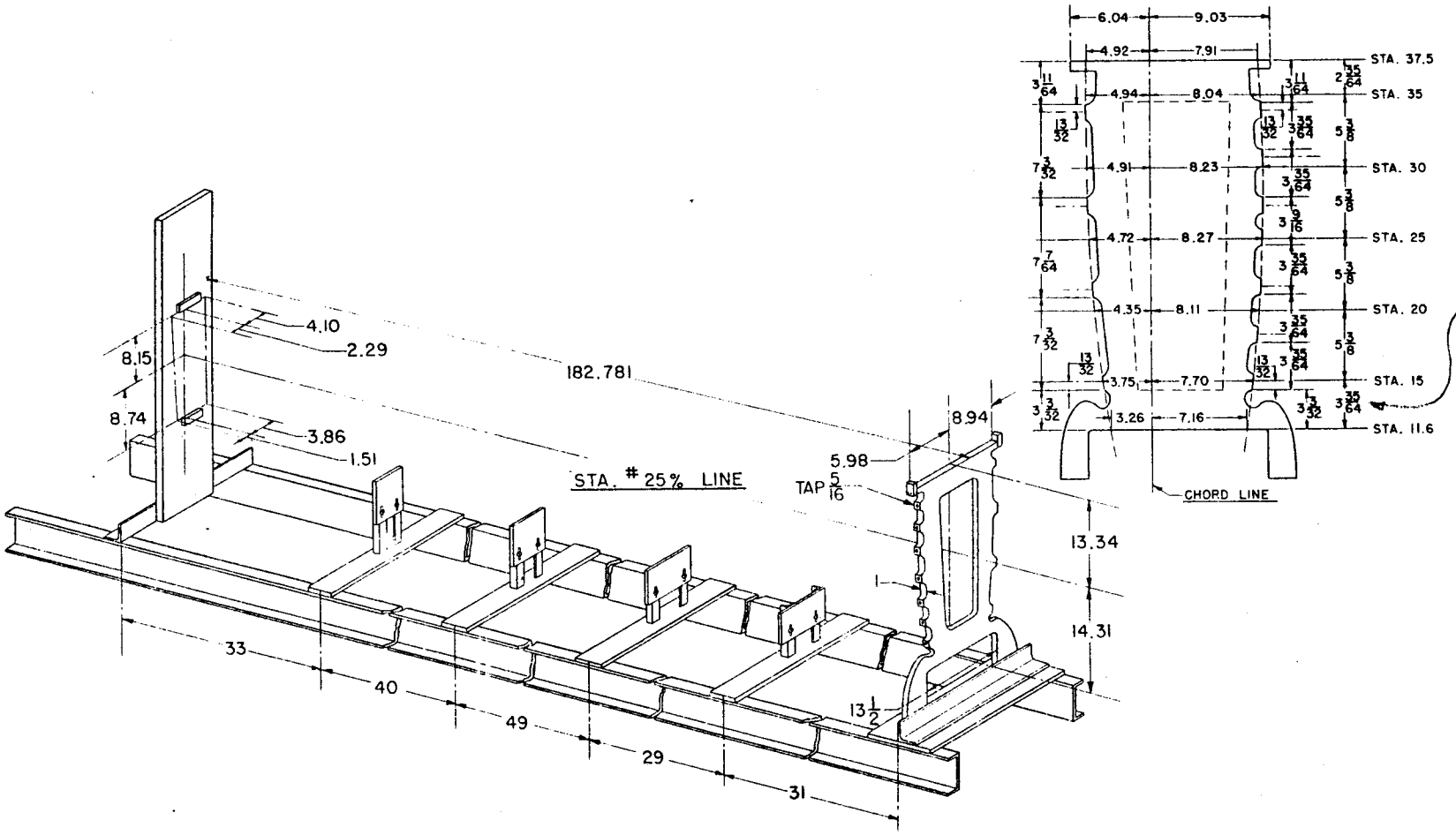
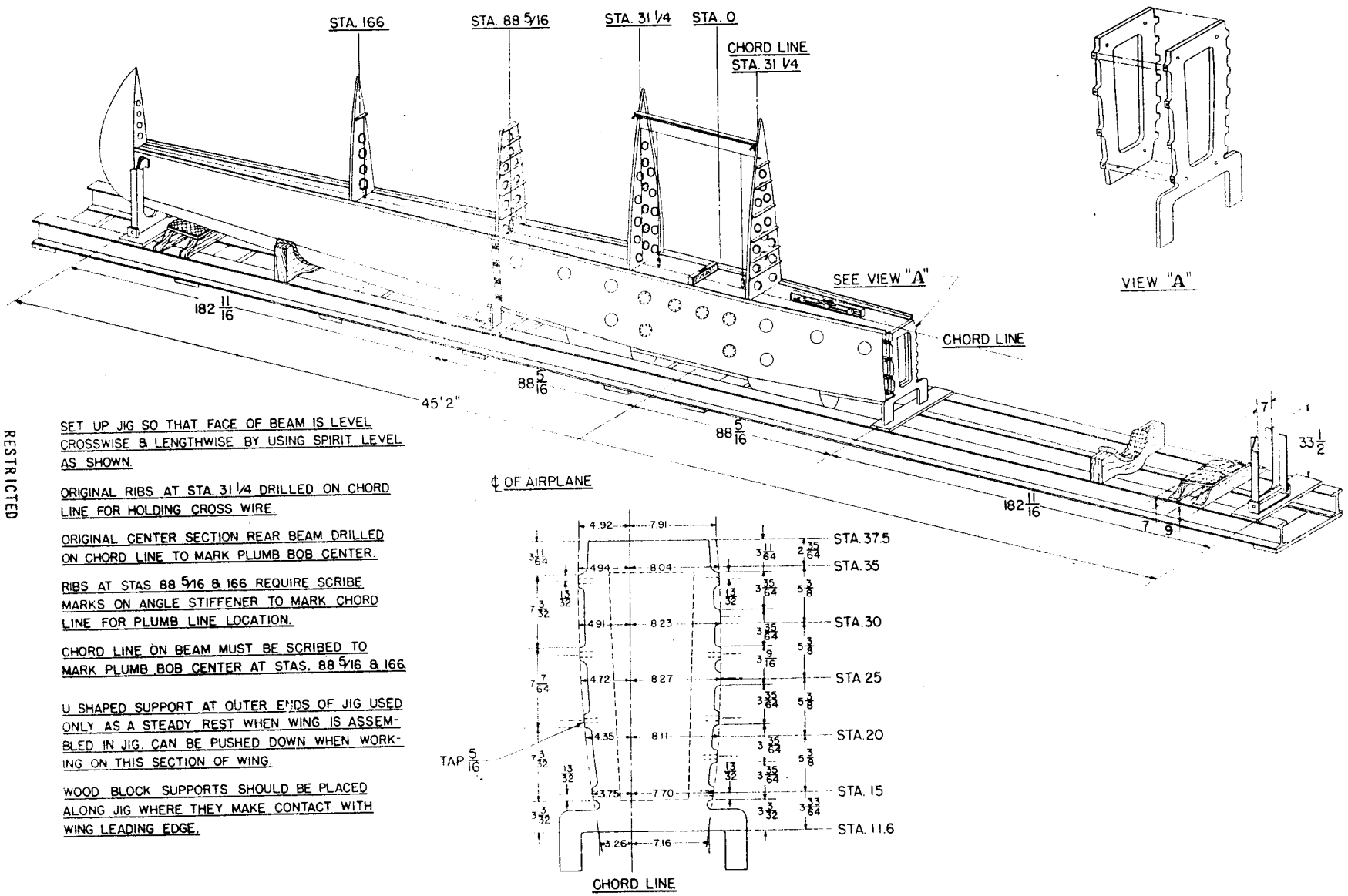


Figure 23 - Wing Outer Panel Box Beam Jig

RESTRICTED
Nav. Aer. 01-85V-3



SET UP JIG SO THAT FACE OF BEAM IS LEVEL CROSSWISE & LENGTHWISE BY USING SPIRIT LEVEL AS SHOWN.

ORIGINAL RIBS AT STA. 31 1/4 DRILLED ON CHORD LINE FOR HOLDING CROSS WIRE.

ORIGINAL CENTER SECTION REAR BEAM DRILLED ON CHORD LINE TO MARK PLUMB BOB CENTER.

RIBS AT STAS. 88 5/16 & 166 REQUIRE SCRIBE MARKS ON ANGLE STIFFENER TO MARK CHORD LINE FOR PLUMB LINE LOCATION.

CHORD LINE ON BEAM MUST BE SCRIBED TO MARK PLUMB BOB CENTER AT STAS. 88 5/16 & 166.

U SHAPED SUPPORT AT OUTER ENDS OF JIG USED ONLY AS A STEADY REST WHEN WING IS ASSEMBLED IN JIG. CAN BE PUSHED DOWN WHEN WORKING ON THIS SECTION OF WING.

WOOD BLOCK SUPPORTS SHOULD BE PLACED ALONG JIG WHERE THEY MAKE CONTACT WITH WING LEADING EDGE.

Figure 24 - Wing Assembly Jig

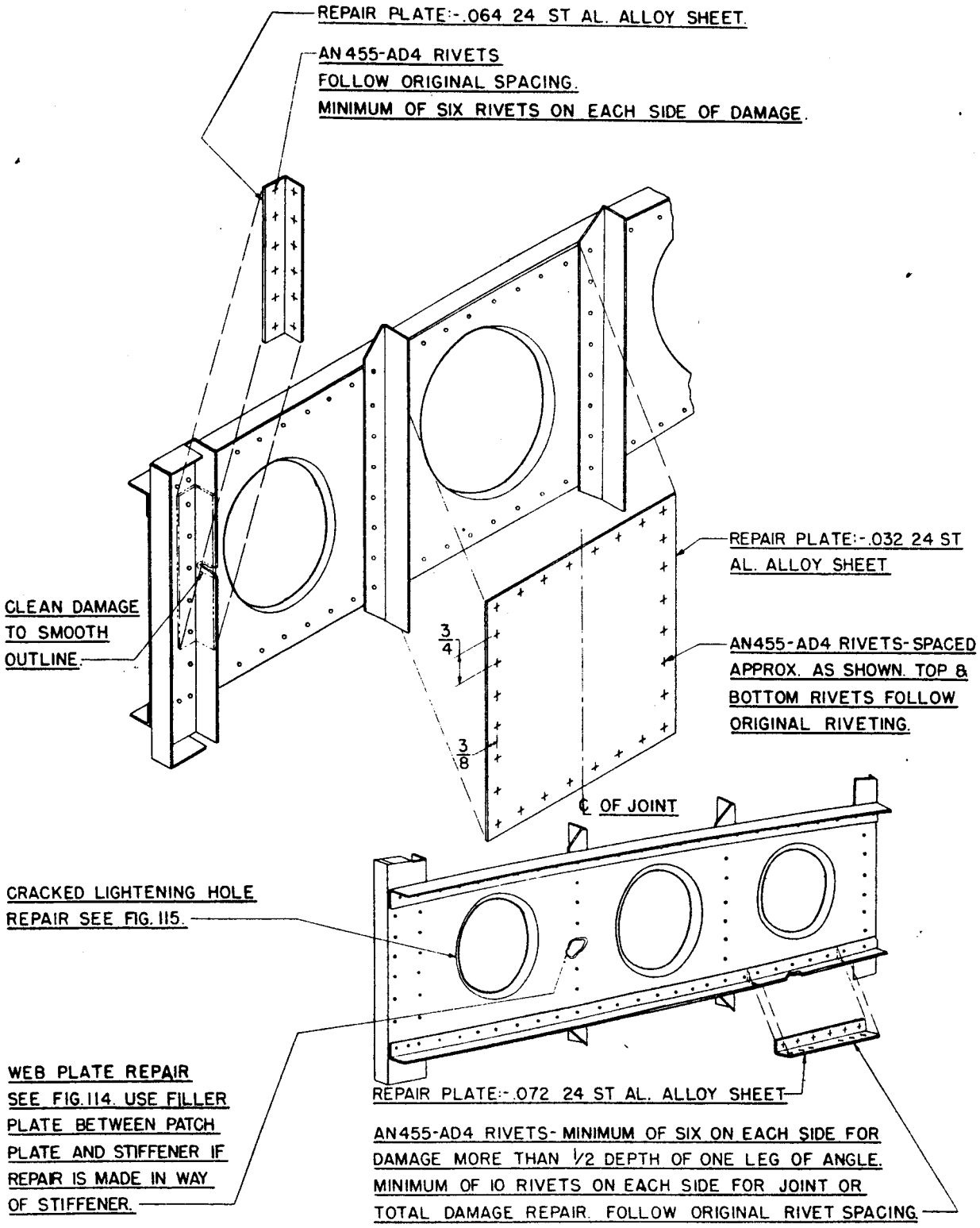


Figure 25 - Wing Outer Panel Bulkhead Repairs

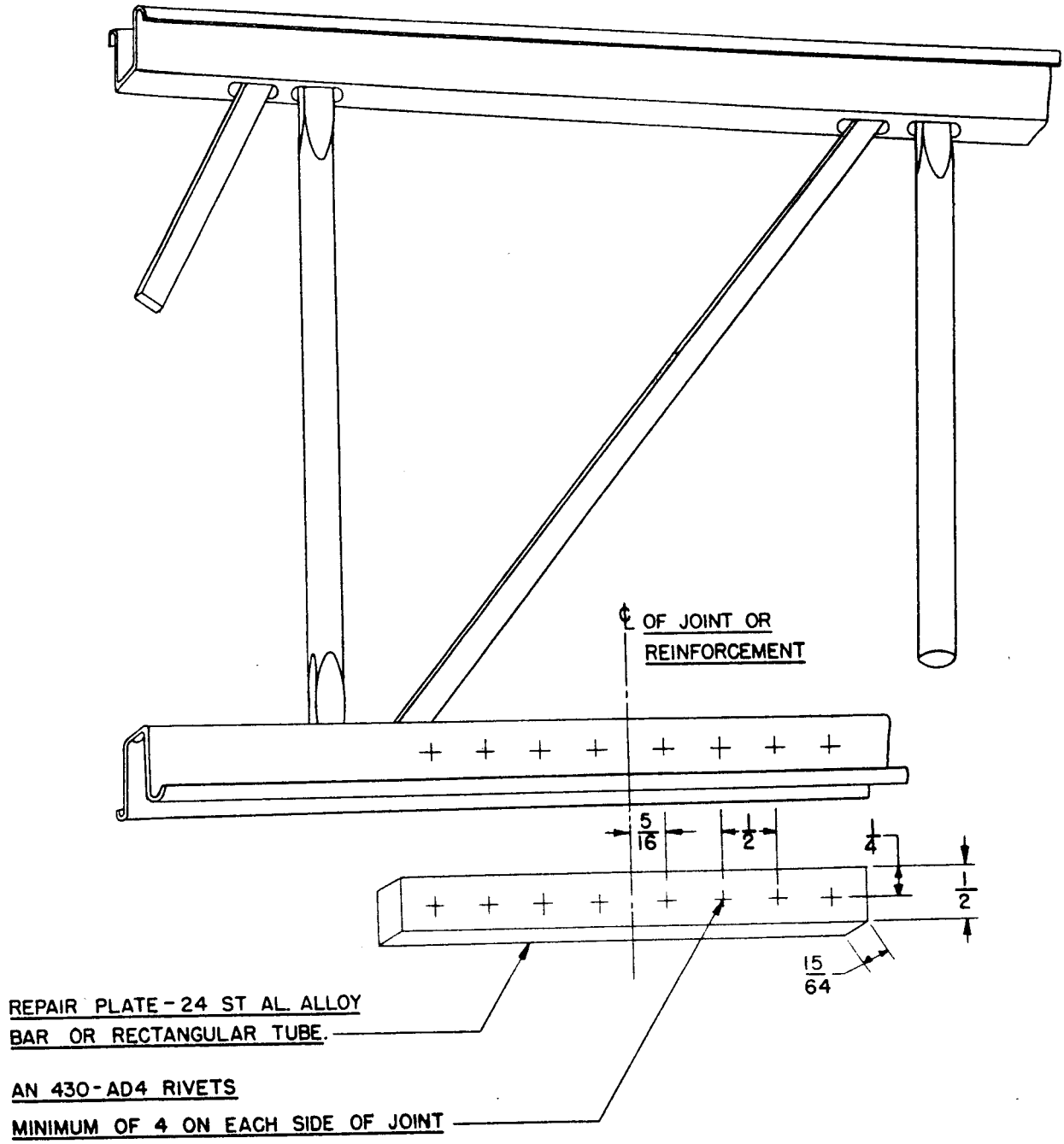


Figure 26 - Wing Outer Panel Truss Type Rib Repairs

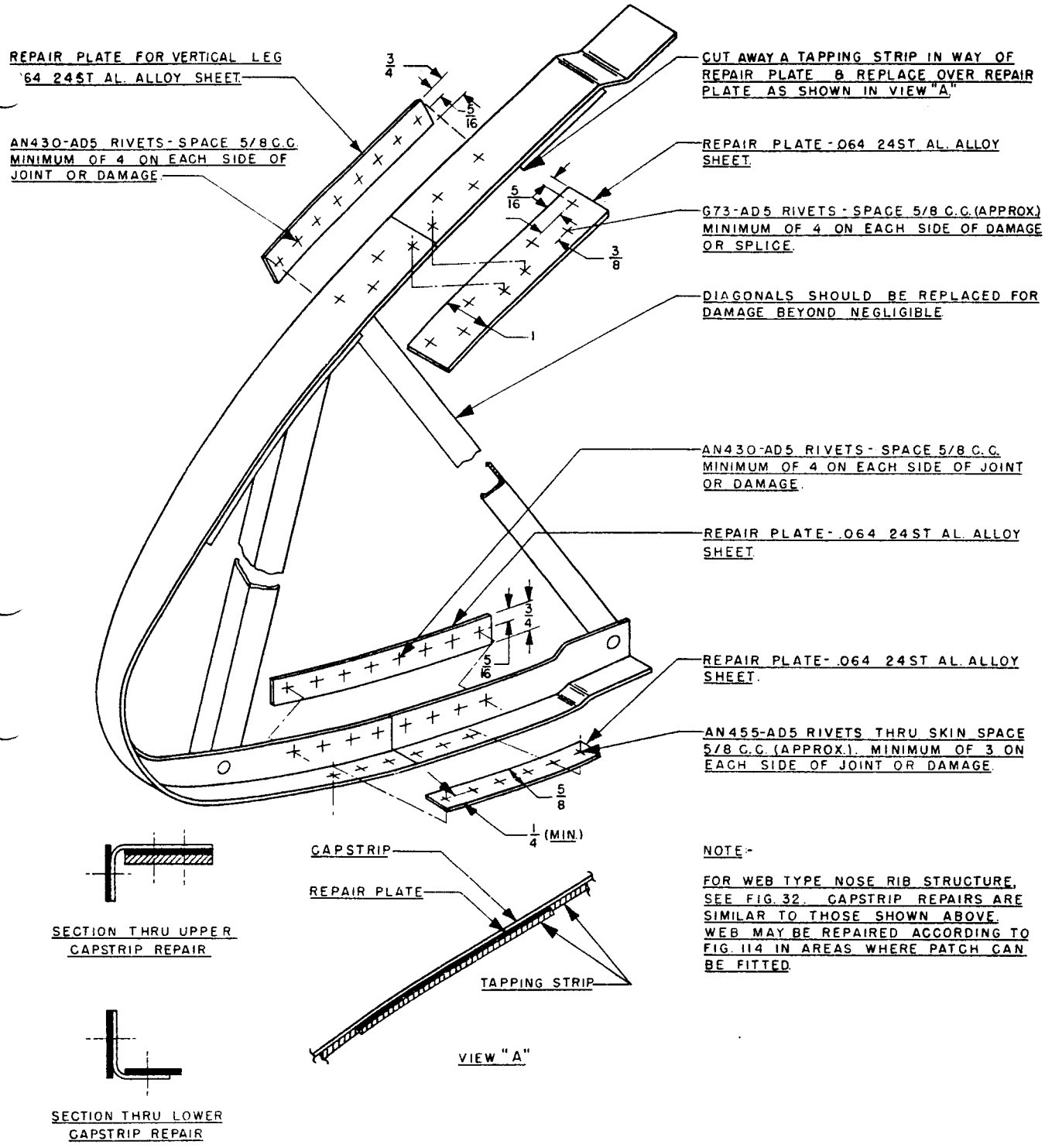
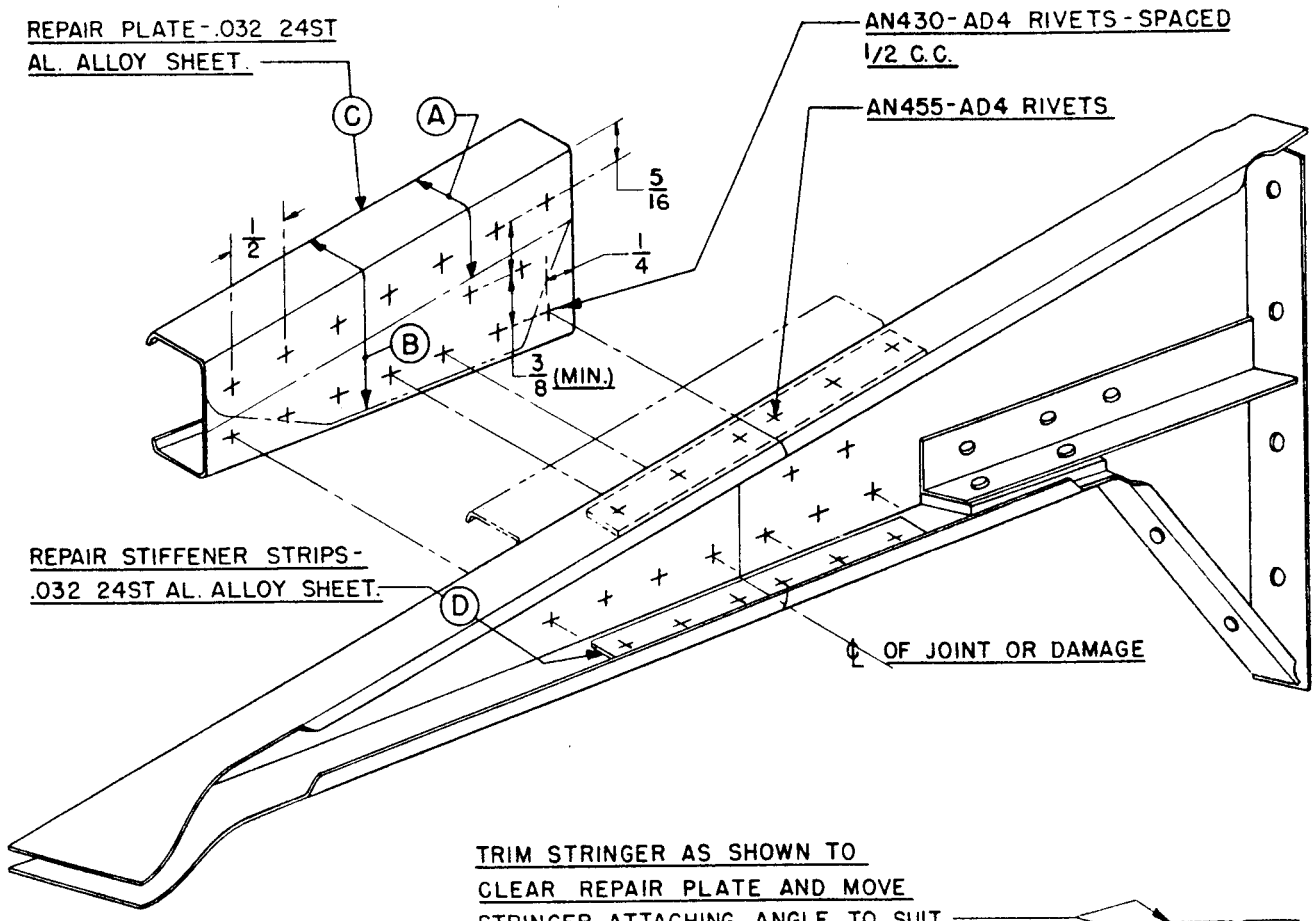
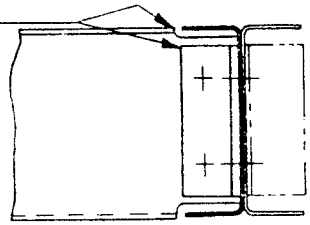


Figure 27 – Wing Nose Rib Repairs



TRIM STRINGER AS SHOWN TO CLEAR REPAIR PLATE AND MOVE STRINGER ATTACHING ANGLE TO SUIT.



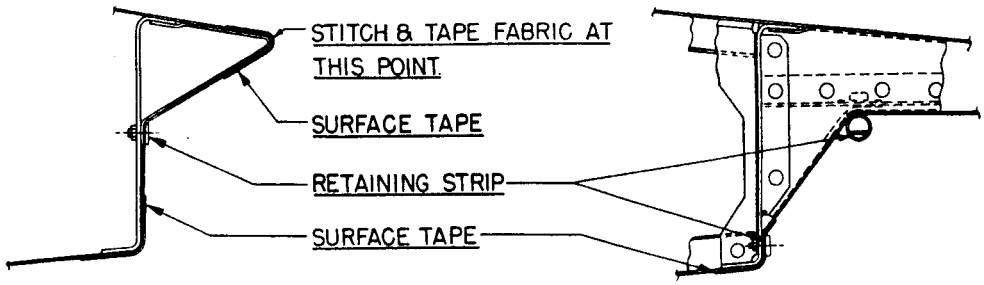
WING CENTER SECTION TAIL RIB STRINGER IN WAY OF REPAIR PLATE.

CASE I - FOR DAMAGE TO ONE FLANGE ONLY, USE REPAIR PLATE "A".

CASE II - FOR DAMAGE EXTENDING THROUGH FLANGE AND UP TO 1/2 WIDTH OF WEB, USE REPAIR PLATE "B".

CASE III - FOR INSERTION, USE REPAIR SPLICE PLATE "C" AND STIFFENER STRIPS "D".

Figure 28 - Wing Tail Rib Repairs



FABRIC ATTACHMENT AT WING AILERON BEAM

FABRIC ATTACHMENT AT WING FLAP BEAM

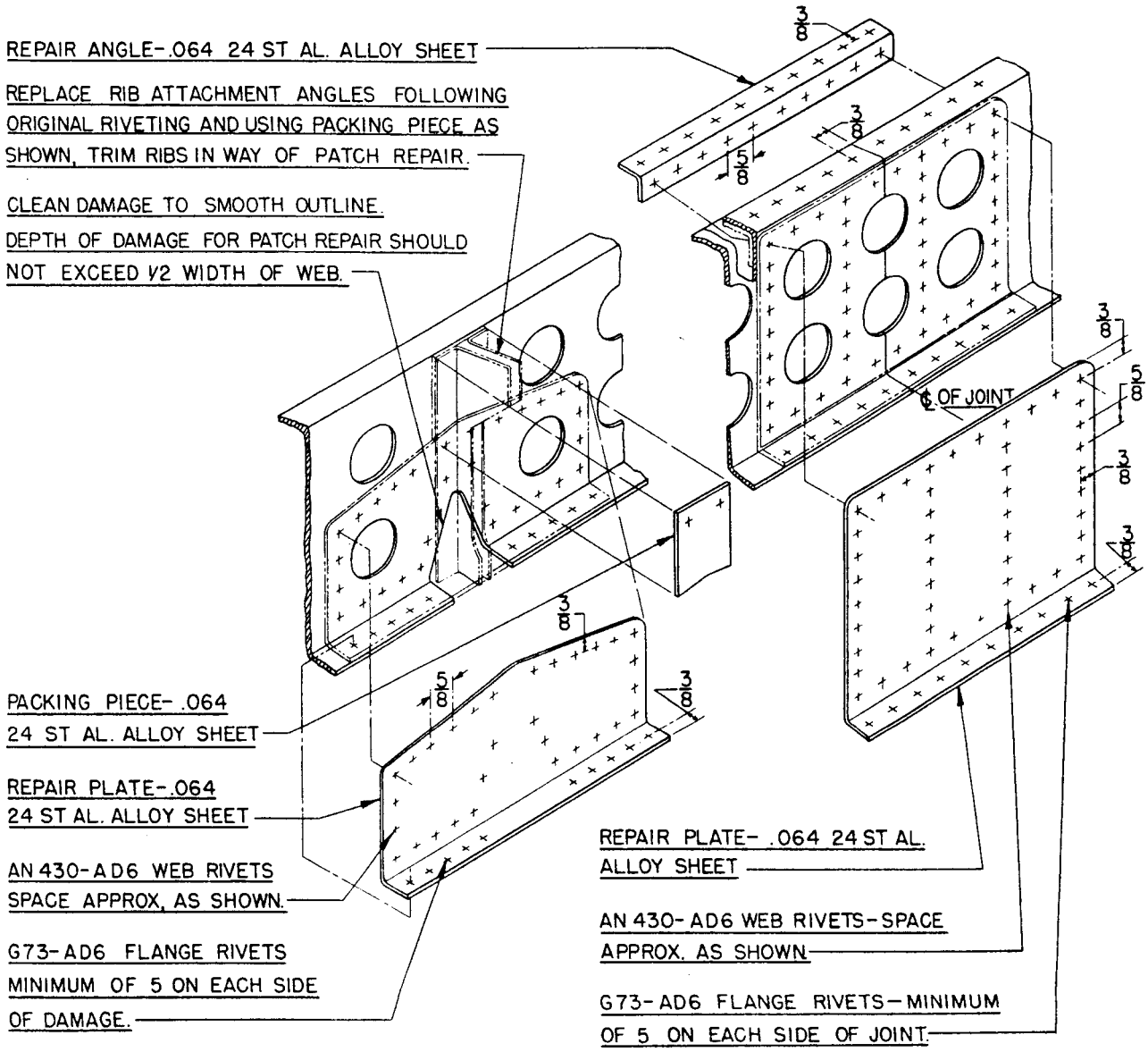


Figure 29 - Wing Flap and Aileron Support Beam Repairs

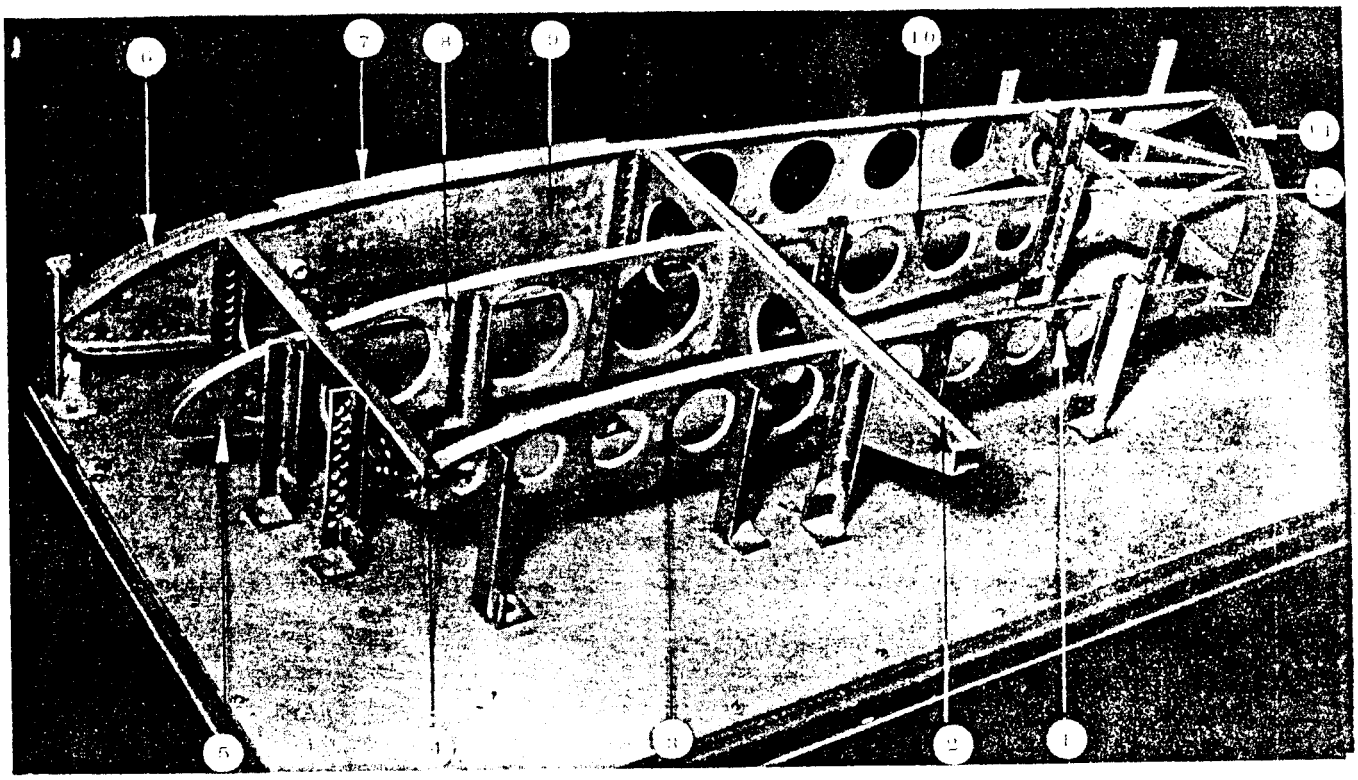


Photo Ref. No.	Part No.	Description	Material	Thickness
1	12420-8	Rib	24ST Aluminum Alloy Sheet	.028
2	12420-1	Beam Center	24ST Aluminum Alloy Sheet	.028
3	12420-7	Rib	24ST Aluminum Alloy Sheet	.028
4	12420-2	Beam Front	24ST Aluminum Alloy Sheet	.028
5	12420-4	Rib Nose	24ST Aluminum Alloy Sheet	.028
6	12382-9	Angle - Nose	24ST Aluminum Alloy Sheet	.040
7	12382-10	Angle Top	24ST Aluminum Alloy Sheet	.040
	12382-11	Angle Bottom	24ST Aluminum Alloy Sheet	.040
8	12420-5	Rib	24ST Aluminum Alloy Sheet	.028
9	12382	Bulkhead Outer Wing Sta. #271		
	12382-3	Plate	24ST Aluminum Alloy Sheet	.028
10	12420-6	Rib	24ST Aluminum Alloy Sheet	.028
11	12420-13	Trailing Edge Piece	24ST Aluminum Alloy Sheet	.028
12	12420-3	Beam Rear	24ST Aluminum Alloy Sheet	.028

Figure 30 - Wing Tip Structure and Jig

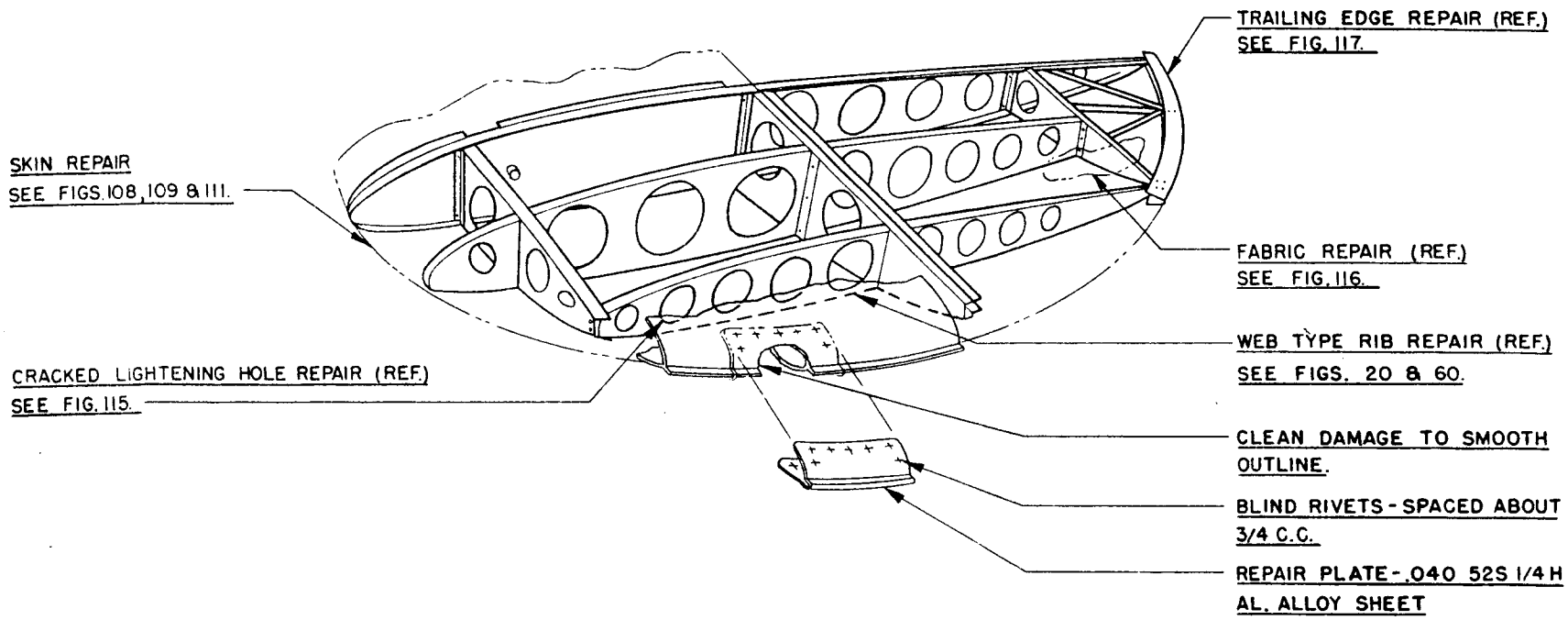
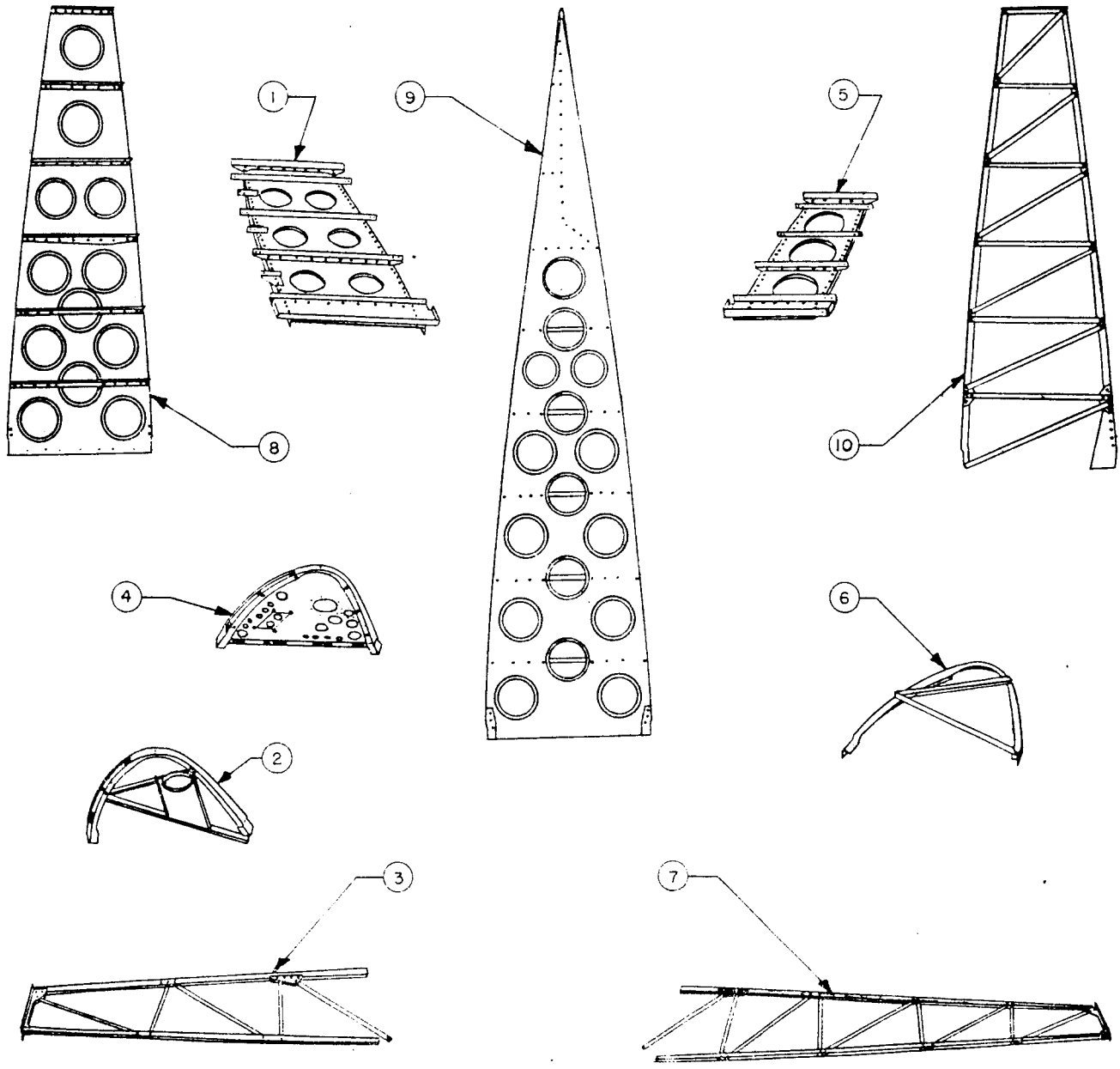
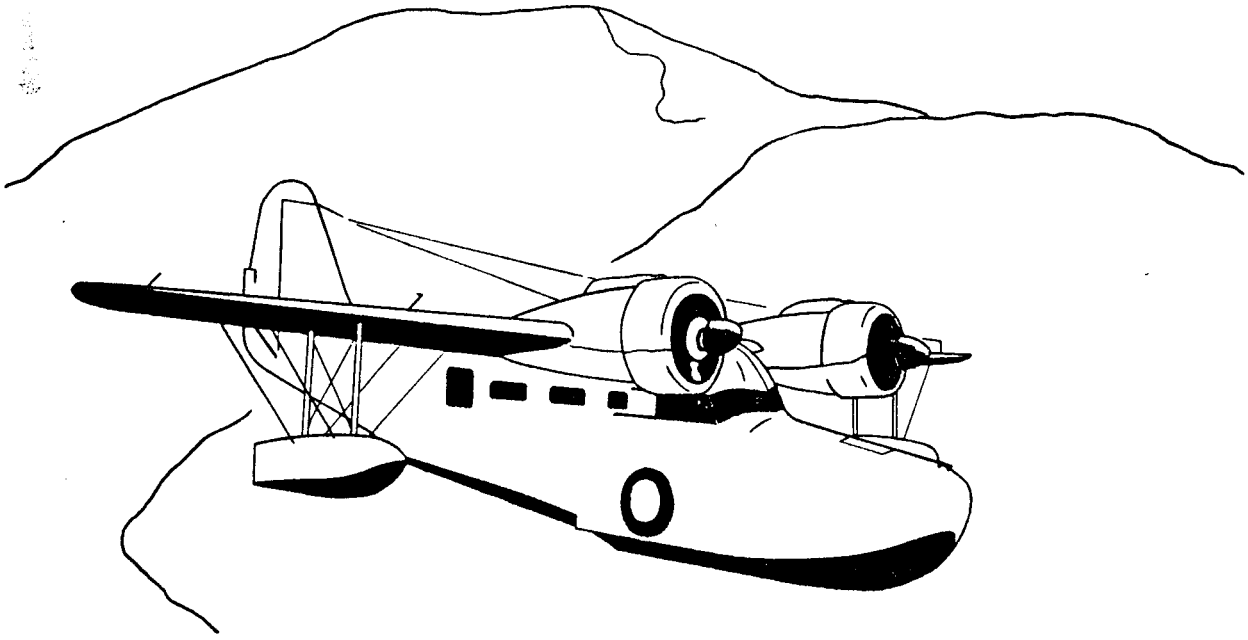


Figure 31 - Wing Tip Repair Reference Diagram



Ref. No.	Description
1	Box Beam Bulkhead - Center Section
2	Nose Rib
3	Trailing Intermediate Rib - Forward of Aileron
4	Nose Rib
5	Box Beam Bulkhead - Middle of Beam
6	Nose Rib
7	Trailing Intermediate Rib - Forward of Flap Outboard Wing
8	Outboard Center Section Rib Extends from Box Beam to Flap Beam
9	Inboard Center Section Rib Extends from Box Beam to Trailing Edge
10	Trailing Intermediate Rib Center Section Forward of Flap

Figure 32 - Wing Bulkheads and Ribs



WING TIP FLOATS.

179. GENERAL.

a. The wing tip floats, 760 lbs. displacement each, are of standard lines and 24ST aluminum alloy construction. Each is attached to an outer panel by two fixed length vertical struts, incidence bracing streamline tie rods, and transverse bracing streamline tie-rods.

b. Reference should be made to Figures 33, 34 and 35.

c. Two bulkheads divide each float into three watertight compartments. The bottom of the float is reinforced by frames, three each in the forward and center watertight compartments, and two in the aft compartment.

d. The bottom skin is .040 24ST aluminum alloy. The keel, in one piece, is bent up .040 24ST aluminum alloy, and extends from the bow to the stern, covering the joint of the right and left hand skin panels on the outside. The joint is covered on the inside of the float by 12 keel backing strips between frames and bulkheads.

NOTE

The floats should be inspected for dents, holes, cracks, leaks, distortion and disturbed riveting. Severe damage to the nose and hull bottom may result from collision with floating objects or other obstructions. Extensive damage to the nose involving combined repair of skin and internal structure is repaired according to Figure 33.

WATERTIGHT JOINTS.

180. GENERAL.-Repairs should be watertight as in the original construction. P.A.W. ("Protective and Waterproof") sealing tape (See Table II) and Duprene cement (See Table II) is used in all faying surfaces. Cotton wicking (See Table II) with Neoprene cement (See Table II) may be used at the keel and chines of bulkheads and at the skeg. The access plates for each watertight compartment, located on the top of each float, each has a strip of P.A.W. tape secured to the inside outer perimeter by Duprene Cement. When a plate is to be secured to the float the tape is coated with Par-al-ketone (See Appendix II) and fastened with machine screws. Waterproof repair as in the original construction is similar to hull waterproofing as described in Section 4.

181. TESTING FOR LEAKS.-The wing tip floats may be tested for leaks by partially filling a compartment with water, sloshing the interior and checking for leaks which will be indicated by water or moisture escaping through damaged joints.

SKIN.

182. NEGLIGIBLE DAMAGE.-Small, smooth, isolated dents, free from cracks, sharp corners or abrasions and less than 1/16 inch deep may be neglected if riveting is undisturbed and the float is not distorted. Because the watertight qualities must be maintained it is important that all other damage be repaired as described below.

NOTE

All repairs should be watertight as noted in paragraph 180 above. Surface nicks and scratches should be smoothed out. If the skin is severely dented it may be possible to smooth it out to original contour and replace without further treatment; this may be done provided the original thickness is retained and no other damage occurs as a result of this treatment. #40 (.098) holes should be drilled at the ends of isolated cracks, and the area should be repaired as described below. Cracked areas should be cut out and repaired as described below. Small, isolated holes up to 1/4 inch in diameter after smoothing out may be repaired by inserting a rivet treated with waterproof cement.

183. DAMAGE REPAIRABLE BY PATCHING.-Damage more than negligible and not so extensive as to require insertion or replacement may be repaired by patching. Either a flush or an outside patch may be used. A flush patch is recommended. Preparation of these patches is described in Paragraphs 101a (2),101b and 101c above, and shown in Figures 108 and 109. Patches must be sealed watertight. Zinc chromate paste may be used for this purpose.

184. DAMAGE REPAIRABLE BY INSERTION.-Partial panels may be replaced by cutting out the damaged area along adjacent internal structure and inserting a new equivalent portion which may be lapped or butt jointed as noted in Figure 33. Joints must be watertight.

185. DAMAGE NECESSITATING REPLACEMENT.-An entire panel should be replaced as in the original construction, if not repairable as above.

NOTE

Factory spares are pilot drilled to facilitate installation as in the original con-

struction. As an alternate, 24ST aluminum alloy sheet of the same gage as the damaged one may be cut and formed to the proper contour and installed by locating rivet holes to match rivet holes in the internal frame. To assist in alignment, reference should be made to Figure 33, showing float installation and jig hole locations.

KEEL.

186. GENERAL.-The keel is an angle section as described in Paragraph 179 above.

NOTE

The keel is liable to minor damage such as nicks, dents and cracks, or major damage such as severe distortion, tears or complete fractures.

187. NEGLIGIBLE DAMAGE.-Negligible damage is defined the same as skin damage as outlined in Paragraph 182 above.

188. DAMAGE REPAIRABLE BY PATCHING.-The keel may be patched by fitting a watertight bent angle patch on the outside over the damaged area in accordance with Figure 33.

189. DAMAGE REPAIRABLE BY INSERTION.-If the ıage is too extensive to be repaired by patching, ıaged portion should be cut out for the full width of the keel and a new equivalent portion inserted with watertight splice plates as shown in Figure 33.

190. DAMAGE REPAIRABLE BY REPLACEMENT.-If the mage cannot be repaired as above, the keel must be replaced with an undamaged watertight equivalent.

INTERNAL STRUCTURE.

191. GENERAL.-The internal structure includes bulkheads, horizontal and transverse members and reinforcements as described in Paragraph 179 above.

NOTE

The internal members should be inspected for cracks, holes, dents, leaks, distortion and disturbed riveting.

192. NEGLIGIBLE DAMAGE.

a. Small, smooth, isolated dents, free from cracks, sharp corners and abrasions and less than 1/16 inch deep may be neglected in the internal structure if the structure is undistorted and riveting and waterproofing are undisturbed.

b. In the bottom "Zee" members of the cross frames isolated nicks in the free edges less than 1/8 inch after smoothing out and isolated holes in the web of the "Zee" less than 1/2 inch in diameter after cleaning out may be neglected; isolated smoothed out nicks less than 1/16 inch deep in the free edge of the upper flange of the cross tie straps and cleaned out isolated holes less than 1/2 inch in diameter may be neglected under same conditions as dents.

c. Isolated nicks in the free edge of the stringers, and angle frames, less than 1/8 inch deep after smoothing out may be neglected under same conditions as dents.

193. DAMAGE REPAIRABLE BY PATCHING.-Repair of only the bulkhead plating, bulkhead angle frames, and deck stringers is recommended. These members may be repaired by patching as noted in Figure 33, provided there is room to fit the patch. Be sure to maintain waterproof joints.

194 DAMAGE NECESSITATING REPLACEMENT.-For damage more than negligible to members which cannot be repaired by patching as above, it is recommended that the member be replaced with an equivalent undamaged member maintaining waterproofing as in the original construction.

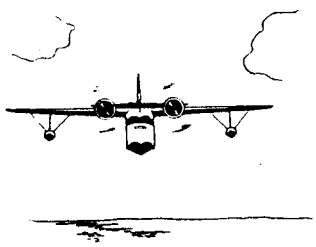
NOTE

In repairing the internal structure or replacing members, reference should be made to Figure 33 to assist in proper alignment.

FLOATS - MISCELLANEOUS.

195. GENERAL.-In addition to the skin and internal members of the wing tip floats, the structure includes the skeg, stern cap, backing strips and struts.

196. DAMAGE NECESSITATING REPLACEMENT.-Unless damage to these members can definitely be classified as negligible, replacement of damaged members is recommended.



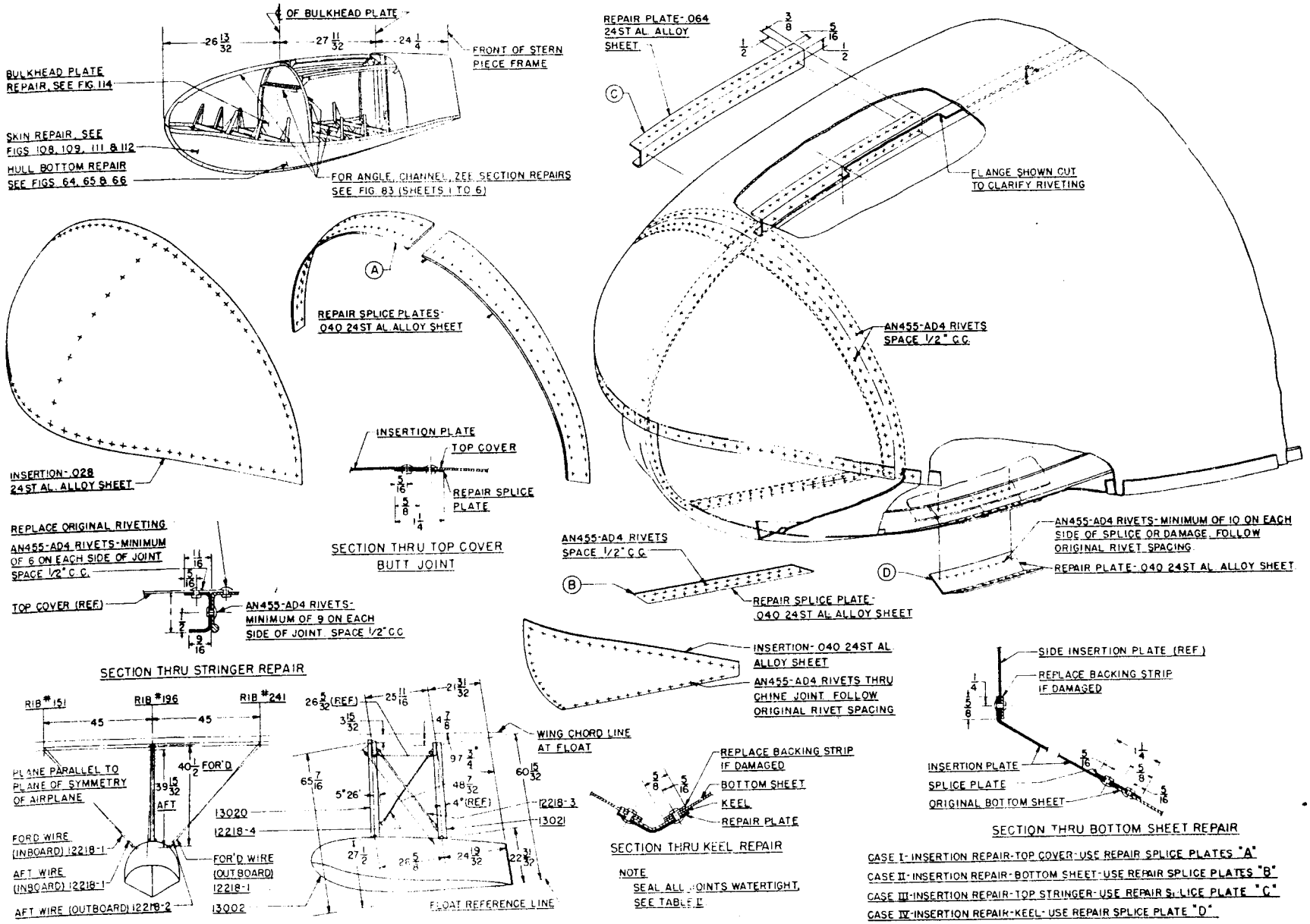


Figure 33 – Wing Tip Float Repair Reference Diagram

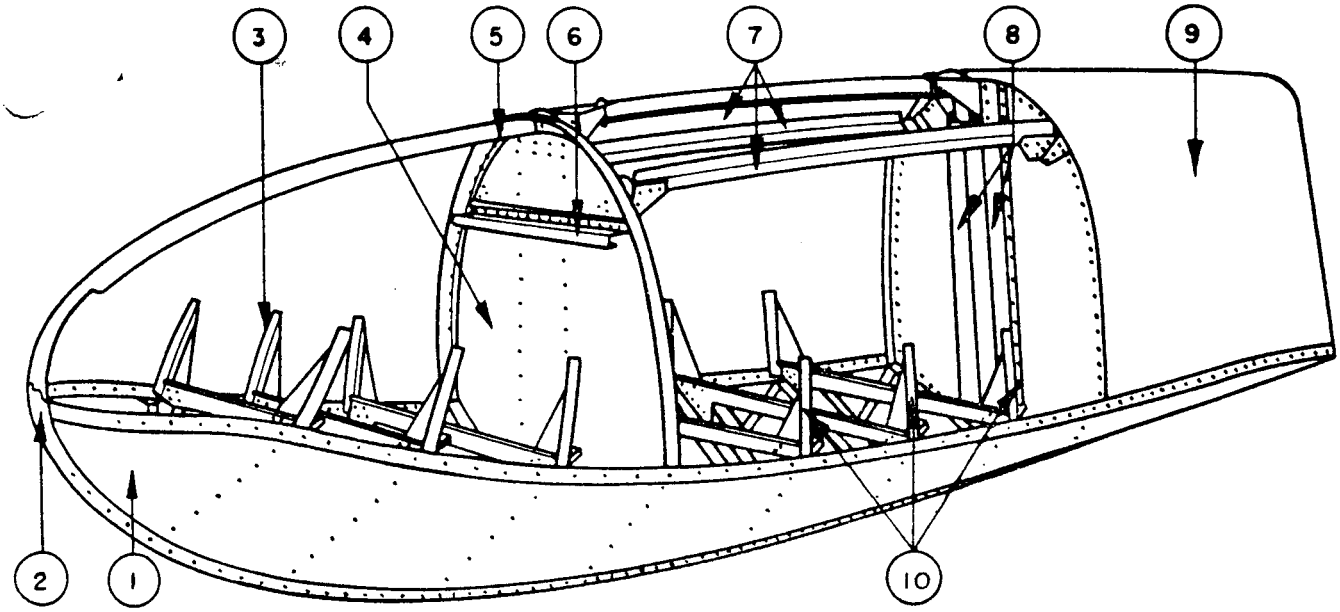
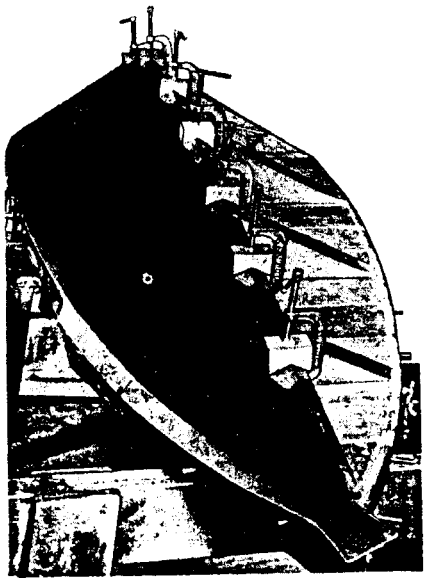
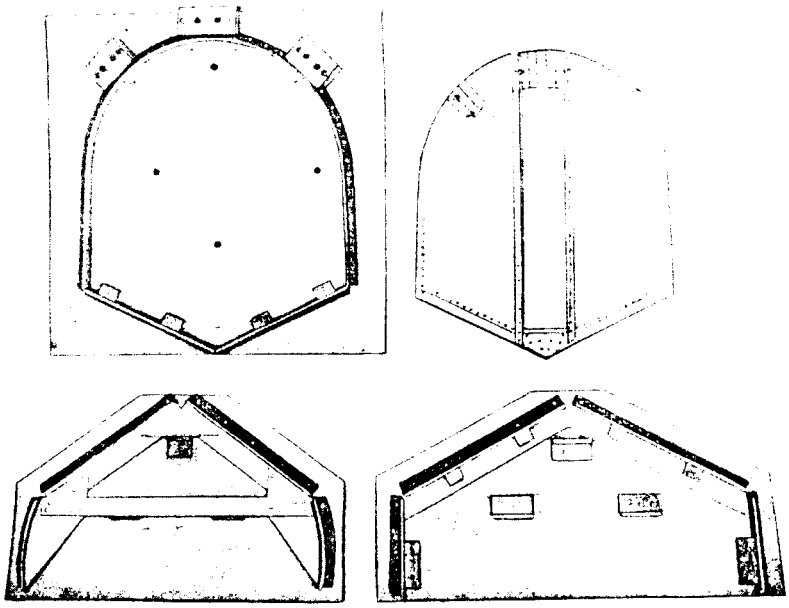
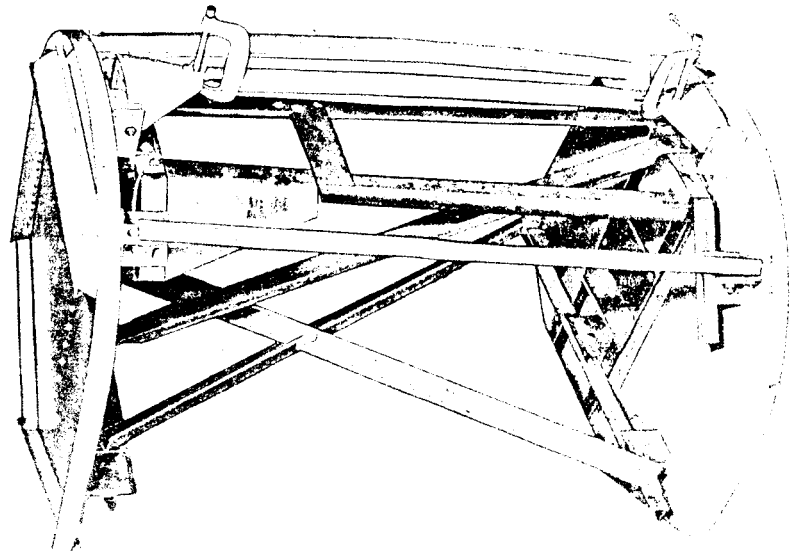


Photo Ref. No.	Part No.	Description	Material	Thickness
1	13002-3	Bottom Sheet 1L - 1R	24ST Aluminum Alloy Sheet	.040
2	13002-8	Keel	24ST Aluminum Alloy Sheet	.040
3	13005	Frames - Similar		
	13006			
	13007			
	13005-1	Zee Bottom	24ST Aluminum Alloy Ext. #12867	
	13005-2	Horizontal Tie Strap	24ST Aluminum Alloy	.032
4	13003	Bulkhead (Forward)		
	13003-1	Bulkhead Sheet	24ST Aluminum Alloy	.028
5	13003-2	Frame Angle	24ST Aluminum Alloy Ext. #78K	1/16
6	13038	Bulkhead - Tie Forward	24ST Aluminum Alloy Ext. #12867	.040
7	13003-4	Bow Deck Stringer	24ST Aluminum Alloy Ext. #1298	
	13003-5	Center Stringer	24ST Aluminum Alloy Ext. #1298	
	13003-7	Stringers 1L - 1R	24ST Aluminum Alloy Ext. #1298	
8	13003-3	Aft Bulkhead Vertical Angles	24ST Aluminum Alloy Ext. #1676	.075
	13004-3	Aft Bulkhead	24ST Aluminum Alloy Ext. #1676	.075
9	13002-2B	Stern Cover	24ST Aluminum Alloy Sheet	.028
	13002-2A	Center Cover	24ST Aluminum Alloy Sheet	.028
	13002-1	Bow Cover	24ST Aluminum Alloy Sheet	.028
10	13002	Frames		

Figure 34 - Wing Tip Float Structure







UPPER LEFT - Wing Tip Float Bottom Skin Jig.

RIGHT TOP - Wing Tip Float Bulkhead and Bottom Frame Jigs.

RIGHT CENTER - Wing Tip Float Center Compartment Jig.

RIGHT BOTTOM - Wing Tip Float Bottom Jig.

Figure 35 - Wing Tip Float Jigs

WING FLAPS.

197. GENERAL.-The wing flaps are of 24ST aluminum alloy construction built around a torque tube and covered with skin across the bottom of the ribs and over the nose. (See Figures 34 and 35). The flaps, left and right, are hinged to the wing flap arm which extends across the wing center section and outer panel.

NOTE

The wing flap structure should be inspected for dents, cracks, holes, distortion and disturbed riveting.

CAUTION

Care should be taken to assure that repairs do not interfere with operation of the flaps.

SKIN.

198. NEGLIGIBLE DAMAGE.-Small, smooth, isolated dents less than 1/8 inch deep, smoothed out holes in open areas less than 1/4 inch in diameter and more than one inch apart, and isolated cracks may be neglected in accordance with Figure 135.

199. DAMAGE REPAIRABLE BY PATCHING.

a. Damage to the skin more than negligible should be cleaned up to a smooth outline. Holes in open areas up to one inch in diameter after smoothing out and more than four diameters on centers from any similar hole may be temporarily repaired by doping on a piece of fabric; however, this repair is not recommended for more than one such hole between adjacent ribs and should be replaced as soon as possible by a metal patch as described immediately below in this Paragraph.

b. Holes up to two inches in diameter should be repaired by a flush patch in accordance with either Figure 108 or 109. An outside patch may be used aft of the lower radius on the skin over the leading edge (See Figure 111), although a flush patch is preferred. The outside patch may be used on the leading edge skin but should be installed on the inside. Preparation of these patches is described in Paragraphs 101a (2), 101b, and 101c above.

200. DAMAGE REPAIRABLE BY INSERTION.-See Paragraph 222 below.

201. DAMAGE NECESSITATING REPLACEMENT.-See Paragraph 223 below.

RIBS.

202. GENERAL.-The wing flap ribs are solid web type, attached to stringers and covered with skin on the bottom and over the top nose portion. The ribs are attached to the torque tube by means of flanged collars which are riveted to the rib webs and torque tubes.

203. NEGLIGIBLE DAMAGE.-See Paragraph 145 above.

204. DAMAGE REPAIRABLE BY PATCHING.-Damage aft of the torque tube, extending the entire width of the flange up to 1/3 the width of the web may be repaired by patching if there is room to fit the patch. Damage to the flange more than negligible should be repaired by the small angle patch shown in Figure 40. If the damage is confined to the web only, the flat patch shown in Figure 40 may be used. Damage involving the flange and web may be repaired by the large patch with single bent up flange as shown in Figure 40. Damage in the way of the torque tube may be repaired by the patch noted in Figure 40 if the damage is confined to the flange. Stringers in the way of damage should be trimmed to accommodate the thickness of the patch.

205. DAMAGE REPAIRABLE BY INSERTION.-Damage not repairable by patching may be repaired by cutting off the damaged portion and splicing on a new equivalent portion. If the rear portion of the rib aft of the torque tube is damaged, the large single splice plate with two bent up flanges shown in Figure 40 should be used at the butt joint. If the web in the nose of the rib is damaged more than negligible, it should be repaired by cutting off the damaged nose section and splicing in a new equivalent section, using the double bent up repair plates shown in Figure 40. The torque tube flange should be cut as shown. The rib may be split at the torque tube, if it is desired to insert a new undamaged portion on either side of this joint.

206. DAMAGE REPAIRABLE BY REPLACEMENT.-Damage not repairable as above requires replacement with an equivalent undamaged rib. It will be necessary to cut the rib at the torque tube and also cut the torque tube flange as in the case of an insertion butt joint, to enable installation of the undamaged rib.

STRINGERS.

207. GENERAL.-The wing flap stringers are bent up angles attached to adjacent ribs.

208. NEGLIGIBLE DAMAGE.-Dents less than 1/16 inch deep, and cracks as shown in Figure 135; cleaned out isolated holes in the free leg, which are less than 1/2 inch in diameter and not in the way of the flange radius; 1/8 inch nicks in the attached leg not in the way of rivets may be neglected.

209. DAMAGE NECESSITATING REPLACEMENT.-For damage more than negligible, replacement of the stringers is recommended.

TRAILING EDGE.

210. GENERAL.-The trailing edge is a 24ST aluminum alloy section extending the length of the flap.

211. NEGLIGIBLE DAMAGE.-Small, smooth, isolated dents less than 1/16 inch deep may be neglected in accordance with Figure 135. Smoothed out damage less than 1/3 the width of the trailing edge may be neglected if riveting is undisturbed and the section is not distorted.

212. DAMAGE REPAIRABLE BY PATCHING.-Damage more than negligible may be repaired by cutting out the damaged area and patching as shown in Figure 117.

213. DAMAGE REPAIRABLE BY INSERTION.-If the damage cannot be repaired by patching, the damaged portion should be cut off between adjacent ribs, removing the entire length to the end, preferably the section which is the shortest length. The new section should then be inserted, using at the butt joint splice plates which are the same as a patch as shown in Figure 117.

214. DAMAGE NECESSITATING REPLACEMENT.-If the damage cannot be repaired as above, replacement of the trailing edge with an equivalent undamaged member is required.

TORQUE TUBE.

215. NEGLIGIBLE DAMAGE.-Refer to Paragraph 230 below.

216. DAMAGE REPAIRABLE BY PATCHING.-See Paragraph 231 below.

217. DAMAGE REPAIRABLE BY INSERTION.-See Paragraph 232 below.

218. DAMAGE NECESSITATING REPLACEMENT.-See Paragraph 233 below.

AILERONS.

219. GENERAL.-The statically and dynamically balanced ailerons are of 24ST aluminum alloy construction, built around a torque tube and covered with fabric. (See Figure 42). The nose section is covered with 24ST aluminum alloy skin under the fabric covering.

NOTE

Before any repair of an aileron is started reference should be made to the procedure for proper mass balancing. See Section 1, Paragraph 17 and Figure 118. Inspect for damage to the fabric, nose cover and other structure, check for dents, holes, cracks, distortion and disturbed riveting. Care should be taken to assure that repairs do not interfere with movement of the ailerons.

NOSE COVER.

220. NEGLIGIBLE DAMAGE.-Small, smooth, isolated dents less than 1/8 inch deep, smoothed out holes in open areas less than 1/4 inch in diameter and more than one inch apart, and cracks may be neglected in accordance with Figure 135.

221. DAMAGE REPAIRABLE BY PATCHING.

a. Damage to the nose cover should be cleaned up to a smooth outline after the fabric in the way of the damage is removed.

NOTE

Repair material in contact with fabric should be protected against dope as noted in Paragraph 115 above. See Section 8 for fabric repair.

b. Cleaned up holes in open areas up to one inch in diameter and more than four diameters on centers from any similar hole may be temporarily repaired by doping on a piece of fabric, but this repair is not recommended for more than one such hole between ribs and should be replaced as soon as possible by a 24ST aluminum alloy patch as described immediately below.

c. Smoothed out holes up to two inches in diameter may be repaired with a flush patch as shown in Figures 108 or 109. As an alternate, a flat patch as shown in Figure 111 may be used, placing the patch on the inside of the nose cover. Preperation of these patches is described in Paragraph 101a (2), 101b and 101c above.

222. DAMAGE REPAIRABLE BY INSERTION.-If the damage cannot be repaired by patching the damaged area may be cut out between ribs and a new equivalent skin inserted, forming a butt joint with the adjacent undamaged skin, placing a 24ST aluminum alloy flat plate under the butt joint and riveting as shown in Figure 113. No spanwise cut should be made and the damaged skin should be removed for the entire width of the section.

223. DAMAGE NECESSITATING REPLACEMENT.-If the nose cover cannot be repaired as described above, it should be replaced, reinstalling fabric covering as noted in Paragraph 221 above.

RIBS.

221. GENERAL.-The aileron ribs are of the web type with flanged lightening holes and are attached to the torque tube by means of flanged collars which are riveted to the rib webs and torque tube. Nose ribs are located between the main ribs and similarly attached to the torque tube.

225. NEGLIGIBLE DAMAGE.-Small, smooth isolated dents less than 1/16 inch deep and nicks in the bent up flanges less than 1/8 inch deep after cleaning out may be neglected provided adjacent riveting is undisturbed and the section is undistorted and no cracks, abrasions or other damage exist. Isolated holes up to 1/2 inch in diameter after smoothing out may be neglected if not in the way of a lightening hole more than 1/2 inch from the radius of the bent up flange and more than four diameters on centers from any similar hole. Cracks may be neglected as shown in Figure 135.

226. DAMAGE REPAIRABLE BY PATCHING.-Damage more than negligible to the flange aft of the torque tube may be repaired by a small angle patch as shown in Figure 44. Damage to the web more than negligible or combined damage to the web and flange aft of the torque tube should be patched with the large patch with two bent up flanges shown in Figure 44. The patch may cover the lightening holes. Damage to the flange in the area of the torque tube may be repaired by the upper or lower portion of the patch noted in Figure 44. If a cracked lightening hole is involved, reference should be made to Figure 115. Repair material in the way of fabric should be treated in accordance with Paragraph 115 above and the fabric should be repaired as noted in Section 8.

227. DAMAGE REPAIRABLE BY INSERTION.-Damage not repairable by patching may be repaired by cutting off the damaged portion and splicing in a new equivalent section. If the rear portion aft of the torque tube is damaged the large single patch with two bent up flanges should be used. If the web in the nose of the rib is damaged more than negligible, it is recommended that the nose section be replaced by cutting the rib at the torque tube as shown in Figure 44 and inserting a new equivalent section, using two splice plates, one upper and one lower as shown. It will be necessary to remove fabric in the way of repairs (See Section 8) and protect repair material as noted in Paragraph 115 above.

228. DAMAGE NECESSITATING REPLACEMENT.-Damage not repairable by patching or insertion necessitates replacement with an equivalent undamaged section. It will be necessary to split the new rib at the torque tube as shown in Figure 44. See Section 8 for fabric repair and Paragraph 115 above.

TORQUE TUBE.

229. GENERAL.-The torque tubes are 24ST aluminum tubing.

230. NEGLIGIBLE DAMAGE.-Small, smooth isolated dents free from sharp corners, cracks and abrasions and not exceeding 1/16 inch in depth may be neglected.

231. DAMAGE REPAIRABLE BY PATCHING.

a. Removal of the fabric to secure access will be necessary to repair the torque tubes. (See Section 8).

b. Dents more than negligible and holes which do not exceed 3/4 inch in diameter after being cleaned out may be repaired by patching. Two 24ST aluminum alloy plates of the next heavier gage as the tube being repaired should be cut to the necessary size and formed as shown in Figure 121. Each should cover the tube and should be bolted together as shown on the repair diagram with taper pins inserted. This type of repair is recommended for repair of damage difficult of access.

c. If desired, an alternate type of patch repairable may be used. It requires only one repair plate formed and riveted as shown in Figure 122.

d. Patch repair shown in Figure 122 should be used to repair damage in the way of a rib. The torque tube flange collar should be removed and replaced by a new collar of the larger diameter to allow for the thickness of the repair plate. A packing strip of the same thickness as the plate should be inserted under the collar. It will be necessary to split the collar in order to install it over the patch and packing strip. Refer to NOTE in the Paragraph immediately below.

232. DAMAGE REPAIRABLE BY INSERTION.-Damage more extensive than that repairable by patching should be repaired by cutting out the damaged area of the tube between ribs and inserting a new length of tube for a gap more than one inch between the tube ends. The gap or butt joint should be covered with a 24ST aluminum alloy repair plate of the same gage as the tube being repaired, cut to size and preformed. The repair plate should be lapped around the tube and riveted as shown in Figure 121. Damage in the way of a rib more extensive than that repairable by patching should be repaired by cutting out the damaged tube on each side of the rib and splicing in a new length of tube.

NOTE

A torque tube bucking bar similar to that used in manufacture may be used for repair. See Figure 123, Sheet 1.

233. DAMAGE NECESSITATING REPLACEMENT.-If damage is not repairable as above, the torque tube should be replaced with an undamaged equivalent.

TRAILING EDGE.

234. GENERAL.-The aileron trailing edge is a bent up 24ST aluminum alloy "V" section.

NOTE

Check for dents, cracks, holes, breaks, distortion and disturbed riveting.

235. NEGLIGIBLE DAMAGE.-Small, smooth isolated dents free from cracks, sharp corners and abrasions and less than 1/16 inch deep may be neglected provided adjacent riveting is undisturbed, and adjacent structure is not distorted. Smoothed out damage with a diameter less than 1/2 the width of either leg of the section may be neglected.

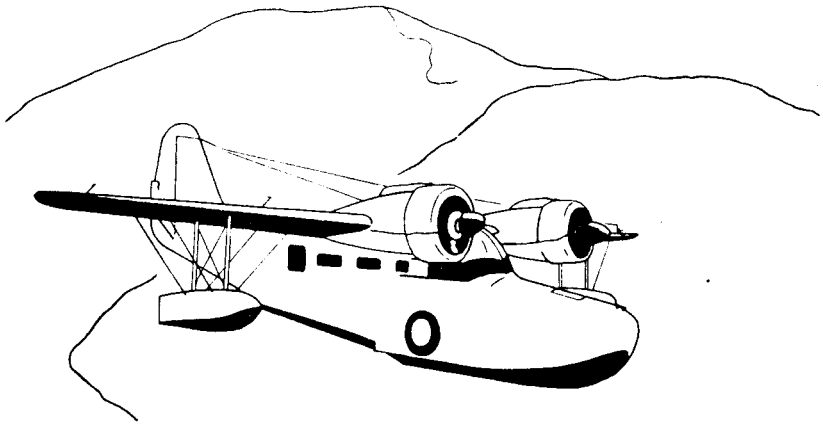
236. DAMAGE REPAIRABLE BY PATCHING.-Cracks, holes, torn or distorted areas, may be repaired by patching as shown in Figure 117. The patch should be a 24ST aluminum alloy filler block shaped to fit inside the "V". A distorted area may be restored to shape to enable a snug fit of the patch and should be long enough to allow for the required rivets as shown in Figure 117.

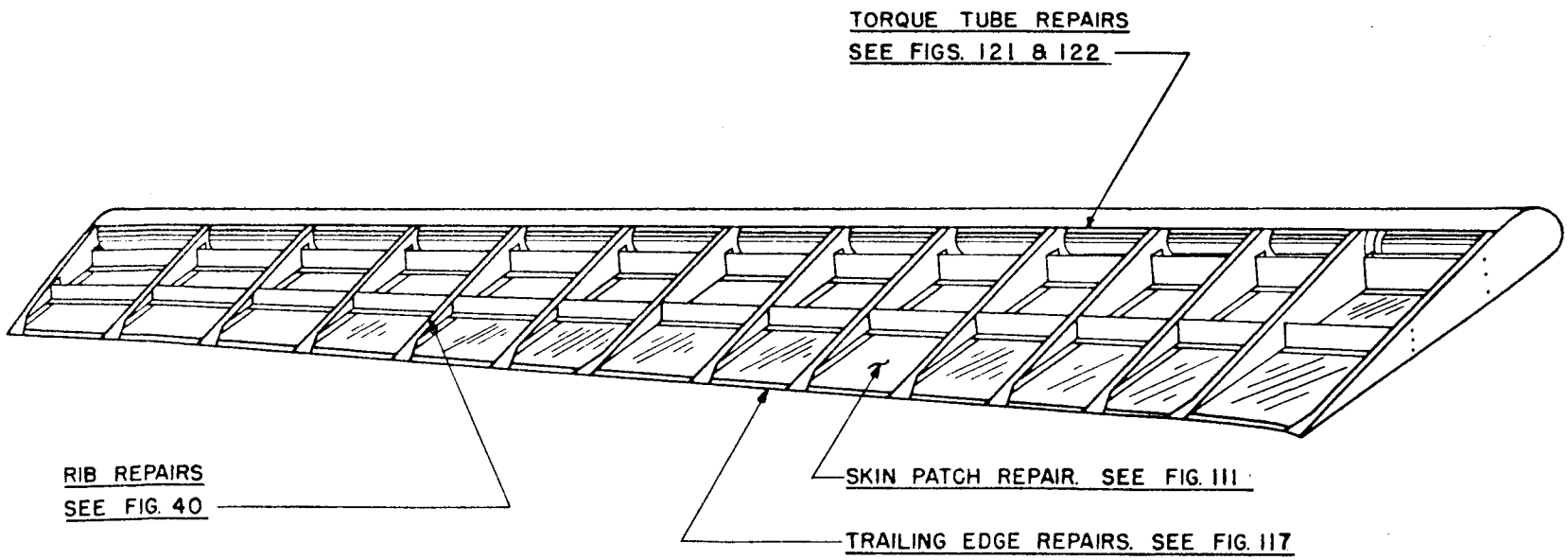
NOTE

Remove fabric in the way of the trailing edge, repair and replace over the repair (See Section 8). New material in contact with fabric should be protected against dope as noted in Paragraph 115 above.

237. DAMAGE REPAIRABLE BY INSERTION.-If the damage is too extensive to permit a patch repair, the damage section should be cut out all the way to the end of the trailing edge. The length which will permit removal of the shortest amount of material should be replaced. The cut off should be made between ribs. The new length of the trailing edge should be the equivalent of the original. It should be joined to the remaining original section by a filler block across the butt joint the same as a patch as shown in Figure 117. Reference should be made to NOTE in Paragraph 236 above.

238. DAMAGE NECESSITATING REPLACEMENT.-If the trailing edge cannot be repaired by patching or insertion, it should be replaced with an equivalent undamaged section. Reference should be made to NOTE in Paragraph 236 above.





NOTE:
SKIN PARTIAL REPLACEMENT SEE FIG. 113
MATERIALS OF CONSTRUCTION, SEE FIG. 37

Figure 36 - Wing Flap Repair Reference Diagram

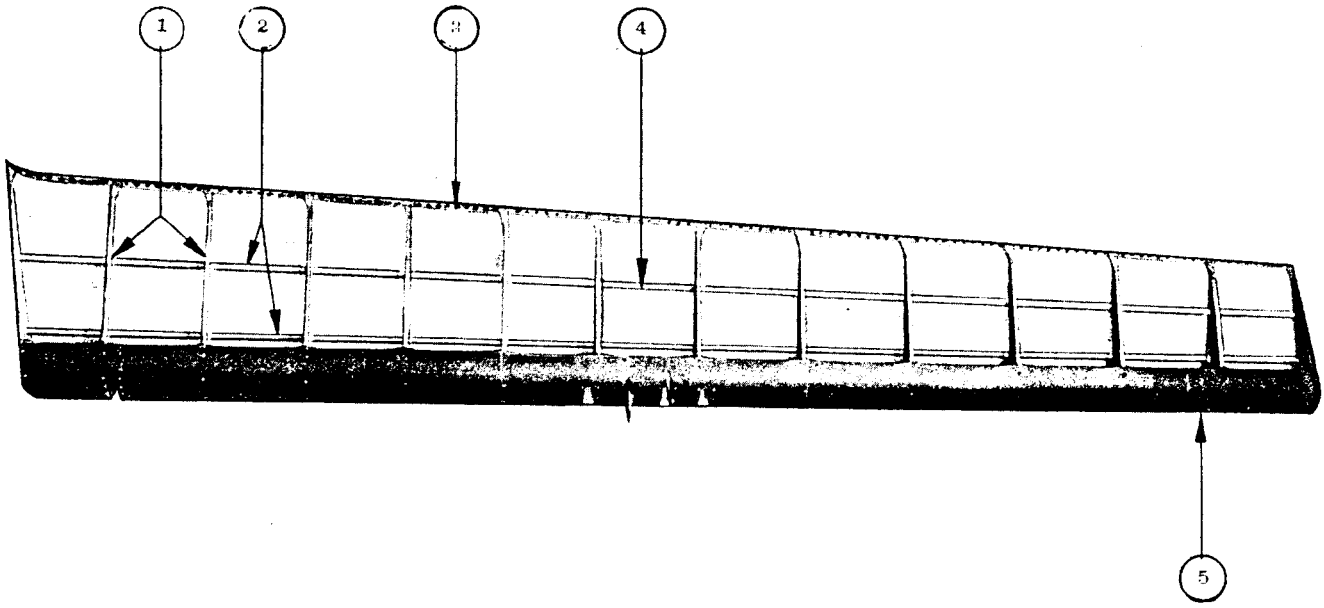


Photo Ref. No.	Part No.	Description	Material	Thickness
1	12444-1-14	Ribs	24ST Aluminum Alloy Sheet	.028
2	12440-14-14	Stringers	24ST Aluminum Alloy Sheet	.028
3	12440-3	Trailing Edge	24ST Aluminum Alloy Sheet	1/8
4	12440-16	Cover Inboard	24ST Aluminum Alloy Sheet	.028
	12440-17	Cover Outboard	24ST Aluminum Alloy Sheet	.028
5	12444-15-20	Nose Ribs	24ST Aluminum Alloy Sheet	.028

Figure 37 - Wing Flap Structure

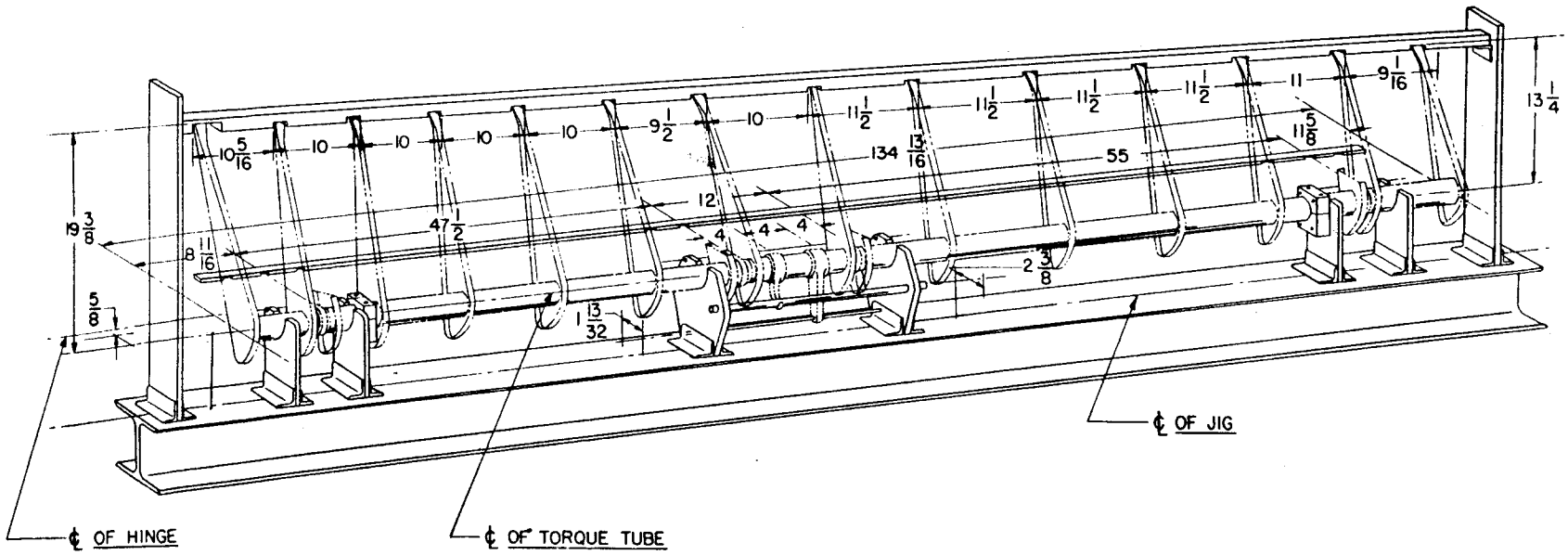


Figure 38 - Wing Flap Jig

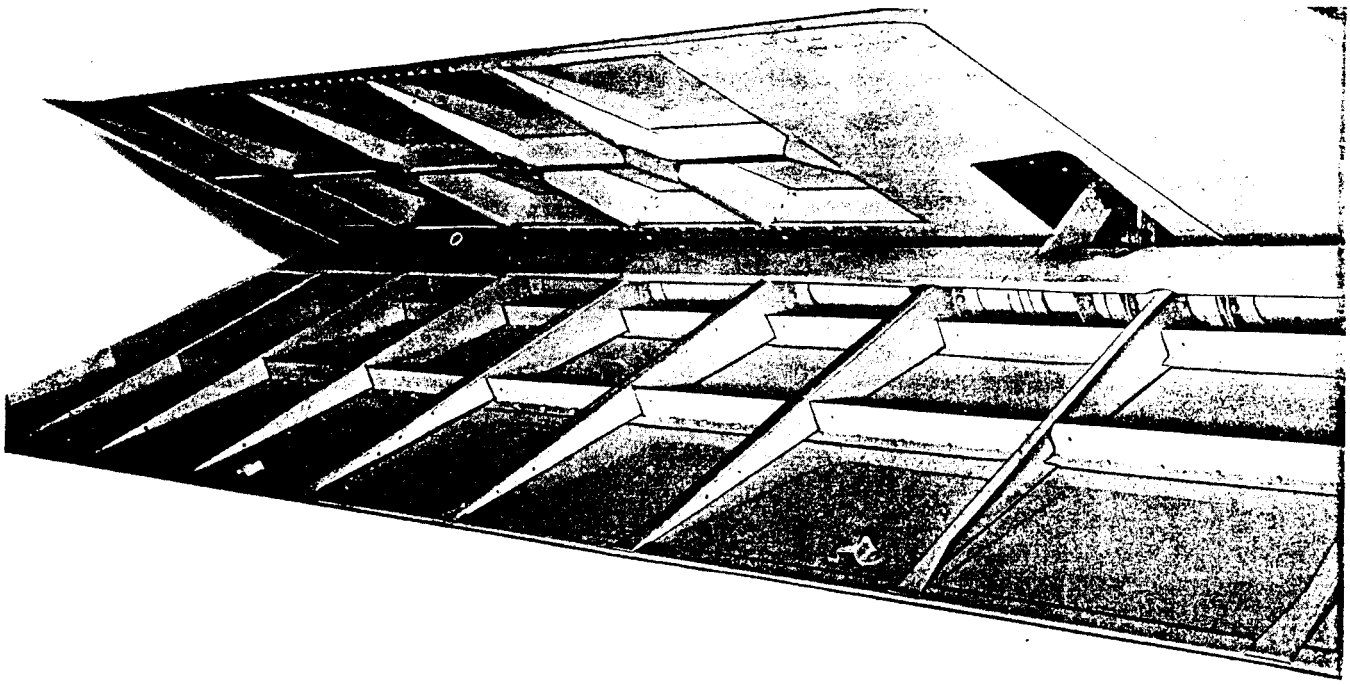
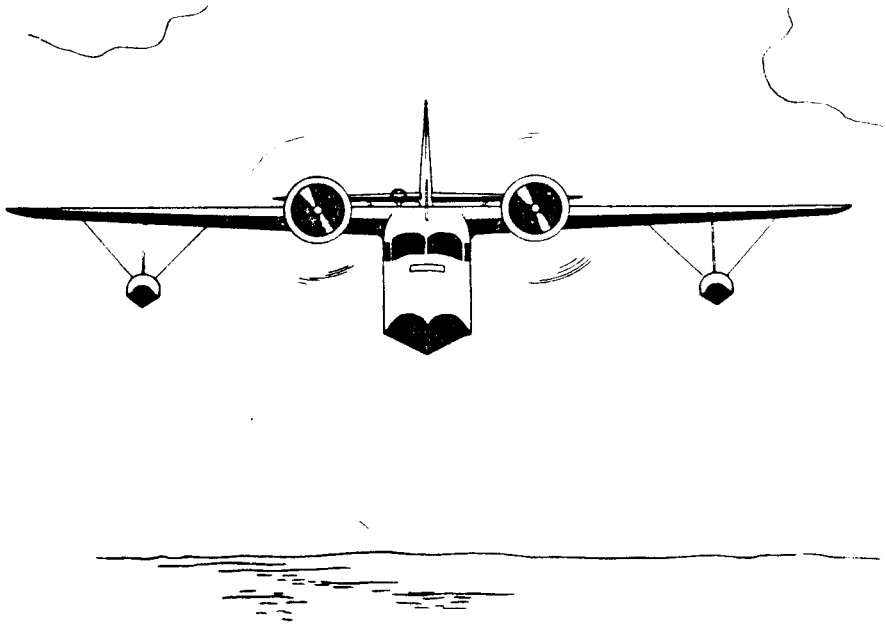
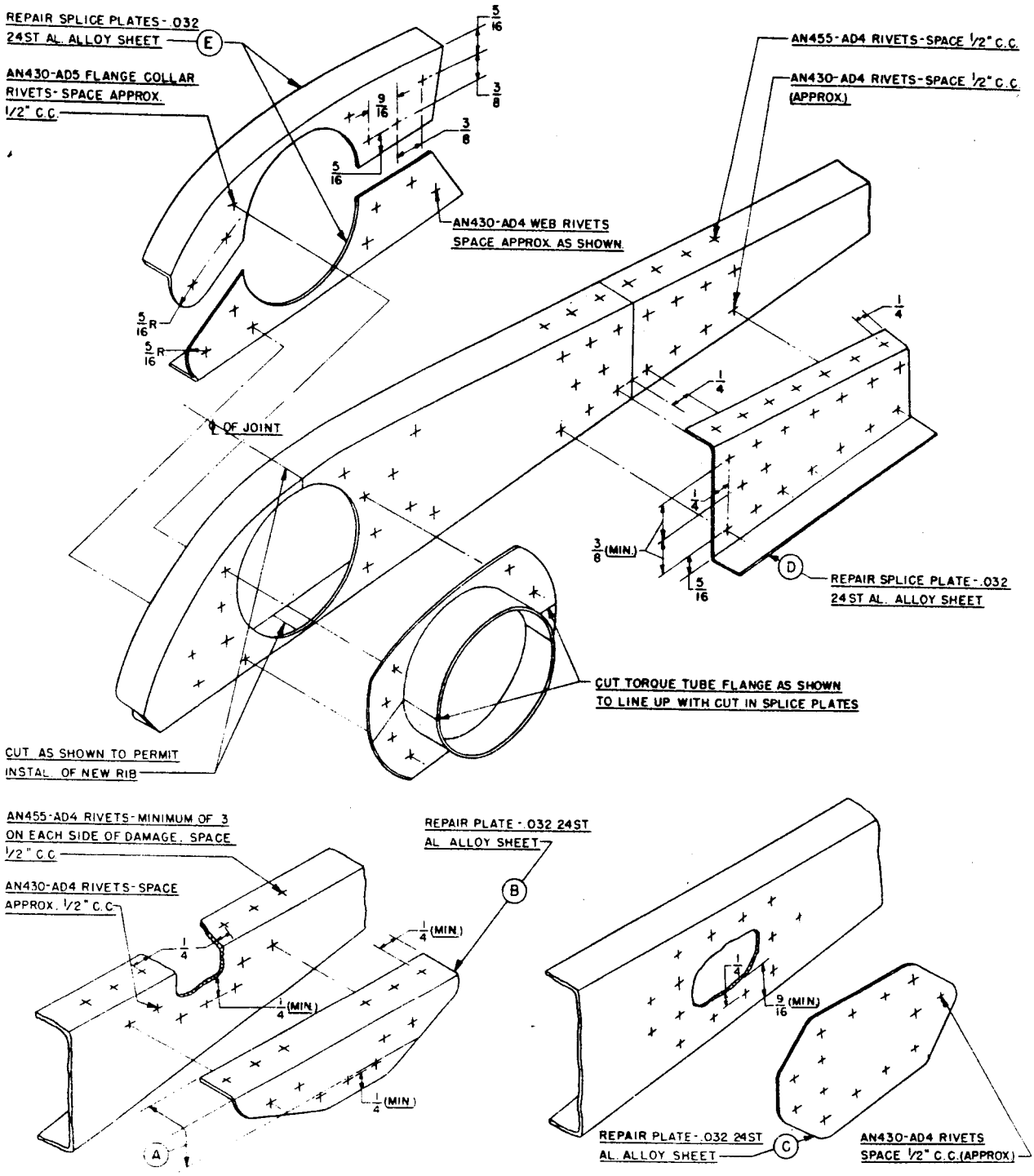


Figure 39 - Wing Trailing Edge and Flap Structure





CASE I - FOR DAMAGE TO FLANGE MORE THAN NEGLIGIBLE
USE REPAIR PLATE "A"

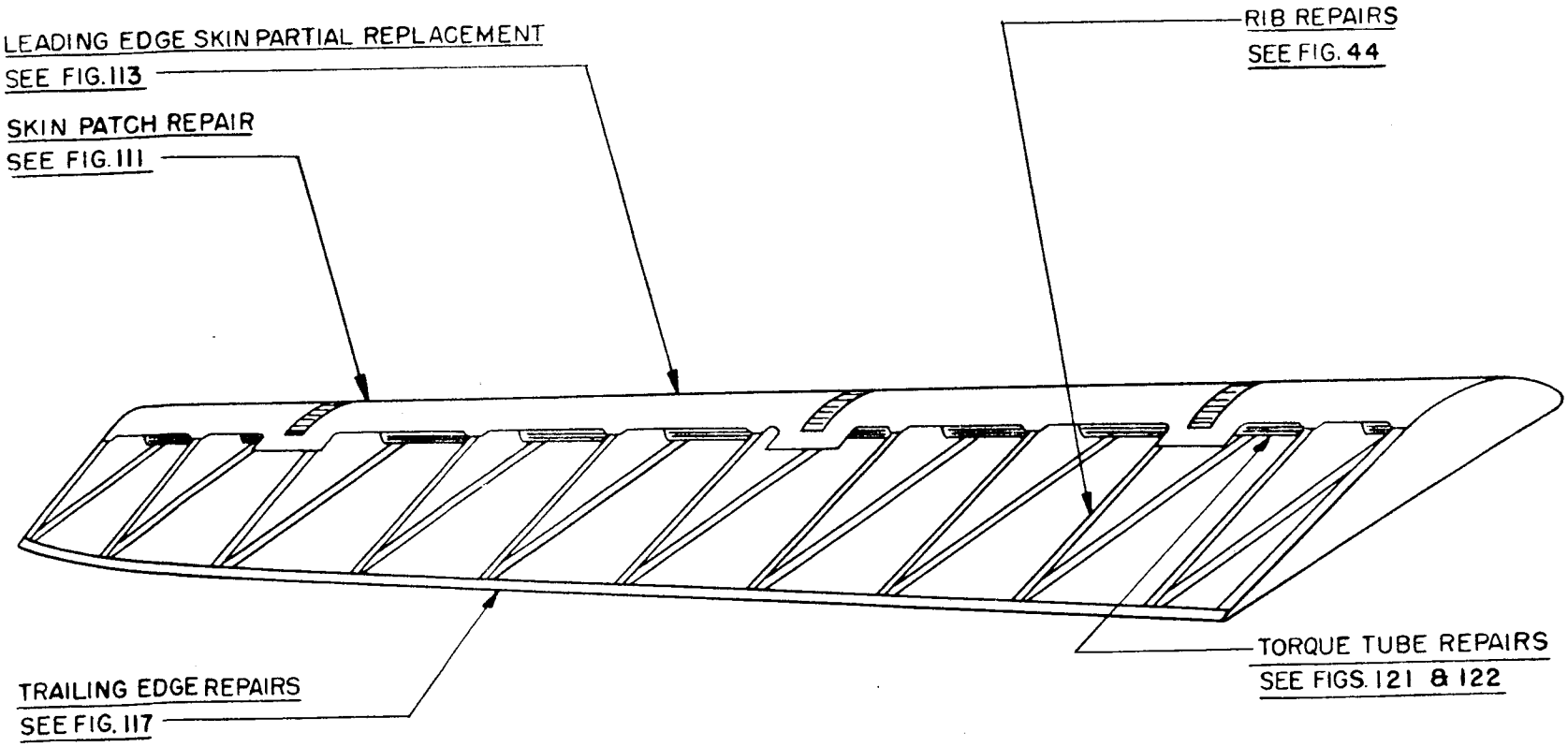
CASE II - FOR DAMAGE EXTENDING THRU FLANGE & INTO WEB
USE REPAIR PLATE "B"

CASE III - FOR DAMAGE TO WEB ONLY (TO LIMIT SHOWN)
USE REPAIR PLATE "C"

CASE IV - FOR INSERTION REPAIR AFT OF TORQUE TUBE
USE REPAIR SPLICE PLATE "D"

CASE V - FOR INSERTION REPAIR IN WAY OF TORQUE TUBE
USE REPAIR SPLICE PLATES "E"

Figure 40 - Wing Flap Rib Repairs



NOTE:
MATERIALS OF CONSTRUCTION, SEE FIG. 42
MASS BALANCING, SEE FIG. 118

Figure 41 - Aileron Repair Reference Diagram

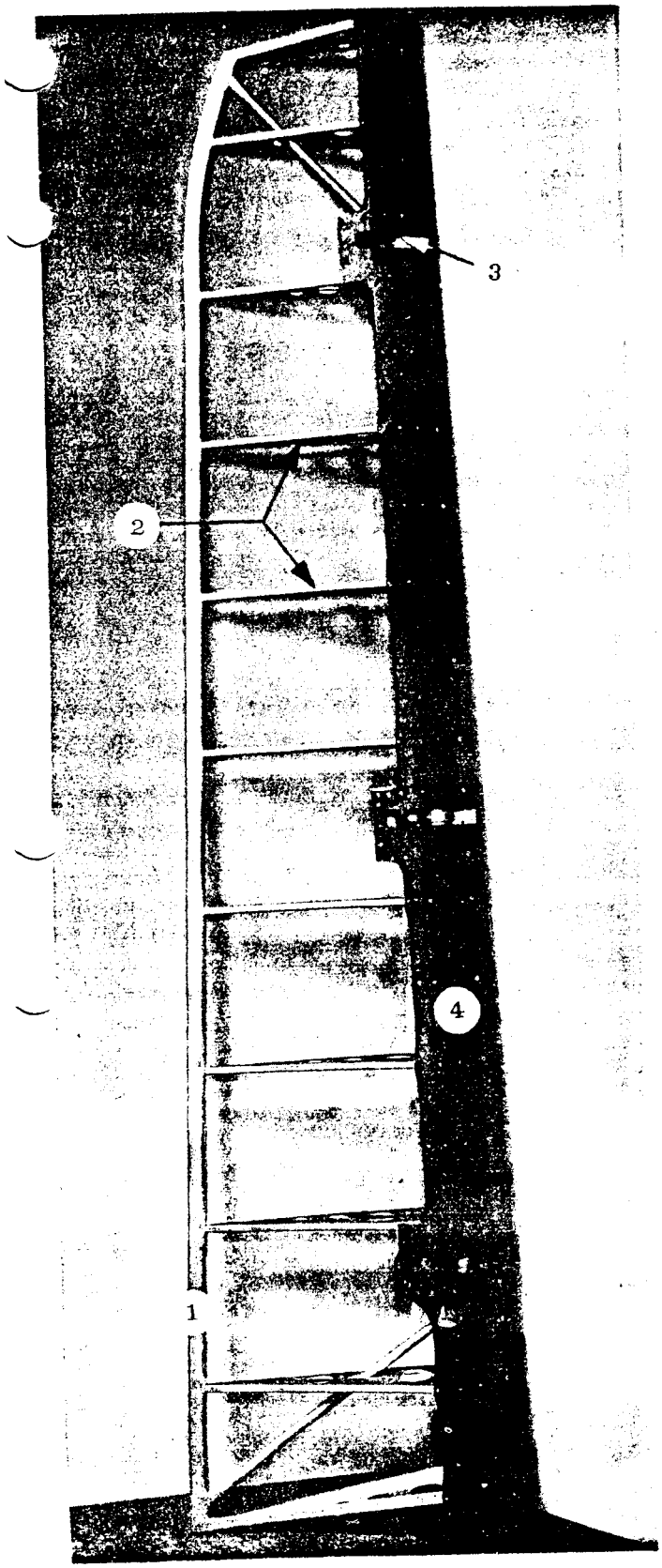


Figure 42 - Aileron Structure

Ref. No.	Part No.	Description	
1	12430-7	Trailing Edge	**
	12430-8	Trailing Edge	**
2	12434-10,-11	Ribs	**
	12434-12,-21	Nose Ribs	**
3	12434-2	Torque Tube	
4	12434-1	Nose Cover	*
	12434-15	Nose Cover	*

* .020
** .028

NOTE: All material 24ST aluminum alloy sheet except Ref. No. 3 which is aluminum alloy tubing.

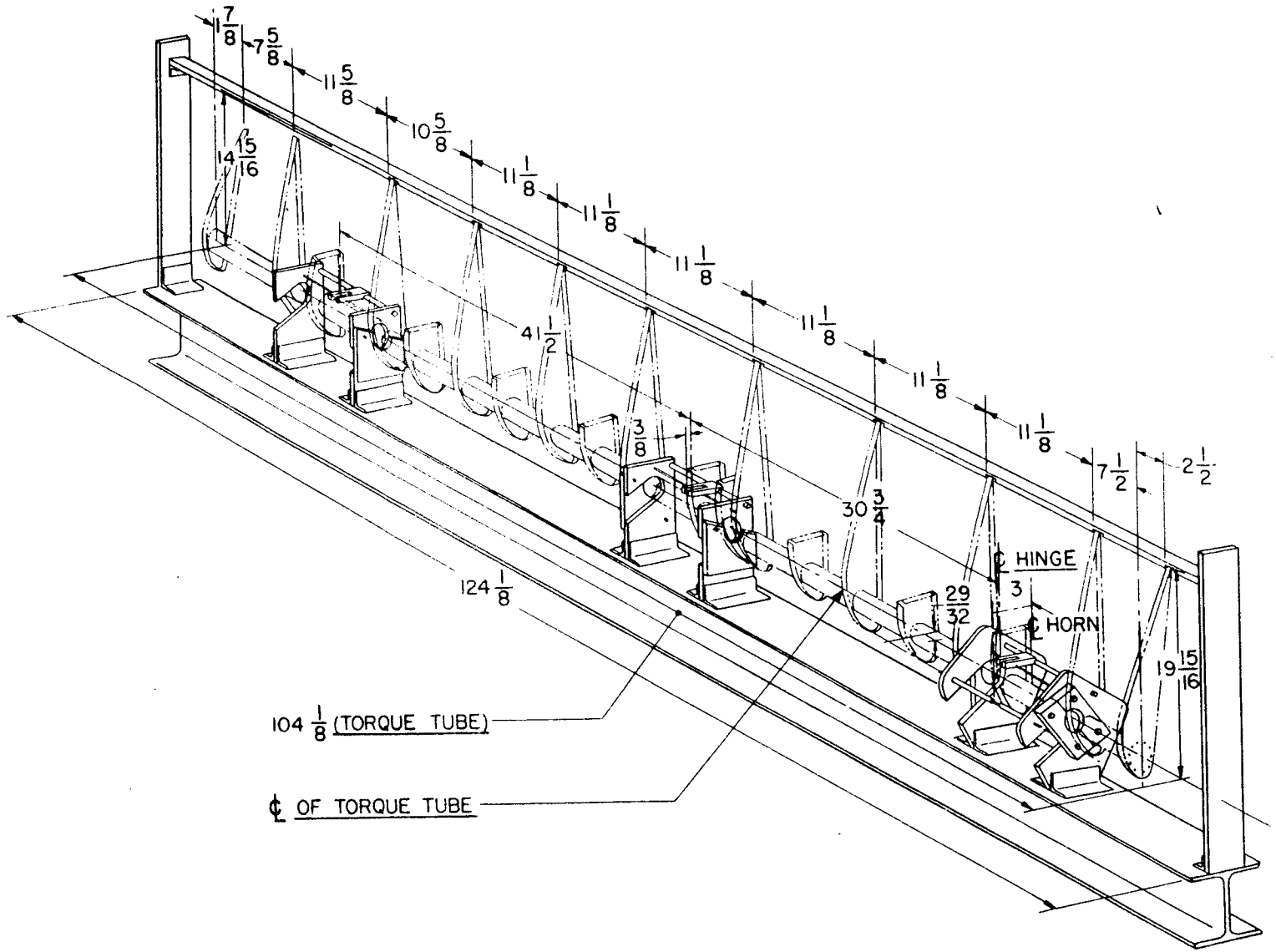


Figure 43 - Aileron Jig

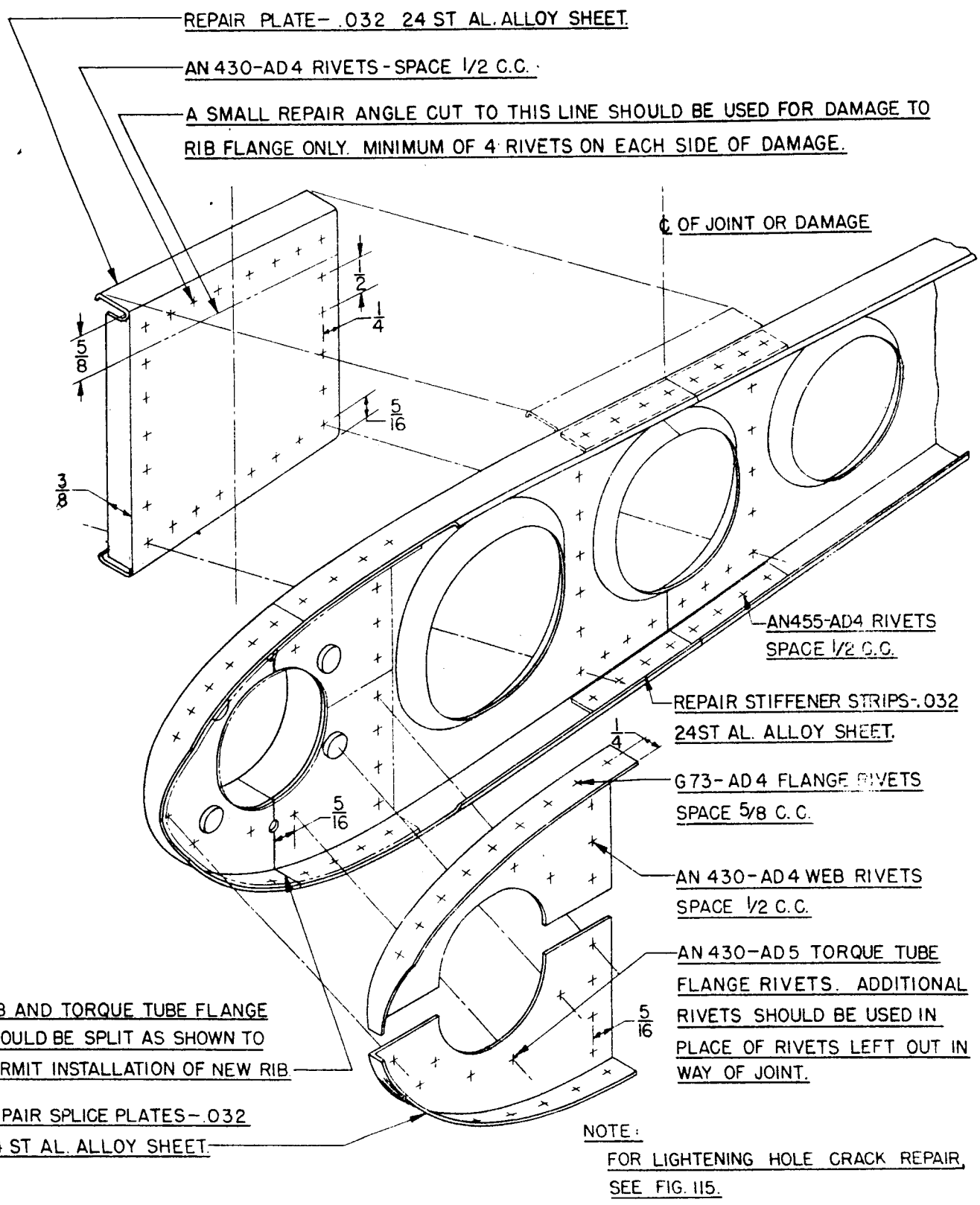


Figure 44 - Rib Repairs - Aileron, Elevator and Rudder

TABLE III

MATERIALS FOR REPAIR

WING GROUP

WING CENTER SECTION

Where Used	Description	Material	Size Thickness	Item
Skin	Sheet	24ST Aluminum Alloy	.020	Patch Repair, Insertion and Replacement
Skin	Sheet	24ST Aluminum Alloy	.028	Patch Repair, Insertion and Replacement
Skin	Sheet	24ST Aluminum Alloy	.040	Patch Repair, Insertion and Replacement
Skin	Sheet	24ST Aluminum Alloy	.064	Patch Repair, Insertion and Replacement
Stringer	Sheet	24ST Aluminum Alloy	.028	Insertion and Replacement
		24ST Aluminum Alloy	.032	Patch Repair and Splice Plates
Stringer	Extrusion	24ST Aluminum Alloy	Alcoa #1060	Insertion and Replacement
	Sheet	24ST Aluminum Alloy	.102	Patch Repair and Splice Plates
Corner Angle	Extrusion	24ST Aluminum Alloy	Alcoa 734-TT	Insertion and Replacement
	Sheet	24ST Aluminum Alloy	1/8	Patch Repair and Splice Plates
Corner Angle	Extrusion	24ST Aluminum Alloy	Alcoa 13864	Insertion and Replacement
		24ST Aluminum Alloy	1/8	Patch Repair and Splice Plates
Hull Angle	Sheet	24ST Aluminum Alloy	.051	Insertion and Replacement
		24ST Aluminum Alloy	.064	Patch Repair and Splice Plates
Rib	Sheet	24ST Aluminum Alloy	.028	Insertion and Replacement
		24ST Aluminum Alloy	.032	Patch Repair and Splice Plates
Rib Cap Strip	Sheet	24ST Aluminum Alloy	.051	Insertion and Replacement
		24ST Aluminum Alloy	.051	Patch Repair and Splice Plates
Beam Plate	Sheet	24ST Aluminum Alloy	.040	Insertion and Replacement
		24ST Aluminum Alloy	.051	Patch Repair and Splice Plates
Beam Plate	Sheet	24ST Aluminum Alloy	.051	Insertion and Replacement
		24ST Aluminum Alloy	.064	Patch Repair and Splice Plates
Beam Plate	Sheet	24ST Aluminum Alloy	.064	Insertion and Replacement
		24ST Aluminum Alloy	.081	Patch Repair and Splice Plates
Stiffening Angles	Extrusion	24ST Aluminum Alloy	Alcoa 78C	Replacement
Bulkhead Plate	Sheet	24ST Aluminum Alloy	.020	Replacement
		24ST Aluminum Alloy	.025	Patch Repair
Bulkhead Plate	Sheet	24ST Aluminum Alloy	.051	Replacement
		24ST Aluminum Alloy	.064	Patch Repair
Nose Ribs	Sheet	24ST Aluminum Alloy	.051	Replacement
		24ST Aluminum Alloy	.064	Patch Repair
Trailing Edge	Extrusion	24ST Aluminum Alloy	Alcoa K14403	Insertion and Replacement
	Sheet	24ST Aluminum Alloy	.051 and 3/16	Patch Repair and Splice Plates
Fuel Tanks		(See Table II)		Gas Tight Joints

TABLE (CONT.)

MATERIALS FOR REPAIR

WING GROUP

OUTER WING PANELS

Where Used	Description	Material	Size Thickness	Item
Skin	Sheet	24ST Aluminum Alloy	.028	Patch Repair, Insertion and Replacement
Skin	Sheet	24ST Aluminum Alloy	.040	Patch Repair, Insertion and Replacement
Skin	Sheet	24ST Aluminum Alloy	.051	Patch Repair, Insertion and Replacement
Rib Web	Sheet	24ST Aluminum Alloy	.028	Insertion and Replacement
		24ST Aluminum Alloy	.032	Patch Repair and Splice Plates
Rib Capstrip	Sheet	24ST Aluminum Alloy	.028	Insertion and Replacement
			.028	Patch Repair and Splice Plates
Nose Rib	Sheet	24ST Aluminum Alloy	.051	Replacement
		24ST Aluminum Alloy	.064	Patch Repair
Nose Rib	Sheet	24ST Aluminum Alloy	.040	Replacement
			.051	Patch Repair
Flap Support Beam	Sheet	24ST Aluminum Alloy	.064	Insertion and Replacement
	Sheet	24ST Aluminum Alloy	.064	Patch Repair and Splice Plates
Aileron Support Beam	Sheet	24ST Aluminum Alloy	.064	Insertion and Replacement
	Sheet	24ST Aluminum Alloy	.064	Patch Repair and Splice Plates
Wing Tip Cover	Sheet	52S½H Aluminum Alloy	.032	Insertion and Replacement
		52S½H Aluminum Alloy	.040	Patch Repair
Bulkhead	Sheet	24ST Aluminum Alloy	.028	Insertion and Replacement
		24ST Aluminum Alloy	.032	Patch Repair and Splice Plates
Bulkhead	Sheet	24ST Aluminum Alloy	.020	Insertion and Replacement
		24ST Aluminum Alloy	.025	Patch Repair and Splice Plates
Stringer	Extrusion	24ST Aluminum Alloy	Alcoa K11256	Insertion and Replacement
	Sheet	24ST Aluminum Alloy	.081	Patch Repair and Splice Plates
Beam Web	Sheet	24ST Aluminum Alloy	.028	Insertion and Replacement
		24ST Aluminum Alloy	.032	Patch Repair and Splice Plates
Beam Web	Sheet	24ST Aluminum Alloy	.040	Insertion and Replacement
		24ST Aluminum Alloy	.051	Patch Repair and Splice Plates
Beam Web	Sheet	24ST Aluminum Alloy	.051	Insertion and Replacement
			.064	Patch Repair and Splice Plates
Beam Corner Angle	Extrusion	24ST Aluminum Alloy	Alcoa 13864	Insertion and Replacement
	Sheet	24ST Aluminum Alloy	1/8	Patch Repair and Splic Plates
Beam Corner Angle	Extrusion	24ST Aluminum Alloy	Alcoa 734-T	Insertion and Replacement
	Sheet	24ST Aluminum Alloy	1/8	Patch Repair and Splic Plates
Angle	Extrusion	24ST Aluminum Alloy	Alcoa 472	Insertion and Replacement
	Sheet	24ST Aluminum Alloy	.081	Patch Repair and Splice Plates
Trailing Edge	Extrusion	24ST Aluminum Alloy	Alcoa K14403	Insertion and Replacement
	Sheet	24ST Aluminum Alloy	.051 & 3/16	Patch Repair and Splice Plates

TABLE III (CONT.)

MATERIALS FOR REPAIR

WING GROUP

WING TIP FLOATS

Where Used	Description	Material	Size Thickness	Item
Top Cover	Sheet	24ST Aluminum Alloy	.028	Patch Repair and Replacement
Bottom Cover	Sheet	24ST Aluminum Alloy	.040	Patch Repair and Replacement
Keel	Sheet	24ST Aluminum Alloy	.040	Insertion and Replacement
		24ST Aluminum Alloy	.040	Patch Repair and Splice Plate
Frame	Extrusion	24ST Aluminum Alloy	Alcoa 12867	Replacement
Frame	Sheet	24ST Aluminum Alloy	.032	Replacement
		24ST Aluminum Alloy	.040	Patch Repair
Bulkhead	Sheet	24ST Aluminum Alloy	.028	Insertion and Replacement
			.032	Patch Repair and Splice Plate
Bulkhead Angle	Extrusion	24ST Aluminum Alloy	Alcoa 78K	Insertion and Replacement
	Sheet	24ST Aluminum Alloy	.081	Patch Repair and Splice Plate
Stringer	Extrusion	24ST Aluminum Alloy	Alcoa 1298	Replacement
	Sheet	24ST Aluminum Alloy	.081	Patch Repair
Bulkhead	Extrusion	24ST Aluminum Alloy	Alcoa 1676	Replacement
	Sheet	24ST Aluminum Alloy	.081	Patch Repair

TABLE III (CONT.)

MATERIALS FOR REPAIR

WING GROUP

WING FLAPS

Where Used	Description	Material	Size Thickness	Item
Ribs	Sheet	24ST Aluminum Alloy	.028	Insertion and Replacement
		24ST Aluminum Alloy	.032	Patch Repair and Splice Plate
Trailing Edge	Sheet	24ST Aluminum Alloy	.125	Insertion and Replacement
		24ST Aluminum Alloy	.032 and .125	Patch Repair and Splice Plate
Cover	Sheet	24ST Aluminum Alloy	.028	Patch Repair, Insertion and Replacement
Torque Tube	Tubing	24ST Aluminum Alloy	.058	Insertion and Replacement
	Sheet	24ST Aluminum Alloy	.064	Patch Repair and Splice Plates

TABLE III (CONT.)

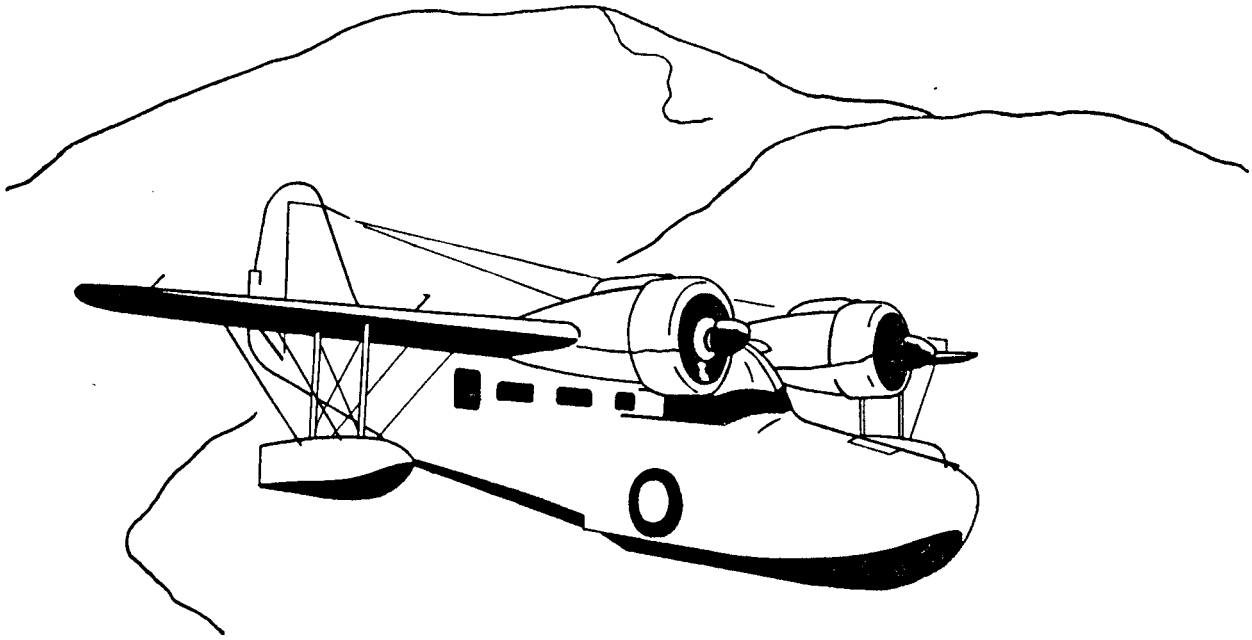
MATERIALS FOR REPAIR

WING GROUP

AILERONS

Where Used	Description	Material	Size Thickness	Item
Trailing Edge	Sheet	24ST Aluminum Alloy	.028	Insertion and Replacement
	Bar	24ST Aluminum Alloy	5/16	Patch Repair and Splice Plates
Rib	Sheet	24ST Aluminum Alloy	.028	Insertion and Replacement
		24ST Aluminum Alloy	.032	Patch Repair and Splice Plates
Torque Tube	Tubing	24ST Aluminum Alloy	.058	Insertion and Replacement
	Sheet	24ST Aluminum Alloy	.064	Patch Repair and Splice Plates
Nose Skin	Sheet	24ST Aluminum Alloy	.020	Patch Repair, Insertion and Replacement
As Required		Lead	To Suit	Mass Balancing

NOTE: For Alternate Replacements of Extrusions with Bent Up 24ST Aluminum Alloy Refer to Figure 106, Sheets 3 and 4.



SECTION 3
TAIL SURFACES

1. GENERAL.-The tail surfaces include the fin, rudder, left and right stabilizers, left and right elevators.

2. CLASSIFICATION OF DAMAGE.-Damage to any of the tail surfaces should be carefully examined to determine in which of the following categories it should be placed:

a. Negligible Damage.
b. Damage Repairable by Patching.
c. Damage Repairable by Insertion.
d. Damage Repairable by Replacement.

ELEVATORS AND RUDDER.

3. GENERAL. - The elevators and rudder are statically and dynamically balanced and are of 24ST aluminum alloy construction in general, built around a torque tube and covered with fabric. The leading edge is covered with 24ST aluminum alloy under the fabric covering. They are similar in construction and definitions of damage and methods of repair are similar unless otherwise noted below.

NOTE

Before any repairs to the elevators or rudder are started, reference should be made to the procedure for proper mass balancing. See Section 1, Paragraph 17, and Figures 119 and 120.

NOSE COVER.

4. NEGLIGIBLE DAMAGE.-See Section 2, Paragraph 220.

5. DAMAGE REPAIRABLE BY PATCHING.-The elevator and rudder nose cover should be repaired by patching the same as the aileron nose cover as described in Section 2, Paragraph 221.

6. DAMAGE REPAIRABLE BY INSERTION.-Refer to Section 2, Paragraph 222.

7. DAMAGE NECESSITATING REPLACEMENT.-Refer to Section 2, Paragraph 223.

RIBS.

8. GENERAL.-The elevator and rudder ribs are of the web type with flanged lightening holes and are attached to the torque tube by means of flanged collars which are riveted to the rib webs and to the torque tube.

9. NEGLIGIBLE DAMAGE.-See Section 2, Paragraph 225.

10. DAMAGE REPAIRABLE BY PATCHING.-Refer to Section 2, Paragraph 226.

11. DAMAGE REPAIRABLE BY INSERTION.-Refer to Section 2, Paragraph 227.

12. DAMAGE NECESSITATING REPLACEMENT.-Refer to Section 2, Paragraph 228.

TORQUE TUBE.

13. GENERAL.-The torque tubes are 24ST aluminum alloy tubing.

14. NEGLIGIBLE DAMAGE.-See Section 2, Paragraph 230.

15. DAMAGE REPAIRABLE BY PATCHING.-The elevators and rudder may be repaired by patching the same as the ailerons as described in Section 2, Paragraph 231, except that damage to the elevator outboard torque tube repairable by patching is limited to 1/2 inch hole.

16. DAMAGE REPAIRABLE BY INSERTION.-Refer to Section 2, Paragraph 232.

17. DAMAGE NECESSITATING REPLACEMENT.-Refer to Section 2, Paragraph 233.

TRAILING EDGE.

18. GENERAL.-The elevator and rudder trailing edge is a "V" bent up 24ST aluminum alloy section.

19. NEGLIGIBLE DAMAGE.-See Section 2, Paragraph 235.

20. DAMAGE REPAIRABLE BY PATCHING.-Refer to Section 2, Paragraph 236.

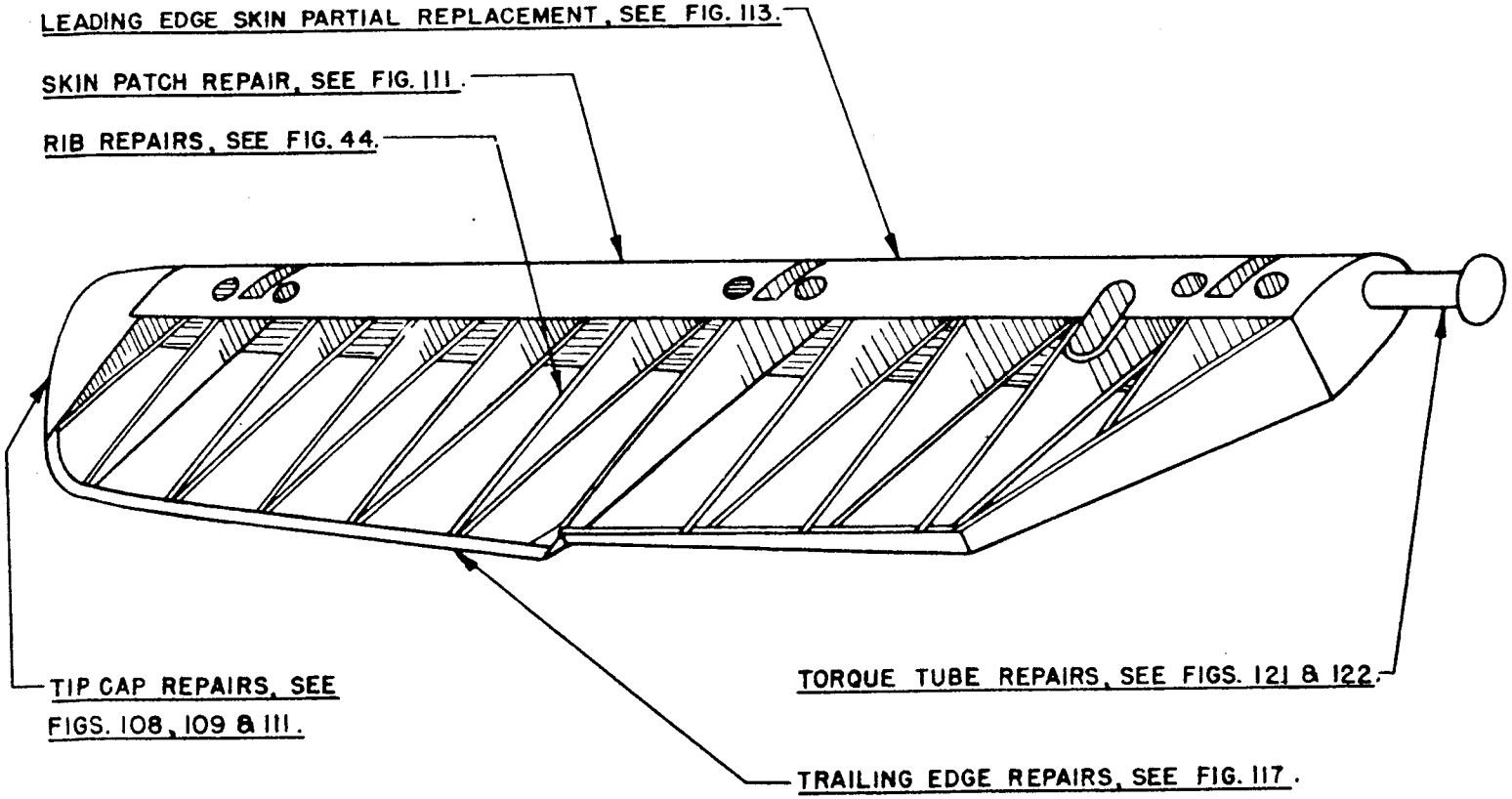
21. DAMAGE REPAIRABLE BY INSERTION.-Refer to Section 2, Paragraph 237.

22. DAMAGE NECESSITATING REPLACEMENT.-Refer to Section 2, Paragraph 238.

TIP CAP.

23. GENERAL.-The tip caps of the elevators and rudder are aluminum alloy sheet comprised of spot welded assemblies as noted in Figures 46 and 49.

24. NEGLIGIBLE DAMAGE.-See Section 2, Paragraph 100.

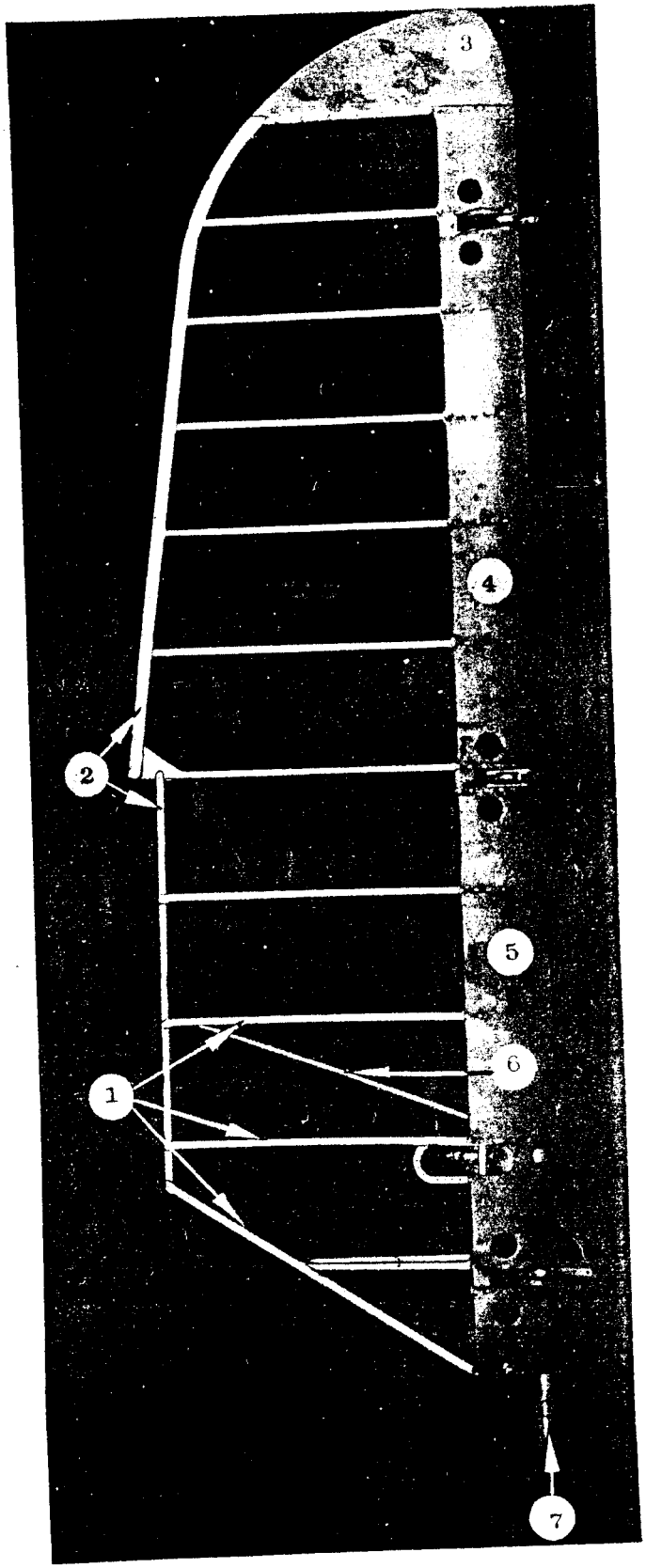


NOTE:

MATERIALS OF CONSTRUCTION, SEE FIG. 46.

MASS BALANCING, SEE FIG. 119.

Figure 45 - Elevator Repair Reference Diagram



Ref. No.	Grumman Part No.	Description	
1	12530-1,-3,-4,-5, -6,-8,-9,-10, -11,-12	Ribs	**
2	12530-28,-39	Trailing Edge	**
3	12530-37	Tip Cap	***
4	12530-27	Covering	*
	12530-33	Covering	*
5	12530-2,-6,-13	Nose Rib	**
6	12530-24	Tube Reinf.	
7	12530-25	Torque Tube	
	12530-26	Torque Tube	

* .020
** .028
*** .032

NOTE; All material 24ST aluminum alloy except Ref. No. 3 which is 3S½H aluminum alloy sheet.

Figure 46 - Elevator Structure

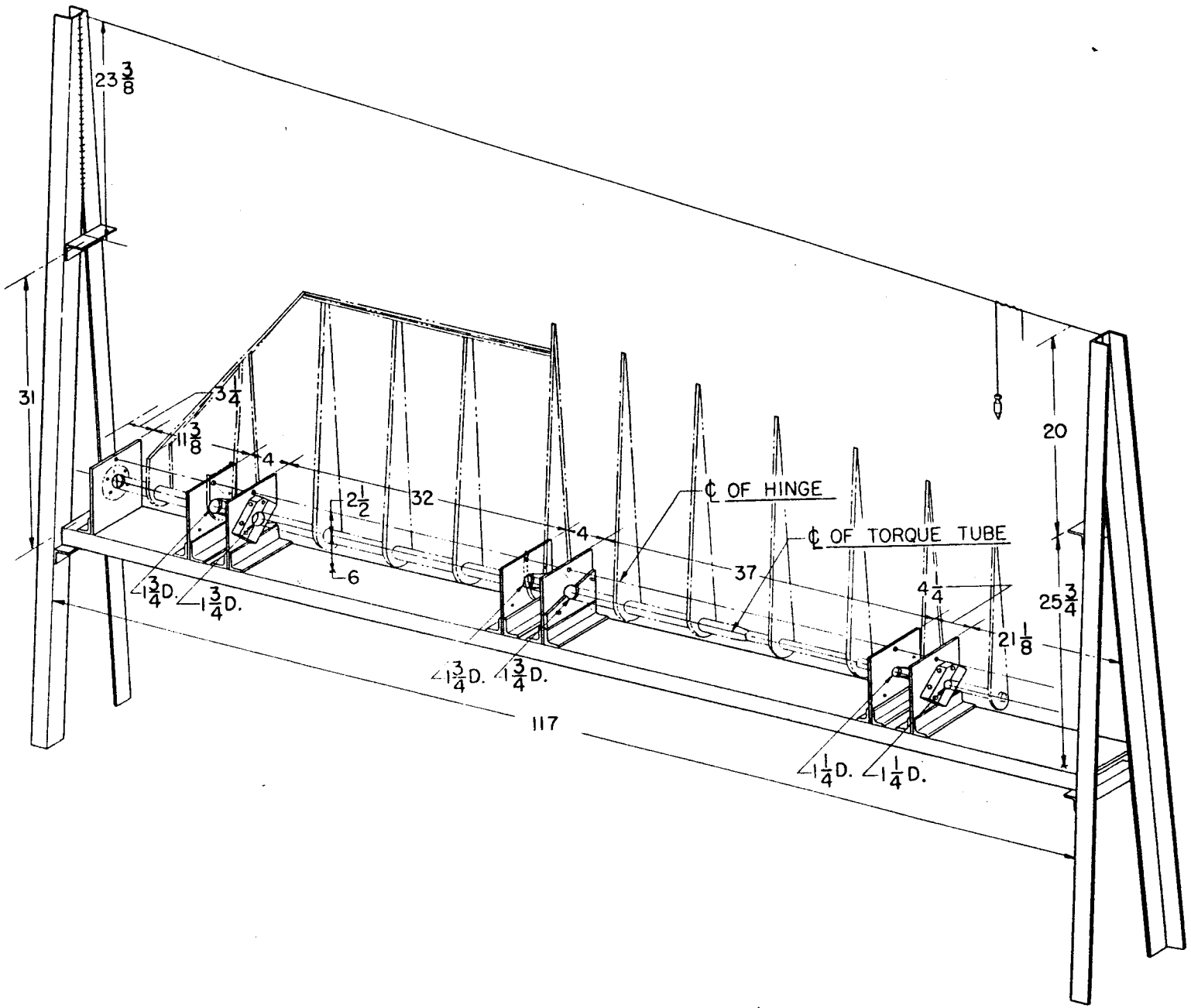
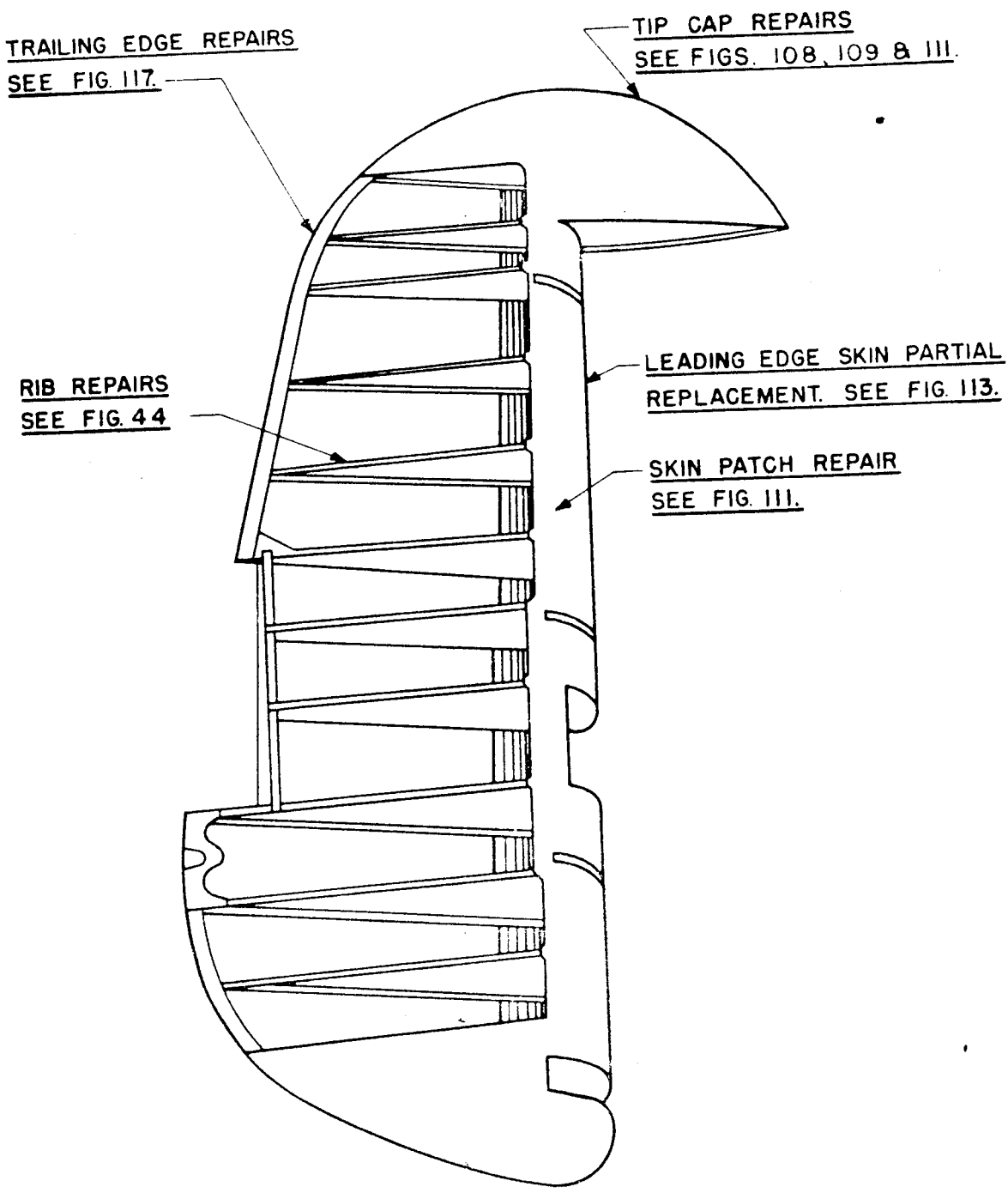


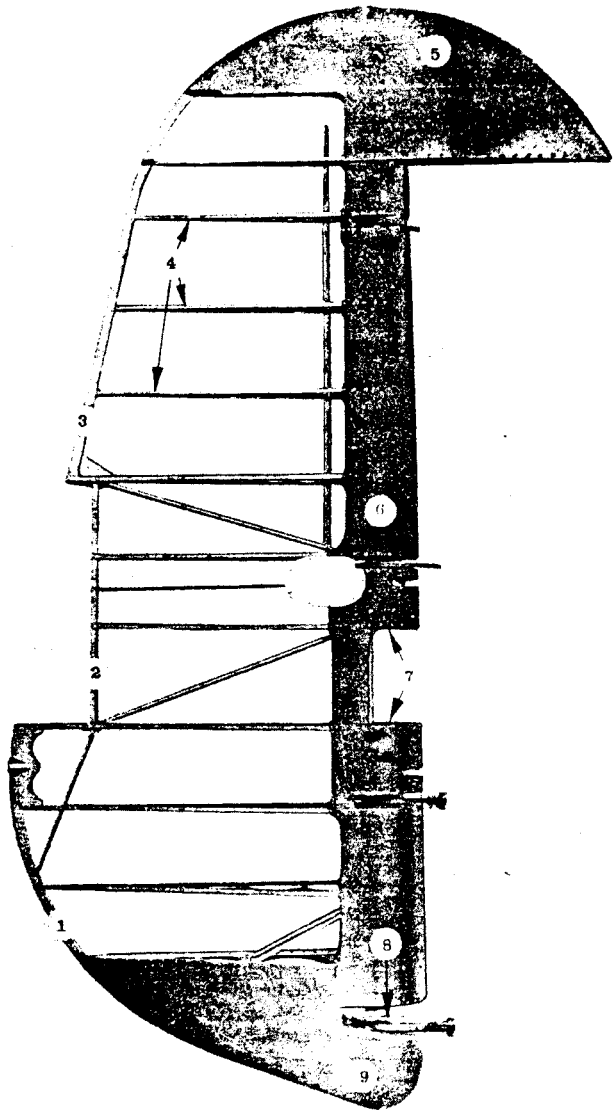
Figure 47 - Elevator Jig



NOTE:

MATERIALS OF CONSTRUCTION, SEE FIG. 49.
MASS BALANCING, SEE FIG. 120.
TORQUE TUBE REPAIRS, SEE FIGS. 121 & 122.

Figure 48 – Rudder Repair Reference Diagram



Ref. No.	Grumman Part No.	Description	Material	Thickness
1	12531-29	Trailing Edge Lower	24ST Aluminum Alloy Sheet	.028
2	12531-22	Beam - Tab Support	24ST Aluminum Alloy Sheet	.040
3	12531-28,-58	Trailing Edge Upper	24ST Aluminum Alloy Sheet	.028
4	12531-3,-4,-5,-7, -8,-10,-11, -12,-15,-16	Ribs	24ST Aluminum Alloy Sheet	.028
5	12534	Cap Sheet Assembly		
	12534-1	Cap Sheet	3S½H Aluminum Alloy Sheet	.040
6	12531	Nose Covering	24ST Aluminum Alloy Sheet	.028
7	12531-1,-6,-9,-14	Nose Ribs	24ST Aluminum Alloy Sheet	.028
8	12531-23	Torque Tube - Upper	24ST Aluminum Alloy Tube	
	12531-24	Torque Tube - Center	24ST Aluminum Alloy Tube	
	12531-25	Torque Tube - Lower	24ST Aluminum Alloy Tube	
9	12537	Cap - Rudder Bottom	52S½H Aluminum Alloy Sheet	.040

Figure 49 - Rudder Structure

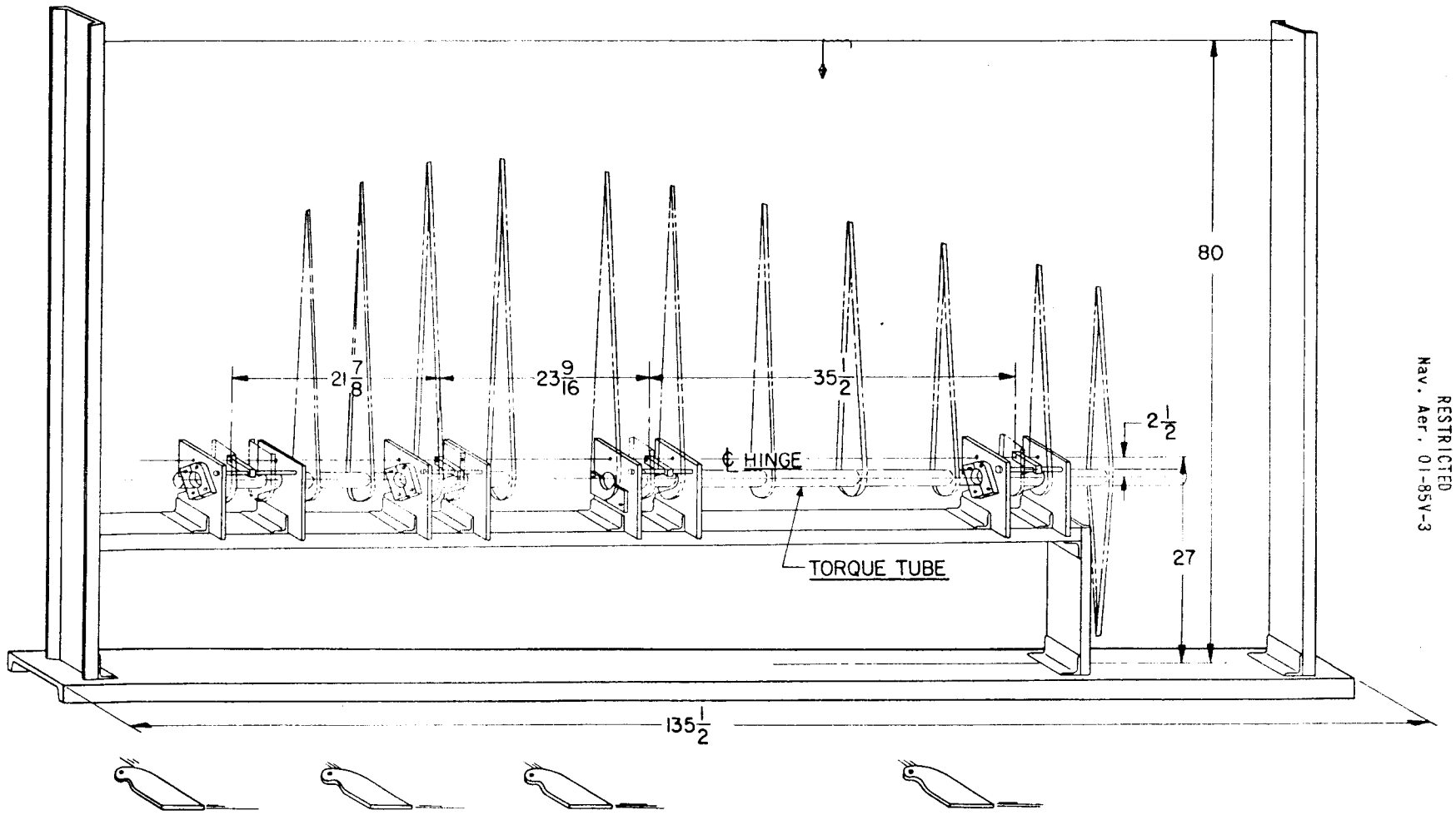


Figure 50 - Rudder Jig

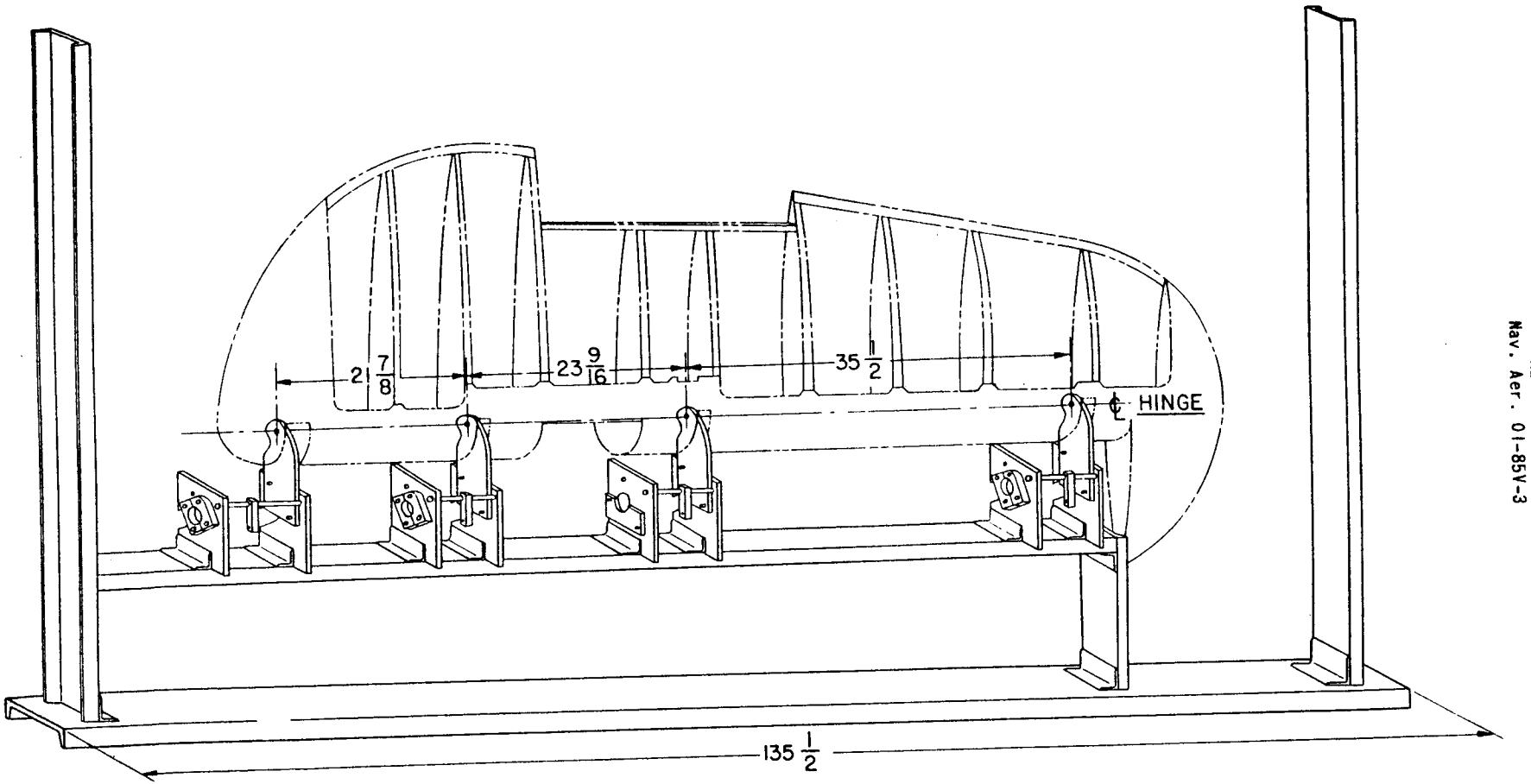


Figure 51 - Rudder Nose Skin Assembly Jig

25. DAMAGE REPAIRABLE BY PATCHING.-The tip caps should be patched similar to the wing tips as described in Section 2, Paragraphs 167 a, b, c, and d, except that the flush type patch only is recommended and the patch may be the same material as the damaged tip caps or 24ST aluminum alloy as an alternate.

26. DAMAGE NECESSITATING REPLACEMENT.-If the tip caps cannot be repaired by patching they should be repaired in accordance with Section 2, Paragraph 169.

FIN AND STABILIZERS.

27. GENERAL.-The fin and stabilizers are constructed of 24ST aluminum alloy, and are built around a beam. The fin is an integral part of the hull. The same methods of repair are applicable to both units unless otherwise specified.

SKIN.

28. GENERAL. The skin panels are riveted to the ribs and beam. (See Figures 53 and 56).

NOTE

Inspect for dents, holes, cracks, distortion and disturbed riveting. Dents should be inspected to insure that they are not stress wrinkles caused by failure of vital structure.

29. NEGLIGIBLE DAMAGE.-Small, smooth isolated dents free from cracks, sharp corners and abrasions and less than 1/16 inch deep may be neglected if riveting is undisturbed and the section is not distorted. Isolated cracks up to one inch may be neglected according to Figure 135.

30. DAMAGE REPAIRABLE BY PATCHING.

a. Holes in open areas less than one inch in diameter after smoothing out may be repaired temporarily by doping on a piece of fabric provided they are not closer than four diameters on centers to any similar hole and are not located in the leading edge. It is recommended that the fabric be replaced as soon as possible with a 24ST aluminum alloy patch described below in this Paragraph.

b. In general, damage as described in Section 2, Paragraph 101a (2) may be repaired by patching.

c. The flush type patch used to repair the wings and described in Section 2, Paragraph 101b should be used to repair the fin and stabilize skin. (See Figures 108 and 109).

d. The outside patch (Refer to Section 2, Paragraph 101c, and Figure 111) may be used as an alternate to the flush patch if excessive patching is guarded against, and is advised only if there is not sufficient time in which to install the flush type patch.

e. A cracked area may be cut out and patched as shown in Figure 112.

31. DAMAGE REPAIRABLE BY INSERTION.-Where the damaged area is so extensive as to render a patch repair impracticable, the damaged section should be cut out chordwise between the ribs on each side of the damage, and spanwise to remove the damaged area. The spanwise plating should be cut well clear of the leading edge. The new skin should be butt joined. When cutting the skin chordwise, close to the ribs, sufficient material should be left for the original skin to form a butt joint with the replacement skin as shown in Figure 57. A channel section of the same gage as the skin should be formed and inserted at the butt joint. G29-AD-4 rivets should be used at one inch pitch and 5/16 inch edge distance.

32. DAMAGE NECESSITATING REPLACEMENT.-Damaged skin panels not repairable by patching or insertion should be replaced with equivalent undamaged sections as in the original construction.

BEAMS.

33. GENERAL.-The stabilizer and fin beams are channel shaped sections of 24ST aluminum alloy, to which the skin and ribs are riveted.

NOTE

Inspect for dents, holes, cracks, nicks, breaks, distortion, and disturbed riveting.

34. NEGLIGIBLE DAMAGE.-Small, smooth isolated dents free from cracks, sharp corners or abrasions and less than 1/16 inch deep may be neglected if adjacent riveting is undisturbed and the section is not distorted. Smoothed out nicks less than 1/8 inch deep in the free edges of the flanges may be neglected under the same provisions as dents. Cleaned up damage to the web leaving an isolated hole less than 1/2 inch in diameter may be neglected provided the hole is more than one inch from the radius of the flange or attachments and more than four diameters on centers from any similar hole. Isolated cracks may be neglected as noted in Figure 135.

35. DAMAGE REPAIRABLE BY PATCHING.

a. Damage to the flange up to 1/2 its width may be repaired by a 24ST aluminum alloy flat plate as shown in Figure 58 for the fin and Figure 59 for the stabilizer.

b. Damage to the flange extending 1/2 the width of the web, or damage confined to the web up o 1/2 its width should be repaired by the small bent up 24ST aluminum alloy patch shown in Figure 58 for the fin and Figure 59 for the stabilizer.

c. Damage involving more than 1/2 the width of the web may be repaired by the large patch with top and bottom bent up flanges provided the patch can be fitted and riveted as shown in Figure 58 for the fin and Figure 59 for stabilizer.

d. It is essential that patches be shaped to fit the contour of the beam so that there is a snug fit between the flanges of the repair plate and the flanges of the beam.

36. DAMAGE REPAIRABLE BY INSERTION.-Damage not repairable by patching may be repaired by cutting out the damaged section between ribs and inserting a new equivalent section, which fits snugly at the butt joint with the adjacent undamaged original structure. The splice plate used at the butt joint is the same as the patch described in Paragraph 35c above and shown in Figure 58 for the fin and Figure 59 for the beam. Reference should also be made to Paragraph 35d above.

37. DAMAGE NECESSITATING REPLACEMENT.- If the damage cannot be repaired by patching or insertion the damaged member should be replaced with an equivalent undamaged section.

RIBS.

38. GENERAL.-The fin and stabilizer ribs are web type stiffened by flanged lightening holes.

39. NEGLIGIBLE DAMAGE.-Small, smooth isolated dents free from cracks, sharp corners or abrasions and less than 1/16 inch deep, and isolated nicks in the free edges of the bent up flanges less than 1/8 inch deep after smoothing out may be neglected if riveting is undisturbed and the section is not distorted. Holes less than 1/2 inch in diameter after smoothing out may be neglected if more than four diameters on centers from any similar hole and more than one inch from the radius of the bent up flange, lightening hole or attachments. Cracks may be neglected in accordance with Figure 135.

40. DAMAGE REPAIRABLE BY PATCHING.

a. Damage to the flange up to 1/2 of its width may be repaired by a flat 24ST aluminum alloy plate as shown in Figure 60.

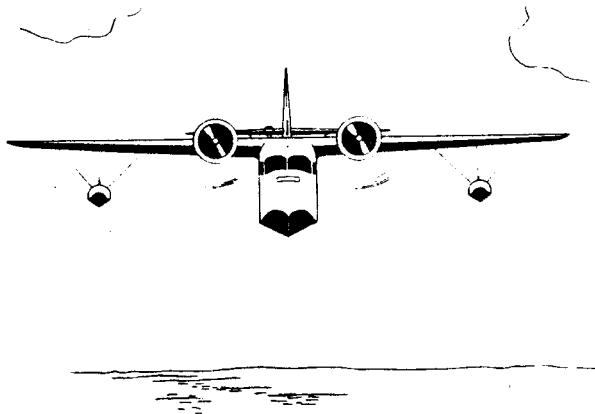
b. Damage to the flange up to its full width requires two plates as shown in Figure 60.

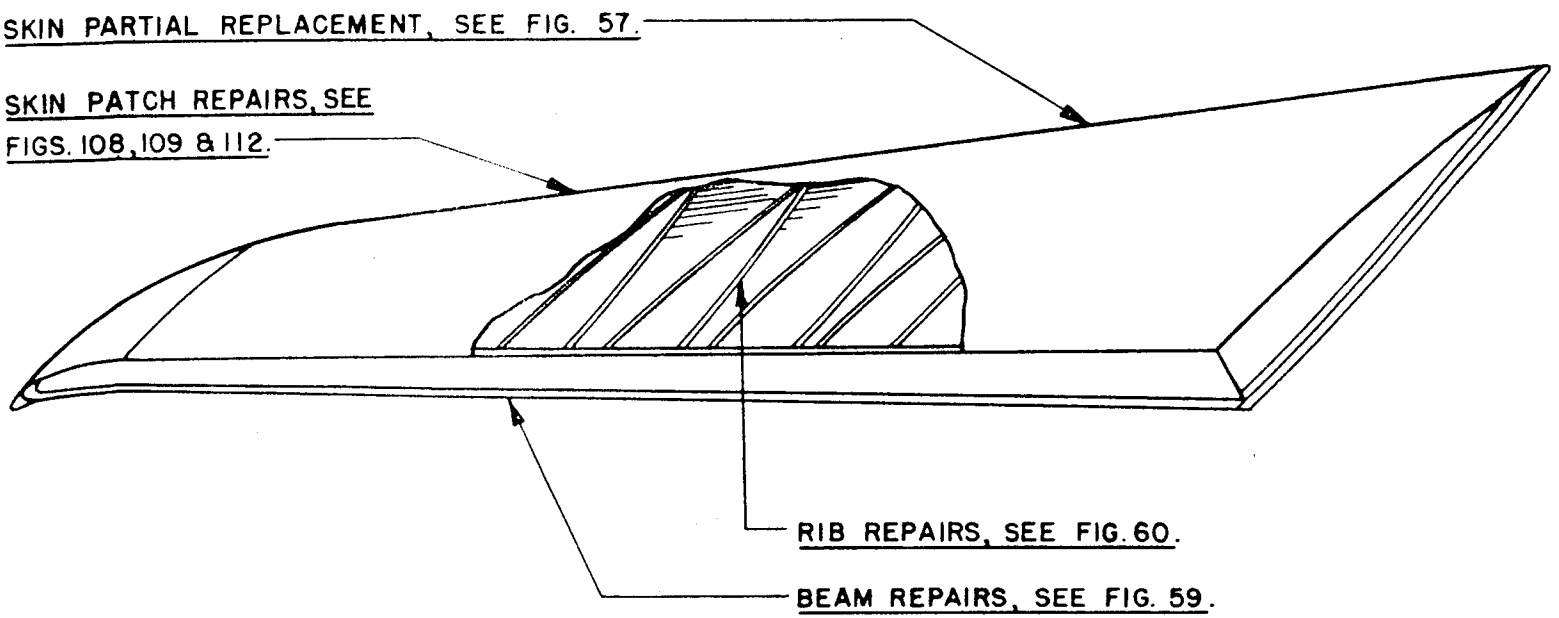
c. Damage to the web may be repaired by the small patch with bent up flanges shown in Figure 60, if there is room to fit the patch. If the flange is damaged in combination with the web, the separate flat plate for the flange should be used in addition to the web plate.

d. Web patches may cover lightening holes.

41. DAMAGE REPAIRABLE BY INSERTION.-Damage not repairable by patching may be repaired by cutting out the damaged section between lightening holes and inserting a new equivalent section. The splice plates at the butt joint consist of the large repair plate with bent up flanges on each side as shown in Figure 60, and two flat plates, one for the top and one for the bottom flanges.

42. DAMAGE NECESSITATING REPLACEMENT.-If the damage cannot be repaired by patching or insertion, replacement with an equivalent undamaged member is required.



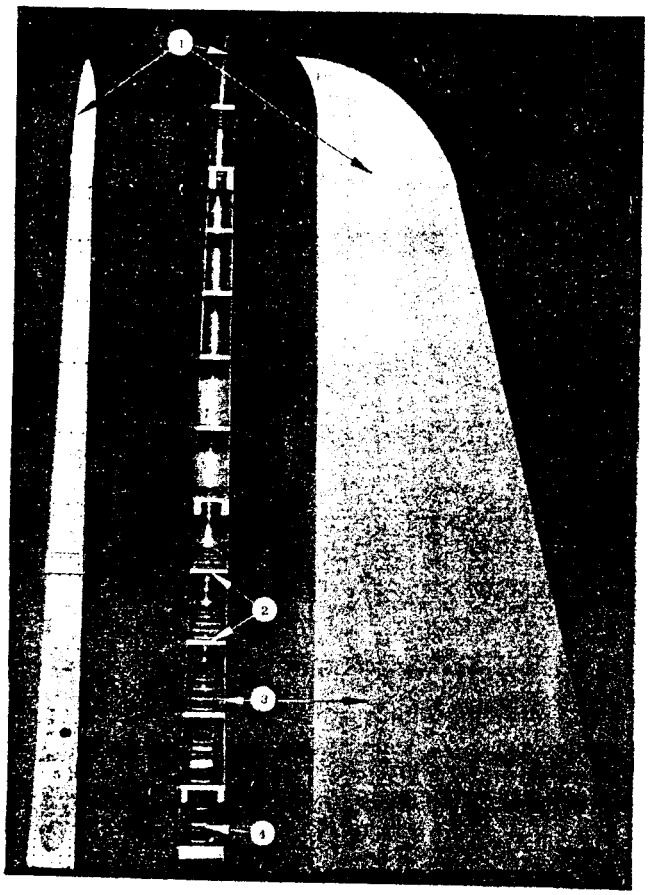


NOTE:

MATERIALS OF CONSTRUCTION, SEE FIG. 53.

STABILIZER SKIN PLATING DIAGRAM, SEE FIG. 55.

Figure 52 - Stabilizer Repair Reference Diagram



Ref. No.	Grumman Part No.	Description	Material	Thickness
1	12532-28	Tip Cap Weld Assembly	52S½H	.040
2	12532-2 to -11	Ribs	24ST Aluminum Alloy Sheet	.028
3	12532-12	Skin Cover Inboard	24ST Aluminum Alloy Sheet	.028
	12532-13	Skin Cover Center	24ST Aluminum Alloy Sheet	.028
	12532-14	Skin Cover Outboard	24ST Aluminum Alloy Sheet	.028
4	12532-1	Rib Inboard End	24ST Aluminum Alloy Sheet	.040
5	12532-15	Beam - Main	24ST Aluminum Alloy Sheet	.081

Figure 53 - Stabilizer Structure

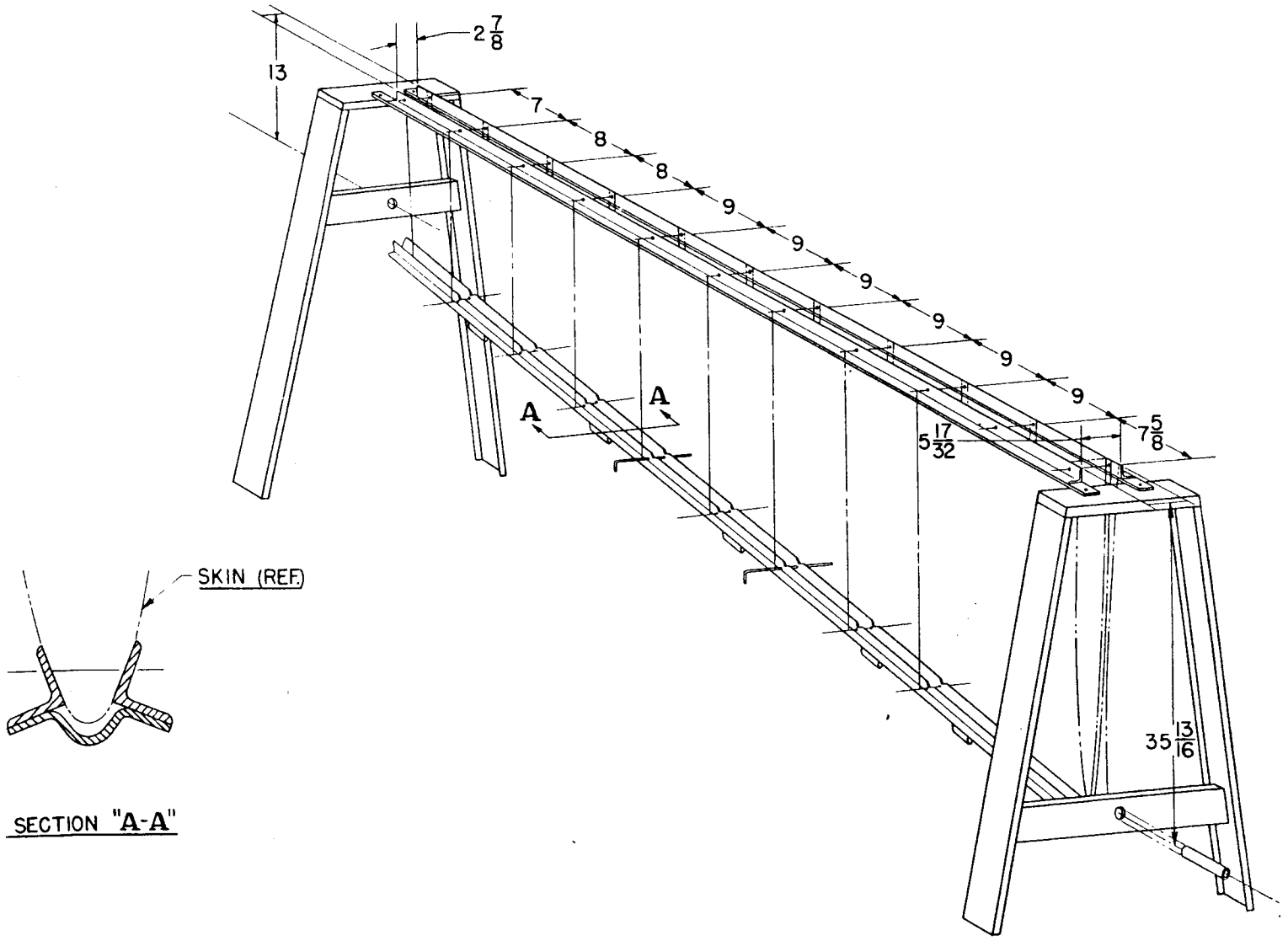
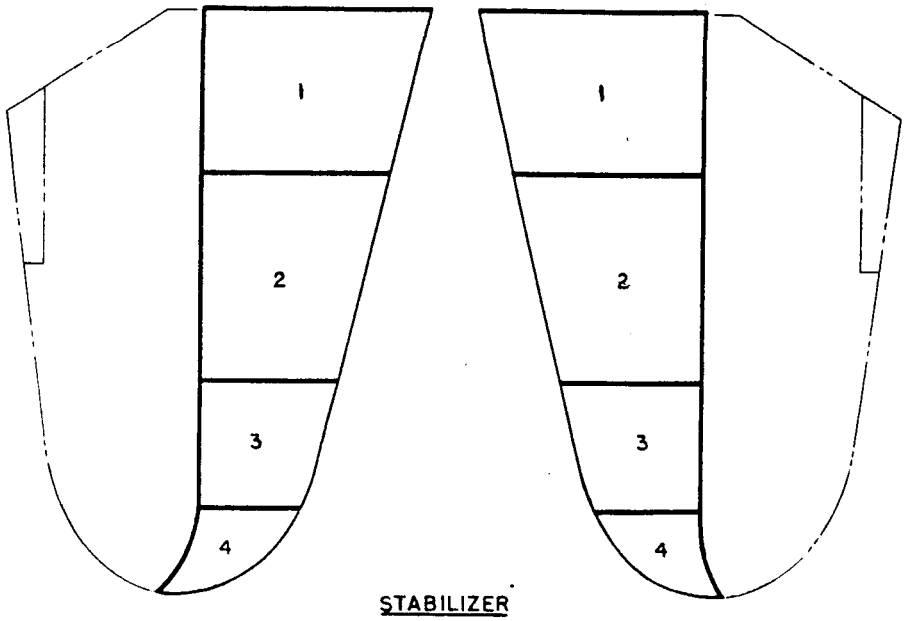


Figure 54 - Stabilizer Jig



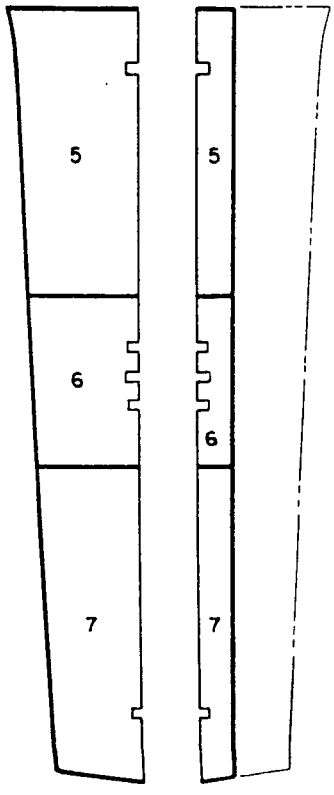
STABILIZER

REF. NO.	NUMBER REQ'D	DESCRIPTION	THICK-NESS	SIZE
1	1L-1R	SKIN COVER-INBOARD	.028	50 X 115
2	1L-1R	SKIN COVER-CENTER	.028	50 X 115
3	1L-1R	SKIN COVER-OUTBOARD	.028	50 X 115
4*	1L-1R	TIP CAP-WELD ASSEM.	.040	22 X 32
5	1L-1R	COVER-INBOARD	.028	32 X 50 1/2
6	1L-1R	COVER-CENTER	.028	28 X 31 1/2
7	1L-1R	COVER-OUTBOARD	.028	26 X 57

NOTE:-

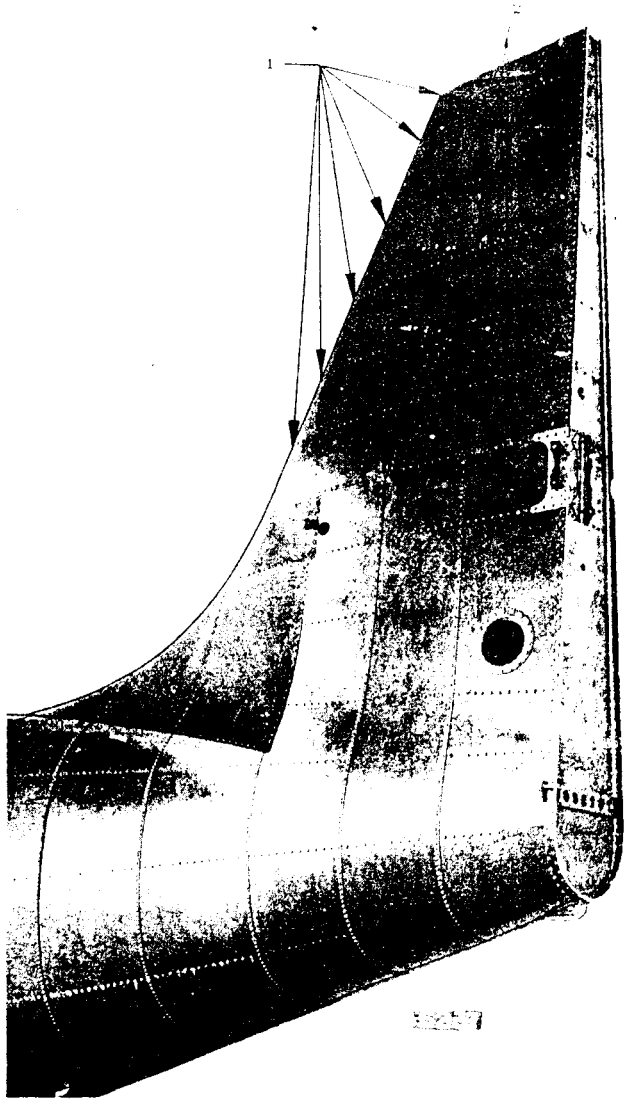
ALL MATERIAL IS 24 ST ALUMINUM ALLOY UNLESS OTHERWISE NOTED.

* 52S 1/4H AL. ALLOY SHEET



FLAP

Figure 55 - Stabilizer and Flap Skin Plating Diagram



Ref. No.	Grumman Part No.	Description	Material	Thickness
1	12533-2 to -7	Ribs	24ST Aluminum Alloy Sheet	.028
2	12533-8	Skin Covering - Bottom	24ST Aluminum Alloy Sheet	.028
2	12533-9	Skin Covering Center	24ST Aluminum Alloy Sheet	.028
2	12533-20	Skin Covering Top	24ST Aluminum Alloy Sheet	.028

Figure 56 - Fin Skin Plating

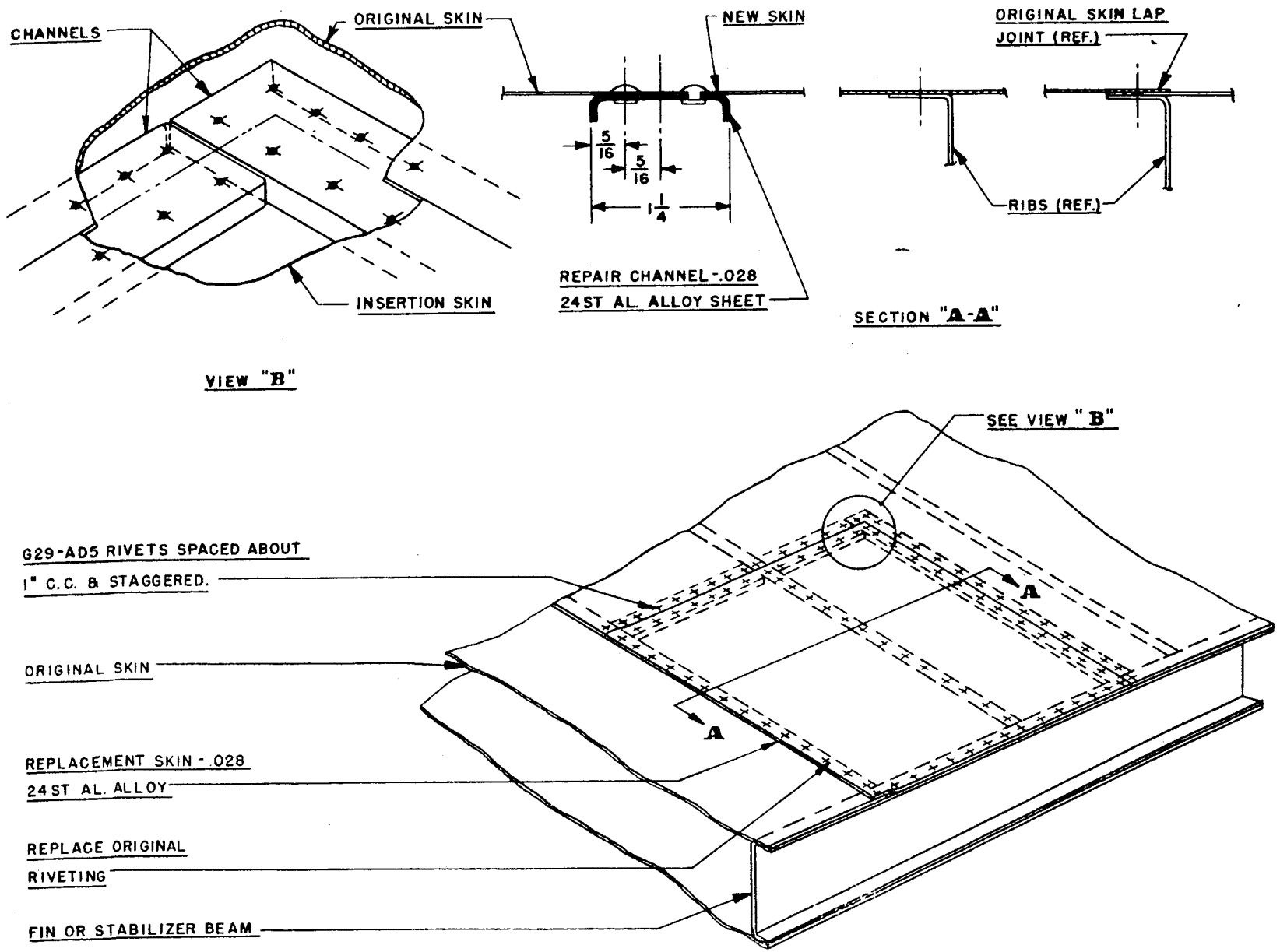


Figure 57 - Fin and Stabilizer Skin Insertion Repair

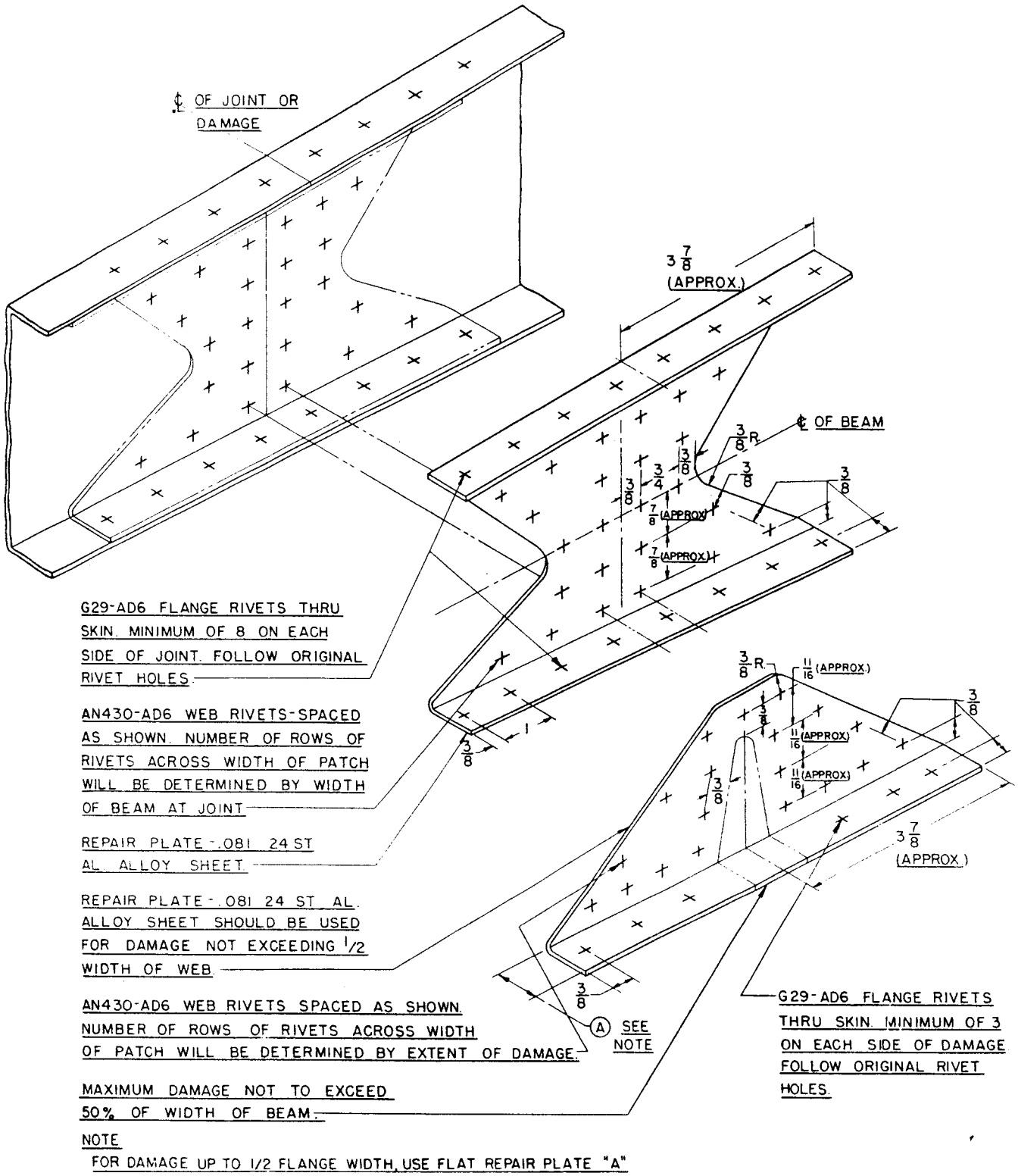
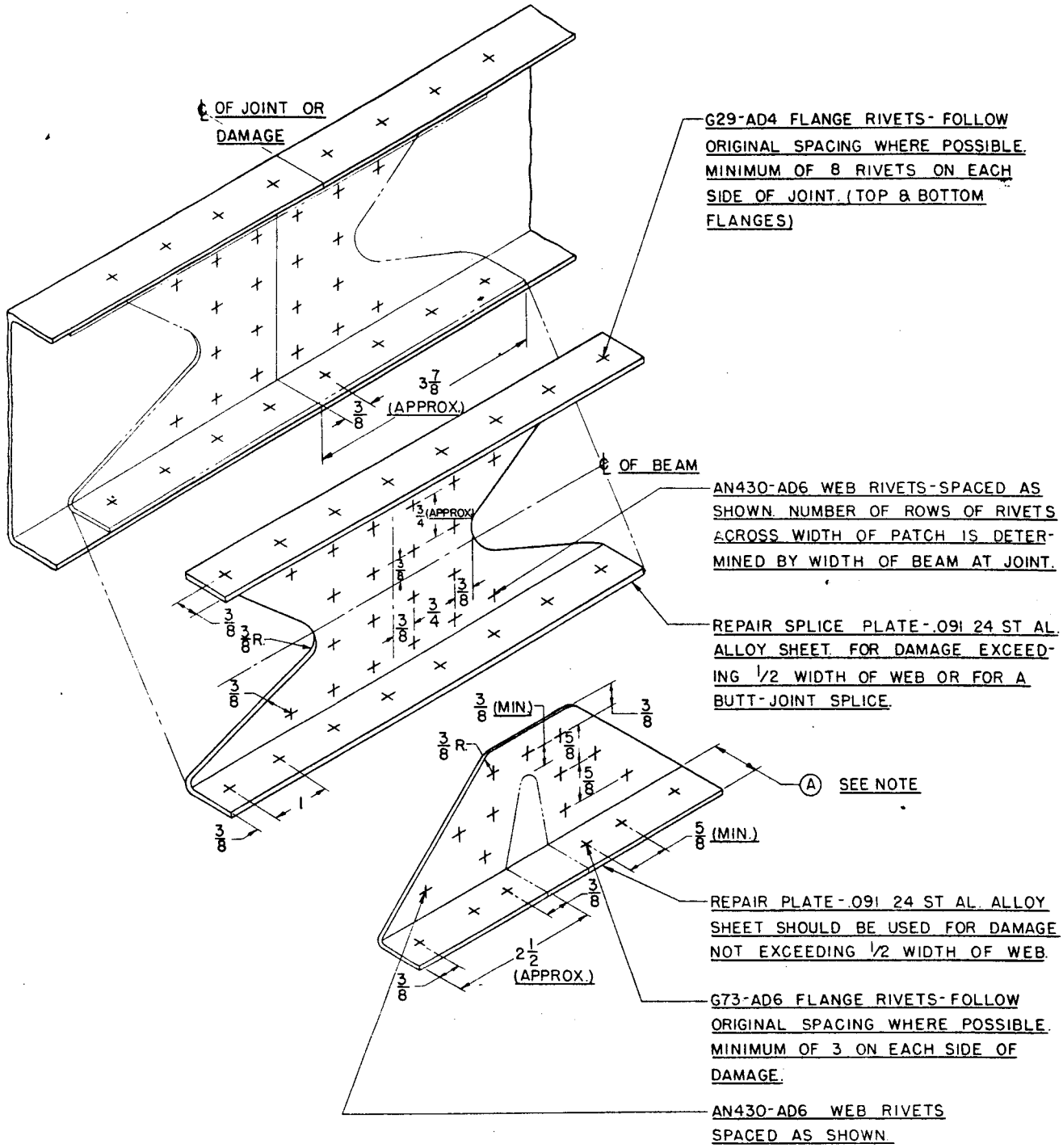


Figure 58 - Fin Beam Repairs



NOTE
FOR DAMAGE UP TO 1/2 FLANGE WIDTH, USE FLAT REPAIR PLATE "A"

Figure 59 - Stabilizer Beam Repairs

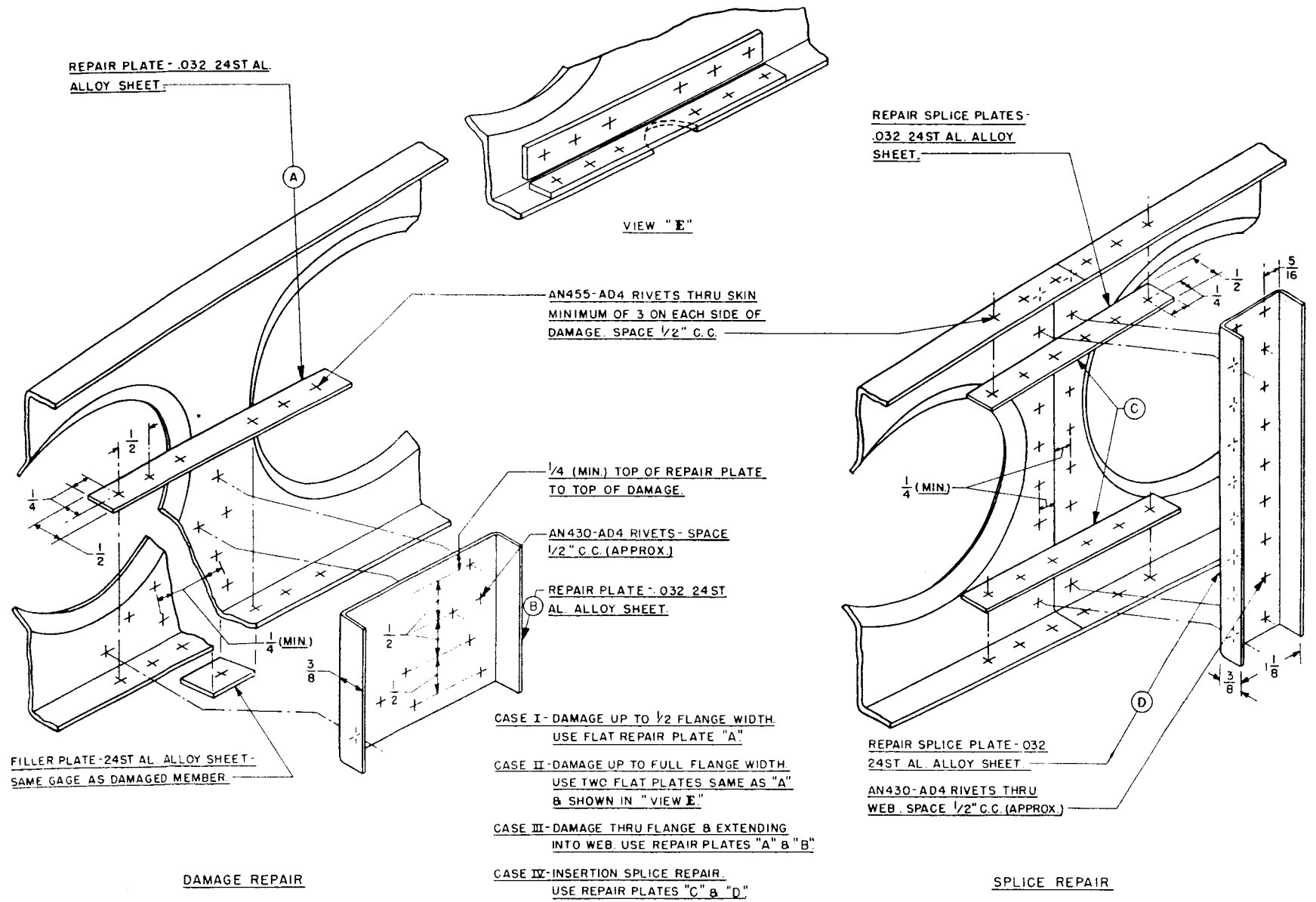


Figure 60 - Fin and Stabilizer Rib Repairs

.E IV

MATERIALS FOR REPAIR

TAIL SURFACES

RUDDER

Where Used	Description	Material	Size Thickness	Item
Trailing Edge	Sheet	24ST Aluminum Alloy	.028	Replacement
	Bar	24ST Aluminum Alloy	3/8	Patch and Splice Plates
Ribs	Sheet	24ST Aluminum Alloy	.028	Insertion and Replacement
		24ST Aluminum Alloy	.032	Patch and Splice Plates
Cap Sheet	Sheet	3S½H Aluminum Alloy	.040	Patch and Replacement
Nose Covering	Sheet	24ST Aluminum Alloy	.028	Patch and Replacement
Torque Tube	Tubing	24ST Aluminum Alloy	.058	Insertion and Replacement
	Sheet	24ST Aluminum Alloy	.064	Patch and Splice Plates
Bottom Cap	Sheet	52S½H Aluminum Alloy	.040	Patch and Replacement
As Required		Lead	To Suit	Mass Balancing

TABLE IV (CONT.)

MATERIALS FOR REPAIR

TAIL SURFACES

ELEVATOR

Where Used	Description	Material	Size Thickness	Item
Ribs	Sheet	24ST Aluminum Alloy	.028	Insertion and Replacement
		24ST Aluminum Alloy	.032	Patch and Splice Plate
Trailing Edge	Sheet	24ST Aluminum Alloy	.028	Insertion and Replacement
	Bar	24ST Aluminum Alloy	3/8	Patch and Splice Plate
Tip Cap	Sheet	3S½H Aluminum Alloy	.032	Patch and Replacement
Nose Covering	Sheet	24ST Aluminum Alloy	.020	Patch and Replacement
Torque Tube Inboard	Tubing	24ST Aluminum Alloy	.083	Insertion and Replacement
	Sheet	24ST Aluminum Alloy	.091	Patch and Splice Plates
Torque Tube Outboard	Tubing	24ST Aluminum Alloy	.095	Insertion and Replacement
	Sheet	24ST Aluminum Alloy	.102	Patch and Splice Plates
As Required		Lead	To Suit	Mass Balancing

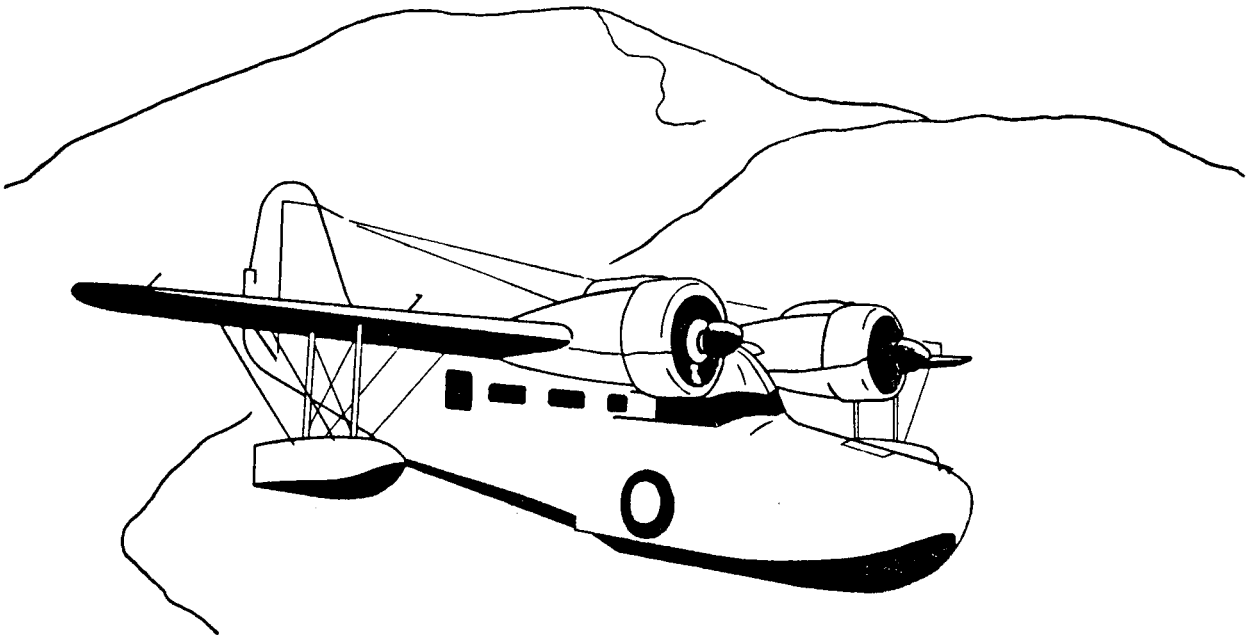
TABLE V (CONT.)

MATERIALS FOR REPAIR

TAIL SURFACES

STABILIZER AND FIN

Where Used	Description	Material	Size Thickness	Item
Tip Cap	Sheet	52S½H Aluminum Alloy	.040	Patch and Replacement
Rib Typical	Sheet	24ST Aluminum Alloy	.028	Insertion and Replacement
		24ST Aluminum Alloy	.032	Patch and Splice Plates
Skin Cover	Sheet	24ST Aluminum Alloy	.028	Patch and Replacement
Rib Inboard	Sheet	24ST Aluminum Alloy	.040	Insertion and Replacement
		24ST Aluminum Alloy	.051	Patch and Splice Plates
Beam	Sheet	24ST Aluminum Alloy	.081	Insertion and Replacement
		24ST Aluminum Alloy	.081	Patch and Splice Plates



SECTION 4
HULL

1. GENERAL.

a. The body is of stressed skin semi-monocoque construction consisting in general of 24ST aluminum alloy main bulkheads, vertical frames, cross members, flooring, angle frames, stringers and horizontal stiffeners covered with 24ST aluminum alloy panels. Cut outs are provided for the windshield windows, doors and bow hatch. The hull and fin are an integral part of the body.

b. All joints forward of Station #9 are watertight and skin joints are watertight as shown in Figure 62, which also notes watertight bulkheads. Duprene sealing tape (See Table II) soaked in kerosene is used with Duprene cement (See Table II) between the sheets and members at all watertight joints. Repairs to the hull should be sealed against water, when necessary, as in the original construction as described below in this Section. Watertight wells are built into the hull for retraction of the landing gear and tail wheel. All compartments are entered through watertight doors. Each cabin door is equipped with a smaller integral door which opens inward allowing use of the compass (JRF-6B only). The windows and windshield are watertight.

c. Special stiffeners are used to distribute concentrated stresses at the wing attachment fittings, landing gear and tail wheel attachment points and cut outs.

d. The interior of the fuselage body is divided into four sections, an anchor compartment in the bow, the pilot's compartment, passengers' cabin and a baggage compartment aft. The floor is removable for inspection of the hull bottom. The bulkheads at Stations #3 and #29 have removable plates for inspection of the enclosed compartments.

2. CLASSIFICATION OF DAMAGE.-Damage to any part of the hull structure should be inspected carefully to determine in which of the following categories it should be placed:

a. Negligible Damage.
b. Damage Repairable By Patching.
c. Damage Repairable by Insertion.
d. Damage Necessitating Replacement.

NOTE

If a slightly distorted structural member has been restored to shape, and no cracks or abrasions have occured, it should be reinforced the same as a damaged section repairable by patching, as material which has been distorted may not retain its original strength after being restored to shape even though there are no cracks or abrasions.

CAUTION

Special attention should be given to repairs at or near the wing attachment fittings, landing gear, tail wheel and tail surfaces attachment points. For other than negligible damage replacement is recommended except when a patch repair can be made as described in this chapter. These areas are located between stations #10 to #17, #28 to #30, and aft of Station #32.

SKIN.

3. GENERAL.-The hull plating is shown in Figure 62 which notes material, location and thickness of the panels.

4. NEGLIGIBLE DAMAGE.-Small, smooth isolated dents free from cracks, sharp corners and abrasions may be neglected after smoothing out, provided adjacent members are undamaged and riveting is undisturbed. Dents should be inspected to insure that they are not stress wrinkles caused by failure of internal structure. It is important that no perforations or large holes be classified as negligible as these will impair the waterproofing or sprayproofing of the airplane.

5. REPAIR OF DENTS, PERFORATIONS.-Dents more than negligible can generally be smoothed out of skin by hammering, and may then be neglected provided no damage has resulted from the treatment, riveting is undisturbed and the damage has not affected the internal structure. In smoothing up the surface once the dent has been removed, emery cloth may be used to remove surface roughness. (Use with extreme care). Small holes in the skin less than 1/4 inch in diameter may be repaired by inserting a rivet after the edges of the hole have been smoothed out. The shank should be treated with cement (See Table II) in waterproofed areas.

6. DAMAGE REPAIRABLE BY PATCHING.

a. Damage more than negligible and not as extensive as to require insertion or replacement of

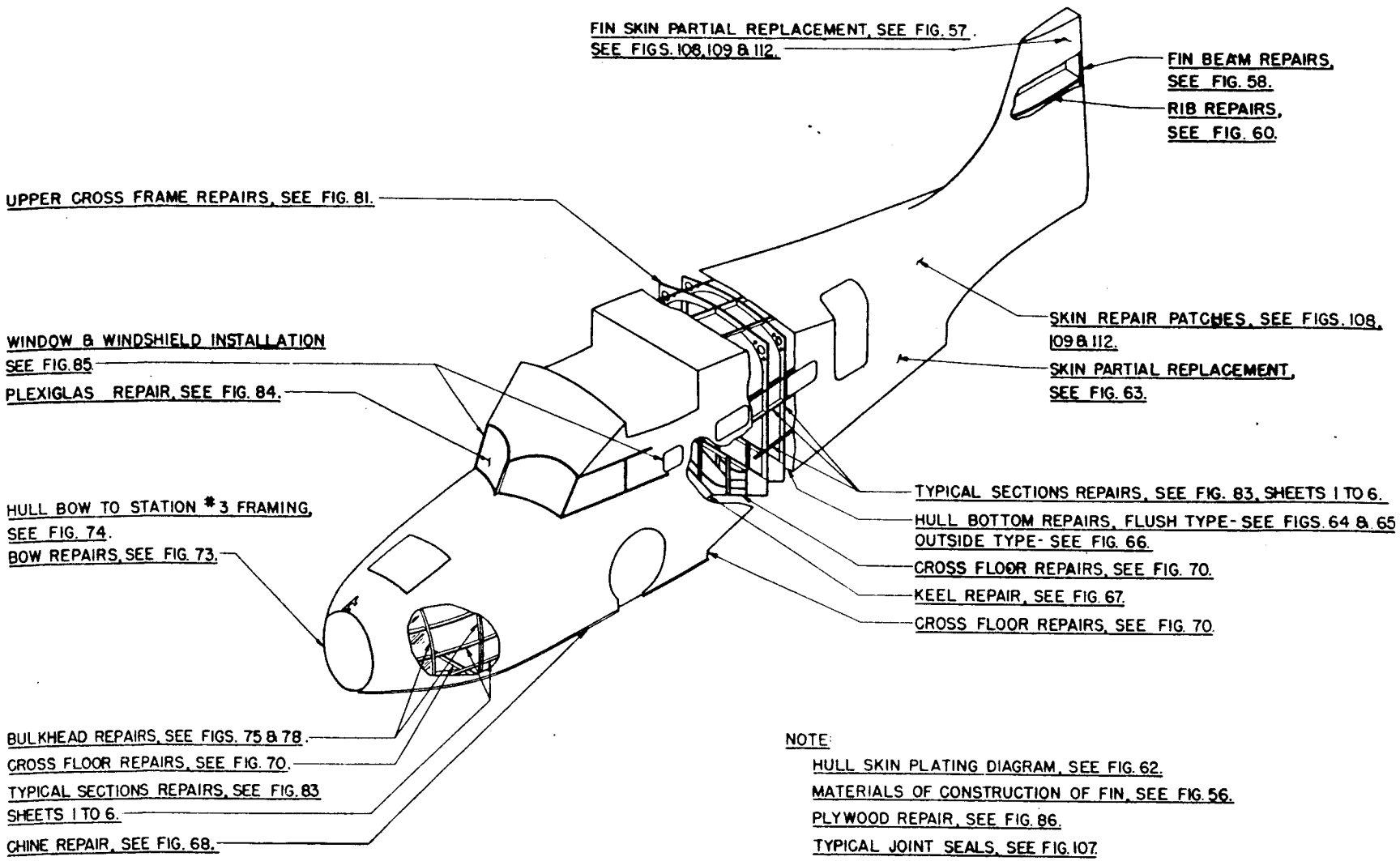


Figure 61 - Hull Repair Reference Diagram

a panel may be repaired by patching, as described in Section 2, Paragraph 101a (2).

b. The flush type patch used for the wings as described in Section 2, Paragraph 101b, may be used on the hull with the exception that it is not necessary to cut the internal frame, and patches in waterproofed areas must be watertight as described in Paragraph 65 below. These patches, shown in Figures 108 and 109, may be used on any part of the hull where the damage will permit forming the patch. Difficulty in forming the patch may be encountered, for example, on the nose of the hull or on top and around the pilot's cabin, in which case the skin may be repaired as described in the next Paragraph below. An outside patch (See Section 2, Paragraph 101c and Figure 111) may be used as an alternate to the flush type patch, and should be watertight the same as the flush patch.

7. DAMAGE REPAIRABLE BY INSERTION.-Damage more extensive than that repairable by patching as outlined above, may be repaired by insertion.

a. HULL BOTTOM PLATING.

(1) Damage to the hull bottom plating repairable by insertion will usually result from striking submerged or other objects in the water or on land. If the damaged skin is not repairable by patching the damaged area should be cut away to a smooth outline and new equivalent skin inserted into the trimmed damaged area. The new plate should be flush with the surrounding skin and fit snugly all around. An inside plate of the next heavier gage should be placed on the inside over the flush plate overlapping and riveted as shown in Figure 64, using the same type of rivets as in the surrounding area.

(2) It will be necessary to remove the cross floors in the way of this repair. These members must be trimmed as shown in Figure 64. Bent up reinforcement angles should be placed over the top of the inside repair plate and cross floors and riveted as noted. This repair is recommended for extensive damage.

(3) An alternate type of repair for less extensive damage may be made by using a reinforcement frame on the inside of the flush repair plate as shown in Figure 65. This repair is recommended for damage to the hull plating at the main step where the damage is in the way of the adjacent heavy stiffeners.

(4) For more extensive damage in this area in the way of these stiffeners a patch plate may be placed over the smoothed out damaged area on the outside of the bottom skin and underneath the keel as shown in Figure 66.

b. HULL NOSE.

(1) The nose of the hull is constructed of 24S0 and heat treated to 62,000 p.s.i. If the damage cannot be repaired by patching as described in Paragraph 6 above, the damaged area should be cut out and replaced by a new equivalent section. It will usually be desirable to replace an entire panel. Panels will require special attention to forming; reference should be made to Figure 72 and Paragraph 8 below.

(2) Severe damage to the hull nose skin panels will generally result in extensive damage to the internal structure at this station, in which case reference should be made to Paragraph 30 below.

c. HULL PLATING - MISCELLANEOUS.-The sides of the hull above the chine may be repaired by insertion replacement of partial or entire panels. (See Figure 63). The damaged area should be cut out along adjacent internal members and replaced with equivalent material, using original riveting and following the procedure for riveting and skin joints described in the following paragraph.

8. DAMAGE NECESSITATING REPLACEMENT.

a. If an entire new panel must be installed, first remove the damaged panel by drilling out the rivets. The new panel should be the equivalent of the damaged panel. Place the new panel in position and drill enough holes to hold it securely. (Every fourth or fifth rivet hole is recommended). Then install machine screws or metal clamps. Where the new panel overlaps the adjacent skin, it is necessary to drill from inside the fuselage out, and where the new panel is inserted at the joint, holes should be drilled from the outside. The new panel should then be riveted in place, using the same riveting and skin joints as in the original construction and if waterproofing is required, reference should be made to Paragraph 65 below. In general, a skin panel should overlap the aft adjacent panel, and should be lapped under the forward adjacent panel; also panels should be lapped over adjacent panels immediately below.

KEEL.

9. GENERAL.-The front and rear keels are 24ST aluminum alloy extruded members, Alcoa K11257.

NOTE

Damage to the keel necessitating repair, in addition to corrosion, will ordinarily

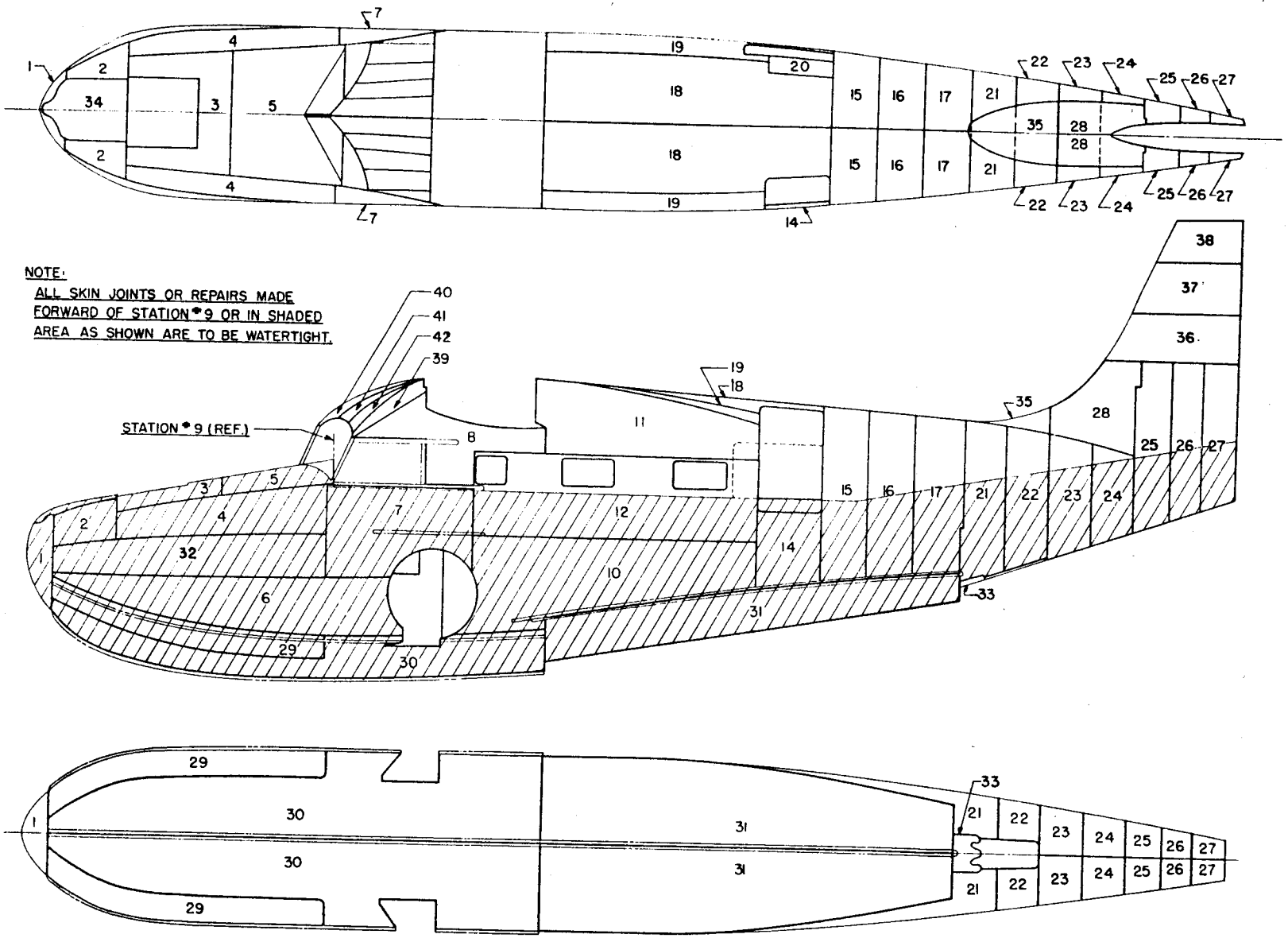


Figure 62 - Hull Skin Plating Diagram (Sheet 1)

REF. NO.	NUMBER REQ'D.	LOCATION	THICK-NESS	SIZE
1	1	NOSE BUMPING	.051	48X58
2	1L-1R	DECK STA.* 1-3	.028	24X26
3	1	DECK STA.* 3-6	.028	39X48
4	1L-1R	UPPER SIDE STA.* 3-9	.028	20X75
5	1	DECK STA.* 6-9	.032	40X57
6	1L-1R	LOWER SIDE WHEEL POCKET	.028	23X126
7	1L-1R	SIDE STA.* 9-14	.040	35X51
8	1L-1R	UPPER SIDE STA.* 9 1/2-16	.028	36X69
10	1L-1R	SIDE WHEEL POCKET	.028	37X110
11	1L-1R	UPPER SIDE STA.* 16-24	.028	27X81
12	1L-1R	SIDE STA.* 14-24	.028	30X101
14	1L-1R	SIDE STA.* 24-26	.040	24X28
15	1L-1R	STA.* 26-27	.028	19X81
16	1L-1R	STA.* 27-28	.028	20X77 1/2
17	1L-1R	STA.* 28-29	.028	22X73 1/2
18	1L-1R	TOP CENTER STA.* 16-26	.028	28X102
19	1L-1R	TOP OUTER STA.* 16-24	.028	7 1/2X76
20	1R	TOP DECK OUTER STA.* 24-26	.028	24 1/2X28
21	1L-1R	STA.* 29-30	.028	19X80
22	1L-1R	STA.* 30-31	.028	17X70

REF. NO.	NUMBER REQ'D.	LOCATION	THICK-NESS	SIZE
23	1L-1R	STA.* 31-32	.028	17X70
24	1L-1R	STA.* 32-33	.028	17 1/2X59
25	1L-1R	STA.* 33-34	.028	14X70
26	1L-1R	STA.* 34-35	.028	14 1/2X66
27	1L-1R	STA.* 35-36	.028	14X62
*28	1L-1R	FIN FAIRING	.032	36X36
*29	1L-1R	BOTTOM FRONT OUTER	.064	18 1/2X110
30	1L-1R	BOTTOM FRONT INNER	.057	34X175
31	1L-1R	BOTTOM REAR	.040	34X153
32	1L-1R	MIDDLE SIDE	.028	16X99
33	1	TAIL WHEEL FAIRING	.051	10X17
*34	1	BOW WALK	.051	16X45
*35	1	FIN FAIRING	.040	39X45
36	1	FIN BOTTOM	.028	38X82
37	1	FIN CENTER	.028	33X68
38	1	FIN TOP	.028	27X46
*39	1L-1R	DOME SIDE - OUTER	.028	15X34
40	1L-1R	DOME TOP - CENTER	.028	8X49
41	1L-1R	DOME CENTER - INTERMEDIATE	.028	8 1/4X39
42	1L-1R	DOME OUTBOARD - INTERMEDIATE	.028	8 3/4X34

NOTE:

ALL MATERIAL 24ST ALUMINUM ALLOY SHEET UNLESS OTHERWISE NOTED.

NOTE:

* REF. NO. 28 - 3S 1/2H
* REF. NO. 29 - 3S 1/2H
* REF. NO. 34 - 52S 1/4H or 3S 1/2H
* REF. NO. 35 - 3S 1/2H
* REF. NO. 39 - 52S 1/2H

Figure 62 - Hull Skin Plating Diagram (Sheet 2)

RESTRICTED
RESTRICTED
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result from collision with floating objects causing bending, breaks or severe distortion, or from a "wheels-up" landing on concrete runways, etc. which "burns off" a portion of the keel, which will generally occur in the vicinity forward of the main step. Check for leaks resulting from damage to the waterproofing.

10. NEGLIGIBLE DAMAGE.-Small, smooth isolated dents free from cracks, sharp corners and abrasions and less than 1/16 inch deep, and smoothed out nicks less than 1/8 inch deep may be neglected if riveting is undisturbed, the section is undistorted and there are no leaks. Damage to the lower portion of the keel, which does not affect more than 1/4 the depth of the member (approximately 1/8 inch) may be neglected.

11. DAMAGE REPAIRABLE BY INSERTION.-Damaged areas should be cut out for the full width of the keel and a new equivalent section inserted as shown in Figure 67, with a splice plate riveted on the inside. As a rule, bent and distorted sections will require an insertion repair, although in some cases it may be possible to straighten the damaged section and reinforce with an inside plate the same as a splice plate used for an insertion repair. When an insertion repair is made, the inserted section must fit as closely as possible against the original adjacent section. (1/64 inch maximum tolerance). Special attention must be paid to waterproofing when repairing a bent, distorted or otherwise damaged keel, and reference should be made to Paragraph 65 below.

12. DAMAGE NECESSITATING REPLACEMENT.-A damaged keel not repairable by insertion must be replaced as in the original construction.

CHINE.

13. GENERAL.-The forward chine is a 24ST aluminum alloy extended angle, Alcoa K12025, and the rear chine Alcoa K15087.

14. NEGLIGIBLE DAMAGE.-Dents and nicks may be classified as negligible the same as for the keel as noted in the applicable parts of Paragraph 10 above.

15. DAMAGE REPAIRABLE BY PATCHING.-Damage to either flange up to 1/2 its width may be repaired by an outside flat plate as shown in Figure 68 provided the damage does not affect the radius and waterproofing is not impaired.

16. DAMAGE REPAIRABLE BY INSERTION.-If the damage cannot be repaired by patching, the damaged section should be cut out midway between attachments and a new equivalent length inserted, which must fit snugly against adjacent structure. (1/64 inch maximum tolerance). Use a bent up angle splice plate on the inside as shown in Figure 68, making watertight joints as described in this Section.

17. DAMAGE NECESSITATING REPLACEMENT.-If the chine cannot be repaired by patching or insertion, it must be replaced with an equivalent undamaged section having watertight joints as described in this Section.

CROSS FLOORS.

18. GENERAL.-The cross floors are "V" shaped sections reinforcing the hull bottom and stiffened across the top by channels.

NOTE

Damage will generally result from poor landings or collision, causing distortion and misalignment.

19. NEGLIGIBLE DAMAGE.-Small, smooth isolated dents less than 1/16 inch, and free from cracks, sharp corners and abrasions may be neglected, if riveting is not disturbed, and the section is undistorted. Isolated nicks in the free edges of the upper cross channel or the edge of the bent up flange may be neglected if less than 1/8 inch deep and riveting is undisturbed. Smoothed out holes in the web less than 1/2 inch in diameter may be neglected if more than four diameters on centers from any similar hole or one inch from the radius of the flange or attachments.

20. DAMAGE REPAIRABLE BY PATCHING.

a. Small holes in the web may be repaired by cutting out the damaged area and covering with a 24ST aluminum alloy flat patch of the next heavier gage. Reference should be made to Figures 70 and 114.

b. Damage involving the flange and/or web may be patched with a bent up plate as shown in Figure 70.

c. If a distorted member can be restored to shape, it may be reinforced with two flat plates, one on each side of the member as shown in Figure 70.

d. Damage to the channel stiffener may be repaired by patching as noted in Figure 70.

e. Be sure rivets where required are coated with watertight cement. (See Table II).

21. DAMAGE REPAIRABLE BY INSERTION.-A damaged section of the web may be cut out and a new equivalent portion inserted using two splice plates as in Paragraph 20c above and shown in Figure 70. Refer

to Paragraph 20e above.

22. DAMAGE NECESSITATING REPLACEMENT.-Damage to the web not repairable as above necessitates replacement with an equivalent undamaged member. If the cross channel cannot be repaired by patching it should be replaced.

STEPS.

23. GENERAL.-The main and rear steps are located just aft of Station #16 and #29, respectively.

24. NEGLIGIBLE DAMAGE.-Dents and nicks may be neglected as in the case of cross floors outlined in Paragraph 19 above.

25. DAMAGE REPAIRABLE BY PATCHING.-These members should be repaired the same as the cross floors as described in Paragraph 20 above, except that all repairs should be waterproof as described in this Section.

26. DAMAGE REPAIRABLE BY INSERTION.-Refer to Paragraph 21 above, taking care to waterproof repairs where required.

27. DAMAGE NECESSITATING REPLACEMENT.-Damage not repairable by patching or insertion requires replacement with a waterproofed undamaged member as in the original construction.

BOW.

28. GENERAL.-The bow includes the nose forward skin panels and decks, internal structure in the nose, forward cross floors, angle rings, forward waterproofed bulkheads, stringers, stiffeners and bow hatch compartment structure; also the forward portions of the keel and chines. The bow compartment is provided with a double door folding hatch.

NOTE

This area is liable to severe damage in the event of collision with floating or other objects, which will necessitate extensive repairs or possible replacement of the entire structure.

29. NEGLIGIBLE DAMAGE.-Damage to the bow structure is described for the individual members under the appropriate paragraph headings in this Section.

30. METHOD OF REPAIR.-Patching, insertion or replacement of the members comprising the bow structure is described under the appropriate paragraph headings in this Section. The bow skin below the "T" formed by angles in the nose may be reinforced according to Figure 73 for distortion, dents and perforations. The internal structure reinforcing the nose panels should be repaired as noted in Figure 73, with special attention to waterproofing. In the event that these members are damaged to an extent necessitating replacement, members should be replaced with equivalent structure. If it is necessary to rebuild this structure, reference should be made to Figure 74.

BULKHEADS (SOLID).

31. GENERAL.-The solid waterproofed bulkheads in general consist of 24ST aluminum alloy plating reinforced by stiffener angles and channels.

BULKHEAD PLATING.

32. NEGLIGIBLE DAMAGE.-Small, smooth isolated dents in the bulkhead plating may be neglected if less than 1/16 inch deep and free from cracks, sharp corners or abrasions, riveting is undisturbed and adjacent members are undamaged.

NOTE

Check carefully for dents, holes, cracks and damaged riveting, and for leaks in the waterproofing. In addition to minor damage, bulkheads may be severely damaged such as misalignment, distortion, tearing and buckling.

33. DAMAGE REPAIRABLE BY PATCHING. - If the material is cracked or broken, the damaged portion should be cut away using 1/4 inch minimum radii. Isolated holes up to 1/4 inch in diameter may be repaired by inserting a rivet treated with waterproof cement. Larger holes or otherwise damaged areas may be repaired by riveting a watertight 24ST aluminum alloy patch of the next heavier gage over the smoothed out damaged area in accordance with Figure 114. The patch may be placed on either side of the bulkhead, depending on interference with stiffeners.

34. DAMAGE NECESSITATING REPLACEMENT.-Damage too extensive to make a patch repair practical should be repaired by replacement of the bulkhead plating as in the original construction.

BULKHEAD STIFFENERS.

35. GENERAL.-The solid bulkheads are stiffened by vertical and horizontal angles and channels. Door frames are riveted channel sections and serve as additional stiffeners.

36. NEGLIGIBLE DAMAGE.-Small, smooth isolated dents less than 1/16 inch deep may be neglected if free from cracks, sharp corners or abrasions; also isolated nicks in the free edges of the flanges may be neglected after cleaning out if less than 1/8 inch.

37. METHOD OF REPAIR.-Damage up to 1/2 the cross sectional area may be repaired by patching.

When the damage exceeds this amount, the shorter members should be replaced; while the longer members may be repaired by cutting out the damaged section and inserting a new equivalent section. Whether to repair by insertion or replace the member should be governed by the extent of the damage and the dictates of speed and economy. Reference should be made to Figure 83, Sheets 1 to 6, inclusive, showing typical patch and insertion repairs to channel and angle stiffeners. The repair of attaching angles is noted in Figure 78. Repairs are made by shaping a patch of 24ST aluminum alloy, fitting to the member being repaired and riveting as shown in Figure 83, Sheets 1 to 6, inclusive, using the same type of rivets as in the original structure. For typical bulkhead repairs, reference should be made to Figure 75.

ANGLE RINGS.

38. GENERAL.-Some bulkheads in the forward section such as the hatch compartment are comprised of angle rings above the cross floors, attaching to the skin. Adjacent stringers are notched for these rings.

39. NEGLIGIBLE DAMAGE.-Dents up to 1/16 inch free from cracks, sharp corners and abrasions may be neglected if adjacent riveting is undisturbed. Isolated nicks up to 1/8 inch in the free edges of the flanges after smoothing out may be neglected.

40. DAMAGE REPAIRABLE BY PATCHING.-Damage up to the full cross sectional area may be repaired by patching. These members may be repaired by a bent up angle patch as shown in Figure 78. Severe damage which may be encountered in the forward section, resulting in severe buckling and distortion, will necessitate replacement of these members with equivalent sections.

41. DAMAGE NECESSITATING REPLACEMENT.-Damaged rings not repairable by patching should be replaced with undamaged equivalents as in the original construction.

VERTICAL FRAMES.

42. GENERAL.-In addition to the solid bulkheads, the hull is stiffened by channel section vertical stiffeners as shown in Figures 79 and 80. These members extended from the cross floors and aft of Station #13 in conjunction with the upper cross frames comprise a bulkhead frame.

43. NEGLIGIBLE DAMAGE.-Small, smooth isolated dents, less than 1/16 inch deep, free from cracks, sharp corners or abrasions; small, isolated nicks in the free edges of the flanges 1/8 inch deep after being cleaned out and small scores confined to a single face of a section may be neglected.

44. DAMAGE REPAIRABLE BY PATCHING.

a. Damage more than negligible which affects up to 1/2 the cross sectional area may be repaired by patching.

NOTE

Before starting repairs, inspect these members and adjacent structures for distortion, elongated rivet holes and other damage.

b. Broken, cracked or otherwise damaged areas should be cut away, keeping 1/4 inch minimum radius. Damaged areas should be straightened, if necessary, to allow the patch to seat properly. These members must be kept as straight as possible as in the original construction.

c. Material for patch repair is 24ST aluminum alloy sheet cut to the size and bent up into the shape shown in Figure 83, Sheets 4 and 5 and riveted according to Figure 83, Sheet 6. Observe the correct bend radii and use the thickness of material noted.

d. If the damage is in the way of horizontal members, so that a patch cannot be fitted, the damaged area should be cut out across the entire section and an insertion repair made.

45. DAMAGE REPAIRABLE BY INSERTION.-For damage more extensive than that repairable by patching, an insertion repair is indicated unless the entire member must be replaced. Proceed as follows:

a. Remove rivets over damaged section.

b. Cut out the frame midway between pairs of existing rivets at least long enough to permit fitting of the repair plate.

c. Insert new equivalent section, making sure butt joints are fitted snugly. (1/64 inch maximum tolerance).

d. Make up repair plates, shaped, formed and riveted as shown in Figure 83, Sheets 4, 5 and 6.

46. DAMAGE NECESSITATING REPLACEMENT.-Damage not repairable by patching or insertion necessitates replacement with an equivalent undamaged section.

UPPER CROSS MEMBERS.

47. GENERAL.-These members are formed from 24S0 aluminum alloy sheet and then heat treated; flanged lightening holes stiffen the structure.

48. NEGLIGIBLE DAMAGE.-Small, smooth isolated dents less than 1/16 inch deep and free from cracks,

sharp corners and abrasions: and isolated nicks in the free edges of the bent up flanges may be neglected if riveting is undisturbed and the section is not distorted. Holes in the web up to 1/2 inch diameter after smoothing out may be neglected if more than one inch from the flange or lightening hole, and more than four diameters on centers from any similar hole.

49. DAMAGE REPAIRABLE BY PATCHING.-If the material is cracked or broken, the damaged portion should be cut away, keeping 1/4 inch minimum radii. If the edge of a lightening hole is damaged, it may be patched in accordance with Figure 115. Damage to the flange should be patched with a bent up angle as referenced in Figure 81. Damage to the web may be repaired with a flat patch of the next heavier gage in accordance with Figure 114 if there is room to fit the patch. This patch is recommended for web damage in the lightening hole area and should be placed on the side opposite the lightening hole flanged edges. It may cover the lightening holes. Damage to the web in the narrow portions of the member or damage involving the web and flange may be repaired with the bent up patch, having top and bottom flanges as shown in Figure 81.

50. DAMAGE REPAIRABLE BY INSERTION.-A damaged section of the rib may be cut off and a new equivalent section spliced in, using at the butt joint the patch with top and bottom flanges as shown in Figure 81.

51. DAMAGE NECESSITATING REPLACEMENT.-A damaged member not repairable by patching or insertion should be replaced with an equivalent undamaged member.

HORIZONTAL FRAMES (STRINGERS).

52. GENERAL.-The horizontal members which extend in varying lengths throughout the fuselage are formed and extruded angles, channels and "Zee" sections.

53. NEGLIGIBLE DAMAGE.-In general, negligible damage to these members is classified the same as to the vertical frames as described in Paragraph 12, above.

54. DAMAGE REPAIRABLE BY PATCHING.

a. Damage to these members close to or in the way of cut-outs and attachments in the vicinity of the bulkheads, vertical frames and angle rings should be inspected with special care to determine if an insertion repair instead of a patch repair should be made.

b. The horizontal frames may be patched in accordance with Paragraph 44a, b, and c above, unless the damage is in the way of vertical members so that a patch cannot be fitted, in which case an insertion repair should be made.

NOTE

The "Zee" stringers reinforcing the hull bottom adjacent to bulkhead Station #13, should be repaired with special care. Damage up to 1/2 the cross sectional area may be repaired by patching as shown in Figure 83, Sheet 3 and riveted according to Figure 83, Sheet 6. If the damage is too close to adjacent bulkheads, to permit fitting of the patch, replacement of these members is recommended.

55. DAMAGE REPAIRABLE BY INSERTION.-Refer to Paragraph 45 above.

56. DAMAGE NECESSITATING REPLACEMENT.-Refer to Paragraph 46 above.

WINDOWS.

57. GENERAL.-Plexiglas windows are provided in the pilot's compartment side windows which slide aft. The windshields are 1/4 inch laminated plate glass. The center cabin window openings are covered on the outside by Plexiglas blisters each of which houses a compass. The windows and windshield are set in metal framework sealed against water.

58. NEGLIGIBLE DAMAGE.-Small, smooth isolated dents in the metal framework free from cracks, sharp corners, and abrasions, and cleaned out nicks which do not interfere with operation of the windows may be neglected.

59. DAMAGE NECESSITATING REPLACEMENT.-Damage which interferes with operation of pilot's windows, large dents which cannot be hammered out without damaging the material, severely cracked areas and tears or fractures necessitate replacement of the damaged member. Distorted sections which cannot be repaired by hammering or straightening to original shape should be replaced.

NOTE

Since damage to waterproofing may allow water or cold air to penetrate the interior, the windows must be kept properly sealed as described below.

PLEXIGLAS.

60. REPAIR OF CRACKS AND HOLES.

a. Cracks in Plexiglas should be repaired by drilling a hole at each end of the crack and inserting a rivet or thread screw. In addition, to repair

longer cracks, holes should be drilled one inch above and below the ends of the cracks and then clamping it together by means of a wire inserted in these drilled holes and twisting the wire tightly.

b. Small holes in Plexiglas should be cleaned out and a patch of Plexiglas riveted or screwed over the hole. Typical repairs to Plexiglas are shown in Figure 84.

61. REPAIR OF SCRATCHES.

a. Plexiglas is not affected by sunlight, salt water, or oil and will not crack or discolor with age. Leaded and aromatic fuels are destructive to Plexiglas.

b. It will scratch if cleaned with gritty rags and should always be wiped off with clean soft rags, thoroughly loosening dirt or grease with water before rubbing hard.

c. Scratches should be removed as follows: Use #120 wet-or-dry paper until scratches disappear. Remove sandpaper frosting with "Kenite" rubbing compound, finishing off with chalk and Berryloid polish as above. A soft buffing wheel mounted in an electric drill will reduce the labor involved.

d. Buffing, sanding or polishing of Plexiglas should not be attempted unless absolutely necessary.

CAUTION

Never clean Plexiglas with dope or lacquer thinner or any of the following solvents: acetone, ethyl acetate, benzene or ethyl dichloride. All of these liquids are absorbed by Plexiglas and will change its structure such that exposure to water or moist air will cause severe clouding.

62. REPLACEMENT OF PANELS. - Damaged Plexiglas which cannot be repaired as described above necessitates replacement of the panel with a new equivalent panel, watertight as described in the following Paragraph. The panel may be cut to the desired size from a flat sheet of Plexiglas of the desired thickness.

63. WATERPROOFING.-When installing new Plexiglas panels, the procedure noted in Figure 85 and described as follows is recommended:

a. Remove damaged panel and frame.

b. Apply Vulcatex caulking compound (See Table II) or equivalent to the inside of the fuselage skin where it comes in contact with the panel when installed.

c. Set panel in, and press against caulking compound until it adheres.

d. Apply Vulcatex compound or equivalent around the edges of the panel, making sure the compound will come in contact with the frame when installed.

e. Set frame in, pressing hard so that it is well sealed against the Plexiglas. Adhesion may be assisted by hammering the frame if care is taken not to damage the frame or panel.

f. Apply Bostik cement (See Table II) or equivalent around the exterior of the panel for about 1/8 inch all around making sure it is well sealed between the fuselage skin and the panel on the outside.

g. Remove excess cement around outside of panel.

A new windshield panel may be installed by applying Vulcatex or equivalent, then installing the panel similar to the procedure for a Plexiglas window panel. (See Figure 85). Then apply Duprene cement (See Table II) similar to waterproofing of a joint in the hull skin, P.A.W. ("Protective and Waterproof") sealing tape (See Table II) soaked in kerosene, and next apply a layer of Duprene cement. Be sure panel is pressed tightly in place against the frame and the tape and cement is carefully applied. Treat the outside of the windshield the same as Plexiglas window-panels, applying Bostik cement or equivalent.

WATERTIGHT JOINTS.

64. GENERAL.-The hull is watertight as outlined in Paragraph 1 above.

65. REPAIR PROCEDURE.-All repairs in watertight areas should be made watertight as in the original construction, which was done by using P.A.W. ("Protective and Waterproof") tape soaked in kerosene and applying Duprene cement. (See Table II). A coating of cement should be used to secure the tape to one surface. The other surface should be covered with cement and the two riveted together with the tape between the two members. After soaking the tape in kerosene, the grease-like coating must be removed with a clean rag or rivets will be difficult to drive through the tape. In repairs, zinc chromate paste may be substituted for Duprene cement. Gasoline should not be used to wet the tape as it dries too quickly. Reference should be made to Figure 107 and Section 2, Paragraph 92 which describes the preparation of gas tight joints, the general procedure being similar to waterproofing

of joints except that Fairprene instead of Duprene is used as the sealant. (See Table II).

DOORS.

66. GENERAL.-The watertight compartments are entered by watertight doors. (See Paragraph 1 above). Rubber moulding is used to seal the doors.

67. DAMAGE NECESSITATING REPLACEMENT.-Cracks and other damage to the rubber moulding will generally necessitate replacement of the moulding. Damage to the door framework, which affects waterproofing, or damage such as distortion which interferes with the operation of the doors will necessitate replacement of the damaged members with new equivalent members and refitting of the entire door structure.

FLOORS.

68. GENERAL.-The floors in the pilot's cockpit and in the hatch in the forward section are 24ST aluminum alloy, while the floors in the passenger's compartment and the baggage compartment are plywood boards.

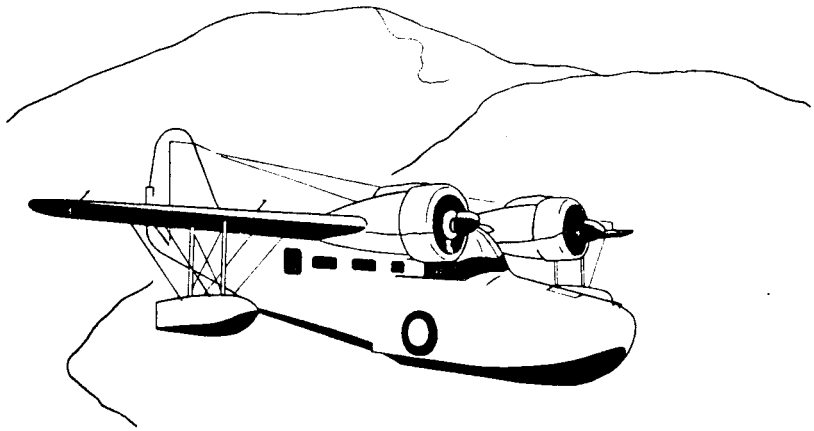
69. METHOD OF REPAIR.-The metal flooring should be repaired similar to repair of the solid bulkhead plating by riveting a patch over the cleaned out damaged area (See Figure 114) or replacing a damaged section. Reference should be made to Paragraphs 32 to 34 above. If the plywood flooring is damaged, it should be replaced with a new equivalent section as in the original construction, or repaired in accordance with Figure 86.

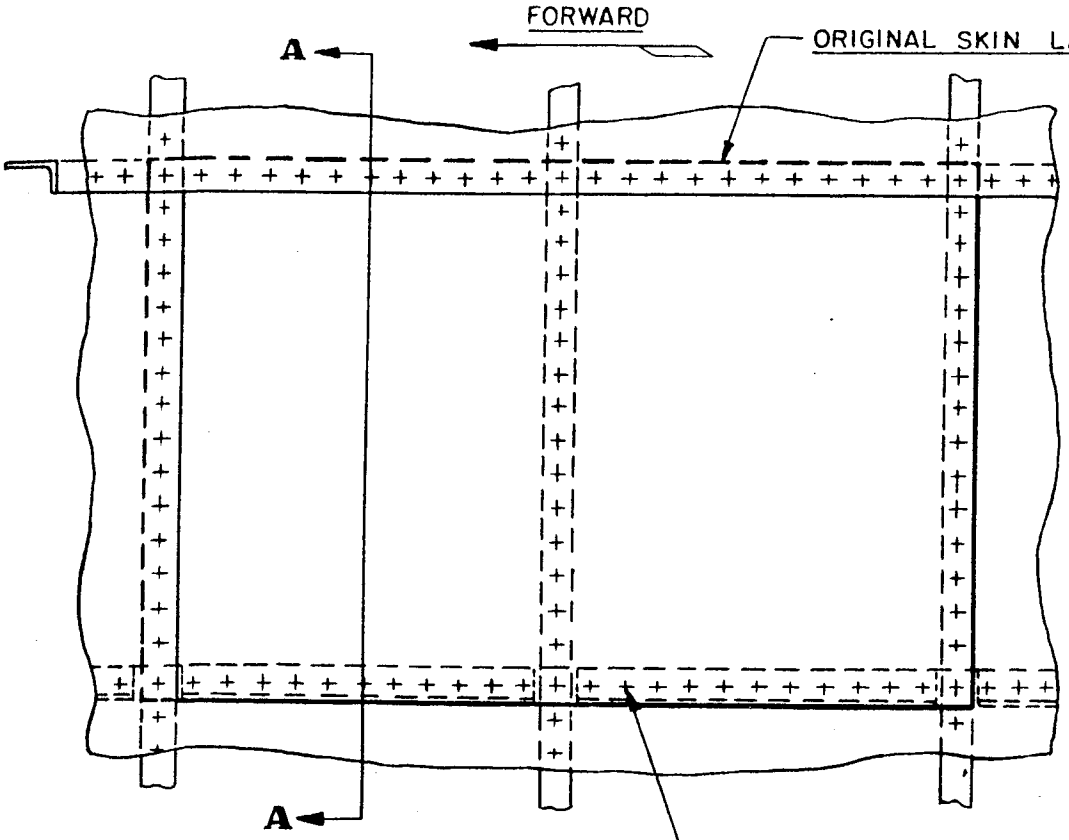
FITTINGS.

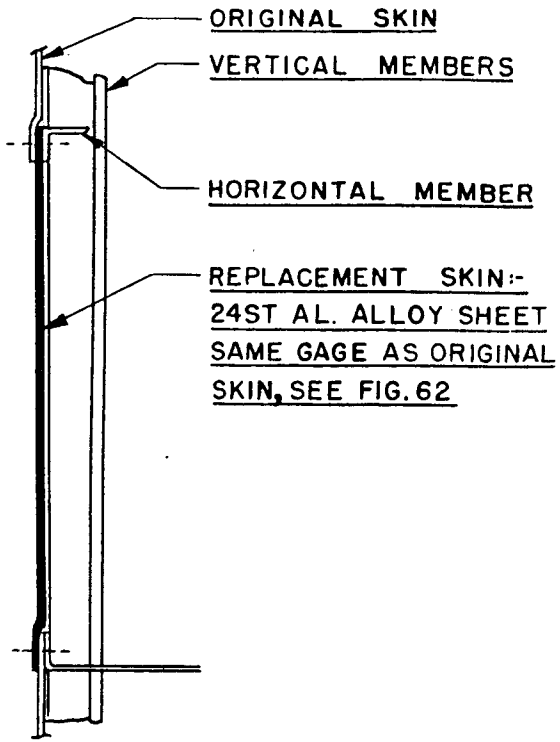
70. GENERAL.-The wing attachment fittings are installed at the top of vertical channels in the hull where the wing center section is attached to the hull.

71. ESTIMATION OF DAMAGE. - Small nicks less than 1/16 inch deep, and scores less than .010 may be neglected after being cleaned out. Inspect carefully for cracks and distortion. Damage to these members will generally be the result of extensive damage to the hull and wing structure, resulting from severe concussion.

72. DAMAGE NECESSITATING REPLACEMENT.-For damage other than negligible, the fittings should be replaced with equivalent undamaged members.







SECTION "A-A"

USE ORIGINAL RIVET TYPE AND SPACING. WHERE RIVET HOLES ARE ENLARGED USE NEXT LARGER SIZE RIVET.

NOTE:

ALL RIVETS AND JOINTS SHOULD BE WATERPROOFED BELOW THE HULL WATERTIGHT LINE.

Figure 63 - Hull Skin Insertion Repair

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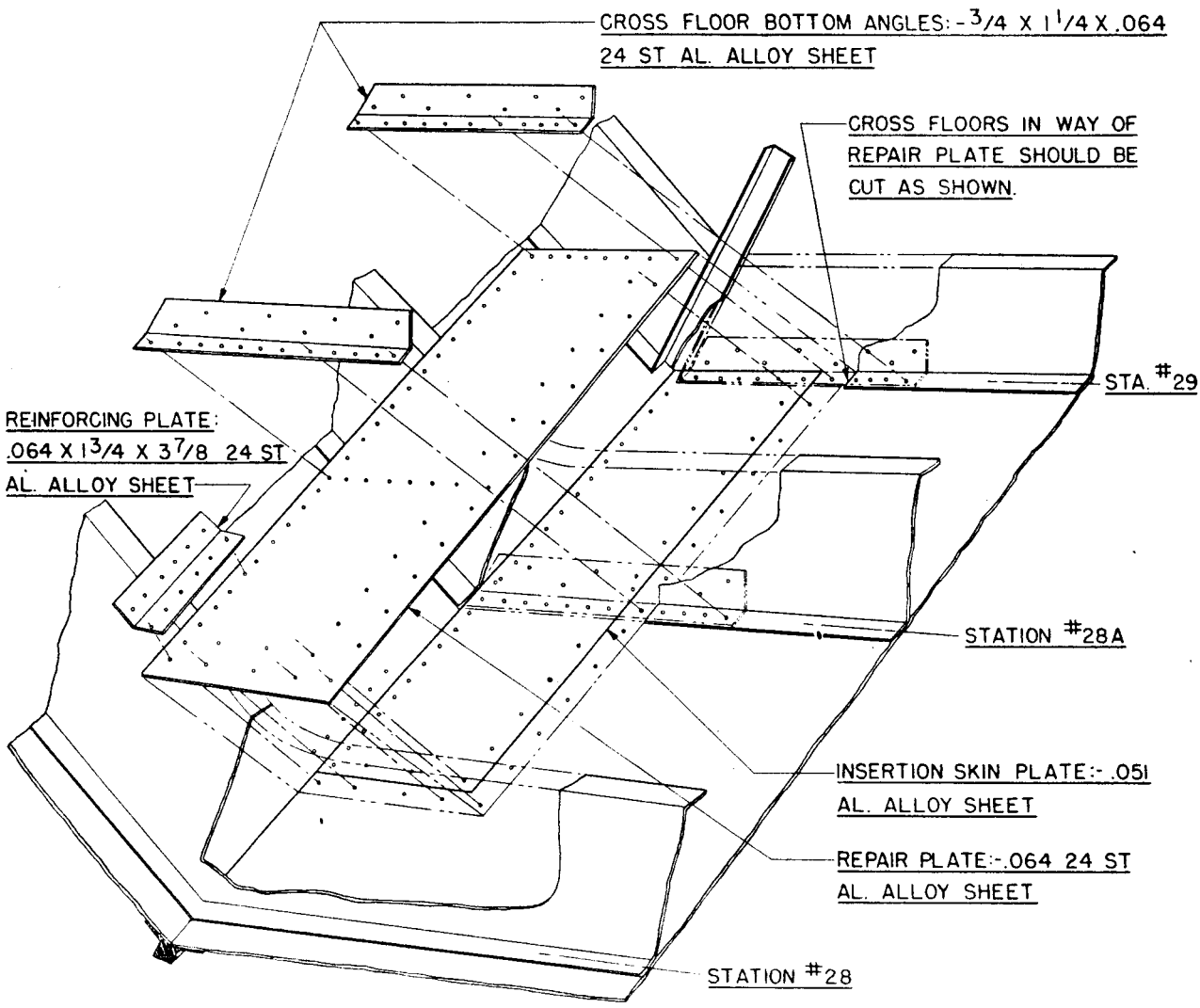


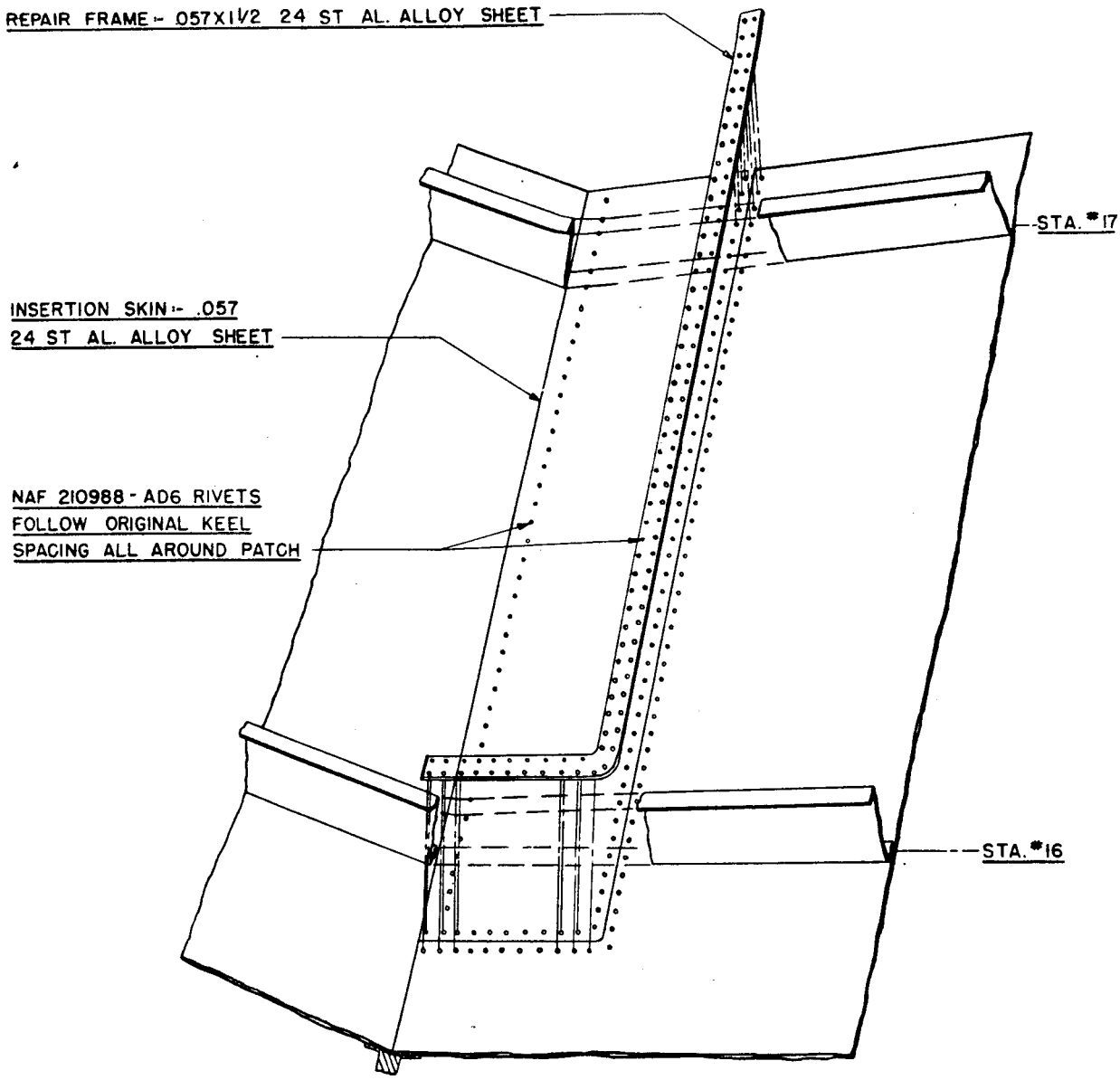
NOTE:-

BOTTOM RIVETS ARE NAF 210988-AD6 USING ORIGINAL RIVET SPACING.
ALL OTHER RIVETS ARE AN430-AD5 SPACED APPROX. 3/4" OR 1" C.C.

NOTE:-

ALL RIVETS AND JOINTS SHOULD BE WATERPROOFED.

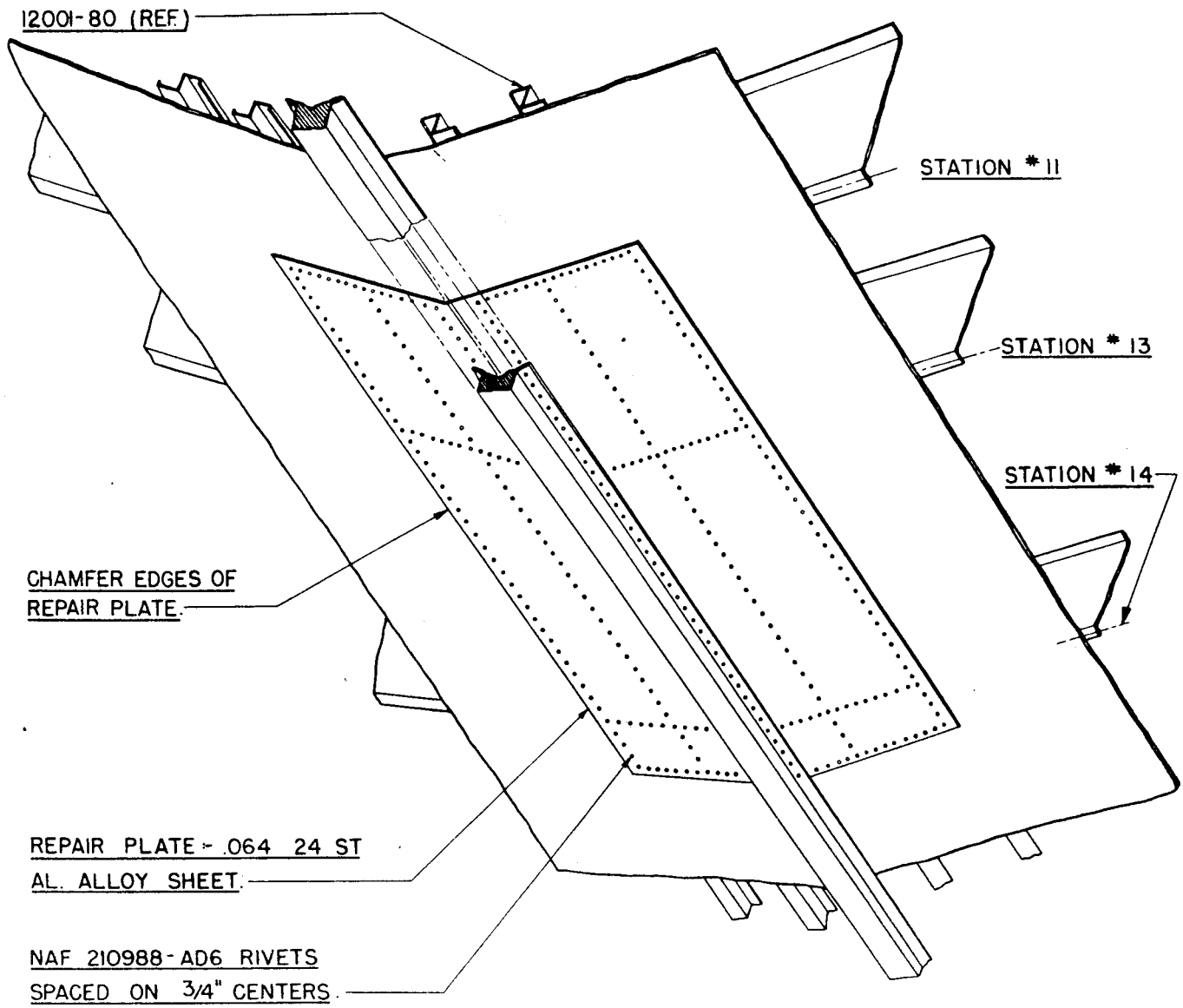
Figure 64 - Hull Bottom Repair - Flush Type



NOTE :-

ALL RIVETS AND JOINTS SHOULD BE WATERPROOFED (REF.)

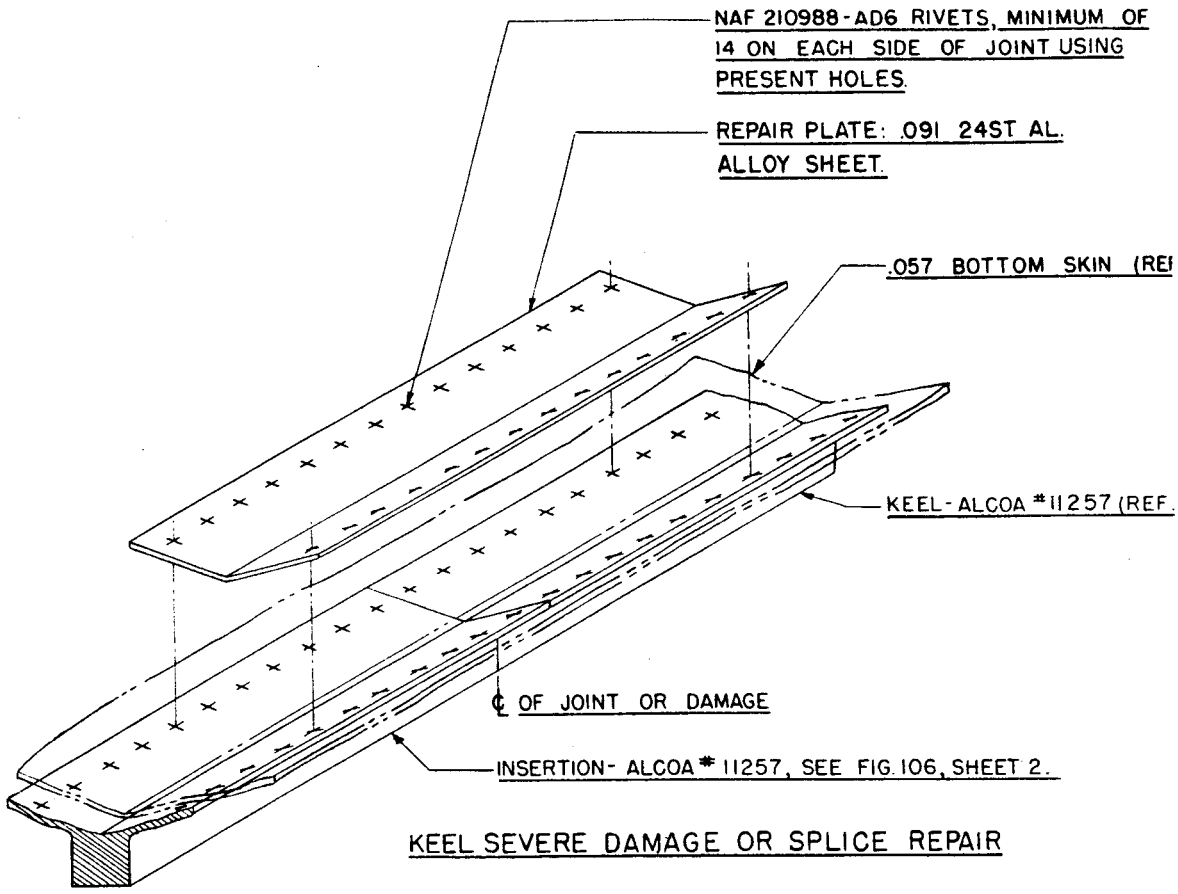
Figure 65 - Hull Bottom Repair - Flush Type



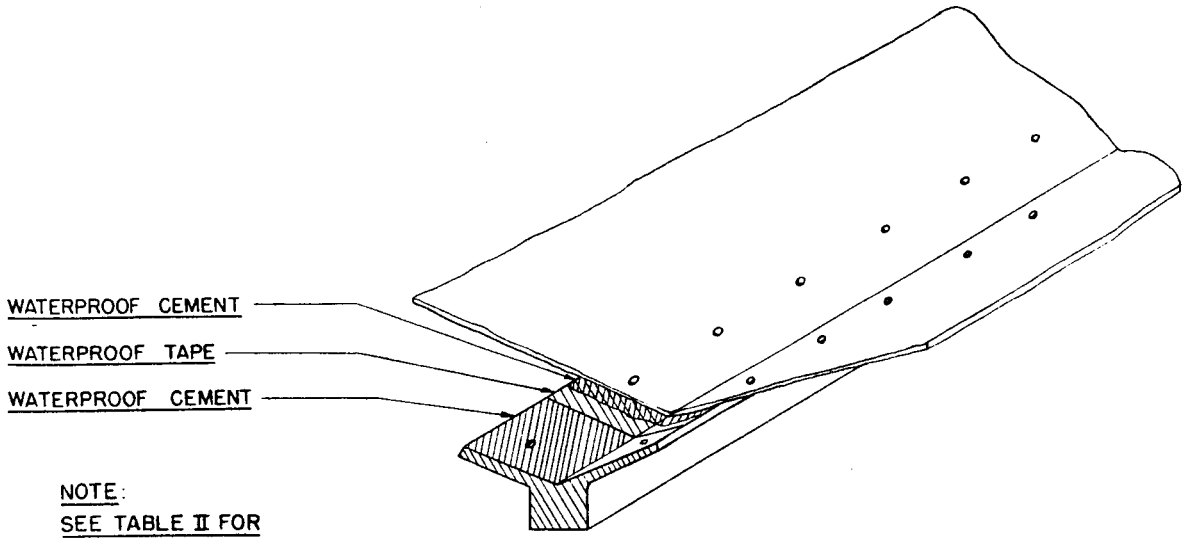
NOTE:-

ALL RIVETS AND JOINTS SHOULD BE WATERPROOFED (REF.)

Figure 66 – Hull Bottom Repair – Outside Plate



KEEL SEVERE DAMAGE OR SPLICE REPAIR



NOTE:
SEE TABLE II FOR MATERIALS SPECIFICATIONS.

RIVETS & JOINTS SHOULD BE WATERPROOFED (REF.)

Figure 67 – Keel Repair

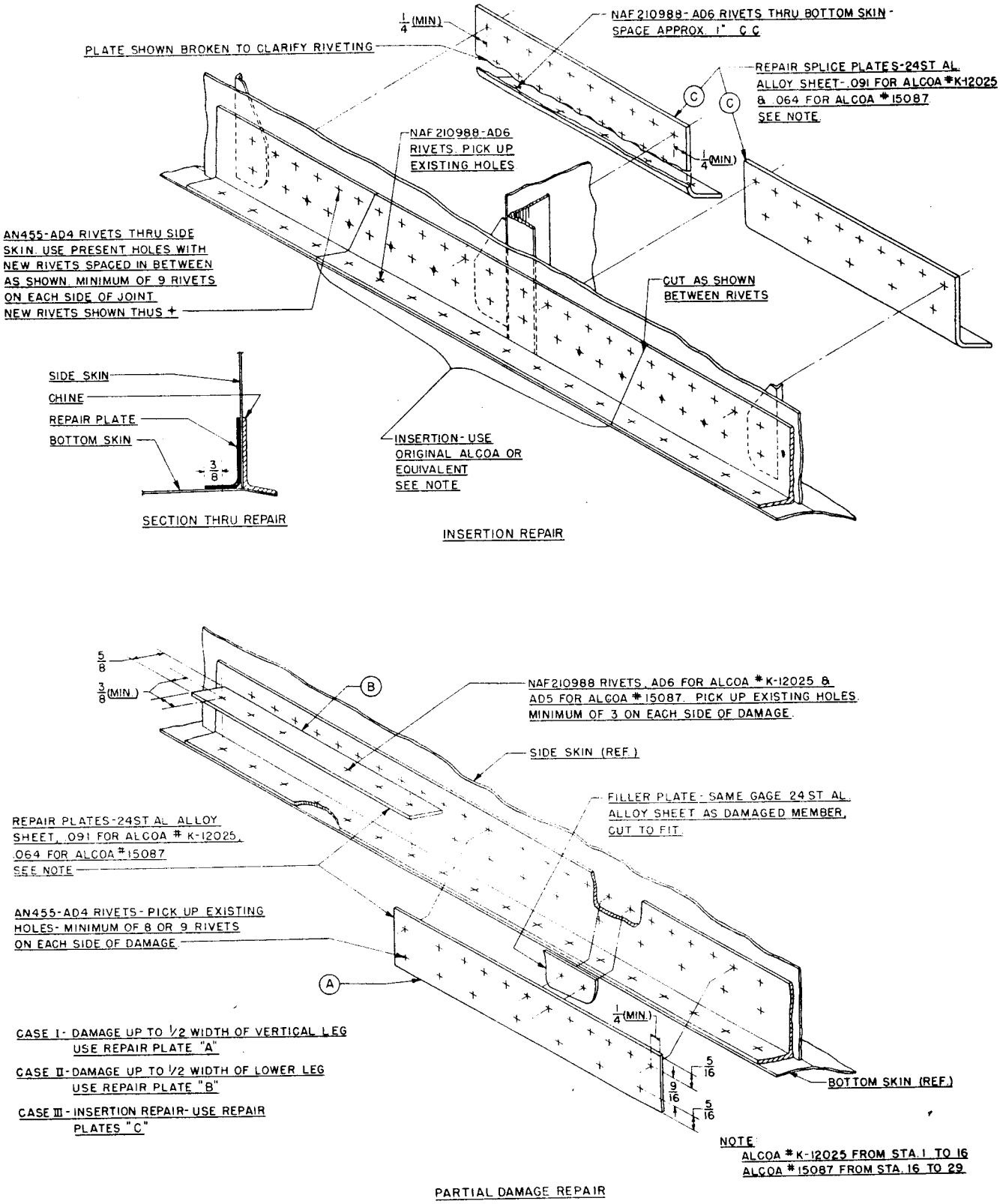
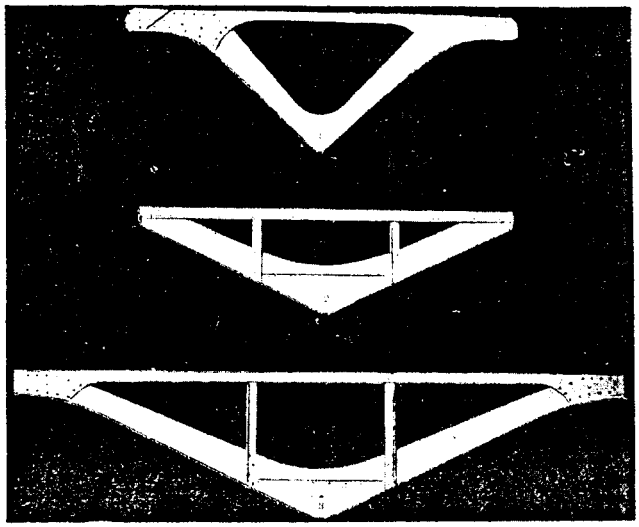
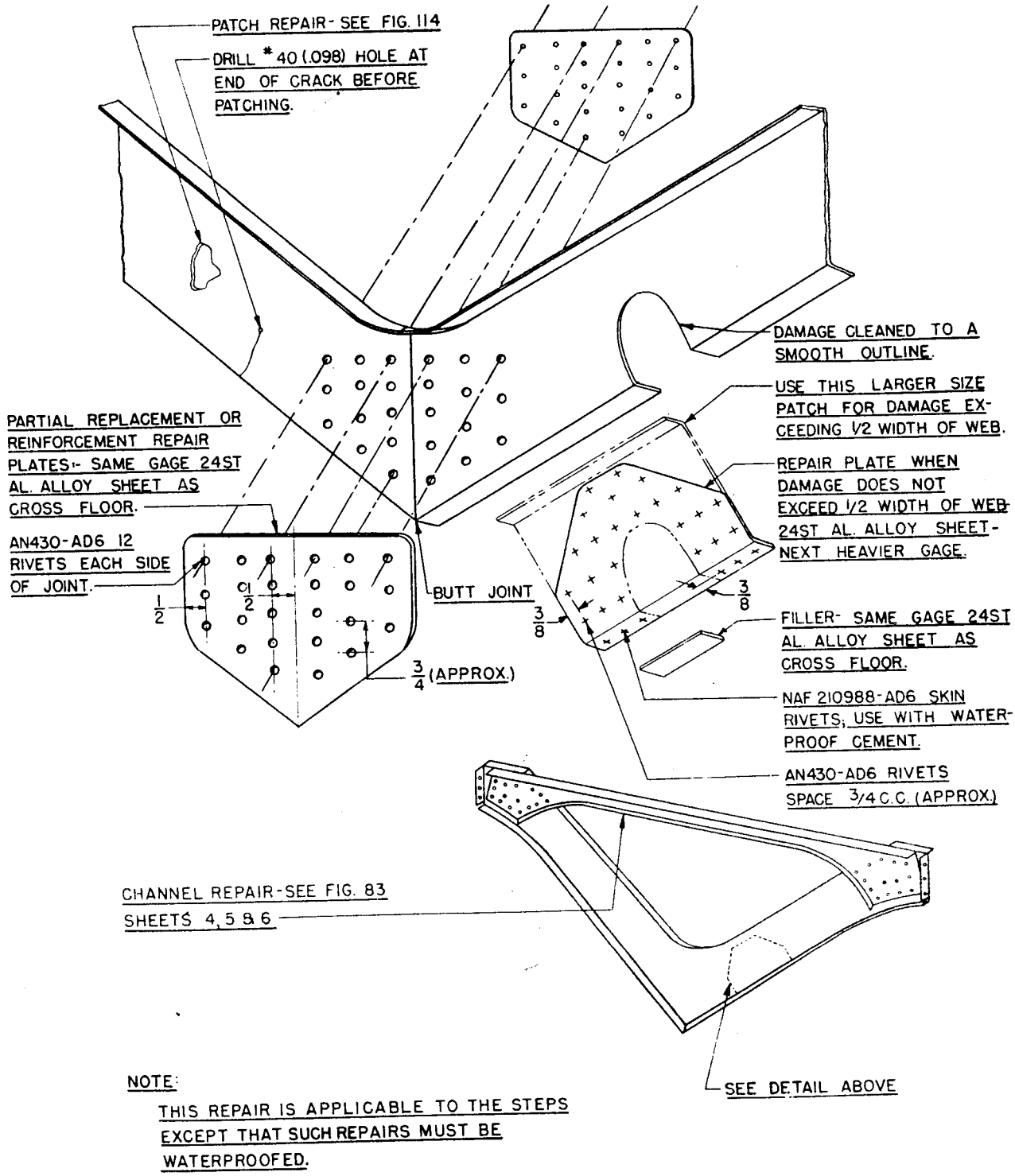


Figure 68 - Chine Repair



Ref. No.	Grumman Part No.	Description	Material	Thickness
1	12032	Nose Cross Floors		
	12032-4	"Z" Member	24ST Aluminum Alloy Sheet	.057
	12032-5	Channel	24ST Aluminum Alloy Sheet	.040
	12036	Similar to 12032 with addition of vertical "Z" braces		
	12036-5	"Z" Member	24ST Aluminum Alloy Sheet	.072
	12036-6	Channel	24ST Aluminum Alloy Sheet	.057
	12036-9	"Z" Brace	24ST Aluminum Alloy Sheet	.028
	12040	Same as 12036		
2 & 3	12045	Floor Frames		
	12045-7	"Z" Member	24ST Aluminum Alloy Sheet	.072
	12045-8	Channel	24ST Aluminum Alloy Sheet	.057
	12045-11	"Z" Brace	24ST Aluminum Alloy Sheet	.028
	12045-12	Angle	Aluminum Alloy Ext. 78-K	

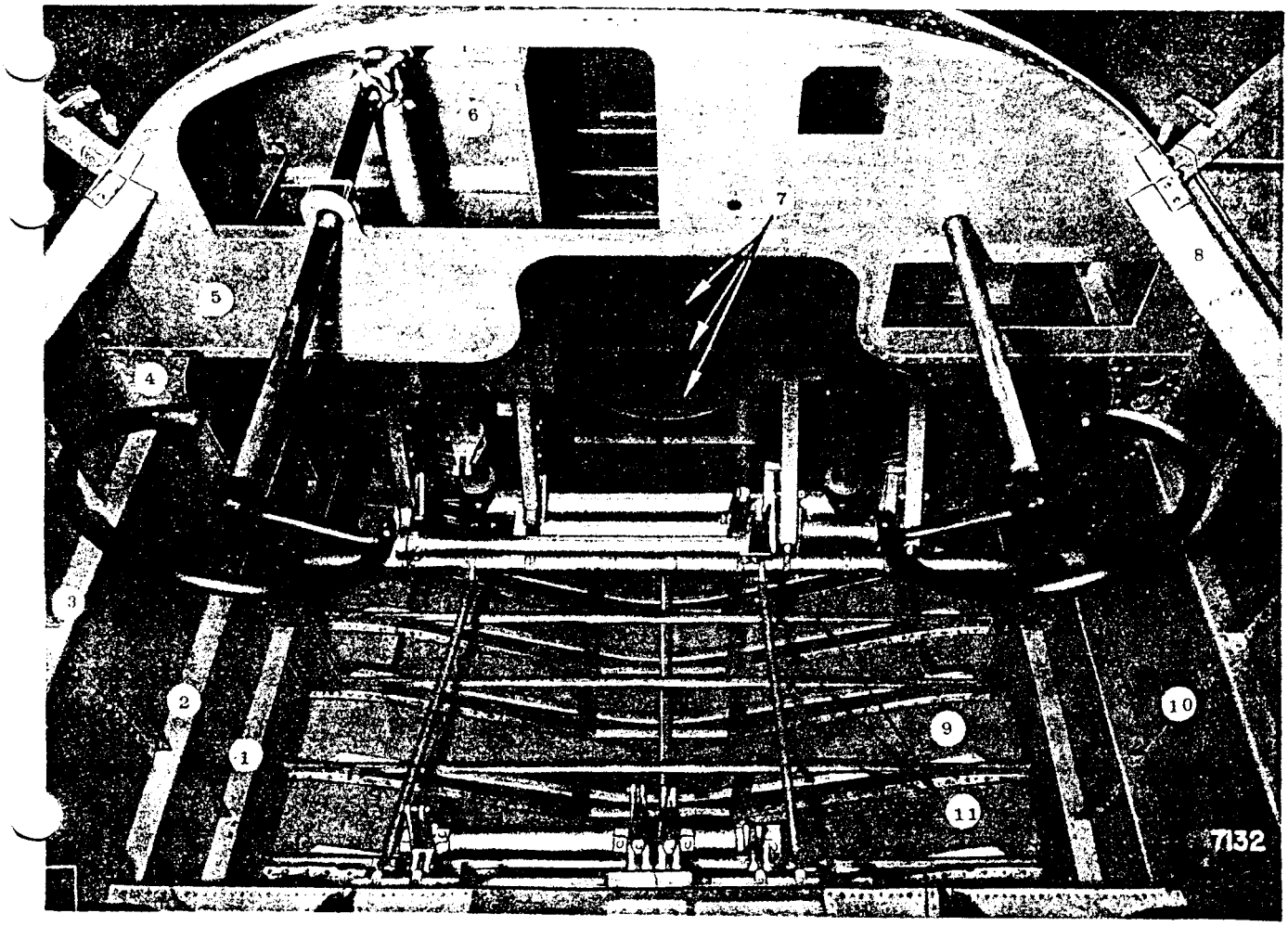
Figure 69 - Hull Floor Frames



NOTE:

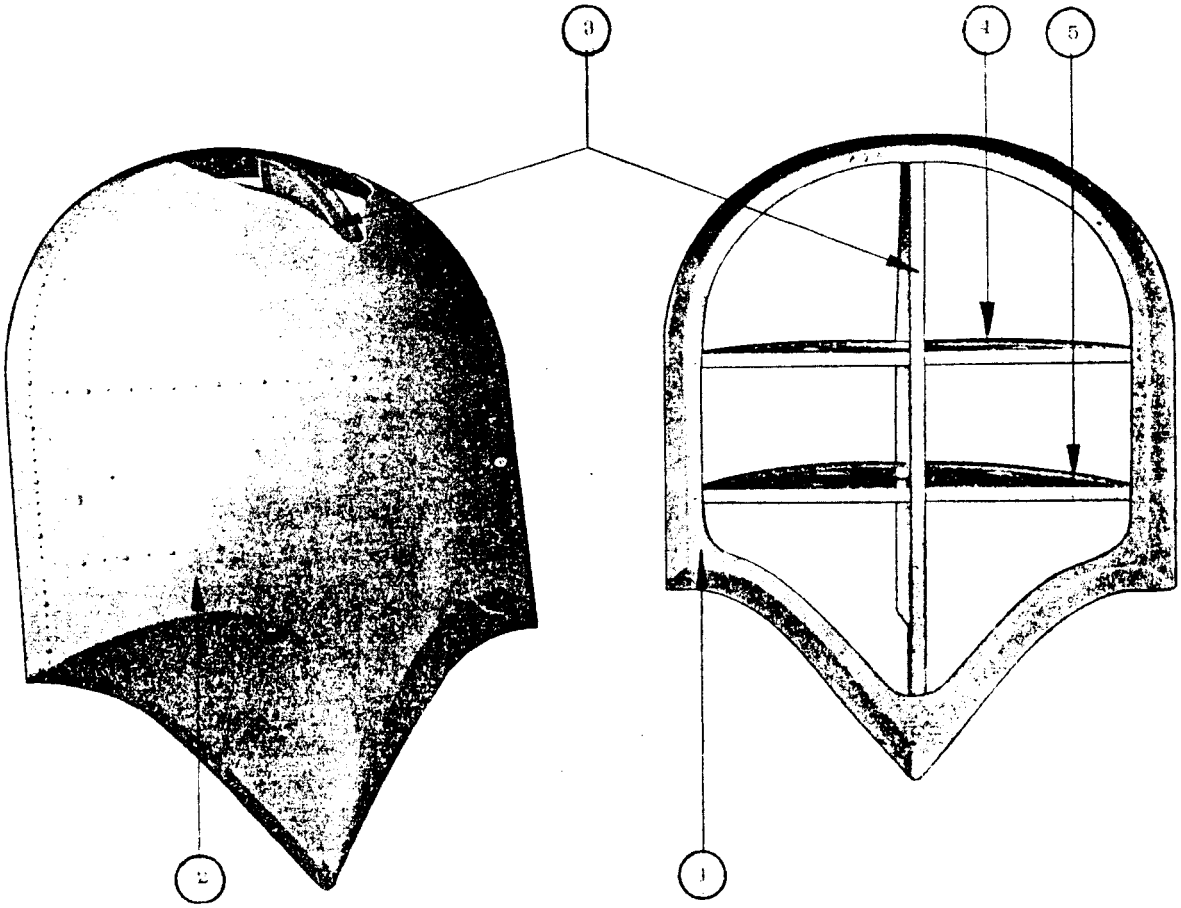
THIS REPAIR IS APPLICABLE TO THE STEPS EXCEPT THAT SUCH REPAIRS MUST BE WATERPROOFED.

Figure 70 - Cross Floor Typical Repairs



Ref. No.	Grumman Part No.	Description	Material	Thickness
1	12001-31	Stringer 1L-1R	24ST Aluminum Alloy Sheet	.028
2	12001-30	Stringer 2L-2R	24ST Aluminum Alloy Sheet	.028
3	12001-28	Stringer 1L-1R	24ST Aluminum Alloy Sheet	.040
4	12073-8	Side Sheet (2)	24ST Aluminum Alloy Sheet	.051
	12073-1	Side Sheet Angle 1L-1R	24ST Aluminum Alloy Ext. 734-18	
	12073-2	Side Sheet Angle 1L-1R	24ST Aluminum Alloy Ext. 9823	
5	12073-7	Panel	24ST Aluminum Alloy Sheet	.064
	12073-4	Panel - Stiffening Angle	24ST Aluminum Alloy Ext. D-14594	
	12073-6	Channel - Stiffening Angle	24ST Aluminum Alloy	.057
6	12043	Water Tight Bulkhead	Station #7	
7	12036	Cross Floors	See Figure 69	
	12040	Cross Floors	See Figure 69	
8	12001-22	Cabin Rail	24ST Aluminum Alloy Ext. 1377	
9		Bottom Sheets	See Figure 62	
10	12001-5	Frame Sta. #10 1L-1R	24ST Aluminum Alloy Ext. D-14594	
11	12045	Cross Floors	See Figure 69	

Figure 71 - Hull Structure - Pilot's Cabin



Ref. No.	Grumman Part No.	Description	Material	Thickness
1	12004-1	Frame (Nose) Sta. #1	24ST Aluminum Alloy Sheet	.064
	12004-2	Frame Sta. #2	24ST Aluminum Alloy Sheet	.064
2		Nose Bumping	24ST Aluminum Alloy Sheet	.051
3	12004-9	Nose Rib Assembly		
	12004-16	Angle	24ST Aluminum Alloy Ext. K-734-18	
	12004-17	Sheet	24ST Aluminum Alloy Sheet	.040
	12004-18	Angle	24ST Aluminum Alloy Ext. K-734-18	
	12004-45	Angle	24ST Aluminum Alloy Ext. K-734-18	
	12004-46	Angle	24ST Aluminum Alloy Ext. K-734-18	
4	12004-32	Horizontal Rib		
	12004-33	Stiffener	24ST Aluminum Alloy Sheet	.028
	12004-34	Reinf. Angle	24ST Aluminum Alloy Ext. 734-18	
	12004-35	Reinf. Angle	24ST Aluminum Alloy Ext. Alcoa 78K	
	12004-36	Reinf. Angle	24ST Aluminum Alloy Ext. Alcoa 78K	
	12004-37	Reinf. Angle	24ST Aluminum Alloy Ext. Alcoa 78K	
5	12004-38	Horizontal Rib		
	12004-39	Stiffener	24ST Aluminum Alloy Sheet	.028
	12004-40	Reinf. Angle	24ST Aluminum Alloy Alcoa 734-18	
	12004-41	Reinf. Angle	24ST Aluminum Alloy Alcoa 78K	
	12004-42	Reinf. Angle	24ST Aluminum Alloy Alcoa 78K	
	12004-43	Reinf. Angle	24ST Aluminum Alloy Alcoa 78K	

Figure 72 - Hull Nose Frame and Plating

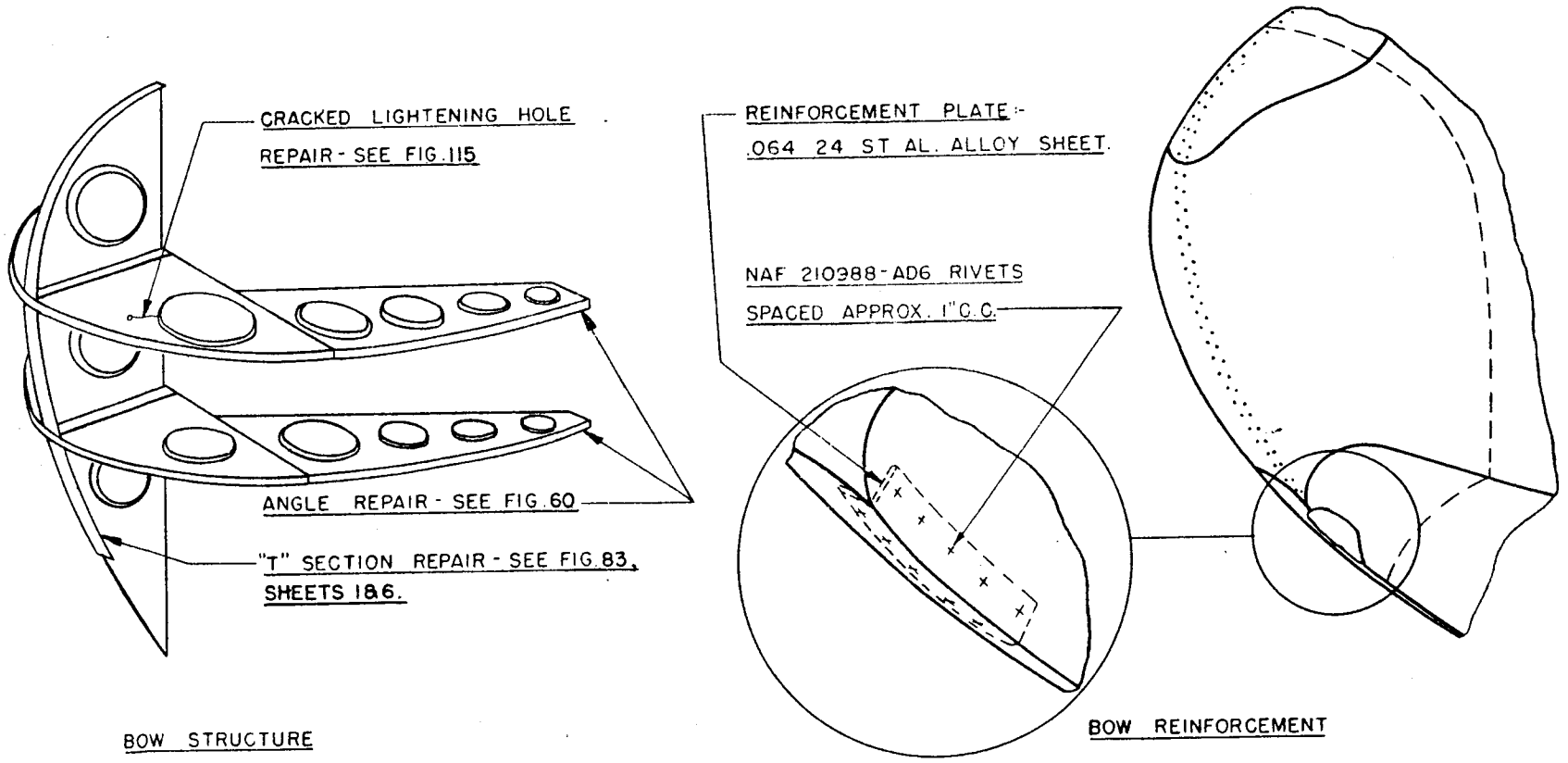


Figure 73 - Bow Repairs

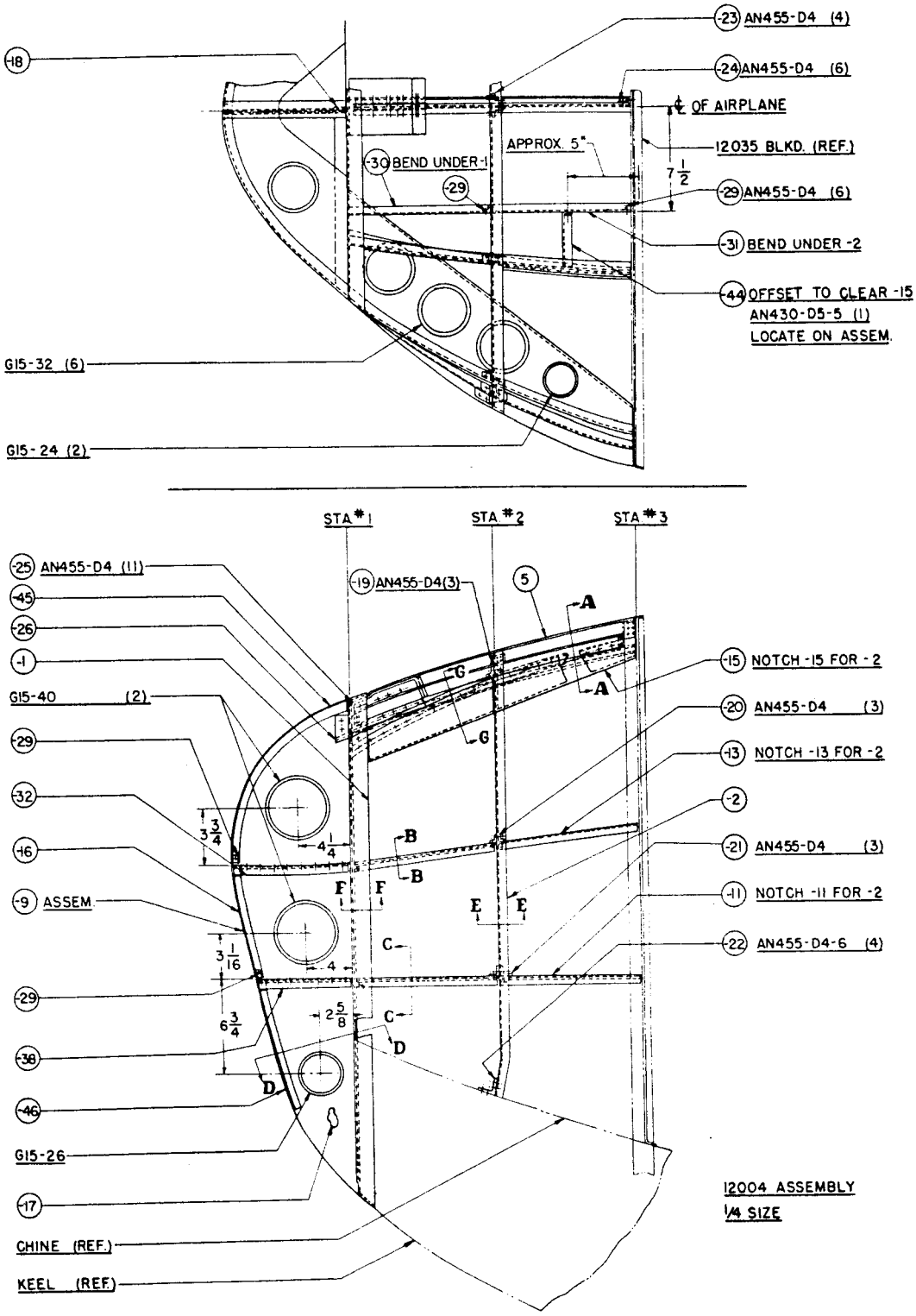
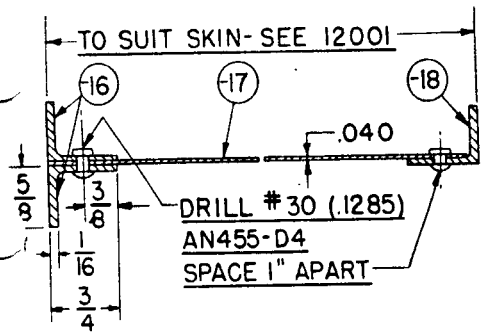
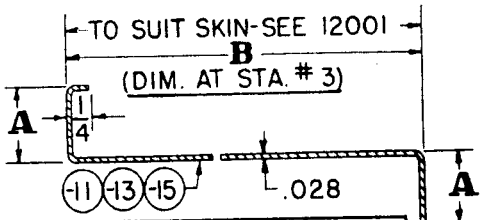


Figure 74 - Hull Bow to Station #3 Framing (Sheet 1)

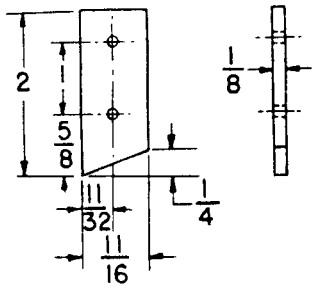


SECTION "**D-D**"-TYPICAL SECTION THRU BOW. NOSE TO STA. 1.
FULL SIZE
CROSS SECTION OF
12004-9 ASSEM.



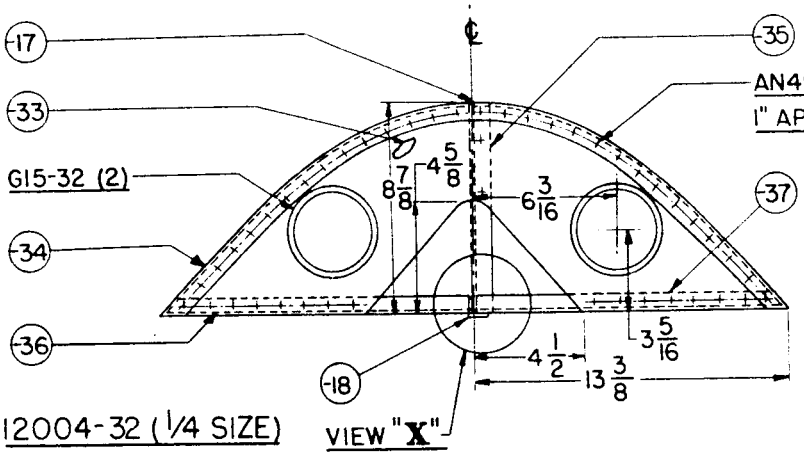
PART NO.	A	B
-11	3/4	1 1/2
-13	3/4	1 1/2
-15	5/8	1 3/4

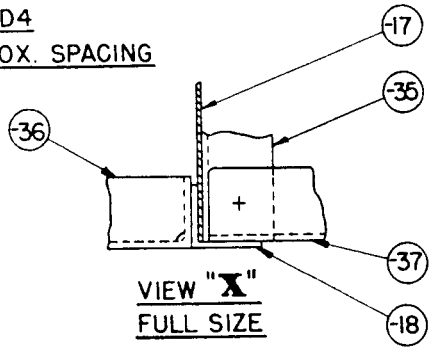
SECTION "**B-B**"; "**C-C**" & "**G-G**"
SHOWING TYPICAL SECTION THRU
STRINGERS **B, I & M** NOSE TO
STA. # 3.
FULL SIZE

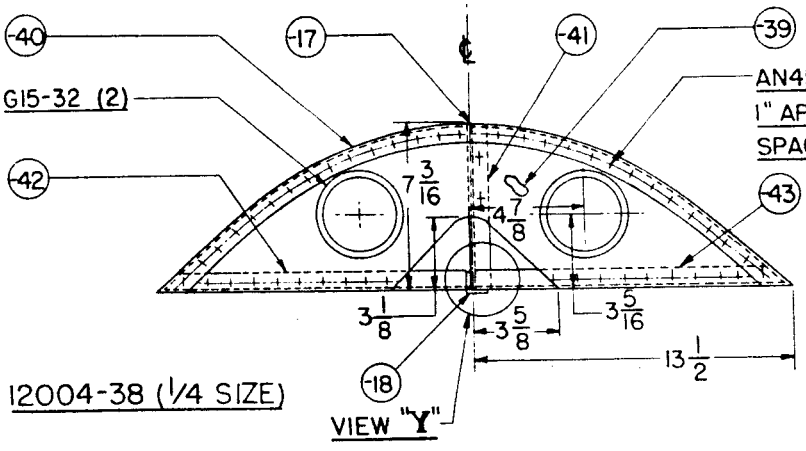


DRILL #30 (.1285) 2
HOLES TO MATCH
12004-25 ON ASSEM.

12004-26
FULL SIZE







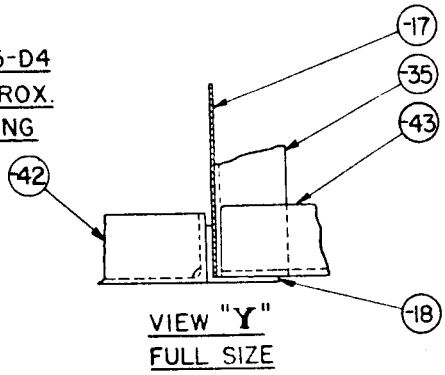
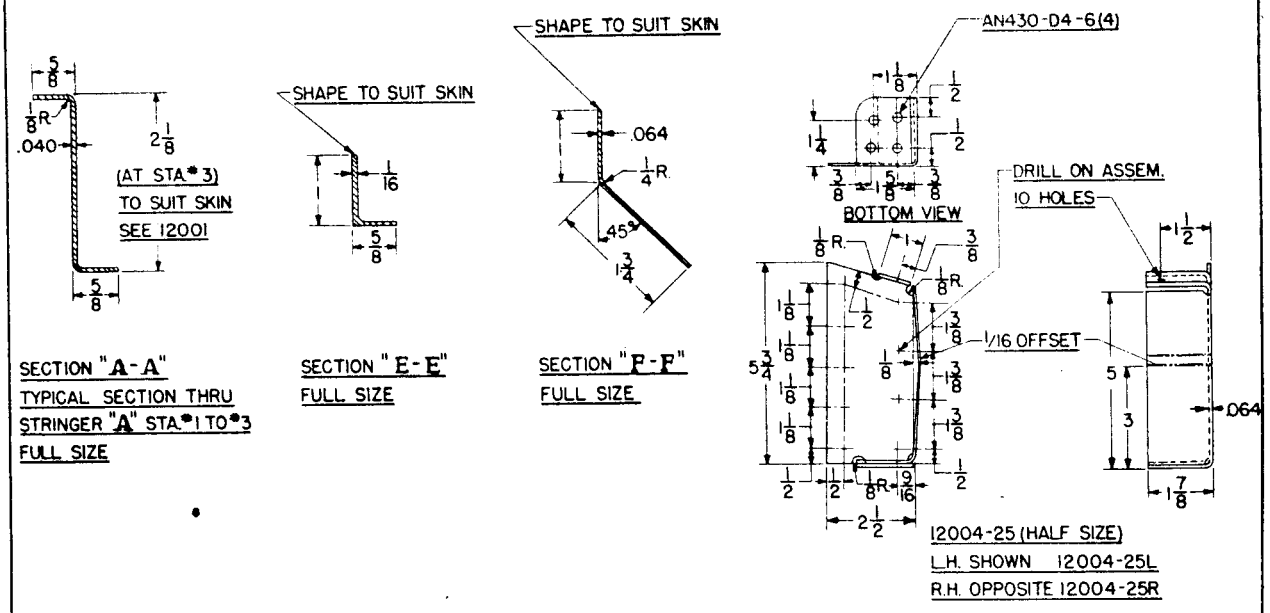


Figure 74 - Hull Bow to Station #3 Framing (Sheet 2)



SECTION "A-A"
TYPICAL SECTION THRU
STRINGER "A" STA* 1 TO* 3
FULL SIZE

SECTION "E-E"
FULL SIZE

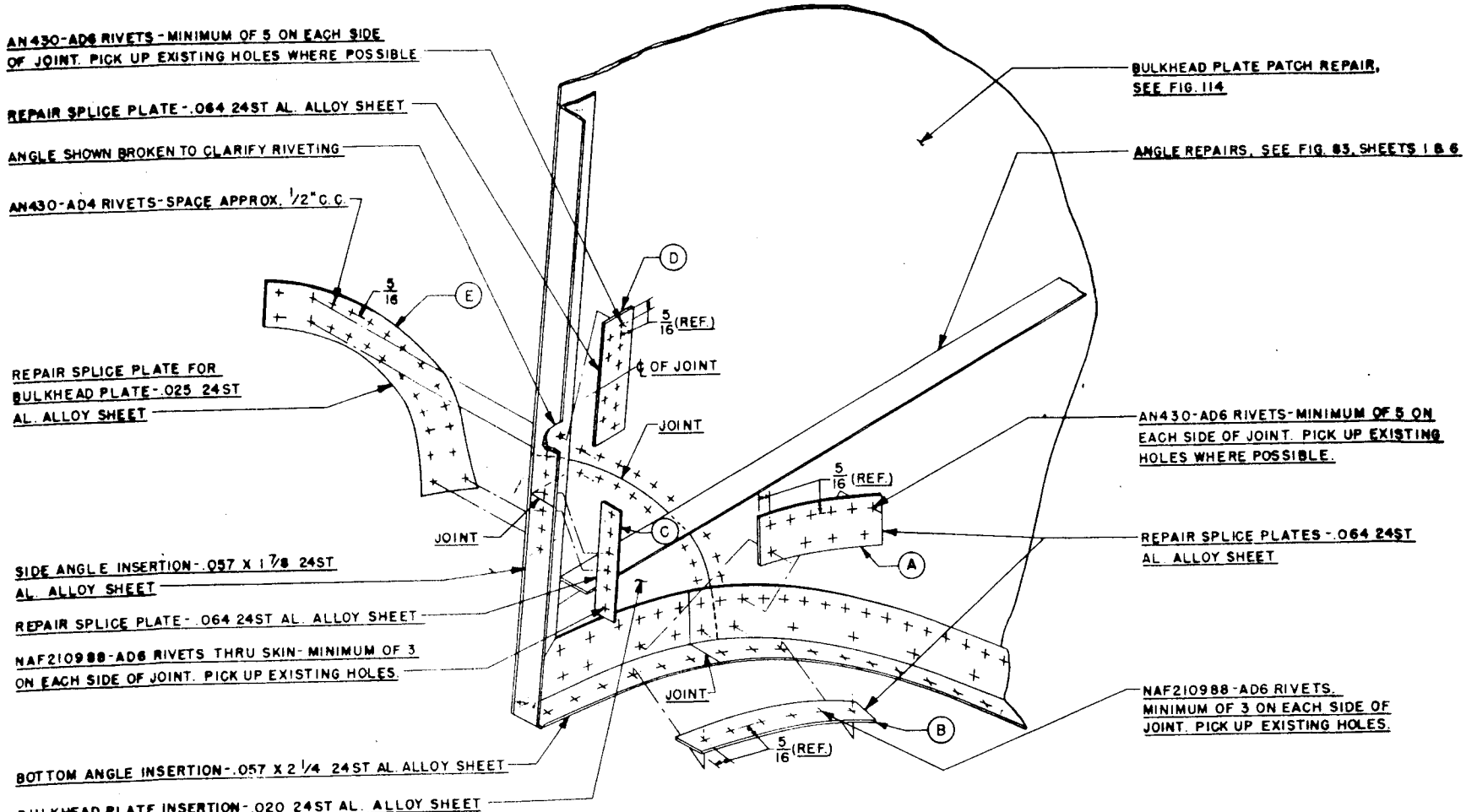
SECTION "F-F"
FULL SIZE

12004-25 (HALF SIZE)
L.H. SHOWN 12004-25L
R.H. OPPOSITE 12004-25R

PER-38	PER-32	PER-9	PER 12004	PER SHIP	PART NO	NAME	MATERIAL	NAVY SPECIFICATION	COMM SPECIFICATION	TENSILE P.S.I.	STOCK SIZE (EACH)
		NUMBER REQUIRED									
50	50	65			AN455-D4-6	RIVET - BRAZ HD.	STD. PART				1/8 D. X 3/8
			4		AN430-D4-6	RIVET-RD. HD.	STD PART				1/8 D. X 3/8
			1		AN430-D5-5	RIVET-RD. HD.	STD PART				5/32 D. X 5/16
		1L-1R			12004-46	ANGLE	AL ALLOY ANGLE	46A9	24ST	57,000	1/16 X 5/8 X 3/4 X 18 ALCOA K734-18
		1L-1R			12004-45	ANGLE	AL ALLOY ANGLE	46A9	24ST	57,000	1/16 X 5/8 X 3/4 X 10 1/2 ALCOA K734-18
			1L-1R		12004-44	STIFFENER	AL ALLOY SHEET	47A10	24ST	62,000	051 X 2 X 6 3/4
1					12004-43	REINF ANGLE	AL ALLOY ANGLE	46A9	24ST	57,000	1/16 X 3/4 X 3/4 X 13 1/2 ALCOA *78K
1					" - 42	" "	" " "	"	"	"	1/16 X 3/4 X 3/4 X 13 1/2 " "
1					" - 41	" "	" " "	"	"	"	1/16 X 3/4 X 3/4 X 9 " *78K
1					" - 40	REINF ANGLE	" " ANGLE	46A9	"	57,000	1/16 X 5/8 X 3/4 X 33 ALCOA *K734-18
1					" - 39	STIFFENER	AL ALLOY SHEET	47A10	24ST	62,000	028 X 8 X 28
			1		" - 38	ASSEM					
	1				" - 37	REINF ANGLE	AL ALLOY ANGLE	46A9	24ST	57,000	1/16 X 3/4 X 3/4 X 13 1/2 ALCOA *78K
	1				" - 36	" "	" " "	"	"	"	1/16 X 3/4 X 3/4 X 13 1/2 " "
	1				" - 35	" "	" " "	"	"	"	1/16 X 3/4 X 3/4 X 9 " *78K
	1				" - 34	REINF ANGLE	" " ANGLE	46A9	"	57,000	1/16 X 5/8 X 3/4 X 35 ALCOA *K734-18
	1				" - 33	STIFFENER	AL ALLOY SHEET	47A10	24ST	62,000	028 X 9 1/2 X 28
			1		" - 32	ASSEM					
			1L-1R		" - 31	REINF ANGLE	AL ALLOY ANGLE	46A9	24ST	57,000	1/16 X 5/8 X 1 X 13 ALCOA *14594
			1L-1R		" - 30	REINF ANGLE	" " ANGLE	"	"	"	1/16 X 5/8 X 1 X 13 " *14594
			E		" - 29	JOINT	" " ANGLE	46A9	"	57,000	1/16 X 3/4 X 3/4 X 1 ALCOA *78K
			1		" - 26	FILLER	" " SHEET	47A10	"	62,000	1/8 X 3/4 X 2
			1L-1R		" - 25	BRACKET ASSEM.	" " SHEET	47A10	"	62,000	064 X 5 X 5 1/2
			1R		" - 24	JOINT STRINGER "A" STA*	" " ANGLE	46A9	"	57,000	1/16 X 3/4 X 3/4 X 21/2 ALCOA *78K
			1L-1R		" - 23	" " "A" STA*	" " "	"	"	"	1/16 X 3/4 X 3/4 X 11/16 " *78K
			1L-1R		" - 22	" " "J"	" " "	"	"	"	1/8 X 1 1/2 X 3/4 X 7/8 " *77E
			2L-2R		" - 21	" " "M"	" " "	"	"	"	1/32 X 1 X 1 3/4 " *79F
			2L-2R		" - 20	" " "1"	" " "	"	"	"	1/32 X 1 X 1 3/4 " *78F
			2L-2R		" - 19	JOINT STRINGER "B"	" " "	"	"	"	1/16 X 3/4 X 3/4 X 7/8 " *78K
					" - 18	ANGLE	" ANGLE	46A9		57,000	1/16 X 5/8 X 3/4 X 36 1/2 ALCOA *K734-18
					" - 17	SHEET	" SHEET	47A10		62,000	042 X 10 7/8
					" - 16	ANGLE	" ANGLE	46A9	24ST	57,000	1/16 X 7/8 X 3/4 ALCOA *K734-18
			1L B-R		" - 15	STIFFENER	" SHEET	47A10	2450	H.T.	028 X 10 X 30
			1L B-R		" - 13	STIFFENER	" "	"	2450	H.T.	028 X 9 1/2 X 32
			1L B-R		" - 11	STIFFENER	AL ALLOY SHEET	47A10	2450	H.T.	028 X 9 1/2 X 33
			1		" - 9	ASSEM (CONSISTS OF -16, -17, & -18, -45, -46					
			1		" - 5	STRINGER "A"	AL. ALLOY SHEET	47A10	24ST	62,000	040 X 4 X 24
			1L - 1R		12004-2	FRAME	" " "	"	2450	H.T.	064 X 20 X 34
					12004-1	FRAME	AL ALLOY SHEET	47A10	2450	H.T.	064 X 36 X 40
				1	12004	BOW FRAME ASSEM					

NOTE:
PARTS 12004-25, -26, -32 & -38 SHOULD BE FINISHED AS FOLLOWS; 1. ANODIZED, 2. ONE COAT ZINC CHROMATE PRIMER AND 3. TWO COATS ALUMINUM ZINC CHROMATE PRIMER.

Figure 74 - Hull Bow to Station #3 Framing (Sheet 3)



NOTE:

FOR TYPICAL CHANNEL REPAIRS, SEE FIG. 83, SHEETS 4, 5 & 6.

CASE I - BOTTOM ANGLE - FOR DAMAGE UP TO 1/2 WIDTH OF VERTICAL LEG, USE REPAIR PLATE "A". FOR DAMAGE UP TO 1/2 WIDTH OF HORIZONTAL LEG, USE REPAIR PLATE "B". FOR MORE SEVERE DAMAGE OR INSERTION REPAIR, USE BOTH REPAIR PLATES "A" & "B".

CASE II - SIDE ANGLE - FOR DAMAGE UP TO 1/2 WIDTH OF SKIN LEG, USE REPAIR PLATE "C." FOR DAMAGE UP TO 1/2 WIDTH OF BULKHEAD LEG, USE REPAIR PLATE "D." FOR MORE SEVERE DAMAGE OR INSERTION REPAIR, USE BOTH REPAIR PLATES "C" & "D".

CASE III - BULKHEAD PLATE - FOR INSERTION REPAIR, USE REPAIR SPLICE PLATE "E."

Figure 75 - Bulkhead Repair Reference Diagram

RESTRICTED

Nav. Aer. 01-85V-3

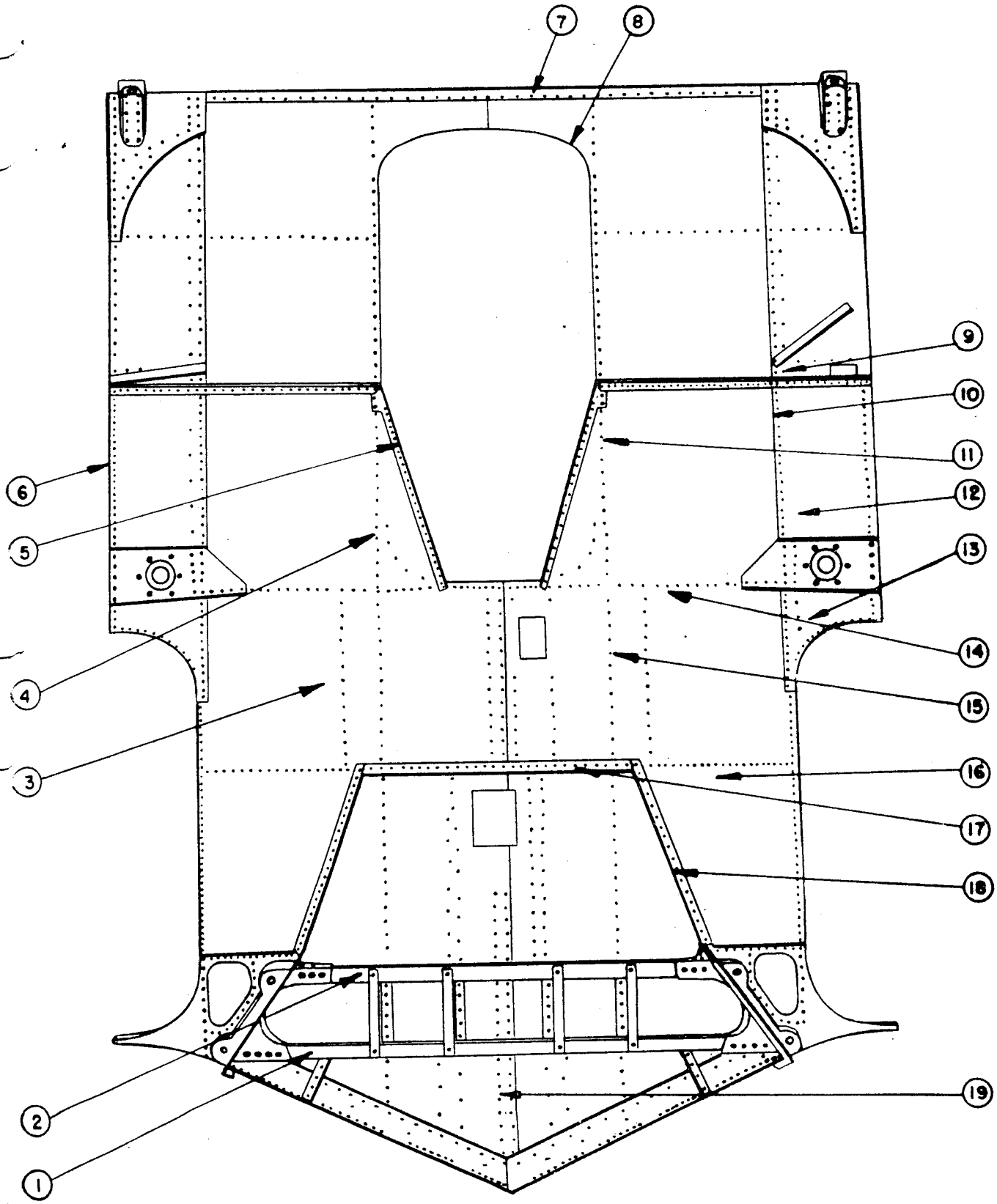
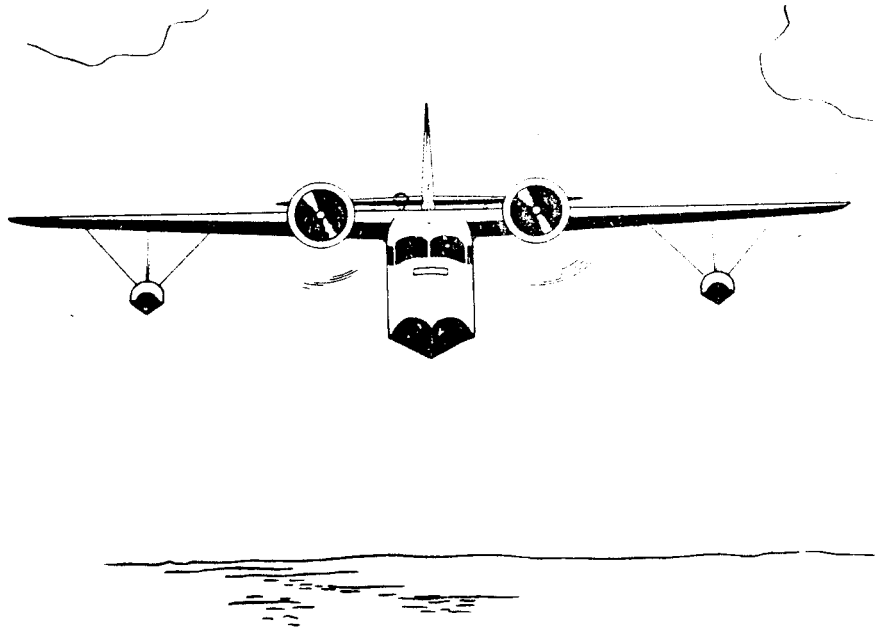
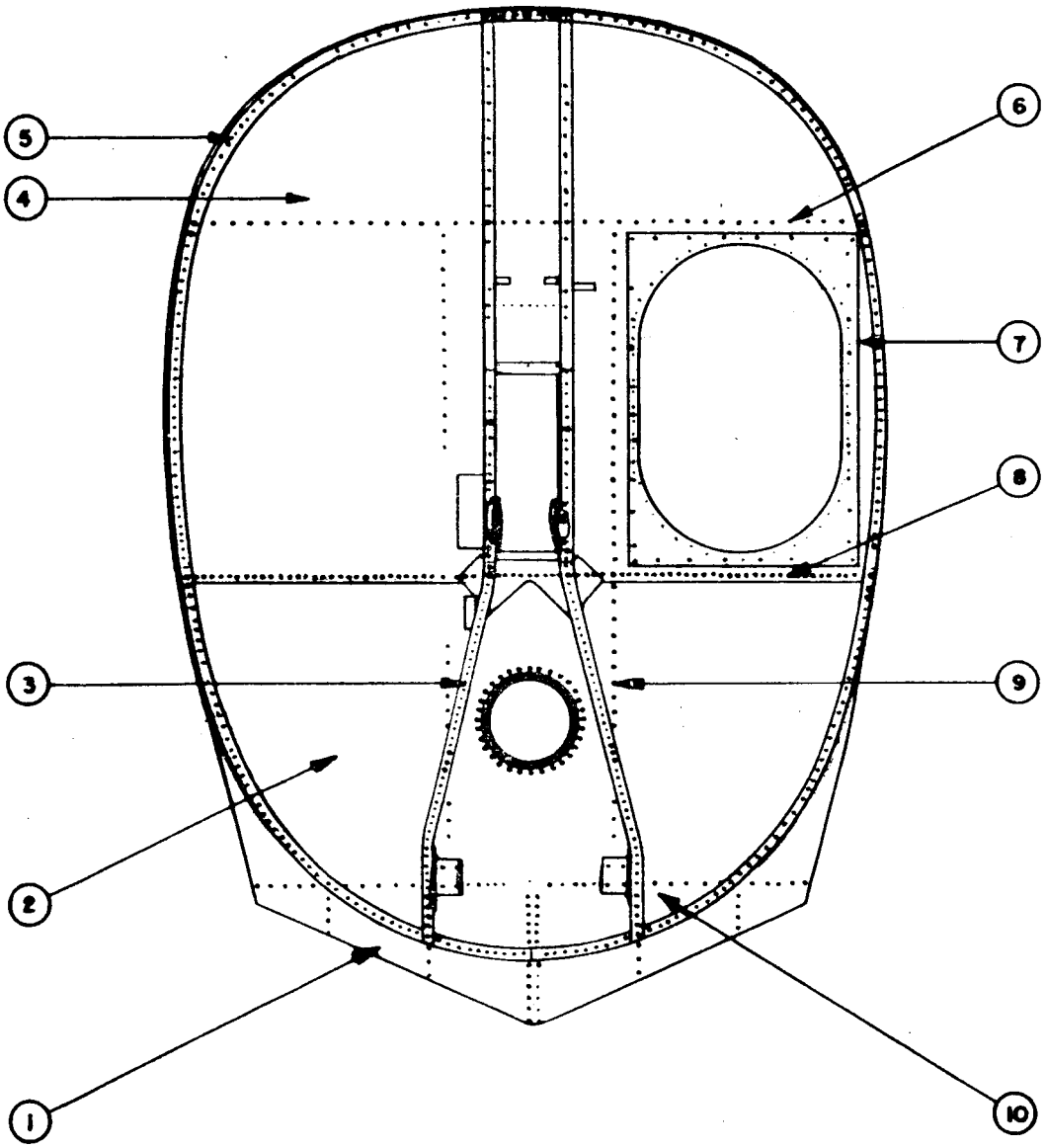


Figure 76 - Bulkhead Station #13

KEY TO FIGURE 76

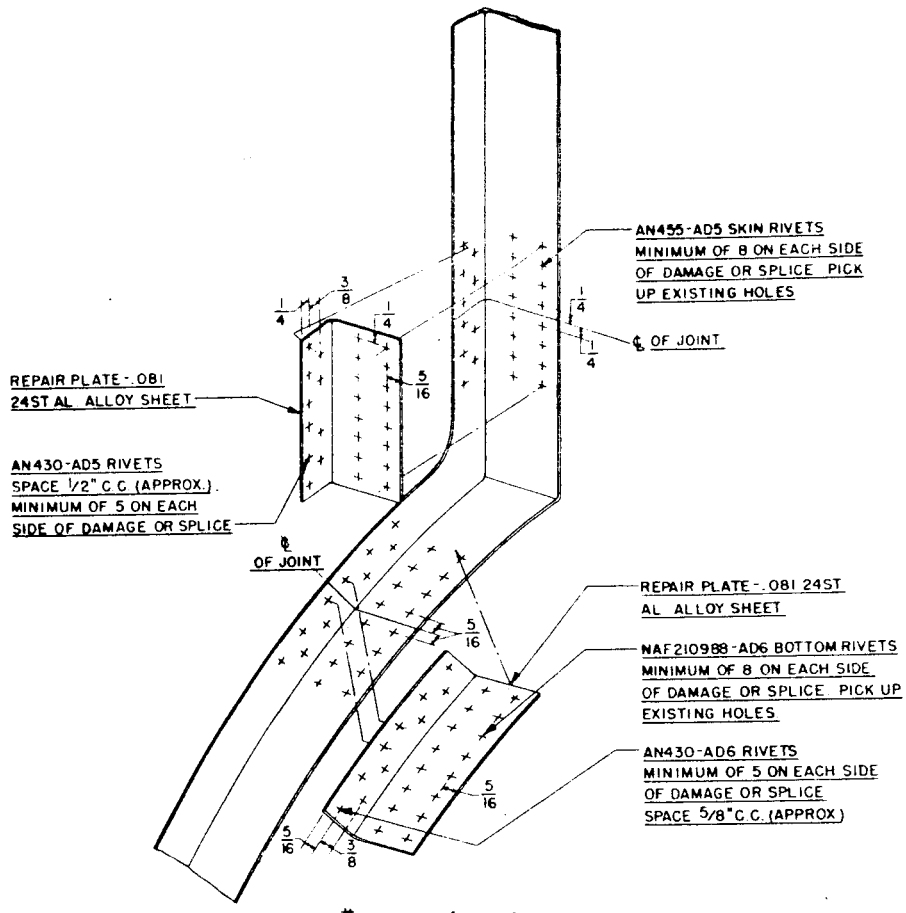
Ref. No.	Grumman Part. No.	Description	Material	Thickness
1	12053-3	Member	24ST Aluminum Alloy Sheet	.091
2	12053-2	Member	24ST Aluminum Alloy Sheet	.091
3	12053-1	Bulkhead Skin Inner	24ST Aluminum Alloy Sheet	.028
4	12053-50	Reinforced Strip (2)	24ST Aluminum Alloy Sheet	.064
5	12053-31	Angle (2)	24ST Aluminum Alloy Ext. Alcoa #3792	
6	12053-5	Member (2)	24ST Aluminum Alloy Ext. Alcoa K6466	
7	12053-30	Channel	24ST Aluminum Alloy Sheet	.040
8	12053-32	Channel	24ST Aluminum Alloy Sheet	.064
9	12053-21	Angle (2)	24ST Aluminum Alloy Ext. Alcoa #472	
10	12053-13	Angle (2)	24ST Aluminum Alloy Ext. Alcoa #472	
11	12053-8	Member (2)	24ST Aluminum Alloy Ext. Alcoa K-12866	
12	12053-18	Bulkhead Skin - Outer (2)	24ST Aluminum Alloy Sheet	.040
13	12053-6	Member (2)	24ST Aluminum Alloy Ext. Alcoa K-12866	
14	12053-12	Member	24ST Aluminum Alloy Ext. Alcoa K-12866	
15	12053-7	Member (2)	24ST Aluminum Alloy Ext. Alcoa K-12866	
16	12053-10	Angle (2)	24ST Aluminum Alloy Ext. Alcoa #472	
17	12053-11	Angle	24ST Aluminum Alloy Ext. Alcoa #472	
18	12053-9	Angle (2)	24ST Aluminum Alloy Ext. Alcoa #472	
19	12053-15	Angle (2)	24ST Aluminum Alloy Ext. Alcoa #472	



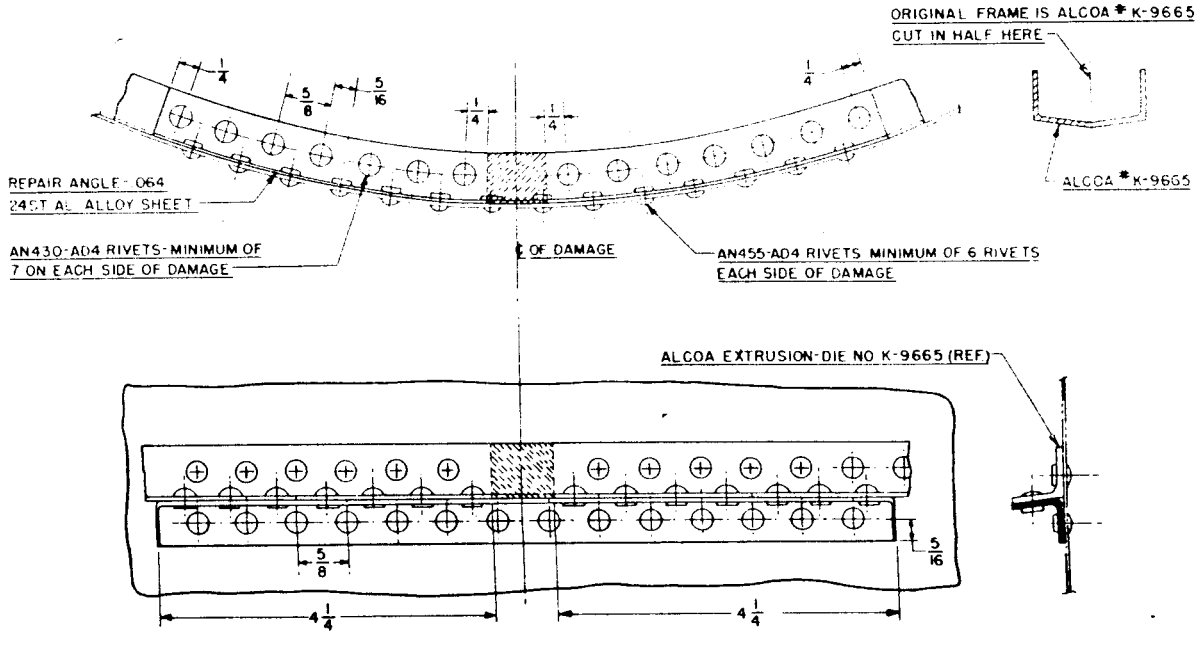


Ref. No.	Grumman Part No.	Description	Material	Thickness
1	12072-3	Step Frame	24ST Aluminum Alloy Sheet	.057
2	12072-34	Bulkhead Skin Lower	24ST Aluminum Alloy Sheet	.020
3	12072-9	Box Conn. Angle (2)	24ST Aluminum Alloy Sheet	.057
4	12072-1	Bulkhead Skin Upper	24ST Aluminum Alloy Sheet	.020
5	12072-2	Outside Angle	24ST Aluminum Alloy Ext. #734-18	
6	12072-13	Stiffener Angle	24ST Aluminum Alloy Ext. #734-18	
7	12072-18	Tapping Plate	24ST Aluminum Alloy Sheet	.091
8	12072-12	Stiffener Angle	24ST Aluminum Alloy Ext. #734-18	
9	12072-25 12072-26	Stiffener Angles 1L-1R	24ST Aluminum Alloy Ext. D-14594	1/16
10	12072-4	Floor Angle	24ST Aluminum Alloy Ext. #78-J	

Figure 77 - Bulkhead Station #29



STATION # 1 FRAME REPAIR



TYPICAL ANGLE FRAME REPAIR

Figure 78 - Angle Frame Repairs

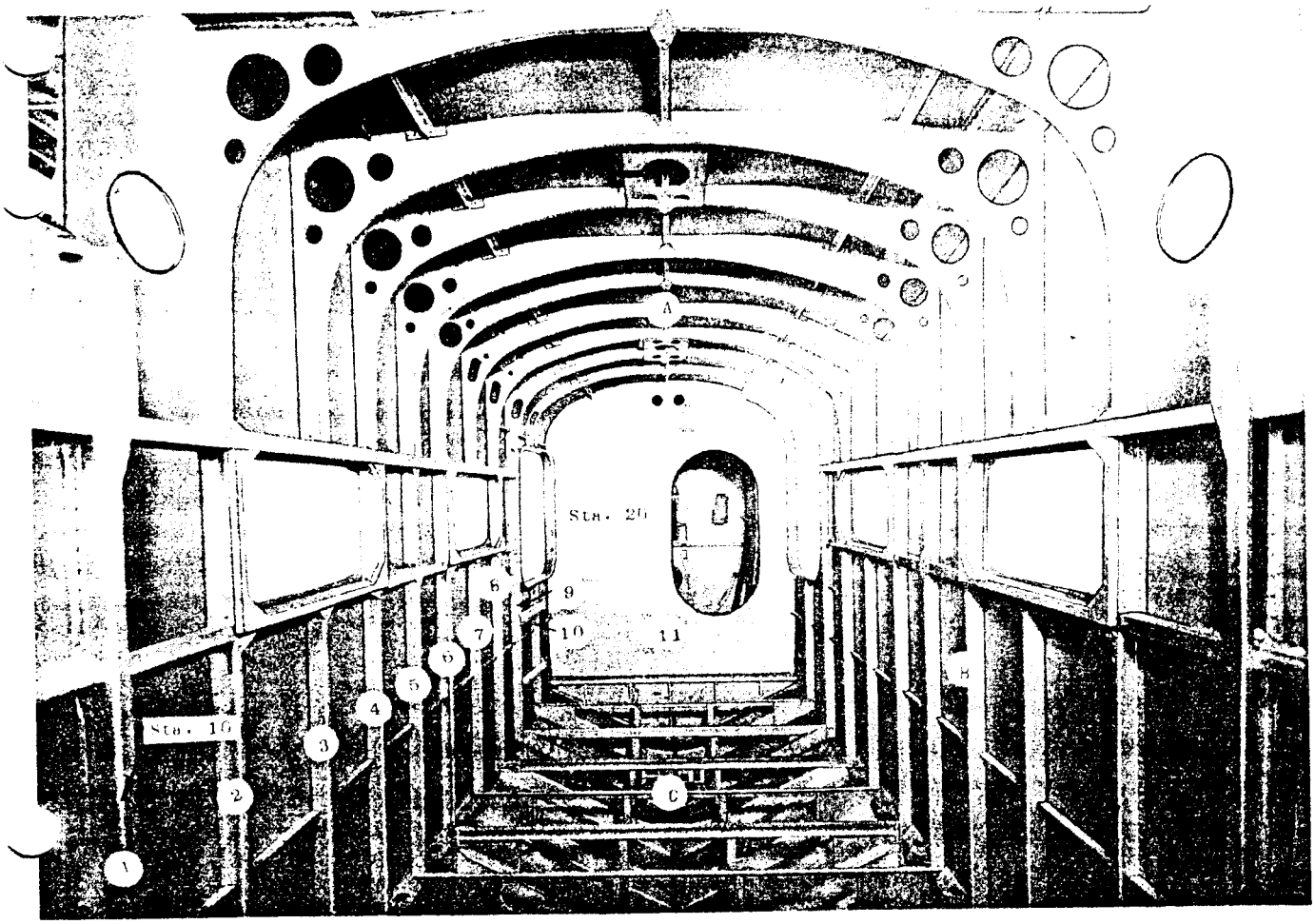


Photo Ref. No.	Sta.	Part No.	Description	Material	Thickness
1B	16	12060-1	Channel	24ST Aluminum Alloy Ext. Alcoa #1377	.081
2B	17	12060-1	Vertical 12060-9	24ST Aluminum Alloy Sheet	.040
3B	18	12060-2	Vertical 12060-9		
4B	19	12060-3	Vertical 12060-9		
5B	20	12060-4	Vertical 12060-9		
6B	21	12060-5	Vertical 12060-9		
7B	22	12060-6	Vertical 12060-9		
8B	23	12063-1	Frame		
		12063-5	Vertical 1L-1R	24ST Aluminum Alloy Sheet	.040
9B	24	12063-2	Frame		
		12063-20L	Vertical 1L-1R	24ST Aluminum Alloy Sheet	.040
10B	25	12063-3	Frame		
		12063-24	Vertical 1L-1R	24ST Aluminum Alloy Sheet	.040
11B	26	12066	Bulkhead		

NOTE: Numerals indicate location. Letters indicate type of member, i.e., A, upper cross members; B, vertical members, left and right; and C, lower cross members.

Figure 79 - Hull Structure - View Aft

KEY TO FIGURE 79 (CONT.)

Photo Ref. No.	Sta.	Part No.	Description	Material	Thickness
		12066-25	Channel	24ST Aluminum Alloy Sheet	.040
		12066-4	Channel	24ST Aluminum Alloy Sheet	.040
		12066-28	Skin - R. H. Side	24ST Aluminum Alloy Sheet	.020
		12066-29	Skin - L. H. Side	24ST Aluminum Alloy Sheet	.020
		12066-34	Zee	24ST Aluminum Alloy Sheet	.028
		12066-37 to 40	Channel	24ST Aluminum Alloy Sheet	.051
		12066-43	Zee	24ST Aluminum Alloy Sheet	.028
2A	17	12057-1	Top Frame	24ST Aluminum Alloy Sheet	.028
3A	18	12058-1	Top Frame	24ST Aluminum Alloy Sheet	.028
4A	19	12059-1	Top Frame	24ST Aluminum Alloy Sheet	.028
5A	20	12061-1	Top Frame	24ST Aluminum Alloy Sheet	.028
6A	21	12062-1	Top Frame	24ST Aluminum Alloy Sheet	.028
7A	22	12064-1	Top Frame	24ST Aluminum Alloy Sheet	.028
8A	23	12065-1	Top Frame	24ST Aluminum Alloy Sheet	.028
9A	24	12067	Top Frame		
		12067-1	Frame	24ST Aluminum Alloy Sheet	.028
		12067-2	Channel	24ST Aluminum Alloy Sheet	.028
10A	25	12091	Top Frame		
		12091-1	Channel	24ST Aluminum Alloy Sheet	.028
		12091-2	Channel	24ST Aluminum Alloy Sheet	.028
2C	17	12060-1	Duplicate Cross Floors		
3C	18	12060-2			
4C	19	12060-3			
5C	20	12060-4			
6C	21	12060-5			
7C	22	12060-6			
		12060-7	Floor	24ST Aluminum Alloy Sheet	.051
		12060-8	Crosstie "Z"	24ST Aluminum Alloy Ext. Alcoa K12867	
		12060-9	Vertical	24ST Aluminum Alloy Sheet	.040
		12060-12	Post	24ST Aluminum Alloy Sheet	.040
		12060-13	Angle	24ST Aluminum Alloy Ext. 78K	
8C	23	12063-1	Cross Floor Assembly		
9C	24	12063-2	Cross Floor Assembly		
10C	25	12063-3	Cross Floor Assembly		
			Cross Floors		
8C	23	12063-6	Floor 12063-1	24ST Aluminum Alloy Sheet	.064
9C	24	12063-17	Floor 12063-2	24ST Aluminum Alloy Sheet	.064
10C	25	12063-21	Floor 12063-3	24ST Aluminum Alloy Sheet	.064
			Posts		
8C	23	12063-9	Post 12063-1	24ST Aluminum Alloy Sheet	.028
9C	24	12063-19	12063-2	24ST Aluminum Alloy Ext. K-12867	
10C	25	12063-23	12063-3	24ST Aluminum Alloy Ext. K-12867	
			Cross Ties		
8C	23	12063-7	Cross ties 12063-1	24ST Aluminum Alloy Sheet	.040
9C	24	12063-18	Cross ties 12063-2	24ST Aluminum Alloy Ext. K12867	
10C	25	12063-22	Cross ties 12063-3	24ST Aluminum Alloy Ext. K-12867	
8C		12063-8	Angle 12063-1	24ST Aluminum Alloy Ext. Alcoa #3792	

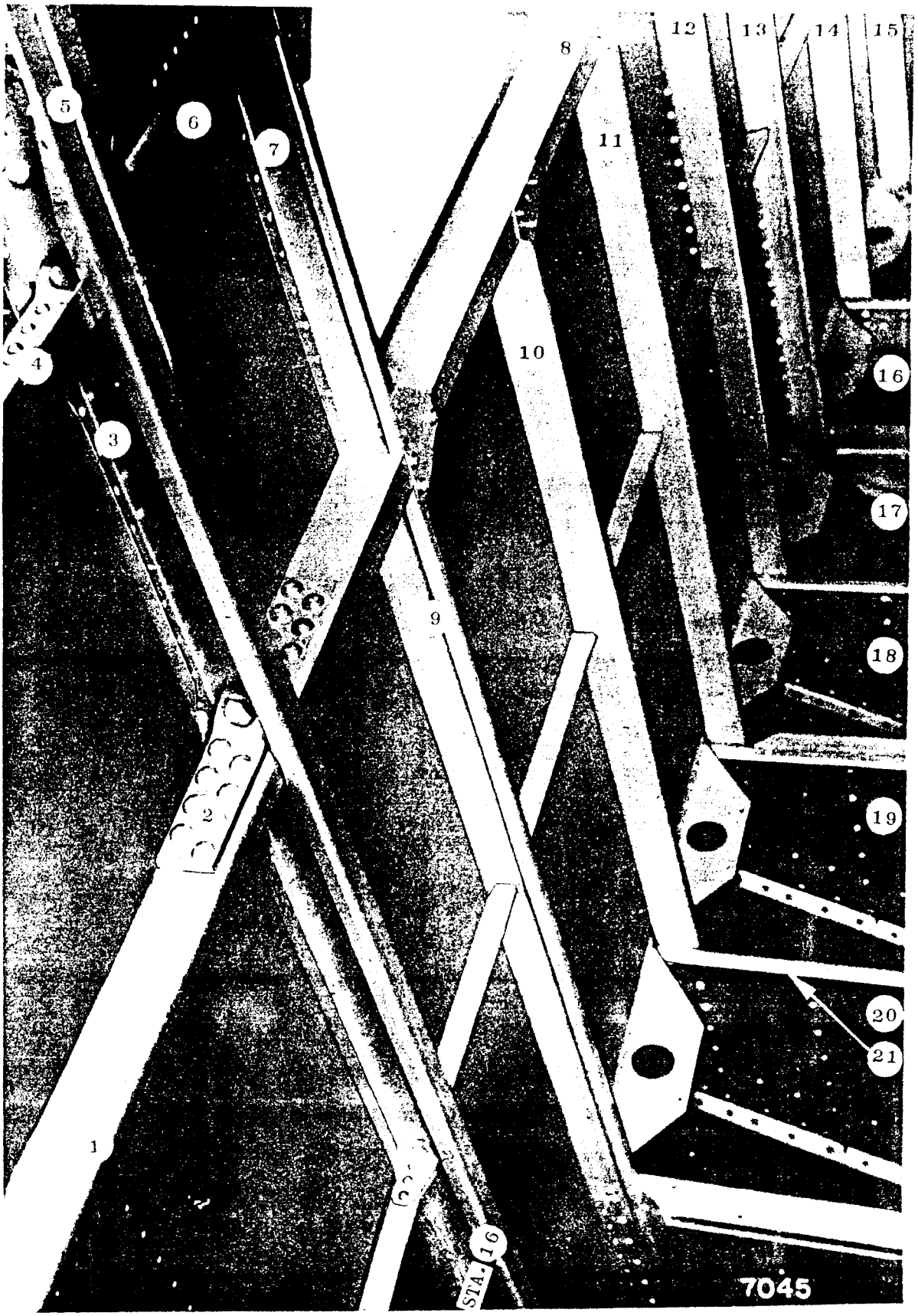
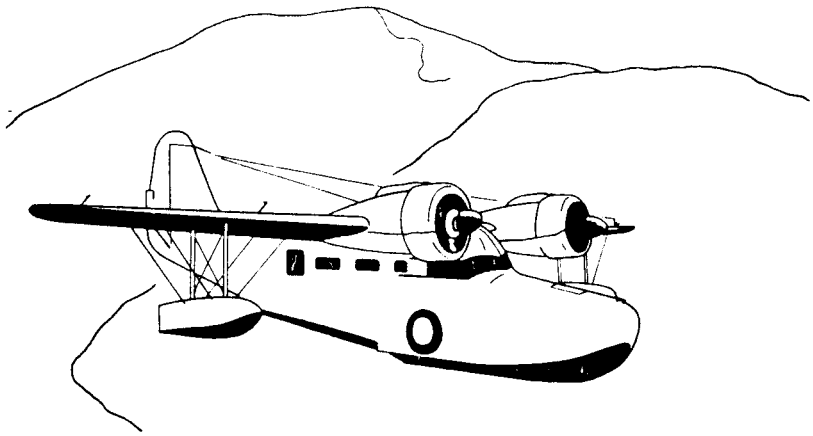


Figure 80 - Hull - Horizontal & Vertical Frames

KEY TO FIGURE 80

Ref. No.	Part No.	Description	Material	Thickness
1	12001-23	Stringer	24ST Aluminum Alloy Sheet	.091
2	12103-1	Joint	Aluminum Alloy Angle Ext. 12823	
3	12056-3	Channel	24ST Aluminum Alloy Ext. Alcoa 1377	
4	12001-25	Stringer	24ST Aluminum Alloy Sheet	.040
5	12056-16	Channel	Aluminum Alloy Ext. Alcoa 1377	
6	12001-26	Stringer	24ST Aluminum Alloy Sheet	.040
7	12001-12	Window	24ST Aluminum Alloy Sheet	.040
9,10,11,12				
13 and 14	12060-9	Vertical Members	24ST Aluminum Alloy Sheet	.040
8	12001-24	Stringer (Sta. #16-24)	24ST Aluminum Alloy Ext. 16433	
			24ST Aluminum Alloy Sheet	.040
15	12063	Vertical	24ST Aluminum Alloy Sheet	.040
16	12060-6	Frame - Assembly Sta. #22		
17	12060-5	Frame - Assembly Sta. #21		
18	12060-4	Frame - Assembly Sta. #20		
19	12060-3	Frame - Assembly Sta. #19		
20	12060-2	Frame - Assembly Sta. #18		
21	12060-8	"Z" Cross Tie	24ST Aluminum Alloy Ext. Alcoa K-12867	
21	12060-13	Angle	24ST Aluminum Alloy Ext. Alcoa 78K	
22	12060-7	Floor	24ST Aluminum Alloy Sheet	.051



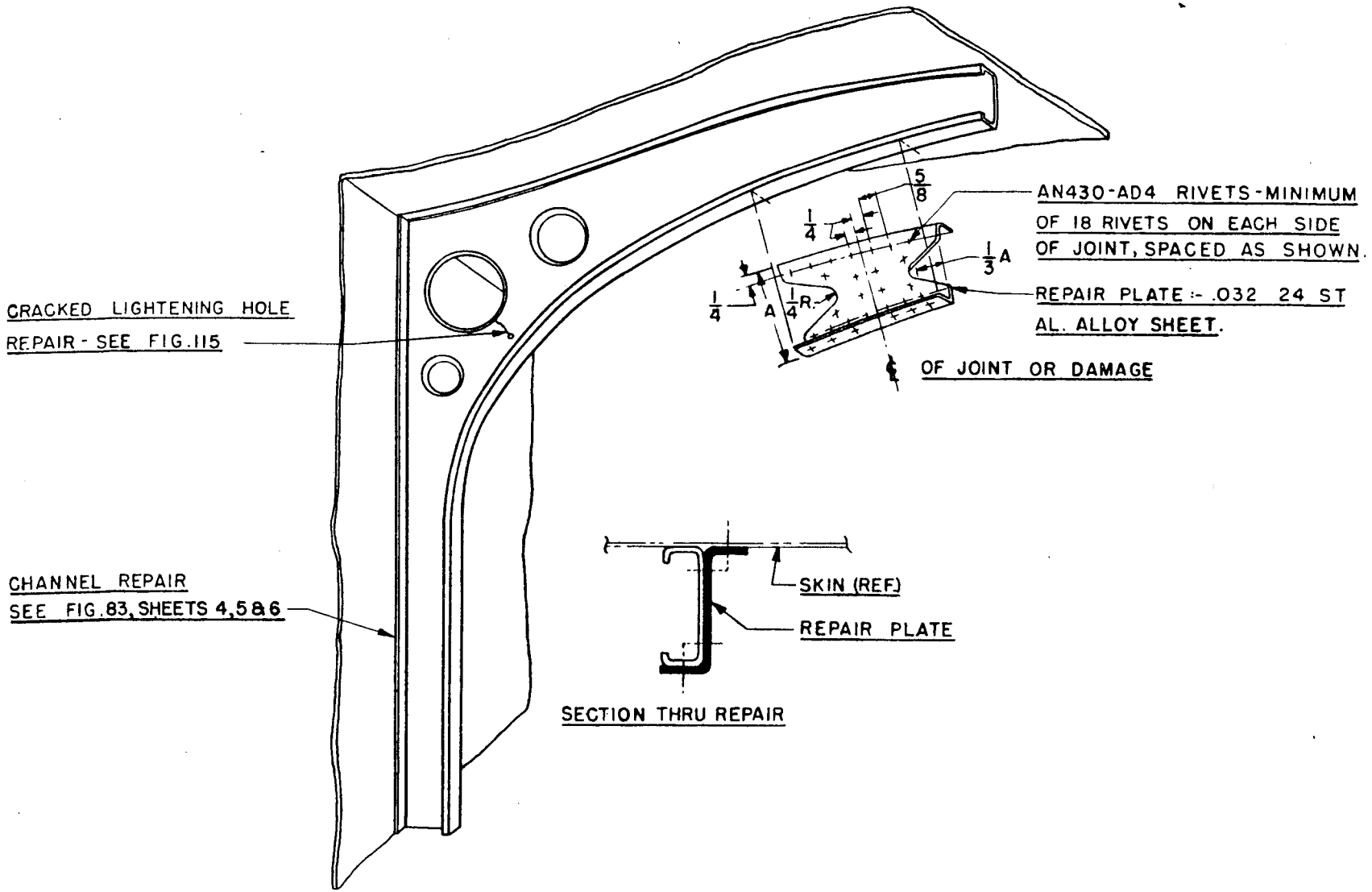
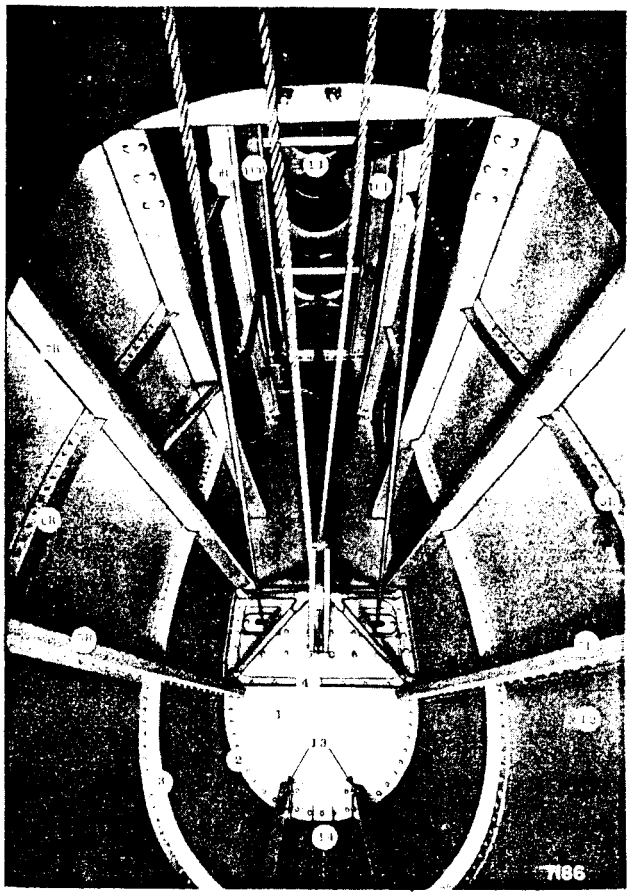


Figure 81 - Upper Cross Frame Repairs



Ref. No.	Grumman Part No.	Description	Material	Thickness
1	12076-1	Bulkhead Sheet	24ST Aluminum Alloy Sheet	.064
2	12076-2	Angle	24ST Aluminum Alloy Sheet	.064
3	12001-16	Frame Angle Sta. #35	24ST Aluminum Alloy Ext. K-9665	
4	12087	Doubling Plate	24ST Aluminum Alloy Sheet	.057
5	12001-46	Stringer 1L-1R	24ST Aluminum Alloy Sheet	.028
6	12001-15	Frame Angle Sta. #34	24ST Aluminum Alloy Ext. K-9665	
7	12001-45	Stringer 1L-1R	24ST Aluminum Alloy Sheet	.028
8	12001-50	Stringer 1L-1R	24ST Aluminum Alloy Sheet	.028
9	12001-52	Stringer 1L-1R	24ST Aluminum Alloy Sheet	.028
10	12001-101	Stringer 1L-1R	24ST Aluminum Alloy Sheet	.028
11		Fin Structure	See Figure 56	
12		Hull Skin Plating	See Figure 62	
13	12001-48	Stringer 1L-1R	24ST Aluminum Alloy Sheet	.028
14	12001-117	Channel (Bottom)	24ST Aluminum Alloy Ext. K-12000	

Figure 82 - Hull Structure - Tail Bulkhead Station #36

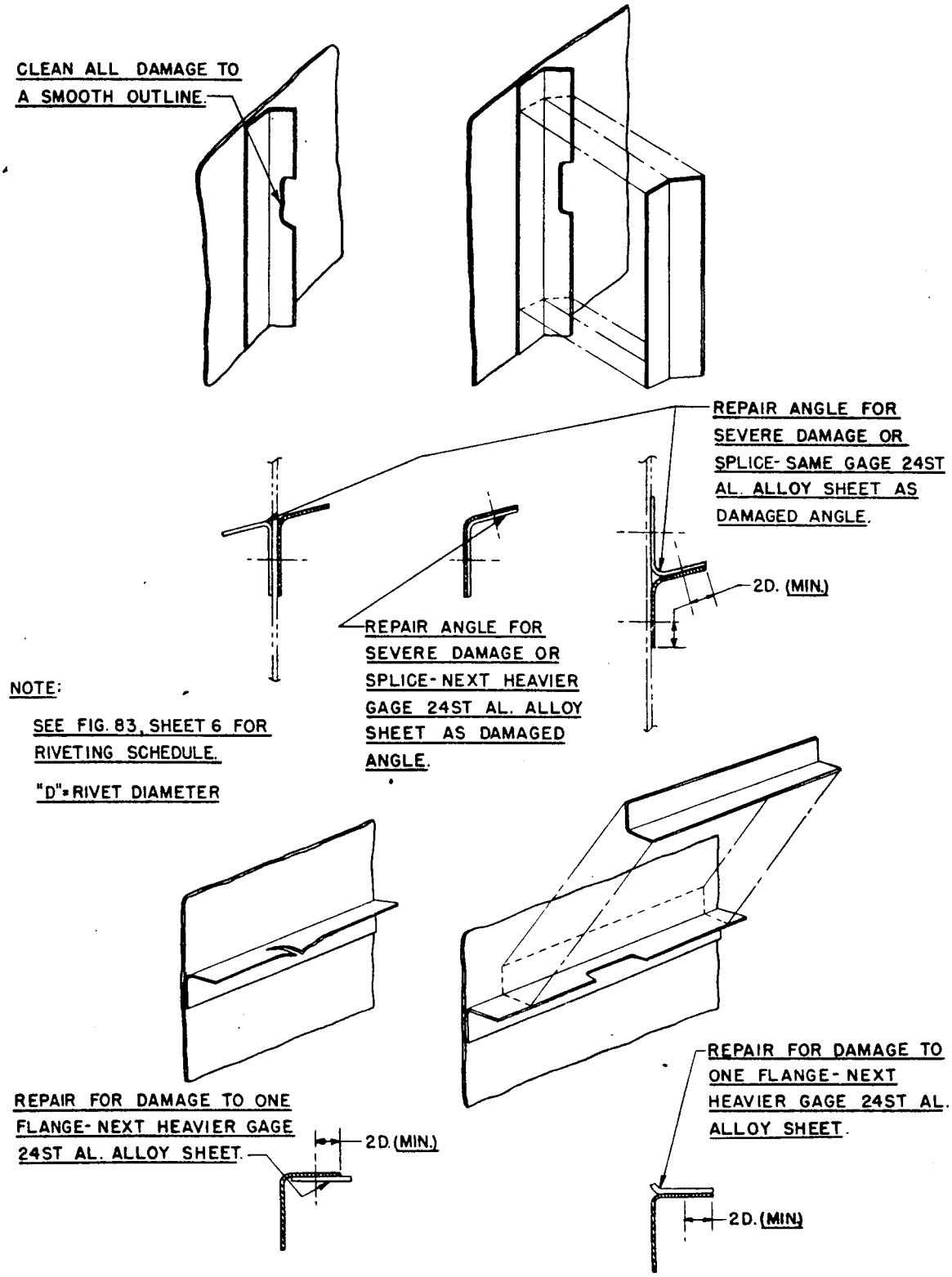
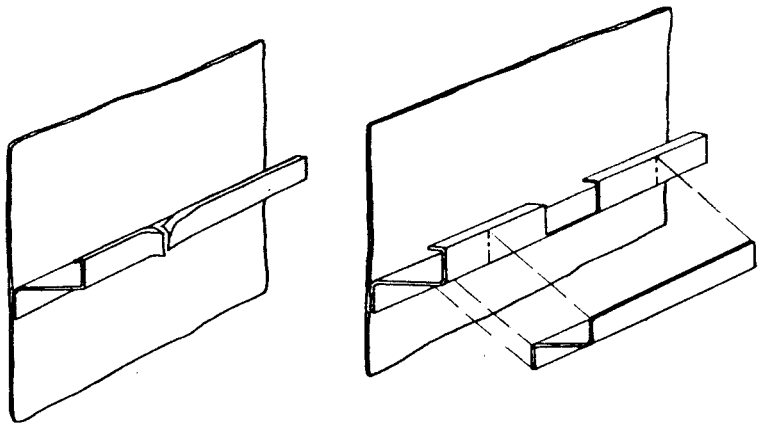
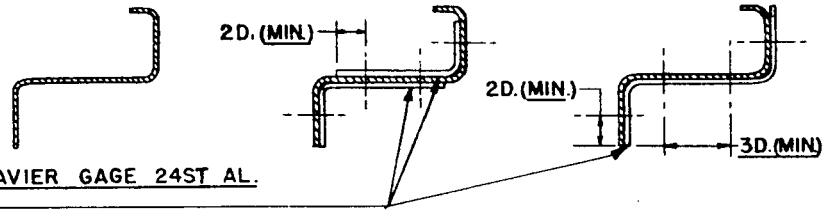


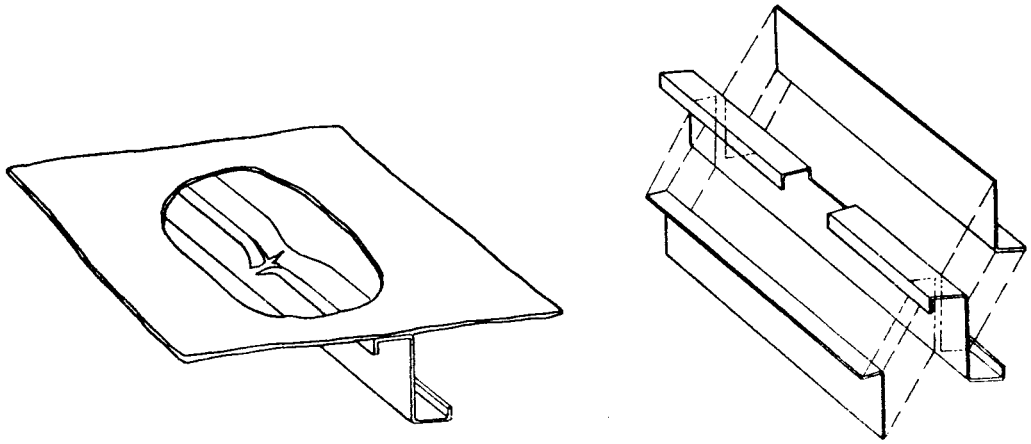
Figure 83 - Typical Section Repairs (Sheet 1)

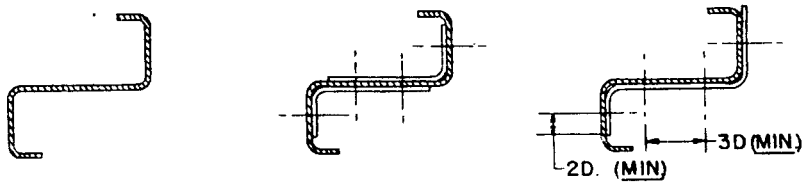
ONE PLATE WITH CORRESPONDING NUMBER OF RIVETS MAY BE USED FOR DAMAGE UP TO 1/2 CROSS-SECTIONAL AREA.





REPAIR PLATES- NEXT HEAVIER GAGE 24ST AL. ALLOY SHEET.





NOTES:

SEE FIG. 83, SHEET 6 FOR RIVETING SCHEDULE.

"D" = DIAMETER OF RIVET.

CLEAN DAMAGE TO SMOOTH OUTLINE.

Figure 83 - Typical Section Repairs (Sheet 2)

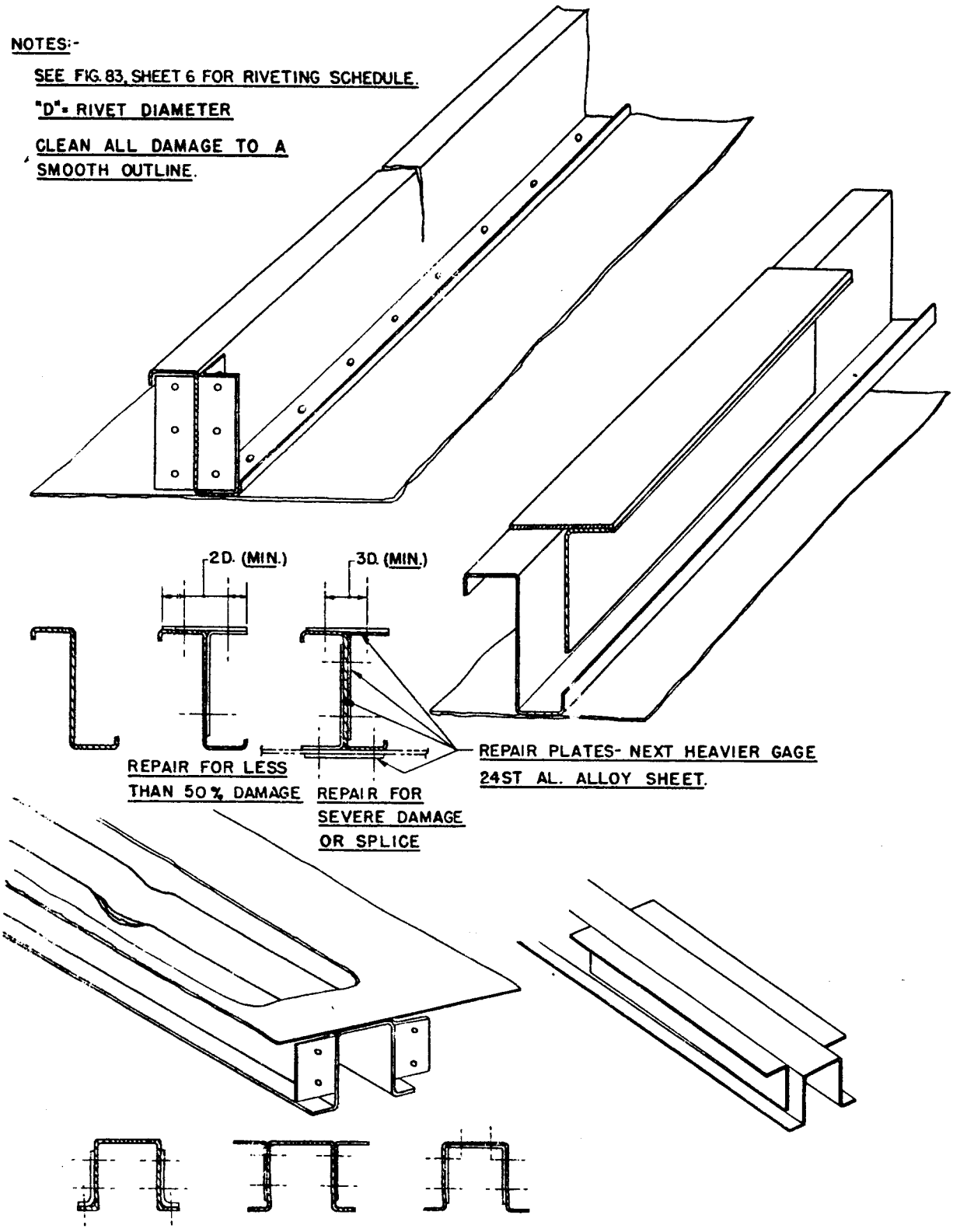
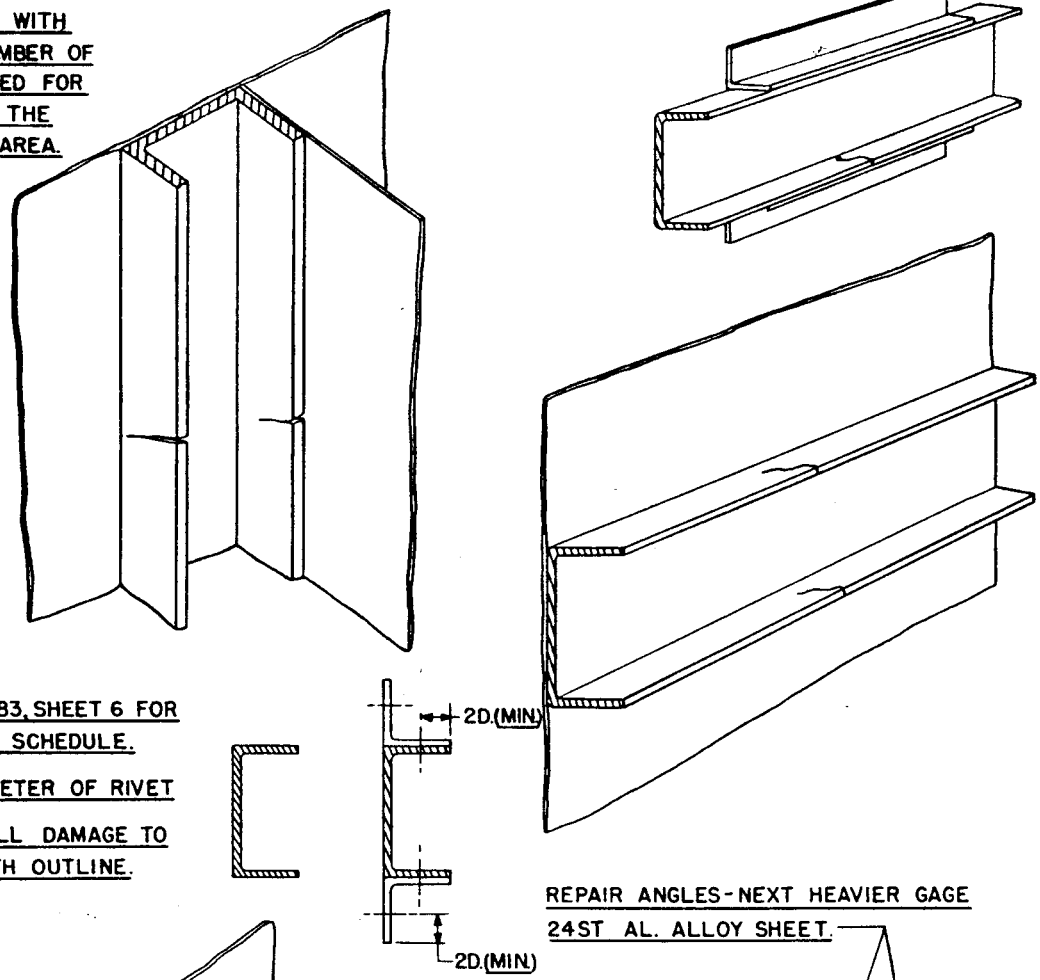


Figure 83 - Typical Section Repairs (Sheet 3)

ONE REPAIR ANGLE WITH CORRESPONDING NUMBER OF RIVETS MAY BE USED FOR DAMAGE UP TO 1/2 THE CROSS-SECTIONAL AREA.



NOTE-

SEE FIG. 83, SHEET 6 FOR RIVETING SCHEDULE.

"D" = DIAMETER OF RIVET

CLEAN ALL DAMAGE TO A SMOOTH OUTLINE.

REPAIR ANGLES - NEXT HEAVIER GAGE 24ST AL. ALLOY SHEET.

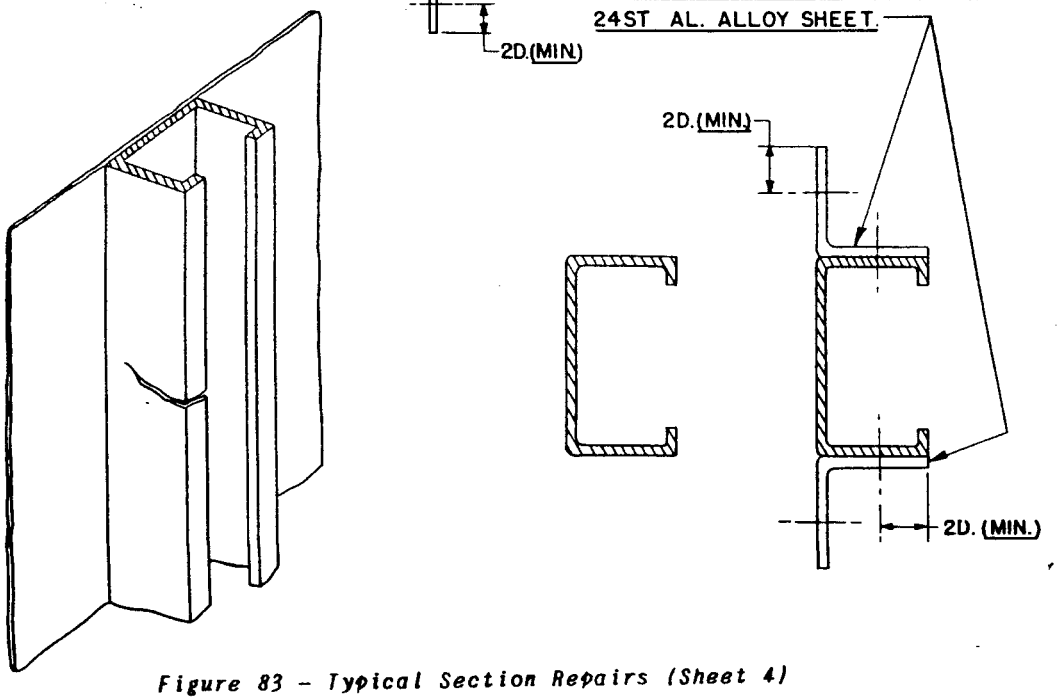


Figure 83 - Typical Section Repairs (Sheet 4)

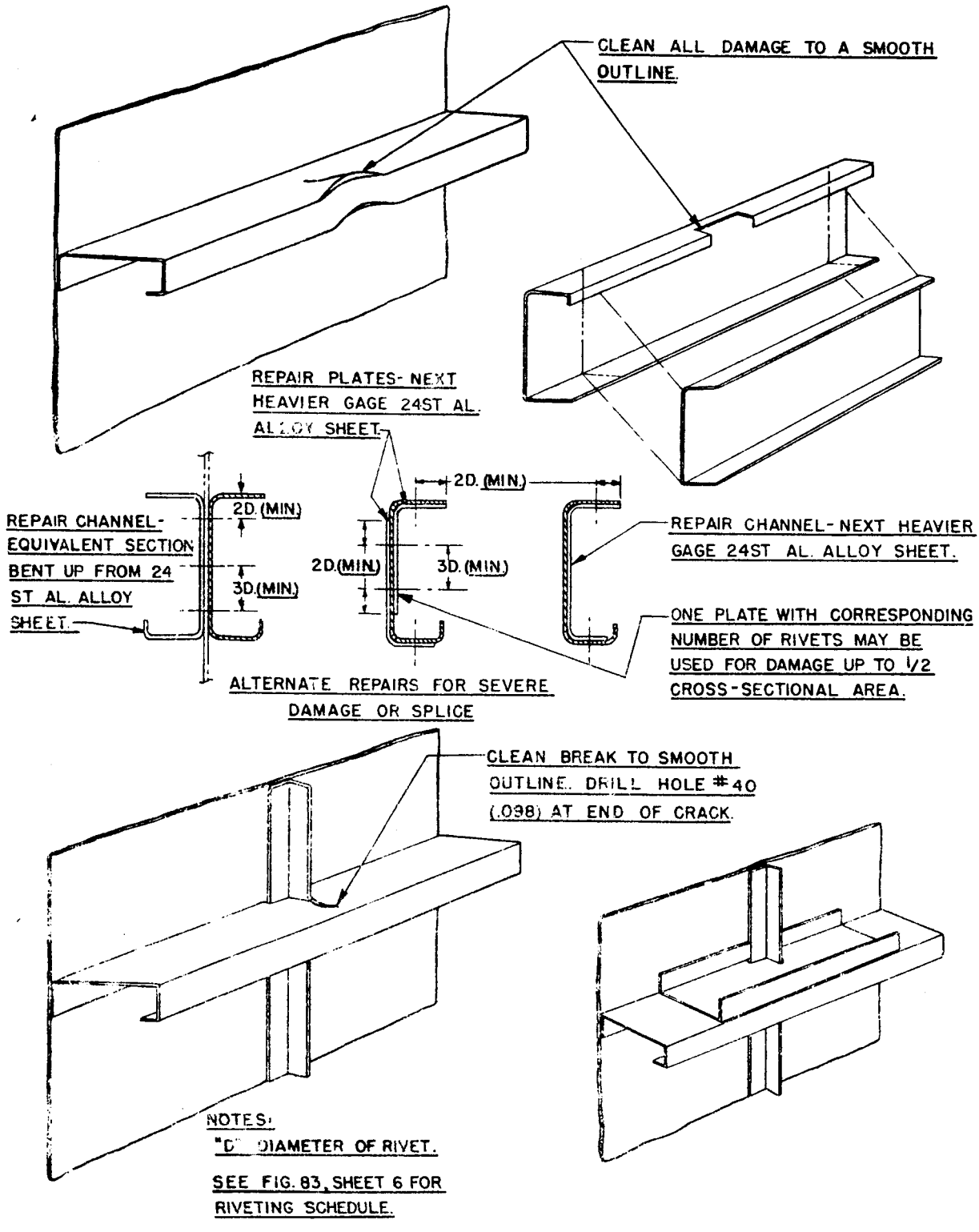
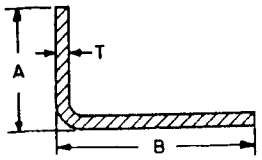
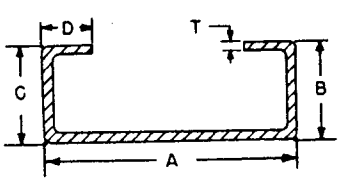


Figure 83 - Typical Section Repairs (Sheet 5)



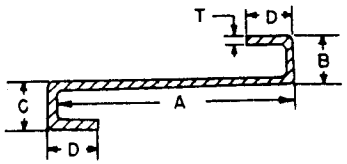
ANGLE SECTIONS

	DIMENSIONS			RIVETS EACH SIDE OF DAMAGE OR SPLICE	RIVET DIA.
	A	B	T		
	7/8	7/8	.072	6	3/16
	3/4	1 1/4	.064	7	3/16
	1 3/4	1	.064	9	3/16
	1	5/8	.064	7	5/32
	1	5/8	.057	6	5/32
	1	7/8	.057	7	5/32
	1 1/4	1	.057	9	5/32
	1 1/8	3/4	.051	7	5/32
ALCOA DIE NO.	3/4	3/4	.051	5	5/32
	3/4	5/8	.057	5	5/32
K-734-18	5/8	3/4	1/16	5	5/32
78-J	1	1	1/16	6	3/16
78-K	3/4	3/4	1/16	6	5/32
472	3/4	3/4	1/16	6	5/32
1288	3/4	1	.070	8	5/32
3792	3/4	1 1/4	1/16	6	3/16
78-C	3/4	3/4	.093	6	3/16
D-14594	5/8	1	1/16	7	5/32



CHANNEL SECTIONS

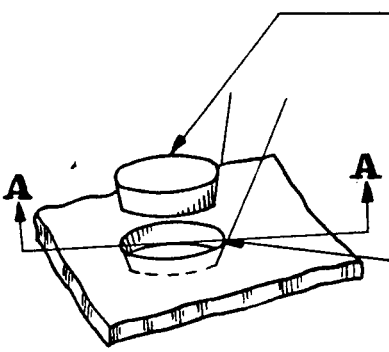
	DIMENSIONS					RIVETS EACH SIDE OF DAMAGE OR SPLICE	RIVET DIA.
	A	B	C	D	T		
	1 5/8	5/8	5/8	5/16	.028	12	1/8
	1 5/8	5/8	5/8	5/16	.040	9	5/32
	1 5/8	1	1	5/16	.091	18 (OR 9 AN3 BOLTS)	3/16
	1 9/16	1	1	1/4	.040	11	5/32
	1 5/8	1	1	1/2	.091	20 (OR 10 AN3 BOLTS)	3/16
	1 25/32	7/8	7/8	3/8	.081	17 (OR 9 AN3 BOLTS)	3/16
	1 25/32	1 1/8	1 1/8	1/2	.091	22 (OR 11 AN3 BOLTS)	3/16
	1 7/8	1 1/4	5/8	—	.040	10	5/32
	3/4	5/8	1/4	—	.028	5	1/8
	1 7/8	3/4	5/8	—	.040	9	5/32
	1 1/8	5/8	5/8	—	.040	6	5/32
	1	1/2	1/2	—	.057	7	5/32
	1 15/32	1 1/4	1 1/4	—	.040	11	5/32
	1	7/16	7/16	—	.040	6	5/32
	1 1/4	3/4	3/4	—	.051	10	5/32
	1 21/32	7/8	3/4	—	.040	9	5/32
	1 1/4	3/4	3/4	—	.040	7	5/32
	2 3/4	1	7/8	—	.051	17	5/32
	2 1 1/16	1	7/8	—	.040	13	5/32
	1 21/32	3/4	7/8	—	.040	6	5/32
	3/4	3/8	3/8	—	.040	7	1/8
ALCOA DIE NO.	1 5/8	1	1	—	.040	10	5/32
	1 1/4	3/4	3/4	3/8	.051	16	5/32
K-12000	1 1/4	3/4	3/4	—	1/16	8	3/16
K-6466	1 21/32	27/32	27/32	—	1/8	17 (OR 7 AN3 BOLTS)	3/16
K-12866	1 5/8	3/4	3/4	—	1/16	9	3/16
K-1380	2 1/8	1	1	1/2	.064	15 (OR 11 AN3 BOLTS)	3/16
K-1377	2 1/8	1	1	1/2	.080	19 (OR 10 AN3 BOLTS)	3/16
K-16433	1 5/8	1	1	—	.081	13 (OR 7 AN3 BOLTS)	3/16



ZEE SECTIONS

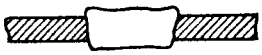
DIMENSIONS					RIVETS EACH SIDE OF DAMAGE OR SPLICE	RIVET DIA.
A	B	C	D	T		
1 5/8	5/8	1/2	1/4	.051	12	5/32
2 1 1/16	1 3/8	3/4	—	.064	15	3/16
1 1/8-1 1/4	1/2	1/2	1/4	.028	10	1/8
2 3/4	3/4	3/4	—	.064	13	3/16
2 3/4	3/4	3/4	—	.051	11	3/16
1 1/2	3/4	3/4	1/4	.028	13	1/8
1 3/4	5/8	5/8	1/4	.028	11	1/8
4 1/8-5	3/4	3/4	—	.072	20	3/16
4	3/4	3/4	—	.057	16	3/16
1	1/2	1/2	3/16	.028	8	1/8
1 1/8	1/2	1/2	1/4	.028	9	1/8
2 1 1/16	1	1	—	.051	17	5/32
2 1 1/16	1	1	3/8	.051	20	5/32

Figure 83 - Typical Section Repairs - Riveting Schedule - Sheet 6



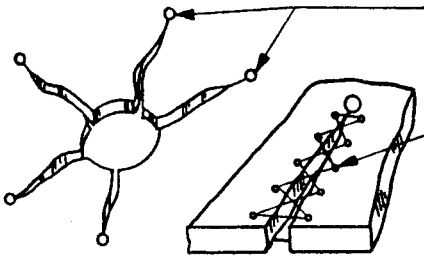
PATCH SHOULD BE OF THICKER MATERIAL WITH SIDES TAPERED AT SHARPER ANGLE. HEAT EDGES OF PATCH UNTIL SOFT & PRESS INTO HOLE TO ASSURE PERFECT FIT, THEN REMOVE TO APPLY CEMENT. APPLY PRESSURE ON TOP ONLY DURING CEMENTING.

CLEAN DAMAGE TO ROUND OR OVAL SHAPED HOLE AVOIDING SHARP CORNERS.



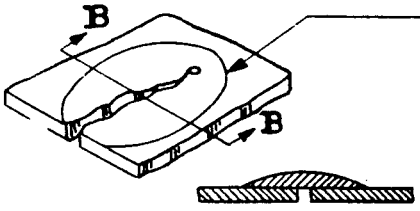
SECTION "A-A"

HOLE REPAIR



DRILL SMALL HOLE AT END OF ALL CRACKS.

EMERGENCY REPAIR MAY BE MADE BY LACING WITH AERIAL WIRE.



PATCHES OVER CRACKS MAY BE MADE OF THIN TRANSPARENT PLASTIC, CELLULOSE ACETATE OR WING FABRIC.

SECTION "B-B"

CRACK REPAIR

Figure 84 - Plexiglas Repairs

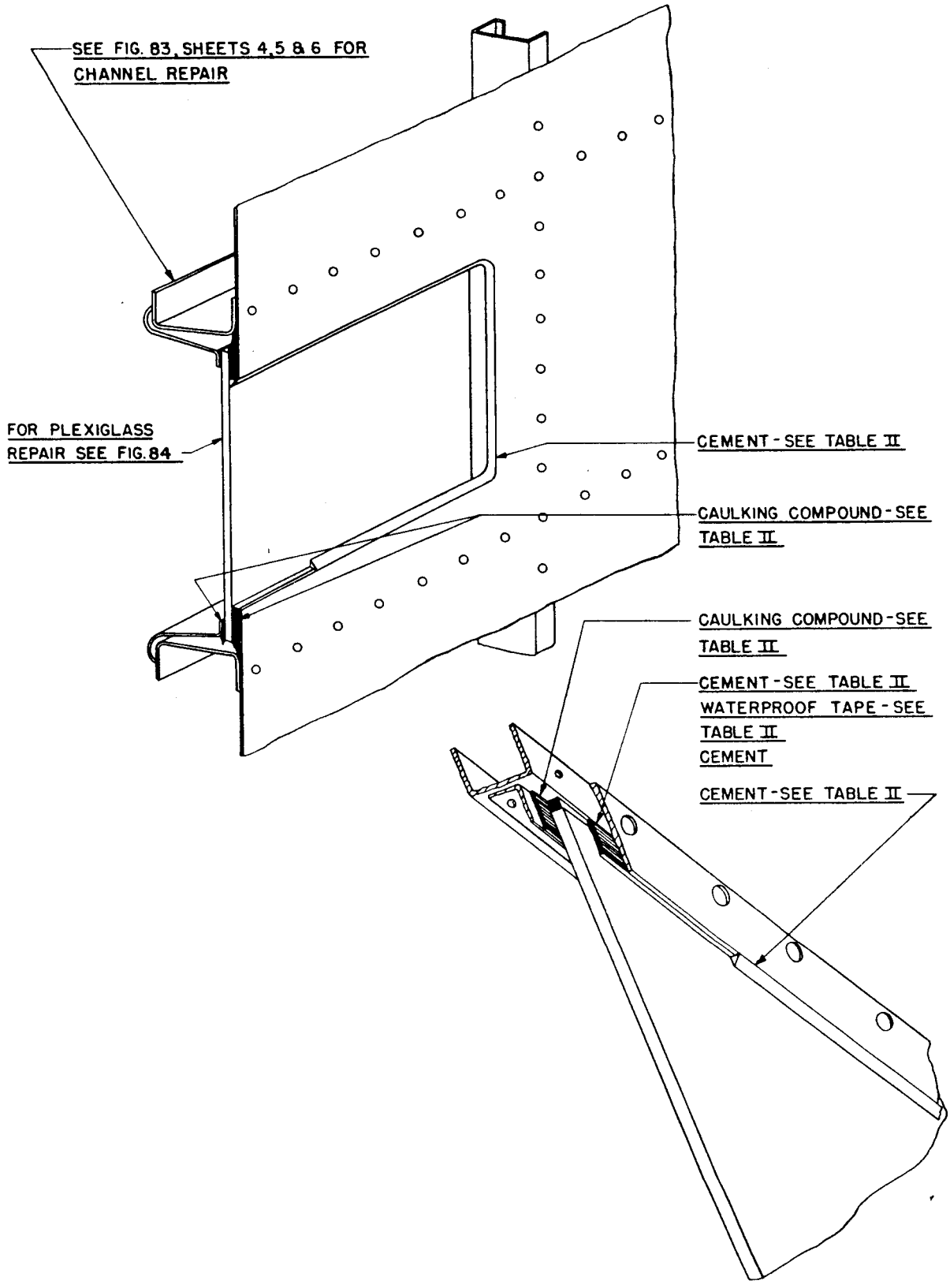
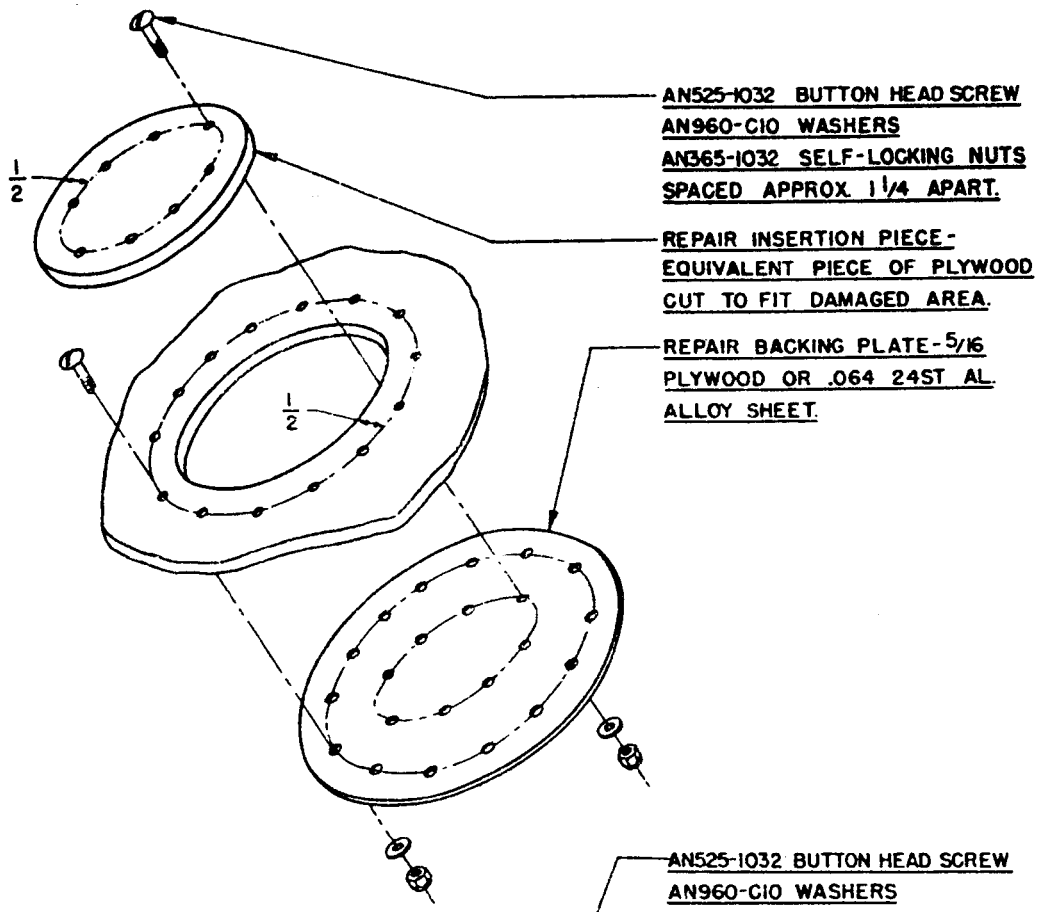
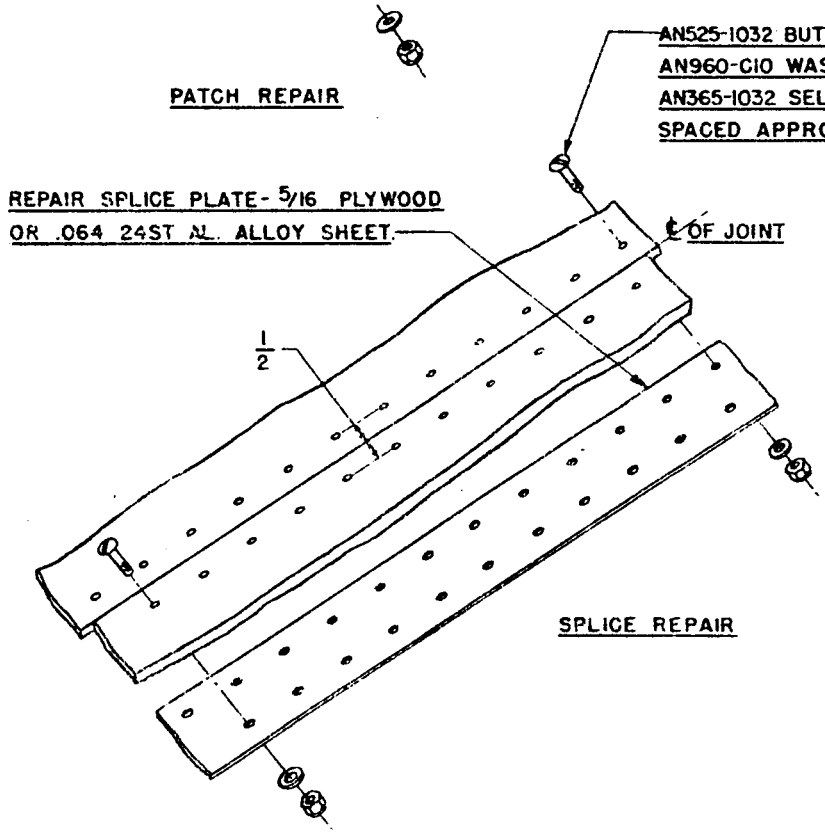


Figure 85 - Window and Windshield Installation



PATCH REPAIR



SPLICE REPAIR

Figure 86 – Plywood Repairs

TABLE V

MATERIALS FOR REPAIR

HULL

Where Used	Description	Material	Size Thickness	Item
Skin	Sheet	24ST Aluminum Alloy	.028	Patch, Insertion and Replacement
Skin	Sheet	24ST Aluminum Alloy	.032	Patch, Insertion and Replacement
Skin	Sheet	24ST Aluminum Alloy	.040	Patch, Insertion and Replacement
Skin	Sheet	24ST Aluminum Alloy	.051	Patch, Insertion and Replacement
Skin	Sheet	24ST Aluminum Alloy	.057	Patch, Insertion and Replacement
Skin	Sheet	24ST Aluminum Alloy	.064	Patch, Insertion and Replacement
Skin	Sheet	3S½H Aluminum Alloy	.028	Patch, Insertion and Replacement
Skin	Sheet	3S½H Aluminum Alloy	.032	Patch, Insertion and Replacement
Skin	Sheet	3S½H Aluminum Alloy	.040	Patch, Insertion and Replacement
Skin	Sheet	3S½H Aluminum Alloy	.051	Patch, Insertion and Replacement
Skin	Sheet	3S½H Aluminum Alloy	.064	Patch, Insertion and Replacement
Keel	Extrusion	24ST Aluminum Alloy	Alcoa K11257	Insertion and Replacement
	Sheet	24ST Aluminum Alloy	.091	Patch and Splice Plates
Chine Angle Front	Extrusion	24ST Aluminum Alloy	Alcoa K12025	Insertion and Replacement
	Sheet	24ST Aluminum Alloy	.091	Patch and Splice Plates
Chine Angle Rear	Extrusion	24ST Aluminum Alloy	Alcoa K15087	Insertion and Replacement
	Sheet	24ST Aluminum Alloy	.064	Patch and Splice Plates
Stringer	Extrusion	24ST Aluminum Alloy	Alcoa 1377	Insertion and Replacement
	Sheet	24ST Aluminum Alloy	.091	Patch and Splice Plate
Stringer	Sheet	24ST Aluminum Alloy	.091	Insertion and Replacement
	Sheet	24ST Aluminum Alloy	.102	Patch and Splice Plate
Stringer	Sheet	24ST Aluminum Alloy	.040	Insertion and Replacement
	Sheet	24ST Aluminum Alloy	.051	Patch and Splice Plate
Stringer	Extrusion	24ST Aluminum Alloy	Alcoa K734-18	Insertion and Replacement
	Sheet	24ST Aluminum Alloy	.081	Patch and Splice Plates
Stringer	Extrusion	24ST Aluminum Alloy	Alcoa 78C	Insertion and Replacement
	Sheet	24ST Aluminum Alloy	.102	Patch and Splice Plates

TAB . (CONT.)

MATERIALS FOR REPAIR

HULL

Where Used	Description	Material	Size Thickness	Item
Floor-Angle	Sheet	24ST Aluminum Alloy	.072	Insertion and Replacement
		24ST Aluminum Alloy	.081	Patch and Splice Plates
Cross Floor	Sheet	24ST Aluminum Alloy	.040	Insertion and Replacement
		24ST Aluminum Alloy	.051	Patch and Splice Plates
Cross Floor	Sheet	24ST Aluminum Alloy	.057	Insertion and Replacement
			.064	Patch and Splice Plates
Floor	Sheet	24ST Aluminum Alloy	.064	Insertion and Replacement
		24ST Aluminum Alloy	.081	Patch and Splice Plates
Frame	Extrusion	24ST Aluminum Alloy	Alcoa D-14594	Insertion and Replacement
	Sheet	24ST Aluminum Alloy	.081	Patch Repair and Splice Plates
Frame	Sheet	24ST Aluminum Alloy	.040	Insertion and Replacement
		24ST Aluminum Alloy	.051	Patch Repair and Splice Plates
Frame Angle	Extrusion	24ST Aluminum Alloy	Alcoa K-9665	Insertion and Replacement
	Sheet	24ST Aluminum Alloy	.081	Patch Repair and Splice Plates
Stringer	Sheet	24ST Aluminum Alloy	.028	Insertion and Replacement
		24ST Aluminum Alloy	.032	Patch Repair and Splice Plates
Stringer	Sheet	24ST Aluminum Alloy	.051	Insertion and Replacement
		24ST Aluminum Alloy	.064	Patch Repair and Splice Plate
Stringer	Extrusion	24ST Aluminum Alloy	Alcoa K-1380	Insertion and Replacement
	Sheet	24ST Aluminum Alloy	.081	Patch Repair and Splice Plate
Frame	Extrusion	24ST Aluminum Alloy	Alcoa 3792	Insertion and Replacement
	Sheet	24ST Aluminum Alloy	.081	Patch Repair and Splice Plates
Cross Tie	Extrusion	24ST Aluminum Alloy	Alcoa K-12867	Insertion and Replacement
	Sheet	24ST Aluminum Alloy	.051	Patch Repair and Splice Plates
Channel	Sheet	24ST Aluminum Alloy	.057	Insertion and Replacement
		24ST Aluminum Alloy	.064	Patch Repair and Splice Plates

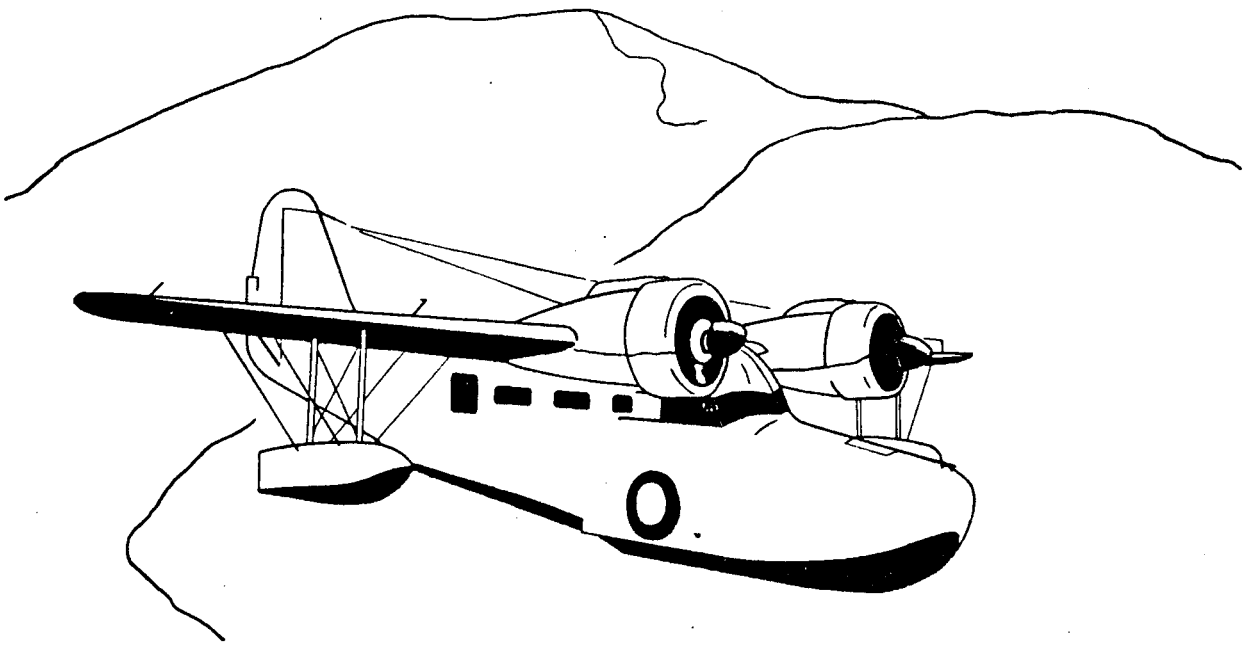
TABLE V (CONT.)

MATERIALS FOR REPAIR

HULL

Where Used	Description	Material	Size Thickness	Item
Angle	Extrusion	24ST Aluminum Alloy	Alcoa 78K	Insertion and Replacement
	Sheet	24ST Aluminum Alloy	.081	Patch Repair and Splice Plates
Frame	Sheet	24ST Aluminum Alloy	.064	Insertion and Repair
		24ST Aluminum Alloy	.081	Patch Repair and Splice Plates
Bulkhead	Sheet	24ST Aluminum Alloy	.020	Insertion and Repair
		24ST Aluminum Alloy	.025	Patch Repair and Splice Plates
Bulkhead	Extrusion	24ST Aluminum Alloy	Alcoa K-734-18	Insertion and Repair
		24ST Aluminum Alloy	.081	Patch Repair and Splice Plates
Bulkhead	Sheet	24ST Aluminum Alloy	.081	Insertion and Repair
		24ST Aluminum Alloy	.091	Patch Repair and Splice Plates
Bulkhead	Extrusion	24ST Aluminum Alloy	Alcoa 78J	Insertion and Repair
	Sheet	24ST Aluminum Alloy	.081	Patch Repair and Splice Plates
Bulkhead	Extrusion	24ST Aluminum Alloy	Alcoa K-12000	Insertion and Repair
	Sheet	24ST Aluminum Alloy	.081	Patch Repair and Splice Plates
Bulkhead	Extrusion	24ST Aluminum Alloy	Alcoa K-6466	Insertion and Repair
	Sheet	24ST Aluminum Alloy	5/32	Patch Repair and Splice Plates
Bulkhead	Extrusion	24ST Aluminum Alloy	Alcoa K-12866	Insertion and Repair
	Sheet	24ST Aluminum Alloy	.081	Patch Repair and Splice Plates
Bulkhead	Extrusion	24ST Aluminum Alloy	Alcoa 472	Insertion and Repair
	Sheet	24ST Aluminum Alloy	.081	Patch Repair And Splice Plates
Skin & Bulkheads	See Table II			Watertight Joints

NOTE: For Alternate Replacement of Extrusions with Bent Up 24ST Aluminum Alloy Refer to Figure 106, Sheets 3 and 4.



SECTION 5
ALIGHTING GEAR

1. GENERAL.

The alighting gear includes the retractable main landing gear and tail wheel. The welded tube structures comprising the upper drag links, lower drag links and compression struts are heat treated. (For heat treated parts list reference should be made to Table I.

NOTE

The wing tip floats should be repaired in accordance with Section II, Paragraphs 87 - 99.

2. CLASSIFICATION OF DAMAGE.

Inspect structural members for dents, nicks, cracks, holes, breaks, distortion, for worn bushings due to hard landings and wear caused by retracting the gear. The damage should be classified as follows:

a. Negligible Damage.
b. Damage Repairable by Welding.
c. Damage Necessitating Replacement.

3. NEGLIGIBLE DAMAGE.

Small, smooth isolated dents, nicks and longitudinal scores not over 1/32 inch in depth with no cracks or abrasions may be classified as negligible.

4. REPAIR OF CRACKS.

Longitudinal cracks in tubing up to 1-1/2 inches in length, and lateral cracks up to 1/2 inch in length may be repaired by arc welding or acetylene (gas) welding. If acetylene welding is used, it will be necessary to reheat treat the welded member. Arc welds over 1/2 inch long should be heat treated. Grind a slight "V" at the end of cracks before welding. Be sure to get a good point. Use extreme care.

5. DAMAGE NECESSITATING REPLACEMENT.

a. All damaged parts which are not repairable should be replaced by spares made up from the requisite drawing.

b. Cracks not repairable as described in Paragraph 4 above necessitate replacement of the damaged member with an equivalent member.

c. If a wheel is cracked or distorted, it should be replaced.

d. Due to hard landings and wear caused by retracting the gear, complete rebushing may be necessary. When replacing bushings reference should be made to Table VI, listing location, ream size prior to pressing in the bushing, and the completed ream size. All bolts which are appreciably worn should be replaced.

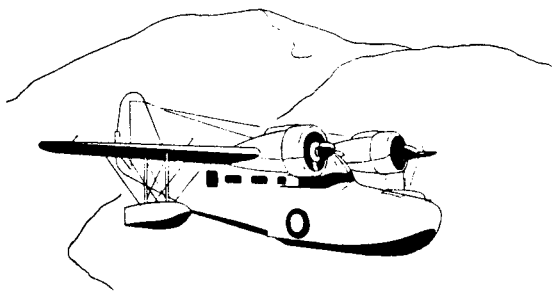
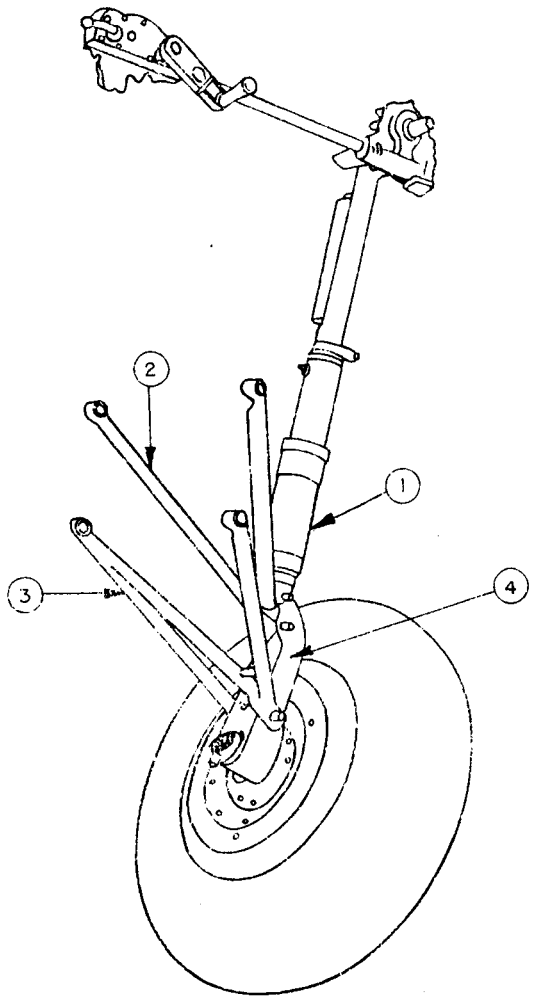


TABLE VI

ALIGHTING GEAR BUSHING LIST

Location	Ream Before Bushing	Bushing Part #	Ream After Bushing
	Landing Gear		
Lower End of Lower Drag Link	1.000 ±.001	9606-1	.750 ±.001
Lower End of Upper Drag Link	.875 ±.001	9606-7	.625 ±.001
Upper Ends of Lower Drag Link and Upper Drag Link	.875 ±.001	9606-4	.625 ±.001
Lower End of Shock Strut	.875 ±.001	9606-2	.625 ±.001
Hinge of Shock Strut	.5625±.001	9606-3	.375 ±.001
	Tail Gear		
Drag Link to Fork Connection	2.125 ±.001	12657	2.000 ±.001
Drag Link to Shock Strut Connection	.5625±.001	9751-7	.375 ±.001
Drag Link to Hull Connection	.5625±.001	G25H-6-108	.375 ±.001
Hinge of Shock Strut	.500 ±.001	9751-5	.375 ±.001



Ref. No.	Part No.	Description	Material	Size
1	Bendix #53590	Shock Strut Assembly		
2	9603	Upper Drag Link		
	9603-1	Forward Tube	C.M. Steel Tubing	.065 x 1-3/8 D. x 27
	9603-2	Rear Tube	C.M. Steel Tubing	.065 x 1-1/8 D. x 21
	9603-3	Bearing Tube	C.M. Steel Bar	1-3/16 D. x 3
3	9602	Lower Drag Link		
	9602-1	Forward Tube	C.M. Steel Tubing	.072 x 1-1/8 D. x 26
	9602-2	Center Tube	C.M. Steel Tubing	.058 x 1-1/8 D. x 18
	9602-3	Rear Tube	C.M. Steel Tubing	.065 x 1 D. x 21
	9602-4	Reinf. Tube	C.M. Steel Tubing	.058 x 1 D. x 6
	9602-5	Reinf. Tube	C.M. Steel Tubing	.058 x 1-1/8 D. x 6
	9602-6	Reinf. Tube	C.M. Steel Tubing	.035 x 7/8 D. x 4
	9602-10	Tube - Tow Link	C.M. Steel Tubing	.065 x 1/2 O.D. x 2-1/2
4	13643	Axle Member (Assem.)		
		Axle Stub	Made from forging SP-648, See #13640 machined axle (used for spares and replacements, all models) superseding #13638 and #12601, welded part used on earlier models.	
	12600	Landing Gear Assembly and Installation		

Figure 87 - Landing Gear

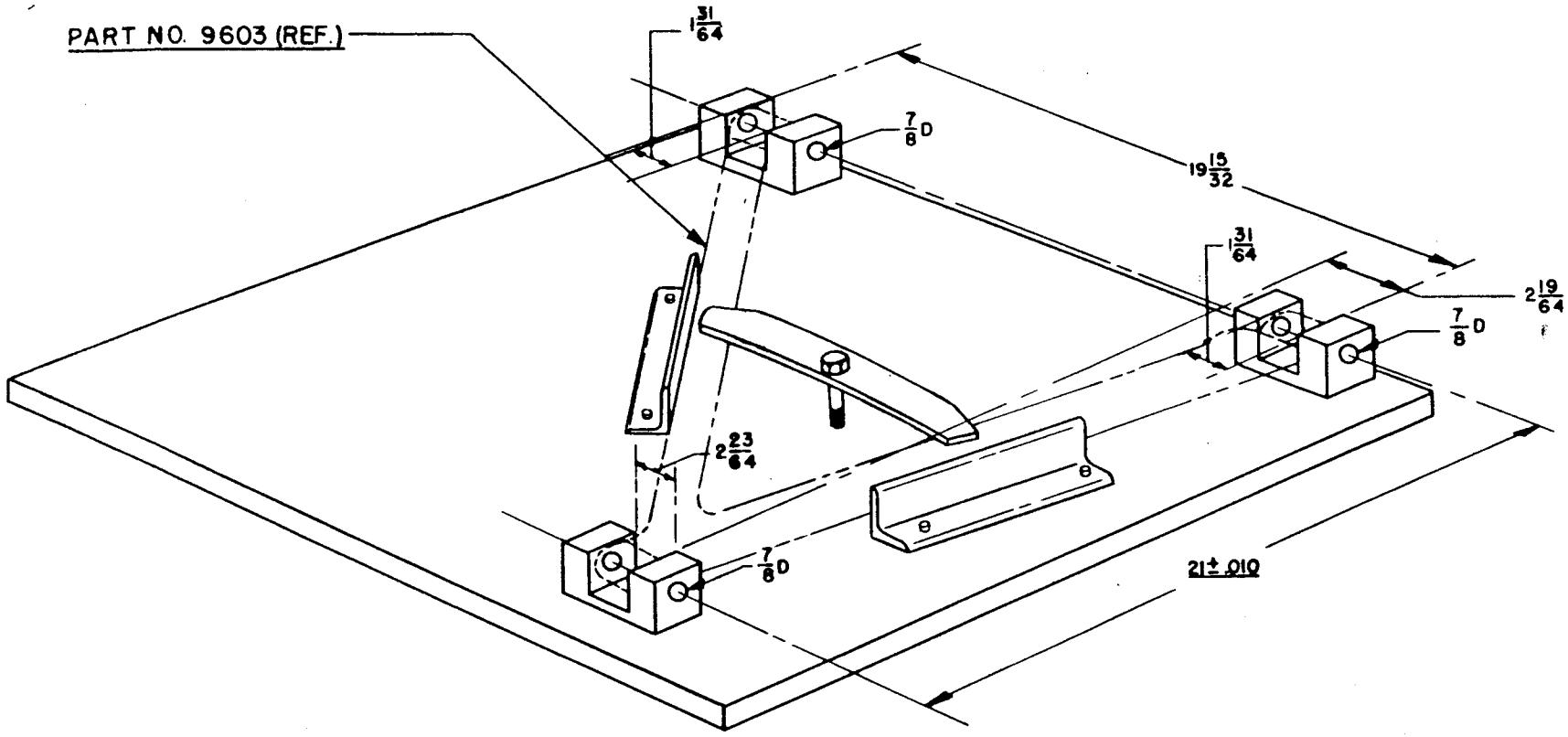


Figure 88 - Landing Gear Upper Drag Link Jig

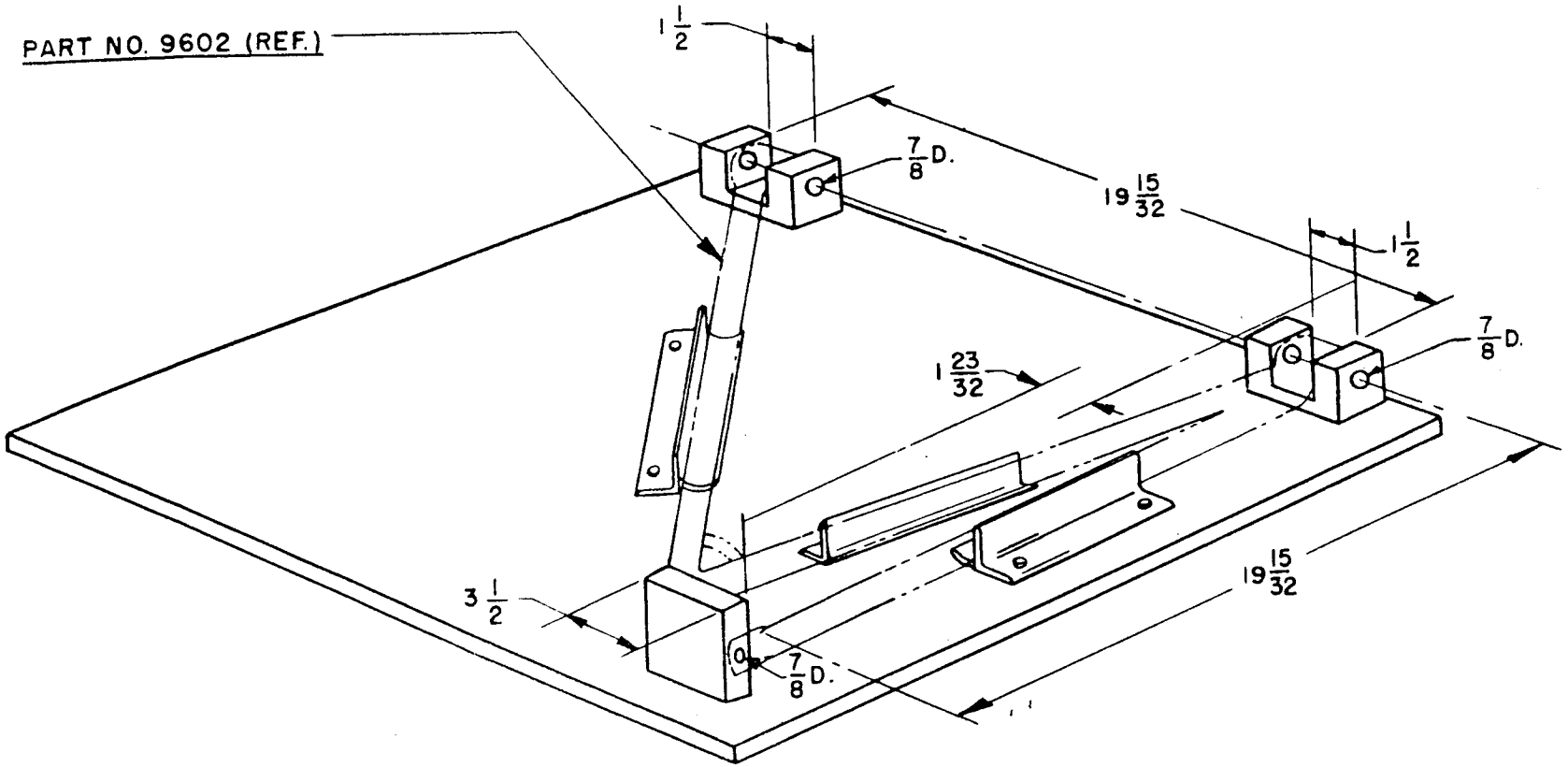
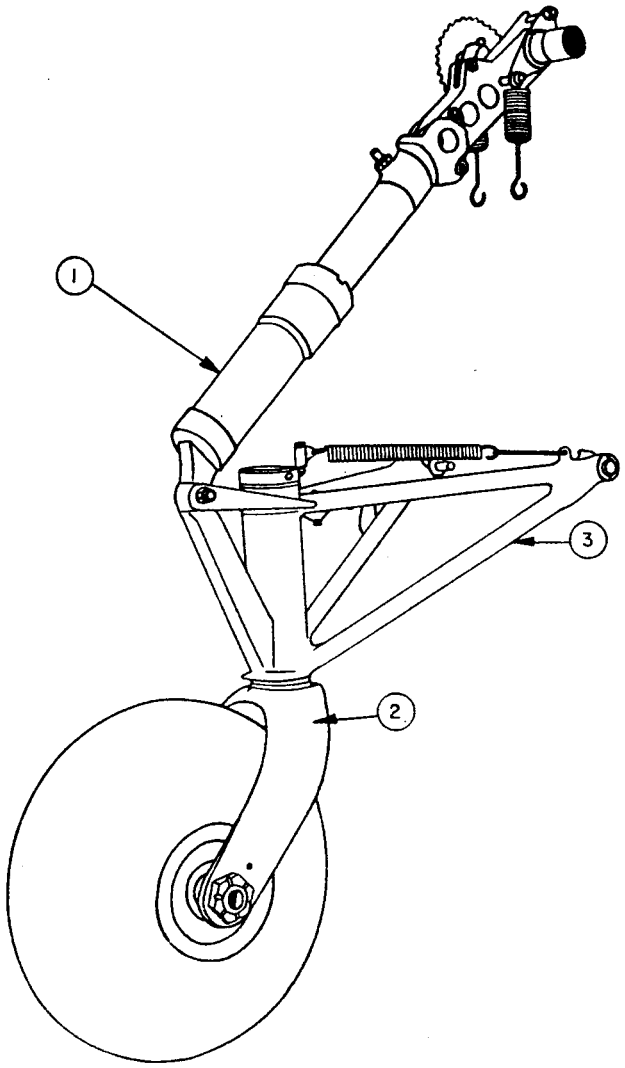


Figure 89 – Landing Gear Lower Drag Link Jig



Ref. No.	Part No.	Description	Material	Size
1	53473 (Bendix)	Shock Strut		
2	12651	Caster		
	12651-1	Post	C.M. Steel Tubing	2 D. x 1/8 x 11
	12651-2	Fork - Inside Plate	C.M. Steel Sheet	.095 x 4 x 9
	12651-3	Fork - Outside Plate	C.M. Steel Plate	.095 x 6 x 20
3	12652	Drag Link		
	12652-1	Weld Assem.		
	12652-2	Tubing	C.M. Steel	2-1/4 D. x .083 x 7-1/2
	12652-3	Tubing	C.M. Steel	3/4 D. x .058 x 14
	12652-4	Tubing	C.M. Steel	3/4 D. x .058 x 12
	12652-5	Tubing	C.M. Steel	7/8 D. x .125 x 1-1/2
	12652-6	Tubing	C.M. Steel	5/8 D. x .065 x 3-5/8
	12652-7	Tubing	C.M. Steel	5/8 D. x .035 x 9-1/4
	12650	Tail Wheel Assembly and Installation Ref. - Figures 92 and 93		

Figure 90 - Tail Wheel

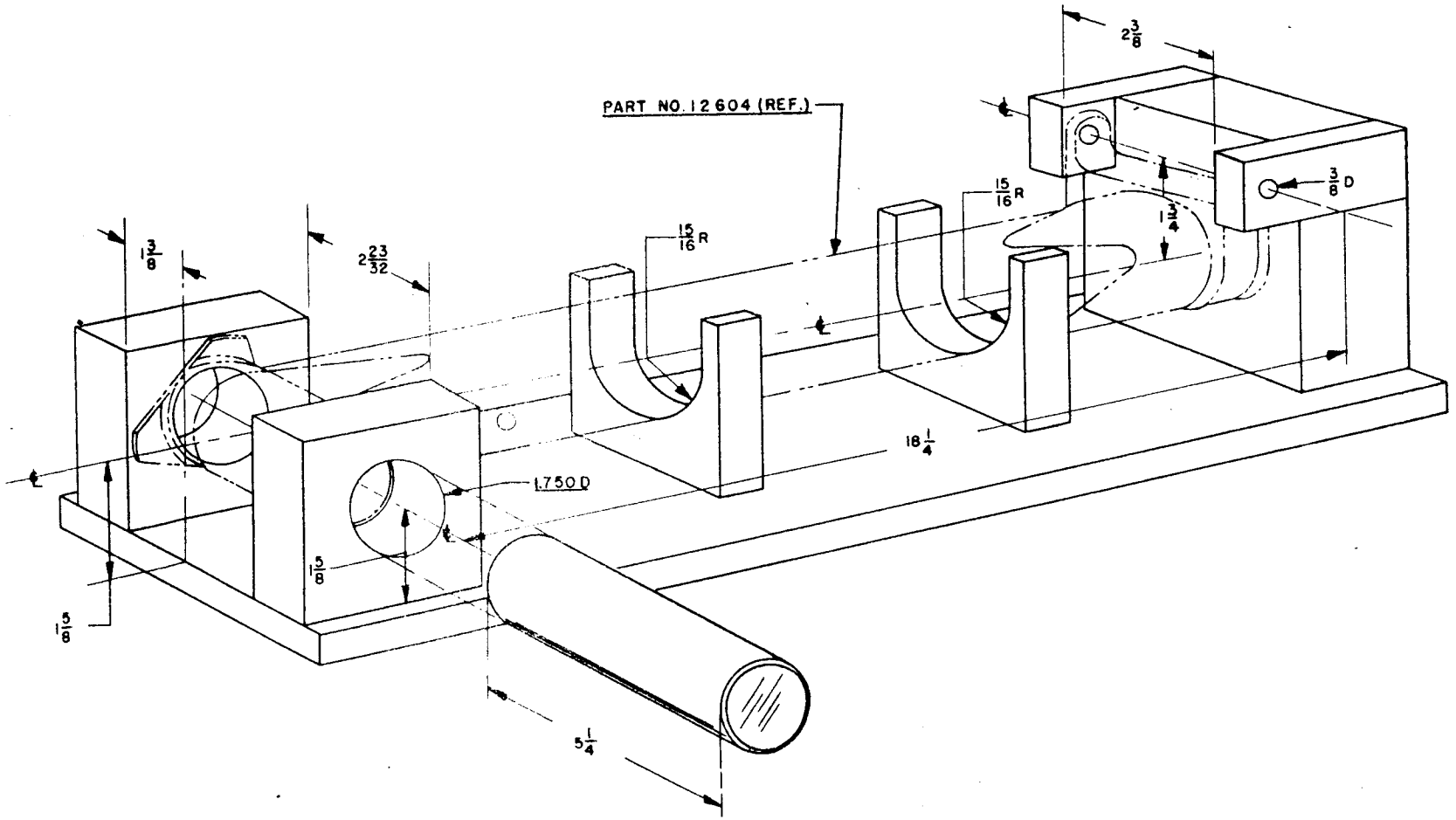


Figure 91 - Landing Gear Upper Compression Strut Jig

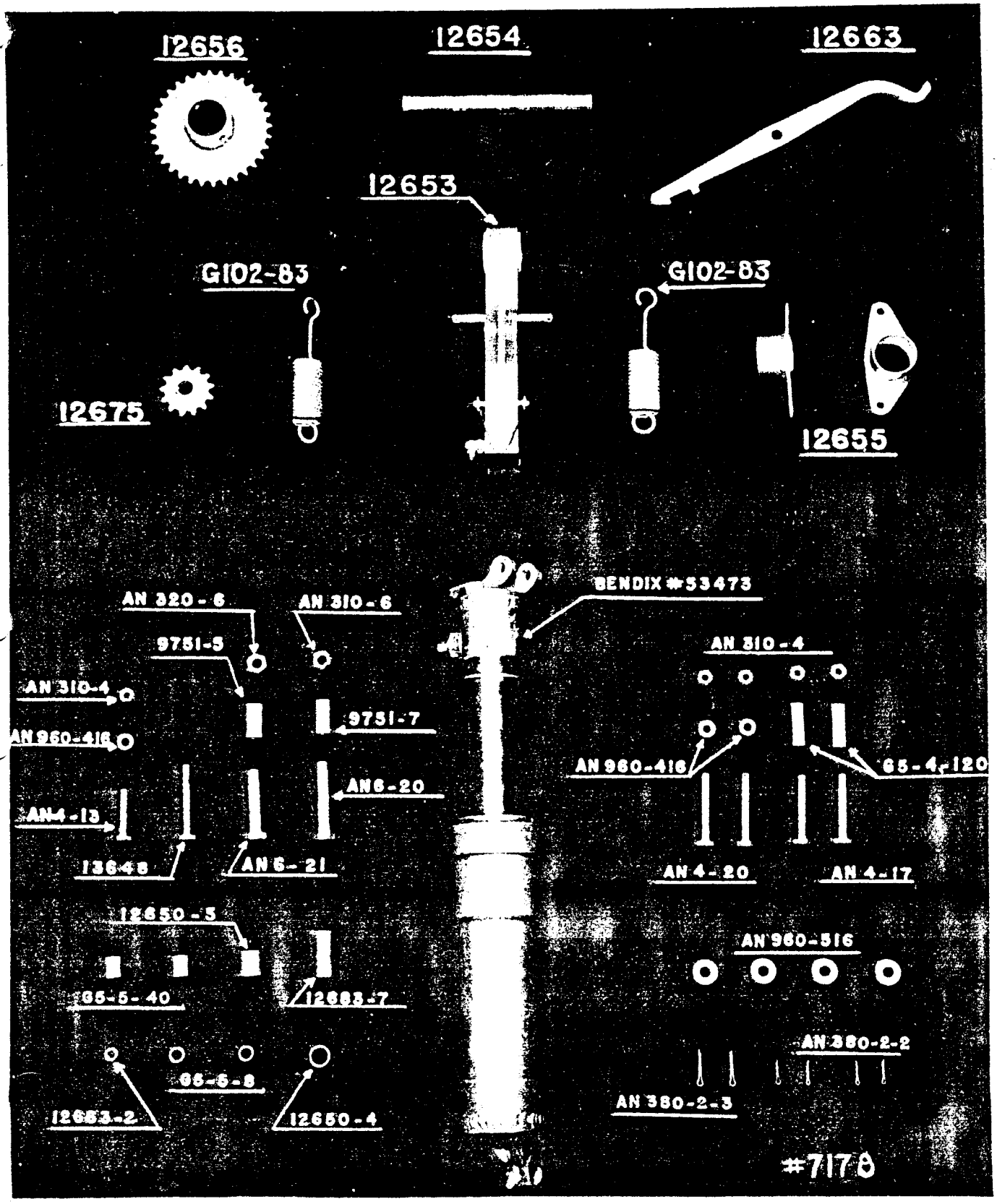


Figure 92 - Tail Wheel Breakdown - View 1

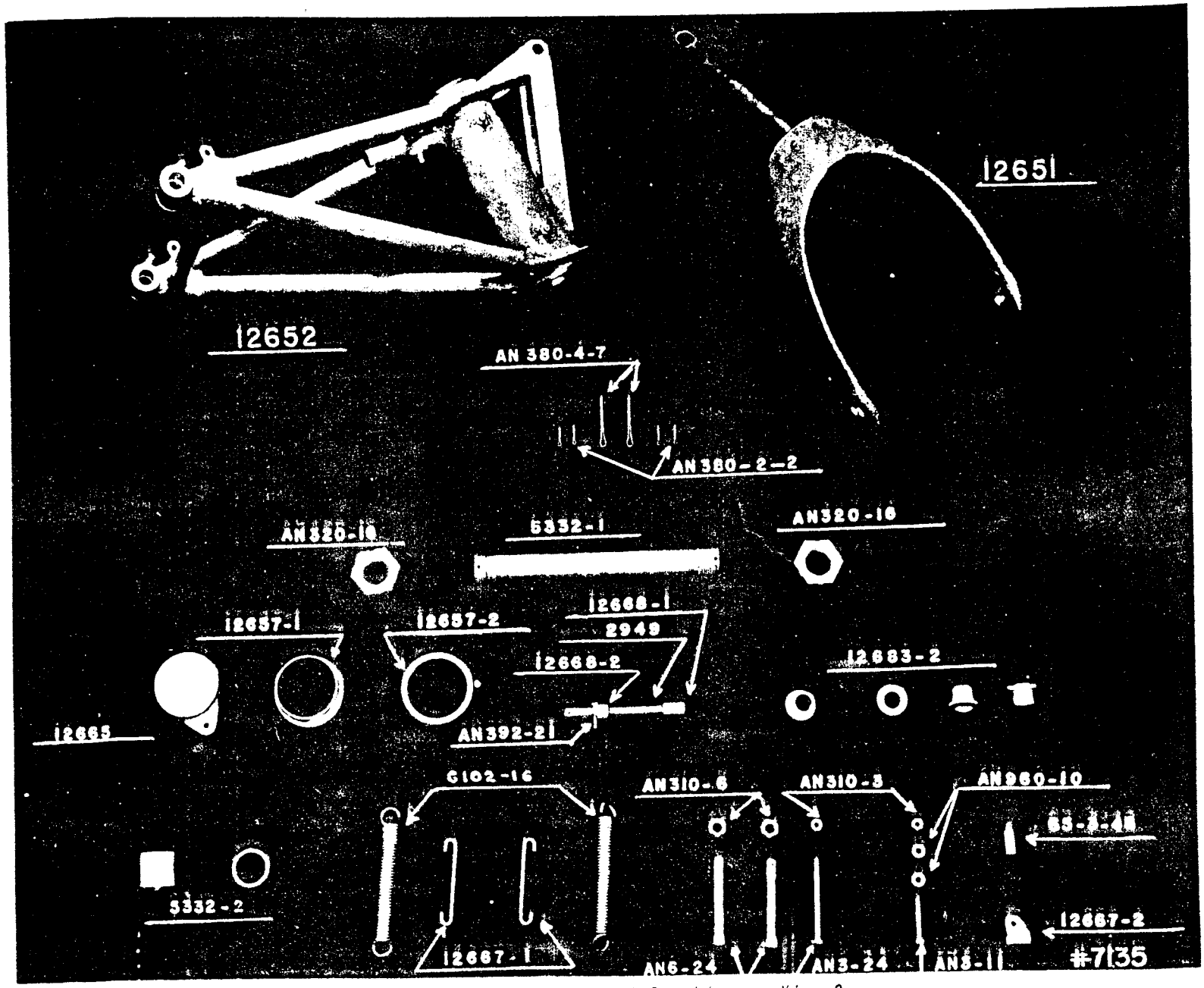


Figure 93 - Tail Wheel Breakdown - View 2

RESTRICTED
Nav. Aer. 01-85A-3
RESTRICTED

RESTRICTED

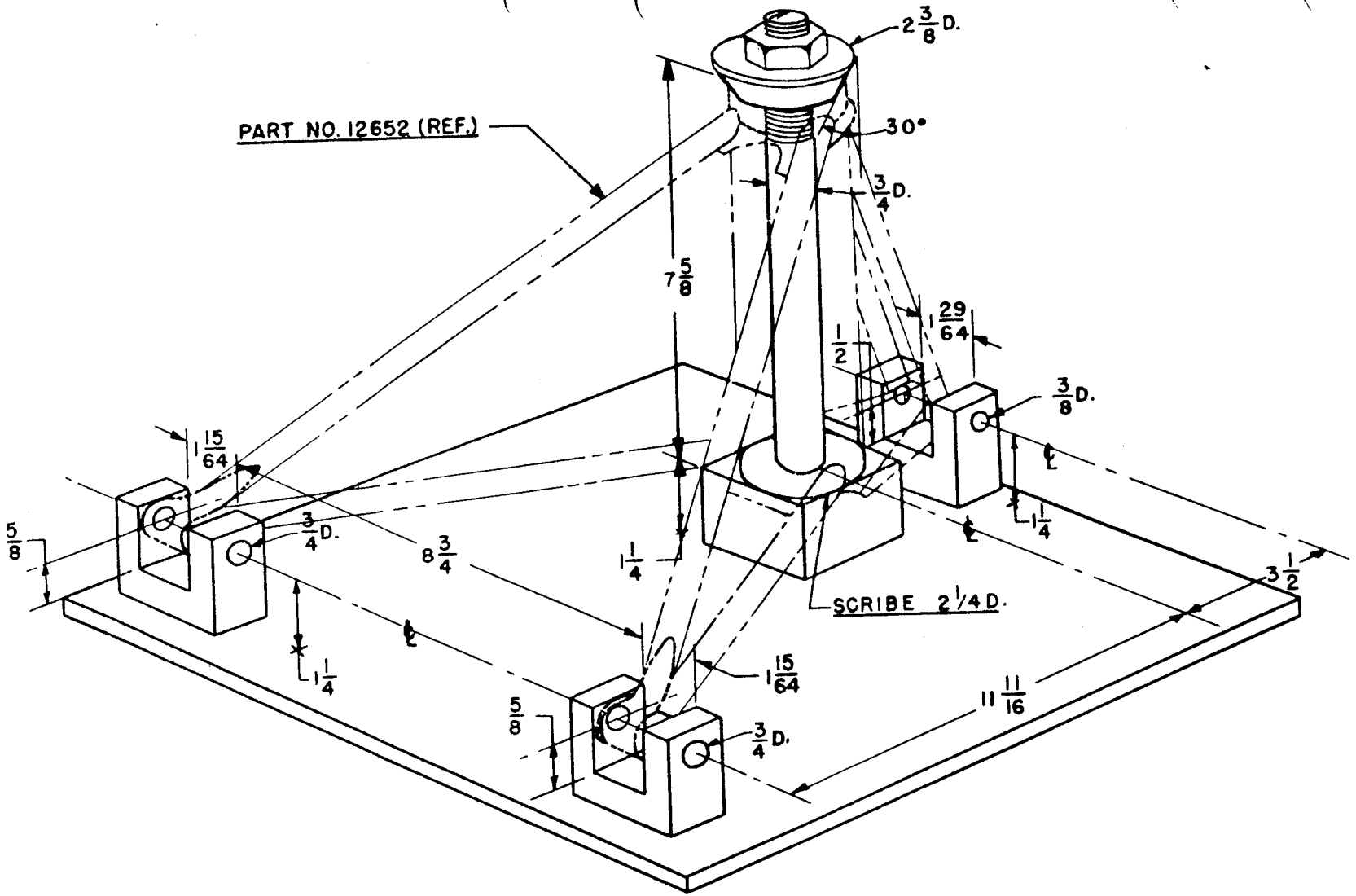


Figure 94 - Tail Wheel Drag Link Jig

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SECTION 6
ENGINE NACELLE GROUP

ENGINE MOUNT.

1. GENERAL.

a. The engine mount is constructed of chrome molybdenum steel tubing and sheet welded as a unit then normalized at 90,000 p.s.i. (See Figures 95 and 96.)

b. The engine support ring is a tubular member provided with welded on fittings, shock absorber bushings and pressure plates. The unit is supported in the wing box beam by large diameter bolts in double shear. The lower engine mount tubes are provided with saddles for supporting an engine work platform.

c. All damage to the engine mount beyond that considered negligible should be repaired unless immediate replacement is necessary. The condition under which dents, holes or cracks may be repaired are given below. If possible, all repairs to the engine mount should be made by welding.

2. CLASSIFICATION OF DAMAGE.-Damage to the engine mount should be carefully inspected to determine in which of the following categories it should be placed:

a. Negligible Damage.
b. Damage Repairable by Patching.
c. Damage Repairable by Insertion.
d. Damage Necessitating Replacement.

3. NEGLIGIBLE DAMAGE.-Small, smooth isolated dents less than the wall thickness of the tube in depth, with no cracks or abrasions may be neglected. Bows in tubes less than the wall thickness of the tube may be classified as negligible. It is important that all other damage be classified as repairable or replacements made as directed in this Manual.

4. DAMAGE REPAIRABLE BY PATCHING.

a. GENERAL.-The sleeve patch repair of a dent or hole in an engine mount tube should be made of chrome molybdenum steel tubing of the same gage as the tube being repaired. The patch should be made up with a slant cut as shown in Figure 98. The repair tube should be split and when necessary, shaped to fit snugly around the damaged tube and then welded in place all around the outside of the patch. Care must be taken to allow room for the weld between the joining edges of the patch.

b. DENTED TUBES.-Tubes with dents more than negligible should be repaired by means of a welded sleeve patch as outlined in Paragraph 4a immediately above, provided that the dent is free from cracks, abrasions and sharp corners and does not lie to close to the ends to prevent fitting of the patch.

c. PERFORATED TUBES.-Tubes with holes may be repaired by means of a welded sleeve patch in accordance with Paragraph 4a above, provided the hole does not exceed the limits of Paragraph 4b immediately above and is not larger than 1/2 inch in diameter after cleaning out.

5. DAMAGE REPAIRABLE BY INSERTION.

a. In the event that the damage to the tube is too extensive to be repaired by patching as above, the damaged portion should be cut away, and a repair made as shown in Figure 99, provided no welds are located within the middle third of the tube and sufficient room for a joint is allowed at the ends. The splice tube should have a large enough wall thickness to be reamed slightly for a close fit.

CAUTION

In welding engine mount tubes, care should be taken to insure the correct location of the tubes. See Paragraph 8 below.

NOTE

Torch normalize after weld repair of tubes.

b. Where a rosette weld is used to fuse an inner tube to an outer member, the hole should be 1/4 diameter of the inner tube. Drill the rosette in the outer tube only. The rosette may be omitted in cases of tightly fitting sleeves.

6. DAMAGE NECESSITATING REPLACEMENT.

a. GENERAL.-When repairable damage is not indicated, or when extensive repairs have been made, engine mount sections should be replaced. Damage which cannot be repaired by patching or insertion as described above, necessitates replacement.

NOTE

Whenever possible, damaged engine mount members should be replaced one at a time

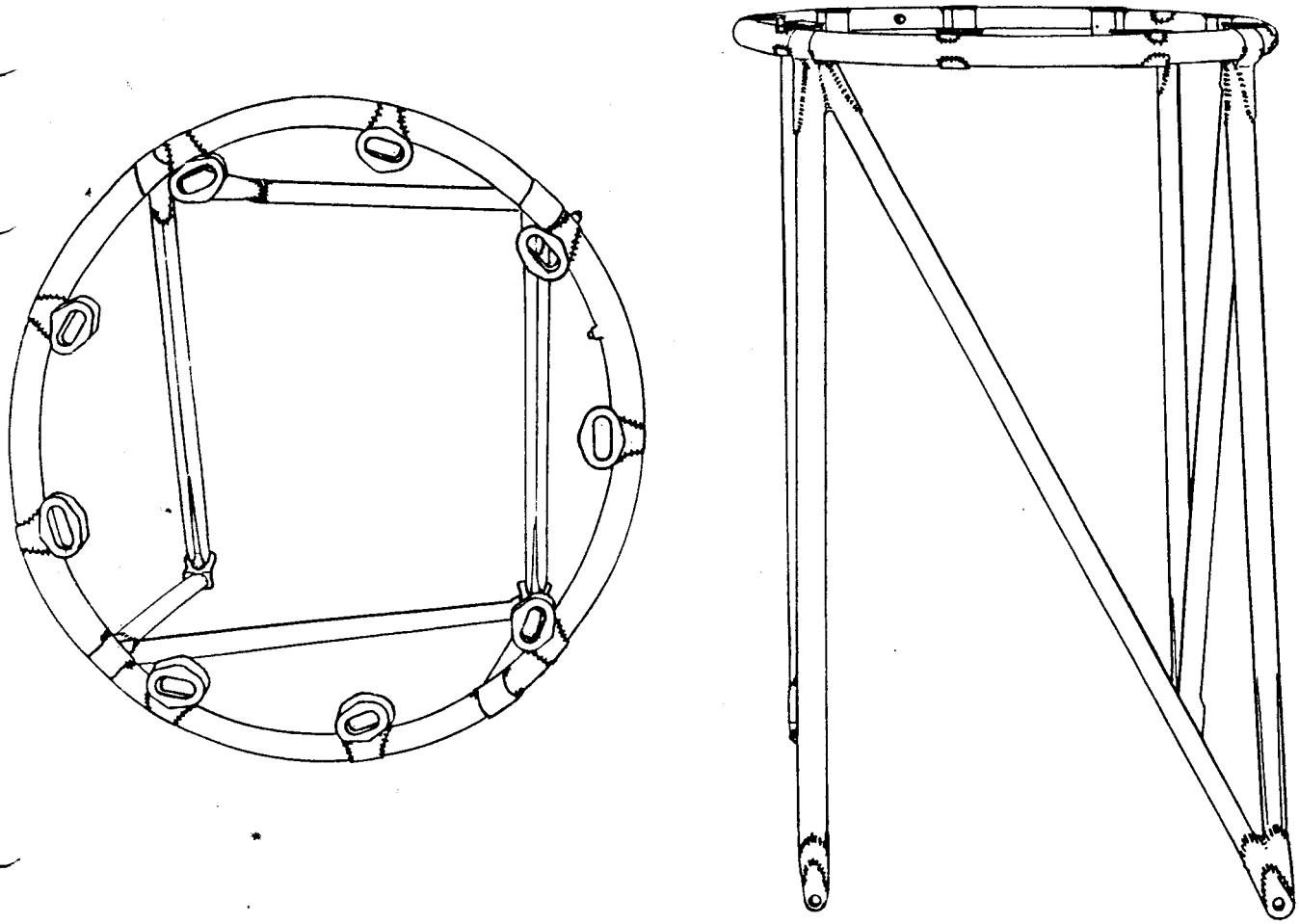


Figure 95 - Engine Mount

to prevent distortion of the structure. See Paragraph 8 below.

b. CRACKED TUBES.-Tubes with longitudinal cracks longer than three inches should be replaced.

c. FITTINGS, BOLTS.-Bolts and fittings securing the engine mount structure should be replaced when any damage causes misalignment or any deformation.

d. ENGINE RING.-The engine ring is not repairable, and any damage necessitates replacement.

e. BOWED TUBES.-Tubes which are bowed to an extent greater than their wall thickness should be replaced.

NOTE

The straightening of tubes bowed more than negligible is not recommended.

7. WELDING CRACKED TUBES.-Longitudinal cracks up to three inches in length may be repaired by careful welding, using standard procedure.

8. ENGINE MOUNT ALIGNMENT.-The engine mount must be properly supported during repairs, so that the entire weight of the engine or airplane is taken up. If the structure is pushed out of line, the entire engine mount must be replaced. All repairs to the engine mount must be in accordance with accurate means of alignment taken from the measurements of good structure drawings. See Figure 97.

9. TESTING REPAIRED ENGINE MOUNT.-After repairs of the engine mount have been completed, the structure should be pressure tested by applying air pressure of 40 p.s.i. at the inlet hole. Then proceed as follows:

a. Submerge engine mount in tank of water, making sure all parts of the structure are tested under water.

b. Mark leaks, if any.

c. If leaks are indicated by air bubbles in the water, repair again and repeat pressure test.

NOTE

If a severe cracking is shown throughout the welded area of the structure so that a repair is not practical or is impossible, the mount should be discarded.

d. If the mount passes the pressure test, finish interior and exterior according to Section 1, Paragraph 16b.

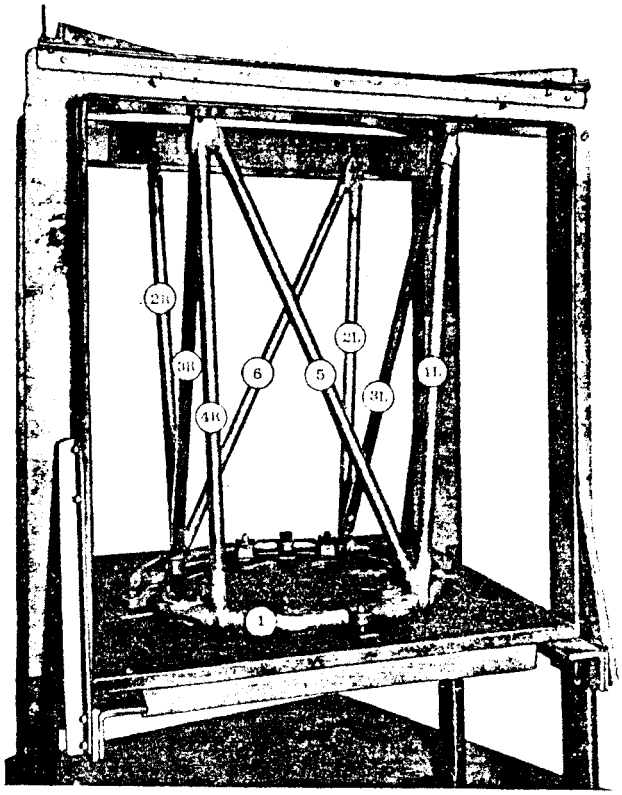


Photo Ref. No.	Part No.	Description	Material	Size
1	12455-1	Tube - Ring	C.M. Steel Tube	1-3/8 O.D. x .058 x 83
2R-2L	12455-2	Tube	C.M. Steel Tube	1-3/8 O.D. x .065 x 38
3R-3L	12455-3	Tube	C.M. Steel Tube	1-1/4 O.D. x .049 x 45
4R-4L	12455-4	Tube	C.M. Steel Tube	1-1/4 O.D. x .049 x 39
5	12455-5	Tube	C.M. Steel Tube	1-1/4 O.D. x .049 x 43
6	12455-6	Tube	C.M. Steel Tube	1-1/4 O.D. x .049 x 43

Figure 96 - Engine Mount and Jig

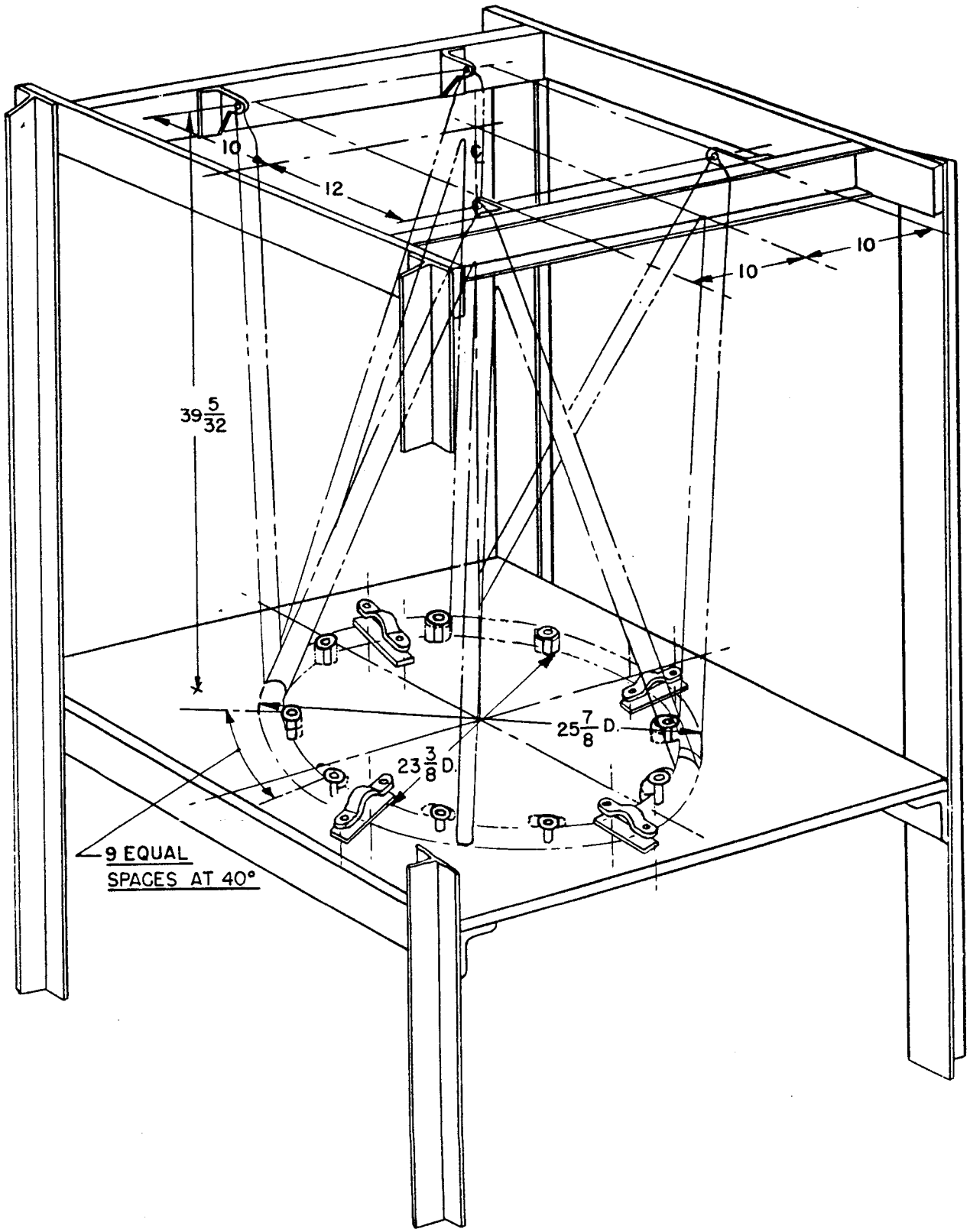
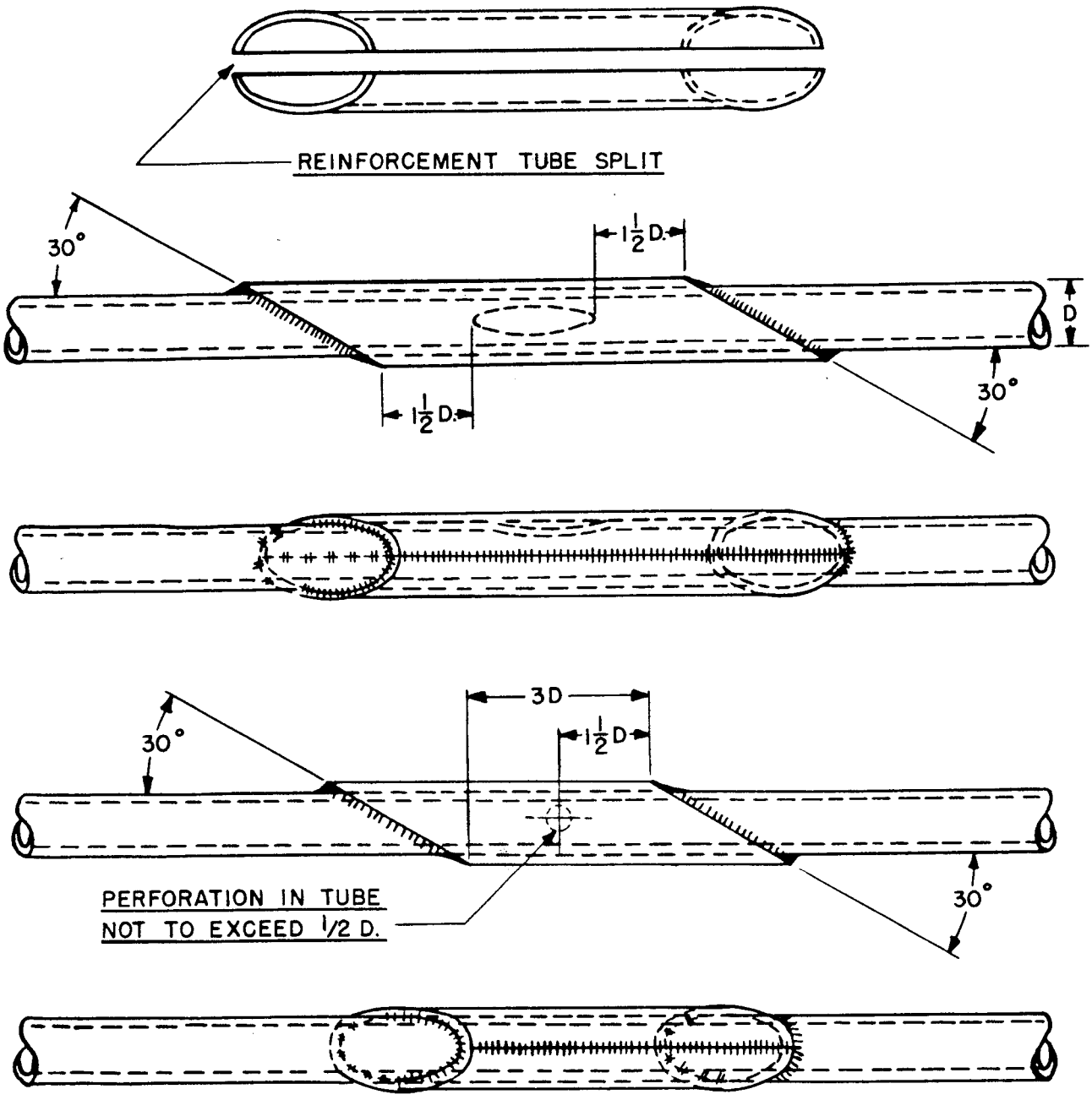
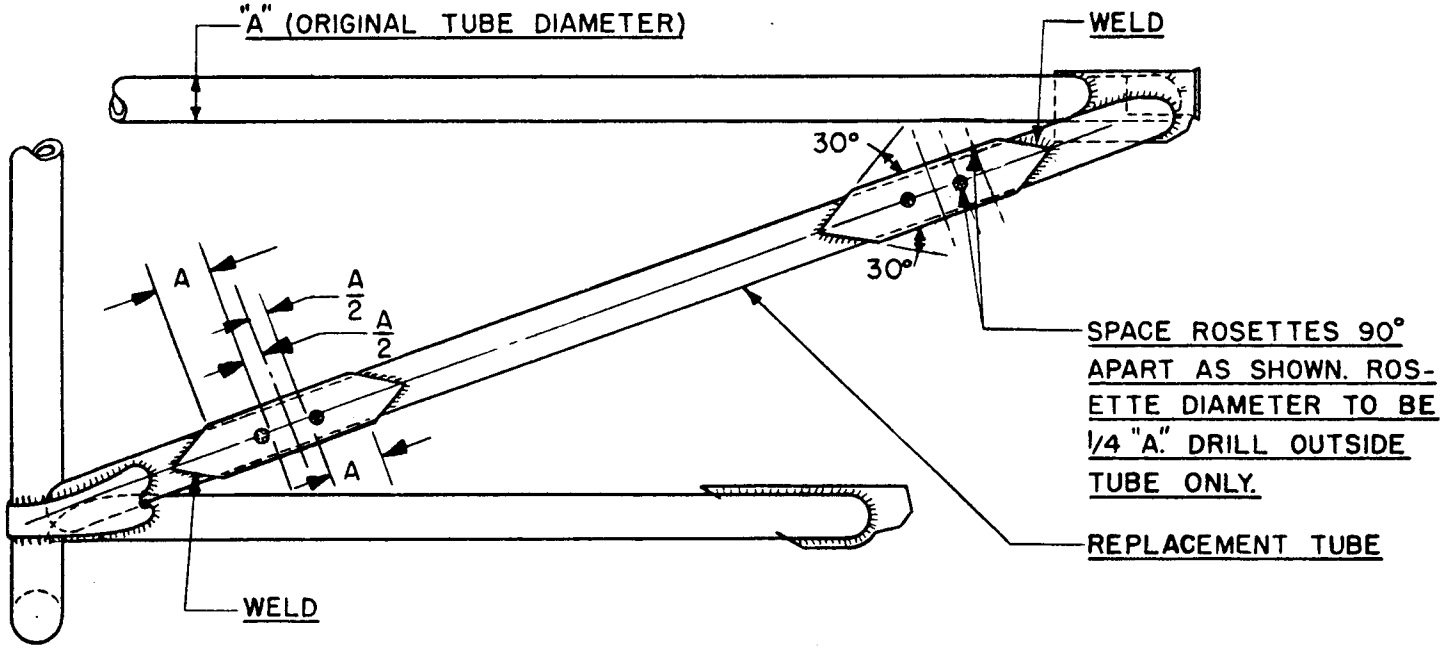


Figure 97 - Engine Mount Jig



NOTE:
REINFORCEMENT SLEEVE SAME GAGE AS TUBE BEING REPAIRED.

Figure 98 - Dented or Perforated Engine Mount Tube Repair



NOTE:
ROSETTE WELDS MAY BE OMITTED IN CASE OF TIGHTLY FITTING SLEEVES.

Figure 99 - Engine Mount Tube Insertion Repair

OIL TANK.

10. GENERAL.-The oil tank is constructed of 3S1/2H aluminum alloy and is attached to support channels on the upper engine mount tubes by padded straps. The method of assembly is welding.

NOTE

Repaired tanks must pass an internal pressure test of four p.s.i. before being returned to service.

11. NEGLIGIBLE DAMAGE.-Small, isolated dents less than 1/16 inch deep and free from cracks, sharp corners, abrasions and pronounced extremities may be neglected provided they do not occur near seams, corners or external fittings.

12. DAMAGE REPAIRABLE BY PATCHING.

a. Dents larger than 1/16 inch should be repaired by knocking them out to original shape with a wooden or rubber hammer. They may then be neglected unless cracks or abrasions are left, in which case, the damage should be repaired as described in Paragraph 12b immediately below.

b. CRACKS AND HOLES.

(1) WELDING.-A #40 (.098) hole should be drilled at the ends of an isolated crack. Intermittent tack welds should first be made along the crack to prevent progression of the crack under the welding heat or after the tank is reinstalled and again in service. The continuous weld should be made after the tack welding.

NOTE

Before welding the tank, the procedures described in Paragraph 12c below must first be followed.

Holes larger than 1/4 inch diameter should be repaired by cleaning the damaged area, using 1/4 inch minimum radii. The edges of the hole should then be bumped up 1/8 inch. A 3S1/2H aluminum alloy patch, of the same thickness as the shell being repaired, should be cut to fit snugly inside the hole, with edges also bumped up 1/8 inch. The flanged edges of the patch and hole should be welded, first using intermittent tack welds as in the repair of cracks, then making a continuous weld. (See Figure 100).

(2) RIVETING.-Holes smaller than 1/4 inch diameter should be repaired by inserting a rivet, treated with zinc chromate primer to insure sealing of the hole in which the rivet should fit snugly. As an alternate to welding, holes over 1/4 inch in diameter may be repaired by a riveted patch. The patch should be 3S1/2H aluminum alloy the same thickness as the shell being repaired. It should be riveted with a single row of 1/8 inch diameter brazier head rivets 3/4 inch pitch and an edge distance of 1/4 inch. The patch should be sealed with a zinc chromate primer. Cracks may be repaired by riveting instead of welding; a patch should be riveted over the crack similar to the patch repair of holes, after #40 (.098) holes have been drilled at the ends.

c. TREATMENT PRIOR TO WELDING.-The paint on the exterior surface should first be removed for at least three inches from the area surrounding the damage. A paint remover (See Table II) should be applied for this purpose and then thoroughly washed off with hot water. The oil should be drained from the tank and all residue may be removed before welding by steaming out the interior or washing out with hot water.

d. TREATMENT AFTER WELDING.-The welded repair should be thoroughly cleaned in a 10 percent solution of sulphuric acid to insure complete removal of the welding flux. After cleaning, wash thoroughly in running water and dry.

13. DAMAGE NECESSITATING REPLACEMENT.-Damage more than negligible not repairable by patching and, in general, damage which by its extent or location would render the repair uncertain, necessitates replacement of the tank. Cracking or perforation of the tank shell due to corrosion necessitates replacement.

TANK STRAPS, PADS.

14. GENERAL.-The tank straps should be checked for cracks and worn spots and replaced if damaged.

15. DAMAGE NECESSITATING REPLACEMENT.-The pads should be replaced if appreciably worn or packed.

OIL LINES, FITTINGS.

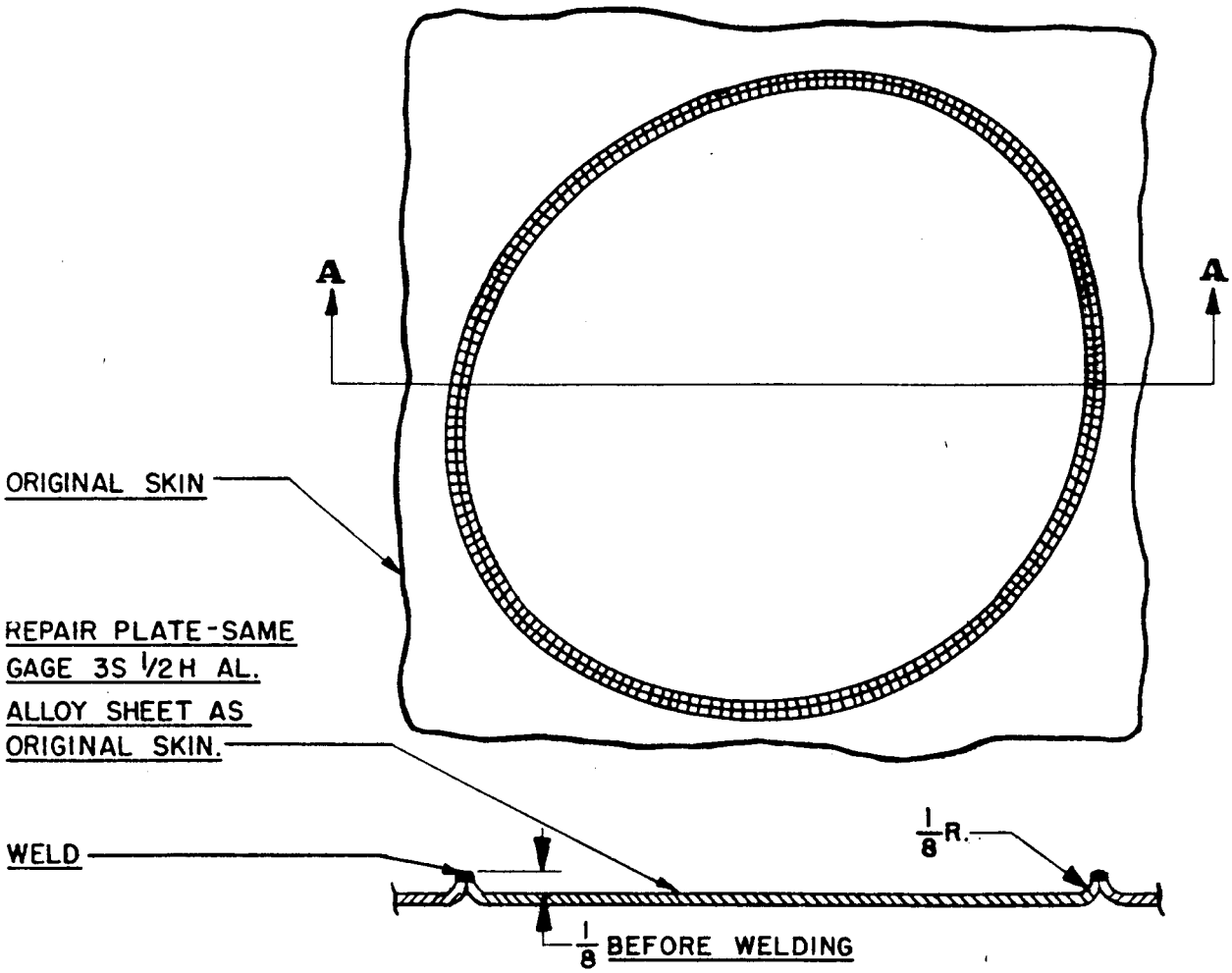
16. GENERAL.-The solid lines are 52S0 aluminum alloy tubing. Lines should be carefully removed and tagged giving their location as an aid to assembly. Check for holes, deep scratches and dents.

17. DAMAGE NECESSITATING REPLACEMENT.-If piping is damaged it should be replaced. If fittings are damaged in any way, replacement is required.

OIL COOLERS.

18. GENERAL.-An oil cooler is installed in each engine compartment on the engine mount tubes.

19. METHOD OF REPAIR.-See General Manual for Structural Repair (Section 15) AN-1A-1 (AP-2600A).



SECTION "A-A"

NOTE:

CLEAN DAMAGE TO A SMOOTH OUTLINE & FLANGE AS SHOWN.

Figure 100 - Oil Tank Welded Patch Repair

ENGINE COWLING.

WING NACELLE

20. GENERAL.-The engine cowling and wing nacelles are an aluminum alloy structure consisting of sheet reinforced by angles, plates and channels. The method of assembly is riveting in earlier models and spot welding in later models. (See Figures 101 and 102 showing riveted assembly).

21. NEGLIGIBLE DAMAGE.-Small, isolated dents may be neglected, provided they are free from cracks, sharp corners and abrasions and they are less than 1/16 inch deep.

22. DAMAGE REPAIRABLE BY PATCHING.

a. Damage other than negligible should be cut out with 1/4 inch radii; leaving a smooth hole not larger than three inches in diameter.

NOTE

For repairs involving spot welds, reference should be made to Section 1, Paragraph 13b and Figures 130 to 134, inclusive.

b. Cracks should be repaired by drilling a #40 (.098) hole at the ends, but where damage must be cut out, any adjacent cracks should be included in the area removed. The patch may be a flush type, either round (See Figure 108) or square (See Figure 109) but riveted as described in Paragraph 22c below. If desired, an outside patch may be used. (See Figure 104). The patch should be the same material and gage as the damaged panel, or 24ST aluminum alloy as alternate material. Note that the edges of the outside patch should be chamfered. Patches must be shaped to fit the contour of the panels and must fit snugly to prevent leaks.

NOTE

Dents more than negligible should be restored to shape with a rubber or wooden hammer. They may then be neglected unless cracks or abrasions are left, in which case the damaged area should be cut out and patched as herewith described.

c. When riveting the cowling or nacelle patch, either flush or outside, brazier head AN-455 rivets of 1/8 inch diameter should be used at 3/4 inch pitch and an edge distance of 5/16 inch as shown in Figure 104.

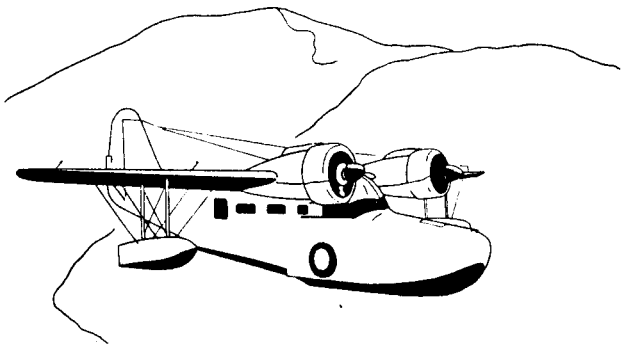
23. DAMAGE NECESSITATING REPLACEMENT.-Damaged panels should be replaced if they cannot be repaired by patching, or if they require excessive patching or reshaping in order to be restored.

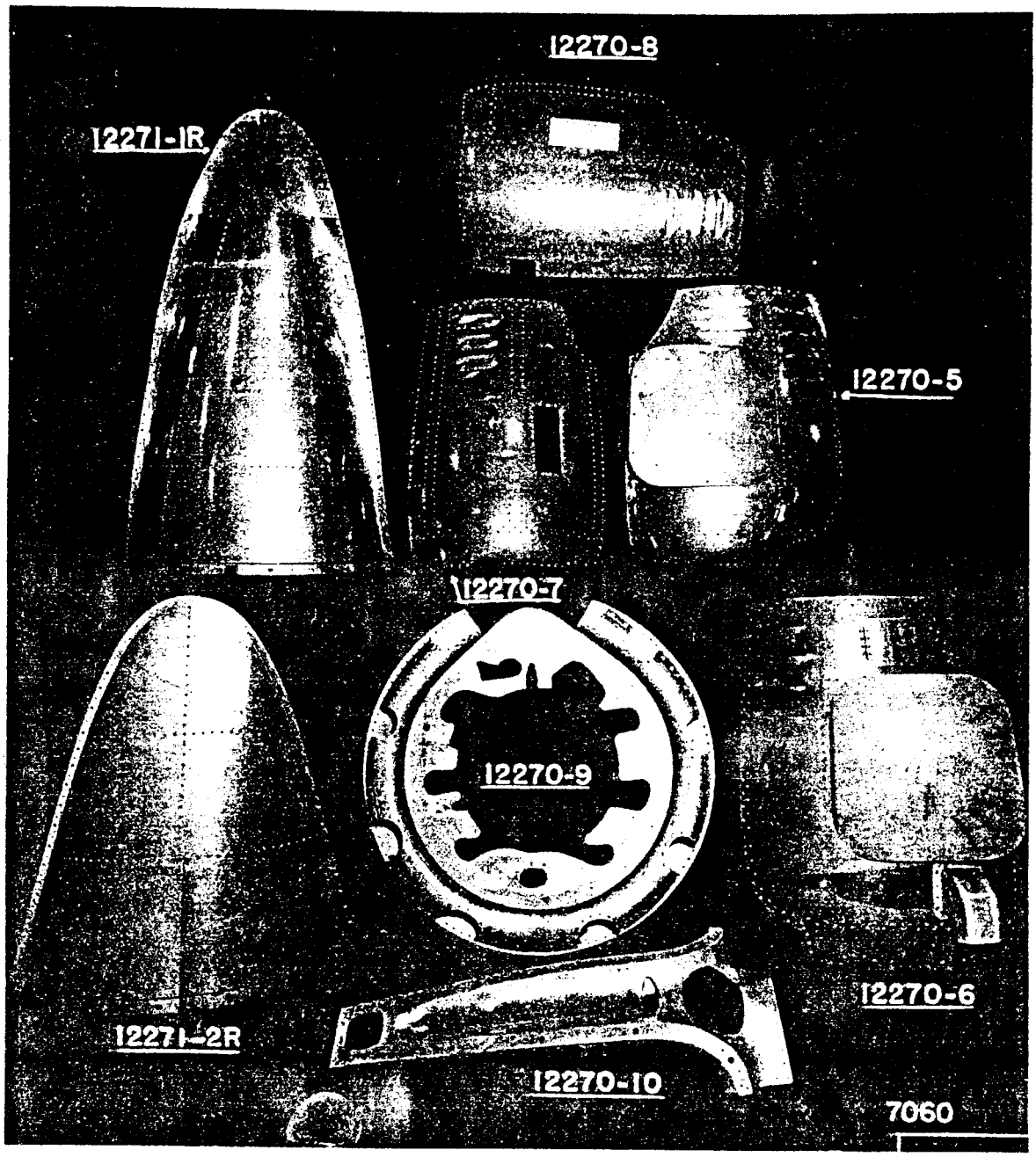
FIREWALL.

24. NEGLIGIBLE DAMAGE.-Refer to Section 4, Paragraph 32.

25. DAMAGE REPAIRABLE BY PATCHING.-Refer to Section 4, Paragraph 33.

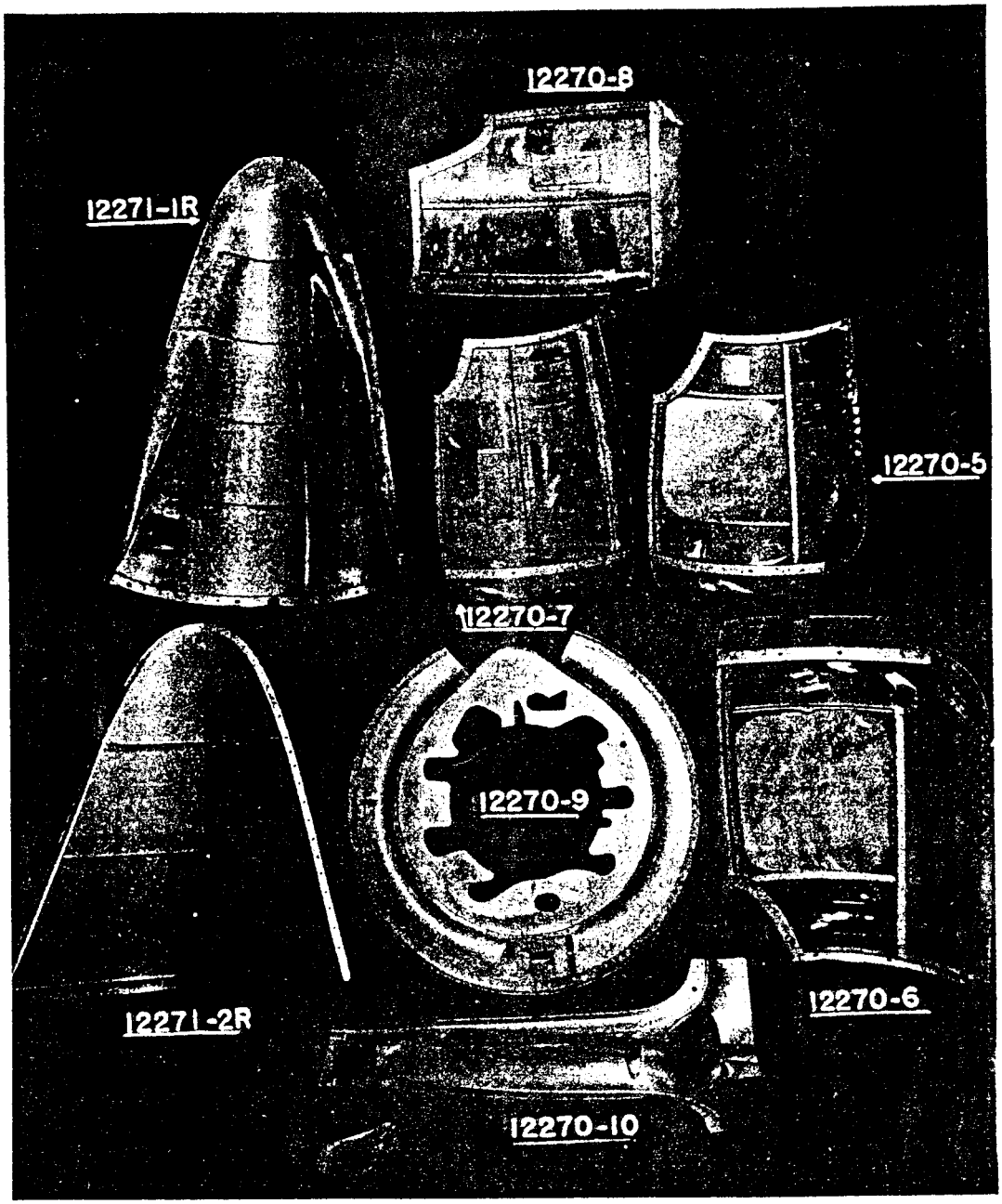
26. DAMAGE NECESSITATING REPLACEMENT.-Refer to Section 4, Paragraph 34.





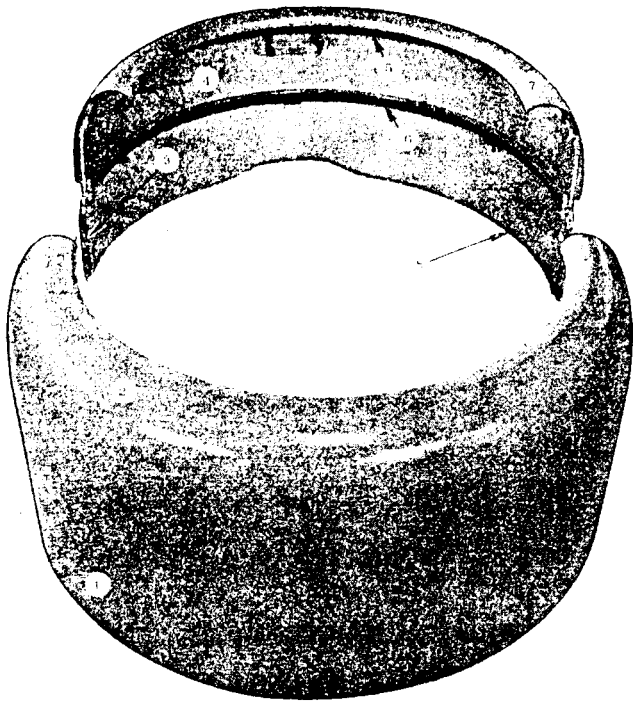
Ref. Grumman Part No.	(Riveted Assembly)	Ref. Grumman Part No.	(Riveted Assembly)
12271-1R	Top Fairing Assembly	12270-9	Shroud Assembly
12270-8	Right Inboard Lower Assembly	12270-6	Right Inboard Upper Assembly
12270-5	Right Outboard Upper Assembly	12270-10	Pan Exhaust Tail
12270-7	Right Outboard Lower Assembly	12271-2R	Bottom Fairing Assembly

Figure 101 - Engine Cowling & Wing Nacelle - Top



Ref. Grumman Part No.	(Riveted Assembly)	Ref. Grumman Part No.	(Riveted Assembly)
12271-1R	Top Fairing Assembly	12270-9	Shroud Assembly
12270-8	Right Inboard Lower Assembly	12270-6	Right Inboard Upper Assembly
12270-5	Right Outboard Upper Assembly	12270-10	Pan Exhaust Tail
12270-7	Right Outboard Lower Assembly	12271-2R	Bottom Fairing Assembly

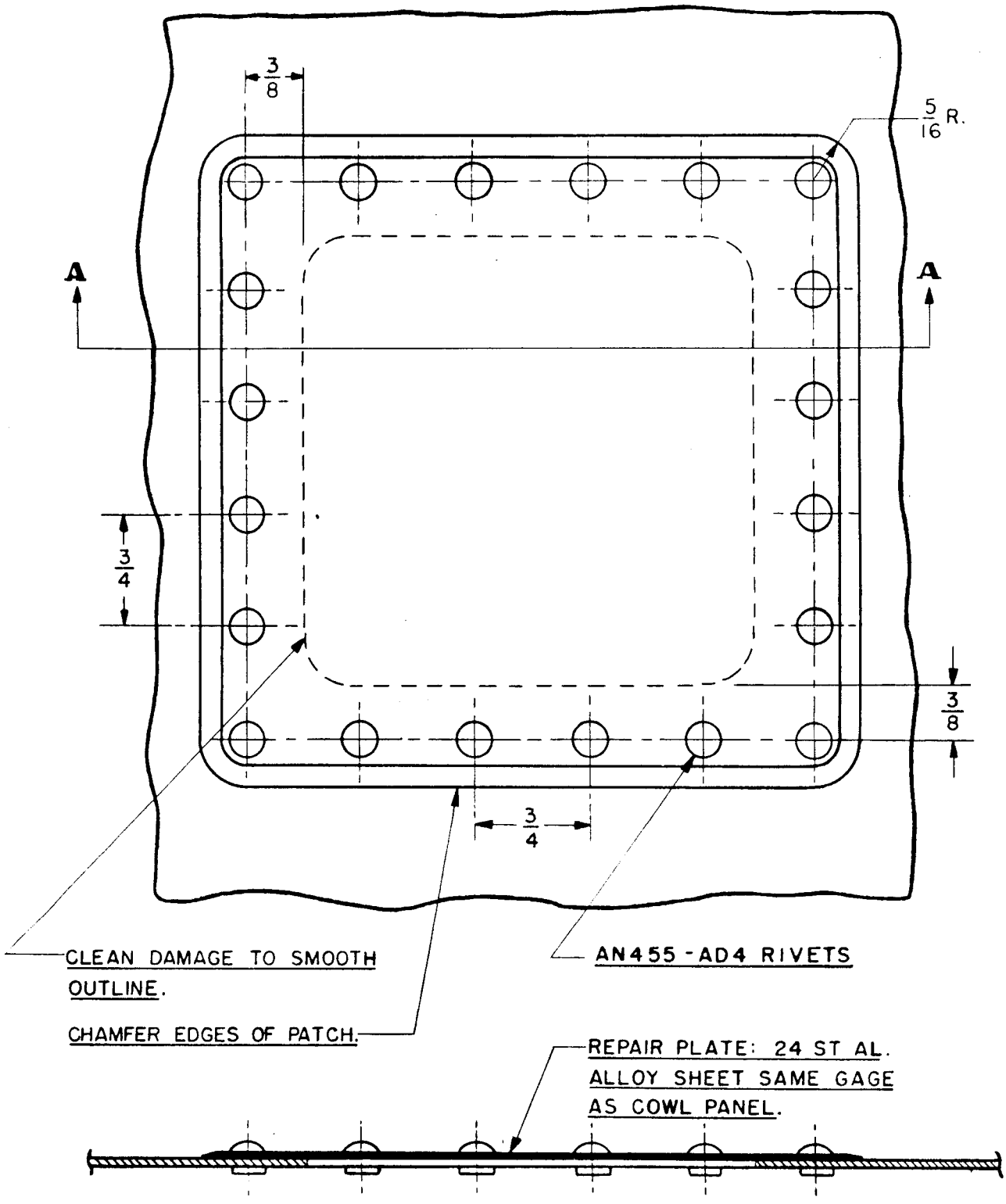
Figure 102 - Engine Cowling & Wing Nacelle - Bottom



ENGINE RING COWL
FIG. 86

Ref. No.	Part No.	Description	Material	Thickness
1	12458-1	Skin Rear	52S½H Aluminum Alloy Sheet	.028
2-7	12469	Spinning Engine Ring Cowl	3 SO Aluminum Alloy Sheet	.051
3	12458-4	Joint Reinf. - Upper	24ST Aluminum Alloy Sheet	.040
	12358-5	Joint Reinf. - Lower	24ST Aluminum Alloy Sheet	.040
4	12458-8	Nose Angle	52S½H Aluminum Alloy Sheet	.064
5	12458-2	Ring Stiffener Front	24ST Aluminum Alloy Sheet	.040
6	12458-3	Ring Stiffener Rear	24ST Aluminum Alloy Sheet	.040
8	12458-10	Tail Reinf. Wire	24ST Aluminum Alloy Rod	3/16 Dia.

Figure 103 - Engine Ring Cowl



SECTION "A-A"

Figure 104 - Engine Cowl and Nacelle Patch Repair

EXHAUST MANIFOLD.

27. GENERAL.-The exhaust manifold is a welded steel assembly. (See Figure 105).

28. NEGLIGIBLE DAMAGE.-Small isolated dents free from cracks, sharp corners and abrasions may be neglected if the member is not distorted or otherwise damaged.

29. METHOD OF REPAIR.

a. CRACKS.

(1) Cracks up to three inches may be welded, using standard procedure. A 1/16 inch stainless steel welding rod with a #21 flame is recommended. Use a slow flame with a little feather on it to avoid burning the metal. Pin holes can be eliminated by running the pin hole along before the flame until it disappears.

b. DAMAGE REPAIRABLE BY PATCHING.-Cracks, longer than three inches, holes and smoothed out damage in general can be repaired by welding a patch of equivalent material over the damaged area. Cracked areas should be cut and patched in the same manner. The patch should overlap the damaged area about one inch.

c. DAMAGE REPAIRABLE BY INSERTION.-A damaged section may be cut out and a new equivalent length inserted. The insertion piece should be welded on, using a two inch patch welded around the section at the butt joint, lapping one inch on each side of the joint.

d. DAMAGE NECESSITATING REPLACEMENT. - A damaged section must be replaced by an undamaged equivalent if not repairable as described immediately above.

NOTE

The exhaust manifold should be torch normalized after welding.

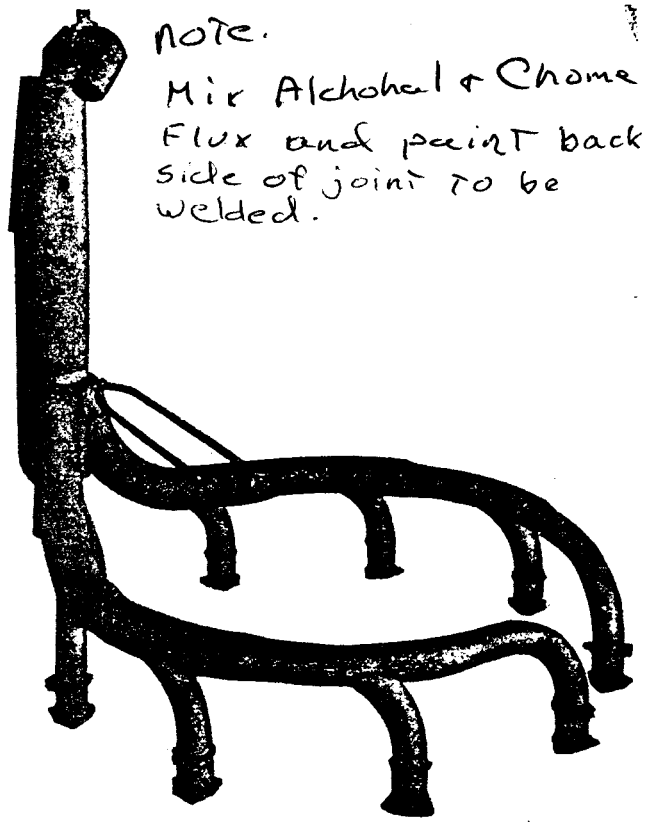


Figure 105 - Exhaust Manifold Assembly

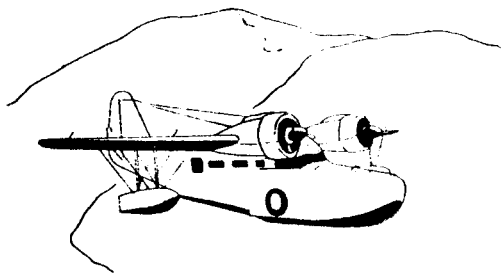


TABLE VII

MATERIALS FOR REPAIR

ENGINE NACELLE GROUP

Where Used	Description	Material	Diameter	Gage	Item
Fig. 96, Ref. #2	Tubing	C.M. Steel	1-3/8 O.D.	.058	Insertion or Replacement
	Tubing	C.M. Steel	1-3/8 I.D.	.058	Patch or Splice
Fig. 96, Ref. #3 #4, #5 & #6	Tubing	C.M. Steel	1-1/4 O.D.	.049	Insertion or Replacement
	Tubing	C.M. Steel	1-1/4 I.D.	.049	Patch or Splice
Oil Tank	Sheet	3S½H Aluminum Alloy		.064	Patch Repair
Wing Nacelle	Sheet	52S½H Aluminum Alloy		.020	Patch Repair or Replacement
Ring Cowl	Sheet	52S½H Aluminum Alloy		.028	Patch Repair or Replacement
Nose Spinning	Sheet	3 S0 Aluminum Alloy		.028	Patch Repair or Replacement
Firewall	Sheet	24ST Aluminum Alloy		.040	Replacement
	Sheet	24ST Aluminum Alloy		.051	Patch Repair
Oil Cooler Shell	Sheet	Brass		.040 or .050	Patch Repair
		Silver Solder			To Suit
Exhaust Manifold	Sheet	Corrosion Resistant Steel		.040	Insertion, Replacement or Patch Repair

SECTION 7
EXTRUDED SECTIONS

1. GENERAL.

a. The Alcoa Extrusions used in this airplane are listed on the accompanying Table 7 and illustrated in Figure 106, Sheets 1 and 2.

b. When patching an extrusion, 24ST aluminum alloy sheet should be bent up to the size and shape shown on the repair diagrams for the respective parts being repaired as described and illustrated in this Manual. In some instances, a flat repair plate of 24ST aluminum alloy sheet may be used.

c. In some types of repair, an equivalent extrusion may be used, if available, being placed on the outside of the angle.

d. Splice plates at a butt joint are similarly made.

e. If an insertion repair is necessary, the damaged section should be cut out, and an equivalent extrusion inserted. If an equivalent extrusion is not available, 24ST aluminum alloy sheet bent up into the required shape may be substituted for an extrusion provided there is equal cross sectional area. Bent up equivalents for the extrusions in this airplane are shown in Figure 106, Sheets 3 and 4.

f. Butt joints must be a snug fit with 1/64 inch maximum tolerance.

g. The minimum bend radii of 24ST aluminum alloy sheet must be observed in patching or splicing in a new section. (Refer to General Manual for Structural Repair).

h. In some cases, 24S0 aluminum alloy may be used to form a repair plate which must be heat treated to 24ST before it is installed in the airplane.

TABLE VIII

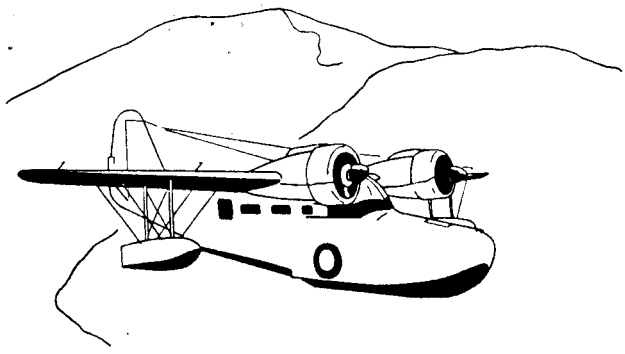
LIST OF ALCOA EXTRUSIONS

Aluminum Alloy		Navy Spec.	Die Number	Quantity per Airplane
Bar	24ST	46A9	Alcoa 74B	26'-0"
Angle	24ST	46A9	Alcoa 77E	0'-3"
Angle	24ST	46A9	Alcoa 77R	62'-6"
Angle	24ST	46A9	Alcoa 77V	3'-6"
Angle	24ST	46A9	Alcoa 78C	51'-8"
Angle	24ST	46A9	Alcoa 78F	2'-0"
Angle	24ST	46A9	Alcoa 78J	32'-2"
Angle	24ST	46A9	Alcoa 78K	121'-0"
Angle	24ST	46A9	Alcoa 78P	4'-0"
Angle	24ST	46A9	Alcoa 472	108'-9"
Angle	24ST	46A9	Alcoa 484	16'-0"
Angle	24ST	46A9	Alcoa 734-18	298'-0"
Angle	24ST	46A9	Alcoa 734-CC	0'-6"
Angle	24ST	46A9	Alcoa 734-FF	0'-6"
Angle	24ST	46A9	Alcoa 734-H	0'-3"
Angle	24ST	46A9	Alcoa 734-P	3'-0"
Angle	24ST	46A9	Alcoa 734-TT	153'-8"
Angle	24ST	46A9	Alcoa 734-W	2'-3"
Zee	24ST	46A9	Alcoa 1060	158'-8"
Angle	24ST	46A9	Alcoa 1288	15'-4"
ngle	24ST	46A9	Alcoa 1298	20'-2"

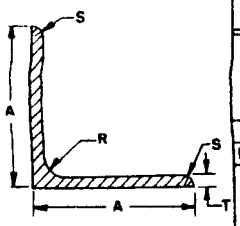
TABLE VIII (CONT'D.)

LIST OF ALCOA EXTRUSIONS

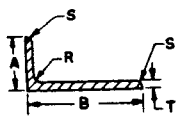
Aluminum Alloy		Navy Spec.	Die Number	Quantity per Airplane
Angle	24ST	46A9	Alcoa 1312	1'-6"
Channel	24ST	46A9	Alcoa K1377	25'-0"
Channel	24ST	46A9	Alcoa K1380	14'-6"
Angle	24ST	46A9	Alcoa 1676	13'-8"
Tee	24ST	46A9	Alcoa 2499	1'-1"
Angle	24ST	46A9	Alcoa 3792	33'-5"
Angle	24ST	46A9	Alcoa 5137	0'-6"
Angle	24ST	46A9	Alcoa 5456	1'-0"
Channel	24ST	46A9	Alcoa K6466	7'-6"
Angle	24ST	46A9	Alcoa 7385	0'-6"
Channel	24ST	46A9	Alcoa K7869	4'-1"
Channel	24ST	46A9	Alcoa K9665	33'-5"
Angle	24ST	46A9	Alcoa K9823	6'-3"
Channel	24ST	46A9	Alcoa K11057	10'-0"
Zee	24ST	46A9	Alcoa K11256	282'-2"
Keel	24ST	46A9	Alcoa K11257	22'-8"
Channel	24ST	46A9	Alcoa K12000	18'-8"
Angle	24ST	46A9	Alcoa K12025	28'-0"
Tee	24ST	46A9	Alcoa K12442	2'-0"
Angle	24ST	46A9	Alcoa K12823	3'-0"
Channel	24ST	46A9	Alcoa K12866	33'-5"
Zee	24ST	46A9	Alcoa K12867	98'-0"
Channel	24ST	46A9	Alcoa K12876	30'-0"
Angle	24ST	46A9	Alcoa K13864	29'-8"
T. Edge	24ST	46A9	Alcoa K14403	25'-0"
Channel	24ST	46A9	Alcoa K14426	0'-3"
Angle	24ST	46A9	Alcoa D14594	76'-0"
Angle	24ST	46A9	Alcoa K15087	28'-0"
Channel	24ST	46A9	Alcoa K16433	13'-2"
Angle	24ST	46A9	Alcoa K16630	14'-10"
Angle	24ST	46A9	Alcoa K22220	171'-6"
Angle	24ST	46A9	Alcoa K22220 (was 1584)	19'-10"



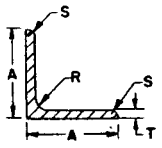
ALCOA DIE NO.	A	T	R	S	AREA
77E	1 3/4	1/8	3/16	1/8	.420
77V	2	1/8	1/4	1/8	.490



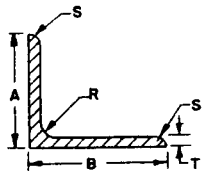
ALCOA DIE NO.	A	B	T	R	S	AREA
1676	9/16	1 1/4	5/64	3/32	1/32	.130
K-734-18	5/8	3/4	1/16	1/16	1/32	.082



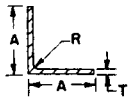
78C	3/4	3/32	1/16	3/32	.130
78F	1	3/32	1/8	3/32	.180
78J	1	1/16	1/16	1/32	.120
78K	3/4	1/16	1/8	3/32	.091



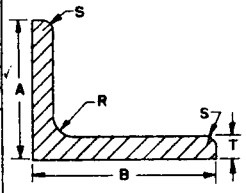
734-CC	1 1/4	1 1/2	1/8	3/16	1/8	.330
734 P	1 1/4	2	1/8	3/16	1/8	.390



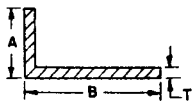
472	3/4	1/16	1/64		.090
K-22220	5/8	1/16	1/64		.074



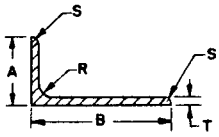
734H	1 1/4	2 1/2	3/16	1/4	3/32	.680
734JJ	1 1/2	2	1/8	3/16	1/8	.420
734W	1 1/2	2	1/4	3/16	1/8	.810



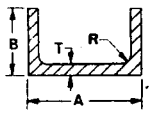
	A	B	T	R	
1312	1/2	1/2	1/16		.057
3792	3/4	1 1/4	1/16		.121
5137	3/4	1 1/2	1/8		.262
5456	1/2	5/8	1/16		.066
7385	3/4	1	1/8		.201



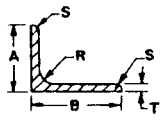
734FF	3/4	1 1/4	3/32	3/32	3/64	.220
484	3/4	1 1/2	3/32	3/32	.050	.197



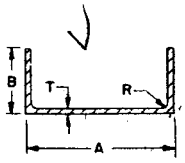
K-12000	1 1/4	3/4	1/16	3/32	.168
K-12876	1 1/4	3/4	1/8	3/32	.316



1288	3/4	1	.070	1/16	1/32	.119
K-22940	3/4	1	3/32	1/8	1/16	.157



	A	B	C	T	R	S	
K-1377	2 1/8	1	1/2	.080	3/32	.174	.386
K-1380	2 1/8	1	1/2	.064	7/64	.173	.309



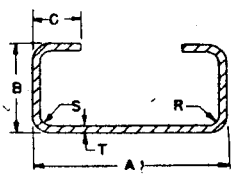
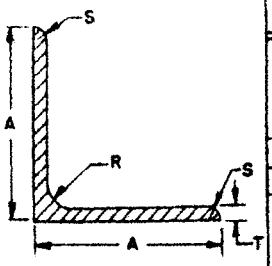
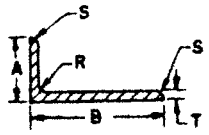


Figure 106 – Extruded Sections (Sheet 1)

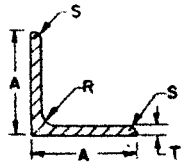
ALCOA DIE NO.	A	T	R	S	AREA
77E	1 3/4	1/8	3/16	1/8	.420
77V	2	1/8	1/4	1/8	.490



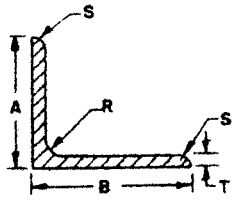
ALCOA DIE NO.	A	B	T	R	S	AREA
1676	9/16	1 1/4	5/64	3/32	1/32	.130
K-734-18	5/8	3/4	1/16	1/16	1/32	.082



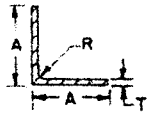
78C	3/4	3/32	1/16	3/32	.130
78F	1	3/32	1/8	3/32	.180
78J	1	1/16	1/16	1/32	.120
78K	3/4	1/16	1/8	3/32	.091



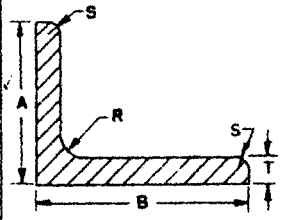
734-CC	1 1/4	1 1/2	1/8	3/16	1/8	.330
734P	1 1/4	2	1/8	3/16	1/8	.390



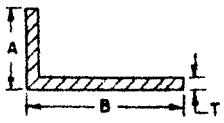
472	3/4	1/16	1/64		.090
K-22220	5/8	1/16	1/64		.074



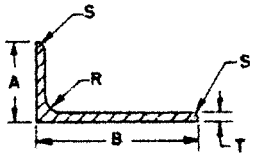
734H	1 1/4	2 1/2	3/16	1/4	3/32	.680
734TT	1 1/2	2	1/8	3/16	1/8	.420
734W	1 1/2	2	1/4	3/16	1/8	.810



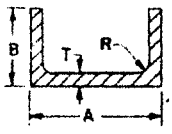
	A	B	T	R	
1312	1/2	1/2	1/16		.057
3792	3/4	1 1/4	1/16		.121
5137	3/4	1 1/2	1/8		.262
5456	1/2	5/8	1/16		.066
7385	3/4	1	1/8		.201



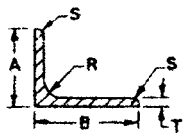
734FF	3/4	1 1/4	3/32	3/32	3/64	.220
484	3/4	1 1/2	3/32	3/32	.050	.197



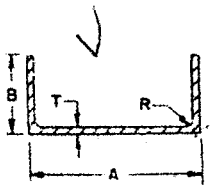
K-12000	1 1/4	3/4	1/16	3/32	.168
K-12876	1 1/4	3/4	1/8	3/32	.316



1288	3/4	1	.070	1/16	1/32	.119
K-22940	3/4	1	3/32	1/8	1/16	.157



K-12866	1 5/8	3/4	1/16	1/32	.188
K-16433	1 5/8	1	.081	1/16	.282



	A	B	C	T	R	S	
K-1377	2 1/8	1	1/2	.080	3/32	.174	.386
K-1380	2 1/8	1	1/2	.064	7/64	.173	.309

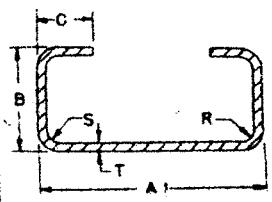
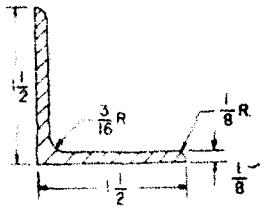
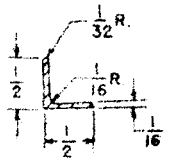


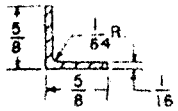
Fig. 106 Sheet 1



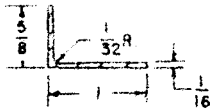
ALCOA DIE NO. 77R
AREA = .360



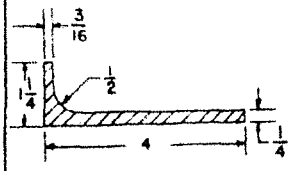
ALCOA DIE NO. 78P
AREA = 060



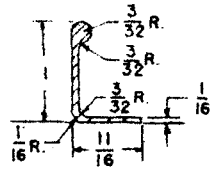
ALCOA DIE NO. K-9823
AREA = .074



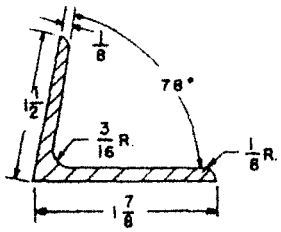
ALCOA DIE NO. D-14594
AREA = .098



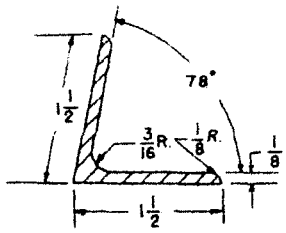
ALCOA DIE NO. K-12823
AREA = 1.069



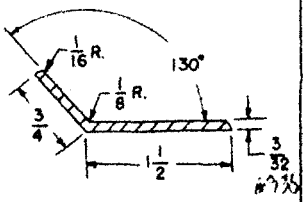
ALCOA DIE NO. K-1298
AREA = .124



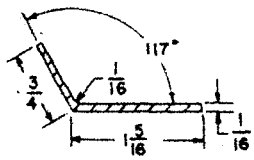
ALCOA DIE NO. K-13864
AREA = .408



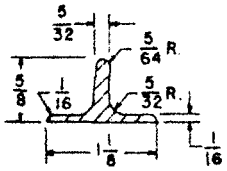
ALCOA DIE NO. K-16638
AREA = .362



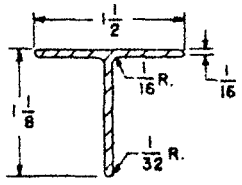
ALCOA DIE NO. 12025
AREA = .206



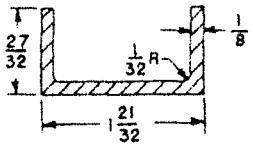
ALCOA DIE NO. K-15087
AREA = .127



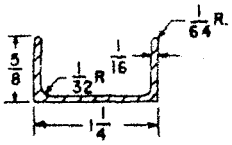
ALCOA DIE NO. K12442
AREA = .158



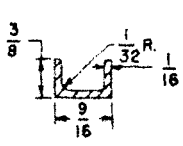
ALCOA DIE NO. 2499
AREA = .161



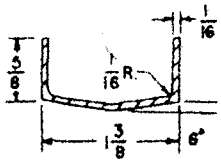
ALCOA DIE NO. K-6466
AREA = .383



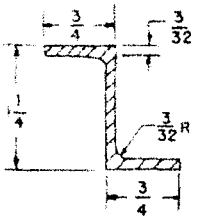
ALCOA DIE NO. K-7869
AREA = .149



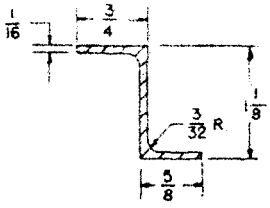
ALCOA DIE NO. K-11057
AREA = .075



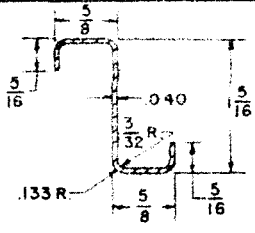
ALCOA DIE NO. K-9665
AREA = 156



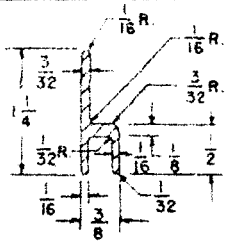
ALCOA DIE NO. 1060
AREA = .240



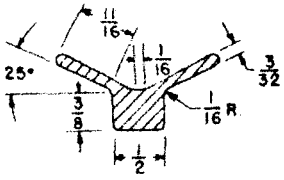
ALCOA DIE NO. K-11256
AREA = .152



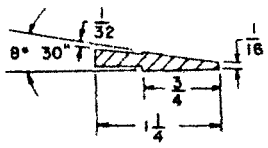
ALCOA DIE NO. K-12867
AREA = .113



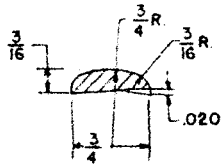
ALCOA DIE NO. K-14426
AREA = .162



ALCOA DIE NO. K-11257
AREA = .334



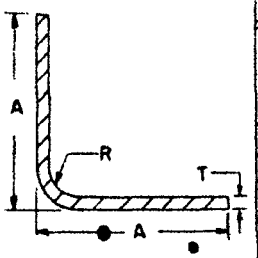
ALCOA DIE NO. K-14403
AREA = .164



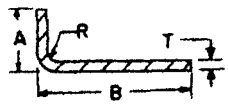
ALCOA DIE NO. 748
AREA = .096

Figure 106 - Extruded Sections (Sheet 2)

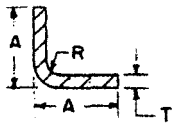
ALCOA DIE NO.	A	T	R		AREA
77 E	1 13/16	1/8	5/16		.422
77 V	2 1/8	1/8	5/16		.500



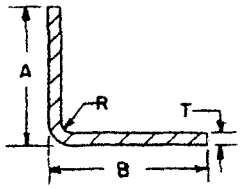
ALCOA DIE NO.	A	B	T	R		AREA
1676	9/16	1 1/4	.081	7/32		.134
K-734-18	11/16	3/4	.064	1/8		.084



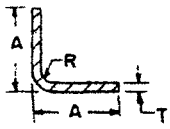
78 C	13/16	.091	1/4		.131
78 F	1 1/8	.091	1/4		.188
78 J	1 1/16	.064	1/8		.128
78 K	13/16	.064	1/8		.096



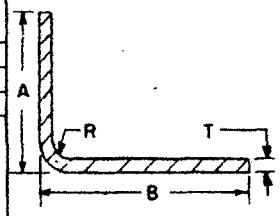
734-CC	1 3/8	1 9/16	1/8	5/16	.336
734 P	1 5/16	2 1/16	1/8	5/16	.391



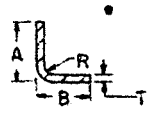
472	13/16	.064	1/8		.096
K-22220	11/16	.064	1/8		.080



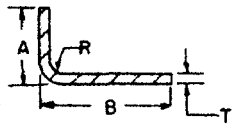
734 H	1 3/8	2 5/8	3/16	9/16	.680
734 TT	1 9/16	2 1/16	1/8	5/16	.422
734-W	1 5/8	2 1/8	.250	3/4	.812



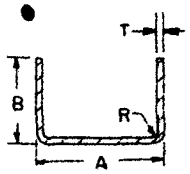
	A	B	T	R	
1312	9/16	1/2	.064	1/8	.060
3792	13/16	1 1/4	.064	1/8	.124
5137	13/16	1 9/16	.125	5/16	.266
5456	9/16	5/8	.064	1/8	.068
7385	13/16	1 1/16	.125	5/16	.203



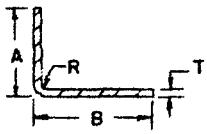
734 FF	3/4	1 1/4	.102	1/4	.183
484	13/16	1 9/16	.091	1/4	.199



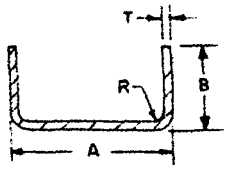
K-12000	1 1/4	13/16	.064	1/8	.168
K-12876	1 1/4	15/16	.125	5/16	.328



1288	7/8	1 1/8	.064	1/8	.120
K-22940	7/8	1 1/16	.091	1/4	.160



K-12866	1 5/8	13/16	.064	1/8	.192
K-16433	1.625	1 1/8	.081	7/32	.288



	A	B	C	D	R		
K-1377	2 1/8	1.00	11/16	.081	7/32		.393
K-1380	2 1/8	1.00	5/8	.064	1/8		.311

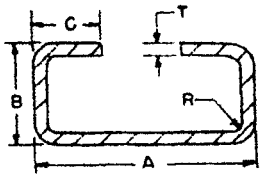


Figure 106 - Extruded Sections - Equivalents (Sheet 3)

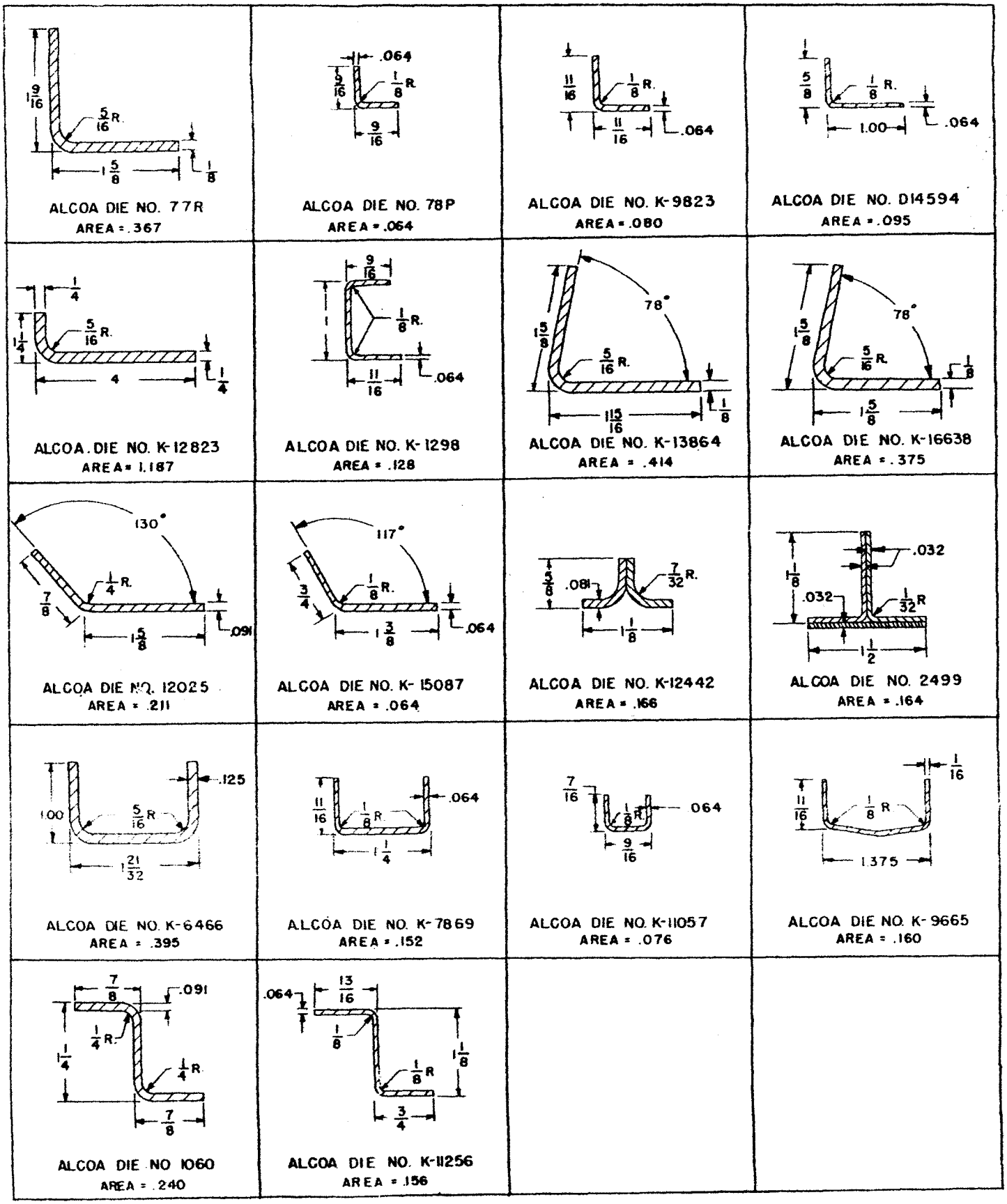


Figure 106 - Extruded Sections - Equivalents (Sheet 4)

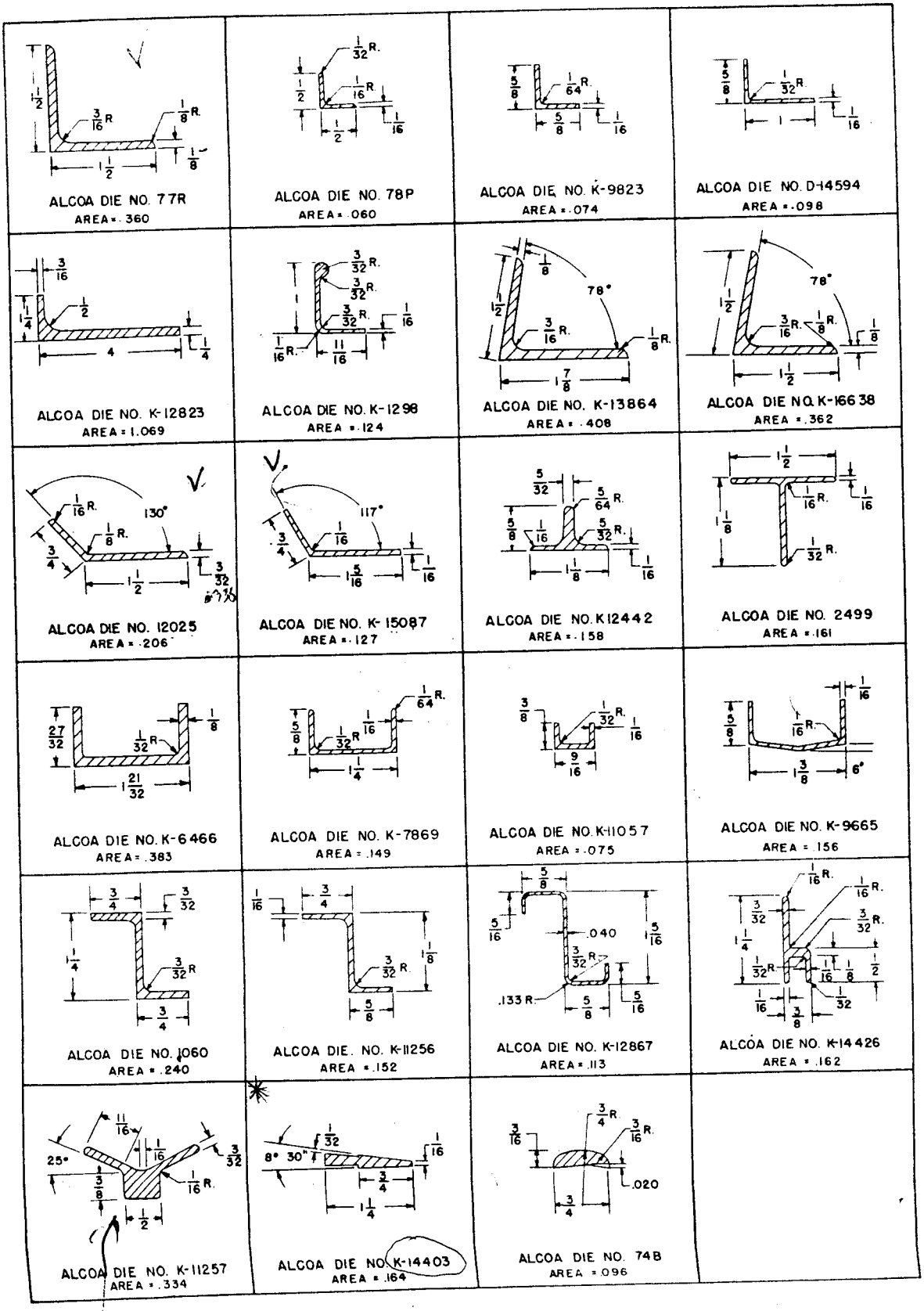
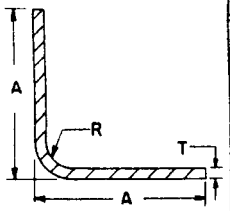


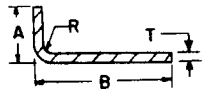
Figure 106 – Extruded Sections (Sheet 2)

TIERNAY
60-15346

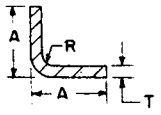
ALCOA DIE NO.	A	T	R		AREA
77 E	1 13/16	1/8	5/16		.422
77 V	2 1/8	1/8	5/16		.500



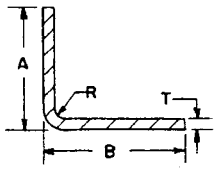
ALCOA DIE NO.	A	B	T	R		AREA
1676	9/16	1 1/4	.081	7/32		.134
K-734-18	11/16	3/4	.064	1/8		.084



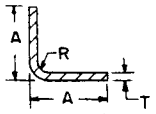
78 G	13/16	.091	1/4		.131
78 F	1 1/8	.091	1/4		.188
78 J	1 1/16	.064	1/8		.128
78 K	13/16	.064	1/8		.096



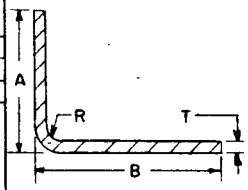
734-CC	1 3/8	1 9/16	1/8	5/16	.336
734 P	1 5/16	2 1/16	1/8	5/16	.391



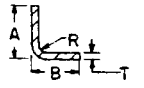
472	13/16	.064	1/8		.096
K-22220	11/16	.064	1/8		.080



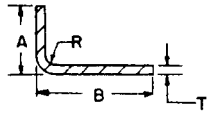
734 H	1 3/8	2 5/8	3/16	9/16	.680
734 TT	1 9/16	2 1/16	1/8	5/16	.422
734-W	1 5/8	2 1/8	.250	3/4	.812



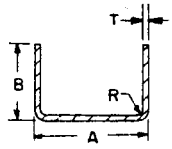
	A	B	T	R	
1312	9/16	1/2	.064	1/8	.060
3792	13/16	1 1/4	.064	1/8	.124
5137	13/16	1 9/16	.125	5/16	.266
5456	9/16	5/8	.064	1/8	.068
7385	13/16	1 1/16	.125	5/16	.203



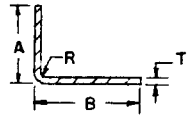
734FF	3/4	1 1/4	.102	1/4	.183
484	13/16	1 9/16	.091	1/4	.199



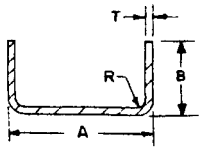
K-12000	1 1/4	13/16	.064	1/8	.168
K-12876	1 1/4	15/16	.125	5/16	.328



1288	7/8	1 1/8	.064	1/8	.120
K-22940	7/8	1 1/16	.091	1/4	.160



K-12866	1 5/8	13/16	.064	1/8	.192
K-16433	1.625	1 1/8	.081	7/32	.288



	A	B	C	D	R	
K-1377	2 1/8	1.00	11/16	.081	7/32	.393
K-1380	2 1/8	1.00	5/8	.064	1/8	.311

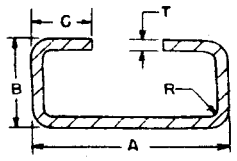


Figure 106 - Extruded Sections - Equivalents (Sheet 3)

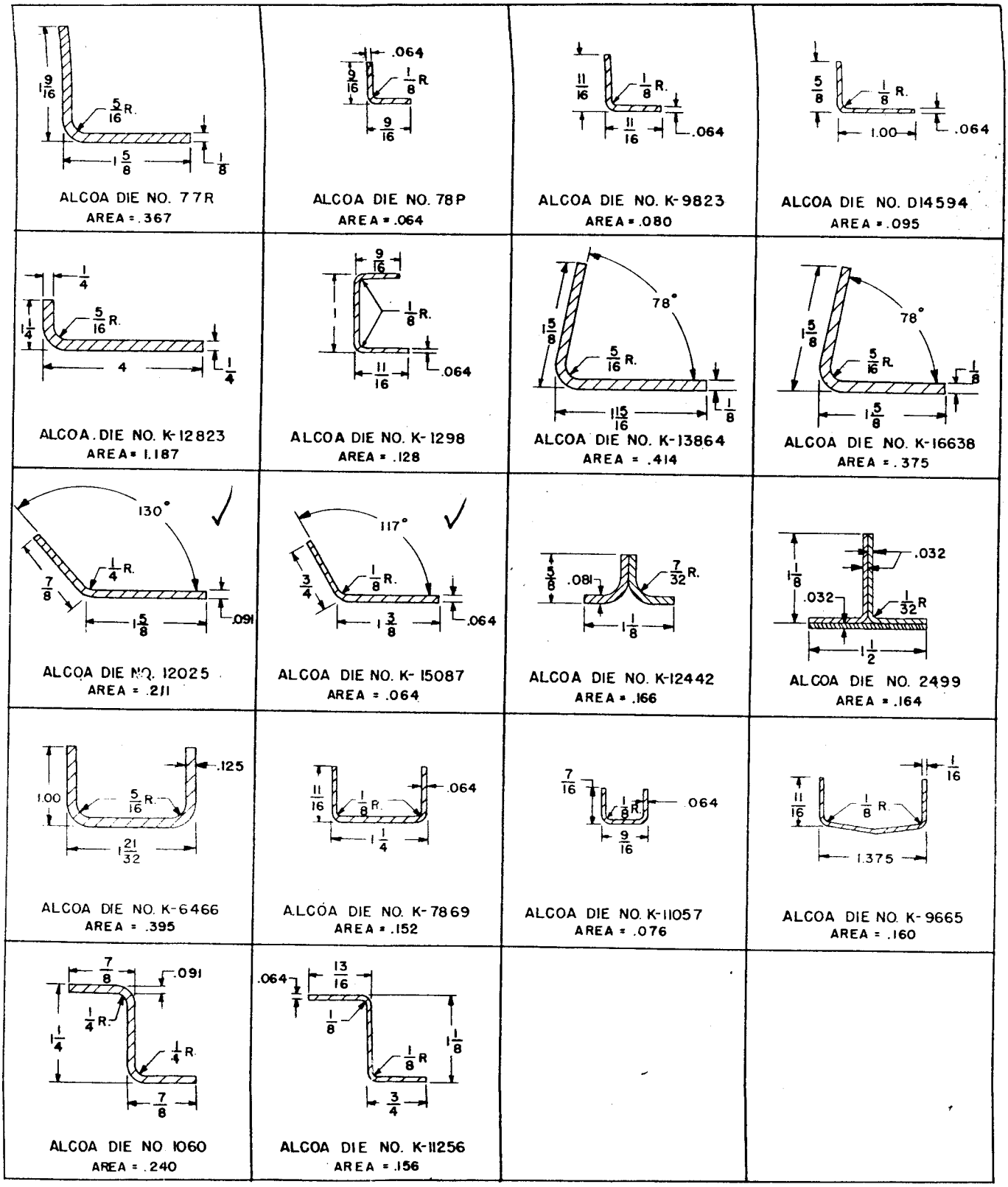


Figure 106 - Extruded Sections - Equivalents (Sheet 4)

SECTION 8

FABRIC REPAIR AND ATTACHMENT

1. FABRIC REPAIR.

a. GENERAL.-Holes and tears in fabric can be repaired as shown in Figure 128. For further information, see General Manual for Structural Repair.

2. FABRIC ATTACHMENT.

a. GENERAL.-The wing outer panels, ailerons, elevators and rudder are fabric covered.

(1) The wing outer panels are covered with Grade A cotton airplane fabric aft of the rear box beam web plating as noted in Figures 4 and 129. Fabric 69 inches wide runs the length of the panel and is secured to the following: box beam rear web capstrips (corner angles), wing flap support beams, aileron support beams, trailing edge, where the fabric is stitched, and web type ribs. Lacing is at 1-1/4 inches on the four inboard ribs and sewn around the capstrips. Lacing is at two inch intervals on the outboard ribs and sewn through the wing. Lock stitch is used every six inches in hand sewing.

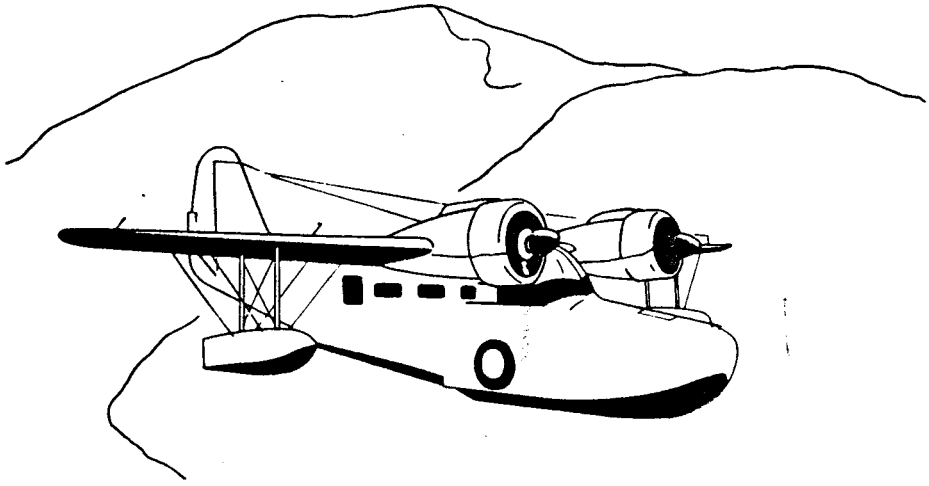
(2) #112 herringbone reinforcing tape and Grade A cotton pinked edge tape is used.

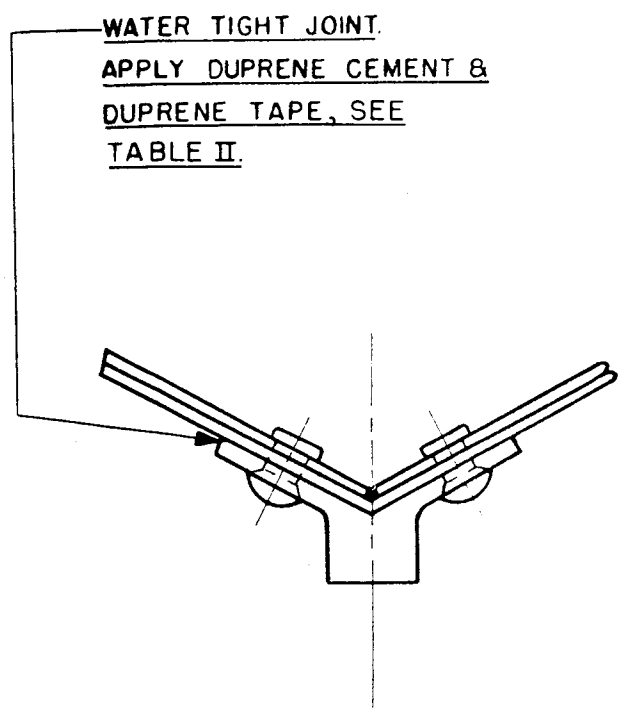
(3) Cellophane tape is used over the trailing edge, sharp edges and rivets.

(4) Internal structure is protected against fabric doping by zinc chromate primer.

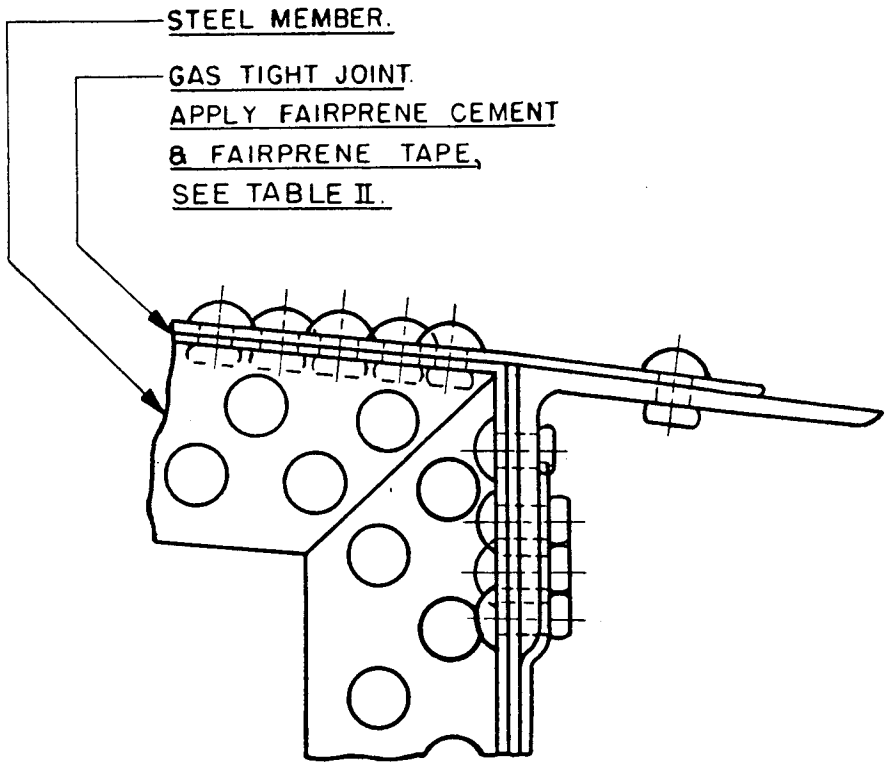
(5) An aluminum alloy tube 72 inches long is attached to the underside of the tail ribs adjacent to the wing flap beam, securing the fabric covering and maintaining the proper tension of the fabric.

(6) The ailerons, elevators and rudder are similarly covered with fabric, which extends over the 24ST aluminum alloy nose cover and the ribs and is stitched and taped at the trailing edge. (See Figure 117).



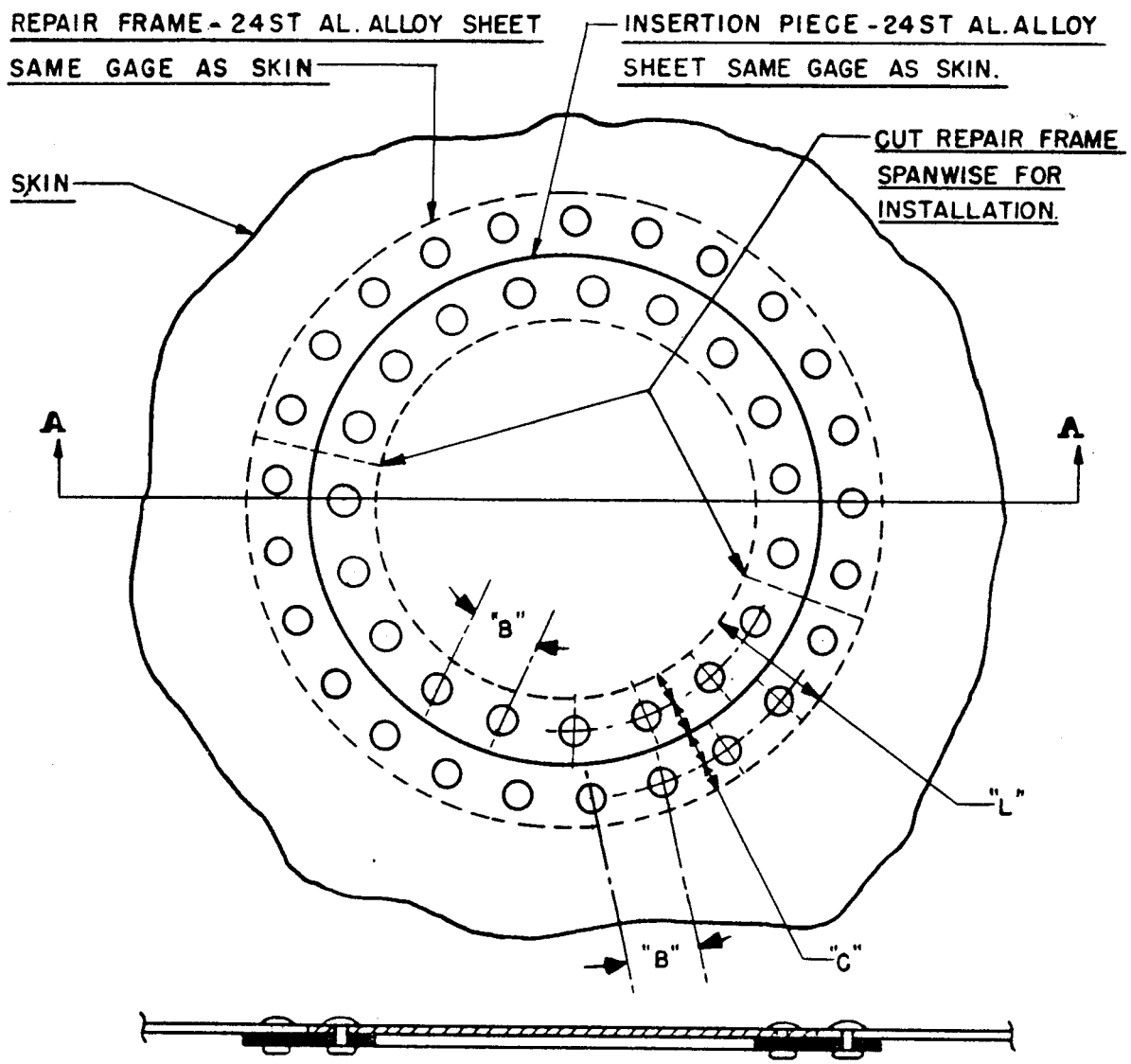


JOINT-HULL KEEL



JOINT- WING FUEL TANK

Figure 107 - Typical Joint Seals



SECTION "A - A"

SKIN THICKNESS	RIVET DIA.	PITCH "B"	EDGE CLEARANCE "C"	WIDTH OF FRAME "L"
.020 TO .040	1/8	1/2	1/4	1
.051	5/32	5/8	5/16	1 1/4
.064	3/16	3/4	3/8	1 1/2
.081	1/4	1	1/2	2

Figure 108 - Skin Patch Repair - Round Flush

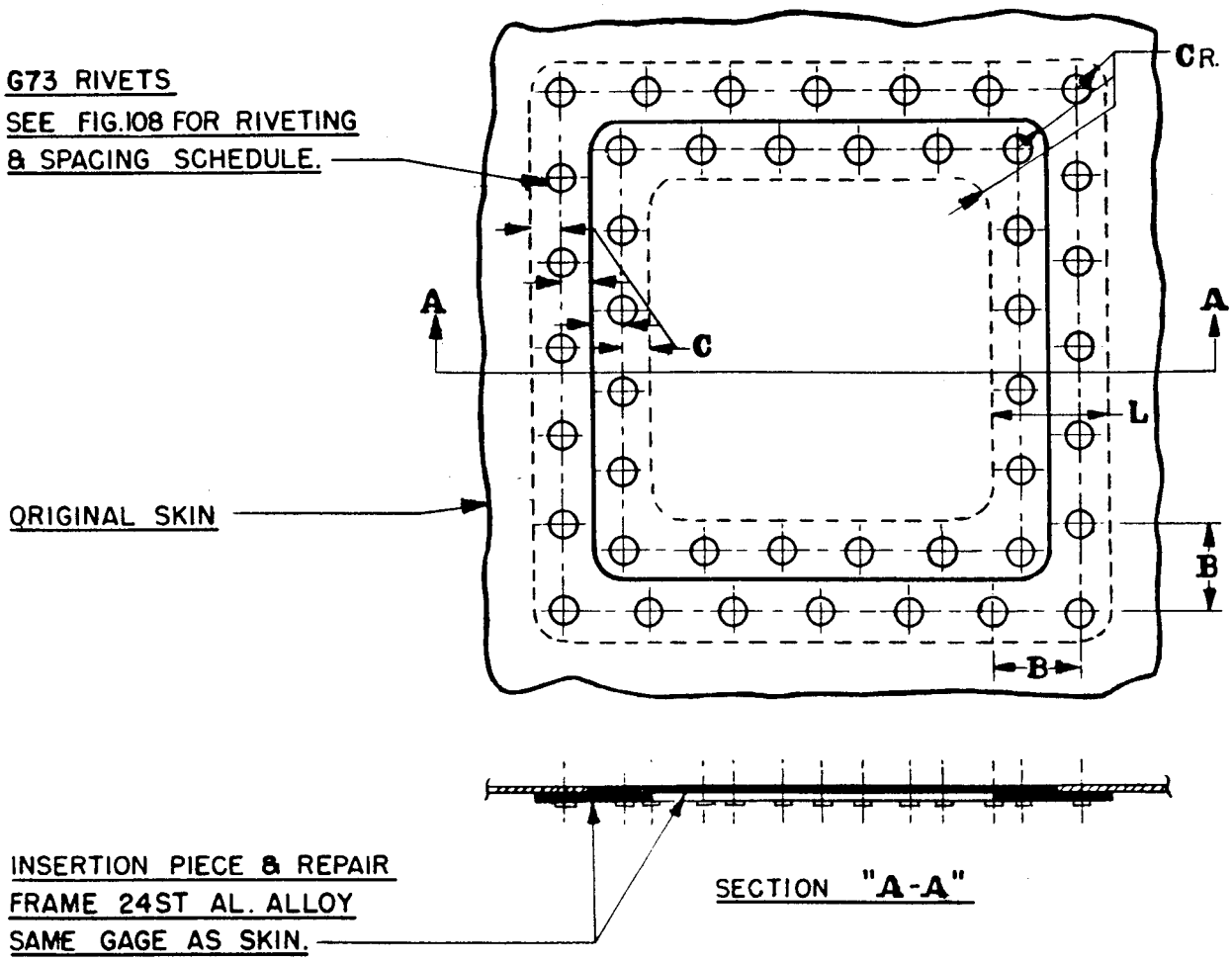
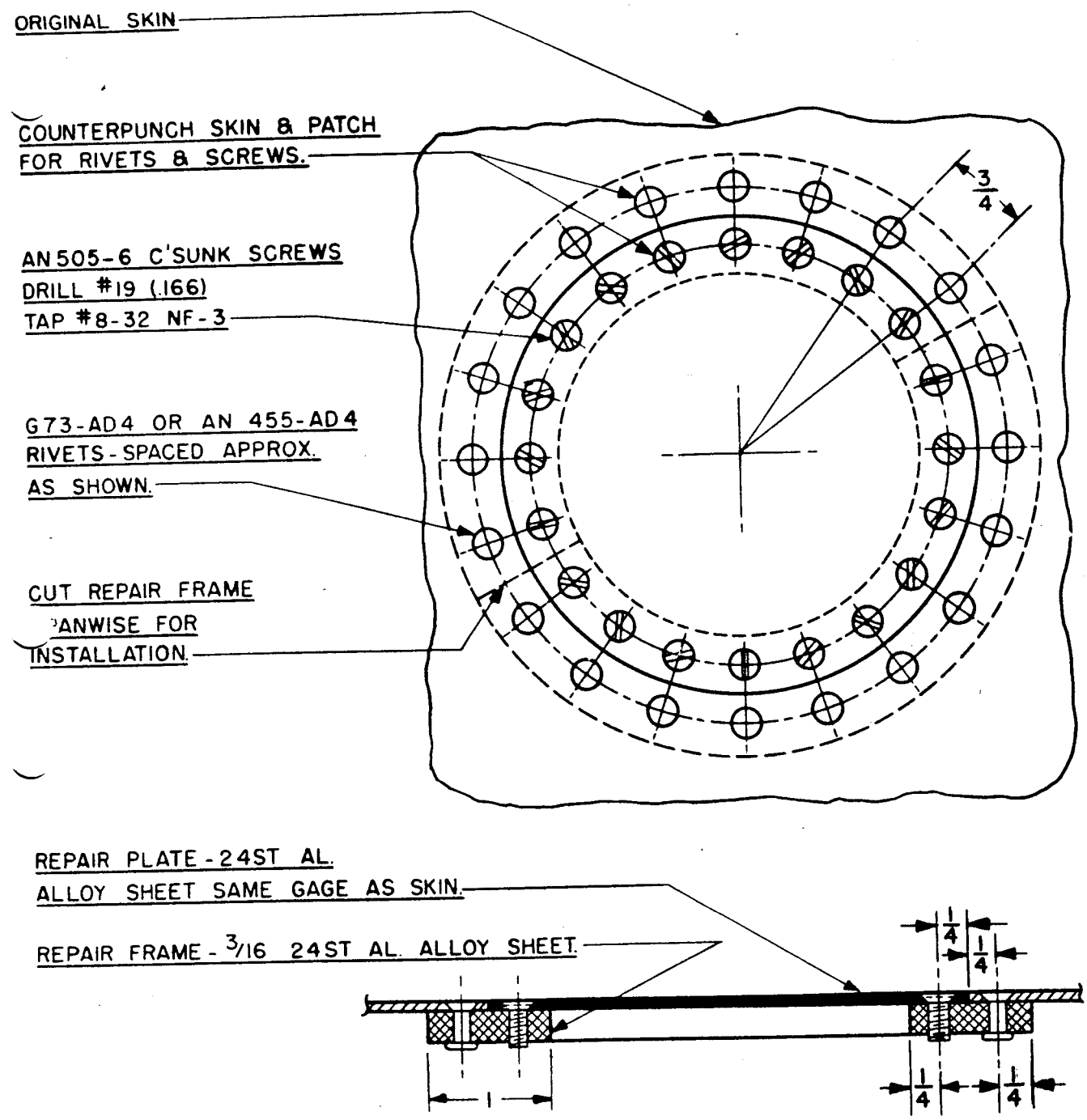


Figure 109 - Skin Patch Repair - Square Flush



NOTE:
USED WITH ENGINEERING APPROVAL ONLY.

Figure 110 - Removable Stressed Skin Patch Repair

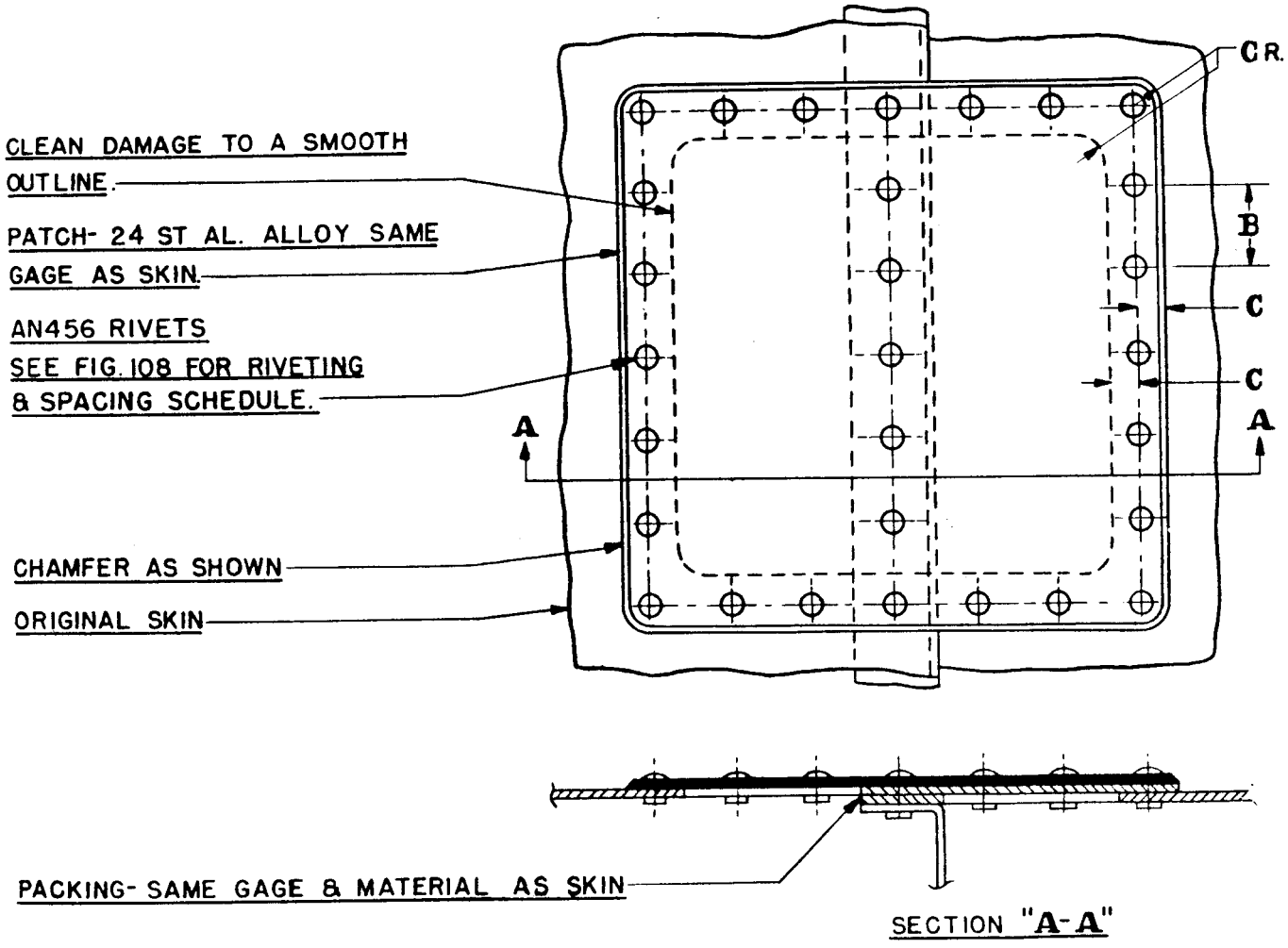
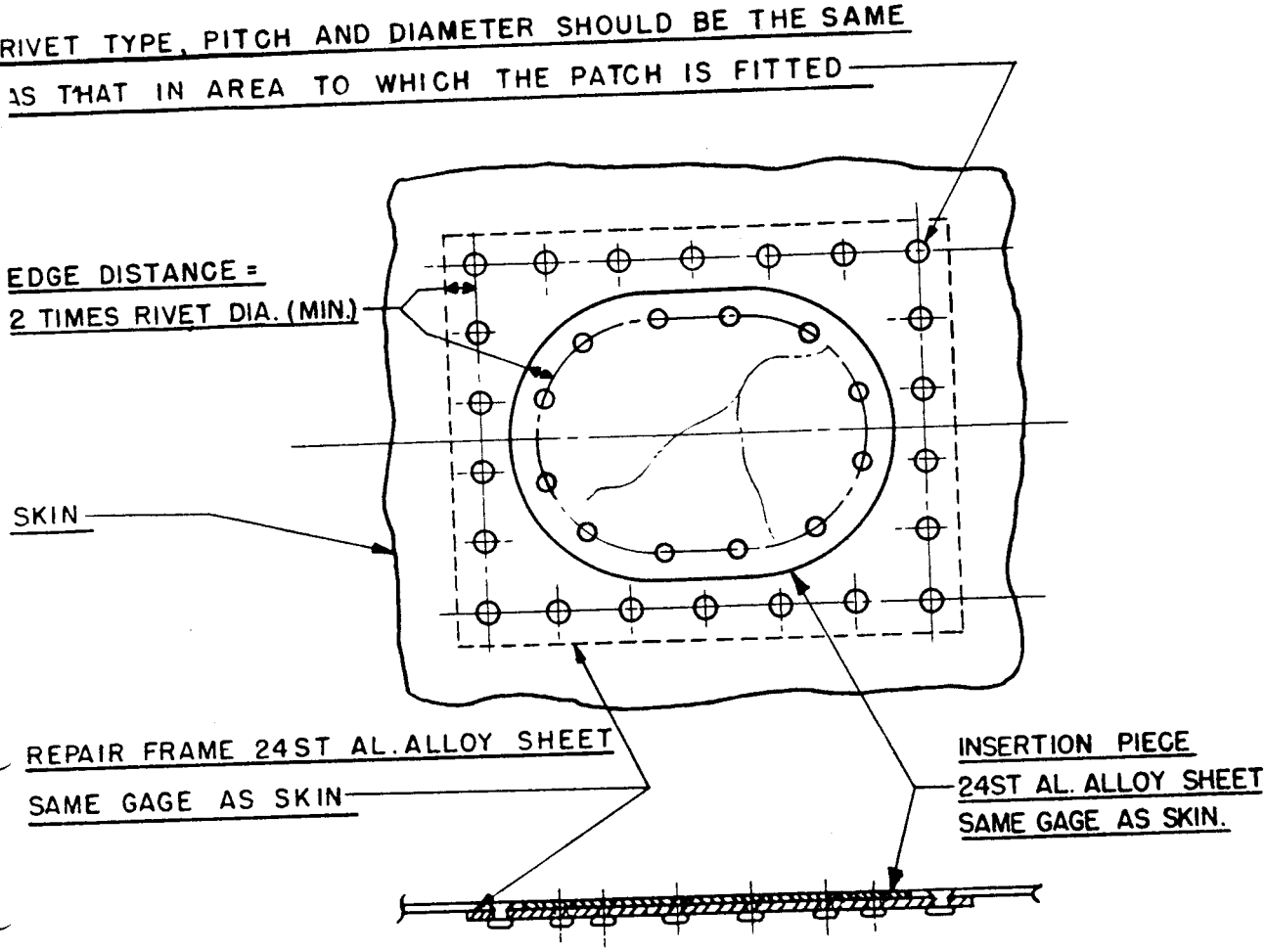


Figure 111 - Skin Patch Repair - Outside



NOTE:

CUT PANEL TO SMOOTH OUTLINE AROUND CRACKED OR DAMAGED AREA AND FIT INSERT TO PANEL. RIVET INSERT TO PATCH AND RIVET PATCH TO SKIN.

THIS TYPE OF PATCH REPAIR MAY BE USED ON FUSELAGE, WINGS, EXCEPT LEADING EDGE, STABILIZER & FIN PANELS.

Figure 112 - Cracked Panel Patch Repair

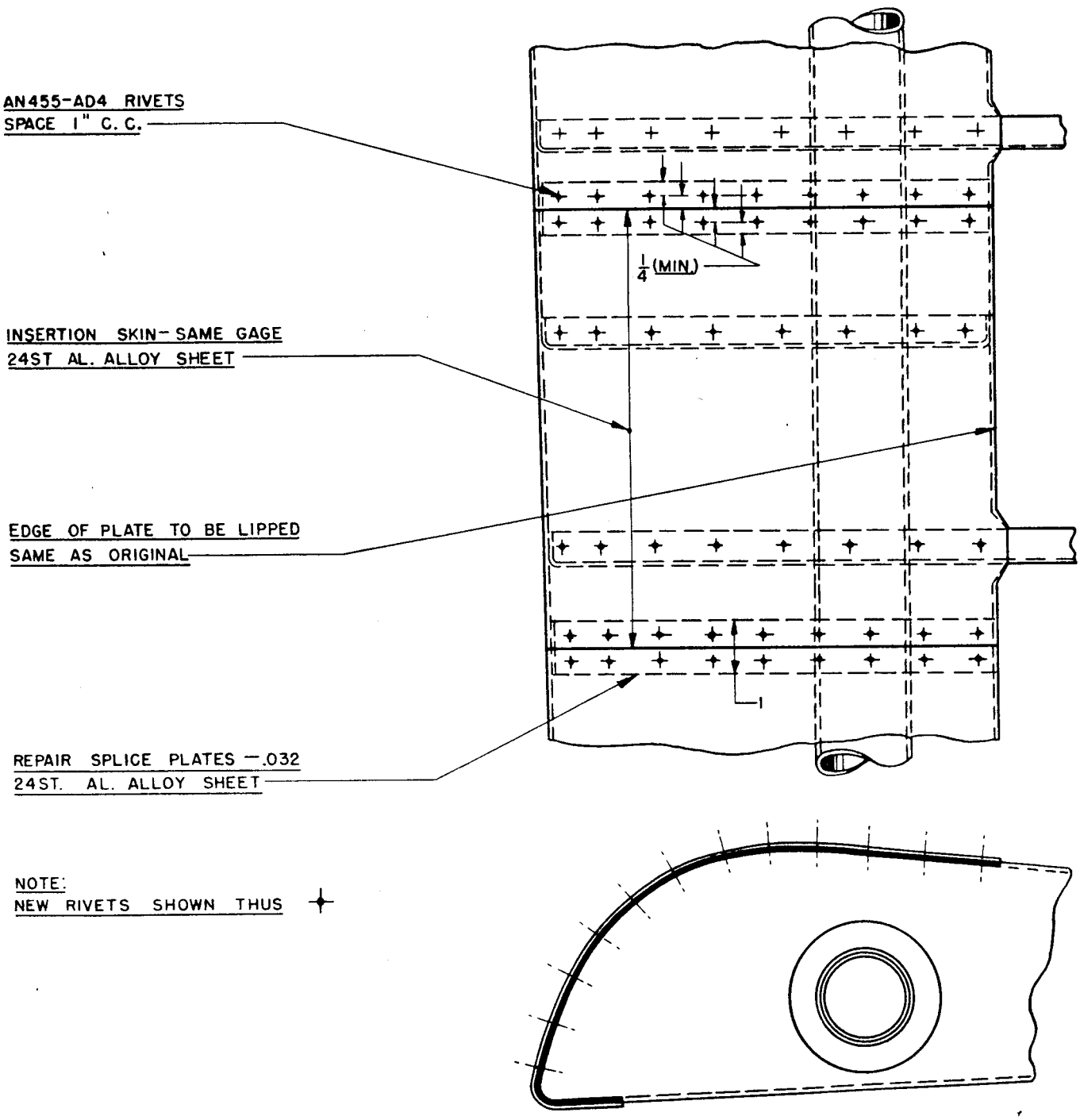
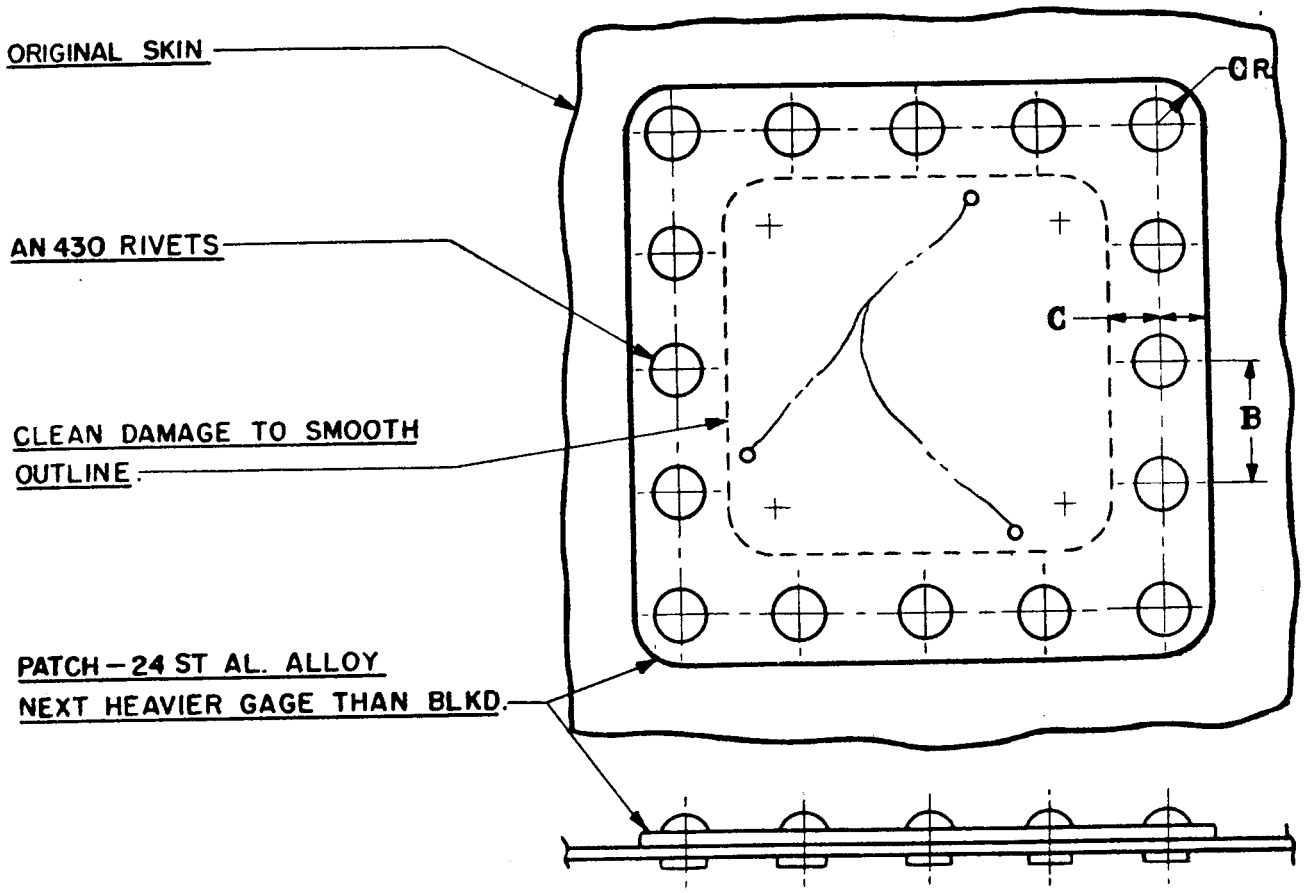


Figure 113 - Leading Edge Skin Repair - Control Surfaces



NOTE:

SEE FIG.108 FOR RIVETING & SPACING SCHEDULE.

SEAL PATCH AS INDICATED IN TEXT.

Figure 114 – Bulkhead Plate Patch Repair

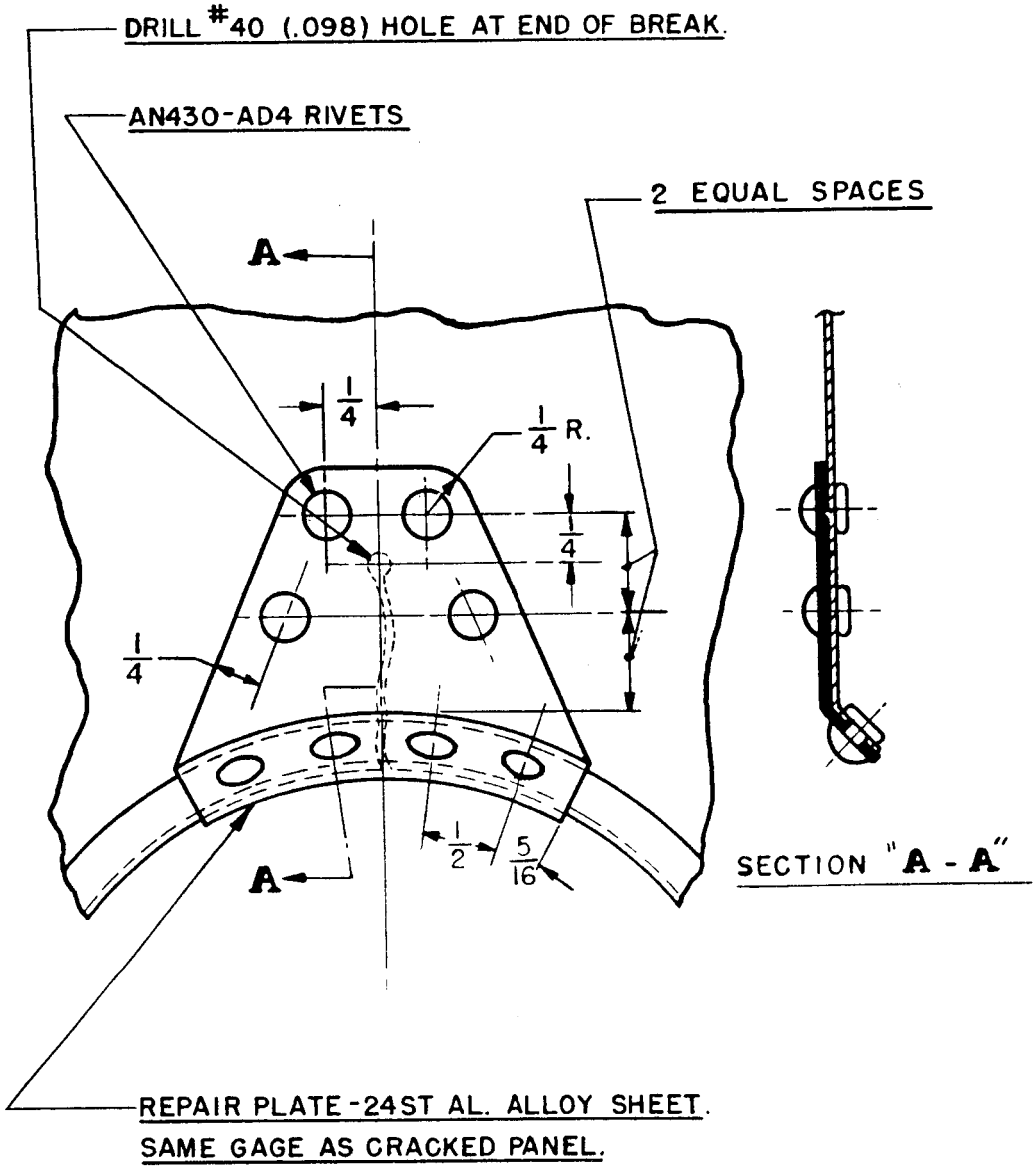
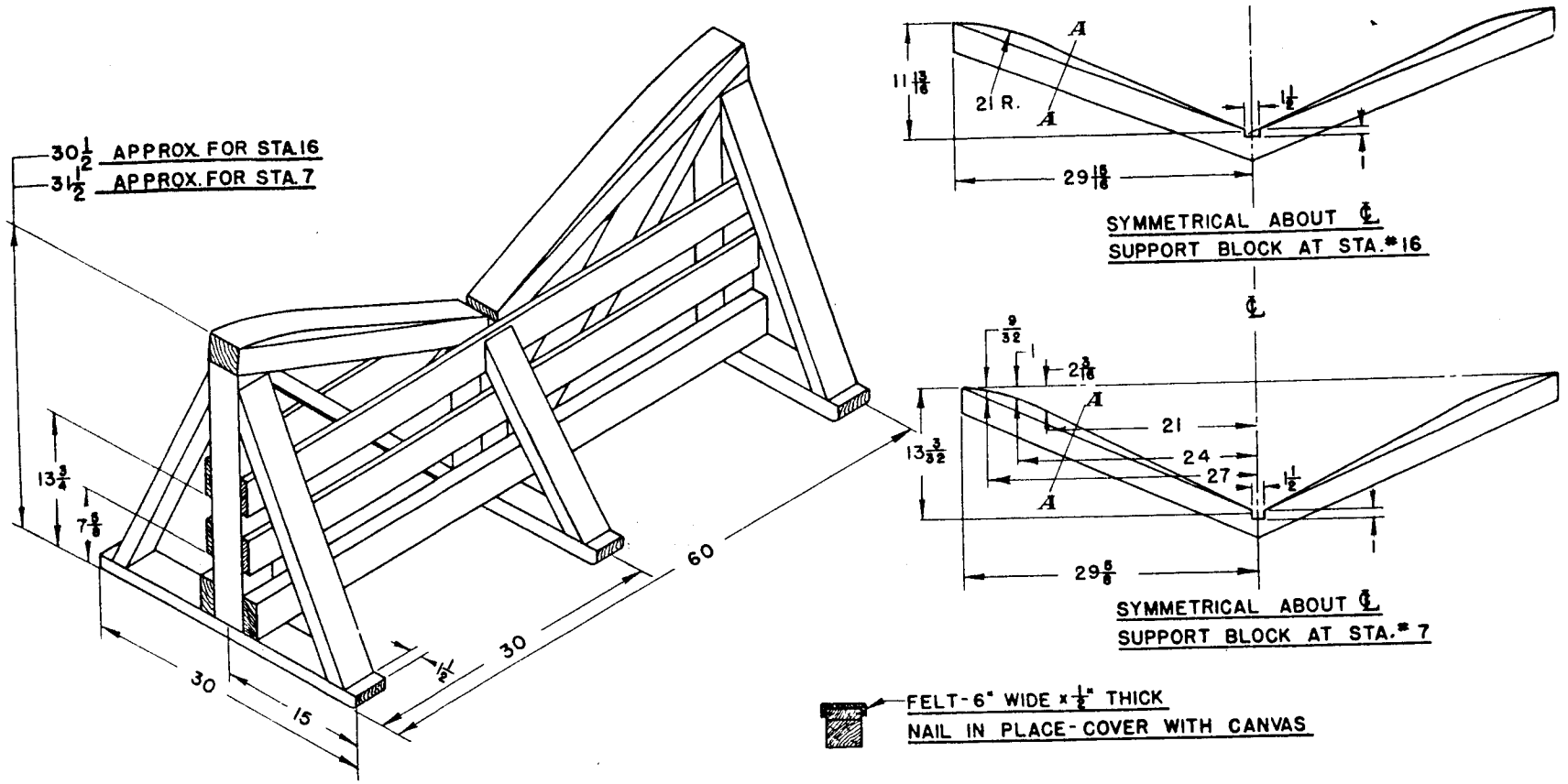


Figure 115 - Lightening Hole Crack Repair

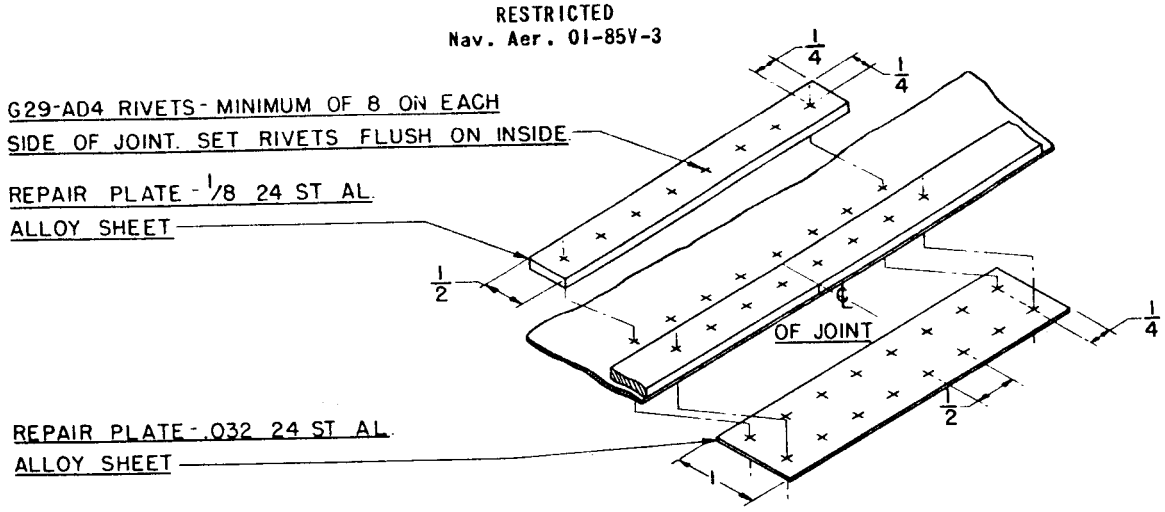


SECTION *A-A*

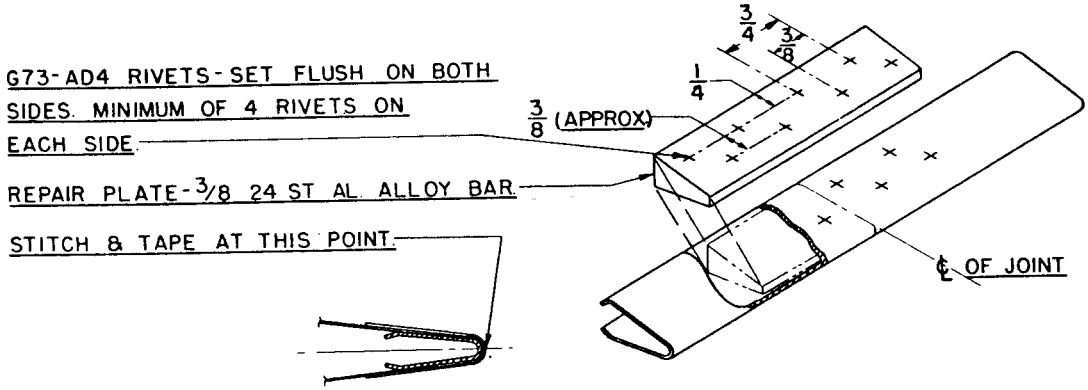
NOTES

1. 4 SIDE PIECES 1x4x60 DRESSED SPRUCE.
   2 LOW SIDE PIECES, ANGULAR SUPPORTS
   & BASE 2x4 DRESSED FIR.
   ALL OTHER PIECES 4x4 DRESSED FIR.
2. ALL JOINTS GLUED, AIDED BY * 10 FLATHEAD WOODSCREWS & 8 OR 10 PENNY NAILS.
3. SUPPORTS FOR STA.* 7 & * 16 IDENT., EXCEPT WHERE SHOWN.
4. ALL DIMENSIONS ARE GIVEN IN INCHES.

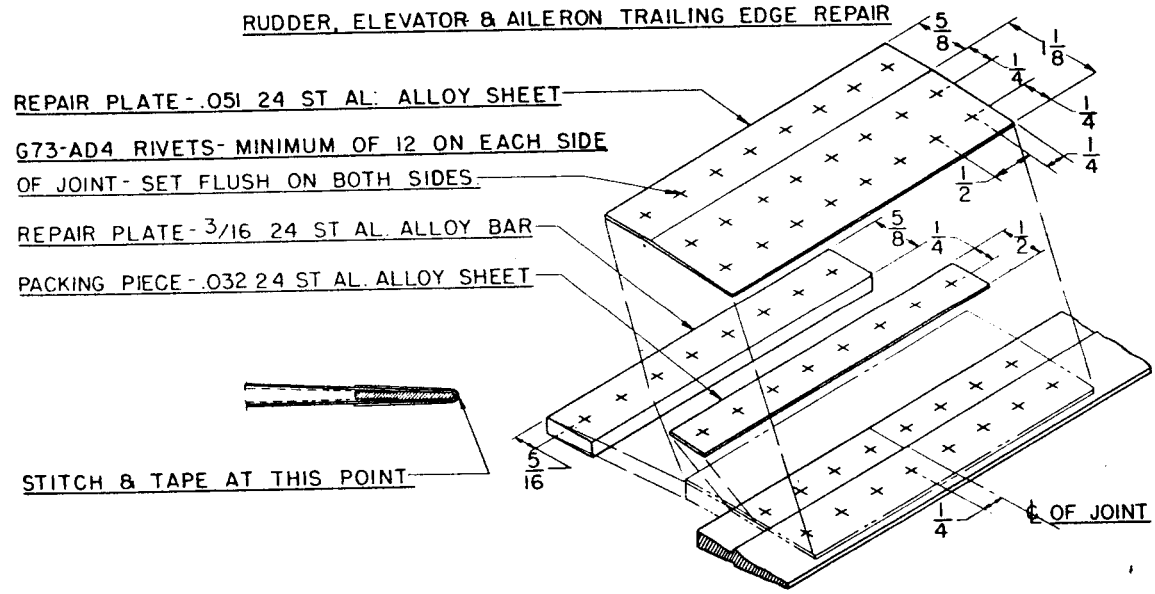
Figure 116 - Hull Supports



FLAP TRAILING EDGE REPAIR

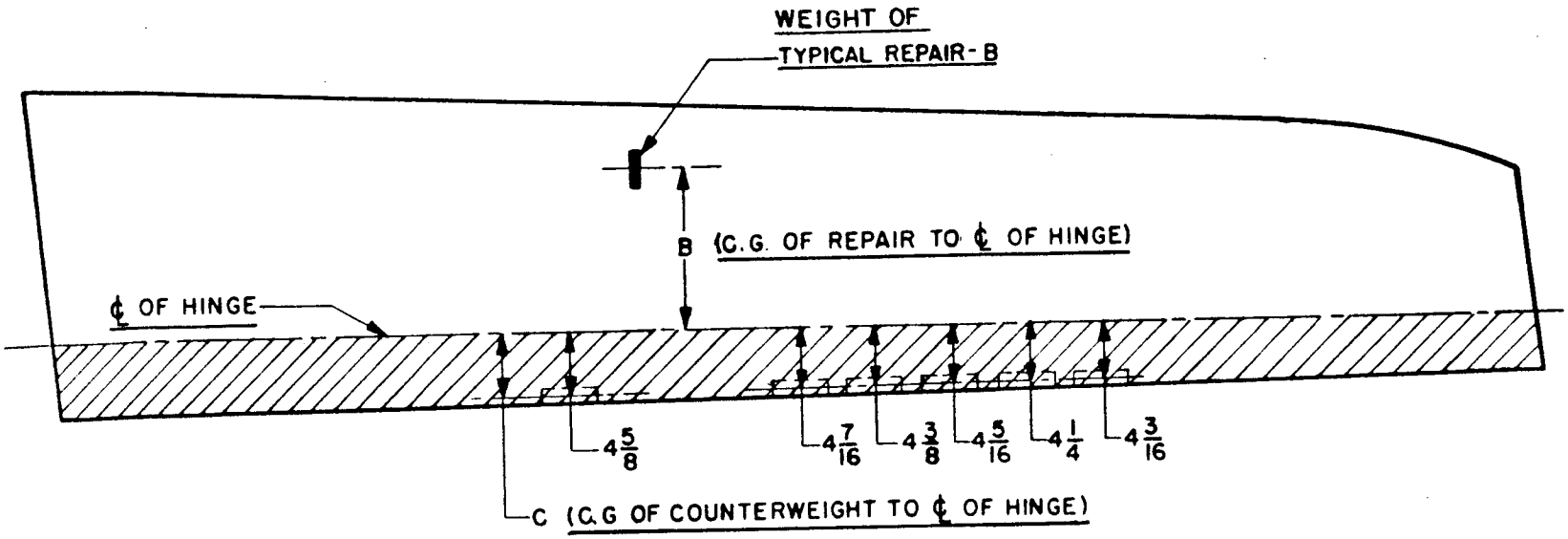


RUDDER, ELEVATOR & AILERON TRAILING EDGE REPAIR



WING TRAILING EDGE REPAIR

Figure 117 - Trailing Edge Repairs



NOTES:

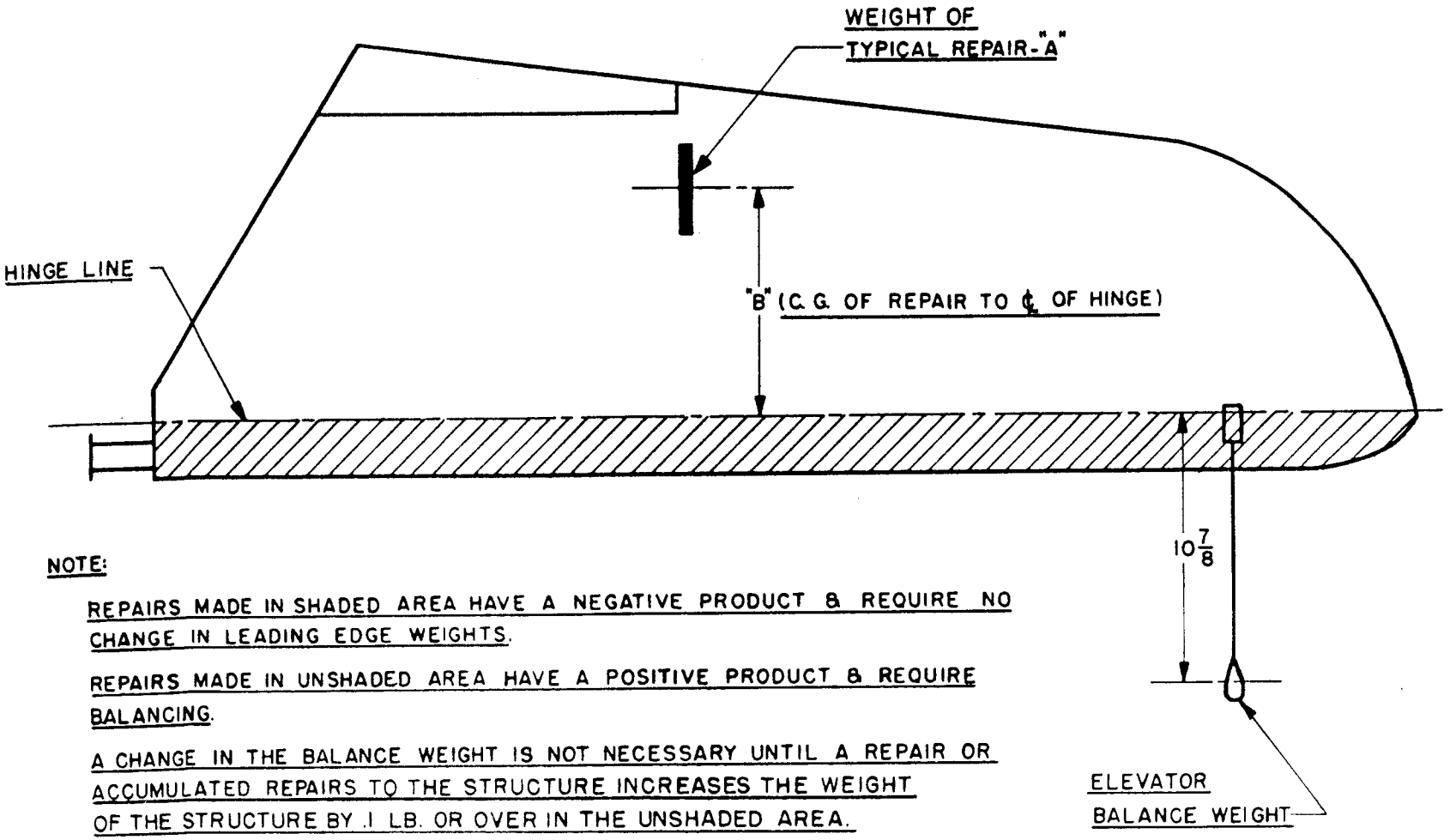
REPAIRS MADE IN SHADED AREA HAVE A NEGATIVE PRODUCT & REQUIRE NO CHANGE IN LEADING EDGE WEIGHTS.

REPAIRS MADE IN UNSHADED AREA HAVE A POSITIVE PRODUCT & REQUIRE BALANCING.

A CHANGE IN THE BALANCE WEIGHTS IS NOT NECESSARY UNTIL A REPAIR OR ACCUMULATED REPAIRS TO THE STRUCTURE INCREASES THE WEIGHT OF THE STRUCTURE BY .1 LB OR OVER IN THE UNSHADED AREA.

BALANCE WEIGHT TO BE ADDED = $\frac{A \times B}{C}$

Figure 118 - Aileron Mass Balancing Diagram



NOTE:

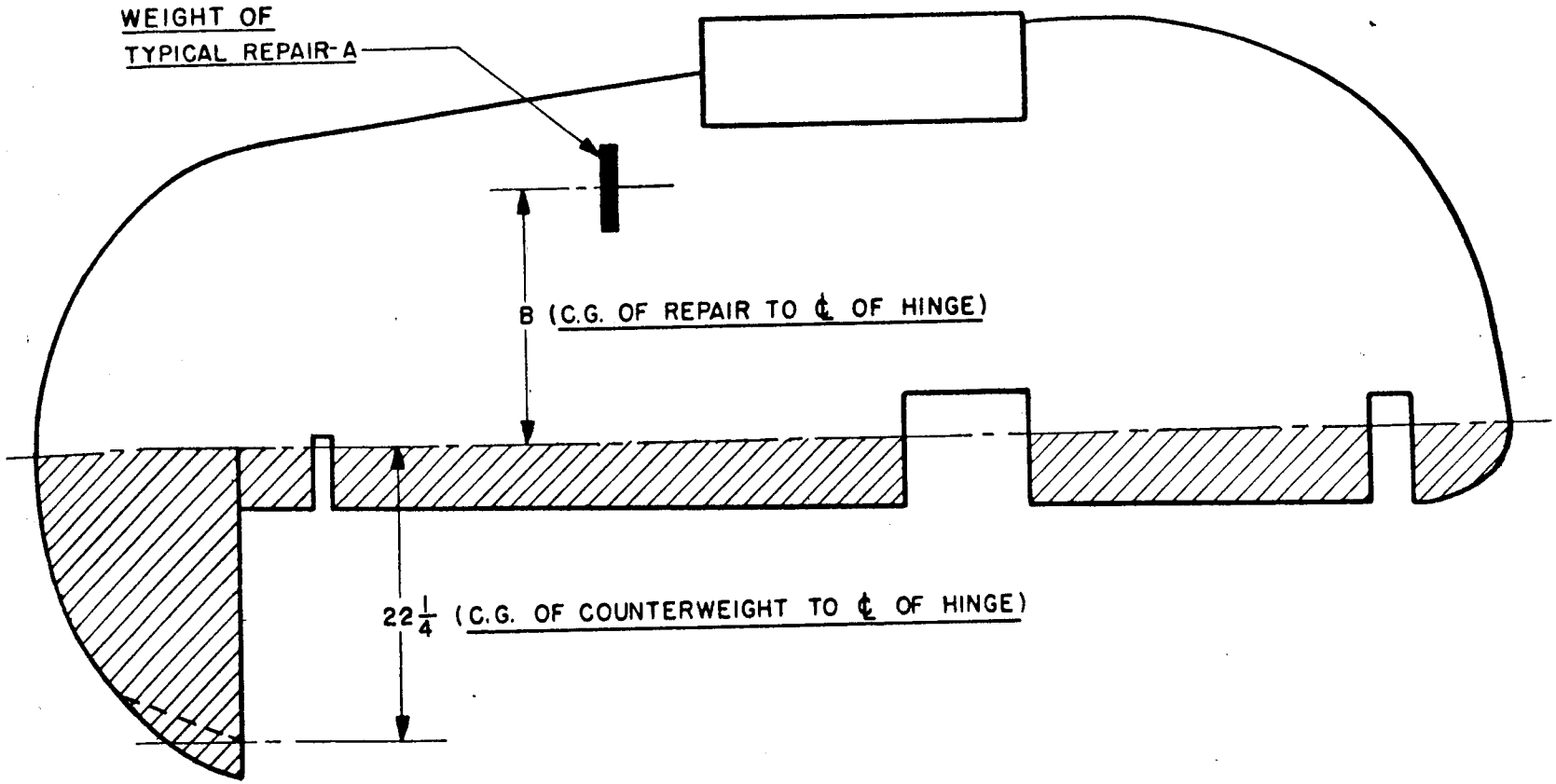
REPAIRS MADE IN SHADED AREA HAVE A NEGATIVE PRODUCT & REQUIRE NO CHANGE IN LEADING EDGE WEIGHTS.

REPAIRS MADE IN UNSHADED AREA HAVE A POSITIVE PRODUCT & REQUIRE BALANCING.

A CHANGE IN THE BALANCE WEIGHT IS NOT NECESSARY UNTIL A REPAIR OR ACCUMULATED REPAIRS TO THE STRUCTURE INCREASES THE WEIGHT OF THE STRUCTURE BY .1 LB. OR OVER IN THE UNSHADED AREA.

$$\text{BALANCE WEIGHT TO BE ADDED} = \frac{A+B}{10.875}$$

Figure 119 - Elevator Mass Balancing Diagram



NOTES:

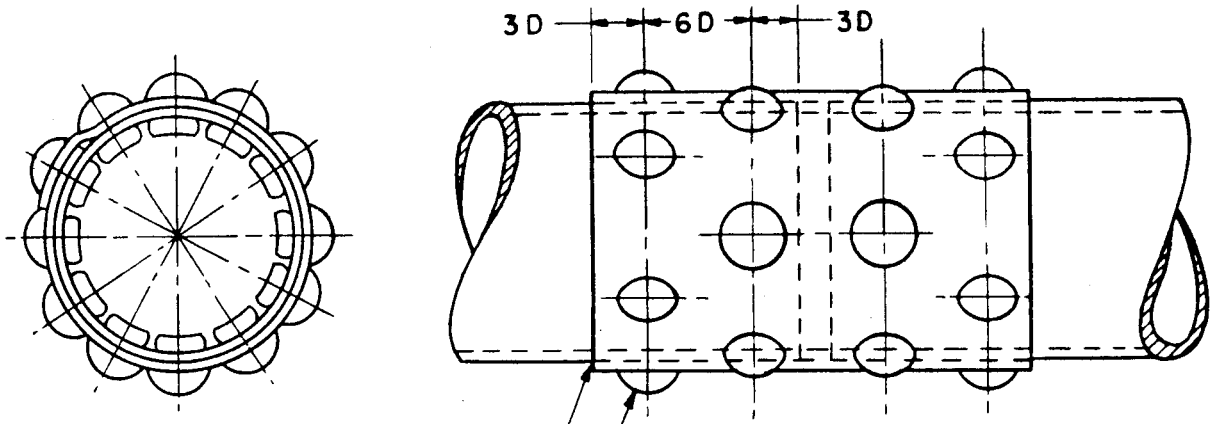
REPAIRS MADE IN SHADED AREA HAVE A NEGATIVE PRODUCT & REQUIRE NO CHANGE IN LEADING EDGE WEIGHTS.

REPAIRS MADE IN UNSHADED AREA HAVE A POSITIVE PRODUCT & REQUIRE BALANCING

A CHANGE IN THE BALANCE WEIGHTS IS NOT NECESSARY UNTIL A REPAIR OR ACCUMULATED REPAIRS TO THE STRUCTURE INCREASES THE WEIGHT OF THE STRUCTURE BY .1 LB. OR OVER IN THE UNSHADED AREA.

BALANCE WEIGHT TO BE ADDED = $\frac{A \times B}{22.250}$

Figure 120 - Rudder Mass Balancing Diagram



REPAIR PLATE:- NEAREST GAGE 24ST AL. ALLOY SHEET AS TORQUE TUBE, CUT TO SIZE AND PREFORMED.

NOTE:- D= DIAMETER OF RIVET

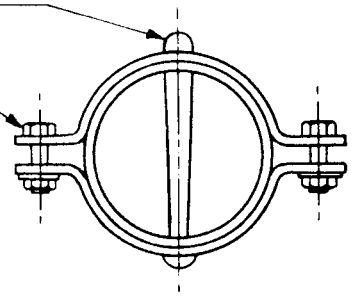
AN430-D6 ROUND HEAD RIVETS TWO STAGGERED ROWS OF RIVETS ON EACH SIDE OF JOINT. SPACE RIVETS EVENLY AROUND TUBE. MINIMUM OF 12 RIVETS ON EACH SIDE OF JOINT.

ALTERNATE REPAIR - AN23 BOLTS MAY BE USED INSTEAD OF RIVETS. MINIMUM OF 6 BOLTS EACH SIDE OF JOINT.

JOINT REPAIR

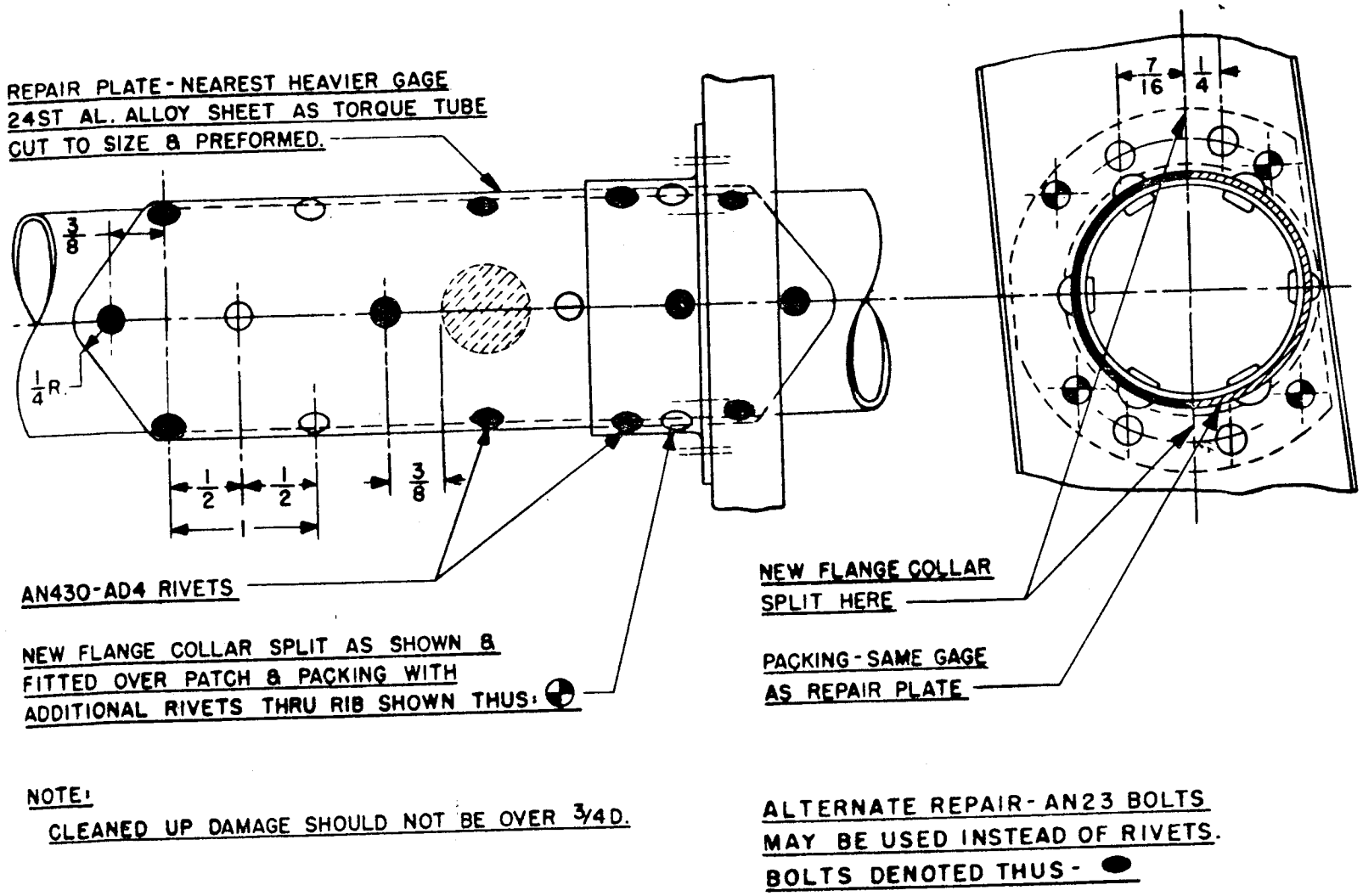
3/16 TAPER PIN

1/4" BOLT, LOCK WASHER & NUT



SMALL HOLE OR DENT REPAIR

Figure 121 - Torque Tube Repair

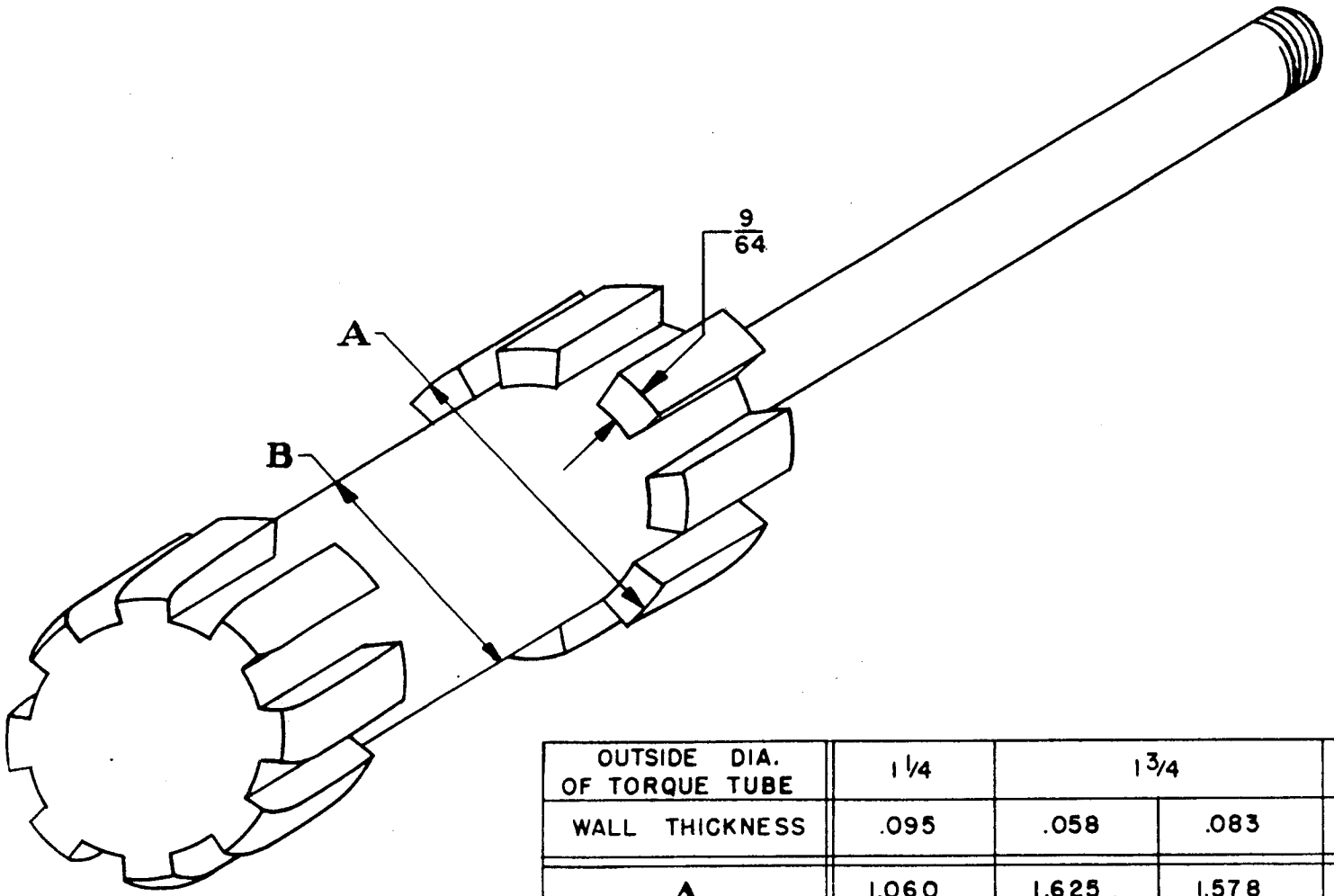


NOTE:
CLEANED UP DAMAGE SHOULD NOT BE OVER 3/4D.

ALTERNATE REPAIR - AN23 BOLTS MAY BE USED INSTEAD OF RIVETS. BOLTS DENOTED THUS -

Figure 122 – Torque Tube Repair

RESTRICTED
RESTRICTED
Nav. Aer. 01-85V-3



OUTSIDE DIA. OF TORQUE TUBE	1 1/4	1 3/4		2
WALL THICKNESS	.095	.058	.083	.058
A	1.060	1.625	1.578	1.800
B	.778	1.343	1.296	1.518

Figure 123 - Torque Tube Bucking Bar

RESTRICTED

RESTRICTED
Nav. Aer. 01-85V-3

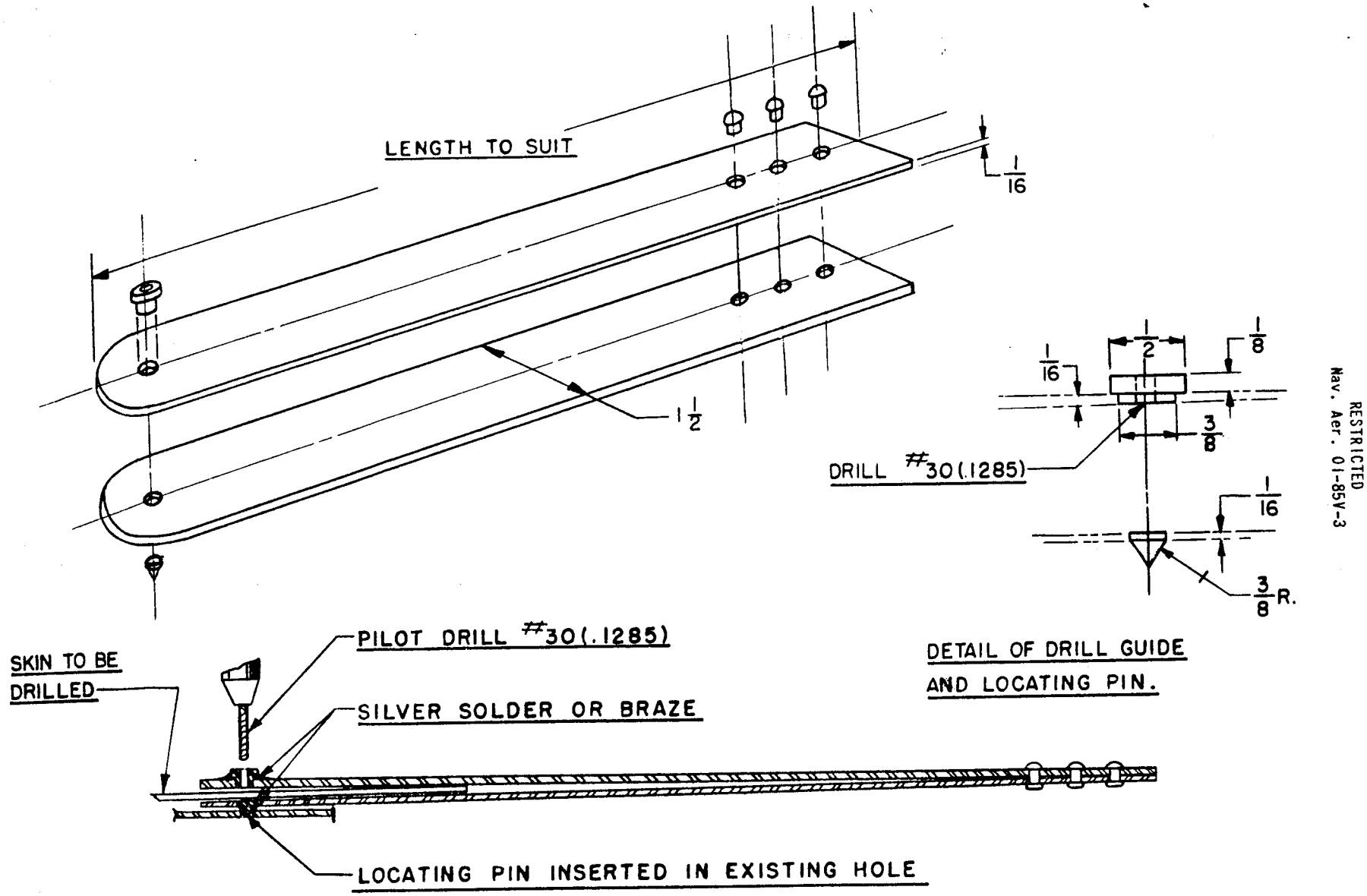
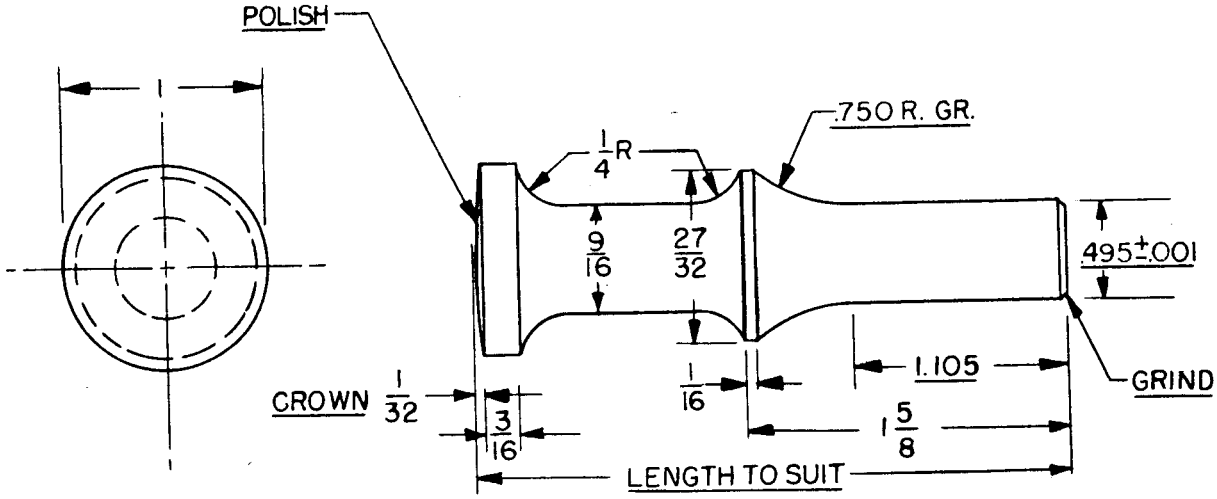
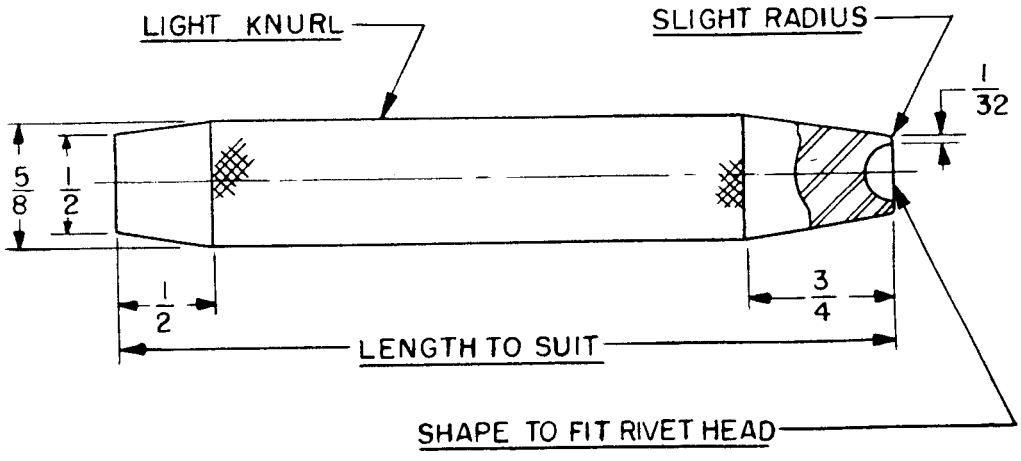


Figure 124 - Rivet Hole Locating Tool

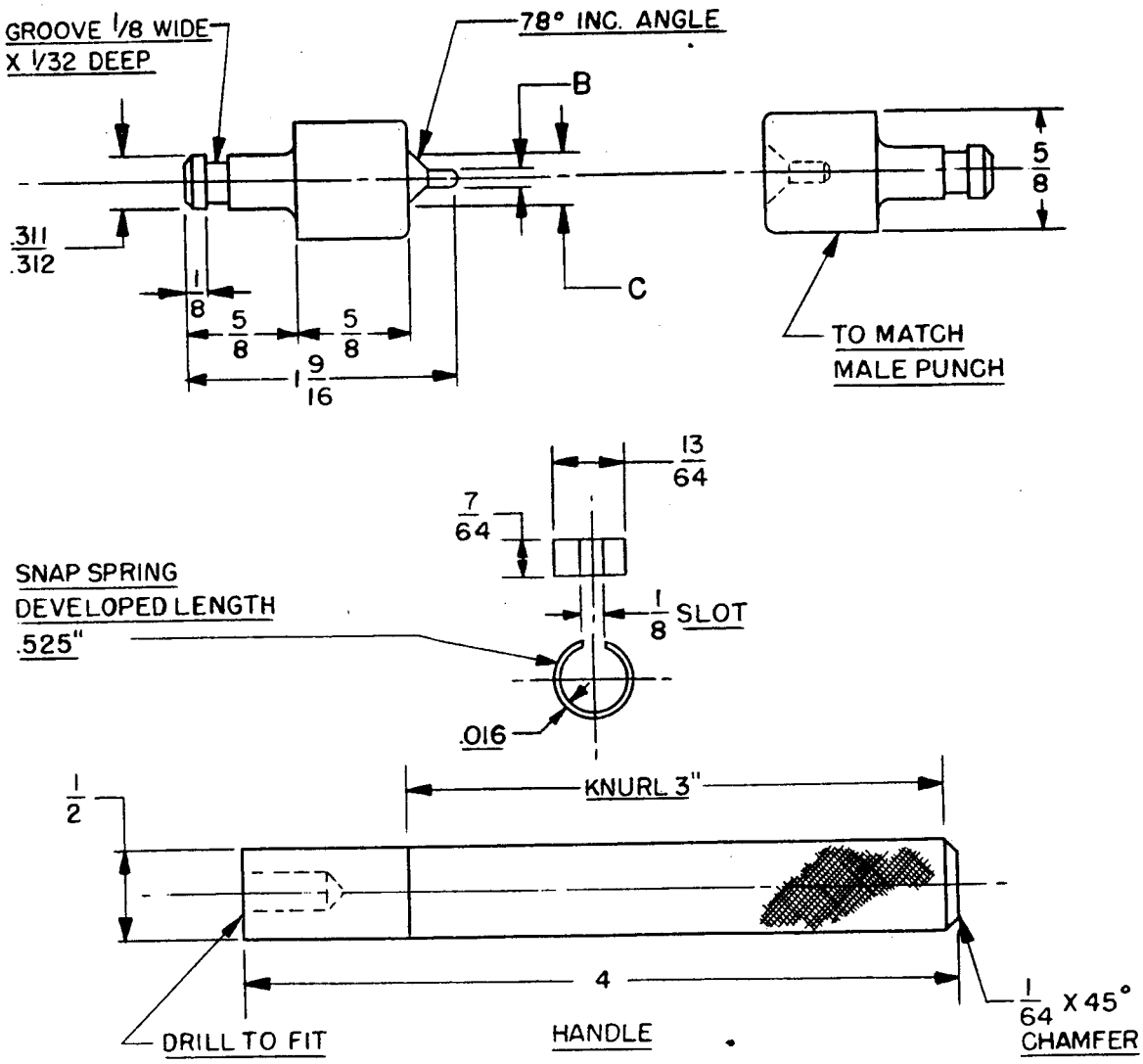


FLUSH RIVET SET



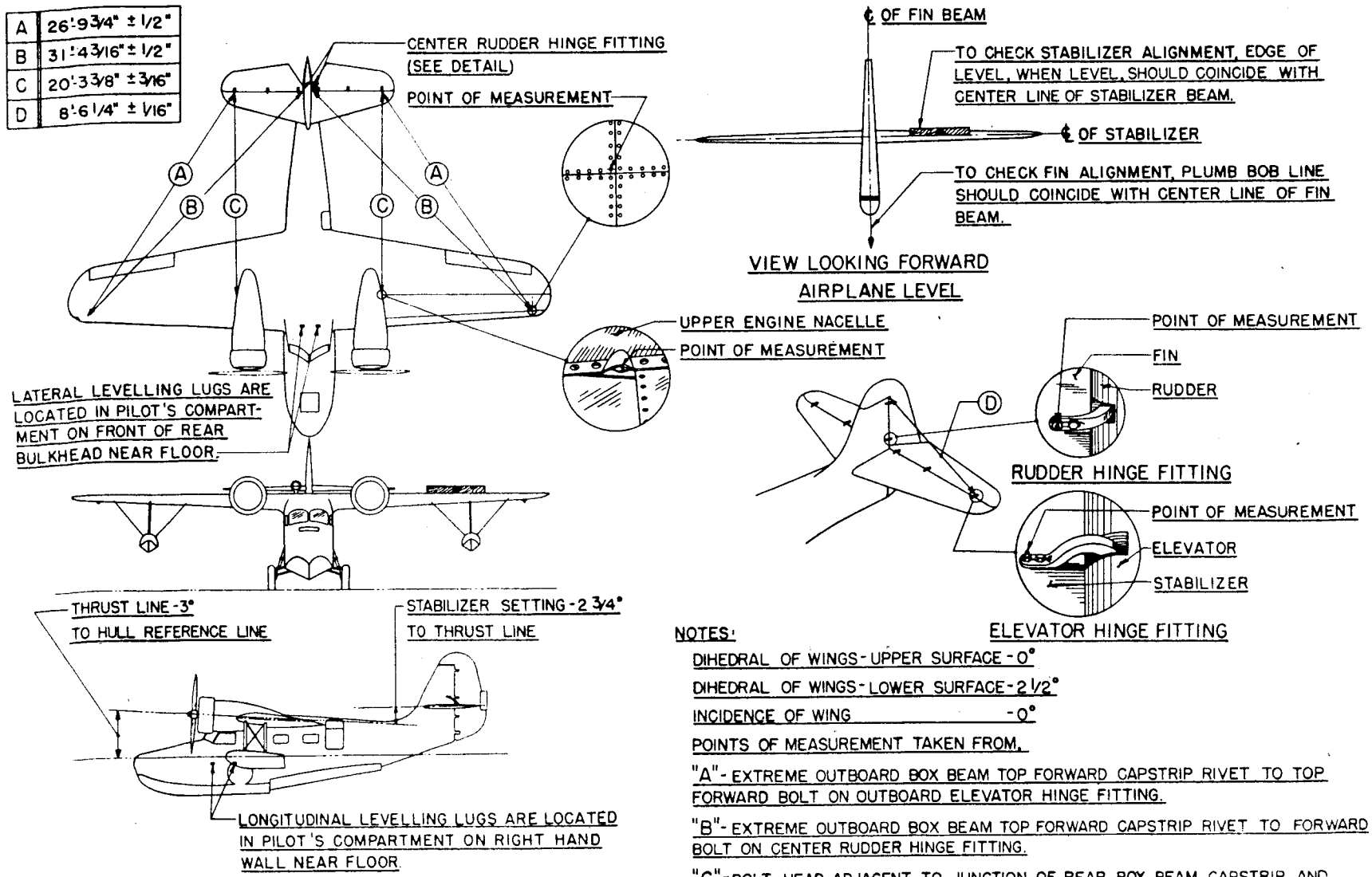
HAND TYPE FIELD REPAIR RIVET SET

Figure 125 - Rivet Sets



	DASH NO.	RIVET DIA.	C +.000 -.001	B
MALE	-1	3/32	1/4	3/32
	-2	1/8	5/16	1/8
	-4	3/16	7/16	3/16
	-3	5/32	3/8	5/32
FEMALE	-21	3/32	.220	.098
	-22	1/8	.292	.128
	-23	5/32	.357	.161
	-24	3/16	.421	.193

Figure 126 - Dimple Sets



NOTES:

DIHEDRAL OF WINGS - UPPER SURFACE - 0°

DIHEDRAL OF WINGS - LOWER SURFACE - 2 1/2°

INCIDENCE OF WING -0°

POINTS OF MEASUREMENT TAKEN FROM,

"A" - EXTREME OUTBOARD BOX BEAM TOP FORWARD CAPSTRIP RIVET TO TOP FORWARD BOLT ON OUTBOARD ELEVATOR HINGE FITTING.

"B" - EXTREME OUTBOARD BOX BEAM TOP FORWARD CAPSTRIP RIVET TO FORWARD BOLT ON CENTER RUDDER HINGE FITTING.

"C" - BOLT HEAD ADJACENT TO JUNCTION OF REAR BOX BEAM CAPSTRIP AND UPPER ENGINE NACELLE, TO TOP FORWARD BOLT ON OUTBOARD ELEVATOR HINGE FITTING.

"D" - UPPER AFT CORNER OF FIN TO TOP FORWARD BOLT ON OUTBOARD ELEVATOR HINGE FITTING.

Figure 127 - Rigging Check Dimension Diagram

RESTRICTED

RESTRICTED
Nav. Aer. 01-85V-3

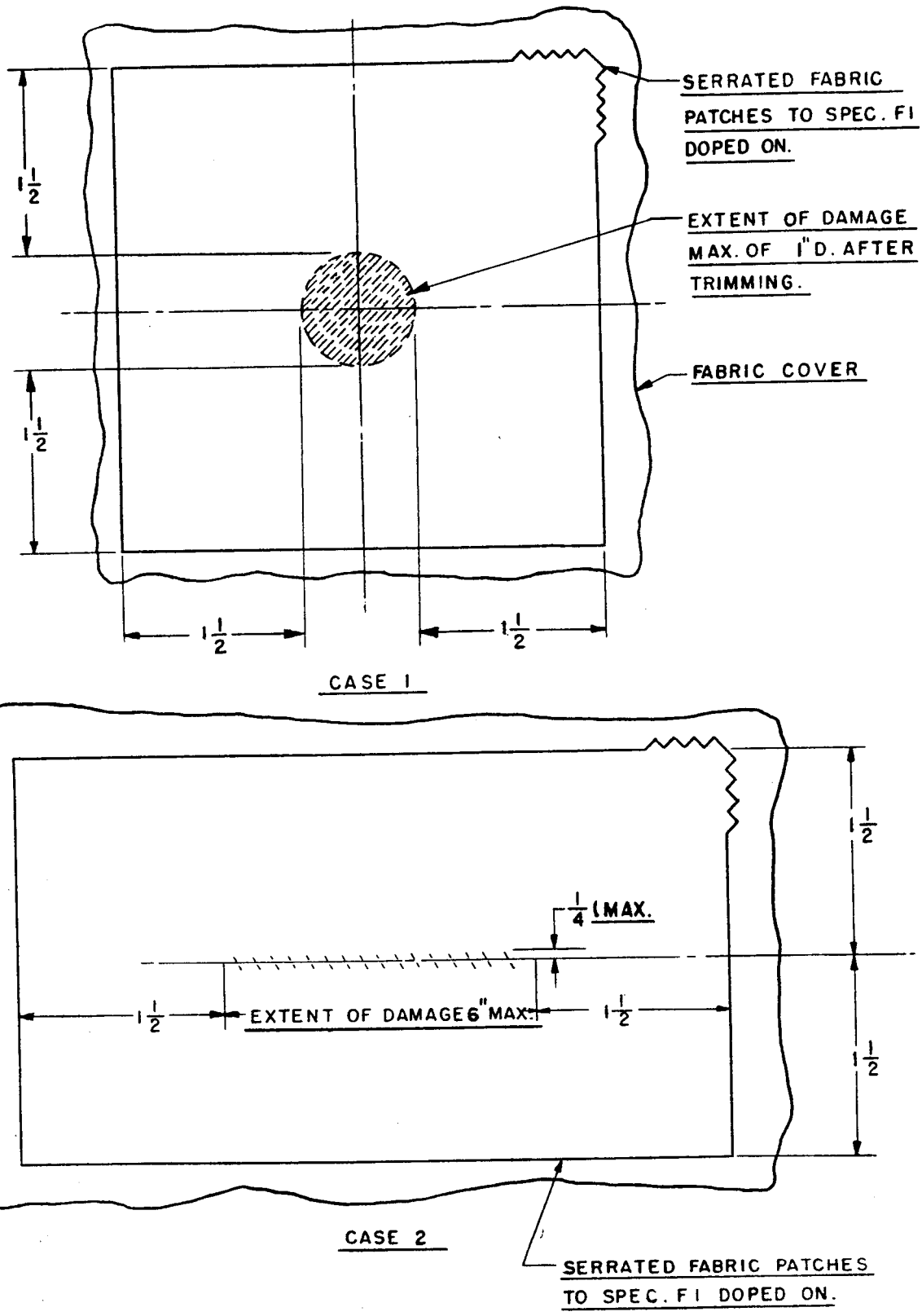
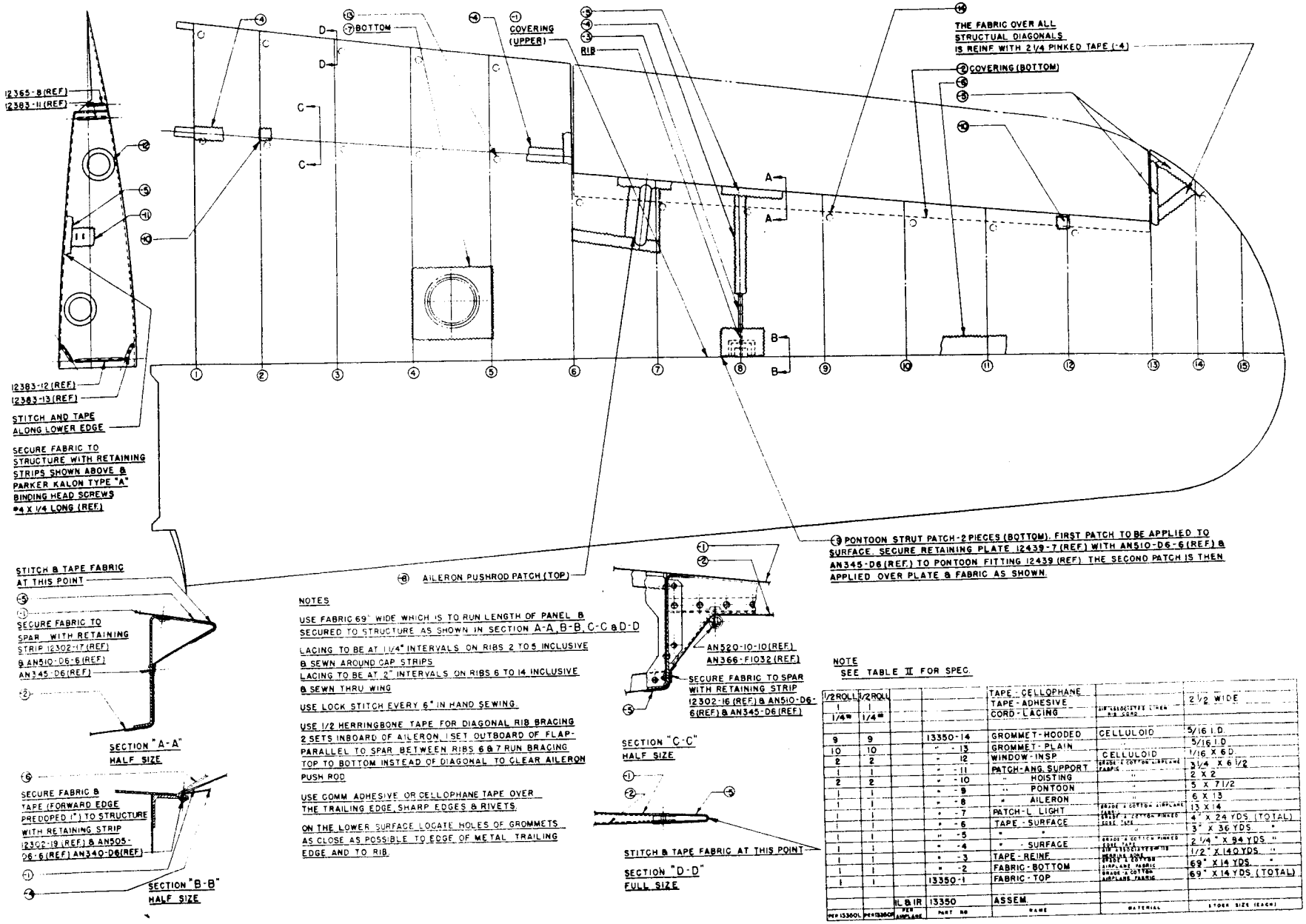


Figure 128 – Fabric Patch Repair



NOTES

USE FABRIC 69" WIDE WHICH IS TO RUN LENGTH OF PANEL & SECURED TO STRUCTURE AS SHOWN IN SECTION A-A, B-B, C-C & D-D

LACING TO BE AT 1 1/4" INTERVALS ON RIBS 2 TO 5 INCLUSIVE & SEWN AROUND CAP STRIPS
LACING TO BE AT 2" INTERVALS ON RIBS 6 TO 14 INCLUSIVE & SEWN THRU WING

USE LOCK STITCH EVERY 6" IN HAND SEWING

USE 1/2 HERRINGBONE TAPE FOR DIAGONAL RIB BRACING 2 SETS INBOARD OF AILERON, 1 SET OUTBOARD OF FLAP-PARALLEL TO SPAR BETWEEN RIBS 6 & 7 RUN BRACING TOP TO BOTTOM INSTEAD OF DIAGONAL TO CLEAR AILERON PUSH ROD

USE COMM ADHESIVE OR CELLOPHANE TAPE OVER THE TRAILING EDGE, SHARP EDGES & RIVETS.

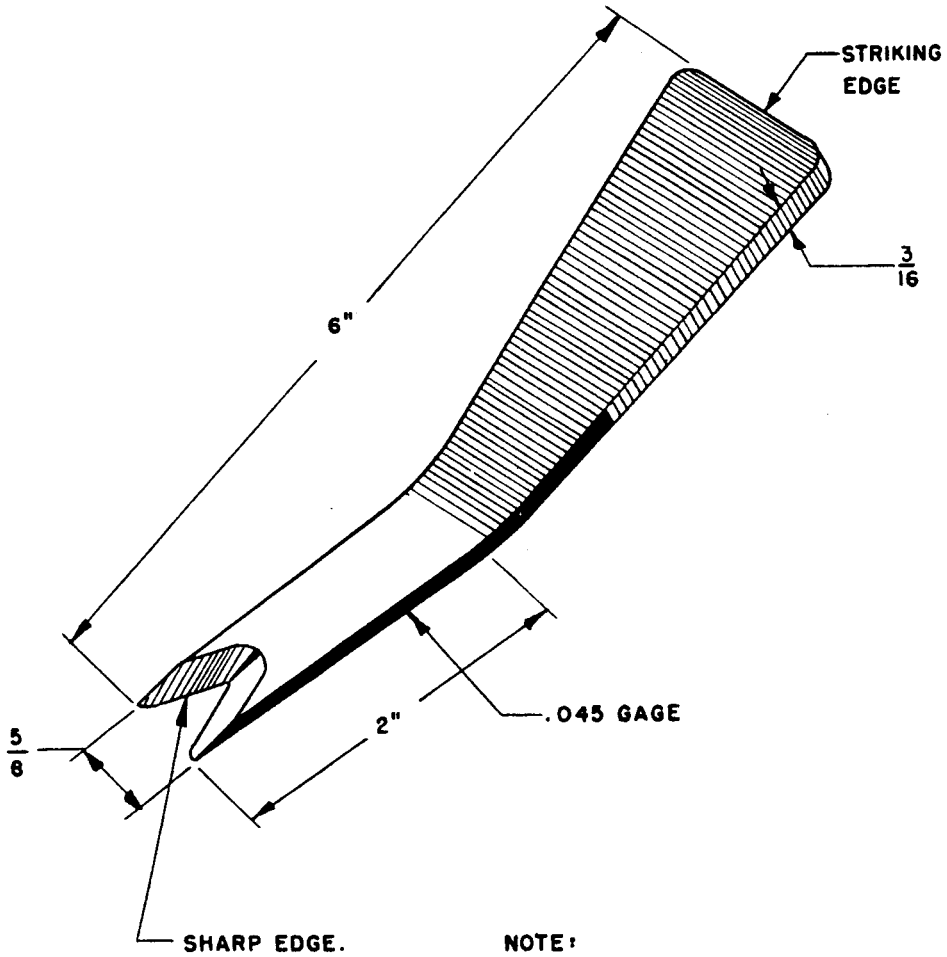
ON THE LOWER SURFACE LOCATE HOLES OF GROMMETS AS CLOSE AS POSSIBLE TO EDGE OF METAL TRAILING EDGE AND TO RIB.

NOTE
SEE TABLE II FOR SPEC.

1/2 ROLL	1/2 ROLL			TAPE - CELLOPHANE			2 1/2 WIDE
1	1			TAPE - ADHESIVE			
1/4 M	1/4 M			CORD - LACING			
9	9		13350-14	GROMMET - HOODED	CELLULOID		5/16 I.D.
10	10		" -13	GROMMET - PLAIN	"		5/16 I.D.
2	2		" -12	WINDOW - INSP	CELLULOID		1/16 X 6 D.
1	1		" -11	PATCH-ANG. SUPPORT			3 1/4 X 6 1/2
2	2		" -10	" HOISTING	"		2 X 2
1	1		" -9	" PONTOON	"		5 X 7 1/2
1	1		" -8	" AILERON	"		6 X 13
1	1		" -7	PATCH-L LIGHT			13 X 14
1	1		" -6	TAPE - SURFACE			4" X 24 YDS (TOTAL)
1	1		" -5	" "	"		3" X 36 YDS "
1	1		" -4	" SURFACE			2 1/4" X 94 YDS "
1	1		" -3	TAPE - REINF.			1/2" X 140 YDS "
1	1		" -2	FABRIC - BOTTOM			69" X 14 YDS "
1	1		13350-1	FABRIC - TOP			69" X 14 YDS (TOTAL)
		NL & IR PER AIRPLANE	13350 PART NO	ASSEM. NAME	MATERIAL		STOCK SIZE (EACH)

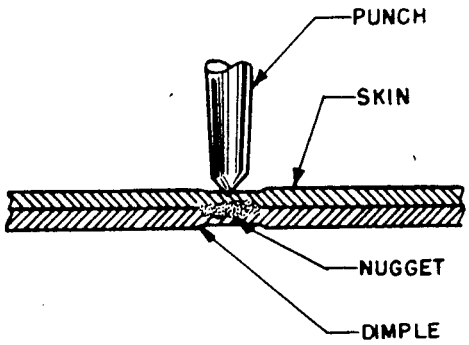
Figure 129 - Fabric Covering

RESTRICTED



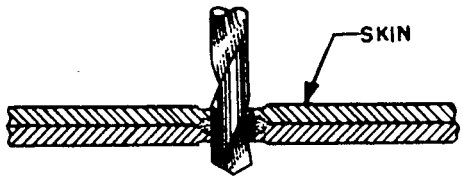
NOTE:
USE GOOD GRADE OF TOOL STEEL WITH HARDENED CUTTING EDGE. HEAT TREAT SHOULD BE A LITTLE HARDER THAN SPRING STEEL.

Figure 130 - Spot Weld Shearing Chisel



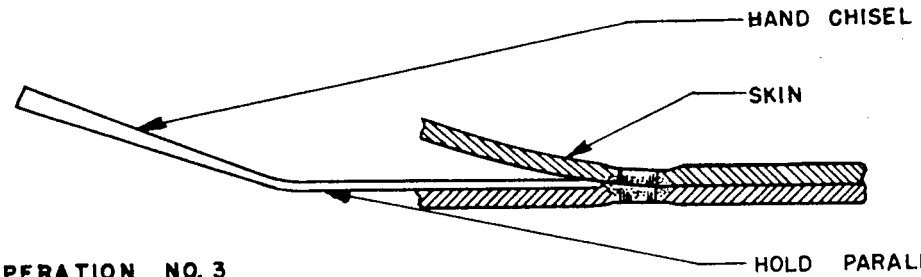
OPERATION NO. 1

CENTER PUNCH IN CENTER OF DIMPLE TO FACILITATE STARTING OF DRILL



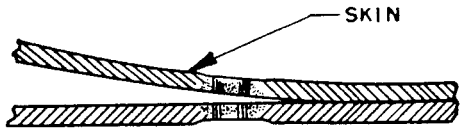
OPERATION NO. 2

DRILL THROUGH SPOTWELD WITH PROPER SIZE DRILL FOR RIVET.



OPERATION NO. 3

CAREFULLY INSERT CHISEL UNDER SKIN CENTERED ON SPOTWELD AND SHEAR OFF REMAINDER OF NUGGET.

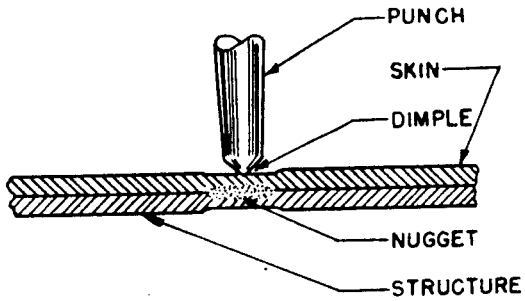


SHEARED SPOTWELD

Figure 131 - Method of Shearing Spot Welds for Riveting

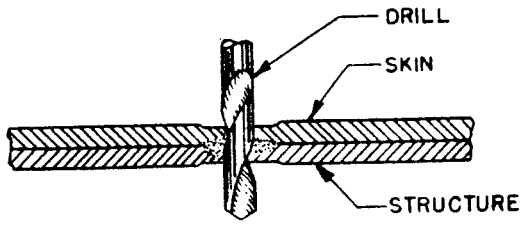
OPERATION NO. 1

CENTER PUNCH IN CENTER OF DIMPLE TO FACILITATE STARTING OF DRILL



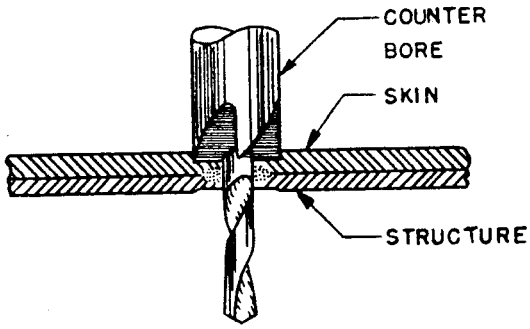
OPERATION NO. 2

DRILL THROUGH SPOTWELD WITH PROPER SIZE DRILL.

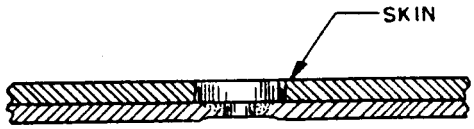


OPERATION NO 3.

PLACE PILOT OF COUNTER BORE INTO DRILLED HOLE & COUNTER BORE THROUGH SPOTWELD UNTIL BOND OF NUGGET HAS BEEN SHEARED OFF.

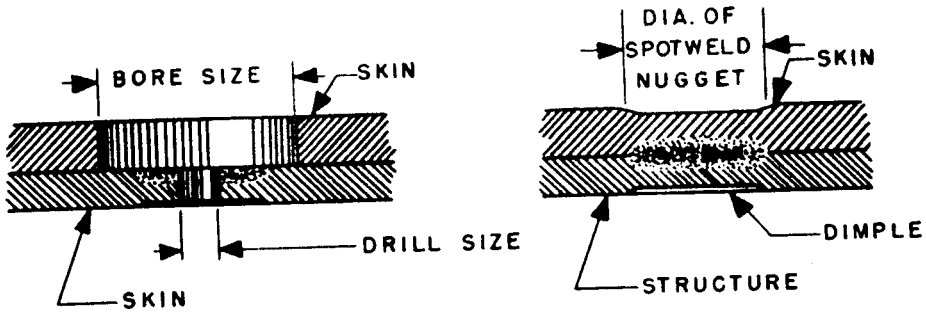


NOTE: THIS PROCEDURE SHOULD BE USED ONLY WHERE STRUCTURE IS OF LIGHT GAUGE ALLOY SHEET. SKIN SHALL BE REMOVED. AND REPLACED WITH NEW PATCH OR INSERTION PIECE.



SPOTWELD BOND REMOVED

Figure 132 - Method of Removing Spot Welded Skin From Structure

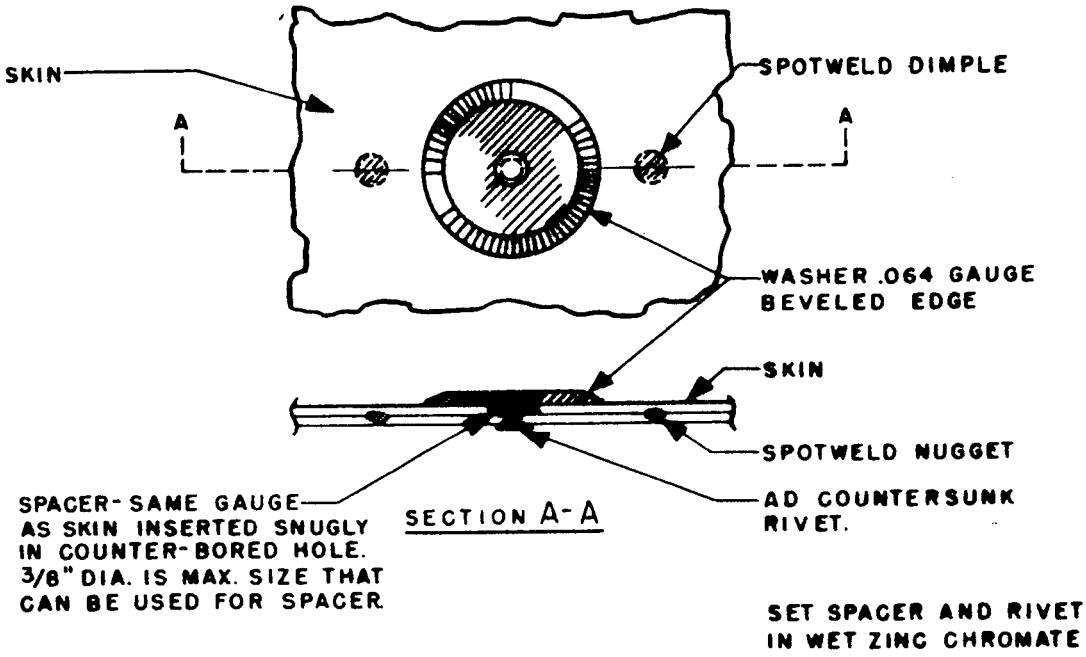


SPOT WELD
TABLE

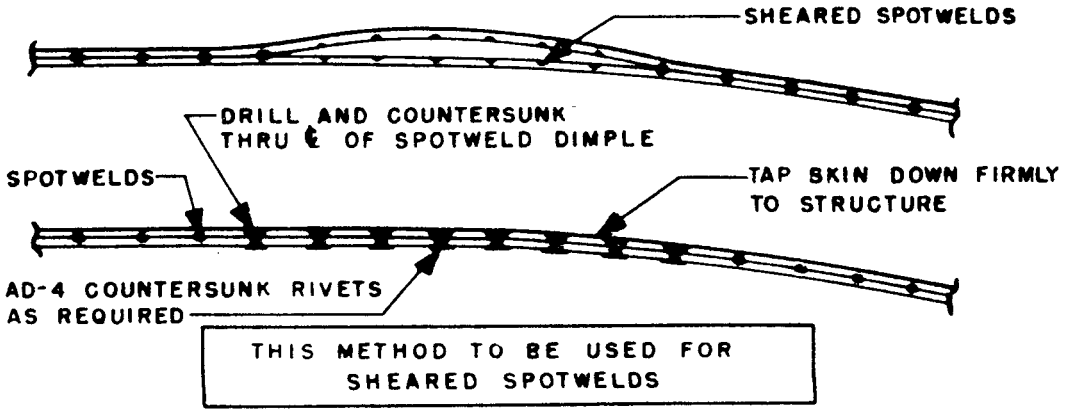
SHEET GAGE	DIAMETER OF NUGGET	BORE SIZE
.016	1/8	1/4
.020	9/64	1/4
.025	5/32	1/4
.032	3/16	1/4
.040	7/32	1/4
.045	15/64	1/4
.051	1/4	1/4
.064	9/32	3/8
.072	19/64	3/8
.081	5/16	3/8
.091	11/32	3/8
.109	3/8	3/8
.125	3/8	3/8

RIVET	DRILL NO.
3/32	41
1/8	30
5/32	22
3/16	12

Figure 133 - Table of Drill Sizes for Removal of Spot Welds



THIS METHOD OF REPAIR SHOULD BE USED ONLY IN CASES WHERE SKIN SEPARATES FROM STRUCTURE LEAVING A BUTTON OF SKIN NOT GREATER THAN 3/8" DIA. ON STRUCTURE



THIS METHOD TO BE USED FOR SHEARED SPOTWELDS

Figure 134 - Repair of Sheared Spot Welds

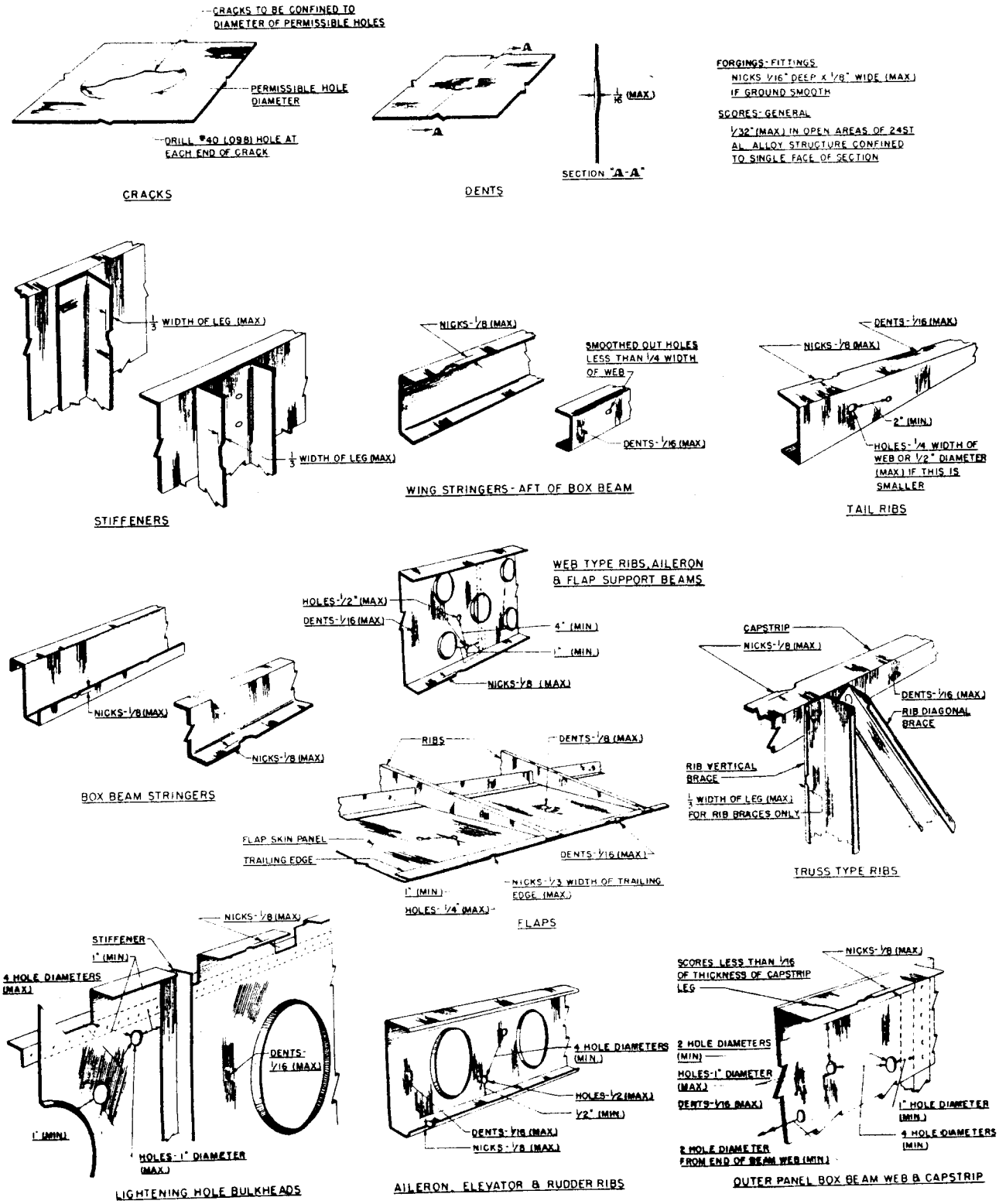


Figure 135 - Negligible Damage Diagram

RESTRICTED

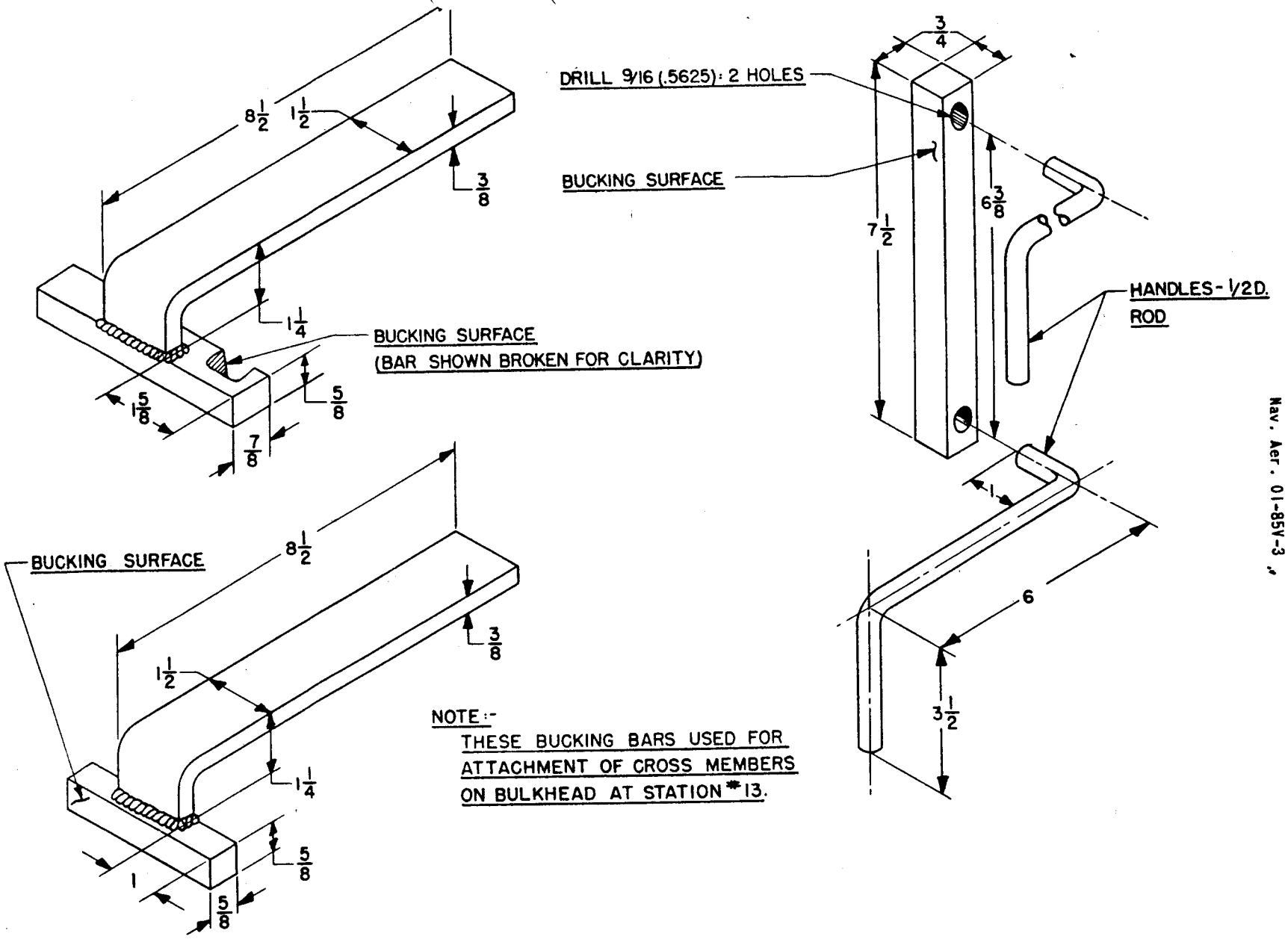


Figure 136 - Bucking Bars - Hull Station #13

RESTRICTED
Nav. Aer. 01-85V-3

APPENDIX I

LIST OF EQUIVALENTS

U.S.A. AND BRITISH SPECIFICATIONS ON MATERIALS

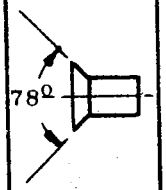
Material	U.S.A. Specification Commercial	U.S. Navy	British Specification	Ultimate Tensile Lbs. per sq. in. U.S.A.	Strength Tons per sq. in British
Aluminum Alloy Extrusion	24ST	46A9	DTD364-A	57,000	25.4
Round Aluminum Tubing	2S½H	44T19	T-9	17,000	7.59
Round Aluminum Alloy Tubing	52SO	44T32	DTD-310-A	29,000	12.9
Steel Sheet	X-4130	47S14	S86	90,000 normalized	40.1
Round Steel Tube	X-4130	44T18	DTD-178 or T-50	90,000 normalized	40.1
SHEET STOCK					
Aluminum Alloy	3S½H	47A4	DTD-213	19,500	8.7
Alclad Aluminum Alloy	AL-24SO	A.Anneal	DTD-275 Annealed	32,000	14.29
Alclad Aluminum Alloy	AL-24ST	47A8 Cond. T	DTD-275	56,000	25.0
Aluminum Alloy	24ST	47A10		62,000	
Aluminum Alloy	52SO	47A11	No. Equiv. Suggest 2L.17	26,500	11.83
		Type 1-A		31,000	13.74
Steel - Chrome Molybdenum	X-4130	47S14	S.86	90,000 normalized	40.1
				200,000 H.T.	80.9
BAR & EXTRUDED STOCK					
Steel - Corrosion Resistant	Columbium 18-8	47S19	No Equivalent	80,000	35.6
FORGING STOCK					
Steel - Corrosion Resistant	Columbium 1-8	47S19	No Equiv. DTD-262 nearest	80,000	35.6

APPENDIX II

ENGINEERING ADDENDA

Grumman Standard Practice

STANDARD GRUMMAN RIVETS

SHAPE	STANDARD NUMBER	DIA.	HEAD AS PURCHASED	MATERIAL	REMARKS & USE
	G10 G10D	3/16 3/16	Flat Flat	X4130 17ST	Hollow Point: Used thru hollow part (Tubing).
	G29AD See foot Note	1/8 only	Brazier Head (Small)	A17ST	May be used for fuselage skins, all commercial and Army airplanes, and all Navy land planes. If used with Alclad, they are OK for use on water planes.
	G29D	1/8 only	Brazier Head (Small)	17ST	Used for fuselage skins, Navy amphibians & flying boats, if material of sheet is alum. alloy.
	for 1/16 and 3/32 Use AN425AD	1/8	78° Countersunk Head	A17ST	Used for flush riveting on all airplanes except Navy flying boats and amphibians: In sizes up to and incl. 3/16 Dia. OK if used with Alclad.
	G73AD See Foot Note	5/32	78° Countersunk Head	A17ST	Used for flush riveting on all airplanes except Navy flying boats & amphibians: In sizes up to and incl. 3/16 Dia. OK if used with Alclad.
		3/16	78° Countersunk Head	A17STT	Used for flush riveting on all airplanes except Navy flying boats & amphibians; In sizes up to and incl. 3/16 Dia. OK if used with Alclad.
	For 1/16 and 3/32 Use AN425D G73D	1/8	78° Countersunk Head	17ST	Used for flush riveting Navy amphibians and flying boats.
		5/32	78° Countersunk Head	17ST	Used for flush riveting Navy amphibians and flying boats.
		3/16	78° Countersunk Head	17ST	Used for flush riveting Navy amphibians and flying boats.
		1/4	78° Countersunk Head	17ST	Used for flush riveting Navy amphibians and flying boats.
	AN455AD See Foot Note	-	Brazier	A17ST	May be used on all planes except Navy amphibians and flying boats: In sizes up to and incl. 3/16 dia. OK if used with Alclad.
	AN455D	-	Brazier	17ST	May be used on Navy amphibians & flying boats, all sizes: and may be used on all planes in sizes above 3/16 dia.
	NAF 210988	- -	Oval Countersunk Head	17ST	Used on hull bottoms. F4F-4, F4F-4B & FM-1, stub wing panels.

RIVET TYPES

	G10	G29	AN455	AN430
	HOLLOW POINT	MODIFIED BRAZIER HD.	BRAZIER HD.	ROUND HD.
MAT'L.	X4130 STEEL 17ST	A17ST 17ST	A17ST 17ST	A17ST 17ST
DIA.	3/16" ONLY	1/8" ONLY	5/32"-3/8"	3/32"-3/8"

	AN425	G73	NAF 210988
	78° C'SUNK HD.	MODIFIED 78° C'SUNK HD.	OVAL C'SUNK HD.
MAT'L.	A17ST 17ST	A17ST 17ST	17ST
DIA.	1/16" & 3/32" ONLY	1/8" - 3/8"	1/8" - 1/4"

G73-AD 4 - 8

- 8 — LENGTH IN 1/16TH. (8/16 = 1/2" LONG)
- 4 — DIA. IN 1/32NDS. (4/32 = 1/8" DIA.)
- AD — MATERIAL (AD = A17ST)
- G73 — HEAD TYPE (MODIFIED 78° C'SUNK. HD.)

MATERIALS

NO CODE = STEEL
AD = A17ST
D = 17ST

DIAMETERS

-2 = 1/16"
-3 = 3/32"
-4 = 1/8"
-5 = 5/32"
-6 = 3/16"
-8 = 1/4"
-10 = 8/16"
-12 = 3/8"

LENGTHS

-2 = 1/8"
-3 = 3/16"
-4 = 1/4"
-5 = 5/16"
-6 = 3/8"
-7 = 7/16"
-8 = 1/2"
-9 = 9/16"
-10 = 5/8"
-12 = 3/4"
-14 = 7/8"
-16 = 1"
-18 = 1-1/8"
-20 = 1-1/4"
-22 = 1-3/8"
-24 = 1-1/2"
-28 = 1-3/4"
-32 = 2"

DRILL SIZES FOR "G" 73 FLUSH RIVETS

Rivet Dia.	Rivet Number	Member	Sheet Thickness Range	Drill Size	Process
1/8	G73-4	Top Sheet	.020 - .025	#34 (.111)	Dimple 78°
			.032 - .040	#30 (.1285)	Dimple 78°
			.051 & Greater	#30 (.1285)	C'sink 78°x13/64 Dia.
		Bottom Sheet	.032 - .040	#30 (.1285)	Dimple 90°
			.051 & Greater	#30 (.1285)	C'sink 90°x1/4 Dia.
5/32	G73-5	Top Sheet	.020 - .051	#21 (.159)	Dimple 78°
			.054 & Greater	#20 (.161)	C'sink 78°x1/4 Dia.
		Bottom Sheet	.040 - .051	#27 (.144)	Dimple 90°
			.064 & Greater	#20 (.161)	C'sink 90°x9/32 Dia.
3/16	G73-6	Top Sheet	.032 - .064	3/16 (.1875)	Dimple 78°
			.081 & Greater	#10 (.1935)	C'sink 78°x19/64 Dia.
		Bottom Sheet	.051 - .064	#17 (.173)	Dimple 90°
			.081 & Greater	#10 (.1935)	C'sink 90°x11/32 Dia.

DRILL SIZES FOR "G" STD. SCREWS

100° C'SUNK. RECESSED HD.

Screw Size	Screw No.	Member	Sheet Thickness Range	Drill Size	Process
#8-32	G92	Top Sheet	.014 - .064	#28 (.1405)	Dimple 100°
			.081 & Greater	#19 (.166)	C'sink 100°x5/16 Dia.
		Bottom Sheet	.014 - .064	#28 (.1405)	Dimple 100°
			.081 & Greater	#19 (.166)	C'sink 110°x3/8 Dia.
#10-32	G93	Top Sheet	.032 - .064	#19 (.166)	Dimple 100°
			.081 & Greater	#11 (.191)	C'sink 100°x3/8 Dia.
		Bottom Sheet	.051 - .064	#19 (.166)	Dimple 100°
			.081 & Greater	#11 (.191)	C'sink 110°x7/16 Dia.

DRILL SIZES

DECIMAL EQUIVALENTS OF DRILL SIZES FROM 1/2" TO NO. 80

Size	Decimal Equiv.	Size	Decimal Equiv.	Size	Decimal Equiv.	Size	Decimal Equiv.
1/2	0.500	G	0.261	5/32	0.1562	51	0.067
31/64	0.4843	F	0.257	23	0.154	52	0.0635
15/32	0.4687	E-1/4	0.250	24	0.152	1/16	0.0625
29/64	0.4531	D	0.246	25	0.1495	53	0.0595
7-16	0.4375	C	0.242	26	0.147	54	0.055
27/64	0.4218	B	0.238	27	0.144	55	0.052
Z	0.413	15/64	0.2343	9/64	0.1406	3/64	0.0468
13/32	0.4062	A	0.234	28	0.1405	56	0.0465
Y	0.404	1	0.228	29	0.136	57	0.043
X	0.397	2	0.221	30	0.1285	58	0.042
25/64	0.3906	7/32	0.2187	1/8	0.125	59	0.041
W	0.386	3	0.213	31	0.120	60	0.040
V	0.377	4	0.209	32	0.116	61	0.039
3/8	0.375	5	0.2055	33	0.113	62	0.038
U	0.368	6	0.204	34	0.111	63	0.037
23/64	0.3593	13/64	0.2031	35	0.110	64	0.036
T	0.358	7	0.201	7/64	0.1093	65	0.035
S	0.348	8	0.199	36	0.1065	66	0.033
11/32	0.3437	9	0.196	37	0.104	1/32	0.0312
R	0.339	10	0.1935	38	0.1015	67	0.032
Q	0.332	11	0.191	39	0.0995	68	0.031
21/64	0.3281	12	0.189	40	0.098	69	0.029
P	0.323	3/16	0.1875	41	0.096	70	0.028
O	0.316	13	0.185	3/32	0.0937	71	0.026
5/16	0.3125	14	0.182	42	0.0935	72	0.025
N	0.302	15	0.180	43	0.089	73	0.024
19/64	0.2968	16	0.177	44	0.086	74	0.0225
M	0.295	17	0.173	45	0.082	75	0.021
L	0.290	11/64	0.1718	46	0.081	76	0.020
9/32	0.2812	18	0.1695	47	0.0785	77	0.018
K	0.281	19	0.166	5/64	0.0781	1/64	0.0156
J	0.277	20	0.161	48	0.076	78	0.016
I	0.272	21	0.159	49	0.073	79	0.0145
H	0.266	22	0.157	50	0.070	80	0.0135
17/64	0.2656						

TAP DRILLS

SIZE	THREAD	TAP DRILL
#4	40 COARSE	#44 (.086)
#4	48 FINE	#42 (.0935)
#6	32 COARSE	#36 (.106)
#6	40 FINE	#34 (.111)
#8	32 COARSE	#29 (.136)
#8	36 FINE	#29 (.136)
#10	24 COARSE	#26 (.147)
#10	32 FINE	#22 (.157)
1/4	20 COARSE	#8 (.199)
1/4	28 FINE	#3 (.213)
5/16	18 COARSE	"F" (.257)
5/16	24 FINE	"I" (.272)
3/8	16 COARSE	5/16 (.3125)
3/8	24 FINE	"Q" (.332)
7/16	14 COARSE	"V" (.368)
7/16	20 FINE	"W" (.386)
1/2	13 COARSE	27/64 (.4219)
1/2	20 FINE	29/64 (.453)
9/16	12 COARSE	31/64 (.4844)
9/16	18 FINE	(.5062)
5/8	11 COARSE	17/32 (.5312)
5/8	18 FINE	(.5709)
11/16	11 COARSE	19/32 (.593)
11/16	16 FINE	5/8 (.625)
3/4	10 COARSE	(.6496)
3/4	16 FINE	11/16 (.6875)
7/8	9 COARSE	49/64 (.7656)
7/8	14 FINE	(.800)
1	8 COARSE	7/8 (.875)
1	14 FINE	(.9252)
1-1/8	7 COARSE	63/64 (.9844)
1-1/8	12 FINE	(1.0433)
1-1/4	7 COARSE	1-7/64 (1.1094)
1-1/4	12 FINE	(1.1614)

NOTE: Threads shown in table are National Coarse and National Fine. Coarse threads shall be called for on all parts where holes are tapped for cap screws.

Tap drill sizes are chosen to produce as near 80% basic thread depth as possible. Ref: Air Corps. D. R. M.

STANDARD SIZE HOLES

NOMINAL SIZE OF SCREW, BOLT OR RIVET	MAX. DIAMETER OF SHANK (AN)			ARTICLE	DRILL SIZE	APPROXIMATE FINISHED HOLE SIZE
	SCREW	BOLT	RIVET			
1/16 (.0625)			.0655	Rivet	#51 (.067)	.068
3/32 (.09375)			.09675	Rivet	#40 (.098)	.098
1/8 (.125)			.1285	Rivet	#30 (.1285)	.130
#6 (.138)	.138			Screw	#28 (.1405)	.142
5/32 (.15625)			.16025	Rivet	#20 (.161)	.163
#8 (.164)	.164			Screw	#19 (.166)	.168
3/16 (.1875)			.1915	Rivet	#10 (.1935)	.195
#10* (.190)	.190	.189		Screw or bolt	#11 (.191)	.193
1/4 (.250)			.254	Rivet	"F" (.257)	.259
1/4 (.250)	.250	.249		Screw or bolt	1/4 (.250)	.252
5/16 (.3125)			.3165	Rivet	"O" (.316)	.318
5/16 (.3125)	.3125	.3115		Screw or bolt	5/16 (.3125)	.315
3/8 (.375)			.379	Rivet	"V" (.377)	.380
3/8 (.375)		.374		Bolt	3/8 (.375)	.378
7/16 (.4375)		.4365		Bolt	7/16 (.4375)	.440
1/2 (.500)		.499		Bolt	1/2 (.500)	.503
9/16 (.5625)		.5615		Bolt	9/16 (.5625)	.566
5/8 (.625)		.624		Bolt	5/8 (.625)	.628
11/16 (.6875)		.6875		Bolt	11/16 (.687)	.691
3/4 (.750)		.749		Bolt	3/4 (.750)	.753

* #10 bolts are prohibited for structural use without specific approval of the structures engineer.

HOLES

EDGE DISTANCE OF RIVET & BOLT HOLES

The normal edge distance of holes in sheet metal members shall equal twice the diameter of the hole unless structural requirements or additional shop allowances dictate the need for a greater margin.

An edge distance of one and one half diameters shall be considered the minimum allowable margin only under conditions conductive to good tolerances, and should not be used for structural members.

PARTS WHICH ARE RIVETED, SCREWED, OR BOLTED TOGETHER

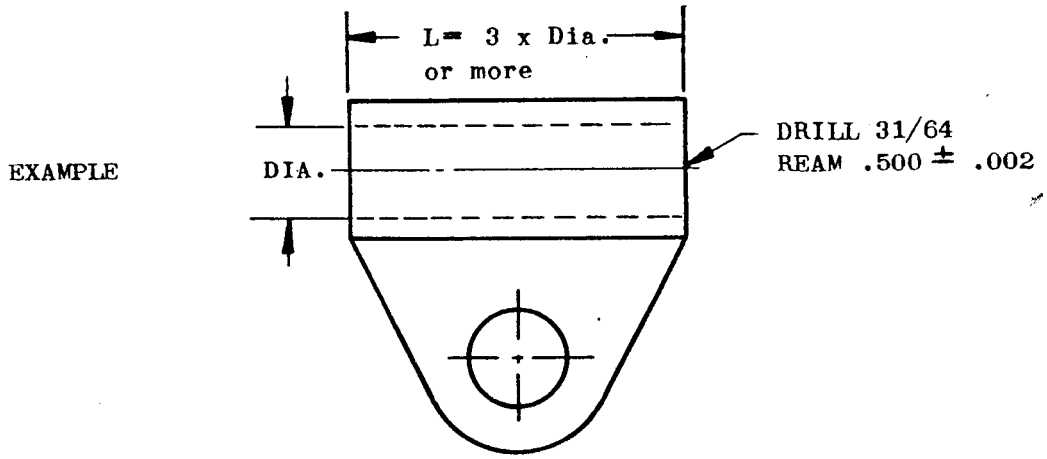
Bolts - not subject to reverse loads, and where a good close push fit is required, shall be drilled (except where punched holes are specified) with the CLEARANCE DRILL SIZES as tabulated on page A-7.

LONG LENGTH BOLT HOLES

Bolt holes which structurally would permit drilling to size, but which are THREE OR MORE DIAMETERS IN LENGTH shall be called for as REAMED HOLES with tolerances of ± .002.

The reason for this is that any long length drilled hole will tend to follow a curved rather than a straight axis and the length of this curve will often be sufficient to prevent the entry of an axially true bolt.

See also "Straight" & "Line Reaming" on page A-10.



BOLTS & PINS SUBJECT TO REVERSE LOADS

Parts which are subject to reverse loads require close fits for Bolts and Pins, and the holes shall be REAMED to size in accordance with the reamed hole tolerances for "AN-Bolts" or "G155 Close Tolerence Bolts" (Grumman Standard Parts) depending on the particular requirements.

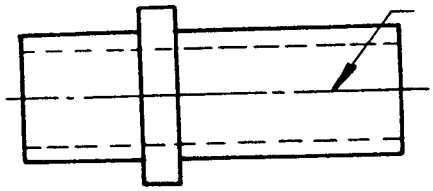
HOLES

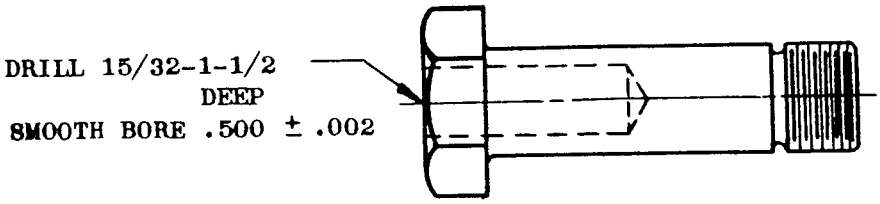
(Continued)

HOLLOW STRUCTURAL PARTS - Shank Bolts, Shafts, Etc.

In order to provide a smooth interior free from any scoring which would cause fatigue susceptability of the part, drilled holes in structural parts shall call for hole to be drilled 1/64 undersize and reamed, or drilled 1/32 undersize and smooth bored to size with a tolerance of ±.002.

EXAMPLES





PUNCHED HOLES

PUNCHED HOLES IN ALUM. ALLOY SHEETS

Note the following revision to U.S. Navy General Specification dated Nov. 3, 1938. (re para #339, Spec. SD-24-D.)

Where punched holes in aluminum alloy sheets are used for structural rivets, bolts, and pins, they may be punched to the finished diameter subject to the following conditions:

(a) The sheet shall not exceed a nominal thickness of .065".

(b) Holes shall not be punched to a nominal diameter greater than 3/16".

(c) The clearance between the punch and the die shall be from 7 percent to 10 percent of the sheet thickness.

(d) Punching shall only be done with sharp punches.

(e) Sheets which have been abraded, dented or otherwise deformed in the vicinity of the holes by the stripping plate of the punch press shall not be accepted.

(f) Where holes larger than 3/16" diameter are desired, or where the sheet thickness is greater than .065", the holes shall either be drilled to the finished size or they may be punched 1/32" undersize and reamed to fit.

REAMED - HOLES

STRAIGHT REAMING, in which the tool is supported only at one end, is a means of accurately bringing a hole to size and finishing to a smooth surface. While this type of reaming also has a tendency to straighten a long hole it cannot be relied upon to do so where the hole is of considerable length because the nature of the tool is such that it must follow the preliminary drilled hole.

LINE REAMING, in which the reamer is supported by bushings at both ends, is a method used to straighten relatively long holes of reasonable size.

LARGE MACHINED HOLES, one inch or more indiameter should be planned for boring rather than reaming. This applies to relatively long holes as well. It can readily be understood careful consideration must be given to tool access and that the length of a bored hole is a function of its diameter.

SIZES OF REAMERS - Ream sizes shall be called for in decimals and shall be of standard diameters. Control of fits may then be obtained by adjusting the diameters of mating parts.

STANDARD DIAMETERS - STRAIGHT REAMERS

.1875	.500	.8125	1.250	1.875
.190	.531	.843	1.3125	1.9375
.250	.5625	.875	1.375	2.000
.281	.593	.906	1.4375	2.0625
.3125	.625	.9375	1.5000	2.125
.343	.656	.968	1.5625	2.1875
.375	.6875	1.000	1.625	2.250
.406	.718	1.0625	1.6875	2.375
.4375	.750	1.125	1.750	2.500
.468	.781	1.1875	1.8125	

DRILLED - HOLES

STANDARD DRILL POINTS have an included angle of 118^{o}

TOLERANCES ON DRILLED HOLES shall be as follows:

From 3/32" dia. to 1/2" dia.= ± .005
Above 1/2" dia. = ± .008

NORMAL TO SURFACE

Drilling of holes where the drill is not normal to the surface being drilled should be avoided to prevent inaccuracies due to creepage. This can only be eliminated thru the use of costly drill jigs having drill bushings ground to the same angle as the work and placed as close as possible to the surface being drilled.

STANDARD TOLERANCES

"AN" BOLTS		REAMED HOLE DIA.	FREE BEARING FITS		
NUMBER	NOMINAL SIZE		SHAFT DIA. +.000 -.002	CLEARANCE	
				MINIMUM	MAXIMUM
		.1875 ± .001	.1860	.0005	.0045
AN3	#10	.190 ± .001	For Use With #10 Bolt Only		
AN4	1/4	.2500 ± .001	.2485	.0005	.0045
AN5	5/16	.3125 ± .001	.3110	.0005	.0045
AN6	3/8	.3750 ± .001	.3730	.001	.005
AN7	7/16	.4375 ± .001	.4355	.001	.005
AN8	1/2	.5000 ± .001	.4975	.0015	.0055
AN9	9/16	.5625 ± .001	.5600	.0015	.0055
AN10	5/8	.6250 ± .001	.6225	.0015	.0055
		.6875 ± .001	.6850	.0015	.0055
AN12	3/4	.7500 ± .001	.7475	.0015	.0055
		.8125 ± .001	.8100	.0015	.0055
AN14	7/8	.8750 ± .001	.8720	.002	.006
		.9375 ± .001	.9345	.002	.006
AN16	1	1.0000 ± .001	.9965	.0025	.0065
		1.1250 ± .001	1.1215	.0025	.0065
		1.2500 ± .001	1.2465	.0025	.0065
		1.3750 ± .001	1.3715	.0025	.0065
		1.5000 ± .001	1.4955	.0035	.0075
		1.6250 +.001 -.0015	1.6200	.0035	.008
		1.7500 +.001 -.0015	1.7450	.0035	.008
		1.8750 +.001 -.0015	1.8700	.0035	.008
		2.0000 +.001 -.0015	1.9950	.0035	.008

NOTES: For G155 Close Tolerance Bolts used singly or in pairs Use Reamer Tolerance

±.0005 Up to and Incl. 9/16" Dia. for 5/8" to 1" Dia. Use Reamer Tolerance +.0005
-.0010

For Patterns of 3 or more bolts use tolerance +.0010 up to and incl. 9/16" dia. -.0005

For 5/8" to 1" dia. use tolerance +.0015
-.0010

The Above Shaft Tolerances Are For Slow Speeds and Grease Lubrication.

STANDARD CYLINDRICAL PRESS FITS

REAMED HOLE	SPECIFIED MIN. RADIUS FOR 24ST FITTING	BUSHING O. D.	INTERFERENCE		MIN. PERMISSIBLE EDGE DISTANCE 24ST FITTING
			MIN.	MAX.	
.4375 ± .0005	5/8	.4387 +.0000 −.0005	.0002	.0017	11/32
.500 ± .0005	11/16	.5012 +.0000 −.0005	.0002	.0017	3/8
.5625 ± .0005	3/4	.5638 +.0000 −.0005	.0003	.0018	3/8
.625 ± .0005	13/16	.6266 +.0000 −.0007	.0004	.0021	13/32
.6875 ± .0005	7/8	.6894 +.000 −.001	.0004	.0024	7/16
.750 ± .0005	13/16	.7520 +.000 −.001	.0005	.0025	11/32
.8125 ± .0005	7/8	.8145 +.000 −.001	.0005	.0025	3/8
.875 ± .0005	7/8	.8772 +.000 −.001	.0007	.0027	3/8
.9375 ± .0005	13/16	.9397 +.000 −.001	.0007	.0027	9/32
1.000 +.001 −.0005	1-1/8	1.003 +.000 −.001	.001	.0035	17/32
1.0625 +.001 −.0005	1	1.0655 +.000 −.001	.001	.0035	13/32
1.125 +.001 −.0005	1	1.128 +.000 −.001	.001	.0035	11/32
1.1875 +.001 −.0005	15/16	1.1905 +.000 −.001	.001	.0035	9/32
1.250 +.001 −.0005	15/16	1.253 +.000 −.001	.001	.0035	7/32
1.3125 +.001 −.0005	15/16	1.3155 +.000 −.001	.001	.0035	3/16
1.375 +.001 −.0005	15/16	1.378 +.000 −.001	.001	.0035	5/32
1.4375 +.001 −.0005	15/16	1.4405 +.000 −.001	.001	.0035	5/32
1.500 +.001 −.0005	1	1.503 +.000 −.001	.001	.0035	5/32
1.5625 +.001 −.0005	1	1.5655 +.000 −.001	.001	.0035	5/32
1.625 +.001 −.0005	1-1/16	1.628 +.000 −.001	.001	.0035	5/32
1.6875 +.001 −.0005	1-1/16	1.6905 +.000 −.001	.001	.0035	1/8
1.750 +.001 −.0005	1-1/16	1.753 +.000 −.001	.001	.0035	1/8
1.8125 +.001 −.0005	1-1/8	1.8155 +.000 −.001	.001	.0035	1/8
1.875 +.001 −.0005	1-1/8	1.878 +.000 −.001	.001	.0035	1/8

(over)

STANDARD CYLINDRICAL PRESS FITS

(CONTINUED)

REAMED HOLE	SPECIFIED MIN. RADIUS FOR 24ST FITTING	BUSHING O.D.	INTERFERENCE		MIN. PERMISSIBLE EDGE DISTANCE 24ST FITTING
			MIN.	MAX.	
1.9375 $^{.001}_{.0005}$	1-3/16	1.9405 $^{.000}_{.001}$	.001	.0035	1/8
2.000 $^{.001}_{.0005}$	1-3/16	2.003 $^{.000}_{.001}$	.001	.0035	1/8
2.0625 $^{.001}_{.0005}$	1-1/4	2.0655 $^{.000}_{.001}$	.001	.0035	1/8
2.1875 $^{.001}_{.0005}$	1-5/16	2.1905 $^{.000}_{.001}$	.001	.0035	1/8

Over 2-3/16" hole = Nominal $^{+.0010}_{-.0005}$ Bushing = (nominal + .003) $^{+.000}_{-.001}$ with minimum edge distance of 1/8 + manufacturing tolerance on hole concentricity in 24ST fitting.

These minimum edge distances are based on only the stresses caused by the maximum interference. The edge distance must be checked independently when other stresses are present.

The above tables are based on bushing wall thickness of 3/32" up to and including 3/4" O.D. and 1/8" wall thickness over 3/4" O.D. of bushing.

FLATTENED TUBE ENDS - AL. ALLOY

When it is desired to flatten the end of a tube, a flat insert shall be used for the purpose of preventing the occurrence of cracks where the wall of the tube is bent 180°. All tubing shall be annealed before flattening.

The thickness of the insert shall be at least the size shown in the following table.

Wall Thickness	Insert Thickness
.020	.051
.028	.064
.032	.081
.041	.091
.051	.125
.064	5/32
.081	3/16
.091	1/4

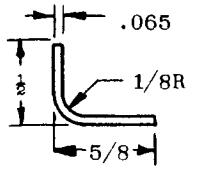
Drawing of such tubular members shall have the inserts identified by dash number, with type of material, gage and overall dimensions indicated thereon.

RADIUS

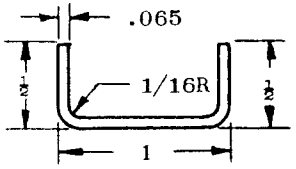
BWG	1/32	3/64	1/16	5/64	3/32	7/64	1/8	9/64	5/32	11/64	3/16	13/64	7/32	15/64	1/4	9/32	5/16	11/32	3/8	7/16	1/2
.330																	.499	.512	.525	.549	.579
.284																.466	.479	.492	.506	.529	.577
.259															.422	.435	.449	.462	.476	.499	.529
.238														.390	.396	.410	.423	.437	.450	.473	.504
.220													.361	.368	.374	.388	.401	.415	.428	.451	.482
.203												.333	.340	.347	.354	.367	.381	.394	.408	.431	.461
.180											.299	.306	.313	.319	.326	.339	.353	.366	.379	.403	.453
.165										.274	.281	.288	.214	.301	.308	.312	.335	.348	.361	.385	.415
.148									.247	.254	.260	.267	.273	.280	.287	.300	.314	.327	.340	.364	.391
.134								.223	.230	.237	.243	.250	.257	.263	.270	.283	.297	.310	.324	.347	.377
.120							.199	.206	.213	.220	.226	.233	.240	.246	.253	.266	.380	.293	.307	.330	.360
.109						.179	.186	.193	.199	.206	.213	.220	.226	.233	.240	.253	.263	.276	.243	.317	.347
.095					.156	.162	.169	.176	.182	.189	.200	.203	.204	.216	.223	.236	.250	.263	.276	.300	.330
.083				.135	.141	.148	.154	.161	.168	.175	.181	.188	.195	.201	.208	.222	.235	.248	.262	.285	.315
.072			.114	.121	.128	.134	.141	.148	.155	.161	.172	.175	.181	.188	.195	.208	.222	.235	.248	.272	.302
.065		.100	.106	.113	.119	.126	.133	.139	.146	.153	.164	.166	.173	.180	.186	.200	.213	.226	.240	.263	.293
.058	.084	.092	.098	.104	.111	.117	.124	.131	.138	.144	.155	.158	.164	.171	.178	.191	.205	.218	.231	.255	.285
.049	.073	.081	.087	.093	.100	.107	.113	.120	.127	.133	.144	.147	.153	.160	.167	.180	.194	.207	.220	.244	.274
.042	.065	.072	.078	.084	.091	.098	.105	.111	.118	.125	.136	.138	.145	.152	.158	.172	.185	.198	.212	.235	.266
.035	.056	.064	.070	.076	.083	.090	.096	.103	.110	.116	.127	.130	.136	.143	.150	.163	.177	.190	.203	.227	.257
.032	.053	.060	.066	.072	.079	.086	.093	.099	.106	.113	.119	.126	.133	.139	.146	.160	.173	.186	.200	.223	.253
.028	.048	.055	.061	.068	.074	.081	.085	.094	.101	.108	.114	.121	.128	.135	.141	.155	.168	.182	.195	.218	.249
.025	.044	.052	.057	.064	.071	.077	.084	.091	.097	.104	.111	.118	.124	.131	.138	.151	.164	.178	.191	.214	.245
.022	.040	.048	.054	.060	.067	.074	.080	.087	.094	.100	.107	.114	.121	.127	.134	.147	.161	.174	.188	.211	.241
.020	.038	.045	.051	.058	.065	.071	.078	.085	.091	.098	.104	.111	.118	.125	.132	.145	.158	.172	.185	.208	.239
.018	.035	.043	.049	.055	.062	.069	.076	.082	.089	.096	.102	.109	.116	.122	.129	.143	.156	.169	.183	.206	.236

TABLE FOR FINDING THE DEVELOPED LENGTH OF 90° BEND

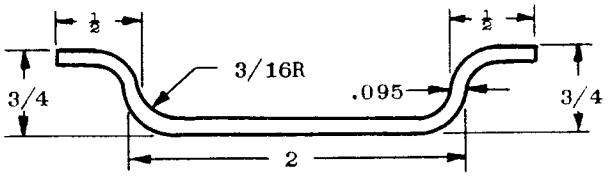
Subtract The Correct Figure In the Table From the Sum Of The Length Of Legs



1/2 5/8 1-1/8
1.125 .133 .992 Length



1/2 1 1/2 2.000: 2x.106 .212
2.000 .212 1.788 Length



1/2 3/4 2 3/4 1/2 4½:4 x .200 .800
4.500 .800 3.700 Length

WELDING

ARC & GAS WELDED STEEL JOINTS

(See General Manual for Structural Repair, Sections 3 and 10)

DESIGN OF WELDED JOINTS

Table I shows types of joints which may be used in designs. According to their degrees of welding difficulties, they are rated A, B, C, etc., A representing the easiest, and F the most difficult joints. The easiest welded can be expected to be most reliable, hence types rated D, E and F should be avoided.

NOTE 1. For .050 stock and lighter, welding should be on only one side of the sheet because of the burning effect on the base metal.

NOTE 2. The figures in parentheses refer to the base metal thickness. If the two parts are of unequal thickness the figures are for the average. It is possible to have a difference in gage of 50% before the joint be classed as one with unequal heating (see Note #5).

NOTE 3. For all heavy welding, provision should be made to fuse, all the way through, the base metal at the joint. Beveling of the edges should be called for on stock thicknesses greater than 1/8 inch and both sides of base metal should be welded. This is to avoid sharp notches on the inside of the joint left by an unfused section and, hence, to prevent stress concentrations on heavy welding.

NOTE 4. Edge welds are one of the easiest types to weld. The quality is easily controlled because the fillet proportions and the fusing through on the inside of the weld are the only considerations.

NOTE 5. Joints having unequal heating ratios greater than 1.5:

The greater the unequal heating, the harder it is to weld the joint.

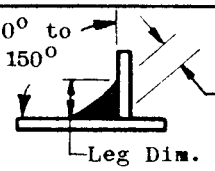
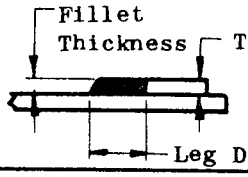
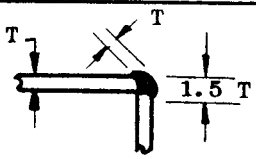
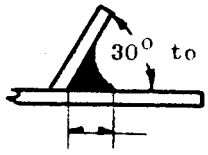
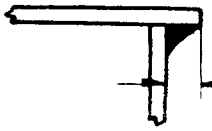
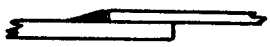
In determining the ratio, the main consideration is the stock thickness ratio. However, if one side of the joint has a great thickness but small mass, the ratio is cut down. For example, a 1/8 inch continuous sheet could be welded to a 1 inch cubical block because the block, once heated up, cannot conduct the heat away as fast as the continuous sheet, with its greater area.

Torch welded joints with ratios greater than 2.0 may require two welders, one preheating and the other finishing the weld and hence are very uneconomical to make. The warpage and burning tendencies are also much greater in joints with unequal heating.

WELDING

TABLE I

Types of Joints

Type	SIMPLE WELDS	Rating	See Note
Fillet	 Light (.031-.063) Medium (.064-.093) Heavy (.094-.250)	A A A	1,2 2 2,3
Lap	 Light (.031-.065) Medium (.064-.093) Heavy (.094-.250)	B A A	2 2 2
Edge	 Light (.031-.050) Medium (.051-.093)	A A	4 4
Type	**COMPLEX WELDS**	**Rating**	**See Note**
Acute Angle Fillet	 Light (.031-.063) Heavy (.064-.250)	D C	1 3
Close Edge (Light Welds -.031 to .063)	 Fillet Lap	F E	
Type	**Welds With Unequal Heating Ratio (Ratio greater than 1.5)**	**Rating**	**See Note**
Fillet	 Light (.031-.125) Heavy (.125-.250)	D C	5 5
Lap	 Light (.031-.125) Heavy (.126-.250)	E D	6 6

SPECIAL COMPLEX WELDS	Rating
Heavy Acute Angle Weld with Unequal Heating	D
Light Acute Angle Weld with Unequal Heating	E
Light Acute Angle Fillet with Close Edge	F

WELDING

WELDED STEEL JOINTS

Since the extensive use of forgings, some welding operations have become very difficult and require preheating the heavier sections of the forgings to assist the operator to obtain full penetration. The forgings being of heavier section than the structure to which they are welded, are not adversely affected by the preheating process.

6. The ratio of gauges should not be greater than 3.0 for lap joints.

7. Fillet welds with close edge are very difficult to make with 100% quality and should not be used except when absolutely necessary, suchas lugs welded in the ends of slotted tubes. When used, the edge distance should never be less than the maximum fillet leg dimension given in Table II.

FILLET SIZES

Table II gives welded fillet proportions and includes the maximum leg dimensions which should be taken into consideration in attaching mating parts to avoid interference with the weld.

TABLE II

STANDARD FILLET PROPORTIONS

(See Table I for proportions of edge welds and definition of terms.)

	Fillet Welds			Lap Welds	
Sheet Thick-ness	Max. Leg	Max. Leg for acute angle weld	Min. Throat	Max. Leg	Minimum fillet thick-ness Measured 1.5 T from edge of sheet
.031	.13	.16	.06	.32	.03
.038	.15	.19	.07	.25	.04
.050	.19	.24	.09	.30	.04
.063	.21	.26	.10	.33	.06
.078	.25	.31	.12	.35	.08
.093	.28	.35	.13	.37	.09
.125	.34	.42	.16	.47	.13
.180	.40	.50	.21	.62	.19
.250	.57	.71	.27	.75	.25

WELDING

WELDED STEEL JOINTS

WELDING INTO POCKETS

Welding should not be used where the torch flame or electric arc will be pocketed. The maximum pocketing allowable is in the corner where three plates are at right angles to one another.

AVOID EXCESSIVE WELDING ON SMALL PARTS

The amount of welding on a single part should be kept as small as possible by use of more extensive flat pattern work or greater use of joints between simple forgings or machined parts. Although it is well to keep the strength margins as high as possible on welded designs, do not use excessive welding where the loads are exceedingly low.

On very small assemblies, say under two ounces in weight, never call for more welding than one or two tacks.

Do not use gussets, the smaller leg of which is less than 3/4 inches for .031 stock and 1-1/4 inches for .094 stock.

WARPAGE AND SHRINKAGE

All assemblies, when welded, shrink and warp to a certain extent. A bad condition for warpage exists when a weld is made on a sheet 1/2 inch or more away from the edge. Much time must be consumed straightening this warpage and this process often results in cracks. On large or complicated welded structures on which there are many close-dimensioned interrelated points, allowance for shrinkage should be made by providing bosses with excess material to allow for pin holes being off center.

AVOID TENDENCIES FOR BURNING

Excessive heat applied to any portion of a welded joint will result in the torch welder burning the metal or in the arc welder melting away corners or melting holes thru thin sections.

NORMALIZING AND HEAT TREATING

Normalizing or Heat Treating is required after welding.

MAGNAFLUX INSPECTION

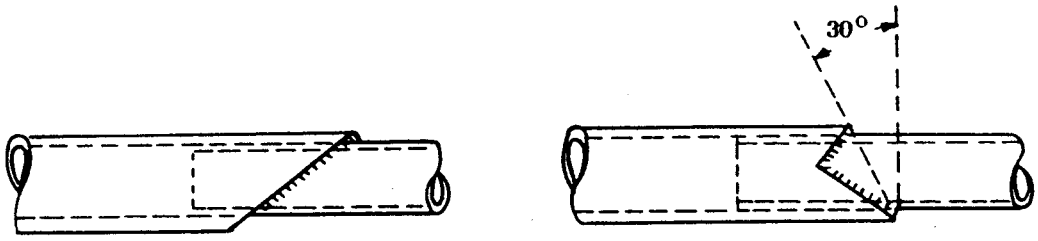
Magnaflux inspection after heat treatment or normalizing is recommended.

CHANGES OF SECTION

In all welded joints every attempt possible should be made to avoid abrupt changes in area in the cross-section of the joint where one member meets another. This can be accomplished by tapering off the members or by staggering the points at which the welding ends.

TYPES OF JOINTS

FISHMOUTH JOINTS - FIG. 1



Type No. 1 Type No. 2

Of the two types of fishmouth joints shown above in Fig. 1, Type No. 1 is to be preferred because of the ease of machining. If the length of the joint is objectionable, Type No. 2 may be used.

GUSSETS

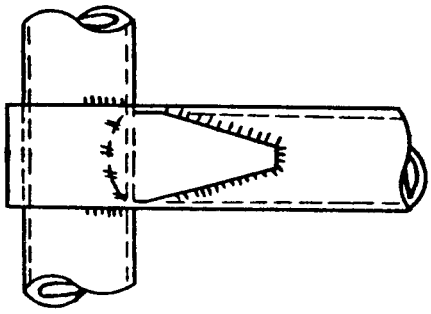


Fig. 2
Wrap Gusset

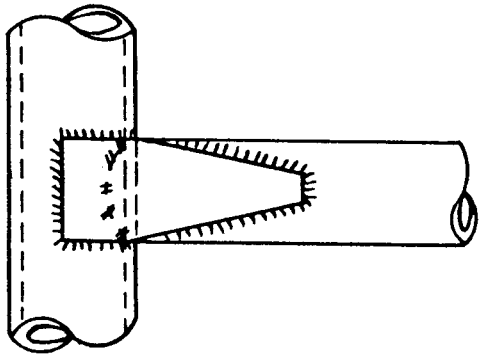


Fig. 3
Modified Wrap Gusset
Gusset on Both Sides of Joint

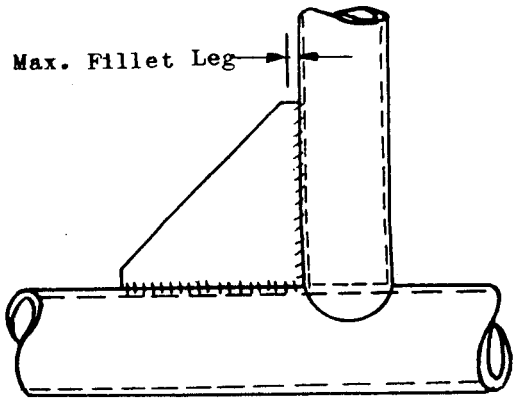


Fig. 4
Corner Gusset

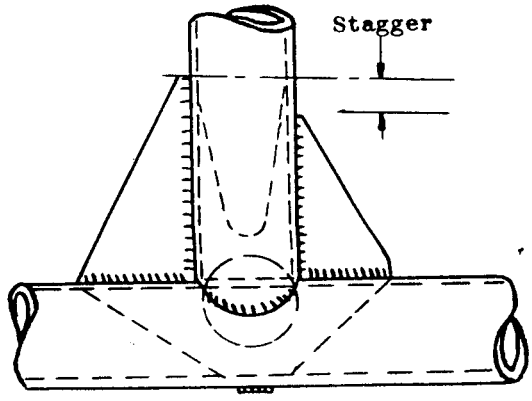


Fig. 5
Slotted Tube Gusset

GUSSETS

WELDING ENDS OF LIGHT GUSSETS

Where welding is ordinarily done on only one side of gussets or plates (see Note #1) the weld should be continued around the end approximately 3/16" as shown in Fig. 5.

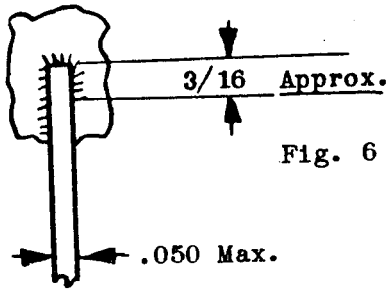


Fig. 6

ROSE AND SLOT WELDS

Rose and slot welds should not be used unless the diameter of the hole or the width of the slot is at least 2-1/2 times the maximum fillet leg dimensions. This will assure fusion to the under metal.

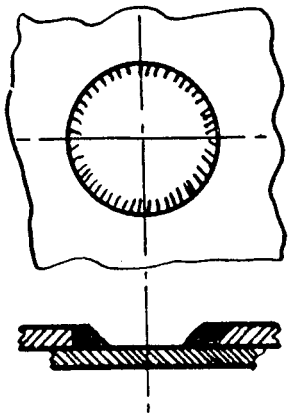


Fig. 7
Rose Weld

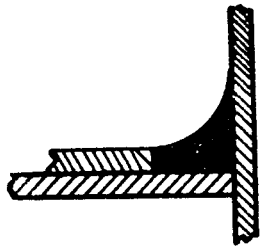


Fig. 8
Slot Weld

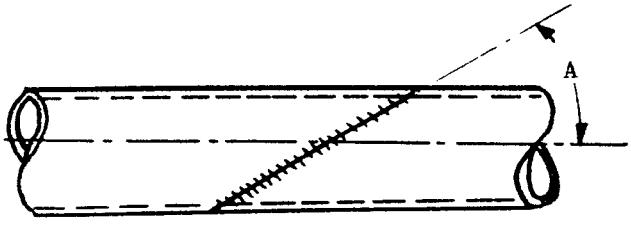


Fig. 9
Scarf Joint
Angle A is usually used as 30°

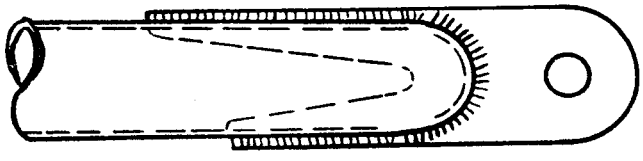
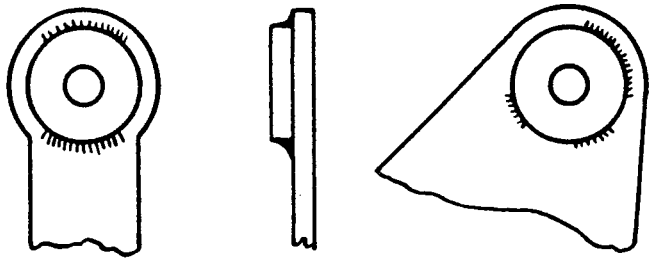


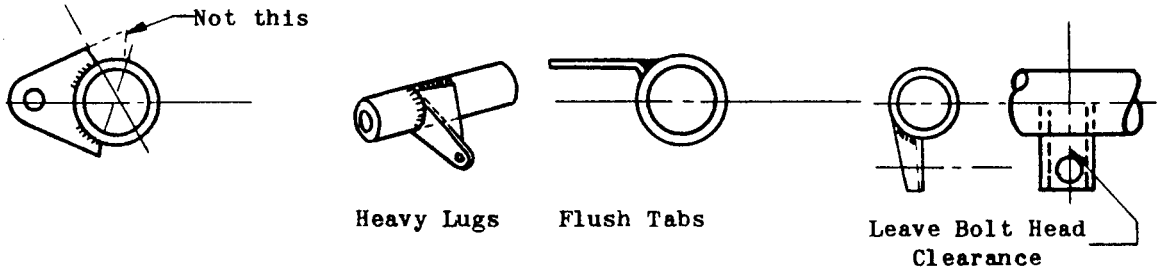
Fig. 10
Tension Fitting in
Slotted Tube

LUGS, TABS & ATTACHMENTS - Fig. 11

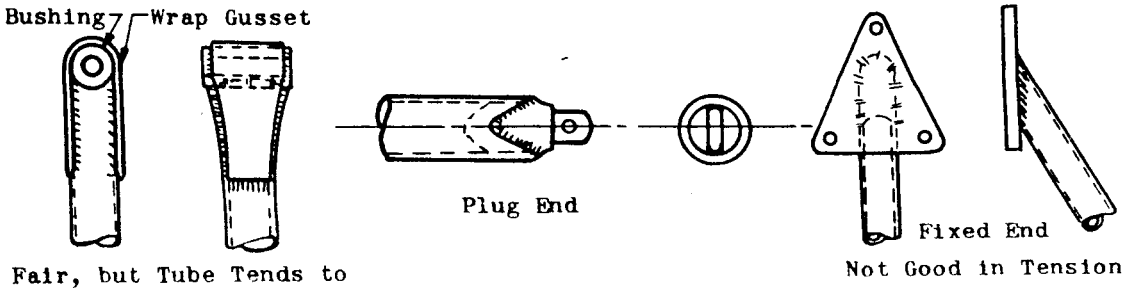
The amount of welding across a given area should be limited. A good rule is not to weld more than 30% of the width of a lug or the circumference of a tube.



This 30% on tubes should be split up in two or more parts symmetrically spaced.



TUBE ENDS - FIG. 12



TORCH WELDING

APPLICATION

Torch welding is adaptable to all types of welded joints, however, since arc welding offers many fabricational advantages on heavier joints torch welding should be confined to small, intricate or light (.058 thickness or less) assemblies.

MATERIALS

All classes of low carbon, low alloy steel can be torch welded. The carbon content should not exceed 0.30.

Torch welding is to be used in the fusion welding of aluminum assemblies. The weldable aluminum alloys generally used are 2S, 3S, 53S, and 61S. Aluminum alloy 52S is weldable but with some difficulty and should be avoided where possible.

Stainless Steel and Inconel are readily weldable.

For tack welding or intermittent welding, give a local note on drawing designating the length of weld and the spacing of welds. Tack welds should never be under 3/8" in length.

WELDING ROD

1. Low test welding rod - Spec. Navy 46R4, Class 1, Type C. This rod should be used only on normalized parts or parts not heat treated.

2. High test welding rod - Spec. Navy 46R4, Class 1, Type B. This rod should be used on all heat-treated parts. This use is mandatory to develop full strength of these parts. Failure of arresting hooks and similar parts have been reported which are believed to have been caused by inadequate strength in the welds.

ARC WELDING

PROCESS

Electric Arc Welding is the process of drawing an electric arc between the parts to be joined and a metallic rod called the welding electrode. The heat of the arc is sufficient to form a molten pool of metal at the point where the arc strikes the work. During the welding the end of the electrode keeps melting off and joins the molten pool on the work. When this molten pool of metal joining the parts cools, a solid weld is formed.

APPLICATION

Arc Welding is generally recognized as being superior to torch welding for the following reasons and should be used wherever possible:

(a) Increased economy due to increased welding speed.
(b) Better penetration.
(c) Better metallurgical characteristics of weld metal.
(d) Less distortion of the base metal.

MATERIALS

All classes of steel can be arc welded.

Whenever it can be avoided, parts of 4140 steel or steels with a carbon content over 0.30% should not be welded. If it is absolutely necessary to weld these steels, a preheat before welding of 400° - 600° should be called for.

HEAT TREATMENT

Arc Welded assemblies must be furnace normalized after welding.

SPOT WELDING

PROCESS:

Electric spot welding is a process of joining metal sheets by passing an electric current of low voltage and high amperage through two or more sheets of metal to be joined. The sheets are gripped between the welder electrodes and an instantaneous surge of current passes between the electrodes. The resistance of the metal and of the contact surfaces of the sheets to the current flow generates sufficient heat to melt a small spot of metal partially in each sheet. On cooling, this spot fuses the sheets together.

MATERIALS & SHEET COMBINATIONS

All aluminum alloys and all combinations of aluminum alloys can be spot welded. However, due to the wide variation in hardness, it is desirable to avoid combining 3S with 24ST.

Stainless Steel, Inconel, K Monel, can be spot welded in any combination. Low Carbon Steels can be spot welded.

Two sheets of different thickness may be spot welded. For two sheets the ratio between thicknesses should not exceed 3 to 1. For three sheets the ratio between any two thicknesses shall not exceed 2 to 1.

It is possible to weld pile-ups of five sheets, however, for efficient and consistent welds, pile-ups of over three sheets should be avoided.

The maximum total thickness to be welded should not exceed 3/16 in.

When welding two sheets of unequal thickness use data for thinner sheet; when welding more than two sheets, use data for the thinner of outer sheets. In cases where the thinner sheet is not the dimpled sheet, use data corresponding to the dimpled sheet.

SPOT SPACING - EDGE DISTANCE - OVERLAP:

The strength of a spot welded joint is not directly proportional to the number of spots. As the distance between the spots is decreased below a certain value, the strength of the individual spot is decreased due to leakage of a portion of the welding current through previous welded spots. For this reason, the values given in TABLE I and II, Column 3, are the absolute minimum which shall be used if high spot strength is required. TABLE I and II, Column 4, gives the standard spot spacing which should be used.

In primary structures or highly stressed secondary structures use Minimum Spot Welding.

The minimum allowable edge distance is given in TABLE I and II, Column 5.

In a single row lap joint the standard overlap shall be 1/8 + 2 x minimum edge distance.

The gauge distance between two or more parallel rows of spots shall be not less than the minimum spot spacing. The spot spacing in each row can be increased to 1.5 times the standard spot spacing.

SHEAR & TENSION LOADING:

Design shear loads of spot welds in aluminum sheet are given in TABLE I, Column 1 and Column 2.

Design shear loads of spot welds in stainless steel are given in TABLE II, Column 1 and Column 2.

STOP RIVETS

In aluminum assemblies Stop Rivets are required at the ends of each row of Spot Welds and at 6 to 12 inch intervals in long rows. The lower figures should be used for the more heavily stressed applications.

Spot Welded steel assemblies do not require Stop Rivets.

SPOT WELDING

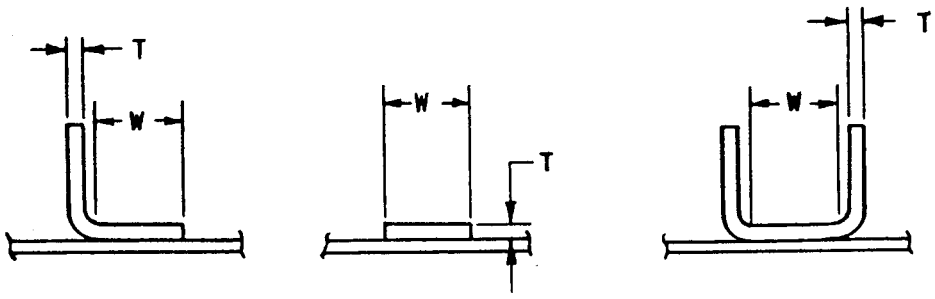


TABLE I

ALUMINUM ALLOY DESIGN VALUES

COLUMN NO.	1	2	3	4	5	6
Sheet Thick-ness	Design Shear Str. 52S	Design Shear Str. 52S	Minimum Spot Spacing	Standard Spot Spacing	Minimum Edge Distance	Minimum W
.016	100	130	3/8	1/2	3/16	3/8
.020	140	175	3/8	1/2	3/16	3/8
.025	180	220	1/2	5/8	7/32	7/16
.032	240	300	1/2	3/4	7/32	7/16
.040	310	370	5/8	1	1/4	1/2
.051	410	490	3/4	1	5/16	5/8
.064	555	630	7/8	1-1/4	5/16	5/8
.081	730	820	7/8	1-1/4	3/8	3/4
.102	960	1060	1	1-1/4	7/16	7/8
.125	1230	1340	1	1-1/4	1/2	1

TABLE II

STAINLESS STEEL DESIGN VALUES

COLUMN NO.	1	2	3	4	5	6
Sheet Thick-ness	Design Shear Str. 1/4H	Design Shear Str. 1/4H	Minimum Spot Spacing	Standard Spot Spacing	Minimum Edge Distance	Minimum W
.010	150	220	1/4	3/8	3/32	3/16
.016	280	400	1/4	3/8	3/32	3/16
.019	340	490	5/16	1/2	1/8	1/4
.025	490	700	5/16	1/2	1/8	1/4
.031	690	980	3/8	5/8	5/32	5/16
.037	945	1330	3/8	3/4	5/32	5/16
.050	1600	2260	1/2	3/4	7/32	7/16
.062	2220	3150	5/8	1	1/4	1/2
.094	3670	4900	13/16	1-1/4	3/8	3/4
.125	4360	5280	1	1-1/4	1/2	1

HEAT TREATMENT

For information concerning heat treatment, See General Manual for Structural Repair.

BONDING PROCEDURE

Reference (a) U.S. Navy Spec. SR-16e, Amendment 2

1. In order to comply with the requirements concerning the use of aluminum bonding jumpers with crimped-on terminals to bond aluminum alloy parts and steel parts on present and subsequent airplanes, bonding jumpers NAF1065 shall be used.

2. Bonding Methods

(a) On non-structural parts, one of the following methods, listed in order of their desirability, shall be used:

1. Bolting
2. Self-Tapping Screw
3. Clamping

(b) On structural parts, the preferred practice is the use of integral tabs which shall be either a part of or welded to the structure. Such joints shall be a part of the initial design and shall not be used in locations where welding might weaken the structural member. Where welded tabs are not applicable for some reason, clamps shall be used. These clamps shall be of steel when attached to steel, and aluminum alloy when attached to aluminum alloy. However, if neither method can be applied, self-tapping screws shall be used, except that special care should be taken regarding the number of screws inserted in order that the effective strength of a member shall not be impaired.

3. In order to clarify the bonding situation, it shall be the general practice to use the following procedure in regards to the use of bonding jumpers and methods employed to secure them to the various bonded parts.

(a) Where aluminum alloy parts are bonded to aluminum or steel (including Cor. Res.) or where steel or Cor. Res. steel parts are bonded to steel (including Cor. Res.) the NAF 1065 aluminum bonding jumper shall be used. See Fig. 1 & 2.

(b) Where a Cor. Res. steel control cable end is bonded to a steel control lever, the NAF 1065 aluminum alloy bonding jumper shall be used. The jumper shall be attached to the cable with a steel clamp as shown in Fig. 2.

(c) In certain cases where it may be found necessary to attach a number of bonding jumper terminals to the same bolted connection or in severe cases where a direct bonding connection becomes undesirable, an adapter lug G90 made of the same material as the part to which it is fastened shall be used. See Fig. 3.

(d) One of the following procedures shall be used as standard practice in securing bonding jumpers:

1. Blind Tapped Holes -	AN515-6, -8	(Steel)
	AN520-10	(Steel)
	G169-6, -8, -10	(Alclad)
2. Bolted Connections -	AN515-6, -8	(Steel)
	AN520-10	(Steel)
	G169-6, -8, -10	(Alclad)
	AC365-632, -832, -1032	(Steel)
3. Self-Tapping Screws -	AC 530-6	
	Parker Kalon #6 - Type Z	
	G169-6	(Alclad)

4. Clamps - Use steel attaching parts on steel and aluminum alloy attaching parts on aluminum alloy. (Generally Ideal clamps on steel and NAF 1051 clamps on alloy).

5. In some cases it may be possible to utilize a steel bolted connection to which the bonding jumper may be attached.

General Notes

Bearing bolts shall not be used as connections for bonding jumpers since they might not be tight enough during normal service operations to provide a "good electrical connection". For test procedure on bonding see Fig. 5.

Self-tapping screws shall not be used where subject to frequent removal and replacement.

Removal of Finish

At bonding connections, except where self-tapping screws are used, paint and anodic film shall be removed in order to assure a metal-to-metal contact. No greater area shall be bared than is essential for contact. However, the protective finish shall never be removed from any vital structural part of the airplane for bonding purposes, in which case self-tapping screws shall be used.

When self-tapping screws are used, the protective coating, finish and/or anodize shall not be removed from any surface nor is any special surface preparation necessary previous to bonding with these screws.

BONDING PROCEDURE

Application of Finish After Bonding

Clamped connections shall be finished with one coat of zinc-chromate primer followed by a routine finish in accordance with the applicable finish specification.

Use of Copper Bonding Jumpers

Copper bonding jumpers shall be used when necessary to attach bonding jumper by soldering. Copper jumpers shall be used with NAF1064 Clip for control cables.

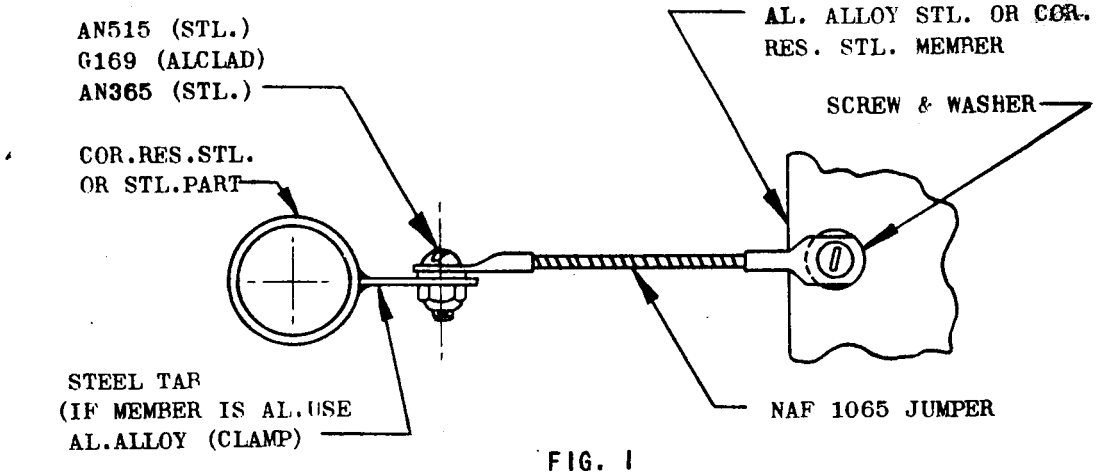


FIG. 1

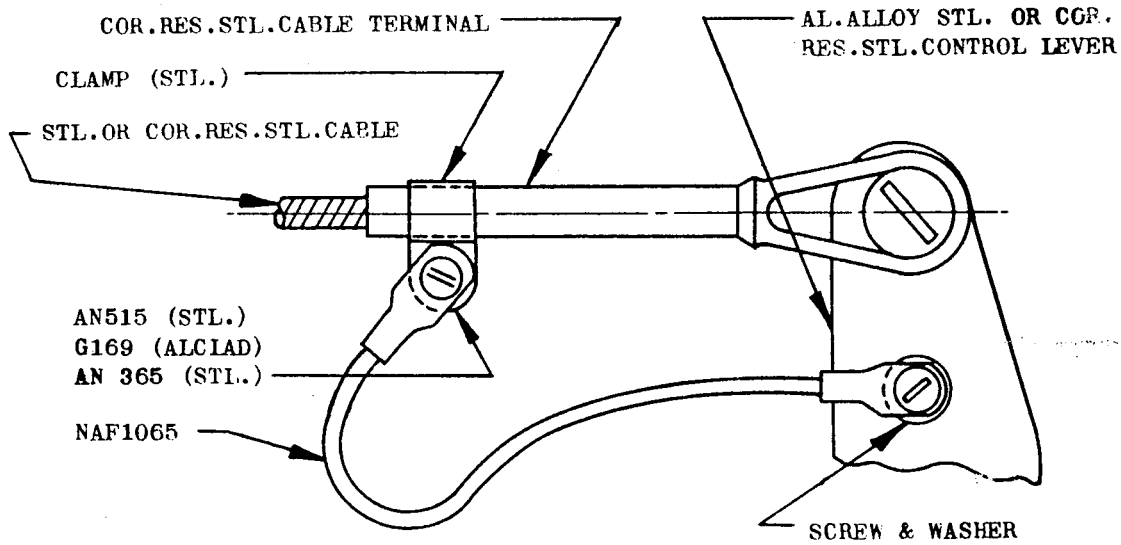


FIG. 2

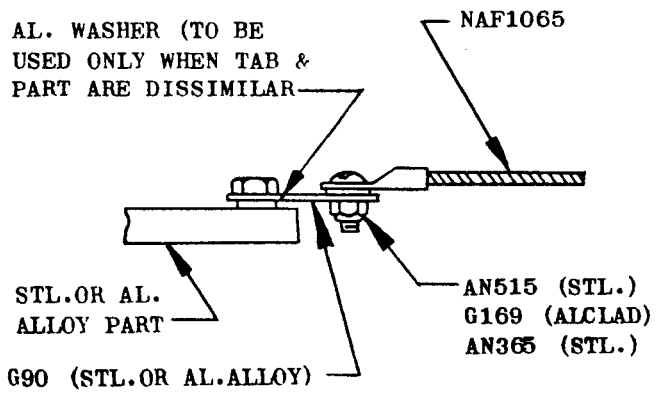


FIG. 3

NOTE:

STL. TAB IN FIG. 1 MAY BE REPLACED BY STL. OR AL. ALLOY CLAMP. USE STL. ATTACHING PARTS ON STL. & AL. ALLOY ATTACHING PARTS ON AL. ALLOY. WASHER MAY BE ELIMINATED ONLY WHEN JUMPER & PART ARE OF SIMILAR MATERIAL.

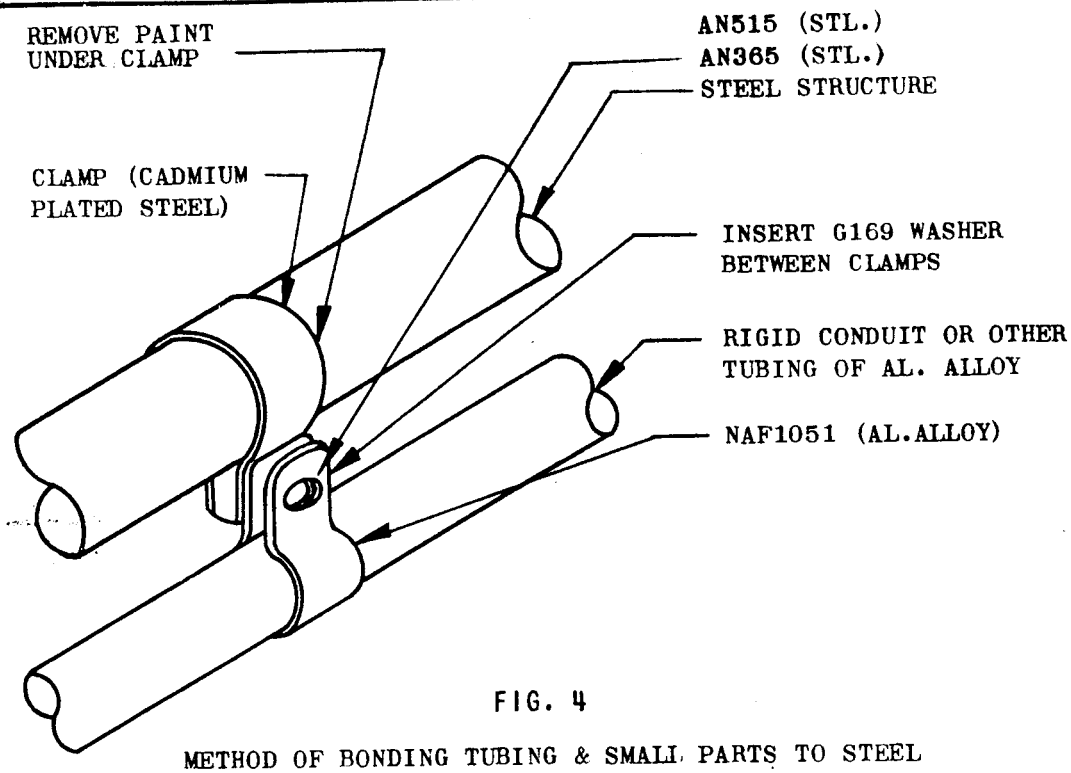
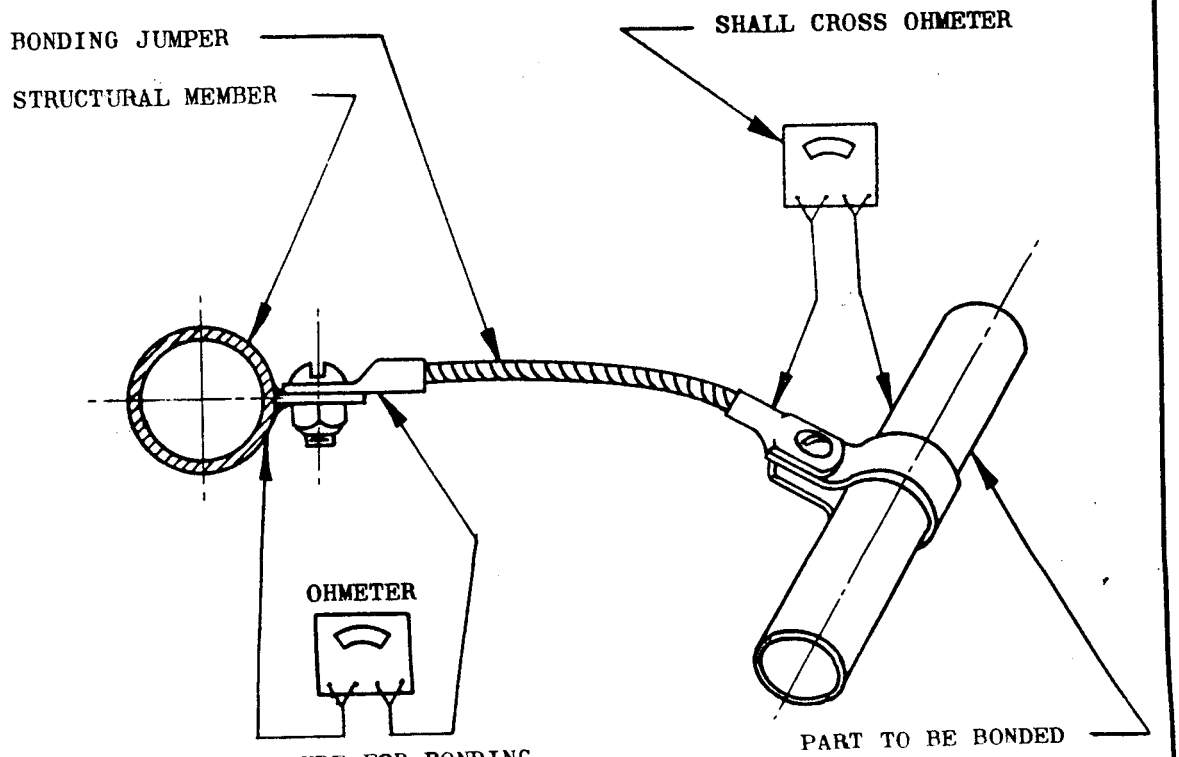


FIG. 4

METHOD OF BONDING TUBING & SMALL PARTS TO STEEL STRUCTURE WHERE TABS CANNOT BE PREDETERMINED



TEST PROCEDURE FOR BONDING

FIG. 5

CHROMIUM PLATING

CHROMIUM PLATING

Wear resistance chromium plating is done directly on the base metal. There are two types used.

Flash Plating is used where the plate thickness is up to approximately .0005" and where a final finishing operation generally will not be made.

Heavy Plating is used where the plate thickness is up to approximately .010. There is generally a final sizing and finishing operation after plating if the plating thickness is in excess of .0025".

Cadmium Plating Portions of Chromium Plated Parts - This is possible and very often desirable. Keep in mind that the harder material is always applied first.

PAR-AL-KETONE "B"

In addition to the regular plating and painting finishes, Par-al-ketone "B" shall be generally used on all exterior removable joints and connections and over all exterior fittings, particularly with respect to parts subjected to salt water immersion and spray.

Par-al-ketone "B" is a thick liquid purchased under U.S. Navy aeronautical specification RM-61.

Before applying, it shall be diluted with not more than equal parts of clear (lead free) gasoline.

It shall be applied preferably by brushing, or dipping, to assure penetration into joints.

Par-al-ketone "B" will replace:

(a) No-Oxide grease, formerly applied over exterior fittings.
(b) Bees Wax and Grease, formerly applied by dipping, strut ends.
(c) Tallow & White Lead, formerly applied on all cable assemblies by dipping.
(d) Grease or Ruse Veto, formerly applied on exterior removable steel parts, such as bolts, bushings, threaded terminals, springs, ball bearings, etc.