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HANDBOOK OF INSTRUCTIONS

FOR THE

D52.1/158
Vultee

Structural Repair

OF THE

P-66 FIGHTER AIRPLANE

Manufactured by Vultee Aircraft Inc., Vultee Field, California

CONTRACT DAW535 ac272

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GENERAL INSTRUCTIONS

1. Type of Construction.

a. The P-66 pursuit airplane is a single-engined, single-place, low wing monoplane of all-metal construction. Its overall span is 35.9 feet, overall length 28.4 feet, and overall height 13.08 feet.

b. The all-metal wing is a stressed-skin cantilever type, comprising a center section and two detachable outer panels. The ailerons are light-metal covered aluminum-alloy structures, and are statically, dynamically, and aerodynamically balanced. They are operated by conventional stick control through a differential control system. A metal trim tab is installed on each aileron. The right-side aileron tab is adjustable on the ground only. The left-side aileron tab is controllable from the cockpit. The wing flaps are of the split trailing edge type, extending from aileron to aileron, except for a small gap at the center section. They are operated through a 45-degree range by a hydraulic actuating cylinder. Emergency manual operation is provided by a hydraulic-hand pump in the cockpit. A position indicator is provided.

c. The all-metal horizontal and vertical stabilizers are aluminum alloy, stressed-skin cantilever type structures, attached in fixed alignment to the fuselage. The elevators are fabric-covered aluminum-alloy structures. They are statically, dynamically, and aerodynamically balanced. A metal trim tab is installed on each elevator - controllable from the cockpit. The rudder is a fabric-covered aluminum-alloy structure. It is statically, dynamically, and aerodynamically balanced. The metal trim tab provided in the trailing edge of the rudder is controllable from the cockpit.

d. The fuselage is of composite construction embodying a welded steel tube forward structure bolted to a semi-monocoque aluminum-alloy aft structure. The steel tube structure is provided with removable aluminum-alloy side panels secured by quick detachable fasteners. An enclosure formed from transparent panels held in a light-metal framework completely encloses the cockpit, and an overturn structure extends to the top of this enclosure to protect the pilot in the event of a nose-over. Armor-plate bulkheads are located aft of the cockpit, and forward of the instrument panel.

e. The fully retractable, hydraulically operated main landing gear is provided with positive, mechanical locks at both extreme positions. Hydraulic shock absorber struts are incorporated. The partially retractable tail gear is hydraulically interconnected with the main gear to operate in unison. A hydraulic selector valve in the cockpit provides control of the alighting gear, and a hydraulic-hand pump provides for emergency operation. A position indicator is provided. The main landing gear is equipped with 30 x 7 smooth-contour tires and wheels, with fully-enclosed, band-type hydraulic brakes. The brakes are operated by individual master hydraulic cylinders mounted on rudder pedals. A 12-1/2 inch smooth-contour tail wheel is used.

f. The oil system consists essentially of an aluminum-alloy tank, oil cooler with spring-loaded relief valve, and a retractable air scoop. An oil dilution system is provided.

g. The fuel system consists essentially of two fuel tanks, each comprising five (5) leak-resistant cells, located within the wing center section; a fuel selector valve, an emergency fuel pump, fuel strainer, engine-driven fuel pump, two fuel-level gages, and a fuel pressure warning unit. A standpipe in the right-hand inboard cell provides a reserve fuel supply.

h. Refer to T. O. Nos. 01-50FA-1, 01-50FA-2 and 01-50FA-3 for complete descriptions of this airplane and its equipment.

2. Scope of Repair Handbook.

Shown in the illustrations forming the bulk of this Handbook are typical repairs for a majority of the structural elements of the air frame. It being obviously impractical to prophesy the probably nature of damage resulting from enemy action, forced landings and improper handling, there is no attempt to show repairs for typical damage. Instead, a genuine effort has been made to show suitable repairs for every structural element, and these may be combined as necessary for the needs of a particular repair.

3. Type of Repairs Described.

It has been assumed that circumstances will make necessary the accomplishment of many repairs at locations where compressed air and electric power are unavailable and personnel is comparatively inexperienced. Accordingly, there has been no attempt to base the repair scheme upon flush-type skin patches and countersunk-head flush rivets. Instead, all basic skin repairs are designed around lap-joint patches and exposed-head rivets, with alternate methods for flush-type repairs given for locations wherein the aerodynamic characteristics might be unfavorably affected by lap-joint patches. In all cases, however, the use of lap-joint patches is acceptable for emergency repairs. Rivets requiring heat treatment before driving have been avoided and all riveted repairs described herein can be accomplished with A17ST (type AD) driven rivets and/or "Cherry" mechanical-type blind rivets.

4. Repair Materials Required.

Tables of repair materials given in the sections following, list the materials necessary to accomplish each repair shown on the relevant repair diagrams. A complete listing of all materials required for repair of the airplane structure would involve a complete Bill of Materials for the airplane, for it cannot be assumed that any portion of the structure is by its nature immune to possible injury. On the other hand, the majority of structural repairs can be accomplished with the raw-stock sheet, bar, tube and extrusions listed in the tables.

5. Estimation of Damage.

In estimating the extent of damage, especially when caused by shock, the surrounding parts must be carefully examined to insure that no secondary damage remain unnoticed. Typical examples of secondary damage would be the transmission of a severe force from one end of a strut or frame to the opposite end, causing bolt or rivet holes to be distorted or plates to be bent at a considerable distance from the point of impact. A feeler gage should be used beneath suspected rivetheads to insure that rivets have not stretched or failed, while leaving the heads intact.

6. Nonrepairable Damage.

a. The majority of important fittings in this airplane are either castings, forgings, or heavy extrusions, and are nonrepairable. When these elements are damaged, it is necessary to replace with a new part - although in some cases it may be possible to machine a new fitting from heat-treated bar stock of the same material.

b. In some cases the complication of the structure may be such that it is more desirable to replace small structural elements rather than attempt their repair by splicing or patching. Several such conditions are noted in the text and drawings following. The most common cases are spar stiffeners, and short intercostal spar caps which also attach or support other components. In many cases, application of a splice angle to these parts will cause serious interference, and the work is best accomplished by replacement rather than repair.

c. When a new repair will involve an area immediately adjacent to an existing repair, it is usually best to remove the existing repair and plan the new repair to include the entire area. This is particularly true if the new repair would be within "touching distance" of the original repair.

7. Support of Structure During Repair.

It is essential that the structure be suitably and firmly supported against distortion during the repair and replacement of any member. If special fixtures are not available, temporary supports should be made up for the purpose, using the data given in figure 9, "Geometry of Air Frame" for establishing locating points.

8. Removal of Damaged Structures.

All torn, jagged material must be carefully removed to obtain an opening with smooth edges and generous corner radii before beginning the actual repair. Bent and/or dented metal sheet can be straightened if the distortion is smooth, of large radii, and without evidence of cracking. Badly distorted material must be removed. All cracks or evidences thereof, should be remedied by removing the material if other damage exists, or by drilling 1/8-inch diameter stop-holes at the ends of the crack.

9. General Rules for Structural Repairs.

The repairs shown in this Handbook are based upon the following general rules, with necessary modifications being made in the case of repairs in highly stressed areas.

a. Use 100 to 125 percent of original section area for repair section area when light metal is repaired with light metal, or steel repaired with like steel.

b. Use 70 to 75 percent of original section area for repair section area when light metal is repaired with CM steel.

c. Repair cross section must be similar to original material in order to maintain the original section properties, for example, an angle having 3/4-inch legs must be replaced by an angle having 3/4- to 7/8-inch legs.

d. Connection of repair material to original material must be with sufficient bolts or rivets (preferably not bolts and rivets) to resist a shear load equal to the total shear strength of the repair material section area. Avoid stress concentrations by using a number of rivets or bolts rather than a few larger fastenings.

e. Rivet pitch, edge distance, gage and diameter for skin patches should be the same as that of adjacent skin splices and attachments, unless otherwise noted in the repair diagrams.

f. Rivet spacing for riveted connections of structural members should be:

(1) Pitch - 5 rivet diameters minimum.

(2) Edge Distance - 2 rivet diameters minimum.

(3) Gage - 3 rivet diameters minimum.

g. Edge distance for bolts and screws should be not less than 1-1/2 diameters. Pitch and gage as noted for rivets.

NOTE: All rivet and bolt spacing is measured to the center of the holes.

h. Corner radii for all cut-outs and patches should be 1/2 inch or larger.

i. Bevel all patch edges approximately 45 degrees.

j. Use a steel washer under boltheads and nuts in contact with light metal.

k. Always use AD driven or "Cherry" blind rivets.

l. All dents and shallow abrasions should be smoothed out.

m. All deep abrasions should be cut out and patched.

n. All damaged doublers and fittings should be replaced.

10. Type of Rivets for Repairs.

All repairs described herein are predicated mainly upon use of either AN430AD round-head, AN455AD brazier-head driven rivets, or "Cherry" mechanical-type brazier-head blind rivets. There may be occasional locations requiring 100-degree countersunk-head rivets (either AN426AD driven, or "Cherry"), particularly where existing rivet holes in exterior skin plating are used to "pick up" new internal structure. In no case are rivets used which require heat treatment before driving.

11. Removal of Rivets.

When it is desired to remove a riveted section of the airplane structure, the rivets should be removed in the following manner:

a. Using the correct size drill, as noted in the chart below, and taking care to insure the drill centering perfectly on rivethead, drill only to the depth of the rivet head. (See sketch A of figure 1.)

Rivet Diameter	Drill Size
3/32 inch	No. 40
1/8 inch	No. 30
5/32 inch	No. 21
3/16 inch	No. 11

b. After reaching the depth of the rivet head, give drill a slight off-center twist. If the right size drill has been used and the rivethead has been drilled directly in the center, the rivethead should fall free. (See sketch B of figure 1.)

c. If the drill was started off-center, or for any reason the drill had a tendency to travel sideways, the rivethead will not be free, and must be removed by gently tapping the rivethead with the same punch later used to drive out the remainder of the rivet.

d. Using flat-end pin punch equal in diameter to the rivet diameter, punch out the remainder of the rivet. (See sketch C of figure 1.) Be certain that punch is squarely aligned with rivet before driving.

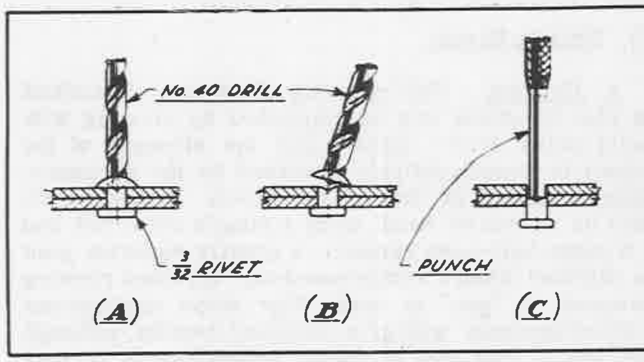


Figure 1 - Removal of Rivets

12. Replacement of Rivets.

a. Rivets should be a good fit in their holes, and it is preferable to start the holes with a pilot drill before using the correct size of drill as listed in paragraph 16. of this section. Rivets used to secure the outside skin of the airplane should be inserted from the outside, and a suitable bucking bar held against the inner ends of the rivets. The manufactured head should then be driven, special rivet-sets being used for round-head and brazier-head rivets and a flat rivet-set for countersunk-head rivets. Before fitting the countersunk-head rivets, it will be necessary to dimple or countersink the material to an angle of 100 degrees. The process of dimpling enlarges the holes slightly, and to allow for this, the holes for the larger sizes of countersunk-head rivets should be drilled smaller than the final diameter and redrilled after dimpling.

b. The majority of the repairs shown in the drawings forming a part of this Handbook employ AN455 brazier-head rivets on surfaces exposed to air stream. This is for the obvious purpose of minimizing drag resulting from the exposed rivetheads. In the majority of such cases, it is entirely practicable to use AN426 100-degree countersunk rivets in place of the brazier-head, if a flush rivet effect is desired; or, on the other hand, it is possible to substitute AN430 round-head rivets for the brazier-head in cases where the required size brazier-head rivet is unobtainable.

c. A general caution to be observed during replacement of rivets is that the thickness of the material through which the rivet passes should be equal to at least half the diameter of the rivet shank. Unless this is the case, there is a tendency for the rivet shank to bend while being driven.

d. Many of the manufacturing drawings for this airplane specify VS418 rivets. These are a special

100-degree countersunk-head rivet developed by Vultee Aircraft, Inc., prior to the establishment of the AN426 100-degree countersunk rivet. The two rivets are very similar, and for all practical purposes are completely interchangeable.

13. Driving Rivets.

a. General. - The majority of repairs described in this Handbook are accomplished by riveting with solid-shank driven rivets, and the strength of the repair is almost entirely governed by the workmanship employed in driving the rivets. While rivets may be driven by hand, using a simple rivet set and a 6 ounce ball-peen hammer, a greatly superior joint is obtained when a compressed-air operated riveting hammer or "gun" is used. For some applications a rivet squeezer will give excellent results, although the use of this tool in repair operations is recommended only for secondary structure parts.

b. Difficulties when Driving Rivets. - Difficulties encountered in forming proper rivetheads when driving aluminum-alloy rivets are usually due to one or more of the following:

(1) Improper riveting hammer used.

(2) Improper bucking bar used.

(3) Material being riveted is too thick or improperly prepared.

(4) Improper rivets used.

c. Riveting Hammers. - Difficulty in forming a proper rivethead will be experienced if the hammer used for driving strikes either too light or too heavy a blow. Too heavy a blow makes it impossible to properly buck the rivet with the result that the rivethead strain-hardens before completely forming and gives a bell-shaped rivethead. Use of a hammer striking too light a blow forms the head too slowly with the result that the material in the rivethead strain-hardens before it can be formed in the proper shape. A hammer equivalent to the Chicago Pneumatic Tool Company's CP-3X Aero riveting hammer should be used for driving rivets up to and including 3/16-inch diameter. For larger rivets use a hammer equivalent to the Chicago Pneumatic Tool Company's Type CP-4X Aero or CP-6 Aero.

d. Bucking Bars. - The proper weight bucking bars must be carefully chosen for various riveting operations if a satisfactory head is to be expected. In normal riveting operations the riveting hammer is applied to the manufactured head of the rivet and the bucking bar to the shank to serve as an anvil for receiving the energy transmitted through the rivet by the blow of the riveting hammer, and thus form the shop-head on the rivet. If too light a bucking bar is used, the blows of the riveting hammer will cause the bar to "dance" on the shank of the rivet, with the result that little forming of the head will occur with each blow. This will cause the rivet shank to strain-harden with the result that the shop-head will crack. No harm can possibly arise from use of too heavy a bucking bar, although it makes the job more difficult for the workman.

e. Riveting Through Extremely Thick Material.

(1) In unusual cases of riveting, where the rivet is being driven through extremely thick material, the thickness of the material itself prevents the full blow of the hammer reaching the bucking bar, and in effect, act as a sort of bucking bar with the result that a satisfactory head cannot be formed on the rivet. In cases of this nature, it is necessary to reverse the normal riveting procedure and use a special bucking bar (formed like a rivet set to receive the rivethead) applied to the manufactured head of the rivet and drive on the shank of the rivet with a flat face rivet set in the hammer. Thus, none of the energy of the riveting hammer's blow is absorbed by the material through which the rivet passes and a satisfactory shop-head can be formed with a few blows of the hammer; assuming, of course, that all other governing conditions are satisfactory.

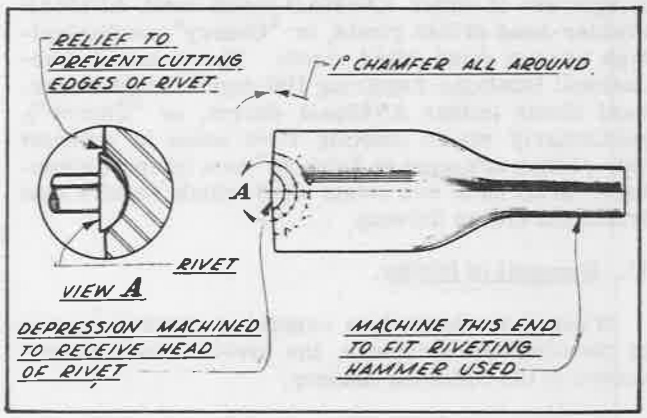


Figure 2 - Special Rivet Set for Use When Driving in Heavy Material

(2) In some special cases, where space limitations prevent driving against the shank of a rivet passing through heavy material, it sometimes is feasible to use a special rivet set and drive on the manufactured head of the rivet in the conventional manner. Such a special rivet set is shown in figure 2 and permits transmitting the blow of the hammer to structure being riveted in such a manner that the complete structure is vibrated, and the force of the hammer blow transmitted undiminished to the rivet shank.

(3) There are some cases, however, where even these methods will not give an entirely satisfactory head and it is necessary to resort to "squeeze" riveting rather than driving with a hammer and bucking bar in the conventional manner. For squeeze riveting operations, the type CP-351 compression "squeeze" riveter, manufactured by the Chicago Pneumatic Tool Company, is entirely satisfactory.

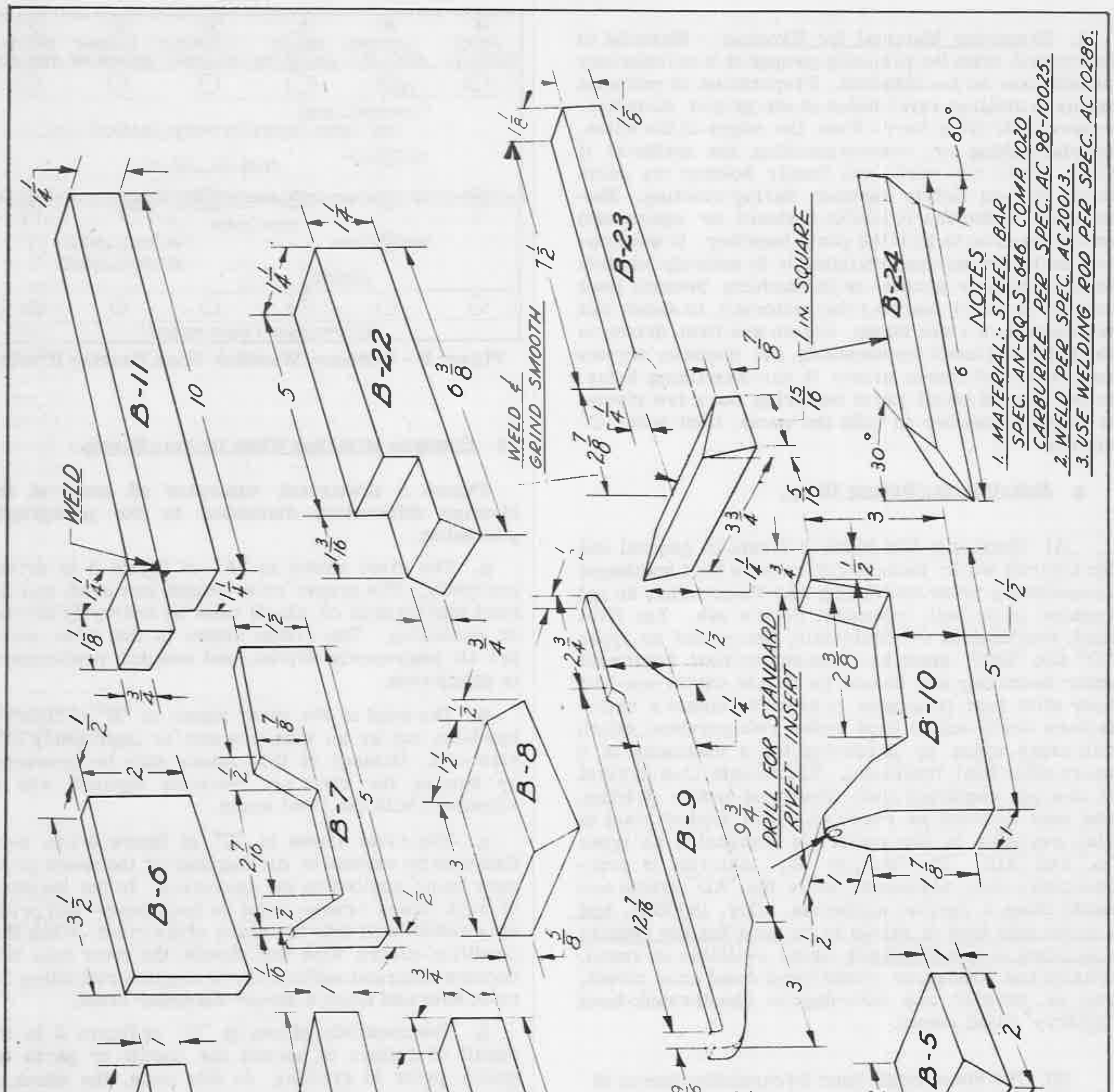


Figure 2a - Standard Bucking Bars

f. Preparing Material for Riveting. - Material to be riveted must be properly prepared if satisfactory results are to be obtained. Preparation of material involves drilling rivet holes of the proper diameter, removing drilling burrs from the edges of the holes, countersinking or counterpunching the material if flush rivets are used, and finally holding the parts being riveted tightly together during riveting. Mechanical fasteners (CLECO fastener or equivalent) should be used to hold the parts together. If mechanical fasteners are not available it is entirely feasible to use machine screws (with washers beneath head and nut to avoid marring the material), in about half the number of rivet holes. Rivets are first driven in the holes not used for clamping, the machine screws removed, and rivets driven in the remaining holes. In the case of small parts requiring but a few rivets, it may be feasible to hold the parts tight with "C" clamps

g. Selecting the Proper Rivet.

(1) There are two kinds of rivets in general use for aircraft work: those which require heat treatment immediately prior to driving; and those which do not require such heat treatment before use. The first kind, available in two materials, designated as types "D" and "DD." must be softened by heat treatment prior to driving and should be driven within one-half hour after heat treatment in order to obtain a satisfactory head; unless kept under refrigeration, which will delay aging or hardening for a maximum of 8 hours after heat treatment. The second kind of rivet is one not requiring heat treatment before driving, and may be used as received. This kind of rivet is also available in two materials designated as types "A" and "AD." The first, or "A," material is commercially pure aluminum, while the "AD" rivets are made from a special aluminum alloy, (A17ST), and are the only kind of rivets to be used for the repairs described in this Handbook; being available as round, brazier and 100-degree countersunk-head solid rivets, and as brazier and 100-degree countersunk-head "Cherry" blind rivets.

(2) The rivet length must be carefully chosen to provide sufficient material to head-over and form a shop-head of proper diameter and thickness. Too much material will result in splitting and/or deforming the shop-head, while insufficient material results in an under-strength rivet. When the proper rivet length is used the shank will extend through the material approximately 1-1/2 times the rivet diameter, before driving. When in doubt as to the proper length, a rivet should be driven experimentally, and its shop-head diameter and thickness checked against the dimensions given in paragraph 17. of this section. The correct length before driving can then be determined without difficulty, and if this is not a standard length, a longer rivet may be clipped to the proper length.

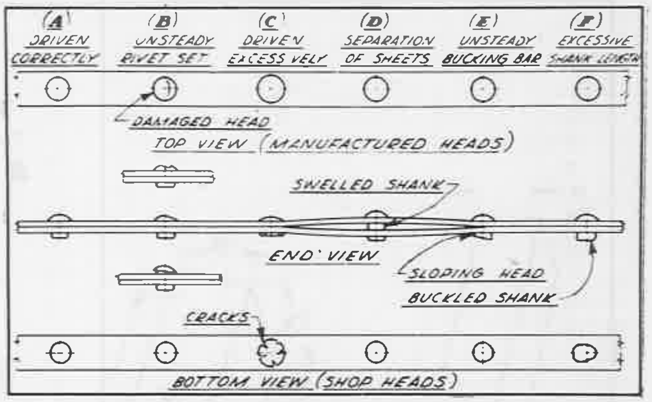


Figure 3 - Common Mistakes When Driving Rivets

14. Common Mistakes When Driving Rivets.

Figure 3 illustrates examples of some of the riveting difficulties discussed in the paragraphs preceding.

a. The rivet shown in "A" of figure 3 is driven correctly. The proper rivet length was used, and the head was formed on shank ends by correctly driving or squeezing. The rivets shown in the other views are all improperly driven, and require replacement in every case.

b. The head of the rivet shown in "B" of figure 3 has been cut by an insecure and/or improperly held rivet-set. Damage of this nature may be prevented by holding the rivet set securely against, and in alignment with the rivet shank.

c. The rivet shown in "C" of figure 3 has been flattened by excessive driving and/or too much pressure being applied to the squeezers. In the majority of such cases cracks exist in both heads and probably extend well into the shank of the rivet. When this condition occurs with thin sheets, the rivet hole may become enlarged sufficiently to require redrilling the rivet hole and using a larger diameter rivet.

d. The condition shown in "D" of figure 3 is the result of failure to secure the sheets or parts together prior to riveting. In this case, the shank of the rivet has swollen into the area produced by separation of the sheets and the rivet must be drilled out and replaced. Special care should be used to prevent such an occurrence as it is awkward to remove drill chips from between the sheets, and upon reriveting a smooth surface is very difficult to obtain.

e. The rivet shown in "E" of figure 3 has a sloping or "cocked" shop-head. This condition is a result of one or more of the following: the bucking bar was not held securely; was forced to one side by pressing too hard without adequate support; or was permitted to bounce and slide carelessly over the rivet. This is a common error and one which should receive careful attention.

f. The rivet shown in "F" of figure 3 has a large, irregular shop-head resulting from using a rivet of excessive length, combined with any one or all of the faults of the rivet shown at condition "E."

15. Installation Data for Driven Rivets.

The majority of aluminum-alloy driven rivets required for repairs are either AN426, 100-degree countersunk-head, AN430 round-head, AN442 flat-head, or AN455 brazier-head, and their proper installation involves establishing the correct drill and countersink or dimple diameters, and selection of the proper length to obtain the correct shop-head. Whenever AN430, AN442 or AN455 rivets are used for internal structure, wherein the rivet is not exposed to the air stream, the manufactured head should be against the thinnest sheet to facilitate driving. Rivets exposed to the air stream should normally have the manufactured head on the outside, regardless of the skin thickness. The main points to be considered in preparing holes for rivet installation are shown in figure 4.

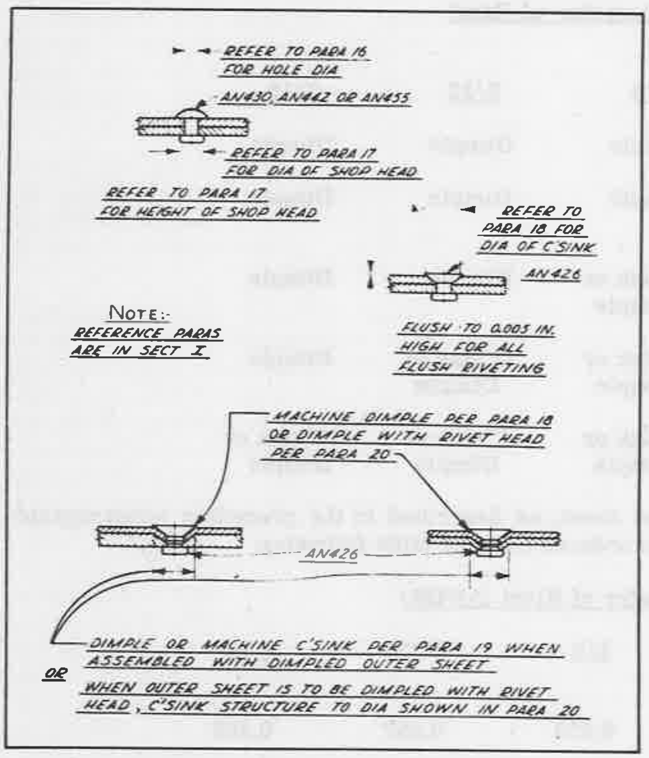


Figure 4 - Installation of Driven Rivets

16. Hole Sizes for Driven Rivets.

All drilled or punched holes for rivets should be made with drills or punches in accordance with the following table.

	Rivet Diameter							
	1/16	3/32	1/8	5/32	3/16	1/4	5/16	3/8
Pilot Drill (No.)	54	50	40	40	40	40	40	40
Drill Size (No. or Letter)	51	40	30	21	11	F	O	W
Punch Diam. +.000 -.0005	—	.100	.132	.164	—	—	—	—

17. Dimensions of Shop-Heads on Driven Rivets.

The shop-head on all types of driven rivets should conform to the following dimension, subject to a maximum variation of plus 1/32 inch.

Type "A", "AD", and "D" Rivets

Rivet Diam.	Head Diam.	Head Height
1/16	3/32	1/32
3/32	9/64	3/64
1/8	3/16	1/16
3/16	9/32	3/32
1/4	3/8	1/8
5/16	15/32	5/32
3/8	9/16	3/16

Type "DD" Rivets

Rivet Diam.	Head Diam.	Head Height
5/32	13/64	7/64
3/16	1/4	1/8
1/4	21/64	11/64
5/16	27/64	13/64

18. Countersinking and Dimpling Sheets for AN426 Rivets.

The installation of flush rivets requires that the skin be suitably recessed to receive the rivet manufactured head. If the skin is of sufficient thickness this may be accomplished by using a suitable 100-degree countersinking tool to cut away the metal around the rivet hole. In the case of thin sheets, however, it is necessary to "dimple" or counterpunch the material around the rivet hole to form a suitable recess for the rivethead. The following table has been prepared to show the required recess diameter, and what method is necessary for various combinations of AN426 100-degree rivet diameters and sheet thicknesses.

	Diameter of Rivet			
	3/32	1/8	5/32	3/16
	Diameter of Countersink or Dimple			
Sheet Thickness (in.)	0.179 in.	0.225 in.	0.287 in.	0.355 in.
0.025	Dimple	Dimple	Dimple	Dimple
0.032	Dimple	Dimple	Dimple	Dimple
0.040	Dimple	Dimple	Dimple	Dimple
0.051	C'sink	Dimple	Dimple	Dimple
0.064	C'sink	C'sink	Dimple	Dimple
0.072	C'sink	C'sink	C'sink	Dimple
0.081	C'sink	C'sink	C'sink	C'sink

19. Countersinking and Dimpling Structure for AN426 Rivets.

a. If the sheet receiving the manufactured rivethead is dimpled, there will be a corresponding extrusion of the opposite side of the sheet, and the structure beneath the sheet must be dimpled or countersunk to receive the dimple extension of the skin. The table following shows the method to be used for various structure thicknesses and rivet diameters.

	Diameter of Rivet			
Thickness of Structure (in.)	3/32	1/8	5/32	3/16
0.032	Dimple	Dimple	Dimple	Dimple
0.040	C'sink or Dimple	Dimple	Dimple	Dimple
0.051	C'sink or Dimple	C'sink or Dimple	Dimple	Dimple
0.064	C'sink or Dimple	C'sink or Dimple	C'sink or Dimple	Dimple
0.072	C'sink or Dimple	C'sink or Dimple	C'sink or Dimple	C'sink or Dimple

b. When the structure is recessed to receive a dimpled sheet, as described in the preceding subparagraph, the diameter of the dimple or countersink used must be accordance with the table following:

	Diameter of Rivet (AN426)			
	3/32	1/8	5/32	3/16
Diameter to Machine C'sink	0.189	0.235	0.297	0.365
Diameter to Dimple	0.179	0.225	0.287	0.355

20. Dimpling with the Rivethead.

a. In some cases, where the sheet requiring dimpling is comparatively thin, it is practical to use the rivet manufactured head to accomplish the dimpling, by driving the rivethead and skin down into a suitable dimple or countersink in the structure. The maximum sheet thickness or combination of sheets possible for dimpling with the rivethead is shown in the table following:

	Diameter of Rivet (AN426)			
	3/32	1/8	5/32	3/16
Maximum thickness to be dimpled with rivethead	0.032	0.040	0.051	0.064
Maximum combination of sheets to be dimpled with rivethead	0.025 and 0.032	0.032 and 0.040	0.040 and 0.051	0.051 and 0.064

b. When the rivethead is used as the dimpling agent, as described in the preceding paragraph, the diameter of the mating dimple or countersink in the structure beneath should be as follows:

	Diameter of Rivet (AN426)			
Thickness of Outer Sheet (in.)	3/32	1/8	5/32	3/16
0.020	0.194	0.240	0.302	0.370
0.025	0.198	0.244	0.306	0.374
0.032	0.202	0.248	0.310	0.378
0.040	——	0.254	0.316	0.384
0.051	——	——	0.325	0.393
0.064	——	——	——	0.403

21. Description of "Cherry" Blind Rivets.

a. There are two types of "Cherry" blind rivets - the hollow-type (used with a drive-in plug where desired), and a self-plugging type with a projecting stem which must be trimmed off after installation. Each type is made either with brazier or 100-degree countersunk head, in three diameters of 1/8, 5/32, and 3/16; and four grip lengths covering all thicknesses between 0.030 and 0.265 inch.

b. The "Cherry" rivet is constructed in two pieces. The rivet itself is hollow, made of A17ST aluminum alloy. Through the hole in the rivet is inserted a stem or mandrel of 17ST aluminum alloy with a preformed head. This stem is inserted from the tail, so that the preformed head rests against the tail of the rivet, the diameter of the head being no greater than the rivet. A pulling head is then die-stamped on the outer end of the stem. All rivets are assembled in this manner before shipment, and are ready for use.

c. When this rivet, with the stem projecting from the head end, is placed in riveting position the gun fits over the stem to exert pressure on the head and tension on the stem. Thus, the preformed head on the stem is forced into the tail of the rivet. This expands the tail and tightens it down against the back of the pieces to be fastened together. The pull on the stem is continuous until the stem breaks and, in the case of a hollow rivet, falls out on either side of the rivet leaving a spread-out, clinched tail. The hole may then be plugged with a knurled pin, if desired.

d. The self-plugging type rivet is essentially the same as the hollow-type, except that the stem is longer and extends from both ends of the rivet. The part extending from the tail of the rivet is slightly larger than the hole in the rivet. When this stem is pulled through from the head end, it enlarges the rivet to fill the hole completely, and thus plugs the rivet. A tulip head is formed on the blind side and continued tension on the stem causes it to break, leaving the broken end extending from the manufactured head of the rivet. This stem may then be trimmed with nippers.

22. Types of "Cherry" Blind Rivets.

There are six types of "Cherry" rivets available, and four of these are illustrated in figure 5. The various "Cherry" rivet types are as follows:

a. LS-1126 Series. - This is a 100 degree countersunk-head, self-plugging rivet with head and shank dimensions identical to the AN426 rivet.

b. LS-1127 Series. - This is a brazier-head, self-plugging rivet with head and shank dimensions identical to the AN455 brazier-head rivet.

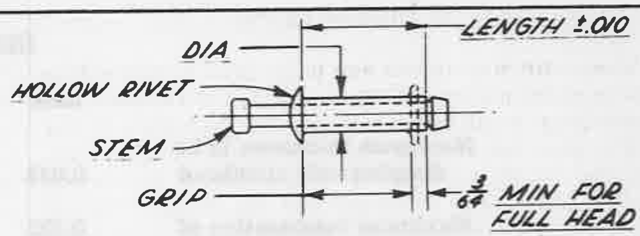
c. LS-1112 Series. - This is a 100 degree countersunk-head hollow rivet with head and shank dimensions identical to the AN426 rivet.

d. LS-1113 Series. - This is a brazier-head hollow rivet with head and shank dimensions identical to the AN455 brazier-head.

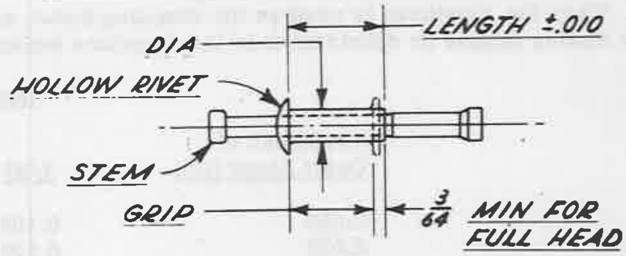
GRIP	LENGTH	DIAMETER & DASH NO'S		
		1/8	5/32	3/16
1/16	1/8	4-2	5-2	--
1/8	3/16	4-4	5-4	6-4
3/16	1/4	4-6	5-6	6-6
1/4	5/16	4-8	5-8	6-8

NOTES:-

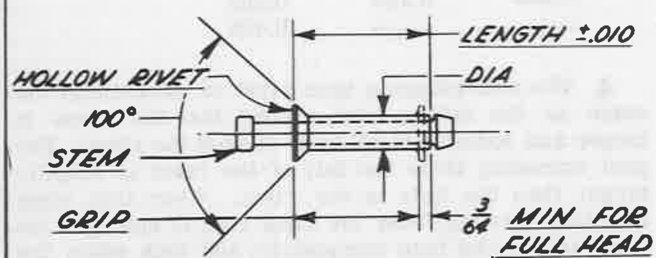
1. IN SELECTING RIVET OF PROPER LENGTH, ALLOW A MINIMUM OF 3/64 INCH SHANK EXTENSION FOR FULL HEAD; THUS, LS-1113-4-4 IS 1/8 INCH DIAMETER x 3/16 INCHES LONG FOR USE IN TOTAL STOCK THICKNESS OF FROM 5/64 INCHES TO 9/64 INCHES.
2. MATERIAL-RIVET IS A17ST & STEM IS 17ST ALUM ALLOY, SPEC AN-FF-R-551.
3. DO NOT RE-HEAT TREAT THESE RIVETS.
4. CHERRY RIVETS ARE MFGD BY THE CHERRY RIVET CO., LOS ANGELES, CALIF.



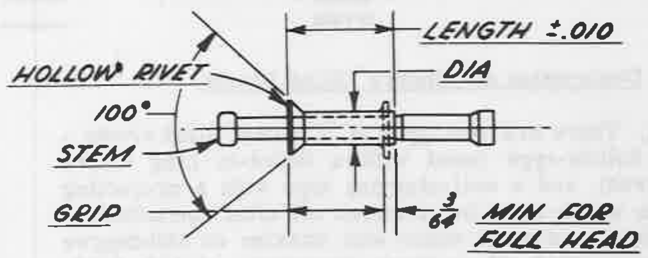
LS-1113 BRAZIER HEAD (HOLLOW TYPE)



LS-1127 BRAZIER HEAD (SELF-PLUGGING TYPE)



LS-1112 100° COUNTERSUNK HEAD (HOLLOW TYPE)



LS-1126 100° COUNTERSUNK HEAD (SELF-PLUGGING TYPE)

Figure 5 - "Cherry" Rivet Data

e. LS-1128 Series. - This oversize-shank rivet is designed primarily for use in double-dimpled construction where the rivet hole size in thin sheets is enlarged (from 0.010 to 0.020 inch) in the dimpling process. The head is identical to the AN426 rivet, but the shank diameter has been enlarged (0.009 to 0.016 inch) over the standard dimensions.

f. LS-1129 Series. - This oversize rivet has the same shank diameter as LS-1128 but with the AN455 brazier-head.

g. The LS-1128 and LS-1129 rivets are particularly well adapted to repair work, as the oversize shank insures a tight rivet in holes slightly enlarged by drilling out the original rivets.

23. Selection of "Cherry" Blind Rivets.

a. In determining what size of rivets to use, it is advisable to select a rivet having a nominal grip length (figure 5) as close as possible to the thickness of the sheets to be riveted. There is however, a considerable tolerance, in that "Cherry" blind rivets will handle materials which are 1/64 inch (0.016) thicker or 3/64 inch (0.047) thinner than the nominal recommended grip length.

b. A 1/8-inch diameter hollow-type brazier-head rivet, to fasten together sheets of a total thickness of 0.125 inch would be described as LS-1113-4-4. A 3/16-inch diameter self-plugging type 100-degree countersunk-head rivet, to fasten together sheets of a total thickness of 0.165 inch, would be described as LS-1126-6-6, because 0.165 falls within the range covered by the -6-6 rivet.

24. Plugs for "Cherry" Hollow Rivets.

If hollow-type rivets are to be used and drive-in plugs are needed, the numbers are similar to those of the rivet, and the plug for the 1/8-inch brazier-head rivet with a 1/8-inch grip, as mentioned in paragraph 23. would be LS-1114-4-4. A plug for a countersunk hollow-type of the same dimension would also be LS-1114-4-4.

25. Grip Lengths for Dimpled Sheets.

Where dimpled sheets are to be used in connection with countersunk rivets, it is easy to determine the proper grip length by taking the total thickness of the sheets, plus the amount which the dimple extends beyond the inside surface. For example, if the sheets are 0.052 inch total thickness and the dimple extends 0.038 inch on the inside of the work, then the total grip length to be handled would be 0.090 inch. This is 0.035 inch less than 1/8 inch, which is within the limits covered by the 1/8-inch grip length. The required grip would be -4 and the rivet used would be either LS-1112-4-4, or LS-1126-4-4. A simple way to calculate dimpled grip length is to add the height of the head to the thickness of the sheets before dimpling. "Cherry" rivethead-heights are as follows:

Countersunk-rivet diameter	1/8	5/32	3/16
Head height	0.042	0.055	0.070

26. Holes for "Cherry" Blind Rivets.

a. In drilling holes for the use of "Cherry" blind rivets, care should be taken to have the hole at right angles to the sheets. The following hole sizes are recommended:

	Rivet Diameter		
	1/8	5/32	3/16
Drill No. for self-plugging rivets	30	20	10
Drill No. for hollow rivets	30	20	11

b. When using countersunk rivets and dimpled holes, it is very important to have the rivet holes smooth. Chips must be carefully eliminated from between the sheets, and any burrs resulting from drilling should be removed, as they prevent proper seating of the manufactured head as well as of the shop-head. In general, material for riveting with "Cherry" blind rivets should be prepared in the same way as though driven rivets were used.

27. Holding Sheets together for Drilling and Riveting ("Cherry" Rivets).

a. The use of clamps or sheet screws at reasonable intervals is recommended. In the case of the hollow-type rivet, wider intervals may be used because the rivet itself, when applied with sufficient pressure to break the stem, exerts a considerable amount of pull on the sheets and tends to bring them close together. "Cherry" hollow rivets are ideal for use as sheet clamps in preparing work for drilling and further riveting. Holding the sheets in intimate contact is considered good practice when inserting self-plugging rivets, as the latter do not have as great a clinching characteristic as the hollow rivets.

b. The hole sizes recommended in paragraph 26. provide a free fit for the rivet, as it is not necessary to have a snug fit. It is necessary, however, to be sure the chips or burrs are eliminated and that the rivets are free from damage. Nicks or dents in the thin edge of the manufactured head may prevent the head from seating properly, and such rivets should be discarded. Speed of application can sometimes be increased by putting a considerable number of rivets in their holes and then applying the gun to the projecting stems and upsetting. In some places, however, it is easier to insert the rivet in the gun head and then into the hole.

28. Use of "Cherry" Rivet Guns.

a. Several types of guns are manufactured by the Cherry Rivet Company, but the hand-operated gun shown in figure 6 is recommended for repair work. The pulling heads on all guns operate on the same principle. Each has a slotted end into which the stem of the rivet is inserted. Each has an inside draw-bar which, upon the application of force, pulls upon the stem of the rivet and by continued pull, forces the inside end of the stem into the tail of the rivet and eventually breaks the stem. Whenever applying a "Cherry" rivet, care should be taken to see that the head of the rivet is held firmly against the sheet to which it is being applied, and that the pulling-head is properly aligned with the rivet. These simple precautions will insure uniform and smooth results.

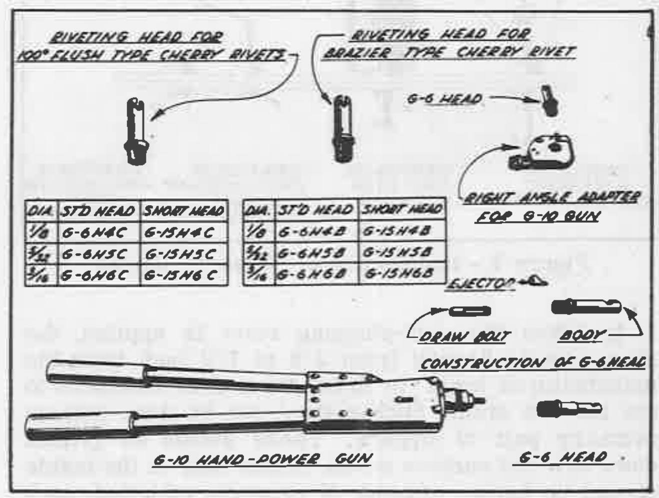


Figure 6 - Tools for Installing Cherry Rivets

b. Care should be used to see that the proper pulling-head is fitted to the gun to handle either countersunk or brazier-type rivets in each diameter. It is necessary to have a separate size of pulling-head for each diameter and type of rivet. These heads are readily interchangeable.

c. Care must always be taken to have the gun in proper working condition. This can be determined by measuring the pulling-head movement. In guns designed for hollow-type rivets, this should be 5/16 inch minimum. In guns for both hollow self-plugging rivets, the movement is 3/4 inch minimum. Decrease in length of the stroke may result in failure to break the rivet stem.

29. Plugging or Trimming "Cherry" Blind Rivets.

a. A knurled plug is available for closing the opening in hollow-type rivets. Descriptive numbers for these plugs are given in paragraph 24. and the sizes to correspond to the diameter and grip length of the rivet should be selected. These plugs are made of aluminum alloy 17ST and are longitudinally knurled. Plugs are made with a tapered end so that insertion in the hollow rivet is relatively easy in spite of the small size of the plug. For driving the plug, the use of a very light weight air-operated riveting gun is best. Many very light blows will drive in the plug without distortion of the sheets, whereas a few heavy blows may have a bad effect upon the work.

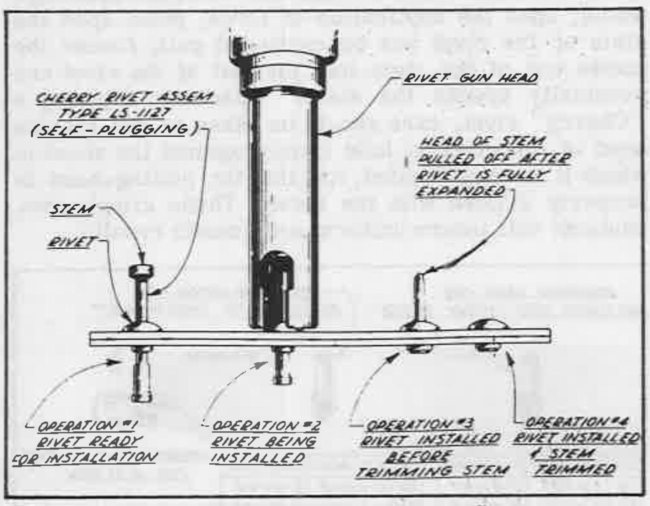


Figure 7 - Installation of "Cherry" Rivets

b. When the self-plugging rivet is applied, the stem usually breaks from 3/8 to 1/2 inch from the manufactured head. In most cases it is desirable to cut off this stem. Such cutting can be done with an ordinary pair of nippers. These should be ground down to a flat surface on the outside and on the inside should be hollow ground. If properly adjusted, such nippers will do satisfactory work.

30. Aluminum Alloy Heat-Treated Parts.

In general, all structural members, such as skin and extrusions, are heat-treated 24ST or 24STAL (alclad) material, except forgings, which in the main are of 14ST material. The rivets used for a majority of cases are A17ST (AD) material; although in highly stressed areas, 24ST (DD) rivets are used. All aluminum-alloy tubing is annealed after forming. Instructions for heat-treating and/or annealing aluminum materials are contained in Specification No. AN-QQ-H-186, "Heat Treatment of Aluminum Alloys."

31. Steel Heat-Treated Parts.

Information on heat treatment of carbon and alloy steels is contained in U.S. Army Specification No. 98-10025, "Heat Treatment for Steels." The nature of the heat treatment required for specific parts is entered upon the drawing of that part. Steel parts of which the relevant drawing does not specify heat treatment, either did not receive heat treatment, are normalized only; are "torch normalized" welded assemblies; or are corrosion-resistant steel parts.

a. Annealed and Normalized Parts. - Steel parts not identified as being heat-treated are manufactured in either the annealed or normalized condition.

b. Welded Assemblies. - All welded assemblies are made from normalized material, and the joints "torch normalized" after welding. Torch normalizing is accomplished after the part has been welded and cooled, by reheating the entire area immediately adjacent to the original weld from 800 to 1000 degrees F. (approximately 430 to 540 degrees C), (dull-red color in the dark), and allowing to cool in still air, or preferably while covered with sand or powdered mica. Use a low-velocity gas flame adjusted to be slightly on the carbonizing side.

c. Corrosion-Resistant Steel Parts. - Welded corrosion-resistant steel parts are annealed after welding by heating to 1950-2000 degrees F (approximately 1065 to 1195 degrees C), for 3 to 5 minutes, and then quenching in water. The application of direct flame during heating is avoided. Scale formed by the heat treatment is removed either by light sandblasting, or by pickling in acid solution. In either case, the part is passivated to restore the chrome-oxide film, as a final operation.

d. Spring Parts. - Parts requiring spring temper are heat-treated for strain and embrittlement relief in accordance with U.S. Navy Specification No. NAF PH-4.

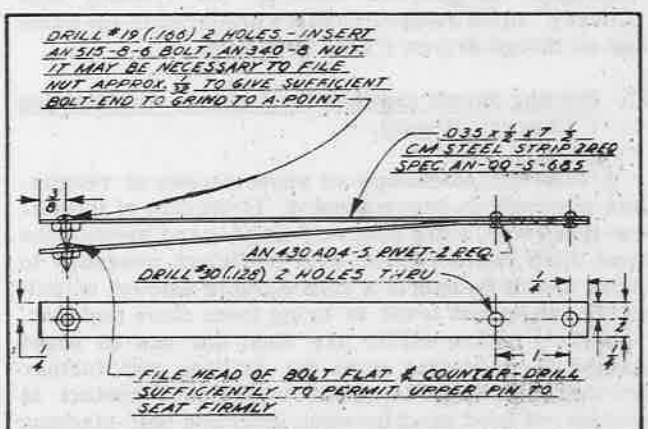


Figure 8 - Hole-Finder for Installing New Fairing

Gage	24STAL Alum. Alloy	Normalized CM Steel
0.025	1/8	1/16
0.030	——	1/16
0.032	1/8	——
0.035	——	1/16
0.040	5/32	——
0.042	——	1/16
0.050	——	1/16
0.051	3/16	——
0.062	——	3/32

Gage		24STAL Alum. Alloy	Normalized CM Steel
0.064		3/16	——
0.072		7/32	——
0.078		——	1/8
0.093		——	1/8
0.125	(1/8)	1/2	3/16
0.156	(5/32)	21/32	1/4
0.187	(3/16)	27/32	5/16
0.250	(1/4)	——	3/8

e. Parts Heat-Treated to a Specified Tensile Strength. - Parts heat-treated to a definite tensile strength and/or hardness are identified on their relative detail or assembly drawings.

32. Bend Radii for Aluminum Alloy and Steel Sheet.

a. Minimum bend radii for the commonly used gages of 24STAL heat-treated aluminum-alloy and normalized CM steel sheet are shown in the above table.

b. All sheet material should be bent or formed with the bend lines approximately at right angles to the grain of the material. The grain of the material usually extends the length of the sheet.

33. Welded Repairs.

a. When making welded repairs, only those structural parts which were welded during manufacture may be repaired by welding. All welding should be in accordance with standard practice. The welds should be similar to those originally made: tack welding, for instance, must be replaced by tack welding.

b. Fittings welded to other structure should not be completely removed when damaged sufficiently to require repair by welding. Instead, short stubs should remain attached to the supporting structure by the original welds, to serve as locating points for the repair.

34. Electric Arc Welding.

The engine mount structure, and the majority of those steel welded assemblies not made from corrosion-resistant steel, are welded by the electric arc method. It is advisable that all repairs to these structures be made by the same method of welding, as an attempt to weld over with gas welding on arc-welded joints, may not be satisfactory. If arc-welding equipment is not available, it is possible to make repairs with gas welding, by using care to remove the majority of the original weld in areas where it is necessary to reweld an original joint. Joints made by the arc process are easily distinguished from those made by gas welding, as the appearance of the arc weld-bead is much rougher than that formed by gas welding.

35. Vultee Welding Specification No. W-100.

All arc-welded joints in this airplane were made in accordance with Vultee Welding Specification No. W-100, which is summarized in the paragraphs following for the convenience of personnel engaged in repair operations involving welding.

a. Welding Machines. - All welding shall be accomplished with a dc (direct current) machine provided with adequate means of voltage and current control.

b. Electrodes. - All electrodes used for welding shall be of the coated type, in accordance with AAF Specification No. 10286, "Wire, Iron, and Steel Welding," grade 1E or 2E. Grade 2E should be used when welding parts are to be heat-treated after welding.

c. Polarity. - The polarity used shall be in accordance with the recommendation of the electrode manufacturer, or as proven satisfactory by the welds obtained.

d. Voltage and Current. - Under normal circumstances the voltage and current used shall be in accordance with the table following, except in special cases where it is found that deviation from these values will produce an improved weld.

	Material Thickness					
	0.035	0.049	0.058	0.063	0.078	0.093
Electrode Diameter	1/16	5/64	5/64	5/64	3/32	3/32
Current (amperes)	30	35	45	55	65	80
Voltage	18	19	20	21	22	23

Material Thickness

	0.109	0.125	0.140	0.156	0.171	0.187	0.093
Electrode Diameter	3/32	1/8	1/8	1/8	1/8	1/8	5/32
Current (amperes)	90	100	110	120	125	130	135
Voltage	24	25	26	27	28	29	30

e. Thickness of Material. - The minimum thickness of material to be arc welded shall normally be 0.035 inch. Gussets and clips are not included in this limitation.

f. Size of Weld Beads. - Weld beads shall be of the size noted on the relevant drawing, except that when the size is not specified the width of the weld bead shall be as follows:

(1) Joints wherein the thinner material is less than 0.040 inch shall have a maximum weld bead width of: 1/4 inch.

(2) Joints wherein the thinner material is 0.040 inch, or more, shall have a maximum weld bead width of: 1/4 inch plus twice the material thickness.

36. General Requirements for Arc Welds.

The following general requirements apply to all arc welded joints:

a. When two or more passes are to be made, the first bead shall be thoroughly cleaned and chipped before laying the second bead over it.

b. Penetration shall be sufficient to secure a good bond, but burning through is to be avoided.

c. All beads shall be laid down in a workmanlike manner and shall be smooth and uniform in cross section. Excessive spattering, slag inclusions, gas pockets and pitting are not permissible. If a weld is undercut for 50 percent or less of its length, the undercut portion shall be chipped out and rewelded. If undercut for more than 50 percent of its length, it is desirable to chip out the entire bead and reweld.

d. If a weld cracks it shall be properly cleaned with a wire brush, and crack chipped out until sound metal is exposed, and then rewelded.

e. When joints are welded on both sides, as in the case of gussets, the scale which forms on the reverse side shall be cleaned with a wire brush before welding.

37. Tubes Bowed During Welding.

a. Upon completion of a repair, it may be found that there is a certain degree of bowing in some members. This is due to the contraction that takes place at the weld (causing bowing) when the weld is on one side of the tube only. Bowing not exceeding 1/16 inch may be neglected, but if in excess of this, the following procedure will generally be found effective.

b. At the point where the bowing originates, heat should be applied to the side opposite the weld by means of an oxyacetylene flame. The straightening effect is obtained by contraction, which takes place in cooling. In this way it is possible to restore the tube to its original straight condition. Great care must be taken in order to insure that too high a temperature is not created and a dull-red heat in daylight should not be exceeded. No attempt should be made to pull a member into position while heat is being applied, as a kink or buckle will most probably occur. If the tube cannot be straightened to within the limits of 1/16 inch by this method, it should be replaced by a new tube.

c. When heating tubes for alignment, no heat should be applied for a distance greater than 6 inches away from any weld. Whenever possible, heat should be applied as close to the joint as possible. Never heat any more than is absolutely necessary for proper straightening or alignment.

38. Welding Heat-Treated Members.

a. Heat-treated steel must not have heat applied during welding at any place other than where welding occurs. Where torch preheating of the weld area is necessary, the metal shall not be brought to a red heat. During preheating, the torch flame should not be applied farther than approximately 2 inches from the joint.

b. All welded seams on heat-treated material shall be made in several steps, preferably four, and no less than two. After each portion of the weld is laid down it is desired to have it cool, at least to a black heat, and preferably until cool to the touch. It has been found that the annealing effect of a weld containing an average amount of heat lowers the strength of the tube for a distance of approximately 1-1/2 to 2 inches on each side of the weld and for this reason it is desired to avoid, as much as possible, continuous seams which will increase the extent of the affected zone, whereas shorter beads will decrease it. However, it is not desired to lay down a bead in more than four strips since this adversely affects the quality of the weld.

39. Control Surface Balance.

a. All flight control surfaces of this airplane were carefully balanced at the time of manufacture to obtain proper dynamic and static balance. This involved the addition of lead ballast weights within the nose section of each surface. These were located so that the total weight (structure and lead) forward of the hinge centerline was at least sufficient to balance the weight of the structure aft of the hinge centerline, and in some cases was sufficient to provide a slight overbalance - as a small amount of overbalance is preferable to insufficient balance. The distribution of the lead weights was arranged to obtain proper dynamic balance. As long as this relationship remains, the surface will retain proper dynamic and static balance.

b. Static balance exists when the part of the surface forward of the hinge line balances the portion aft of the hinge line, with the chord line of the surface being in level flight position.

c. Dynamic balance exists when a rotation about one axis, (axis of oscillation of supporting structure), does not tend to induce a rotation or flutter about a second axis (hinge centerline), but rather tends to return to the surface to its original position.

40. Rebalancing Control Surfaces After Repair.

Should the balance be disturbed by repairs adding weight to some portion of the surface, aft of the hinge centerline, it will be necessary to rebalance the surface, and the following procedure should be followed to determine the necessary amount of additional ballast and its proper location.

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

b. Accurately weigh the replacement parts and measure their location with reference to the axes noted in subparagraph a. preceding.

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

d. The additional lead ballast weights must be located inside the leading edge of the surface, as far forward as possible, and at least as far outboard as the station at the cg of the repair.

Equation I

$$B = \frac{W\,d_r}{d_1}$$

Where: B = Ballast necessary at chosen location
W = Weight increase due to repair
d_r = Distance of repair aft of hinge centerline.
d_1 = Distance of lead forward of hinge centerline

d_r to be measured from structure
d_1 to be obtained from the graph of the surface in question, as shown in figure 44.

e. Following is an example of typical calculations necessary to determine the proper amount of ballast to compensate for a repair at approximately 40 inches out from the inboard end of the aileron.

Parts Removed		Parts Added	
Rib	0.05 lb	Rib	0.08 lb
Skin and Rivets	0.04 lb	Skin and Rivets	0.07 lb
Fabric	0.01 lb	Doubler	0.04 lb
Total	0.10 lb	Fabric	0.01 lb
		Total	0.20 lb

Additional weight due to repair:

0.20 lb - 0.10 = 0.10 lb

Substituting in Equation I:

$$B = \frac{W\,d_r}{d_1} = \frac{0.10 \times d_r}{d_1}$$

d_r = 16 inches, cg of repair aft of hinge centerline.
d_1 = 2.625 inches, from Graph No. I of figure 44.

Then:

$$B = \frac{0.10 \times 16}{2.625} = 0.61 \text{ lb}$$ additional ballast necessary to rebalance the aileron for the conditions described.

41. Finding Approximate Center of Gravity of a Repair.

The center of gravity (cg) is that point at which all the weights may be considered as acting. Use the hinge centerline of any convenient station line as reference axes. Measure the distance from the reference axes to the cg of each part added; (this distance is known as the "arm"). Multiply the weight of each part by the distance to each reference axes to obtain the "moment" of each. Add the moments taken about each axes and divide by the total weight. The result is the distance from the reference axis to resultant centerline of the repair. Following is an example of the calculations necessary to locate the approximate center of gravity of a repair.

a. Take hinge and airplane centerlines as reference axes.

b. Distance from hinge centerline is obtained thus:

Item	Weight (lb)		Arm (in.)		Moment (in.-lb)
Rib	0.10	x	12.0	=	1.20
Skin and Rivets	0.16	x	10.8	=	1.73
Trailing Edge	0.07	x	15.0		1.05
Fabric	0.01	x	10.0		0.10
Totals	0.34				4.08

$$\frac{4.08}{0.34} = 12 \text{ inches}$$ = Distance from hinge centerline to resultant cg of parts added by the repair.

c. Distance from airplane centerline is obtained thus:

Item	Weight (lb)		Arm (in.)		Moment (in.-lb)
Rib	0.10	x	89	=	8.90
Skin and Rivets	0.16	x	93	=	14.90
Trailing Edge	0.07	x	85	=	5.95
Fabric	0.01	x	85	=	0.85
Totals	0.34				30.60

$\frac{30.6}{0.34}$ = 90 inches = Distance from airplane centerline to resultant cg of parts added by the repair.

42. Geometry of Air Frame.

Figure 9 illustrates the basic dimensions, or geometry, of the units forming the air frame of this airplane. Herein are shown all fittings and major structural members, together with the mold-lines of all airfoils. Dimensions and angles show the location and relationship of all fittings. The information given is sufficient to permit construction of any and all assembly jigs required for repair of the air frame. Sheet No. 4 of figure 9, shows the ordinates of the wing at root, tip, and junction of center section with outer panel at station No. 106.653. The center section is a straight taper between the root and station No. 106.653, and the outer panel is a straight taper (of a different value due to the difference in wing sections), between stations No. 106.653 and 193.528, (wing tip junction).

43. Prevention of Corrosion.

Every precaution must be taken during repair to prevent corrosion and to insure that no existing corrosion goes undetected, especially in places where it will not be visible after repair. Corrosion cannot 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.

44. Protective Coatings for Repairs.

The anodic treatment of aluminum-alloy repair parts is good practice. All steel parts other than those made of corrosion-resistant steel should be cadmium plated. In addition to the primary protective treatment, most parts of the airplane should be given two coats of zinc-chromate primer. Emergency repairs may be accomplished without use of anodic or cadmium plate protection, if two heavy coats of zinc-chromate primer are applied to each contacting surface. Steel tubes should be protected internally with an application of hot linseed oil. All parts which come into contact with doped fabric should be coated with a dope-resistant paint, and all parts which are liable to be splashed with acid should be given two coats of an acid-resistant paint. When making repairs, all joints which are made of dissimilar materials should bed down on wet zinc-chromate primer or other approved sealing material. Aluminum-alloy rivets passing through steel (including corrosion-resistant steel), should be driven "wet" with zinc-chromate primer. In fact, all bolts, screws and rivets employed in joints of dissimilar metals should always be coated with primer just prior to assembly. This procedure is particularly important in the case where a steel bolt or screw passes through aluminum alloy, or where an aluminum-alloy fastening passes through steel.

45. Repairing Fabric Covering.

The fabric covering on ailerons and elevators is cotton fabric. Due to the possibility of this type of fabric not being available in repair depots, it is advised that repair to fabric be accomplished by complete replacement, except in the case of small doped-on patches. Cotton fabric should not be repaired with linen patches. Care should be taken to obtain a replacement fabric equivalent in strength requirements to Specification No. AN-CCC-C-399, "Mercerized Airplane Cloth, Cotton."

46. Marking Off.

All new parts made up for replacement of important members or fittings must be carefully marked-off on a surface plate to the dimensions given on the relevant drawing. When scribing the lengths of these parts, care should be exercised to prevent heavy marking of material, for a deep scratch might weaken the material and develop a serious crack.

47. Replacement of Bolts.

Bolts must be well fitted, and care must be taken to insure that none of the threads are in 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. It is essential that standard washers should be fitted under the head of all bolts except those which pass through heavy fittings which are countersunk to clear the radius under the bolthead.

48. Replacement of Nuts, Washers, Cotter Pins, Etc.

Where possible, replace all self-locking nuts with new nuts when removed for any reason. When replacing bolts, care must be taken to insure that the nuts are locked in the same manner as those of the original bolts. Spring washers, cotter pins, and lock wires must never be used twice.

49. Enlarged Rivet, Bolt and Bushing Holes.

a. Before replacing parts which have been secured by bolts, bushings, or rivets, the holes should be examined for elongation. Enlarged and/or elongated holes will necessitate the replacement of the

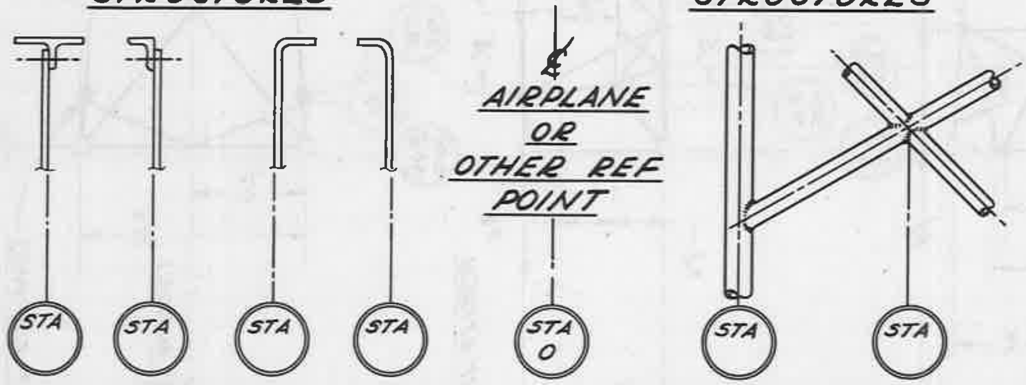
EXPLANATION OF ABBREVIATIONS & SYMBOLS USED ON SHEETS FOLLOWING

- ℄ - CENTER LINE
- ML - MOLD LINE; REPRESENTS THE TRUE OUTLINE OF A SURFACE
- L.E. - LEADING EDGE
- T.E. - TRAILING EDGE
- STA. - STATION OR INDEX POINT (REFERENCE LINE)
- L.G. - LANDING GEAR
- ⊕ - PIVOT OR POINT OF ROTATION
- SYM. - SYMMETRICAL

HOW STATION OR INDEX POINTS ARE INDICATED

SHEET METAL STRUCTURES

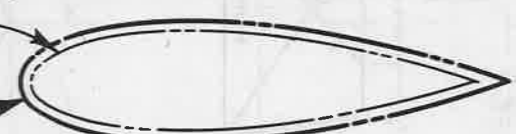
TUBULAR STRUCTURES



STATIONS ARE INDICATED TO WEB FACES

STATIONS ARE INDICATED TO TUBE ℄

ML STRUCTURE - OUTSIDE SURFACE OF THE DETAIL PART (SIMILAR IN MOST CASES TO INSIDE SURFACE OF SKIN COVERING); SOMETIMES REFERRED TO AS ML SURFACE.



ML SKIN - OUTSIDE SURFACE OF SKIN COVERING (USED PRINCIPALLY FOR ESTABLISHING FAIRING CONTOURS).

Figure 9 - Geometry of Air Frame
(Sheet 1 of 6 Sheets)

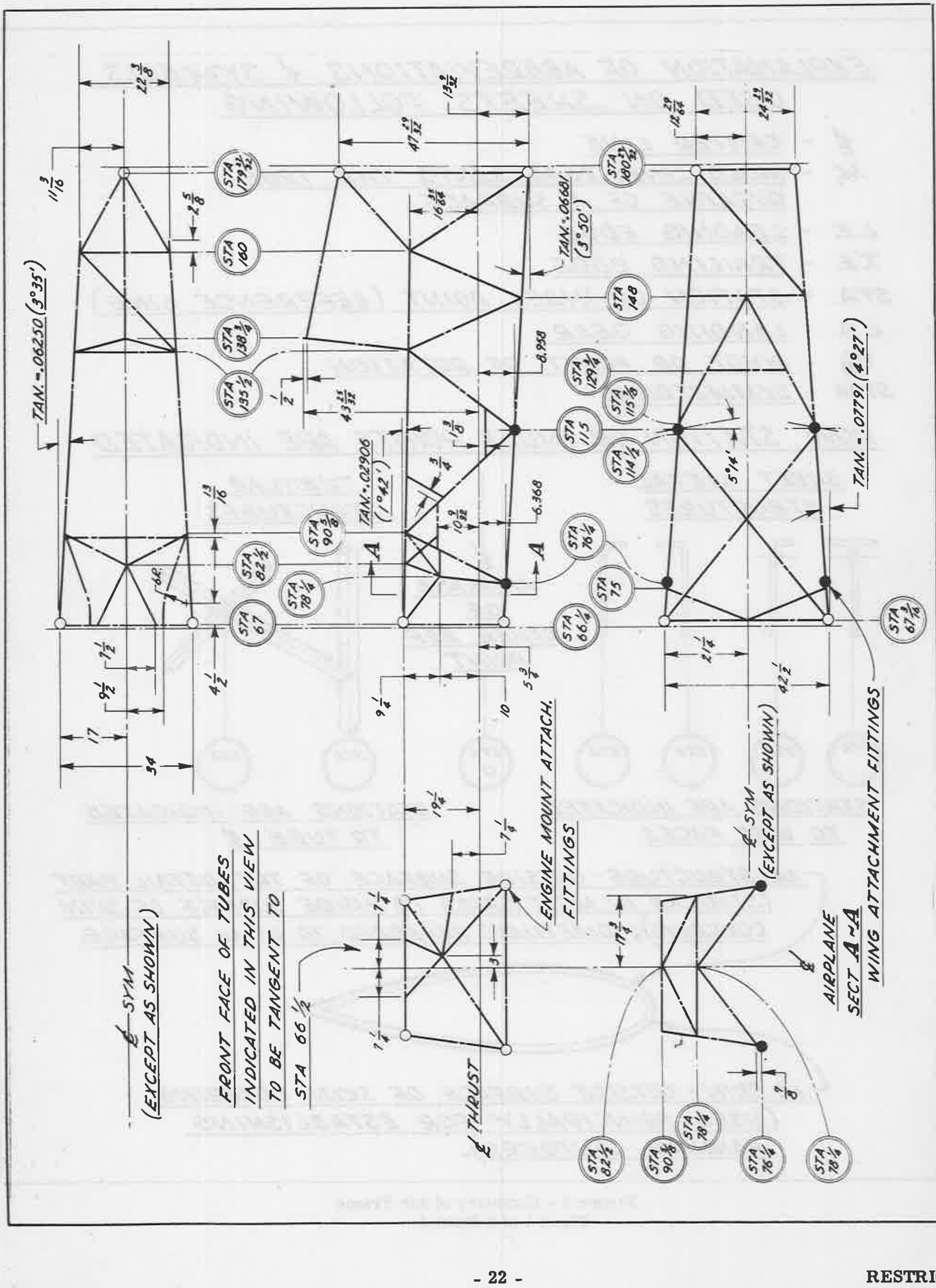


Figure 9 - Geometry of Airframe - Fuselage Steel Tube Structure
(Sheet 2 of 6 Sheets)

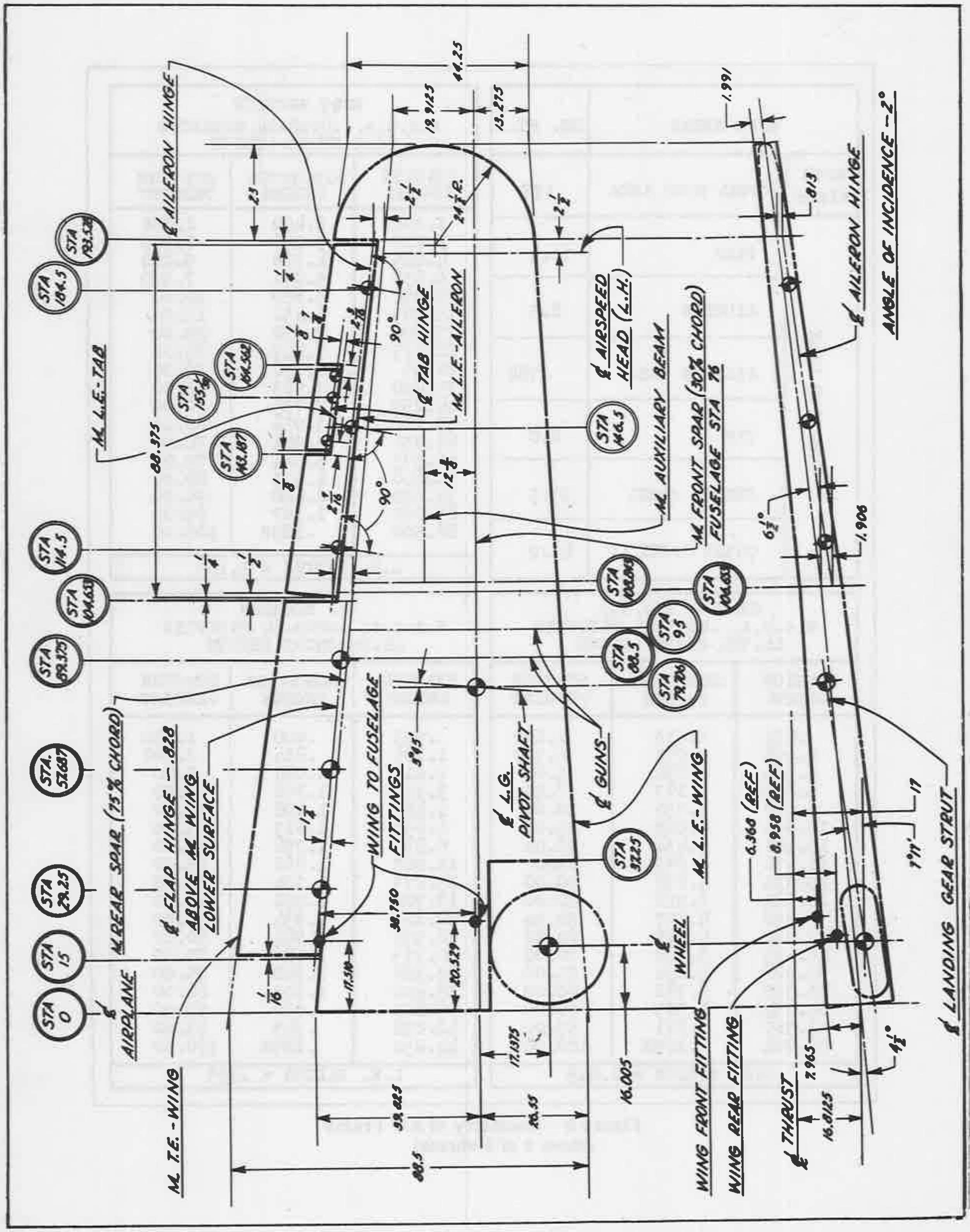


Figure 9 - Geometry of Air Frame
(Sheet 3 of 6 Sheets)

WING AREAS		SQ. FT.
BOTH WINGS	TOTAL WING AREA	197
ONE WING ONLY	FLAP	10.4
	AILERON	8.5
	AILERON TAB	.788
	TIP	6.0
	CENTER PANEL	57.5
	OUTER PANEL	41.0

ROOT SECTION N.A.C.A. .0018-64 MODIFIED 88.5 CHORD LENGTH		
STATION INCHES	ORDINATES INCHES	STATION PERCENT
1.106	2.400	1.250
2.213	3.256	2.500
4.425	4.336	5.000
6.638	5.071	7.500
8.850	5.630	10.00
13.275	6.452	15.00
17.700	7.032	20.00
22.125	7.449	25.00
26.55	7.736	30.00
35.400	7.965	40.00
44.250	7.735	50.00
53.100	7.056	60.00
61.950	5.944	70.00
66.375	5.224	75.00
70.800	4.413	80.00
79.650	2.480	90.00
84.075	1.367	95.00
88.500	.125R	100.00
L.E. RADIUS = 3.160		

STATION 106.653 N.A.C.A. .0015-64 MODIFIED 66.704 CHORD LENGTH		
STATION INCHES	ORDINATES INCHES	STATION PERCENT
.834	1.513	1.250
1.668	2.053	2.500
3.335	2.734	5.00
5.003	3.197	7.50
6.670	3.550	10.00
10.006	4.068	15.00
13.341	4.434	20.00
16.676	4.697	25.00
20.011	4.878	30.00
26.682	5.022	40.00
33.352	4.877	50.00
40.022	4.449	60.00
46.693	3.748	70.00
50.028	3.294	75.00
53.363	2.782	80.00
60.034	1.575	90.00
63.369	.871	95.00
66.704	.125R	100.00
L.E. RADIUS = 1.845		

TIP SECTION N.A.C.A. .0009-64 MODIFIED 44.25 CHORD LENGTH		
STATION INCHES	ORDINATES INCHES	STATION PERCENT
.553	.600	1.250
1.106	.814	2.500
2.213	1.084	5.00
3.319	1.268	7.50
4.425	1.408	10.00
6.638	1.613	15.00
8.850	1.758	20.00
11.063	1.862	25.00
13.275	1.934	30.00
17.700	1.991	40.00
22.125	1.934	50.00
26.550	1.764	60.00
30.975	1.486	70.00
33.188	1.302	75.00
35.400	1.103	80.00
39.825	.620	90.00
42.038	.345	95.00
44.250	.125R	100.00
L.E. RADIUS = .395		

Figure 9 - Geometry of Air Frame
(Sheet 4 of 6 Sheets)

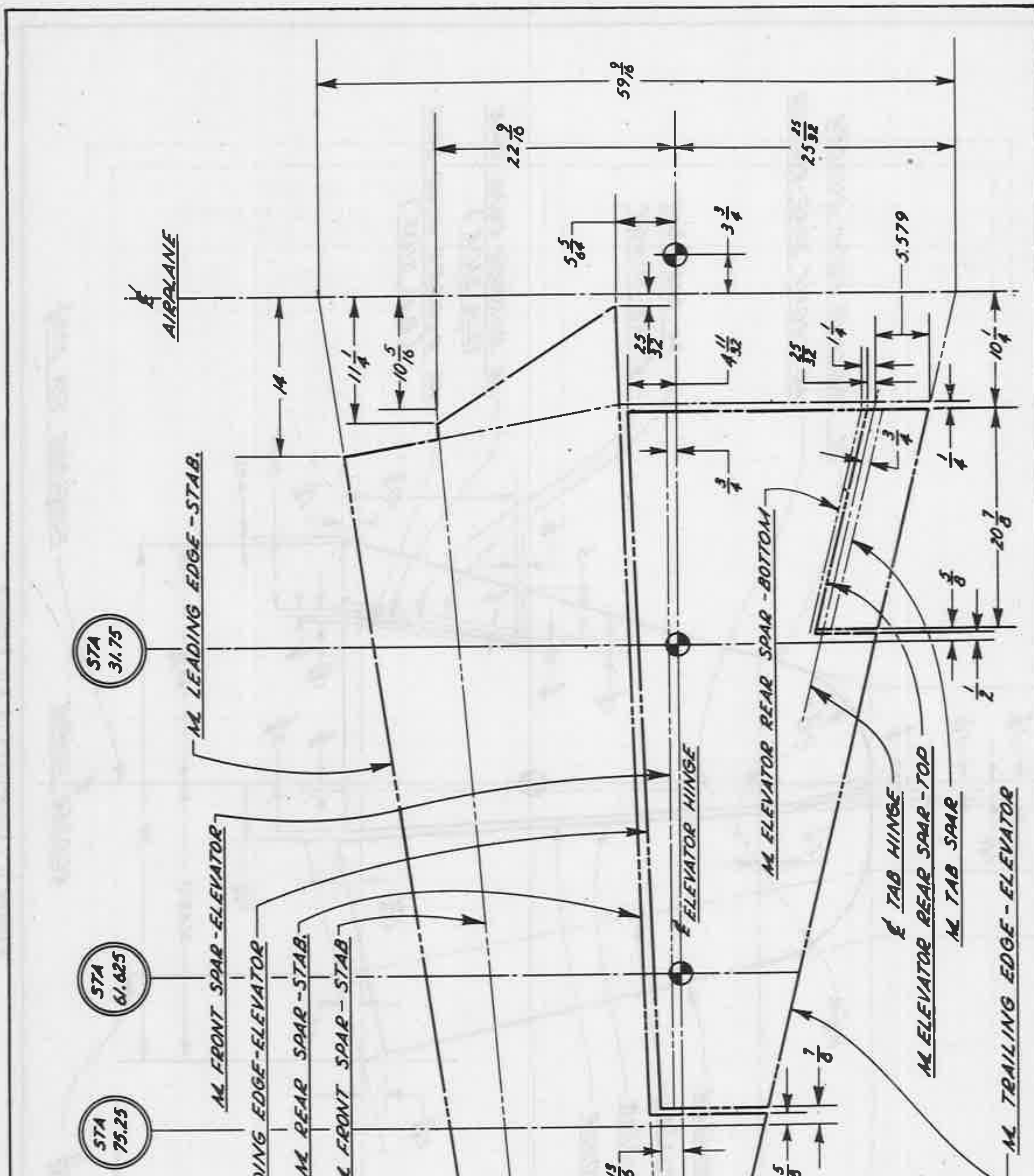


Figure 9 - Geometry of Air Frame
(Sheet 5 of 6 Sheets)

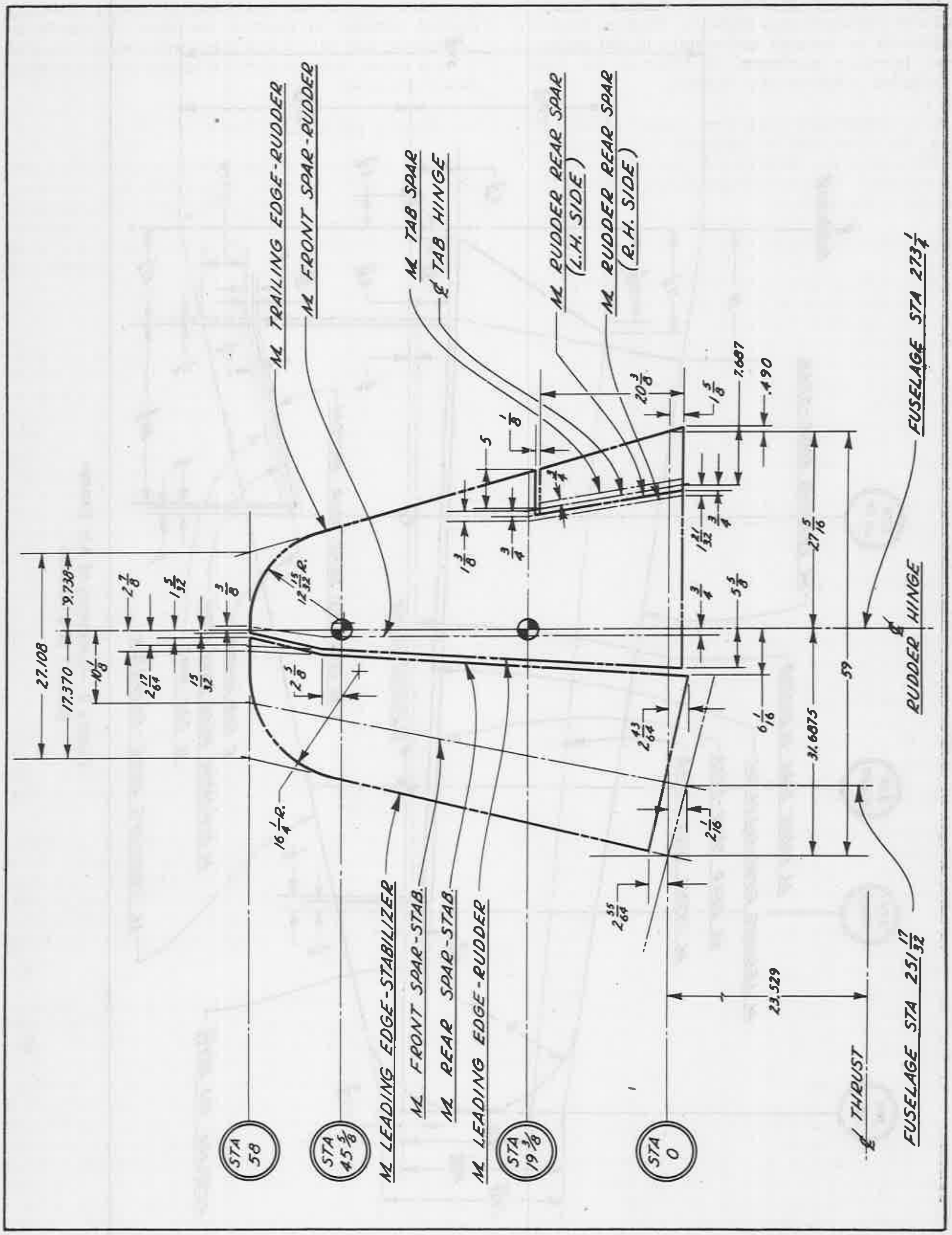


Figure 9 - Geometry of Air Frame
(Sheet 6 of 6 Sheets)

part affected, unless oversize rivets or bolts can be fitted with sufficient edge distance. Bushing bosses can ordinarily be reamed sufficiently (0.050 inside-diameter increase maximum) to clear-up the hole for installation of an oversize bushing.

b. If, in removing a solid rivet during repair operations, the rivet hole is damaged or enlarged, a rivet 1/32 inch larger in diameter than the original (or an oversize "Cherry" Rivet) should be used for reassembly of the parts.

50. Replacement of Cables.

Damaged cables, and those having broken strands greater than the maximum allowable of six strands in any one inch, must be replaced. No attempt should be made to splice the cables except at their end fittings, and then only in the case of making up replacement cable assemblies. The cable assemblies furnished with this airplane have swaged-on end fittings, and should be replaced with similar cable assemblies. However, it is entirely practical to make up spliced cable assemblies, using thimble and bushing terminals at the ends and tuck splices of at least five full tucks, if the original pin-center distances between attachment points are maintained. Refer to section IX for detail information.

51. Fitting New Fairing.

The attachment screw holes in locally manufactured replacement fairing must be located and drilled before the fairing can be installed. This can be done without difficulty by installing the fairing in place, and using a tool similar to that shown in figure 8, as a transfer punch to mark the hole locations on the fairing. Then remove the fairing and drill holes where marked.

52. Dzus Fasteners.

Complete information regarding the installation of Dzus fasteners is given in section IX of this Handbook. It must always be remembered, however, when a Dzus fastener installation is involved in a repair, the the possibility exists of the added thickness of the repair material affecting the relationship between Dzus stud and spring, with resultant excessive deflection of the spring. In such cases it may be necessary to replace stud or spring with parts differing from the original installation, and in some cases use washers beneath the spring loops to locate the spring properly.

53. Fillers and Shims.

Many repairs involve splicing of rib flanges, spar caps and similar members to which skin covering attaches. The repair in most cases involves the use of an inserted angle or channel section, with the result that a filler or shim equal in thickness to the original flange or cap must be used where the original material has been removed - in order to restore the mold-line of the part and provide a smoothly molded surface to receive the skin. It should be understood that fillers and shims are always required in such cases, even though not shown on the relevant repair drawing.

54. Bonding Braid and Clips.

There are many places where bonding braid and clips are used in order to provide the necessary electrical continuity to minimize radio interference. In all cases where such bonding material is removed during repair operations, it is necessary that it be replaced in the original manner upon completion of the repair.

55. Scratches, Dents, and Cracks.

Scratches and dents in the metal parts may produce stress concentrations leading to fatigue failure of the part. Sharp nicks in a smooth surface are especially dangerous and care must be used to smooth out such damage. When this is done, high concentrations of stress disappear. The importance of surface irregularities cannot be over-emphasized because the normal working stresses in many parts are so high that an apparently harmless defect may produce stresses above the design strength of the part. Care should be taken to insure that no cracks remain undetected. Cracks in the plating generally occur at points of cold working, and where the plating is drilled or dimpled for flush-type rivets or bolts. To stop the growth of a crack in plating, drill a No. 40 hole at both ends of the crack.

56. Tools Used with Riveted Repairs.

In addition to hammers, rivet sets, bucking bars and standard drills, it will be found advantageous to have 100-degree countersinks, spiral reamers, right angle drills, and "snake" drills available when making riveted repairs.

a. In connection with plating repair, a countersinking attachment is essential when preparing holes for countersunk-head rivets. The attachment consists of a 100-degree countersink cutter fitted with a pilot. It is provided with a carefully made stop and handle. In use, this countersink is applied to small pilot holes previously drilled.

b. Another tool that facilitates plating repairs is a 1/4-inch diameter spiral reamer. The use of a spiral reamer and a power drill as a linear cutter is quite satisfactory for cutting out and/or cleaning-up holes in aluminum-alloy skin prior to patching. Mark the outline to be cut, with a pencil and drill a 1/4-inch diameter hole in one corner. Insert the reamer into the hole, tilt it towards the operator and apply power. Pull reamer towards operator and cut on the line. Care should be taken to cut a 1/2-inch radius in all corners. Sharp corners result in concentrations of stress and ultimate cracking of the material.

c. The use of a right-angle drill chuck is particularly advantageous when drilling in areas having restricted access.

d. A "snake" drill is a flexible-shaft extension for a standard power drill, and when used in combination with a right-angle drill chuck often permits drilling holes in confined areas where drilling would otherwise be impossible.

57. Repairing Cracked Members.

The majority of the repairs described and shown in the sections following are based upon assumed damage by gunfire or forced landings. In such cases the damage usually requires removal of damaged skin and structural members, which must then be replaced and/or patched. In some cases, however, the need for repair may arise from the presence of cracks due to vibration or fatigue failure of the material, and such repairs will not require the removal of material. The repair should be treated, however, as though the material affected by the cracks was entirely removed, for cracked material no longer possesses its original strength. Stop holes should be drilled at the ends of all cracks, using a No. 40 drill, the affected area marked with a lead penciled circle or oval enclosing the cracks, and repaired as though the material within the marked area was removed entirely.

TABLE I. LIST OF TOOLS FOR REPAIR OPERATIONS

Part No.	Material Spec. No.	Material Title	Size	Remarks
		BUCKING BARS		
B-1	AN-QQ-S-646 Composition 1020	Steel, Carbon Bar	Refer Fig. 2A	Carburize After Machining per Spec. AC-98-10025
B-2	" " "	" " "	" " "	" " " "
B-3	" " "	" " "	" " "	" " " "
B-4	" " "	" " "	" " "	" " " "
B-5	" " "	" " "	" " "	" " " "
B-6	" " "	" " "	" " "	" " " "
B-7	" " "	" " "	" " "	" " " "
B-8	" " "	" " "	" " "	" " " "
B-9	" " "	" " "	" " "	" " " "
B-10	" " "	" " "	" " "	" " " "
B-11	" " "	" " "	" " "	" " " "
B-22	" " "	" " "	" " "	" " " "
B-23	" " "	" " "	" " "	" " " "
B-24	" " "	" " "	" " "	" " " "

SECTION II

ENGINE MOUNT

1. General.

The engine mount is a steel tubular structure with welded joints, and the tubing is chrome-molybdenum CM steel of the diameter and gage shown in figure 10. All members which are used in the structure may be repaired or replaced, and in general it is practicable to splice all tubes except the circular type supporting the engine attachment fittings, while all damaged fittings must be replaced.

2. Negligible Damage.

Damage to tubes not greater than the following may be neglected.

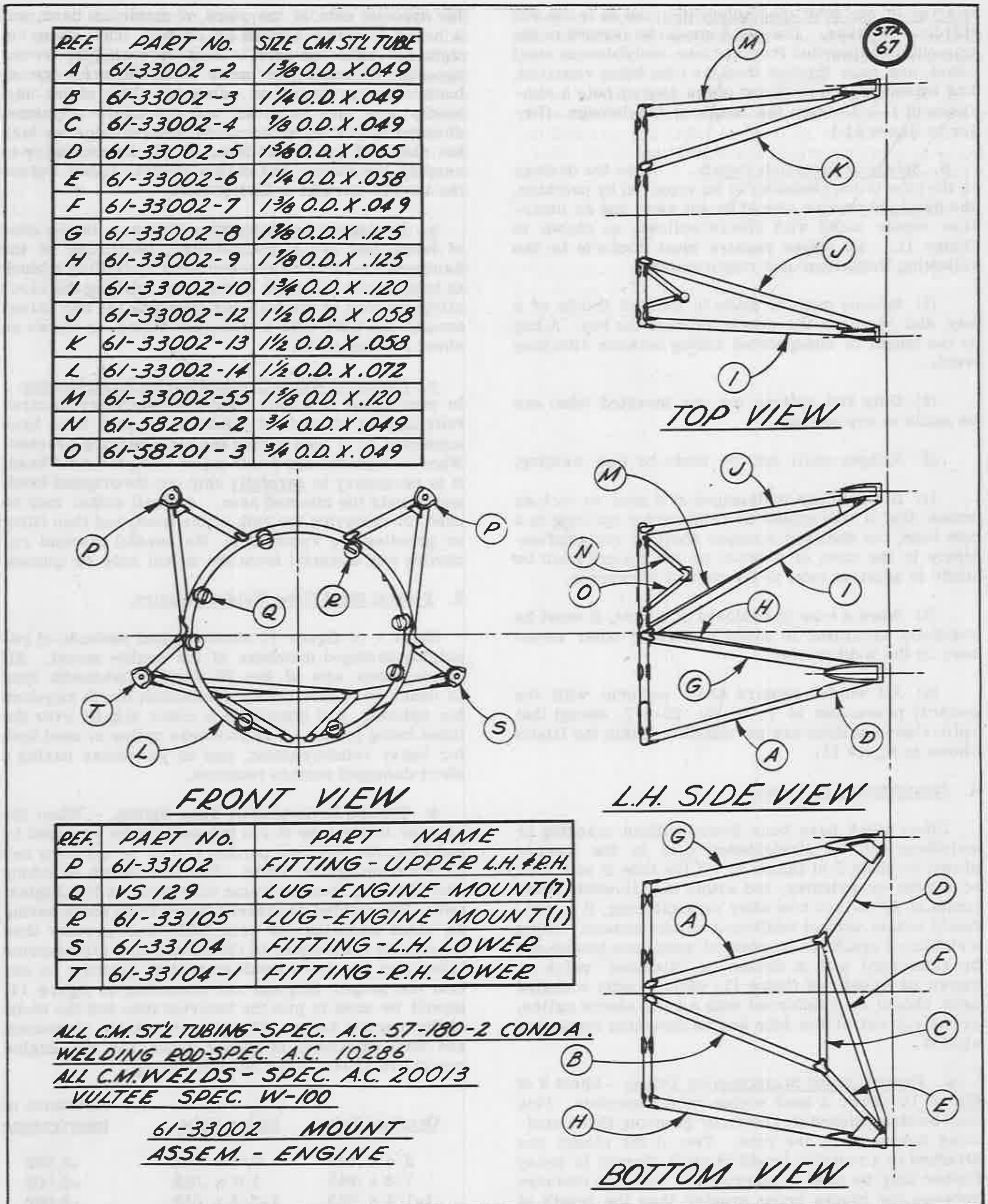
a. Smooth dents, the depth of which does not exceed 1/30 of the tube diameter, providing there are no sharp corners or signs of cracks or fracture, and that they are situated in the end thirds of the tube length.

b. Bowing of a tube to an extent not exceeding 1/16 inch.

3. Repairable Damage.

Any reasonable damage to the tubes may be repaired by welding. There are two general types of repairs used, patches and splices, and their use is governed by the nature of the damage, as follows:

a. Patch Repairs. - Patches may be used to repair dents or holes up to a maximum dimension of 3/4 inch provided that the damage involves not more than a



REF.	PART No.	SIZE C.M. ST'L TUBE
A	61-33002-2	1 3/8 O.D. X .049
B	61-33002-3	1 1/4 O.D. X .049
C	61-33002-4	7/8 O.D. X .049
D	61-33002-5	1 5/8 O.D. X .065
E	61-33002-6	1 1/4 O.D. X .058
F	61-33002-7	1 3/8 O.D. X .049
G	61-33002-8	1 3/8 O.D. X .125
H	61-33002-9	1 1/8 O.D. X .125
I	61-33002-10	1 3/4 O.D. X .120
J	61-33002-12	1 1/2 O.D. X .058
K	61-33002-13	1 1/2 O.D. X .058
L	61-33002-14	1 1/2 O.D. X .072
M	61-33002-55	1 5/8 O.D. X .120
N	61-58201-2	3/4 O.D. X .049
O	61-58201-3	3/4 O.D. X .049

REF.	PART No.	PART NAME
P	61-33102	FITTING - UPPER L.H. & R.H.
Q	VS 129	LUG - ENGINE MOUNT (7)
R	61-33105	LUG - ENGINE MOUNT (1)
S	61-33104	FITTING - L.H. LOWER
T	61-33104-1	FITTING - R.H. LOWER

ALL C.M. ST'L TUBING - SPEC. A.C. 57-180-2 COND A.
WELDING ROD - SPEC. A.C. 10286
ALL C.M. WELDS - SPEC. A.C. 20013
VULTEE SPEC. W-100

61-33002 MOUNT
ASSEM. - ENGINE

Figure 10 - Engine Mount Structure

quarter of the tube circumference, and is in the end thirds of the tube. The patch should be formed to the tube outside diameter from chrome-molybdenum steel sheet, one gage thicker than the tube being repaired, and extend beyond each end of the dent or hole a minimum of 1-3/4 times the length of the damage. (Refer to figure 11.)

b. Splice or Insertion Repair. - When the damage to the tube is too extensive to be repaired by patching, the damaged portion should be cut away and an insertion repair made with sleeve splices, as shown in figure 11. All splice repairs must conform to the following limitations and requirements:

(1) Splices must be made in the end thirds of a bay, and never in the center third of the bay. A bay is the length of unsupported tubing between attaching welds.

(2) Only two splices (or one inserted tube) can be made in any one bay.

(3) Splices shall not be made by butt welding.

(4) If a member is damaged at a joint to such an extent that a stub cannot be retained for splicing in a new tube, the damaged member shall be replaced entirely in the case of a strut, or the splices shall be made in adjacent bays in the case of a longeron.

(5) When a tube is removed at a joint, it must be carefully separated to avoid disturbing other members in the weld cluster.

(6) All welded repairs shall conform with the general provisions of T. O. No. 23-5-2, except that split-sleeve splices are permissible within the limits shown in figure 11.

4. Straightening of Tubes.

Tubes which have been bowed without cracking or wrinkling can be straightened cold in the manner shown on sheet 2 of figure 11. If the tube is still free of cracks or wrinkles, and within the allowable maximum of 1/16-inch bow after straightening, it is perfectly usable without additional reinforcement. Slight wrinkles or cracks at the point of maximum bow should be reinforced with a welded-on "diamond" patch as shown on sheet 1 of figure 11, while a badly wrinkled area should be reinforced with a split-sleeve splice, or be cut out of the tube and an insertion repair installed.

a. Procedure for Straightening Tubes. - Sheet 2 of figure 11 shows a bent engine-mount member. This may be straightened as shown, by grooving three hardwood blocks to fit the tube. Two of the blocks are attached to a suitable length of steel channel (a heavy timber may be used in emergency), with the distance between the blocks being greater than the length of the tube's bent portion. The third block is located on the opposite side at the point of maximum bend, and a heavy C-clamp applied as shown. The clamp is tightened until the tube is bent very slightly in the opposite direction, in order to provide for spring back when pressure is released. The clamp and blocks are then removed, and the tube's alignment checked by placing an accurate straight edge on both the side and top of the tube. It may be necessary to reapply the blocks and clamp several times before the tube is straight in both planes.

b. Procedure for Reforming Tubes. - In the case of tubes that are slightly dented, reforming of the damaged area may be accomplished by drilling a block of steel to the diameter of the tube, splitting the block along the axis of the hole and clamping the two halves around the tube with a powerful clamp, as shown on sheet 2 of figure 11.

c. Repair of Welds Cracked During Straightening. - In every case of a bent tube, it is necessary to carefully inspect all welded joints which may have been subjected to a load during the straightening process. Wherever cracks are found in, or along the weld bead, it is necessary to carefully chip out the original bead, and reweld the affected area. A small chisel may be used for removing the bulk of the bead, and then filing or grinding the remainder. Be careful to avoid removing any material from the actual tube or gusset.

5. Typical Steel Tube Welded Repairs.

Sheet 1 of figure 11 shows typical methods of repairing damaged members of the engine mount. All splice tubes are of the 60-degree fishmouth type in order to reduce the minimum stub length required for splicing, and should be a close slip fit over the tubes being joined. A split-sleeve splice is used both for heavy reinforcement, and to join tubes having a short damaged section removed.

a. Typical Replacement Tube Splice. - When the damage to the tube is too extensive to be repaired by patching, the damaged portion should be cut away and an insertion splice made. The new length of tubing should be cut from the same size stock as the original tube. Two fishmouth sleeves, made from tubes having an inside diameter not over 0.015 inch greater than the outside dimensions of the tubes being joined (some tubes may require a small amount of reaming to obtain the proper fit), and cut according to figure 11, should be used to join the inserted tube and the stubs of the original tubes. The proper outside dimension and wall thickness of splice tubes for the engine mount are shown in the table following;

Original Tube	Splice Tube	Clearance or Interference
3/4 x .049	7/8 x .058	+0.009
7/8 x .049	1.0 x .058	+0.009
1-1/4 x .049	1-3/8 x .058	+0.009
1-1/4 x .058	1-3/8 x .065*	-0.005

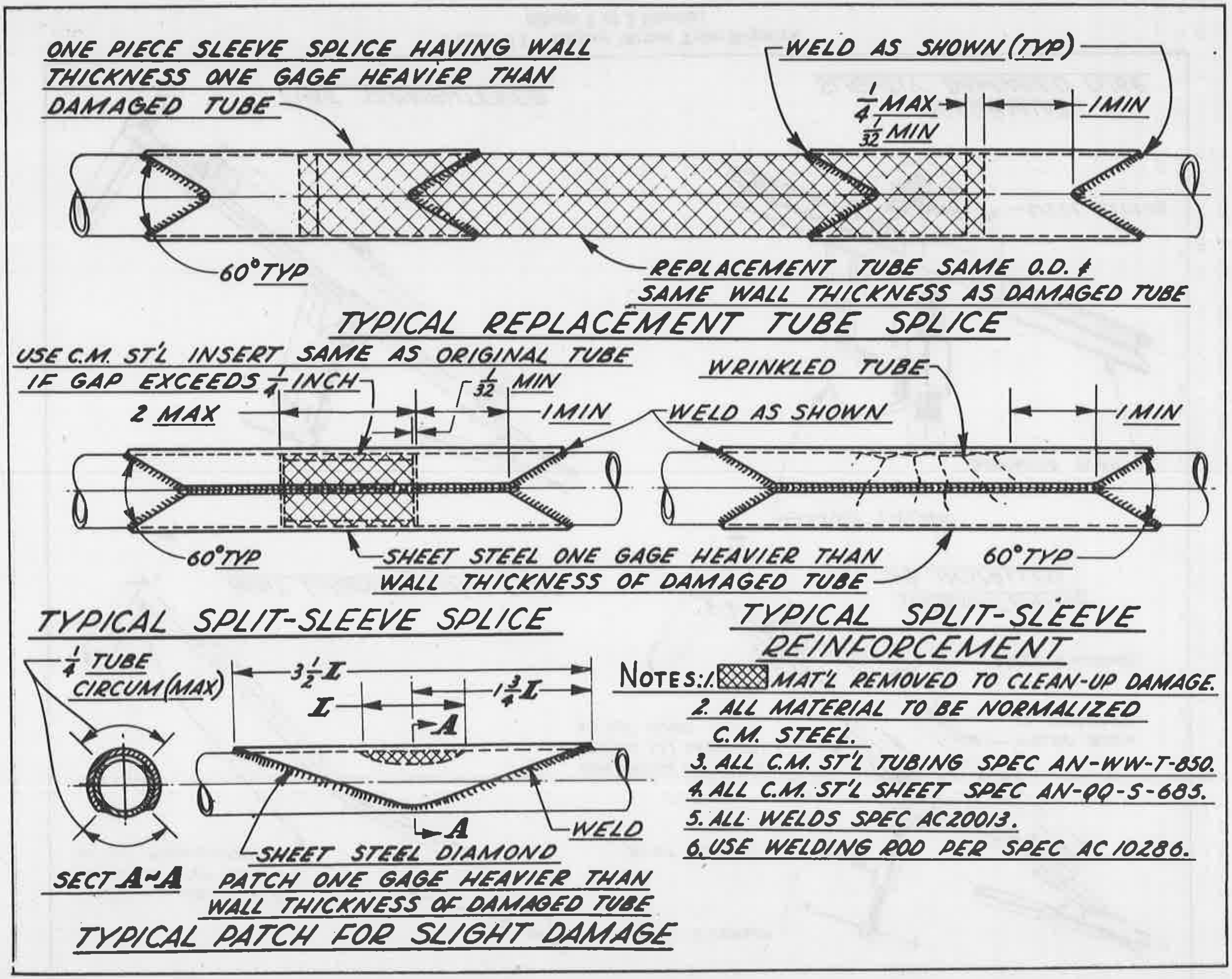


Figure 11 - Engine Mount Tube Repairs
(Sheet 1 of 2 Sheets)

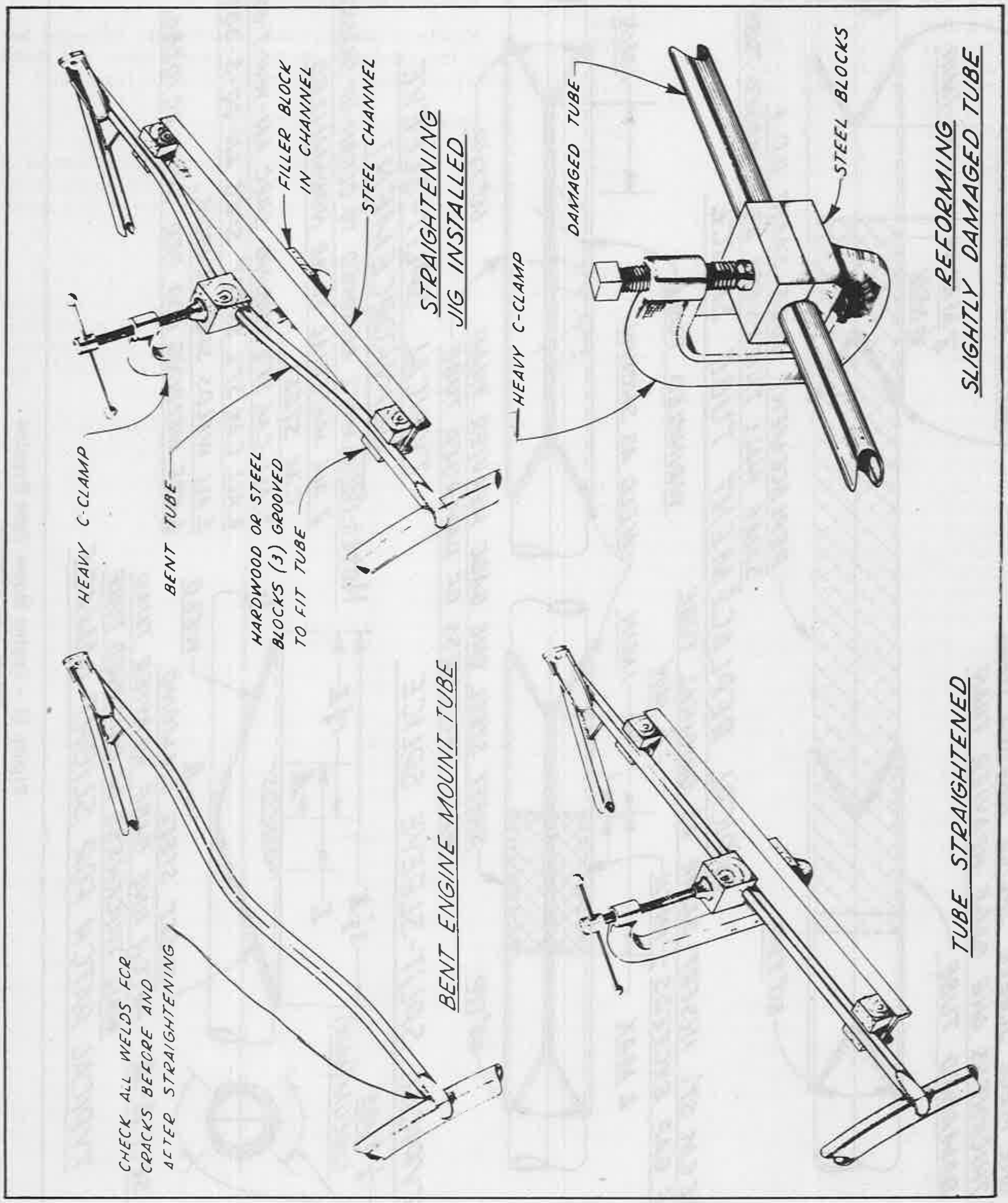


Figure 11 - Engine Mount Tube Repairs
(Sheet 2 of 2 Sheets)

Original Tube	Splice Tube	Clearance or Interference
1-1/4 x .058	1-1/2 x .120	+0.010
1-3/8 x .049	1-1/2 x .058	+0.009
1-1/2 x .058	1-5/8 x .065*	-0.005
1-1/2 x .058	1-3/4 x .120	+0.010
1-1/2 x .072	1-3/4 x .120	+0.010
1-5/8 x .065	1-7/8 x .120	+0.010
1-5/8 x .120	2.0 x .187	+0.001
1-3/4 x .120	2-1/8 x .187	+0.001
1-7/8 x .125	2-1/4 x .187	+0.001

NOTE: Splice tubes marked thus (*) require reaming.

b. Typical Split-Sleeve Splice. - Cases involving the simple joining of two tubes, wherein the gap between the ends of the tubes being joined does not exceed 2 inches, can best be accomplished with a split-sleeve splice. This method eliminates springing the tubes to install a one-piece sleeve. An insert of tubing identical with the tubes being spliced should be used if a gap between their ends exceeds 1/4 inch, to provide weld material for the full length of the split. The split sleeve should be prepared in the same manner as a one-piece fishmouth sleeve, and then be split lengthwise (figure 11) to form two symmetrical halves. These halves are clamped around the tubes at the joint, and the split portions welded together first, to utilize the weld shrinkage to clamp the sleeve sections tightly around the tubes being joined. Then weld the fishmouth portions.

c. Typical Split-Sleeve Reinforcement. - Localized damage, beyond the capacity of a "diamond" patch, should be reinforced with a split sleeve, as shown in figure 11. This type of reinforcement is particularly well adapted to tubes having a deep, localized buckle after straightening. The method of installation is identical with that of a split-sleeve splice, except that no insert is required owing to the original tube remaining intact.

d. Typical Patch for Slight Damage. - The "diamond" patch shown on sheet 1 of figure 11 is ideally adapted to reinforcing small dents, holes, and cracks, where the damage is confined to a maximum of a quarter of the tube circumference.

6. Replacement of Brackets.

Welded brackets should be replaced if damaged beyond repair. In such cases the bracket should be entirely removed, the original weld ground down flush with the tube outside dimensions, and a new bracket welded in place. Make new brackets from normalized CM steel sheet (Specification No. AN-QQ-S-685 "Steel, CM Sheet") of the same gage as the original bracket.

7. Replacement of Fittings.

Fittings are employed to bolt the engine to its mount, and the mount to the fuselage. Damage causing misalignment of the reamed holes or deformation of the fittings will necessitate their replacement. These fittings are not repairable.

8. Replacement of Tubes.

Members and portions of members damaged beyond the allowable limits of patch repair, and those showing evidence of corrosion must be replaced.

9. Damage to Engine Ring.

Any damage to the engine mount ring impractical of repair by patching will necessitate replacement of the ring, or preferably, replacement of the entire mount assembly.

10. Bent or Bowed Engine Mount.

The nature of the engine mount truss is such that a side load sufficient to distort the mount will usually bow, not one, but a majority of the tubes, and in such a case it may be more economical to replace the entire mount.

11. Removing Cadmium Plating Preparatory to Welding.

The engine mount structure is cadmium plated, and before welding is attempted, it is necessary to remove the plating in the area of the weld by one of the following methods:

a. When practicable, tightly wrap a sheet of 0.002-inch copper shim stock close to each side of the tube area to be stripped of plating, thus protecting the adjacent plating. Apply a solution of one pound of U.S.P. ammonium nitrate in one U.S. gallon of water to the area to be stripped.

b. Emery cloth may also be used to remove the cadmium plating where only a small area is affected by the repair operation.

12. Refinishing Repair Area.

Upon completion of all repair operations, refinish the repaired area (including as much as possible of the area where plating was removed) with two coats of zinc-chromate primer, followed by two coats of aluminum lacquer. If at all practicable, the inside of closed-end repaired tubes should be filled with hot linseed oil, and then permitted to drain. This can usually be done by drilling a small hole near each end of the tube and then later closing these with self-tapping screws. Use No. 44 drilled holes for oil circulation in tubes under 1-inch diameter, and No. 31 drilled holes for tubes 1 inch or larger. Close the No. 44 holes with a No. 2 self-tapping screw, and use a No. 6 screw for the No. 31 drilled holes. Open-end tubes should receive two coats of zinc-chromate primer on their interior surfaces.

13. Torch Normalizing.

Refer to section I for information on torch normalizing of joints after welding.

TABLE II. LIST OF REPAIR MATERIALS FOR ENGINE MOUNT

	Material			
Part No.	Spec. No.	Title	Size	Remarks
61-33102	AC-57-107 Gd WD-X4130	Forgings, Carbon and Alloy Steel	--	Upper LH and RH Mount-to-Fuselage Fittings
61-33104	" "	" " "	--	Lower LH Mount-to-Fuselage Fitting
61-33104-1	" "	" " "	--	Lower RH Mount-to-Fuselage Fitting
61-33105	AC-57-107 Gd W-1020	" "	--	Engine-to-Mount Lug (Special)
VS129	AC-57-107 Gd W-1020	Forging, Carbon and Alloy Steel	--	Engine-to-Mount Lug (Vultee Standard)
AC530	--	Screw, Sheet Metal, Round Head	No. 2	For Closing Oil Holes in Steel Tubes.
"	--	" " "	No. 6	" " " "
--	AN-WW-T-850 Type I, Cond N	Tubing, CM Steel	3-3/4 x .049	Tube Replacement and Insert
--	" "	" " "	7/8 x .049	" "
--	" "	" " "	1-1/4 x .049	" "
--	" "	" " "	1-1/4 x .058	" "
--	" "	" " "	1-3/8 x .049	" "
--	" "	" " "	1-1/2 x .058	" "
--	" "	" " "	1-1/2 x .072	" "
--	" "	" " "	1-5/8 x .065	" "
--	" "	" " "	1-5/8 x .120	" "
--	" "	" " "	1-3/4 x .120	" "
--	" "	" " "	1-7/8 x .125	" "
--	AN-WW-T-850 Type I, Cond N	Tubing, CM Steel	7/8 x .058	Tube Splice Sleeve
--	" "	" " "	1.0 x .058	" " "
--	" "	" " "	1-3/8 x .058	" " "
--	" "	" " "	1-3/8 x .065	" " "
--	" "	" " "	1-1/2 x .058	" " "
--	" "	" " "	1-1/2 x .120	" " "
--	" "	" " "	1-5/8 x .065	" " "
--	" "	" " "	1-3/4 x .120	" " "
--	" "	" " "	1-7/8 x .120	" " "
--	" "	" " "	2.0 x .187	" " "
--	" "	" " "	2-1/8 x .187	" " "
--	" "	" " "	2-1/4 x .187	" " "
--	AN-TT-P-656	Primer, Zinc Chromate	--	--
--	AC-3-158	Lacquer, Cellulose Nitrate	--	--
--	Fed-TT-A-466 Type B	Aluminum Paste	--	--
--	--	Ammonium Nitrate U.S.P.	--	For Removing Plating
--	Fed-JJJ-O-331	Oil, Linseed, Boiled	--	For Coating Inside of Tubes

SECTION III

FUEL, OIL, AND HYDRAULIC SYSTEMS

1. Fuel Tanks.

Two fuel tanks are contained within the wing center panel. Each comprises five (5) leak-resistant moulded cells connected to form a tank. The tank cells are removable, with access provided by removable panels in the center panel lower surface. Each cell essentially comprises a moulded structure of rubber and synthetic-rubber sheeting arranged to form a container having three-layer laminated walls. The inner layer is a gasoline-resistant material; the center layer, a plastic sealing compound; and the outer layer is an abrasion-resistant protective cover.

a. Repairing Fuel Cells. - Fuel cells damaged by gun fire or other causes can be repaired in a manner similar to "cold patching" an inner tube, providing the damaged area is confined to a flat surface and consists of a puncture or slit. When the cell corners or moulded flanges and tubes are damaged, or when a section has been torn from the cell wall, it is not considered practicable to attempt a repair and the cell must be replaced. Patches are applied to the interior and exterior of cell simultaneously, as follows:

(1) Clean inside and outside surfaces of grease or other foreign matter with solvent.

(2) Rough up areas surrounding tear with rubber-roughening tool or coarse-carborundum paper, taking particular pains not to tear the cell.

(3) Cut patches of the interior and exterior patching material so that it overlaps the tear 2 inches all around.

(4) Roughen sides of patches that are to be laid against cell.

(5) Apply three coats of cement to both the roughened area and the patch. These three coats should be applied very thin, and each coat allowed to dry thoroughly (approximate drying time is one hour per coat) before the succeeding coat is applied.

(6) Center both patches, inner and outer, carefully over tear and "stitch" well with stitching tool or roller.

(7) Refer to figure 12 for additional information.

NOTES: (i) The use of solvent should be confined to thinning cement and cleaning of roughened areas. In the latter case it should be used sparingly.

(ii) Read directions on cement container. These should conform to those given in this procedure.

(iii) Do not attempt to speed up drying time of cement by blowing with hot or cold air.

(iv) Satisfactory results will not be obtained unless the directions given herein are followed closely.

(v) Refer to T. O. No. 03-10-26 for general information relevant to repair of fuel cells.

b. Materials for Repairing Fuel Tank Cells. - The following materials are recommended for the repair of fuel tank cells:

(1) Interior Patching Material. - Cured Buna type "OR" (oil resistant) sheet 1/32 inch thick; shore

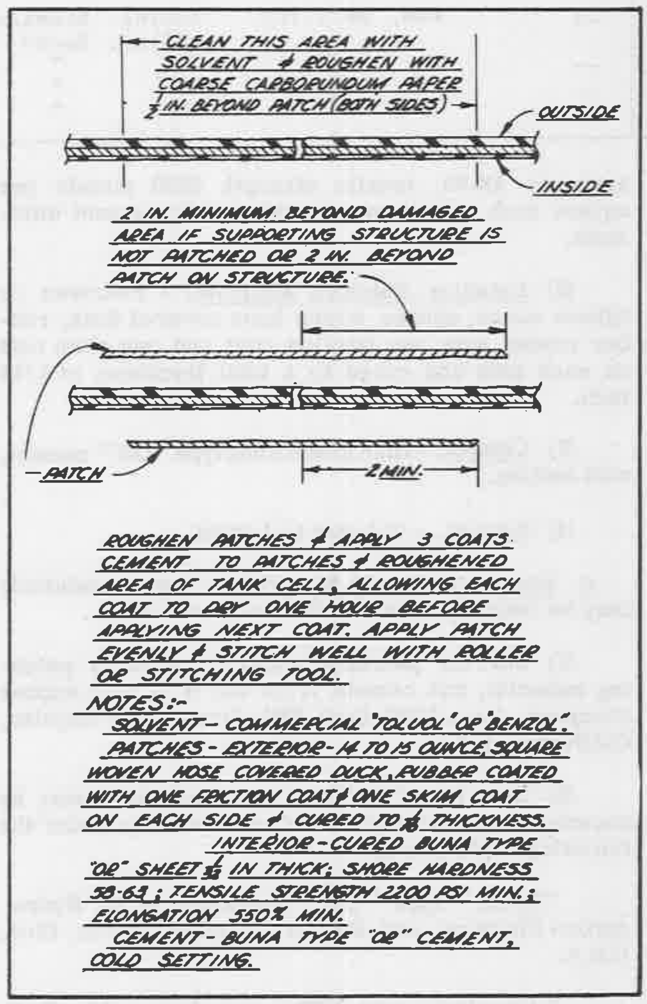


Figure 12 - Fuel Tank Repair

TABLE III. LIST OF REPAIR MATERIALS FOR FUEL TANK CELLS AND FUEL LINES

Part No.	Material Spec. No.	Title	Size	Remarks
		FUEL TANK CELLS		
--	AN-R-T-541	Toluene	As Required	Solvent for Patching Cells
--	Commercial	Benzol	As Required	Alternative Solvent for Patching Cells
--	Commercial	Cured Buna Type "OR" Sheet	1/32 Thick	For Patching Inside of Cell
--	Commercial	Square-woven Hose Covered Duck, 14 to 15 ounce	1/16 Thick	For Patching Outside of Cell
--	Commercial	Buna Type "OR" Cold Setting Cement	As Required	For Cementing Cell Patches
		FUEL LINES		
--	Fed. WW-T-787	Tubing, Aluminum Alloy, Round	1/4 x .032	52SO Tubing
--	" " "	" "	1/2 x .042	" "
--	" " "	" "	5/8 x .042	" "
--	" " "	" "	1.0 x .049	" "

hardness 58-63; tensile strength 2200 pounds per square inch minimum; elongation 550 percent minimum.

(2) Exterior Patching Material. - Fourteen or fifteen ounce, square woven hose covered duck, rubber coated with one friction coat and one skim coat on each side and cured to a total thickness of 1/16 inch.

(3) Cement. - High grade Buna type "OR" cement, cold setting.

(4) Solvent. - Toluene or benzol.

c. Sources of Repair Materials. - Repair materials may be obtained from the following sources:

(1) Interior patching material, exterior patching material, and cement from the W. J. Voit Rubber Company, Inc., 1600 East 25th Street, Los Angeles, California, U.S.A.

(2) Buna type "OR" (oil resistant) sheet may be secured from the major rubber companies under the following trade names:

"Hycar" type "OR," manufactured by Hydrocarbon Chemical and Rubber Company, Akron, Ohio, U.S.A.

"Ameripol" type "OR," manufactured by B. F. Goodrich Company, Akron, Ohio, U.S.A.

"Chemigum" type "OR," manufactured by Goodyear Tire and Rubber Company, Inc., Akron, Ohio, U.S.A.

d. Tools for Repairing Fuel Tank Cells. - The following tools are necessary to repair fuel tank cells properly:

(1) Brush or applicator (one inch wide).

(2) Rubber roughening tool (coarse carborundum paper or punched metal plate).

(3) Roller stitcher (1/16 inch thick by 1-1/8 inch diameter).

(4) Knife (sharp knife for cutting rubber).

e. Repairing Tank Support Structure. - The fuel tank cells are contained within the wing center section, and repairs for this structure are described and shown elsewhere in this Handbook.

2. Oil Tank. - The oil tank essentially comprises a welded assembly of two 3SO aluminum-alloy stampings. Suitable connections and fittings are welded to the tank shell.

a. Negligible Damage. - Smooth dents in the oil tank, not deeper than 15 percent of their smallest linear dimension, two inches or more from baffles or supports and free from cracks may be considered negligible damage. Small scratches and abrasions

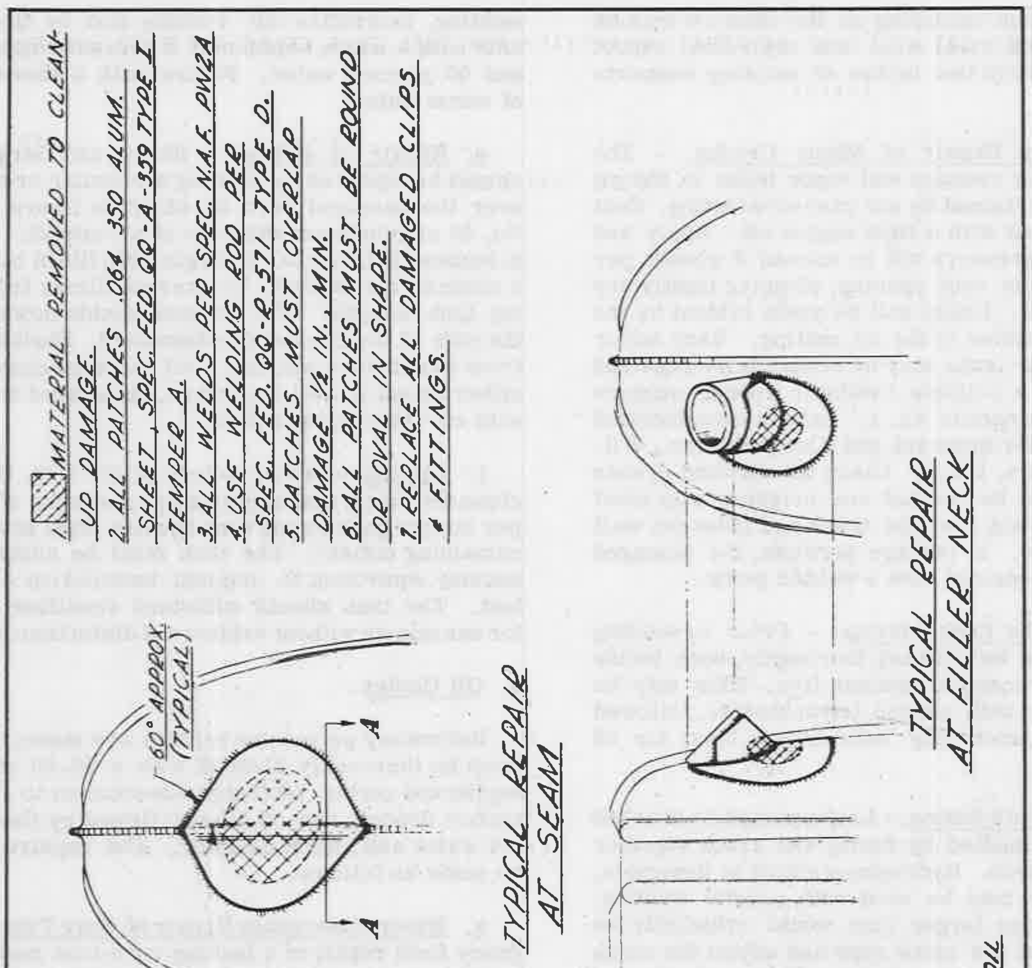


Figure 13 Oil Tank Repairs

or minor corrosion occurring on the exterior may be smoothed out with steel wool and neglected, except where located within two inches of existing supports or baffles.

b. Emergency Repair of Minor Cracks. - The presence of minor seepage and vapor leaks in the oil tank may be ascertained by air pressure testing. Coat the suspected area with a light engine oil. Apply and maintain an air pressure not to exceed 2 pounds per square inch to the vent opening, plugging tightly any remaining outlets. Leaks will be made evident by the appearance of bubbles in the oil coating. Very minor seepage and vapor leaks may be temporarily repaired by sealing with a suitable synthetic rubber mixture equivalent to "Fairprene No. 1," cement manufactured by E. I. DuPont De Nemours and Company, Inc., Wilmington, Delaware, U.S.A. Clean all dirt and grease from the area to be treated and brighten with steel wool. Apply cement over the crack and fillet out well to a feather edge. If leakage persists, the damaged area should be repaired with a welded patch.

c. Cleaning the Tank Interior. - Prior to welding the tank, it must be cleaned thoroughly, both inside and out, as a precaution against fire. This may be done by flushing with carbon tetrachloride, followed by drying and ventilating with an air blast for 30 minutes.

d. Repair of Split Seams. - Leaks caused by cracked welds may be remedied by fusing the crack together with a welding torch. Hydrogen-welding is desirable, but oxyacetylene may be used with careful welding. Use a tip one size larger than would ordinarily be used with steel of the same gage and adjust the torch to produce a low-velocity, slightly carbonizing flame. Weld with 2SO welding wire and suitable fluxes. After welding, neutralize all welding flux by flushing the tank with a warm solution of 5 percent sulphuric acid and 95 percent water. Follow with a thorough flush of warm water.

e. Repair of Holes. - Holes, and large cracks should be repaired by welding a circular or oval patch over the damaged area as shown in figure 13. Drill No. 40 stop holes at the ends of all cracks. If a hole is somewhat irregular to begin with, file it out to form a clean circle or oval. To prevent filings from entering tank interior turn the tank upside down, reverse the ends of the file and file downward. Flush all filings from tank before welding. All such patches must be either round or oval in pattern, and shaped to conform with curvatures and beads.

f. Testing. - Prior to testing the tank, thoroughly clean and flush; then apply an air pressure of 2 pounds per square inch to one vent opening after plugging any remaining outlets. The tank must be supported in a manner equivalent to original installation during the test. The tank should withstand specified pressure for one minute without evidence of distortion or leakage.

3. Oil Cooler.

Before any permanent repairs are made, the cooler must be thoroughly cleaned with a 50-50 mixture of naptha and carbon tetrachloride solution to remove all carbon deposit and oil film, followed by flushing with hot water and steam cleaning. The repairs may then be made as follows:

a. Minor Emergency Repair of Core Tube. - Emergency field repair of a leaking core tube may be made by plugging both ends of the affected tube with soft solder. However, such damage should be properly

TABLE IV. LIST OF REPAIR MATERIALS FOR OIL TANK AND OIL LINES

Part No.	Material Spec. No.	Title	Size	Remarks
		OIL TANK		
--	Fed-QQ-A-359 Type I, Temper A	Sheet and Plate, Aluminum Alloy	.064 Thich	3SO Sheet
--	Fed-QQ-R-571 Type D	Rod, Welding (Gas) Non-Ferrous	As Required	For Welding Oil Tank
--	Commercial	DuPont "Fairprene No. 1" Cement	As Required	For Temporary Sealing of Minor Leaks
		OIL LINES		
--	Fed-WW-T-787	Tubing, Aluminum Alloy, Round	1/2 x .035	52SO Tube
--	Fed-WW-T-787	Tubing, Aluminum Alloy, Round	1 x .049	52SO Tube
--	Fed-WW-T-799 Type N	Tubing, Copper (Seamless)	1/4 x .035	Oil Dilution Lines

repaired by experienced personnel as soon as practicable. Repair of the radiator always requires the attention of personnel familiar with this type of work, if the damage exceeds minor proportions.

b. Replacing Defective Core Tube. - Dampen ends of tubes with soldering acid. Heat two small soldering irons and insert small tip of each iron in ends of defective tube until solder around tube end melts. Then push on one iron to force tube out of core. Tin hexagon ends of new tube. Push new tube into core and sweat solder around tube ends, with conventional soldering iron.

c. Leaks in Core Face Between Adjacent Tubes. - Apply soldering acid at point of leak and sweat solder in between the tubes.

d. Plugged Core Tube. - Use a straight wire to push foreign material out of core tube, being careful not to damage tube.

e. Leak in Shell. - Place cooler on end with end nearest to point of leak on the bottom. This permits any soft solder which may melt to run away from core and not into tubes. Then use a torch to silver solder the leak. If leak is caused by large opening cut small sealing strip of brass (same thickness as shell) and cover opening of cut with brass, and silver solder to shell.

f. Shallow Dents in Shell. - Close all cooler openings except pipe inlet to which air pressure should be connected. Apply 40 to 80 pounds per square inch air pressure to inside of cooler. Then, using torch gently, apply heat to surface where dent appears until metal is annealed and air pressure straightens out the dent.

g. Sharp Deep Dents. - Silver solder end of silver solder wire to bottom of dent. Heat shell around dent, but not enough to melt solder; and while heat is applied, pull on wire to straighten out the dent.

h. Precautionary Measures. - In all cases where dents in shell have been repaired, it is advisable to stiffen the section by flowing a film of silver solder over the repaired surface to strengthen it. This is especially necessary where abrasion accompanies the dent.

4. Hydraulic Tank.

The hydraulic tank is constructed of 3S1/2H aluminum sheet. The method of assembly is welding.

a. Repair of Dents. - Dents may be repaired by restoring the original contour. The general procedure is similar to that for the oil tank. If the damaged area is not great, and if there are no residual cracks or abrasion, this will be sufficient. If the damaged area is extensive, it is good practice to weld an 0.032-inch thick patch of 3SO aluminum sheet over the area after restoring to shape. Gas welding must be used.

b. Repair of Cracks and Holes. - Cracks or holes should be cleaned up and then repaired by welding an 0.032-inch patch of 3SO aluminum in place over the damage. Cracks must have 1/8-inch diameter holes drilled at the ends. In the case of severe damage it will be good practice to replace the tank.

5. Lines and Fittings. - Any damage to lines or fittings will require replacement of the affected part.

TABLE V. LIST OF REPAIR MATERIALS FOR HYDRAULIC TANK AND LINES

Part No.	Material Spec. No.	Title	Size	Remarks
--	Fed-QQ-A-359 Type I, Temper A	Sheet and Plate, Aluminum Alloy	.032 Thick	3SO for Tank Patches
--	Fed-QQ-R-571 Type D	Rod, Welding (Gas) Non-Ferrous	As Required	For Welding Hydraulic Tank
--	Fed-WW-T-787	Tubing, Aluminum Alloy, Round	1/4 x .042	52SO Tube
--	" " "	" "	3/8 x .042	" "
--	" " "	" "	1/2 x .042	" "
--	" " "	" "	5/8 x .042	" "

SECTION IV

FUSELAGE

1. General.

a. The fuselage structure essentially comprises a composite construction, embodying a welded steel tube, cadmium plated, truss-type forward section, and an aluminum-alloy monocoque aft section, with the two connected by three bolts passing through suitable fittings. The steel tube structure begins at the firewall and continues rearward to a point immediately aft of the cockpit enclosure, at which point the monocoque structure begins and continues aft to the fuselage aft bulkhead.

b. A flame-tight, fireproof bulkhead of corrosion-resistant steel provides a firewall for separating the engine compartment from the fuselage.

c. The fuselage steel tube structure is covered with panels of aluminum-coated, aluminum-alloy sheet curved to give a smooth contour to the fuselage, beginning as an approximately circular section at the firewall and fairing into a semi-elliptical section at the junction of the semi-monocoque section. The fuselage side panels are readily removable.

2. Fuselage Structure. - Figure 14 is a diagram of the fuselage steel tube structure, and figure 19 shows the structure of the fuselage monocoque section. A plating diagram for the monocoque section is shown in figure 18.

3. Classification of Damage. - Damage to any part of the fuselage structure must be carefully examined to decide in which classification it belongs, as follows:

a. Negligible damage.

b. Damage repairable by patching.

c. Damage repairable by splicing.

d. Nonrepairable damage.

4. Steel Tube Section Repairs.

a. General. - Repairs to the fuselage steel tube section will be very similar to those for the engine mount, and the instructions contained in section II and figure 11 are applicable to repair of the fuselage tube structure. Figure 15 shows additional repairs suitable for damage occurring at a fuselage tube cluster.

b. Longeron Dented at Tube Cluster. - When a longeron is dented at a tube cluster, as shown in figure 15, repairs can be made by fitting a finger patch around the member and welding it in place. The finger patch plate should be formed to the tubes in the cluster while hot, and be made from normalized or annealed CM steel sheet equal in thickness to the gage of the heaviest tube in the cluster.

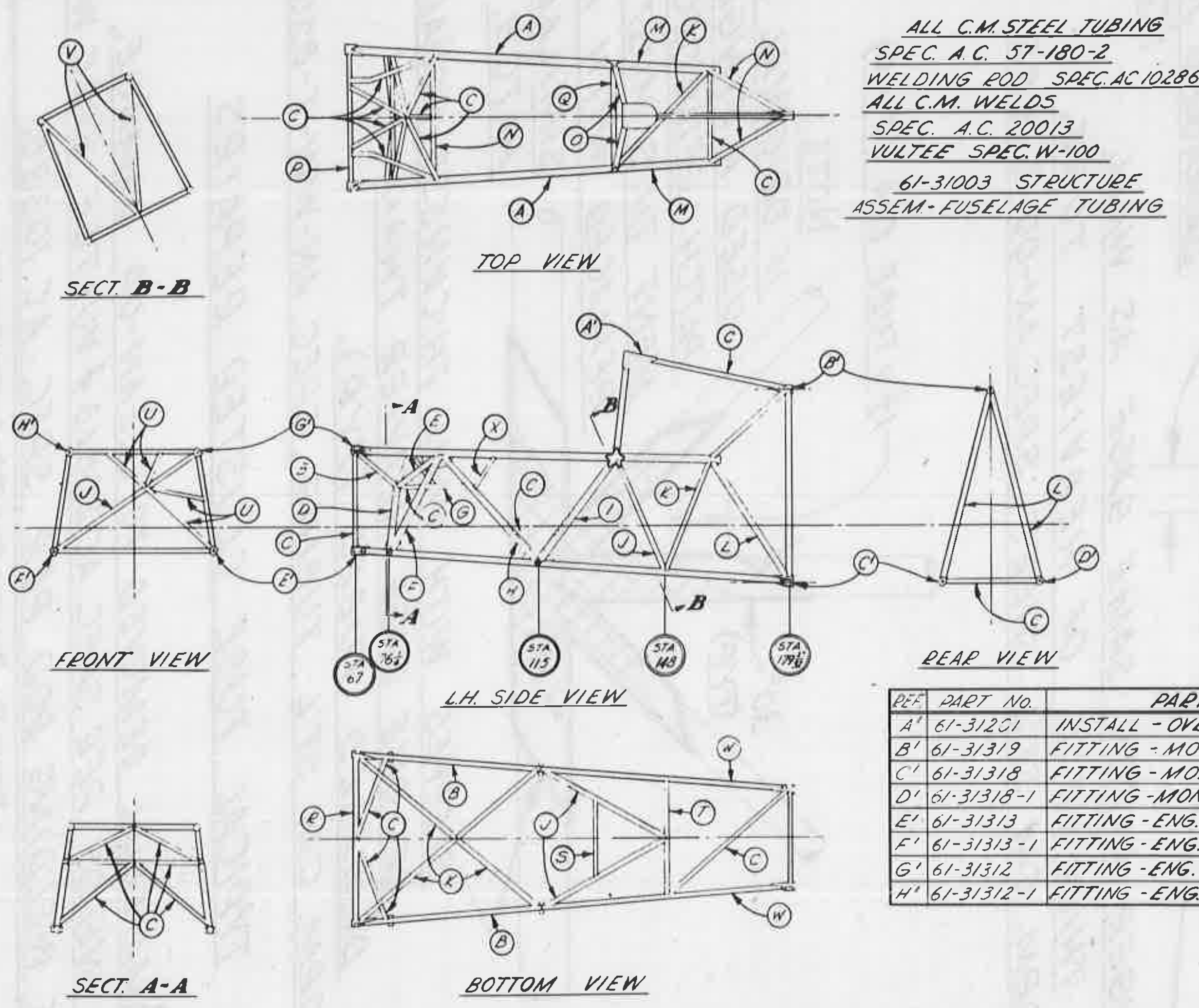
c. Longeron Badly Damaged at Tube Cluster.

(1) When a longeron is badly damaged at a tube cluster it is sometimes possible to carefully remove the damaged section of the longeron without injury to the other tubes forming the cluster. In this case a section of new tube may be spliced into the longeron, the undamaged tubes welded to the new longeron to complete the tube cluster, and a finger patch welded to the cluster to provide additional strength. If a short section of longeron was removed it is satisfactory to use a long splice sleeve to join the severed ends of the longeron, as shown in figure 15, with either a 30-degree diagonal or fishmouth splice being used. In this case it will be necessary to shorten the tubes joining to the longeron by an amount equal to the wall thickness of the splice tube.

(2) In cases where both the longeron and one or more of the tubes forming a cluster are damaged, it may be necessary to remove a portion of the entire cluster and build up an identical cluster of splice tubes to join with the stubs remaining after removing the damaged portions of the tubes. These splice tubes should be slipped over the stubs, carefully profiled to properly join at the cluster, be welded in place at the cluster, and then to their respective stubs. Either a 30-degree diagonal joint as shown in figure 15, or the fishmouth joint shown in figure 11 may be used to join the splice tubes to the stubs. In either case the indicated overlap must be used. Considerable care must be used during a repair of this nature to insure proper alignment of the structure after welding, and suitable clamps and braces must be applied to the structure and splice tubes to prevent misalignment. Refer to sheet 2 of figure 15.

d. Splice Tube Data. - In the table following are listed the correct splice tubes for all the main fuselage members. The size listed should be used for either a one-piece sleeve or a split sleeve.

Original Tube	Splice Tube	Clearance
1/2 x .035	5/8 x .058	+0.009
7/8 x .035	1.0 x .058	+0.009
1.0 x .035	1-1/8 x .058	+0.009
1.0 x .049	1-1/8 x .058	+0.009
1.0 x .058	1-1/4 x .120	+0.010
1-1/8 x .049	1-1/4 x .058	+0.009
1-1/4 x .035	1-3/8 x .058	+0.009
1-1/4 x .049	1-3/8 x .058	+0.009
1-3/8 x .035	1-1/2 x .058	+0.009
1-3/8 x .049	1-1/2 x .058	+0.009
1-3/8 x .065	1-5/8 x .120	+0.010



REF.	SIZE C.M. STEEL TUBE
A	2 O.D. X .095
B	1 5/8 O.D. X .095
C	1 O.D. X .035
D	1 3/4 O.D. X .120
E	1 1/2 O.D. X .120
F	1 3/4 O.D. X .049
G	1 1/2 O.D. X .035
H	1 1/2 O.D. X .083
I	1 3/4 O.D. X .083
J	1 1/4 O.D. X .049
K	1 1/8 O.D. X .049
L	1 3/8 O.D. X .049
M	2 O.D. X .049
N	1 1/2 O.D. X .049
O	1 5/8 O.D. X .065
P	1 O.D. X .058
Q	1 3/8 O.D. X .049
R	1 3/8 O.D. X .065
S	1 O.D. X .049
T	1 1/4 O.D. X .035
U	7/8 O.D. X .035
V	1 3/8 O.D. X .035
W	1 5/8 O.D. X .058
X	1/2 O.D. X .035

REF.	PART NO.	PART NAME
A'	61-31201	INSTALL - OVERTURNING STRUCTURE CAP
B'	61-31319	FITTING - MONO. UPPER ATTACH.
C'	61-31318	FITTING - MONO. LOWER L.H. ATTACH.
D'	61-31318-1	FITTING - MONO. LOWER R.H. ATTACH.
E'	61-31313	FITTING - ENG. MOUNT LOWER L.H. ATTACH.
F'	61-31313-1	FITTING - ENG. MOUNT LOWER R.H. ATTACH.
G'	61-31312	FITTING - ENG. MOUNT UPPER L.H. ATTACH.
H'	61-31312-1	FITTING - ENG. MOUNT UPPER R.H. ATTACH.

Figure 14 - Fuselage Steel Tube Section Structure

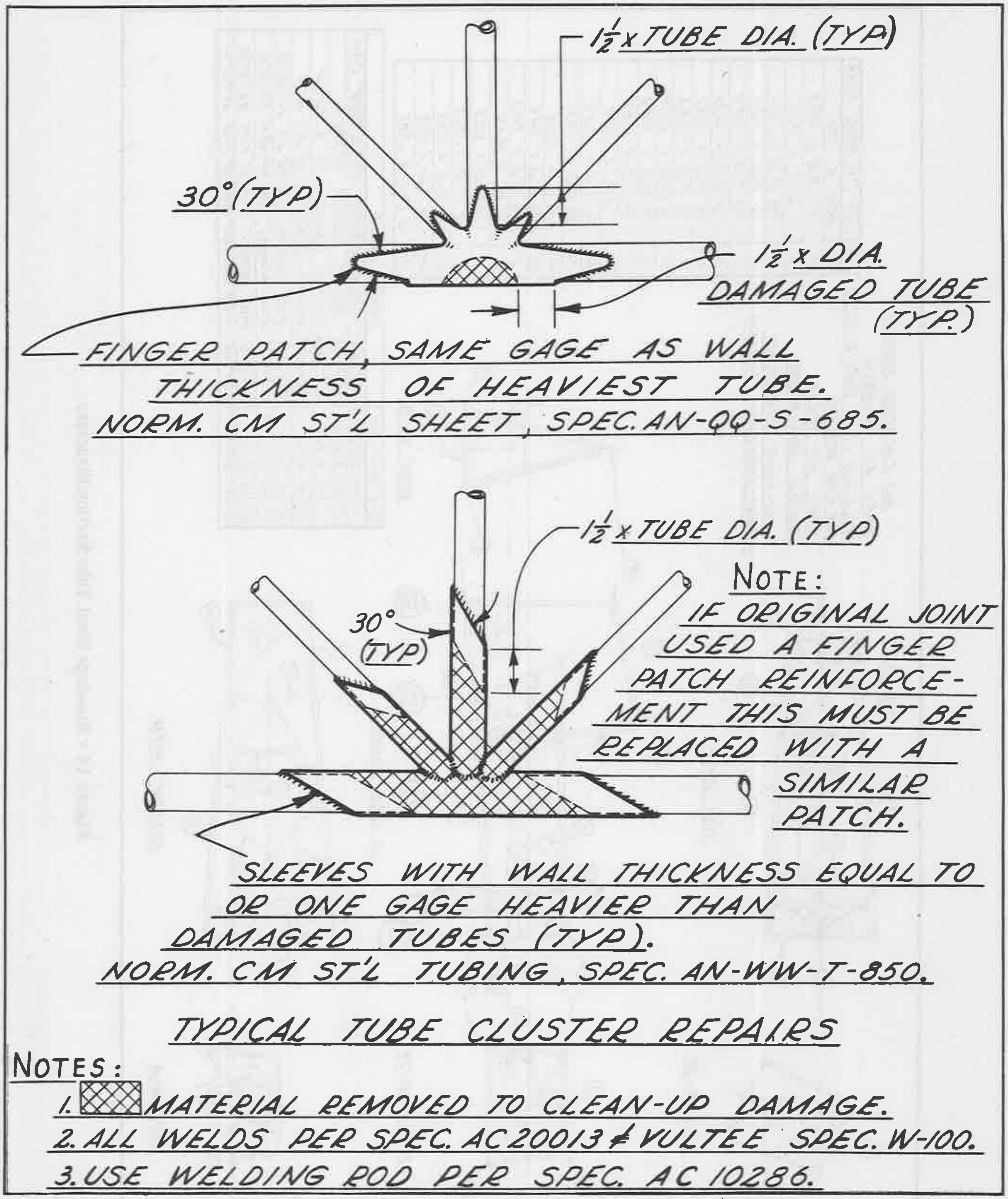


Figure 15 - Fuselage Steel Tube Section Repairs (Sheet 1 of 2 Sheets)

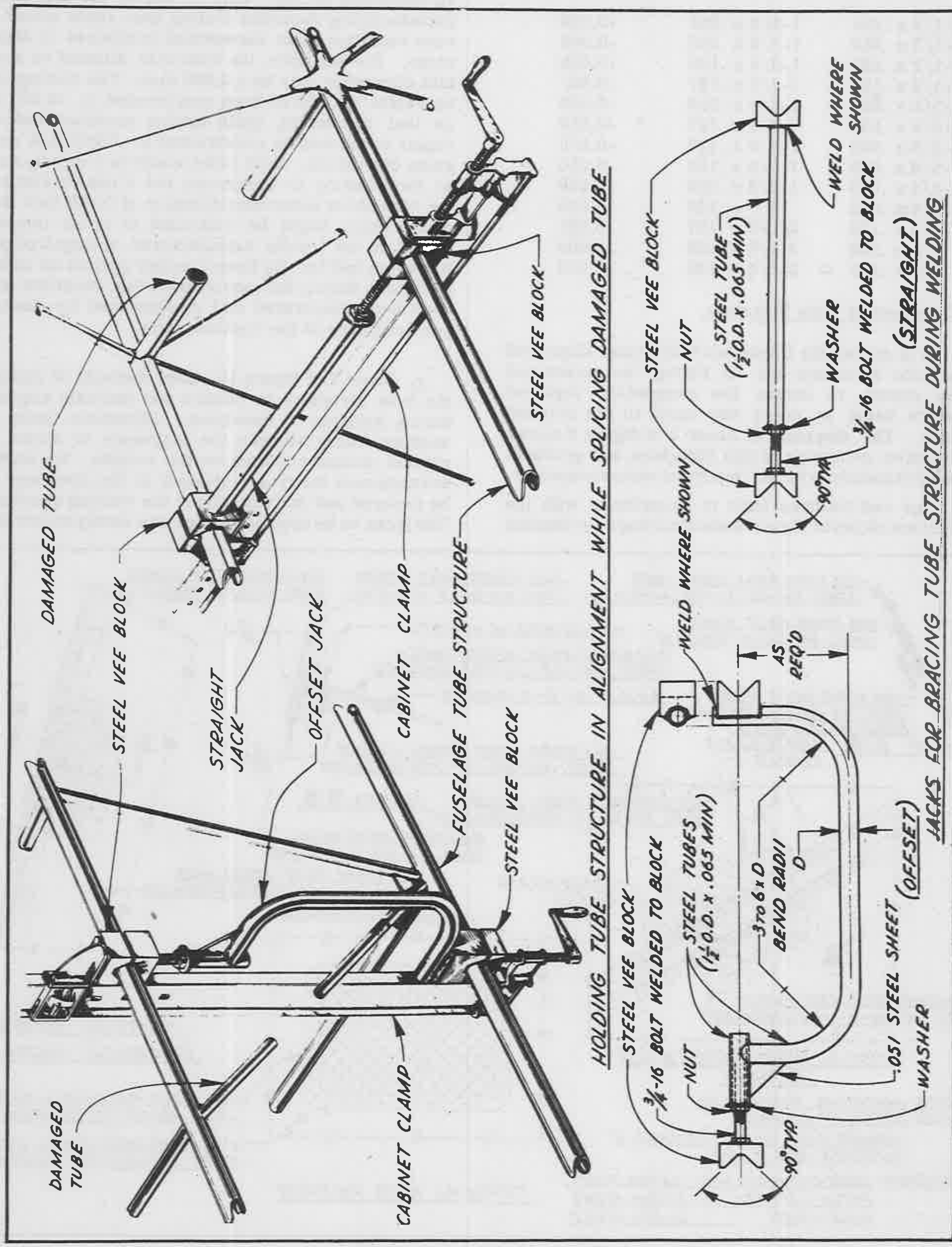


Figure 15 - Fuselage Steel Tube Section Repairs
(Sheet 2 of 2 Sheets)

Original Tube	Splice Tube	Clearance
1-1/2 x .035	1-5/8 x .058	+0.009
1-1/2 x .049	1-5/8 x .058	+0.009
1-1/2 x .083	1-3/4 x .120	+0.010
1-1/2 x .120	1-7/8 x .187	+0.001
1-5/8 x .049	1-3/4 x .058	+0.009
1-5/8 x .058	1-7/8 x .120	+0.010
1-5/8 x .065	1-7/8 x .120	+0.010
1-5/8 x .095	1-7/8 x .120	+0.010
1-3/4 x .049	1-7/8 x .058	+0.009
1-3/4 x .083	2.0 x .120	+0.010
1-3/4 x .120	2-1/8 x .187	+0.001
2.0 x .049	2-1/8 x .058	+0.009
2.0 x .095	2-1/4 x .120	+0.010

5. Alignment of Tube Structure.

a. It is extremely important that proper alignment of the tube structure and its fittings be maintained during repair, to insure the completely repaired structure being in every way equal to the original fuselage. The diagram on sheet 2 of figure 9 shows the complete geometry of this structure, and provides checking dimensions for all important reference points.

b. Jigs and fixtures built in accordance with the dimensions shown in figure 9 should always be checked with an undamaged part to insure perfect alignment of all attaching points. This is due to the difficulty of manufacturing duplicate tooling free from minor errors resulting from the normal tolerances on dimensions. For example, the tolerance allowed on a certain dimension may be ± 0.005 inch. The tooling used by Vultee may have been constructed to +0.005 inch on that dimension, while tooling manufactured at a repair depot may be constructed to -0.005 inch on the same dimension. Both tools would be correct, so far as the drawing is concerned, but a total variation in the dimension under consideration of 0.010 inch would exist; which might be sufficient to cause improper fitting of the locally manufactured or repaired part. However, had the jig been checked against an undamaged part during its construction this variation would have been discovered and compensated for, insuring perfect fitting of the repaired part.

c. Sheet 2 of figure 15 shows methods of clamping the tube structure to secure and maintain alignment during splicing of members. Adjustable jacks are used as braces between the longerons or struts, and cabinet clamps are used on the outside. By such an arrangement the true alignment of the structure may be secured and maintained for the welding operations. The jacks to be used as braces are easily constructed.

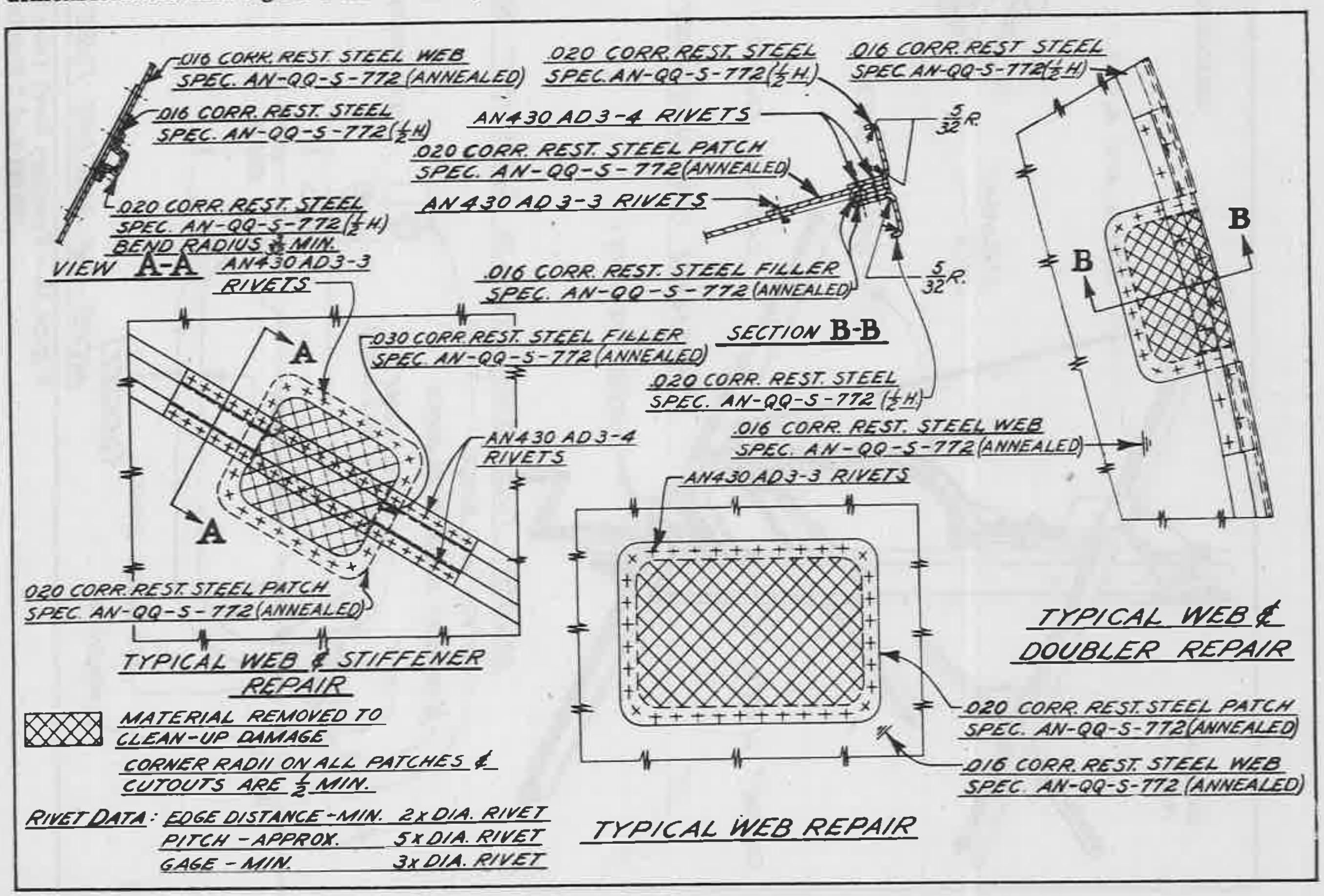


Figure 16 - Firewall Repairs

6. Firewall Repairs.

Figure 16 shows typical repairs for the engine firewall. At the left side portion of figure 16 is a view entitled "Typical Web and Stiffener Repair," which serves as a good example of repairs to the firewall. In this case it is assumed that the damage involves both web and stiffener, requiring splicing the stiffener and patching the web.

a. Typical Web and Stiffener Repair. (Refer to figure 16.) - Proceed as follows:

(1) Remove the damaged web material to obtain a rectangular opening with 1/2-inch corner radii. The severed ends of the stiffener should terminate at the edges of the web cut-out, and the cut edges should be filed smooth to remove all burrs.

(2) Form a splice channel from 0.20 inch corrosion-resistant steel to snugly fit over the stiffener; and long enough to provide a 2-13/16 inch overlap at each side of the cut-out.

NOTE: The 2-13/16 inch value is the product of the number of rivets required per splice and the rivet pitch. Inspection of the repair drawing shows that six rivets are required per splice, the proper pitch is five times the rivet's diameter, and that 3/32-inch diameter rivets are used. Thus, 6 x 5 x 3/32 = 90/32 or 2-13/16 inch for the splice overlap.

(3) Place the splice channel in position, being certain that an identical amount of overlap exists at each end, and mark (with lead pencil) the positions of the severed ends of the original stiffener.

(4) Remove the splice channel and lay out the rivet pattern (with lead pencil) for all rivets passing through the channel flanges, spacing these approximately 15/32 inch to obtain the required pitch of five rivet diameters, and locating along a straight line representing the center of the flange. Locate the six rivet holes through each flange at the splice overlap to obtain the proper edge distance of 3/16 inch (2 rivet diameters) for the rivets at the edge of the cut-out. The pencil marks showing the position of the severed ends of the stiffener can be used as a guide for this purpose. Drill a No. 50 pilot hole through each of the rivet locations marked.

(5) Clamp the splice channel in place, and drill No. 40 through channel, stiffener and web for all the pilot holes of rivets joining the splice channel to the severed ends of the stiffener, except the four holes (one in each flange at both sides of the cut-out) at the edge of the cut-out. Clamp the channel tightly to stiffener and web with machine screws and nuts installed in about half of the No. 40 holes, using fibre or aluminum washers beneath each screwhead and nut to prevent marring the material. Then drive an AN430AD3-4 rivet (wet in zinc-chromate primer) in each of the holes remaining open - followed by removing the machine screws and driving identical rivets in the remaining holes.

(6) Make a filler strip from the 0.016 corrosion-resistant steel to fill the gap between the splice channel and web patch. This strip should extend the full length of the web cut-out, and span the width of the channel, so that all rivets in this area will pass through channel flange, filler and web. Clamp this in place, and drill through No. 50 from each of the pilot holes in the channel flanges. This filler should then be held in place with two 1/16-inch diameter countersunk rivets located at random in opposite corners of the filler. Owing to the thin gage of the material it will probably be necessary to dimple the rivet holes to provide clearance for the countersunk rivethead.

(7) Make a patch of 0.030 corrosion-resistant steel to provide a patch overlap of 3/8 to 1/2 inch (twice the edge distance of 2 rivet diameters, or 3/8, is minimum) all around, being certain to provide the patch corners with 1/2-inch radii. The best method of laying out the patch is to first mark (with pencil) the outline of the web cut-out on a suitable piece of material, and then mark another outline 3/8 to 1/2 inch outside of the first outline. The larger outline will represent the patch, which may then be cut out of the material, and all edges filed smooth. The outline of the web cut-out should remain as a guide to align patch with cut-out.

(8) Lay out a rivet pattern along a line midway between the patch edge and the outline of the web cut-out. Space the rivets approximately 15/32 inch and drill No. 50 pilot holes for all rivet locations except those passing through the channel flanges, which are drilled from the pilot holes in the channel. This exception includes the four holes adjacent to the cut-out edges previously drilled through the web from the channel flanges.

(9) Hold the patch securely in position so that the pencil marks showing the outline of the cut-out are aligned with the edges of the cut-out, and drill through from the channel flanges two No. 40 holes, located in opposite corners. Install machine screws and nuts through these holes to hold the patch securely in position. Always use washers beneath screwheads and nuts to prevent marring the material. Drill all remaining rivet holes No. 40 from pilot holes in channel and patch, installing additional machine screws in about half the holes, and working from the center outwards to avoid developing an oil-can in the patch. Then drive AN430AD3 rivets (wet with primer) in the open holes, again working from the center out, and finally removing all machine screws and driving rivets in these holes to complete the repair.

b. Using Aluminum-Alloy Rivets in Corrosion-Resistant Steel. - The repairs shown in figure 16 specify aluminum-alloy rivets; and in order to minimize corrosion between these rivets and the steel

TABLE VI. LIST OF REPAIR MATERIALS FOR FUSELAGE STEEL TUBE SECTION

	Material			
Part No.	Spec. No.	Title	Size	Remarks
61-31312	AC-57-107 Gd WD-X4130	Bars, Steel, Carbon and Alloy	--	Fitting - Engine Mount Upper LH
61-31312-1	" " "	" "	--	Fitting - Engine Mount Upper RH
61-31313	" " "	" "	--	Fitting - Engine Mount Lower LH
61-31313-1	" " "	" "	--	Fitting - Engine Mount Lower RH
61-31318	" " "	" "	--	Fitting - Monocoque Lower LH
61-31318-1	" " "	" "	--	Fitting - Monocoque Lower RH
61-31319	AN-QQ-S-685 Condition N (Normalized)	Chrome-Molybdenum (X4130) Rod and Bar	--	Fitting - Monocoque Upper
--	AN-WW-T-850 Type I, Cond N	Tubing, CM Steel	1/2 x .035	Tube Replacement and Inserts
--	" " "	" "	7/8 x .035	" "
--	" " "	" "	1.0 x .035	" "
--	" " "	" "	1.0 x .049	" "
--	" " "	" "	1.0 x .058	" "
--	" " "	" "	1-1/8 x .049	" "
--	" " "	" "	1-1/4 x .035	" "
--	" " "	" "	1-1/4 x .049	" "
--	" " "	" "	1-3/8 x .035	" "
--	" " "	" "	1-3/8 x .049	" "
--	" " "	" "	1-3/8 x .065	" "
--	" " "	" "	1-1/2 x .035	" "
--	" " "	" "	1-1/2 x .049	" "
--	" " "	" "	1-1/2 x .083	" "
--	" " "	" "	1-1/2 x .120	" "
--	" " "	" "	1-5/8 x .049	" "
--	" " "	" "	1-5/8 x .058	" "
--	" " "	" "	1-5/8 x .065	" "
--	" " "	" "	1-5/8 x .095	" "
--	" " "	" "	1-3/4 x .049	" "
--	" " "	" "	1-3/4 x .083	" "
--	" " "	" "	1-3/4 x .120	" "
--	" " "	" "	2.0 x .049	" "
--	" " "	" "	2.0 x .095	" "
--	AN-WW-T-850 Type I, Cond N	Tubing, CM Steel	5/8 x .058	Tube Splice Sleeve
--	" " "	" "	1.0 x .058	" " "
--	" " "	" "	1-1/8 x .058	" " "
--	" " "	" "	1-1/4 x .058	" " "
--	" " "	" "	1-1/4 x .120	" " "
--	" " "	" "	1-3/8 x .058	" " "
--	" " "	" "	1-1/2 x .058	" " "
--	" " "	" "	1-5/8 x .058	" " "
--	" " "	" "	1-5/8 x .120	" " "
--	" " "	" "	1-3/4 x .058	" " "
--	" " "	" "	1-3/4 x .120	" " "
--	" " "	" "	1-7/8 x .058	" " "
--	" " "	" "	1-7/8 x .120	" " "
--	" " "	" "	1-7/8 x .187	" " "
--	" " "	" "	2.0 x .120	" " "
--	" " "	" "	2-1/8 x .058	" " "
--	" " "	" "	2-1/8 x .187	" " "
--	" " "	" "	2-1/4 x .120	" " "

firewall it is necessary to drive the rivets wet with zinc-chromate primer, Specification No. 14080. Whenever AN435 iron rivets are available for firewall repairs these should be substituted for the AN430AD aluminum-alloy rivets, and do not require the primer.

7. Side Panel and Support Structure Repairs.

Repairs for the removable side panels covering the fuselage steel tube structure are shown in figure 17, as are repairs for the structure supporting these panels.

a. Typical Side Panel Repair. - Simple damage to the side panels which does not injure the internal structure can be repaired in a manner similar to that used for simple skin patches on the fuselage monocoque skin. Cases wherein the internal structure is damaged require that first this structure be suitably repaired, then fillers installed to bring the repaired structure flush with the skin line, and lastly riveting a skin patch over the affected area to lap over the edges of the skin cut-out; followed by painting the repaired area to match the surrounding parts. The sketch in the lower right portion of figure 17 is typical of such repairs and can be accomplished in the following manner:

(1) Clean up the damaged area by carefully removing the damaged skin and stiffener frame to leave a square or rectangular opening with the severed ends of the frame terminating flush with the edges of the skin cut-out. File the cut edges smooth and provide 1/2-inch radii in the corners of the skin cut-out.

(2) Make two splice angles from 0.040 24STAL aluminum coated aluminum-alloy sheet, bent to the dimensions shown in figure 17, and long enough to span the gap in the severed frame with a splice overlap of approximately 1-13/32 (three 3/32 rivets spaced 15/32 inch apart) inches. The splice angles have a curled flange formed along their free edge to provide the necessary stiffness, and two separate splice angles are used to avoid the necessity of forming a special splice channel to fit over the frame member.

(3) Lay out a rivet pattern on the splice angles, using a pitch of approximately 15/32 inch, and a minimum edge distance of 3/16 inch. The important items to observe when laying out the rivet pattern are that: - (i) three rivets are used in the splice overlap at each end of the angle; and - (ii) that proper rivet edge distance is maintained, including the rivets at the edge of the cut-out and at the ends of the angles. Drill a No. 50 pilot hole through the splice-angle flange at each of the rivet locations.

(4) Clamp the splice angles into position, with the angles positioned to provide the proper edge distance for the rivets adjacent to the cut-out. Drill through the hole at each end (4 holes in all) No. 40, and rivet the angles in place with four AN455AD3 rivets.

(5) Make a filler of 0.040 24STAL aluminum coated aluminum-alloy sheet, to extend from one side of the skin cut-out to the other, and wide enough to span the splice angles, so that all rivets in the skin cut-out area will pass through, filler and skin patch. Locate this filler in place with two 1/16-diameter countersunk aluminum rivets, placed at random near opposite corners of the filler. These rivets serve only to hold the filler in place during subsequent drilling and riveting, and their exact location is not important, except that they must not interfere with rivets used to hold the skin patch. Clamp the filler securely to the angles, and drill all pilot holes No. 50 through the filler. Remove the clamps.

(6) Mark (with lead pencil) the patch outline all around the cut-out. This will be 3/8 to 1/2 inch larger than the cut-out on the sides, and increase to about 7/8 inch at top and bottom centers, to provide for a double row of rivets through the angles. Then make a patch of 0.040 24STAL material to the dimensions of this outline. Lay out a rivet pattern on the patch in accordance with the data shown in figure 17, and drill No. 50 pilot holes for the rivets.

NOTE: Do not drill pilot holes in the patch for the rivets passing through the angles, as these are drilled through from the pilot holes existing in the angles.

(7) Hold the patch securely in position, and properly align with the outline penciled on the skin, and drill through from the splice angles two No. 40 holes, located diagonally across the patch. Install machine screws and nuts through these holes to hold the patch in position, using fibre washers beneath head and nut. Continue drilling No. 40 holes through the remainder of the pilot holes in the splice angles. Install machine screws in about half of these holes. Then install AN455AD3-4 rivets through the holes remaining open, and securely rivet in place. Then remove the machine screws and install rivets in the remaining holes.

(8) Lastly drill No. 40 through the pilot holes in the patch, and install AN455AD3-3 rivets to secure the patch to the skin. Best results will be obtained if machine screws are first installed in about half the rivet holes. to hold the patch tightly in place, rivets driven in the holes remaining open, the screws removed and the remaining rivets then installed. Finish both sides of the repair to match the color of the surrounding structure.

b. Typical Side Panel Support Structure Repair. - The majority of repairs involving the side-panel support structure will involve simple splicing of a damaged or severed channel. The view in the upper left portion of figure 17 shows such a splice, consisting of a channel formed to snugly fit inside the existing channel to join its severed ends. In this case it is assumed that the damage requires removal of a portion of the complete channel, leaving two severed ends to be

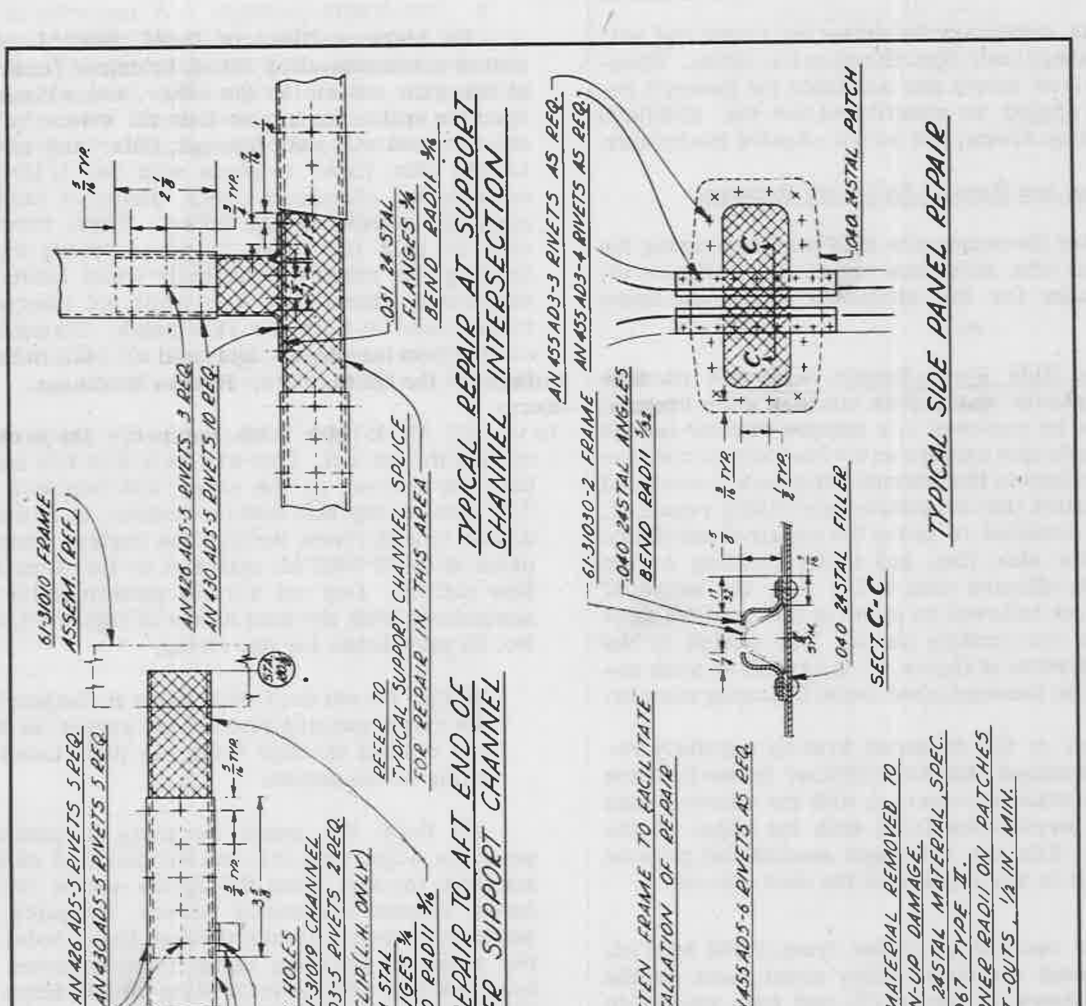


Figure 17 - Fuselage Side Panel and Support Structure Repairs

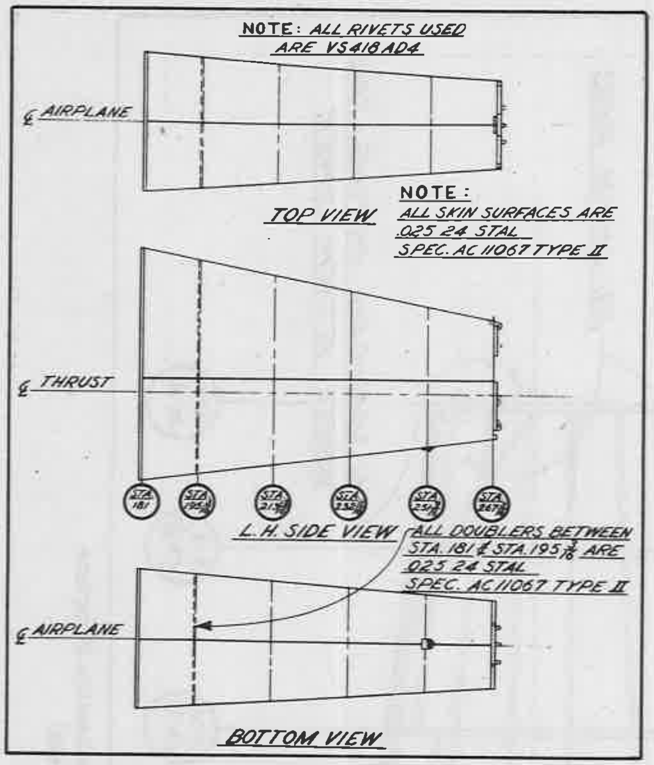


Figure 18 - Fuselage Monocoque Section Plating

joined. In cases where removal of the damaged material does not completely sever the channel, the same splice channel may be used as a reinforcement. Proceed as follows to accomplish this repair:

(1) Clean up the damaged area by carefully removing the damaged portion of the channel to leave square ends if the channel is completely severed, or to leave a symmetrical area having 1/2-inch corner radii if but a portion of the channel is removed.

(2) Make a splice channel to snugly fit within the severed ends of the support channel, with a splice overlap of 2-1/8 inches at each end. Clamp this in place, and lay out the rivet pattern on the ends of the original channel, in accordance with the data shown in figure 17 - wherein each splice requires three AN426AD countersunk rivets through the web of the channel, and two AN430AD rivets through each channel flange. Drill suitable holes for the AN426AD rivets in accordance with the data in section I, and install the rivets. Finish the repair area to match the color of the original parts.

8. Monocoque Section Skin Repair.

a. Negligible Damage. - Small dents in skin plating need no further attention than daily inspection to see that they do not develop. Dents in the skin up to 1/4 inch deep and 3 square inches in area are not important provided that they are more than fifty times the thickness of the skin from adjacent structural members such as stringers and frames.

b. Repairable Damage. - A majority of skin repairs and some minor repairs to frames and stringers can be accomplished by patching. Fuselage skin patches are shown in figure 20. In many cases it will be necessary to combine these with stringer and frame repairs in order to complete the job.

c. Nonrepairable Damage. - When more than 50 percent of the area of a skin plate is damaged, it may be considered as nonrepairable and the entire plate replaced.

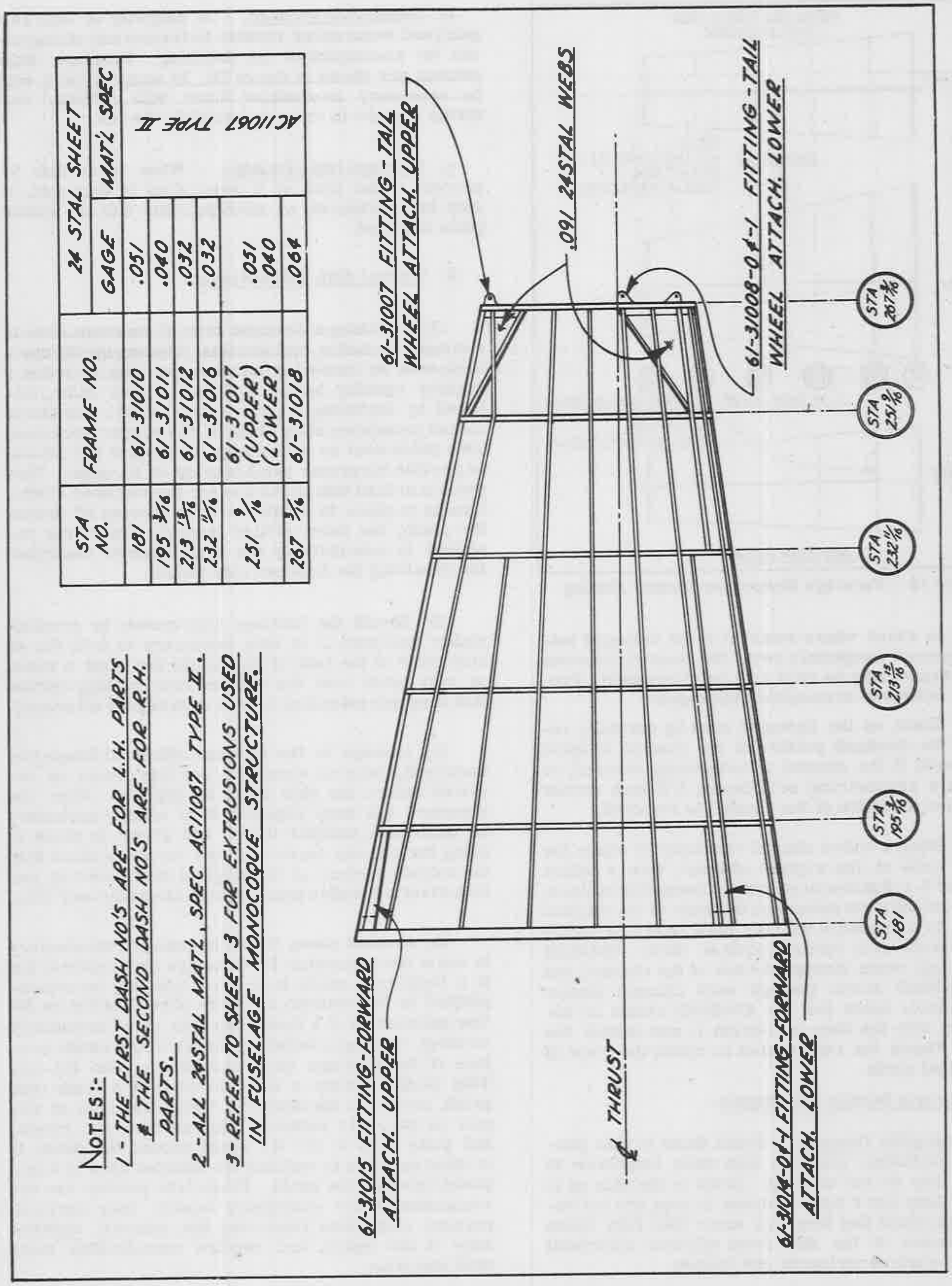
d. Typical Skin Patch Repair.

(1) Patching a damaged area of fuselage skin is a simple operation, and involves cleaning up the damaged area by removing all damaged skin to leave a regular opening having 1/2-inch corner radii, followed by installing a patch from 24STAL aluminum coated aluminum-alloy sheet of the proper thickness. This patch must be sufficiently larger than the cut-out to provide the proper patch overlap on all edges. This patch is drilled with pilot holes for the required rivets, located in place to obtain an even overlap all around the patch, the holes drilled through, and rivets installed in substantially the same manner described for repairing the fuselage side panels.

(2) Should the fuselage skin merely be cracked, rather than torn, it is only necessary to drill No. 40 stop holes at the ends of the cracks and rivet a round or oval patch over the affected area, making certain that the patch extends at least 1 inch beyond all cracks.

(3) Damage to the fuselage skin will frequently involve the internal structure, and this should be repaired before the skin patch is applied. After the structure has been repaired it is usually necessary to tack-rivet suitable fillers and shims in place to bring the outside surface of the structure flush with the outside surface of the original skin covering, and then rivet a suitable patch to both structure and skin.

(4) In most cases it will be entirely satisfactory to use a lap-type patch for fuselage skin repairs, but if a flush-type patch is desired, this may be accomplished in the manner shown on sheet 2 of figure 20. The installation of a flush-type skin patch essentially involves riveting a suitable doubler to the inside surface of the fuselage skin, around the skin cut-out. This doubler forms a ledge to support a flush-type patch, riveted to the doubler. When this type of repair is carefully installed with countersunk rivets, and putty used to fill the seam around the patch, it is often possible to refinish the affected area to completely conceal the patch. Flush-type patches are not recommended for emergency repair: they serve no purpose other than improving the external appearance of the repair, and require considerably more skill and time.



STA NO.	FRAME NO.	24 STAL SHEET GAGE	MAT'L SPEC
181	61-31010	.051	AC11067 TYPE II
195 3/16	61-31011	.040	
213 13/16	61-31012	.032	
232 11/16	61-31016	.032	
251 9/16	61-31017 (UPPER) (LOWER)	.051 .040	
267 3/16	61-31018	.064	

Figure 19 - Fuselage Monocoque Section Structure (Sheet 1 of 3 Sheets)

EXTRUSIONS USED IN FUSELAGE MONOCOQUE SECTION STRUCTURE
Refer To Sheet 3 For Detail Views Of Extrusions

VS No.	DIE NUMBERS		
	Alcoa	Bohn	Reynolds
175	L24210	B8761	E941
176	L24145	B9675	---
179	L24263	B9647	---
189	L24203	B9721	E1113
192	L24316	---	E670
193	L24317	---	E669
250-5	78-K	B8716	---
250-8	12871	---	---
250-9	78-J	B9653	---
251-3	K12872	---	---
251-6	1288	---	---
251-9	734-FF	B8639	---
253-5	5456	---	---
478	L13613	B9655	---
484	K15644	B9648	---
487	L24806	---	---
488	L24807	---	---
499	L24824	---	---
708	---	B8960	---

NOTES: -

1. All extrusions, except those requiring forming are 24ST Alum Alloy Spec Fed QQ-A-354 Cond. T.

2. Extrusions requiring forming are 24SO Alum Alloy (Spec Fed QQ-A-354 Cond. A), and must be heat-treated (to Cond. T per Spec AN-QQ-H-186), after forming.

VS No.	HOW USED	WHERE USED
488	Fitting	Fwd Attach. Upper Fit.
487	Fitting	Fwd Attach. Lower Fit.
192	Clip	Fwd Upper Fit. Stiffener
192	Clip	Fwd Lower Fit. Stiffener
179	Stiffeners	Mono. Attach. Fit.
176	Stiffeners	Mono. Attach. Fit.
250-8	Pulley Brkt	Sta 213-15/16
250-9	Support	Pulley Brkt - Sta 213-15/16
192	Clip	Frame to Stringer Sta 232-11/16
192	Clip	Sta 251-9/16
478	Stiffener	Inspection Door Frame
193	Clip	Inspection Door Frame
175	Stiffener	Inspection Door
251-6	Support	Torque Tube Brkt - Sta 267-3/16
251-3	Stiffener	Bulkhead - Sta 267-3/16
250-8	Formers	Bulkhead - Sta 267-3/16
253-5	Stiffener	Bulkhead - Sta 267-3/16
216	Fitting	Tail Wheel Upper Attach.
189	Used to Make VS 216	
250-5	Stiffener	Web - Tail Wheel Upper Attach.
251-9	Clip	Web - Tail Wheel Upper Attach.
708	Fitting	Tail Wheel Lower Attach.
484	Stiffener	Web - Tail Wheel Lower Attach.
499	Stiffener	Skin at Horiz. Stab.
377	Clip	Typical
193	Used to Make VS 377	
478	Stringers	

Figure 19 - Fuselage Monocoque Section Structure
(Sheet 2 of 3 Sheets)

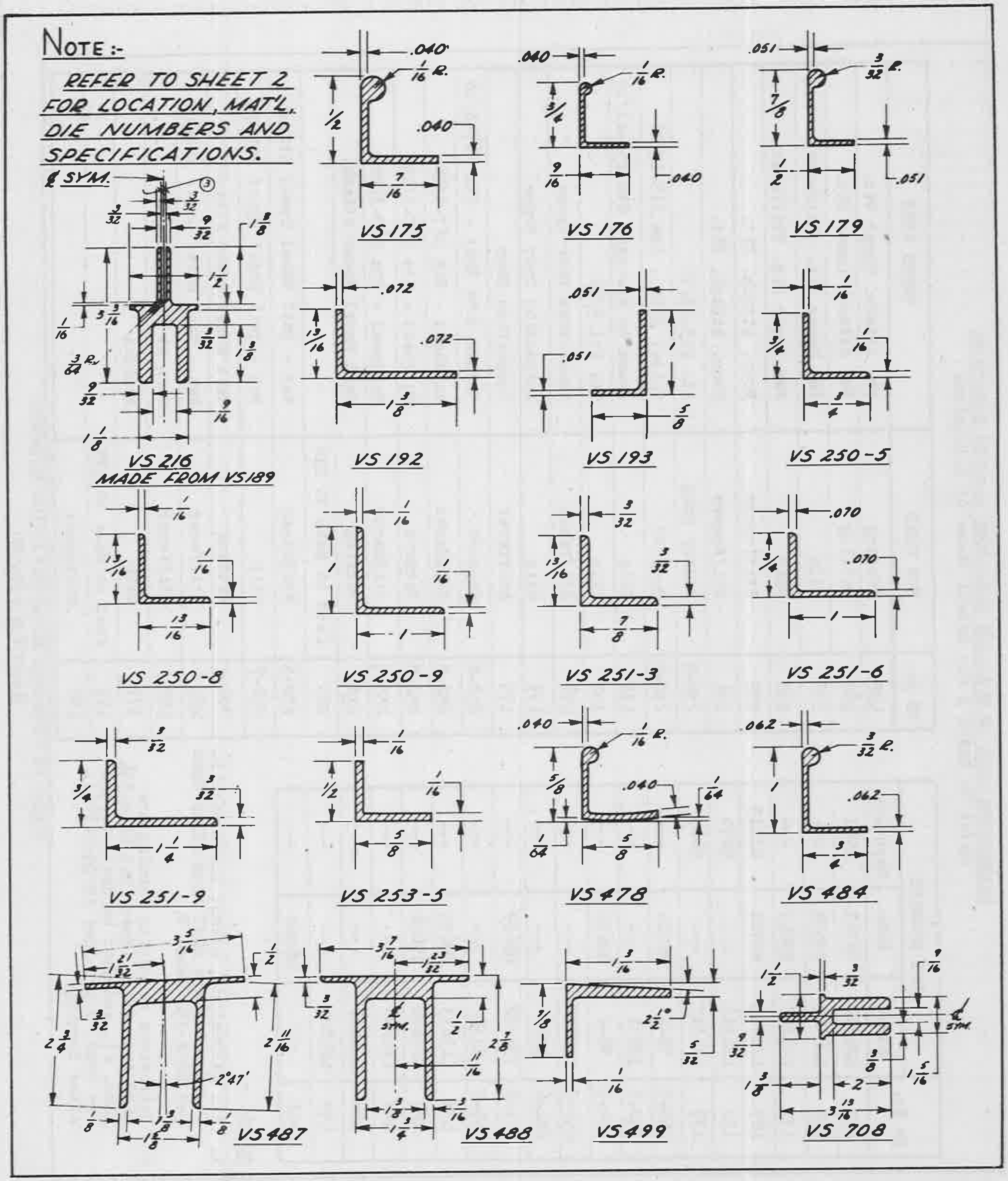


Figure 19 - Fuselage Monocoque Section Structure
(Sheet 3 of 3 Sheets)

TABLE VII. LIST OF REPAIR MATERIALS FOR FIREWALL AND FUSELAGE SIDE PANELS

Part No.	Material Spec. No.	Title	Size	Remarks
63-31103	--	Fitting	--	Side Panel Attachment Fitting.
AN426AD5-5	--	Rivet, 100° C'sunk	5/32 Diam.	--
AN426AD5-6	--	" " "	5/32 Diam.	--
AN430AD3-3	--	Rivet, Round Head	3/32 Diam.	--
AN430AD3-4	--	" " "	3/32 Diam.	--
AN430AD3-5	--	" " "	3/32 Diam.	--
AN430AD5-5	--	" " "	5/32 Diam.	--
AN430AD5-6	--	" " "	5/32 Diam.	--
AN455AD3-3	--	Rivet, Brazier Head	3/32 Diam.	--
AN455AD3-4	--	" " "	3/32 Diam.	--
AN455AD5-6	--	" " "	5/32 Diam.	--
--	AN-QQ-S-772, Class I Comp G, Cond A	Steel; Corrosion Resisting Sheet	0.020 Thick	Firewall Repairs
--	" " "	" " "	0.030 Thick	" "
--	AN-QQ-S-772, Class I Comp G, Cond C	Steel; Corrosion Resisting Sheet	0.016 Thick	Firewall Repairs
--	" " "	" " "	0.020 Thick	" "
--	AN-QQ-S-685, Cond N	Sheet, CM Steel	0.125 Thick	Replacement Side Panel Attachment Fitting
--	AC-11067, Type II	Aluminum Coated Alum Alloy Sheet	0.040 Thick	Side Panel and Support Repairs
--	" "	" " "	0.051 Thick	" " "
--	" "	" " "	0.064 Thick	" " "

(5) Probably the most complicated form of slush-type skin patching would be the repairing of an extensive area at a skin lap, wherein the stringer must also be spliced, as shown in the views at the top of sheet 2 of figure 20. Proceed as follows:

(a) Remove the damaged skin and stringer to obtain a square or rectangular opening with 1/2-inch corner radii. Then cut the severed ends of the stringer 15/16 inch back from the edges of the skin cut-out to provide for installation of the doublers. File all cut edges smooth.

(b) Owing to the damage being located at the skin overlap, it will be necessary to make two C-shaped doublers, which will also overlap at a point immediately above the existing skin overlap. If the damage is located at a point not affected by a skin overlap the repair will be simplified by using a one piece doubler extending around the inside of the skin cut-out. The doubler in each case is a strip of 0.032 inch 24STAL aluminum-coated aluminum alloy 1-3/8 inches wide, cut to match the skin cut-out, and with 7/8 inch larger outside-dimensions than the skin cut-out. This provides 7/8 inch of material to rivet to the inside of the existing skin, and establishes a 1/2-inch wide ledge inside the skin cut-out to receive the flush-type skin patch.

(c) Make the upper doubler first, trimming the ends of the C-shaped strip to butt against the upper edge of the lower skin sheet, with 7/8 inch overlap of the doubler all around the inside of the upper portion of the skin cut-out. Mark the outline of the skin cut-out on the doubler with lead pencil as an aid to alignment when the doubler is riveted in place, and then remove the doubler.

(d) Lay out the rivet pattern on the upper doubler, using lead pencil, and arranged so that two staggered rows of AN455AD4 rivets (1/4-inch edge distance, 5/8-inch pitch, and 3/8 gage) are used to attach the doubler to the inside of the skin, and one row of AN455AD4 rivets (1/4-inch edge distance, and 5/8-inch pitch) are used for attachment of patch to doubler. The rivets at the doubler overlap deviate from the remaining rivet pattern (as will be seen from inspection of sheet 2 of figure 20) in that but two rivets are used - one passing through the skin, and the other through the patch. Drill No. 50 pilot holes through each rivet location, except the two at the doubler overlap which were drilled through from the lower doubler.

(e) Clamp the doubler in place, aligning the previously marked pencil outline with the cut-out, and drill No. 40 through the doubler pilot holes. Rivet the doubler in place with AN455AD4 rivets.

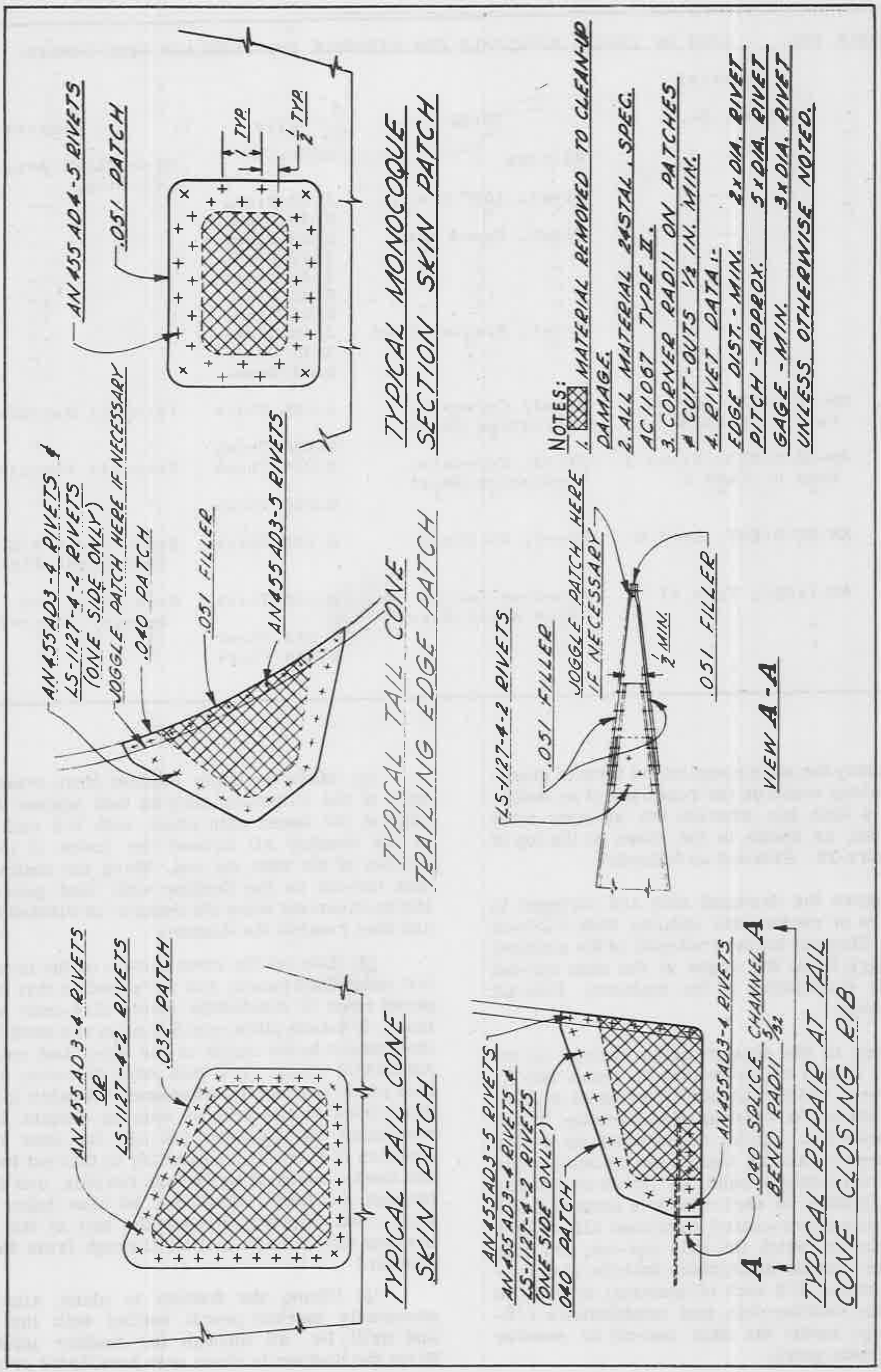


Figure 20 - Fuselage Skin Patches
(Sheet 1 of 2 Sheets)

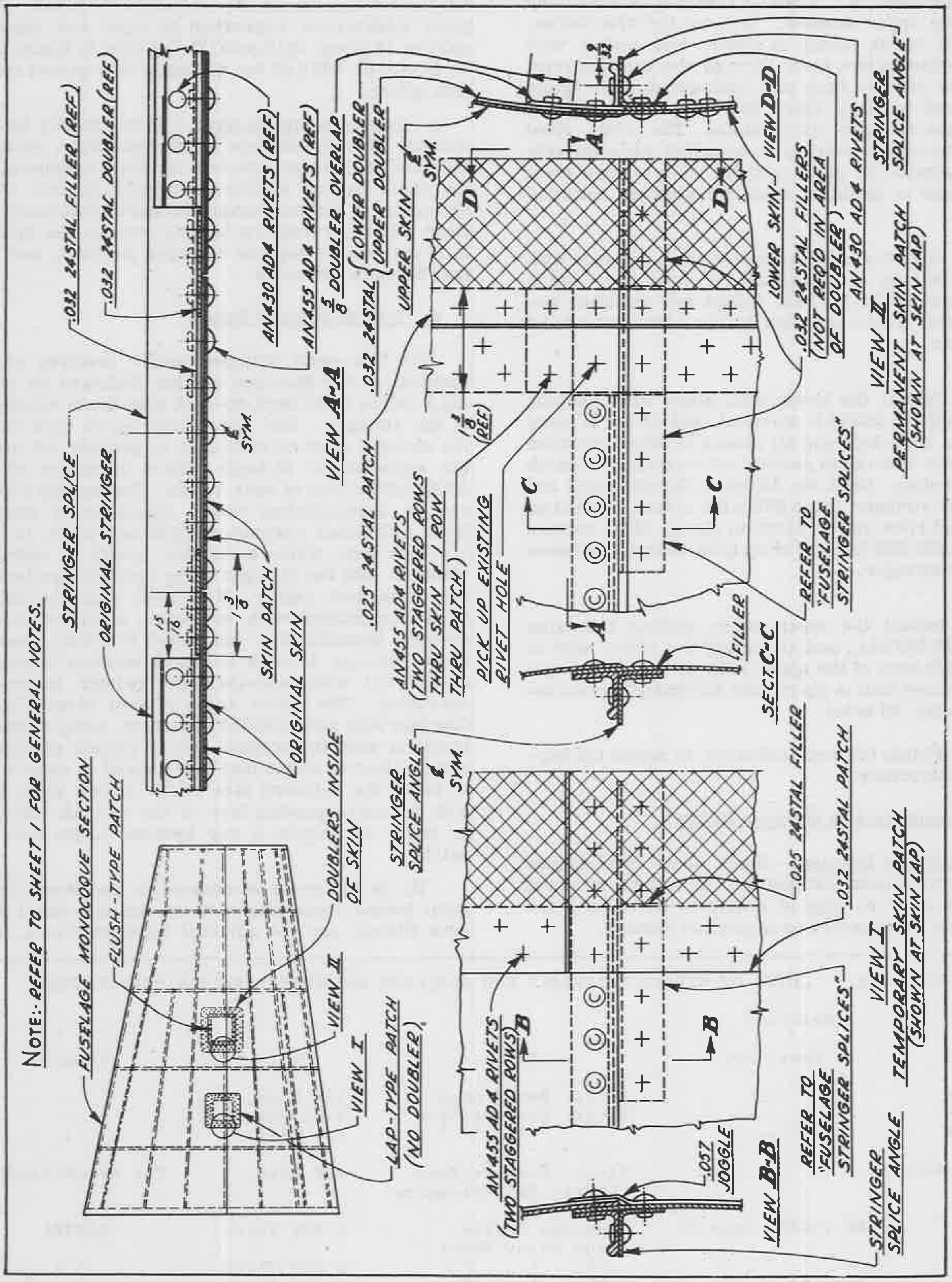


Figure 20 - Fuselage Skin Patches
(Sheet 2 of 2 Sheets)

(f) Make the lower doubler in the same manner as the upper doubler, except that the legs of this doubler must be long enough to lap 5/8 inch over the legs of the upper doubler. Lay out the rivet holes, drill pilot holes, clamp in place, and install with rivets; including one rivet through the existing rivet hole in the skin at each side (through doubler splice overlap and fuselage skin), but excepting the rivets through the stringer splice angle. The other rivet through the splice overlap is installed when the skin patch is riveted in place, and the splice-angle rivet at each side is installed when the stringer splice is made.

(g) Install a stringer splice in accordance with the instructions in paragraph 9. following. Make certain that 0.032 24STAL fillers are installed between splice angle and skin in the areas outside of the doubler.

(h) Install the lower skin patch first, making this from 0.032 24STAL material, and fitting in place with about 1/32-inch gap all around between patch and edge of skin cut-out to prevent oil-canning the patch during riveting. Drill No. 30 holes through patch and doubler or stringer for AN455AD4 rivets, located as shown, and rivet lower patch in place. Make certain that the 0.032 24STAL filler strip is installed between patch and stringer.

(i) Install the upper patch, making this also from 0.032 24STAL, and trimming the lower edge to line up with edge of the upper skin on the monocoque section. Rivet this in place with AN455AD4 rivets installed in No. 40 holes.

(j) Finish the repaired area to match the surrounding structure.

9. Monocoque Section Stringer Repairs.

a. Negligible Damage. - Small dents in stringers without pronounced extremities or sharp corners, and which show no sign of cracks or abrasion of the metal, may be regarded as negligible damage.

b. Repairable Damage. - Stringers are repaired by splicing, as their relatively small section does not permit application of a satisfactory patch. Complete information regarding stringer and longeron splices is given in figure 21. (Refer to figure 23 of T. O. No. 01-50FA-3 for example of a typical insertion splice.)

c. Nonrepairable Damage. - It can hardly be said that any stringer damage is nonrepairable, except in the case of fittings attached to these members, and the short channel sections attaching certain of the stringers to the monocoque forward attachment fittings. Stringer repairs largely involve the splicing in of material to replace damaged sections, and thus may be quite extensive.

d. Typical Stringer Splice.

(1) The usual stringer splice involves simple removal of the damaged section, followed by riveting a splice angle back-to-back with the severed ends of the stringer. The splice overlap at each end of the stringer must be sufficient to provide for joining the angle to the stringer with a minimum of four AN455AD5 rivets at each splice. Emergency repairs can be accomplished with a splice angle bent-up, from 0.038-inch chrome-molybdenum steel, to have 5/8-inch legs; while a suitable length of extrusion identical with the stringer being spliced may be used for permanent repair. If a steel angle is used it should be painted with two coats of zinc-chromate primer (Specification No. AN-TT-P-656), and all rivets passing through the steel member should be driven wet with zinc-chromate primer to prevent corrosion. The splice angle is also riveted to the fuselage skin with AN455AD5 rivets, using a spacing identical with the original rivets joining stringer to skin. Filler or shims may be required in some cases to bring the outboard face of the splice angle level with the corresponding face of the original stringer, in order to prevent a gap between angle and skin patch.

(2) In the event of damage to the short, triangular beams connecting between the tail-wheel bulkhead fittings and the adjacent fuselage frame, there

TABLE VIII. LIST OF REPAIR MATERIALS FOR FUSELAGE MONOCOQUE SECTION SKIN PATCHES

Part No.	Material Spec. No.	Title	Size	Remarks
AN430AD4	--	Rivet, Round Head	1/8 Diam.	--
AN455AD3	--	Rivet, Brazier Head	3/32 Diam.	--
AN455AD4	--	" " "	1/8 Diam.	--
LS-1127-4-2	--	Rivet, Brazier Head Cherry Self-plugging	1/8 Diam.	For Blind Riveting
--	AC-11067, Type II	Aluminum Coated Alum Alloy Sheet	0.025 Thick	24STAL
--	" "	" " "	0.032 Thick	"
--	" "	" " "	0.040 Thick	"
--	" "	" " "	0.051 Thick	"

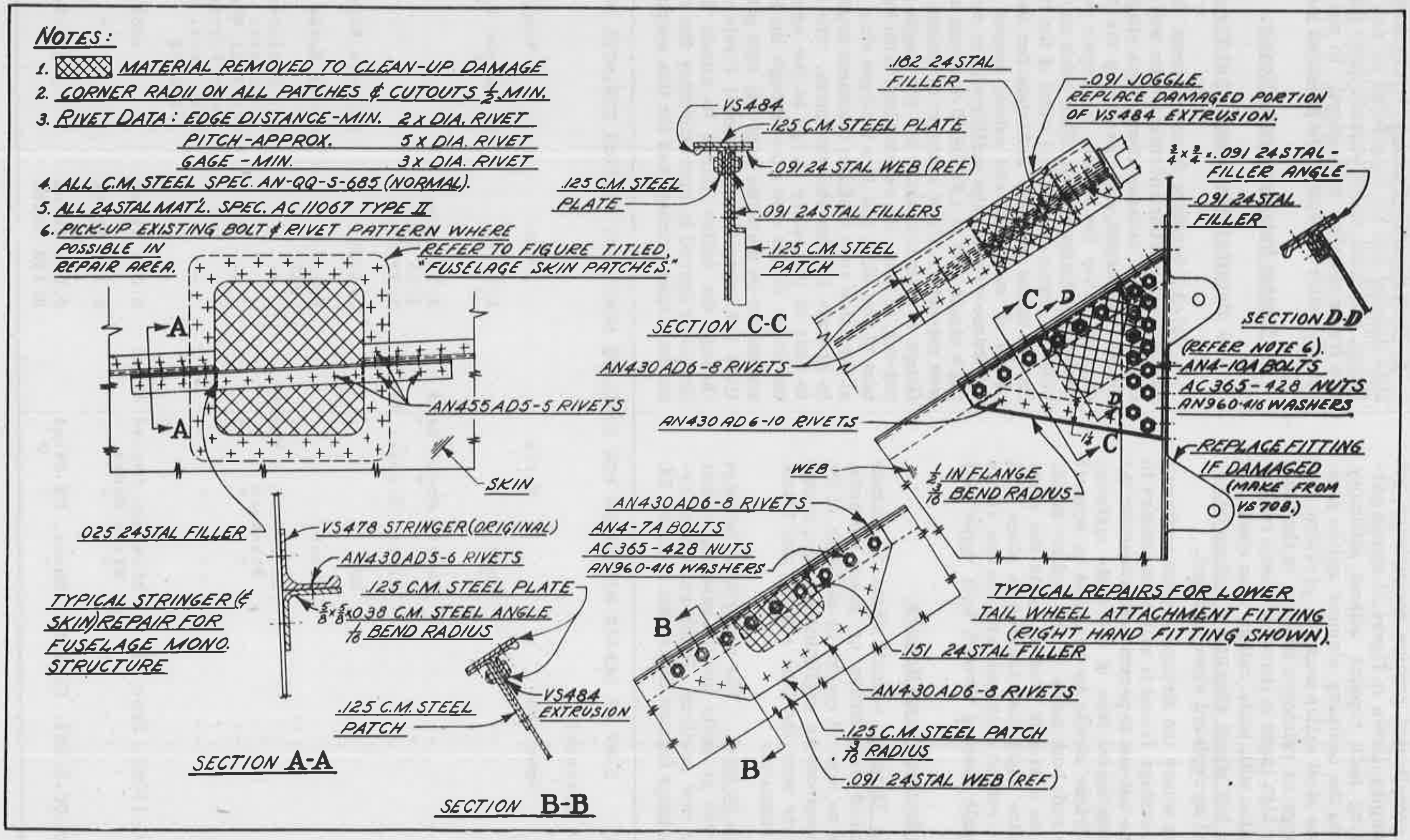


Figure 21 - Fuselage Stringer Splices

may be rather complicated repairs encountered, but study of the examples shown in figure 21 should permit accomplishing such repairs without difficulty. These differ from the ordinary stringer splice principally in that the steel splice angle is provided with an extended flange to reinforce damage to the beam web, and that the high loads in these members require attaching the splice with bolts rather than rivets. In no case can the tail wheel attachment fittings be repaired, and must be replaced when damaged.

(3) In cases where the stringer-splice angle will pass through a fuselage frame it will be necessary to modify the frame cut-out to provide clearance for the splice angle. Attachment tabs of the same material as the fuselage frame should be provided to connect between frame and both sides of the splice angle. These tabs can be a simple bent-up angle the same width as the splice angle, and secured in place with two AN455AD4 rivets at each end, with the two rivets at the splice angle passing through both upper and lower tabs.

10. Monocoque Section Frame Repairs.

a. Negligible Damage. - Small dents in frames without pronounced extremities or sharp corners, and which show no sign of cracks or abrasion of the metal, may be regarded as negligible damage, except that damage at or near the free edge of any frame flange must be repaired.

b. Repairable Damage. - The majority of fuselage frame repairs will probably involve patching, rather than splicing in new sections. Patch and splice repairs for the fuselage frames are shown in figure 22.

c. Nonrepairable Damage. - In general, nonrepairable damage can be considered as any damage to a fitting, and those cases wherein more than 50 percent of a frame member is damaged. In such cases it is usually better to replace the damaged member.

d. Typical Fuselage Frame Repair.

(1) Repairs for Stations No. 181 Through 251-9/16.

(a) All fuselage frames except the tail-wheel bulkhead are similar and their repair will involve identical methods. In cases where only a single flange of the frame is damaged, and cleaning up the damaged area does not sever the frame, the repair can be accomplished by a flanged patch. This patch should nestle inside the frame for the full width of the flange, have a flange splice overlap sufficient for two AN455AD5 rivets at each end, and extend beyond the edges of the frame web damage sufficiently to permit installing a single row of AN430AD5-6 rivets all around the web cut-out. A filler equal in thickness to the frame flange will be necessary for the length of the flange cut-out, to bring the repair flush with the inside surface of the skin; and if a lap-type skin patch is used at the same area the filler thickness must be increased to provide for the skin thickness. The rivets joining to ends of the splice flange to the severed ends of the frame flange also pass through the fuselage skin, and cannot be installed until all skin patching operations are complete. Additional rivets are required through the splice flange to attach the skin, and should be spaced in approximately the same manner as the original rivets used for this purpose.

TABLE IX. LIST OF REPAIR MATERIALS FOR FUSELAGE MONOCOQUE SECTION STRINGER SPLICES

Part No.	Material Spec. No.	Title	Size	Remarks
AN4-7A	--	Bolt	1/4-28	No Cotter Pin Hole
AN4-10A	--	"	" "	" " " "
AN430AD5	--	Rivet, Round Head	5/32 Diam.	--
AN430AD6	--	" " "	3/16 Diam.	--
AN455AD5	--	Rivet, Brazier Head	5/32 Diam.	--
AC365-428	--	Nut	1/4-28	Elastic Stop Mut
AN960-416		Washer	For 1/4 Bolt	Steel Washer
VS478	--	Extrusion - Vultee Standard	--	For Replacement Stringers
VS484	--	" " "	--	For Tail Wheel Attachment Fitting Beam
VS708	--	" " "	--	Tail Wheel Attachment Fitting
--	AC-11067, Type II	Aluminum Coated Alum. Alloy Sheet	0.091 Thick	24STAL
--	" " "	" " "	0.151 Thick	"
--	AN-QQ-S-685, Cond N	Sheet, CM Steel	0.038 Thick	SAE-X4130
--	" "	" " "	0.125 Thick	" "

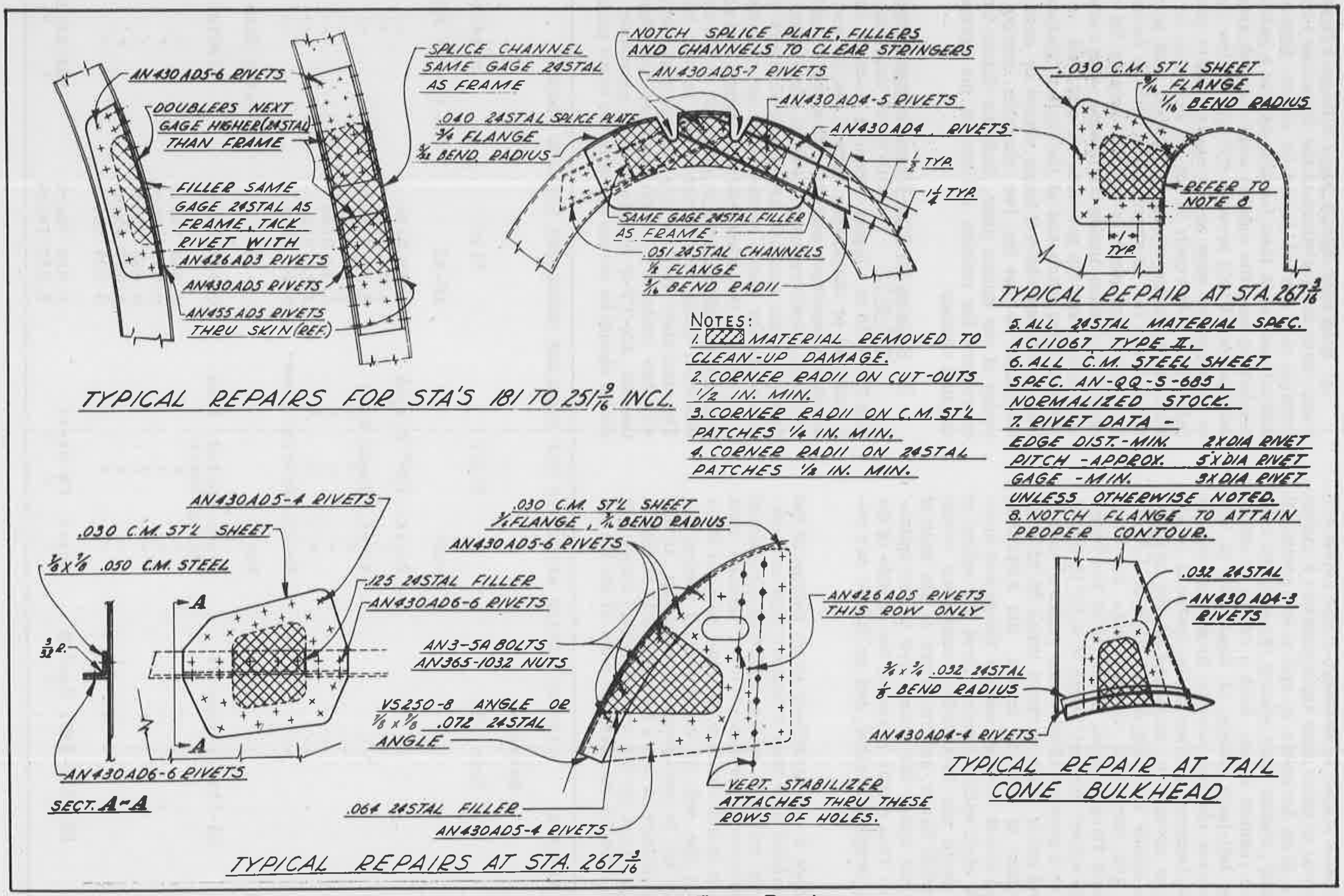


Figure 22 - Fuselage Frame Repairs

(b) When a frame is damaged to an extent requiring removal of more than approximately 8 inches of the frame it is desirable to splice in a section of frame member, rather than joining the severed ends with a splice channel alone. Such a repair is shown in the upper left-hand portion of figure 22. In this case an inserted channel section formed to exactly duplicate the removed portion of the frame is joined with a splice channel to each end of the original frame. The splice channels should each be 4-11/16 inches long and formed to nestle within the frame members, with flanges equal in height to the frame flanges. The splice channel length of 4-11/16 inches is obtained as a produce of the rivets required in each row and rivet pitch. Thus, 6 rivets times 25/32 pitch gives a product of 4-11/16 inches. Six AN455AD5 brazier-head rivets through outside flange and fuselage skin of each splice channel form the splice at this point, while six AN430AD5 round-head rivets splice the inside flange, and two rows of six each of the same rivet splice the frame web to the splice-channel web. This repair restores the outside of the flange to its original contour, and no fillers are required.

(c) When a comparatively short section of the frame is removed (less than 8 inches), it is unnecessary to use an insertion splice, as the splice channel alone is sufficient. Use three rivets through each flange at each splice overlap, and two rows of three each through the web at each overlap - using the rivets called for in paragraph (b) preceding. In this case it is necessary to use a filler equal in thickness to the frame flange on the outside splice flange for the distance between the severed ends of the frame.

(2) Alternate Splice for Fuselage Frames. - In some cases the curvature of the frame may make the forming of a curved insert or splice channel very difficult, and it is then feasible to use a patch member having only the outside edge flanged; reinforced with comparatively narrow, straight-splice channels, as shown in the view at the upper, center portion of figure 22. This repair is not so desirable as the insertion repair previously described, and is recommended only for emergency use. It will be observed that the splice plate is flanged only on its outside edge, and nestles inside the frame, with a considerable splice overlap provided at each end. A splice channel joins each end of the splice plate and the frame, with one channel being placed on each side of the frame so that the two channels overlap at the center of the splice plate. Suitable fillers are used to restore the outside surface of the frame to its original contour.

(3) Repairs for Tail-Wheel Bulkhead (Station No. 267-3/16). - The tail-wheel bulkhead at station 267-3/16 is a highly stressed member involving a bulkhead or diaphragm across the aft end of the fuselage monocoque section, with a variety of fittings and local reinforcements. Several repairs for typical damage to this member are shown at figure 22. The procedure for these repairs does not greatly differ from that for the other stations, except that chrome-molybdenum steel sheet is used for splice and patch material, owing to the high loads in this bulkhead. The steel sheet used for this purpose should be painted with two coats of zinc-chromate primer (Specification No. AN-TT-P-656) to prevent corrosion, and all rivets should be driven wet with the same primer.

TABLE X. LIST OF REPAIR MATERIALS FOR FUSELAGE MONOCOQUE SECTION FRAMES

Part No.	Material Spec. No.	Title	Size	Remarks
AN3-5A	--	Bolt	10-32	No Cotter Pin Hole
AN426AD3	--	Rivet, 100° C'sunk	3/32 Diam.	--
AN426AD5	--	" " "	5/32 Diam.	--
AN430AD3	--	Rivet, Round Head	3/32 Diam.	--
AN430AD4	--	" " "	1/8 Diam.	--
AN430AD5	--	" " "	5/32 Diam.	--
AN430AD6	--	" " "	3/16 Diam.	--
AN455AD5	--	Rivet, Brazier Head	5/32 Diam.	--
AN365-1032	--	Nut	10-32	Elastic Stop Nut
--	AC-11067, Type II	Alum. Coated, Alum. Alloy Sheet	0.032 Thick	24STAL
--	" "	" " "	0.040 Thick	"
--	" "	" " "	0.051 Thick	"
--	" "	" " "	0.064 Thick	"
--	" "	" " "	0.072 Thick	"
--	" "	" " "	0.125 Thick	"
--	AN-QQ-S-685, Cond N	Sheet, CM Steel	0.030 Thick	SAE-X4130
--	" "	" " "	0.050 Thick	" "

SECTION V

LANDING GEAR

1. General.

Refer to T. O. No. 01-50FA-2 for a complete description of the landing gear, its mechanism, operation, and rigging.

2. Repair.

No repairs, other than replacement of parts, are permitted to any part of the main landing gear or tail gear.

SECTION VI

WING

1. General.

The cantilever stressed-skin wing consists primarily of front and rear beams, bulkheads, chordwise ribs, and formers, covered with aluminum-alloy smooth sheets to form the skin, and is built in three major units of a center section and two detachable outer panels.

2. Wing Plating.

Figures 23 and 27 are diagrams showing all wing skin plating, with information regarding the thickness of each and the rivets used for attachment.

3. Access Provisions.

Refer to section IV of T. O. No. 01-50FA-3 for complete information regarding access to the wing structure.

4. Wing Structure.

Figure 24 shows diagrams of the wing center section structure showing the location of all stringers and ribs. Information is given regarding the part numbers of ribs and extrusions, together with cross section views of each extrusion. Similar information for the wing outer panel is given in figure 28.

5. Classification of Damage. - Damage to any part of the wing structure must be carefully examined to decide in which classification it belongs, as follows:

a. Negligible damage.

b. Damage repairable by patching.

c. Damage repairable by splicing.

d. Nonrepairable damage.

6. Skin Repairs.

a. Negligible Damage. - Damage to the skin can be considered negligible if the greatest dimension of the area, after all damaged material is smoothly trimmed out, does not exceed one inch. Damage falling within this classification should be covered with a doped-on fabric patch. However, any hole closer than 1-1/2 inch to an existing hole must be repaired regardless of its size.

b. Repairable Damage. - The majority of skin repairs can be accomplished by patching. Wing skin patches are shown in figures 25 and 29.

c. Nonrepairable Damage. - When more than fifty percent of the area of a skin plate is damaged it may be considered nonrepairable, and the entire plate replaced.

d. Typical Wing Skin Repair.

(1) Lap-Type Patch. - At the lower right-hand portion of sheet 2 of figure 25 will be seen typical lap-type patches for damage confined to the wing skin. This type of patch is recommended for permanent use in areas aft of the wing front spar, but should be used only for emergency repair in areas forward of the front spar. Lap patches in the nose section area introduce unfavorable stalling characteristics, and such repairs should be accomplished with flush-type patches similar to those shown in sheet 3 of figure 26. Repairs of this nature are accomplished in the manner previously described for fuselage skin repairs, except that in areas where access is difficult it may be necessary to use "Cherry" self-plugging blind rivets to secure the patch to the skin. The procedures for patching wing center and outer panel skins are identical.

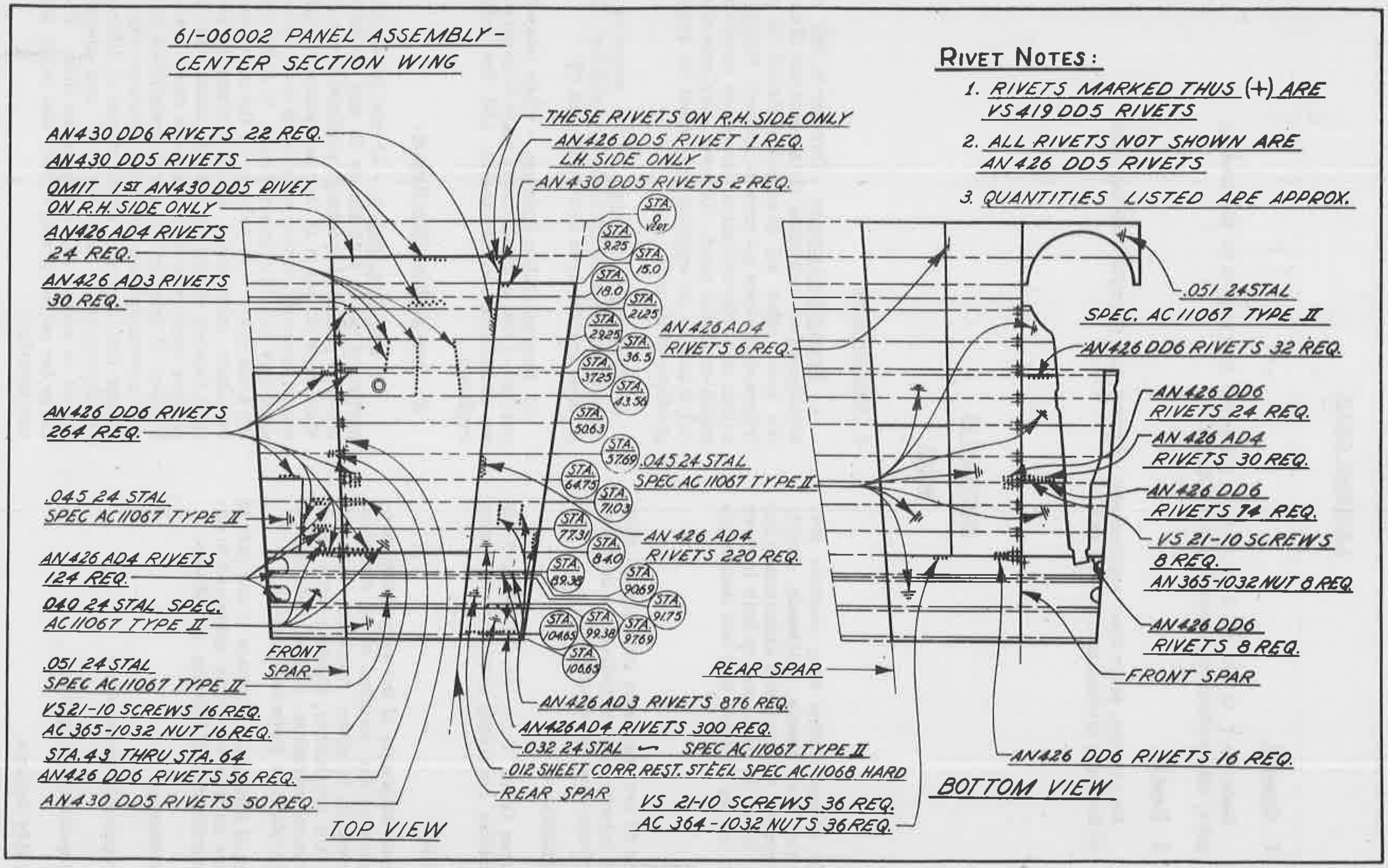
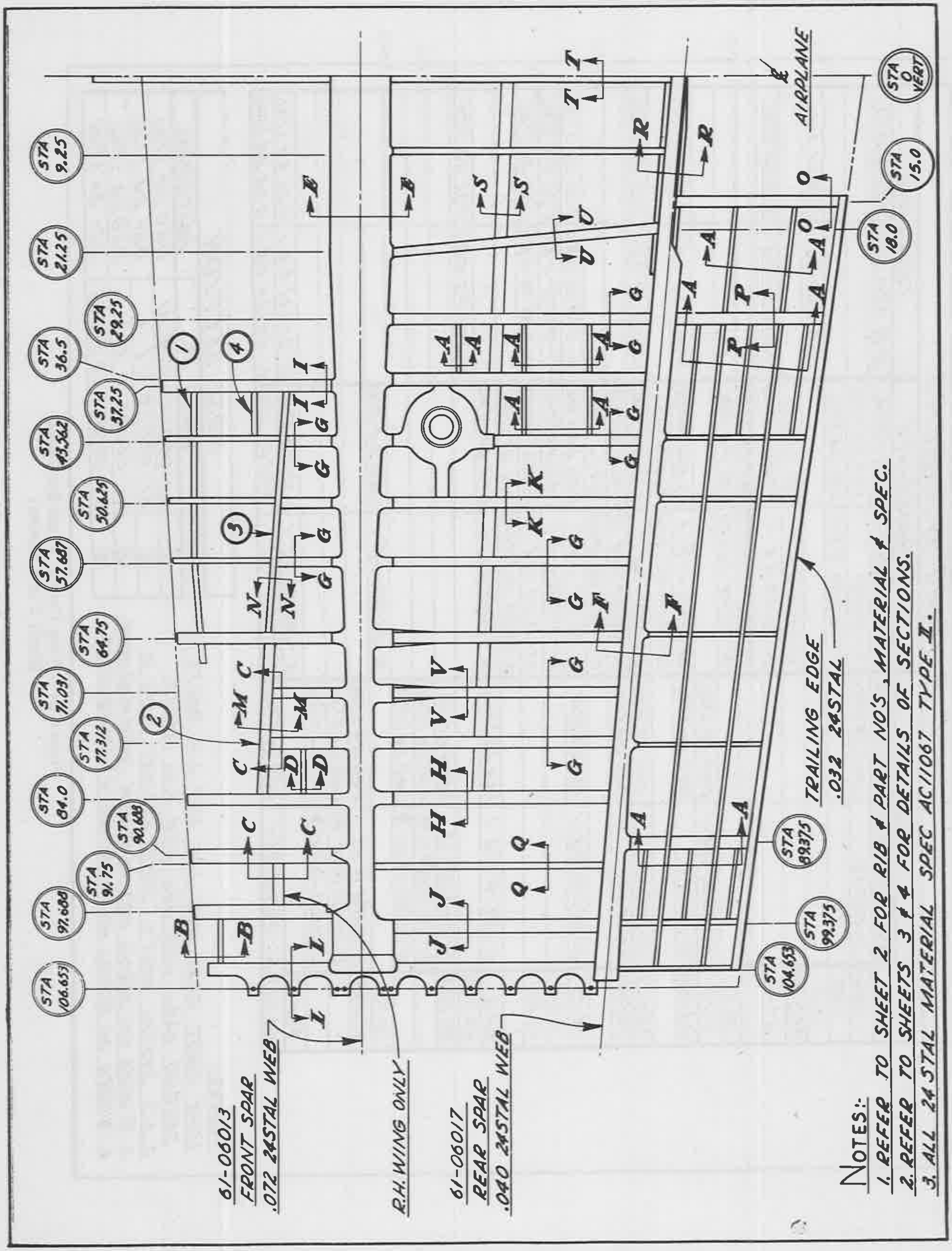


Figure 23 - Wing Center Panel Plating



NOTES:
1. REFER TO SHEET 2 FOR RIB & PART NO'S, MATERIAL & SPEC.
2. REFER TO SHEETS 3 & 4 FOR DETAILS OF SECTIONS.
3. ALL 24STAL MATERIAL SPEC AC11067 TYPE II.

Figure 24 - Wing Center Panel Structure
(Sheet 1 of 7 Sheets)

RIB PART NUMBERS						
STA. No.	NOSE		INTERMEDIATE		TRAILING	
	RIB NUMBER	MATERIAL	RIB NUMBER	MATERIAL	RIB NUMBER	MATERIAL
0 (MAT.)	61-06046	.040 24 STAL	61-06031	.032 24 STAL		
9.25			61-06024-0 & -1	.032 24 STAL		
15.0					61-06029-0 & -1	.032 24 STAL
18.0 To 21.25 -CANTED-			61-06011-0 & -1	.051 24 STAL		
29.25			61-06126-8 & -1	VS496 (NOTED)	61-06032-0 & -1	.032 24 STAL
			61-06126-17(LH & RH)	.064 24 STAL		
36.5			61-06014-28 & 29	.032 24 STAL		
37.25	61-06030-0 & -1	.040 24 STAL				
43.5625	61-06019	.040 24 STAL	61-06126-10 & -3	VS496 (NOTED)	61-06033-0 & -1	.032 24 STAL
			61-06126-18(LH & RH)	.064 24 STAL		
50.625	61-06020	.040 24 STAL	61-06057-0 & -1	.032 24 STAL	61-06034-0 & -1	.032 24 STAL
57.6875	61-06021	.040 24 STAL	61-06126-14 & -13	VS496 (NOTED)		
			61-06126-19(LH & RH)	.064 24 STAL		
64.75	61-06015-0 & -1	.064 24 STAL	61-06043-0 & -1	.040 24 STAL	61-06035-0 & -1	.032 24 STAL
71.031			61-06037-0 & -1	.040 24 STAL	61-06051-0 & -1	.032 24 STAL
77.312			61-06126-16 & -15	VS496 (NOTED)	61-06036-0 & -1	.032 24 STAL
			61-06126-20(LH & RH)	.064 24 STAL		
84.0	61-06010-0 & -1	.064 24 STAL	61-06018-0 & -1	.040 24 STAL		
89.375					61-06040-0 & -1	.032 24 STAL
90.688	61-06058(L.H.)	.040 24 STAL				
	61-06022(R.H.) ◉	.040 24 STAL				
	61-06022-1(R.H.) ◑	.040 24 STAL				
91.75			61-06160-0 & -1	.040 24 STAL		
97.688	61-06188 (L.H.)	.040 24 STAL				
	61-06023 (R.H.) ◉	.040 24 STAL				
	61-06023-10(R.H.) ◑	.040 24 STAL				
99.375			61-06039-0 & -1	.032 24 STAL	61-06041-0 & -1	.032 24 STAL
104.653	61-06012-0 & -1	.040 24 STAL	61-06012-0 & -1	.040 24 STAL	61-06124-0 & -1	.032 24 STAL

NOTES:-

1. THE FIRST DASH NO'S ARE FOR L.H. PARTS & SECOND DASH NO'S ARE FOR R.H. PARTS.
2. ALL 24STAL MAT'L SPEC AC11067 TYPE II.
3. ◉ USED ON SERIAL NO'S AC42-6834 THRU AC42-6860.
4. ◑ USED ON SERIAL NO'S AC42-6861 & SUBSEQUENT.

NOSE SECTION		
REF.	PART No.	MATERIAL
1	61-06002-20 & 21	.040 24 STAL
2	61-06009-0 & -1	.081 24 STAL
3	61-06028-0 & -1	.040 24 STAL
4	61-06002-64 & -248	.051 24 STAL

Figure 24 - Wing Center Panel Structure
(Sheet 2 of 7 Sheets)

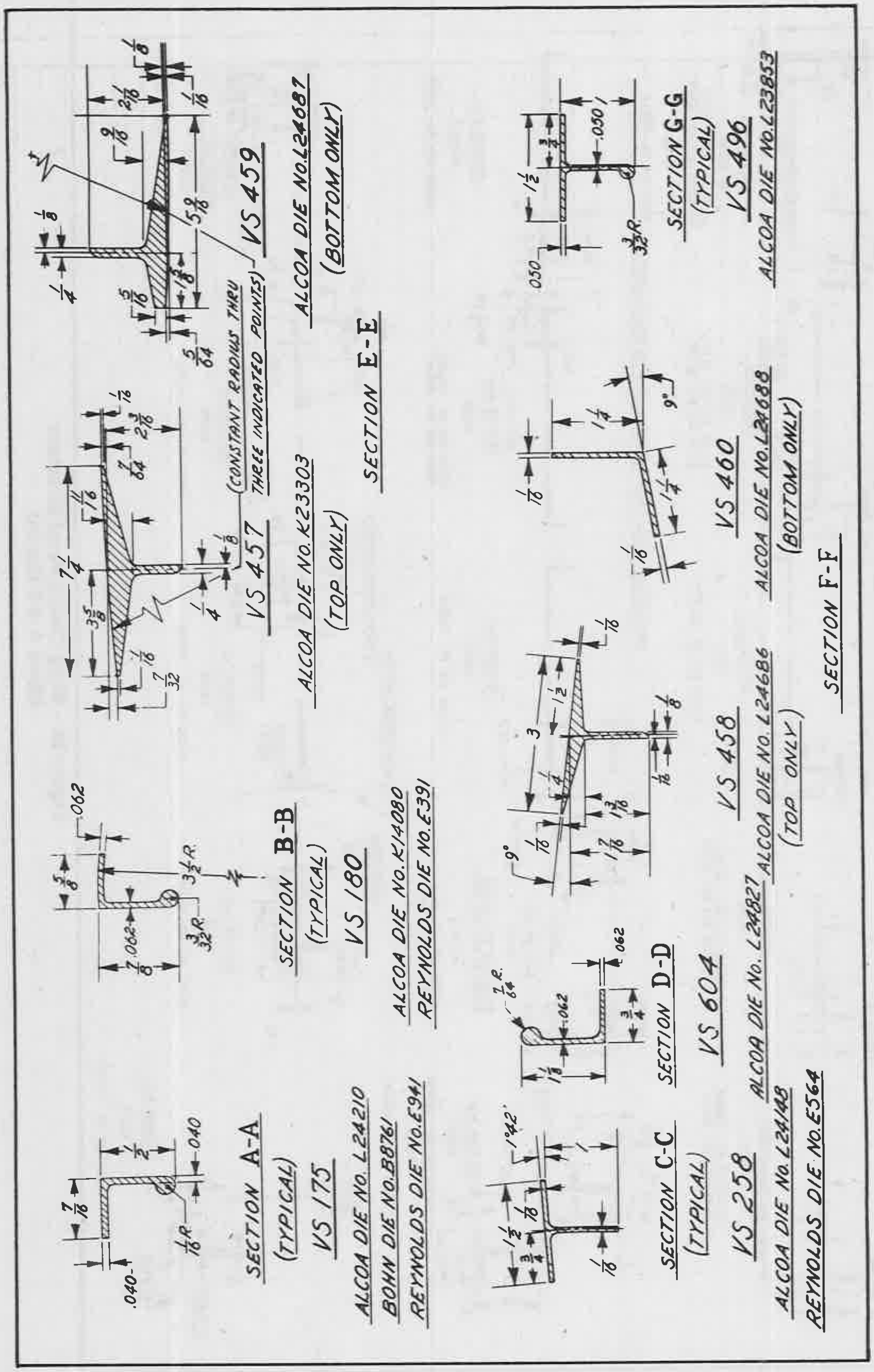


Figure 24 - Wing Center Panel Structure
(Sheet 3 of 7 Sheets)

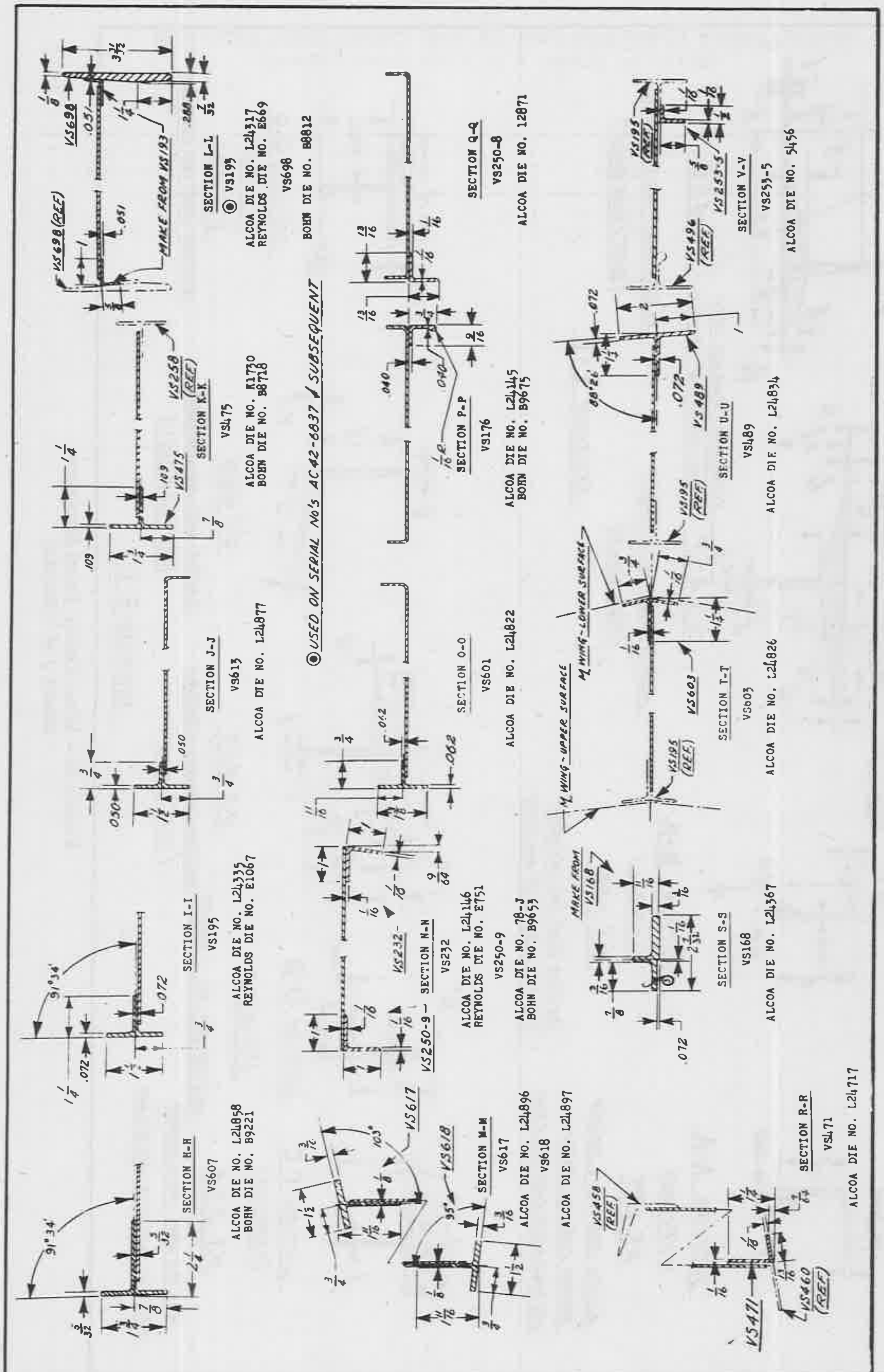


Figure 24 - Wing Center Panel Structure
(Sheet 4 of 7 Sheets)

MISCELLANEOUS EXTRUSIONS USED IN WING CENTER PANEL STRUCTURE
(Refer to Sheets 6 & 7 for Detail Views)

Ribs:

At Station	Forward of Front Spar	Intermediate Section	Aft Of Rear Spar
0	VS192, VS250-9 VS195, VS611 ◕ VS612 ◕	VS176, VS250-9 VS497 VS251-10, -21	---
9.25	---	VS451	---
15.0	---	---	VS253-5
18.0 to 21.25	---	VS195, VS604	---
29.25	---	---	VS184
36.5	---	VS258	---
37.25	VS451, VS603	---	---
43.5625	---	---	VS175, VS184
50.625	VS180, VS258	VS258	VS184
64.75	---	VS251-6, VS258, VS497	VS184
71.031	---	VS195	---
77.312	---	---	VS184
84.0	VS253-14, VS688	VS183, VS252-25, VS451	---
89.375	---	---	VS175
91.750	---	VS250-5	---
99.375	---	VS184, VS493	VS175
104.653	VS175, VS493	VS175, VS193, VS493	VS184

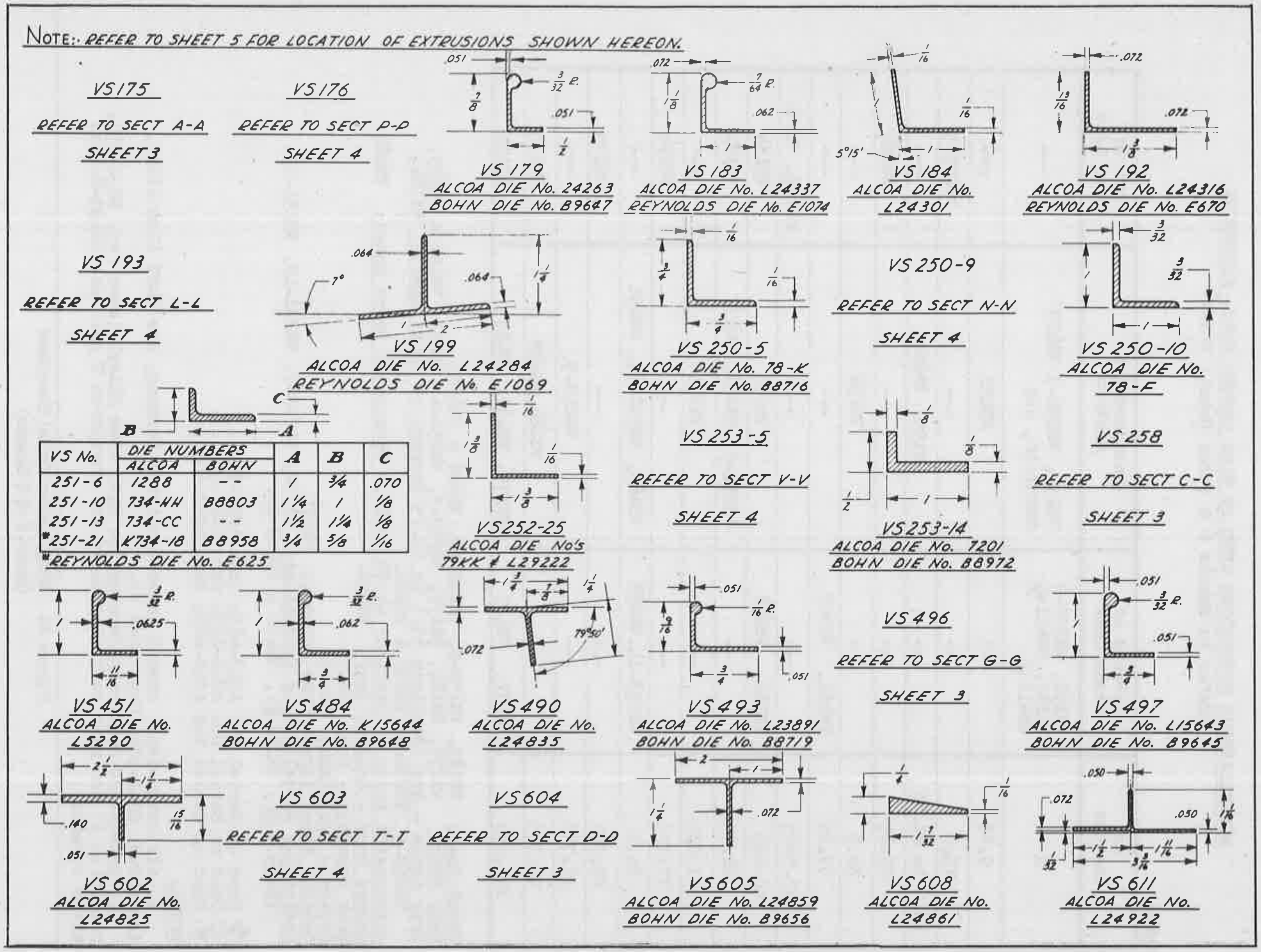
Front Spar: VS183, VS250-9, VS250-10, VS602 & VS605.
Rear Spar: VS176, VS184, VS199, VS250-5, VS251-6, VS451, VS496 & VS619.
Spar Assem - Aux (Stations 37.5 to 64.75 Forward of Front Spar): VS184, VS250-5, VS250-9, VS620 & VS621.
Intercostal Assem - (Stations 64.75 to 84.0 Forward of Front Spar): VS484.
Access Door - Landing Gear: VS258.
Door Assembly - Gun: VS179.
Covers - Fuel Tank: VS605.
Control Stick Torque Tube Support: VS614.
Additional Miscellaneous Extrusions: VS192, VS250-9, VS251-10, VS251-13, VS253-5 ⊕, VS258 ◐, VS490 & VS608 ⊕.

◕ Used on Serial Nos AC42-6834 thru AC42-6836.
⊕ Used on Serial Nos AC42-6834 thru AC42-6840.
◐ Used on Serial Nos AC42-6834 thru AC42-6860.

NOTES:

1. All extrusions, except those requiring forming, are 24ST Alum Alloy, (spec Fed. QQ-A-354, Condition T).
2. Extrusions requiring forming are 24SO Alum Alloy, (spec Fed. QQ-A-354, Condition A) and must be heat treated (to Condition T per spec AN-QQ-H-186) after forming.

Figure 24 - Wing Center Panel Structure
(Sheet 5 of 7 Sheets)



VS No.	DIE NUMBERS ALCOA	DIE NUMBERS BOHN	A	B	C
251-6	1288	--	1	3/4	.070
251-10	734-HH	B8803	1 1/4	1	1/8
251-13	734-CC	--	1 1/2	1 1/4	1/8
*251-21	K734-18	B8958	3/4	5/8	1/16

*REYNOLDS DIE No. E625

Figure 24 - Wing Center Panel Structure
(Sheet 6 of 7 Sheets)

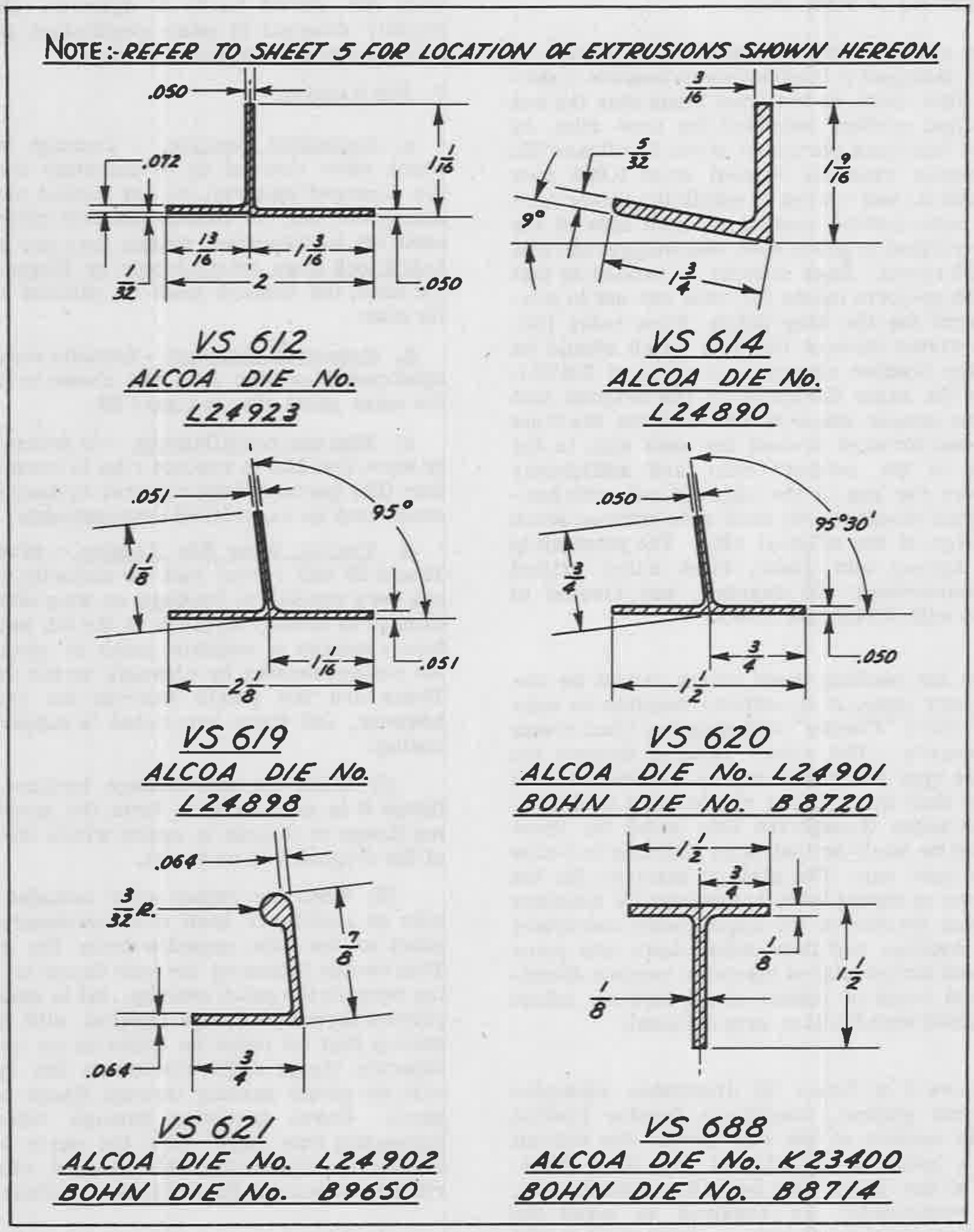


Figure 24 - Wing Center Panel Structure
(Sheet 7 of 7 Sheets)

(2) Flush-Type Patches.

(a) Sheet 3 of figure 25 shows typical flush-type repairs for use in the nose section area of either the center section or outer wing.

(b) In cases where a considerable portion of nose skin is damaged it is advisable to remove a section of the skin, back to the front beam skin lap and parallel to (but midway between) the nose ribs, as shown at the left-hand portion of sheet 3 of figure 25. Flanged doubler channels formed from 0.064 inch 24STAL material and curved to match the inside surface of the nose section contour at each side of the cut-out are riveted in place with two staggered rows of AN426AD5 rivets. Each doubler is located so that half its width projects inside the skin cut-out to provide a support for the skin patch. Pilot holes (No. 40) for the rivets through the skin patch should be drilled in the doubler channels. A strip of 24STAL material, of the same thickness as the original skin is cut to the proper shape to extend from the front beam skin lap forward around the nose skin to the termination of the original skin, and sufficiently wide to cover the gap in the skin cut-out, with perhaps 1/32-inch clearance on each side between patch strip and edge of the original skin. The patch strip should be sprung into place, rivet holes drilled (No. 21), countersunk 100 degrees, and riveted to the doublers with AN426AD5 rivets.

If access for bucking these rivets cannot be obtained in every case, it is entirely feasible to substitute LS-1126-6 "Cherry" self-plugging blind rivets where necessary. The rivets passing through the spar must be type AD rivets having a diameter 1/32 inch greater than the original rivets used in this location. The holes through the skin patch for these rivets should be back-drilled from existing full-size holes in the spar cap. The strip of material for the skin patch can be sprung into place around the doublers by first being formed to the approximate curvature of the nose section, and then pulled down into place with hardwood strips placed spanwise beneath chordwise disposed loops of rubber shock cord (or fabric straps provided with friction-grip buckles).

(c) Sheet 3 of figure 25 illustrates examples of small flush patches, involving a doubler riveted to the inside surface of the skin around the cut-out to provide a ledge for attachment of a flush patch. The shape of the patch may be either round, oval, square, or rectangular, as required to mend the damage, but in any case, the corner radii used should not be less than 1/2 inch. The skin patch proper may be either riveted to the doubler, if a permanent patch is required, or may be attached with countersunk screws threading into plush-type nut plates riveted to the back of the doubler strip. The latter method is advisable if the patch is to serve as an access door, or should the riveting required be blind and blind rivets unobtainable.

(d) In cases where the repair cut-out provides the only access to the interior of the wing, it will be necessary to cut the doubler ring through one side in order to permit its insertion inside the wing. This cut should be in a spanwise direction, and slightly diagonal to pass equidistant between rivet locations in the staggered rows.

7. Rib Repairs.

a. Negligible Damage. - Damage to rib webs, which when cleaned up by smoothly trimming away the damaged material do not exceed one inch in any dimension, may be considered negligible damage and need not be repaired, unless they are located within 1-1/2 inch of an existing hole or flange. In this latter case, the damage must be patched regardless of its size.

b. Repairable Damage. - Suitable repairs for damaged center section ribs are shown in figure 25, and for outer panel ribs in figure 29.

c. Nonrepairable Damage. - In general, it is usually more feasible to replace ribs in cases where more than fifty percent of the rib area is damaged, and such cases may be considered nonrepairable.

d. Typical Wing Rib Repairs. - Study of figures 25 and 29 will reveal that the majority of rib repairs are very similar to fuselage or wing skin patches, as damage is usually confined to the rib web, and therefore requires a suitable patch to properly overlap the cut-out formed by cleaning up the damaged area. There are few points wherein rib repairs differ, however, and these are listed in subparagraphs following:

(1) When rib web damage includes the cap or flange it is necessary to form the patch with a mating flange or flanges to nestle within the severed ends of the original cap or flange.

(2) When the repair area includes a lightening hole or a stiffener bead it is necessary to place the patch on the side opposite from the hole or bead. This avoids flattening the hole flange or bead extending beneath the patch overlap, but in some cases may prevent forming a flange integral with the patch; requiring that the patch be installed on one side, and a separate flange angle riveted on the opposite side, with the rivets passing through flange angle, rib and patch. Cases involving damage extending into a lightening hole must have the patch edge passing across the lightening hole flanged away from the rib web to provide the necessary stiffness.

(3) All repairs involving patching both rib flange and web will require the installation of a filler or shim to span the gap between the severed ends of the flange, and thus restore the outside surface of the rib to its original contour. If a flush-type patch is installed over the repair area, the filler will be the same thickness as the rib flange, while if a lap-type patch is used, the filler thickness will be the sum of flange and skin thicknesses.

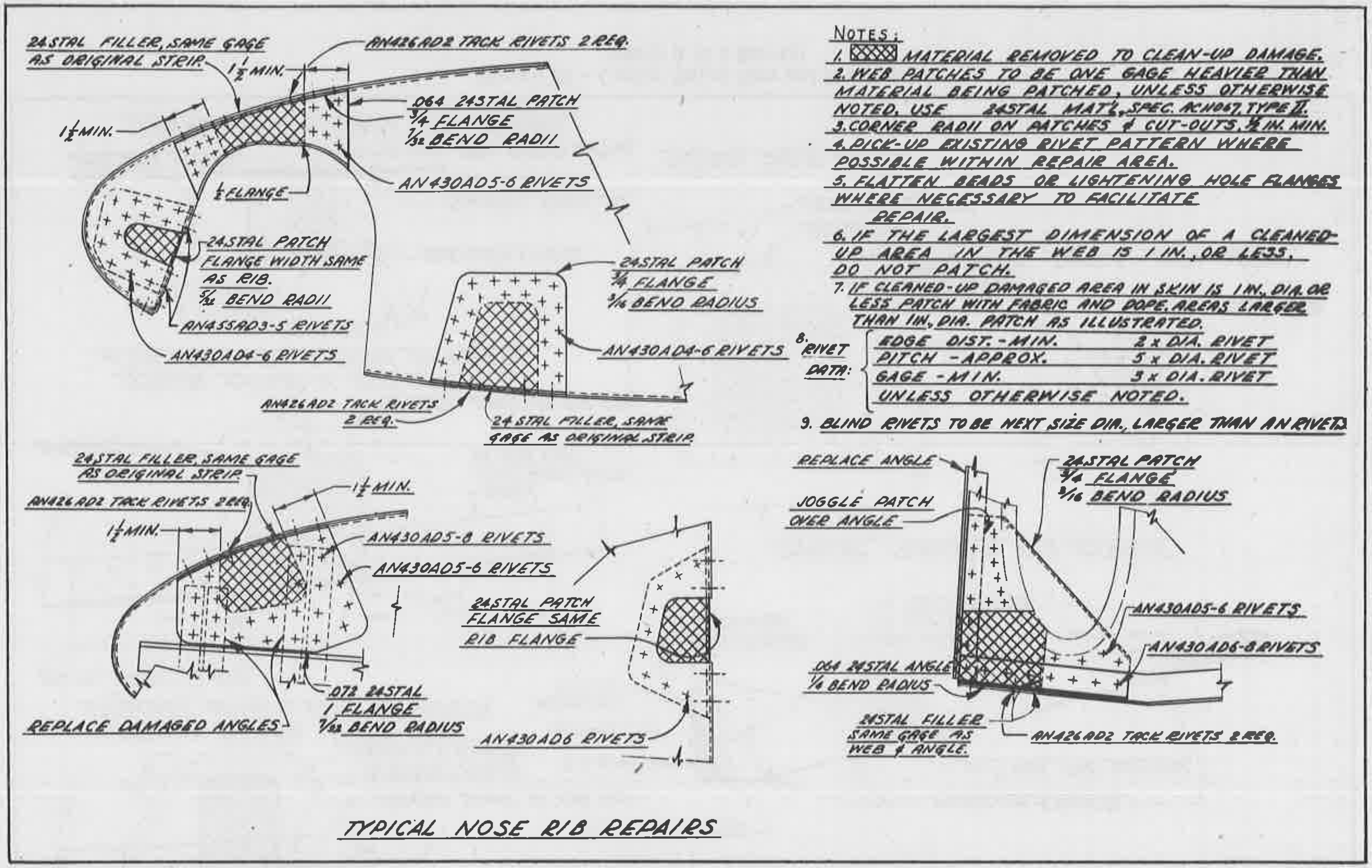


Figure 25 - Center Panel Skin and Rib Repairs
(Sheet 1 of 3 Sheets)

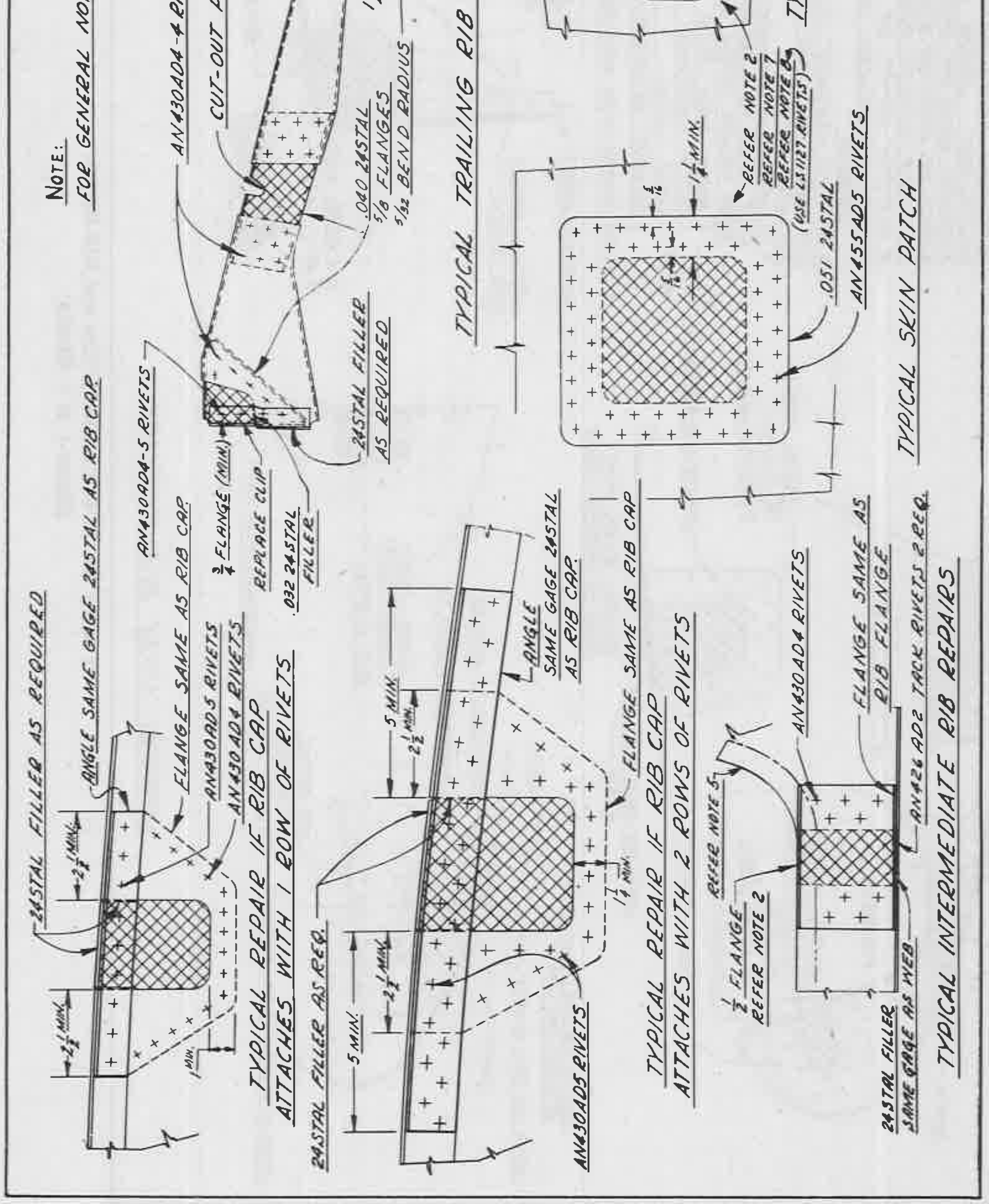


Figure 25 - Center Panel Skin and Rib Repairs
(Sheet 2 of 3 Sheets)

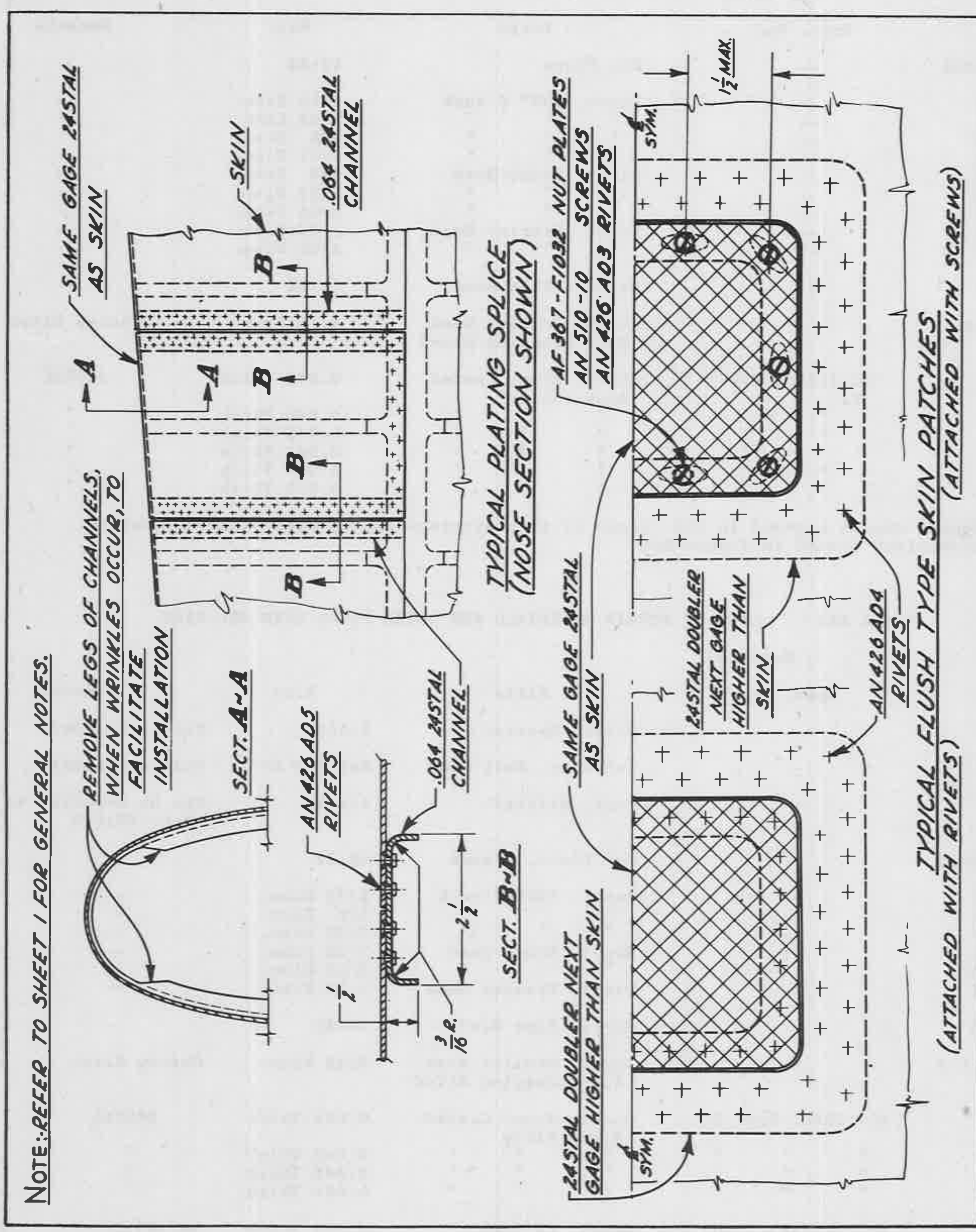


Figure 25 - Center Panel Skin and Rib Repairs
(Sheet 3 of 3 Sheets)

TABLE XI. LIST OF REPAIR MATERIALS FOR CENTER PANEL SKIN AND RIBS

Part No.	Material Spec. No.	Title	Size	Remarks
AN367-F1032	--	Nut Plate	10-32	--
AN426AD2	--	Rivet, 100° C'sunk	1/16 Diam.	--
AN426AD3	--	" " "	3/32 Diam.	--
AN426AD4	--	" " "	1/8 Diam.	--
AN426AD5	--	" " "	5/32 Diam.	--
AN430AD4	--	Rivet, Round Head	1/8 Diam.	--
AN430AD5	--	" " "	5/32 Diam.	--
AN430AD6	--	" " "	3/16 Diam.	--
AN455AD3	--	Rivet, Brazier Head	3/32 Diam.	--
AN455AD5	--	" " "	5/32 Diam.	--
AN510-10	--	Screw - Flat Head	10-32	--
LS-1127-6	--	Rivet, Brazier Head Self-plugging Blind	3/16 Diam.	Cherry Rivet
--	AC-11067, Type II	Sheet, Alum. Coated Alum. Alloy	0.032 Thick	24STAL
--	" "	" " "	0.040 Thick	"
--	" "	" " "	0.045 Thick	"
--	" "	" " "	0.051 Thick	"
--	" "	" " "	0.064 Thick	"
--	" "	" " "	0.072 Thick	"

Note: Repair depots engaged in the repair of this airplane should also stock all Vultee extrusions listed in figure 24.

TABLE XII. LIST OF REPAIR MATERIALS FOR OUTER PANEL SKIN AND RIBS

Part No.	Material Spec. No.	Title	Size	Remarks
VS25-2	--	Screw, Special	1/4-28	Vultee Standard
VS500	--	Retainer, Bolt Head	For 1/4 Bolt	Vultee Standard
AN4-10A	--	Bolt, Aircraft	1/4-28	Can be Reworked to Make VS25-2
AC367-F1032	--	Nut Plate, C'sunk	10-32	--
AN426AD3	--	Rivet, 100° C'sunk	3/32 Diam.	--
AN426AD4	--	" " "	1/8 Diam.	--
AN426AD5	--	" " "	5/32 Diam.	--
AN430AD5	--	Rivet, Round Head	5/32 Diam.	--
AN430AD6	--	" " "	3/16 Diam.	--
AN455AD5	--	Rivet, Brazier Head	5/32 Diam.	--
AN510-10	--	Screw, Flat Head	10-32	--
LS-1127-6-4	--	Rivet, Brazier Head Self-plugging Blind	3/16 Diam.	Cherry Rivet
--	AC-11067, Type II	Sheet, Alum. Coated Alum. Alloy	0.032 Thick	24STAL
--	" " "	" " "	0.040 Thick	"
--	" " "	" " "	0.045 Thick	"
--	" " "	" " "	0.051 Thick	"
--	AN-QQ-S-685, Cond N	Sheet, CM Steel	0.050 Thick	SAE-X4130

Note: Repair depots engaged in the repair of this airplane should also stock all Vultee extrusions listed in figure 28.

8. Spar Repairs.

a. Negligible Damage. - If the largest dimension of a damaged area in the spar web is not more than one inch after being smoothly cleaned up, it may be considered negligible, unless closer than one inch to an existing hole or spar cap.

b. Repairable Damage. - Refer to figure 26 for diagrams of repairs for damage to the center section spars, and to figure 30 for outer panel spar repairs.

c. Spar Web Repair Requirements. - The following general requirements should be observed for all spar web repairs.

(1) The material used for the patch should be the same as that of the web, except in special cases requiring the use of steel.

(2) The patch thickness should be the same as, or one gage heavier than, the web. Under no circumstances can it be less.

(3) In general, the rivets attaching the patch to the web should be of the same diameter and spacing as the rivets attaching the web to the spar cap in the region of the repair.

(4) When type DD (24ST aluminum alloy) rivets were used for the original web to spar cap attachment, the type AD (A17ST aluminum alloy) rivets are used for the repair attachment, it is necessary to use rivets of 1/32-inch larger diameter. If this cannot be done, it is necessary to use 20 percent more AD rivets. This may be accomplished in most cases by adding an additional row of rivets.

(5) Where "Cherry" self-plugging, blind rivets are used for repair, it is necessary to use 15 to 20 percent more rivets than if type AD solid rivets were used, and 20 to 25 percent more when replacing type DD solid rivets. Type AD or DD rivets may be replaced with the same number of "Cherry" self-plugging rivets if a diameter 1/32 inch larger is used.

(6) Where "Cherry" hollow-blind rivets are used for the repair it is necessary to use 30 to 40 percent more rivets if type AD solid rivets were used originally, and 40 to 50 percent more when replacing type DD rivets.

d. Typical Wing Spar Repairs. - All wing spar repairs will involve either: - (i) patching of the spar web; - (ii) splicing of the spar-cap strips; or - (iii) combination-web patching and cap-strip splicing. In all cases the general nature of the work will not differ appreciably from previously described patching and splicing operations; except that the wing spars are very highly loaded members, demanding use of only the materials specified on the relevant repair diagrams, and the best possible workmanship.

(1) Spar web repairs are accomplished in the same manner as other patch repairs of a flat sheet. In the case of damage extending too near the spar cap strip to permit obtaining the necessary patch overlap, it is necessary to joggle the patch edge over the spar-cap leg and pick up the existing rivet holes through cap leg and web. In other cases it may be possible to install the patch on the side opposite from the spar-cap leg, and eliminate the joggle, although it is still necessary to pick up the rivet holes through the leg and web.

(2) Spar-cap splices are accomplished in a manner similar to stringer splicing, except that heavier material is required, and bolts are used in the majority of cases (rather than rivets) in order to obtain the necessary strength. The space available often makes spar-cap splicing very complicated, and it will be observed that some splices shown use an angle bent up from CM steel sheet stock, while other repairs use flat strips of CM steel plate, to avoid the large bend radii necessary with heavy gage material.

(3) Spar repairs frequently involve complicated work, and the procedure to be followed in each case should be carefully worked out before attempting the repair, in order to avoid needless duplication of effort. The repair to the front-spar cap strip and web shown at the upper, left-hand portion of sheet 1 of figure 26 is used for the following example of wing spar repair procedure:

(a) Remove sufficient wing skin to provide access to the damaged area of the spar. In repairs of this nature the wing skin is nearly always damaged, and the skin removed to clean up the damage will usually provide access to the spar repair, although in some cases it may be necessary to remove additional skin for access.

(b) Remove the damaged portion of the spar cap, leaving square surfaces, free from saw or file marks at each severed end. Remove all damaged material from the spar web, to leave a square or rectangular opening with 1/2-inch corner radii.

(c) Prepare a patch from 0.050-inch thick CM steel sheet with sufficient overlap to provide for two rows of 1/4-inch diameter specified bolts and AC365-428 nuts. AN4-5A bolts are used through patch and web, through web, patch and stiffener angle; while AN4-10A bolts are required through web, patch and the 1/4-inch thick steel splice strip. AN960-416 washers are used as required to obtain the proper bolt grip.

(d) Attach the patch to the spar web only, lining up the edge of the patch with the edge of the original web, and using bolts and self-locking nuts.

NOTE: All holes drilled through patch and web, (or other aluminum-alloy members) must be drilled from pilot holes in the steel patch,

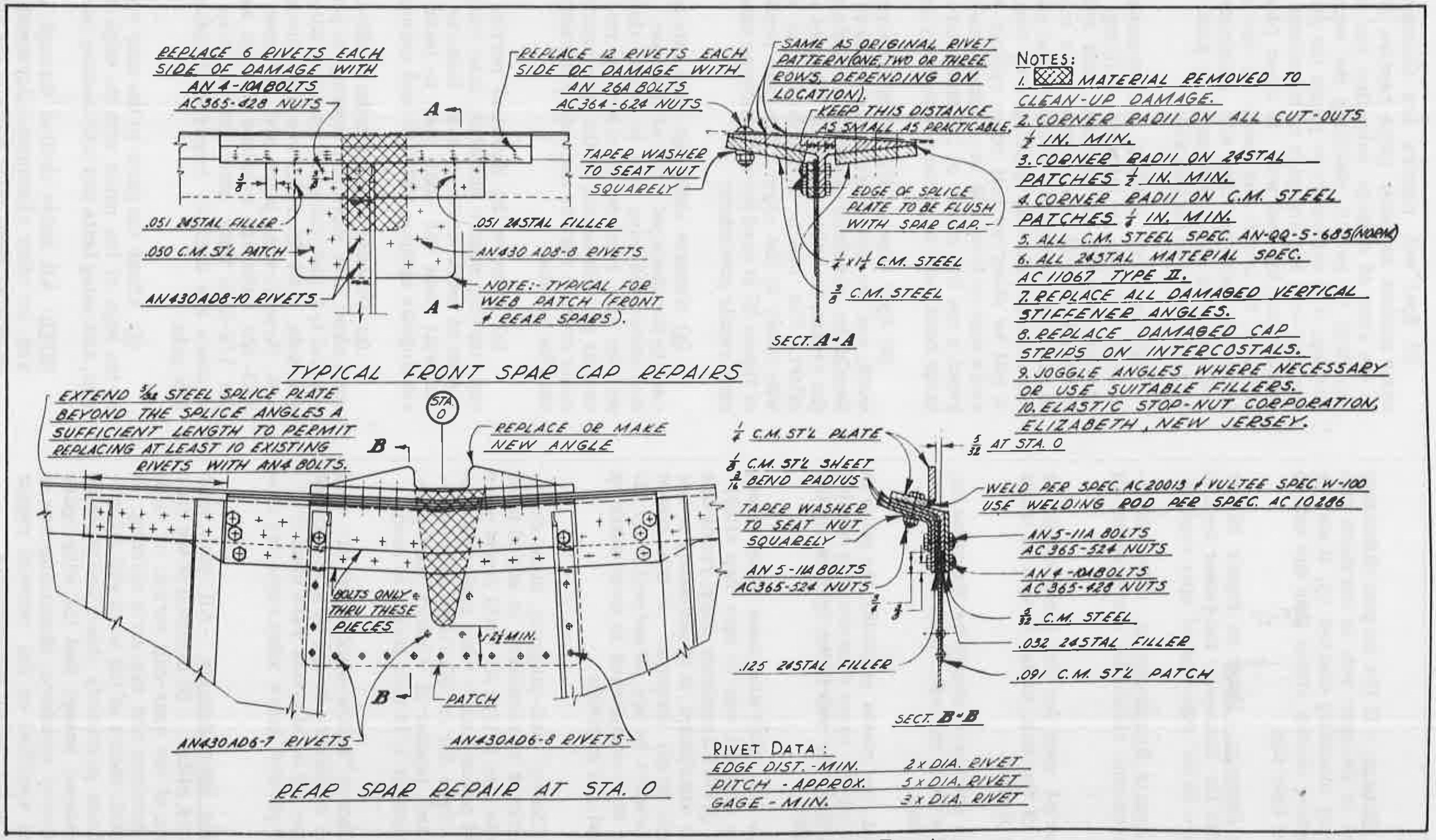


Figure 26 - Center Panel Spar Repairs
(Sheet 1 of 2 Sheets)

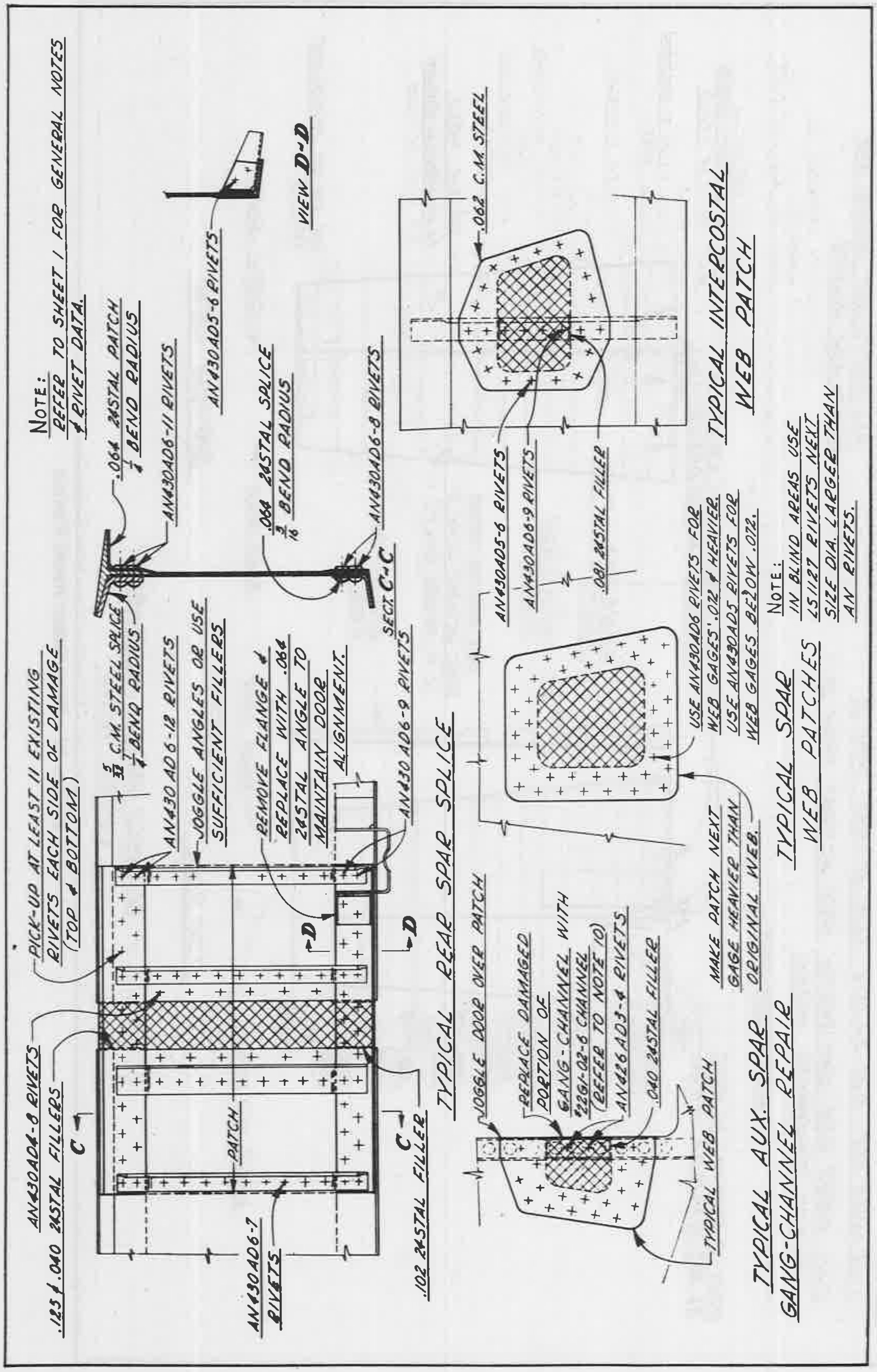


Figure 26 - Center Panel Spar Repairs
(Sheet 2 of 2 Sheets)

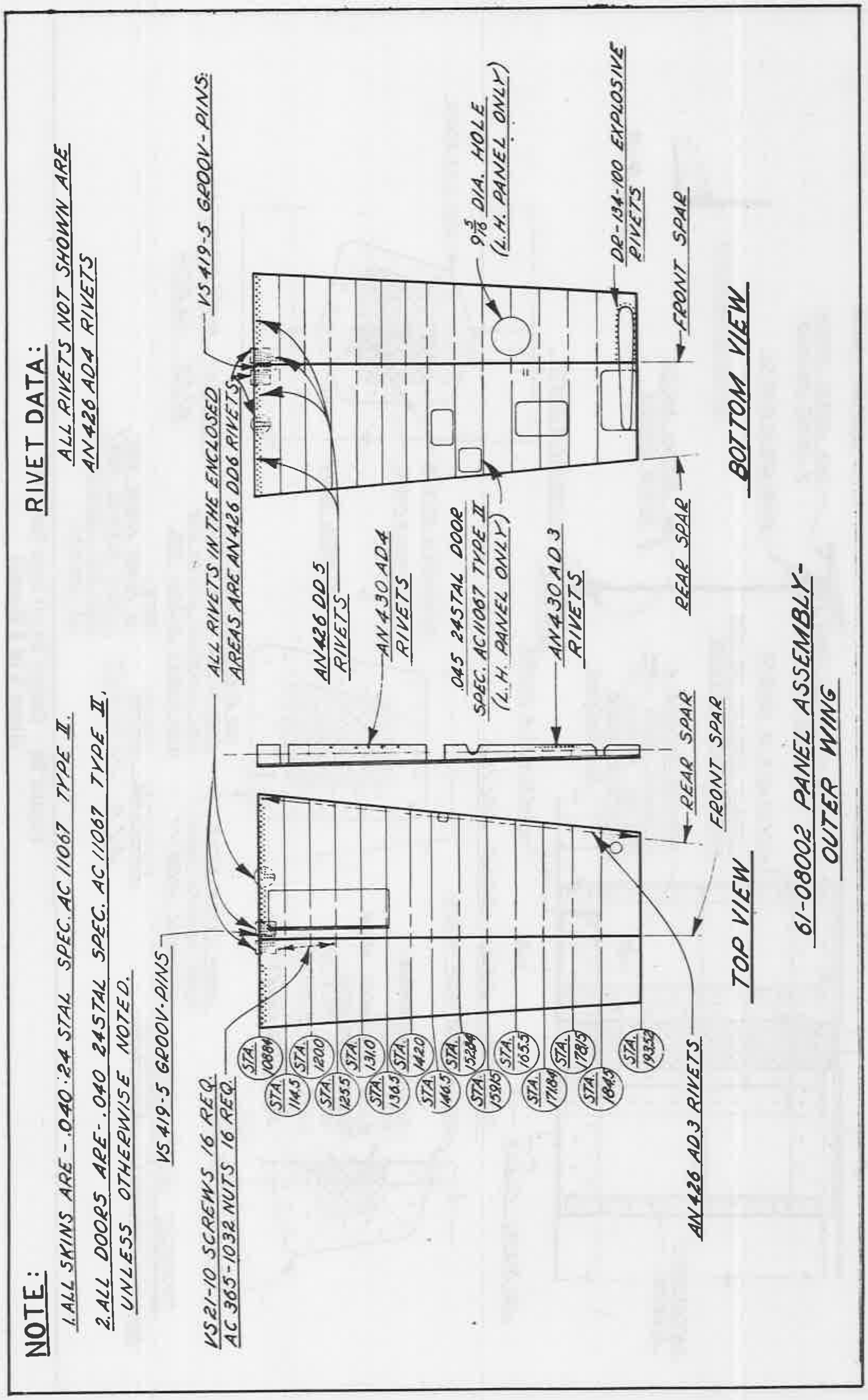
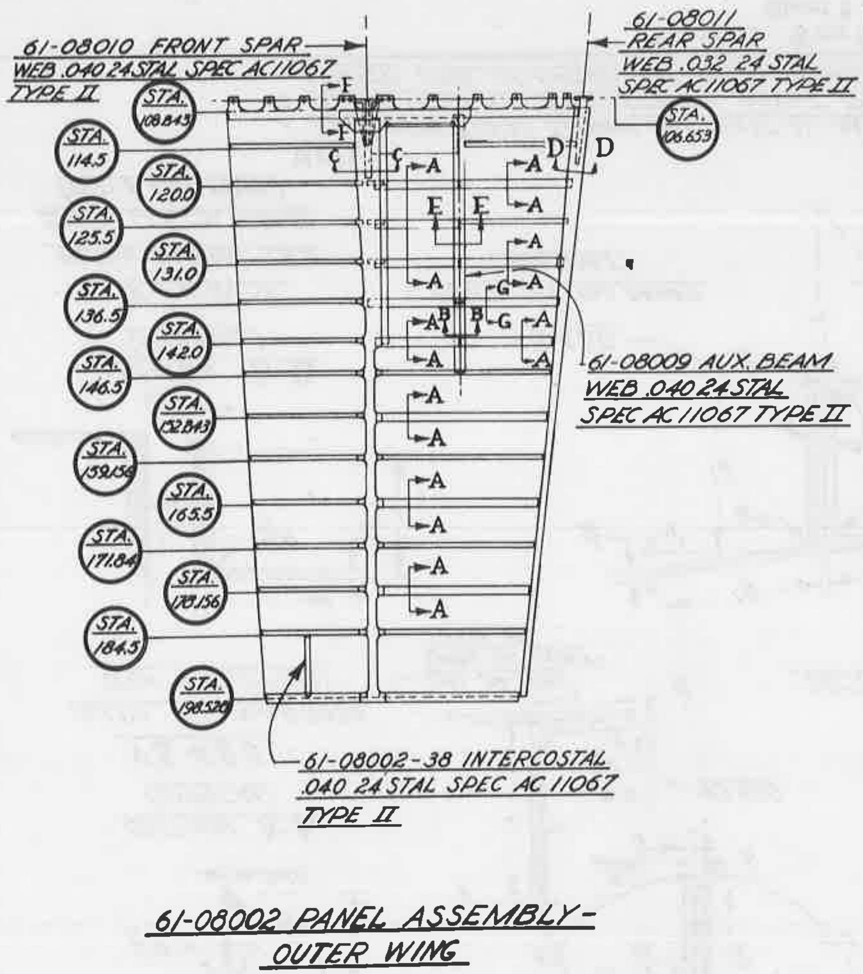


Figure 27 - Wing Outer Panel Plating



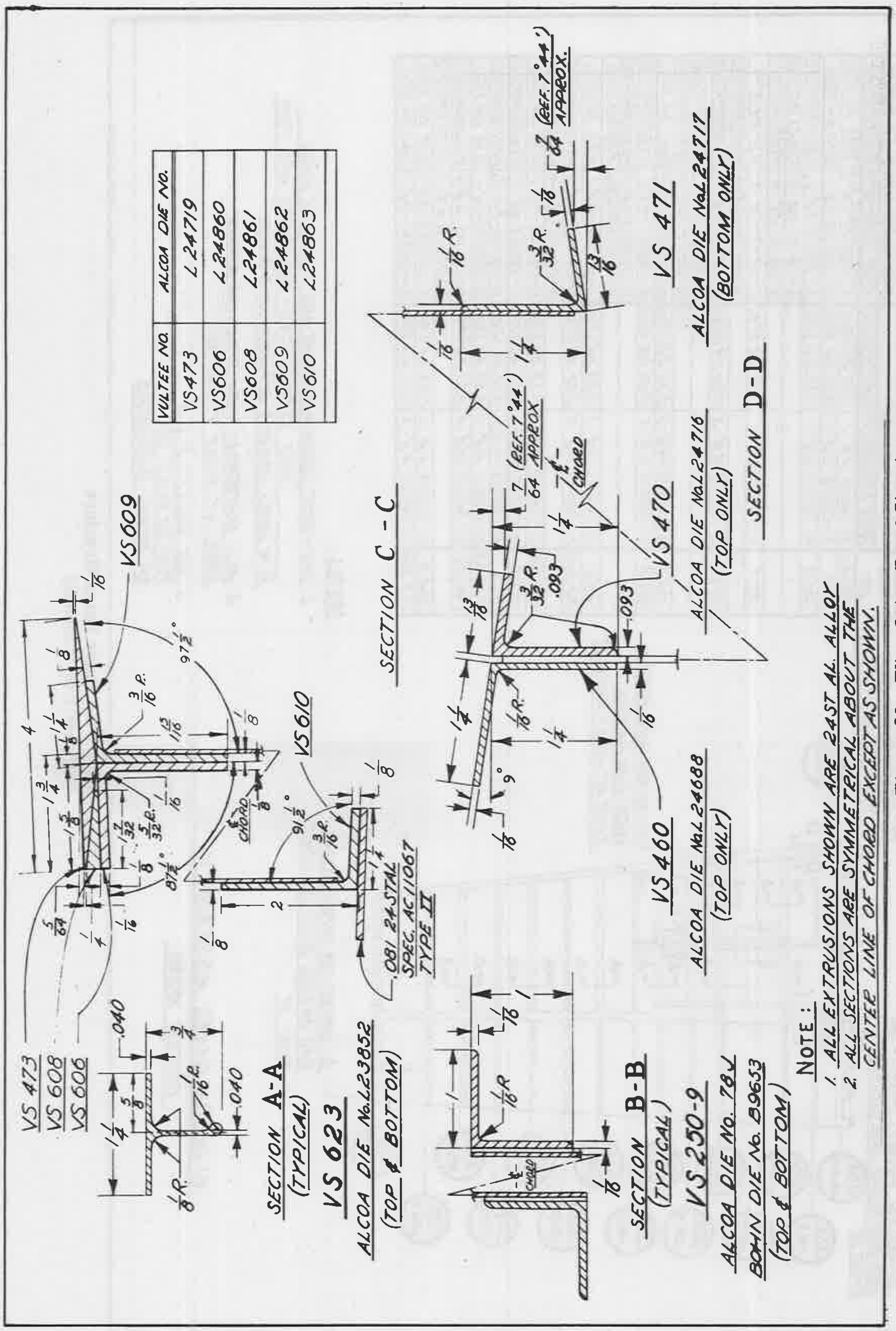
RIB PART NUMBERS

STA. No.	NOSE RIB NUMBER	NOSE MATERIAL	INTERMEDIATE & FORMER RIB NUMBER	INTERMEDIATE & FORMER MATERIAL
108.843	61-08031-0 & -1	.032 24 STAL	61-08030-0 & -1	.032 24 STAL
114.5	61-08014-0 & -1	.032 24 STAL	61-08032-0 & -1	.032 24 STAL
120.0	61-08013-2 & -1	.032 24 STAL	61-08119-2 & -1	VS623 (NOTED)
			61-08119-4 & -3	VS623 (NOTED)
			61-08119-10 & -9	VS623 (NOTED)
125.5	61-08015-2 & -1	.032 24 STAL	61-08117-0 & -3	.032 24 STAL
			61-08119-10 & -9	VS623 (NOTED)
131.0	61-08013-4 & -3	.032 24 STAL	61-08119-6 & -5	VS623 (NOTED)
			61-08119-8 & -7	VS623 (NOTED)
			61-08119-10 & -9	VS623 (NOTED)
136.5	61-08015-4 & -3	.032 24 STAL	61-08021-0 & -1	.040 24 STAL
142.0	61-08013-6 & -5	.032 24 STAL	61-08027-4 & 5	VS623 (NOTED)
			61-08027-6 & -7	VS623 (NOTED)
			61-08027-14 & 15	.040 24 STAL
146.5	61-08015-6 & -5	.032 24 STAL	61-08022-0 & -1	.032 24 STAL
152.843	61-08013-8 & -7	.032 24 STAL	61-08105-10 & -9	VS623 (NOTED)
			61-08105-12 & -11	VS623 (NOTED)
159.156	61-08012-6 & -5	.032 24 STAL	61-08023-0 & -1	.032 24 STAL
165.5	61-08017-0 L.H.	.032 24 STAL	61-08105-6 & -5	VS623 (NOTED)
165.5	61-08013-11 R.H.	.032 24 STAL	61-08105-8 & -7	VS623 (NOTED)
171.843	61-08012-8 & -7	.032 24 STAL	61-08024-0 & -1	.032 24 STAL
178.156	61-08013-10 & -9	.032 24 STAL	61-08105-2 & -1	VS623 (NOTED)
			61-08105-4 & -3	VS623 (NOTED)
184.5	61-08016-2 & -1	.032 24 STAL	61-08025-0 & -1	.032 24 STAL
193.528	61-08016-4 & -3	.032 24 STAL	61-08026-0 & -1	.040 24 STAL

NOTES:

1. THE FIRST DASH NUMBERS ARE FOR L.H. RIBS AND SECOND DASH NUMBERS ARE FOR R.H. RIBS, UNLESS OTHERWISE NOTED.
2. ALL MATERIAL 24 STAL OR EQUIV. - SPEC AC 11067 TYPE II
3. SEE SHEETS 2 & 3 FOR DETAILS OF SECTIONS INDICATED

Figure 28 - Wing Outer Panel Structure
(Sheet 1 of 5 Sheets)



VULTEE NO.	ALCOA DIE NO.
VS473	L24719
VS606	L24860
VS608	L24861
VS609	L24862
VS610	L24863

Figure 28 - Wing Outer Panel Structure
(Sheet 2 of 5 Sheets)

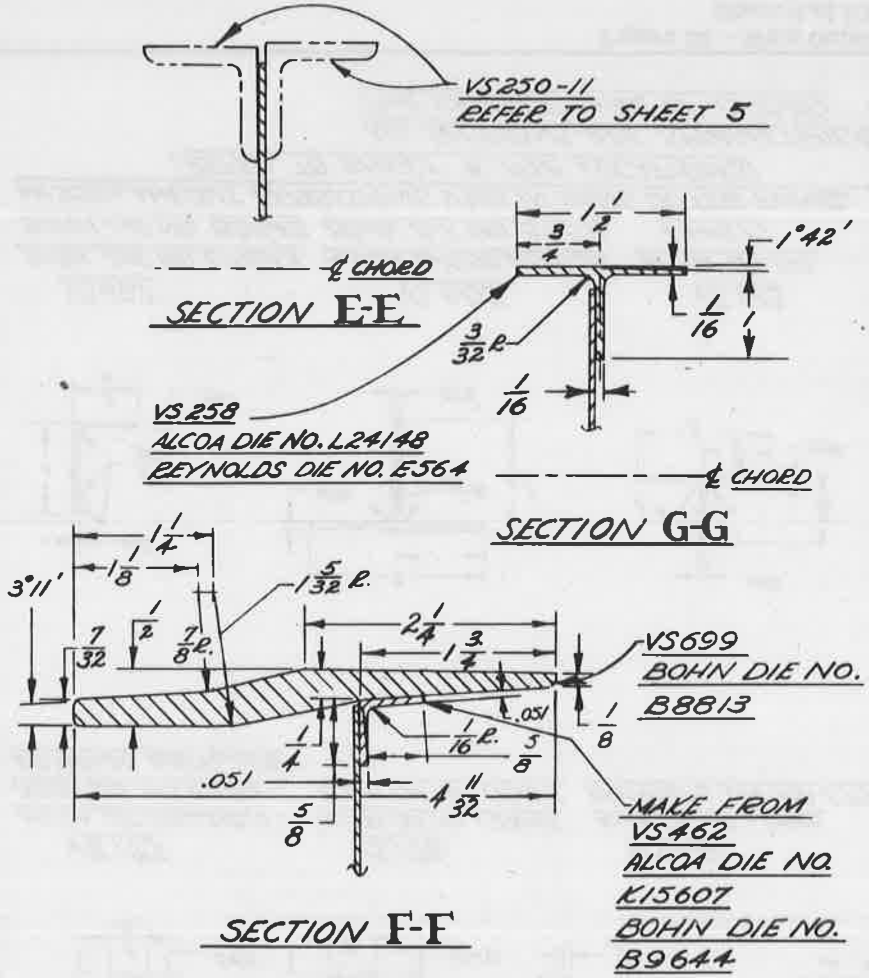


Figure 28 - Wing Outer Panel Structure
(Sheet 3 of 5 Sheets)

MISCELLANEOUS EXTRUSIONS USED IN THE OUTER PANEL STRUCTURE
(Refer to Sheet 5 for Detail Views)

Ribs:

At Station	Forward of Front Spar	Aft of Front Spar
108.843	VS175	VS175, VS176, VS493
114.5	VS605	VS176, VS497, VS619
131.0	VS175	---
136.5	---	VS176
142.0	VS175	---
146.5	---	VS176, VS619
152.843	VS175	---
165.5	VS175	---
178.156	VS175	---
184.5	---	VS619
193.528	---	VS620

Front Spar:
VS497 & VS605

Rear Spar:
VS176, VS232 & VS620

Auxiliary Rear Spar:
VS176, VS250-5, VS250-11 & VS613

Figure 28 - Wing Outer Panel Structure
(Sheet 4 of 5 Sheets)

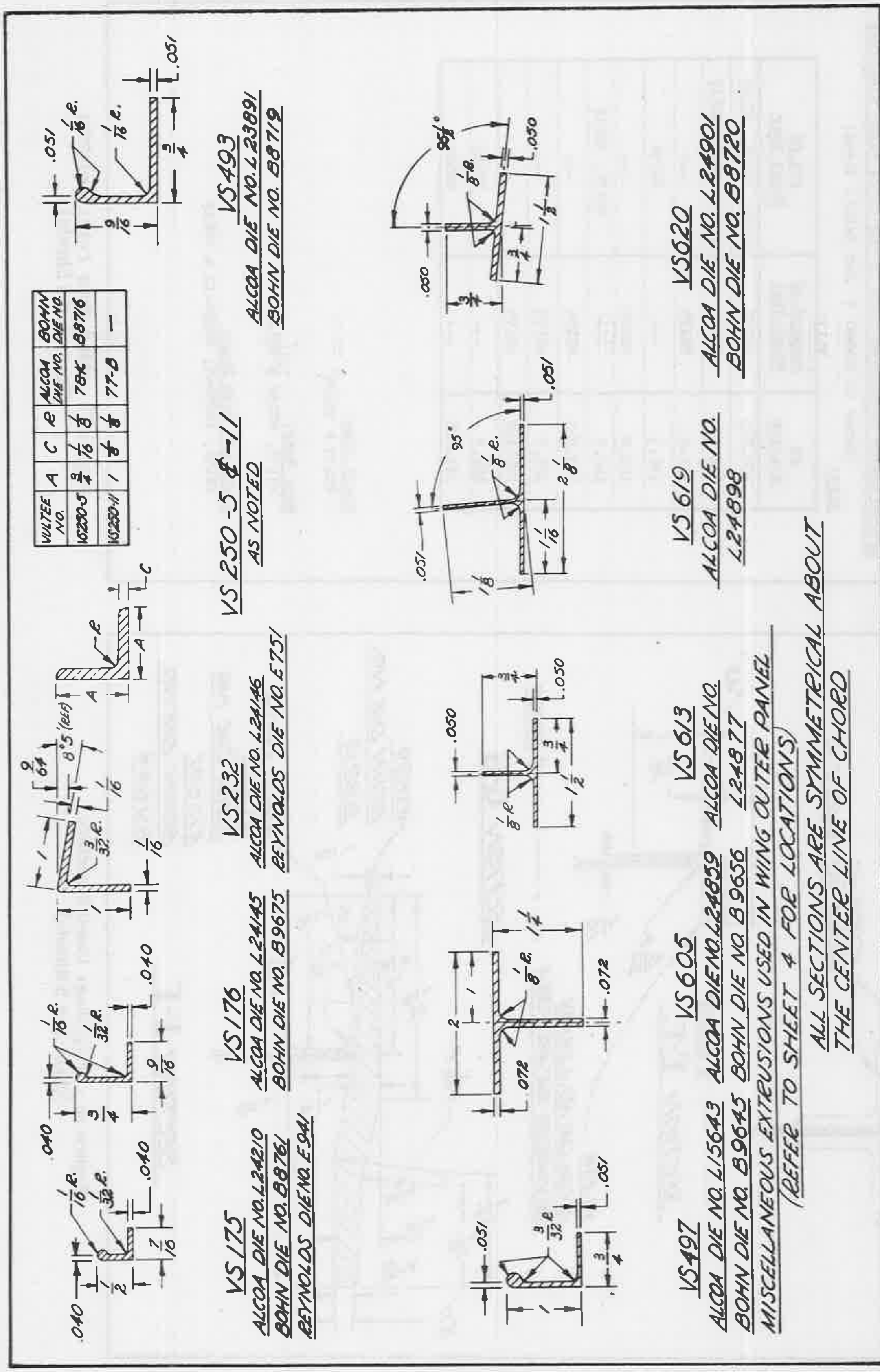


Figure 28 - Wing Outer Panel Structure
(Sheet 5 of 5 Sheets)

for it is impractical to drill through steel from pilot holes in aluminum alloy. In the case of picking up existing holes in aluminum-alloy members it is desirable to carefully clamp the steel part in place, scribe or punch the hole locations on the steel part through the holes in the aluminum-alloy member, remove the steel part, drill pilot holes, and then drill through from the steel part. If the new holes are larger than the original holes in the aluminum-alloy member, this can be accomplished without difficulty. In cases where the new holes through the steel member are the same size as existing holes in the aluminum-alloy member, the job requires very accurate workmanship to avoid enlarging or elongating the holes through the softer material.

(e) Make a splice strip for the spar-cap leg from 1/4 x 1-1/4 CM steel, sufficiently longer than the spar-web patch to provide a minimum extension of 1-5/16 inches at each end. This strip is bolted to the spar-cap leg with AN4-10A bolts arranged in two staggered rows spaced approximately on a 1-inch pitch and 1/2-inch gage to pick up the existing rivet pattern through the spar-cap leg. If the splice extends over a stiffener angle it will be necessary to pick up the stiffener angle with bolts, and should the stiffener angle be damaged, it should be replaced rather than attempting a splice. An 0.072-inch filler will be required between splice strip and spar web where the strip extends over the edge of the web patch.

(f) Make two splice strips to join the severed ends of the spar-cap flange. These are made of 3/8

TABLE XIII. LIST OF REPAIR MATERIALS FOR CENTER PANEL SPARS

Part No.	Material Spec. No.	Title	Size	Remarks
AN4-5A	--	Bolt, Aircraft	1/4-28	--
AN4-10A	--	" "	1/4-28	--
AN5-11A	--	" "	5/16-24	--
AN26-( )A	--	Bolt, Clevis	3/8-24	Length as Required
AC364-624	--	Nut, Self-locking	3/8-24	Thin Type
AC365-428	--	" " "	1/4-28	Regular Type
AC365-524	--	" " "	5/16-24	" "
AN426AD3	--	Rivet, 100° C'sunk	3/32 Diam.	--
AN430AD4	--	Rivet, Round Head	1/8 Diam.	--
AN430AD5	--	" " "	5/32 Diam.	--
AN430AD6	--	" " "	3/16 Diam.	--
AN430AD8	--	" " "	1/4 Diam.	--
AN960-428	--	Washer, Plain	For 1/4 Bolt	--
AN960-516	--	" "	For 5/16 Bolt	--
AN960-616	--	" "	For 3/8 Bolt	--
LS-1127-6	--	Rivet, Brazier Head Self-plugging Blind	3/16 Diam.	Cherry Rivet
22G1-02-6	--	Channel, Gang-Nut	--	Product of Elastic Stop Nut Co
--	AC-11067, Type II	Sheet, Alum. Coated Alum. Alloy	0.032 Thick	24STAL
--	" " "	" " "	0.040 Thick	"
--	" " "	" " "	0.051 Thick	"
--	" " "	" " "	0.064 Thick	"
--	" " "	" " "	0.081 Thick	"
--	" " "	" " "	0.125	"
--	AN-QQ-S-685, Cond N	Sheet, CM Steel	0.050 Thick	SAE-X4130
--	" " "	" " "	0.062 Thick	" "
--	" " "	" " "	0.091 Thick	" "
--	" " "	" " "	0.125 Thick	" "
--	" " "	" " "	0.156 Thick	" "
--	" " "	" " "	0.250 Thick	" "
--	" " "	" " "	0.375 Thick	" "

Note: Repair depots engaged in the repair of this airplane should also stock all Vultee extrusions listed in figure 24.

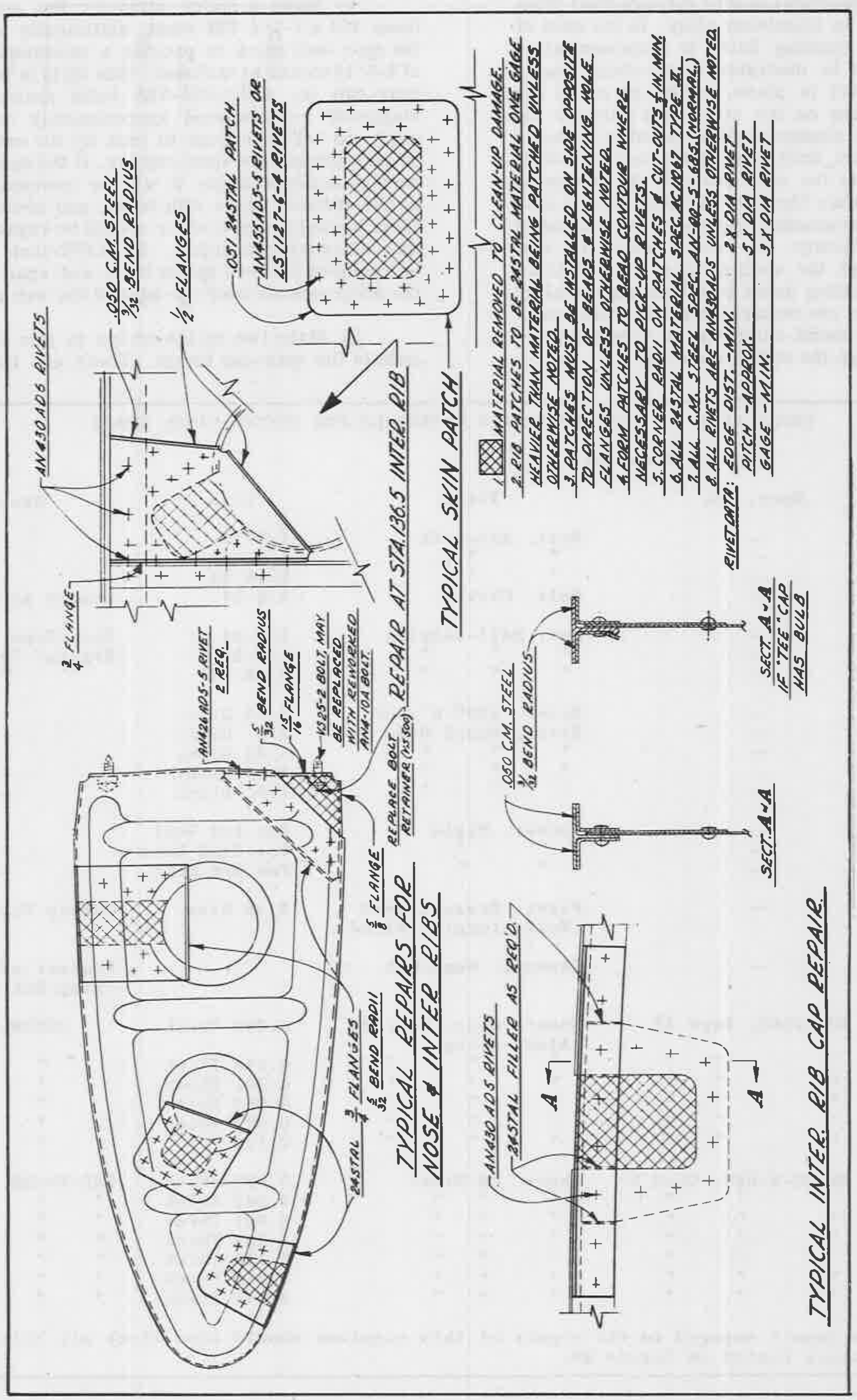


Figure 29 - Outer Panel Skin and Rib Repairs

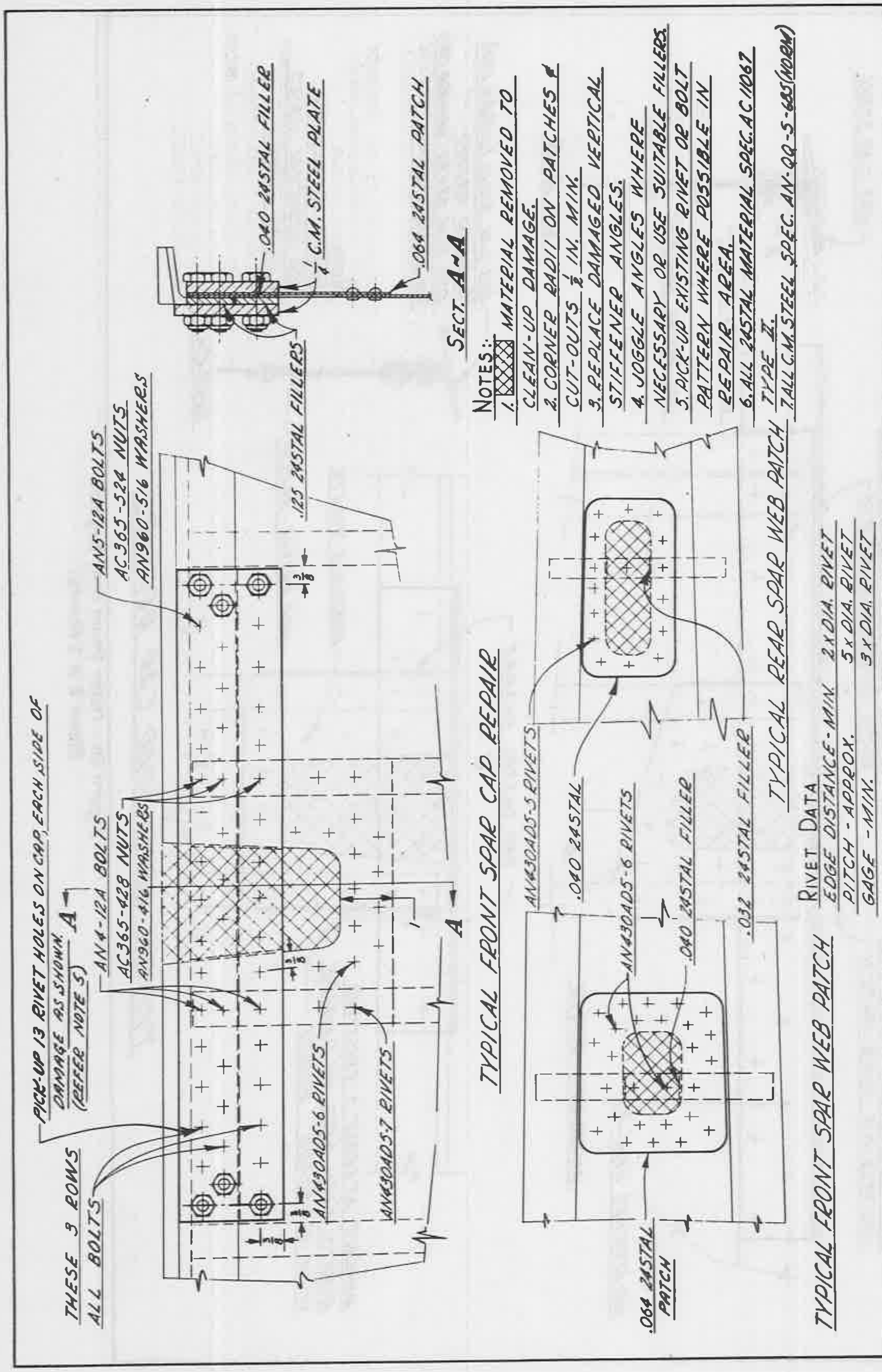


Figure 30 - Outer Panel Spar Repairs
(Sheet 1 of 2 Sheets)

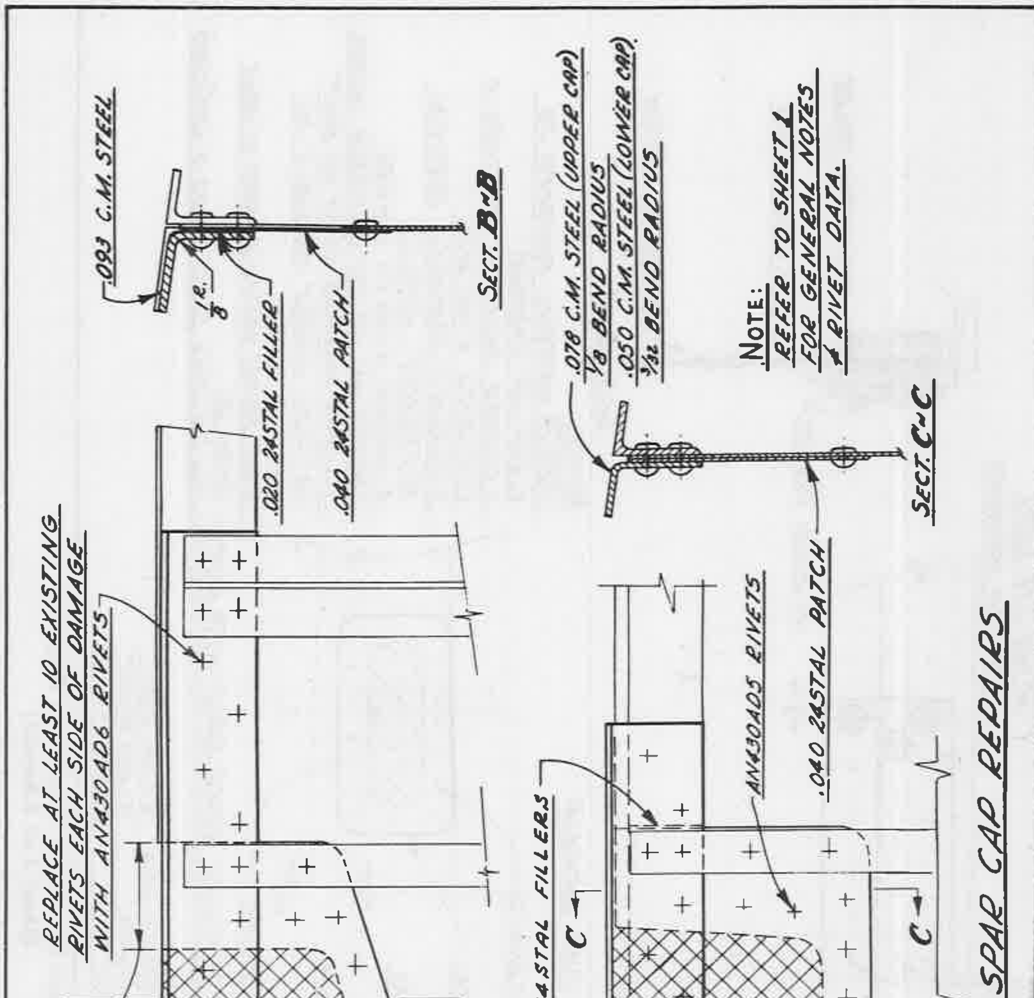


Figure 30 - Outer Panel Spar Repairs
(Sheet 2 of 2 Sheets)

inch thick CM steel plate and shaped to be flush with the outside edges of the flange, and to come as close as possible to the spar-cap leg when installed underneath the flange. Definite dimensions cannot be given for these splice strips as the width of the flange varies throughout the wing span, but all flange splice strips must be sufficiently long to pick up at least 12 existing flange rivet holes through each end.

(g) Modify rib attachment flanges as required to provide clearance for additional material added by the spar repairs. In some cases this will necessitate trimming off the original rib flange and riveting on a new flange angle of material identical with that of the rib. Use the same number of rivets provided for the original attachment, but 1/32-inch greater diameter.

(h) Install the skin patch before bolting the spar-cap flange splice strips into place, as their attachment bolts also pass through the wing skin. In some cases this may require the installation of an access door in the opposite skin surface.

(i) The washers used beneath the nuts to secure the flange splice strips must be filed to a taper permitting the nuts to bear squarely upon the washers.

(j) Finish all areas affected by the repair in a manner identical to the original finish. All steel parts in contact with aluminum alloy must receive two coats of zinc-chromate primer (Specification No. AN-TT-D-656) to prevent corrosion, and rivets and bolts passing through dissimilar metal must be installed when wet with zinc-chromate primer.

9. Wing Tip Repairs.

a. General. - A wing tip plating diagram is shown in figure 31. Repairs for the wing tip are shown in figure 32.

b. Typical Wing Tip Repairs. - Wing tip repairs will involve either skin patching or stringer splicing, and the methods of accomplishing the work is identical with those previously described for repairs to the wing panels.

10. Wing Flap and Aileron Repairs.

a. General. - Complete information regarding wing flap and aileron plating and structure is given in figures 33 and 35. Repairs are shown in figures 34 and 36.

b. Rebalancing Ailerons After Repair. - The subject of control surface balance, and methods of calculating the additional balance weight required after repairs are made is discussed in section 1. The aileron balance is very critical on this airplane, and more than usual care must be taken to insure proper rebalancing after repair.

c. Repairs to Aileron Trailing Edge. - It will be observed that the aileron trailing edge consists of a tube section split along its forward edge. It is very important that repairs to the trailing edge do not appreciably alter its shape or diameter, as undesirable wing heaviness will result if this trailing edge section is altered or bent up or down from its original position. A practical wrap-around patch form of repair is shown in the lower left-hand portion of figure 36.

TABLE XIV LIST OF REPAIR MATERIALS FOR OUTER PANEL SPARS

Part No.	Material Spec. No.	Title	Size	Remarks
AN4-12A	--	Bolt, Aircraft	1/4-28	--
AN5-12A	--	" "	5/16-28	--
AC365-428	--	Nut, Self-locking	1/4-28	Regular Type
AC365-524	--	" " "	5/16-24	" "
AN430AD5	--	Rivet, Round Head	5/32 Diam.	--
AN430AD6	--	" " "	3/16 Diam.	--
AN960-416	--	Washer, Plain	For 1/4 Bolt	--
AN960-516	--	" "	For 5/16 Bolt	--
--	AC-11067, Type II	Sheet, Alum. Coated Alum. Alloy	0.020 Thick	24STAL
--	" " "	" " "	0.032 Thick	"
--	" " "	" " "	0.040 Thick	"
--	" " "	" " "	0.045 Thick	"
--	" " "	" " "	0.064 Thick	"
--	" " "	" " "	0.125 Thick	"
--	AN-QQ-S-685, Cond N	Sheet, CM Steel	0.093 Thick	SAE-X4130
--	" " "	" " "	0.125 Thick	" "

Note: Repair depots engaged in the repair of this airplane should also stock all Vultee extrusions listed in figure 28.

d. Typical Wing Flap Repairs. - Wing flap repairs are facilitated by the skin being on one side only, providing ample access to all portions of the structure. The general nature of wing flap repairs will involve: - (i) simple skin patching; - (ii) splicing the trailing edge hat section; - (iii) rib repairs; and - (iv) patching or splicing the torsion box spar located near the forward edge of the flap. The skin patching procedure is similar to that previously described for wing skin, while the other flap repairs justify some individual explanation.

(1) The trailing edge hat section can be spliced with a simple bent-up vee-shaped strip inserted between the severed ends of the hat section, and provided with sufficient overlap at each end to permit installing six rivets through each overlap. Either driven or blind rivets may be used, as dictated by available access. If a considerable length of hat section must be removed to clean up the damage it is advisable to make a length of new hat section sufficient to span the gap between the severed ends of the original member, and splice this into place with a vee-channel at each end.

(2) The wing flap ribs are quite narrow, and the use of patches is not generally advisable. In most cases damage will be confined to the aft portion of the rib, and a new rib section long enough to extend between the severed end (remaining after cleaning up damage) and the trailing edge, can be bent up and spliced to the remaining portion of the original rib. Refer to the view in the lower left-hand portion of sheet 1 of figure 34. Should more than 50 percent of the rib be damaged it is recommended that a new rib be installed.

(3) The torsion box spar at the forward edge of the flap essentially consists of a zee-section joining to a channel section, with the base of each member riveted to the flap skin. Damage to either member may be repaired by a lap splice formed from appropriate material bent-up to nestle within the severed ends, and joined with suitable rivets. If both members are damaged it is necessary to patch each separately, and then rivet the two splice members together. In the case of repairs involving a rib member it will be necessary to make up a new rib to properly fit within the space remaining after repairs are completed. In no case may the flanges be straightened out, and then bent again.

e. Typical Aileron Repairs. - The general nature of aileron repairs is very simple, for the structure comprises ribs covered by thin aluminum-alloy skin, with local reinforcement at hinge locations, and a short rear spar member at the trim tab cut-out. Skin patching and rib patching will be similar to repairs previously described for the wing skin. "Cherry" self-plugging blind rivets will be required for the majority of skin patches, owing to the lack of access for bucking rivets. In the case of damage occurring at the skin lap between nose skin and cover sheets, it will be necessary to splice the stringer angle at the lap. This may require removing considerably more skin than is actually necessary to clean up the damage, in order to obtain access for drilling and installing the necessary bolts.

11. Fittings and Skin Attaching Strips.

a. Fittings. - Fittings formed from forgings, castings and extrusions are nonrepairable and must be replaced when damaged.

b. Wing Skin Attaching Strips.

The wing skin attaching strips at the junction of center section and outer panels are nonrepairable and must be replaced when damaged.

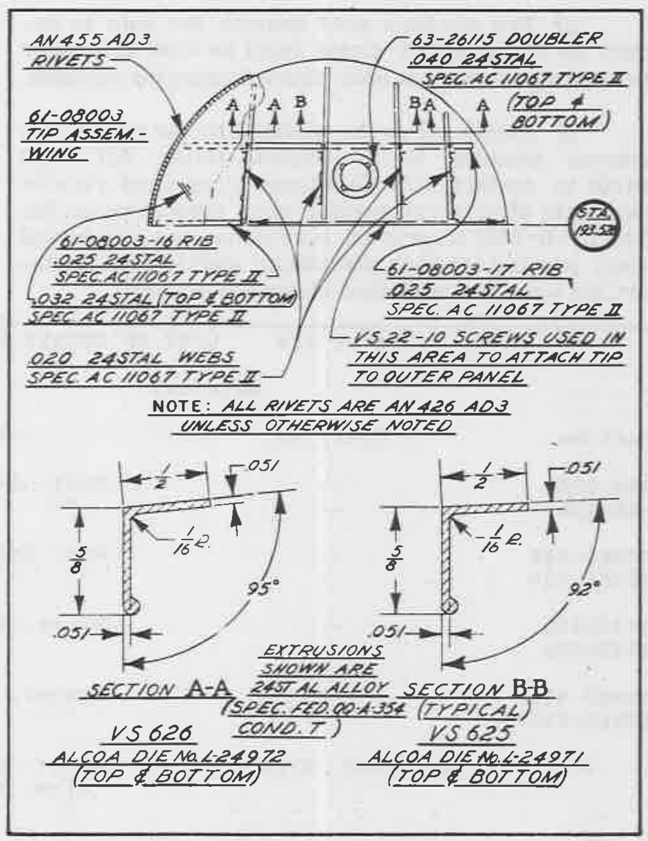


Figure 31 - Wing Tip Structure and Plating

TABLE XV LIST OF REPAIR MATERIALS FOR WING TIP

Part No.	Material Spec. No.	Title	Size	Remarks
63-26115-1	--	Doubler	--	Vultee Part
AN426AD4	--	Rivet, 100° C'sunk	1/8 Diam.	--
AN430AD3	--	Rivet, Round Head	3/32 Diam.	--
AN455AD3	--	Rivet, Brazier Head	3/32 Diam.	--
AN455AD4	--	Rivet, Brazier Head	1/8 Diam.	--
--	AC-11067, Type II	Sheet, Alum. Coated Alum. Alloy	0.032 Thick	24STAL
--	" " "	" " "	0.040 Thick	"
--	" " "	" " "	0.051 Thick	"
--	" " "	" " "	0.064 Thick	"

Note: Repair depots engaged in the repair of this airplane should also stock all Vultee extrusions listed in figure 31.

TABLE XVI. LIST OF REPAIR MATERIALS FOR WING FLAPS AND AILERONS

Part No.	Material Spec. No.	Title	Size	Remarks
VS625	--	Extrusion	--	Vultee Standard
AN3-4A	--	Bolt, Aircraft	10-32	--
AC365-1032	--	Nut, Self-locking	10-32	--
AN426AD2	--	Rivet, 100° C'sunk	1/16 Diam.	--
AN426AD3	--	" " "	3/32 Diam.	--
AN426AD4	--	" " "	1/8 Diam.	--
AN430AD3	--	Rivet, Round Head	3/32 Diam.	--
AN430AD4	--	" " "	1/8 Diam.	--
AN455AD3	--	Rivet, Brazier Head	3/32 Diam.	--
AN455AD4	--	" " "	1/8 Diam.	--
AC525-10-8	--	Screw, Washer Head	10-32	--
AN960-10	--	Washer, Plain	For 10-32 Screw	--
22A17-02	--	Nut Plate	10-32	Elastic Stop Nut Co.
LS-1126-4-2	--	Rivet, 100° C'sunk Self-plugging Blind	1/8 Diam.	Cherry Rivet
LS-1126-5-4	--	" " "	5/32 Diam.	" "
LS-1126-5-8	--	" " "	5/32 Diam.	" "
--	AC-11076, Type II	Sheet, Alum. Coated Alum. Alloy	0.025 Thick	24STAL
--	" " "	" " "	0.032 Thick	"
--	" " "	" " "	0.040 Thick	"
--	" " "	" " "	0.051 Thick	"
--	" " "	" " "	0.064 Thick	"
--	" " "	" " "	0.072 Thick	"

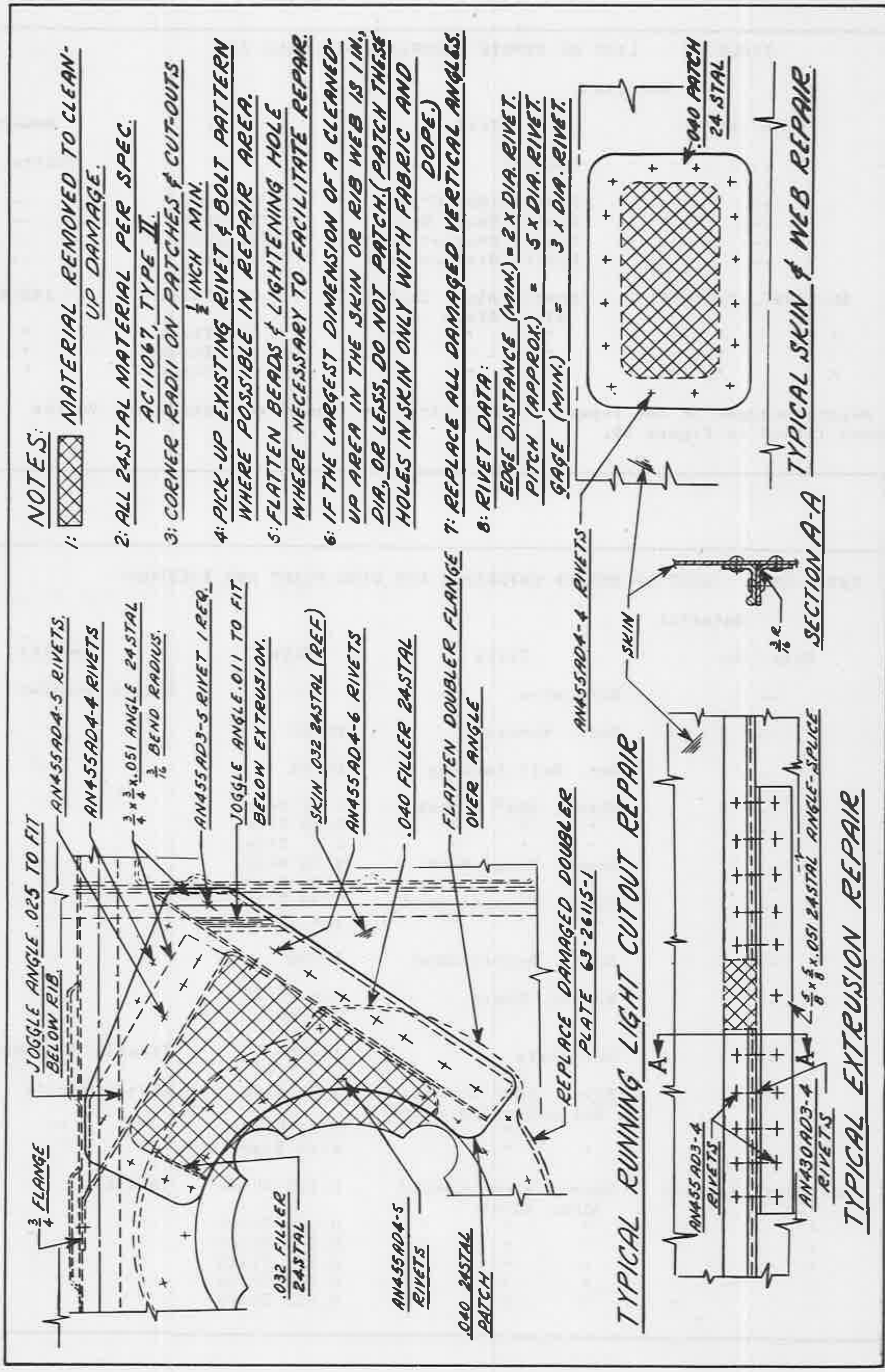


Figure 32 - Wing Tip Repairs
(Sheet 1 of 2 Sheets)

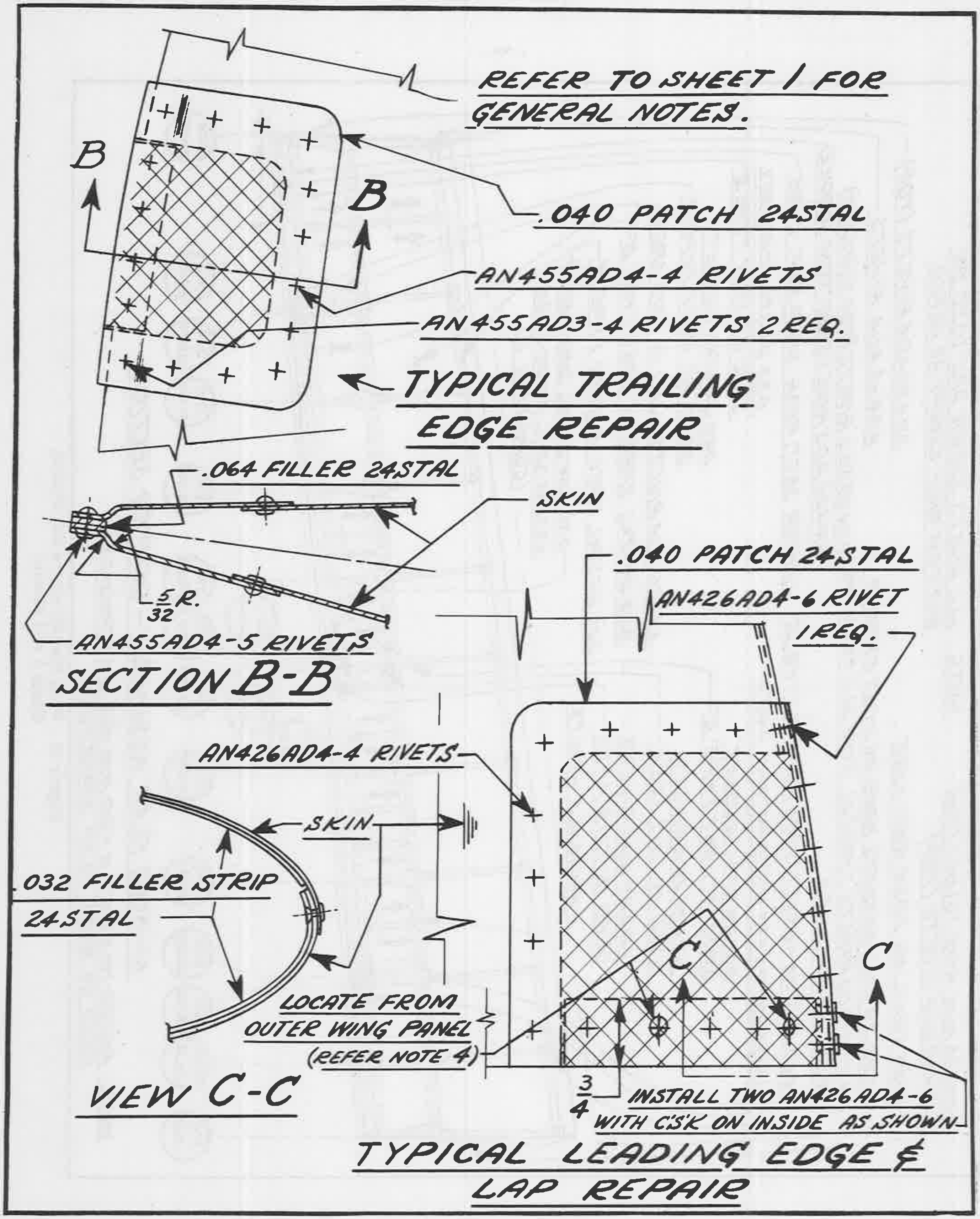


Figure 32 - Wing Tip Repairs
(Sheet 2 of 2 Sheets)

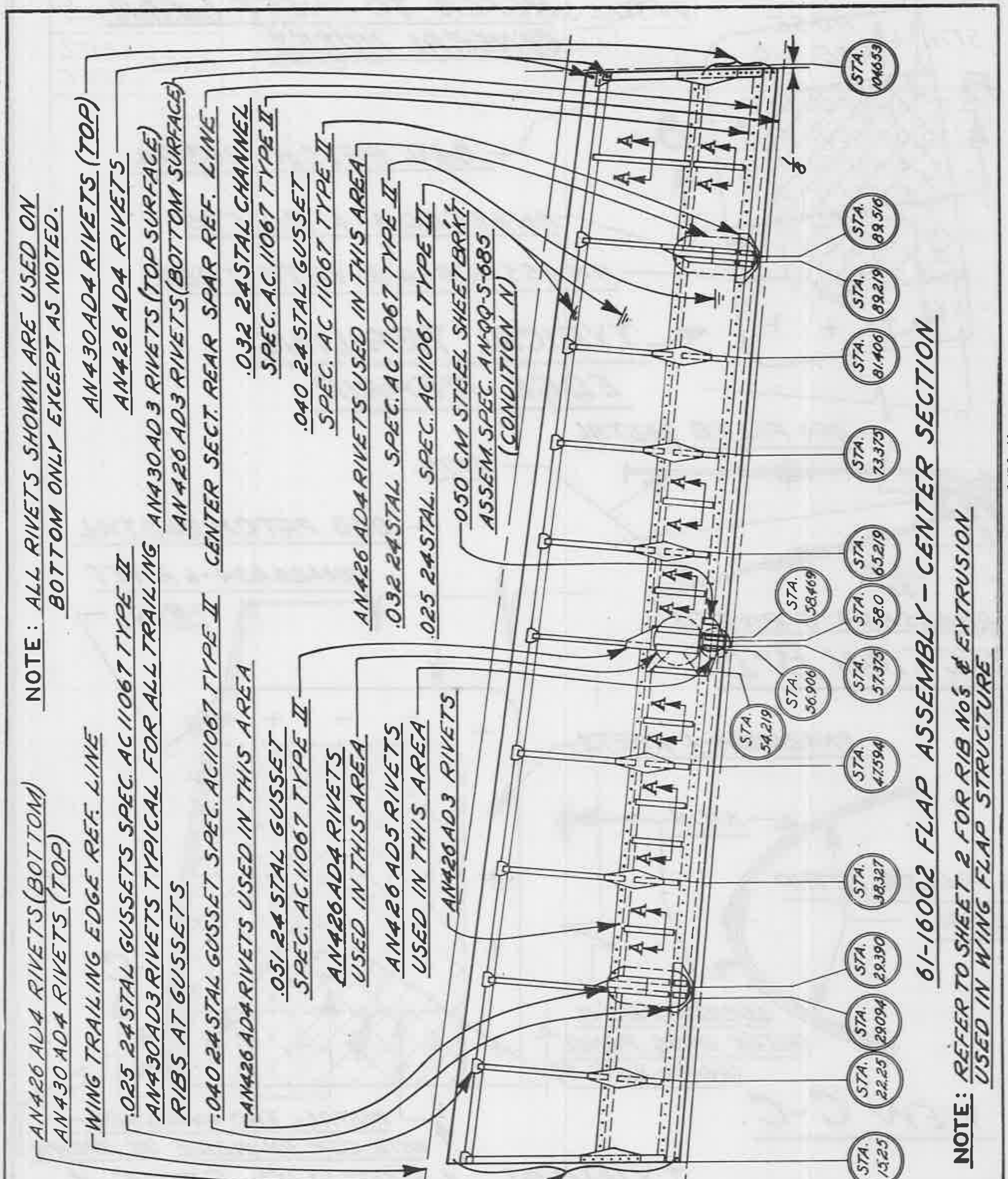


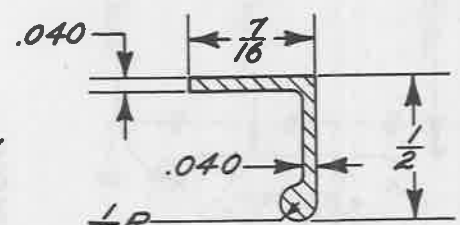
Figure 33 - Wing Flap Structure and Plating (Sheet 1 of 2 Sheets)

STA.	NOSE RIB NO.	24ST AL SH'T		STA.	TRAILING RIB NO.	24ST AL SH'T	
		GAGE	MAT'L SPEC.			GAGE	MAT'L SPEC.
15.25	61-16002-2 & -3	.025	AC 11067 TYPE II	15.25	61-16002-2 & -3	.025	AC 11067 TYPE II
22.25	61-16002-92 & -93	.025		22.25	61-16002-6 & -7	.025	
29.094	61-16002-95 & -96	.040		29.094	61-16002-8 & -9	.025	
	61-16002-90 & -91	.025					
29.390	61-16002-96 & -95	.040					
	61-16002-91 & -90	.025					
38.327	61-16002-88 & -89	.025		38.327	61-16002-10 & -11	.025	
47.594	61-16002-86 & -87	.025		47.594	61-16002-12 & -13	.025	
54.219	61-16002-84 & -85	.025					
56.906	61-16002-26 & -27	.040		56.906	61-16002-14 & -15	.025	
57.375	61-16002-38 & -37	.051					
58.0	61-16002-36 & -35	.051					
58.469	61-16002-27 & -26	.040					
65.219	61-16002-82 & -83	.025		65.219	61-16002-16 & -17	.025	
73.375	61-16002-80 & -81	.025		73.375	61-16002-18 & -19	.025	
81.406	61-16002-94 & -79	.025		81.406	61-16002-20 & -21	.025	
89.219	61-16002-33 & -34	.040					
	61-16002-24 & -25	.025					
89.516	61-16002-34 & -33	.040		89.516	61-16002-22 & 23	.025	
	61-16002-25 & -24	.025					
104.528	61-16002-4 & -5	.025		104.528	61-16002-4 & -5	.025	

NOTES:

1. - THE FIRST DASH NUMBERS ARE FOR L.H. FLAP RIBS & THE SECOND DASH NUMBERS ARE FOR R.H. FLAP RIBS.
2. - ALL GUSSETS ARE .032 24ST AL SPEC. AC11067 TYPE II (EXCEPT AS NOTED).

REYNOLDS DIE No. E 941
ALCOA DIE No. L 24210
BOHN DIE No. B 8761



VS 175

SECTION A-A
(TYPICAL)
(TOP & BOTTOM)

Figure 33 - Wing Flap Structure and Plating
(Sheet 2 of 2 Sheets)

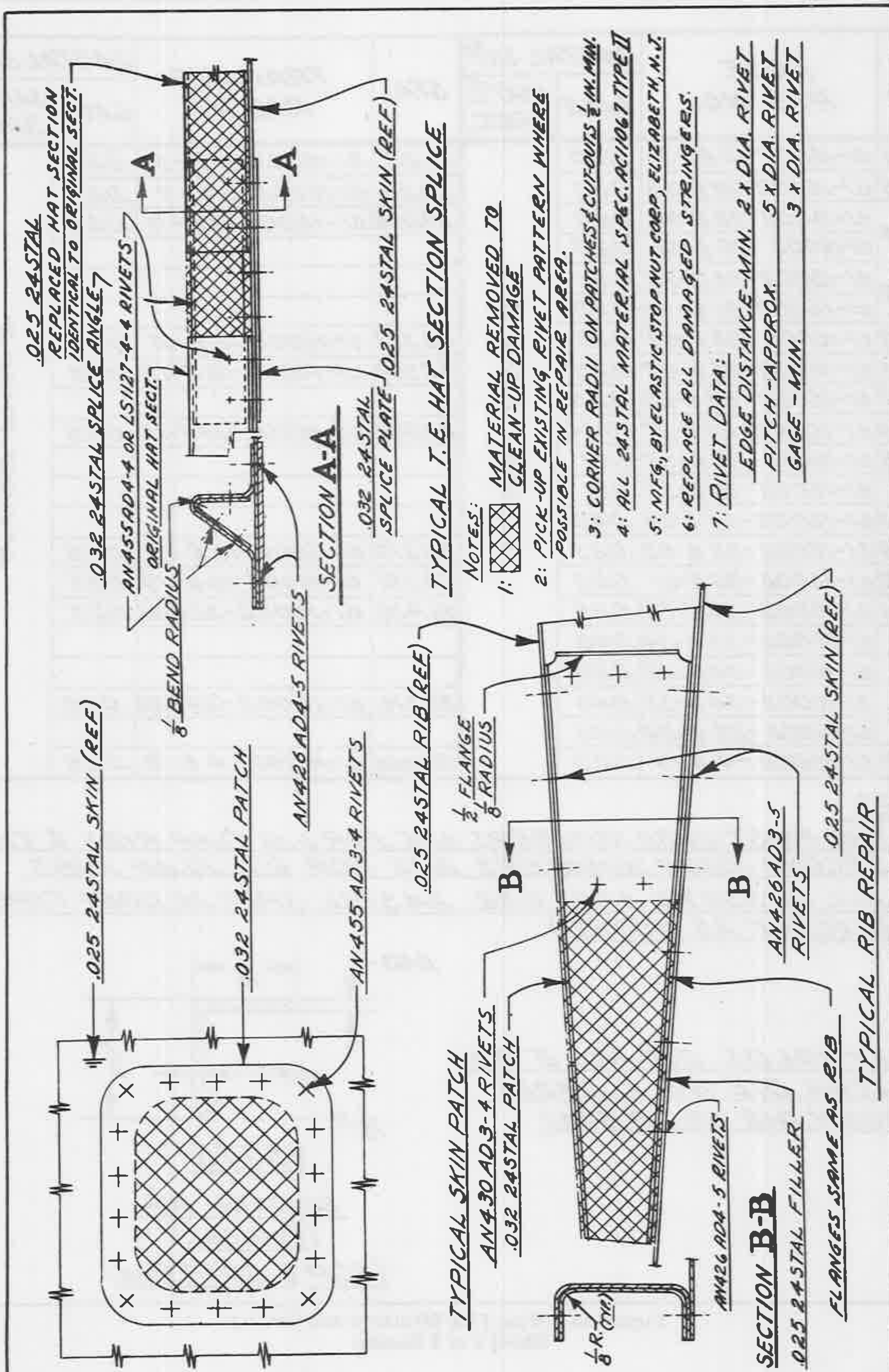


Figure 34 - Wing Flap Repairs
(Sheet 1 of 2 Sheets)

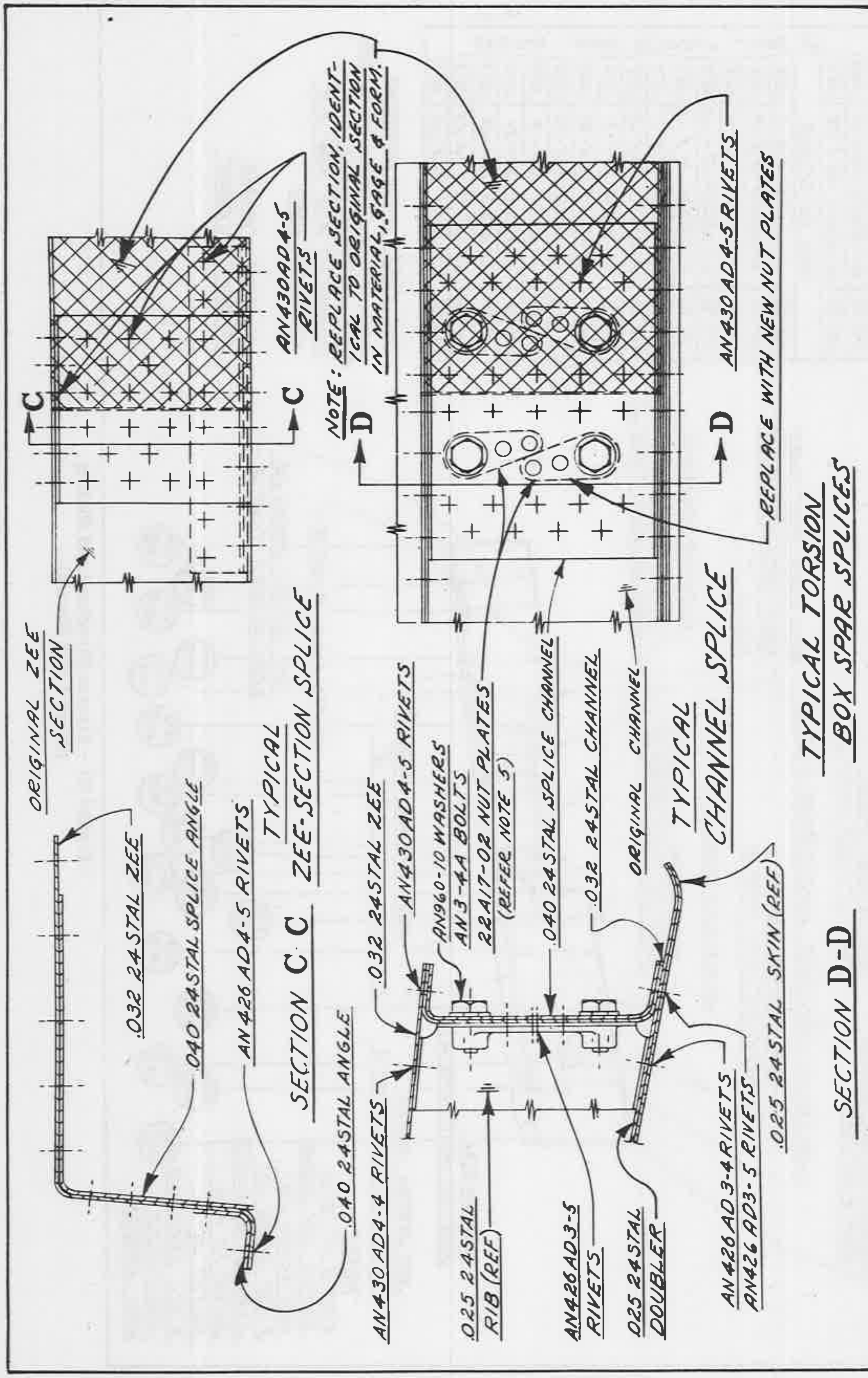
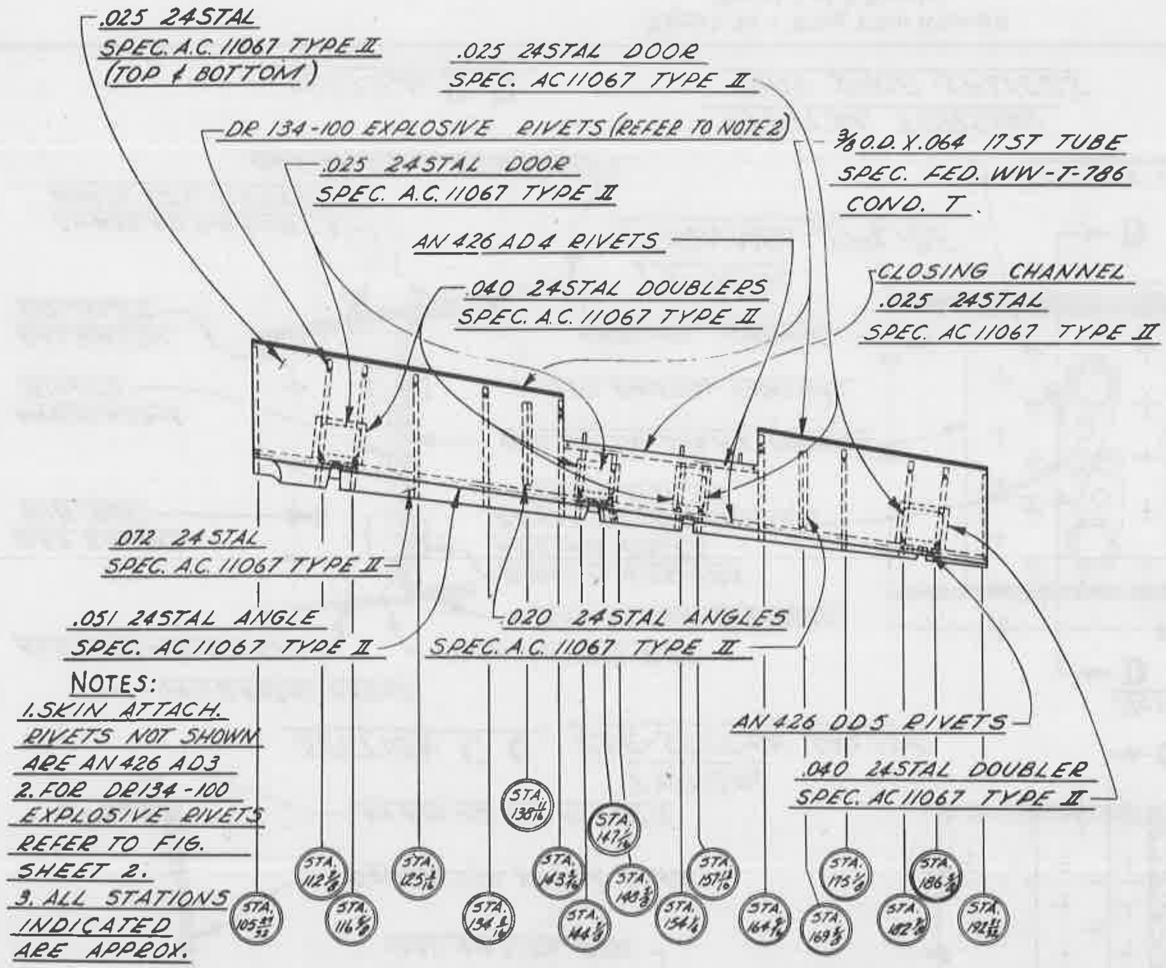


Figure 34 - Wing Flap Repairs
(Sheet 2 of 2 Sheets)



NOTES:
1. SKIN ATTACH. RIVETS NOT SHOWN ARE AN 426 AD3
2. FOR DR134-100 EXPLOSIVE RIVETS REFER TO FIG. SHEET 2.
3. ALL STATIONS INDICATED ARE APPROX.

STA.	NOSE RIB No.	MAT'L
147 1/16	61-12005-40 & -41	.040
148 5/8	61-12005-38 & -39	.040
	FULL OR T.E. RIB	
105 27/32	61-12005-6 & -7	.025
112 7/8	61-12005-8 & -9	.025
116 5/8	61-12005-10 & -11	.025
125 3/16	61-12005-12 & -13	.025
134 3/16	61-12005-14 & -15	.025
143 3/16	61-12005-16 & -17	.025
144 3/8	61-12005-28 & -29	.032
148 5/8	61-12005-30 & -31	.032
154 1/4	61-12005-34 & -35	.032
157 13/16	61-12005-32 & -33	.032
164 9/16	61-12005-18 & -19	.025
175 1/8	61-12005-20 & -21	.025
182 7/8	61-12005-22 & -23	.025
186 5/8	61-12005-24 & -25	.025
192 21/32	61-12005-26 & -27	.025

(MAT'L: 24STAL SPEC. AC 11067 TYPE II)

THE FIRST DASH NUMBERS ARE FOR L.H. AILERON RIBS
& THE SECOND DASH NUMBERS ARE FOR R.H. AILERON RIBS.

61-12005 FRAME ASSEM. - AILERON

Figure 35 - Aileron Structure and Plating
(Sheet 1 of 2 Sheets)

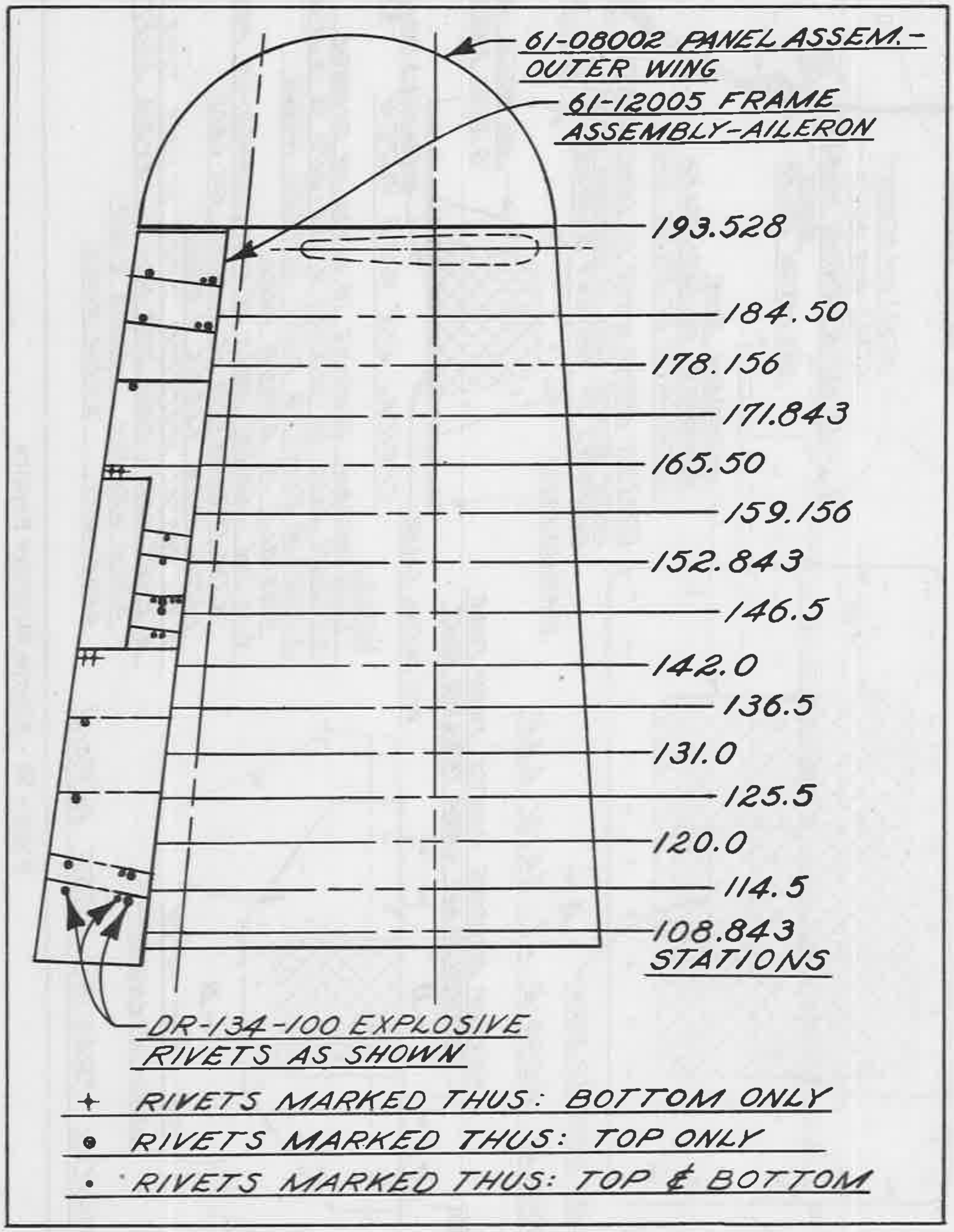


Figure 35 - Aileron Structure and Plating
(Sheet 2 of 2 Sheets)

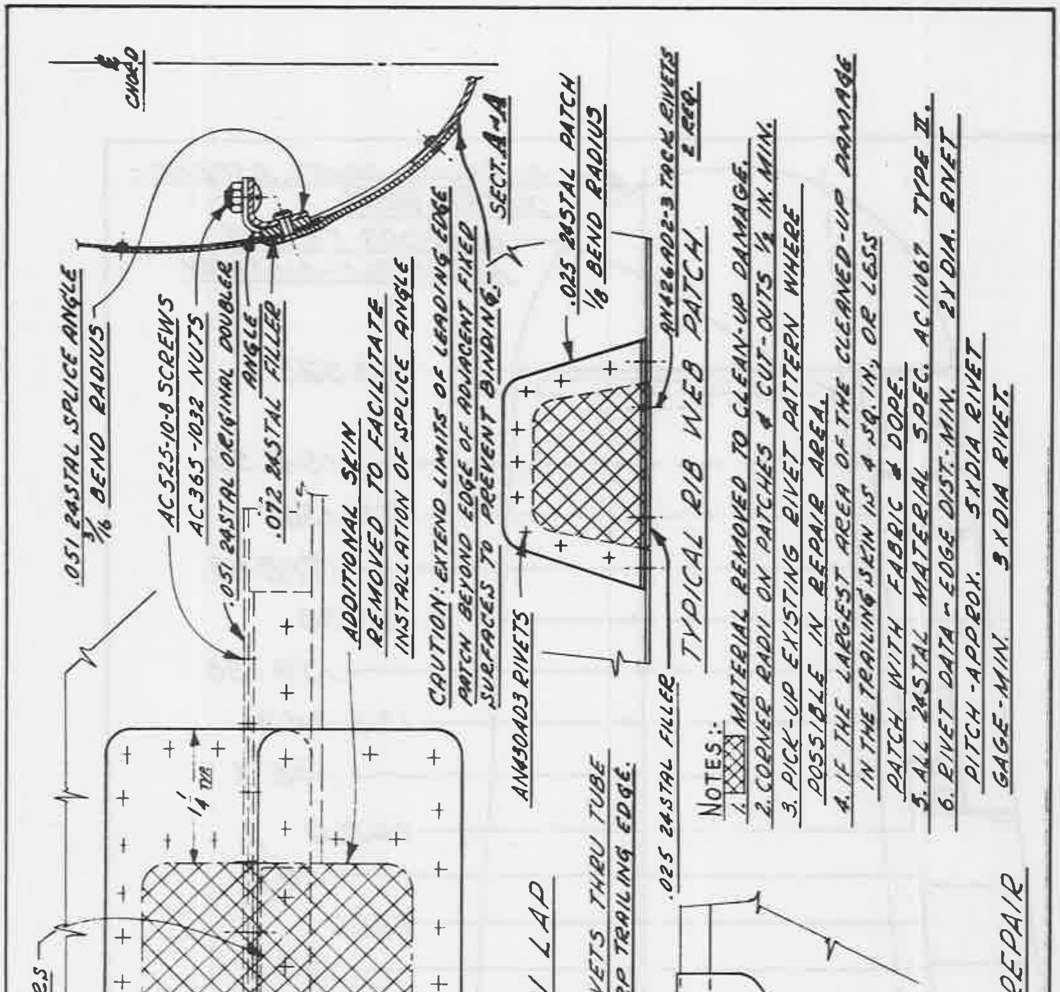


Figure 36 - Aileron Structure Repairs

SECTION VII

HORIZONTAL AND VERTICAL STABILIZERS

1. General.

The horizontal and vertical stabilizers are constructed in the same general manner, being spar and rib structures covered with smooth aluminum alloy sheet riveted in place. A single stringer is used on each side of the forward portion of the horizontal and vertical stabilizers, with the spar proper being at the aft edge.

2. Horizontal Stabilizer Plating and Structure.

Figure 37 shows a structure diagram for the horizontal stabilizer, showing all important structural details.

3. Vertical Stabilizer Plating and Structure.

Figure 40 consists of a diagram showing all important structural details of the vertical stabilizer.

4. Negligible Damage.

a. Damage to horizontal and vertical stabilizer spar and rib webs wherein the greatest dimension of the smoothly cleaned-up damaged area does not exceed one inch can be ignored as negligible damage, excepting that any damage closer than one inch to an existing hole, flange or spar cap must be repaired.

b. Damage to horizontal and vertical stabilizer skin wherein the greatest dimension of the smoothly cleaned-up damage does not exceed one inch may be considered negligible and covered with a doped-on patch, excepting that any skin damage closer than one inch to an existing hole must be repaired.

c. Any damage to stringers and/or spar caps must be repaired.

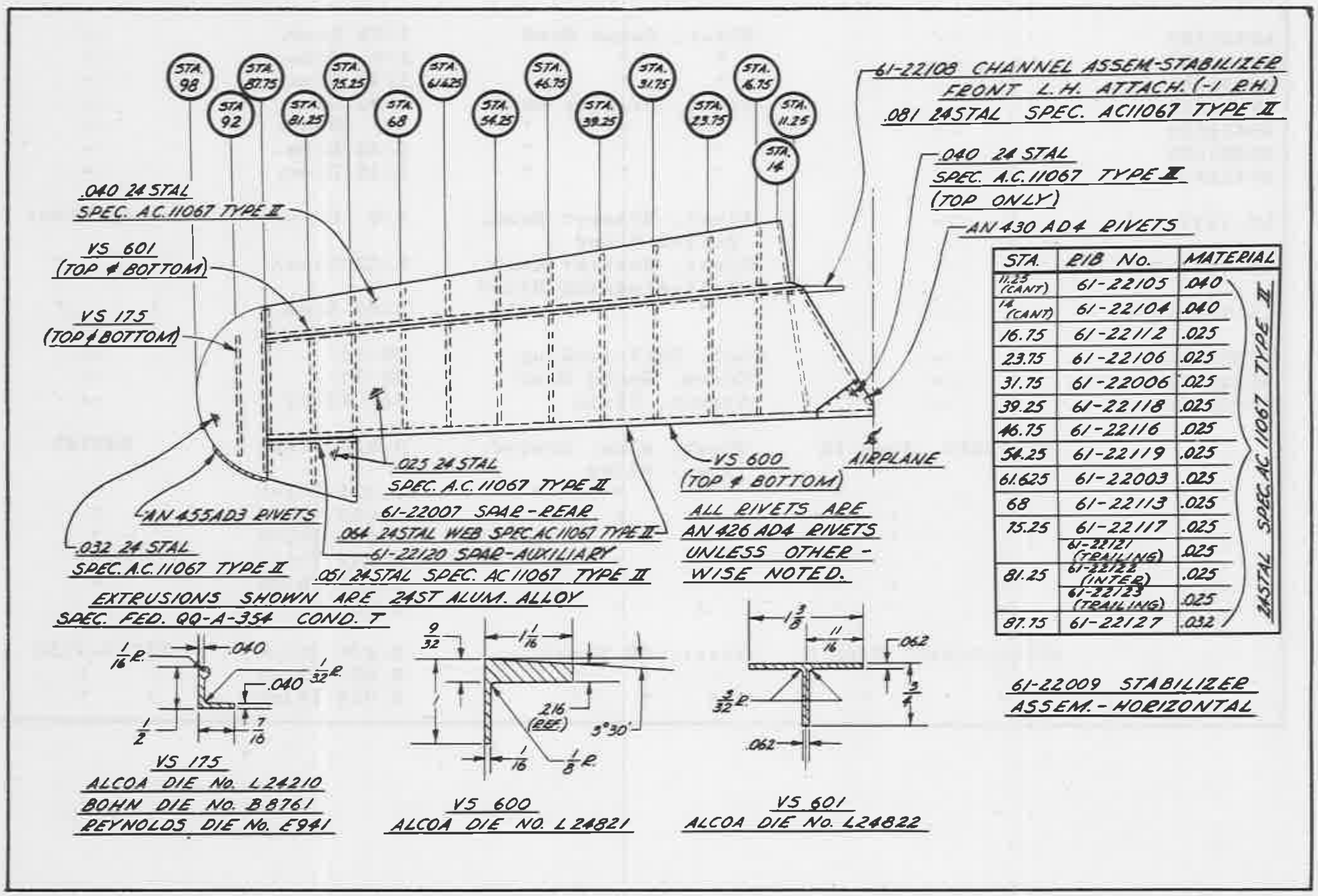


Figure 37 - Horizontal Stabilizer Structure and Plating

5. Repairable Damage.

Skin and rib repairs for both horizontal and vertical stabilizers are shown in figure 38. Stringer splices are also shown in figure 38, while repairs to the horizontal and vertical stabilizer spars are shown in figure 39.

6. Nonrepairable Damage.

Damaged fittings are nonrepairable, and it will generally be found more economical to replace skin sheets and ribs damaged over more than 50 percent of their area.

7. Repair Methods.

The general nature of the stabilizer structures is very similar to that of the wing, in that these surfaces comprise beams, stringers, ribs and skin covering. Therefore, the repair methods will be very similar to those previously outlined for the wing, and do not require repetition here.

TABLE XVII. LIST OF REPAIR MATERIALS FOR HORIZONTAL AND VERTICAL STABILIZERS

Part No.	Material Spec. No.	Title	Size	Remarks
AN3-5A	--	Bolt, Aircraft	10-32	--
VS175	--	Extrusion (Angle)	7/16 x 1/2	Vultee Standard
VS499	--	" "	1-3/16 x 7/8	" "
VS600	--	" "	1-1/16 x 1	" "
VS601	--	Extrusion (Tee)	1-3/8 x 3/4	" "
AN430AD3	--	Rivet, Round Head	3/32 Diam.	--
AN430AD4	--	" " "	1/8 Diam.	--
AN430AD5	--	" " "	5/32 Diam.	--
AN455AD3	--	Rivet, Brazier Head	3/32 Diam.	--
AN455AD4	--	" " "	1/8 Diam.	--
AN455AD5	--	" " "	5/32 Diam.	--
AN455AD6	--	" " "	3/16 Diam.	--
LS-1113-4-4	--	Rivet, Brazier Head, Hollow Blind	1/8 Diam.	Cherry Rivet
LS-1127-5-2	--	Rivet, Brazier Head, Self-plugging Blind	5/32 Diam.	" "
LS-1127-5-4	--	" " "	5/32 Diam.	" "
AC365-1032	--	Nut, Self-locking	10-32	--
AC525-10-10	--	Screw, Round Head	10-32	--
AN960-10	--	Washer, Plain	For 10-32	--
--	AC-11067, Type II	Sheet, Alum. Coated Alum. Alloy	0.020 Thick	24STAL
--	" " "	" " "	0.025 Thick	"
--	" " "	" " "	0.032 Thick	"
--	" " "	" " "	0.040 Thick	"
--	" " "	" " "	0.051 Thick	"
--	" " "	" " "	0.064 Thick	"
--	" " "	" " "	0.081 Thick	"
--	AN-QQ-S-685, Cond N	Sheet, CM Steel	0.038 Thick	SAE X-4130
--	" " "	" " "	0.050 Thick	" "
--	" " "	" " "	0.078 Thick	" "

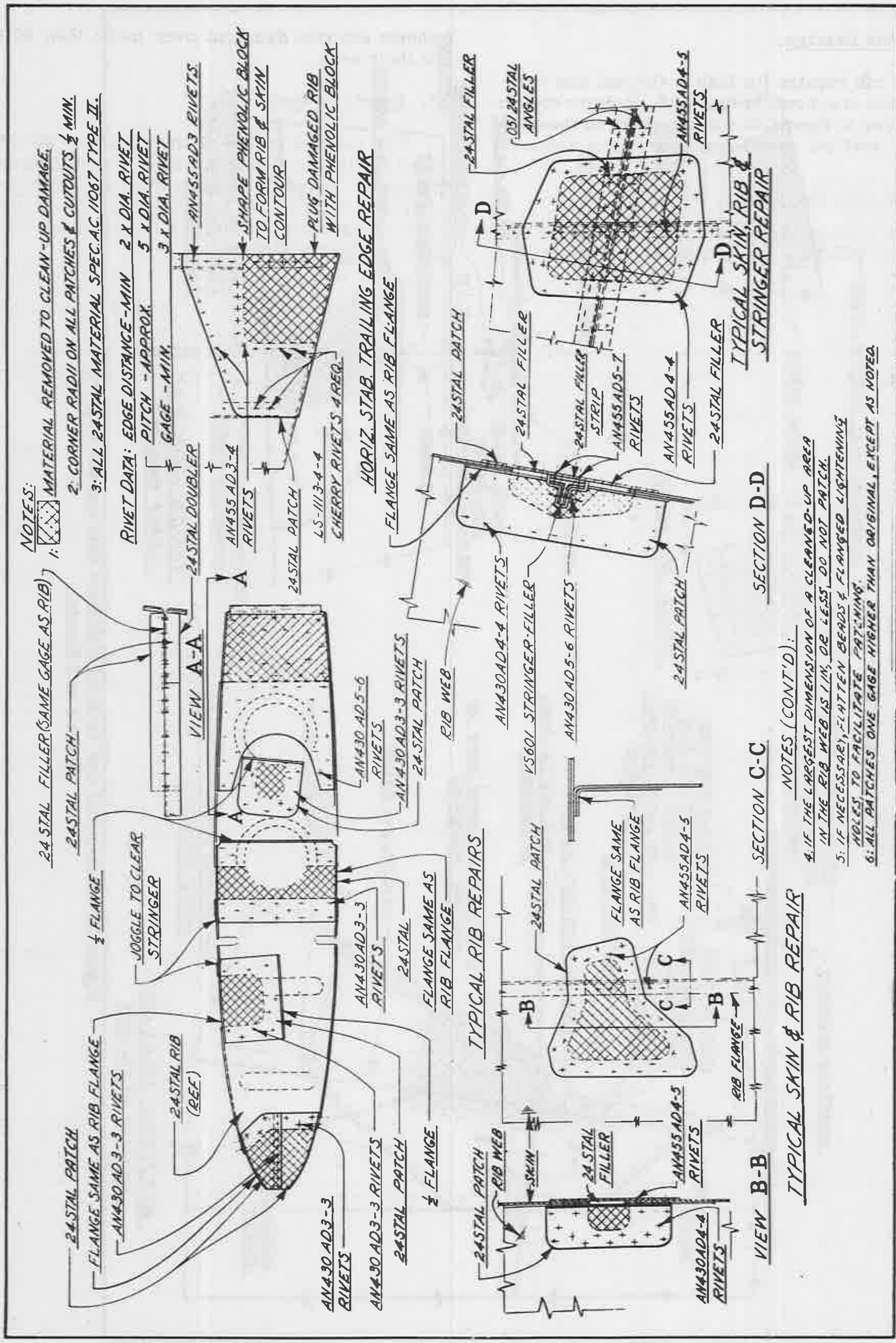


Figure 38 - Horizontal and Vertical Stabilizer Skin and Rib Repairs
(Sheet 1 of 2 Sheets)

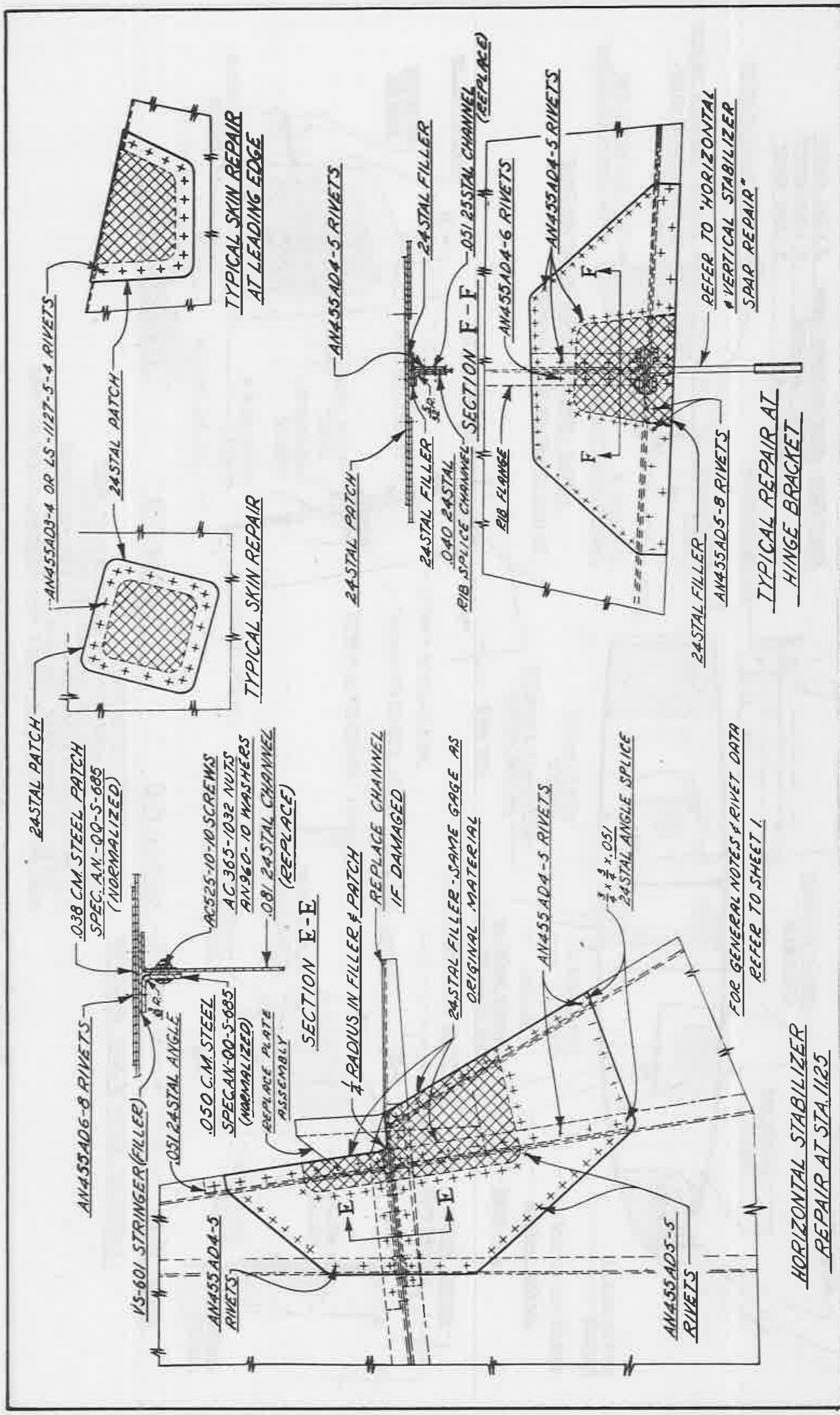


Figure 38 - Horizontal and Vertical Stabilizer Skin and Rib Repairs
(Sheet 2 of 2 Sheets)

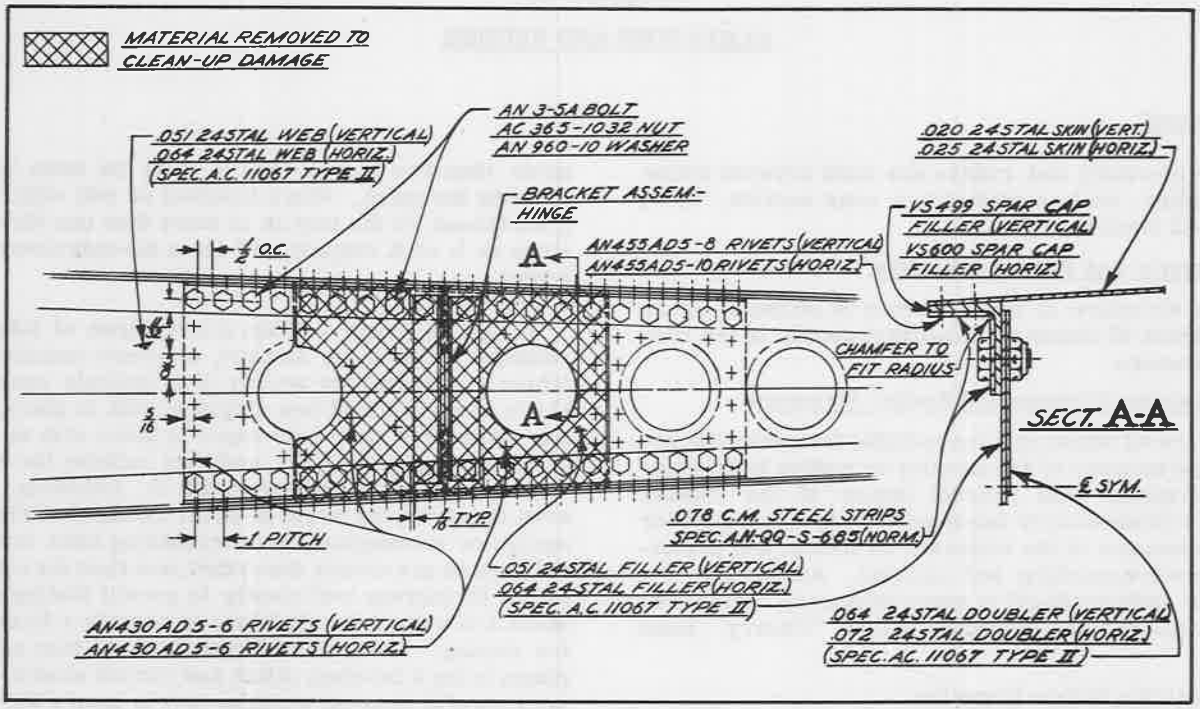
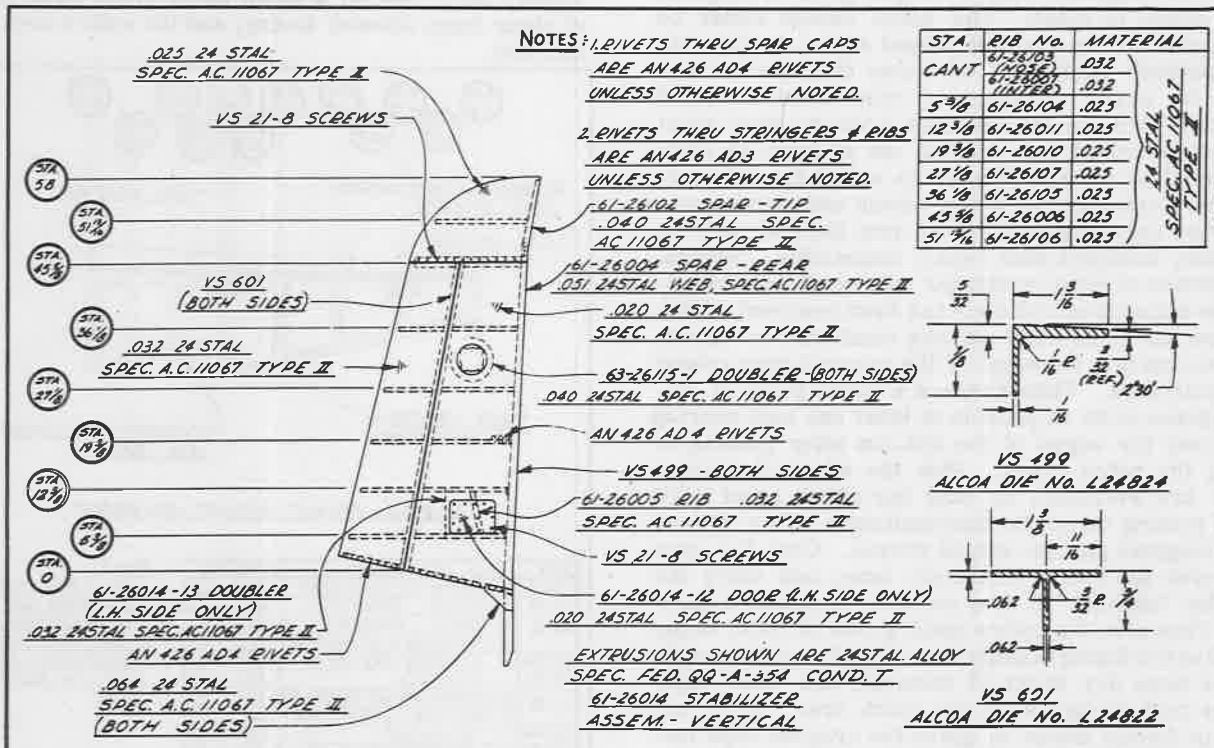


Figure 39 - Horizontal and Vertical Stabilizer Spar Repair



STA.	RIB No.	MATERIAL
CANT	61-26103 (NOSE)	.032
	61-26001 (INTER)	.032
5 3/8	61-26104	.025
12 3/8	61-26011	.025
19 3/8	61-26010	.025
27 1/8	61-26107	.025
36 1/8	61-26105	.025
45 5/8	61-26006	.025
51 7/16	61-26106	.025

Figure 40 - Vertical Stabilizer Structure and Plating

SECTION VIII

ELEVATORS AND RUDDER

1. General.

The elevators and rudder are cloth covered frame assemblies; each comprising a nose section, spar, ribs, and trailing edge.

2. Elevator and Rudder Structure.

The structure of the elevators is shown in figure 41. Figure 43 shows all important details of the rudder structure.

3. Repairing Elevator and Rudder Structure.

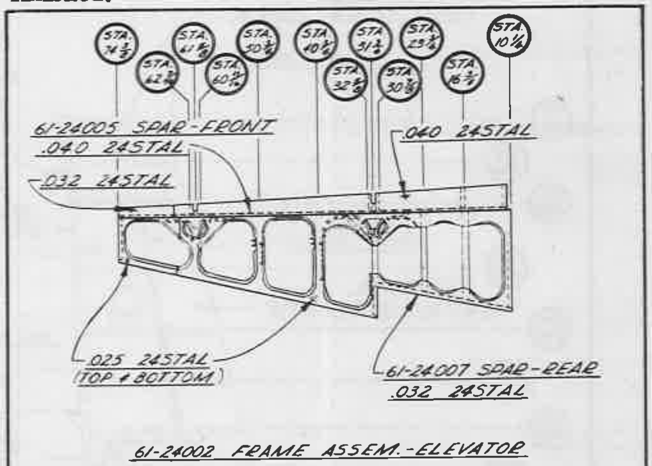
Figure 42 shows repairs suitable for restoring any damaged member of the elevator or rudder to its original strength. The general nature of the repairs shown follows closely those previously described for other elements of the airframe structure, and principally involve patching and splicing. Access for riveting is rather critical in some areas, and certain repairs will require extensive use of "Cherry" blind rivets.

4. Repairing Fabric Covering.

a. Small Holes. - Small holes in the fabric covering can be repaired with a simple patch of airplane fabric doped in place. The patch should either be rectangular or square with frayed edges, or circular with "pinked" edges. In all cases the hole or tear should be neatly trimmed to remove all damaged material. Remove the old dope from an area about four inches around the edges of the cleaned-up hole, by using clear dope or thinner to soften the old dope, and then scraping this away. Avoid excessive pressure when scraping or the cloth near the hole will be stretched, making a neat repair impossible. Several applications of dope or thinner may be necessary before the majority of old dope has been removed. After the dope has been removed use steel wool to smooth the area and fair the edges of the original dope around the repair area. Then prepare a fabric patch of cotton airplane cloth to provide at least one inch overlap all around the edges of the cut-out after pinking or fraying the patch edges. Pink the edges if pinking shears are available, or fray the edges about 3/16 inch if pinking cannot be accomplished. Only square or rectangular patches can be frayed. Coat the area to receive the patch with clear dope, and apply the patch by "rubbing" it into position to obtain a good bond. Then give the entire patch a coat of clear dope, extending the doping slightly over the edge of the patch. Let the dope dry about 15 minutes, and then apply another coat of dope over the patch area. After the patch is firmly doped in place the original dope finish may be restored to the repair area, by following the scheme given in paragraph 5. following.

b. Tears. - Tears may be repaired with a doped-on patch as previously described, but if the tear is more than two inches long it must be sewn before applying the patch. Use a baseball or roll stitch, and linen thread. If the tear is in more than one direction (such as L or X shaped), sew from the ends toward the center.

c. Large Holes. - When a large area of fabric is removed to clean up damage, or where considerable fabric is removed for access, it is entirely practicable to sew a patch of new airplane cloth in place, seal the seams with cloth tape doped in place with at least three coats of clear dope, and then refinish the entire area as described in paragraph 5. following. The area receiving the sewn-on patch should be trimmed square or rectangular, the surrounding area freed of old dope as previously described, and then the corners slit at 45 degrees sufficiently to permit folding under about 1/2 inch of the old fabric to provide a firm base for sewing. The patch of new cloth is then sewn in place, using a baseball stitch and curved needle, being very careful to avoid wrinkles and to insure the completely sewn patch being taut before application of dope. The tape is then applied in the manner previously described for a small patch, given three coats of clear dope, allowed to dry, and the entire area refinished.



STA.	RIB NUMBERS	MATERIAL	
10 1/4	61-24109-0 & -1 (INTER)	.032	24STAL SPEC AC11067 TYPE II
10 7/8	61-24110 (NOSE)	.032	
16 3/4	61-24111 (NOSE)	.032	
	61-24002-36 & -37 (INTER)	.025	
23 3/4	61-24002-34 & -35	.025	
30 7/8	61-24112	.032	
31 3/4	61-24002-28 & -29 (INTER)	.025	
	61-24117-0 & -1 (TRAILING)	.025	
32 5/8	61-24113	.032	
40 3/4	61-24002-27 & -27	.020	
50 3/4	61-24002-26 & -26	.020	
60 13/16	61-24115	.032	
62 1/16	61-24114	.032	
74 1/2	61-24121	.032	

NOTE: THE FIRST DASH NUMBERS ARE FOR L.H. ELEVATOR RIBS & SECOND DASH NUMBERS ARE FOR R.H. ELEVATOR RIBS.

Figure 41 - Elevator Structure

d. Stretched Fabric. - An area where the fabric has been stretched, but not torn, can sometimes be restored by carefully removing all old dope, and then redoping to tighten the fabric. This is not always successful, for if the fabric is old it may not tighten.

5. Recovering Elevator and Rudder Frame Assemblies.

The following general instructions outline the procedure used by the manufacturer of this airplane to apply the fabric covering to elevator and rudder frame assemblies. Slight modifications of the procedure may be required in some cases, but the general method will always apply.

a. Make certain that original fabric and all foreign material are thoroughly removed from the frame assembly before installing cloth to frame.

b. Place frame assembly on a suitable support and slip a fabric covering (in the form of an envelope sewn to neatly enclose the frame), over the frame, starting from the outboard end of each elevator and working to the opposite end or from the top of the rudder to the bottom end. The sewn edge of the slip cover must be along the trailing edge.

c. Make certain that covering is made taut by pulling cloth aft and inboard for the elevator, and aft and down when covering the rudder. As slack is taken up in covering, pin cloth along trailing and inboard (or bottom) edges. Excess cloth over the tab cut-out may be removed and the remaining portion of the cloth temporarily sewn together.

d. Place a piece of 1/4-inch cotton herringbone reinforcing tape over the cloth covering and directly above the total length of the existing bead on the top and bottom surfaces of each rib. Temporarily pin each tape to the covering to hold tape in position while sewing attachment wire in place.

e. Place a fabric attachment wire over each tape and use a rib stitching needle (approximately 9 inches long) to sew wire, tape, and cloth to rib structure. This may be accomplished by starting thread at one end of wire and on one side of assembly, passing needle and thread through structure, around opposite wire and then back through structure to join with a sein knot at the original starting point. From this location the thread is continued to the next lower hole in the rib beading, repeating the same operation, until the cloth is securely fastened to the structure. Proceed to next rib (or other fabric attachment point).

f. Apply a brush coat of semi-pigmented dope to all exterior surfaces of cloth covering. Allow dope to dry at least one-half hour. Next, place "pinked" tape

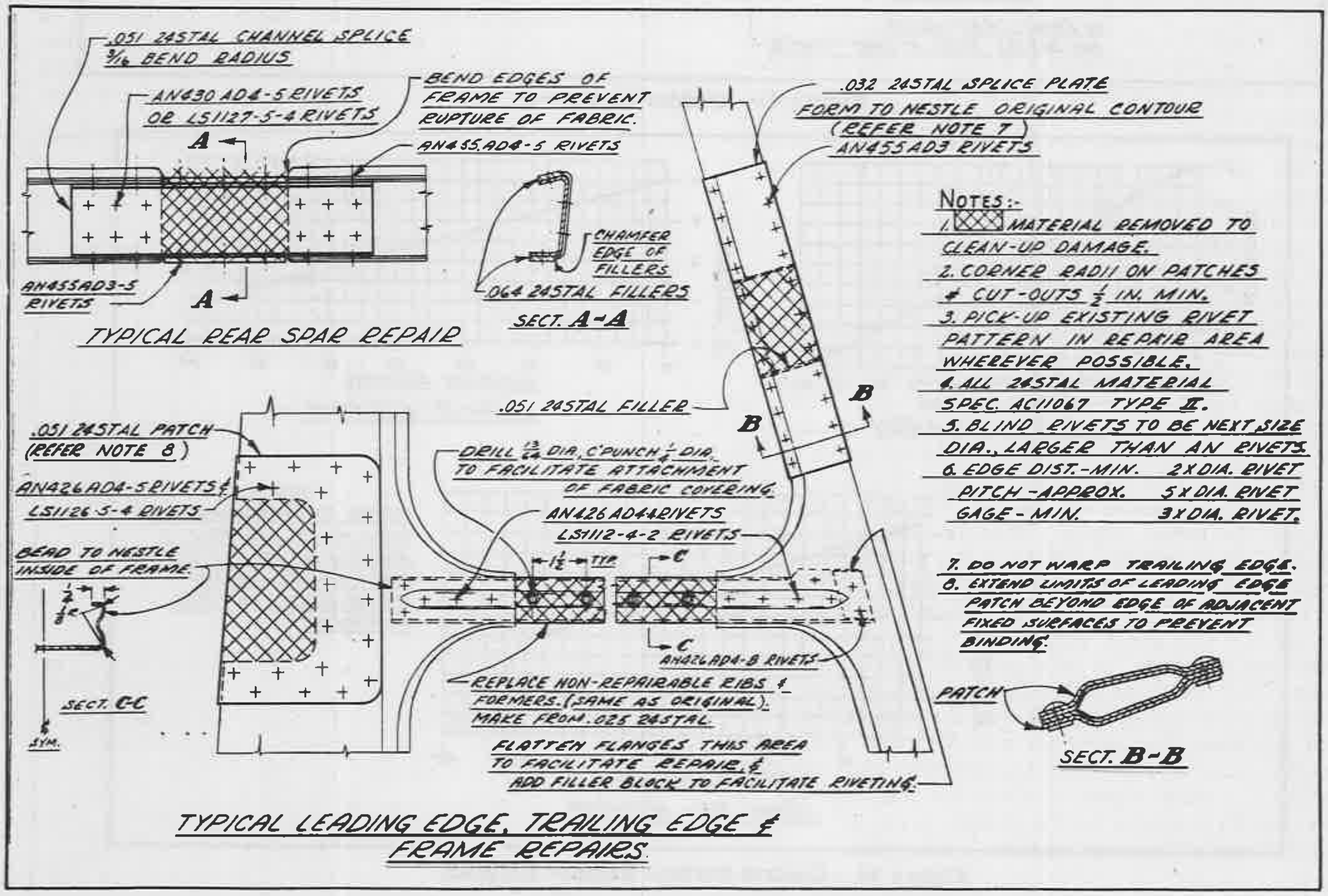
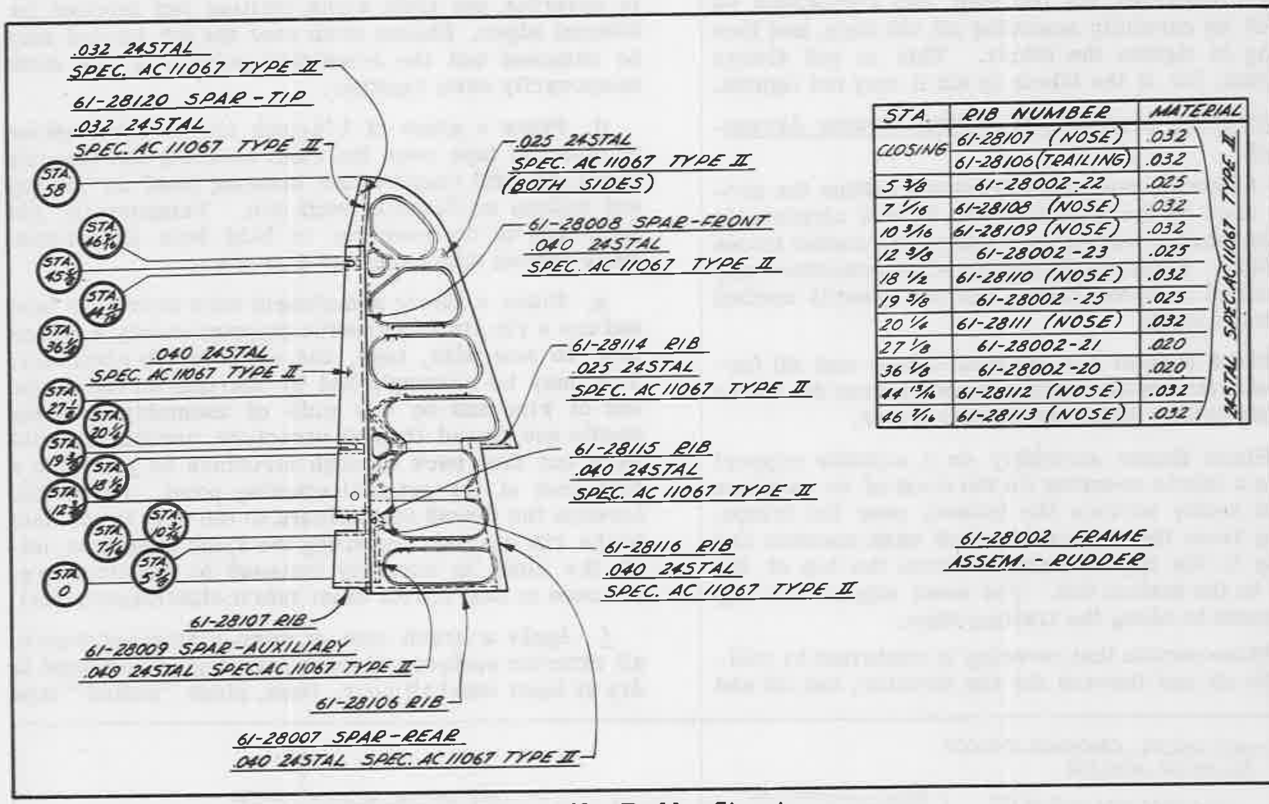


Figure 42 - Elevator and Rudder Structure Repairs



STA.	RIB NUMBER	MATERIAL
CLOSING	61-28107 (NOSE)	.032
	61-28106 (TRAILING)	.032
5 3/8	61-28002-22	.025
7 1/16	61-28108 (NOSE)	.032
10 3/16	61-28109 (NOSE)	.032
12 3/8	61-28002-23	.025
18 1/2	61-28110 (NOSE)	.032
19 3/8	61-28002-25	.025
20 1/4	61-28111 (NOSE)	.032
27 1/8	61-28002-21	.020
36 1/8	61-28002-20	.020
44 13/16	61-28112 (NOSE)	.032
46 7/16	61-28113 (NOSE)	.032

Figure 43 - Rudder Structure

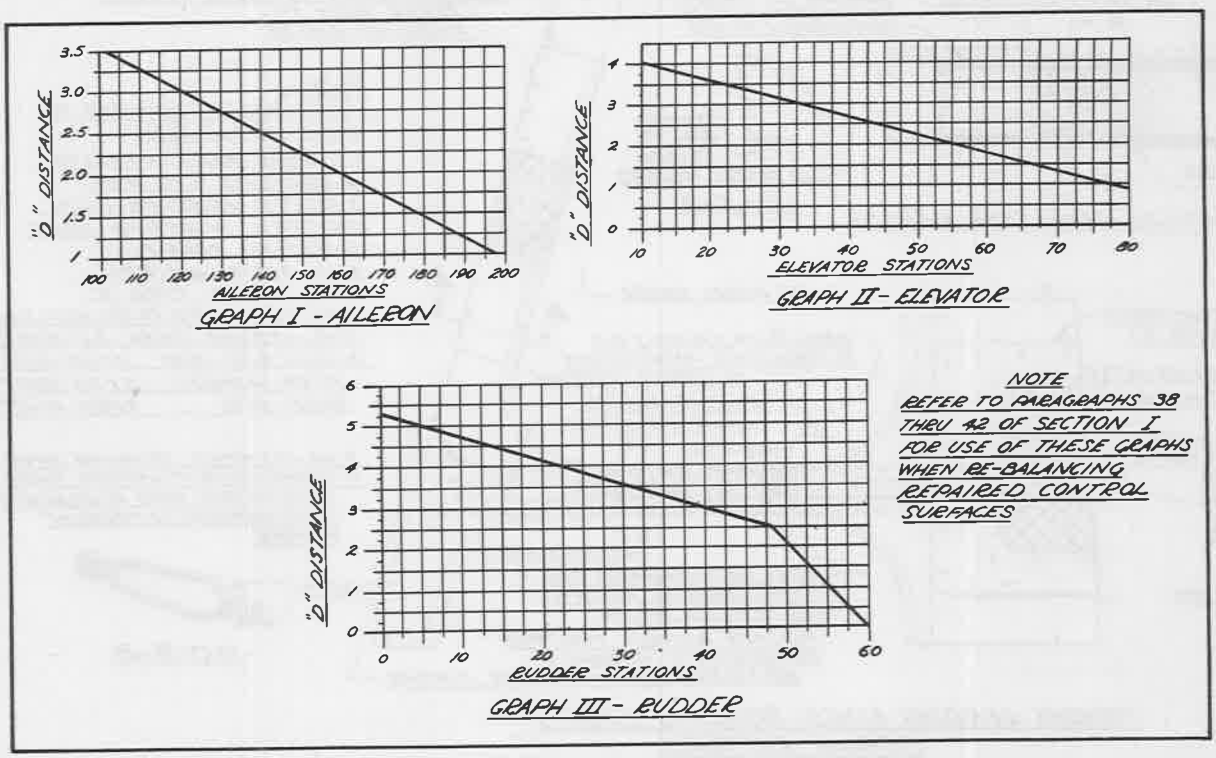


Figure 44 - Control Surface Balance Diagram

along surfaces of cloth covering to cover all sewing, seams, around hinge and tab cut-outs, along the trailing edge, and at junctions of nose skin and frame. Tape around the cut-outs and along the trailing edge should be folded over the edge for half its width. Ends of tape that extend completely around surface are to be joined at the trailing edge.

g. Apply second coat of semi-pigmented dope to cloth and tape. Allow dope to dry at least one-half hour.

h. Install drain grommets in undersurface of elevator, locating the grommets 1-1/2 to 2 inches forward of the trailing edge and in the low point of each rib bay. Dope grommet in place and make certain holes in grommet and cloth register properly to insure drainage. Then apply a brush coat of dope to these surfaces. Allow dope to dry at least one-half hour.

i. Use No. 6-0 sandpaper to smooth all doped surfaces, and then apply three spray coats of semi-pigmented dope. Allow approximately fifteen minutes drying time between each spray application.

j. Next, install tab half-hinge and retaining strips by riveting both to rear spar flange using AN426AD-4-5 rivets.

k. Use Specification No. AF-14105 shade No. 41, "Camouflage Lacquer" for applying two coats of camouflage finish.

6. Rebalancing a Repaired Elevator or Rudder.

Refer to section I for information on rebalancing an elevator or rudder after repair. Control surface balance is very critical on this airplane, and more than usual care must be taken to insure proper rebalancing after repair.

TABLE XVIII. LIST OF REPAIR MATERIALS FOR ELEVATOR AND RUDDER

Part No.	Material Spec. No.	Title	Size	Remarks
AN426AD4	--	Rivet, 100° C'sunk	1/8 Diam.	--
AN430AD4	--	Rivet, Round Head	1/8 Diam.	--
AN455AD3	--	Rivet, Brazier Head	3/32 Diam.	--
AN455AD4	--	" "	1/8 Diam.	--
LS-1112-4-2	--	Rivet, 100° C'sunk Hollow Blind	1/8 Diam.	Cherry Rivet
LS-1126-5-4	--	Rivet, 100° C'sunk Self-plugging Blind	5/32 Diam.	" "
LS-1127-5-4	--	Rivet, Brazier Head Self-plugging Blind	5/32 Diam.	" "
--	AC-6-62	Tape, Pinked, Surface, Grade A	2 in. Wide	
--	AC-11067, Type II	Sheet, Alum. Coated Alum. Alloy	0.025 Thick	24STAL
--	" " "	" " "	0.032 Thick	"
--	" " "	" " "	0.040 Thick	"
--	" " "	" " "	0.051 Thick	"
--	" " "	" " "	0.064 Thick	"
--	AC-14105	Lacquer, Cellulose Nitrate, Camouflage	No. 41	--
--	Fed V-T-276, No. 16 4 Cord, Type 1B1	Thread, Cotton, Machine	--	--
--	Fed QQ-A-356, Temper H	Wire, Aluminum Alloy	0.064 Diam.	3SH Aluminum Alloy
--	AN-CCC-C-399	Cloth, Airplane, Cotton	--	--
--	AN-TT-D-514	Dope, Cellulose Nitrate Clear	--	--
--	AN-TT-D-556	Dope, Cellulose Nitrate, Semi-Pigmented	Yellow	--
--	Commercial	Cord, Linen Barbours	9 Strand	--
--	Commercial	Tape, Cotton Herringbone	1/4 in.	--
--	Commercial	Grommet, Celluloid Drain	--	Air Associates No. 1, Catalog 17

SECTION IX

MISCELLANEOUS

1. Flight Control System.

No repairs are permissible to any part of the flight control system. Damaged parts must be replaced by new members. Refer to T. O. Nos. 01-50FA-2 and 01-50FA-3 for detailed information on control system construction, operation, rigging, and bushing replacement.

2. Control Cables.

a. Cables are used for operation of: - (i) flight control surfaces, including trimming tabs; - (ii) landing gear and tail wheel lock system; - (iii) wing gun charging system; - (iv) tail wheel centering lock; - (v) cockpit enclosure latch release; - (vi) propeller governor; - (vii) cockpit access step; and - (viii) parking brake.

b. Cables for the landing gear and tail wheel locks, tail wheel centering lock, control surface trimming tabs, parking brake, cockpit enclosure latch, and pilot's step are 1/16-inch diameter 7 x 7 carbon steel. The gun charging cables are 1/16-inch diameter 7 x 7 corrosion-resistant steel. The propeller control cable is 3/32-inch diameter 7 x 7 carbon steel. Cables for the rudder control system are 1/8-inch diameter 7 x 19 carbon steel. Aileron control cables are 5/32-inch diameter 7 x 19 carbon steel, and the elevator cables are 3/16-inch diameter 7 x 19 carbon steel. All carbon steel cable conforms to Specification No. AN-RR-C-43, "Flexible Preformed Carbon Steel Cable," and all corrosion-resistant steel cable conforms to Specification No. AN-RR-C-48, "Flexible Preformed Corrosion-Resistant Steel Cable."

c. All cables are attached to their end fittings by either swaging or the standard AAF 5-tuck splice. Cables having swaged-on Vultee Standard end fittings should be replaced with duplicate cables obtained from spare parts stores.

3. Negligible Damage to Control Cables.

A maximum of six broken wires in any one inch of straight, uninterrupted length of 7 x 19 cable is permitted by T. O. No. 01-1-26 without replacement of the cable. Broken wires should not be permitted in 7 x 7 cables, nor in main control system cables where the break will pass over a pulley or through a fairlead. Broken wires in locations where the defect will not pass through a fairlead or over a pulley may be cut off short, and then served or soldered to the cable.

4. Fabrication of Replacement Cables.

a. Where spare cables are not available, replacements may be locally manufactured in the customary manner, using tuck splices in accordance with Specification No. 98-25515 ("Splicing Cable Terminals"), and AN and AF standard thimbles, cable eyes, clevises, bushings and turnbuckle parts in place of the swaged fittings, in accordance with data given in figure 45; being careful to maintain the original cable assembly length in each case. In some cases it is necessary to slightly modify the AN standard turnbuckle eyes by reducing their thickness to that of the VS361 swaged-on cable eye, as shown in figure 45.

b. Vultee Standard swaged fitting VS360 is interchangeable with AN666 and AN669; VS361 is interchangeable with AN668; and VS362 is interchangeable with AN667.

c. Army Air Force design requirements specify that cables of 1/8-inch and larger diameter must be spliced to cable bushings, rather than thimbles. The swaged-fitting substitutes shown in figure 47 were selected to require the minimum number of parts in each case, and should be used only in emergencies for 1/8-inch and larger diameter cables; to be replaced by swaged-fitting cable assemblies as soon as practical. The substitutes shown for 1/16 and 3/32-inch diameter cables, however, are suitable for permanent use.

5. Engine Cowling Repairs.

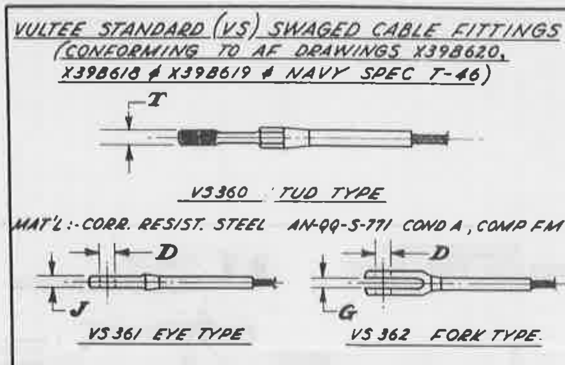
Repairs for the engine cowling are shown in figure 46. Many cowling repairs will involve simple patching of cracks and holes, and the general procedure is similar to that used for patching wing and fuselage skin, except that fewer rivets are required owing to the reduced loads. In all cases the repair schemes shown in figure 46 involve a simple procedure of removing the damaged material, applying shims and fillers of aluminum alloy sheet to bring the outer surface of the repaired structure flush with the outside surface of the undamaged skin, and then riveting a patch to skin and structure to cover the opening at the point of repair.

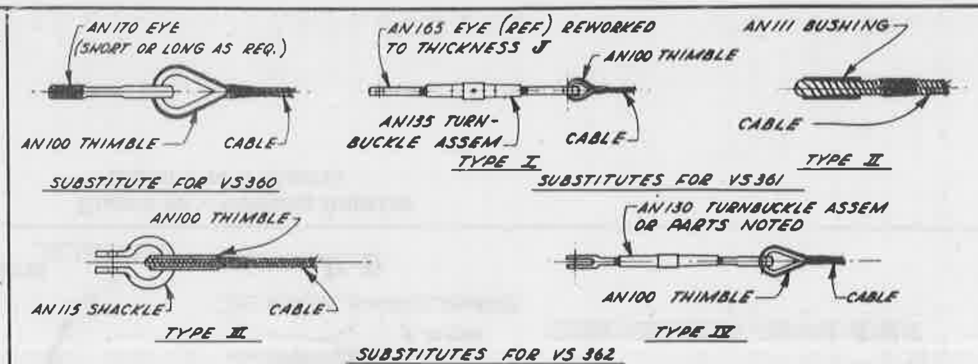
6. Fairing Repairs.

Fairing repairs will be similar to the cowling repairs shown in figure 46. Refer to section I for instructions regarding the fitting of new fairing.

7. Installation of Dzus Fasteners.

Many cowling and fairing repair operations will involve replacement of Dzus fasteners and springs. It is important that these replacements be correctly accomplished to avoid difficulty with improperly fitting fasteners and/or broken springs, as these fasteners must be installed to closer limits on hole





VS SWAGED FITTINGS						SPLICED CABLE FITTING SUBSTITUTES FOR EMERGENCY USE							
CABLE DIA	SWAGED FITTING	T THREAD	D HOLE DIA	J THICKNESS	G GAP	TYPE	BUSHING	FORK	EYE	BARREL	TURNBUCKLE ASSEM	THIMBLE	SHACKLE
1/16 7X7	VS360-2L	6-40LH				SHORT			AN170-8LS			AN100-3	
	VS360-2R	6-40RH				SHORT			AN170-8RS			-3	
	VS361-2		0.188	0.088		I					AN135-8S	-3	
	VS362-2		0.188		0.093	IV					AN130-8S	-3	
3/32 7X7	VS360-3L	10-32LH				SHORT			AN170-16LS			AN100-4	
	VS360-3R	10-32RH				SHORT			-16RS			-4	
	VS360-33L	10-32LH				LONG			-16LL			-4	
	VS360-33R	10-32RH				LONG			-16RL			-4	
	VS361-3		0.188	0.103		I					AN135-16S	-4	
	VS362-3		0.188		0.108	III						-4	AN115-16
1/8 7X19	VS360-4L	12-28LH				SHORT			AN170-21LS			AN100-4	
	VS360-4R	12-28RH				SHORT			-21RS			-4	
	VS360-44L	12-28LH				LONG			-21LL			-4	
	VS360-44R	12-28RH				LONG			-21RL			-4	
	VS361-4		0.188	0.190		II	AN111-4						
	VS362-4		0.188		0.195	IV		AN161-21RS	AN170-21LS	AN155-21S		AN100-4	
5/32 7X19	VS360-5L	1/4-28LH				SHORT			AN170-32LS			AN100-5	
	VS360-5R	1/4-28RH				SHORT			-32RS			-5	
	VS360-55L	1/4-28LH				LONG			-32LL			-5	
	VS360-55R	1/4-28RH				LONG			-32RL			-5	
	VS361-5		0.250	0.197		I					AN135-32S	-5	
	VS362-5		0.250		0.202	III						-5	AN115-32
3/16 7X19	VS360-6L	5/16-24LH				SHORT			AN170-46LS			AN100-6	
	VS360-6R	5/16-24RH				SHORT			-46RS			-6	
	VS360-66L	5/16-24LH				LONG			-46LL			-6	
	VS360-66R	5/16-24RH				LONG			-46RL			-6	
	VS361-6		0.313	0.255		II	AN111-6						
	VS362-6		0.313		0.260	IV		AN161-46RS	AN170-46LS	AN155-46S		-6	

Figure 45 - Swaged Cable Fittings and Equivalent Spliced Cable Fittings

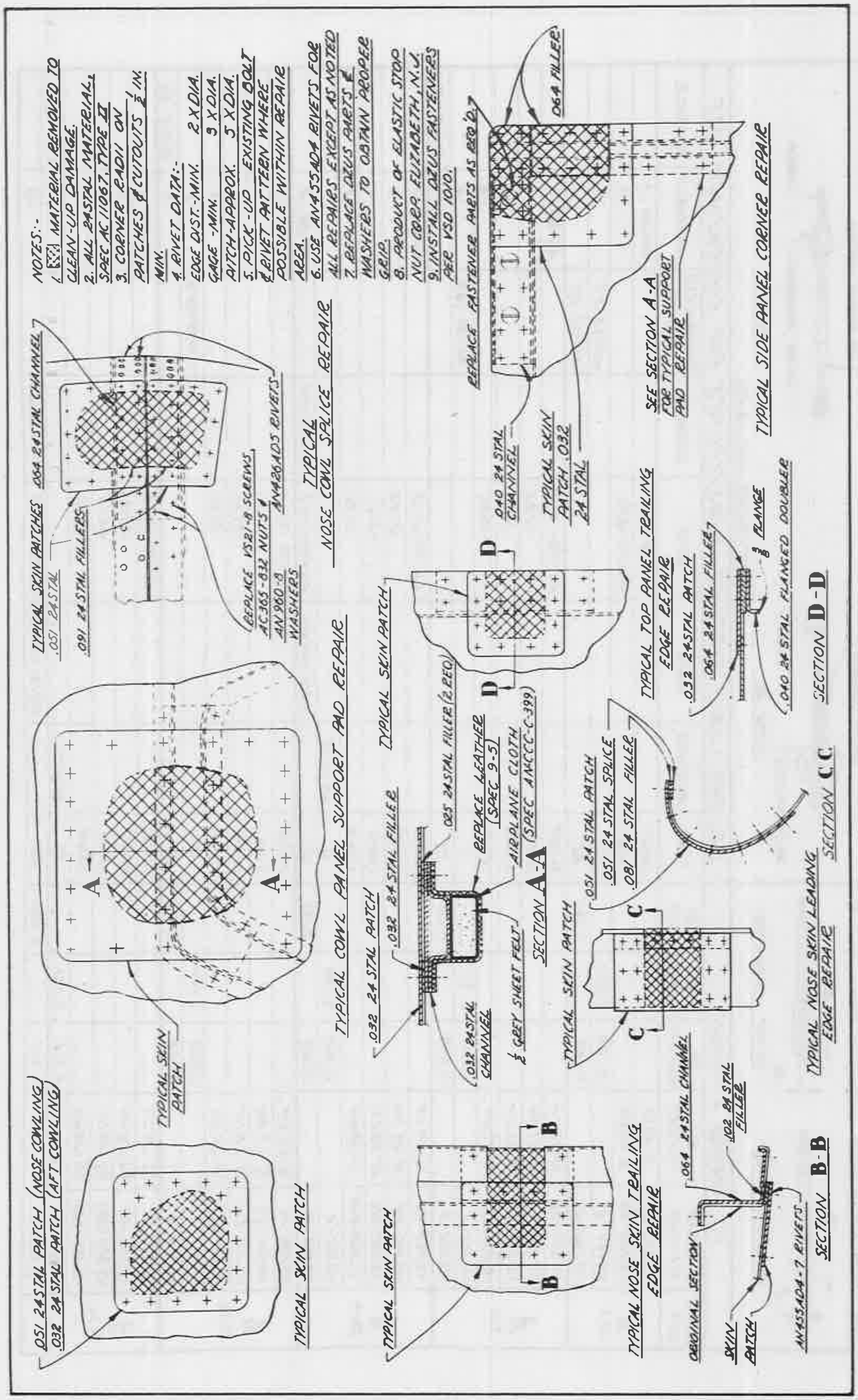


Figure 46 - Cowling Repairs
(Sheet 1 of 2 Sheets)

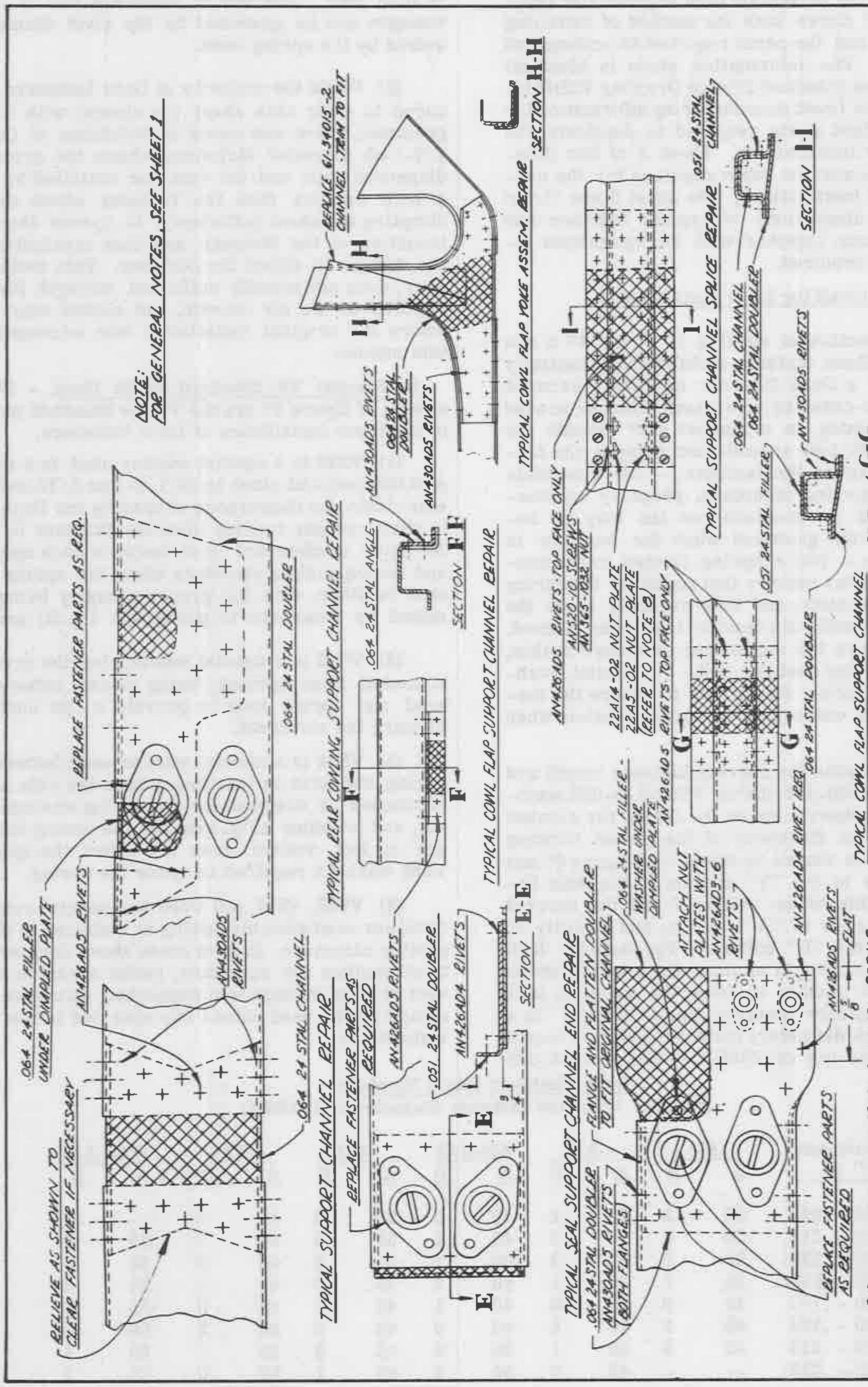


Figure 46 - Cowling Repairs
(Sheet 2 of 2 Sheets)

location and spring deflection than is generally realized. Figure 47 shows both the method of installing Dzus fasteners, and the parts required to accomplish an installation. The information given is identical with that in Vultee Standard Design Drawing VSD1010. On sheet 1 will be found manufacturing information for the Vultee Standard parts required to duplicate the original fastener installations. Sheet 2 of this illustration shows the various parts required for the normally used Dzus installations. On sheet 3 are shown the limits and dimensions of typical fastener and spring installations, together with the operations involved and tools required.

a. Parts Required for Dzus Installations.

(1) By inspection of sheet 2 of figure 47 it can be seen that a Dzus fastener installation essentially consists of - (i) a Dzus fastener or "stud" secured to a skin panel or cover by a grommet clinched around the fastener opening in a manner that extends the clinched grommet into an undercut beneath the fastener head, to secure the fastener; - (ii) a suitable hole in the supporting structure, properly counterpunched, dimpled or counterbored (as may be required) to clear the grommet when the fastener is latched in place; - (iii) a spring riveted to the supporting structure in a manner that registers the spring with the fastener slots, and thus securely holds the fastener under a moderate tension load when latched; (iv) in cases where the supporting structure is thin, a special reinforcing doubler; and - (v) special washers to correctly locate the spring to insure the fastener being held under proper spring tension when latched.

(2) To determine the correct fastener length and the quantity of VS80-4-4-020 or VS80-5-8-020 washers required to properly space the spring for correct deflection, add the thickness of the pieces forming the "T" dimension shown on sheet 2 of figure 47 and locate this value in the "T" column of the table below. Opposite this value will be found the correct fastener dash number in "A" column, and quantity of VS80 washers in the "B" column. The fastener dash number given is its length in hundredths, and is added to the basic type number to form the complete part number of the fastener required, thus; "AJ4-30" is a type AJ4 (1/4-inch diameter) fastener having a length of 0.30 inch. The use of VS80-4-4-020 or -5-8-020

of 0.30 inch. The use of VS80-4-4-020 or -5-8-020
washers will be governed by the rivet diameter required by the spring used.

(3) While the majority of Dzus fasteners are secured to their skin sheet (or sheets) with a special grommet, there are some installations of the small 1/4-inch diameter fasteners where the grommet is dispensed with, and the fastener installed by drilling a hole smaller than the fastener shank diameter, dimpling the sheet sufficiently to spread the hole for insertion of the fastener, and then straightening out the dimple to clinch the fastener. This method however, does not provide sufficient strength for panels exposed to the air stream, and should only be used where the original installation was accomplished in this manner.

b. Special VS Standard Parts Used. - Shown on sheet 1 of figure 47 are the Vultee Standard parts used to facilitate installation of Dzus fasteners.

(1) VS80 is a special washer used in a thickness of 0.020 inch and sizes to fit 1/8- and 3/32-inch diameter rivets, for the purpose of spacing the Dzus springs to obtain proper tension when the fastener is latched. An equal number are used between each spring loop and the supporting structure when the spring is riveted in place, with the proper quantity being determined by reference to paragraph 7.a.(2) preceding.

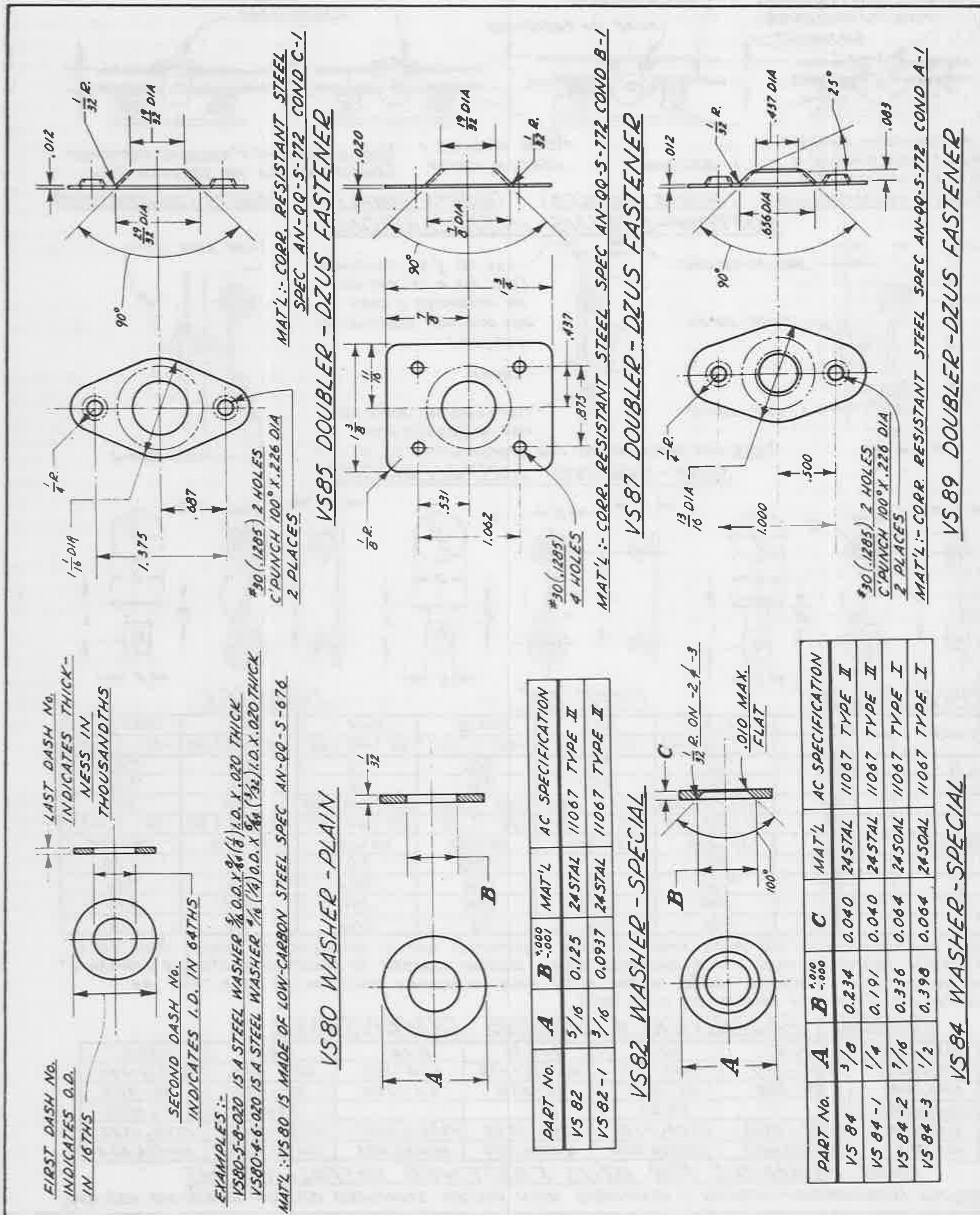
(2) VS82 is a special washer for the rivets used to install Dzus springs; being placed between shophead and spring loop to provide a flat surface for forming the rivethead.

(3) VS84 is a special washer used between Dzus spring and skin in locations where the skin is counterpunched or dimpled for the spring attachment rivets, and provides a flat seat for the spring loop. The use of this washer does not affect the quantity of VS80 washers required to space the spring.

(4) VS85, VS87, and VS89 are special reinforcing doublers used when the spring is installed in thin supporting structure. In such cases these doublers serve to strengthen the structure, resist abrasion and prevent chafing through thin supporting structure. These should not be used unless incorporated in the original installation.

Dzus Fastener Basic Numbers
(Number indicates fastener diameter in 1/16ths)

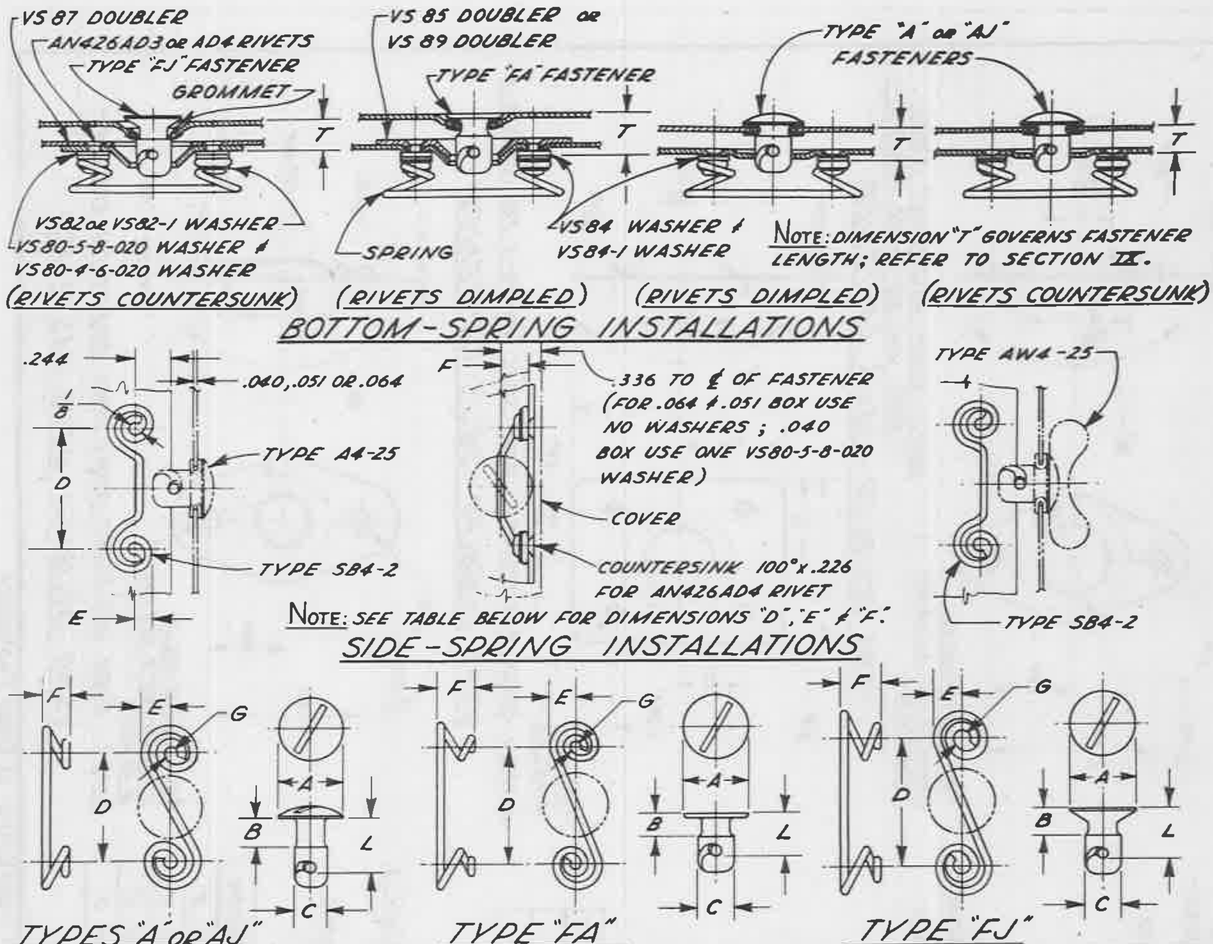
Thickness	AJ4		AJ5		AJ6-1/2		FJ4		FA5		FA6-1/2	
"T" in.	A	B	A	B	A	B	A	B	A	B	A	B
.080 - .099	30	2	35	4	40	5	35	3	40	2	--	--
.100 - .119	30	1	35	3	40	4	35	2	40	1	55	4
.120 - .139	30	0	35	2	40	3	35	1	40	0	55	3
.140 - .159	35	1	35	1	40	2	35	0	45	1	55	2
.160 - .179	35	0	35	0	40	1	40	1	45	0	55	1
.180 - .199	40	1	40	2	40	0	40	0	50	2	55	0
.200 - .219	40	0	40	1	50	4	45	2	50	1	65	4
.220 - .239	--	-	40	0	50	3	45	1	50	0	65	3



PART No.	A	B +.000 -.001	MAT'L	AC SPECIFICATION
VS 82	5/16	0.125	24STAL	11067 TYPE II
VS 82-1	3/16	0.0937	24STAL	11067 TYPE II

PART No.	A	B +.010 -.000	C	MAT'L	AC SPECIFICATION
VS 84	3/8	0.234	0.040	24STAL	11067 TYPE II
VS 84-1	1/4	0.191	0.040	24STAL	11067 TYPE II
VS 84-2	7/16	0.336	0.064	24SOAL	11067 TYPE I
VS 84-3	1/2	0.398	0.064	24SOAL	11067 TYPE I

Figure 47 - Installation of Dzus Fasteners
(Sheet 1 of 3 Sheets)



TYPES	A4	AJ4			AJ5		AJ6½		FJ4			FA5			FA6½	
	-25	-30	-35	-40	-35	-40	-40	-50	-35	-40	-45	-40	-45	-50	-55	-65
A	7/16	7/16			9/16		11/16		7/16			9/16			23/32	
C	1/4	1/4			5/16		13/32		1/4			5/16			13/32	
B	.080	.100	.150	.200	.125	.190	.188	.250	.175	.200	.225	.188			.250	
L	.250	.30	.35	.40	.35	.40	.40	.50	.35	.40	.45	.40	.45	.50	.55	.65
SPRING	SB4-2	S4-200			S5-200		S6-250		S4-250			S5-325			S6-425	
D	15/16	3/4			1		1 3/8		3/4			1			1 3/8	
E	9/64	13/64			9/32		5/16		13/64			9/32			5/16	
F	5/32	.200			.200		.250		.250			.325			.425	
G	1/8	3/32			1/8		1/8		3/32			1/8			1/8	

NOTE:- THE NUMERAL IN THE BASIC TYPE NUMBER INDICATES THE "C" DIAMETER IN 1/16 THS; THUS "A4" IS A TYPE "A" FASTENER WITH A 1/4 IN. DIAMETER BODY. A DASH NUMBER TO INDICATE FASTENER LENGTH "L" IN HUNDREDTHS IS ALWAYS ADDED TO THE BASIC TYPE NUMBER: THUS "A4-25" IS A TYPE A4 FASTENER HAVING A LENGTH OF 0.250 INCH.

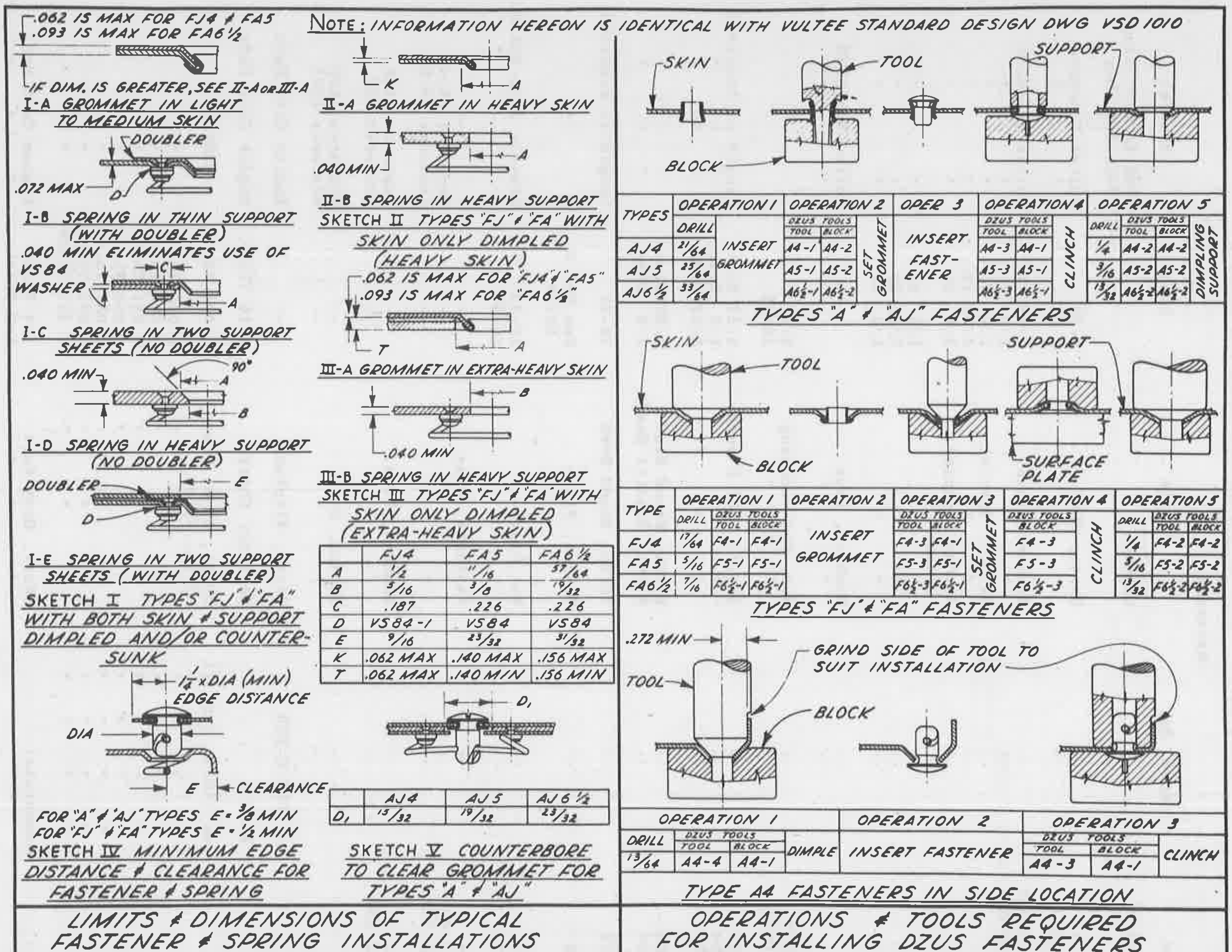
TYPICAL FASTENER & SPRING DIMENSIONS

FASTENER	AJ4	AJ5	AJ6½	FJ4	FA5	FA6½
GROMMET	GA4-250	GA5-312	GA6½-375	GF4-150	GF5-175	GF6½-250
SPRING	S4-200	S5-200	S6-250	S4-250	S5-325	S6-425
DOUBLERS		VS86			VS89	VS87, VS89
WASHERS	VS84-1, VS82-1	VS84, VS82	VS84, VS82	VS84-1, VS82-1	VS84, VS82	VS84, VS82
RIVETS	AN426AD3	AN426AD4	AN426AD4	AN426AD3	AN426AD4	AN426AD4

PART NUMBERS FOR DZUS FASTENER INSTALLATIONS

NOTE:- THE INFORMATION HEREON IS IDENTICAL WITH VULTEE STANDARD DESIGN DRAWING VSD 1010.

Figure 47 - Installation of Dzus Fasteners
(Sheet 2 of 3 Sheets)



	FJ4	FA5	FA6½
A	½	11/16	37/64
B	5/16	3/8	19/32
C	.187	.226	.226
D	VS84-1	VS84	VS84
E	9/16	23/32	31/32
K	.062 MAX	.140 MAX	.156 MAX
T	.062 MAX	.140 MIN	.156 MIN

	AJ4	AJ5	AJ6½
D1	15/32	19/32	23/32

TYPES	OPERATION 1		OPERATION 2			OPER 3	OPERATION 4			OPERATION 5			
	DRILL		DZUS TOOLS TOOL	DZUS TOOLS BLOCK			DZUS TOOLS TOOL	DZUS TOOLS BLOCK		DRILL	DZUS TOOLS TOOL	DZUS TOOLS BLOCK	
AJ4	21/64	INSERT GROMMET	A4-1	A4-2	SET GROMMET	INSERT FASTENER	A4-3	A4-1	CLINCH	¼	A4-2	A4-2	DIMPLING SUPPORT
AJ5	25/64	INSERT GROMMET	A5-1	A5-2	SET GROMMET	INSERT FASTENER	A5-3	A5-1	CLINCH	3/16	A5-2	A5-2	DIMPLING SUPPORT
AJ6½	33/64	INSERT GROMMET	A6½-1	A6½-2	SET GROMMET	INSERT FASTENER	A6½-3	A6½-1	CLINCH	13/32	A6½-2	A6½-2	DIMPLING SUPPORT

TYPES "A" & "AJ" FASTENERS

TYPE	OPERATION 1			OPERATION 2	OPERATION 3			OPERATION 4		OPERATION 5		
	DRILL	DZUS TOOLS TOOL	DZUS TOOLS BLOCK		DZUS TOOLS TOOL	DZUS TOOLS BLOCK		DZUS TOOLS BLOCK		DRILL	DZUS TOOLS TOOL	DZUS TOOLS BLOCK
FJ4	17/64	F4-1	F4-1	INSERT GROMMET	F4-3	F4-1	SET GROMMET	F4-3	CLINCH	¼	F4-2	F4-2
FA5	5/16	F5-1	F5-1	INSERT GROMMET	F5-3	F5-1	SET GROMMET	F5-3	CLINCH	5/16	F5-2	F5-2
FA6½	7/16	F6½-1	F6½-1	INSERT GROMMET	F6½-3	F6½-1	SET GROMMET	F6½-3	CLINCH	13/32	F6½-2	F6½-2

TYPES "FJ" & "FA" FASTENERS

OPERATION 1				OPERATION 2	OPERATION 3		
DRILL	DZUS TOOLS TOOL	DZUS TOOLS BLOCK			DZUS TOOLS TOOL	DZUS TOOLS BLOCK	
13/64	A4-4	A4-1	DIMPLE	INSERT FASTENER	A4-3	A4-1	CLINCH

TYPE A4 FASTENERS IN SIDE LOCATION

Figure 47 - Installation of Dzus Fasteners
(Sheet 3 of 3 Sheets)

TABLE XIX. LIST OF REPAIR MATERIALS FOR COWLING

Part No.	Material Spec. No.	Material Title	Size	Remarks
61-34015-2	--	Channel	--	Used in Cowl Flap Yoke Assembly
VS21-8-8	--	Screw, 100°	8-32	Vultee Standard
VS21-8-9	--	" "	8-32	" "
VS80-4-6-020	--	Washer, Plain	3/32 ID	Vultee Standard
VS80-5-8-020	--	" "	1/8 ID	" "
VS82	--	Washer, Special	1/8 ID	" "
VS82-1	--	" "	3/32 ID	" "
VS84	--	Washer, Special C'sunk	3/8 OD	" "
VS84-1	--	" "	1/4 OD	" "
VS84-2	--	" "	7/16 OD	" "
VS84-3	--	" "	1/2 OD	" "
VS85	--	Doubler, Dzus	--	Vultee Standard
VS89	--	" "	--	" "
AC365-832	--	Nut, Self-locking	8-32	--
AC365-1032	--	" " "	10-32	--
AN426AD3	--	Rivet, 100° C'sunk	3/32 Diam.	Length as Required
AN426AD4	--	" " "	1/8 Diam.	" " "
AN426AD5	--	" " "	5/32 Diam.	" " "
AN430AD5	--	Rivet, Round Head	5/32 Diam.	" " "
AN455AD4	--	Rivet, Brazier Head	1/8 Diam.	" " "
AN520-10	--	Screw, Round Head	10-32	Length as Required
AN960-8	--	Washer, Plain	For No. 8 Screw	--
22A5-02	--	Nut Plate	10-32	Elastic Stop Nut Co.
22A14-02	--	" "	10-32	" " " "
FA5-40*	--	Fastener, Dzus	--	--
FA6-1/2-45*	--	" "	--	Replaces FA-46
FA6-1/2-55*	--	" "	--	Replaces FA-56
GF5-175	--	Grommet, Dzus	--	Replaces 375F
GF6-1/2-250	--	" "	--	Replaces 502
S5-325	--	Spring, Dzus	--	Replaces 100F
S6-425	--	" "	--	Replaces 1375
--	AN-CCC-C-399	Cloth, Airplane	--	Engine Cowl Pads
--	AC-9-5	Leather, Chrome	1/16 Thick	Engine Cowl Pads
--	AC-11067, Type II	Sheet, Alum. Coated Alum. Alloy	0.025 Thick	24STAL
--	" " " "	" " "	0.032 Thick	"
--	" " " "	" " "	0.040 Thick	"
--	" " " "	" " "	0.051 Thick	"
--	" " " "	" " "	0.064 Thick	"
--	" " " "	" " "	0.081 Thick	"
--	" " " "	" " "	0.091 Thick	"
--	" " " "	" " "	0.102 Thick	"
--	Commercial	Sheet, Grey Felt	1/4 Thick	Engine Cowl Pads
--	"	" " "	1/2 Thick	" " "

*Note: Longer fasteners may be required for some repairs. Refer to figure 47.

c. Limits and Dimensions for Dzus Fastener Installations. - On sheet 3 of figure 47 will be found dimensional data for the proper installation of fasteners and springs.

(1) Sketch I shows the limits for countersunk type "FJ" and "FA" fasteners with both skin and support structure counterpunched and/or countersunk, for installations wherein the skin is relatively thin. In this case the grommet clinches around all the skin sheets, and the spring support structure is counterpunched or countersunk (depending upon its thickness) to provide clearance for the grommet.

(2) Sketch II shows the limits for installing countersunk type "FJ" and "FA" fasteners and springs in heavy skin and structure. It will be observed that only the outer skin sheet is counterpunched, and that the grommet is clinched over this sheet only. The inner skin sheet is countersunk to the outside diameter of the counterpunch in the outer skin sheet, and not counterpunched. The installation is further simplified by elimination of the countersink in the spring support structure, by substitution of a plain, straight side clearance hole. This arrangement is practical when the structure and skin are considerably thicker than the head of the fastener.

(3) Sketch III shows limits for installing countersunk type "FJ" and "FA" fasteners and stringers in extra heavy skin and structure. The procedure is identical with that shown on sketch II, but some limits and dimensions are different.

(4) Sketch IV indicates the minimum edge distance for fastener installation, and shows the minimum clearance permissible between spring loops and sidewalls or flanges.

(5) Sketch V shows the proper clearance hole diameter for support structure receiving types "A" and "AJ" fasteners.

d. Operations and Tools Required for Installing Dzus Fasteners. - Sheet 3 of figure 47 shows the methods of installing the various Dzus fastener types. The Dzus tools required for the various operations are also listed.

(1) The installation of types "A" and "AJ" fasteners first involves accurately locating the hole for the fastener, drilling this to proper size, and burring the edges of the drilled hole. The grommet is then installed, and by the aid of the required Dzus tools is "set" or flared sufficiently to hold in place. The fastener is then installed, and clinched by placing the head of the fastener (inserted in the grommet located in the sheet) upside down against the proper block, and then using the proper clinching tool and a hammer to clinch the grommet down around the skin sheet, and into the undercut beneath the fastener head. When this clinching operation is properly accomplished, the fastener will be securely held in the skin sheet, and still be free to turn the grommet. This completes the installation of the fastener, and the remaining operations involve drilling the dimpling of the support structure to clear the grommet (unless a counterbore is used, as is the case with heavy structure), location, drilling, and counterpunching or countersinking of the spring rivet holes, and installation of the spring by the proper rivets, washers, and doublers as previously described.

(2) The installation procedure for types "FJ" and "FA" flush fasteners is somewhat different from that previously described. The skin is prepared by accurately locating the hole for the fastener, drilling this to the proper size, and then dimpling the hole with appropriate Dzus tools. The grommet is then installed, and "set" with the proper Dzus tools, followed by inserting the fastener. The fastener, (inserted in grommet located in the sheet) is then placed upside down on a surface plate, and the grommet is clinched by using the proper clinching tool and a hammer, with the taper of the fastener head serving to force the grommet into the undercut beneath the head. The support structure is then drilled to match with the proper diameter hole, and this hole counterpunched with the proper tools. Holes for the spring attaching rivets are then drilled, countersunk or counterpunched, and the spring installed with the required rivets, washers, and doubler.

(3) The 1/4-inch diameter fasteners used to secure electrical junction box covers, and the like, are frequently installed without the use of a grommet. This is accomplished by drilling a hole slightly larger than the diameter of the undercut beneath the fastener head, dimpling this hole to expand its diameter sufficiently to permit inserting the fastener, and then straightening out the dimple to secure the fastener in place. The tools required for this operation are listed and shown on sheet 3 of figure 47.

8. Cockpit Enclosure.

Figure 48 identifies all transparent panels, rubber extrusions and metal extrusions used in the cockpit enclosure.

a. Windshield and Bullet Resistant Glass. - The windshield and bullet resistant glass mounted inside the windshield are nonrepairable, and must be replaced when damaged.

b. Transparent Plastic Panels. - The transparent panels forming the top and sides of the cockpit enclosure are manufactured from acrylic resin plastic conforming to Specification No. 94-12014, "Transparent Sheet." These panels are repairable within reasonable limits, and their service life will be greatly extended if care is used to avoid scratching and marring of the panels during operation and maintenance of the airplane.

(1) Cleaning. - Soap and water should be used to remove dirt, while kerosene or naptha may be used to remove oil and grease. Never use acetone, benzene,

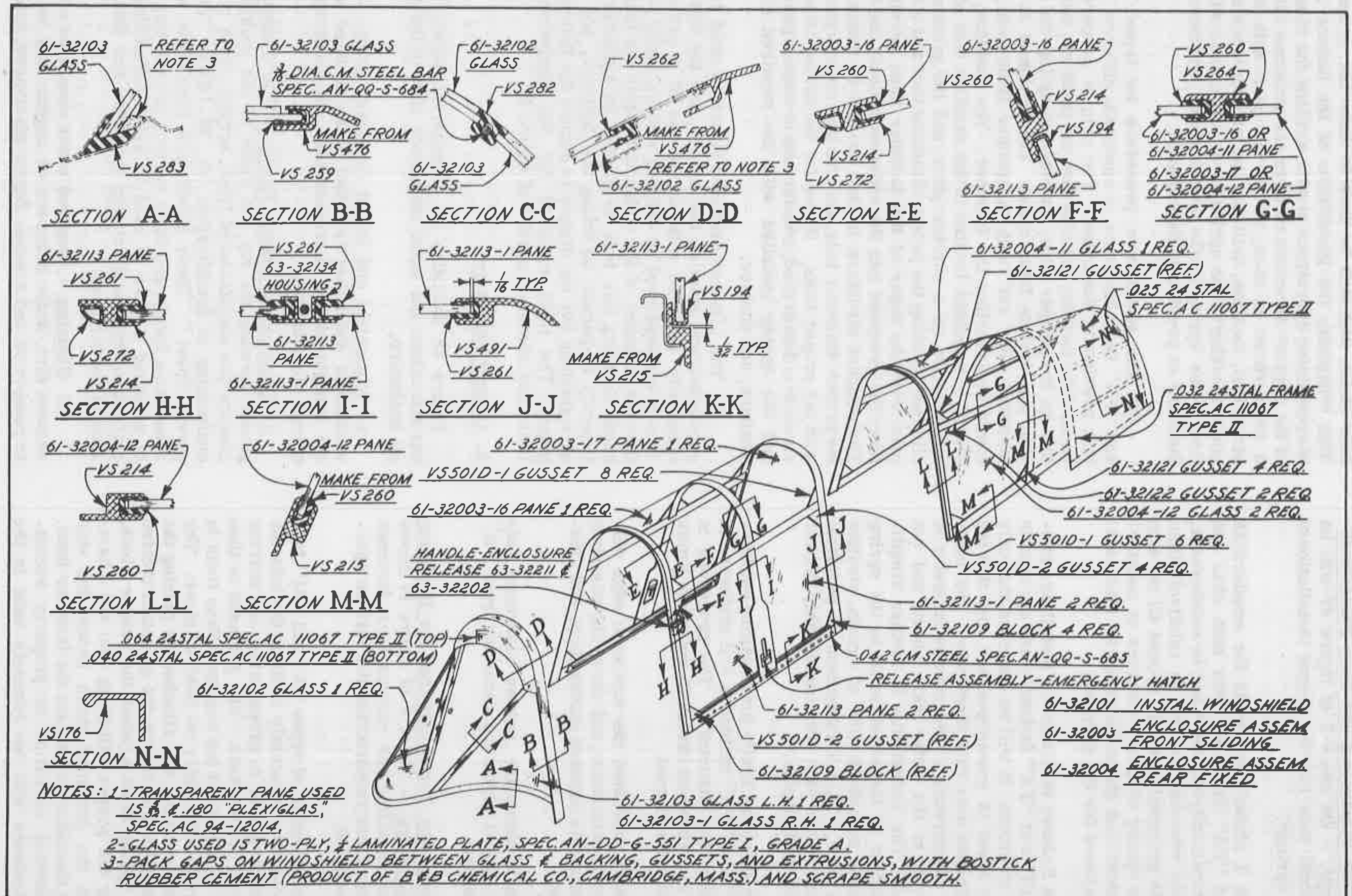


Figure 48 - Cockpit Enclosure Structure

lacquer thinner, or prepared window cleaning solutions to clean transparent plastic, for these may soften and blemish the plastic. A clean, grit-free soft cloth, chamois, or sponge may be used to apply the soap and water, and to scrub the panel. Never attempt to clean these panels by rubbing with a dry cloth, for not only is this likely to cause scratches, but it will also build up an electrostatic charge which attracts dust particles to the surface. The panels should be finished with a good grade of automobile or furniture wax after cleaning, to cover minor scratches, provide a good gloss to the surface, and prevent further scratching.

(2) Polishing.

(a) Best polishing results are obtained with a very soft, open type of cotton buffing wheel. At the start of each buffing operation, the transparent plastic should be clean and dry. Use standard polishing compounds composed of very fine alumina or similar abrasive in combination with wax, tallow, or grease binders. The buff on which these abrasives are used should run at about 2000 surface feet per minute; for example, a 6-inch diameter buff should operate at approximately 1400 rpm. After most of the scratches have been reduced with abrasive, buff the panel on a wheel to which only tallow has been applied - using an unbleached cotton sheeting buff operating at 3200 to 3600 surface feet per minute. Finish buff the panel to a high polish on a buff on which no abrasive or tallow is used. This final buff may be of imitation chamois 10- to 12-inch diameter running at 8000 to 10,000 surface feet per minute. Caution must be used during all buffing operations to avoid generating enough heat in any one spot to soften the plastic and "burn" its surface.

(b) Wet-sand all sawed or rough edges to a smooth dull finish, using 320-A or finer sandpaper, and then buff lengthwise to a good gloss against the side of a clean, firm wool-felt buff (approximately 1/4 inch thick on a wood or steel disc) operating at 5500 surface feet per minute, using a paste of water and pumice, magnesium carbonate or similar abrasive. Finish buff by following the procedure outlined in paragraph (a) preceding.

(c) In emergencies, when buffing equipment is not available, a good automobile body cleaner (such as "Simonize Kleener") can be applied by hand to remove scratches and other imperfections in the transparent panels. Use a damp, soft cloth such as imitation chamois, glove lining or outing flannel. The area to be polished is rubbed vigorously, but not too long in one place. Rub with a free, circular motion over a fairly wide area. Several applications of cleaner may be necessary. When the scratches are removed or considerably reduced, the cleaner should be removed with a damp, soft cloth, and a good automobile wax applied and rubbed to a high polish.

(3) Repairing and Patching. - In the paragraphs following are described both emergency repairs for the transparent panels, and those which can be accomplished at a properly equipped repair base. The former represent methods which can be followed in the shortest possible time and with a minimum of equipment. Seriously damaged panels should be replaced as soon as possible. Even when adequate facilities are available, replacing the panel may be less expensive than attempting a repair. In general it will be found economical to buff almost any scratched section, but patching is not usually justified if replacement panels are obtainable, as even a carefully patched part is not optically or structurally equal to a new panel.

(a) Cracks. - At the first sign of cracking, a hole 1/8- to 3/16-inch diameter should be drilled at the ends of the crack. This simple operation will prevent further cracking by distributing the load over a larger area. It is also possible to strengthen the adjacent area by lacing the crack with wire as shown in figure 49. A row of holes should be drilled 1/2 inch distant from each side of the crack, and a strong flexible wire (such as antenna wire) used for lacing. This will not seriously interfere with vision, and will usually suffice until the crack can be patched, or the panel replaced.

(b) Holes. - The first step in repairing holes in the transparent panels is to trim the damaged area to a circle, as soon as possible. This will prevent the development of radial cracks and confine the damage to a minimum area. As an emergency repair, the hole can be patched with wing fabric or thin transparent sheet applied to both surfaces with dope or other suitable solvent. Acetone, ethylene dichloride and lacquer thinners will serve to soften the surface so that a satisfactory bond between the patch and the panel may be obtained. This method is for emergency repair only, however, for the solvent will eventually cause "crazing" of the plastic surface.

(c) Patching. - The three guiding principles of patching the transparent panels are: (i) the patch must fit perfectly; (ii) a firm pressure must be applied evenly to all edges of the patch while the cement is drying; and (iii) sufficient time must be allowed for the cement to dry.

1. The hole to be patched must first be trimmed to a perfect circle or oval and the edges of the hole given a slight taper. The patch is cut out of equivalent transparent sheet, slightly thicker than the section to be repaired and given a more oblique taper than the hole itself. Its edges are heated in an oven or over an alcohol lamp until it is very soft and pliable. Then it is forced into the hole and allowed to cool.

2. The patch is then removed and both surfaces thoroughly masked with "Permacel" masking paper. The edges of the patch are allowed to soak in monomeric methyl methacrylate or ethylene dichloride until the edges are considerably softened. This may require 30 to 45 minutes for monomeric methyl methacrylate or two to three minutes for ethylene dichloride.

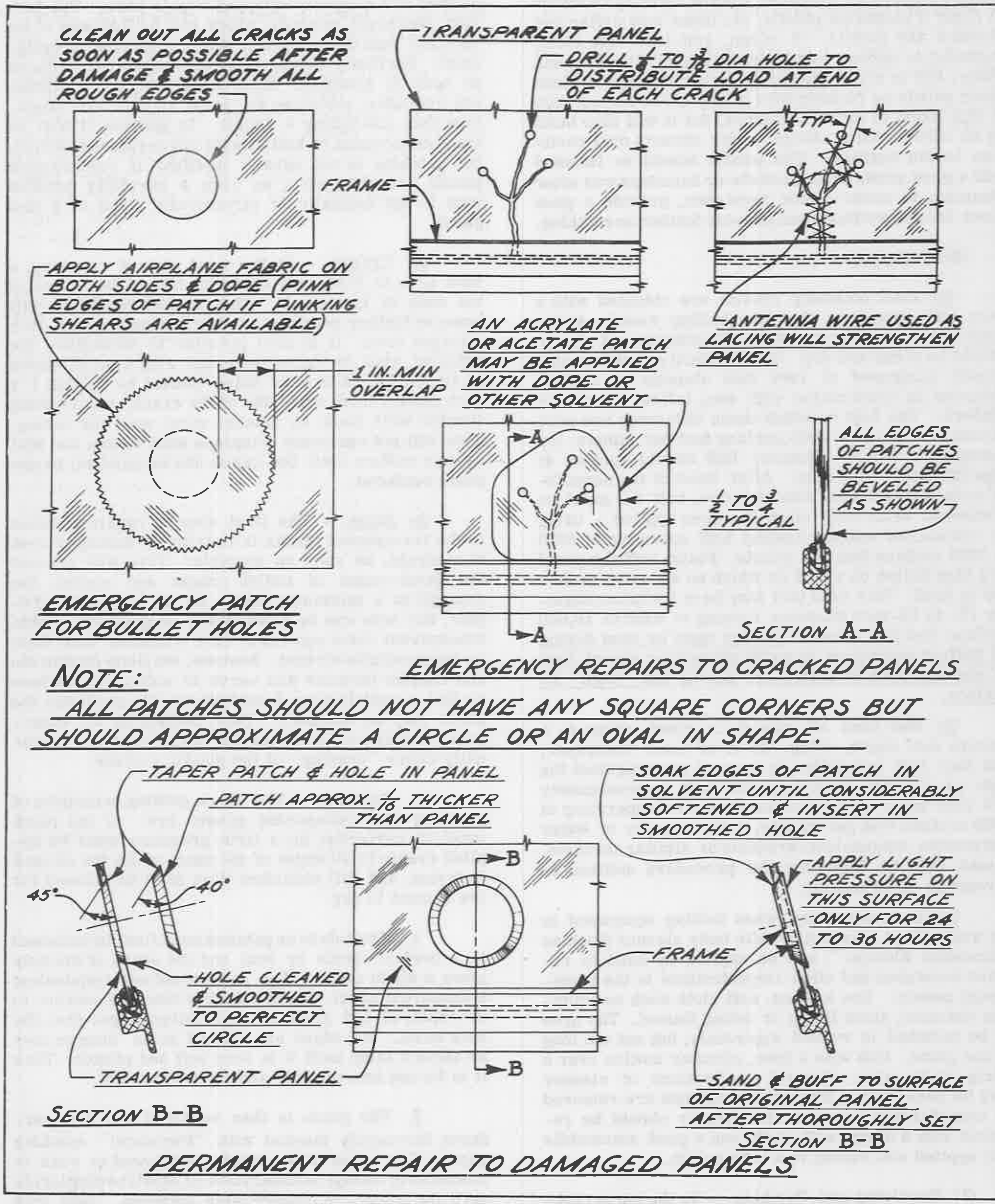


Figure 49 - Cockpit Enclosure Transparent Panel Repairs

The patch is then inserted in the hole again. Because the edges are tapered, pressure need be applied only on one surface and equal pressure will automatically ap ly to all edges. It is advisable to leave the patch under light pressure for 24 to 36 hours and preferably longer before any attempt is made to clean up the patch by filing, sanding, and buffing it to the level of the patched piece.

3. In patching a curved or large section where it is not possible to heat the patch, it is possible to obtain a perfect fit by cutting the patch first and using it as a template. The area to be cut out of the damaged piece is indicated by scribe lines. The operator should saw within the scribe lines and sand or file the edges to a smooth 45-degree taper. With careful workmanship, it will be possible to obtain a good fit.

4. When the section is curved, the part to be repaired may be used as a form for the patch simply by protecting it with outing flannel or similar soft cloth. The patch may be heated as described in paragraph (4) following to facilitate forming.

5. The patch should never be square or have any sharp corners at which strains may develop. An oval or round patch will always prove more satisfactory.

(4) Fabrication of Curved Panels. - When spare curved panels are not available it is possible to fabricate these from acrylate base flat sheet conforming to Specification No. 94-12014, "Transparent Sheet." In order to provide sufficient plasticity for working, heat the trimmed flat panel in a hot-air oven at 220 to 250 degrees F, (105 to 120 degrees C approximately). If the hot-air oven is not available, the flat panel may be heated in perfectly clean hot oil, glycerine, or kerosene. Hot water is unsatisfactory and should not be used. If the heated liquid method is used, immerse the panel for a few minutes, remove it and allow to form over a cloth-covered wood or metal form-block of the proper curvature. Since the warm plastic readily takes impressions, it must be handled carefully with clean cotton gloves. After the plastic sheet has cooled on the form, remove, trim, and polish the panel. To drill the panel for installation, ordinary drills for metal may be used. Apply the drill lightly to eliminate "grabbing" when the drill penetrates the piece.

c. Negligible Damage to Cockpit Enclosure Frames. - Small isolated dents in the cockpit enclosure structure, free from cracks, sharp corners, or perforations may be neglected. Nicks in the free edges of structural members should be cleaned out and if the depth is not greater than 1/16 inch they may be neglected.

d. Repairs to Cockpit Enclosure Frames. - The nature of the cockpit enclosure frames are such that it is necessary to consider them as being nonrepairable, and damaged sections must be replaced with new members.

9. Armor Plate.

Armor plate is nonrepairable, and all sections that are cracked or pierced should be replaced. The entire structure in the vicinity of damaged armor plate should be carefully examined for damage due to transmittal shock loads.

TABLE XX. LIST OF REPAIR MATERIALS FOR COCKPIT ENCLOSURE TRANSPARENT PANELS

Part No.	Material Spec. No.	Title	Size	Remarks
--	AC-94-12014	Sheet, Transparent	5/32 Thick	For Making New Panels
--	" " "	" "	0.180 Thick	" " " "
--	" " "	" "	7/32 Thick	For Patches
--	" " "	" "	1/4 Thick	" "
--	AN-CCC-C-399	Cloth, Airplane	--	For Patching Small Holes
--	AN-TT-D-514	Dope, Nitrate, Clear		For Patching Small Holes
--	Fed-O-A-51	Acetone	--	For Cementing Patches
--	Commercial	Monomeric Methyl Methacrylate	--	" "
--	Commercial	Ethylene Dichloride	--	" "
--	Commercial	Tape, "Permacel"	1 in. Wide	Rohm & Haas Co.
--	Commercial	Wire, Flexible Aerial	7 x 26 Approx. .050	For Lacing Cracks: Belden Mfg. Co.