DC-4

REPAIR MANUAL

DOUGLAS AIRCRAFT CO., INC. SANTA MONICA, CALIF., U.S.A.

STRUCTURAL REPAIR MANUAL

FOR THE MODEL

DC-4 SERIES

AIRPLANE

PUBLISHED BY

DOUGLAS AIRCRAFT CO., INC. SANTA MONICA, CALIF., U. S. A.

REVISED JANUARY 15, 1948

PREFACE

The purpose of this manual is to aid operators in repairing Douglas DC-4 series airplanes. All typical repair manuals for this series of aircraft bearing an earlier date are hereby superseded.

The design of the repairs in this manual has been approved by the Aircraft and Components Branch of the Civil Aeronautics Authority; however, when repairs are made in accordance with the instructions in this manual, it will still be necessary to obtain specific approval from the C.A.A. as to workmanship and compliance with the applicable Douglas drawings.

DOUGLAS AIRCRAFT CO., INC.

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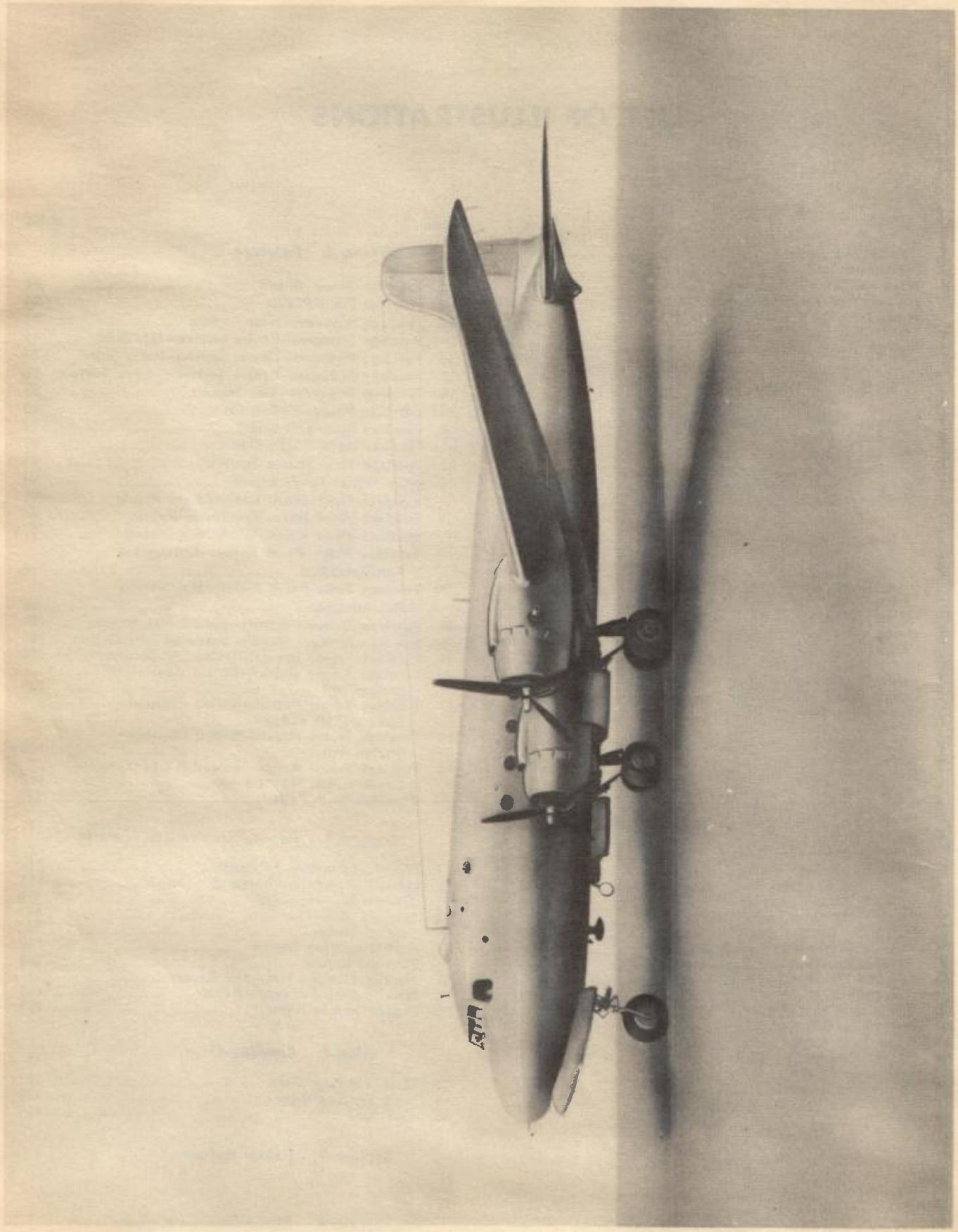


Figure 1 – Douglas Skymaster

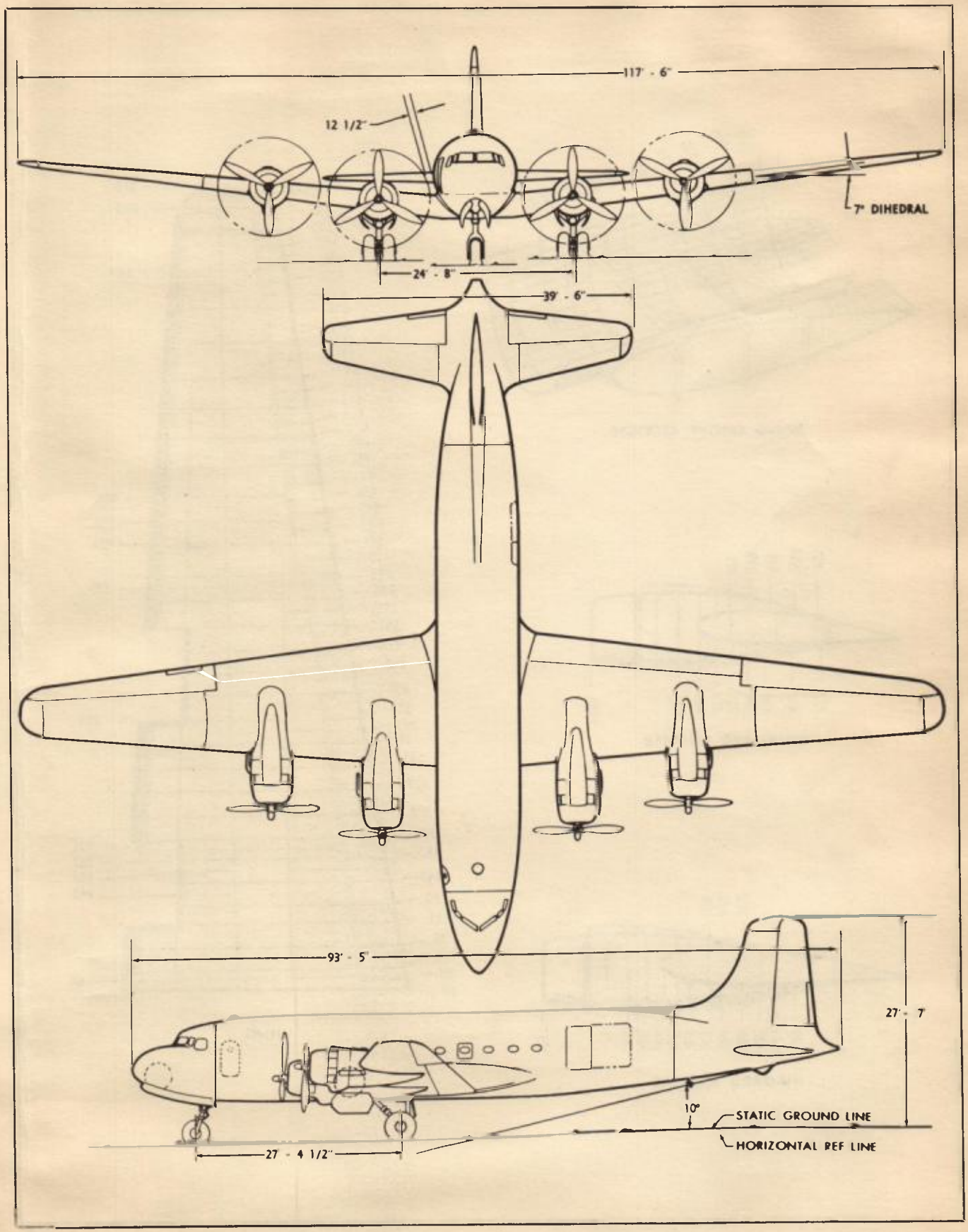
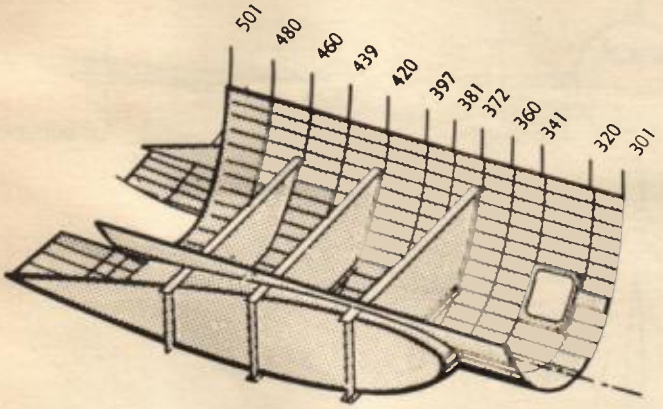
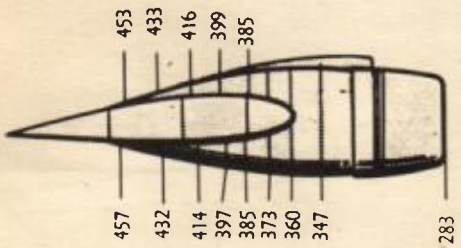


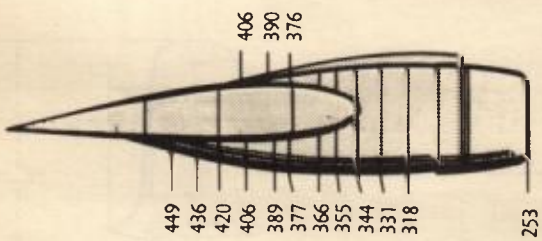
Figure 2 – Dimensions and Areas



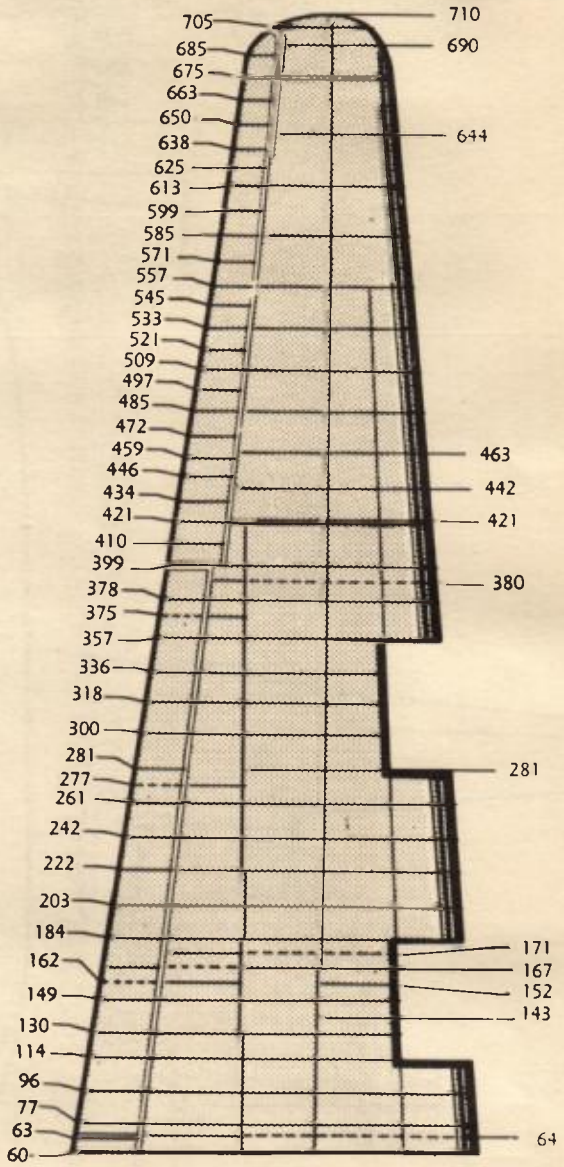
WING CENTER SECTION



OUTBOARD NACELLE

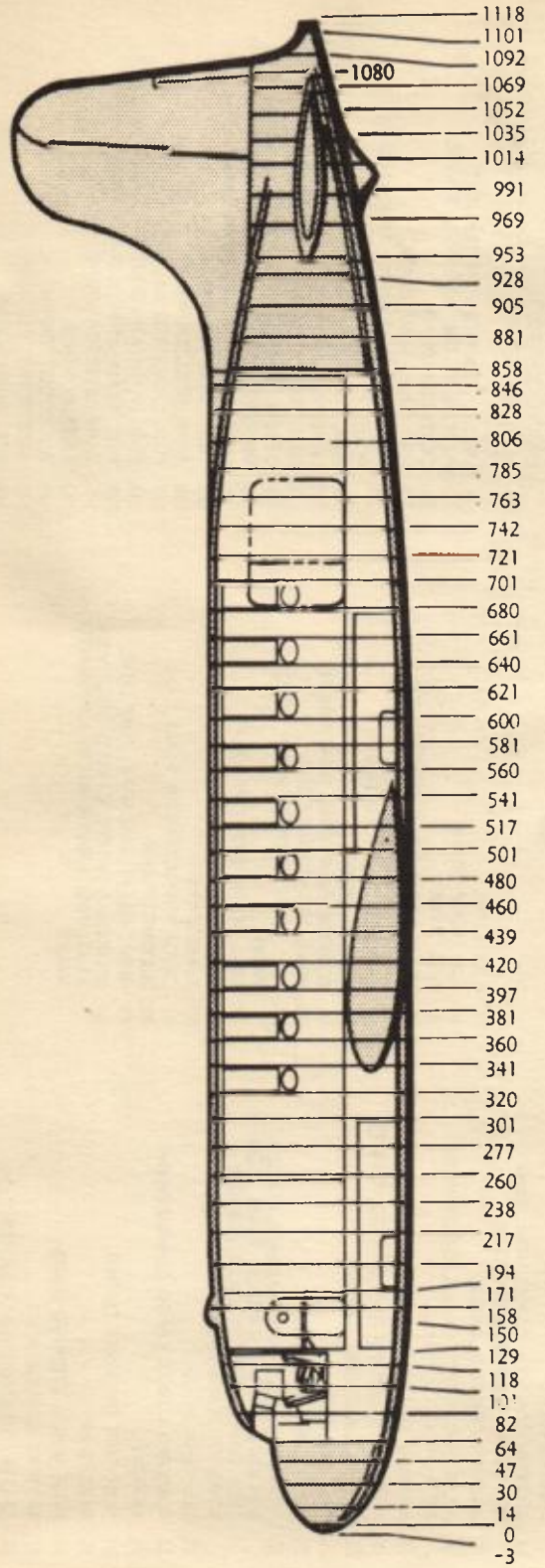


INBOARD NACELLE

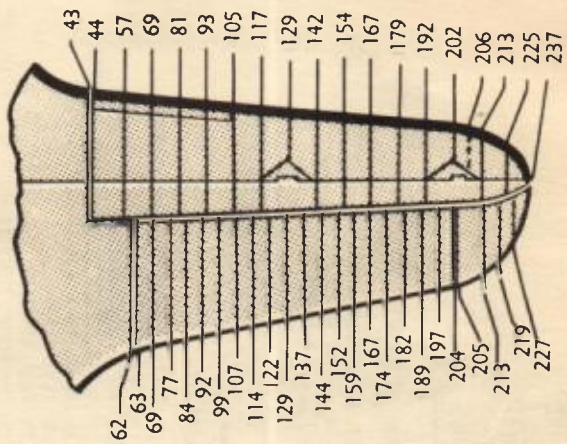


WING

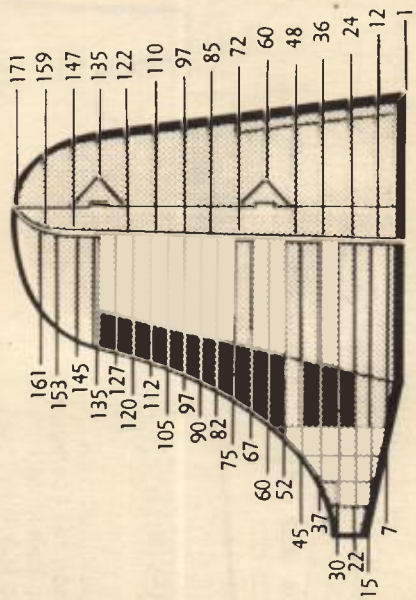
Figure 3 — Wing and Nacelle Stations



FUSELAGE INTERIOR



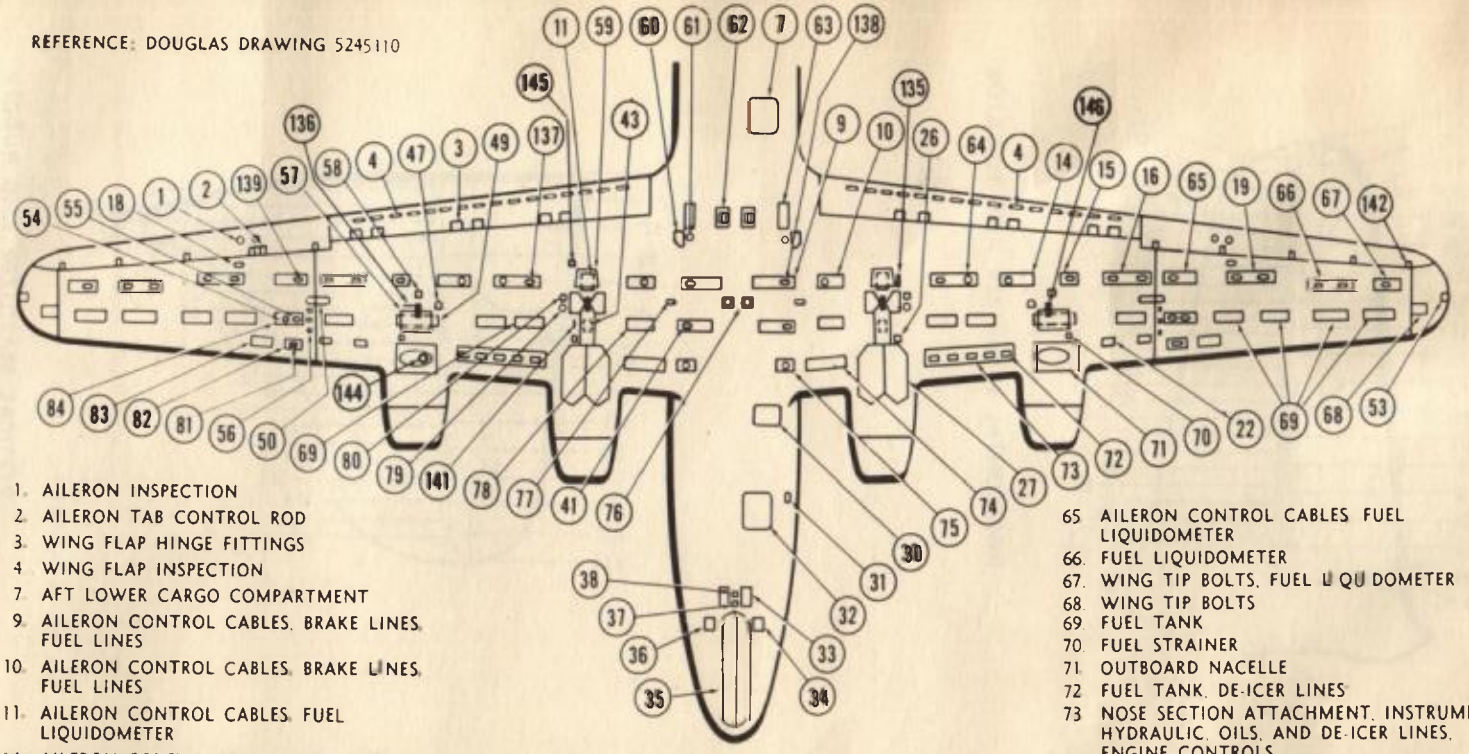
HORIZONTAL STABILIZER AND ELEVATOR



VERTICAL STABILIZER AND RUDDER

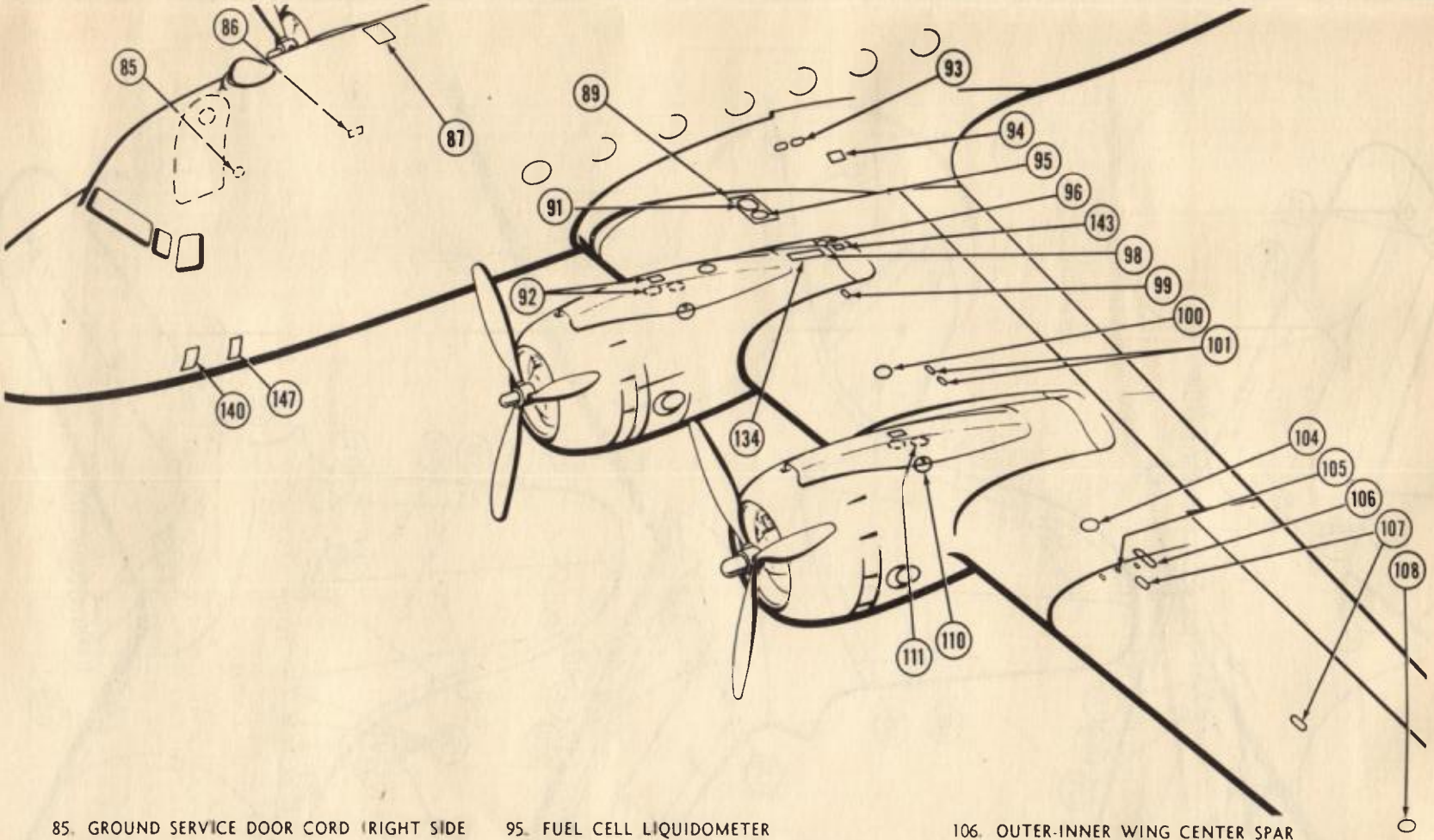
Figure 4 — Fuselage and Tail Group Stations

REFERENCE: DOUGLAS DRAWING 5245110



1. AILERON INSPECTION
2. AILERON TAB CONTROL ROD
3. WING FLAP HINGE FITTINGS
4. WING FLAP INSPECTION
7. AFT LOWER CARGO COMPARTMENT
9. AILERON CONTROL CABLES, BRAKE LINES, FUEL LINES
10. AILERON CONTROL CABLES, BRAKE LINES, FUEL LINES
11. AILERON CONTROL CABLES, FUEL LIQUIDOMETER
14. AILERON CONTROL CABLES, FUEL TANK VENT LINE, FUEL LIQUIDOMETER
15. AILERON CONTROL CABLES
16. AILERON CONTROL CABLES, OUTER WING ATTACHMENT FITTINGS
18. AILERON BELLCRANK
19. AILERON BELLCRANK AND CONTROL CABLES
22. DE-ICER LINES, FUEL TANK
26. FUEL STRAINER
27. MAIN LANDING GEAR
30. HYDRAULIC RESERVOIR, HYDRAULIC ACCUMULATOR, MAIN HYDRAULIC PANEL, CONTROL CABLES, DE-ICER VALVES, DE-ICER LINES, FUSELAGE FUEL TANK DRAIN
31. OIL TANK DRAIN
32. FORWARD LOWER CARGO COMPARTMENT
33. BATTERY
34. NOSE SECTION LINES TUNNEL
35. NOSE GEAR
36. NOSE WHEEL STEERING UNITS
37. BATTERY GROUND PLUG
38. BATTERY HEATING INSTALLATION
41. CROSS-FEED DRAIN
43. FUEL LINES
47. FUEL SUMP DRAIN
49. FUEL TANK
50. OUTER-INNER WING CENTER SPAR ATTACHING BOLTS
53. WING TIP LIGHT CORDAGE
54. BOOSTER PUMP
55. BOOSTER PUMP, FUEL TANK DRAIN
56. WING ATTACHING STUDS
57. FUEL TANK, BOOSTER PUMP, SELECTOR VALVE
58. FUEL DRAIN, SHUT-OFF VALVE
59. NACELLE ACCESS TO ITEM 11
60. FLARE CANS
61. QUICK INSPECTION OF FLARE CANS
62. ALCOHOL TANK
63. WING FILLET AND WING FLAP LINES
64. AILERON CONTROL CABLES, FUEL TANK VENT, FUEL LIQUIDOMETER, CROSS-FEED VALVE
65. AILERON CONTROL CABLES, FUEL LIQUIDOMETER
66. FUEL LIQUIDOMETER
67. WING TIP BOLTS, FUEL LIQUIDOMETER
68. WING TIP BOLTS
69. FUEL TANK
70. FUEL STRAINER
71. OUTBOARD NACELLE
72. FUEL TANK, DE-ICER LINES
73. NOSE SECTION ATTACHMENT, INSTRUMENT, HYDRAULIC, OILS, AND DE-ICER LINES, ENGINE CONTROLS
74. NOSE SECTION ATTACHMENT, ENGINE CONTROLS
75. ENGINE CONTROLS, INSTRUMENT, HYDRAULIC, OIL, AND DE-ICER LINES
76. CROSS-FEED DRAIN
77. FUEL TANK SUMP DRAIN
78. FUEL TANK (WARNING: REMOVE ONLY WHEN FUEL CELLS ARE EMPTY)
79. FUEL TANK PUMP DRAIN
80. LANDING GEAR PIN
81. FUEL DRAIN AND SHUT-OFF VALVE
82. DE-ICER LINE CONNECTIONS
83. DE-ICER BOOT SPLICE AND CONNECTIONS
84. BOOSTER PUMP, FUEL TANK DRAIN
135. TANK SELECTOR VALVE
136. TANK SELECTOR VALVE
137. FUEL CROSS-FEED VALVE
138. FUEL DRAIN AND SHUT-OFF VALVE
139. FUEL DRAIN AND SHUT-OFF VALVE
141. TANK SELECTOR VALVE
142. AILERON HINGE
144. OIL COOLER DRAIN
145. JACK POINT
146. FUEL DUMP VALVE

Figure 5 (Sheet 1 of 2 Sheets) — Wing, Fuselage and Nacelle Access Doors



85. GROUND SERVICE DOOR CORD (RIGHT SIDE ONLY)
86. FUSELAGE OIL TANK FILLER NECK (RIGHT SIDE ONLY)
87. WATER TANK AUXILIARY FILLER
89. FUEL CELL
91. NO. 2 AUXILIARY FUEL TANK FILLER NECK
92. OIL TANK UPPER LINES AND STICK GAUGE, ENGINE CONTROL CABLES
93. WING-TO-FUSELAGE FILLET ATTACHING BRACKET
94. FUSELAGE ALCOHOL TANK FILLER NECK
95. FUEL CELL LIQUIDOMETER
96. WING HOIST FITTING ATTACH POINT
98. LANDING GEAR UPLATCH, AILERON CONTROL CABLES
99. FUEL LIQUIDOMETER FLOAT, NACELLE HOOD CONTROL CABLES
100. WING FUEL TANK FILLER NECK
101. FUEL LIQUIDOMETER FLOAT, NACELLE HOOD CONTROL CABLES
104. WING FUEL TANK FILLER NECK
105. OUTER-INNER WING ATTACHING STUDS
106. OUTER-INNER WING CENTER SPAR ATTACHING BOLTS
107. FUEL LIQUIDOMETER
108. OUTER WING FUEL TANK FILLER
110. OIL TANK FILLER NECK
111. OIL TRANSFER LINES AND LIQUIDOMETER
134. LANDING GEAR UPLATCH, AILERON CONTROL CABLES
140. NOSE GEAR MECHANISM
143. NACELLE ACCESS
147. NOSE SECTION RIGHT HAND LINES TUNNEL

Figure 5 (Sheet 2 of 2 Sheets) — Wing, Fuselage and Nacelle Access Doors

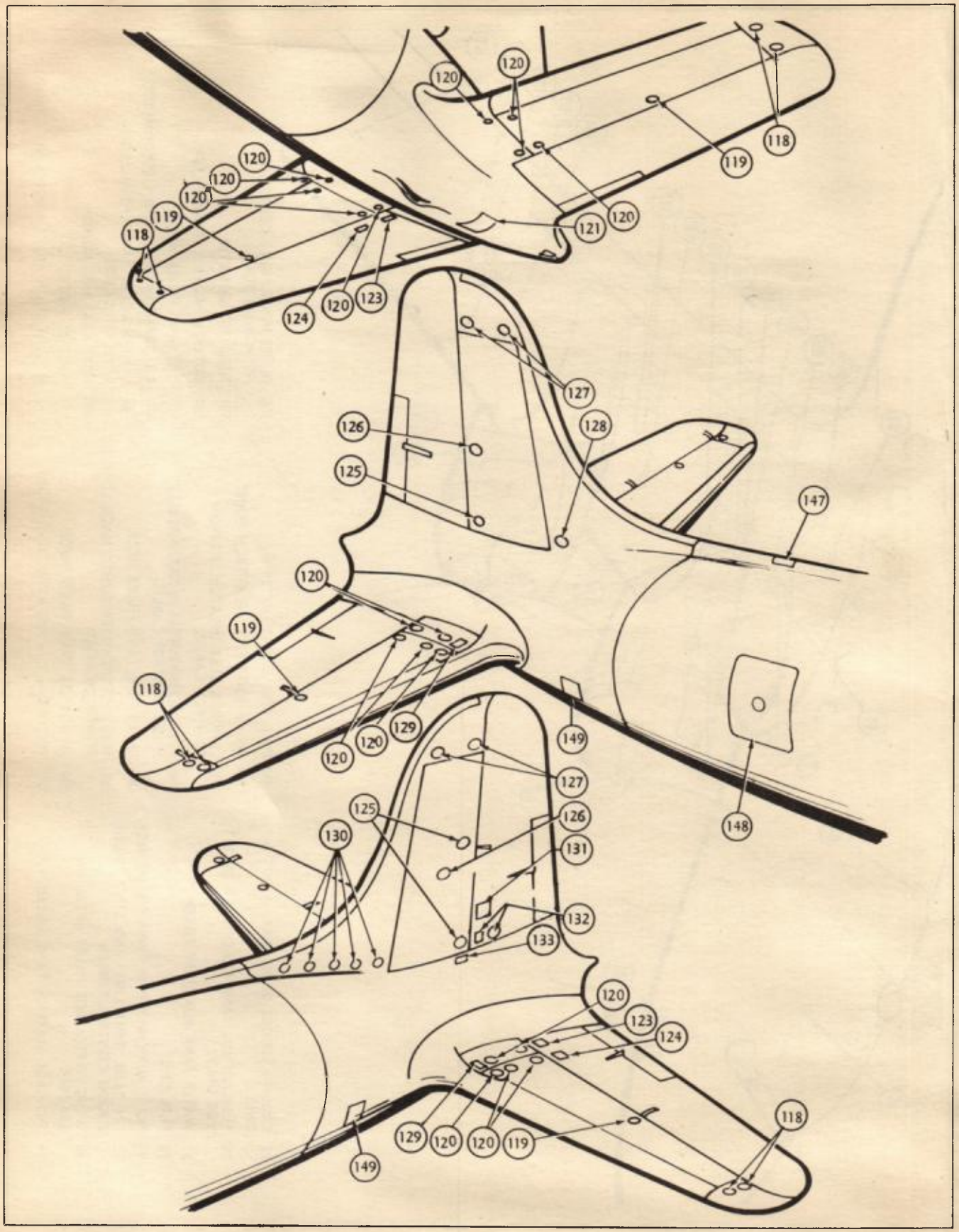


Figure 6 — Tail Group Access Doors

Item List for Figure 6

Tail Group Access Doors

118. HORIZONTAL STABILIZER TIP ATTACHING BOLTS
119. ELEVATOR TAB CONTROL CABLES
120. HORIZONTAL STABILIZER ATTACHING BOLTS
121. FLIGHT CONTROL MECHANISM AND TORQUE TUBES
122. DELETED
123. ELEVATOR TAB CONTROL CABLES
124. ELEVATOR TAB CONTROL ROD AND CABLES
125. VERTICAL STABILIZER ATTACHING BOLTS AND RUDDER TAB CONTROL CABLES
126. RUDDER TAB CONTROL CABLES
127. VERTICAL STABILIZER TIP ATTACHING BOLTS
128. VERTICAL STABILIZER NOSE SECTION ATTACHING BOLTS
129. DE-ICER TUBE
130. VERTICAL STABILIZER NOSE SECTION ATTACHING BOLTS
131. RUDDER TAB CONTROL ROD
132. RUDDER TAB CONTROL CABLES
133. VERTICAL STABILIZER ATTACHING BOLTS AND RUDDER CONTROL CABLES

Item List for Figure 7

Interior Access Doors

1. WIRING
2. PILOT'S HEEL REST
3. FLIGHT CONTROLS AND WIRING
4. CONTROLS BENEATH CONTROL PEDESTAL
5. WIRING AND RUDDER TORQUE TUBES
6. AUTOMATIC PILOT FOLLOW-UP CABLES
7. WIRING
8. NOSE JUNCTION BOX, WIRING, FLIGHT CONTROLS, AND HYDRAULIC LINES (RIGHT SIDE ONLY)
9. HYDRAULIC LINES
10. FUEL DUMP VALVE CONTROLS
11. HYDRAULIC LINES ACCESSORY CONTROLS PULLEY BRACKET
12. EMERGENCY EXIT MECHANISM
13. DOOR WARNING SWITCH
15. CREW COMPARTMENT OXYGEN OUTLETS
16. DELETED
17. WATER TANKS
18. MAIN CABIN HEATERS
19. HEATER FUEL PRESSURE SWITCH
20. DELETED
21. TAIL SECTION
22. AFT LOWER CARGO COMPARTMENT
23. TRAP DOOR TO AFT LOWER CARGO COMPARTMENT
24. FLIGHT CONTROLS
25. FLIGHT CONTROLS
26. FORWARD LOWER CARGO COMPARTMENT
27. TRAP DOOR TO FORWARD LOWER CARGO COMPARTMENT
28. REAR OF MAIN JUNCTION BOX
29. DRIFT SIGNAL CHUTE
30. ACCESSORY CONTROLS BELOW CONTROL PEDESTAL (NOSE GEAR WELL)

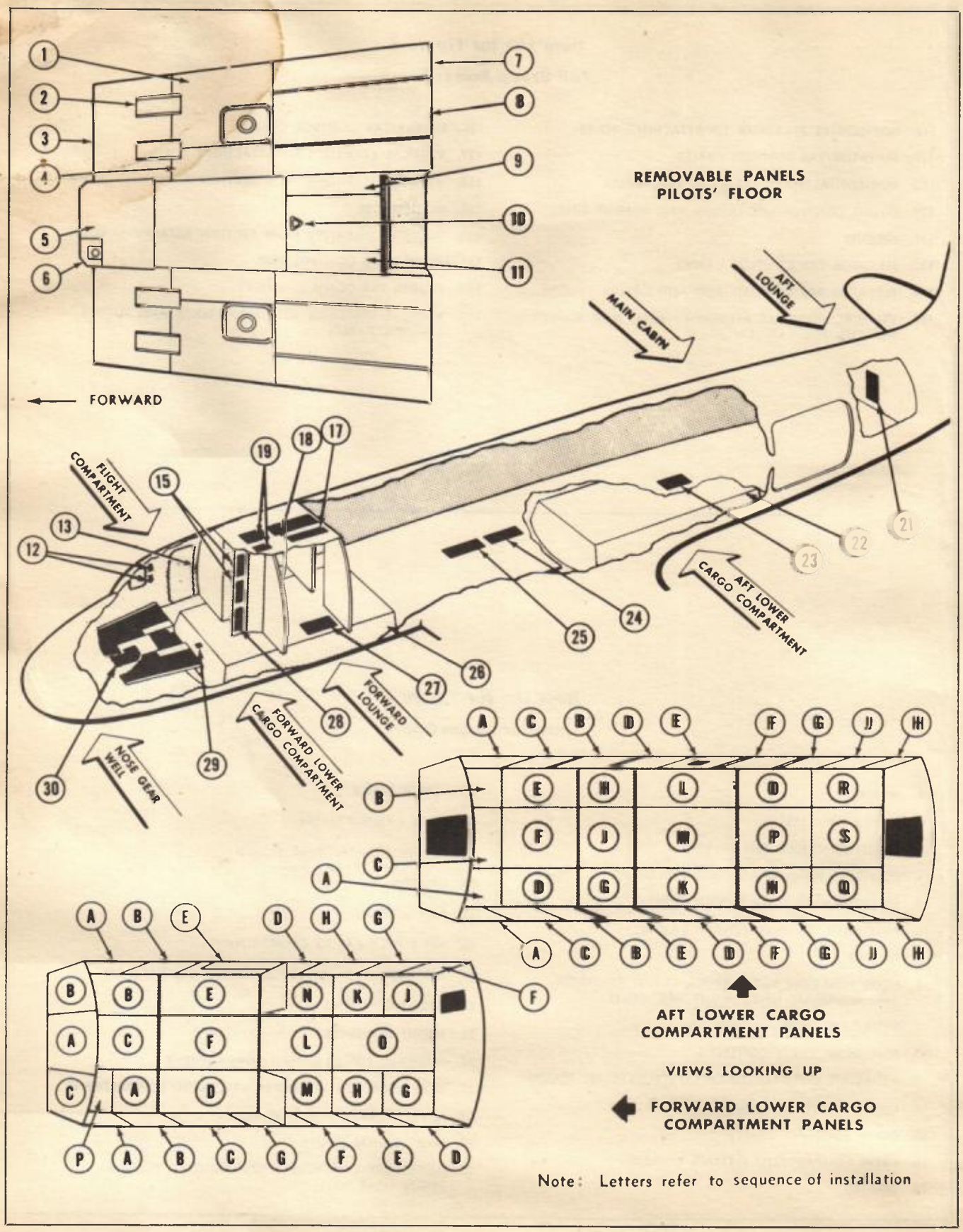


Figure 7 — Interior Access Doors

Section 1

GENERAL

1. GENERAL.—In addition to the material contained herein, reference is also made to the engineering information contained in the government publications, Strength of Aircraft Elements, ANC-5; and Civil Aeronautics Manual No. 18.

Requests for assistance in specific problems should be directed to the Customer Service Department, Douglas Aircraft Company, Inc., Santa Monica, California. When such requests are made it will be appreciated if serial numbers of airplanes affected are given, together with as much pertinent information as is available regarding the extent of damage, etc. When a specific repair is not covered in this manual it is sometimes more expedient for the operator to submit a proposed repair for checking and approval than to request a repair method of the Douglas Aircraft Company. This is particularly true when photographs do not show clearly the extent of the damage, or when the operator's repair facilities are limited to the extent that they might be unable to fabricate the parts Douglas would recommend as easily as they could use alternate methods which would be equally as satisfactory.

2. LEVELING.

Leveling lugs are located in the nose wheel well and aft lower cargo compartment. Longitudinal lugs in the aft lower cargo compartment are located on the left side of the airplane at Stations 640 and 661. Transverse lugs are secured to the aft face of the bulkhead at Station 680, one on each side of the doorway. The master leveling points are two brazier-head rivets in the left fuselage skin of the airplane in the fuselage reference plane. One rivet is 5 inches aft of Station 129 and the other is 5 inches forward of Station 858.

3. ALIGNMENT.—An alignment diagram (see Figure 9) is provided for the purpose of checking alignment measurements where necessary. Preparatory to alignment measurements, the airplane must be in a level position with the necessary reference points the proper height above ground level.

4. HOISTING AND JACKING.—The DC-4 airplane may be raised from the ground, either with tackle and slings attached to eyebolts on the upper surface of the wings and fuselage, or with jacks, using the jacking points located in the inboard nacelles and fuselage (see Figure 10).

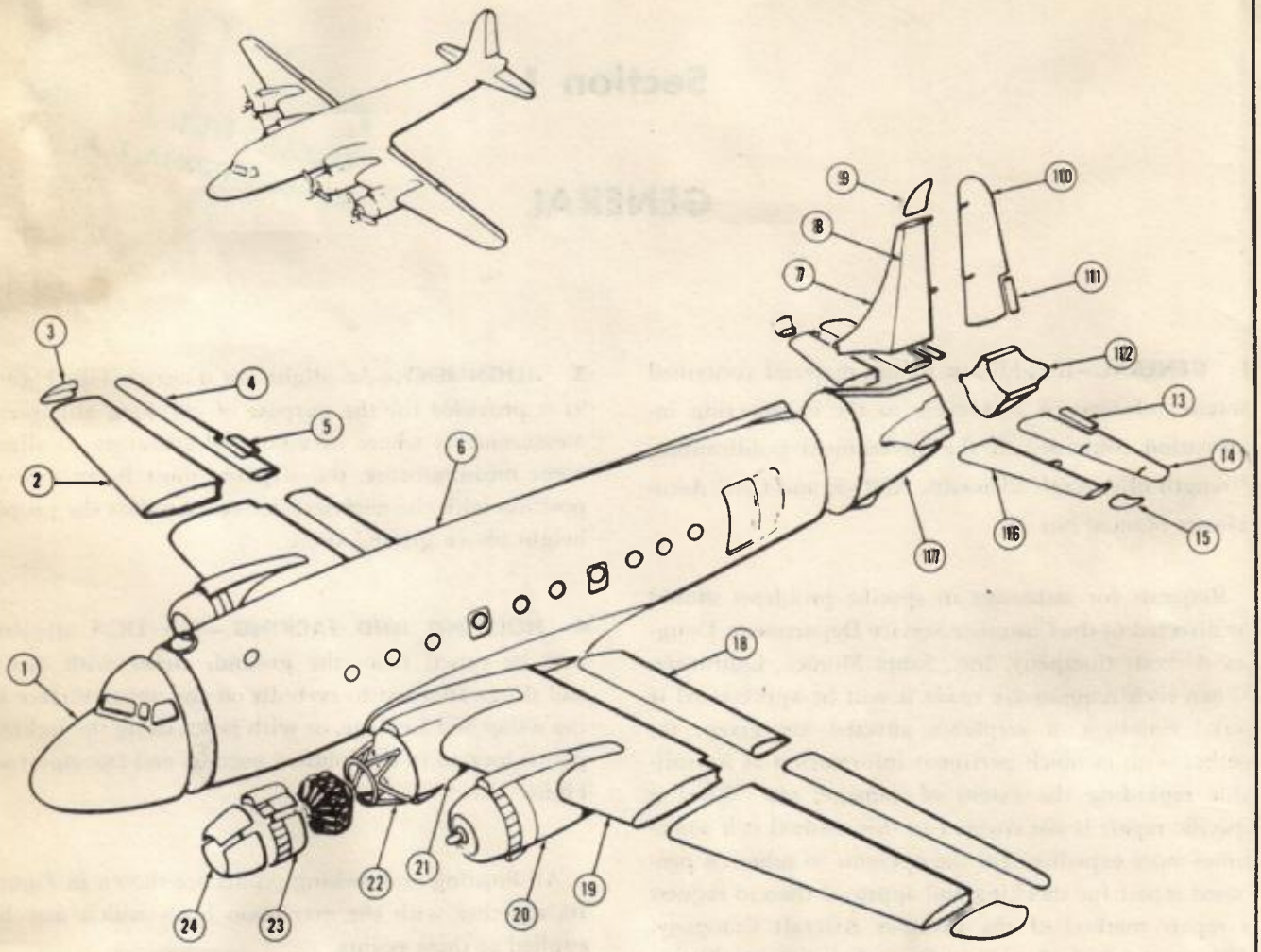
All hoisting and jacking points are shown in Figure 10, together with the maximum loads which may be applied at these points.

CAUTION

Apply lifting force in a vertical direction only.

5. FUSELAGE AND WING SKIN DATA. — Typical wing skin data is presented in Figures 21-23, and typical fuselage skin data is shown in Figures 60-62.

6. STATION IDENTIFICATION. — Stations diagrams are provided to indicate the method of station identification for DC-4 airplanes. To facilitate reference to stations in this manual they are designated only by the numerals preceding the decimal point when the decimal figure is not a critical value.



1. FUSELAGE NOSE SECTION
2. OUTER WING PANEL
3. WING TIP
4. AILERON
5. AILERON TAB
6. FUSELAGE CENTER SECTION
7. VERTICAL STABILIZER NOSE SECTION
8. VERTICAL STABILIZER
9. VERTICAL STABILIZER TIP
10. RUDDER
11. RUDDER TAB
12. FUSELAGE TAIL CONE
13. ELEVATOR TAB
14. ELEVATOR
15. HORIZONTAL STABILIZER TIP
16. HORIZONTAL STABILIZER
17. FUSELAGE TAIL SECTION
18. WING FLAP
19. CENTER WING SECTION
20. OUTBOARD NACELLE
21. INBOARD NACELLE
22. ENGINE MOUNT
23. COWLING
24. ANTI-DRAG RING

Figure 8 — Exploded View of Airplane

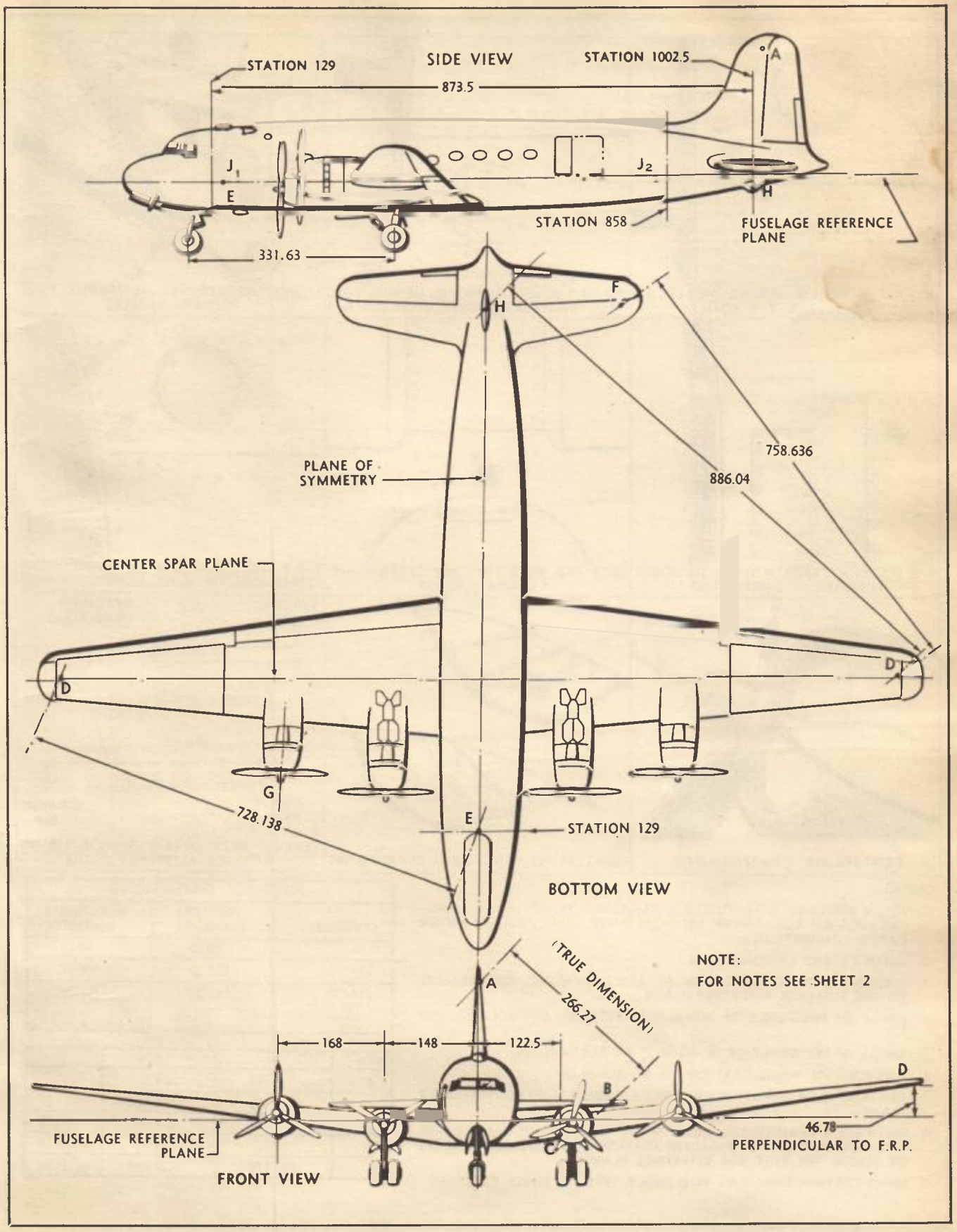
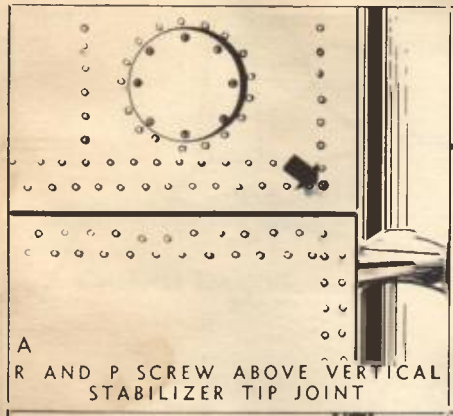
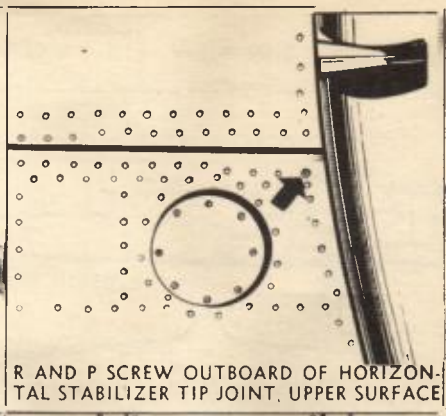


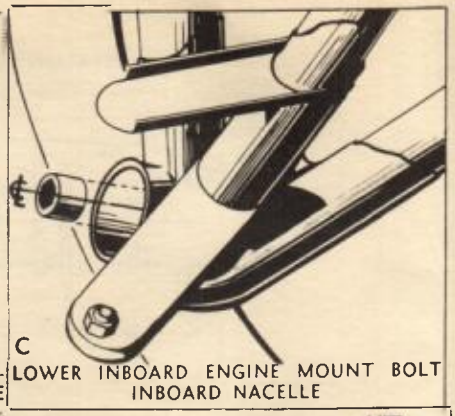
Figure 9 (Sheet 1 of 3 Sheets) — Alignment Diagram



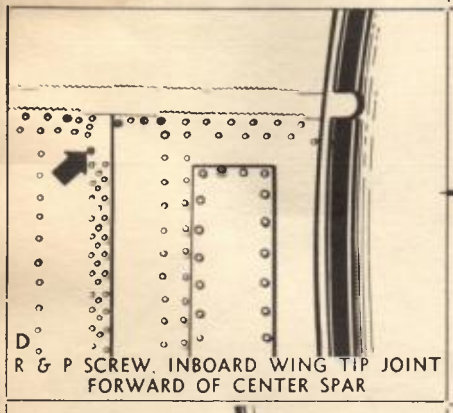
A
R AND P SCREW ABOVE VERTICAL STABILIZER TIP JOINT



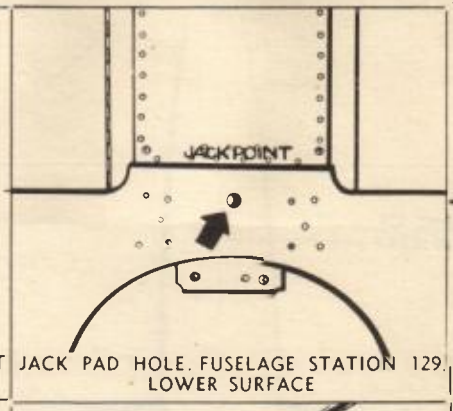
R AND P SCREW OUTBOARD OF HORIZONTAL STABILIZER TIP JOINT, UPPER SURFACE



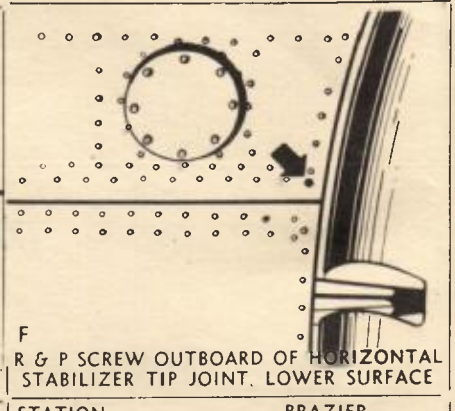
C
LOWER INBOARD ENGINE MOUNT BOLT INBOARD NACELLE



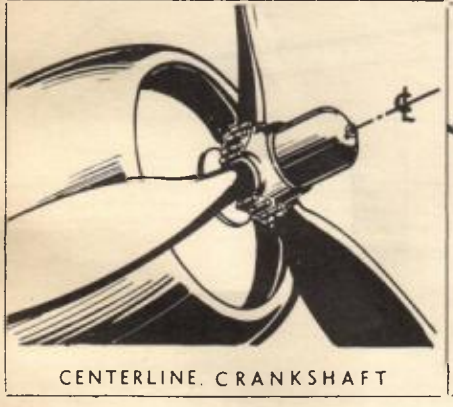
D
R & P SCREW, INBOARD WING TIP JOINT FORWARD OF CENTER SPAR



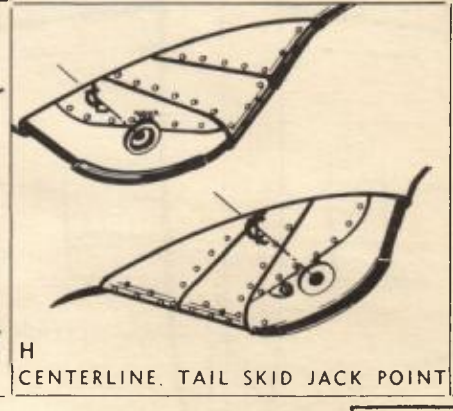
JACK PAD HOLE, FUSELAGE STATION 129, LOWER SURFACE



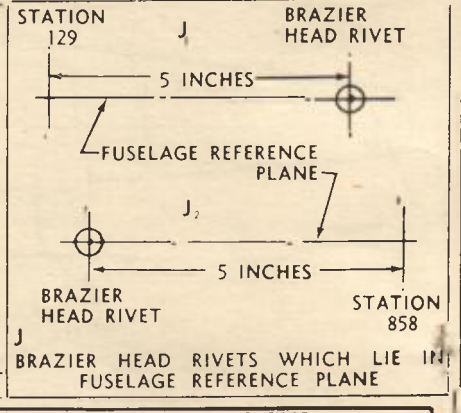
F
R & P SCREW OUTBOARD OF HORIZONTAL STABILIZER TIP JOINT, LOWER SURFACE



CENTERLINE, CRANKSHAFT



H
CENTERLINE, TAIL SKID JACK POINT



J
BRAZIER HEAD RIVETS WHICH LIE IN FUSELAGE REFERENCE PLANE

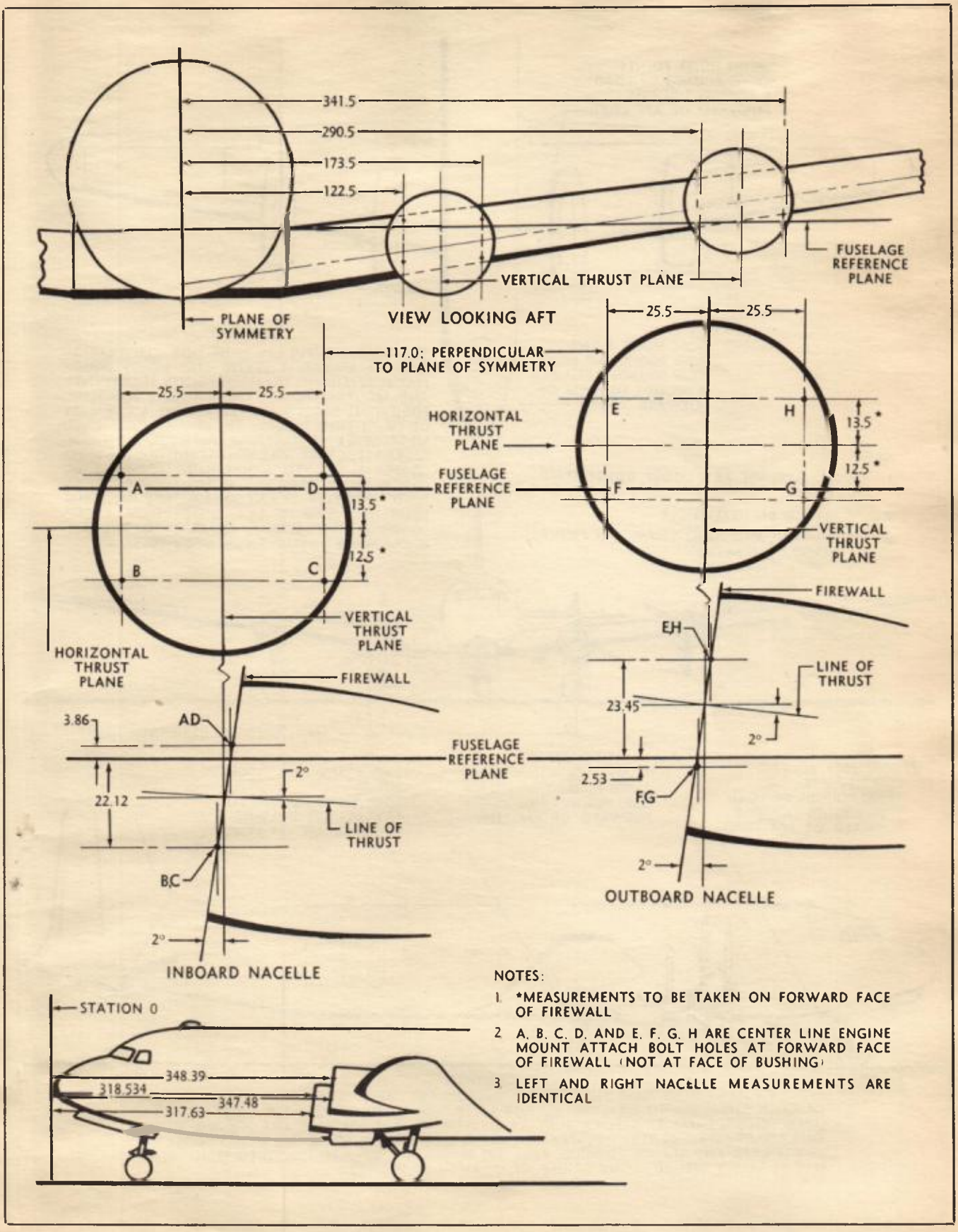
NOTES:

1. ALIGN AIRPLANE WITH FUSELAGE REFERENCE PLANE LEVEL. LEVELING LUGS ARE LOCATED IN THE NOSE WHEEL WELL AND AFT LOWER CARGO COMPARTMENT.
2. FULLY EXTEND LANDING GEAR.
3. UNLESS NOTED TO THE CONTRARY, ALL DIMENSIONS ARE PARALLEL TO THE FUSELAGE REFERENCE PLANE.
4. ANGLE OF INCIDENCE OF WING IS 4° BETWEEN STATIONS 60 AND 421.
5. ANGLE OF INCIDENCE OF WING IS 1° AT STATION 675.
6. WASHOUT OF WING, STATION 421 TO 675 IS 3°
7. CENTERLINE OF THRUST IS CANTED UP 2° FROM FUSELAGE REFERENCE PLANE.
8. DISTANCE X IS MEASURED RIGHT OR LEFT OF FUSELAGE CENTER LINE. Y IS MEASURED AFT OF FUSELAGE STATION 0. Z IS MEASURED ABOVE OR BELOW THE FUSELAGE REFERENCE PLANE.
9. MAKE CERTAIN THAT TAIL SKID SHOCK STRUT IS FULLY EXTENDED

FUSELAGE DIMENSIONS		
STATION	VERTICAL DIAMETER	HORIZONTAL DIAMETER
14	48.02	34.10
129	127.26	104.36
277.875 TO 560	138.00	125.00

POINT	X	Y	Z
A	4.138	1024.867	205.55
B	206.125	1022.162	32.07
D	667.526	419.850	46.78
E	0	129.00	—38.50
F	206.125	1022.044	25.32

Figure 9 (Sheet 2 of 3 Sheets) — Alignment Diagram



NOTES:

1. *MEASUREMENTS TO BE TAKEN ON FORWARD FACE OF FIREWALL
2. A, B, C, D, AND E, F, G, H ARE CENTER LINE ENGINE MOUNT ATTACH BOLT HOLES AT FORWARD FACE OF FIREWALL (NOT AT FACE OF BUSHING)
3. LEFT AND RIGHT NACELLE MEASUREMENTS ARE IDENTICAL

Figure 9 (Sheet 3 of 3 Sheets) — Alignment Diagram

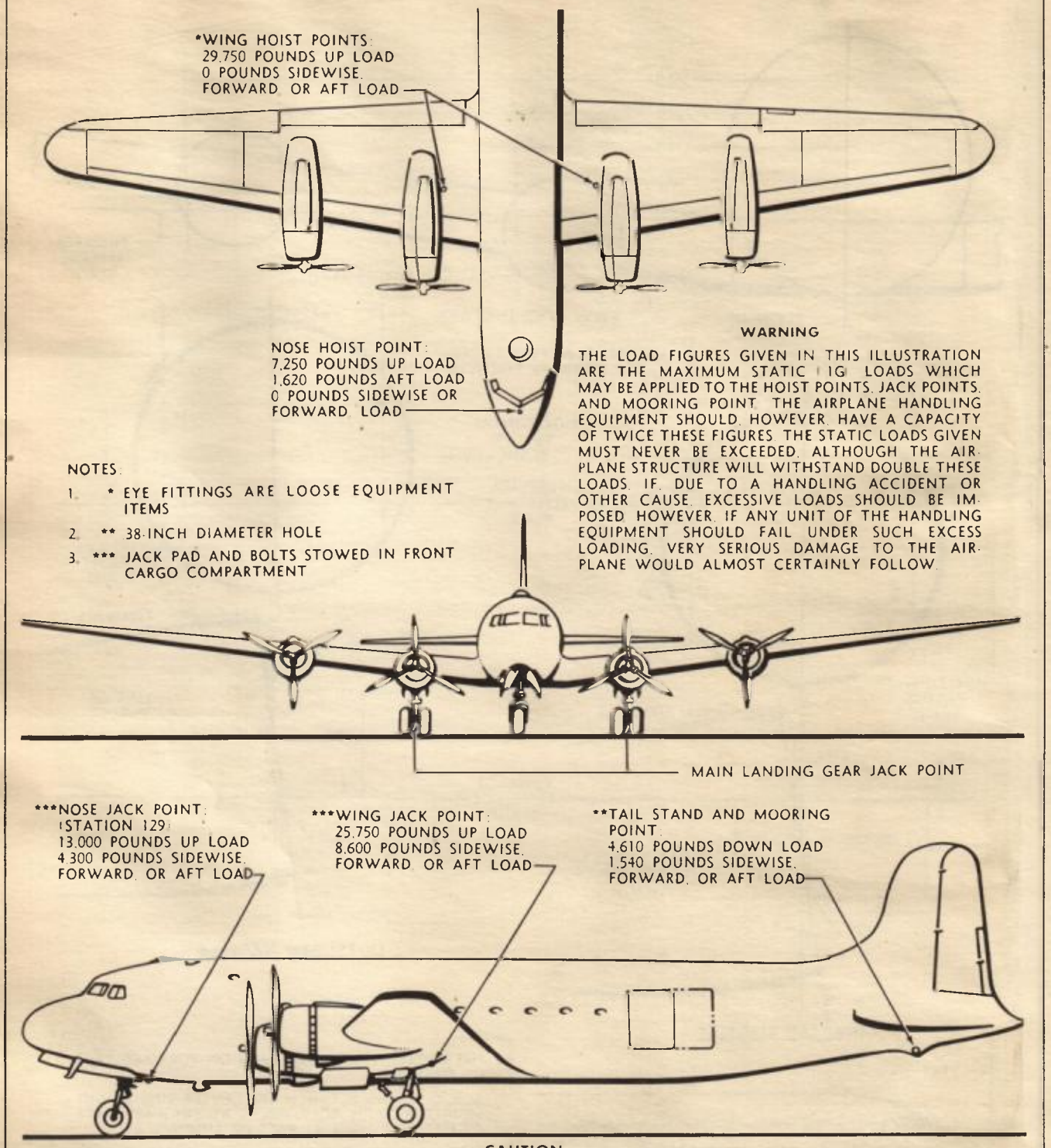
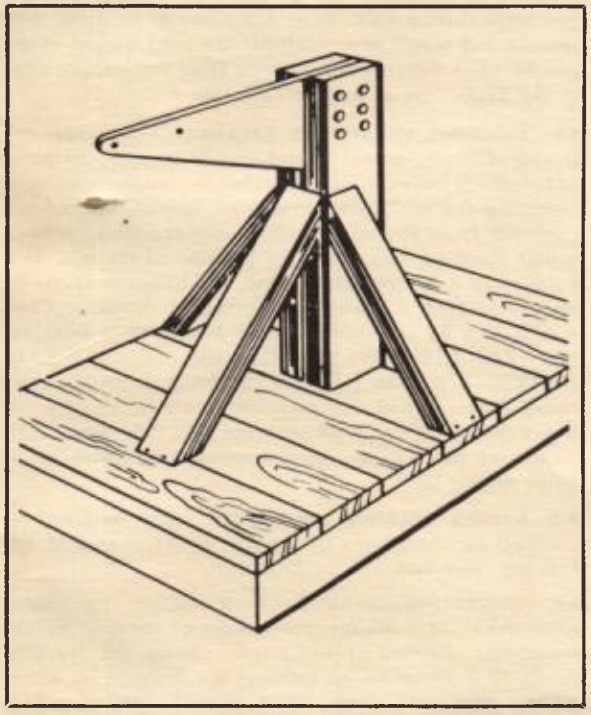


Figure 10 — Hoisting and Jacking Points

CONTROL SURFACE BALANCE

1. **GENERAL.**—Ailerons, elevators, and rudder, when installed on the airplane, are statically balanced or slightly overbalanced (nose heavy) about the hinge line. Static balance is achieved by adding or removing adjustable weights in the leading edge. To gain access to aileron balance weights, cut fabric and reach through spar lightening holes. To gain access to rudder and elevator weights, reach through access holes provided on leading edge of surface.



Balancing Stand for Control Surfaces

2. AILERON BALANCE.

2.1. MOUNTING AILERON TO CHECK BALANCE.

a. Mount aileron upside down on balance stand.

b. Make sure that trim tab and its operating mechanism is not removed from right hand aileron.

c. Pull trim tab cables up so that they do not rest on inner structure and tape them to balance stand arm.

d. Check to see that cables are not placed in a position that will affect the re-balancing procedure.

2.2. CHECKING AILERON BALANCE.—After allowing the aileron to come to rest, place a bubble protractor on the inboard end rib and check angle of inclination of the lower surface which, as shown in Figure 11, is now uppermost. If the angle is between 1 and 5 degrees tail up from the horizontal, the aileron is properly balanced. If it does not come to rest within these angular limits, the counter weights in the nose must be re-adjusted.

2.3. CORRECTING AILERON BALANCE.—If the aileron has been thrown out of balance because of a repair, it is necessary to adjust the counterweight that is opposite or nearest to the repair. For instance, if the trailing edge opposite the inboard hinge was damaged and repaired thereby adding weight to the trailing edge, it would be necessary to increase the balance weights on each side of the hinge cut-out. Similarly, if a doubler has been added to a rib to re-inforce a cracked flange, the adjustment should be made at the balance weight located at this station or in the nearest accessible bay. If repairs are made in the leading edge so that the surface becomes nose heavy, the weight should be removed only from the positions nearest to where the repairs were made.

When the surface is thrown out of balance due to repairs made in numerous places, or when new covering, extra dope, etc., are applied, weight should be added or removed from the bays nearest the spanwise CG of the surface.

The spanwise CG can be determined by balancing the aileron over the edge of a bench or over a round or triangular support placed chordwise across the surface. Move the support along the span of the aileron until point of balance is located, then mark the point with chalk so that it may be referred to again after the aileron is mounted on balance stands for checking. A small amount of weight then should be either added or deleted from the bays on each side of the chalk mark until the aileron again balances in the proper attitude.

3. ELEVATOR BALANCE.

3.1. MOUNTING ELEVATOR TO CHECK BALANCE.

a. Mount elevator with its tab and tab operating mechanisms on balance stands as shown in Figure 12. DO NOT INCLUDE TORQUE TUBE.

b. Tape tab operating cables to balance stand hinge arm so that they will not rest on the inner structure and interfere with the balance and rotation of the elevator.

c. Check hinge bearings for binding, and adjust stands so that elevator rotates freely.

3.2. CHECKING ELEVATOR BALANCE.—Suspend a weight pan from the nose at Station 105.5, which is the station adjacent to the outboard end of the tab (see Figure 12). The weight pan may be made from most any small container available (tin can, paint can, etc.) hung from a bridle of lacing cord or stout twine. Tie a small hook of stiff wire on the other end to go around the trailing edge of the surface. Add lead shot, sand, in the weight pan until surface assumes a horizontal position (chord plane horizontal). The weight pan should then be removed and weighed (the weight of the cord can be disregarded provided it is not over ½ ounce). Multiply the total weight of the pan by the distance to the hinge line. (At Station 105.5 the distance from the leading edge to the hinge is 13.67 inches—see Figure 12.)

CONTROL SURFACE BALANCE (Continued)

3.3. ELEVATOR BALANCE LIMITS.—The value obtained by multiplying the weight of the pan by 13.67 should fall between 31.8 and 41.8 inch pounds.

3.4. CORRECTING ELEVATOR BALANCE.—When, because of repairs, the elevators exceed the balance limits specified, add or remove weight nearest the repair. As in the case of the aileron, if a repair is made in the trailing edge of a particular station, the weight to rebalance the elevator should be added in the leading edge of that station. If the nose section is repaired, the weight necessary to rebalance the surface should be removed from the region nearest the repair.

If it becomes necessary to rebalance because of new covering, extra paint or general over-all repairs, the weight added or removed should be close to the spanwise CG of the elevator, as in paragraph 2.2, preceding.

NOTE

Dynamic balance will be least affected if the counter weights are removed or added uniformly from 12 to 18 inches each side of the spanwise CG.

4. RUDDER BALANCE.

4.1. MOUNTING RUDDER TO CHECK BALANCE.

a. Mount rudder with tab and tab operating mechanism installed on balance stands as shown in Figure 13. DO NOT INCLUDE TORQUE TUBE OR FLYING TAB OPERATING TUBE ASSEMBLY.

b. Tape tab operating cables to balance stand hinge arm so that they will not rest on the inner structure and interfere with the balance and rotation of the rudder.

c. Check hinge bearings for binding, and adjust stands so that the rudder rotates freely.

4.2. CHECKING RUDDER BALANCE.— Procedures for checking rudder balance are similar to that used for the elevators (see paragraph 3.2 preceding). The weight pan is suspended from the nose of Station 72 (station adjacent to outboard end of tab). Add weight to the pan until surface balances in a horizontal position, then remove and weigh pan. Multiply the total weight of the pan by 14.25 which is the distance from the leading edge to the hinge line at Station 72.5 (see Figure 13).

4.3. CHECKING RUDDER TAB BALANCE.—The rudder tab is also statically balanced and should be checked prior to balancing the main surface. This may be done without removing the tab from the rudder. Disconnect the tab pushrods from the tab, block up the rudder to a horizontal position, then check the position of the tab. If it remains in a horizontal position, i.e. balances about its own hinge line, the tab is satisfactory. It is also satisfactory if it is 5.0 inch-pounds nose heavy, BUT UNDER NO CIRCUMSTANCES SHOULD IT BE TAIL HEAVY. If the tab is within the 5.0 inch-pounds nose heavy range, it will change from a nose heavy to a tail heavy condition upon the addition of a 0.53 pound test weight at the trailing edge, opposite the center hinge point of the tab.

4.4. RUDDER BALANCE LIMITS.—The value obtained by multiplying the weight of the pan by 14.25 should fall between 59.7 and 69.7 inch-pounds.

4.5. CORRECTING RUDDER BALANCE.—When the value obtained by multiplying the weight of the pan by the hinge line distance of 14.25 falls outside the specified limits, it is necessary to readjust the balance by either adding or removing weight. This readjustment is handled similarly to that of the elevator. Weight should be adjusted nearest the repair; when general repairs are made covering the entire surface, the weights should be adjusted around the spanwise CG of the surface. If the surface is thrown out of balance due to a rebalancing of the flying tab, the weights added or removed from the main surface should be in the region opposite the tab.

★ ★ ★

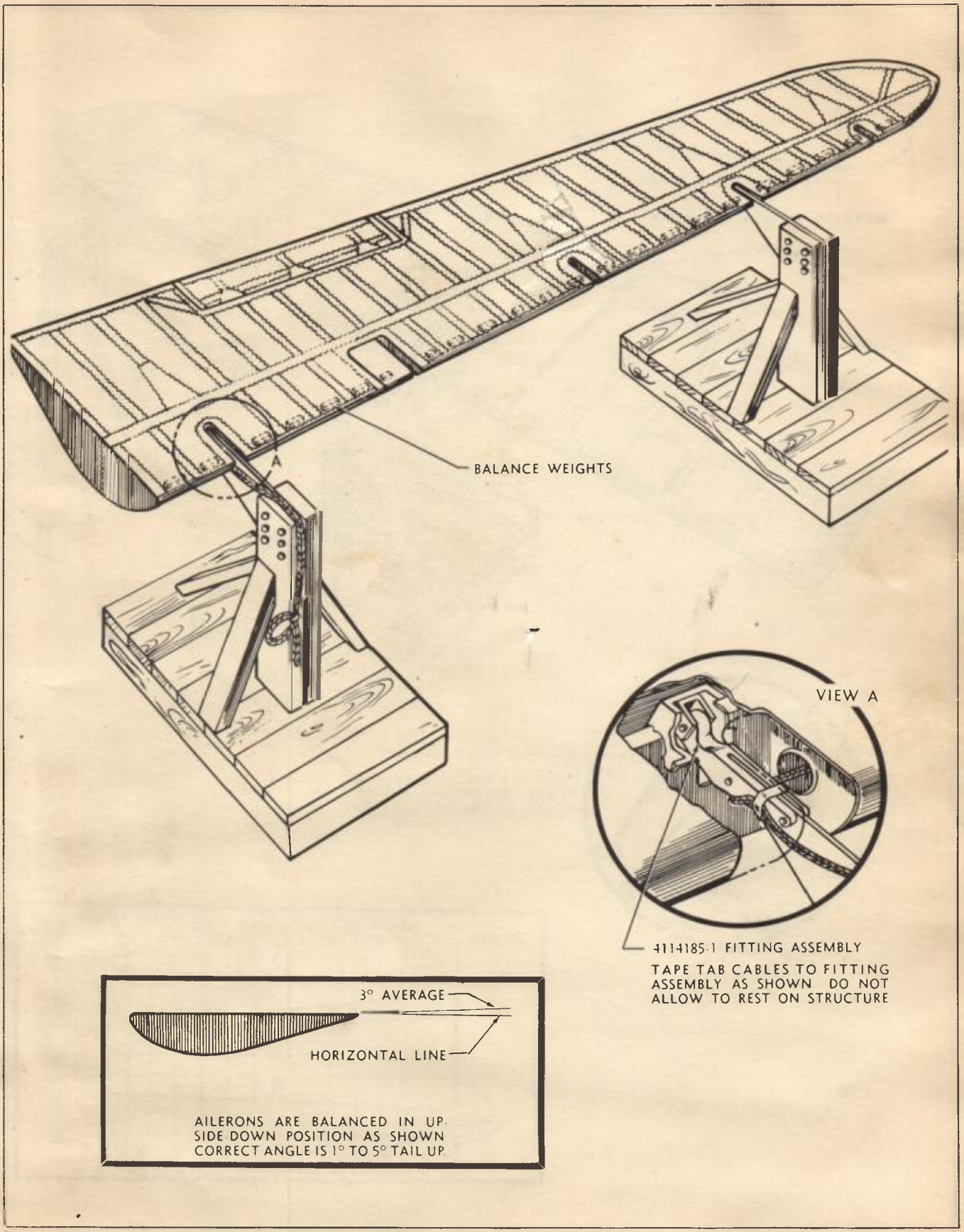


Figure 11 — Balancing Surface Controls — Aileron

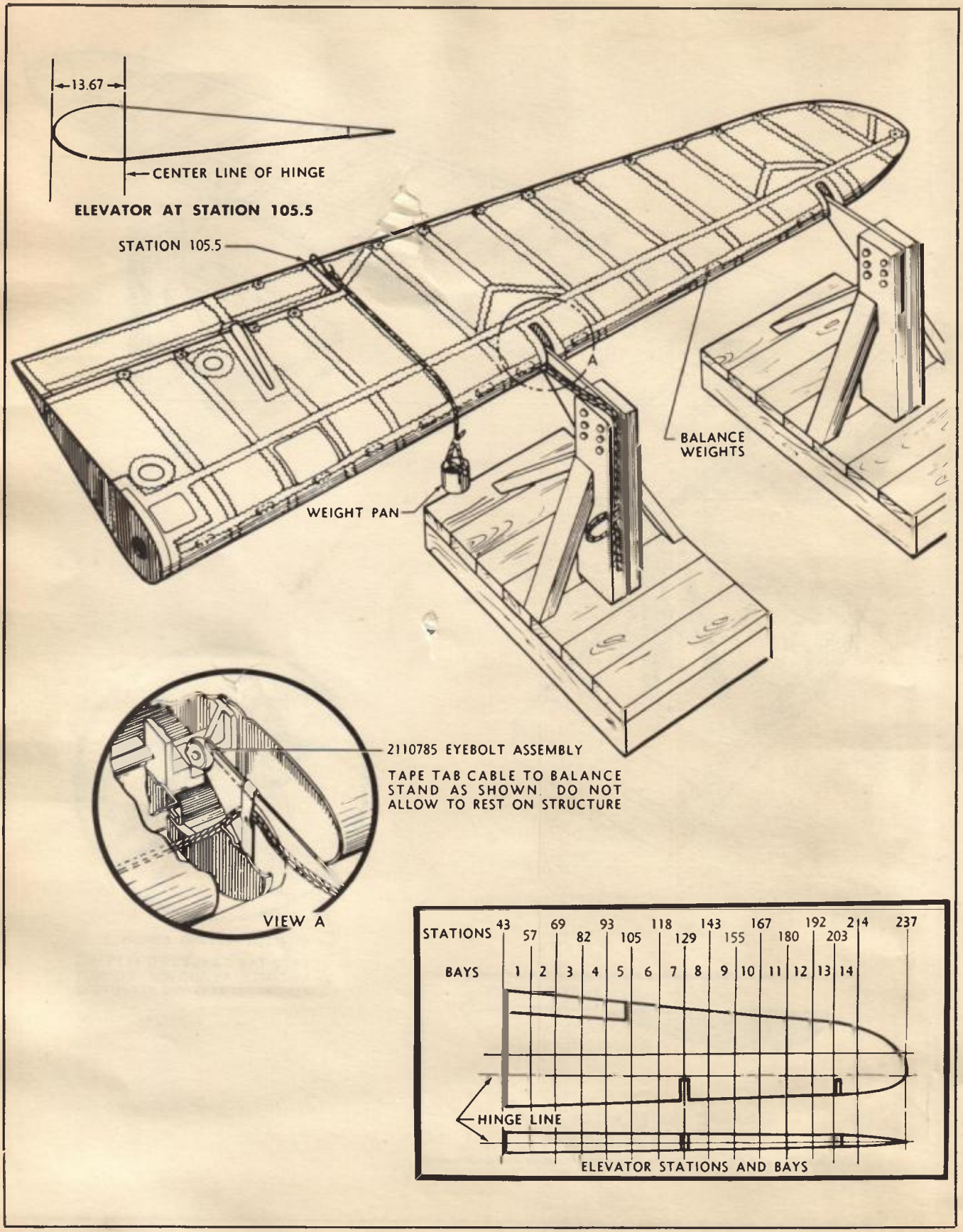


Figure 12 — Balancing Surface Controls — Elevator

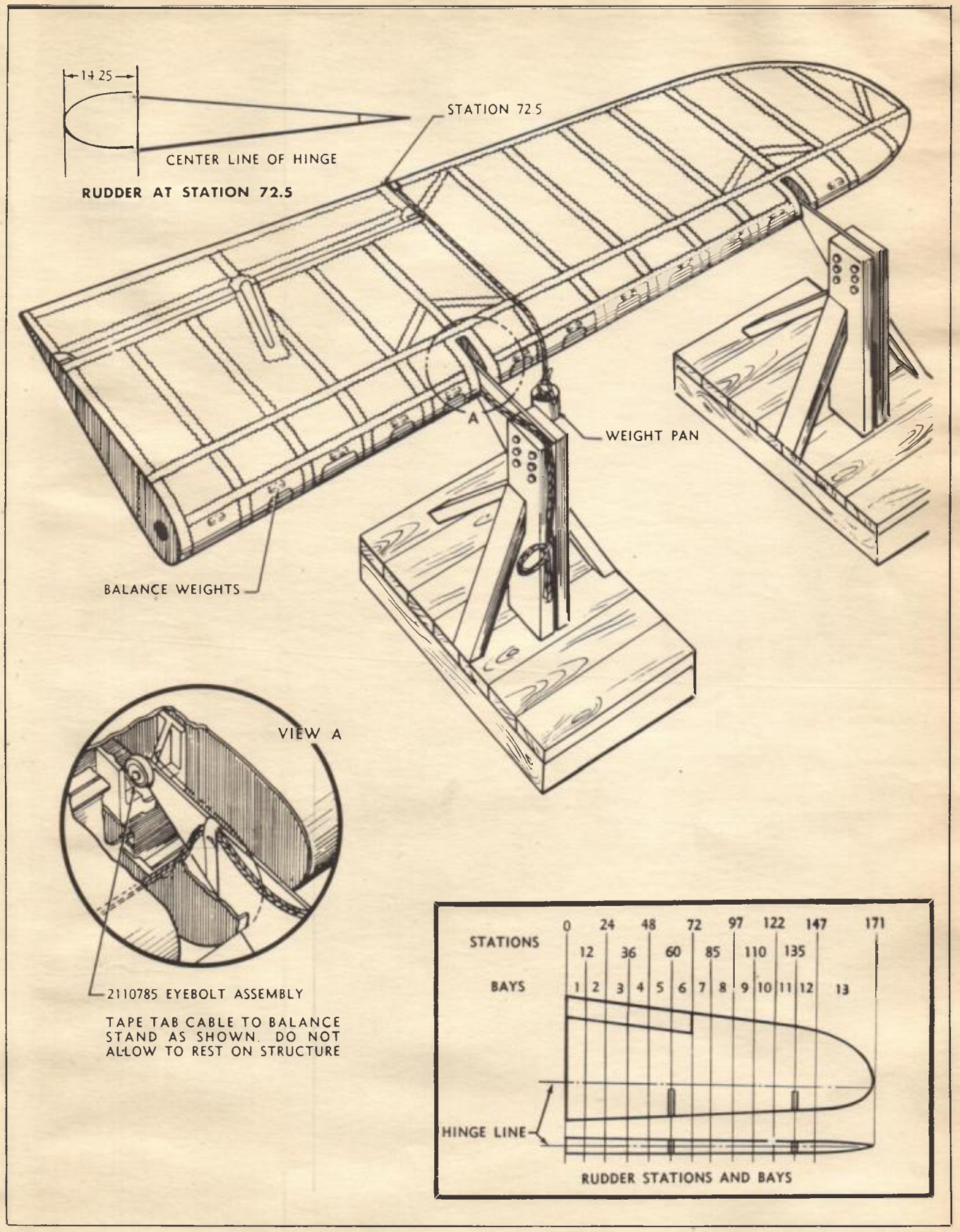


Figure 13 — Balancing Surface Controls — Rudder

Section 2

WING GROUP

1. GENERAL.

The wing is of full cantilever construction, and is fabricated of 24 S-T and 24S-RT aluminum alloy. It's span is 117 feet 6 inches and is comprised of a center section where it passes through the fuselage, inner panels permanently attached to the center section, two removable outer panels bolted to the inner panels, and two removable wing tips, bolted to the outer panels. A wing flap is attached to each inner panel, and an aileron is attached to each outer wing panel.

2. WING CONSTRUCTION.—The principal structural components of the wing are spars, ribs, stringers, and skin. Three spars run the entire length of the inner wing. The outer wing has one full length spar, which is a continuation of the inner wing center spar and a short false spar, which is a continuation of the inner wing front spar. Ribs connect the three inner wing spars, extending forward and aft of the spars. Ribs also extend forward and aft of the outer wing spars, forming the wing nose and trailing edge sections. Stringers inter-connect the ribs and strengthen the skin. The skin is attached to spar caps, ribs, and stringers. Fuel-tight compartments between inner wing front and center spars, and between the outer wing spar and wing nose skin, serve as integral fuel tanks (see Figure 42). Four engine nacelles are permanently attached to the inner wing panel. Main landing gear attachments are located on the front and center spar at the inboard engine nacelles.

The structural components of the wing flaps and ailerons are similar to those of the wings. A spar runs the entire length of the flap, with nose ribs and trailing edge ribs attached. Stringers connect the ribs, and a complete metal skin is attached to these members. The aileron has no stringers; a metal nose skin is attached to the spar and the nose ribs, and a fabric covering is applied over the entire surface.

3. CLASSIFICATION OF DAMAGE TO WINGS.

3.1. NEGLIGIBLE DAMAGE.

3.1.1. Wing Spars.

a. CAPS.—Smooth indentions and scratches are permissible when not over $\frac{1}{16}$ inch in depth after rounding out and polishing, and which have been carefully inspected for cracks.

b. WEB STIFFENERS.—Edge nicks in the free leg of the angle are permissible when not more than $\frac{1}{32}$ inch in depth after rounding out and polishing.

3.1.2. Wing Stringers.—Edge nicks in stringers are permissible when not more than $\frac{1}{8}$ inch in depth after rounding out and polishing.

3.1.3. Wing Ribs.

a. INTERSPAR RIBS.—Edge nicks in flanges, angles, and channels are permissible when not more than $\frac{1}{8}$ inch in depth after rounding out and polishing. Holes in web are permitted that are no more than $\frac{1}{2}$ inch in diameter after cleaning out, or at least 5 inches from a similar hole, and at least 2 inches from the edge of a lightening hole. Edge nicks are permitted in stiffeners as in flanges if they are no deeper than $\frac{1}{2}$ inch diameter after cleaning out, and if they are not in the middle third of the stiffener.

b. NOSE AND TRAILING EDGE RIBS.—Edge nicks in flanges are permissible if not more than $\frac{1}{4}$ inch in depth after rounding out and polishing, and if not directly opposite a skin rivet. For holes in web, and holes and edge nicks in stiffeners, see 3.1.3 preceding.

3.1.4. Skin.—Smooth shallow dents in skin are permissible when sheared rivets or distorted structure, cracks, or abrasions do not appear. Inspect carefully for distorted adjacent structural members before considering skin damage to be negligible.

3.2. REPAIRABLE DAMAGE.— Figures 27 thru 41 inclusive give procedure for typical cases of repairable damage. In all cases where repairs are necessary, it is recommended that entire units such as skin panels, etc., be replaced if available. Damage to spar caps or other wing structures which are integral with the fuel tanks require special repair procedures and all questions concerning temporary or permanent repairs in these areas should be directed to the Customer Service Department, Douglas Aircraft Company, Santa Monica, California.

CAUTION

Spar web and wing skin repairs must not be carried closer than one inch to heavier structures. Repairs which fall in such locations, must be extended so that they can be attached to the heavier structure.

Note

In the event of spar damage involving more than one spar cap in the same bay, stagger splices so that not more than one splice occurs in the same bay. The same precaution must be observed for stringer repairs.

3.3. DAMAGE NECESSITATING REPLACEMENT OF PARTS.

3.3.1. Spar Web Stiffeners.—Replace damaged spar web stiffeners.

3.3.2. Stringers.—Replace short stringers which are damaged. For repair of long stringers see Figures 30 and 31.

3.3.3. Wing Ribs.—Replace gussets on inner wing rear section ribs at Stations 77, 96, and 114 if damaged. Inner wing trailing edge ribs are reinforced by small extrusions, which must be replaced if damaged.

4. WING WRENCH TORQUE TABLE.—Given in table below:

BOLT NO.	NUT NO.	NO. REQ.	ATTACHED PART	INSTALLATION	TORQUE (INCH-POUNDS*)
			FRONT SPAR		
AN7-30A	AN365-720	2	2108134	5145006	450-500
AN7-27A	AN365-720	2	2108134	5145006	450-500
NAS-147-56	12B-070	4	4074686	5145006	650-720
NAS-148-56	12B-080	4	4074686	5145006	700-1000
AN6-13A	AN365-624	16	4074686	5145006	160-190
S-1175352A-13	AN365-624	4	4074686	5145006	160-190
AN7-26A	AN365-720	4	2108134	5145006	450-500
			CENTER SPAR		
AN5-11A	AN365-524	20	4074694	5145006	100-140
NAS-147-62	12B-070	4	5135818	5145006	650-720
NAS-147-66	12B-070	4	5135818	5145006	650-720
AN4-23A	AN365-428	4	2114115	5145006	50-70
			REAR SPAR		
NAS-144-24	AN365-428	4	2108133	5145006	73-100
NAS-144-28	AN365-428	4	2108133	5145006	73-100
NAS-147-48	12B-070	4	5135818	5145006	650-720
NAS-147-44	12B-070	4	5135818		650-720
AN5-14A	AN365-524	28	5074799		100-140
			OUTER TO INNER WING ATTACHMENT		
AN6-15A	AN365-624	4	Rear Spar	5233002	160-190
NAS-156-70	12B-164	4	Center Spar	5233002	450-665 (ft-lb)
NAS-148-44	12B-080	30	Longerons 1, 2, 3, 4 5,12,13,14,15,16 22,23,24,25,26.	5233002	700-1000
			OUTER TO INNER WING ATTACHMENT		
4105725-1	12B-080	6	Lower Inner Wing	5074909	700-1000
4105725-2	12B-080	4	Lower Inner Wing	5074909	700-1000
4105725-1	12B-080	6	Upper Inner Wing	5074910	700-1000
4105725-2	12B-080	4	Upper Inner Wing	5074910	700-1000
			AILERON TO OUTER WING		
	AN365-820	1	1166012	5166083	480-690
	AN365-820	1	1166003	5166083	480-690
	AN365-820	1	1166013	5166083	480-690
	AN365-624	1	1166014	5166083	160-190
	AN365-624	1	1166022	5166083	160-190
			AILERON TRIM TAB HINGE		
AN3-5A	AN365-1032	4	1105817	5102992	20-25
	AN365-1032	8	1106568	5102992	20-25
			WING FLAP AND FLAP DOOR SUPPORT—STATIONS 167-247		
NAS-150-50	12B-108	2	5107248	5111502	135-155 (ft-lb)
NAS-148-54	12B-080	2	5107249	5111502	700-1000
			WING FLAP AND FLAP DOOR SUPPORT—STATIONS 281-.083		
NAS-146-32	12B-064	4	5107193	5111503	230-280
AN6-16A	AN365-624	8	4107197	5146723	160-190
			WING FLAP SUPPORT—STATION 378		
NAS-146-32	12B-064	4	5107188	5111217	230-280
NAS-146-34	12B-064	4	4107191	5111217	230-280

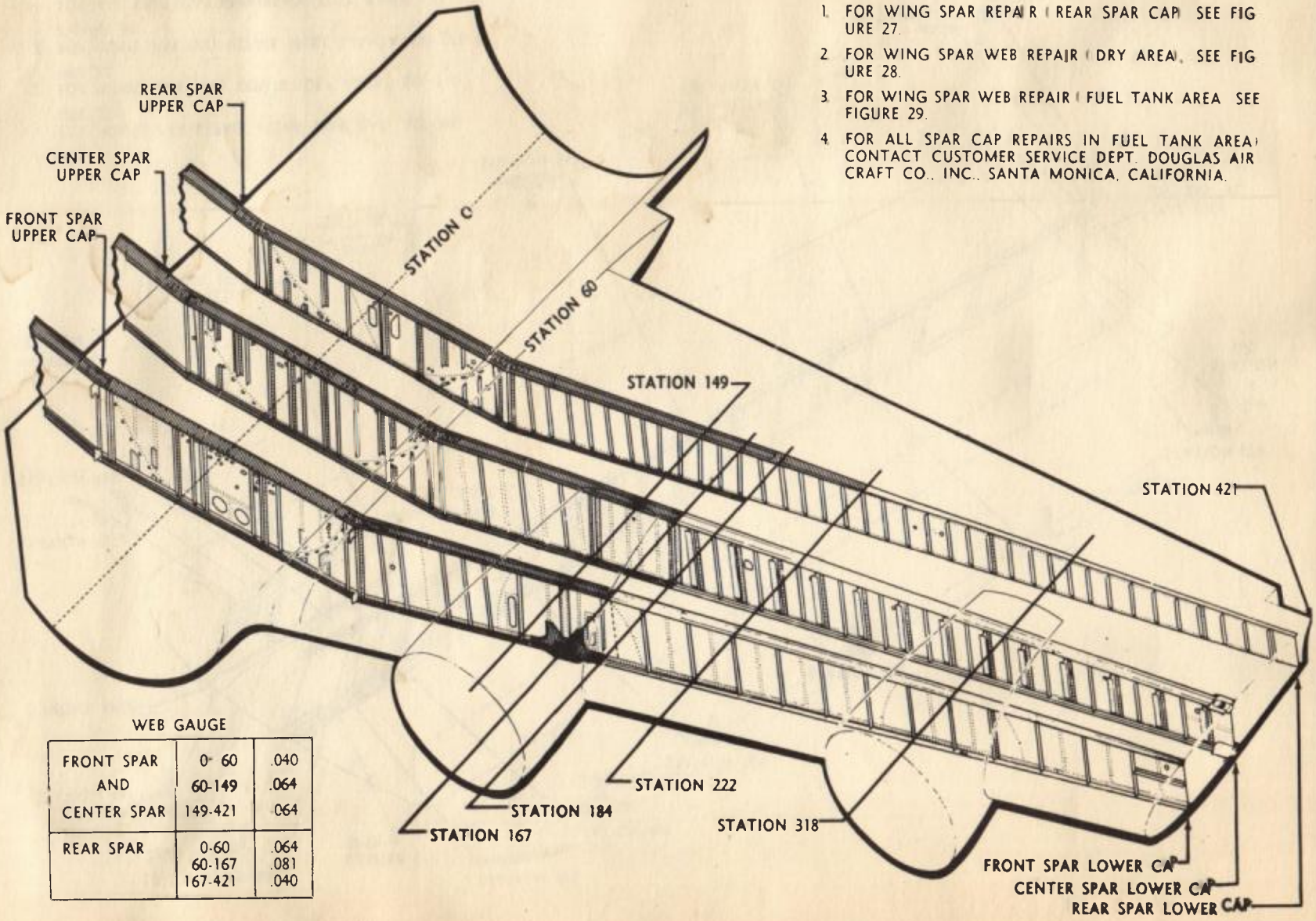
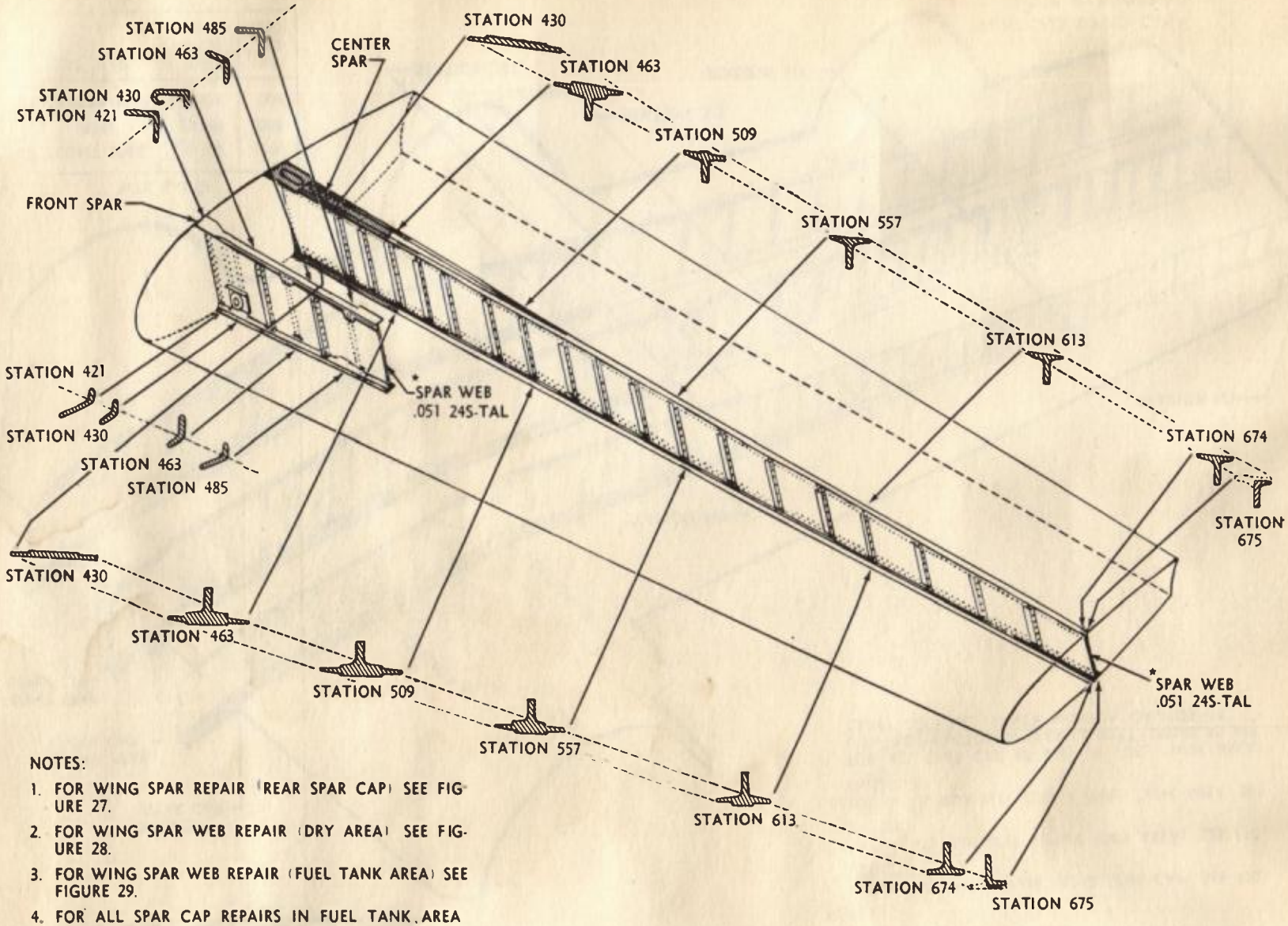


Figure 14 — Center Wing Spars



NOTES:

1. FOR WING SPAR REPAIR (REAR SPAR CAP) SEE FIGURE 27.
2. FOR WING SPAR WEB REPAIR (DRY AREA) SEE FIGURE 28.
3. FOR WING SPAR WEB REPAIR (FUEL TANK AREA) SEE FIGURE 29.
4. FOR ALL SPAR CAP REPAIRS IN FUEL TANK AREA CONTACT CUSTOMER SERVICE DEPT. DOUGLAS AIRCRAFT CO., INC., SANTA MONICA, CALIFORNIA.
5. SHADED AREAS ARE NOT REPAIRABLE.

Figure 15 — Outer Wing Spars

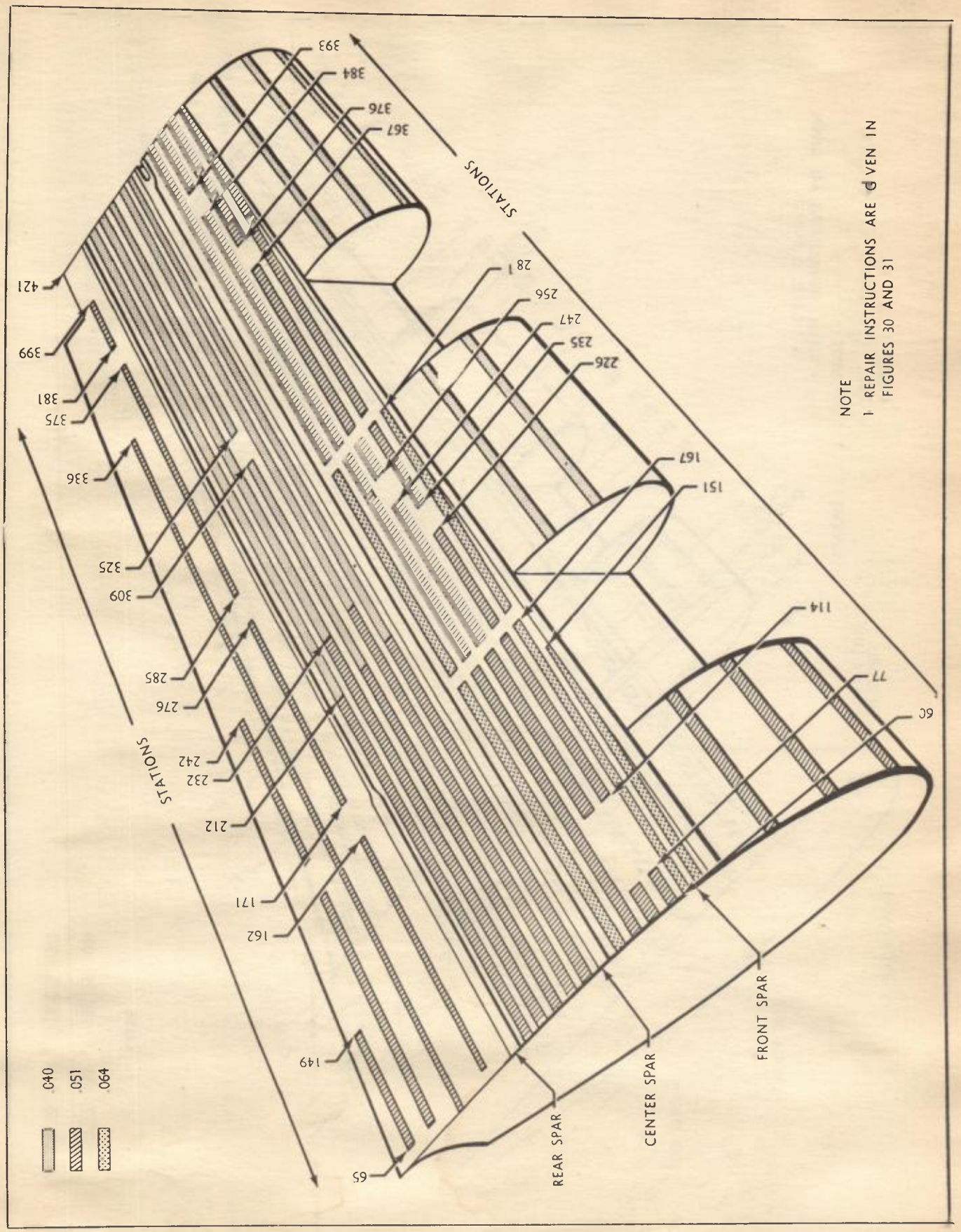


Figure 16 — Center Wing Stringers — Upper Surface

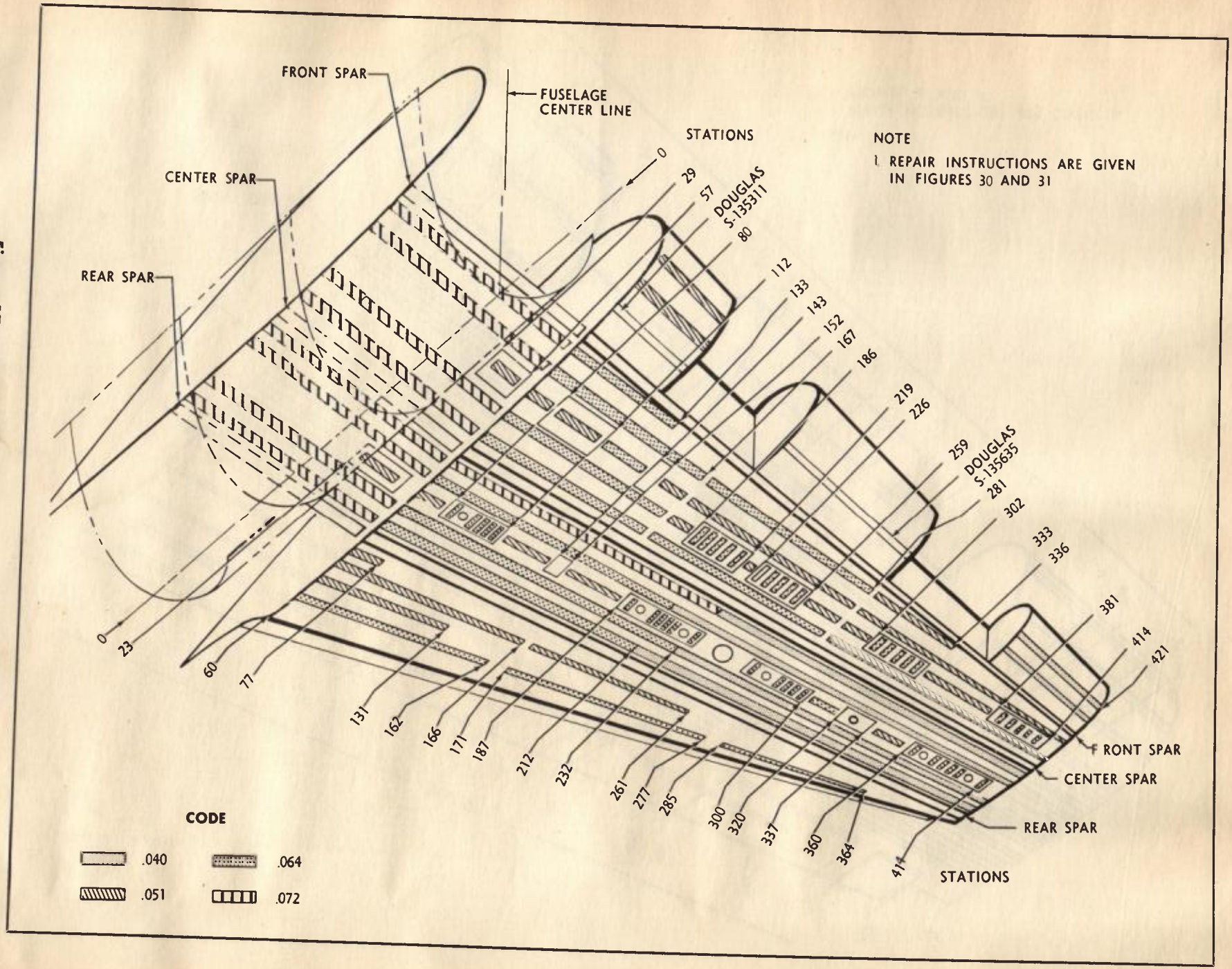


Figure 17 — Center Wing Stringers — Lower Surface

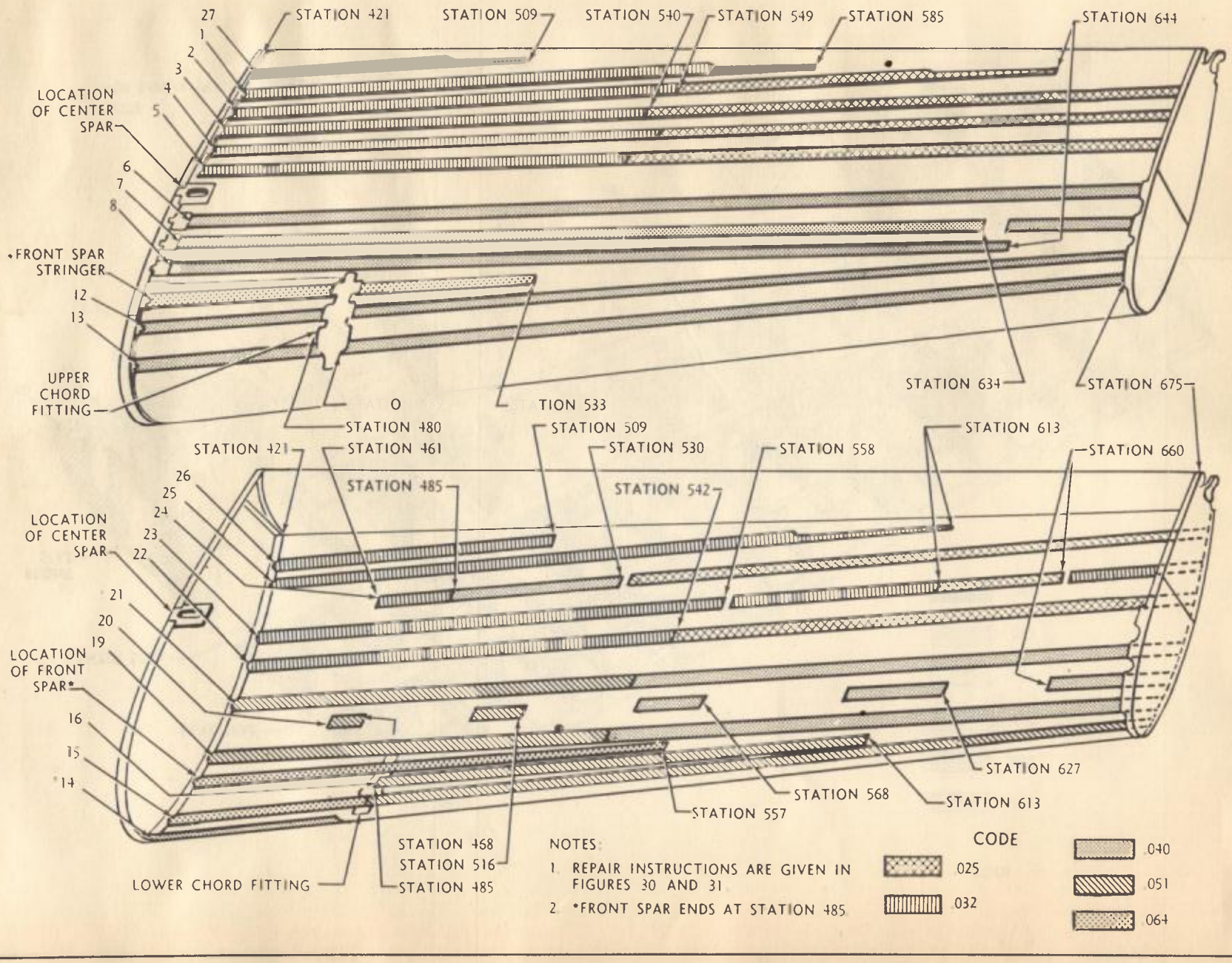


Figure 18 — Outer Wing Stringers

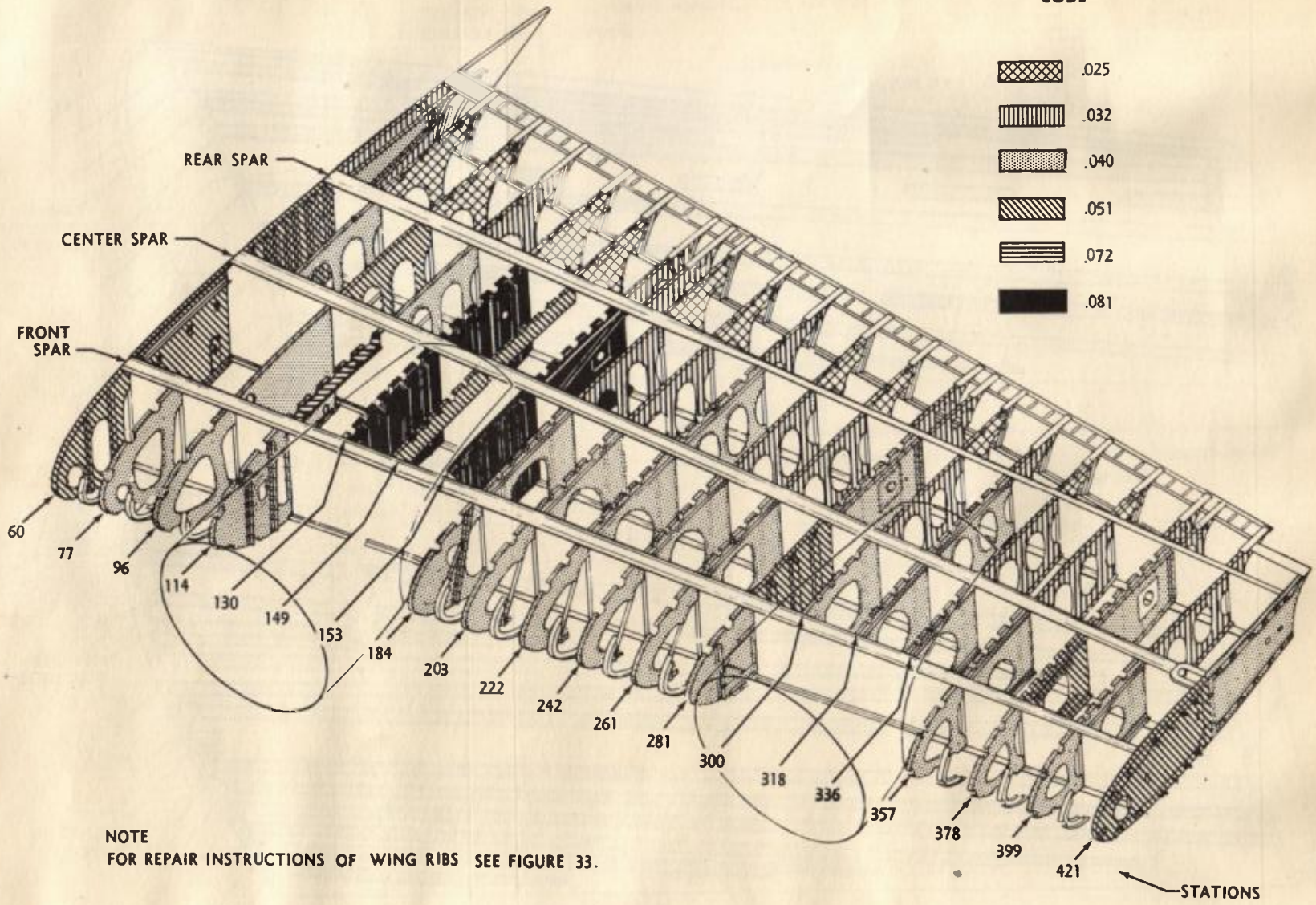


Figure 19—Center Wing Ribs

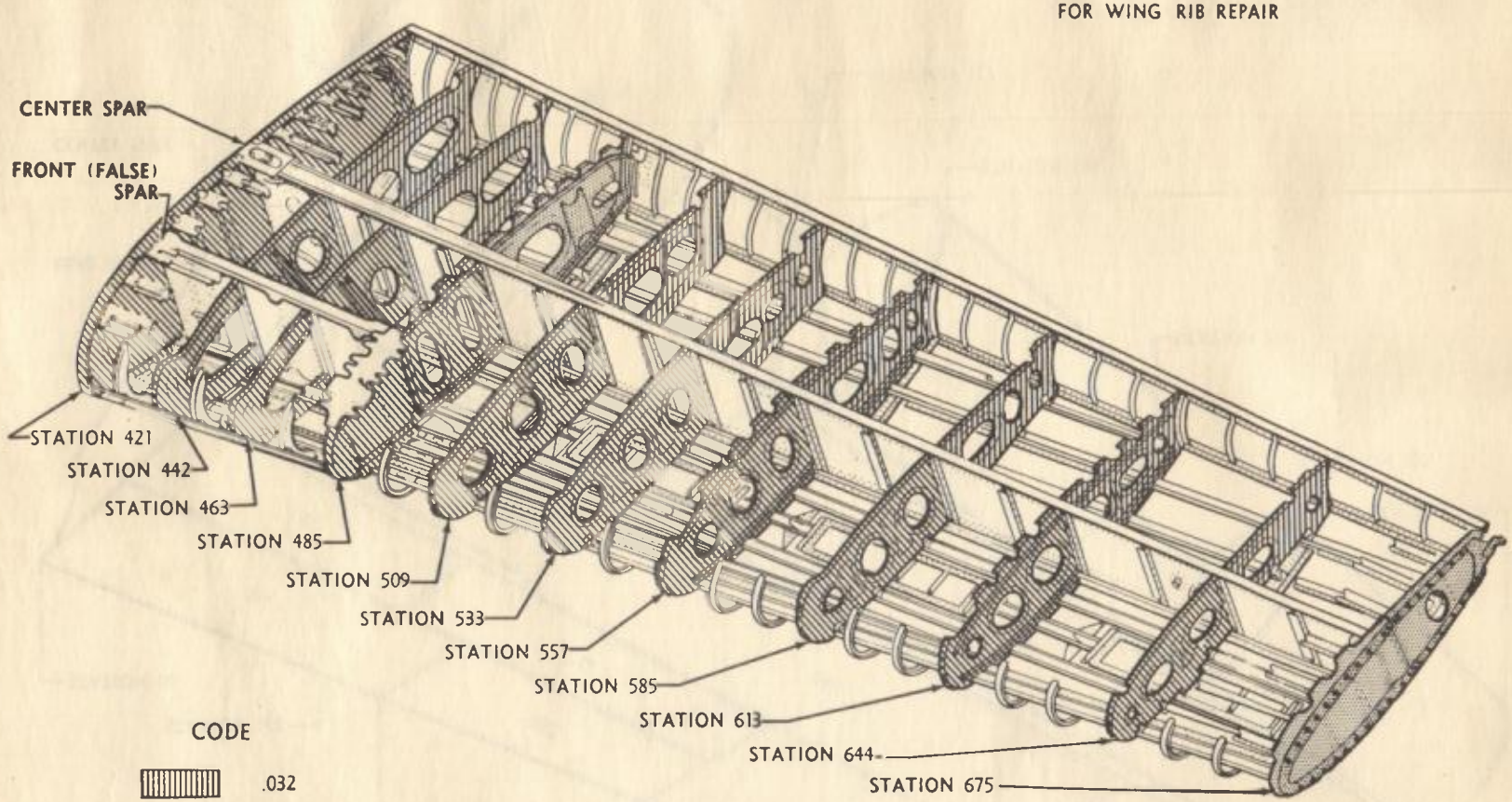


Figure 20 – Outer Wing Ribs

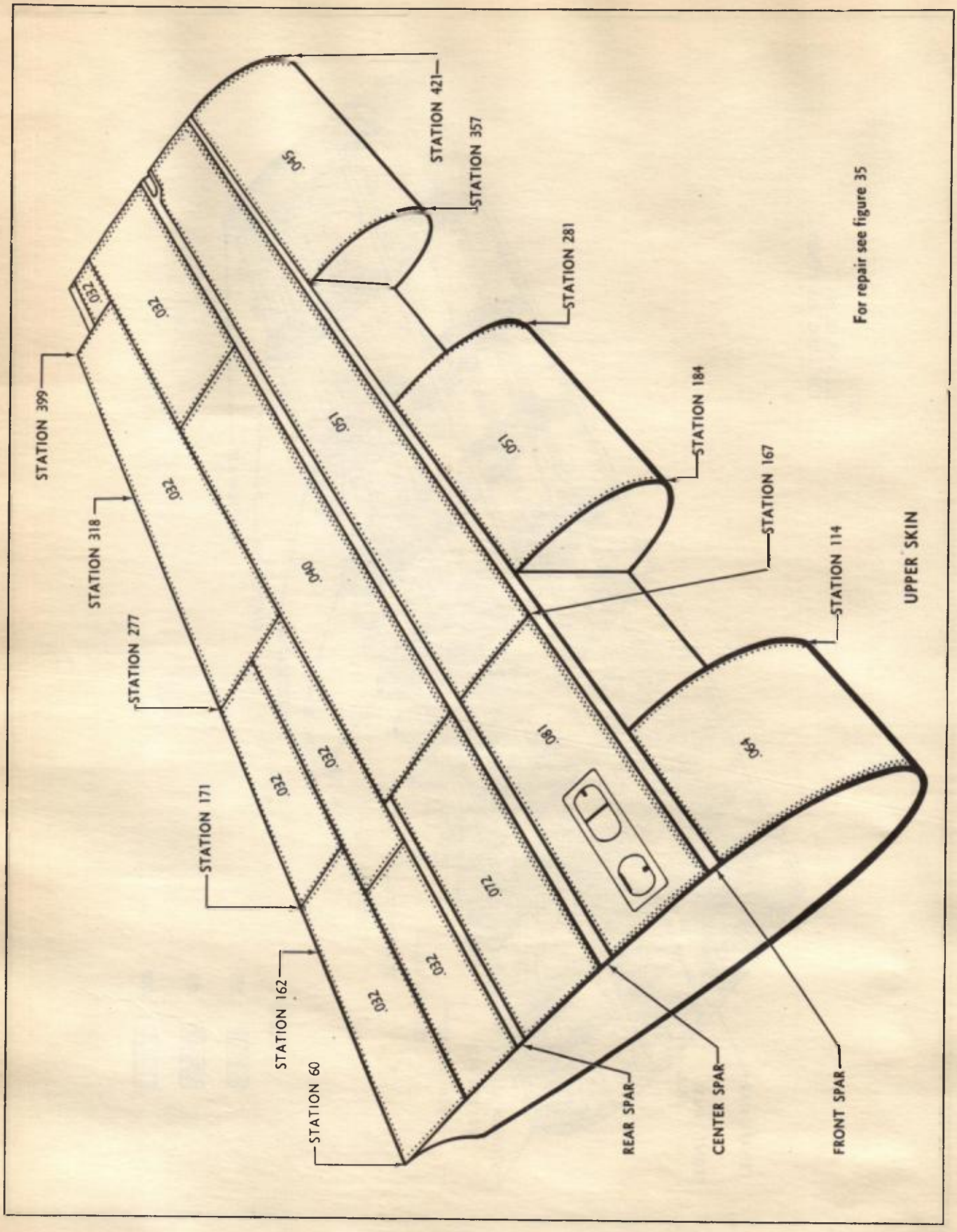
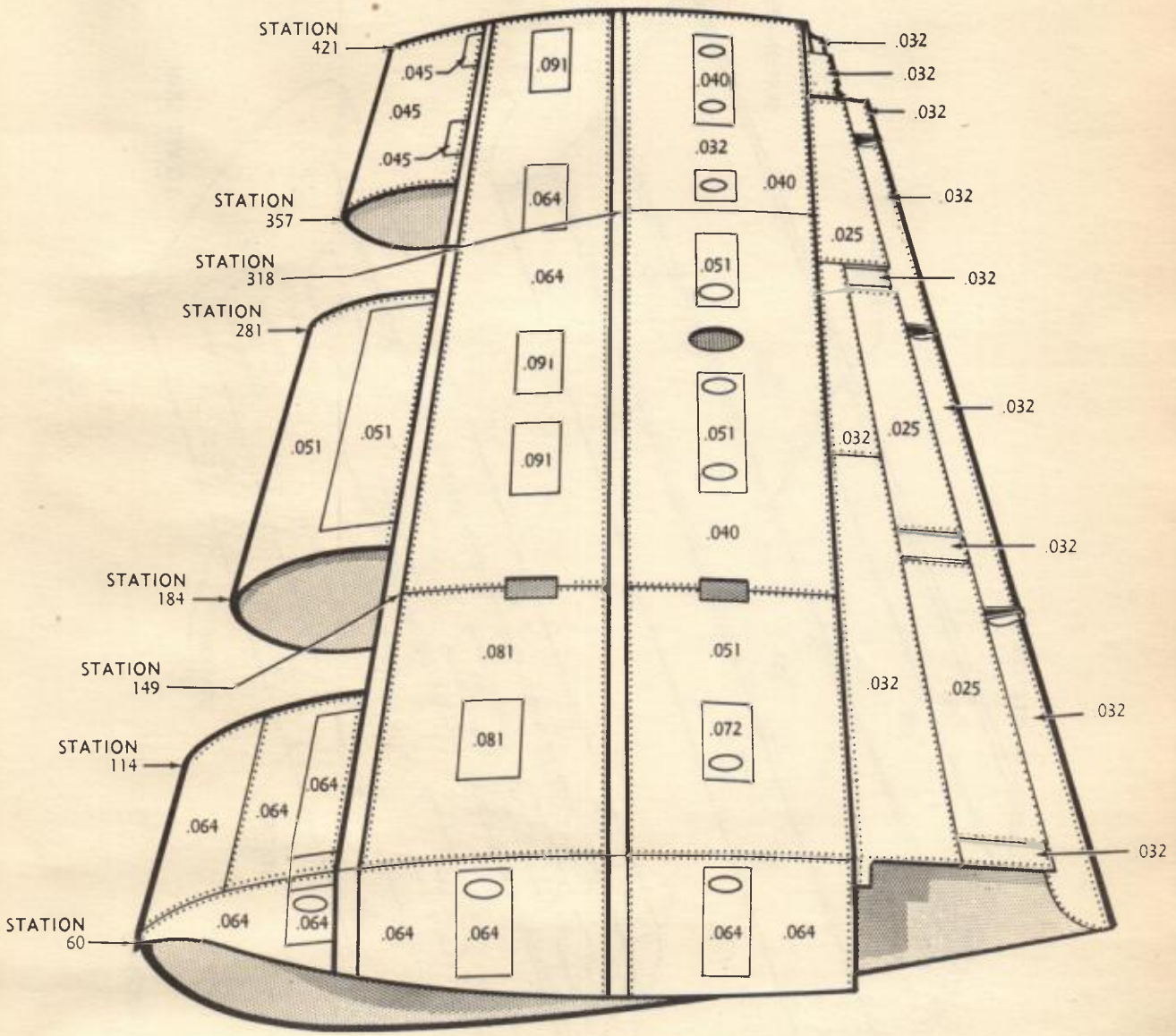


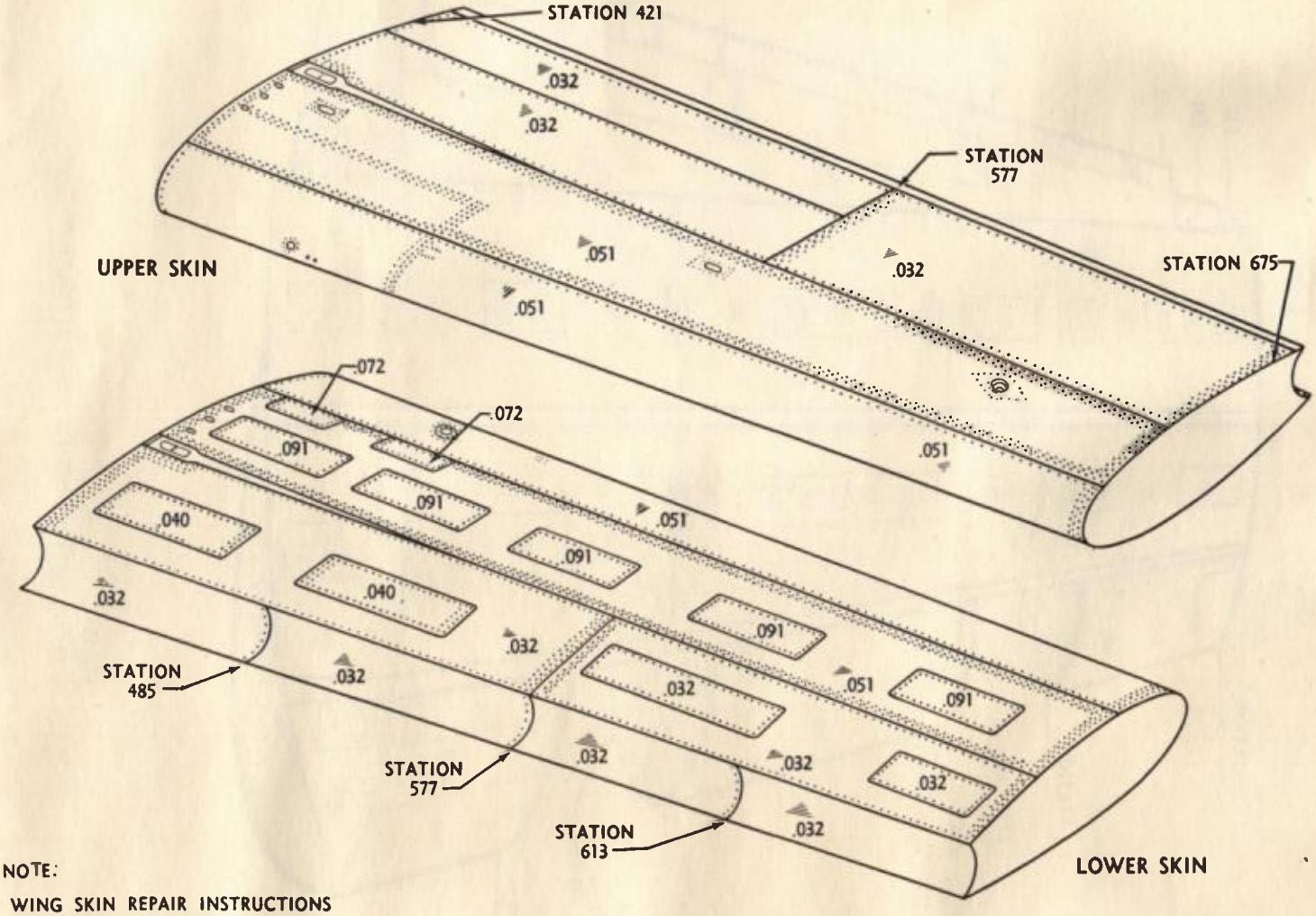
Figure 21 — Center Wing Skin — Upper Surface



NOTES:

1. REPAIR INSTRUCTIONS ARE GIVEN IN FIGURE 35

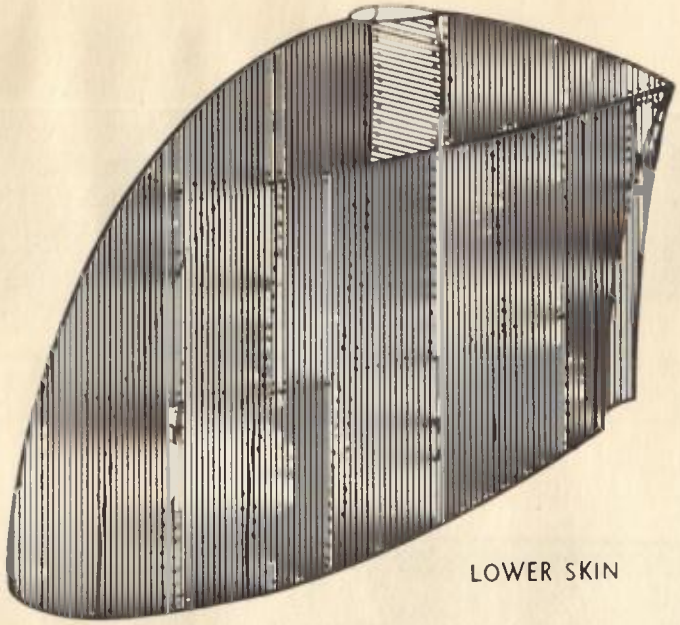
Figure 22 — Center Wing Skin — Lower Surface



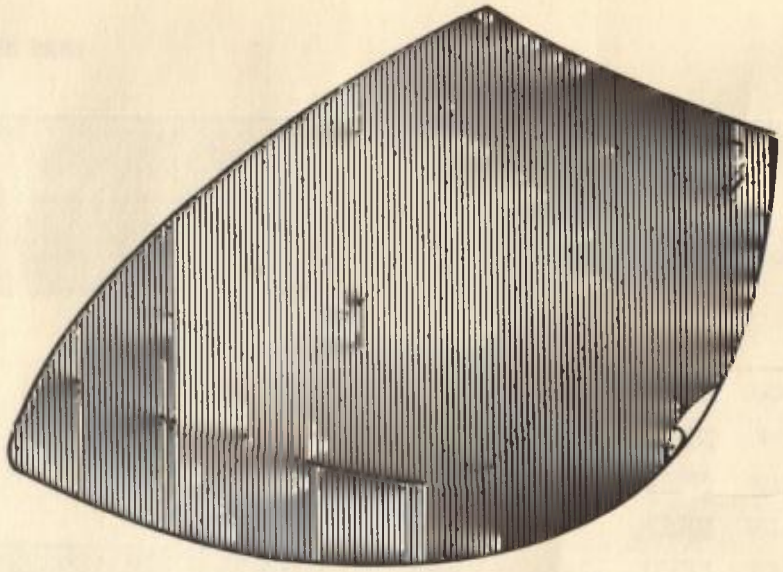
NOTE:

WING SKIN REPAIR INSTRUCTIONS ARE GIVEN IN FIGURE 34

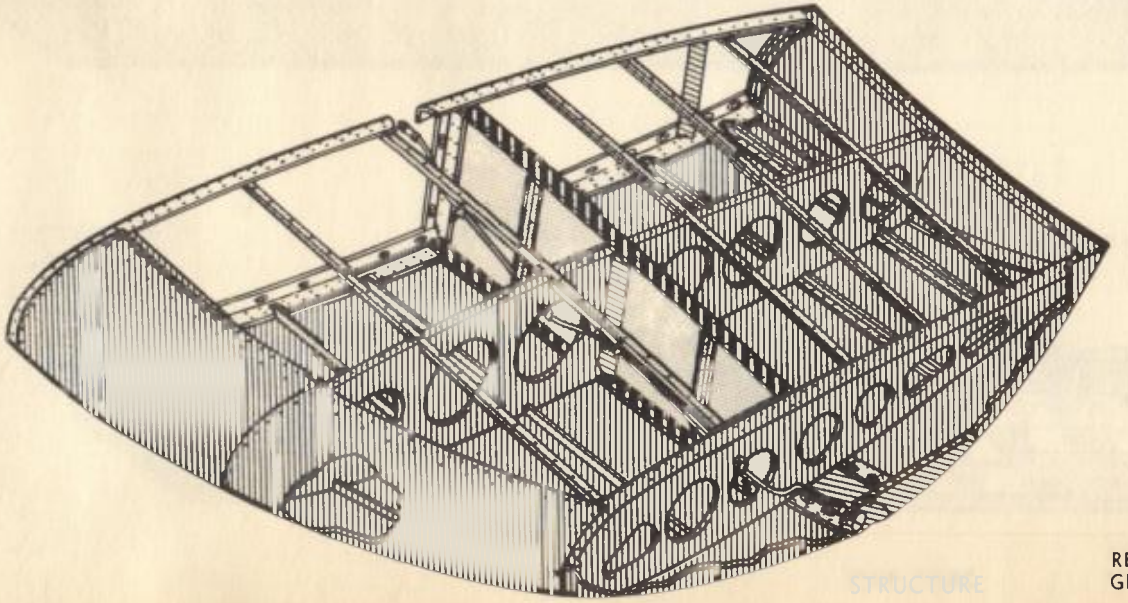
Figure 23 — Outer Wing Skin



LOWER SKIN



UPPER SKIN



CODE

DOUGLAS 1109080
ALCOA L-28714

.040

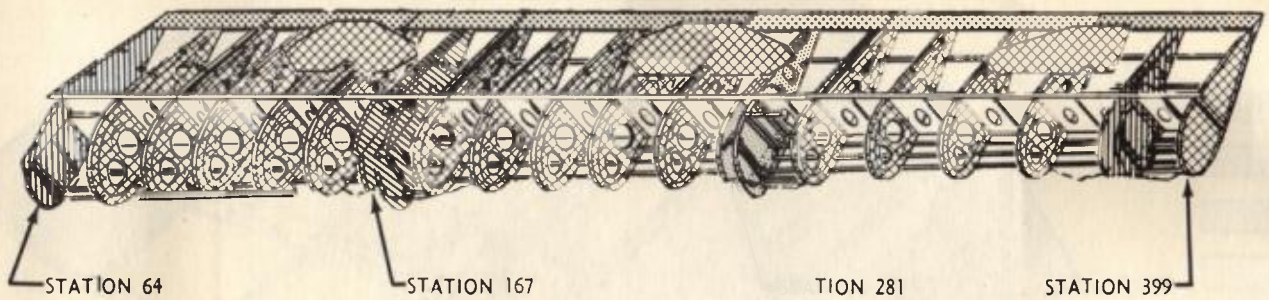
.032

.051

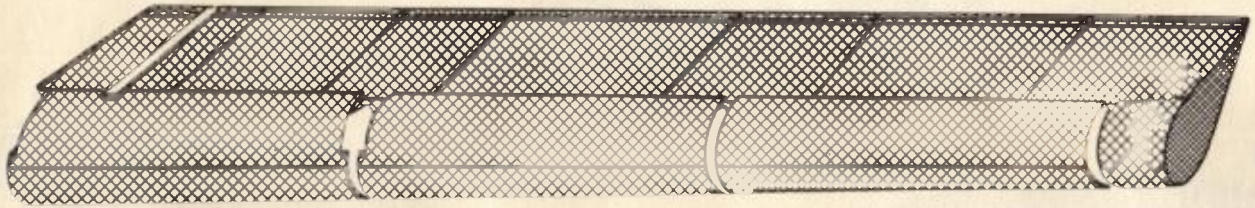
.062

REPAIR INSTRUCTIONS ARE GIVEN IN FIGURE 36

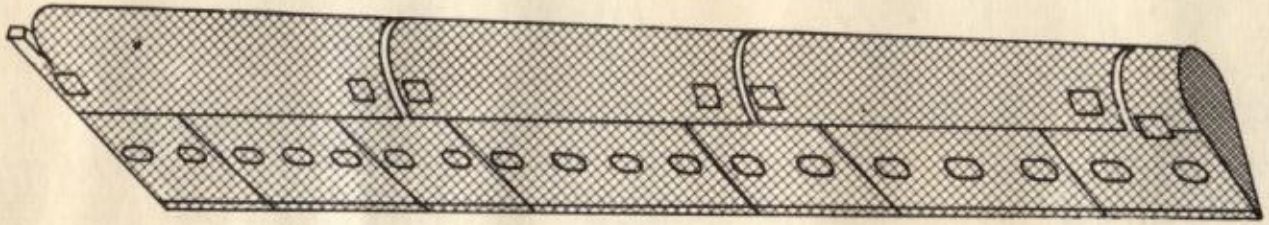
Figure 24 – Wing Tip



STRUCTURE



UPPER SKIN



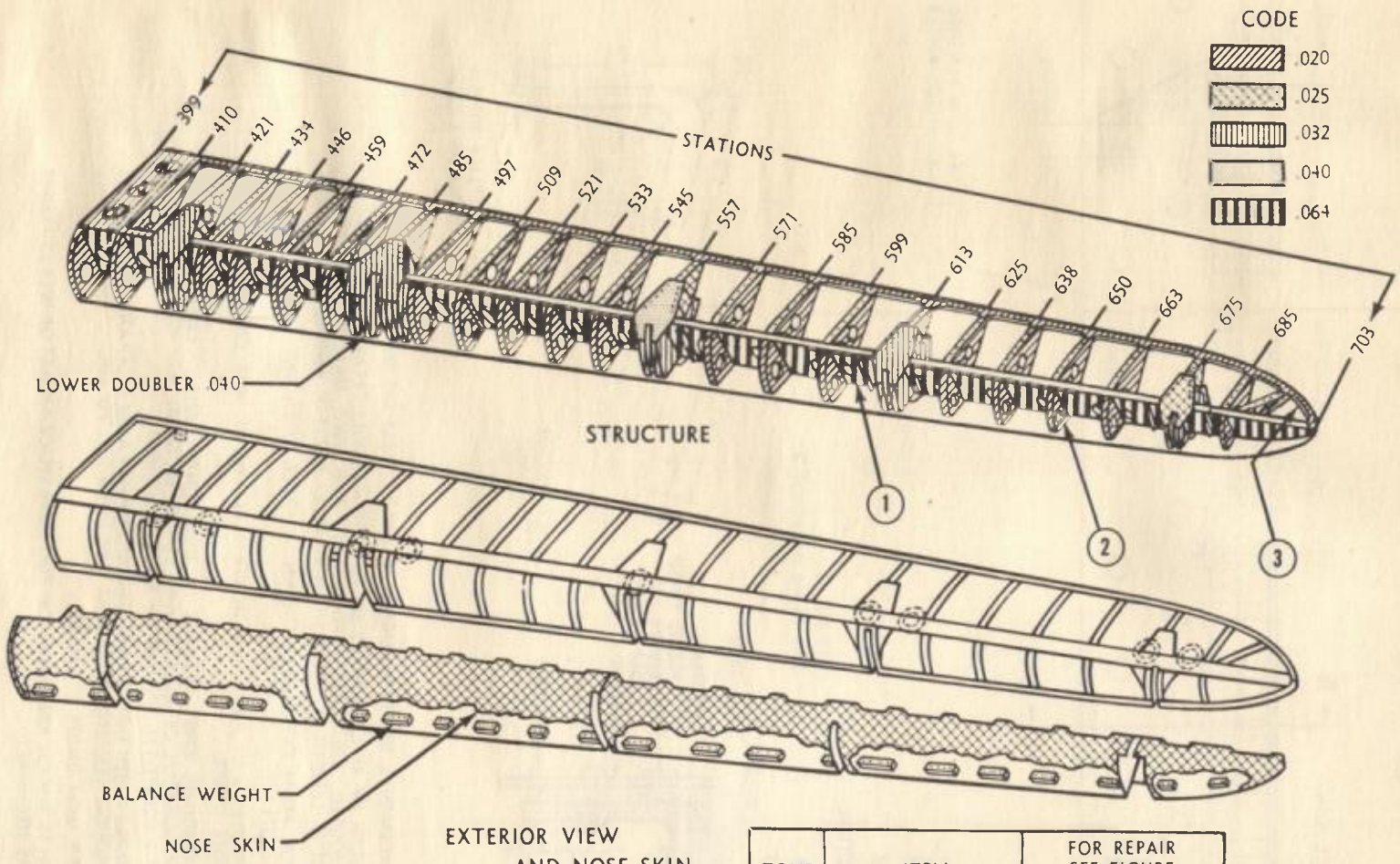
LOWER SKIN

CODE

- .025
- .032
- .051
- .064
- .040

NOTE:
REPAIR INSTRUCTIONS ARE GIVEN IN FIGURES 40 AND 41

Figure 25 — Wing Flap

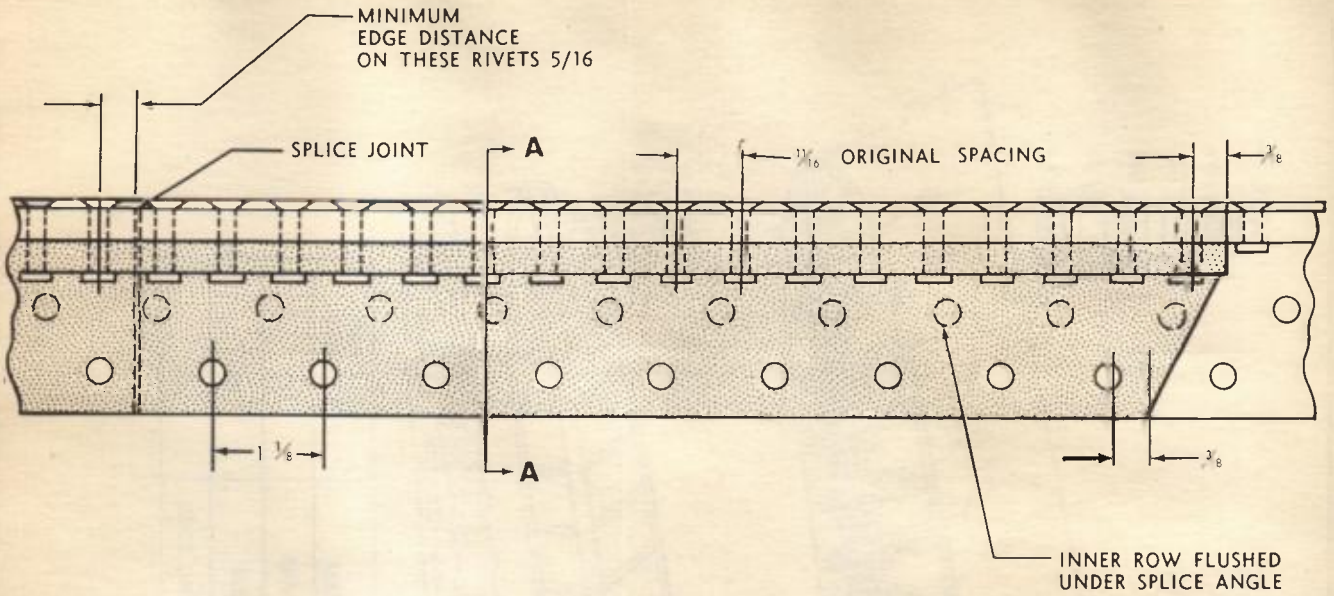


EXTERIOR VIEW
AND NOSE SKIN

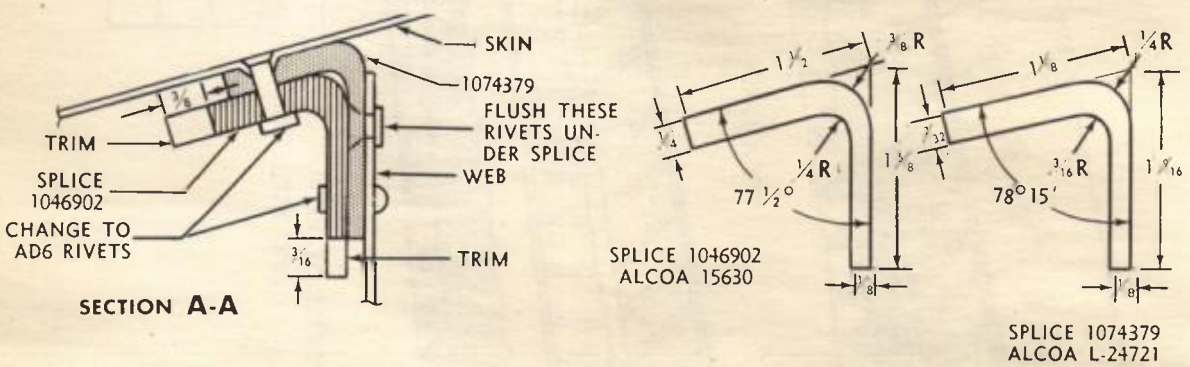
ZONE	ITEM	FOR REPAIR SEE FIGURE
1	SPAR	37
2	RIB	38
3	TRAILING EDGE	39

NOTE:
TAB STATIONS ARE 446 TO 521 RIGHT SIDE ONLY

Figure 26 – Aileron



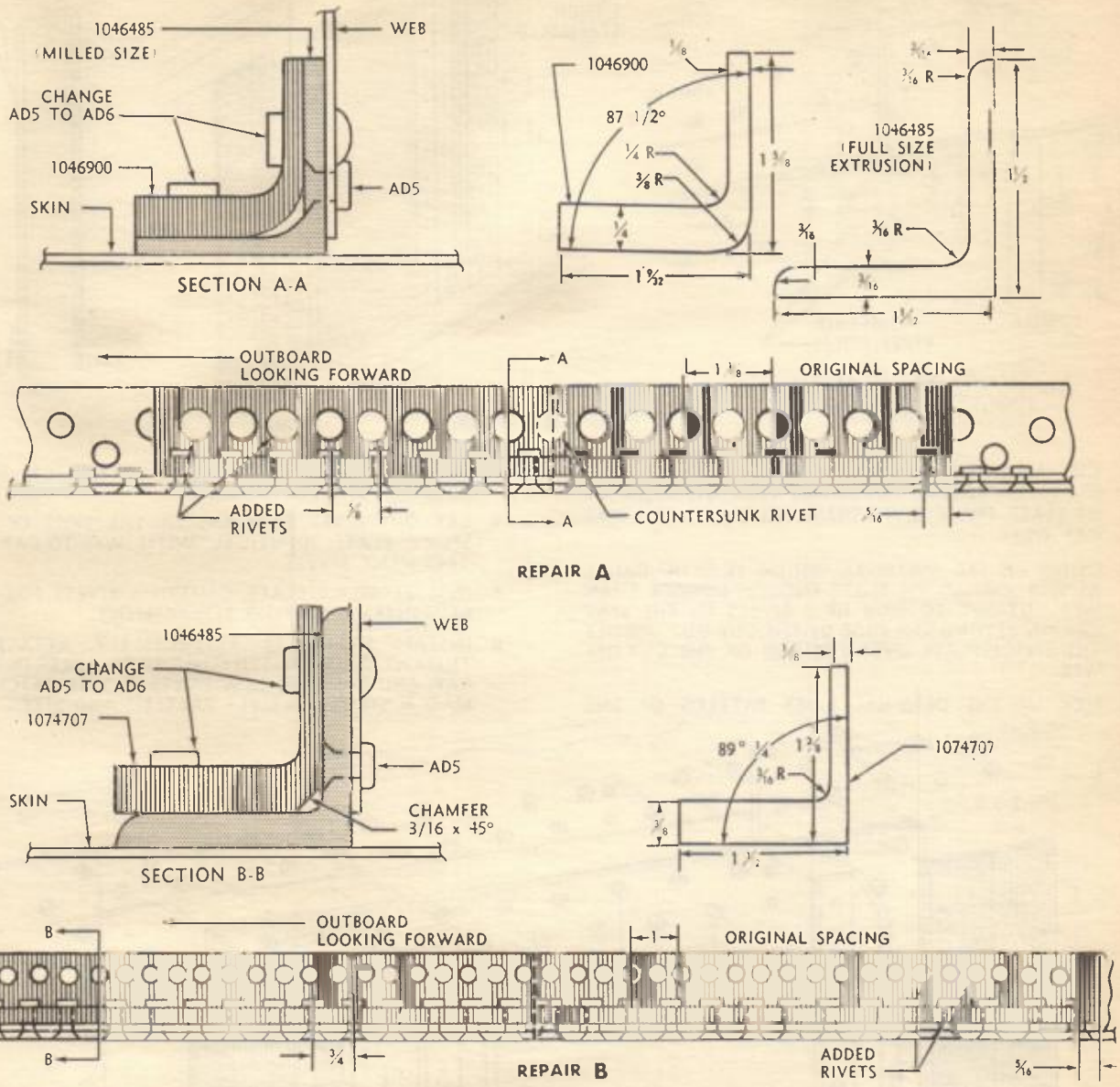
REPAIR C
See table on sheet 2.



NOTES:

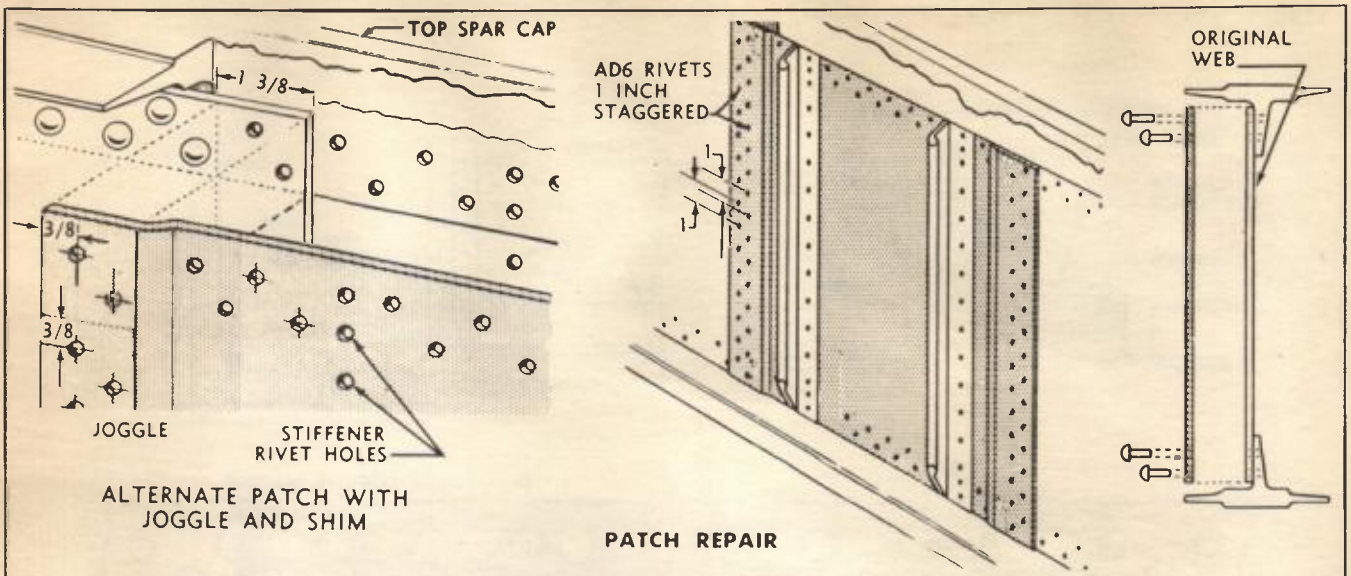
1. FOR REPLACEMENTS, USE EXTRUSIONS SHOWN IN TABLE ON SHEET 2.
2. PLAN LENGTH OF REPLACEMENTS SO THAT SPLICES WILL CLEAR RIBS, AS RIBS CANNOT BE JOGGED. USE LONG REPLACEMENT AND TWO SPLICES IF NECESSARY. REPLACEMENT LENGTH IS DETERMINED BY RIVET PATTERN AND EDGE DISTANCES.
3. CUT SPLICES FROM EXTRUSIONS SHOWN IN TABLE. OPEN ANGLES AS NECESSARY TO NEST PROPERLY.
4. FLUSH INNER ROW OF AD5 RIVETS IN VERTICAL LEG OF SPAR CAP AND REPLACEMENT UNDER SPLICE.
5. PICK UP ORIGINAL RIVET PATTERN IN HORIZONTAL AND VERTICAL LEGS. ALL RIVETS THROUGH SPLICE ANGLES MUST BE AD6, ORIGINAL SIZE IS AD5. SEE TABLE ON SHEET 2 FOR TOTAL NUMBER OF RIVETS REQUIRED.
6. AT STIFFENERS FLUSH OUTER RIVET THROUGH SPLICE ANGLE, CAP AND WEB. CHANGE RIVET THROUGH STIFFENER AND SPAR CAP FROM AD5 TO AD6.
7. USE A 24S-T SHIM UNDER STIFFENER.
8. FLUSH RIVETS WHICH ARE UNDER OR TOO NEAR SPLICE ANGLES OR WEB STIFFENER ANGLES AS NECESSARY.

Figure 27 (Sheet 1 of 2 Sheets) — Wing Spar Repair — Rear Spar Caps

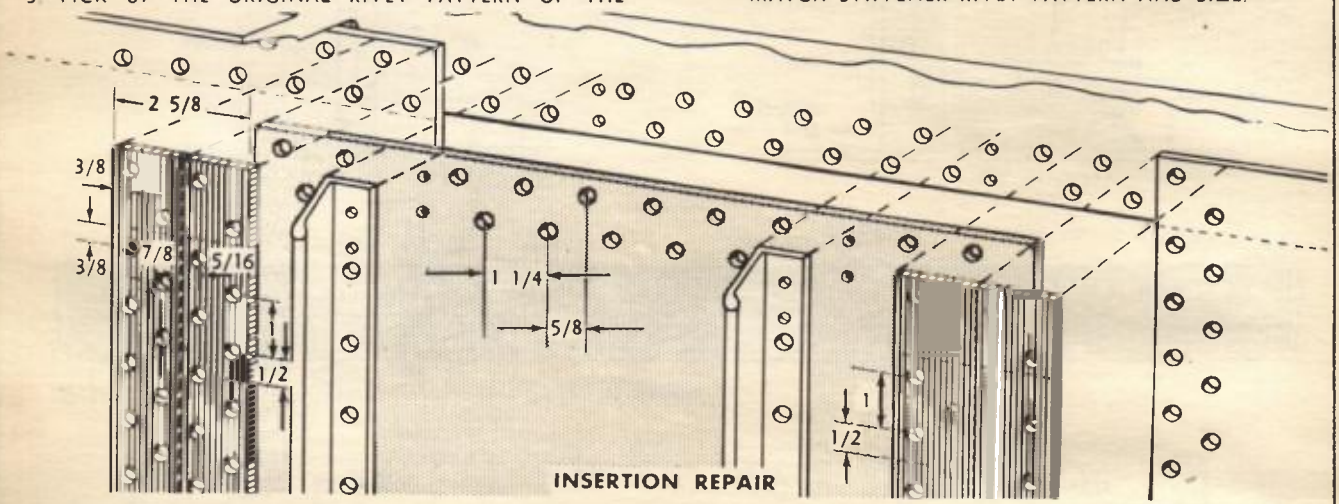


REPAIR AREA			REPLACEMENT		SPLICE	
LOCATION		STATIONS	DOUGLAS EXTRUSION NUMBER	MAXIMUM LENGTH	DOUGLAS EXTRUSION NUMBER	RIVETS USED EACH SIDE OF SPLICE
A	LOWER CAP	318-421	S-1046485 (AND 10133-1404)	10 1/8	S-1046900 (ALCOA 15628)	16 AD-6
B	LOWER CAP	184-318	1046485 (AND 10133-1404)	16 5/8	S-1074707 (ALCOA L124732)	34 AD-6
C	UPPER CAP (SEE SHEET 1)	222-421	1074379 (ALCOA L24721)	16 1/8	S-1046902 (ALCOA 15630)	26 AD-6

Figure 27 (Sheet 2 of 2 Sheets) — Wing Spar Repair — Rear Spar Caps



1. CUT AWAY DAMAGED WEB SO THAT PATCH WILL CLEAR STIFFENERS, ALLOWING EDGE DISTANCE OF AT LEAST TWICE RIVET DIAMETER FROM LAST SPAR CAP RIVET.
2. USING 24S-TAL MATERIAL WHICH IS SAME GAUGE AS WEB, CUT SPLICE PLATE ENOUGH LONGER THAN WEB CUT-OUT TO PICK UP 2 RIVETS IN THE SPAR CAP FIN BEYOND THE EDGE OF THE CUT-OUT. JOGGLE THE SPLICE PLATE OVER THE END OF THE CUT-OFF WEB.
3. PICK UP THE ORIGINAL RIVET PATTERN OF THE SPAR CAP FIN FOR THE TOP AND BOTTOM RIVET ROWS OF THE SPLICE.
4. LAY OUT RIVET PATTERNS IN THE ENDS OF THE SPLICE PLATE IDENTICAL WITH WEB-TO-CAP ATTACHMENT RIVETS.
5. INSTALL SPLICE PLATE, OMITTING RIVETS FOR ANY STIFFENERS REQUIRING REPLACEMENT.
6. INSTALL STIFFENERS, AS NECESSARY, ATTACHING THEM AT ORIGINAL STIFFENER RIVET HOLES IN SPAR CAP, AND DRILLING NEW HOLES IN WEB PATCH TO MATCH STIFFENER RIVET PATTERN AND SIZE.

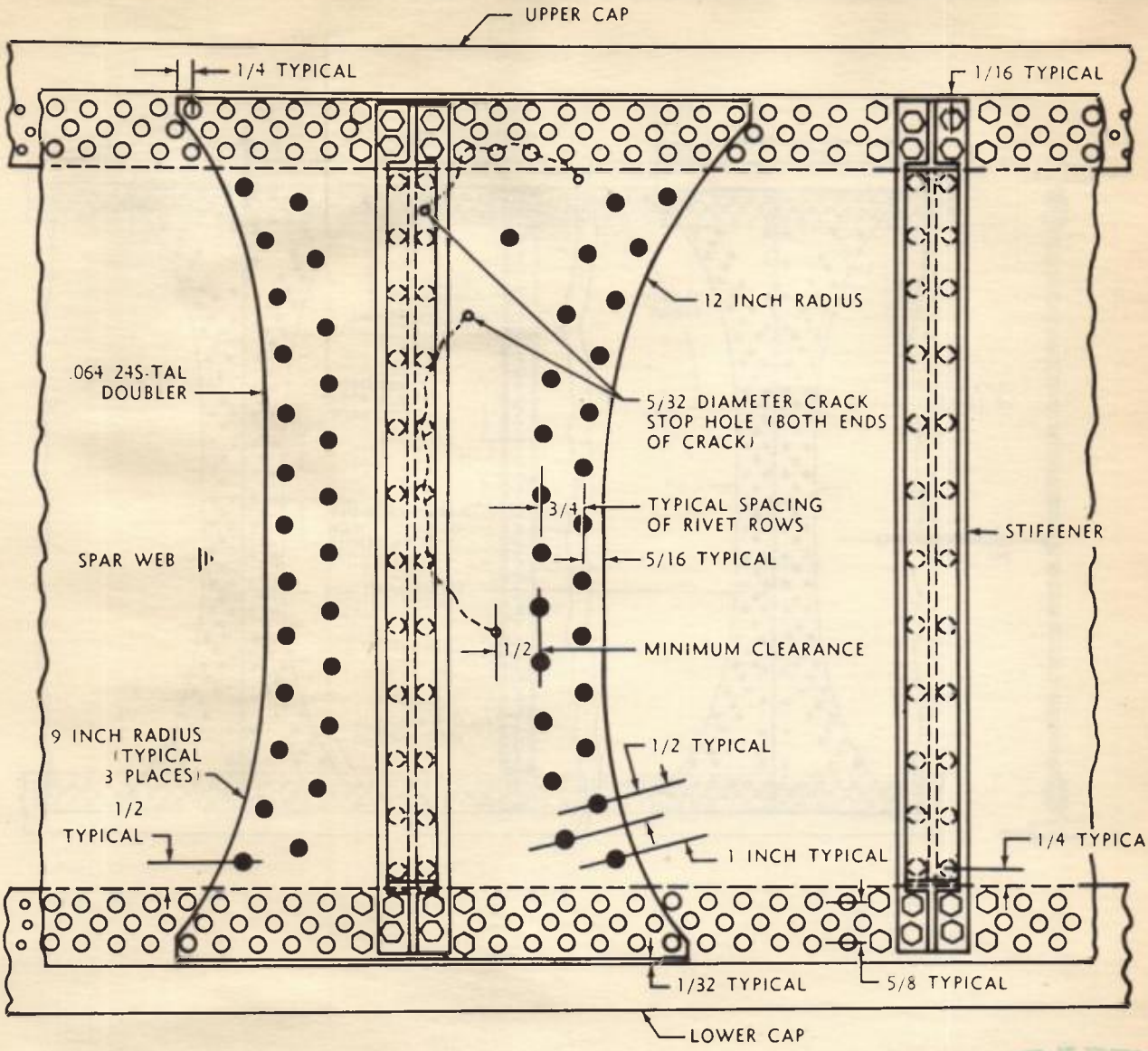


1. CUT AWAY DAMAGED WEB SO THAT TRIM LINE FALLS HALFWAY BETWEEN RIVETS OF SPAR CAP VERTICAL FIN.
2. CUT REPLACEMENT TO FIT CUT-OUT, USING 24S-TAL, WHICH IS SAME GAUGE AS WEB.
3. USING 24S-TAL, WHICH IS SAME GAUGE AS WEB, CUT 2 SPLICE PLATES TO JOIN REPLACEMENT TO ORIGINAL WEB; CUT PLATES WIDE ENOUGH TO ACCOMMODATE 2 ROWS OF RIVETS ON EACH SIDE OF SPLICE JOINT. RIVET PATTERN AND SIZE IDENTICAL WITH WEB-TO-CAP ATTACHMENT.
4. GENERAL PROCEDURE SAME AS FOR THE PATCH REPAIR.

REPAIR FOR SMALL HOLES IN WEB

1. FOR SMALL HOLES IN WEB, SO LOCATED THAT THE REPAIR PATCH WILL CLEAR ALL SPAR STRUCTURE BY 3/4 INCH, A PATCH OF THE SAME GAUGE AND MATERIAL AS THE WEB MAY BE INSTALLED.
2. CUT AWAY DAMAGE, SMOOTHING EDGES AND ROUNDING CORNERS TO 1/2-INCH RADIUS.
3. CUT PATCH LARGE ENOUGH TO ALLOW SUFFICIENT OVERLAP FOR RIVET PATTERN THE SAME AS FOR LARGE REPAIRS.

Figure 28 — Wing Spar Web Repair — Dry Area



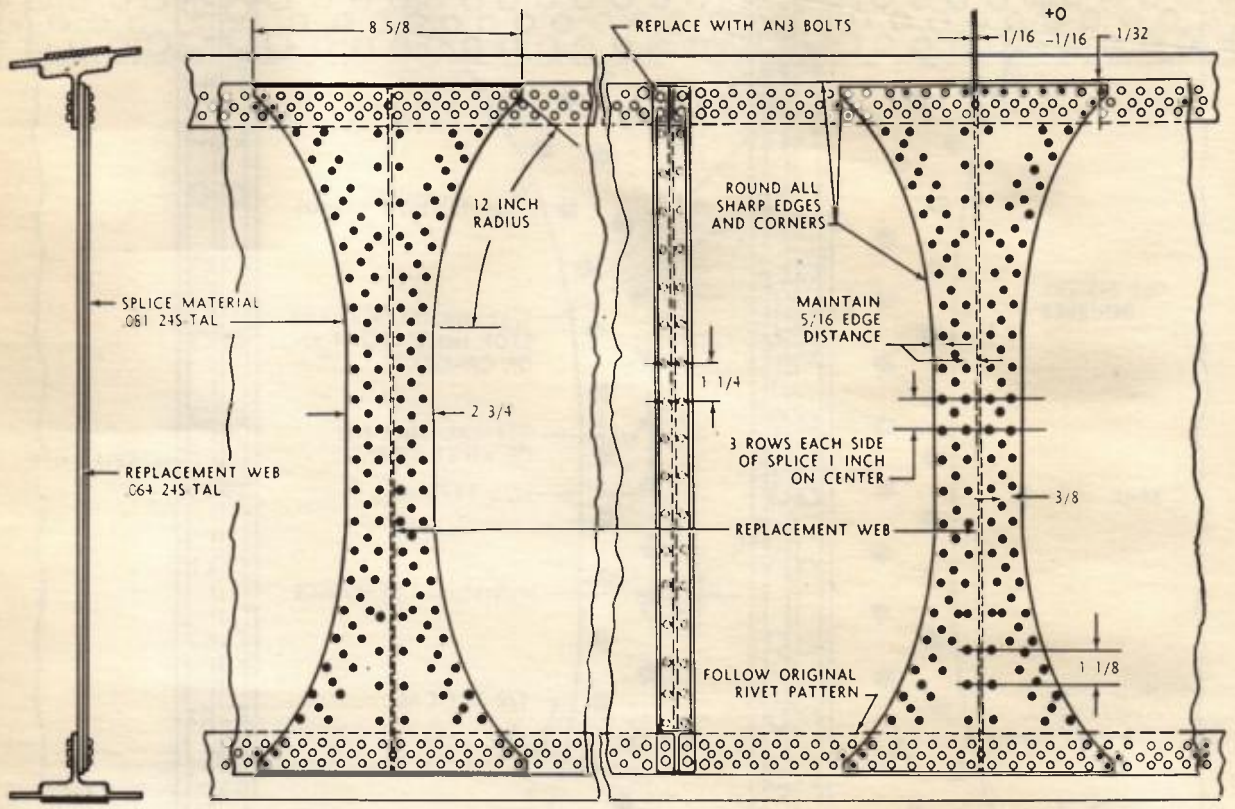
NOTES:

1. MAKE DOUBLER FROM .064 24S-TAL MATERIAL.
2. DRILL 5/32-INCH STOP HOLES EACH END OF CRACK.
3. ROUND ALL SHARP EDGES AND SEAL PER DPS 2.50.
4. UPSET ALL RIVETS ON IN-TANK SIDE.
5. KEEP 1/2-INCH EDGE DISTANCE FROM STOP HOLE OR CRACK TO RIVET HOLE.
6. RIVETS MUST MAINTAIN AT LEAST 5/16-INCH EDGE DISTANCE FROM DOUBLER.
7. INSTALL RIVETS IN WEB, 2 ROWS STAGGERED, 1 INCH ON CENTER WITH 3/4 INCH BETWEEN ROWS.
8. ALL RIVETS ARE AN430 AD5.
9. MAINTAIN 1/32-INCH CLEARANCE BETWEEN WEB AND DOUBLER AT BOTH TOP AND BOTTOM.

CODE

● NEW RIVETS ○ ORIGINAL RIVETS

Figure 29 (Sheet 1 of 2 Sheets) — Wing Spar Web Repair — Fuel Tank Area



NOTES

1 MAKE REPLACEMENT WEB FROM 064S TAL MATERIAL PREFERABLY ANODIZED

2 MAKE SPLICE FROM 081 24S TAL MATERIAL PREFERABLY ANODIZED

3 ROUND ALL SHARP EDGES AND CORNERS

4 INSTALL 3 ROWS OF STAGGERED RIVETS 1 INCH ON CENTER EACH SIDE OF SPLICE 3/8 INCH APART MAINTAIN 5/16 EDGE DISTANCE

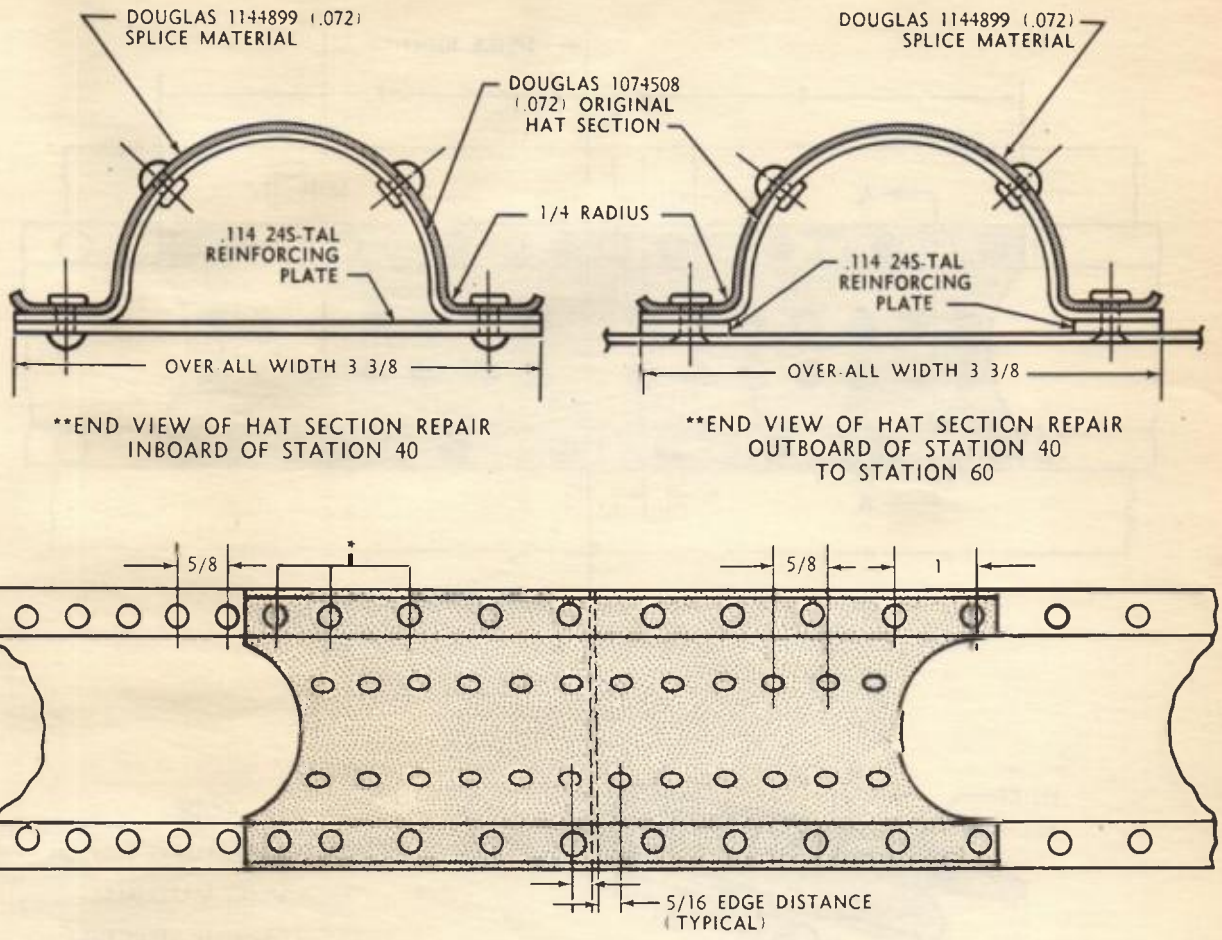
5 MAINTAIN 1/32 INCH CLEARANCE BETWEEN WEB AND SPLICE PLATE AT BOTH TOP AND BOTTOM OF SPLICE

6 ALL RIVETS ARE AN430 AD5 WITH THE EXCEPTION OF SPAR CAP FIN TO WEB RIVETS IN OUTER WING WHICH ARE AD4

7 REPLACE ALL BOLTS IN SPLICE WITH AN3 BOLTS

8 PERFORM ALL SEALING IN ACCORDANCE WITH INSTRUCTIONS IN PARAGRAPHS 5 TO 5.3, THIS SECTION

Figure 29 (Sheet 2 of 2 Sheets) — Wing Spar Web Repair — Fuel Tank Area



NOTES:

1. TRIM AWAY DAMAGED PORTION OF STRINGER.
2. TRIM DAMAGED PORTIONS OF ALL MEMBERS SO THAT SPLICE POINTS COME BETWEEN RIVETS OF ORIGINAL PATTERN.
3. FABRICATE SPLICE FOR CROWN OF STRINGER FROM .072 24S-TAL SHEET, 2 7/8 INCHES WIDE, AND OF SUFFICIENT LENGTH TO PICK UP 22 RIVETS ON EACH SIDE OF SPLICE. USE AD6 RIVETS PREFERABLY, OR A TOTAL OF 22 CR 178-6, CR 179-6 (OVER SIZE CHERRY) AND AD6 RIVETS, IN ANY COMBINATION NECESSARY.
4. MAINTAIN EDGE DISTANCES ON ALL RIVETS AND BOLTS, FOLLOWING ORIGINAL RIVET PATTERN OR AS SHOWN.
5. RIVET AND BOLT SPACING IS GOVERNED BY ORIGINAL RIVET PATTERN IN FLAT EDGES OF HAT SECTION.
6. * NOTE POINT AT WHICH RIVET SPACING IN FLAT EDGES OF HAT SECTION CHANGES FROM 5/8-INCH TO 1 INCH. SPACING OF BOLTS AND RIVETS THROUGHOUT THE REPAIR IS GOVERNED BY THIS CHANGE.
7. ** WHEN INSTALLED, THE HAT SECTION IS REINFORCED BY A .114 24S-TAL PLATE, RIVETED TO THE FLAT EDGES UNDER THE FULL WIDTH OF THE STRINGER, INBOARD OF STATION 40. OUTBOARD OF STATION 40, THIS PLATE IS CUT OUT, LEAVING A FORK OF 2 STRIPS, 1 UNDER EACH OF THE FLAT EDGES OF THE HAT SECTION.

Figure 30 — Wing Stringer Repair — Flat Edge Hat Section

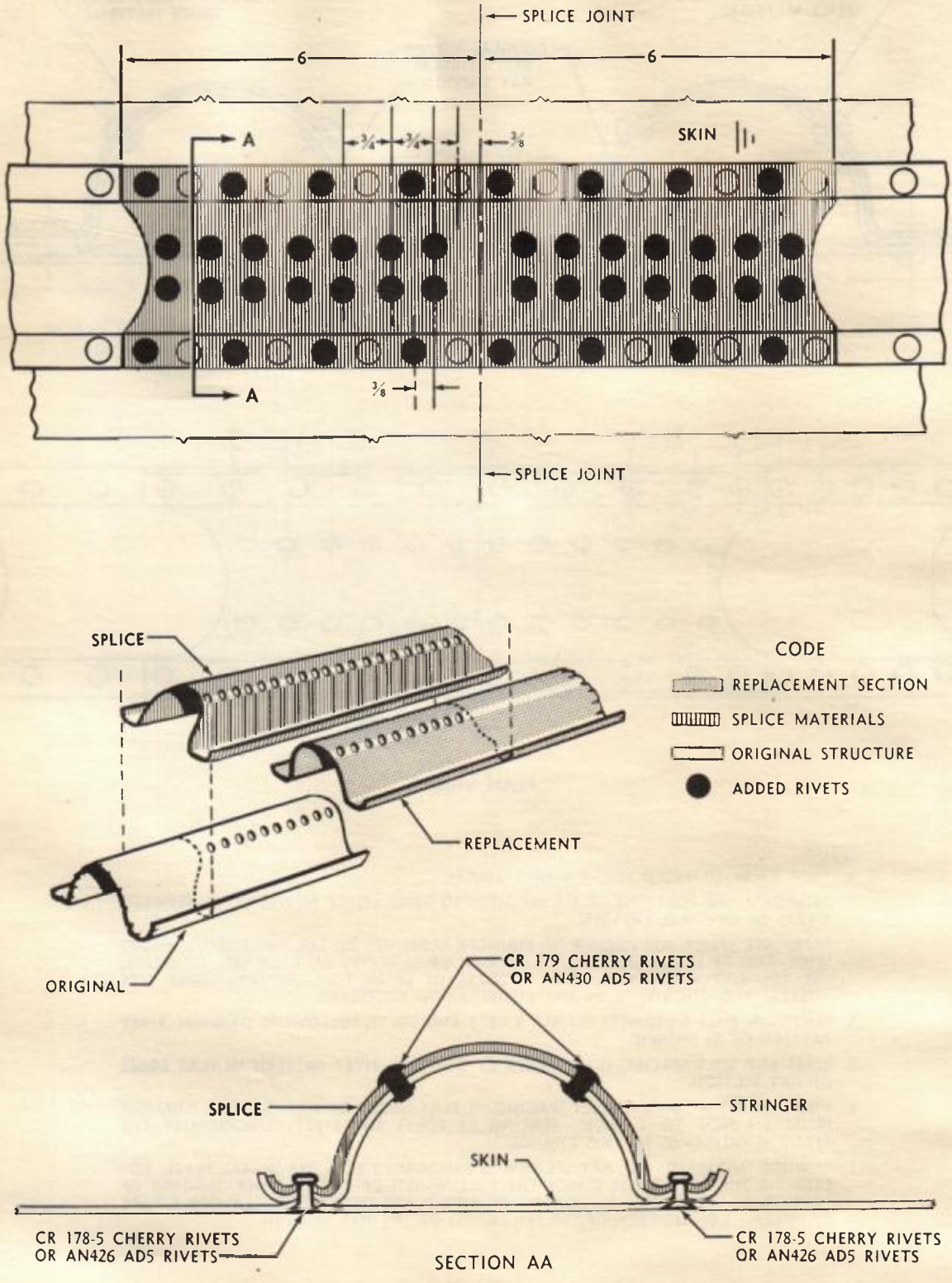


Figure 31 — Wing Stringer Repair — Curled Edge Hat Section

NOTES FOR WING STRINGER REPAIR _ CURLED EDGE HAT SECTION

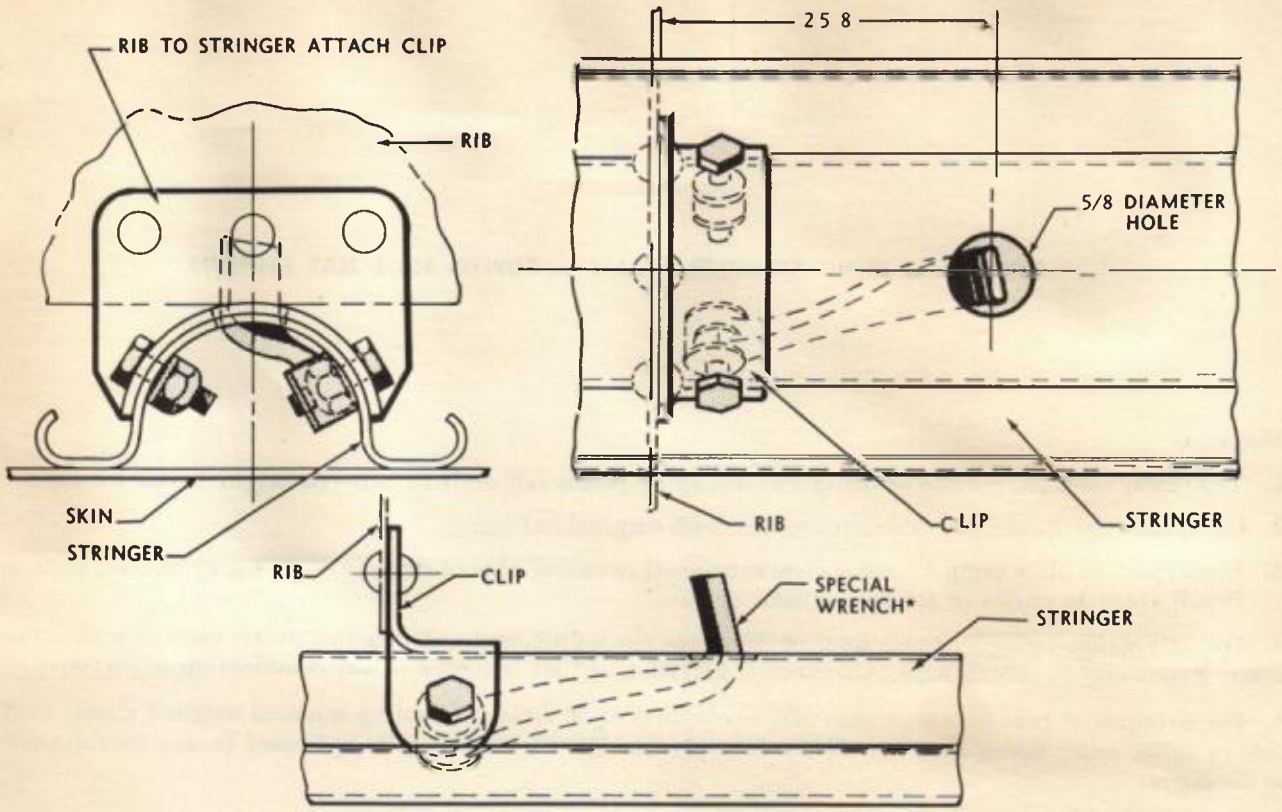
Notes:

1. Trim away damaged portion of stringer so that splice points fall midway between original rivet locations.
2. Cut splice from hat section fabricated to nest with original stringer.
3. Rivet splice in place using same size rivet as original in curled edge of stringer doubling up on rivet pattern. Install rivets in crown of stringer as illustrated.
4. For .025 gauge stringers use a total of 30 rivets (including replaced original rivets) each side of splice joint. Rivets may be AN426AD4, AN430AD4, CR178-4, or CR179-4, used in any combination as necessary.
5. For stringers of heavier gauge than .025 use a total of 30 rivets (including replaced original rivets) each side of splice joint. Rivets may be AN426AD5, AN430AD5, CR178-5 or CR179-5, used in any combination as necessary.

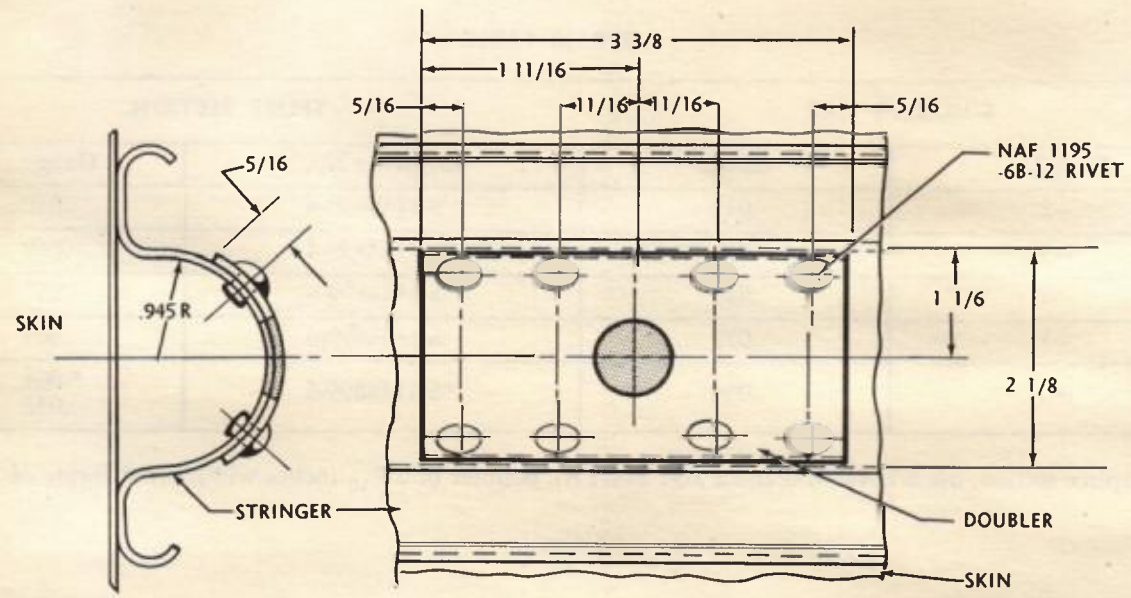
REPAIR TABLE

S-1073273 HAT		SPLICE SECTION	
Dash No.	Gauge	Drawing No.	Gauge
–2	.025	S-1144899-4	.040
–3	.032	S-1144899-4	.040
–4	.040	S-1144899-5	.051
–5	.051	S-1144899-6	.064
–6	.064	*S-1144899-6	*.064 .032

*For splice section, use S-1144899-6 and a .032 24S-TAL doubler of $2^{13}/_{16}$ inches width fitted inside of .064 hat.



INSTALLATION OF STRINGER CLIP

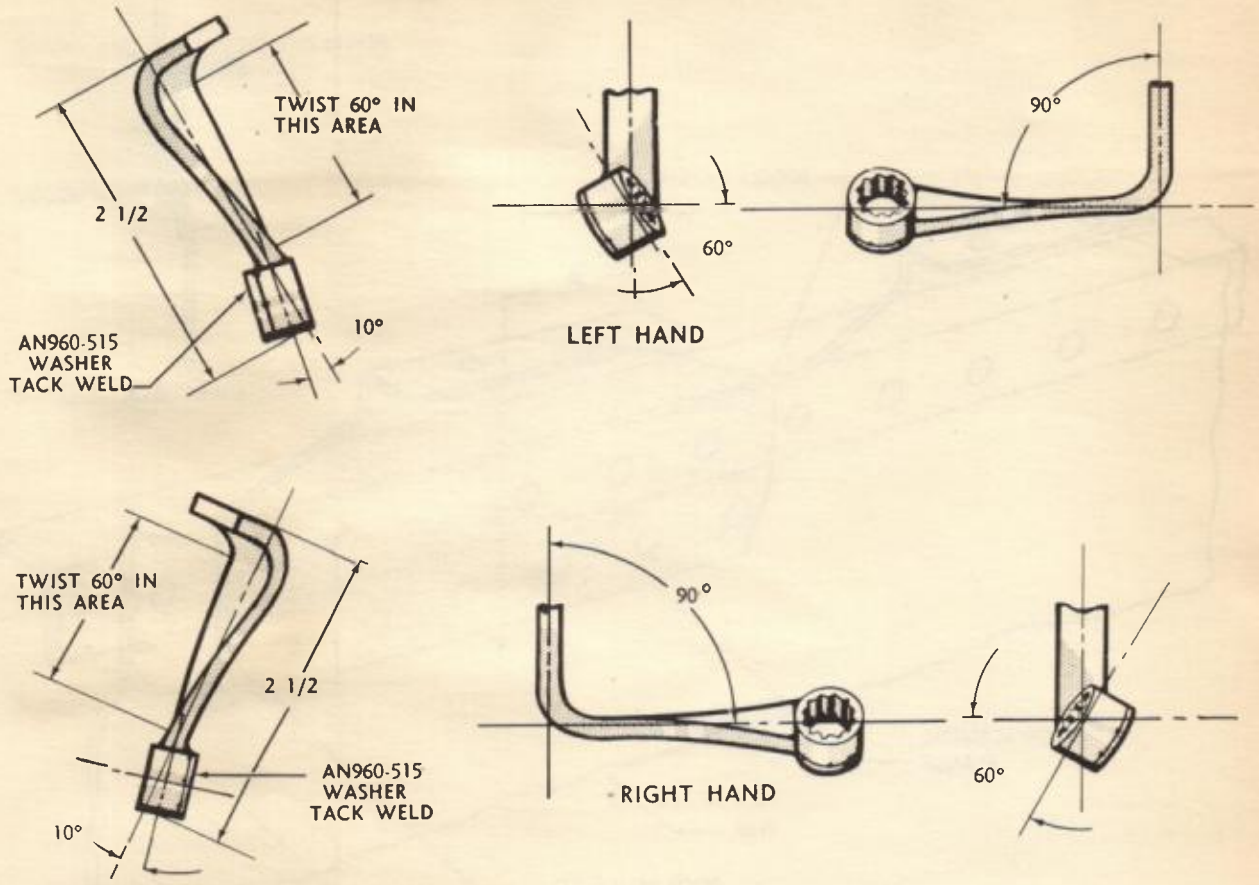


INSTALLATION OF DOUBLER

NOTE:

*SEE SHEET 2 FOR REPAIR NOTES AND WRENCH DETAILS

Figure 32 (Sheet 1 of 2 Sheets) — Rib to Stringer Clip Repair



FABRICATION OF SPECIAL BOX WRENCHES

FABRICATION OF SPECIAL BOX WRENCHES

NOTES:

1. FABRICATE SPECIAL WRENCHES FROM 3/8-INCH, 12-POINT, 10- OR 15-DEGREE OFFSET BOX WRENCHES. TWO WRENCHES ARE REQUIRED, ONE LEFT-HAND AND ONE RIGHT-HAND.
2. TACK WELD AN960-516 WASHER ON EACH WRENCH TO RETAIN NUT.

RIB-TO-STRINGER CLIP REPAIR

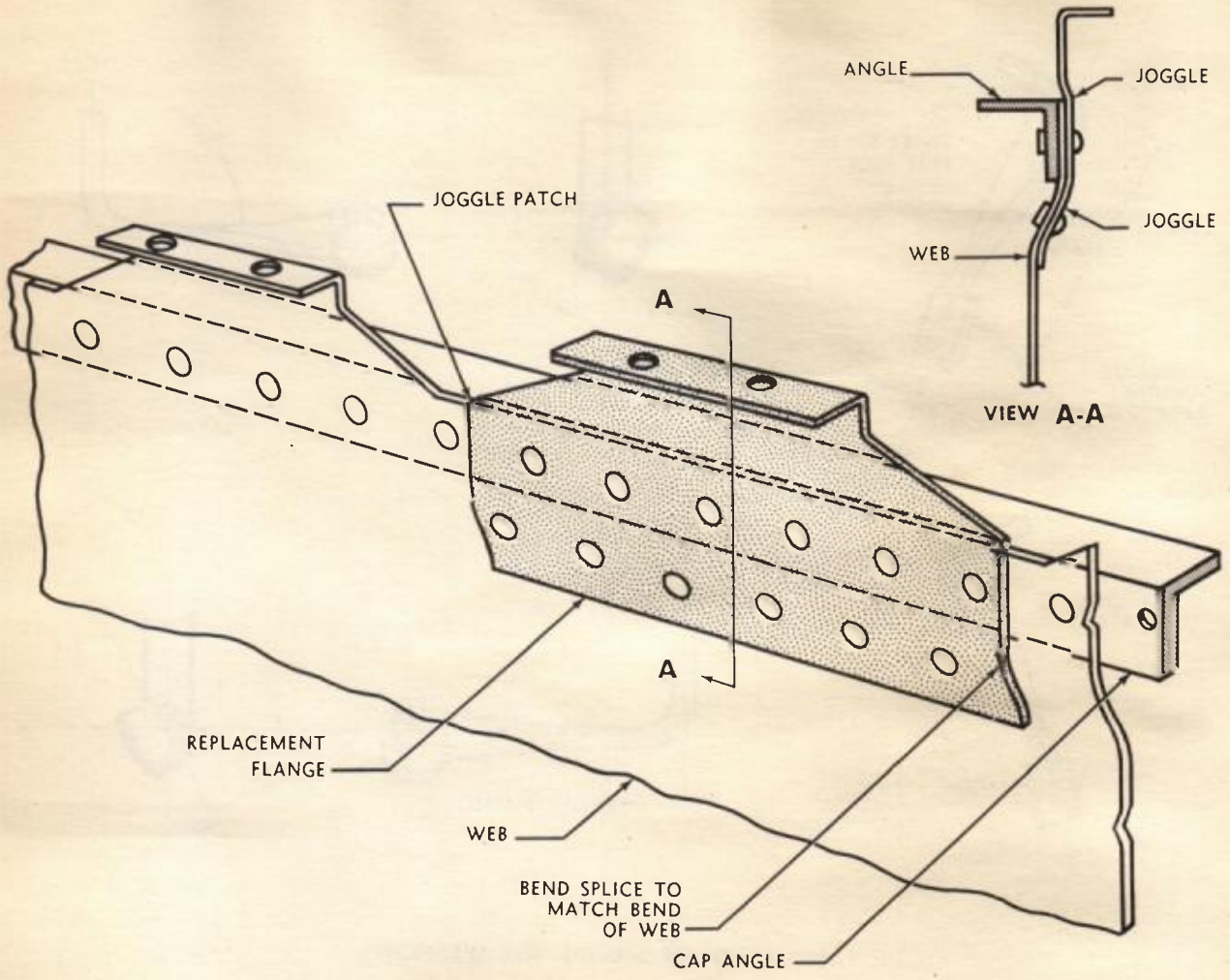
NOTES:

1. DRILL 5/8-INCH DIAMETER HOLE AS ILLUSTRATED, TO ADMIT WRENCH TO BLIND AREAS OF STRINGERS. REMOVE BURRS.
2. REMOVE DAMAGED CLIP BY DRILLING OUT RIVETS IN RIVETED CLIPS, OR WITH AID OF ILLUSTRATED WRENCH IN BOLTED CLIPS.
3. INSTALL NEW CLIP ON STRINGER WITH AN3 BOLTS AND AN365 NUTS.
4. INSTALL .064 24S-TAL (OR EQUIVALENT) DOUBLER OVER 5/8-INCH HOLES. IF MORE THAN ONE HOLE IS CUT AT ONE STATION, CUT DOUBLER TO DIMENSIONS AS ILLUSTRATED.
5. ATTACH DOUBLER WITH NAF1195-6B-12 RIVETS OR EQUIVALENT.

WARNING

DO NOT USE EXPLOSIVE RIVETS.

Figure 32 (Sheet 2 of 2 Sheets) — Rib-to-Stringer Clip Repair



NOTES:

1. REPAIR RIB FLANGES ONLY WHEN DAMAGE IS LIMITED TO THE FLANGE. MORE EXTENSIVE DAMAGE REQUIRES WEB AND FLANGE REPAIR.
2. REPLACE FLANGE WITH 24S-TAL OF SAME GAUGE AS ORIGINAL MATERIAL.
3. TRIM FLUSH WITH CAP ANGLE.
4. CUT REPLACEMENT WITH OVERLAP EQUIVALENT TO WIDTH OF CAP ANGLE LEG.
5. JOGGLE PATCH TO LINE UP WITH SKIN RIVET HOLES.
6. REPLACE ORIGINAL RIVETS IN CAP ANGLE WEB AND SPLICE, AND INSTALL ONE ROW OF REPAIR RIVETS IN FLANGE SPLICE AND RIB WEB, BELOW CAP ANGLE AS SHOWN. USE SAME RIVET TYPE AND PATTERN AS IN CAP ANGLE.
7. IF UPPER OR LOWER CAP ANGLES ARE DAMAGED, REPLACE THEM.

Figure 33 — Wing Rib Repair, Center Section Aft — Stations 222, 318 and 378

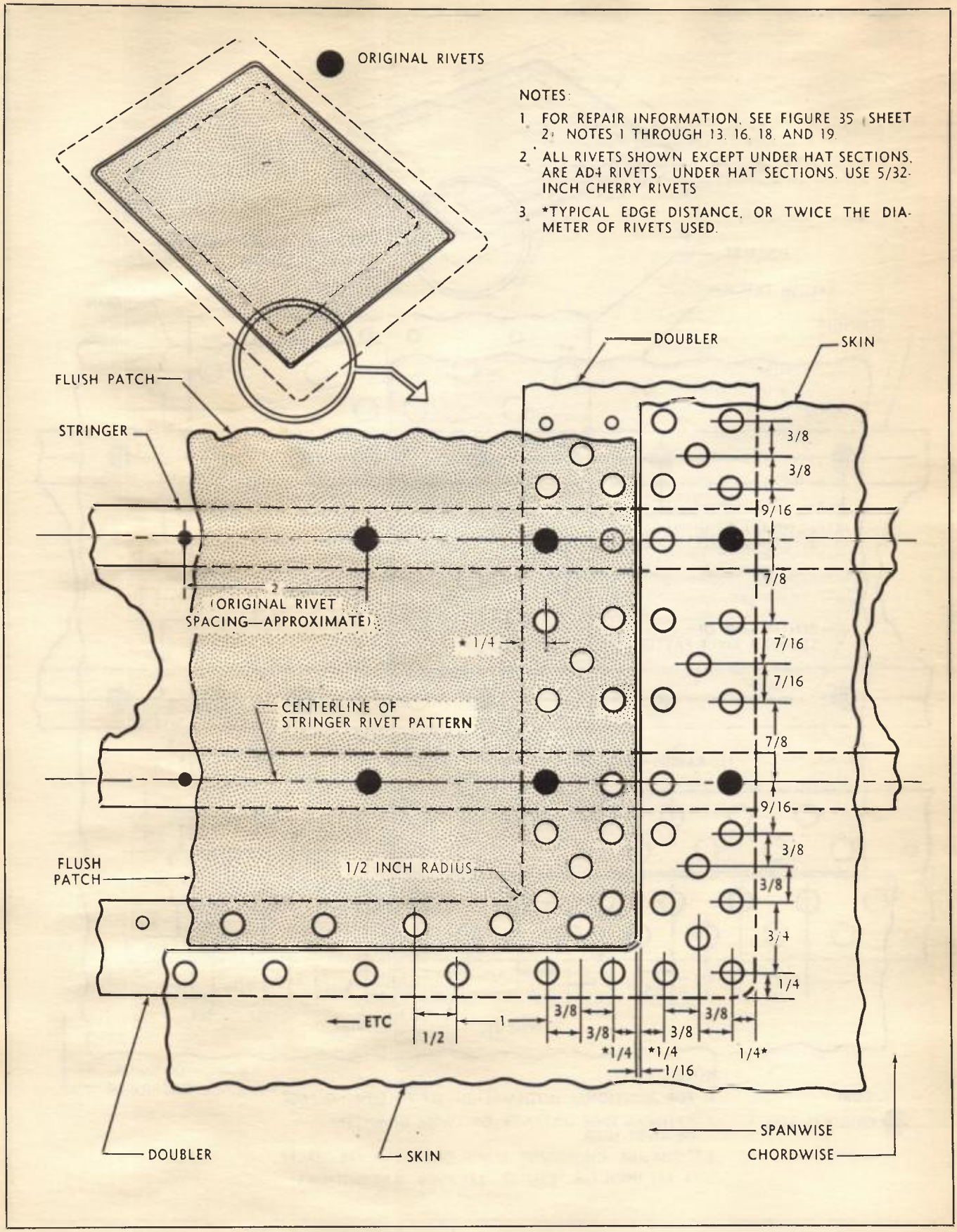


Figure 34 — Outer Wing Skin Repair — Dry Area

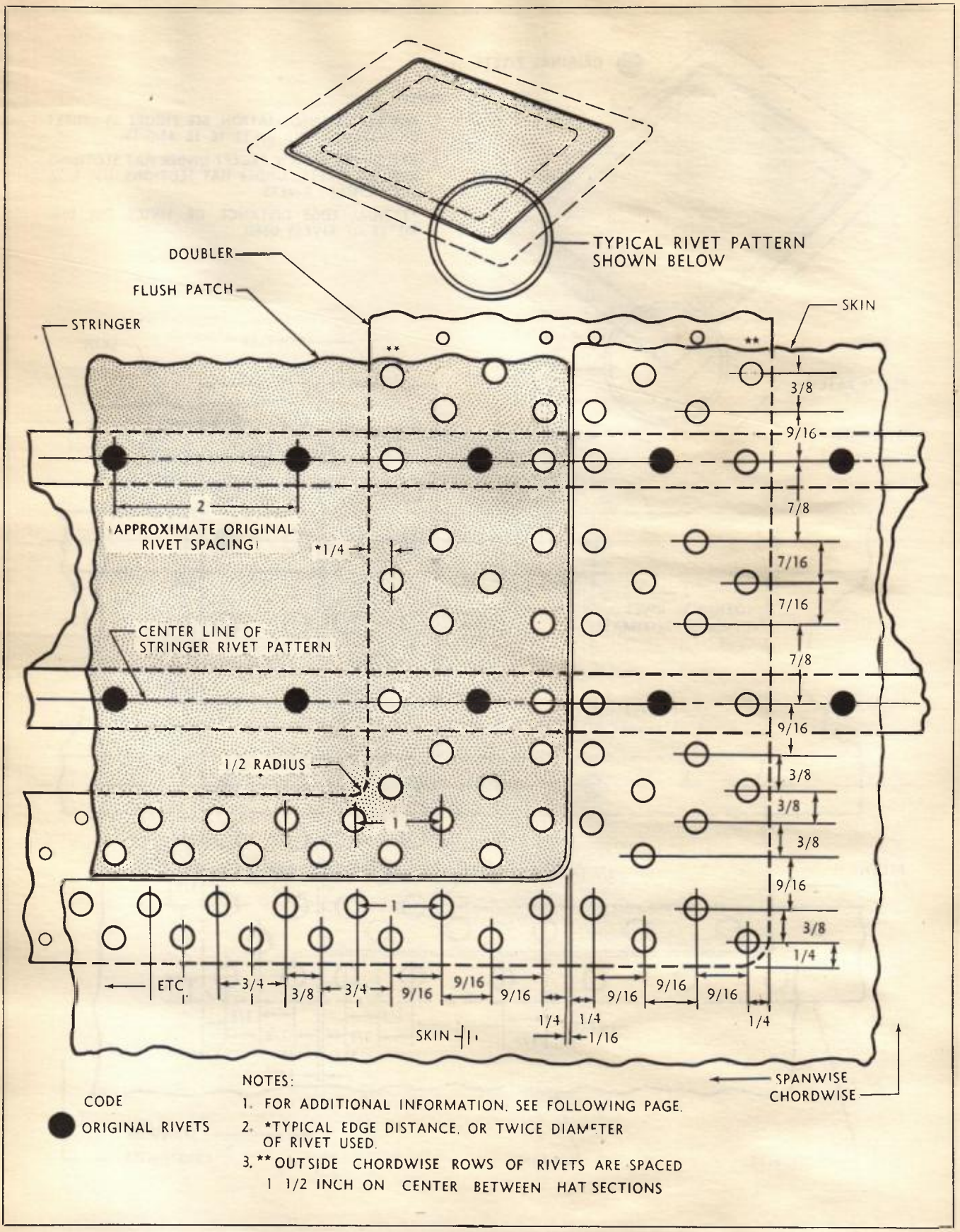


Figure 35 — Inner Wing Skin Repair — Dry Area

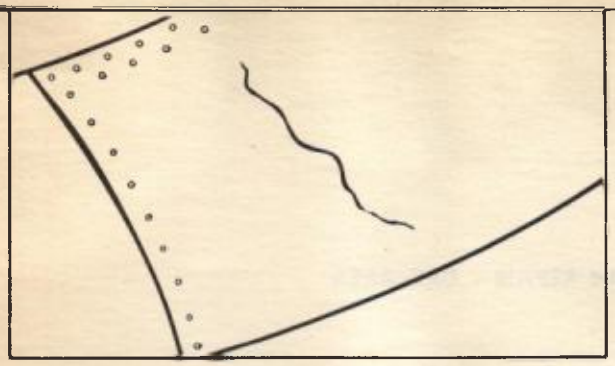
NOTES FOR INNER WING SKIN REPAIR - DRY AREA

1. All wing skin repairs should be flush.
2. Drill No. 40 Stop holes (.098 inch) in ends of cracks. Repair crack by using solid doubler. Keep rivets at least ½ inch from crack. Use same rivet pattern as specified for greater damage.
3. For repairs requiring replacement of skin, fabricate repair as illustrated.
4. Peel back skin and trim out damage, maintaining ½ inch radius in corners. Trim area in spanwise direction approximately midway between stringers. Trim area in chordwise direction midway between any two stringer-to-skin rivets.
5. Maintain ¾ inch on center rivet spacing from each row of original stringer rivets where possible. Where changing stringer pattern or interference of stringer edges cause interruption in symmetry, use illustration as a guide for correct spacing.
6. Cut doubler rectangular to facilitate easy insertion through cut out.
7. Rivet insertion (skin replacement) to doubler in blind areas before installing.
8. Install doubler and insertion.
9. Drive rivets in blind areas through skin and doubler.
10. Drive rivets in stringer edges.
11. Drive remaining rivets in repair; replace skin.
12. If it becomes necessary to use cherry rivets, in addition to those indicated below, use one size larger than original.
13. Illustrated repair is typical. Adapt to varying conditions at other locations as necessary.
14. Use 3/16 AD rivets and 3/16 cherry rivets under hats for .081 material.

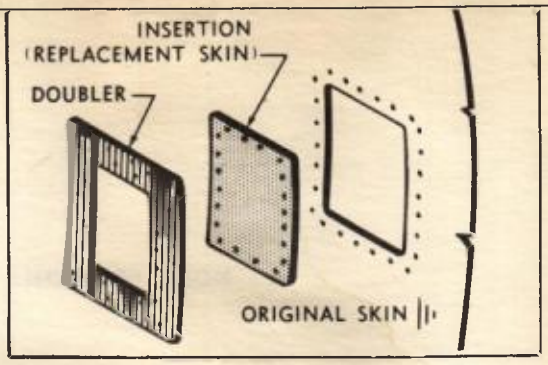
    Use 3/16 AD rivets and 3/16 cherry rivets under hats for .064 and .072 material.

    Use 5/32 AD rivets and 5/32 cherry rivets under hats for .040 and .051 material.

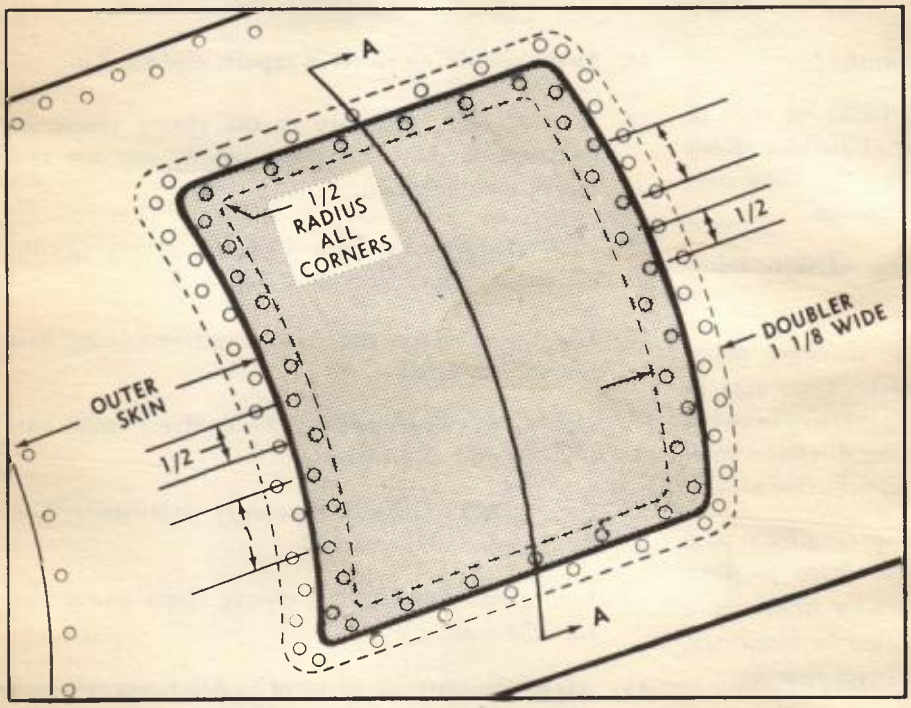
    Use 1/8 AD rivets and 1/8 cherry rivets under hats for .032 material.
15. Aft of rear spar use 1 row of 1/8 AD rivets at 1 inch on center for chordwise and spanwise connections.
16. Do not increase size of existing 100° rivets.
17. Do not increase number of rivets in outside rows.
18. All rivets shown are dimpled.
19. Insertion (replacement skin) is same gauge as original. Doubler is one gauge heavier than original skin.



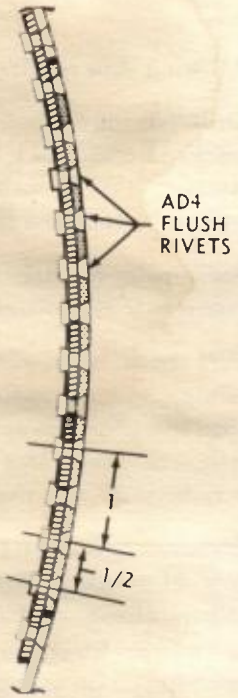
DAMAGE TO WING TIP



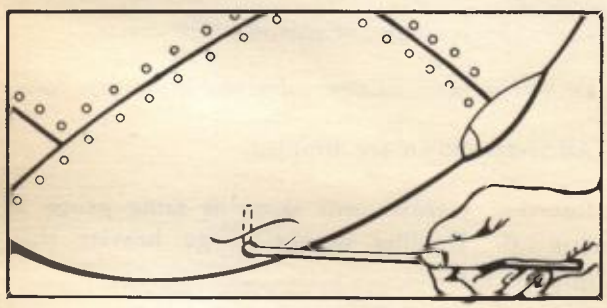
EXPLODED REPAIR



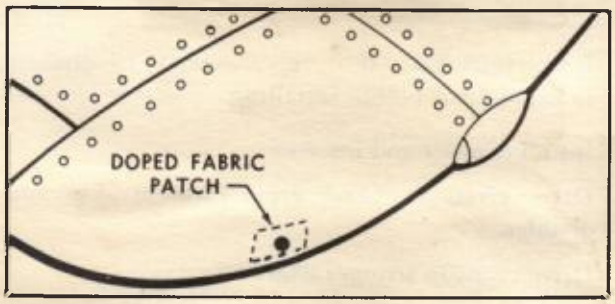
ASSEMBLED REPAIR



VIEW A-A



REMOVING DENT

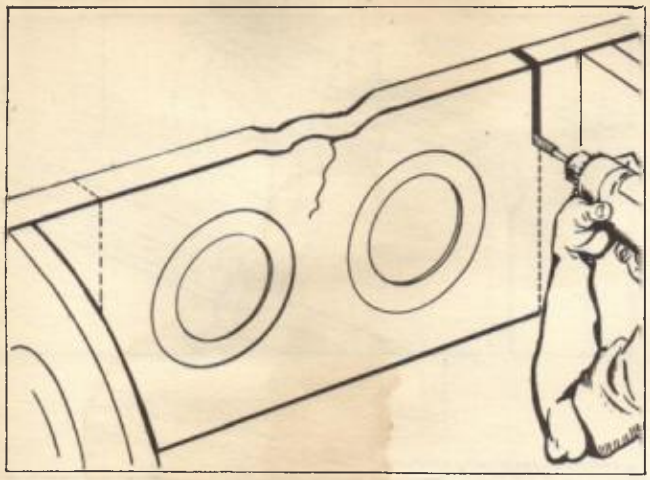


DENT REMOVED

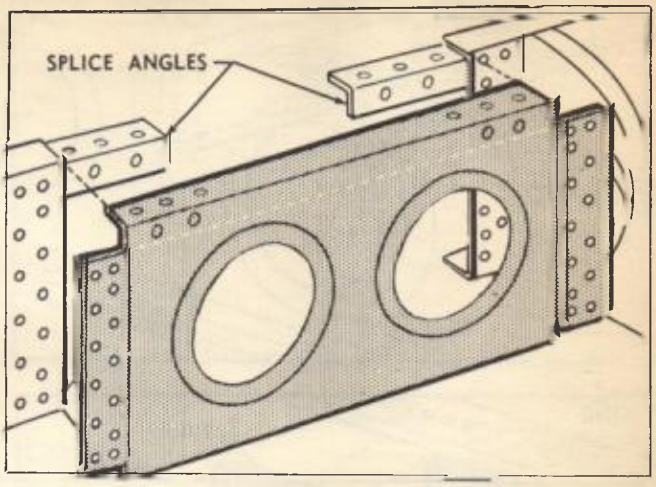
NOTES:
1. MAKE ALL WING TIP SKIN REPAIRS OF FLUSH PATCH TYPE.
2. REMOVE SMALL DENTS BY DRILLING A SMALL HOLE IN CENTER OF DENT. INSERT A STIFF WIRE IN THE HOLE AND PULL DENT OUT. COVER HOLE WITH A SMALL DOPED-ON FABRIC PATCH.
3. REPAIR HOLES OR TEARS IN SKIN AS ILLUSTRATED.
4. REPLACE TIP IF INTERNAL STRUCTURE SEVERELY DAMAGED

CODE
- REPLACEMENT SECTION
- SPLICE MATERIALS
- ORIGINAL STRUCTURE

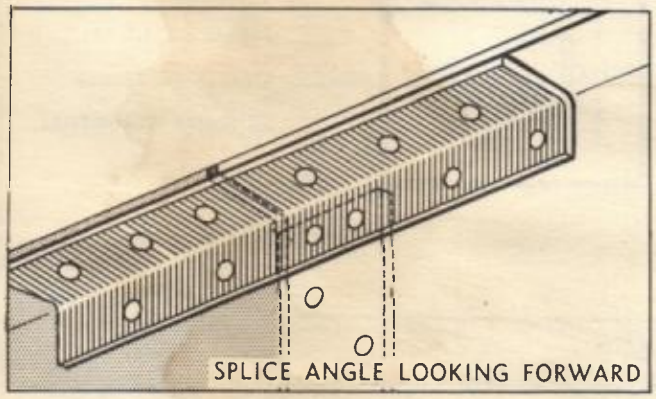
Figure 36 — Wing Tip Repairs



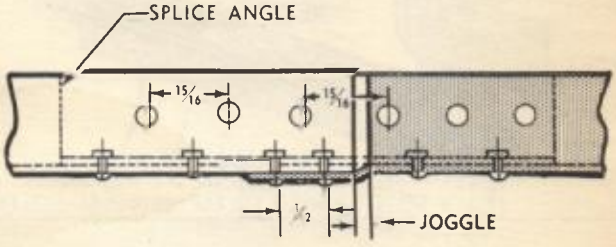
DAMAGE TO SPAR



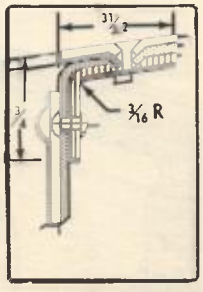
PATCH — .040 24S-TAL



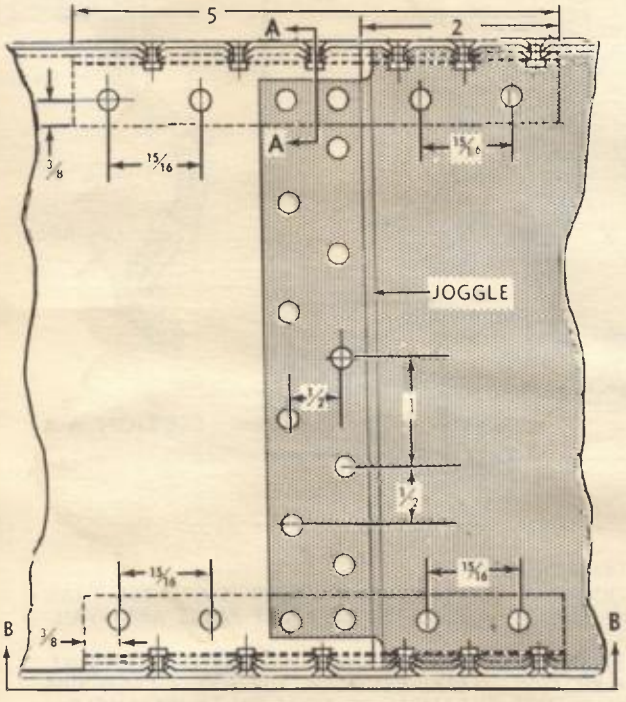
SPLICE ANGLE LOOKING FORWARD



VIEW B-B



SECTION A-A



INBOARD AREA OF PATCH

NOTES:

1. TRIM DAMAGED AREA, LEAVING SUFFICIENT SPACE FOR SPLICE LAP OR CARRY TRIM LINE INTO NEXT BAY.
2. FABRICATE REPLACEMENT FROM .064 24S-TAL AS SHOWN. JOGGLE TO ALIGN WITH ORIGINAL WEB.
3. CUT SPLICE ANGLE FROM .051 24S-TAL BENT TO FIT.
4. USE AD5 RIVETS TO STATION 638. OUTBOARD OF STATION 638, USE AD4 RIVETS.

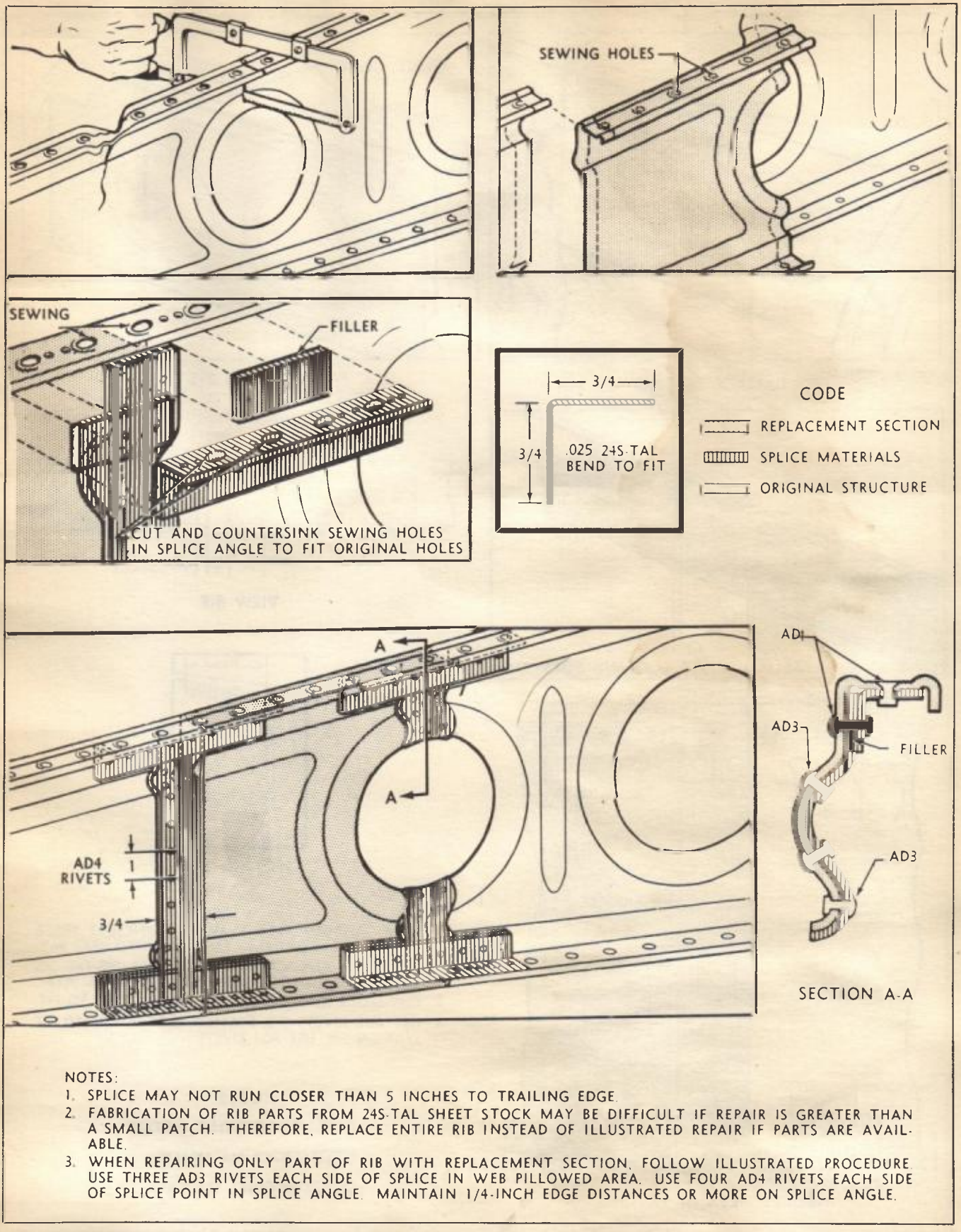
CODE

REPLACEMENT SECTION

SPLICE MATERIALS

ORIGINAL STRUCTURE

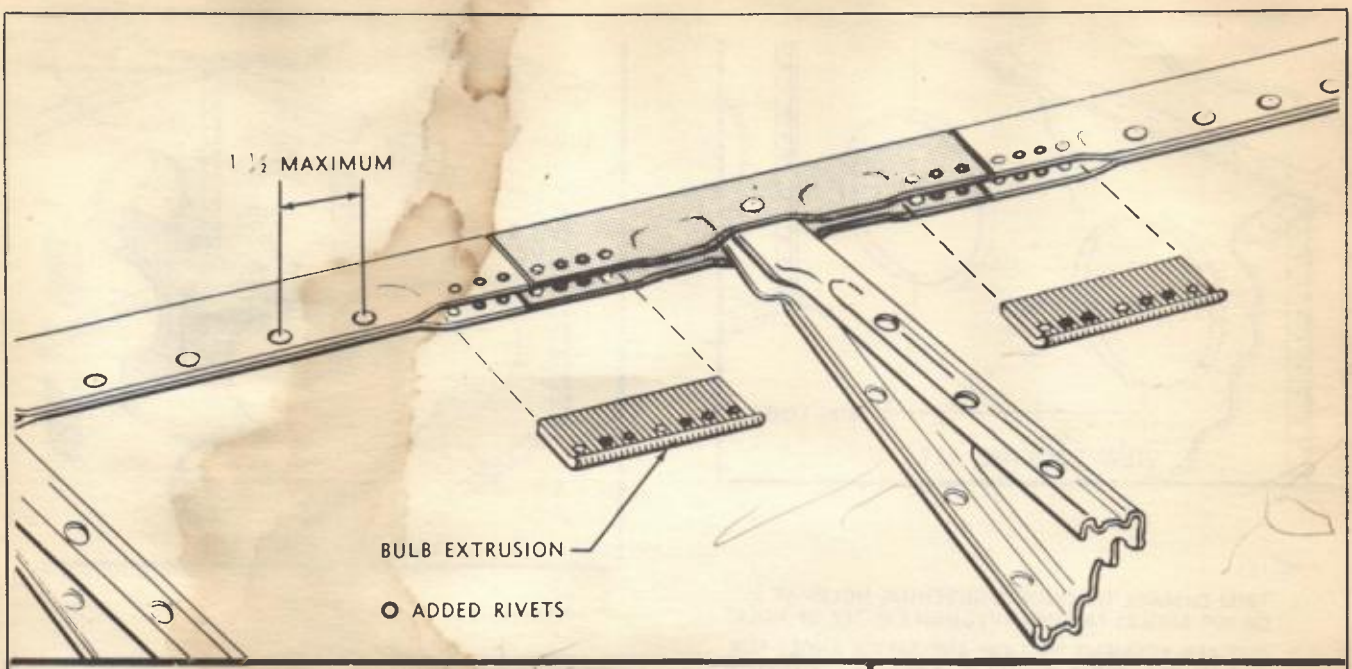
Figure 37 — Aileron Spar Repair



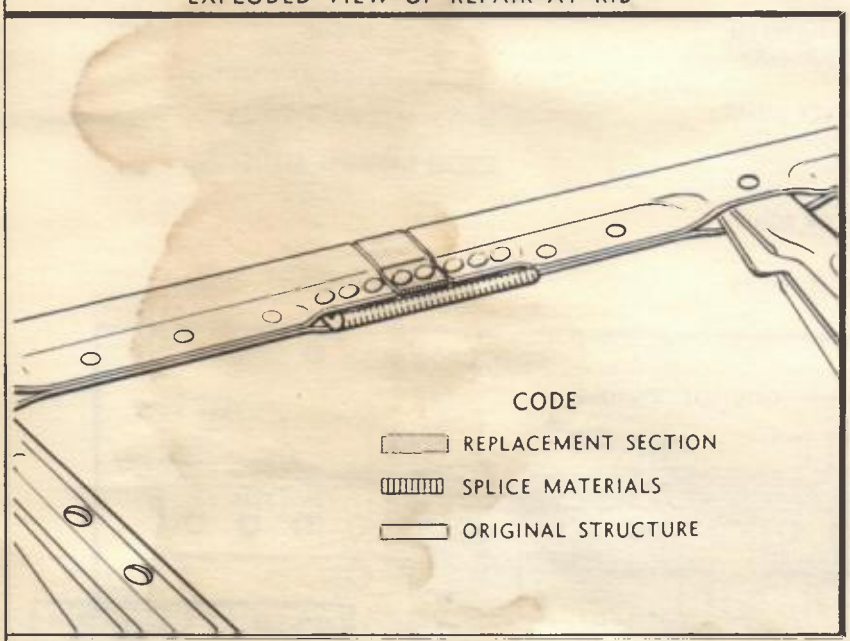
NOTES:

1. SPLICE MAY NOT RUN CLOSER THAN 5 INCHES TO TRAILING EDGE.
2. FABRICATION OF RIB PARTS FROM 24S-TAL SHEET STOCK MAY BE DIFFICULT IF REPAIR IS GREATER THAN A SMALL PATCH. THEREFORE, REPLACE ENTIRE RIB INSTEAD OF ILLUSTRATED REPAIR IF PARTS ARE AVAILABLE.
3. WHEN REPAIRING ONLY PART OF RIB WITH REPLACEMENT SECTION, FOLLOW ILLUSTRATED PROCEDURE. USE THREE AD3 RIVETS EACH SIDE OF SPLICE IN WEB PILLOWED AREA. USE FOUR AD4 RIVETS EACH SIDE OF SPLICE POINT IN SPLICE ANGLE. MAINTAIN 1/4-INCH EDGE DISTANCES OR MORE ON SPLICE ANGLE.

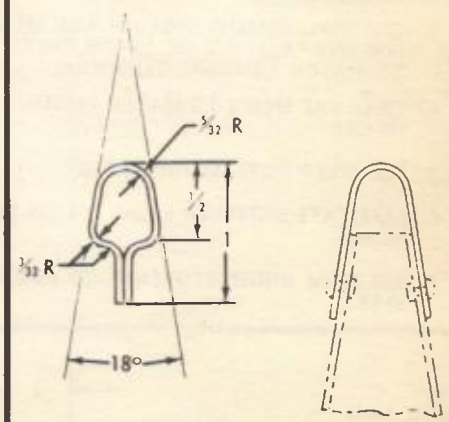
Figure 38 — Aileron, Elevator and Rudder Rib Repair



EXPLODED VIEW OF REPAIR AT RIB



EXAMPLE OF SMALL REPAIR BETWEEN RIBS

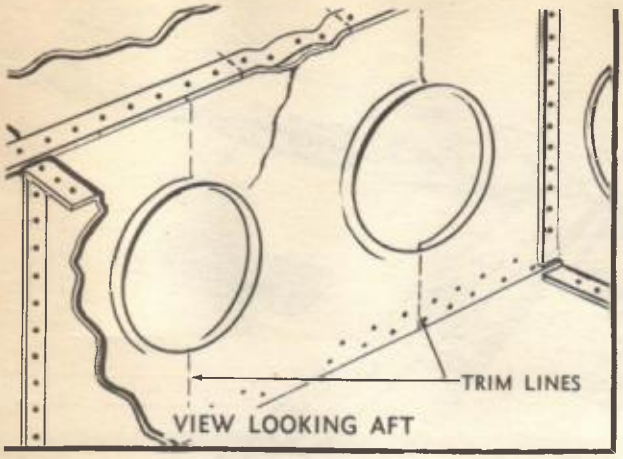


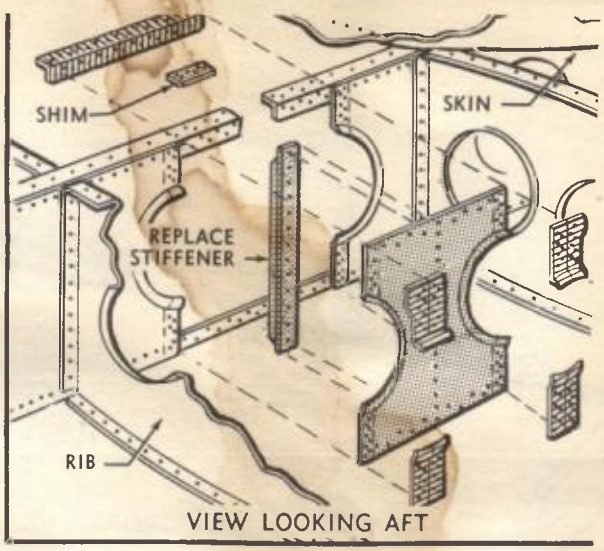
CROSS SECTION OF TRAILING EDGE

NOTES:

1. FABRICATE REPLACEMENT SECTION FROM .020 24S-TAL. OR CUT FROM FACTORY REPLACEMENT PART. MILL TO ACCURATE FIT.
2. USE DOUGLAS S-1002772 EXTRUSION (ALCOA 11069) FOR SPLICE MATERIAL.
3. USE AT LEAST THREE AD3 RIVETS EACH SIDE OF SPLICE.
4. SPACE RIVETS 3/8 INCH ON CENTER. LEAVE 1 1/2 INCHES FROM LAST TRAILING EDGE RIVET TO FIRST SPLICE RIVET. MINIMUM EDGE DISTANCE IS 1/4 INCH.
5. WHEN REPAIR IS MADE BETWEEN RIBS, SPLICE MATERIAL MUST NOT EXTEND NEARER RIB THAN NEAREST RIVET TO RIB. ADD NO RIVETS BETWEEN THIS RIVET AND RIB.

Figure 39 — Aileron, Elevator and Rudder Trailing Edge Repair





NOTES:

1. TRIM DAMAGE THROUGH LIGHTENING HOLES AT 45° OR 90° ANGLES PASSING THROUGH CENTER OF HOLE.
2. CUT REPLACEMENT SECTION AND SPLICE ANGLE FOR CAP ANGLE FROM DOUGLAS PART NO. S-1109270 (ALCOA 28739).
3. CUT REPLACEMENT SECTION AND SPLICE MATERIAL FOR WEB FROM .032 OR .064 24S-TAL OR EQUIVALENT TO MATCH ORIGINAL STRUCTURE.
4. DRILL CAP SPLICE TO MATCH EXISTING RIVET HOLES IN CAP.
5. USE RIVET SIZES AS INDICATED.
6. FABRICATE STIFFENER FROM .064 24S-TAL OR EQUIVALENT.
7. USE SHIM UNDER STIFFENER OR JOGGLE AS NECESSARY.

CODE

- REPLACEMENT SECTION
- SPLICE MATERIALS
- ORIGINAL STRUCTURE

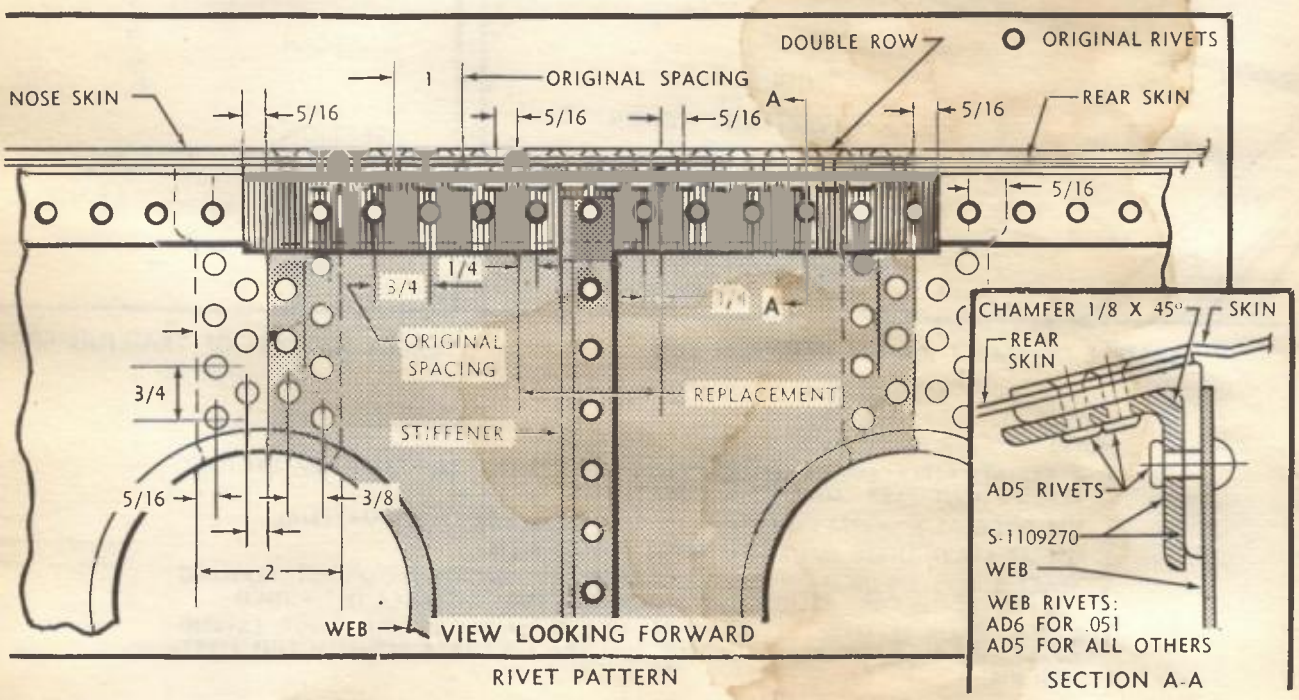
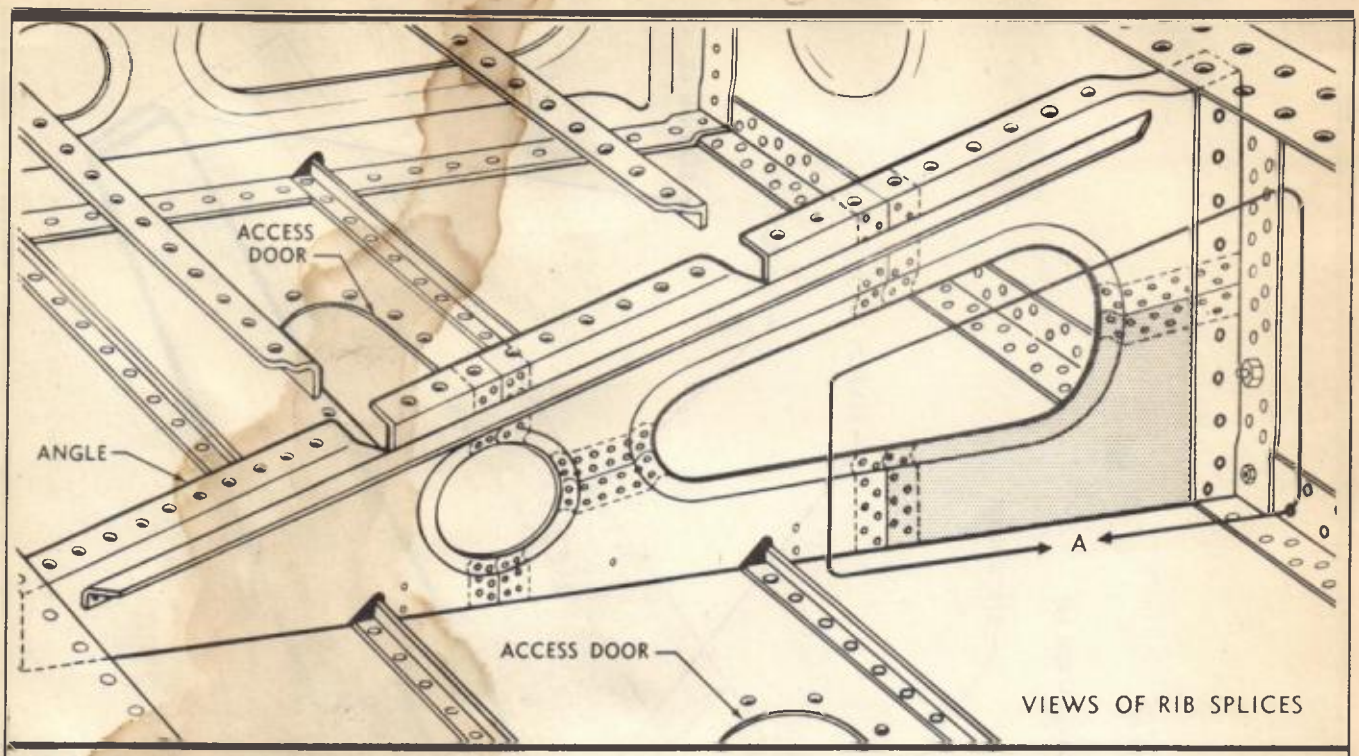
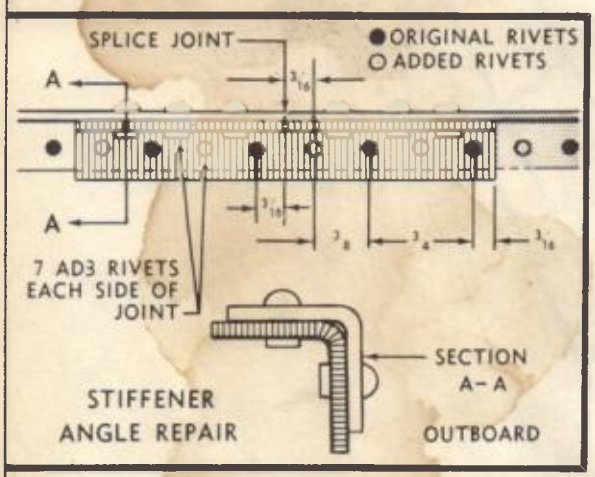


Figure 40 — Wing Flap Spar Repair





NOTES:

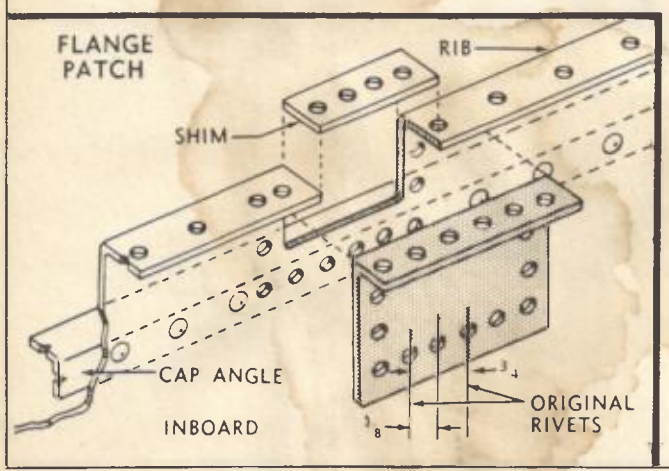
1. SEE FIGURE 27 FOR RIB GAUGES TO DETERMINE GAUGE OF REPLACEMENT MATERIAL.
2. CAP ANGLES ARE .032 24S-TAL SHEET. BEND REPLACEMENT AND SPLICE SECTIONS FROM THE SAME MATERIAL. USE 7 AD5 RIVETS EACH SIDE OF REPLACEMENT.
3. APPLY GENERAL INSTRUCTIONS FOR RIVETING, ETC.
4. FOR RIB WEB REPAIR USE 2 ROWS OF RIVETS SPACED 1 INCH ON CENTER. FOR .025 USE AD4. FOR .032 AND .040 USE AD5, FOR .051 USE AD6.

CODE

REPLACEMENT SECTION

SPLICE MATERIALS

ORIGINAL STRUCTURE



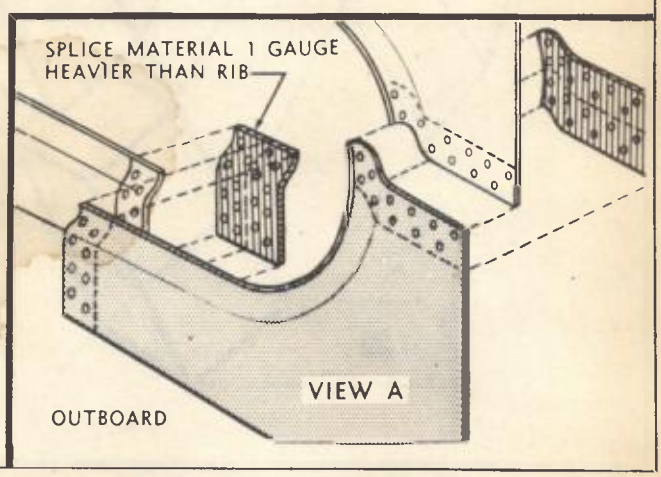


Figure 41 — Wing Flap Rib Repair

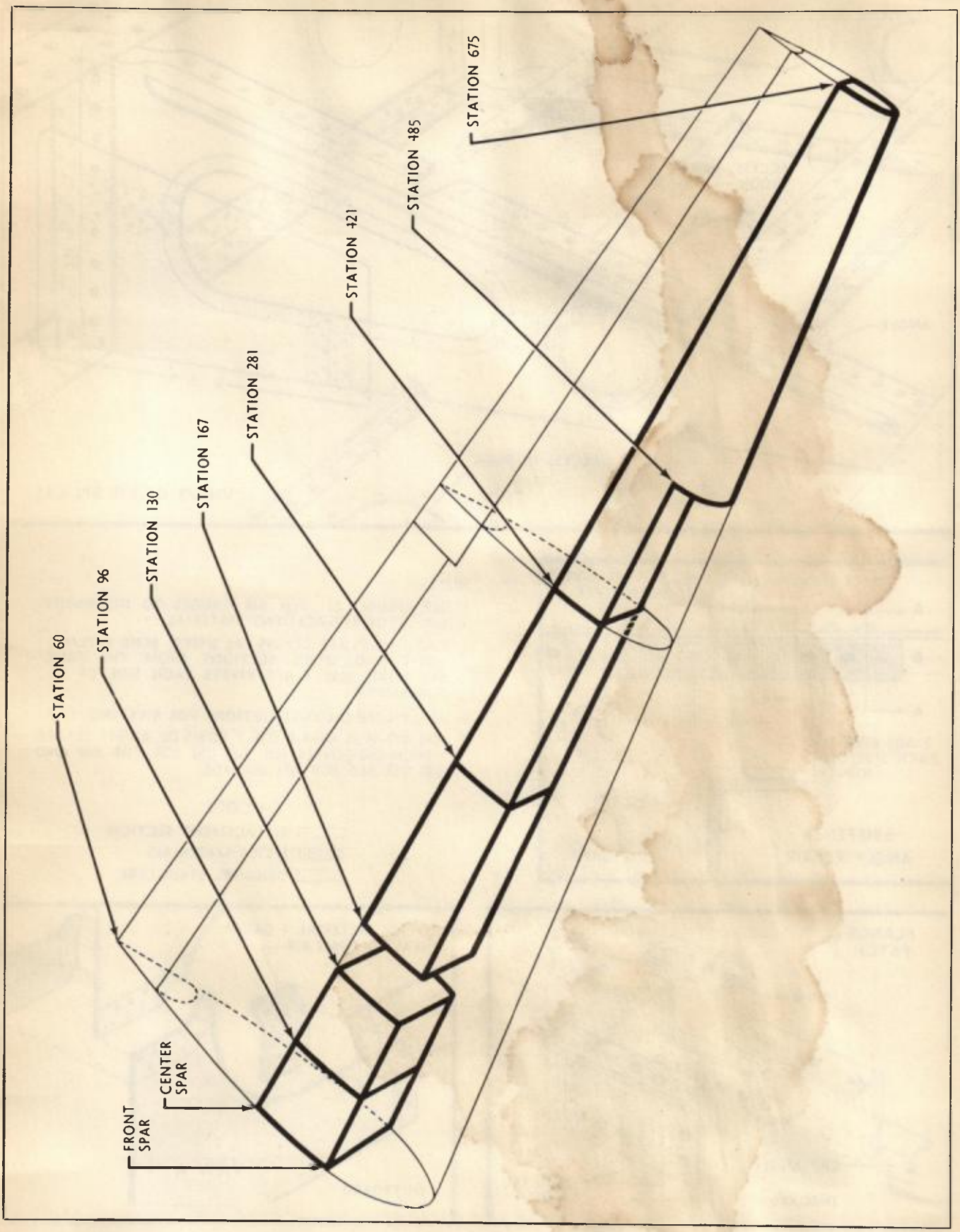


Figure 42 — Wing Fuel Tanks

5. WING FUEL TANKS.

5.1. GENERAL INFORMATION.—All wing fuel tanks in the DC-4 are integral tanks, except that in some models there is an additional inner wing 'stub' tank between stations 60 and 130. The stub tank consists of two synthetic rubber bladder cells retained and supported by a smooth inner construction. The wing structure in the integral tank areas is especially designed to be leakproof. Therefore, all tank seams must be resealed after other repairs are completed. Instructions regarding integral fuel tank resealing are given in the various repair illustrations and in 5.2 and 5.3 following. For layout of fuel tanks see Figure 42.

Note

It is imperative that the instructions on resealing procedures contained in 5.2. and 5.3 be carefully studied and followed, step by step, in order that fueltight joints will result. READ THE ENTIRE PROCEDURE CAREFULLY BEFORE STARTING WORK.

5.1.1. Wing Fuel Tank Doors.—Doors are provided in the wing surfaces for access to the interior of the fuel tanks. The integral tanks have lower surface doors and the bladder-lined tank has additional upper surface doors. Access doors are stressed installations and must be replaced if damaged.

5.1.2. Wing Fuel Tank Skin.—Repairs are shown in the appropriate repair illustration in this section. Skin repairs in the integral tank area must be fuel-tight and properly sealed after completion of the repair. Read instructions in 5.2. and 5.3, following, and use riveting and sealing procedures, etc., as outlined.

5.1.3. Wing Fuel Tank Collapsible Cells.—For removal, repair, and installation procedures for wing fuel tank cells, see Volume VI, Section 1, 3.2.2. and 3.2.3, DC-4 Maintenance Manual.

5.2. RESEALING PROCEDURE FOR WING INTEGRAL FUEL TANKS, USING RL3700 SEALING COMPOUND.

5.2.1. General Information. — The following instructions are provided as a guide for service repairs to the sealing of integral wing fuel tanks. Specific areas in which leaks have been found to occur are covered by specific instructions and illustrations in 5.2.20, following. A special chromating tool (see Figure 43) will be found useful in making small fillets in difficult areas such as seams, and corners formed by fittings and stiffeners.

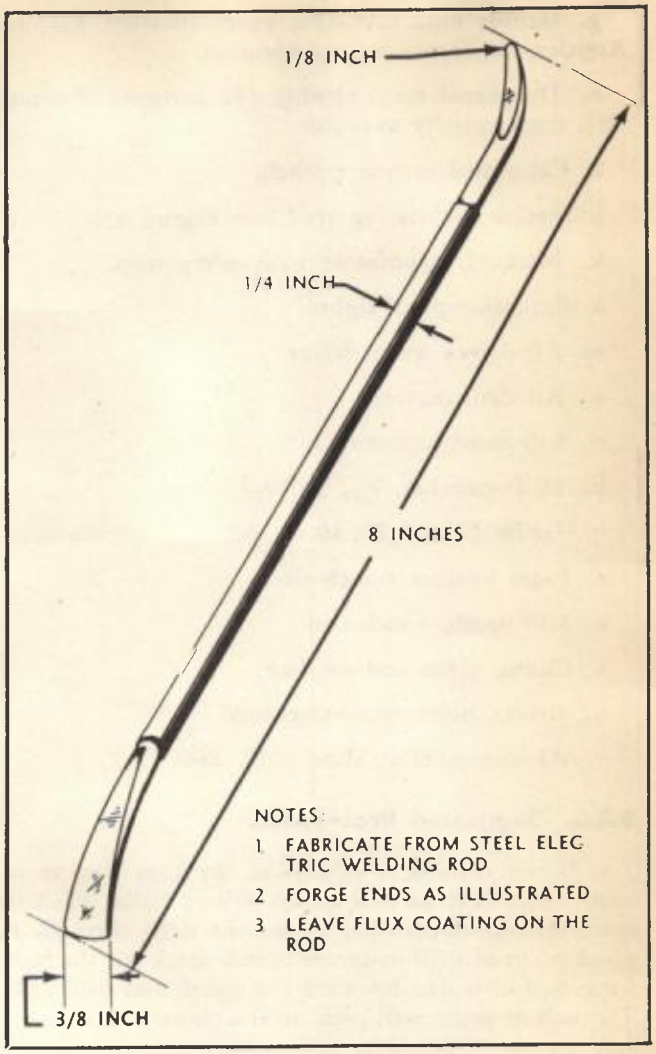


Figure 43 — Special Chromating Tool

5.2.2. Materials and Tools.—The following materials and tools are required for the resealing of integral wing fuel tank leaks:

a. Seam sealing compound RL-3700, W. P. Fuller and Co., Los Angeles, California, no specification.

b. Slushing compound TL-652, W. P. Fuller and Co., Los Angeles, California, no specification.

c. Zinc chromate primer, Specification No. AN-TT-P-656, or equivalent.

d. Dry cleaning solvent, Federal Specification No. P-S-661, or equivalent.

e. Paint stripper L-800, Turco Products Co., Los Angeles, California, no specification.

Note

Ethyl acetate (item f) may be used if item e is not obtainable.

f. Ethyl acetate, Specification No. AN-O-E-758, or equivalent.

g. Bubble fluid LAC-598, Turco Products Co., Los Angeles, California, no specification.

h. Denatured ethyl alcohol (90 percent), Formula "B", commercially available.

i. Calibrated torque wrench.

j. Special chromating tool (see Figure 43).

k. Mercury manometer with safety trap.

l. Explosion-proof lights.

m. Air-driven screw driver.

n. Air drill motor.

o. Soft-faced hammer.

p. Drift punches, 3/32, 1/8, 5/32.

q. Drills, No. 12, 21, 30, 40, 60.

r. Paint brushes, 6-inch size.

s. Stiff brush, 4-inch size.

t. Cloths, clean and oil free.

u. Rivets, bolts, etc.—assortment.

v. Aluminum alloy sheet, .010, 2S-0.

5.2.3. Suggested Procedures.

a. When drilling a new hole, the best way to remove chips is to form a 1-inch ball of Fuller RL-3700 seam sealing compound, thrust the drill through it, place point of drill in center punch mark for the hole, force ball of sealer down on the metal, and drill hole. The ball of sealer will pick up the chips.

b. When reaming a hole, place a small amount of Fuller RL-3700 seam sealer over the hole inside the tank to catch and hold the chips.

c. A light coat of zinc chromate primer over slushed areas in the proximity of the rework will prevent chips from sticking. The chips can then be easily picked up with a vacuum cleaner hose.

d. When performing final cleaning, with final cleaning compound, observe the following:

Wear rubber gloves.

Pour Turco L-800 on the cloth, wring out the excess and throw it away—do not allow the excess to drain back into the container.

Clean approximately 2 square feet or 6 linear feet of surface; wipe dry with a clean dry cloth before proceeding further.

Note

Use CLEAN, oil-free cloths in cleaning operations.

5.2.4. Precautions. — All access doors to the tank under repair must be removed. Remove or block open the filler cap. Thoroughly ventilate the tank until all gasoline fumes have been removed by using a large volume blower. Time required will vary for each tank and as it is dependent on several conditions, no specification as to minimum time can be given. When using ethyl acetate in cleaning operations, continuous forced ventilation must be supplied to protect workers in the tanks. Workers must be instructed to leave tanks immediately on becoming faint or any feeling of lightheadedness. Explosion-proof safety lights must be used at all times. The use of soft-faced, non-sparking hammers is mandatory. Adequate carbon dioxide fire extinguishers must be provided and kept easily and quickly accessible.

5.2.5. Determining Source of Leakage. — Determining source of leakage requires a close inspection of the fuel stains on the outside boundary of the tank. It is necessary to understand the significance of the various colors in the resulting stains to determine the exact location and cause of a large leak. The three significant colors of the fuel stains of a large leak are tan, dark brown, and blue. An irridescent tan-colored stain will be found immediately around the exact point of a large leak. Beyond the tan-colored area, the stain changes from tan to dark brown, and beyond this to a blue color. By a close inspection of the area covered by the tan stain, the exact point from which the fuel has been leaking can be determined. The size of the tan stain will signify the size of the leak, since the stain will be large around a fast-running leak and small around a slow leak. In case of seepage, a blue stain only will be found. Thoroughly examine the structure, especially the spar web adjacent to the leak, for fatigue cracks, which may be the source of the leak.

When a structure has been completely covered with Fuller RL-3700 seam sealing compound a leak is usually caused by failure of the fillet. This is due to air pockets or poor adhesion between the fillet and metal surface. To determine the location of failure, inspect the fillet for one to two feet on each side of the point where the leak shows, and look for small pinholes, blisters, cracks and peeling of the fillet from metal.

Fuel leaks occurring in open or ventilated areas around the integral wing fuel tanks that can be classified as *stain, seep, heavy seep,* and *running leak,* may be considered as negligible and need not be repaired between overhaul periods.

5.2.6. Removing Old Sealants.

a. To remove old fillet material, use micarta, Plexiglas, or wooden scrapers. Do not use metal instruments.

b. Soak cloth in Turco L-800 paint stripper or ethyl acetate. Wring out excess solvent. Pack cloth on area to be cleaned for a period of not more than 15 minutes.

c. Scrape away any remaining softened fillet, slushing compound or zinc chromate primer.

d. Clean away all remaining sealant and zinc chromate primer with a short bristle paint brush dipped in Turco L800 paint stripper or ethyl acetate.

e. Remove all slushing compound which has been softened by the solvent.

f. Soak cloth in Turco L-800 and wring to dampness. Wipe down surface and allow to dry slightly.

g. Use clean cloths to wipe surface dry.

CAUTION

Be careful not to injure sealing compound in faying surfaces. This may be controlled by using a minimum of cleaning solvent in areas of sealed joints, or protecting them with a dam of sealant. Use rubber gloves when handling Turco L-800 paint stripper.

5.2.7. Removal of Rivets.—When removing rivets the following procedure must be carefully followed to prevent damage to the rivet hole:

a. Select a drill which is .030 inch smaller than the diameter of the rivet shank to be removed. Drill hole through center of manufactured rivet head, the shank, and part way through the upset rivet head. Break off manufactured head with drift punch the same size as drilled hole in rivet (see Figure 44).

b. Punch out rivet shank with drift punch .030 inch smaller than hole in rivet. A punch smaller than the rivet hole must be used to allow the thin walls of the remaining shank, when driven out, to collapse inwardly.

c. To prevent damage, when removing a rivet, use a wood block with a drilled hole to back up structure around the upset rivet head, as illustrated in Figure 44.

Note

Never use a chisel or other sharp object to cut off rivet heads. This procedure causes a damaged hole which will be the source of a leak.

5.2.8. Countersink and Dimple Procedure. — Do not use machine countersinking for rivets larger than 1/8-shank diameter on sheets of .051 inch thickness. All sheets thinner than .051 will be dimpled with the standard tools for 100-degree flush rivets. In cases where the 1/8-inch hole has been damaged or enlarged in removing the old rivet, ream hole to 5/32 inch. Rework head of 5/32-inch rivet until the head will project

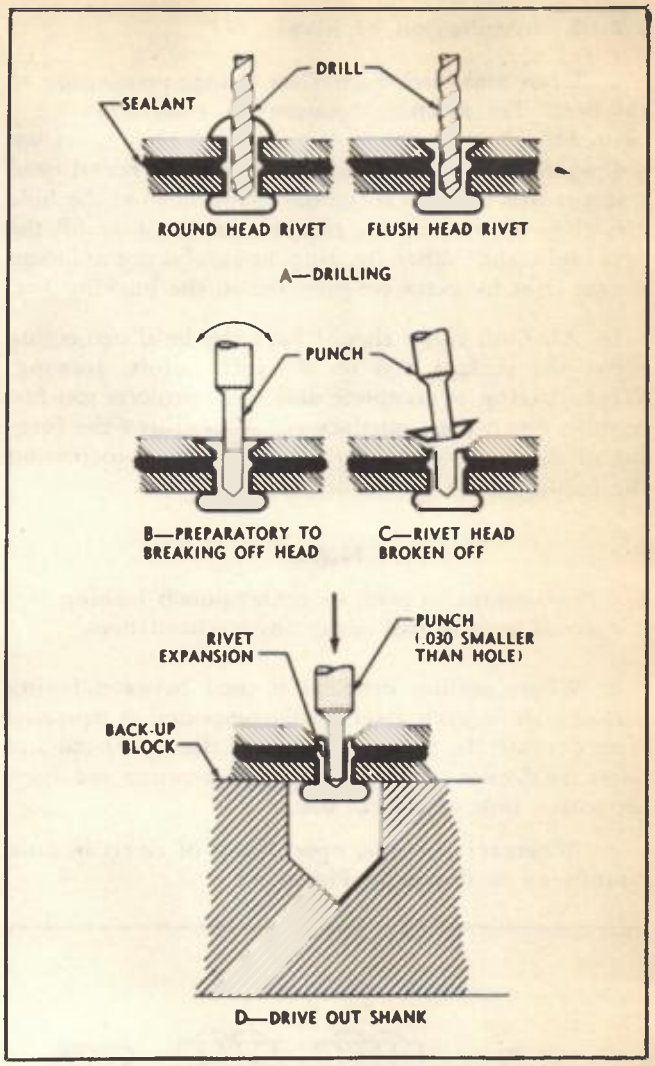


Figure 44 — Removing Rivets

above the skin .005 inch to .007 inch before driving. Drill a hole in a wood or metal block to hold the rivet for this operation. Do not place rivet in a vise or other tool that will distort rivet shank or head.

5.2.9. Repair of Cracked Dimples.—For repairing cracked dimples where crack is entirely within the dimple, drill smallest stop hole possible and install rivet with a special washer made of .010-inch 2S-O sheet aluminum. Cut the washer so that hole is sufficiently smaller than rivet shank to cause a slight amount of turn-up around the rivet head. Drive the washer onto the rivet using hardwood or steel tools which have been fabricated to give sufficient 'dish' to the washer and ensure proper fit. After washer is fitted to rivet, insert in hole and drive in usual manner. The use of the 2S-O washer in .010-inch thickness is permissible for any badly-leaking rivet replacement and where hole is only slightly damaged in rivet removal operation.

5.2.10. Installation of Rivets.

a. Draw and buck each rivet before proceeding to the next. For machine countersunk rivet holes use a plain hole, button draw. For dimpled rivet holes use a dimpled draw tool. Use a brazier set on round head rivets as this tends to forge the round head at the hole and gives better swelling of the rivet shank to fill the hole fuel-tight. When bucking, be careful not to loosen drawn rivet by excessive pressure on the bucking bar.

b. All flush rivets should have the head projecting above the surface .005 to .007-inch before drawing. When driving is complete and rivet projects too far, burnish down until satisfactory. This allows the forging of the flush head into the countersink, increasing the fuel-tightness of the driven rivet.

Note

No attempt to peen or center-punch leaking rivets is permitted under any circumstances.

c. Where sealing material is used between faying surfaces, draw each rivet until compound is squeezed from beneath the bearing surface of the rivet head and parts are drawn together. For this operation use draw set with a hole of correct size.

d. Wherever possible, upset heads of rivets in tank boundaries as shown in Figure 45.

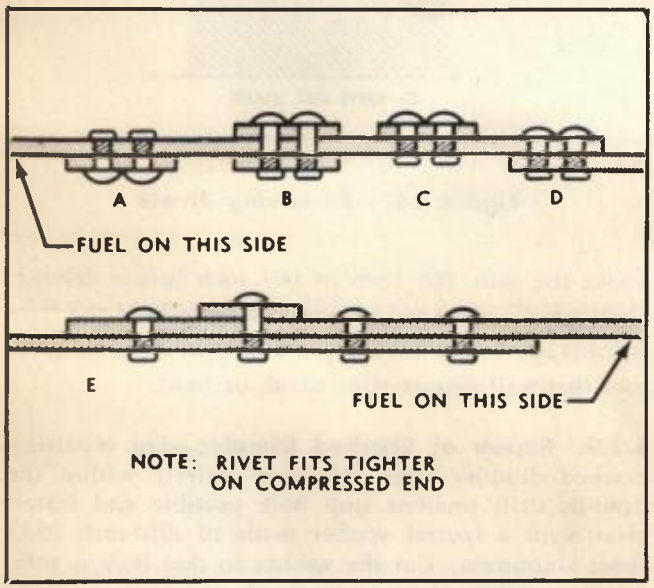


Figure 45 — Positioning of Rivet Heads

1. Upset the rivet from the outside for attachments involving one or more members inside the tank, as well as the skin or web, but not involving any seam leading to the outside of the tank, or any member attached outside the tank, as illustrated in A, Figure 45.

2. For attachments involving one or more members inside, and one or more members outside the tank, as well as the skin or web, but not involving any seam leading to the outside of the tank, upset the rivet from the inside (see B, Figure 45).

3. For attachments involving one or more members outside the tank, as well as the skin or web, but not involving any seam leading to the outside of the tank, or any member attached inside the tank, upset the rivet from the inside (see C, Figure 45).

4. Upset the rivet from the inside for seams leading to the outside of the tank as illustrated in D, Figure 45.

5.2.11. Redriving Rivets.—Redriving or rehitting rivets is permissible, however, the following guides and precautions must be observed:

A correctly-driven rivet has an upset head with a diameter equal to 1½ times the shank diameter and a thickness of ½ the shank diameter. Replace all doubtful rivets. If rivets appear to have been previously redriven, replace them. Do not try to redrive rivets that have large leaks.

5.2.12. Installation of Bolts.—When installing bolts for which torque values are given, tighten with a calibrated torque wrench. Wherever possible, all non-flush-head bolts passing through tank boundaries should be inserted from inside the tank.

Wherever there is sealing compound between the faying surfaces at the point of bolt installation, use torque values given in 5.2.13, immediately following. At three intervals of not less than 15 minutes each, retorque to proper value. Best results will be obtained if bolts are tightened slowly. This will permit the flowing of sealant between faying surfaces and approach as nearly as possible a metal-to-metal contact.

Coat bolt shanks with a thin application of seam sealing compound before inserting in hole. DO NOT ALLOW ANY COMPOUND TO GET ON BOLT HEAD; do not build fillets from bolt head to shank, and use particular care to keep all compound away from threads.

5.2.13. Special Fuel Tank Area Bolt Torque Table.

Bolt Size	Thread	Torque in inch pounds Minimum	Max.
No. 10 (3/16 inch)	32	45	50
¼ inch	28	80	90
5/16 inch	24	140	155
⅜ inch	24	240	265
7/16 inch	20	500	550
½ inch	20	660	725
9/16 inch	18	960	1060
⅝ inch	18	1400	1540

5.2.14. Preparing Surface For Resealing. – After all parts have been fabricated, including doublers, etc., for rework or repairs involving faying surfaces, prepare for sealing as follows:

a. Thoroughly clean faying or matching surfaces, using a clean cloth dampened with Turco L-800 paint stripper or ethyl acetate. Pour solvent onto the cloth and wring out excess. Do not allow waste solvent to run back into fresh solvent supply. After cleaning approximately 2 square feet or 6 linear feet of surface, wipe area with a clean, dry cloth before proceeding.

b. After stripping and all necessary rework in the area has been completed, brush Turco L-800 paint stripper over the surfaces. Thoroughly scrub oily or dirty areas with a brush and paint stripper. Wipe down with a clean cloth dampened with fresh Turco L-800 paint stripper. Use a stiff brush to assist in cleaning around upset ends and heads of rivets, etc. After cleaning with Turco L-800 paint stripper, dry all remaining traces of the paint stripper and wipe down with a clean, dry cloth. An air blast may be used to speed up the drying of paint stripper that may be entrapped in crevices, but such air *must* be filtered to remove all traces of oil or water. Wipe down and allow surface to dry slightly. Wipe surface dry with absolutely clean, dry cloths.

c. When installing doublers for repairs of spar web cracks, use no sealant on faying surfaces when there are no buckles, wrinkles, badly scratched or otherwise distorted faying surfaces that will prevent doubler lying flat on spar web. River as specified in 5.2.10, preceding.

5.2.15. Sequence of Resealing.

a. PRIMING.–Zinc chromate primer, Specification No. AN-TT-P-656, is not to be used except between faying surfaces when one or more of the members is not ALCLAD. In the latter case, one surface must be primed.

b. FILLETING.

In all areas where a seam, doubler, or fitting originates inside of the tank and leads to the outside of the tank, or may cause leaks through rivets, a bead fillet, or partial base fillet must be applied. This special fillet may be applied manually or with the special chromating tool (see Figure 43). Apply the special fillet so that it fills approximately half of the triangular corner. Make sure that Fuller RL-3700 seam sealing compound is forced into the corner, entirely eliminating all possibility of entrapment of air. Then follow filleting procedures described in the following.

Manually apply small pieces of Fuller RL-3700 seam sealing compound to the area to be covered, by rubbing and pressing the pieces into the surface over an area of approximately 1 square inch at a time. This step is important; the fillet *must* be built up by applying numerous small pieces rather than several large pieces. Hands must be clean and dry. Apply a thin base coat of compound to the metal surface and allow it to set for approximately 15 minutes before building up the fillet. This will allow better adhesion between compound and metal surface. Make sure the compound is rubbed and pressed tightly in place to eliminate all air pockets. Build up fillet by continuing to apply small pieces of compound and working in to prevent air pockets. In areas of rivet clusters the base coat will be about one-half the depth of the rivet head. Fillet must be at least $\frac{1}{16}$ inch thick over rivet heads and intervening structural points that are covered. Fillets must extend a minimum of $\frac{1}{2}$ inch out onto all surfaces from the in-tank edge of any seam which leads to the exterior, such as doublers, skin to spar cap, spar web to spar cap, fittings, etc.

After completing the fillet, dampen the fingers in ethyl acetate, smooth off the surface and feather the edges down to the metal. The chromating tool shown in Figure 43 may be used to press and force the filleting compound into cracks, crevices, corners, and joggles.

c. SEALING FAYING SURFACES.–When sealing between surfaces with Fuller RL-3700 compound, apply a uniformly thin layer to one of the faying surfaces. Spread the compound about .005-inch thick. Use .010-inch thickness where the faying surface is damaged, coating the high spots with no more than about .005-inch thickness. Do not use water or solvent to change the consistency of the compound. Set the part into position as soon as the sealant has been applied.

d. SLUSHING.–Brush or spray Fuller TL-652 slushing compound over all areas which have been reworked and over new Fuller RL-3700 seam sealing compound fillets. The slushing compound should be .010-inch thick when dry. Apply in thin coats to prevent pinholes and bubbles after drying. A thick coat of slushing compound will dry on the surface and trap solvents in the slush. The solvents in evaporating through this dry surface will cause pinholes and bubbles. Old slushing compound must be thoroughly cleaned with dry-cleaning solvent before applying new slushing compound.

5.2.16. Stripping of Old Sealant From Fuel Tank.

a. MATERIALS REQUIRED.

Quantity	Item
2	Aeroil pressure spray tanks, No. 306
1	High pressure water pump, triplex type, with 15 to 20 G.P.M. capacity at 1250 p.s.i. suitably piped for 4 outlets for high pressure hose assemblies.
1	Air compressor
1 set	Hydraulic jack and tools
4	Air motors–¼-inch chuck

Quantity	Item
4	Reed & Prince screw-driver bits for air motors
8	350-6W-96 hose assemblies, $^{5}/_{16}$" I.D. Hose with $^{3}/_{8}$" Swivel Fittings, Aeroquip Co., Jackson, Michigan.
8	$^{3}/_{8}$" H.P. Hydraulic Plugs drilled with #50 drill to form nozzles.
1 set	Reed & Prince screw drivers and assorted screws
1 set	Thin-wall socket wrenches and flex handles
2	Purolators, 16931, Type AC-302—with extra cartridges
6	Stripping suits and hoods (complete outfits —Dickson Safety Products Co., 1328 S. Flower St., Los Angeles, California)
2	Spider air outlets to suits
24 pair	Rubber gloves (elbow length, 18x20 inches, light weight)
6 pair	Rubber boots
125 gal.	Cleaning compound L-732, Turco Products Co., Los Angeles, California, no specification
40 gal.	Cleaning compound 713-D, Turco Products Co., Los Angeles, California, no specification
15 gal.	Paint stripper L-800, Turco Products Co., Los Angeles, California, no specification
1 gal.	EC-801 and accelerator, Minnesota Manufacturing Co., St. Paul, Minnesota
	Glue Brushes:
12	2-inch
12	4-inch
	Micarta scrapers:
6	3-inch x ¼-inch
6	2-inch x ¼-inch
12	1-inch x ¼-inch
12	1-inch to ½-inch taper x ¼-inch
	Masking tape:
5	1-inch rolls
5	2-inch rolls
1	Masking paper (36-inch roll)
2	Water hoses with high pressure metal nozzles (50-foot lengths)
4	CO_2 fire extinguishers (50-pound)
2	10-inch funnels
12	Drip pans
12	Buckets
48	75-watt light bulbs
1	Air hose and fittings
2	Inner sump drainage attachments
2	Outer sump drainage attachments
1	Bipod tailstand
1	Complete first aid kit, including 1 pint castor oil, 1 gallon isopropyl alcohol, and extra absorbent cotton
	Working platforms
	Propeller protective material
	Step ladders
	Rags or wipers—*clean*
	Explosion-proof extension cord lights with Cellophane shields
	Canvas for shading inner wings
	Solvent-resistant covers for tires
	Plate cover for Liquidometer cutout
	Warm air blowers

b. PREPARATION FOR STRIPPING.

1. Park airplane in shaded area or shade wing area involved with canvas. Provide adequate drainage. High pressure water (150 to 200 psi) should be available.

2. Jack up airplane to prevent solvent accumulating around tires. If tripods are not available, arrange plank assembly under wheels.

3. Cover tires with canvas or heavy waxed paper.

4. Place working platforms so that they will properly drain free of drippings from the tanks.

Note

When removing the following parts, identify them as to their proper location on the airplane.

5. Remove access doors. Attach blowers to remove fuel fumes (from 4 to 6 hours depending on the size of the blowers). While tanks are venting, remove inspection doors (forward of front spar, aft of center spar, and outboard of No. 1 and No. 4 tanks).

6. Remove fuel tank filler neck screen assembly.

7. Remove fuel tank screen base assembly.

8. Remove Liquidometers.

9. Remove sumps and install special sump adapters.

10. Remove all fuel and vent lines opening into the fuel tank. Cap lines with metal caps.

11. Remove all nacelle fairing that covers any portion of the integral fuel tank.

12. Attach trough or pipe to special sump adapter so that effluent (waste material) from the tanks will not flood the working area.

c. REMOVAL OF SEAM SEALING COMPOUND FILLETS.—Remove seam sealing fillets from tank, using small Plexiglas or micarta scrapers. Fillet removal should be as complete as possible on all areas, particularly around rivet clusters. The presence of any appreciable amount of filleting material will necessitate extensive cleaning in the later stages.

d. REMOVAL OF SLUSHING COMPOUND.

1. Following removal of fillets, carefully seal the open ends of all hat-section stringers and stiffeners to prevent the entrance of cleaning material into areas beneath them. Seal with synthetic rubber plugs; Minnesota EC-801 is satisfactory, or Fuller RL-3700 seam sealing compound. Do not permit cleaning material to enter these inaccessible areas, as complete cleaning in these areas is virtually impossible.

2. After sealing stringers, spray a liberal application of Turco L-732 compound on all the areas in each tank. The applied coat should be thick enough to indicate a tendency to sag or run on vertical surfaces; insufficient thickness of coating will necessitate more numerous applications. Allow the sprayed tank to stand for approximately 2 to 3 hours, after covering the access doors and closing the filler neck to prevent any ventilation which will cause drying out of the Turco L-732 compound. *Do not close tank pressure tight.* At the end of this period, using the largest scraper, remove all softened slush and repeat with a second coat of Turco L-732 compound. After a second soaking period of not over 2 hours, practically all of the remaining slushing compound can be scraped from the treated surface with large scrapers. Following this removal of nearly all of the slushing compound from the surface, apply a third spray coat of Turco L-732 compound, slurrying it with a stiff brush. Allow this coat to soak for approximately 1 hour. The tank is now prepared for final washing out with water.

In cases where high pressure pumping equipment and nozzles are available, clean the treated area by directing a fine stream of water angularly against the surface at a distance of from 6 to 12 inches. Cut lower surface first and work backwards, away from the far edge of any one area, in order to avoid excess splashing on adjacent areas. Repeat until the slushing compound is removed.

If high pressure water is not available, the treated area can then be worked into a slurry with a stiff bristle brush *dampened only with water.* Continue scrubbing until slushing compound and primer undercoating is completely loosened. Brushes will become sticky and soft and should be periodically changed. Wash slurried surface clean with a jet of water. Make repeated applications in the same manner until a clean surface is obtained. To aid in removal of the slushing compound and primer undercoating in difficult places, use a small flat scrubbing brush, preferably with end bristle. Palmetto fibre brushes are best.

In the event all the slushing compound has not been removed, it will be necessary to repeat the third step in paragraph 2. Remaining slushing will be found around fittings, bolt ends, rivet clusters, and similar spots. *Be sure to thoroughly dry all areas to be reworked.* Using a stiff brush, work a new coat of Turco L-732 compound over the area requiring additional slushing compound removal by thoroughly slurrying the cleaning compound into all the hard to reach spots. Allow to soak for 1 hour and wash down with water.

e. REMOVAL OF HARDENED PRIMER UNDERCOAT.—In certain areas, the primer undercoat beneath the slushing compound will resist the softening action of Turco L-732 compound. Such mottled primer surfaces can be treated with Turco 713-D compound. The softening action of this material should be considerably faster, and in *no case* should it be allowed to remain in the tank over 60 minutes. Removal of this material can be accomplished with the same dampened brush or high-pressure technique as indicated for the L-732 compound (see d, immediately preceding). Between applications of cleaning compound and following the water wash-down, remove seals from the ends of hat section stringers or stiffeners and inspect for possible seepage of cleaning compound. If seepage exists, thoroughly flush the areas underneath the hat sections with water.

f. FINAL CLEANING. Following the entire clean-up procedure in any one tank, carefully wipe down all areas of the interior of the tank with Turco L-800 paint stripper. Follow immediately by a wipe-down with *clean, dry rags* to assure removal of any remaining traces of the cleaning materials.

g. INSPECTION.—Make final visual inspection of tank cleanliness with incandescent or "black" light (shaded ultra-violet). Under "black" light, residues will fluoresce light yellow or dark brown as contrasted to the normal purple of the anodic film. Use of "black" light is desirable; however, satisfactory final inspection may be accomplished with explosion-proof incadescent lights.

h. PERSONNEL PRECAUTIONS.

1. Wear complete protective clothing at all times when working in tank with cleaning compound. This includes protective hood with adequate air supply, protective full length suit, rubber gloves and rubber boots. Although the cleaning compounds listed are not permanent toxic or dangerous, prolonged breathing or continued exposure must be strictly avoided.

WARNING

DO NOT ALLOW THE HIGH-PRESSURE WATER JET TO CONTACT THE BARE SKIN.

2. Should any cleaning material splash or leak through to the skin, leave the tank and wash the affected part with isopropyl alcohol. If this is not available, wash the affected areas thoroughly with water. Should any burning sensation be noticed, immediately investigate for a possible leak in the protective clothing.

3. If any material is splashed into the eyes, immediately drop several drops of castor oil into the eyes.

i. TANK CLEANING PRECAUTIONS.

1. Certain areas underneath stringer fittings at the bulkhead attachments cannot be thoroughly cleaned. Where possible, pull small rags or bottle brushes underneath these fittings, adjacent to their intersection with the bulkhead.

2. Make every effort to remove accumulation of residue from lower ends of tanks, underneath the ribs and in the areas adjacent to the sumps. Natural drainage of the effluent (cleaning compound) will deposit considerable amounts of residue in such areas and in any place where a natural gravity flow down the lower skin is restricted.

3. Take care in parking the airplane and hooding the wings to prevent high air temperature within the tank. Excessive temperature will cause accelerated drying of the cleaning materials, and will detract from the efficiency of the cleaner.

4. Carefully seal with metal caps all fuel and vent lines entering the tanks. Do not use plastic caps, as they will be attacked by the cleaning materials.

5. When cleaning of an area is started, carry the cleaning procedure to completion without interruption. It is essential that the solvent wipe-down and dry rag follow-up be thorough and complete on all areas.

6. Do not use materials or equipment in the fuel tanks other than those listed.

7. Workmen must leave the tank *immediately* after completing a spray or brush application of a cleaning compound to have the protective clothing washed off with low pressure water spray.

CAUTION

Use rubber gloves when handling Turco L-800 paint stripper.

5.2.17. External Sealing.

a. MATERIALS REQUIRED.—In addition to materials listed in 5.2.2. and 5.2.16, preceding, the following will be required:

1 Clear lacquer No. 1234, E. I. DuPont de Nemours and Co., Wilmington, Delaware, no specification. Clear lacquer, Specification No. AN-L-29, may be used if DuPont lacquer is not available.

2. Aluminum paste, Federal Specification No. TT-A-461, or equivalent.

3. Lacquer thinner, Specification No. AN TT-T-256, or equivalent.

4. Cement EC-776, Minnesota Mining and Manufacturing Co., St. Paul, Minnesota, no specification.

5. Sealer, N-T Blend "C," Douglas Aircraft Co., Santa Monica, California, no specification.

6. Fairing glaze PX-2555, Arco Co., Los Angeles, California, no specification.

b. PREPARATION.

1. Douglas N-T Blend "C" Sealer must be in a free-flowing condition when applied. Since it becomes jellied at temperatures below 32°C (90°F), place the container in an electrically heated water bath, 71 ± 3°C (160 ±5°F), until the blend is clear and has reached a constant temperature. Stir the blend occasionally. Preheat the water bath to shorten the immersion time. Loosen the covers or stoppers on the containers before heating to prevent excessive pressure.

CAUTION

Avoid prolonged heating of the sealer, as the solvent is highly volatile. The vapors quickly accumulate around the container, creating a fire hazard.

2. Prepare aluminized exterior lacquer by mixing ingredients in the following order. ⅞ gallon clear lacquer, 1⅛ gallon lacquer thinner, 8 ounces aluminum paste.

c. SEALING PROCEDURE.

1. Remove zinc chromate primer and sealing compounds from the surfaces to be sealed. Use Turco L-800 paint stripper.

2. Thoroughly clean all surfaces with Turco L-800. Pour cleaner onto cloths and wring to dampness, discarding excess. Wipe down approximately 2 square feet or 6 linear feet and allow surface to dry slightly. Wipe surface dry with absolutely clean, dry cloths before repeating this operation.

3. Apply Arco PX-2555 fairing glaze with a putty knife, forcing the glaze into cracks, slots, hollows, recesses in screw heads, etc., spreading it evenly, and filling all areas level. Remove excess material from metal surface with a cloth dampened with denatured ethyl alcohol. Allow the fairing glaze to dry until dry to the touch before applying the cement.

4. Apply one even, medium coat of Minnesota EC776 cement in the condition as received in the package. Allow to dry approximately ½ hour, or until dry to the touch. Apply this coat over a greater area than the subsequent coats will cover.

5. Apply three medium coats of Douglas N-T Blend "C" Sealer with an absolutely clean brush. Allow the sealer to dry a minimum of one hour between coats. Apply the sealer as rapidly as possible.

Note

Make sure that the surface of the cement is free of contamination, such as fingerprints, etc., immediately prior to the application of the sealer. Remove contamination with a clean cloth dampened with denatured alcohol.

Do not attempt to rebrush the sealer or to apply more coating when the coating has been allowed more than four seconds drying time. A simple method of application is to take a full brush of the sealer, make a few brush spots on the area, and quickly spread these spots by rapid brushing.

Do not let any succeeding coat extend beyond the area covered by the preceding coat. Each new application of the sealer should cover a slightly smaller area. This is necessary because succeeding coats will not adhere as firmly as those which were applied before, and will possibly loosen along the edges should the sealer overlap onto bare metal.

6. Allow the sealer to dry at least four hours. Then apply two spray coats of aluminized lacquer, with 30 minutes drying time between coats. The aluminized lacquer coat should overlap the primed and sealed surfaces by at least six inches wherever practical.

Note

All brushes must be kept clean. Use denatured alcohol for cleaning after using sealer. Keep brushes, used to apply cement, in a closed container of the cement. Camel's hair brushes are too flexible for uniform application of the materials; therefore, a stiff brush should be used.

Use only oil-free, clean cloths in cleaning operations. Always pour the cleaning materials onto the cloth; never dip the cloths into the cleaning material. Never wring out a cloth and allow the surplus liquid to get back into the container.

Every precaution must be taken to ensure that the bare metal is absolutely clean and dry before application of the cement. THE ENTIRE SUCCESS OF THIS SEALING PROCEDURE DEPENDS ON COMPLETE CLEANING.

Use rubber gloves when handling Turco L-800 paint stripper.

d. REPAIR. Carefully cut away damaged portions of the seal. Clean and re-cement any area in excess of one square inch, being careful not to overlap old sealer. After cement has thoroughly dried, reseal and lacquer as outlined in c. 5 and 6, preceding. For scratches and minor damage, apply three coats of Douglas N-T Blend "C" Sealer over the damaged area, allowing approximately one inch lap-over.

5.2.18. Cleaning Leak Stains After Resealing Operation.—In all cases where the resealing operation has been successfully completed, all the old leakage stains *must* be completely removed. Removal of stains generally requires removal of the zinc chromate primer and a repriming of the area, as leak stains are usually absorbed into the primer. Remove primer with ethyl acetate, lacquer thinner, or Turco L-800 paint stripper. Clean as specified in 5.2.14, preceding.

Where leak stain is on the surface of the bare aluminum exterior, scrub off with ethyl acetate followed by dry-cleaning solvent wipe-down.

Where leak stain is in insignia or other enamel-covered area, clean to bare metal with Turco L-800 paint stripper, remove any zinc chromate primer that may be present, wipe down with dry-cleaning solvent, and reapply the enamel.

Note

Removal of old leak stains is necessary so that subsequent inspection will be effective.

5.2.19. Test After Resealing Operation.—The tanks may be tested after the resealing operation has been completed by using air pressure. Allowable test pressures are:

a. Inner wing—3.0 psi.

b. Outer wing—3.0 psi.

A brushed coat of LAC-598 bubble fluid applied to the tank exterior will aid in detection of any leaks that may be present.

5.2.20. Application of Wing Tank Resealing Procedure to Specific Locations.

a. LEAKS IN OUTER WING ATTACH FITTINGS, STATION 421. *(See view A, Figure 46)*

1. Remove all sealing compounds from the fitting and adjacent areas. Clean thoroughly with ethyl acetate or equivalent as specified in 5.2.14, preceding.

2. Tighten all drive pins with Reed & Prince screws to correct torque as specified in 5.2.13, preceding.

3. Redrive all rivets in the leak area as specified in 5.2.11, preceding.

4. Tighten all seal plugs in corners of fitting by driving them with an ⅛-inch drift punch and soft-faced hammer. Do not damage fitting or adjacent structure while tightening seal plugs.

5. Prepare surface for sealing as specified in 5.2.14, preceding.

6. Install RL-3700 seam sealing compound fillets as specified in 5.2.15, preceding.

7. Apply TL-652 slushing compound as specified in 5.2.15, preceding.

b. LEAKS IN FUEL-TIGHT FITTINGS AT STATIONS 167 AND 281. *(See views B and C, Figure 46)*

1. Remove all sealing compound and zinc chromate primer from the fitting and adjacent areas. Clean thoroughly with ethyl acetate or equivalent as specified in 5.2.14, preceding.

2. Replace all old bolts in fitting with new bolts, as specified in 5.2.12 and 5.2.13, preceding.

3. Check around the edges of the fitting with a .002-inch feeler guage and determine that no gaps over .002-inch remain between the fitting and the adjacent structural parts.

4. If an oversized gap is found, remove all rivets and bolts in the area of the fitting where the excessive gap is located, as specified in 5.2.7, preceding.

5. Replace all rivets and bolts in the area of the excessive gap, as specified in 5.2.10, 5.2.11, 5.2.12, and 5.2.13, preceding, making sure that metal-to-metal contact is made between the fitting and the structural part to which it is attached

6. Redrive all rivets in the fittings, as specified in 5.2.10 and 5.2.11, preceding.

7. Tighten all seal plugs in corners of fitting by driving them with a ⅛-inch drift punch, using a soft-faced hammer. Do not damage fitting or adjacent structure while tightening seal plugs.

8. Prepare surface for sealing, as specified in 5.2.14, preceding.

9. Install RL-3700 seam sealing compound fillets as specified in 5.2.15, preceding.

10. Apply TL-652 slushing compound, as specified in 5.2.15, preceding.

c. LEAKS AT BULKHEAD ATTACH-ANGLE BOTTOM SKIN, STATION 167. *(See view C, Figure 46*

1. Remove all sealing compounds from the leak area. Clean thoroughly with ethyl acetate or equivalent. If leak is near a stringer fitting, clean around gap and under fitting. Check Allen bolt and tighten if loose.

2. Replace all old bolts as specified in 5.2.12 and 5.2.13, preceding.

3. Redrive rivets as specified in 5.2.11, preceding.

4. Clean thoroughly between stringer fitting and skin. Prepare surface for sealing as specified in 5.2.14, preceding.

5. Install RL-3700 seam sealing compound fillets as specified in 5.2.15, b, preceding.

6. Apply TL-652 slushing compound, as specified in 5.2.15 4., preceding.

b. LEAKS AT FUEL TANK VENT AND OVERFLOW LINE FITTINGS ON CENTER SPAR WEB AND CARBURETOR OVERFLOW LINE FITTING ON FRONT SPAR WEB. *(See view D, Figure 46)*

1. Disconnect lines from fitting.

2. Remove rivets through fitting and spar web as specified in 5.2.7, preceding. Ream enlarged rivet holes for next size rivet.

3. Clean all faying surfaces and prepare for resealing, as specified in 5.2.14 and 5.2.15, preceding.

4. Apply a thin coating of RL-3700 seam sealing compound to faying surfaces of fitting, as specified in 5.2.15, preceding.

5. Attach the fitting tightly in place with screws to squeeze out excess seam sealing compound, as specified in 5.2.12, preceding.

6. Install rivets as specified in 5.2.10, preceding.

7. Install a ½-inch RL-3700 seam sealing fillet entirely around fitting, as specified in 5.2.15, preceding.

8. Apply TL-652 slushing compound as specified in 5.2.15, preceding.

e. LEAKS AT SUMPS AND SUMP ADAPTERS. *(See views E and G, Figure 46)*

1. Leaks between sump adapter and bottom skin.

a. Remove the sump adapter from the bottom skin by removing all bolts.

b. Clean and prepare all faying surfaces, as specified in 5.2.14, preceding.

c. Apply a thin coating of RL-3700 seam sealing compound to faying surfaces of sump adapter, as specified in 5.2.15, preceding.

d. Install sump adapter to bottom skin, using new bolts, as specified in 5.2.12., preceding.

2. Leaks between sump and sump adapter.

a. Remove all bolts and disconnect the sump from the sump adapter.

b. Clean and prepare all faying surfaces for sealing as specified in 5.2.14., preceding.

c. Apply a thin coating of RL-3700 seam sealing compound to faying surfaces, as specified in 5.2.15., preceding.

d. Reinstall part using new bolts, as specified in 5.2.12., preceding.

f. LEAKS AT DOUBLERS, GUSSET STIFFENERS, BOXES, BRACKETS, CLIPS, AND BULB ANGLE STIFFENERS ON SPAR WEBS.

(See views F and J, Figure 46)

1. Remove leaking rivets, as specified in 5.2.7., preceding.

2. Install new rivets. Drive the rivets in the proper direction, as specified in 5.2.10., preceding.

3. Clean all sealing compounds from the edge of parts inside the tank. Clean a 1-inch strip on the spar web around the part, as specified in 5.2.6., preceding.

4. Prepare surface for sealing, as specified in 5.2.14., preceding.

5. Install and RL-3700 seam sealing compound fillet entirely around the part and extending out 3/8-inch on the spar web.

6. Apply TL-652 slushing compound as specified in 5.2.15., preceding.

7. For parts outside of the tank, apply *only* TL-652 slushing compound to the rivet heads on the inside.

g. LEAKS AT SPAR WEB STIFFENERS.

(See view F, Figure 46)

1. Remove leaking rivets and rivets which have leaked, as specified in 5.2.7., preceding.

2. Install new rivets with manufactured head inside of the tank, as specified in 5.2.8., 5.2.9., and 5.2.10., preceding.

3. Ream oversize holes for next size rivet.

4. If leaks occur at the end of the stiffener, remove sealing compounds from the end of the stiffener as specified in 5.2.6., preceding.

5. At the end of the stiffener remove the two rivets (through the spar cap fin) and install in the second hole from the end an AN3-7A bolt, an AN960-D-10 washer, and a tapered washer on the spar cap fin, as specified in 5.2.12., preceding. Install rivet in the end of the stiffener, as specified in 5.2.10., preceding.

6. Prepare surface for sealing, as specified in 5.2.14., preceding.

7. Install RL-3700 seam sealing compound fillet at end of stiffener, as specified in 5.2.15., preceding.

8. Apply TL-652 slushing compound, as specified in 5.2.15., preceding.

h. LEAKS AT RIVETS CONNECTING HAT SECTION STRINGERS TO TOP AND BOTTOM SKIN. *(See view G, Figure 46)*

1. Minor seeps can usually be repaired by carefully redriving the rivet as specified in 5.2.10., preceding. Replace rapidly leaking rivets, as specified in 5.2.7. and 5.2.10., preceding.

2 If the hole or dimple is damaged in the removal of the rivet it is better to reinstall the same size rivet with a .010-inch, 2S-O aluminum washer, as specified in 5.2.9., preceding.

3. In many cases a small outside seal may be installed, as specified in 5.2.17., preceding, without draining the fuel.

4. If the leaking rivet is inside the nacelle at such location that redriving cannot be accomplished due to its inaccessibility, replace the rivet with a Reed & Prince screw. Install a .010-inch 2S-O aluminum washer, as specified in 5.2.9., preceding, and use a countersunk washer to fit over the dimple and under the nut, on the inside of the tank.

i. LEAKS AT SEAMS, TOP OR BOTTOM SKIN TO SPAR CAP. *(See view H, Figure 46)*

1. Inspect seam sealing compound fillets in leak area for pinholes or bubbles. The pinhole or bubble causing the leak may be one or two feet away from the point where the leak shows on the outside. This is due to the passage of the gasoline along and through the wing structure.

2. Remove seam sealing compound fillets from the area of the pinhole or bubble causing the leak to the point of appearance of the leak on the outside of the structure.

3. Remove all sealing compound and zinc chromate primer from spar cap areas for approximately 2 inches from the edge of the old fillet on the skin, as specified in 5.2.6., preceding.

4. Redrive rivets which appear to be loose in the leak area. Replace any rivets which show signs of large leaks, as specified in 5.2.7., 5.2.8., 5.2.9., and 5.2.10., preceding.

5. Prepare surface for sealing, as specified in 5.2.14., preceding.

6. Install RL-3700 seam sealing compound fillets as specified in 5.2.15., preceding.

7. Apply TL-652 slushing compound as specified in 5.2.15., preceding.

j. LEAKS BETWEEN SPAR CAP FIN AND SPAR WEB. *(See view H, Figure 46)*

1. Inspect seam sealing compound fillets in leak area for pinholes or bubbles, as specified in 5.2.9., preceding.

2. Remove seam sealing compound fillets from the area of the pinhole or bubble causing the leak to the point of appearance of the leak on the outside of the structure.

3. If no pinhole or bubble can be found, remove all seam sealing compound fillets along the junction of the spar cap and spar web in the bay where the leak has been found. Remove seam sealing compound fillets from the rib attach angle on each side of the leak and the end of the spar web stiffener in the center of the bay.

4. Redrive rivets which appear to be loose in the leak area. At the end of the hat section stiffener, remove the two rivets (through the spar cap fin) and install in the second hole from the end an AN3-7A bolt, AN960-D10 washer, and a tapered washer on the spar cap fin, as specified in 5.2.7., preceding. If necessary, make a similar installation at the same hole in rib attach angles. Replace rivets which show signs of large leaks around the head, as specified in 5.2.7., 5.2.8., 5.2.9., and 5.2.10., preceding.

5. If RL-3700 seam sealing compound fillet has been removed from the end of the rib attach angles and spar web stiffeners, the fillet should be applied around the ends first. Pack the fillet tightly to eliminate chances of small pinholes along the edge of angles or stiffeners.

6. Install RL-3700 seam sealing compound fillets as specified in 5.2.15., preceding.

7. Apply TL-652 slushing compound as specified in 5.2.15., preceding.

k LEAKS AT RIB ATTACH ANGLES. *(See view I, Figure 46)*

1. Remove rivets in the leak area, as specified in 5.2.7., preceding.

2. Ream oversize holes for next size rivets. Remove chips from between faying surfaces with a thin chip chaser.

3. Install rivets, as specified in 5.2.8., 5.2.9., and 5.2.10., preceding.

4. If rivet leaks occur at the end of the rib attach angle at the spar cap, install an AN3-7A bolt, AN960-D10 washer, and a tapered washer on spar cap fin, as specified in 5.2.7., preceding, using torque valves in 5.2.13., preceding.

5. Remove all sealing compound from the rib end and rib angle, as specified in 5.2.14., preceding.

6. Install RL-3700 seam sealing compound fillets by building up at points of junction of rib attach angle with spar web around ends. Extend fillet ⅜-inch out on spar web and ⅛-inch over the top of the web-angle rivets. Extend fillet on the rib end to the rivet line, as specified in 5.2.15., preceding.

7. Apply TL-652 slushing compound, as specified in 5.2.15., preceding.

l. LEAKS AT RIB FLANGES AT TOP OR BOTTOM SKIN. *(See view I, Figure 46)*

1. Redrive rivets showing small seepage, as specified in 5.2.10., preceding.

2. Remove and replace rapidly leaking rivets as specified in 5.2.7. and 5.2.10., preceding.

3 Inspect the dimple in rib flange and skin for small cracks If a crack is found in the skin dimple, it should be repaired as specified in 5.2.9., preceding. Repair cracks in the rib flange dimple, by drilling a No. 60 stop hole at the end of the crack. Install a doubler (same gauge as rib) on the flange, and catch at least two good rivets.

4. Clean slushing compound from rib flange and prepare for resealing as specified in 5.2.14., preceding.

5. Apply a thin coating of RL-3700 seam sealing compound to faying surface of doubler, as specified in 5.2.15., preceding.

6. Attach the doubler tightly to the rib flange with screws to squeeze out excess seam sealing compound. Install rivets, as specified in 5.2.10., preceding.

7. Apply TL-652 slushing compound to the repaired area, as specified in 5.2.15., preceding.

m. LEAKS AT LIQUIDOMETER DOUBLERS AND FITTING ON CENTER SPAR WEB. *(See view L, Figure 46)*

1. Repair any rivet showing small seepage by redriving, as specified in 5.2.10., preceding.

2. Replace rapidly leaking rivets as specified in 5.2.7., preceding.

3. When several rivets, or a seam, are leaking between the doubler and spar web, disconnect Liquidometer by removing bolts and rivets through adapter ring, doubler, and spar web. See 5.2.7., preceding.

4. Clean all faying surfaces and prepare for sealing, as specified in 5.2.14 and 5.2.15., preceding. Ream enlarged rivet holes for next size rivet. Make a new doubler, if many holes are enlarged.

5. With new bolts and no sealing compound, bolt doubler in place. Drive rivets with manufactured heads outside of tank, as specified in 5.2.10., preceding.

6. Apply RL-3700 seam sealing compound thinly to faying surfaces of adapter ring and bolt in place, as specified in 5.2.12., preceding.

7. Install a ½-inch RL-3700 seam sealing compound fillet completely around the Liquidometer doubler, as specified in 5.2.15., preceding.

8. Apply TL-652 slushing compound, as specified in 5.2.15., preceding.

n. LEAKS AT NACELLE ATTACH ANGLES ON TOP OR BOTTOM SKIN. *(See view M, Figure 46)*

1. Remove rivets in the leak area, as specified in 5.2.7., preceding.

2. Ream enlarged holes for next size rivet. Remove chips from between faying surfaces.

3. Install new rivets, as specified in 5.2.10., preceding.

4. Apply TL-652 slushing compound over the rivet heads inside the tanks, as specified in 5.2.15., preceding.

o. LEAKS AT RIB ATTACH ALLEN BOLT FITTING TO SPAR WEB: STATIONS 222, 317, AND 378. *(See view N, Figure 46)*

1. Remove sealing compound around fittings as specified in 5.2.14., preceding.

2. Back out Allen bolt approximately 1 inch.

3. Apply RL-3700 seam sealing compound to shank of Allen bolt and bearing surface of head, as specified in 5.2.12., preceding.

4. Drive Allen bolt in place, install nut, and tighten to proper torque, as specified in 5.2.13., preceding.

5. Prepare surface for sealing as specified in 5.2.14., preceding.

6. Install a small RL-3700 seam sealing compound fillet around fitting at its attachment to the spar web. Apply a fillet around Allen bolt head and in all crevices of the fitting, as specified in 5.2.15., preceding.

7. Apply TL-652 slushing compound to the Dill lock nut *inside* the tank after installation, as specified in 5.2.15., preceding.

p. LEAKS AT DILL LOCK NUTS. *(See view O, Figure 46)*

1. Leaks in Dill lock nuts are usually caused by stripping of internal threads within the nut. Replace leaking Dill lock nuts.

2. Do not use sealing compounds on Dill lock nuts before installing.

3. Apply TL-652 slushing compound to the Dill lock nuts *inside* the tank after installation, as specified in 5.2.15., preceding.

q. LEAKS AT NACELLE ATTACH ANGLES ON FRONT SPAR. *(See view P, Figure 46)*

1. Repair leaks at nacelle attach angles on the front spar, Stations 167 to 184, 281 to 300, and 336 to 357, as specified in 5.2.11., preceding.

Note

RL-3700 seam sealing compound fillets are not used for leaks at stations 336 to 357, because an internal matching back-up angle is not used.

r. LEAKS AT ACCESS DOORS AND METHOD OF REINSTALLING DOORS. *(See view Q, Figure 46)*

1 Remove the door, scrape away all old sealant and clean the contact surfaces of the door and recess with ethyl acetate.

2. Install a heavy coating of TL-652 slushing compound, as specified in 5.2.15., preceding. Do not allow any of the slushing compound to get on the faying surface area of the door.

3. Install RL-3700 seam sealing compound with a putty knife on the faying surface area of the door, in a thin, lump-free coating approximately .005 inch thick. DO NOT place seam sealing compound on the contact area of the recess in the wing, as the seam sealer will then get into the threads of the steel ring and will cause loosening of the Reed and Prince attach screws.

4. Place the door in position and install Reed and Prince screws loosely with an air-driven screw driver. Tighten the screws with a hand screw driver only.

5. Retighten all screws at THREE different fifteen-minute intervals, after the initial installation.

s. LEAKS AT RIVETS AROUND ACCESS DOOR DOUBLERS TO BOTTOM SKIN. *(See view Q, Figure 46)*

1. Install outside seal as specified in 5.2.17., preceding.

2. Redrive only extremely loose rivets. Redriving rivets in these areas will tend to loosen all neighboring rivets. Should this occur it entails an almost endless redriving around the access door. In order to avoid damaging rivet holes, replace rivets in these

areas only in exceptional cases, as machine countersinking for next size rivet cannot be done. See 5.2.8., preceding.

t. LEAKS IN RIVETS THROUGH FILLER NECK DOUBLER AND FILLER NECK FITTING TO TOP SKIN. *(See view R, Figure 46)*

1. For serious leakage, redrive all rivets through filler neck doubler only if leakage shows it to be necessary. See 5.2.17., preceding.

2. Install external seal for seepage without redriving rivets, as specified in 5.2.17., preceding.

u. LEAKS IN OUTER WING PANEL. *(See view S, Figure 46)*

1. Repair leaks in outer wing panel in the manner described in preceding paragraphs for similar locations in the inner wing. Make extensive use of external sealing for skin rivet leaks in the outer wing panel, as specified in 5.2.17., preceding.

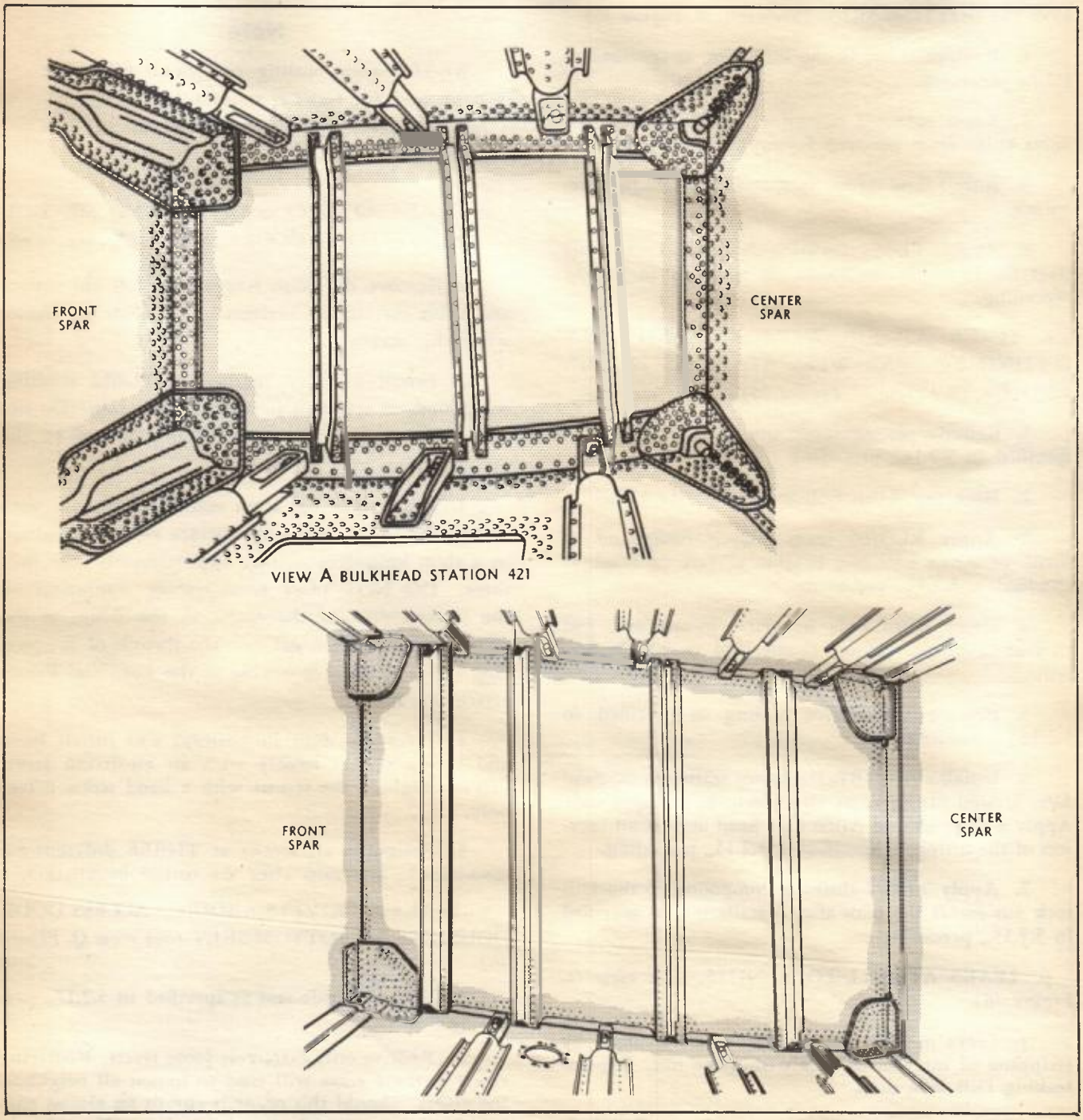


Figure 46 (Sheet 1 of 6 Sheets) — Fuel Tanks — Possible Leakage Areas

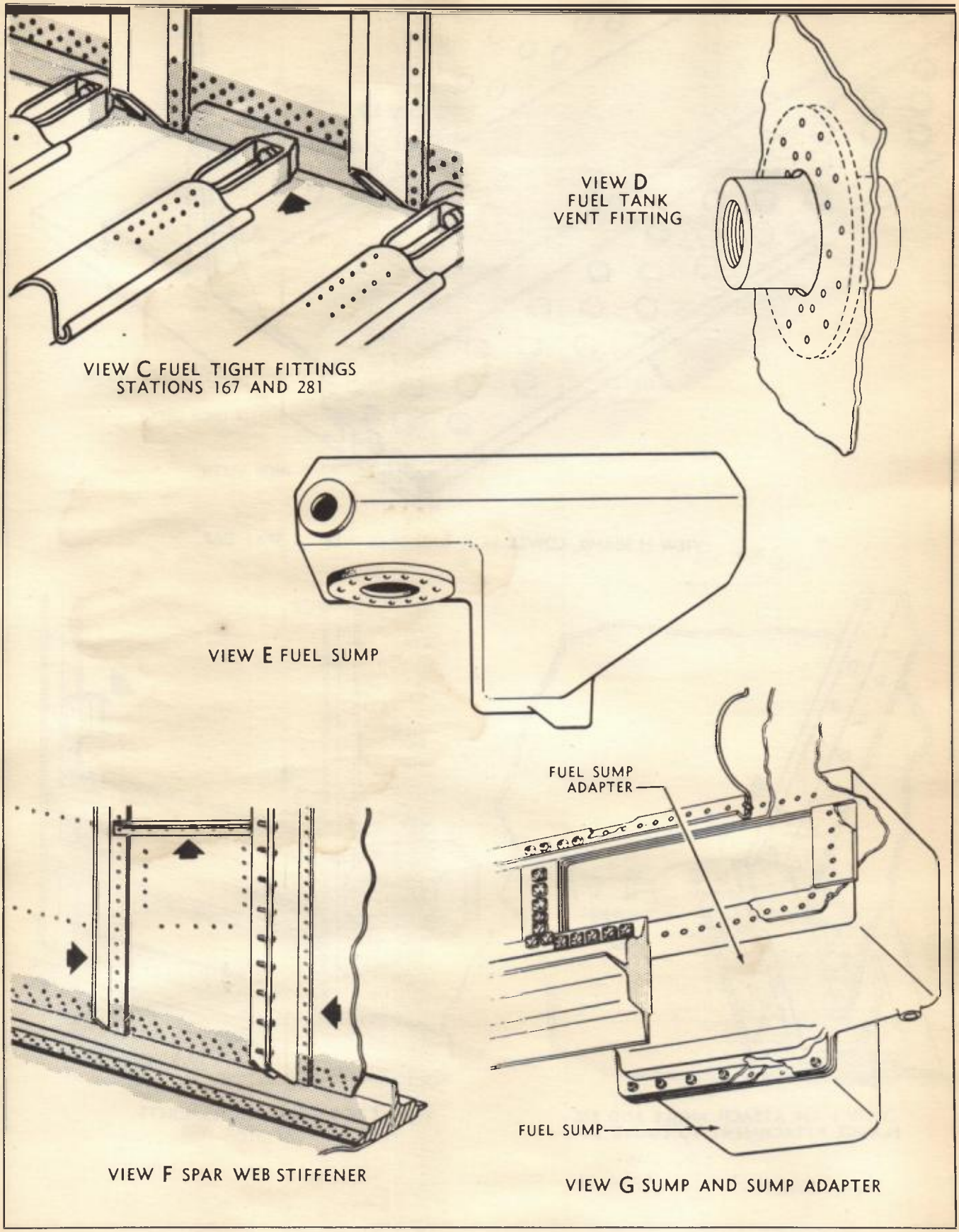
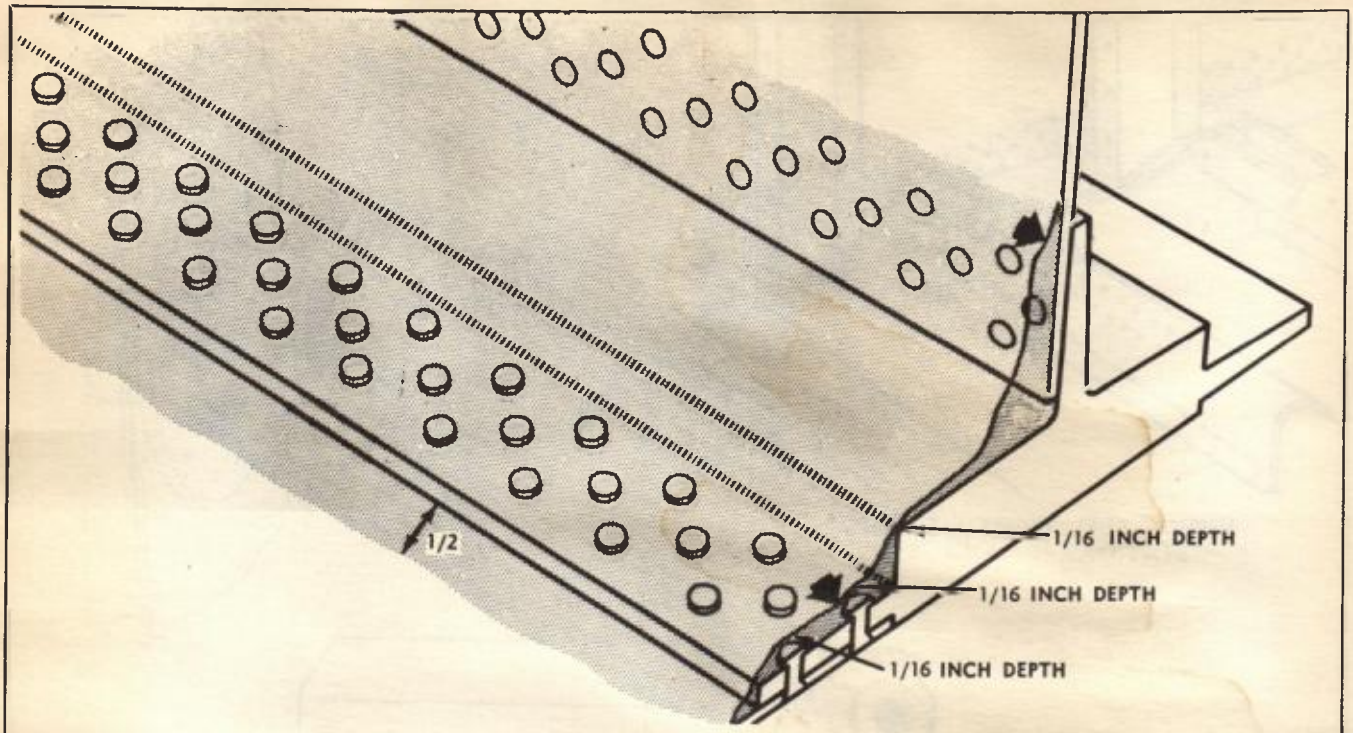
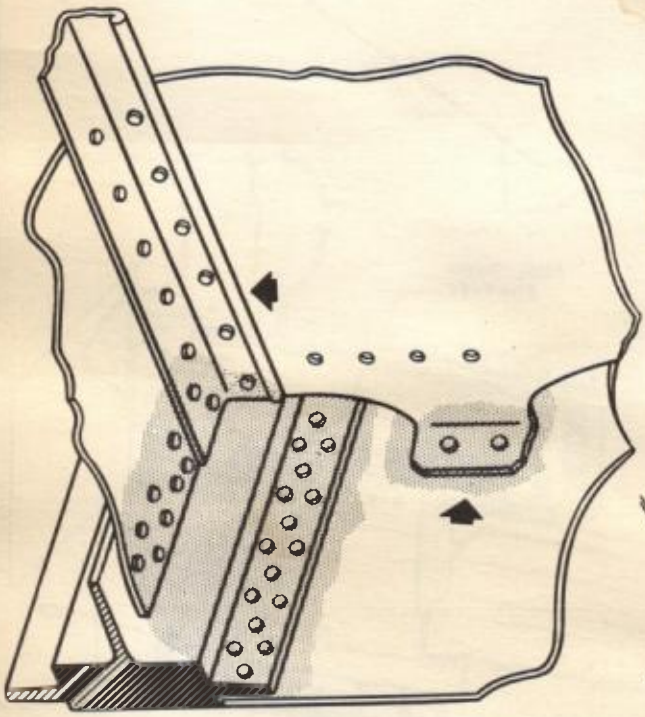


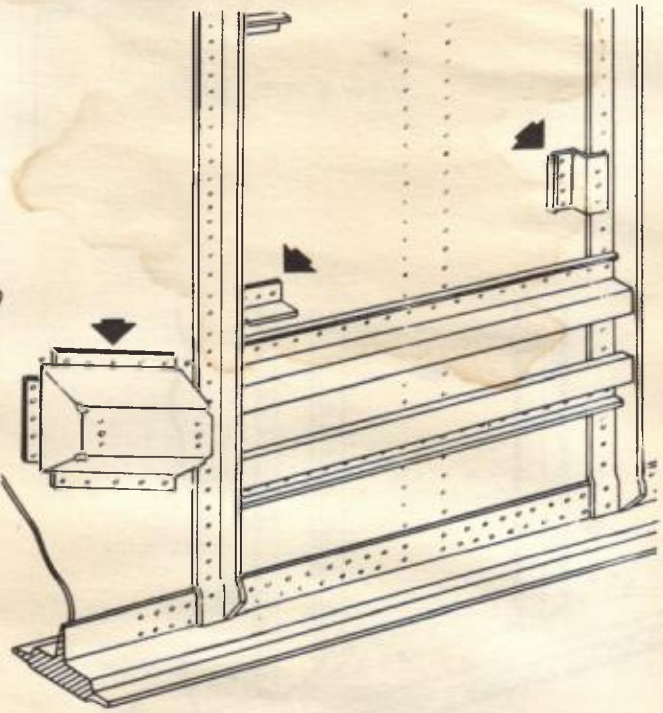
Figure 46 (Sheet 2 of 6 Sheets) — Fuel Tanks — Possible Leakage Areas



VIEW H SEAMS, LOWER SKIN AND SPAR WEB TO SPAR CAP



VIEW I RIB ATTACH ANGLE AND RIB FLANGE ATTACHMENT TO LOWER SKIN



VIEW J DOUBLERS, BOX, BRACKETS AND CLIPS ON SPAR WEB

Figure 46 (Sheet 3 of 6 Sheets) — Fuel Tanks — Possible Leakage Areas

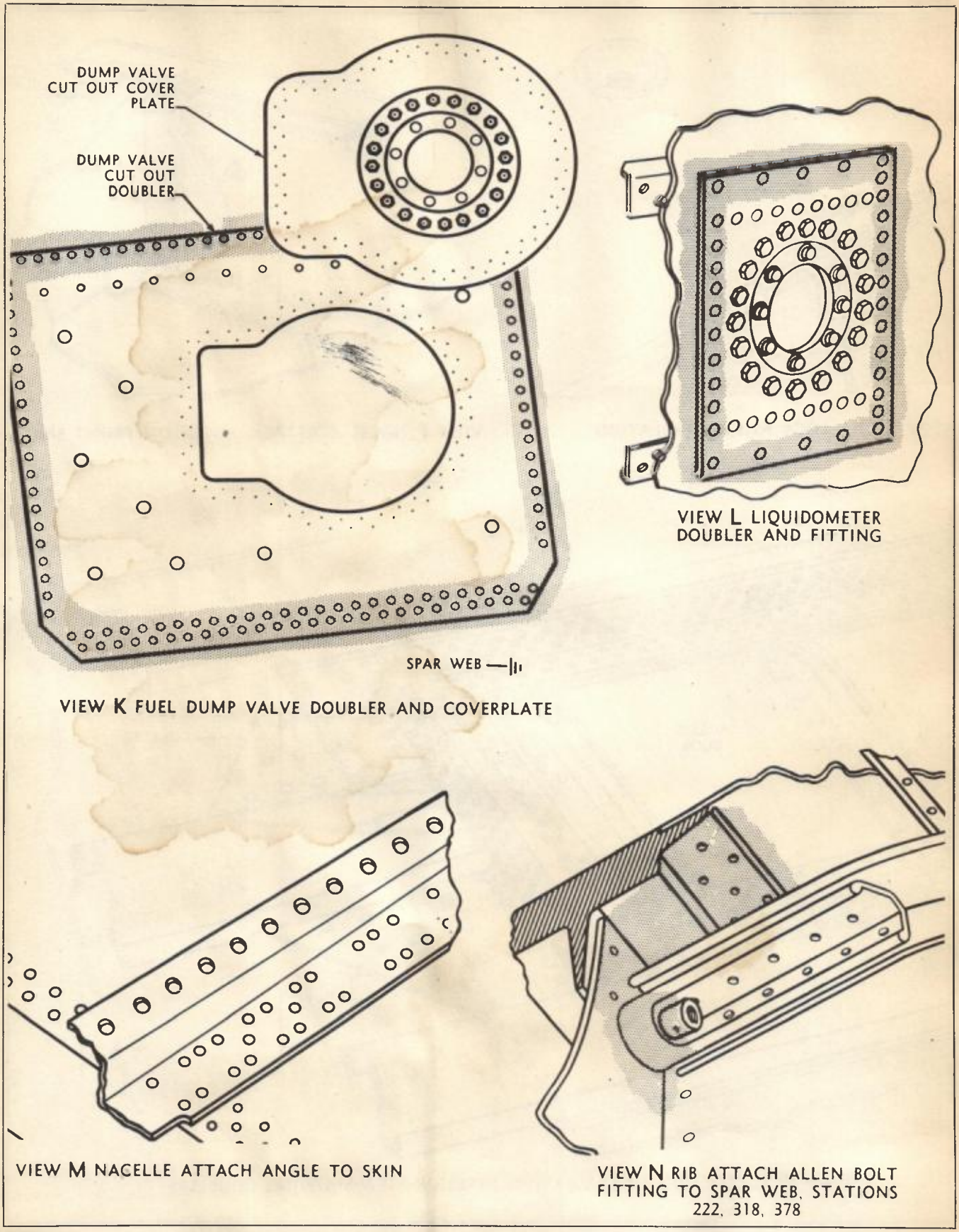
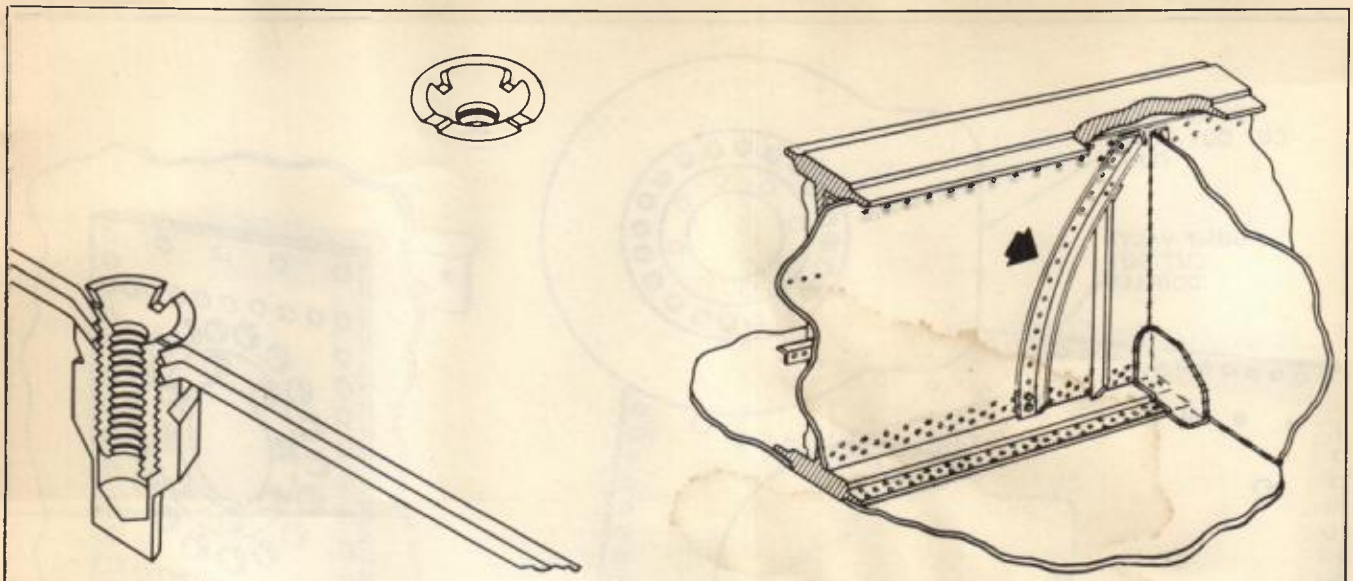
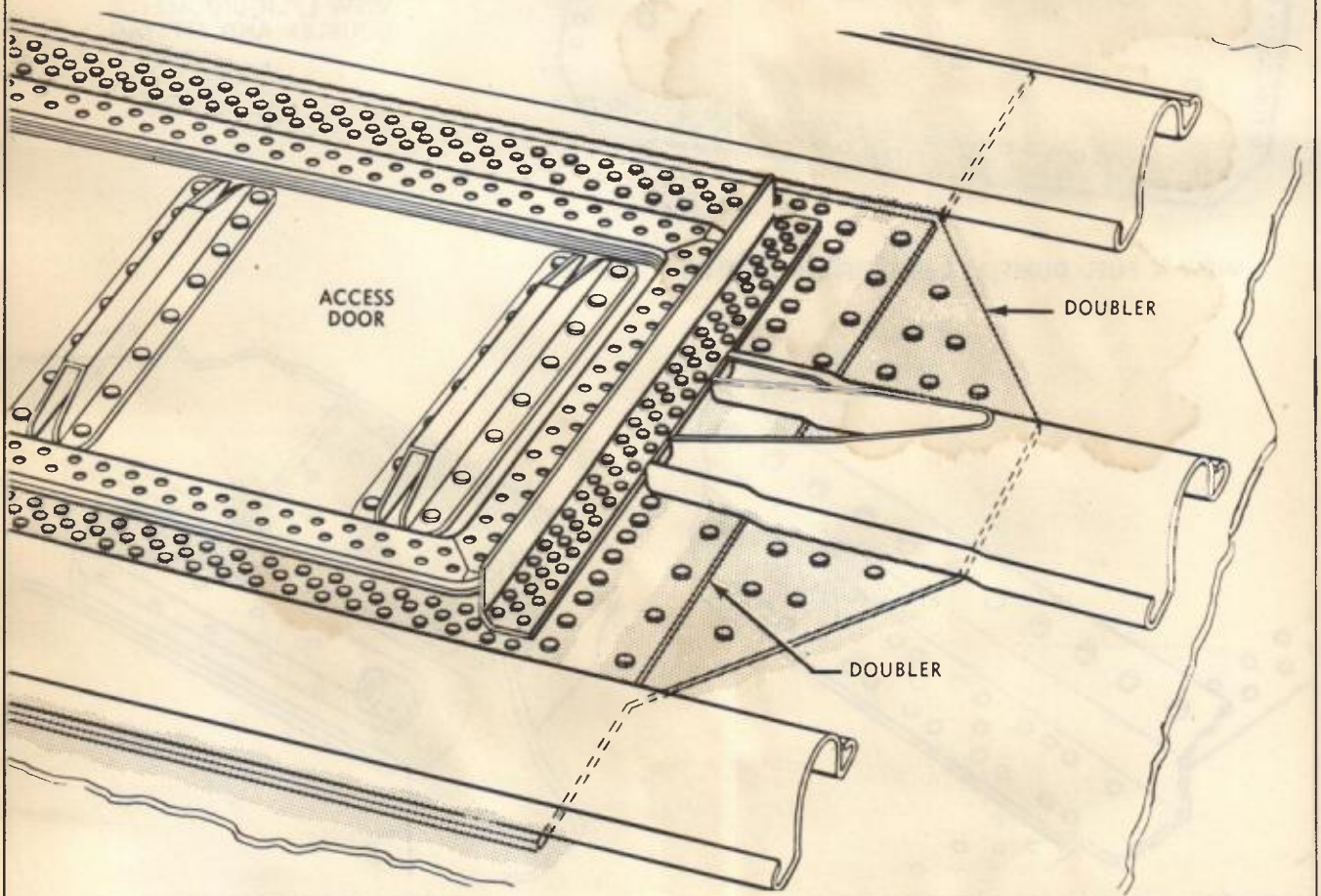


Figure 46 (Sheet 4 of 6 Sheets) — Fuel Tanks — Possible Leakage Areas



VIEW O DILL LOCK NUT INSTALLATION

VIEW P NACELLE ATTACH ANGLE ON FRONT SPAR



VIEW Q ACCESS DOOR INSTALLATION INTERIOR VIEW SHOWING DOUBLERS

Figure 46 (Sheet 5 of 6 Sheets) — Fuel Tanks — Possible Leakage Areas

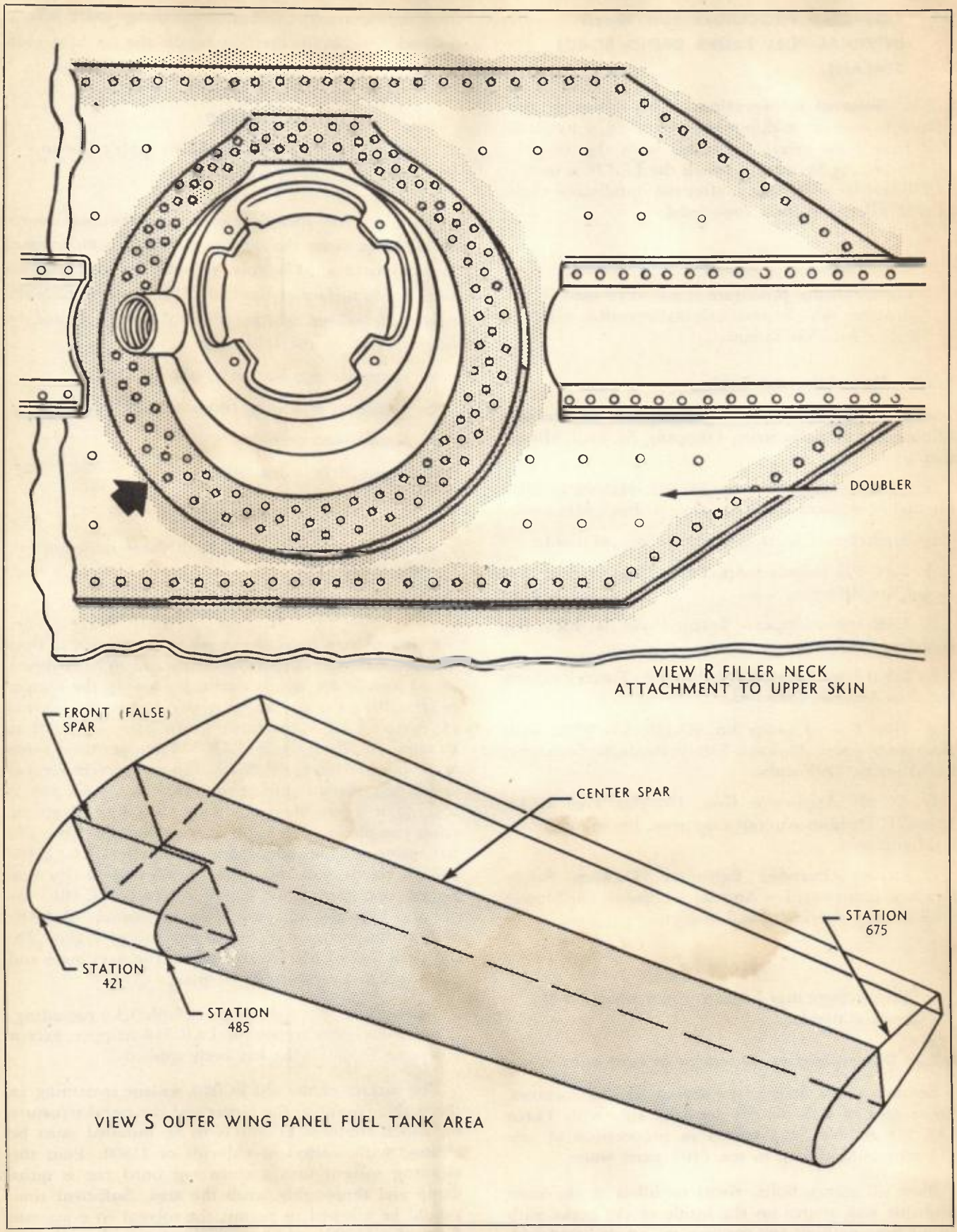


Figure 46 (Sheet 6 of 6 Sheets) — Fuel Tanks — Possible Leakage Areas

5.3. RESEALING PROCEDURE FOR WING INTEGRAL FUEL TANKS USING EC-801 SEALANT.

5.3.1. General Information. – The following procedure is used in making repairs on DC-4 airplanes that have been originally sealed with the EC-801–EC-776 Sealing System, in which the EC-776 is used as a "Fill and Drain" coating, after the installation of the EC-801 fillets has been completed.

Note

The following procedure is not to be used in airplanes which were originally sealed with Fuller RL-3700 Sealant.

5.3.2. Materials and Tools.

a. EC-801 Thiokol Sealing Compound, Minnesota Mining and Manufacturing Company, St. Paul, Minnesota.

b. EC-807 Accelerator for EC-801, Minnesota Mining and Manufacturing Company, St. Paul, Minnesota.

c. Methylene Chloride–commercially available.

d. LAC-598 Bubble Soap, Turco Products Inc., Los Angeles, California.

e. LAR-388 Stripper – Turco Products Inc., Los Angeles, California.

f. L-800 Final Cleaning Compound–Turco Products Inc., Los Angeles, California.

g. Heat Curing Lamp No. SO-130, 125 Watt, with aluminum stand, Dickson Safety Products Company, Los Angeles, California.

h. EC-801 Applicator Gun, Douglas Tool K652-3340-GT, Douglas Aircraft Company, Inc., Santa Monica, California.

i. Airjax Airectifier Exhauster, Dickson Safety Products Company, Los Angeles, California–or blower with 20 feet of 6 inch flexible duct.

Note

Ethyl Acetate may be substituted when L-800 is not available.

5.3.3 Determination of Source of Leakage.

Remove access door cover nearest to leak location. Cover area of leak on the out tank side with Turco LAC-598 Bubble Soap mixed in proportions of one (1) part bubble soap to ten (10) parts water.

Blow all seams, bolts, rivets or fillets at the most probable leak source on the inside of the tanks with an air hose without any connections on the open end. Hold end of hose over each rivet or against seam or fillet being tested. Continue checking until leak is located. To obtain the best results the air hose must be held snuggly against the areas being tested.

Note

A filter must be used on the air supply line to remove all oil or water.

Start blowing operation at the apparent leak source as indicated from the outside, working both inboard and outboard until bubbles form at the leak stain on the outside surface of the tank. This will indicate the source of leakage which will probably be caused by one or more of the following:

a. Improper application of the EC-801.

b. Omission of sealing compound in leaking area.

c. Loose rivets or bolts.

d. Improperly sealed bolts.

Note

Air pressure at the end of the hose must not exceed 100 p.s.i.

5.3.4. Removal of Old EC-801 Sealant.

Using a sharp plexiglas or micarta scraper, cut away as much old fillet as possible in the area to be stripped. Metal knives are not permissible, due to the danger of scratching the structure. Apply a generous portion of Turco's LAR-388 stripper to the area of EC-801 to be removed. Reapply the LAR-388 stripper three times at 10 minute intervals. By pushing a micarta scraper under the sealant during the time the LAR-388 is soaking, it is possible to accelerate the stripping action. After completing this application, scrape off loose EC-801, using a chisel edged micarta scraper. The LAR-388 on the sealant must not be allowed to dry out. Repeat operation until metal is free of EC-801. Do not use plexiglas scrapers after application of LAR-388, as the stripper often softens the plexiglas. Do not permit the LAR-388 stripper to run over areas and fillets which are not to be stripped.

To repair b., c., or d., of paragraph 5.3.3 preceding, it is not necessary to use the LAR-388 stripper, except where an EC-801 fillet has been applied.

The surface of the old EC-801 sealant remaining in the tank adjacent to the repair and the metal structure on which the new EC-801 is to be installed must be cleaned with methylene chloride or L-800. Pour the cleaning solvent into a clean rag until rag is quite damp and thoroughly scrub the area. Sufficient time should be allowed to permit the solvent to evaporate from the EC-801 sealant. Wipe down cleaned area with a *clean dry* cloth.

Note

The LAR-388 does not attack, soften or deteriorate the EC-801 sealant in short periods of time. This peculiarity protects any faying surface sealant that may be present.

5.3.5. Precautions.

a. To use methylene chloride in any form, personnel must be protected from its fumes. IT IS ABSOLUTELY MANDATORY THAT PERSONNEL WEAR OUTSIDE AIR SUPPLY MASKS OF THE SAME TYPE AS USED FOR TANK STRIPPING.

b. Only vapor and explosion proof lights are permissible.

c. Personnel must wear rubber gloves for all operations.

d. The fumes of Methylene Chloride are very toxic. Adequate safety precautions must be taken at all times.

e. Heavy rubber gloves must be worn at all times when using the LAR-388 stripper. LAR-388 must be stored in a cool, dry place; excessive heat jells the top surface of the stripper, therefore it is imperative that it be kept tightly corked or closed air-tight.

f. A constant supply of fresh air must be maintained while cleaning and resealing operations are being accomplished in the tanks. There are two satisfactory methods of maintaining this fresh air supply; by means of a blower with a flexible duct leading into the tank through an access door; or by placing an air mover, such as an Airjax Airectifier, over the open tank filler neck. The latter method is preferable as it moves the air from the bottom and out the top through the access door used by the worker. This method utilizes the compressed air supply for its action.

Note

Air from a mechanical compressor is not permissible unless it is passed through a filter to remove oil, water and other impurities which might prevent a satisfactory resealing operation through contaminating the surfaces to be sealed. It is also detrimental to personal health.

5.3.6. Cleaning Prior to Resealing.—All drilling, fitting and repairing operations must be completed before cleaning and subsequent application of sealing compounds.

Remove all chips and foreign particles from the tank interior. Dampen a clean cloth with Mythelene Chloride and scrub area completely free of the wax residue resulting from use of LAR-388 stripper. Follow with a wipe-down, using a rag dampened with Turco L-800. This should include any parts that are added to the structure, i.e., doublers, fittings, etc. Complete the structure rework in the specified manner and finally clean areas to be sealed. Use Turco L-800 final cleaner in the finishing operation, to be followed by a thorough wipe-down with a clean, dry cloth.

5.3.7. Bolts Leaking.—When installing bolts, either permanent or temporary, torqueing shall be accomplished by means of a calibrated torque wrench. Whenever possible, all bolts passing through the tank boundaries shall be inserted from in-tank i.e., inside of the tank boundary. Final bolts and drive pins are to be coated on the shanks with EC-801 compound before insertion. Torque inspection of the bolts must be made within two and one-half hours after the application of the sealant. If bolt is disturbed after the EC-801 has become set, it must be removed, cleaned and reinstalled.

5.3.8. Special Fuel Tank Area Bolt Torque Table.

BOLT	THREAD	TORQUE (inch pounds)
#10	32	35-40
1/4	28	80-90
5/16	24	140-155
3/8	24	240-265
7/16	20	500-550
1/2	20	660-725
9/16	18	960-1060
5/8	18	1400-1540

5.3.9. Bead and Fillet Material, EC-801 Sealant and EC-807 Accelerator.

Note

The EC-801 sealing compound must be thoroughly mixed and in paste form before adding it to the EC-807 accelerator.

The EC-807 accelerator should be mixed with the EC-801 sealing compound in the proportion, by weight, of twelve parts of EC-807 to 100 parts of EC-801. Add EC-807 in small parts to the EC-801, stirring slowly. The materials MUST NOT be stirred or mixed too rapidly as internal heat will be generated resulting in fast setting. However, the EC-801 and EC-807 must be thoroughly and completely mixed to obtain an even and complete cure of the sealant. After being mixed with EC-807 accelerator, EC-801 sealant has a working life of approximately two and one half hours.

Note

Sealant must be discarded when it becomes too stiff to work easily.

To prevent the EC-801 and EC-807 mixture from setting up before the resealing operation has been completed, store the material in a box containing dry

ice. In this way it will stay in a usable condition for 24 hours at temperatures ranging between 0 and 10 degrees F. DO NOT STORE MIXED EC-807 and EC-801 MORE THAN 24 HOURS.

When the climate is unusually humid or hot, it may be necessary to chill the EC-807 and EC-801 prior to mixing. This can be accomplished by placing the containers in an ice box, a refrigerator or in chipped ice and water bath.

5.3.10. Base and Top Coat Material.—Prepare a small amount of EC-801 and EC807 as directed in the foregoing paragraph. Mix this with methylene chloride in the following proportions:

> One (1) part by *volume* of EC-801 to two and one-half (2½) parts by *volume* of methylene chloride. Stir slowly but thoroughly until it becomes a thick paint.

The working life of this paint is approximately one (1) hour. Hence, it must be used in the tank repair within forty-five (45) minutes after mixing in order to secure good adhesion and a successful resealing job.

5.3.11. Resealing Procedure.

a. After thoroughly cleaning area, apply a heavy, brushed on base coat of the EC-801 and methylene chloride mixture to the metal and the adjacent areas to be resealed. Carry the brush application a minimum of ¾" over the ends of the old sealant fillet. This application gives the best possible adhesion of the new EC-801 to the old EC-801 sealing compound.

b. Bead edges of all tank seams, fittings doublers, etc., with EC-801 sealant. This beading must be built up in two stages as follows:

1. Initial bead should be approximately ¼" wide. The width of the bead will vary somewhat, depending on the thickness of materials forming the seam to be sealed. In all cases, the initial bead should fair in the angle formed by the member (see Figure 47).

2. After initial beading has been applied to not more than two or three feet of the seam, it must be worked down with a chromate tool in order to eliminate all trapped air (see Figure 47).

Note

> The quality of beading obtained and the leak-free service life of the bead depends upon how thoroughly and carefully the above application is performed.

When an emergency arises, the initial bead and final fillet may be applied in one application, being sure that the dimension of the final fillet is being maintained. To speed up the action and curing time, install the heat lamp or a hot air blast on the outside of the tank structure. The applied heat should not exceed 115 degrees F. As the sealant sets up faster when applied to hot metal, the above method will decrease the overall time for making the repair.

c. Before applying final fillet, carefully examine the initial bead and break open any bubbles or blisters appearing on the area. Remove enough EC-801 in these areas to enable material to flow in and fill the pockets when the final fillet is applied. Apply final fillet so that designated cracks, crevices and joggles are packed solidly with EC-801, making sure that the completed fillet of EC-801 has a width of ½" on each side of the joint being sealed. In all cases carry the fillet up and over the edges of doublers, stiffeners and similar attachments. All exposed edges of the old fillets of EC-801 sealant must be sealed completely over all areas cut back to make the repair. This should be done in the same manner as that used on a metal joint. Carry the EC-801 a minimum of ½" each side of the ends of the old sealant fillet. (See Figure 47).

Work down final beading with a chromate tool in the same manner as initial beading.

EC-801 should be applied with an applicator gun, Douglas Tool K 652-3340-GT, however, if the applicator gun is not available, a spatula may be used.

d. Apply a heavy, brushed on top coat of the EC-801 and methylene chloride mixture over the entire repair area and carry it well over the old fillet to insure bonding in of the repair. The following is a guide as to the time required:

1. Allow base coat (step a.) to set for thirty (30) minutes, then apply EC-801 bead and fillet.

2. Allow bead and fillet (step b. and c.) to set for one (1) hour, then apply top coat.

3. Allow top coat (step d.) to set for thirty (30) minutes before filling tank with gasoline.

Notes

1. Access doors can be installed immediately on completion of step d. without injury to the repair.
2. The replacement of the EC-776 coating over the repaired area is not necessary and should not be accomplished.

5.3.12. Heat Curing.—EC-801 mixed with EC-807 accelerator cures very well at temperatures from 70 degrees F. to 115 degrees F. maximum. Below 70 degrees F. the cure of this material requires rapidly increasing curing time. At 55 degrees F., a cure requires approximately 250 hours. During cold weather, additional heat must be supplied.

The heat curing lamp is to be used in preference to hot air as this method of heating directs the infra-red directly on the repair. The temperature on the sealant may be regulated by moving the lamp closer to the repair for high degree of heat or by moving it further away to prevent overheating. It must be noted that 115 degrees F., is the maximum curing temperature.

Section 3

TAIL GROUP

1. GENERAL.

The tail group includes the vertical and horizontal stabilizers, rudder, elevators, and tabs. Complete balancing information for control surfaces is given in Section I of this manual.

2. TAIL GROUP CONSTRUCTION. – The stabilizers are constructed of two longitudinal spars each, built-up ribs, and alclad skin. Rudder and elevators have a longitudinal spar, ribs, alclad skin covering over the leading edge, and a complete fabric cover. Tabs are of plywood or aluminum alloy construction, with fabric covering.

3. CLASSIFICATION OF DAMAGE TO TAIL GROUP.

3.1. NEGLIGIBLE DAMAGE.

3.1.1. Spars and Ribs.—The following damage is considered negligible: Scratches in flange surfaces not deeper than one-half flange thickness after cleaning out and polishing, web holes not over ½ inch in diameter after cleaning and rounding out, and not closer than 2 inches to an existing hole, and edge nicks in flanges not deeper than ½ inch after cleaning out and polishing.

3.1.2. Skin.—Holes of ½ inch maximum diameter, located not closer than 1 inch from ribs and stringers, or less than 3 inches from another hole are permissible. Cracks are permitted if not longer than 2 inches, with no material removed or distorted. Such cracks must be stopped with ⅛ inch holes which in turn are plugged with soft aluminum plugs. Shallow, smooth, isolated dents, free of cracks or abrasions are also permitted.

Note

Investigate carefully all skin dents for internal structural damage.

3.2. REPAIRABLE DAMAGE. – Appropriate illustrations are provided in this section to cover typical cases. In all instances where repairs are necessary, it is recommended that entire units such as skin panels, etc., be replaced if available.

3.3. DAMAGE NECESSITATING REPLACEMENT OF PARTS.—All small clips, extrusions, forgings, etc., must be replaced if damaged.

4. TAIL GROUP WRENCH TORQUE TABLE.

The following wrench torque table lists allowable wrench torques in inch-pounds or foot-pounds for all important bolts in the tail group. These limits must be adhered to because under-torque encourages fatigue, and over-torque may result in excessive elongation of the bolt.

BOLT NO.	NUT NO.	NO. REQ.	ATTACHED PART	INSTALLATION	TORQUE (INCH-POUNDS*)
		VERTICAL STABILIZER TO FUSELAGE TAIL–STATION 953			
NAS-152-64	12B-126	2	4108085	5073635	280-300 (ft-lb)
		VERTICAL STABILIZER TO FUSELAGE TAIL–STATION 1014			
NAS-150-58	12B-108	4	41080884	5073635	135-155 (ft-lb)
		UPPER RUDDER HINGE BRACKET			
NAS-144-26	12B-048	4	5109897	5110238	73-100
		LOWER RUDDER HINGE BRACKET			
NAS-145-30	12B-054	4	5109896	5110238	145-200

Continued on next page

BOLT NO.	NUT NO.	NO. REQ.	ATTACHED PART	INSTALLATION	TORQUE (INCH-POUNDS*)
		RUDDER TO STABILIZER EYEBOLTS			
	AN365-720	2	5073639	5073638	450-500
		RUDDER TO RUDDER TORQUE TUBE			
AN4-13A	AN365-428	2	5166948	5073638	50-70
AN5-6A	AN365-524	6	5166948	5073638	100-140
		RUDDER TRIM TAB BRACKET			
AN3-5A	22A5-02	4	2220750	5114537	20-25
AN3-5A	22A5-02	4	2220750	5114537	20-25
AN3-6A	22A17-02	4	2220750	5114537	20-25
		HORIZONTAL STABILIZER TO FUSELAGE TAIL ASSEMBLY			
NAS-150-58	12B-108	16	4106422	5073629	135-150 (ft-lb)
		ELEVATOR HINGE BRACKETS			
NAS-144-26	12B-048	8	5109899	5110237	73-100
NAS-144-26	12B-048	8	5109898	5110237	73-100
		ELEVATORS TO STABILIZER EYEBOLTS			
	AN365-720	4	5073633	5073632	450-500
		ELEVATOR TO ELEVATOR TORQUE TUBE			
AN5-6A		10	5167273	5073632	100-140
	AN365-524	6	5167273	5073632	100-140
AN4-11A	AN365-428	4	5167273	5073632	50-70
		ELEVATOR TRIM TAB BRACKETS			
AN3-5A	AN365-1032	8	1111237	5111389	20-25
AN3-6A	AN365-1032	8	2114427	5111389	20-25
AN3-5A	AN365-1032	4	1111234	5111389	20-25

*Except as otherwise noted.

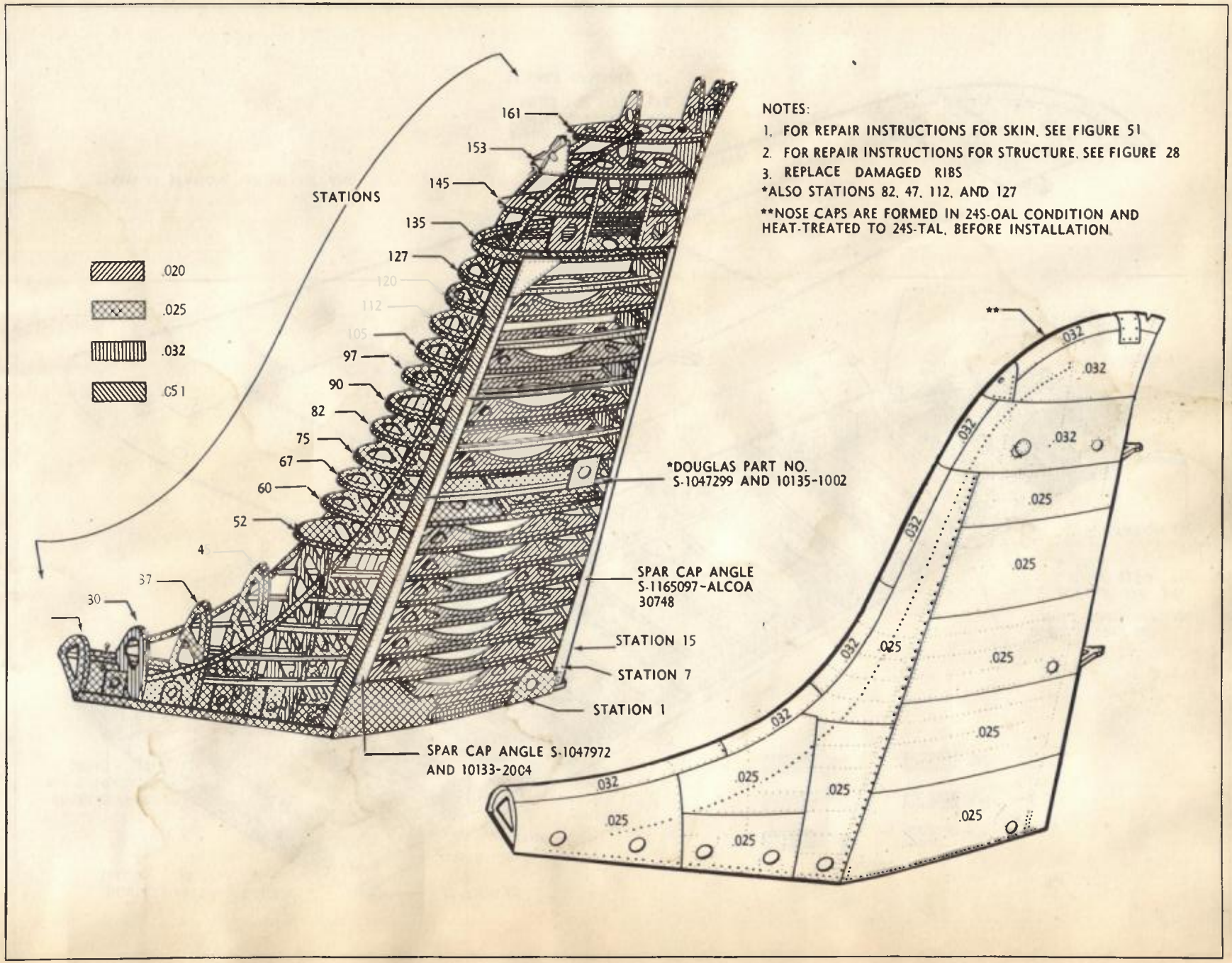


Figure 48 – Vertical Stabilizer Structure and Skin

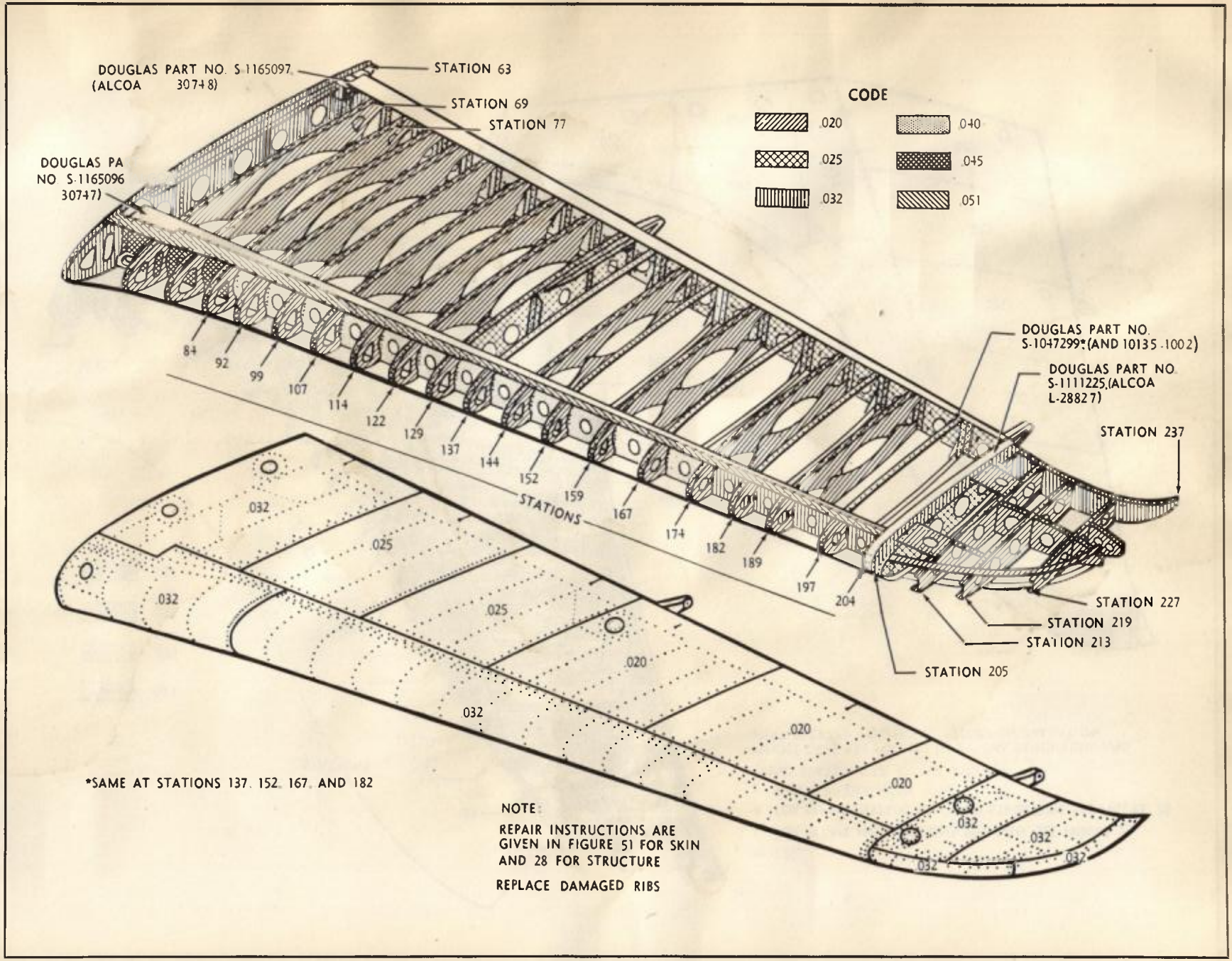
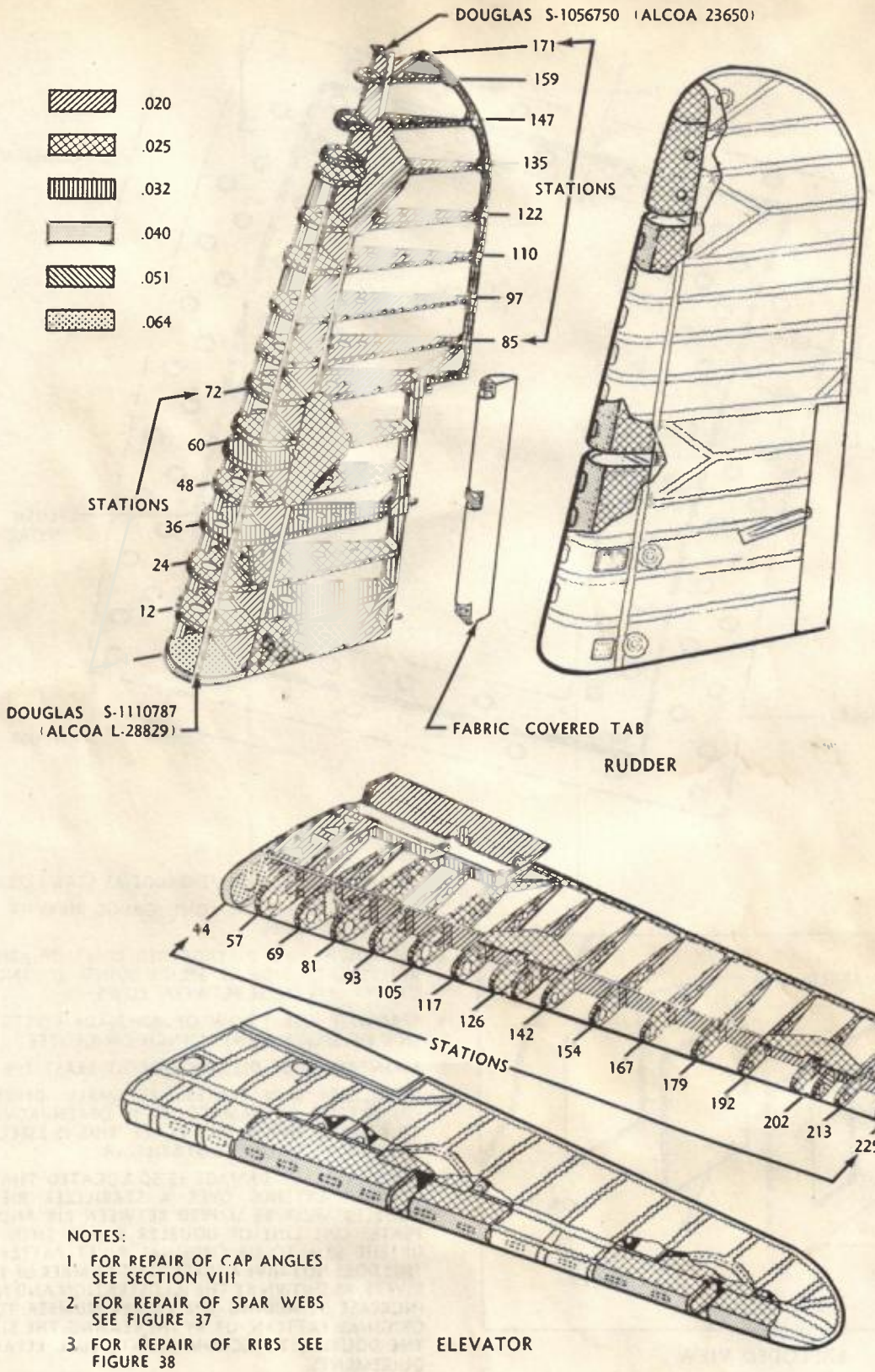


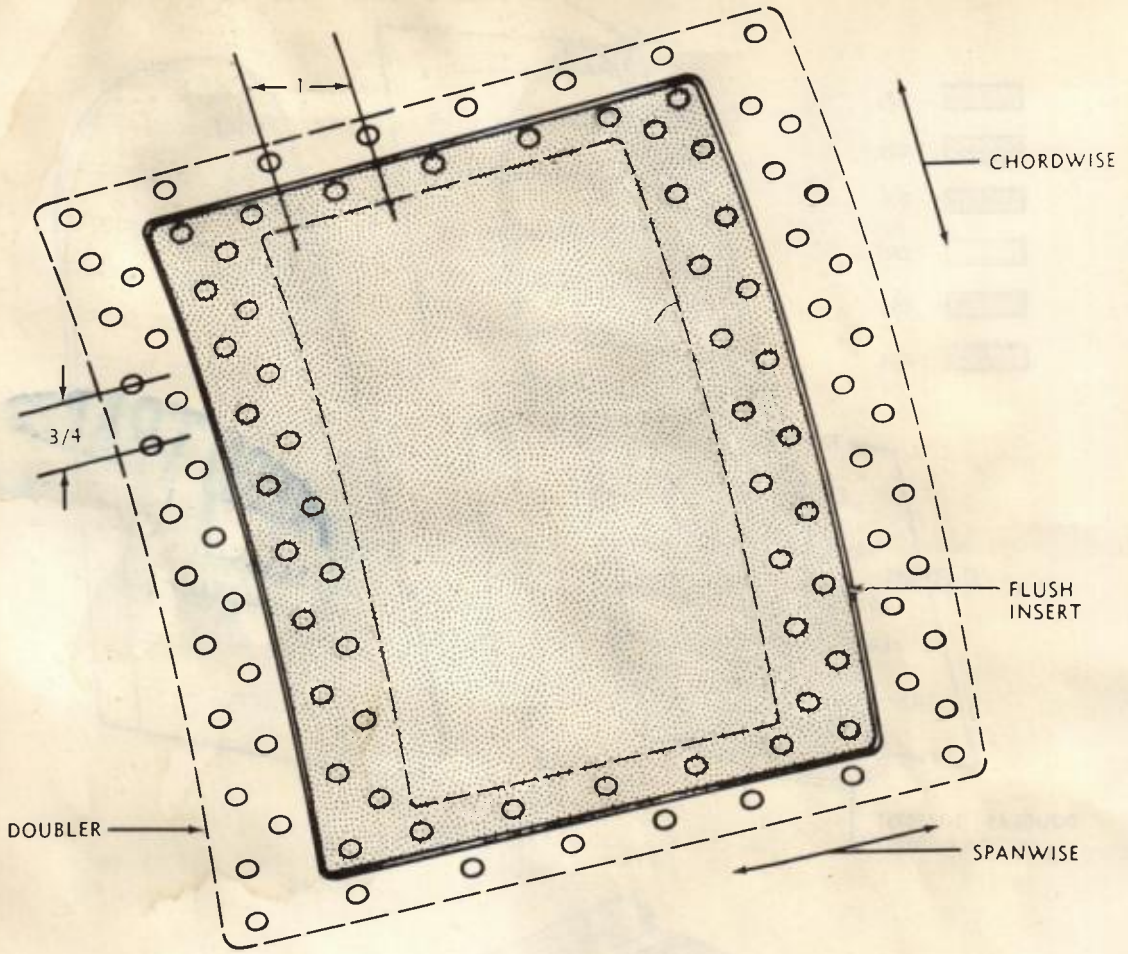
Figure 49 — Horizontal Stabilizer Structure and Skin

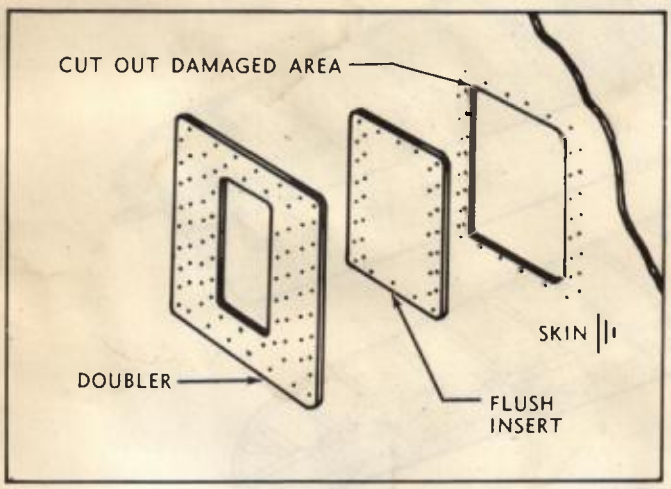


NOTES:

1. FOR REPAIR OF CAP ANGLES SEE SECTION VIII
2. FOR REPAIR OF SPAR WEBS SEE FIGURE 37
3. FOR REPAIR OF RIBS SEE FIGURE 38
4. FOR REPAIR OF TRAILING EDGE SEE FIGURE 39

Figure 50 — Elevator and Rudder Structure and Skin





EXPLODED VIEW

NOTES:

1. INSERT IS 24S-TAL, SAME GAUGE AS STABILIZER SKIN.
2. DOUBLER IS 24S-TAL, ONE GAUGE HEAVIER THAN STABILIZER SKIN.
3. CHORDWISE, USE 2 STAGGERED ROWS OF AN426AD4 RIVETS EACH SIDE OF SPLICE JOINT, 3/4 INCH ON CENTER, 3/8 INCH BETWEEN ROWS.
4. SPANWISE, USE 1 ROW OF AN426AD4 RIVETS EACH SIDE OF SPLICE JOINT, 1 INCH ON CENTER.
5. MAINTAIN EDGE DISTANCE OF AT LEAST 1/4 INCH.
6. STABILIZER SKIN PLATES ARE SMALL. DEPENDING ON EXTENT OF DAMAGE, IT IS OFTEN ADVISABLE TO REPLACE ENTIRE SKIN PLATE. THIS IS ESPECIALLY TRUE OF HORIZONTAL STABILIZER.
7. WHENEVER THE DAMAGE IS SO LOCATED THAT THE DOUBLER EXTENDS OVER A STABILIZER RIB, THE DOUBLER MUST BE SLIPPED BETWEEN RIB AND SKIN PLATE. ONE LINE OF DOUBLER RIVETS THEN PICKS UP THE SKIN-TO-RIB ORIGINAL RIVET PATTERN. IF THIS DOES NOT GIVE A SUFFICIENT NUMBER OF REPAIR RIVETS, AS SHOWN BY THE ILLUSTRATION AND NOTES, INCREASE BY ADDING THE PROPER NUMBER TO THE ORIGINAL PATTERN, OR BY INCREASING THE SIZE OF THE DOUBLER TO ACCOMMODATE FULL REPAIR REQUIREMENTS.

Figure 51 – Vertical and Horizontal Stabilizer Skin Splice

Section 4

FUSELAGE

1. GENERAL.

The fuselage is of all-metal, semi-monocoque construction and is fabricated almost entirely of 24S and 61S aluminum alloy. It consists of a nose assembly, 11 feet 4 inches long; a center assembly, 60 feet 9 inches long; and a tail assembly, 14 feet 9½ inches long. The inner wing section is permanently attached to the center fuselage section from station 301 to station 501. The tail cone is bolted to the fuselage tail section.

2. FUSELAGE CONSTRUCTION.—The main structural components of the fuselage are longitudinal beams under the floor, longitudinal stringers, transverse floor beams, bulkheads, frames, floor panels, and flush-riveted skin.

3. CLASSIFICATION OF DAMAGE TO FUSELAGE.

3.1. NEGLIGIBLE DAMAGE.

3.1.1. Fuselage Floor Beams.—Holes in web are permissible when not exceeding ½ inch after being cleaned out, and when located more than 1 inch from upper or lower flange, flange member, or stiffener. Edge nicks in all flanges are permitted under the same conditions as for fuselage frames (see 3.1.3, following).

3.1.2. Fuselage Bulkheads.—Smooth dents in webs are permissible when not caused by failure of adjacent structure. Edge nicks in bulkhead stiffeners are permitted under same conditions as for frames (see 3.1.3, following).

3.1.3. Fuselage Frames.—Local smooth dents in flat portion of frames are permissible provided they are not the result of damage to flanges or corners, or caused by failure of adjacent structure. Edge nicks in all flanges are permitted that are not deeper than ⅛ inch after being cleaned out and polished, provided edge distance to rivets is not reduced. Holes ½ inch maximum diameter after cleaning out are permitted, if located at least 1 inch from bends in frame cross section, and if edge distance to rivets is not reduced.

3.1.4. Fuselage Skin. — Smooth shallow dents are permissible when free from cracks and abrasions, and without sheared rivets or elongated holes. Inspect carefully for distorted adjacent structural members before considering skin damage to be negligible.

3.2. REPAIRABLE DAMAGE. — Appropriate illustrations in this section give the procedure for typical cases of repairable damage.

3.3. DAMAGE NECESSITATING REPLACEMENT OF PARTS.

3.3.1. Extruded Fuselage Frames.—For repair of fuselage frames, see Figures 71 through 75. All damage not covered by applicable repair illustrations in this manual, should be referred to the Customer Service Department, Douglas Aircraft Company, Inc., Santa Monica, California.

3.3.2. Longitudinal Floor Beams and Nose Wheel Beams.—Web stiffeners for these beams are too short for repair. Replace if damaged.

4. FUSELAGE WRENCH TORQUE TABLE.

The following wrench torque table lists allowable wrench torques in inch-pounds or foot-pounds for all important bolts in the fuselage group. These limits must be adhered to because under-torque encourages fatigue and over torque may result in excessive elongation of the bolt.

BOLT NO.	NUT NO.	NO. REQ.	ATTACHED PART	INSTALLATION	TORQUE (INCH-POUNDS*)
		NOSE TO FUSELAGE ATTACH—STATION 129			
***AN4-7A	AN365-428	52	5233069	5233066	50-70
***NAS-145-32	12B-054	2	4167784	5233066	145-200
***NAS-145-32	12B-054	2	5233068	5233066	145-200
***NAS-145-32	12B-054	1	5233069	5233066	145-200
***AN4-6A	AN365-428	169	5233069	5233066	50-70
***NAS-146-24	12B-064	2	5111020	5233066	230-280
***NAS-145-32	12B-054	2	5233069	5233066	145-200
***AN3-5A	AN365-1032	4	5233069	5233066	20-25
***NAS-144-26	12B-048	1	5233069	5233066	73-100
***AN3-7A	AN365-1032	2	5233068	5233066	20-25
***AN3-4A	AN365-1032	4	4167980	5233066	20-25
***AN3-4A	AN365-1032	2	5233069	5233066	20-25
***NAS-145-32	12B-054	1	5168143	5233066	145-200
***AN3-5A	AN365-1032	2	5168469	5233066	20-25
		FUSELAGE TO TAIL ASSEMBLY—STATION 858			
***AN4-6A	AN365-428	221	5166459	5233066	50-70
		FUSELAGE TO TAIL CONE ASSEMBLY—STATION 1035			
AN4-6A	AN365-428	65	5074921	5233066	50-70
		TAIL SKID LONGERON 5107313—STATION 991.5			
NAS-146-56	12B-064	2	3106312	5107313	230-280

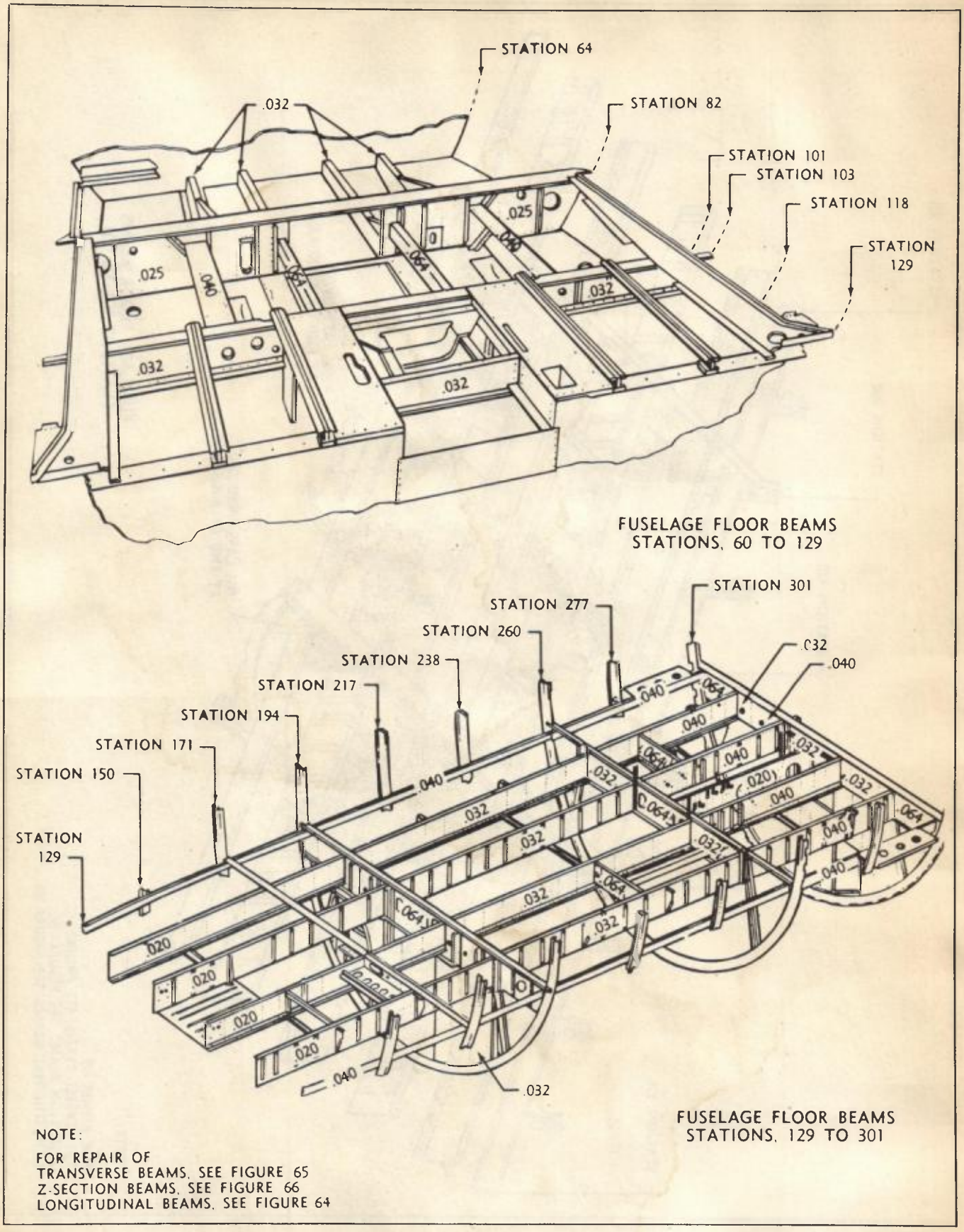
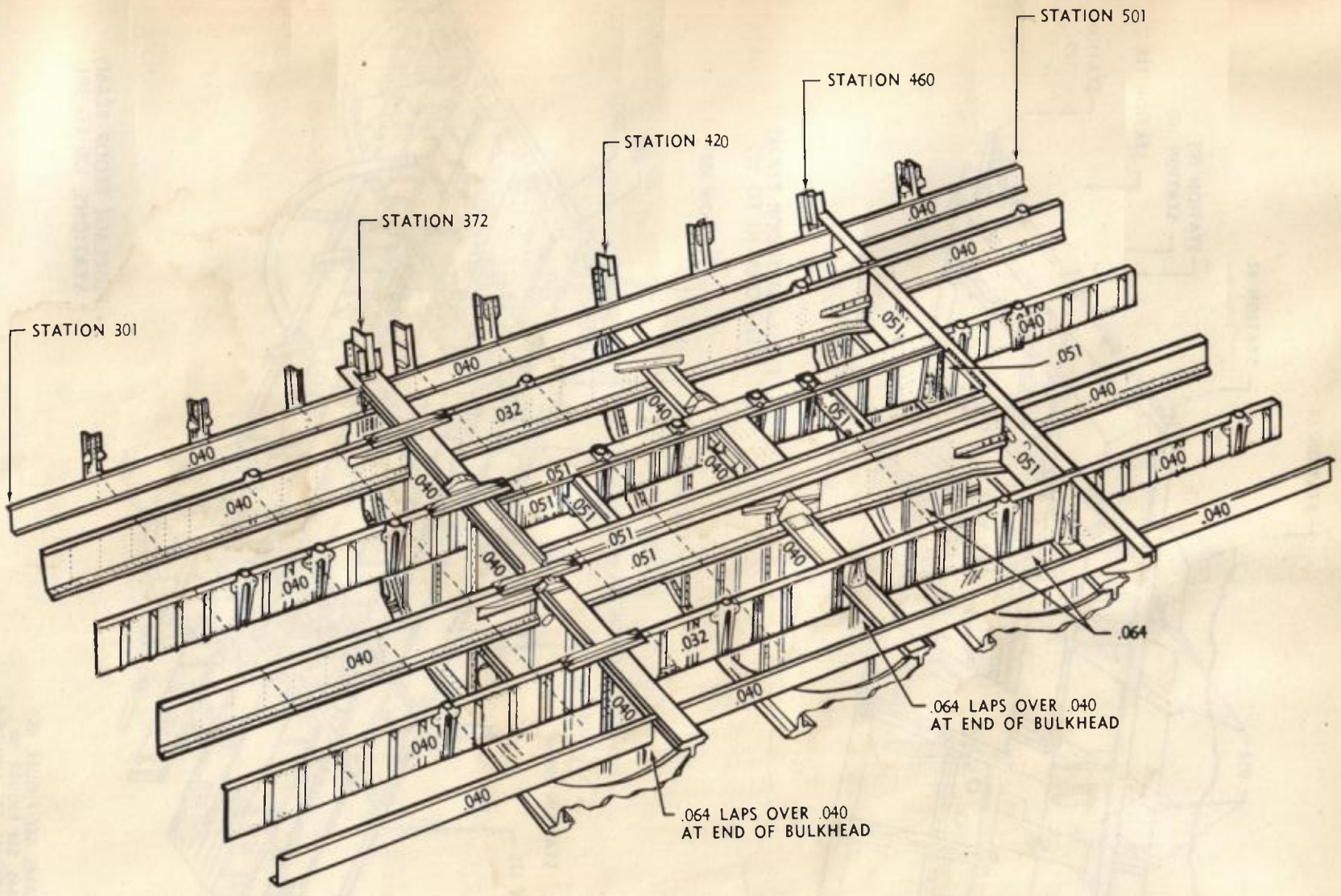


Figure 52 (Sheet 1 of 3 Sheets) — Fuselage Floor Beams

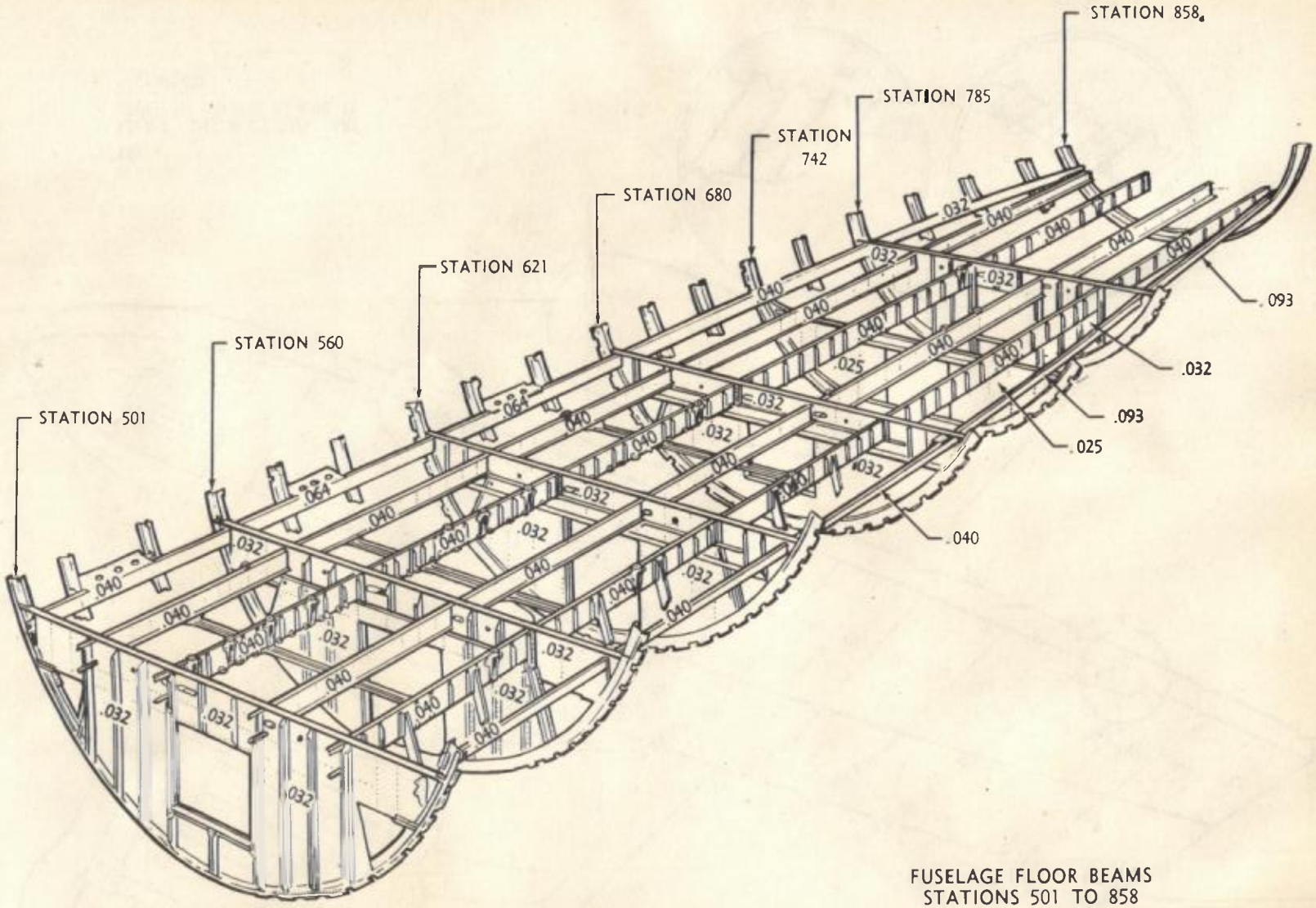


NOTE:

FOR REPAIR OF
TRANSVERSE BEAMS, SEE FIGURE 65
Z-SECTION BEAMS, SEE FIGURE 66
LONGITUDINAL BEAMS, SEE FIGURE 64

FUSELAGE FLOOR BEAMS
STATIONS 301 TO 501

Figure 52 (Sheet 2 of 3 Sheets) — Fuselage Floor Beams



FUSELAGE FLOOR BEAMS
STATIONS 501 TO 858

NOTE:

FOR REPAIR OF
TRANSVERSE BEAMS, SEE FIGURE 65
Z-SECTION BEAMS, SEE FIGURE 66
LONGITUDINAL BEAMS, SEE FIGURE 64

Figure 52 (Sheet 3 of 3 Sheets) — Fuselage Floor Beams

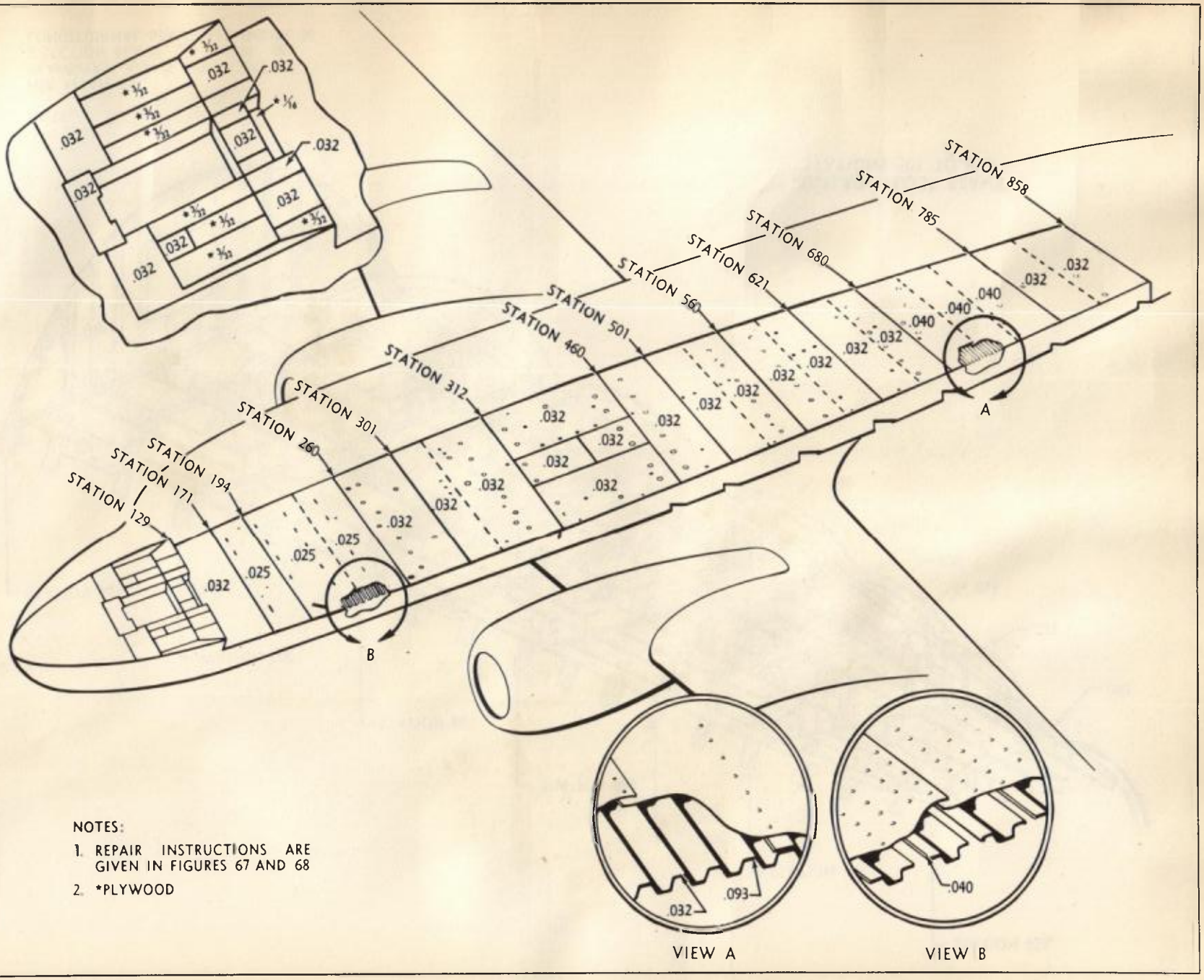


Figure 53 — Fuselage Floor Panels

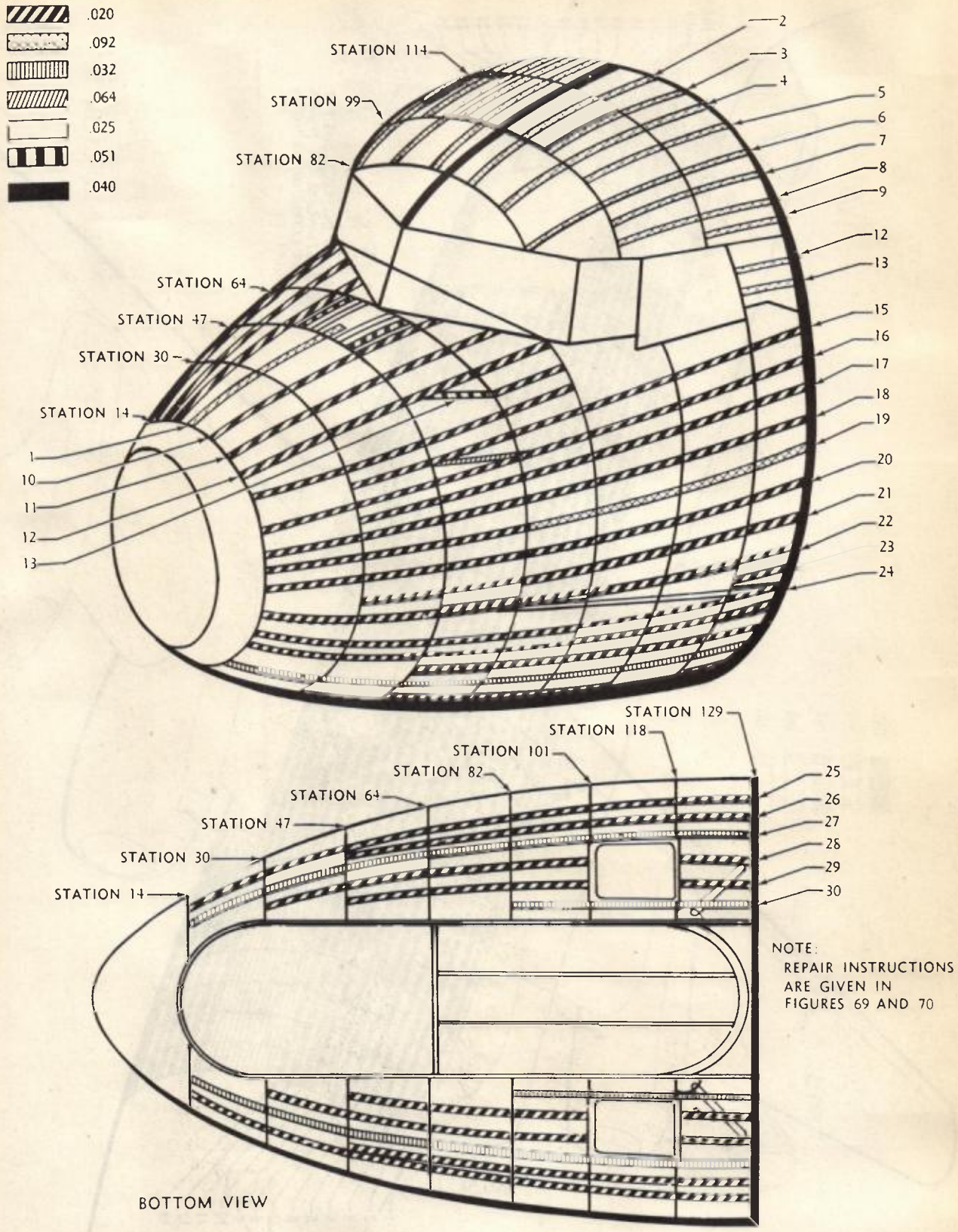


Figure 54 — Fuselage Stringers — Nose Section

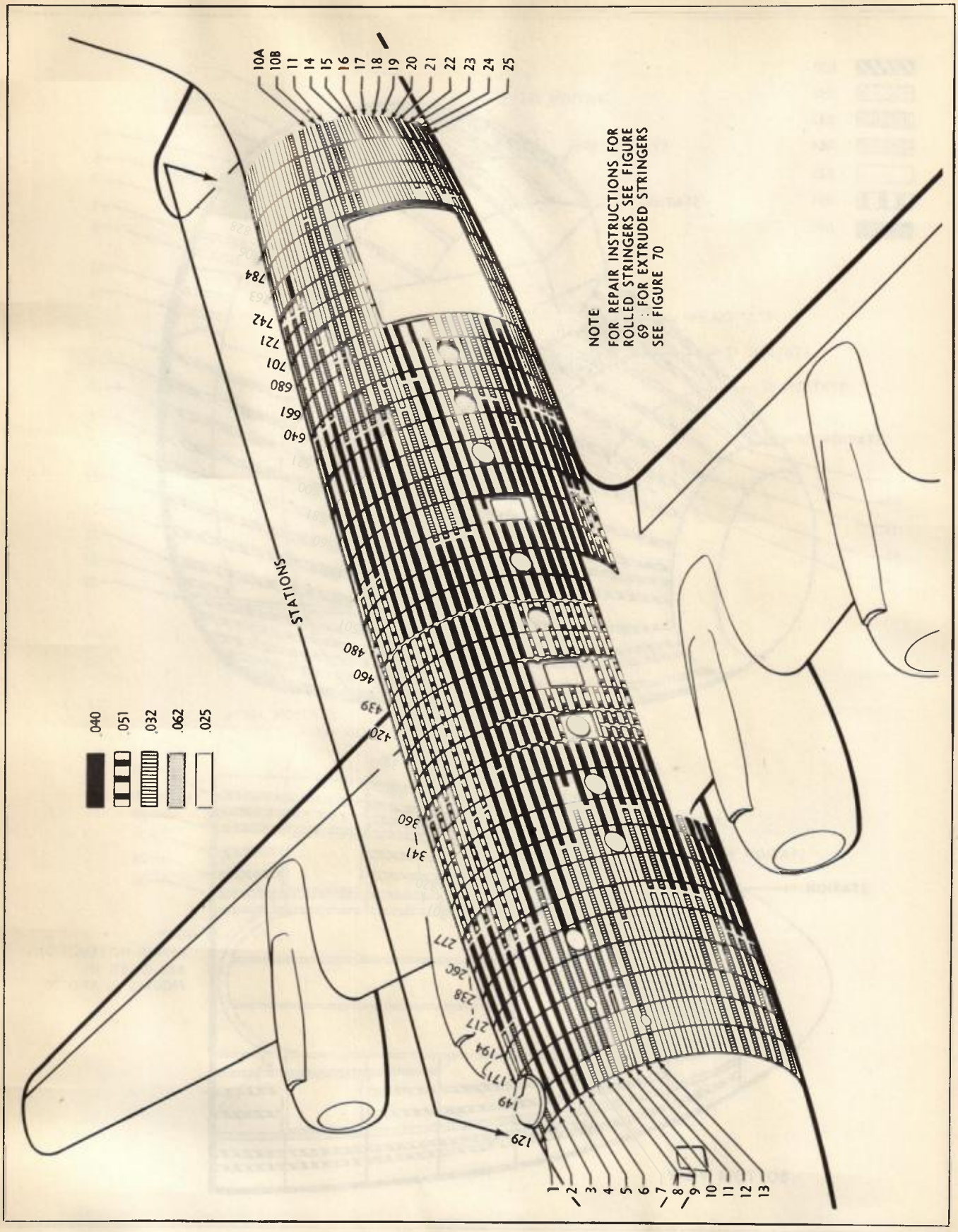


Figure 55 — Fuselage Stringers — Center Section — Left Side

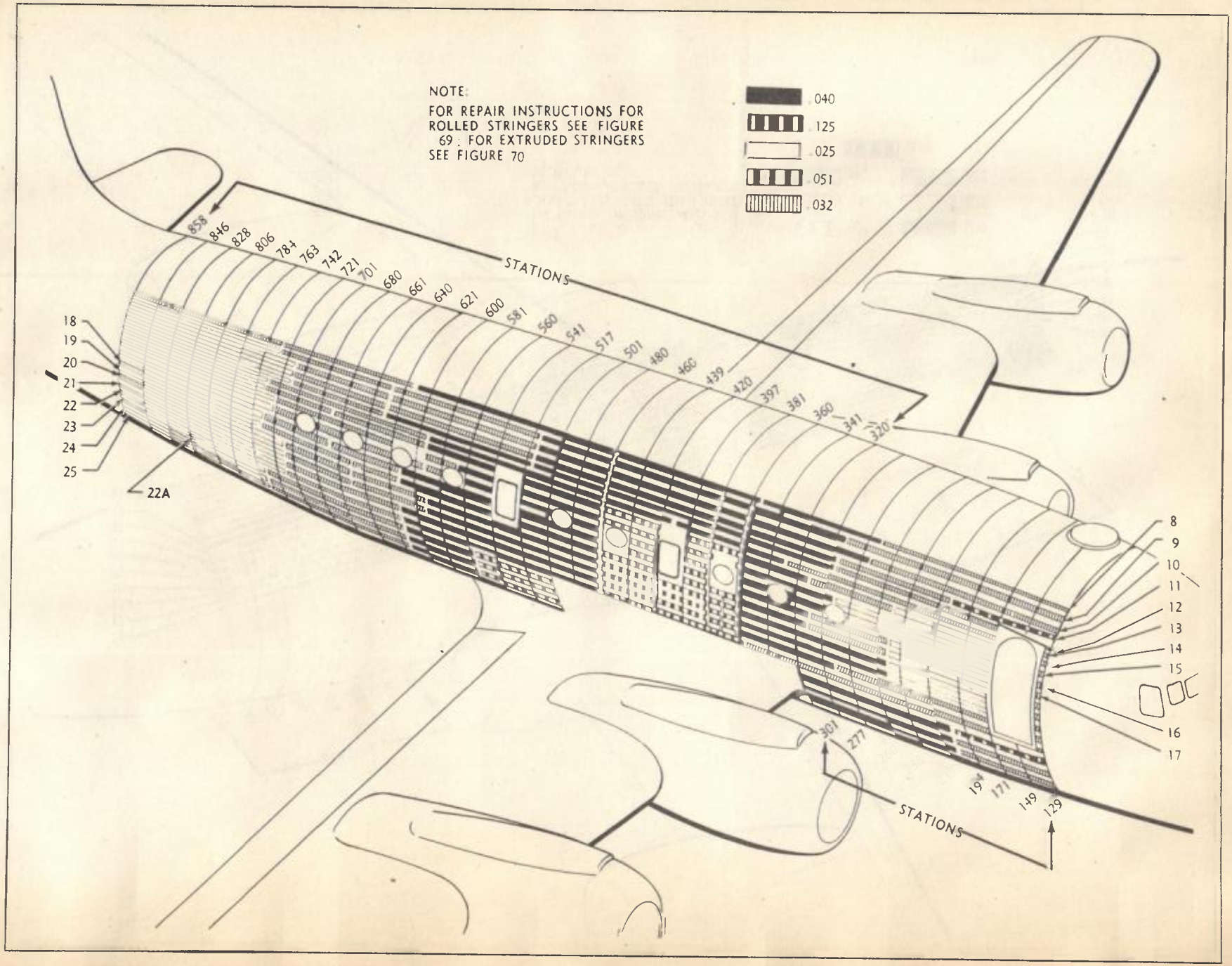


Figure 56 — Fuselage Stringers — Center Section — Right Side

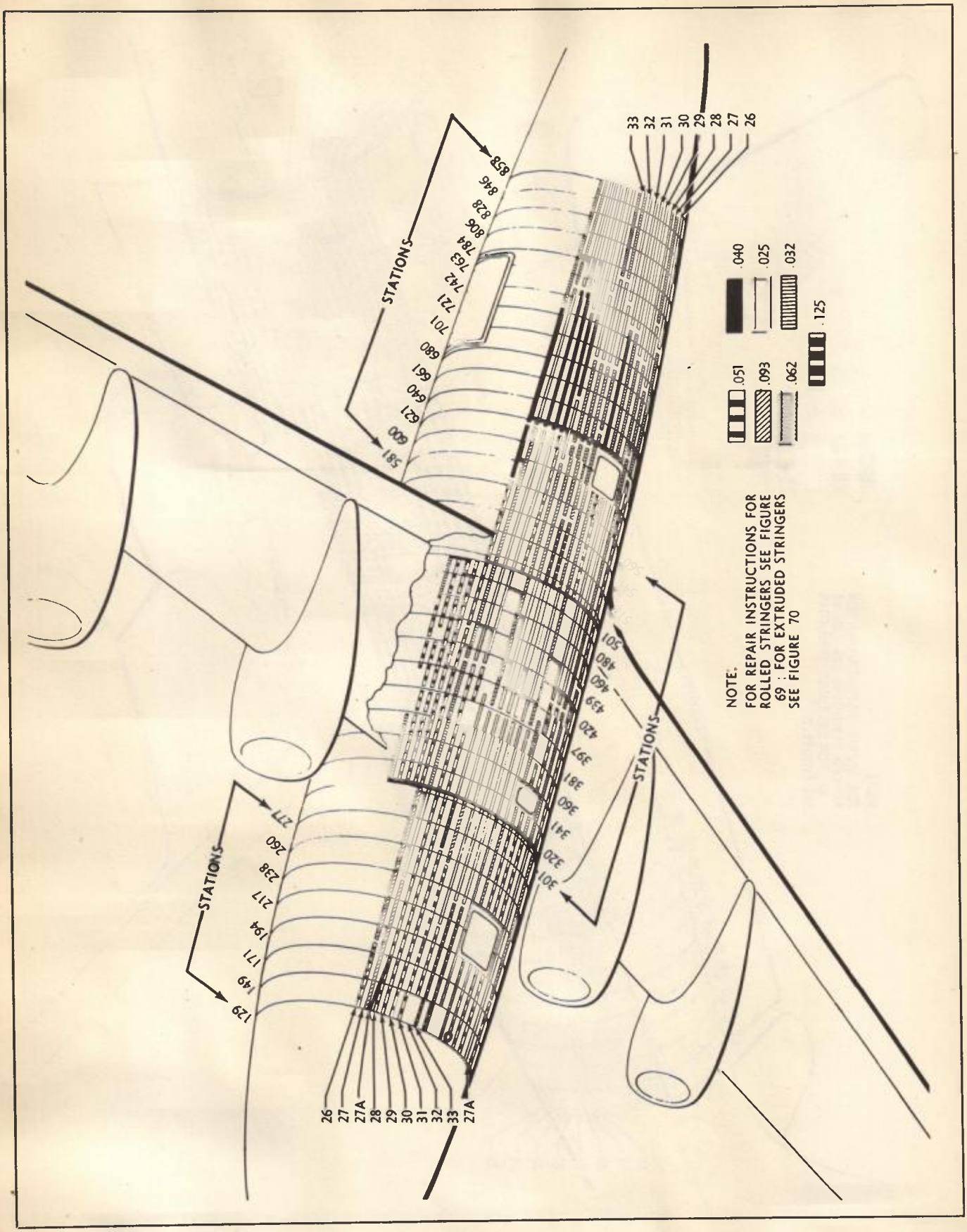


Figure 57 — Fuselage Stringers — Center Section — Lower Surface

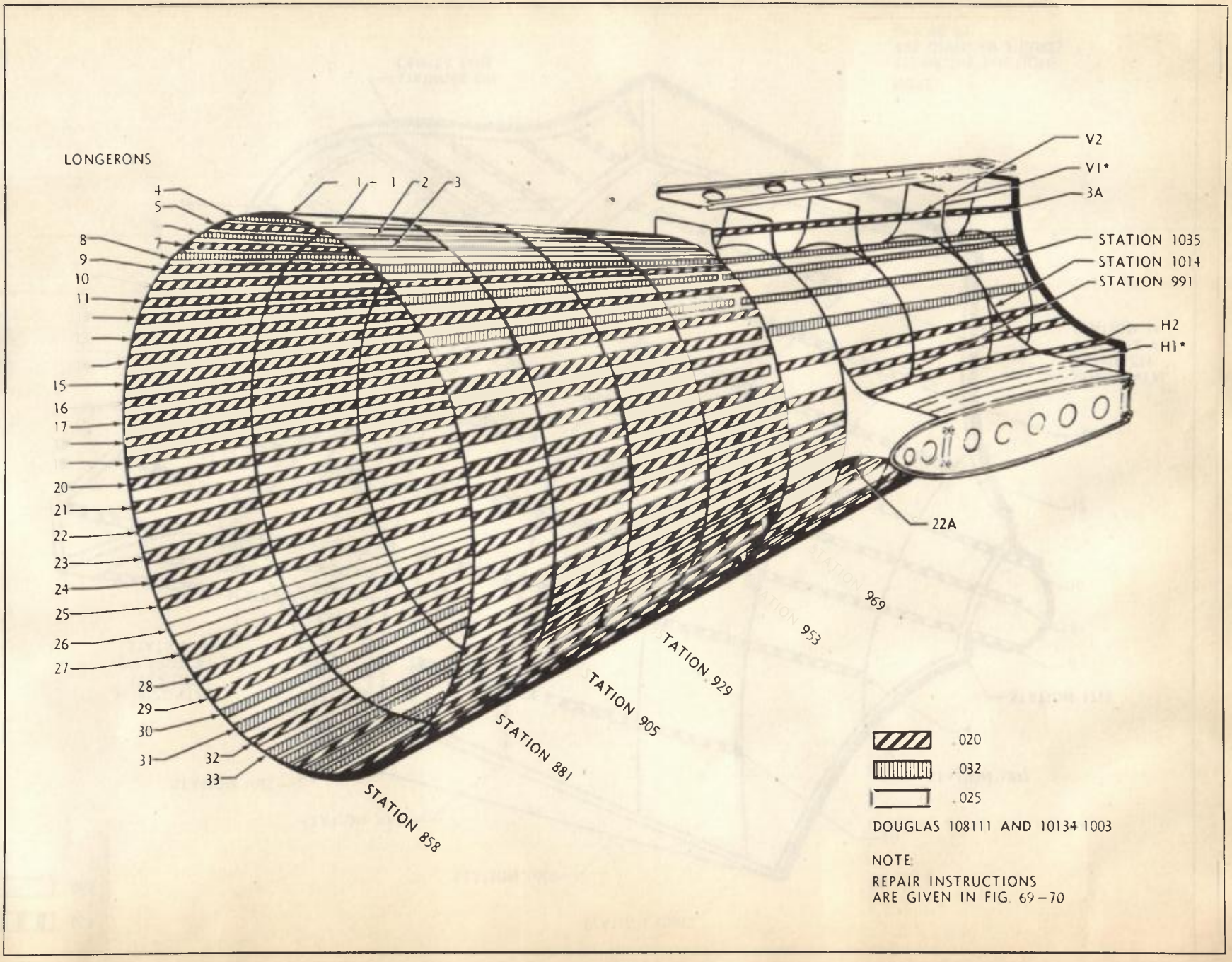


Figure 58 — Fuselage Stringers — Tail Section

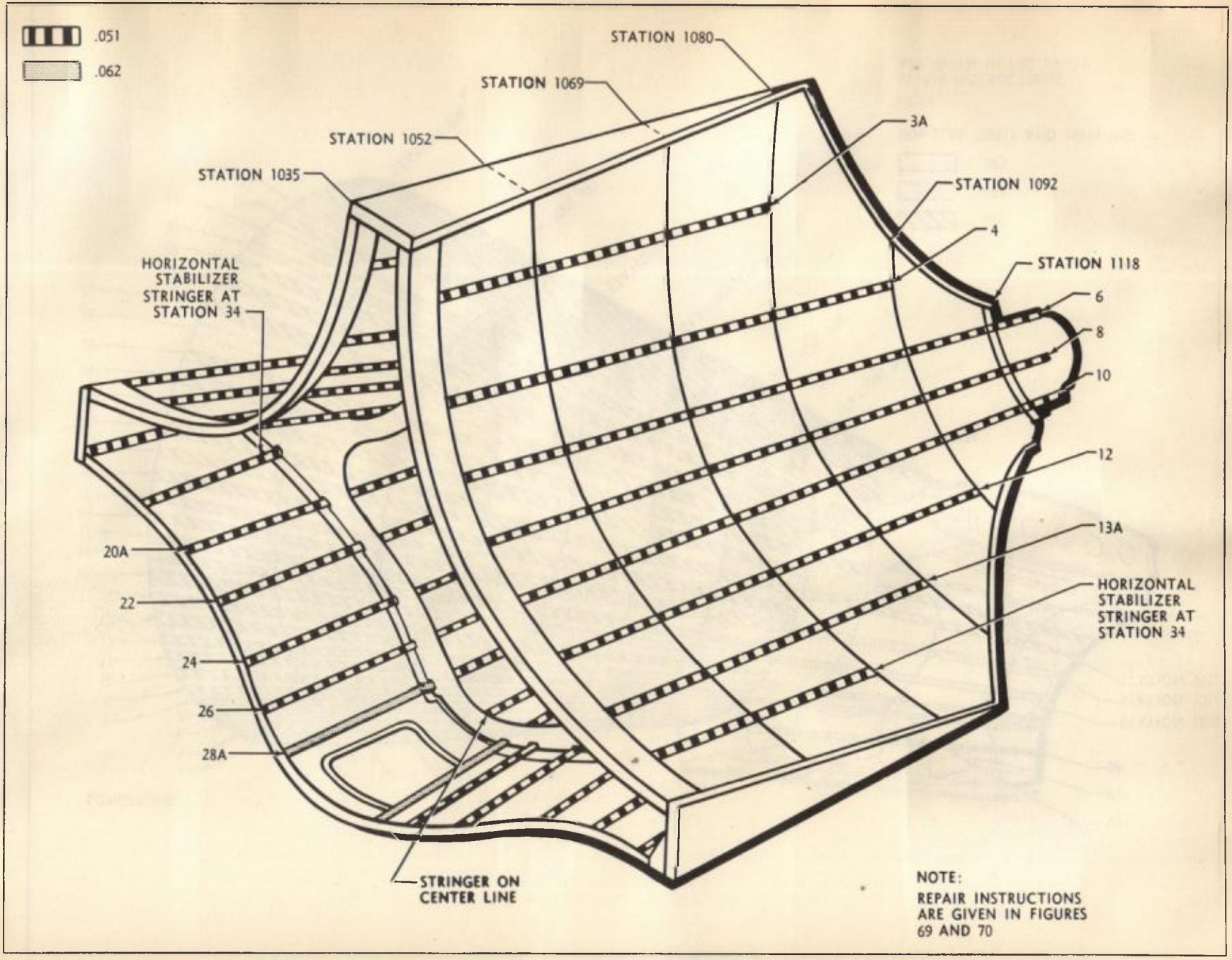


Figure 59 – Fuselage Stringers – Tail Cone

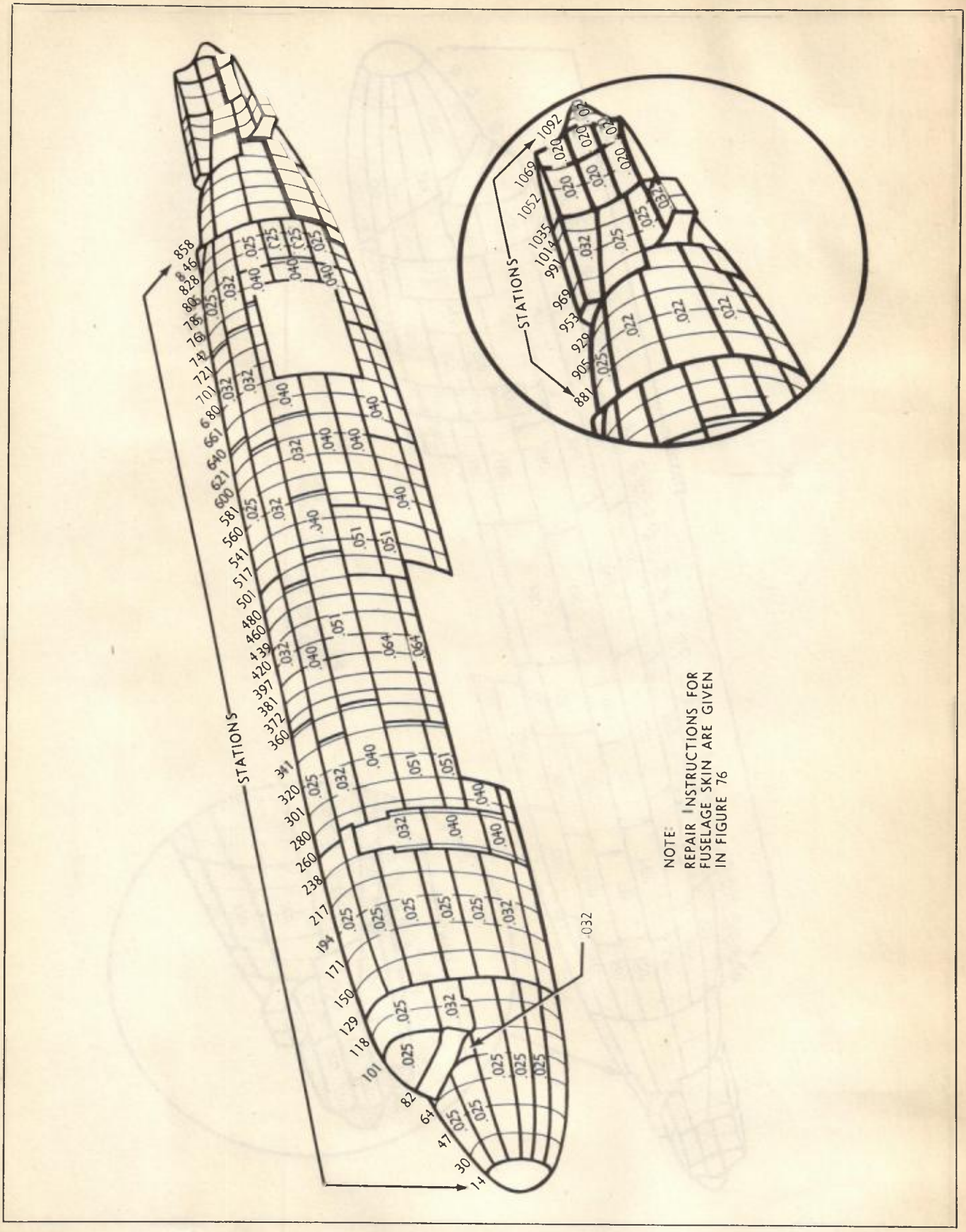


Figure 60 — Fuselage Skin — Left Side

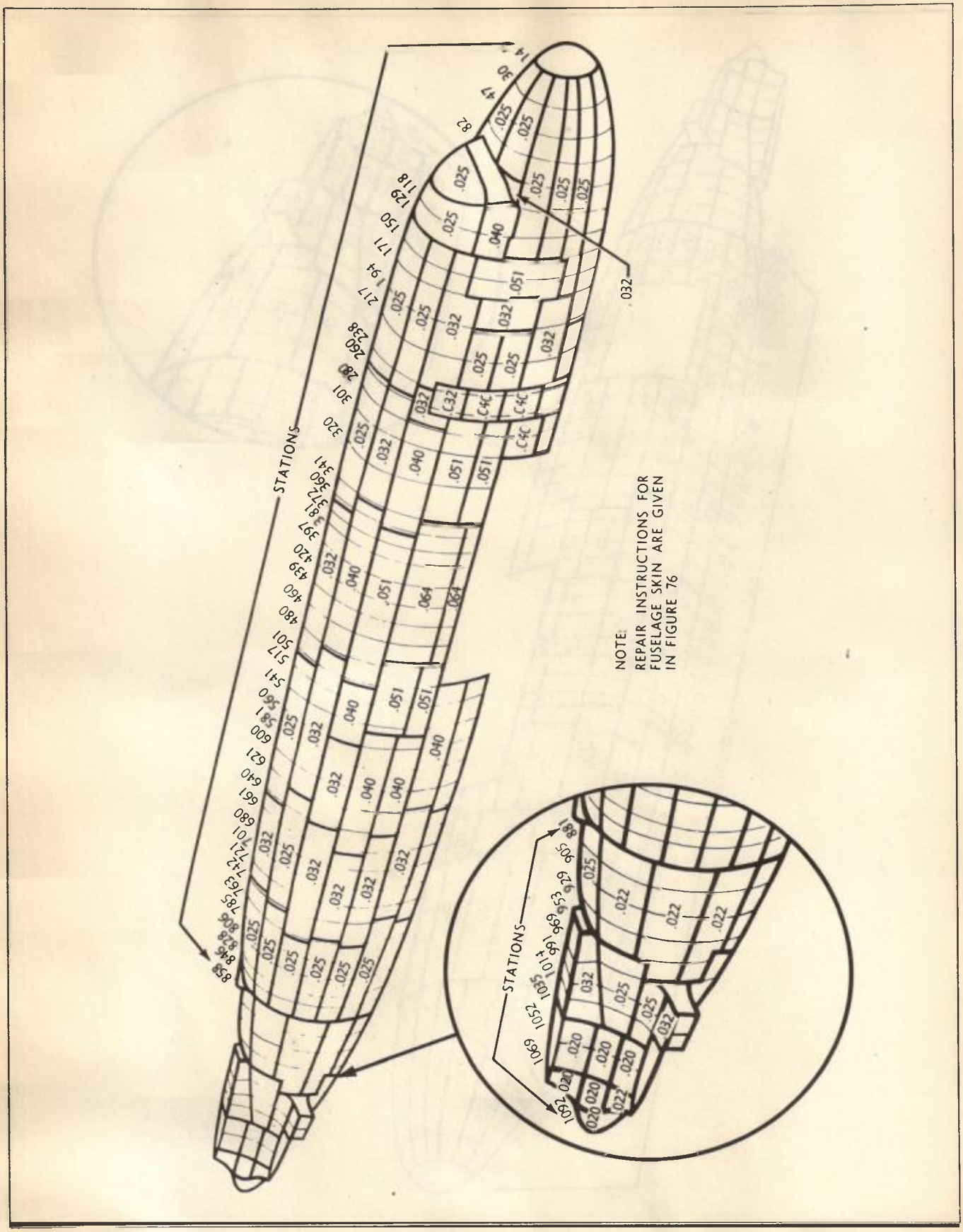
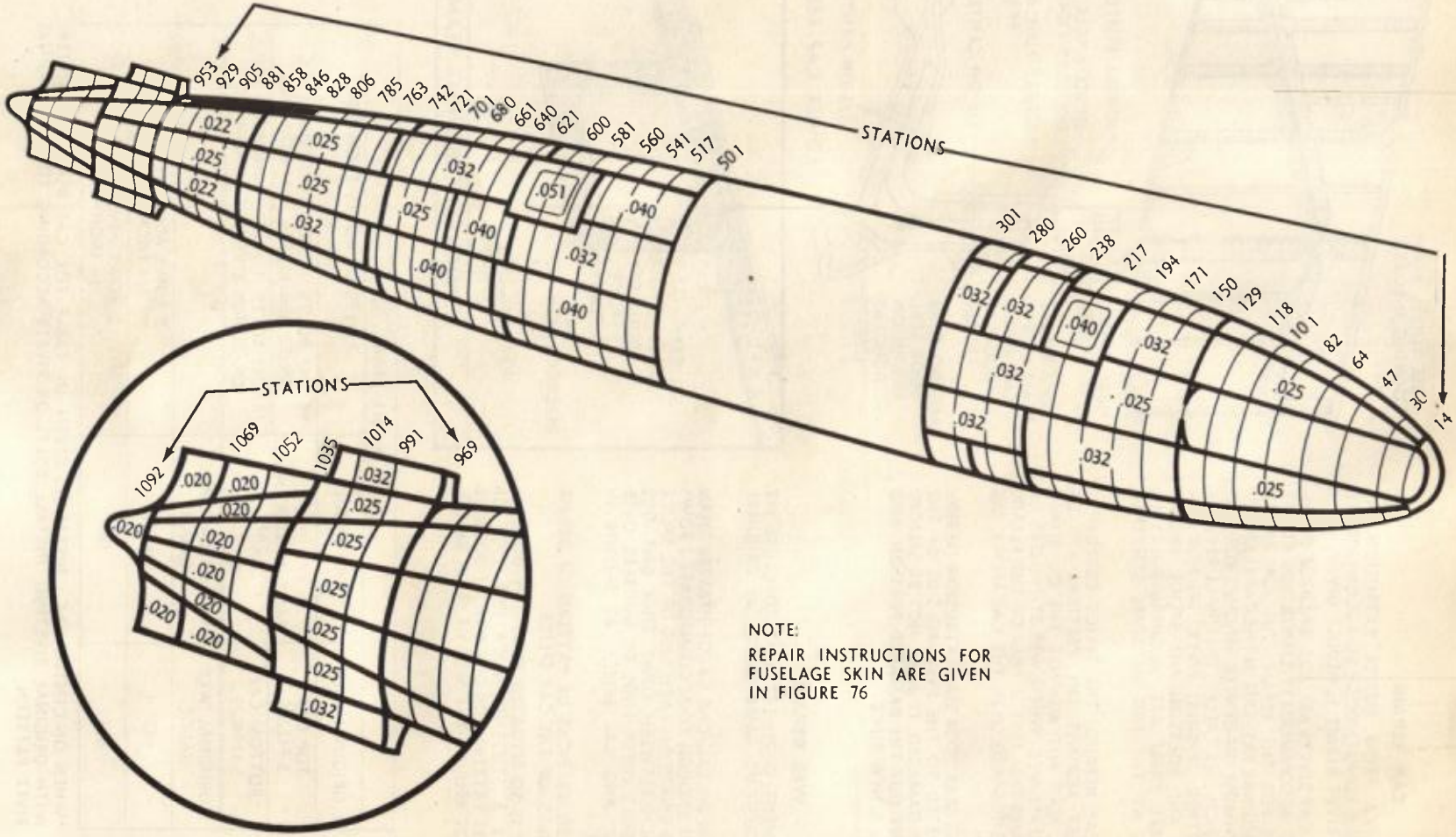


Figure 61 — Fuselage Skin — Right Side



NOTE:
REPAIR INSTRUCTIONS FOR FUSELAGE SKIN ARE GIVEN IN FIGURE 76

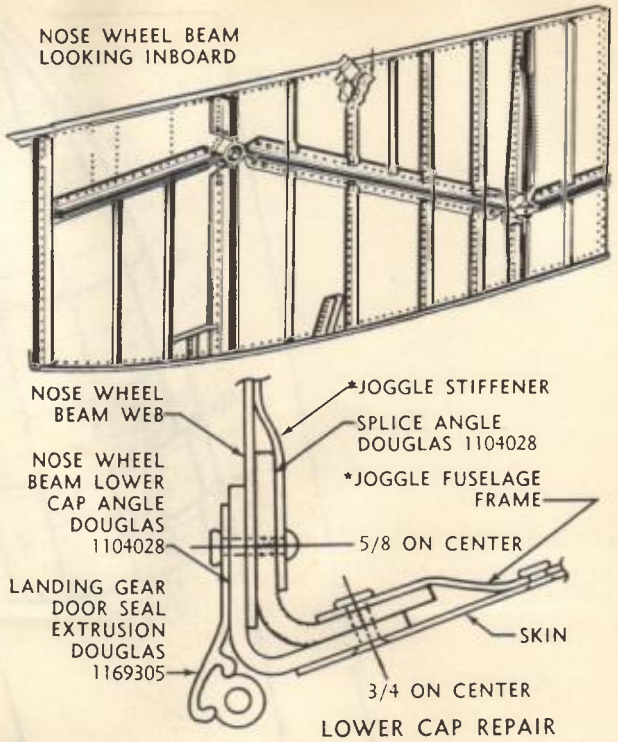
Figure 62 — Fuselage Skin — Lower Surface

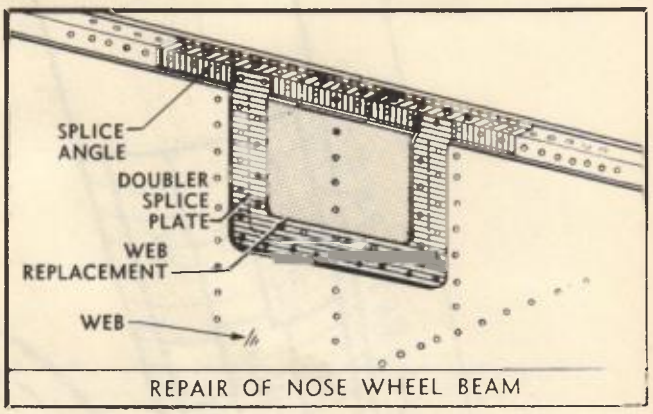
CAP REPAIR

1. CUT CAP SPLICE FROM PROPER EXTRUSION, AS SHOWN IN TABLE, LONG ENOUGH TO ACCOMMODATE THE BOLT OR RIVET REPAIR SCHEDULE GIVEN.
2. THE ORIGINAL CAP RIVETS ARE AD5. ENLARGE ORIGINAL HOLES TO ACCOMMODATE EITHER AD6 RIVETS OR AN3 BOLTS FOR THE REPAIR. THE AD6 RIVETS PICK UP THE ORIGINAL PATTERN IN THE CAP FLANGES. SINCE THE MINIMUM ON-CENTER SPACING FOR AN3 BOLTS IS ONE INCH (SEE TABLE), THEY WILL REPLACE ONLY EVERY OTHER ORIGINAL RIVET. DO NOT MIX REPAIR RIVETS AND BOLTS IN ANY SPLICE, EXCEPT IN CASES WHERE THERE ARE ORIGINAL BOLTS IN THE CAP — AS AT THE END OF SOME STIFFENER ANGLES.
3. FOR LOWER CAP REPAIRS, THE SPLICE EXTRUSION DOES NOT NEST AGAINST THE VERTICAL LEG OF THE ORIGINAL CAP, BUT AGAINST THE OUTBOARD SIDE OF THE BEAM WEB. WHEN WEB STIFFENERS OR FUSELAGE FRAMES FALL IN THE AREA OF THE REPAIR, THEY MUST BE JOGGLED OVER THE CAP SPLICE. SEE ILLUSTRATION.
4. IF THE LANDING GEAR DOOR SEAL EXTRUSION 1169305, WHICH IS RIVETED TO THE INBOARD SIDE OF THE LOWER CAP, IS DAMAGED, IT NEED NOT BE SPLICED FOR REPAIR. CUT OUT THE DAMAGED PORTION, AND REPLACE WITH A NEW PIECE.

WEB REPAIR

1. WEB REPLACEMENT IS 24S-TAL, CUT TO CLOSE FIT OF DAMAGE CUT OUT, SAME GAUGE AS ORIGINAL WEB.
2. THE DOUBLER IS 24S-TAL, ONE GAUGE HEAVIER THAN WEB, AND WIDE ENOUGH TO ACCOMMODATE 2 ROWS OF STAGGERED RIVETS ON EACH SIDE OF THE SPLICE JOINT, 3/8 INCH BETWEEN ROWS, EDGE DISTANCE 1/4 INCH. JOGGLE UPPER ENDS OF DOUBLER OVER ORIGINAL CAP, AND CAP SPLICE, AS SHOWN IN ILLUSTRATION.
3. TOP OF WEB SPLICE PICKS UP PATTERN OF REPAIR RIVETS, OR BOLTS, OF THE CAP SPLICE.
4. IF THE REPAIR IS SO SITUATED THAT THE DOUBLER EXTENDS OVER A STIFFENER LOCATION, PICK UP STIFFENER RIVET PATTERN FOR ONE ROW OF DOUBLER RIVETS. DO NOT REDUCE THE SIZE OF SUCH RIVETS.

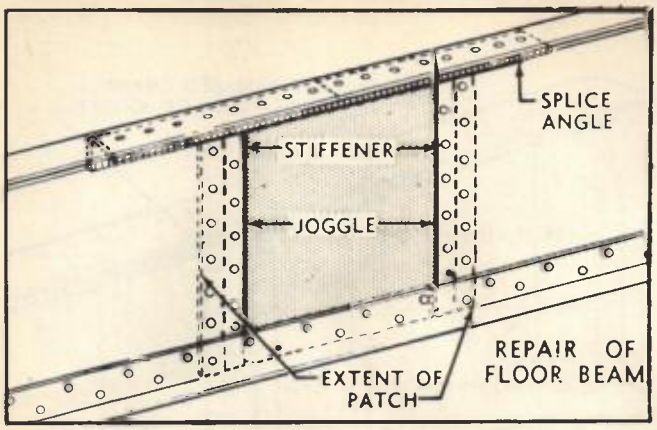


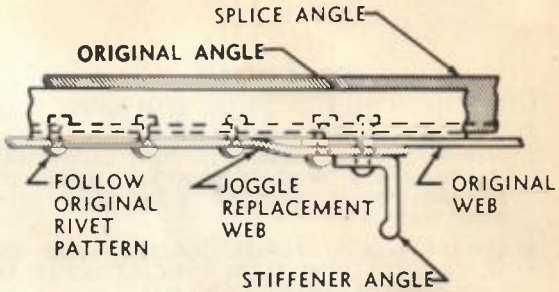


NOSE WHEEL BEAM		
ORIGINAL CAP	CAP SPLICE	RIVETS OR BOLTS EACH SIDE OF SPLICE
TOP CAP S-142266	SAME AS ORIGINAL CAP	*8 AN3 BOLTS, 1 INCH (MINIMUM) O.C., OR 22 AD6 RIVETS, 3/4 INCH O.C.
BOTTOM CAP S-1104028		*8 AN3 BOLTS, 1 INCH (MINIMUM) O.C., OR 22 AD6 RIVETS, 3/4 INCH O.C.
ORIGINAL WEB GAUGE	WEB REPLACEMENT GAUGE	
.040	.040	2 ROWS AD4 RIVETS, 3/4 INCH O.C.
.064	.064	2 ROWS AD6 RIVETS 3/4 INCH O.C.

*WHEN ON-CENTER (O.C.) DISTANCES GIVEN IN TABLE FOR CAP REPAIRS INTERFERE WITH ORIGINAL RIVETING, INSTALL BOLTS OR RIVETS ACCORDING TO THE ORIGINAL RIVET PATTERN.

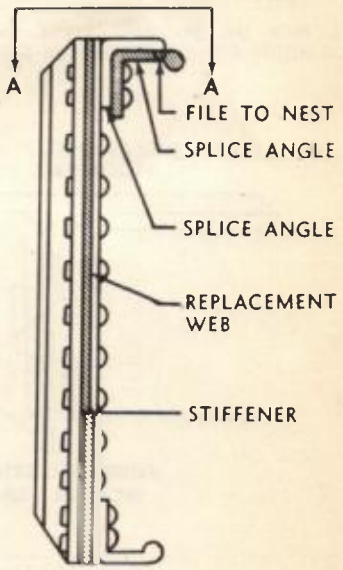
Figure 63 — Nose Wheel Beam Repair





VIEW A-A

LONGITUDINAL FLOOR BEAMS				
	ORIGINAL CAP	SPLICE SECTION	BOLTS EACH SIDE OF SPLICE	SPACING
CAPS FOR 8-INCH BEAM	S-1145307	SAME AS ORIGINAL CAP	8 AN3 BOLTS	
	S-1145305		8 AN3 BOLTS	SEE NOTES
CAPS FOR 6-INCH BEAM	S-1145307		12 AN3 BOLTS	
	S-1145305		12 AN3 BOLTS	
WEBS	.020	24S TAL SHEET SAME AS ORIGINAL WEB GAUGE	2 ROWS AN430 AD4	3/4 INCH O.C.
	.025		2 ROWS AN430 AD4	3/4 INCH O.C.
	.032		2 ROWS AN430 AD4	3/4 INCH O.C.
	.040		2 ROWS AN430 AD4	1/2 INCH O.C.
	.051		2 ROWS AN430 AD4	1/2 INCH O.C.



END SECTION

CAP REPAIR

1. IN ORDER THAT THE SPLICE CAP MAY NEST INTO THE ORIGINAL CAP, MILL OFF THE OUTER ANGLE ON THE HORIZONTAL LEG OF THE ORIGINAL CAP LOCALLY THROUGH THE LENGTH OF THE SPLICE ANGLE, AND CHAMFER THE ANGLE OF THE SPLICE. SEE ILLUSTRATION
2. REPAIR BOLTS ARE EQUALLY DIVIDED IN EACH LEG OF THE CAP SPLICE.
3. IN THE VERTICAL LEG OF THE SPLICE, REPAIR BOLTS PICK UP THE ORIGINAL RIVET PATTERN. ORIGINAL RIVETS ARE AD5, AND THE HOLES MUST BE ENLARGED FOR AN3 REPAIR BOLTS.
4. IN THE HORIZONTAL LEG OF THE LOWER CAP, THE REPAIR BOLTS FOLLOW THE PATTERN OF REPAIR BOLTS IN THE VERTICAL LEG.
5. IN THE HORIZONTAL LEG OF THE UPPER CAP, THE SPACING OF THE REPAIR BOLTS IS GOVERNED BY THE SPACING OF THE NODES OF THE FLOOR PANEL REINFORCEMENT. FOR PANELS WITH CORRUGATED REINFORCEMENT, INSTALL ONE BOLT BETWEEN EACH NODE, 1 1/4 INCHES ON CENTER. FOR PANELS WITH HAT SECTION REINFORCEMENT, INSTALL 3 BOLTS, 3/4 INCH ON CENTER, CENTRALLY BETWEEN HATS.
6. REPLACE THE ORIGINAL CHERRY BLIND RIVETS, WHICH FASTEN THE FLOOR PANEL REINFORCEMENTS TO THE FLOOR BEAM, WITH RIVETS OF THE SAME TYPE AND DIAMETER. DRILL HORIZONTAL LEG OF UPPER CAP SPLICE TO ACCOMMODATE THESE ORIGINAL RIVETS.

WEB REPAIR

1. WEB REPLACEMENT IS 24S-TAL, LARGE ENOUGH TO FILL DAMAGE CUT-OUT AND JOGGLE OVER ORIGINAL WEB, WITH SUFFICIENT LENGTH TO ACCOMMODATE 2 ROWS OF AD4 RIVETS, AS SHOWN IN ILLUSTRATION AND TABLE.
2. WHEN THE DAMAGE CUT-OUT IS OF SUCH SIZE THAT THE SPLICE PLATE COVERS A STIFFENER, PICK UP THE ORIGINAL RIVET PATTERN OF THE STIFFENER FOR ONE ROW OF RIVETS IN THE SPLICE. DO NOT REDUCE THE SIZE OF THE STIFFENER RIVETS.

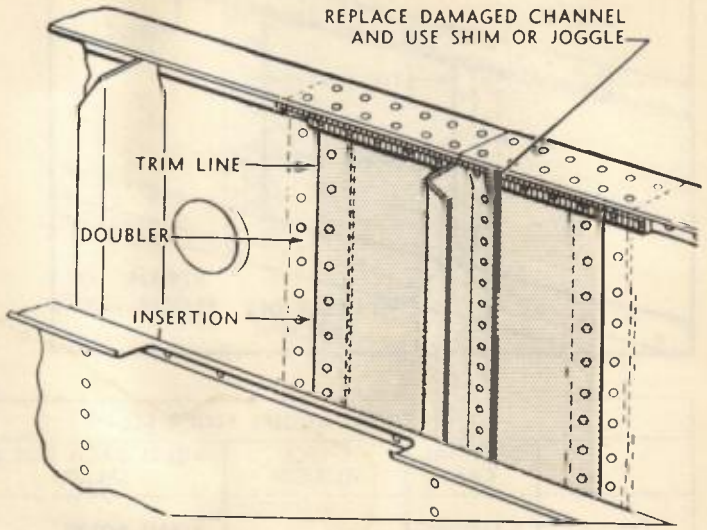
Figure 64 — Fuselage Floor Beam Longitudinal Repair

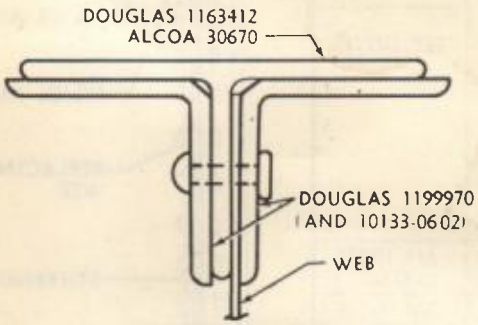
WEB REPAIR:

1. WEB REPLACEMENT IS 24S-TAL, SAME GAUGE AS ORIGINAL.
2. WEB SPLICE PLATES ARE 24S TAL, ONE GAUGE HEAVIER THAN WEB, WIDE ENOUGH TO ALLOW EDGE DISTANCES OF AT LEAST TWICE THE REPAIR RIVET DIAMETER.
3. REPLACE WEB STIFFENERS, JOGGLING OVER CAP SPLICE ANGLE. IF JOGGLE IS DIFFICULT, USE 24S-TAL SHIM BETWEEN STIFFENER AND WEB.

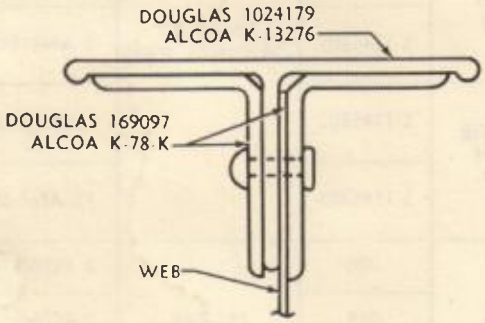
CAP REPAIR:

1. SPLICE EXTRUSION NUMBERS ARE GIVEN IN ILLUSTRATION AND TABLE. CUT SPLICE LONG ENOUGH TO ACCOMMODATE RIVET SCHEDULES GIVEN IN TABLE.
2. PICK UP ORIGINAL RIVET PATTERNS, ENLARGING HOLES FOR LARGER REPAIR RIVETS AS NECESSARY.





FUSELAGE CENTER SECTION BEAMS



PILOT'S COMPARTMENT BEAMS

TRANSVERSE FLOOR BEAMS

LOCATION	PART		RIVETS EACH SIDE OF SPLICE
	CAP	CAP SPLICE	
STATIONS 82 AND 103	1024179	169097	6 AD5, 3/4 INCH O.C., OR PICK UP ORIGINAL RIVET PATTERN
STATION 194	1093707	169097	6 AD5, 3/4 INCH O.C., OR PICK UP ORIGINAL RIVET PATTERN
STATIONS 82, 103, 194	WEB	WEB SPLICE	1 ROW AD4, 3/4 INCH O.C.
	ORIGINAL	ONE GAUGE HEAVIER THAN ORIGINAL WEB	
FUSELAGE CENTER SECTION	CAP	CAP SPLICE	14 AD6, 3/4 INCH O.C., OR PICK UP ORIGINAL RIVET PATTERN.
	1163412	1199970	
	WEB	WEB SPLICE	1 ROW AD4 1/2 INCH O.C.
	ORIGINAL	ONE GAUGE HEAVIER THAN ORIGINAL WEB	

Figure 65 — Fuselage Floor Beam Transverse Repair

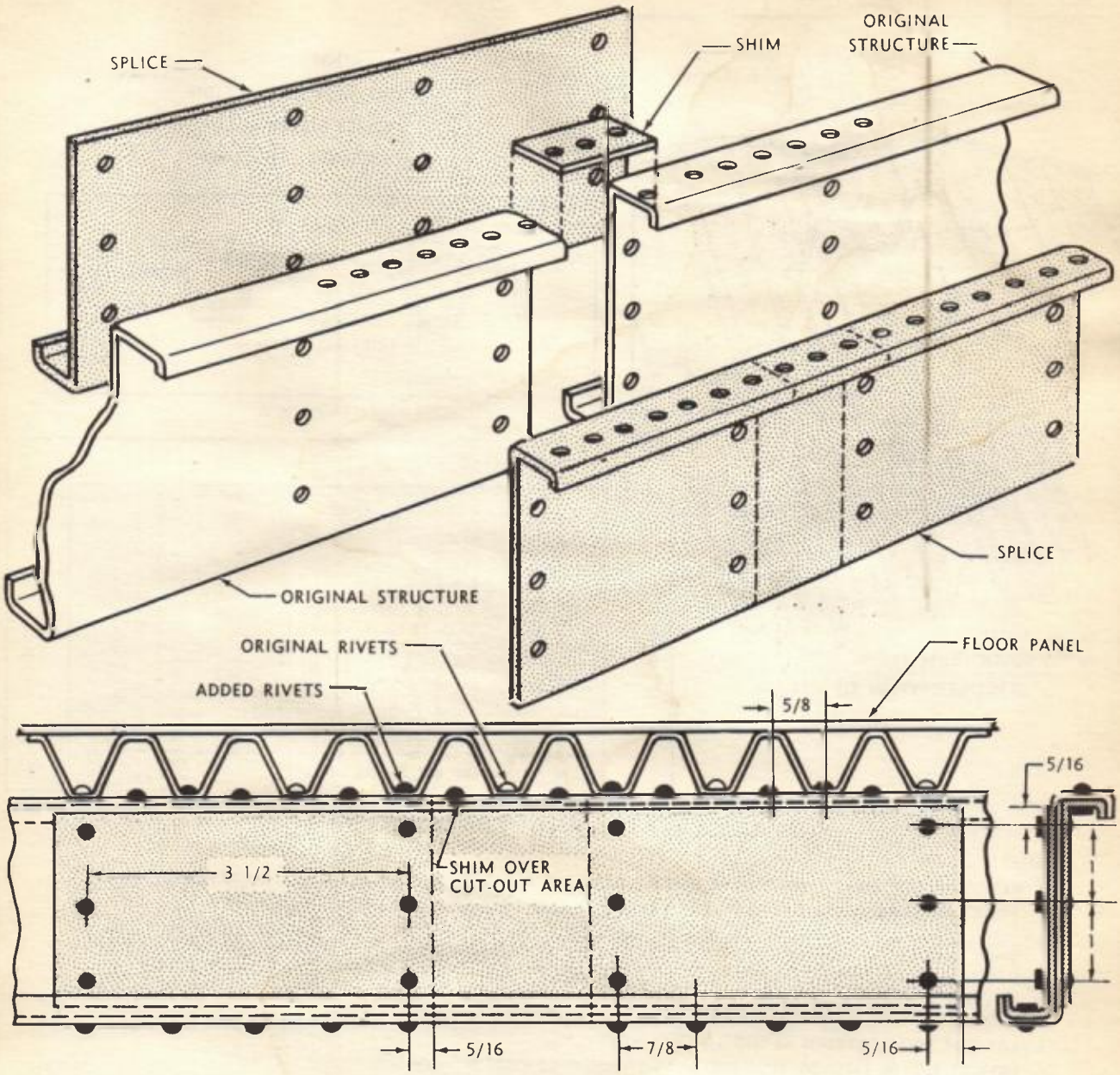


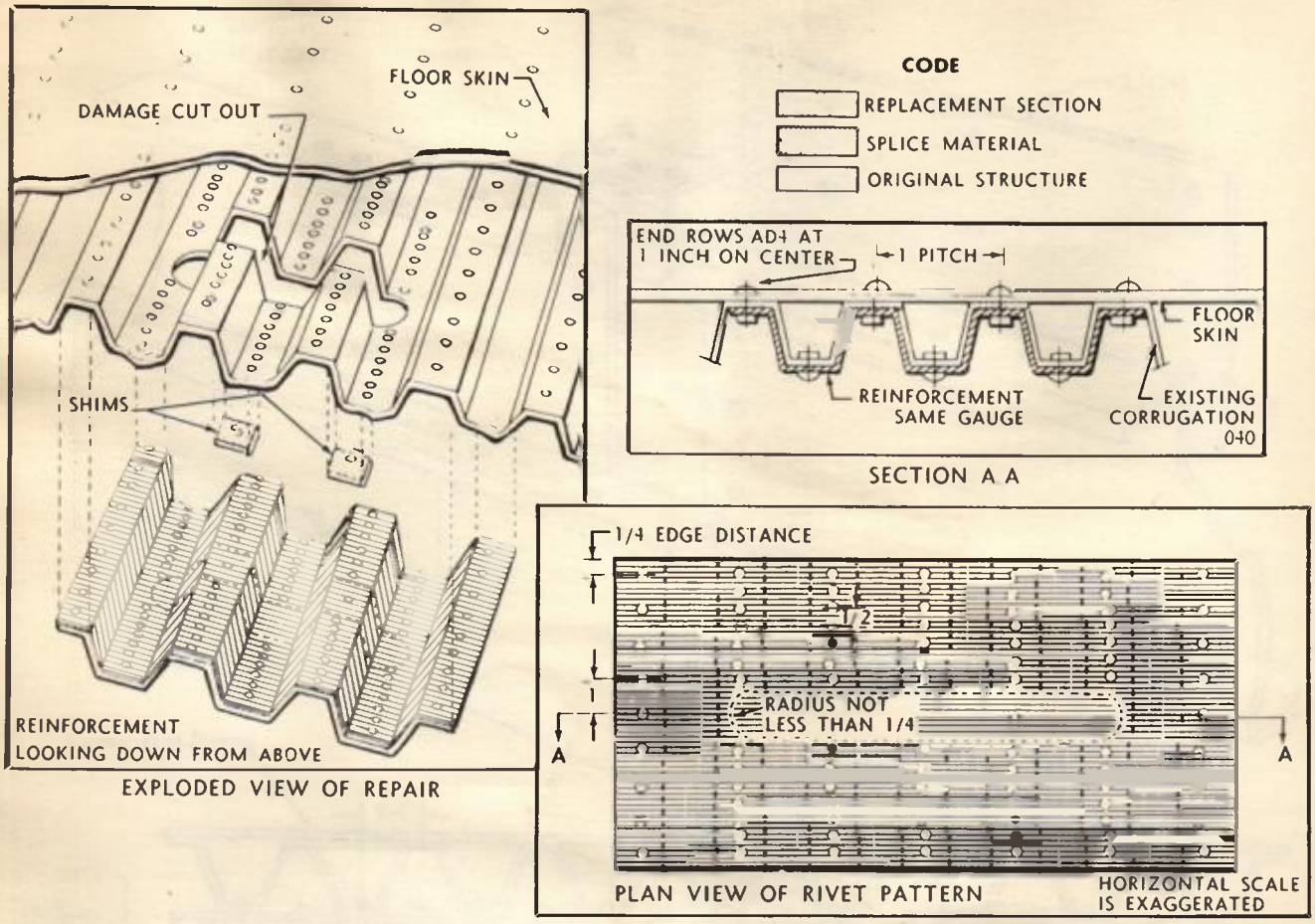
TABLE		
LOCATION	RIVETS REQUIRED EACH SIDE OF SPLICE	SPACING
TOP FLANGE	7 RIVETS REPLACED RIVETS AD4 ADDED RIVETS AD5	5/8 ON CENTER
BOTTOM FLANGE	5 AD5 RIVETS	7/8 ON CENTER
WEB	6 AD5 RIVETS	2 VERTICAL ROWS AS SHOWN
	TOTAL: 18 RIVETS	

● ADDED RIVETS

NOTES:

1. CUT OUT DAMAGED PORTION OF FLOOR BEAM AS SHOWN
2. FABRICATE SPLICES AS SHOWN. USE 24S-T AL MATERIAL SAME GAUGE AS FLOOR BEAM.
3. MAKE SHIM, SAME MATERIAL AND GAUGE AS SPLICE TO BE INSTALLED ON TOP OF THE SPLICE TOP FLANGE WHERE ORIGINAL FLOOR BEAM TOP FLANGE HAS BEEN CUT OUT
4. INSTALL SPLICES, USING RIVET PATTERN AS SHOWN IN ILLUSTRATION AND TABLE. IN ORIGINAL STRUCTURE ONLY EVERY OTHER CORRUGATION NODE IS FASTENED TO FLOOR BEAM WITH AD4 RIVETS. REPLACE THESE RIVETS WITH ORIGINAL SIZE.
5. IF A PORTION OF FLOOR PANEL MUST BE REMOVED TO MAKE THIS REPAIR, SEE FIGURE 67 FOR REMOVAL AND REPLACEMENT PROCEDURE.

Figure 66 — Fuselage Floor Beam "Z" Section Repair



CORRUGATED REINFORCEMENT AND FLOOR SKIN

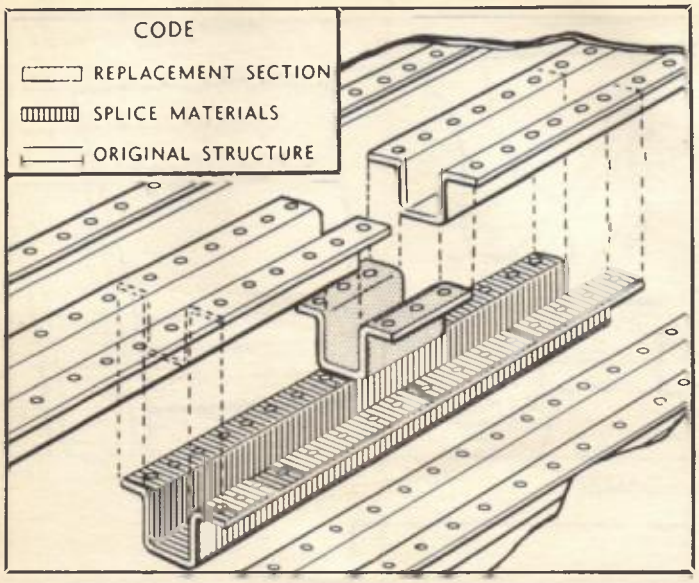
NOTES:

1. REMOVE FLOOR RIVETS AND PEEL SKIN FROM DAMAGED PORTION OF CORRUGATED REINFORCEMENT.
2. TRIM AWAY DAMAGED CORRUGATIONS. CAREFULLY FOLLOWING PLAN ILLUSTRATED.
3. CUT SPLICE FROM 24S TAL CORRUGATED STOCK OR FROM FORMED SHEET OF SAME GAUGE AS ORIGINAL. WIDE ENOUGH TO PICK UP ORIGINAL RIVET PATTERN IN FIRST CORRUGATION CROWN ON EACH SIDE OF DAMAGED AREA. AND SEVEN RIVETS. SPACED $\frac{1}{2}$ INCH ON CENTER. ON EACH END OF DAMAGED AREA.
4. CUT REPLACEMENT FILLERS FROM 24S TAL SHEET OF SAME GAUGE AS FLOOR SKIN TO FILL GAP BETWEEN SKIN AND CORRUGATION SPLICE CROWNS.
5. LAY OUT RIVET PATTERN AS SHOWN IN ILLUSTRATION.
6. INSTALL REPAIR. FIRST DRIVING RIVETS IN TROUGHS OF CORRUGATIONS.
7. INSTALL FILLERS ON CROWNS OF CORRUGATION SPLICE. REPLACE SKIN AND INSTALL RIVETS IN CROWNS OF CORRUGATION.
8. USE SEVEN AD4 RIVETS IN EACH TROUGH AND CROWN OF SPLICE CORRUGATIONS. EACH SIDE OF CUT AWAY. USE ORIGINAL RIVET PATTERN IN CROWNS ON EACH END OF REPAIR. INSTALL ADDITIONAL RIVETS TO ATTACH REPLACEMENT FILLERS TO SPLICE PLATE.
9. IF SKIN IS DAMAGED. CUT PATCH FROM 24S TAL SHEET OF SAME GAUGE AS FLOOR SKIN. AND INCORPORATE WITH CORRUGATED REINFORCEMENT REPAIRS. PICKING UP RIVET PATTERN OF CORRUGATION REPAIRS. IN STALL FILLERS BETWEEN SKIN REPAIR AND CROWN OF CORRUGATIONS. CHAMFER EDGES OF PATCH.
10. IF SKIN ALONE IS DAMAGED. TRIM ALONG NEAR EDGES OF CORRUGATIONS NEAREST TO DAMAGE. TRIM OTHER TWO EDGES AT RIGHT ANGLES TO CORRUGATIONS BETWEEN TWO RIVETS. CUT REPAIR PATCH FROM 24S-TAL SHEET OF SAME GAUGE AS FLOOR SKIN. LENGTH ACROSS CORRUGATIONS MUST BE SUFFICIENT TO PICK UP RIVETS IN CROWN OF CORRUGATIONS MARKING ENDS OF DAMAGE. LENGTH ALONG CORRUGA TIONS MUST BE SUFFICIENT TO PICK UP THREE RIVETS IN FLOOR BEYOND DAMAGE.

CUT FILLER PLATES FOR GAP BETWEEN PATCH AND CROWN OF CORRUGATIONS.

DOUBLE UP ON ORIGINAL RIVET PATTERN IN FLOOR WHEN INSTALLING PATCH.

Figure 67 — Fuselage Floor Panel Repair — Corrugated Reinforcement



EXPLODED VIEW HAT SECTION REPAIR

NOTES:

1 TRIM DAMAGED AREAS.

2 CUT REPLACEMENT AND SPLICE MATERIALS FOR VARIOUS SECTIONS AS SPECIFIED IN TABLE.

*Splice for S-1074883 stringer is made from same extrusion as original. See cross section view for dimensions.

3 LENGTH OF REPLACEMENT DEPENDS ON EXTENT OF DAMAGE.

4 CUT SPLICES OF SUFFICIENT LENGTH TO PICK UP THE NUMBER OF RIVETS ON EACH SIDE OF SPLICE JOINT. GIVEN IN TABLE.

5 LAY OUT RIVET PATTERN, CONFORMING TO ORIGINAL PATTERN, AS ILLUSTRATED.

6 INSTALL RIVETS IN CROWN OF HAT SECTION.

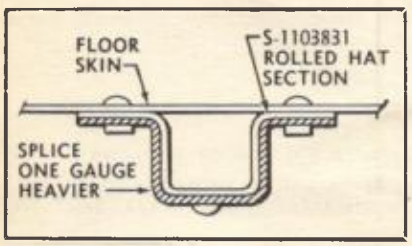
7 REPLACE FLOOR SKIN AND REMAINING RIVETS THROUGH SKIN, SPLICES, AND LEGS OF HAT SECTION.

8 IF FLOOR SKIN IS DAMAGED, FOLLOW PROCEDURE AS FOR FLOOR PANELS WITH CORRUGATED REINFORCEMENT. LEGS OF HAT SECTION CORRESPONDING TO CROWN OF CORRUGATIONS. (SEE FIGURE 67.)

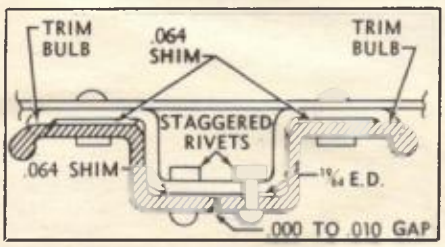
9 *INSERT MAY BE OMITTED IF GAP IS LESS THAN 1 INCH.

TABLE

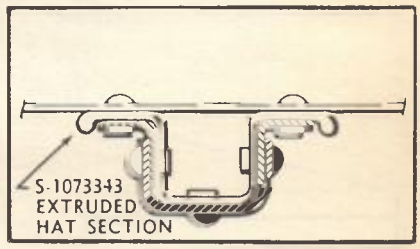
ITEM	REPLACEMENT	SPLICE	RIVETS REQUIRED EACH SIDE OF SPLICE
S-1103831	S-1103831 OR .032 24S-TAL SHEET	.040 24S-TAL SHEET	18 AD4 RIVETS
S-1073343 (ALCOA L-24990)	S-1073343	CROWN .064 24S-TAL SHEET, LEG S-167882 (ALCOA 78P)	24 AD4 RIVETS
S-1074883 (ALCOA L-24992)	* S-1074883	* S-1074883 (ALCOA L-24992) CUT LONGITUDINALLY, 2 PIECES REQUIRED	28 AD6 RIVETS



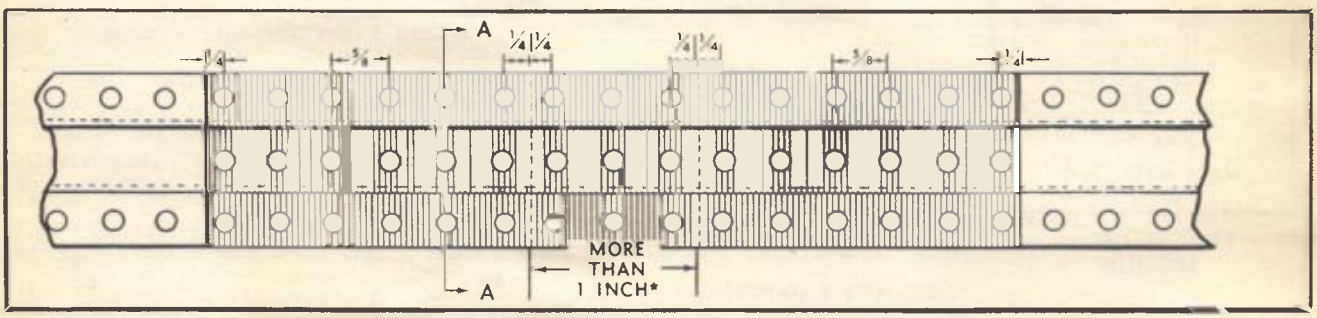
SECTION A-A



CROSS SECTION — SPLICE S-1074883

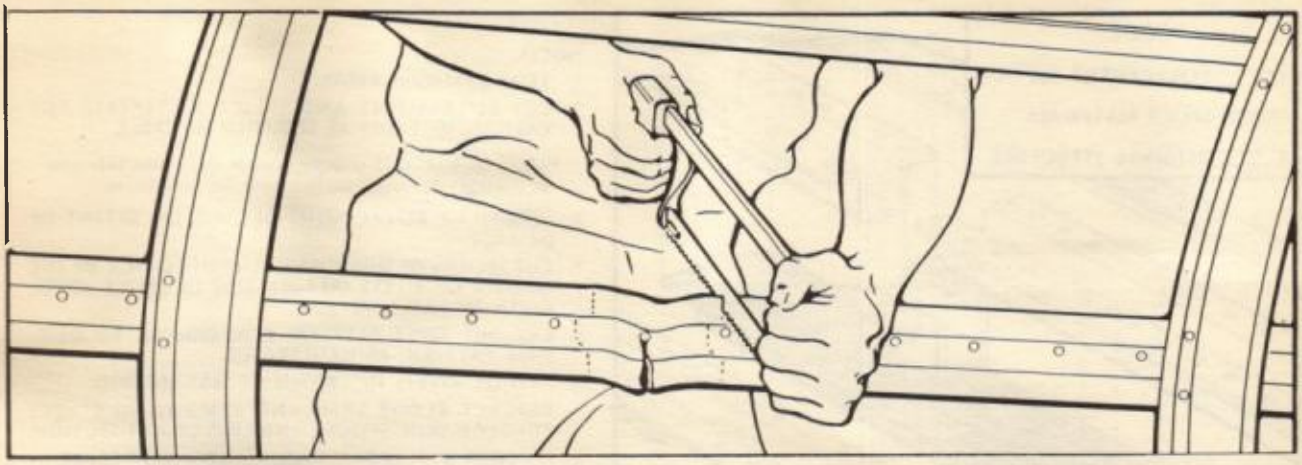


CROSS SECTION — SPLICE S-1073343

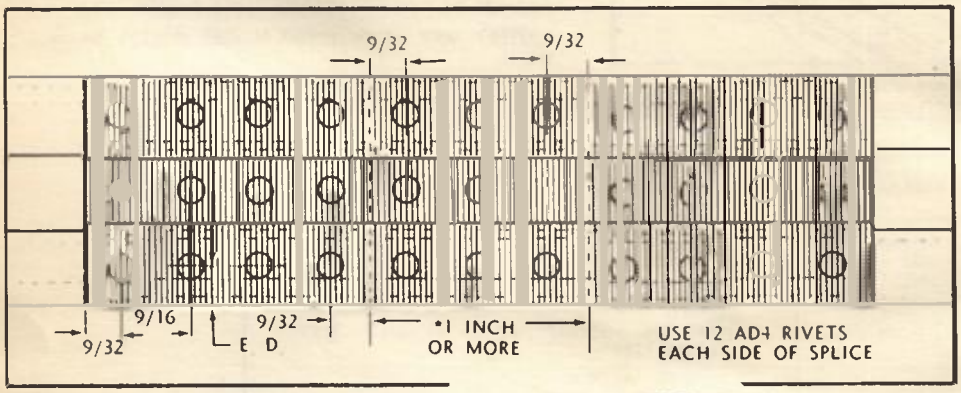


PLAN VIEW OF RIVET PATTERN

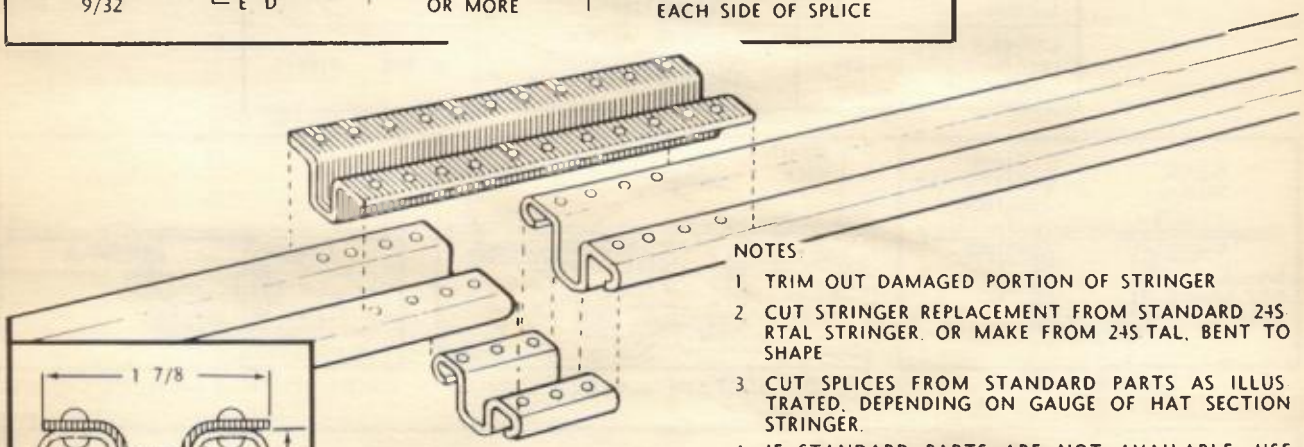
Figure 68 — Fuselage Floor Panel Repair — Hat Section Reinforcement



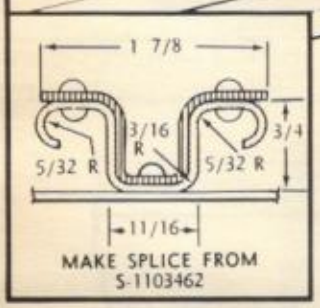
TRIMMING DAMAGE



PLAN VIEW OF REPAIR
OF 020 STRINGER



EXPLODED VIEW OF REPAIR



TYPICAL CROSS
SECTION

CODE

REPLACEMENT SECTION

SPLICE MATERIALS

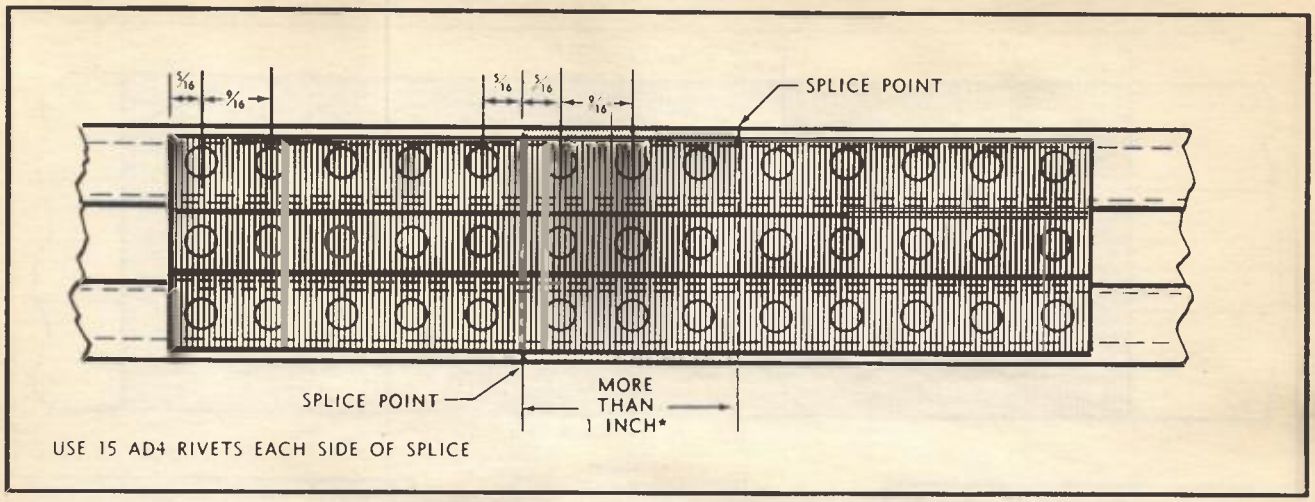
ORIGINAL STRUCTURE

NOTES:

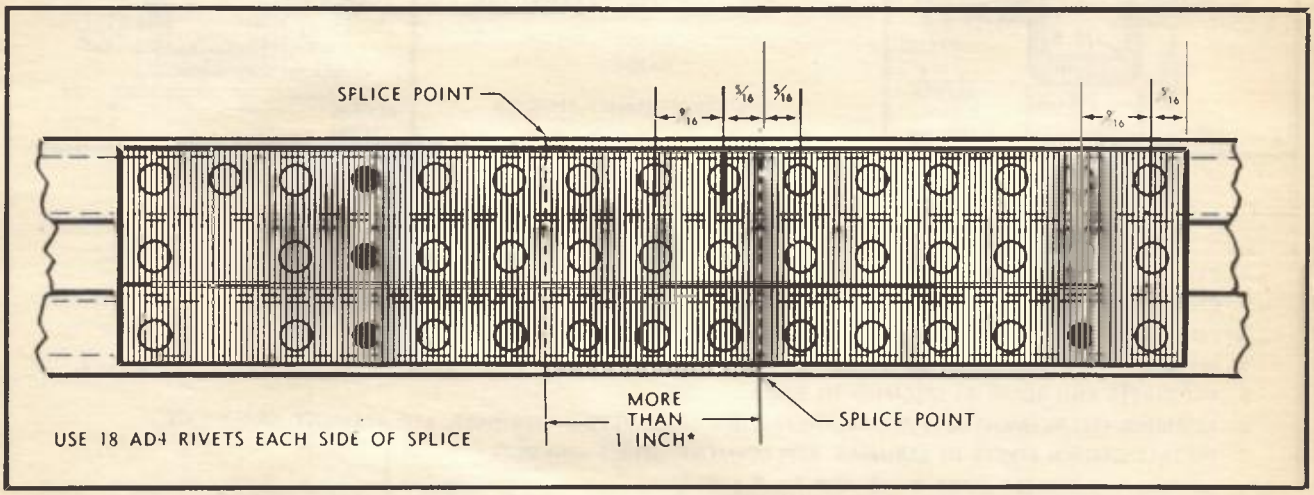
1. TRIM OUT DAMAGED PORTION OF STRINGER
2. CUT STRINGER REPLACEMENT FROM STANDARD 24S RTAL STRINGER, OR MAKE FROM 24S TAL, BENT TO SHAPE
3. CUT SPLICES FROM STANDARD PARTS AS ILLUSTRATED, DEPENDING ON GAUGE OF HAT SECTION STRINGER.
4. IF STANDARD PARTS ARE NOT AVAILABLE, USE FORMED 24S TAL SHEET
5. MARK OUT RIVET PATTERN AS SHOWN
6. INSTALL RIVETS IN CROWN OF STRINGER, SPACE AND REPLACEMENT, ATTACHING REPAIR TO SKIN
7. STAGGER SPLICE POINTS SO THAT 2 STRINGER REPAIRS DO NOT FALL AT THE SAME STATION, IN EVENT OF MULTIPLE STRINGER DAMAGE.

*INSTALL SPLICE AND INSERT, DRIVING LEG RIVETS FIRST (IF GAP IS LESS THAN 1 INCH, INSERT MAY BE OMITTED)

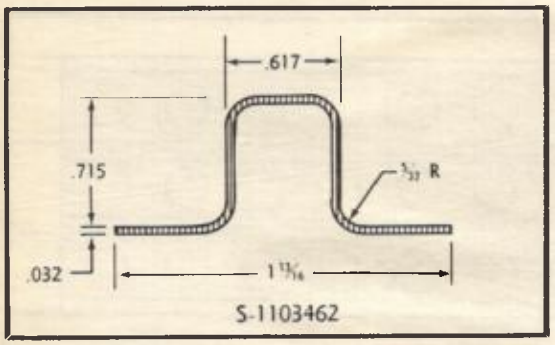
Figure 69 (Sheet 1 of 2 Sheets) — Fuselage Stringer Repair — Rolled Hat Section



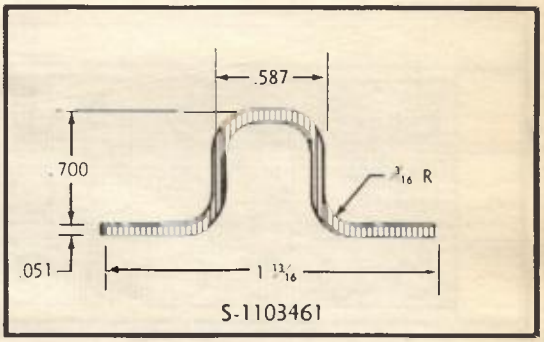
PLAN VIEW OF REPAIR OF .032 STRINGER



PLAN VIEW OF REPAIR OF .040 STRINGER



SPLICE FOR .020 AND .025 STRINGERS



SPLICE FOR .032 AND .040 STRINGERS

CODE

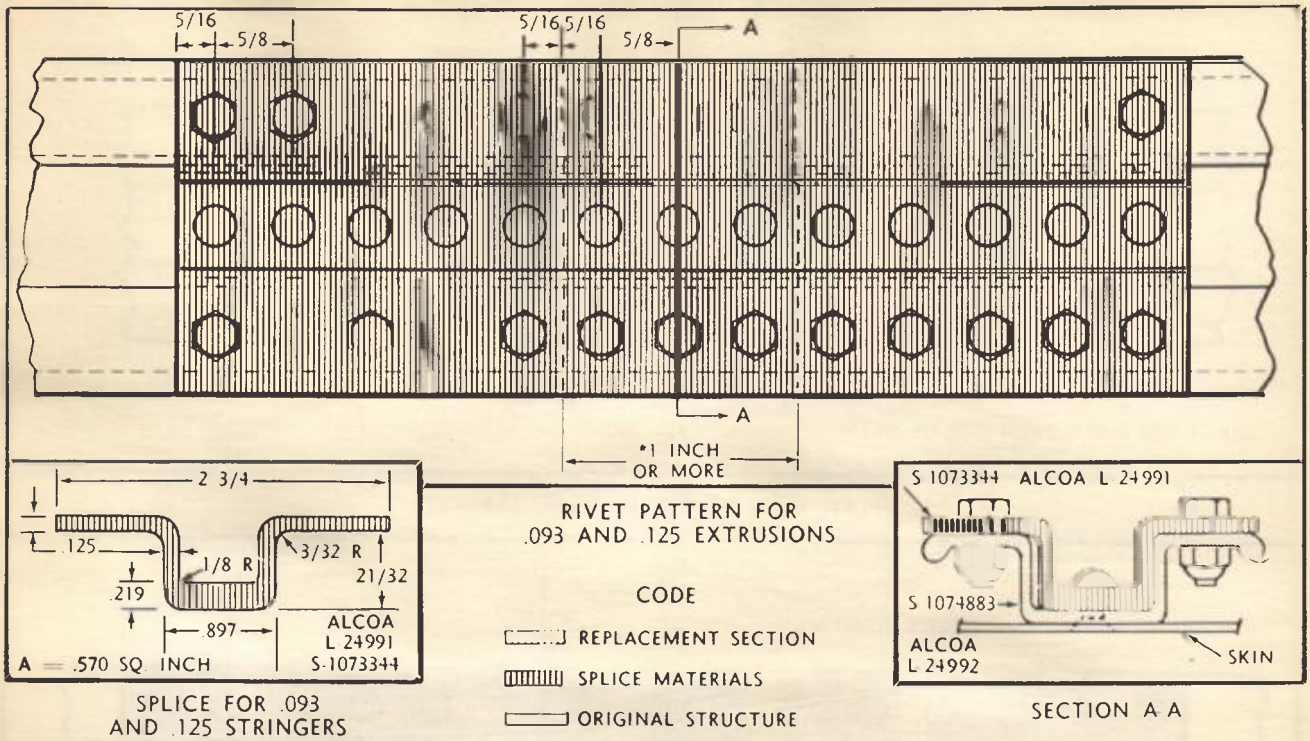
REPLACEMENT SECTION

SPLICE MATERIALS

ORIGINAL STRUCTURE

*INSERT MAY BE OMITTED IF GAP IS LESS THAN 1 INCH

Figure 69 (Sheet 2 of 2 Sheets) — Fuselage Stringer Repair — Rolled Hat Section



SPLICE FOR .093
AND .125 STRINGERS

RIVET PATTERN FOR
.093 AND .125 EXTRUSIONS

CODE

REPLACEMENT SECTION

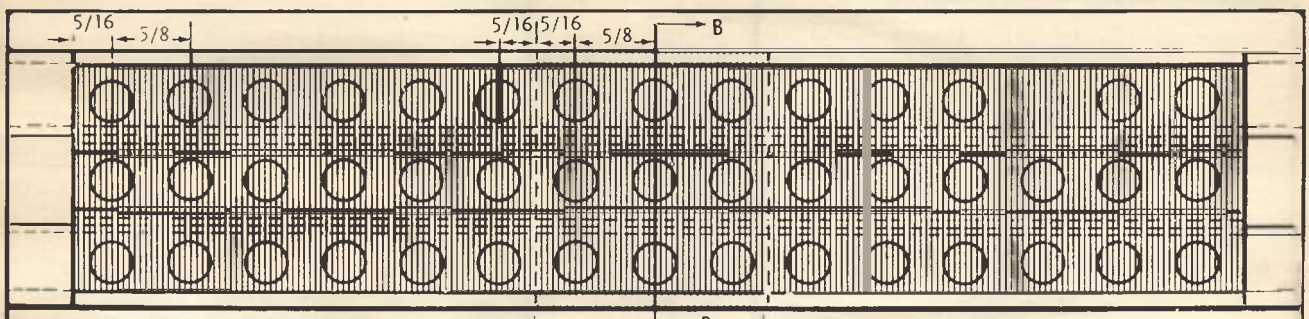
SPLICE MATERIALS

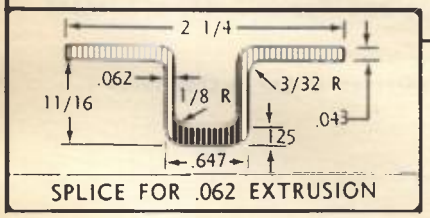
ORIGINAL STRUCTURE

SECTION A-A

FUSELAGE STRINGER REPAIR — EXTRUDED HAT STRINGERS

1. TRIM OUT DAMAGED PORTION OF STRINGER.
2. CUT REPLACEMENT SECTION FROM EXTRUSION.
3. CUT SPLICE FROM EXTRUSION, OR FROM FORMED 24S TAL SHEET AS SPECIFIED IN TABLE.
4. MARK RIVET PATTERN AS SHOWN.
5. USE RIVETS AND BOLTS AS SPECIFIED IN TABLE.
6. ASSEMBLE REPLACEMENT AND SPLICE, INSTALLING LEG RIVETS IN STRINGER, REPLACEMENT AND SPLICE.
7. INSTALL CROWN RIVETS IN STRINGER, REPLACEMENT, SPLICE AND SKIN.
8. SEE TABLE ON SHEET 2 FOR RIVET AND BOLT PATTERN.

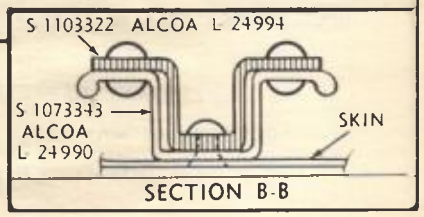




SPLICE FOR .062 EXTRUSION

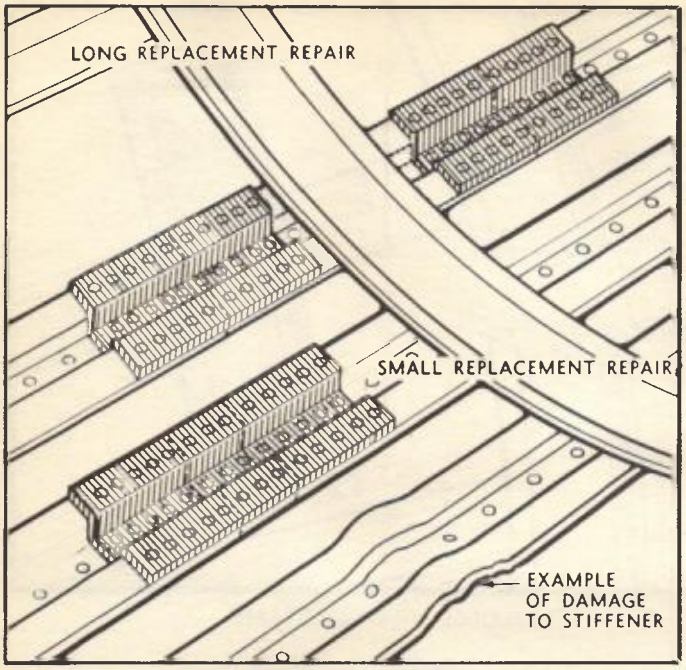
RIVET PATTERN
FOR .064 STRINGERS

*INSERTION MAY BE DELETED
IF GAP IS LESS THAN 1 INCH

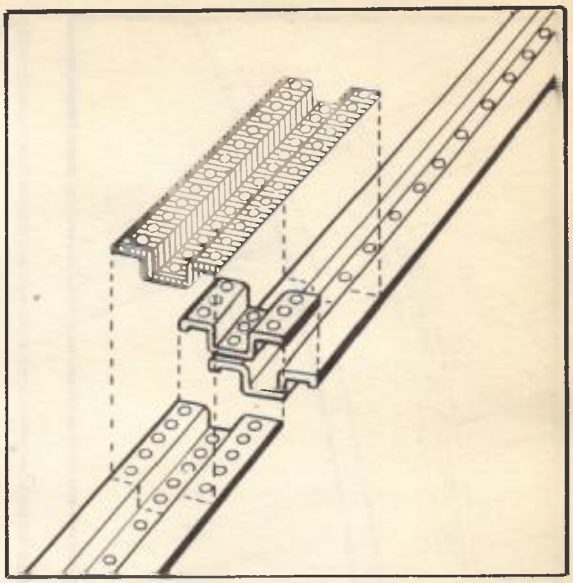


SECTION B-B

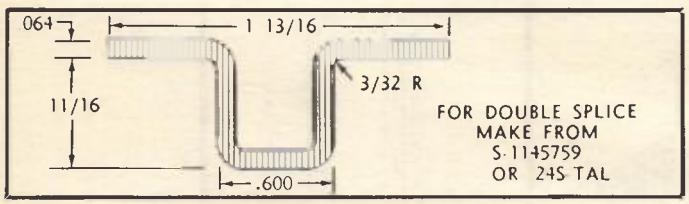
Figure 70 (Sheet 1 of 2 Sheets) — Fuselage Stringer Repair — Extruded Hat Section



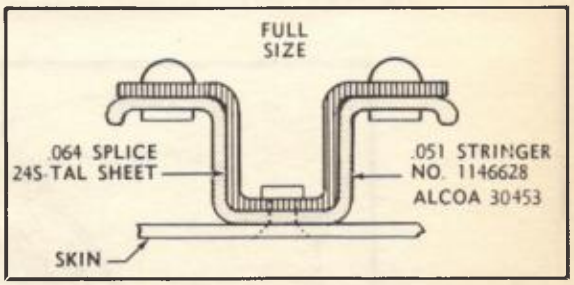
COMPLETE REPAIRS



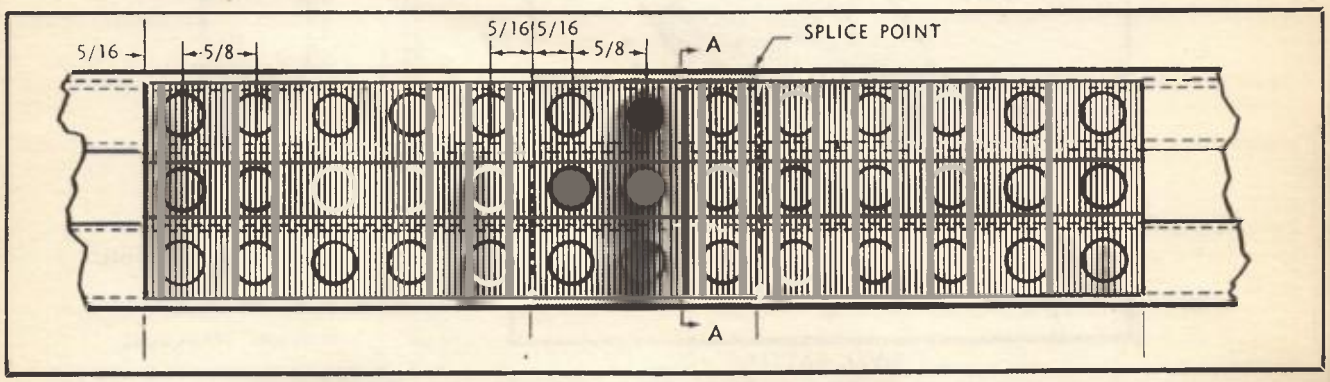
EXPLODED VIEW OF REPAIR



SPLICE FOR .051 EXTRUSIONS



SECTION A-A



RIVET PATTERN FOR SPLICING .051 EXTRUDED SECTION

TABLE

EXTRUSION	SPLICE	RIVET AND BOLT REQUIREMENTS—EACH SIDE OF SPLICE
S-1146628	.064 24S-TAL SHEET	15 AD5 RIVETS
S-1074883	S-1073344	10 AN3 BOLTS 5 AD5 RIVETS
S-1074484	S-1073344	10 AN3 BOLTS 5 AD5 RIVETS
S-1073343	S-1103322	15 AD5 RIVETS

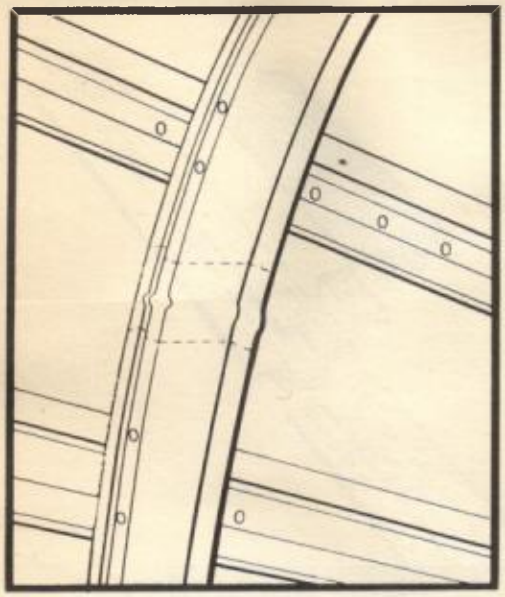
CODE

REPLACEMENT SECTION

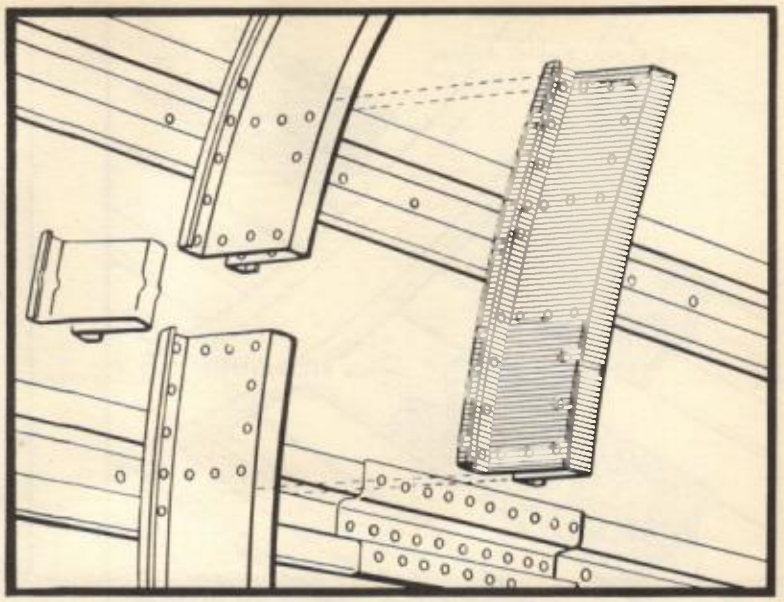
SPLICE MATERIALS

ORIGINAL STRUCTURE

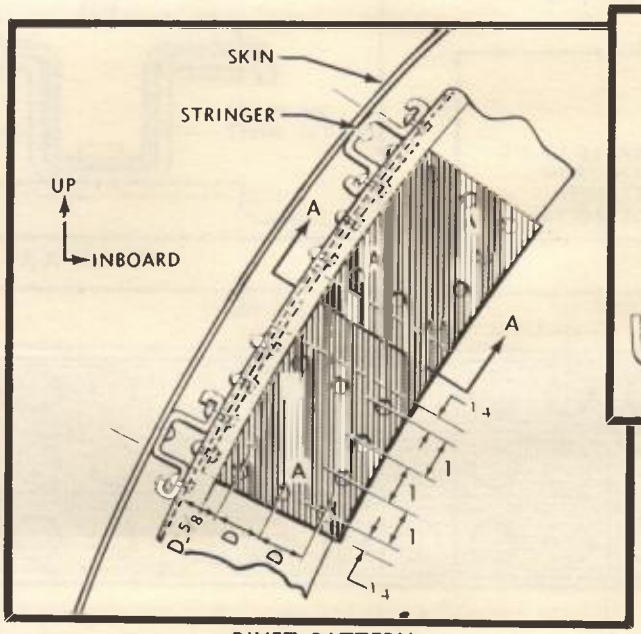
Figure 70 (Sheet 2 of 2 Sheets) — Fuselage Stringer Repair— Extruded Hat Section



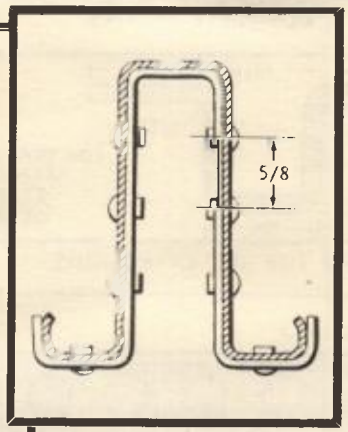
KINKED FRAME



EXPLODED VIEW OF REPAIR



RIVET PATTERN



SECTION A-A

CODE

REPLACEMENT SECTION

SPLICE MATERIALS

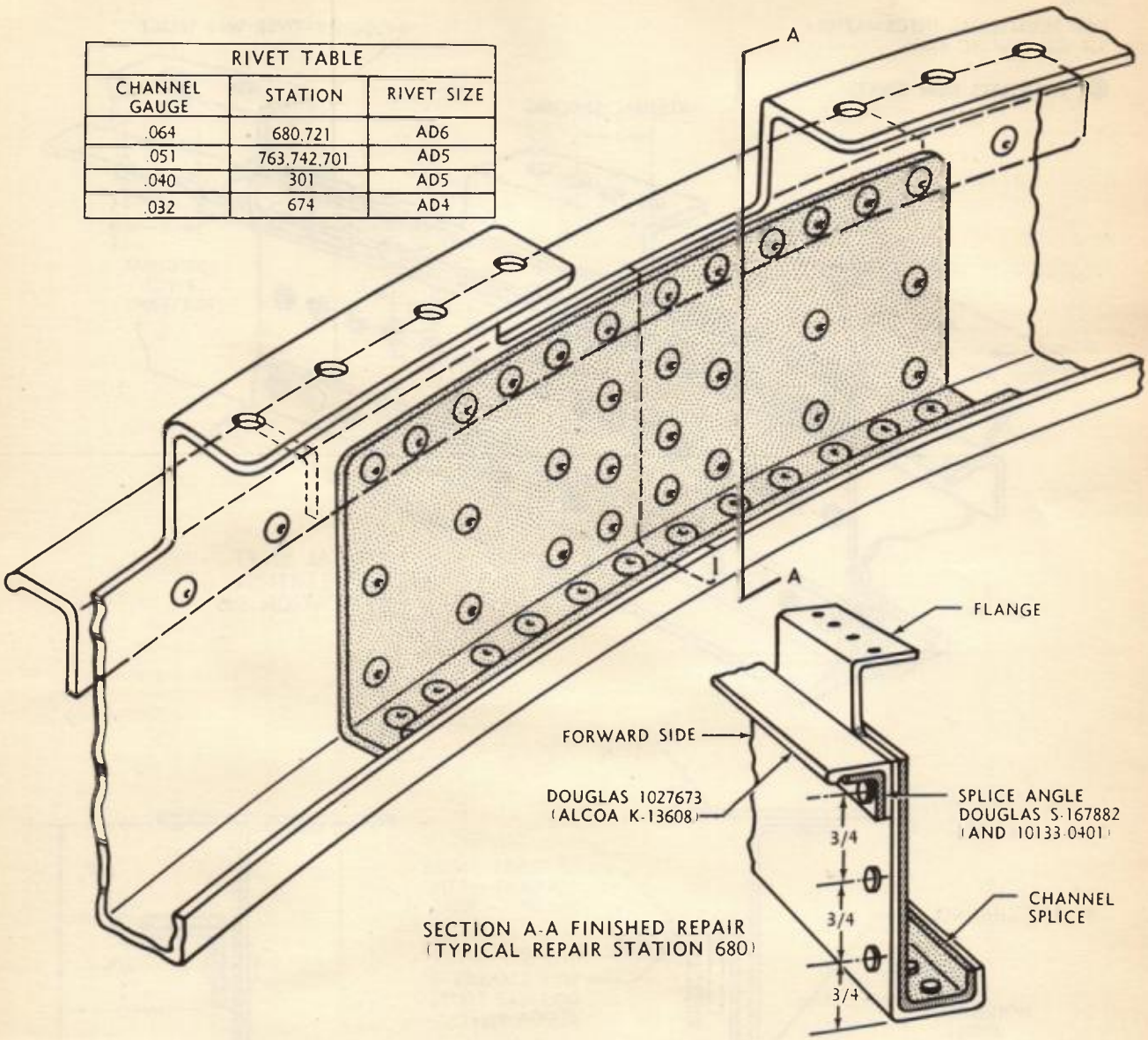
ORIGINAL STRUCTURE

NOTES:

1. TRIM OUT DAMAGED AREA.
2. FORM SPLICE FROM 24S-TAL OF SAME GAUGE AS FRAME AND OF SUFFICIENT LENGTH TO PICK UP RIVET PATTERN AS ILLUSTRATED.
3. UNCURL EDGES OF ORIGINAL HAT SECTION FRAME FOR SUFFICIENT LENGTH TO ALLOW NESTING OF SPLICE.
4. INSTALL SPLICE. USE 24 AD4 RIVETS EACH SIDE OF SPLICE FOR FRAME 2 1/2 INCHES HIGH USE 20 AD4 RIVETS EACH SIDE OF SPLICE FOR FRAME 1 3/4 INCHES HIGH NO RIVETS AT A
5. *FOR FRAME 1 3/4 INCHES DEEP. THE DISTANCE BETWEEN RIVETS IS 3/8 INCH

Figure 71 — Fuselage Frame Repair — Rolled Hat Section

RIVET TABLE		
CHANNEL GAUGE	STATION	RIVET SIZE
.064	680,721	AD6
.051	763,742,701	AD5
.040	301	AD5
.032	674	AD4



1. FORM CHANNEL SPLICE FROM 24S-TAL SHEET, SAME GAUGE AS ORIGINAL CHANNEL, OF SUFFICIENT LENGTH TO PICK UP 5 RIVETS ON EACH SIDE OF SPLICE POINT IN THE ORIGINAL STIFFENER ANGLE.
2. CUT SPLICE ANGLE FROM DOUGLAS S-167882 EXTRUSION, SAME LENGTH AS CHANNEL SPLICE.
3. INSTALL 21 RIVETS ON EACH SIDE OF THE SPLICE JOINT, 5 THROUGH THE VERTICAL LEG OF THE SPLICE ANGLE, 5 THROUGH THE HORIZONTAL LEG, 5 THROUGH THE CHANNEL FLANGE, AND 6 THROUGH THE CHANNEL WEB, AS SHOWN IN THE ILLUSTRATION.
4. USE AD4 RIVETS IN CHANNEL WEB OF .032 GAUGE OR UNDER, AD5 RIVETS IN .040 AND .051 GAUGE, AD6 IN .064 GAUGE OR OVER.

Figure 72 — Fuselage Frame Repair — Rolled Channel — Station 680

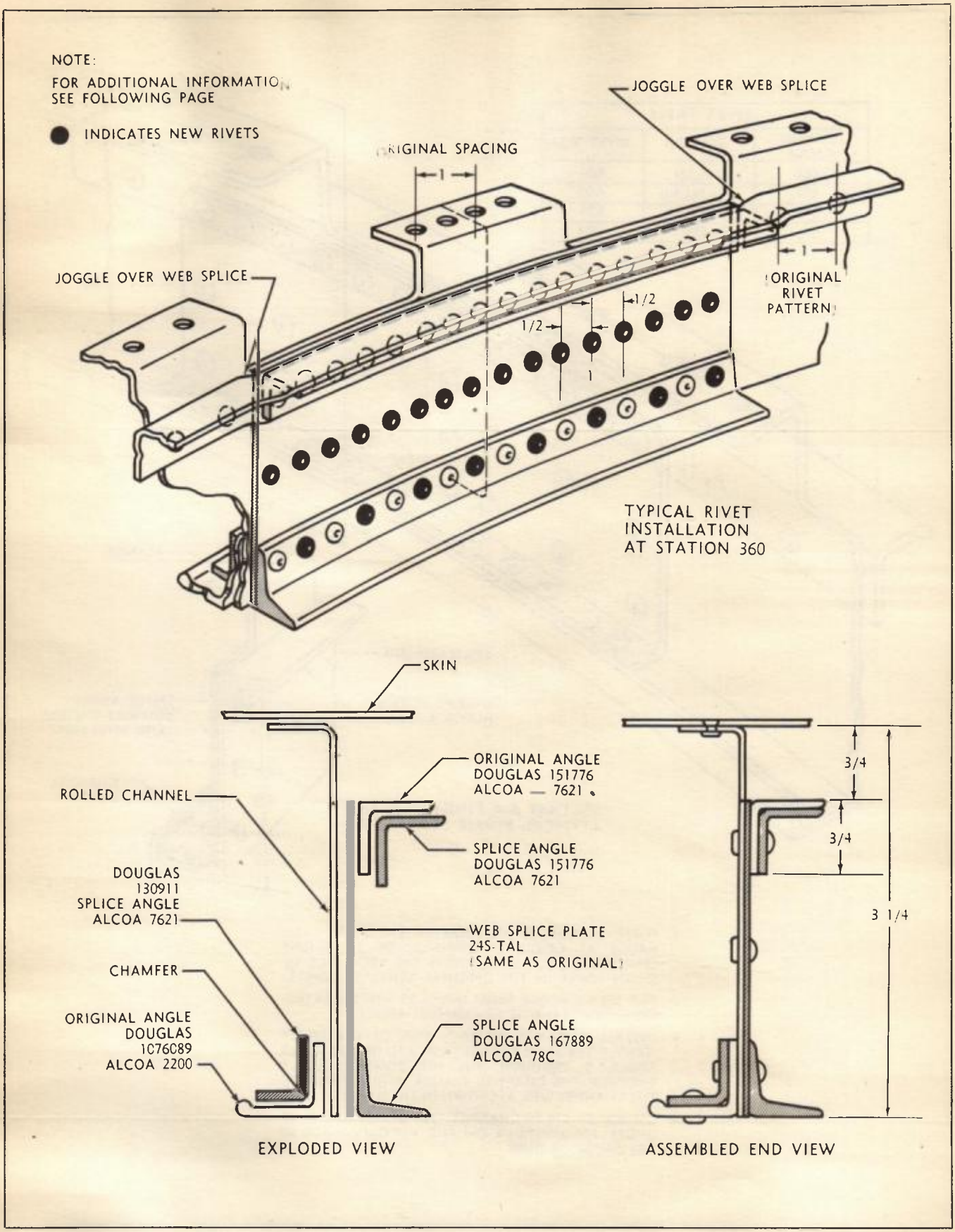


Figure 73 — Fuselage Frame Repair — Rolled Channel — Stations 360 and 381

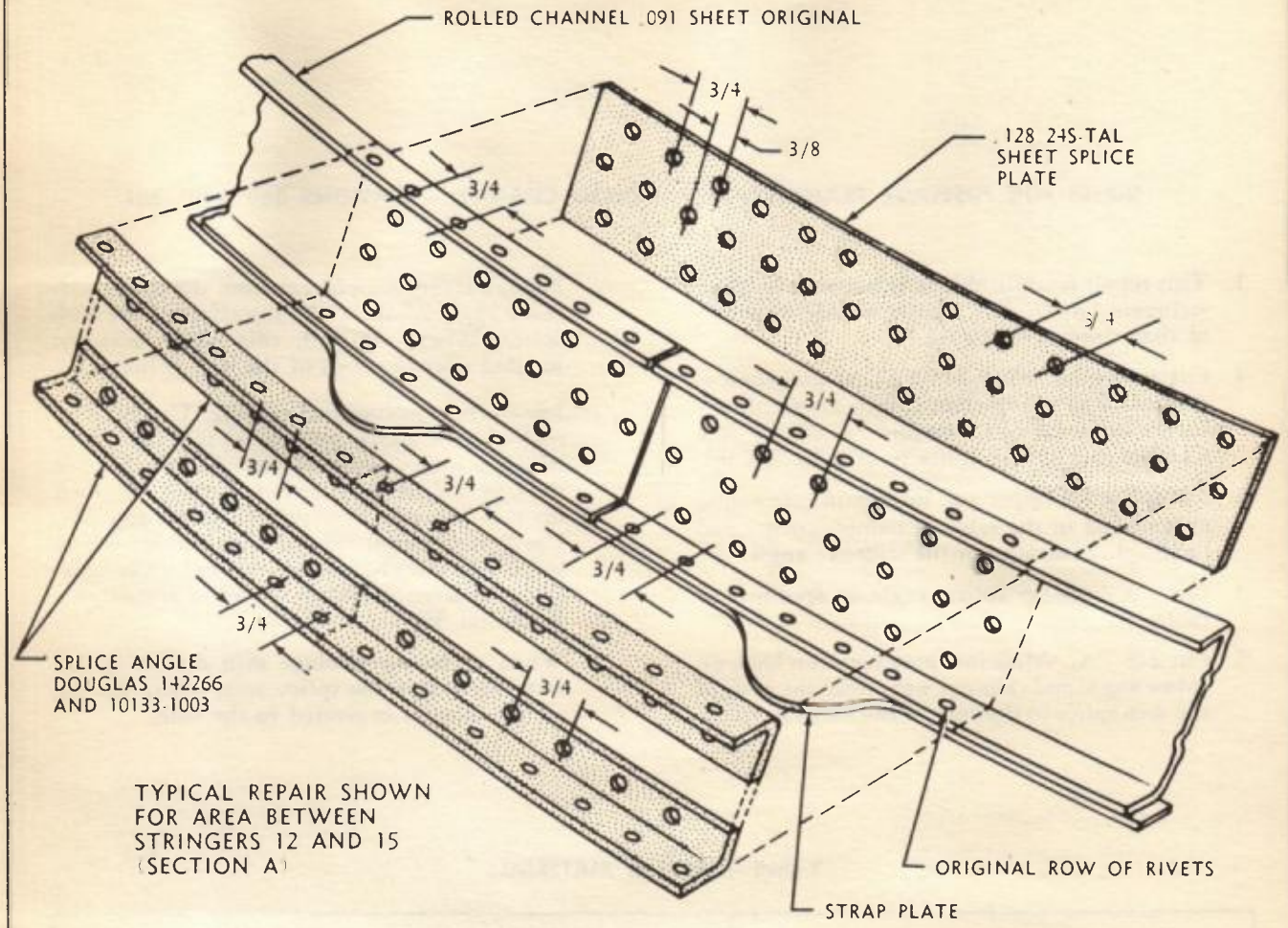
NOTES FOR FUSELAGE FRAME REPAIR – ROLLED CHANNEL – STATIONS 360 AND 381

1. This repair is applicable only between fuselage stringers 1 to 9. For repairs to side segments of these frames see figure 74.
2. Cut web splice from 24S-TAL, same gauge as original, and of sufficient length to extend 4⅛ inches each side of splice joint, at station 360, 6 inches each side of splice joint at station 381.
3. Cut splice for upper and lower stiffener angles as specified in the table. Chamfer corner and bend splice angle to fit the stiffener angle.
4. Cut the back-up splice angle as specified in table.
5. Cut 24S-TAL shims for space between back-up splice angle and channel web, from the ends of the web splice to the ends of the back-up angle.
6. Enough rivets must be cut from the upper stiffener angle to allow the insertion of the web splice. When replaced, this angle must be joggled over the ends of the web splice.
7. Install rivets as specified in table. Use 16 rivets each side of splice joint in upper and lower stiffener angles, 8 in each leg of angle. Double the original rivet pattern at statiton 360. Pick up the original rivet pattern at station 381. Use 8 rivets each side of splice point where installed through channel web and splice only. (The illustration shows the rivet installation at station 360.)
8. When replacing fuselage skin double up on rivet pattern in the splice area, where the leg of the channel is riveted to the skin.

TABLE – REPAIR MATERIALS

	STATION 360		STATION 381	
	Use Douglas No.	Alcoa No.	Use Douglas No.	Alcoa No.
Outboard Stiffener Angle Splice	151776	K-7621	133193	K-744-JJ
Inboard Stiffener Angle Splice	130911	77-G	133193	K-744-JJ
Back-up Splice Angle	167889	78-C	1081111	and 10134-1003
Rivets	AD5		AD6	
Original Stiffeners: Rivet Spacing in Angle	1 Inch		¾ Inch	

NOTE: Cut repair material of sufficient length to pick up rivets on each side of splice, as given in table and shown in rivet patterns in illustration.



NOTES:

1. SECTION A ILLUSTRATES REPAIR BETWEEN STRINGERS 12 AND 15. SECTION B BETWEEN 15 AND 19. SECTION C BETWEEN 19 AND 21. (SEE FOLLOWING PAGE.)
2. WEB SPLICES ARE 24S-TAL. GAUGE AS SHOWN IN ILLUSTRATION, AND LENGTH TO ACCOMMODATE RIVET PATTERN AS ILLUSTRATED AND AS GIVEN IN NOTE 4 BELOW.
3. SPLICE ANGLES ARE 24S-T EXTRUSIONS. NUMBERS ARE GIVEN IN ILLUSTRATION. LENGTH TO ACCOMMODATE RIVET PATTERNS SHOWN. CHAMFER NESTING ANGLE OF SPLICE EXTRUSIONS IF NECESSARY
4. INSTALL RIVETS AS FOLLOWS:

   FOR SECTIONS A AND B, 13 AD6 RIVETS IN UPPER AND LOWER SPLICE ANGLES, 6 IN VERTICAL LEG, 7 IN HORIZONTAL LEG, EACH SIDE OF SPLICE JOINT, AND 7 IN WEB SPLICE, EACH SIDE OF SPLICE JOINT, LOCATED MIDWAY BETWEEN SPLICE ANGLES
   FOR SECTION C, 15 AD6 RIVETS IN UPPER AND LOWER SPLICE ANGLES, 7 IN VERTICAL LEG, 8 IN HORIZONTAL LEG, EACH SIDE OF SPLICE JOINT, AND 8 IN WEB SPLICE, EACH SIDE OF SPLICE JOINT, MIDWAY BETWEEN SPLICE ANGLES.
8. REPAIRS COVER DAMAGE TO COMPLETE FRAME ASSEMBLY FOR EACH SECTION.

Figure 74 (Sheet 1 of 2 Sheets) — Fuselage Frame Repair — Rolled Channel — Station 420

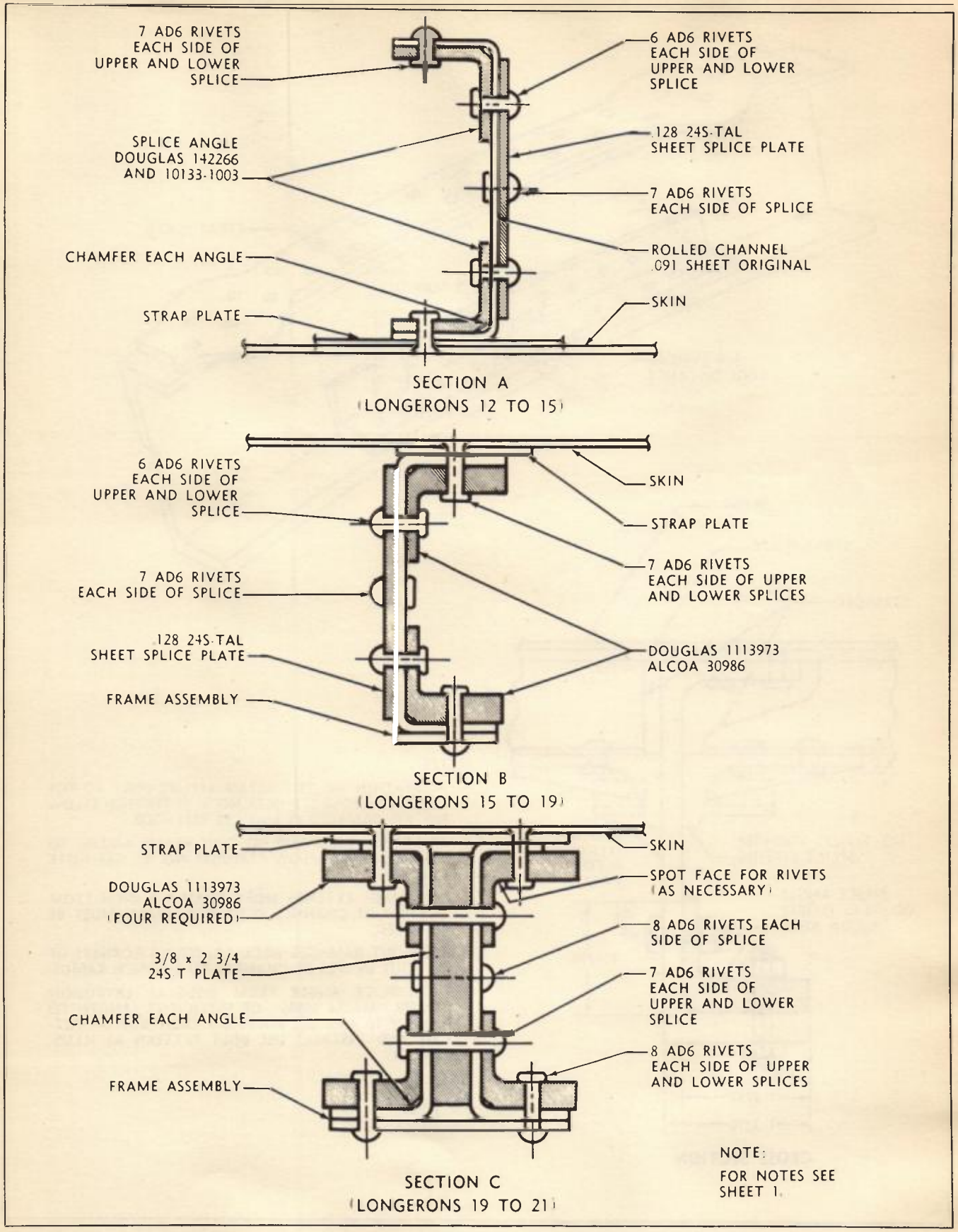
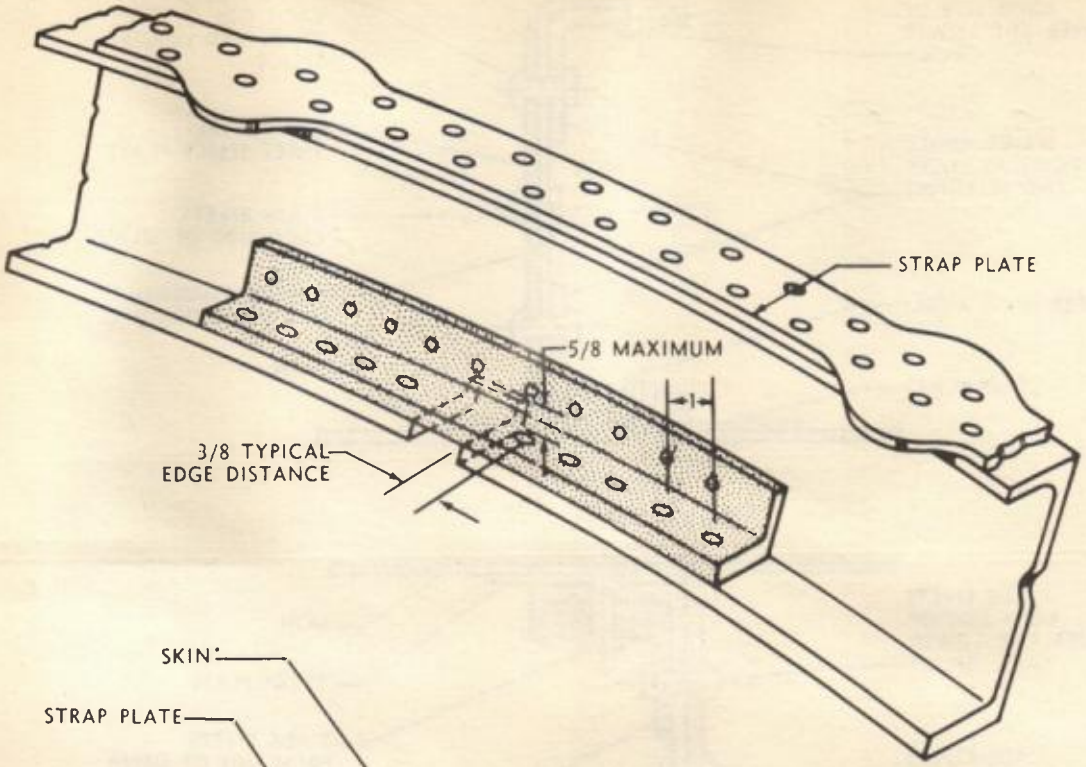
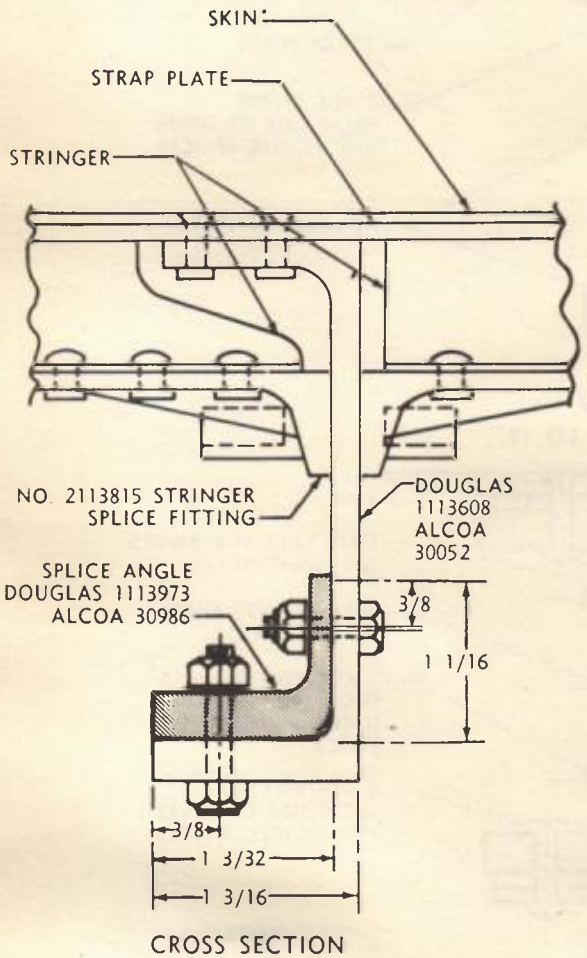


Figure 74 (Sheet 2 of 2 Sheets) — Fuselage Frame Repair — Rolled Channel — Station 420

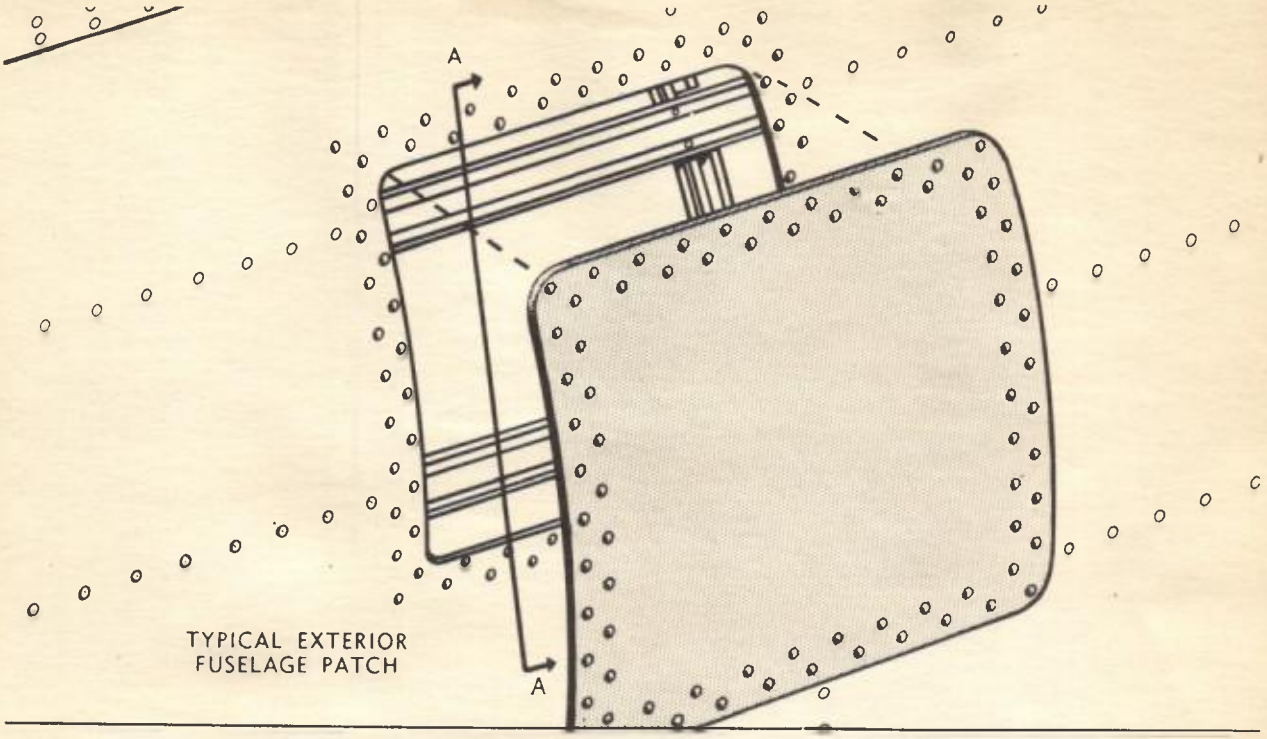


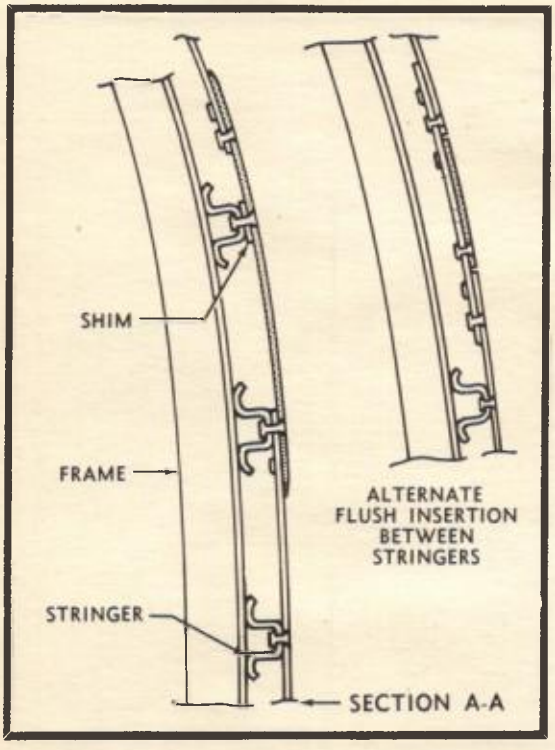


NOTES:

1. AT STATION 460, THIS REPAIR APPLIES ONLY TO TOP SEGMENT ABOVE STRINGER NO. 9. IF SECTION BELOW NO. 9 IS DAMAGED IT MUST BE REPLACED.
2. AT STATIONS 360 AND 381, THIS REPAIR APPLIES TO SIDE SEGMENTS BELOW STRINGER NO. 9. (SEE NOTE 1 FIG. 77).
3. IF DAMAGE EXTENDS MORE THAN 5/8 INCH FROM BOTTOM OF CHANNEL INTO WEB, FRAME MUST BE REPLACED.
4. TRIM OUT DAMAGED AREA, ROUNDING CORNERS OF CUT OUT IN WEB OF CHANNEL TO 1/4 INCH RADIUS.
5. CUT SPLICE ANGLE FROM DOUGLAS EXTRUSION 1113973 (ALCOA 30986), OF SUFFICIENT LENGTH TO PICK UP 10 AN3-1032 BOLTS ON EACH SIDE OF CUT OUT AND INSTALL. USE BOLT PATTERN AS ILLUSTRATED.

Figure 75 — Fuselage Frame Repair — Extruded Channel — Stations 360, 381 and 460





CODE

REPLACEMENT SECTION

SPLICE MATERIALS

ORIGINAL STRUCTURE

NOTES:

1. TRIM OUT DAMAGE TO RECTANGULAR SHAPE.
2. LAY OUT RIVET PATTERN FOR PATCH ON SKIN. HORIZONTAL SEAMS DUPLICATE RIVET PATTERN OF NEAREST HORIZONTAL SEAM AND VERTICAL SEAMS DUPLICATE PATTERN OF NEAREST VERTICAL SEAM OF DAMAGED PANEL.
3. CUT PATCH FROM 24S-TAL SHEET, SAME GAUGE AS SKIN, AND LARGE ENOUGH TO PICK UP RIVET PATTERN.
4. CHAMFER EDGES OF PATCH 30° AND INSTALL USING AD4 RIVETS, ON .020 TO .032 SKIN, AND AD5 RIVETS FOR HEAVIER GAUGE.
5. ATTACH SKIN PATCH TO STRINGERS USING SHIMS IF NECESSARY. FOLLOW EXISTING RIVET PATTERNS.
6. FOR SMALL DAMAGE CONFINED TO AN AREA BETWEEN INTERNAL ATTACHMENTS, USE A FLUSH INSERTION AND DOUBLER.

   USE 24S-TAL, SAME GAUGE AS ORIGINAL, FOR INSERTION.

   USE 24S-TAL, ONE GAUGE HEAVIER THAN ORIGINAL FOR DOUBLER.

   FOLLOW RIVET PATTERN FOR DOUBLER AS SPECIFIED IN NOTE 2 PRECEDING.

   INSTALL INSERTION ON DOUBLER WITH ONE ROW OF AD4 OR AD5 RIVETS (SEE NOTE 4, PRECEDING) STAGGER THIS ROW IN RELATION TO PATTERN OF RIVETS THROUGH DOUBLER AND SKIN.

Figure 76 — Fuselage Skin Repair

Section 5

ENGINE SECTION AND NACELLE

1. GENERAL.

The four engine nacelles are permanently attached to the inner wing panel and serve as support and fairing for the demountable power plant units. The two inboard nacelles house the main landing gear.

2. ENGINE SECTION AND NACELLE GROUP CONSTRUCTION.—The structural components of the nacelle consist of a stainless steel firewall, longerons, stringers, frames and skin. The structural components of the engine section of the nacelle are the chrome-molybdenum-steel engine mount, baffle, cowl flap support ring, cowling support ring, and the engine cowling. The engine cowling consists of an anti-drag ring and airscoop, cowl flap assembly, and accessory cowling with oil cooler fairing.

3. CLASSIFICATION OF DAMAGE TO ENGINE SECTION AND NACELLE GROUP.

3.1. NEGLIGIBLE DAMAGE.—Negligible damage to the nacelle frames, stringers, and skin is similar to that for like structural members of the fuselage (see Section 4 of this Manual). Special care, however, must be taken in the event of damage to the highly-stressed engine mount. Small dents not more than $\frac{1}{16}$ inch deep, having smooth edges, and showing no cracks or abrasions may be ignored.

3.2. REPAIRABLE DAMAGE. — Appropriate illustrations in this section cover repairable damage.

3.3. DAMAGE NECESSITATING REPLACEMENT OF PARTS.

a. In case of extensive damage to any of the four longerons of the nacelle, which absorb the load from the engine mount suspension points, replace the entire longeron.

b. If an engine-mount tube is damaged near a joint, a welded splice repair cannot be made, and the member must be replaced.

c. Many parts of the cowling, including small plates, airscoop nose section, oil cool fairings, cowl plate stiffeners, etc., are too small for repair and should be replaced if damaged.

4. ENGINE SECTION AND NACELLE GROUP WRENCH TORQUE TABLES.

The following wrench torque table lists allowable wrench torques in inch-pounds or foot-pounds for all important bolts in the engine section and nacelle group. These limits must be adhered to because under-torque encourages fatigue, and over-torque may result in excessive elongation of the bolt.

BOLT NO.	NUT NO.	NO. REQ.	ATTACHED PART	INSTALLATION	TORQUE (INCH-POUNDS*)
ENGINE MOUNT TO FIREWALL					
NAS-148-48	1087925	16		5325050	700-1000
NAS-146-34	AN365-624	4		5325050	230- 280

ENGINE MOUNT TO ENGINE

ITEM	NAME	PRATT & WHITNEY PART NOS.	TORQUE (INCH-POUNDS)
1	Engine Mount Ring Nut	33957	400-800
2	Flexible Bracket Cap Screws	41999	200-220
3	Flexible Bracket Nut	43875	300-800
4	Rigid Bracket Nuts	533	400-650

NOTE: When tightening the rigid bracket nuts on studs which have two cotter pin holes, use the lower torque value and then with an ordinary wrench turn the nut to the next locking point.

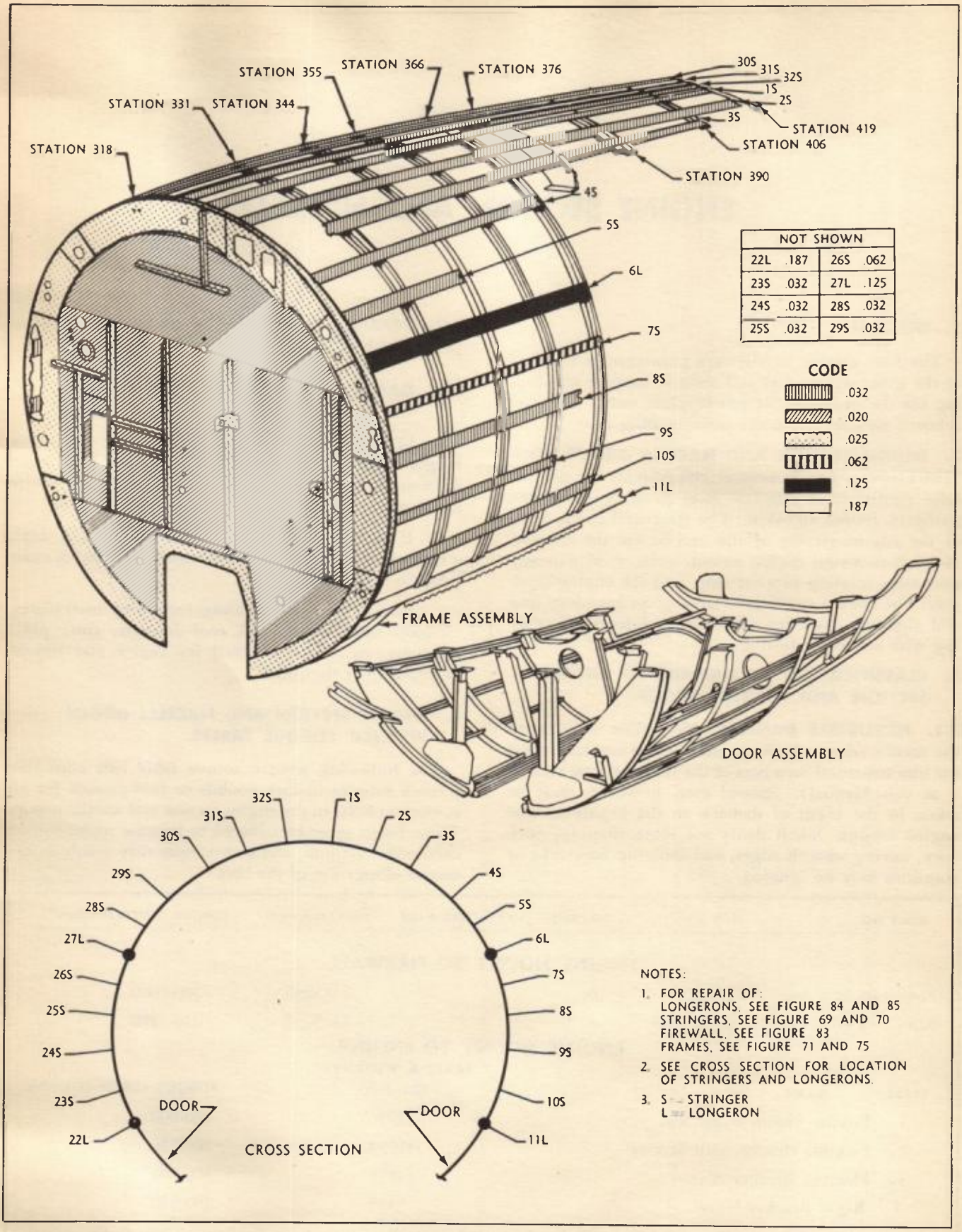
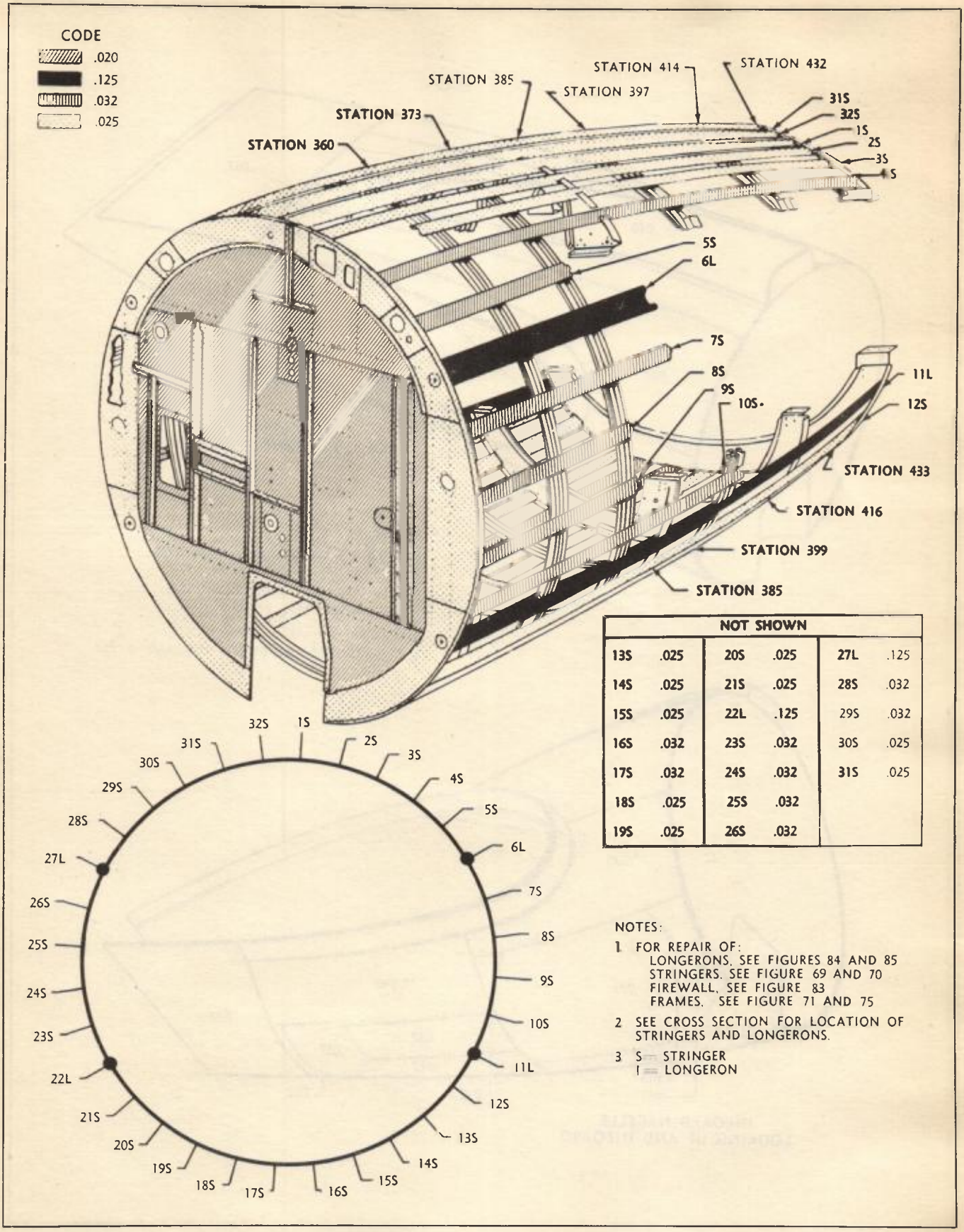


Figure 77 — Nacelle Structure — Inboard



NOT SHOWN					
13S	.025	20S	.025	27L	.125
14S	.025	21S	.025	28S	.032
15S	.025	22L	.125	29S	.032
16S	.032	23S	.032	30S	.025
17S	.032	24S	.032	31S	.025
18S	.025	25S	.032		
19S	.025	26S	.032		

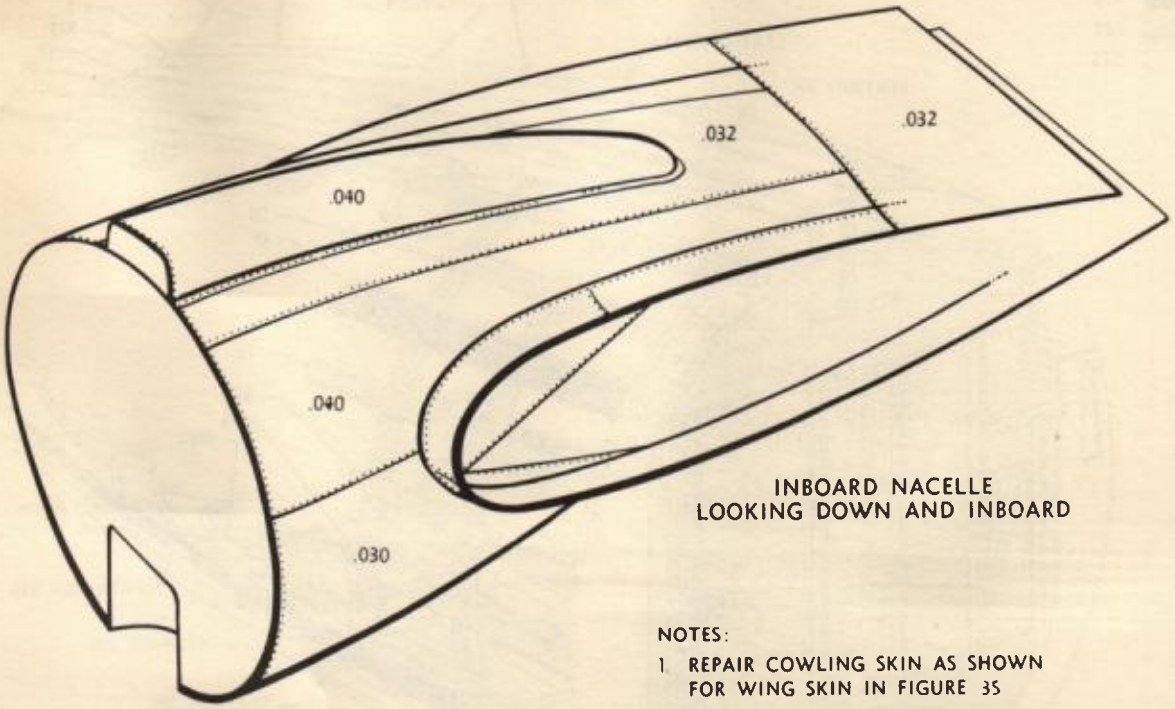
NOTES:

1 FOR REPAIR OF:
LONGERONS, SEE FIGURES 84 AND 85
STRINGERS, SEE FIGURE 69 AND 70
FIREWALL, SEE FIGURE 83
FRAMES, SEE FIGURE 71 AND 75

2 SEE CROSS SECTION FOR LOCATION OF STRINGERS AND LONGERONS.

3 S = STRINGER
L = LONGERON

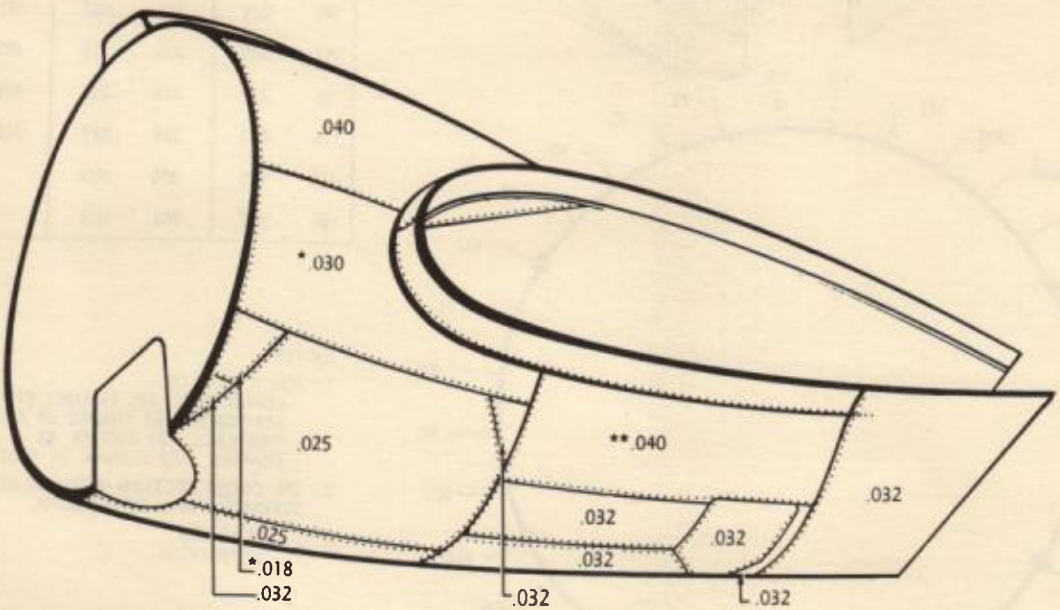
Figure 78 — Nacelle Structure — Outboard



INBOARD NACELLE
LOOKING DOWN AND INBOARD

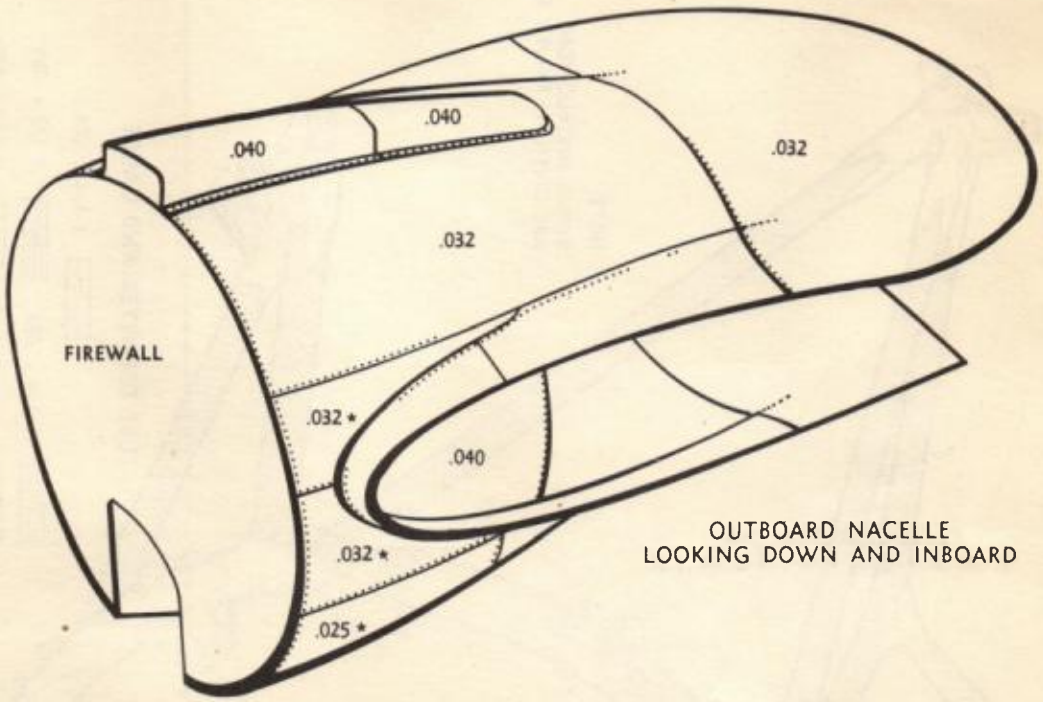
NOTES:

1. REPAIR COWLING SKIN AS SHOWN FOR WING SKIN IN FIGURE 35
2. USE SS RIVETS WHEN REPAIRING STAINLESS STEEL PANELS
3. *STAINLESS STEEL PANEL
4. ** OUTBOARD INDICATED: INBOARD IS .032



INBOARD NACELLE
LOOKING UP AND INBOARD

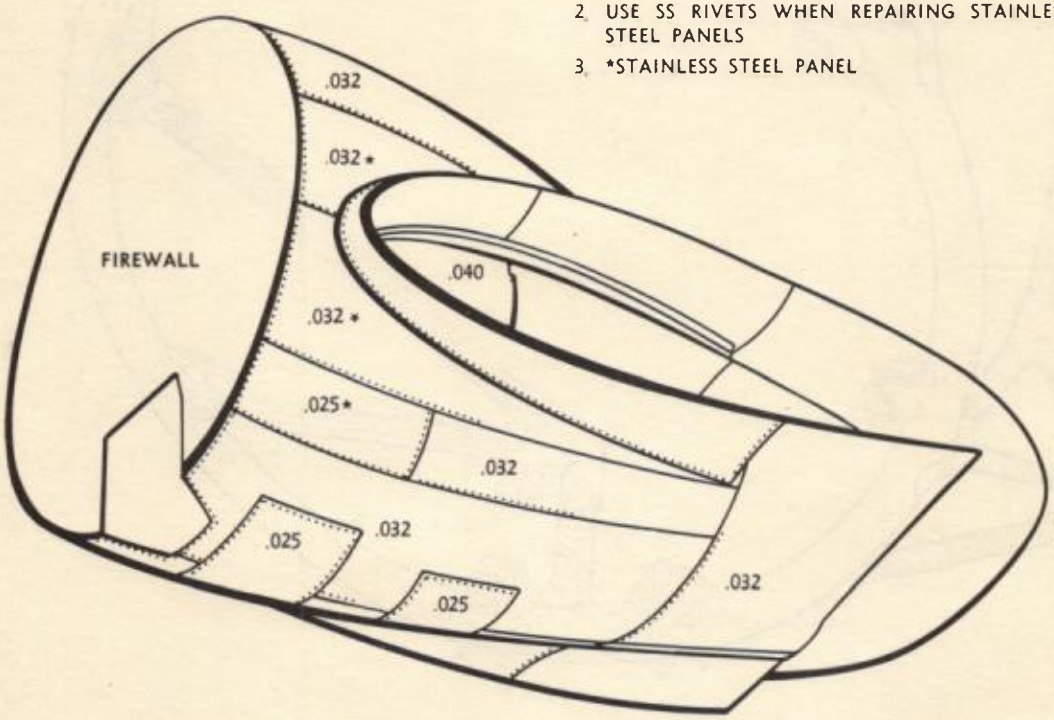
Figure 79 — Nacelle Skin — Inboard



OUTBOARD NACELLE
LOOKING DOWN AND INBOARD

NOTES:

1. REPAIR COWLING SKIN AS SHOWN FOR WING SKIN IN FIGURE 35
2. USE SS RIVETS WHEN REPAIRING STAINLESS STEEL PANELS
3. *STAINLESS STEEL PANEL



OUTBOARD NACELLE
LOOKING UP AND INBOARD

Figure 80 — Nacelle Skin — Outboard

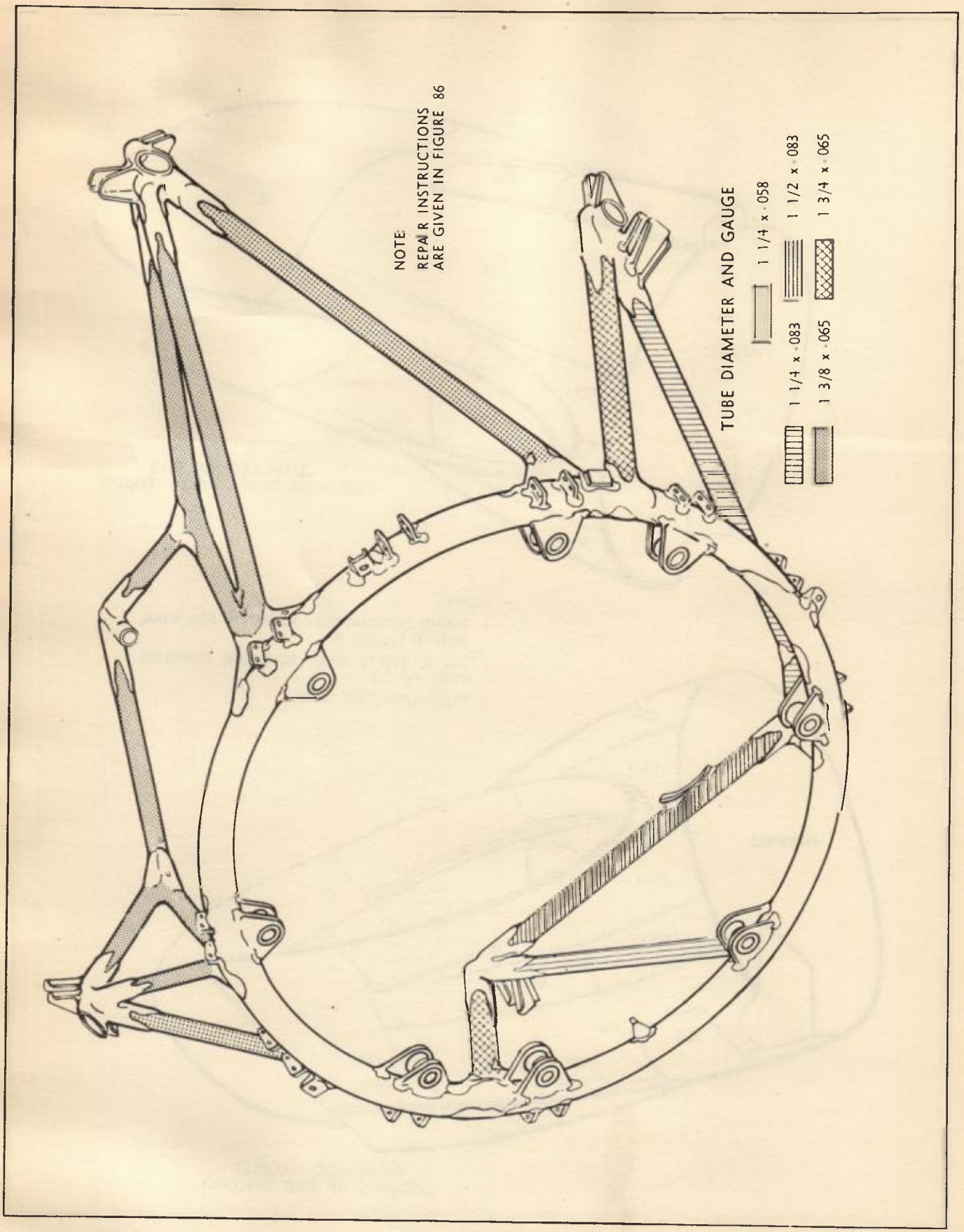
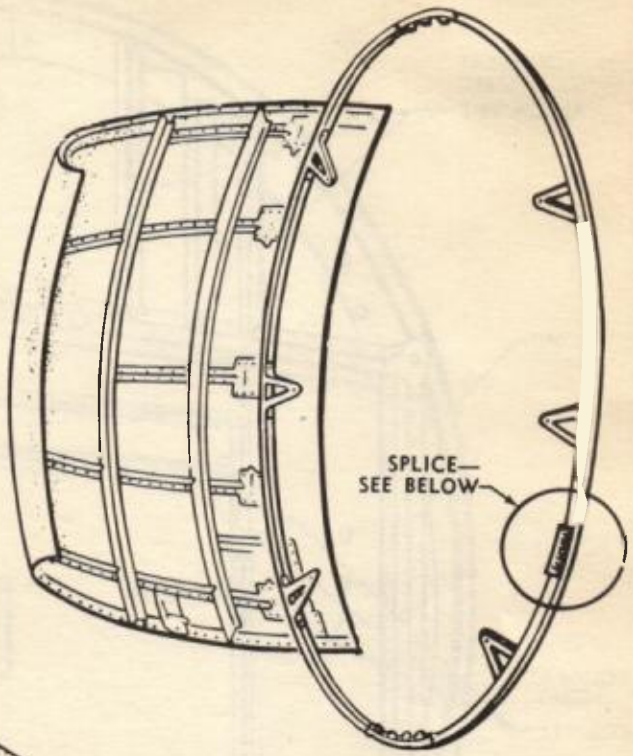


Figure 81 — Engine Mount

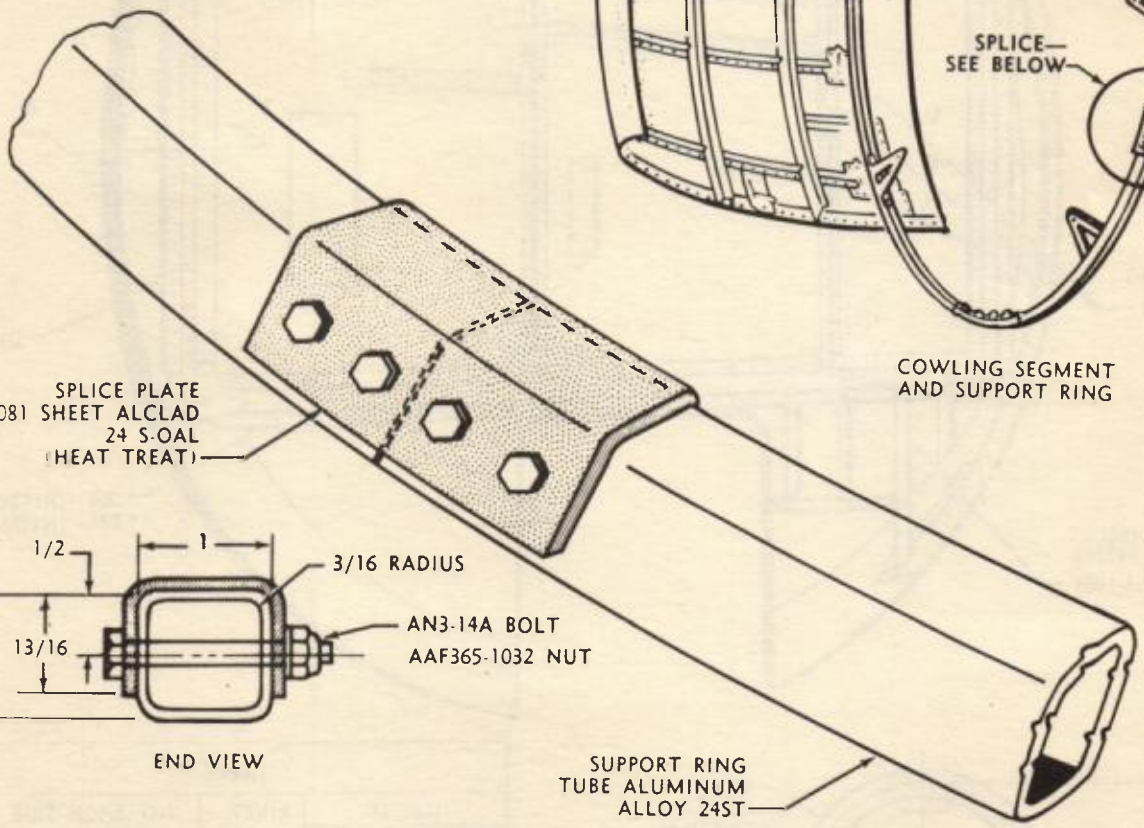
NOTES:

1. COWLING IS MADE OF .040 24S-TAL SKIN, WITH TEE SECTION EXTRUSIONS, HAT SECTIONS, AND ROLLED CHANNEL FRAME FOR STIFFENERS. REPLACE TEE AND HAT SECTIONS WHICH ARE DAMAGED.

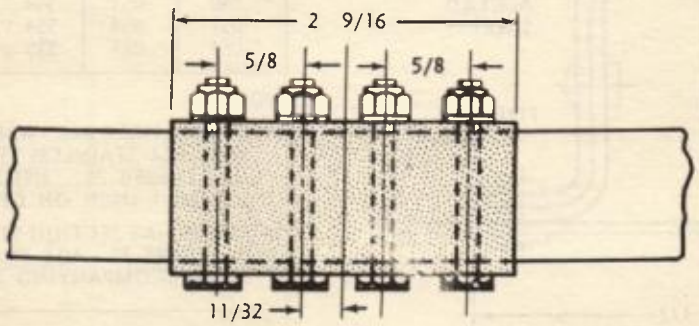
   REPAIR DAMAGED CHANNEL AS SPECIFIED FOR SIMILAR FUSELAGE FRAMES (SEE FIGURES 71, 72, 73, AND 74). REPAIR SKIN WITH FLUSH PATCH AS SPECIFIED FOR WING (SEE FIGURE 34). USE 1 ROW AD4 RIVETS, SPACED 3/4 INCH ON CENTER.
2. THE FRONT SUPPORT RING IS NOT REPAIRABLE. REPLACE IF DAMAGED.
3. THE REAR SUPPORT RING MAY BE REPAIREL WITH A CHANNEL SPLICE AS SHOWN.



COWLING SEGMENT AND SUPPORT RING

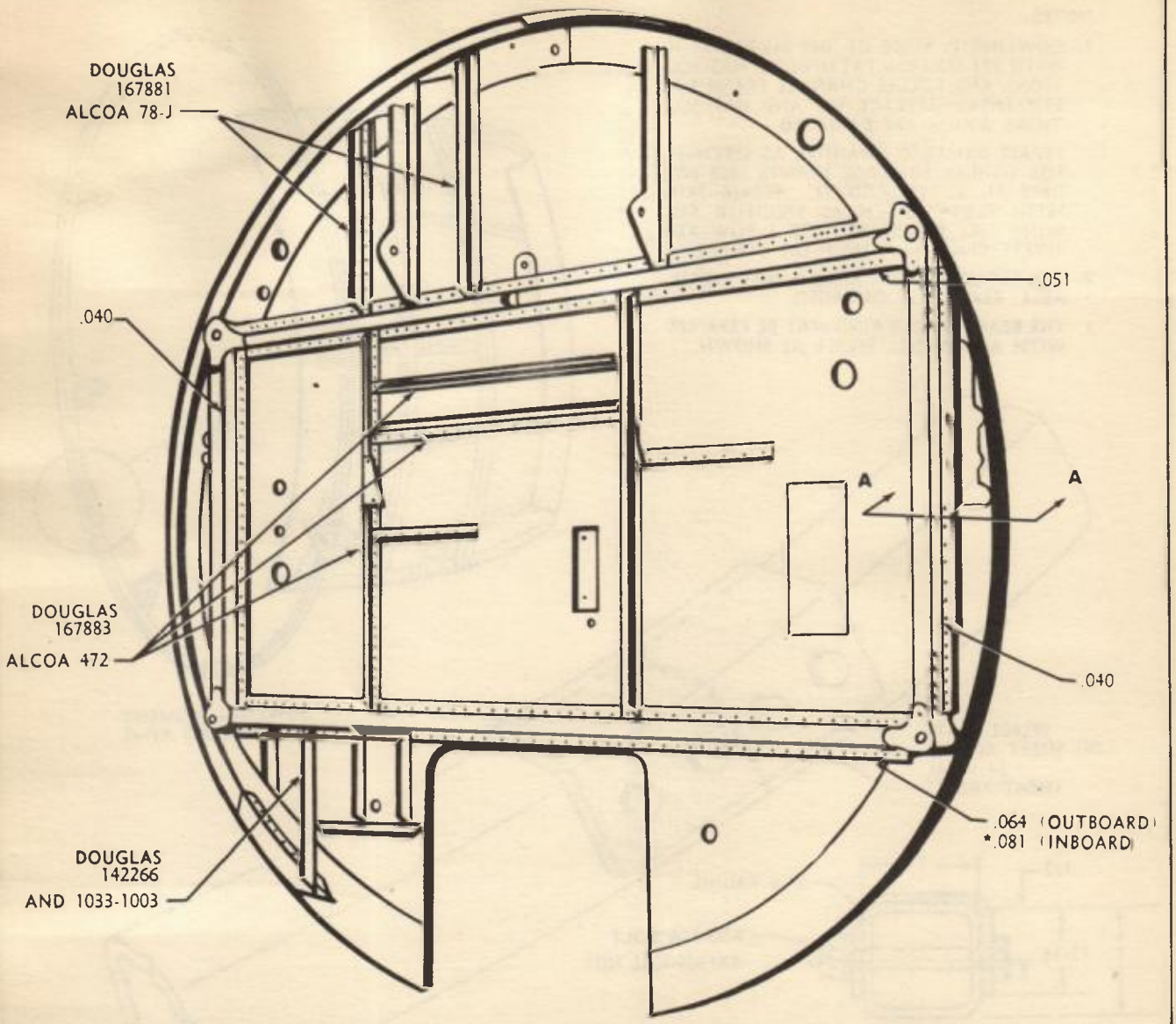


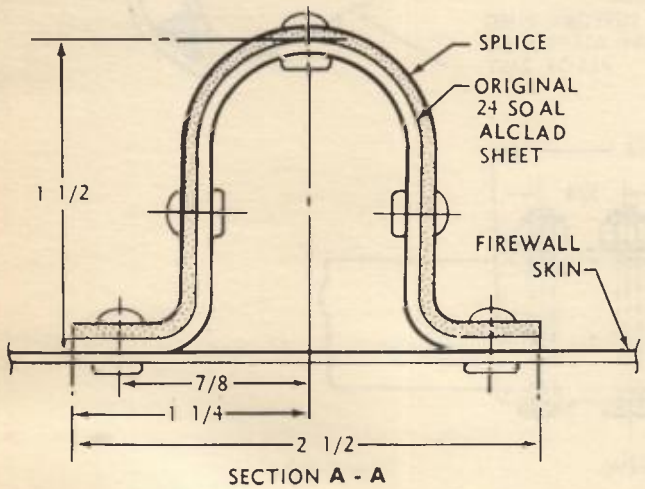
END VIEW



PLAN VIEW

Figure 82 — Anti-Drag Ring Repair





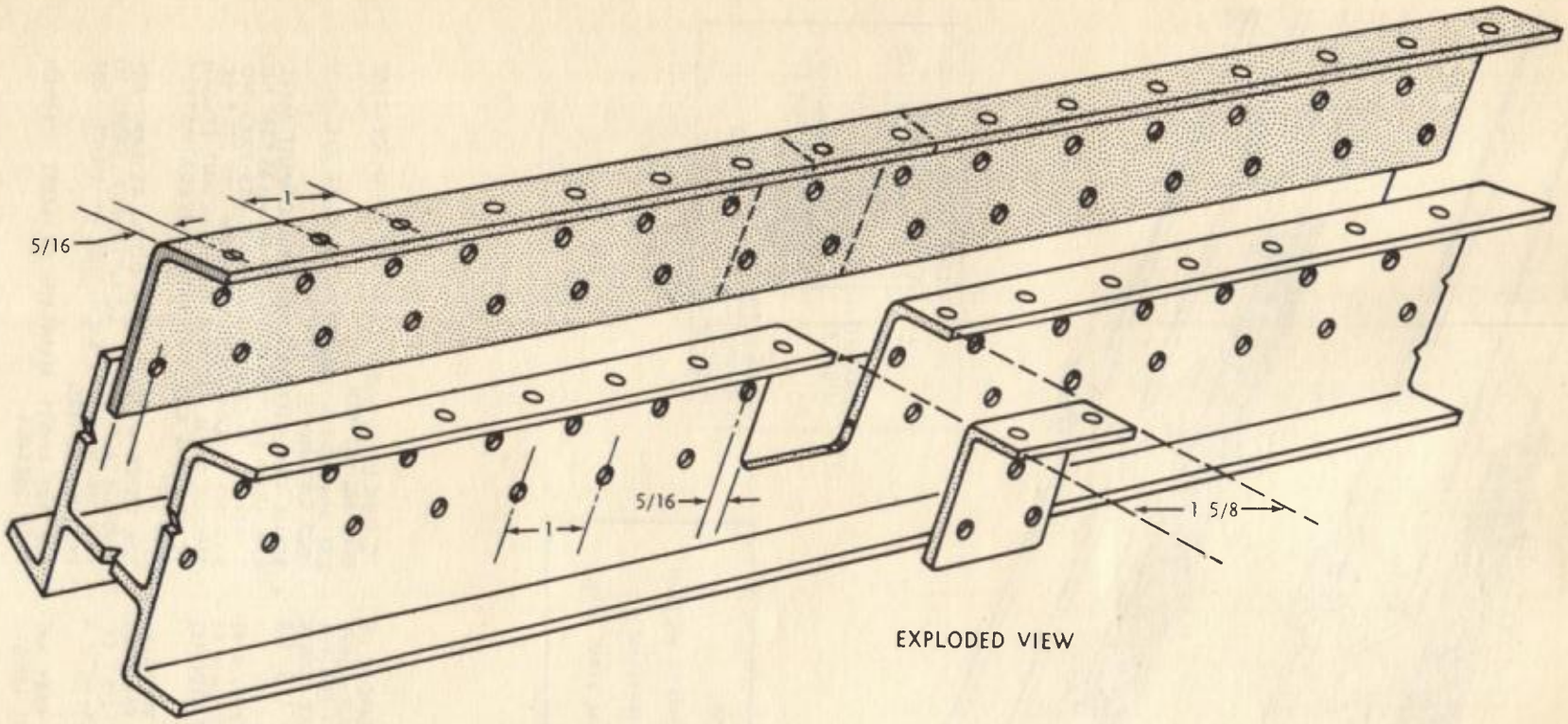
TABLE

GAUGE STIFFENER	GAUGE SPLICE	RIVET SIZE	NO. EACH SIDE OF SPLICE
.040	.051	SS4	22
.051	.064	SS4	24
*.064	.081	SS5	28

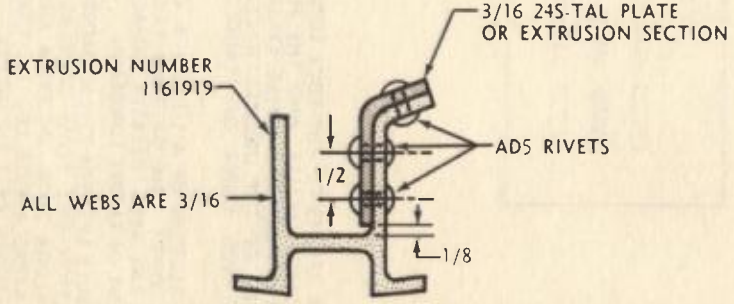
NOTES:

1. REPAIR FIREWALL WEB SIMILARLY TO SPAR WEB. USE STAINLESS STEEL SHEET AND RIVETS (SEE FIGURE 28). USE SS4 RIVETS IN 2 ROWS, SPACED 1 INCH ON CENTER.
2. REPAIR HAT SECTION STIFFENERS AS DESCRIBED IN FIGURE 30. USE EXISTING RIVET PATTERN AND ACCOMPANYING TABLE.

Figure 83 — Firewall Repair



EXPLODED VIEW

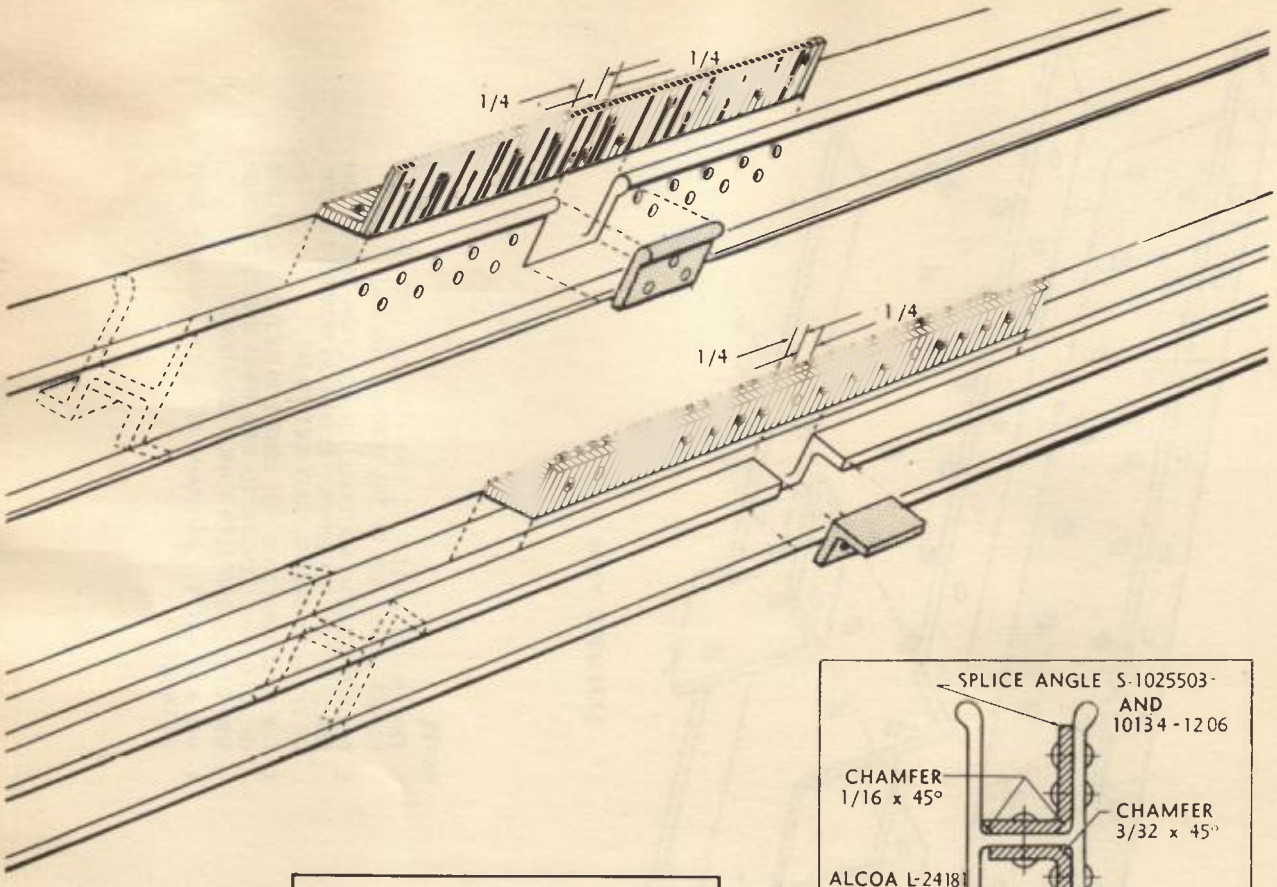


END VIEW OF REPAIR

NOTES:

1. THIS REPAIR APPLIES TO THE FLANGED LEGS OF THE 2 LOWER LONGERONS OF THE INBOARD NACELLE.
2. FOR REPLACEMENT MATERIAL, USE A SECTION TAKEN FROM DOUGLAS PART NO. 5103960 (EXTRUSION NUMBER 1161919) OR 3/16-INCH 24S-TAL PLATE CUT TO FIT.
3. FOR SPLICE MATERIAL, USE BENT 3/16-INCH 24S-TAL PLATE OF SUFFICIENT LENGTH TO PICK UP 21 RIVETS ON EACH SIDE OF SPLICE, SPACED 1 INCH ON CENTER.
4. USE ADS RIVETS. MAINTAIN AT LEAST 5/16-INCH EDGE DISTANCE.

Figure 84 – Nacelle Flanged Longeron Repair



CODE

- REPLACEMENT SECTION
- SPLICE MATERIALS
- ORIGINAL STRUCTURE

NOTES:

1. THIS REPAIR APPLIES TO THE FOUR LONGERONS OF THE OUTBOARD NACELLE AND THE FOUR LONGERONS OF THE INBOARD NACELLE, EXCEPT FOR THE FLANGED LEG OF THE INBOARD NACELLE LOWER LONGERONS. FOR REPAIR OF FLANGED LEG, SEE FIGURE 84.
2. AN ENTIRE SECTION OF A LONGERON CANNOT BE SPLICED. ONLY ONE OR TWO LEGS CAN BE SPLICED IN ANY AREA. GREATER DAMAGE REQUIRES REPLACEMENT OF ENTIRE LONGERON.
3. REPAIR OF BULB LEG: FOR REPLACEMENT MATERIAL, USE A SECTION CUT FROM DOUGLAS PART NO. S-1074767 (ALCOA 24779), OR FROM ANY 24S-T EXTRUSION HAVING A BULB LEG .125 THICK WITH A STRAIGHT LENGTH OF 1 1/2 INCHES.

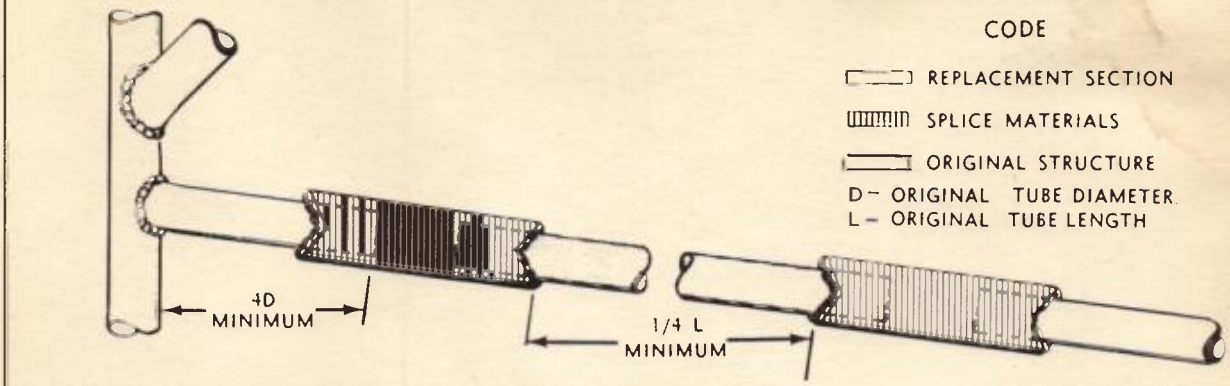
   FOR SPLICE MATERIAL, USE DOUGLAS PART NO. S-1025503 (AND10134-1206) OF SUFFICIENT LENGTH TO PICK UP 22 RIVETS EACH SIDE OF SPLICE— USE EXISTING PATTERN.

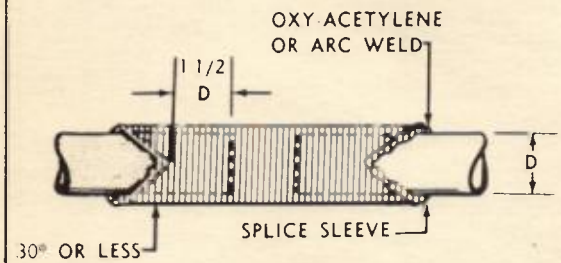
   USE AD4 RIVETS. MAINTAIN AT LEAST 1/4 INCH EDGE DISTANCE.
4. REPAIR OF ANGLE LEG: FOR REPLACEMENT MATERIAL, USE A SECTION CUT FROM DOUGLAS PART NO. S-1074767 (ALCOA 24779), DOUGLAS PART NO. S-1161919 (ALCOA 30645), OR FROM ANY 24S-T EXTRUSION WITH .125 LEGS OF SUFFICIENT LENGTH TO FILL THE CUT OUT AREA (APPROXIMATELY 3/4 x 3/4).

   FOR SPLICE MATERIAL, USE DOUGLAS PART NO. S-1059654 (ALCOA 24181) OF SUFFICIENT LENGTH TO PICK UP 16 RIVETS EACH SIDE OF SPLICE— USE EXISTING PATTERN.

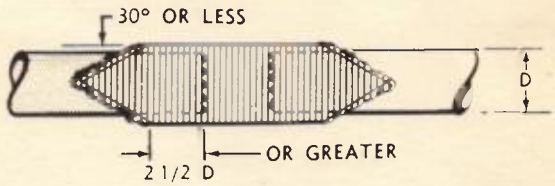
   USE AD4 RIVETS. MAINTAIN AT LEAST 1/4 INCH EDGE DISTANCE.

Figure 85 — Nacelle Bulb Longeron Repair

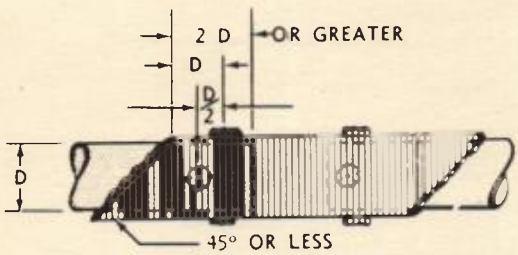




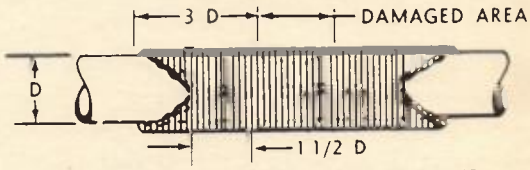
FISHMOUTH SPLICE



ALTERNATE FISHMOUTH SPLICE



ROSETTE SPLICE



DAMAGED TUBE REINFORCEMENT

NOTES:

1. USE OXY-ACETYLENE OR ELECTRIC ARC WELDING (PREFERABLY THE LATTER).
2. USE X4130 CHROME MOLYBDENUM STEEL TUBE OF SAME WALL THICKNESS AS ORIGINAL FOR REPLACEMENT AND SPLICE MATERIAL. SPLICE MUST HAVE PROPER WALL THICKNESS AFTER HONING OR REAMING TO CLOSE SLIDING FIT.
3. REPLACE ENTIRE DAMAGED TUBE IF PRACTICABLE, IN ANY CASES OF DAMAGE.
4. REMAINING STUB OF ORIGINAL TUBE MUST BE 4 DIAMETERS IN LENGTH AND MUST EXTEND 1 DIAMETER INTO SPLICE TUBE.
5. USE FISHMOUTH TYPE WELD IN PREFERENCE TO OTHER TYPES.
6. DIAMETER OF ROSETTE WELDS IS AT LEAST 1/4 TUBE DIAMETER. DRILL HOLE IN SPLICE TUBE ONLY. DO NOT FILE ROSETTE WELDS TO IMPROVE APPEARANCE.
7. DAMAGED UNBROKEN TUBES MAY BE STRAIGHTENED AND REPAIRED. CUT THE SPLICE TUBE LENGTHWISE, LAP IT OVER THE DAMAGED AREA, EXTEND IT 3 DIAMETERS PAST THE DAMAGE IN EACH DIRECTION, AND WELD IT ON, USING STANDARD FISH MOUTH ON ENDS. DO NOT USE THIS SPLICE IN THE MIDDLE FOURTH OF ANY TUBE.

Figure 86 — Engine Mount Repairs

Section 6

LANDING GEAR

1. GENERAL.

The landing gear consists of the following units: two fully retractable main gears with dual wheels; a fully retractable nose gear; and a faired, non-retractable, shock-strut supported tail skid. Each of these assemblies is constructed of numerous parts, such as links, cranks, tubes, etc. Since most of the parts are small, and of a shape not permitting repairs, they should be replaced when damaged.

2. MAIN LANDING GEAR.

In the event of damage to the main landing gear, replace the part damaged. Part numbers and names are listed in the DC-4 Illustrated Parts Catalog. Procedures for removal, disassembly, and reassembly of the main landing gear are described in the DC-4 Maintenance Manual, Vol. III, Section 2.

3. NOSE GEAR.

Do not attempt to repair damage on any part of the nose gear; replace the damaged part. Damage may result from hard landings, rough terrain, or improper technique in towing, involving the use of the brakes. Part numbers and names are listed in the DC-4 Illustrated Parts Catalog. Procedures for removal, disassembly and reassembly of the nose gear are described in the DC-4 Maintenance Manual, Volume III, Section 2.

4. TAIL SKID.

Damage to the fuselage in the event of a tail-down landing is usually prevented by the tail-skid shock strut, which absorbs the impact. Replace the tail-skid shoe contact-plate if it shows evidence of excessive wear or severe damage.

5. LANDING GEAR WRENCH TORQUE TABLE.

The following wrench torque table lists allowable wrench torques in inch-pounds or foot-pounds for all important bolts in the landing gear. These limits must be adhered to because under-torque encourages fatigue, and over-torque may result in excessive elongation of the bolt.

BOLT NO.	NUT NO.	NO. REQ.	ATTACHED PART	INSTALLATION	TORQUE (INCH-POUNDS*)
		MAIN LANDING GEAR ATTACHMENT			
3107368	2107484	2	4074846&7	5233115	1230
		LANDING GEAR RETRACT STRUT ROD END			
	1105710	2	2074256	5233115	320 (ft-lb)
		MAIN LANDING GEAR RETRACT STRUT END FITTING PIN RETAINER			
S-132100-3-3A		8	1103874	5165593	20-25
		BRAKE TORQUE BOLTS			
AN80-17	1234065	48	511064-M	5073669	95-105 (ft-lb)
		MAIN GEAR RETRACT CYLINDER			
	2104755	2	5233129	5233129	240 (ft-lb)

Continued on next page

BOLT NO.	NUT NO.	NO. REQ.	ATTACHED PART	INSTALLATION	TORQUE (INCH-POUNDS*)
		NOSE WHEEL YOKE GLAND ASSEMBLY			
NAS-147-24	AN365-720	3	4230717	5233111	450-500
NAS-147-34	AN365-720	7	4230717	5233111	450-500
NAS-147-38	AN365-720	2	4230717	5233111	450-500
		NOSE WHEEL AXLE TO NOSE GEAR ASSEMBLY			
NAS-148-64	12B-080	8	3138661	5073665	900
		NOSE WHEEL RETRACT STRUT			
	1103165	1	2103170	5073667	295 (ft-lb)
		NOSE WHEEL LINK BARREL			
	1106779-2	1	2103204	5233111	150 (ft-lb)
	1106779-4	1	2103204	5233111	150 (ft-lb)
		NOSE GEAR TORQUE LINK PIN			
2237789	1223318	2	5087982&3	5073666	115 (ft-lb)
		NOSE GEAR SHOCK STRUT AIR VALVE CAP			
	AN813 or 2525	1	7607A Schrader or SK-1517A Dill	5073666	15-25

*Except as otherwise noted.

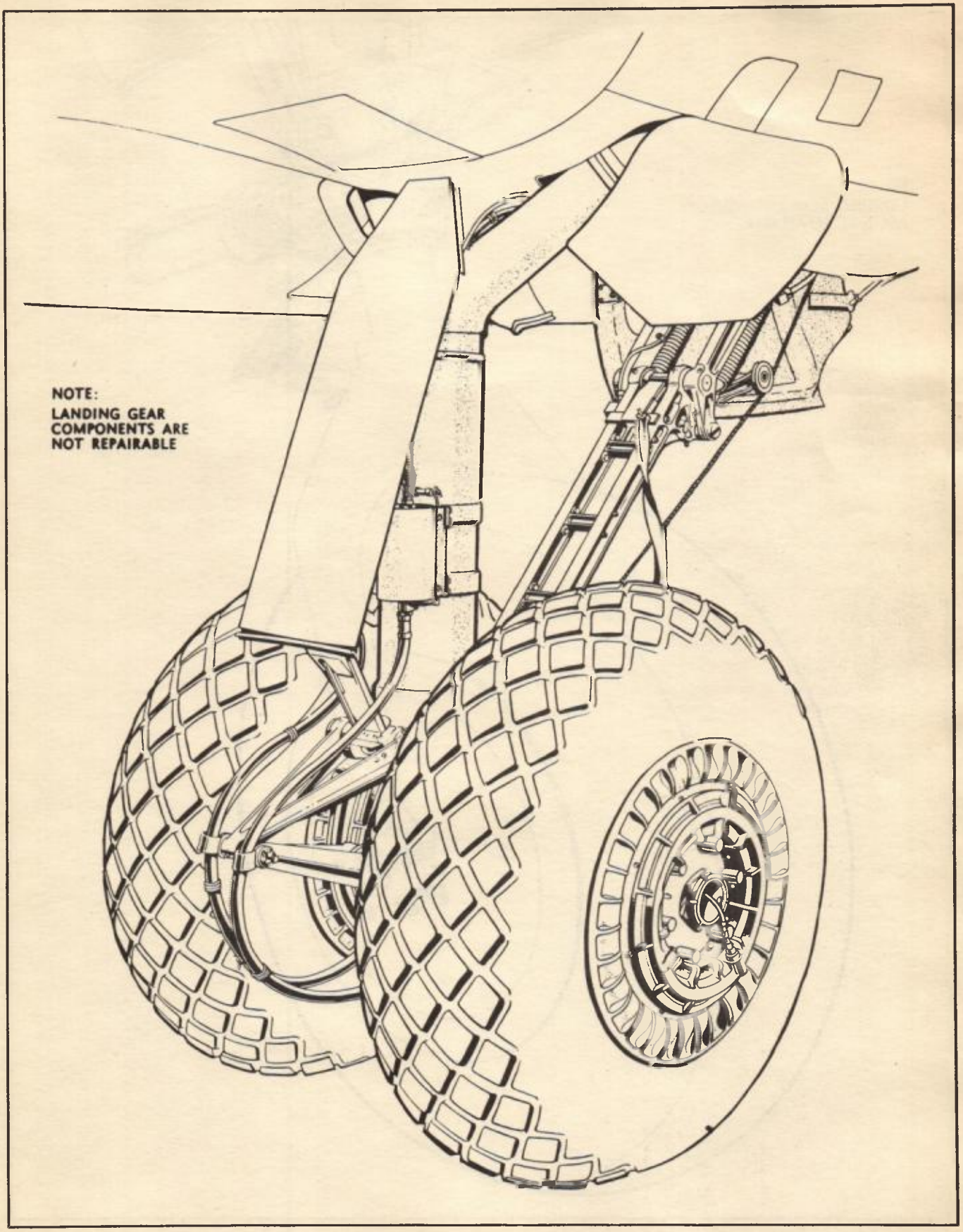


Figure 87 — Main Landing Gear

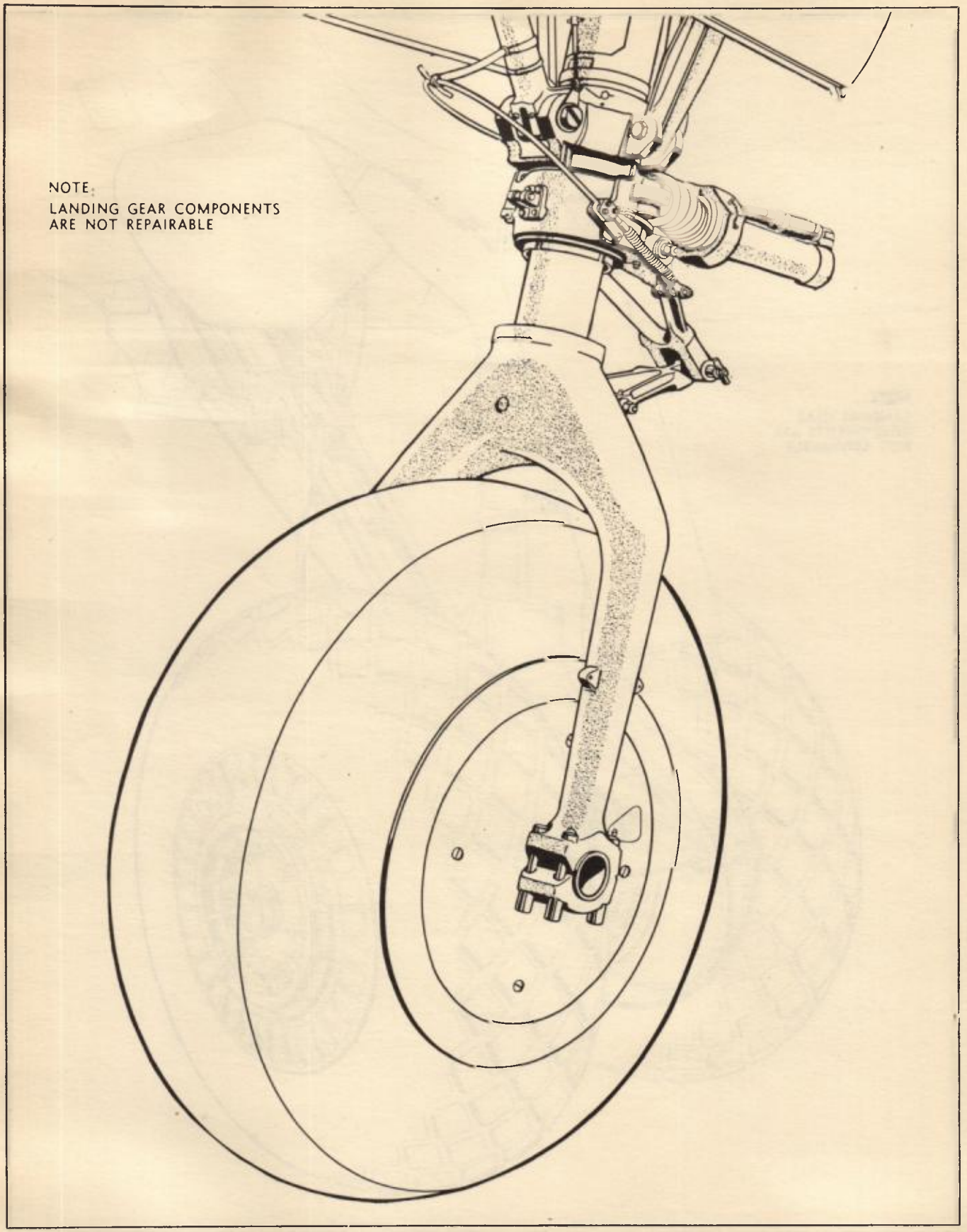


Figure 88 — Nose Landing Gear

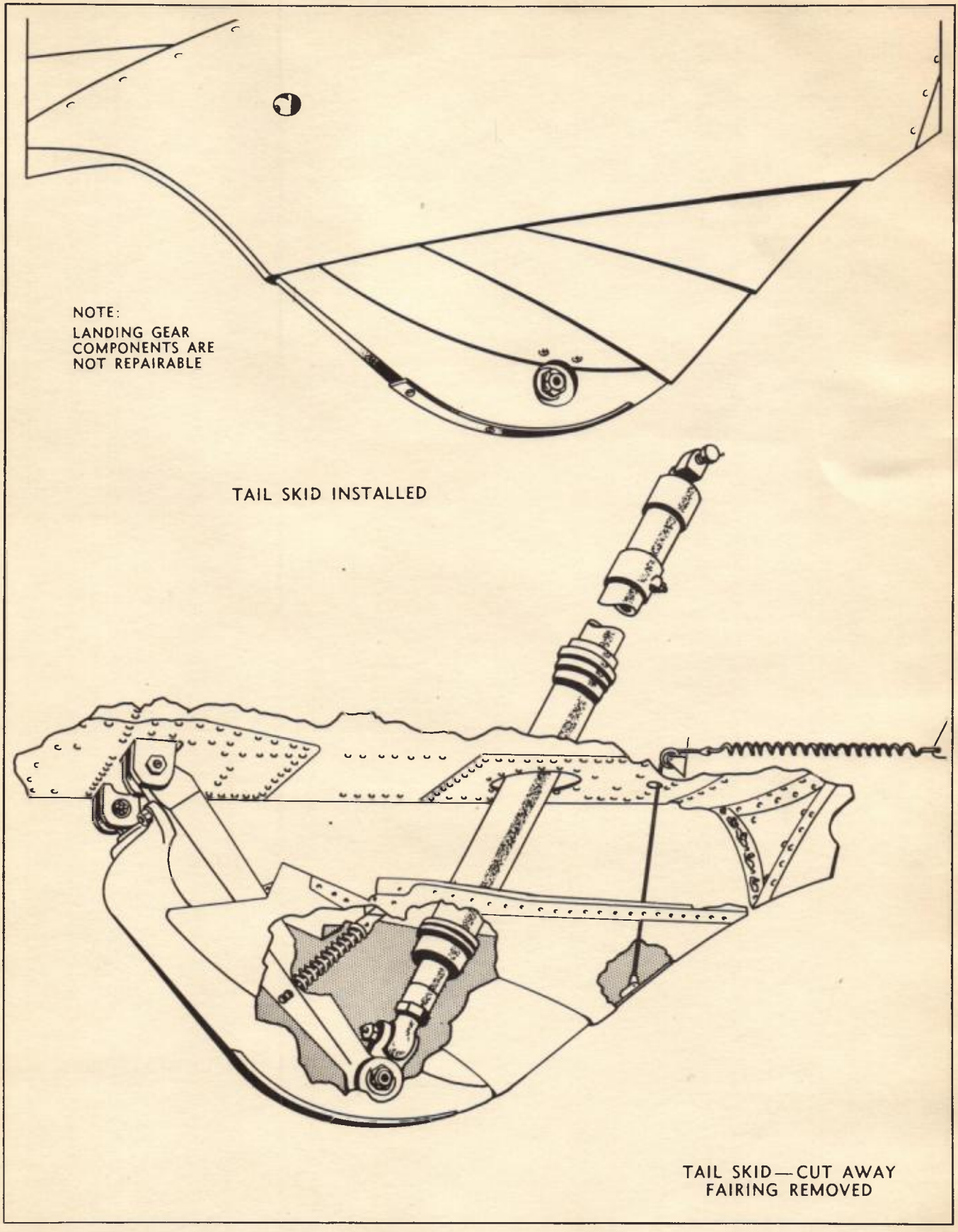


Figure 89 — Tail Skid

Section 7

FABRIC REPAIR

1. GENERAL.

To save weight in units not subjected to high stress loads, fabric is used in place of metal skin on the ailerons, elevators, and rudder. For control rebalancing information, see Section I of this manual.

2. CONSTRUCTION OF FABRIC SURFACES.—Grade "A" cotton fabric is used in the original covering of the surfaces and also for repairs. The fabric is applied to the metal structural members with Parker Kalon screw strips. Repair as instructed in General Manual for Structural Repair, AN01-1A-1.

3. CLASSIFICATION OF DAMAGE TO FABRIC CONTROL SURFACES.

3.1. NEGLIGIBLE DAMAGE. – Damage to fabric is never classified as negligible, as slight imperfections rapidly enlarge. Loss or tearing of fabric in flight may cause serious difficulty in controlling the airplane.

3.2. REPAIRABLE DAMAGE.—Small tears are repaired by sewing torn edges together, doping a pinked edge fabric patch over the seam, and then applying nitrate dope over the entire area. Small holes are either stitched over until closed, or enlarged enough to allow the sewing on of a patch.

Note

Extensive fabric repairs, causing the addition of fabric, thread, and dope, may change static and dynamic balance of the surface. It is therefore necessary to rebalance control surfaces after repairs, as described in Section I of this manual.

Never overlap one patch with another. If area to be repaired exceeds half a section between ribs, replace with new fabric over entire section.

Section 8

MISCELLANEOUS REPAIRS

1. GENERAL INFORMATION.—The units listed below are not classified as structural components of the airplane, but as they are joined to structural members, they may often be damaged if the contiguous structure is injured.

2. WING FUEL TANK COLLAPSIBLE CELLS. — Some DC-4 airplanes are equipped with collapsible fuel tanks, located between the front and center spars, between wing stations 60 and 130. They consist of an inner lining of aromatic-fuel-resistant synthetic rubber, a middle layer of nylon, and an outer layer of rubber-coated fabric. An enclosure of Fiberglas "V" board prevents chafing of the cell against the metal wing structure. Detailed procedures for the removal, repair and installation of these cells is given in Volume VI, Section I of the DC-4 Maintenance Manual.

CAUTION

Carefully tape edges of the access door through which the collapsible cells are removed, to prevent snagging the cell. Exercise great care to prevent bending the fuel overflow line in the access door opening.

3. DE-ICING EQUIPMENT.—Air inflated de-icer shoes are installed on the leading edges of the wings and stabilizers. They are constructed of an outer and inner layer of soft, flexible rubber. A fabric reinforcement lies between the rubber surfaces. Even slight damage should be repaired as soon as discovered; for, due to the nature of the material, slight damage may develop into extensive tears, which could endanger the performance of the airplane.

Procedure for removal, repair and replacement of De-icer boots is given in Section VI, Paragraph 7 of the DC-4 Maintenance Manual.

4. HEATING AND VENTILATING SYSTEM DUCTS.—Heating and ventilating system ducts are of fabric or soft aluminum construction. As the metal ducts are not structural, airtight repair is satisfactory. A 2S aluminum patch, riveted to the duct with blind rivets, will generally meet all requirements. Fabric ducts may be repaired by sewing or doping on a patch. Flexible hose P212L should be replaced if damaged.

5. SOUNDPROOFING.—Various materials are used in the soundproofing of the flight compartment, cabin walls and ceiling. It is generally applied in prefabricated panels of proper width and thickness to fit between stringers and frames. Damage is repaired by trimming back to uninjured material, filling in the hole with the same product, and fastening the patch with cement or wire clips. A repair to Kapoc felt made in this manner requires an outer cemented reinforcing patch of airplane cloth extending 3 inches beyond the damage on all sides.