SECTION 17

STRUCTURAL REPAIR

TABLE OF CONTENTS

17-1. STRUCTURAL REPAIR.

17-2. REPAIR CRITERIA. Although this section outlines repair permissible on structure of the aircraft, the decision of whether to repair or replace a major unit of structure will be influenced by such factors as time and labor available, and by a comparison of labor costs with the price of replacement assemblies. Past experience indicates that replacement, in many cases, is less costly than major repair. Certainly, when the aircraft must be restored to its airworthy condition in a limited length of time, replacement is preferable. Restoration of a damaged aircraft to its original design strength, shape, and alignment involves careful evaluation of the damage, followed by exacting workmanship in performing the repairs. This section suggests the extent of structural repair practicable on the aircraft, and supplements Federal Aviation Regulation, Part 43. Consult the factory when in doubt about a repair not specifically mentioned here.

17-3. EQUIPMENT AND TOOLS.

17-4. SUPPORT STANDS. Padded, reinforced sawhorse or tripod type support stands, sturdy enough to support any assembly placed upon them, must be used to store a removed wing or tailcone. Plans for local fabrication of support stands are contained in figure 17-1. The fuselage assembly, from the tailcone to the firewall, must NOT be supported from the underside, since the skin bulkheads are not designed for this purpose. Adapt support stands to fasten to the wing attach points or landing gear attach points when supporting a fuselage.

17-5. FUSELAGE REPAIR JIGS. Whenever a repair is to be made which could affect structural alignment, suitable jigs must be used to assure correct alignment of major points, such as fuselage, firewall, wing and landing gear. These fuselage repair jigs are obtainable from the factory.

17-6. WING JIGS. These jigs serve as a holding fixture during extensive repair of a damaged wing, and locates the root rib, leading edge and tip rib of the wing. These jigs are also obtainable from the factory.

17-7. WING TWIST AND STABILIZER ANGLE-OF-INCIDENCE. Wing twist (washout) and horizontal stabilizer angle of incidence are shown below. Stabilizers do not have twist. Wings have no twist from the root to the lift strut station. All twist in the wing panel occurs between this station and the tip rib. Refer to figure 17-2 for wing twist measurement.

WING	Twist (Washout)	3°
STABILIZER	Angle of Incidence	-3° 30'

17-8. REPAIR MATERIALS. Thickness of a material on which a repair is to be made can easily be determined by measuring with a micrometer. In general, material used in Cessna aircraft covered in this manual is made from 2024 aluminum alloy, heat treated to a -T3, -T4, or -T42 condition. If the type of material cannot readily be determined, 2024-T3 may be used in making repairs, since the strength of -T3 is greater than -T4 or -T42 (-T4 and -T42 may be used interchangeably, but they may not be substituted for -T3). When necessary to form a part

with a smaller bend radius than the standard cold bending radius for 2024-T4, use 2024-0 and heat treat to 2024-T42 after forming. The repair material used in making a repair must equal the gauge of the material being replaced unless otherwise noted. It is often practical to cut repair pieces from service parts listed in the Parts Catalog. A few components (empennage tips, for example) are fabricated from thermo-formed plastic or glass-fiber constructed material.

17-9. WING.

17-10. DESCRIPTION. The wing assemblies are a semicantilever type employing semimoncoque type of structure. Basically, the internal structure consists of built-up front and rear spar assemblies, a formed auxiliary spar assembly and formed sheet metal nose, intermediate, and trailing edge ribs. Stressed skin, riveted to the rib and spar structures, completes the rigid structure. Access openings (hand holes with removable cover plates) are located in the underside of the wing between the wing root and tip section. These openings afford access to aileron bellcranks, flap bellcranks, electrical wiring, strut attach fittings, control cables and pulleys, and control disconnect points.

17-11. WING SKIN.

17-12. NEGLIGIBLE DAMAGE. Any smooth dents in the wing skin that are free from cracks, abrasions and sharp corners, which are not stress wrinkles and do not interfere with any internal structure or mechanism, may be considered as negligible damage. In areas of low stress intensity, cracks, deep scratches, or deep, sharp dents, which after trimming or stop-drilling can be enclosed by a two-inch circle, can be considered negligible if the damage area is at least one diameter of the enclosing circle away from all existing rivet lines and material edges. Stop drilling is considered a temporary repair and a permanent repair must be made as soon as practicable.

17-13. REPAIRABLE DAMAGE. Figure 17-4 outlines typical repair to be employed in patching skin. Before installing a patch, trim the damaged area to form a retangular pattern, leaving at least a one-half inch radius at each corner, and de-burr. The sides of the hole should lie span-wise or chord-wise. A circular patch may also be used. If the patch is in an area where flush rivets are used, make a flush patch type of repair; if in an area where flush rivets are not used, make an overlapping type of repair. Where optimum appearance and airflow are desired, the flush patch may be used. Careful workmanship will eliminate gaps at butt-joints; however, an epoxy type filler may be used at such joints.

17-14. DAMAGE NECESSITATING REPLACEMENT OF PARTS. If a skin is badly damaged, repair must be made by replacing an entire skin panel, from one structural member to the next. Repair seams must be made to lie along structural members and each seam must be made exactly the same in regard to rivet size, spacing and pattern as the manufactured seams at the edges of the original sheet. If the manufactured seams are different, the stronger must be copied. If the repair ends at a structural member where no seam is used, enough repair panel must be used to allow an extra row of staggered rivets, with sufficient edge margin, to be installed.

17-15. WING STRINGERS.

17-16. NEGLIGIBLE DAMAGE. (Refer to paragraph 17-13.)

17-17. REPAIRABLE DAMAGE. Figure 17-5 outlines a typical wing stringer repair. Two such repairs may be used to splice a new section of stringer material in position, without the filler material.

17-18. DAMAGE NECESSITATING REPLACEMENT OF PARTS. If a stringer is so badly damaged that more than one section must be spliced. replacement is recommended.

17-19. WING AUXILIARY SPARS.

17-20. NEGLIGIBLE DAMAGE. (Refer to paragraph 17-13.)

17-21. REPAIRABLE DAMAGE. Figure 17-8 illustrates a typical auxiliary spar repair.

17-22. DAMAGE NECESSITATING REPLACEMENT OF PARTS. If damage to an auxiliary spar would require a repair which could not be made between adjacent ribs. the auxiliary spar must be replaced.

17-23. WING RIBS.

17-24. NEGLIGIBLE DAMAGE. (Refer to paragraph 17-13.)

17-25. REPAIRABLE DAMAGE. Figure 17-6 illustrates a typical wing rib repair.

17-26. DAMAGE NECESSITATING REPLACEMENT OF PARTS. Leading and trailing edge ribs that are extensively damaged can be replaced. However, due to the necessity of unfastening an excessive amount of skin in order to replace the rib. they should be repaired if practicable. Center ribs, between the front and rear spar should always be repaired if practicable.

17-27. WING SPARS.

17-28. NEGLIGIBLE DAMAGE. Due to the stress which wing spars encounter. very little damage can be considered negligible. All cracks, stress wrinkles. deep scratches. and sharp dents must be repaired. Smooth dents, light scratches and abrasions may be considered negligible.

17-29. REPAIRABLE DAMAGE. Figure 17-7, illustrates typical spar repairs. It is often practical to cut repair pieces from service parts listed in the Parts Catalog. Service Kits are available for certain types of spar repairs.

17-30. DAMAGE NECESSITATING REPLACEMENT OF PARTS. Damage so extensive that repair is not practicable requires replacement of a complete wing spar. Also refer to paragraph 17-2.

17-31. WING LEADING EDGES.

17-32. NEGLIGIBLE DAMAGE. (Refer to paragraph 17-12.)

17-33. REPAIRABLE DAMAGE. Wing skin repairs, outlined in paragraph 17-13, may be used to repair leading edge skins, although the flush-type patches should be used. To facilitate repair, extra access holes may be installed in locations noted in figure 17-13. If the damage would require a repair which could not be made between adjacent ribs, refer to the following paragraph.

17-34. DAMAGE NECESSITATING REPLACEMENT OF PARTS. Where extreme damage has occurred, complete leading edge skin panels should be replaced. Extra access holes may be installed (refer to figure 17-13) to facilitate replacement.

17-35. BONDED LEADING EDGES REPAIR.

17-36. NEGLIGIBLE DAMAGE. (Refer to paragraph 17-12.)

17-37. REPAIRABLE DAMAGE. (Refer to figure 17-11.) Cut out damaged area, as shown, to the edge of undamaged ribs. Using a corresponding section from a new leading edge skin, overlap ribs and secure to wing using rivet pattern as shown in the figure.

17-37A. WING STRUT.

17-37B. REPAIRABLE DAMAGE.

a. For grooves in wing strut caused by strut fairings, the following applies.
   1. If groove exceeds .010 inch in depth and is less than .75 inch from a rivet center, the strut should be replaced.
   2. If groove exceeds .025 inch in depth and is more than .75 inch from a rivet center, the strut should be replaced.
   3. If groove depth is less than .025 inch and is more than .75 inch from a rivet center, strut should be repaired by tapering gradually to the original surface and burnishing out to a smooth finish. The local area should be checked with dye penetrant to ensure that no crack has developed.

b. The following applies to wing struts with grooves worn in the lower trailing edge. This type damage can occur after extensive cabin door usage with a missing or improperly adjusted door stop which allows the door to bang against the aft edge of the strut at the lower end.

NOTE

Struts with a groove deeper than 50% of the original material thickness should be replaced. Lesser damage may be repaired as follows:

   1. Without making the damage deeper, remove strut material on each side of groove to reduce notch effect of damage. Smooth and blend the surface to provide a gradual transition of strut tube material thickness in damaged area. The local area should be checked with dye penetrant to ensure that no crack has developed.
   2. Apply brush alodine or zink chromate primer and repaint area.
   3. Rerig the door stop and/or reform the lower portion of the door pan and skin inboard to prevent the door from rubbing the strut tube. If these actions prove to be ineffective, install some form of protective bumper, either on strut or lower protion of door, to prevent further damage. A short hard rubber strip bonded to the trailing edge of the strut where the door comes close to strut is a possibility.

c. Tie-downs and attaching parts may be replaced. If a wing strut is badly dented, cracked or deformed, it should be replaced.

17-38. AILERONS.

17-39. NEGLIGIBLE DAMAGE. (Refer to paragraph 17-12.)

17-40. REPAIRABLE DAMAGE. The repair shown in figure 17-9 may be used to repair damage to aileron leading edge skins. Figure 17-4 may be used as a guide to repair damage to flat surface between corrugations, when damaged area includes corrugations refer to figure 17-12. It is recommended that material used for repair be cut from spare parts of the same guage and corrugation spacing. Following repair the aileron must be balanced. Refer to paragraph 17-43 for balancing. If damage would require a repair which could not be made between adjacent ribs, refer to paragraph 17-41.

17-41. DAMAGE NECESSITATING REPLACEMENT OF PARTS. If the damage would require a repair which could not be made between adjacent ribs, complete skin panels must be replaced. Ribs and spars may be repaired, but replacement is generally preferable. Where extensive damage has occurred, replacement of the aileron assembly is recommended. After repair and/or replacement, balance aileron in accordance with paragraph 17-42 and figure 17-3.

17-42. AILERON BALANCING. Following repair, replacement or painting, the aileron must be balanced. A flight control surface balancing fixture kit is available (P N 5180002-1). See figure 17-3 for procedures pertaining to the use of this kit.

17-43. WING FLAPS.

17-44. NEGLIGIBLE DAMAGE. (Refer to paragraph 17-12.)

17-45. REPAIRABLE DAMAGE. Flap repairs should be similar to aileron repairs discussed in paragraph 17-41. Since the flap is not considered a movable control surface, no balancing is required.

17-46. DAMAGE NECESSITATING REPLACEMENT OF PARTS. Flap repairs which require replacment of parts should be similar to aileron repairs discussed in paragraph 17-41. Since the flap is not considered a movable control surface, no balancing is required.

17-47. ELEVATORS AND RUDDER.

17-48. NEGLIGIBLE DAMAGE. Refer to paragraph 17-12. The exception to negligible damage on the elevator surfaces is the front spar, where a crack appearing in the web at the hinge fittings or in the structure which supports the overhanging balance weight is not considered negligible. Cracks in the overhanging tip rib, in the area at the front spar intersection with the web of the rib, also cannot be considered negligible.

17-49. REPAIRABLE DAMAGE. Skin patches illustrated in figure 17-4 may be used to repair skin damage between corrugations. For skin damage which includes corrugations refer to figure 17-12. Following repair the elevator/rudder must be balanced. Refer to figure 17-3 for balancing. If damage would require a repair which could not be made between adjacent ribs, see paragraph 17-50.

17-39A. CRACKS IN CORRUGATED AILERON SKINS (Continued from page 17-5)

1. It is permissible to stop drill crack(s) that originate at the trailing edge of the control surface provided the crack is not more than 2 inches in length.

2. Stop drill crack using a #30 (.128 inch) drill.

3. A crack may only be stop drilled once.

   NOTE: A crack that passes through a trailing edge rivet and does not extend to the trailing edge of the skin may be stop drilled at both ends of the crack.

4. Any control surface that has a crack that progresses past a stop drilled hole shall be repaired. Refer to paragraphs 17-39, -40, and -41 as applicable for repair information.

5. A control surface that has any of the following conditions shall have a repair made as soon as practicable:

   A. A crack that is longer than 2 inches.

   B. A crack that does not originate from the trailing edge or a trailing edge rivet.

   C. Cracks in more than six trailing edge rivet locations per skin.

   Refer to paragraphs 17-39, -40, and -41 as applicable for repair information.

6. Affected control surfaces with corrugated skins and having a stop drilled crack that does not extend past the stop drilled hole, may remain in service without additional repair.

17-44A. CRACKS IN CORRUGATED FLAP SKINS (Continued from page 17-6)

1. It is permissible to stop drill crack(s) that originate at the trailing edge of the control surface provided the crack is not more than 2 inches in length.

2. Stop drill crack using a #30 (.128 inch) drill.

3. A crack may only be stop drilled once.

   NOTE: A crack that passes through a trailing edge rivet and does not extend to the trailing edge of the skin may be stop drilled at both ends of the crack.

4. Any control surface that has a crack that progresses past a stop drilled hole shall be repaired. Refer to paragraphs 17-44, -45, and -46 as applicable for repair information.

5. A control surface that has any of the following conditions shall have a repair made as soon as practicable:

   A. A crack that is longer than 2 inches.

   B. A crack that does not originate from the trailing edge or a trailing edge rivet.

   C. Cracks in more than six trailing edge rivet locations per skin.

   Refer to paragraphs 17-44, -45, and -46 as applicable for repair information.

6. Affected control surfaces with corrugated skins and having a stop drilled crack that does not extend past the stop drilled hole, may remain in service without additional repair.

17-48A. CRACKS IN CORRUGATED ELEVATOR SKINS (Continued from page 17-6)

1. It is permissible to stop drill crack(s) that originate at the trailing edge of the control surface provided the crack is not more than 2 inches in length.

2. Stop drill crack using a #30 (.128 inch) drill.

3. A crack may only be stop drilled once.

   NOTE: A crack that passes through a trailing edge rivet and does not extend to the trailing edge of the skin may be stop drilled at both ends of the crack.

4. Any control surface that has a crack that progresses past a stop drilled hole shall be repaired. Refer to paragraphs 17-48, -49, and -50 as applicable for repair information.

5. A control surface that has any of the following conditions shall have a repair made as soon as practicable:

   A. A crack that is longer than 2 inches.

   B. A crack that does not originate from the trailing edge or a trailing edge rivet.

   C. Cracks in more than six trailing edge rivet locations per skin.

   Refer to paragraphs 17-48, -49, and -50 as applicable for repair information.

6. Affected control surfaces with corrugated skins and having a stop drilled crack that does not extend past the stop drilled hole, may remain in service without additional repair.

17-50. DAMAGE NECESSITATING REPLACEMENT OF PARTS. If the damaged area would require a repair which could not be made between adjacent ribs, complete skin panels must be replaced. Ribs and spars may be repaired, but replacement is generally preferable. Where extensive damage has occurred, replacement of the entire assembly is recommended. After repair and/or replacement, balance elevators and rudder in accordance with paragraph 17-51 and figure 17-3.

17-51. ELEVATOR AND RUDDER BALANCING. Following repair, replacement or painting, the elevators and rudder must be balanced. A flight control surface balancing fixture kit is available (P/N 5180002-1). See figure 17-3 for procedures pertaining to the use of this kit.

17-52. FIN AND STABILIZER.

17-53. NEGLIGIBLE DAMAGE. (Refer to paragraph 17-12.)

17-54. REPAIRABLE DAMAGE. Skin patches illustrated in figure 17-4 may be used to repair skin damage. Access to the dorsal area of the fin may be gained by removing the horizontal closing rib at the bottom of the fin. Access to the internal fin structure is best gained by removing skin attaching rivets on one side of the rear spar and ribs, and springing back the skin. Access to the stabilizer structure may be gained by removing skin attaching rivets on one side of the rear spar and ribs, and springing back the skin. If the damaged area would require a repair which could not be made between adjacent ribs, or a repair would be located in an area with compound curves, see the following paragraph.

17-55. DAMAGE NECESSITATING REPLACEMENT OF PARTS. If the damaged area would require a repair which could not be made between adjacent ribs, or the repair would be located in an area with compound curves, complete skin panels must be replaced. Ribs and spars may be repaired, but replacement is generally preferable. Where damage is extensive, replacement of the entire assembly is recommended.

17-56. FUSELAGE.

17-57. DESCRIPTION. The fuselage is of semimonocoque construction, consisting of formed bulkheads, longitudinal stringer, reinforcing channels, and skin panels.

17-58. NEGLIGIBLE DAMAGE. Refer to paragraph 17-12. Mild corrosion appearing upon alclad surfaces does not necessarily indicate incipient failure of the base metal. However, corrosion of all types must be carefully considered, and approved remedial action taken. Small cans appear in the skin structure of all metal aircraft. It is strongly recommended however, that wrinkles which appear to have originated from other sources, or which do not follow the general appearance of the remainder of the skin panels, be thoroughly investigated. Except in the landing gear bulkhead areas, wrinkles occurring over stringers which disappear when the rivet pattern is removed, may be considered negligible. However, the stringer rivet holes may not align perfectly with the skin holes because of a permanent "set" in the stringer. If this is apparent, replacement of the stringer will usually restore the original strength characteristics of the area.

NOTE

Wrinkles occurring in the skin of the main landing gear bulkhead areas must not be considered negligible. The skin panel must be opened sufficiently to permit thorough examination of the lower portion of the landing gear bulkhead and its tie-in structure.

Wrinkles occurring in open areas which disappear when the rivets at the edge of the sheet are removed, or a wrinkle which is hand removable, may often be repaired by the addition of a 1 2 × 1 2 × .060 inch 2024-T4 extruded angle, riveted over the wrinkle and extended to within 1 16 to 1 8 inch of the nearest structural members. Rivet pattern should be identical to existing manufactured seam at edge of sheet. Negligible damage to stringers, formed skin flanges, bulkhead channels, and like parts is similar to that for the wing skin, given in paragraph 17-12.

17-59. REPAIRABLE DAMAGE. Fuselage skin repairs may be accomplished in the same manner as wing skin repairs outlined in paragraph 17-13. Stringers, formed skin flanges, bulkhead channels and similar parts may be repaired as shown in figure 17-5.

17-60. DAMAGE NECESSITATING REPLACEMENT OF PARTS. Fuselage skin major repairs may be accomplished in the same manner as the wing repairs outlined in paragraph 17-13. Damaged fittings must be replaced. Seat rails serve as structural parts of the fuselage and must be replaced if damaged.

17-61. BONDED DOORS.

17-62. REPAIRABLE DAMAGE. Bonded doors may be repaired by the same methods used for riveted structure. Rivets are a satisfactory substitute for bonded seams on these assemblies. The strength of the bonded seams in doors may be replaced by a single 3/32, 2117-AD rivet per running inch of bond seam. The standard repair procedures outlined in AC43.13-1 are also applicable to bonded doors.

17-63. BULKHEADS.

17-64. LANDING GEAR BULKHEADS. Since these bulkheads are highly stressed members, irregularly formed to provide clearance for control cables, fuel lines, etc., the patch-type repairs will be, for the most part, impractical. Minor damage, consisting of small nicks or scratches, may be repaired by dressing out the damaged area, or by replacement of rivets. Any other damage must be repaired by replacing the landing gear support assembly as an aligned unit.

17-65. REPAIR AFTER HARD LANDING. Buckled skin or floorboards, and loose or sheared rivets in the area of the main gear support will give evidence of damage to the structure from an extremely hard landing. When such evidence is present, the entire support structure must be examined, and all support forgings must be checked for cracks, using a dye penetrant and proper magnification. Bulkheads in the damaged area must be checked for alignment, and deformation of the bulkhead webs must be determined with the aid of a straightedge. Damaged support structure, buckled floorboards and skins, and damaged or questionable forgings must be replaced.

17-66. FIREWALL DAMAGE. Firewall sheets may be repaired by removing the damaged material (.016-inch aluminumized iron sheet), and splicing in a new section. The new portion must be lapped over the old material, sealed with Pro-Seal No. 700 (Coast Pro-Seal Co., Chemical Division, 2235 Beverly Blvd., Los Angeles, California), compound or equivalent, and secured with MS16535 (steel) or MS20613 (corrosion-resistant steel) rivets. The heater valve assembly is attached with MS16535 and MS20613 rivets. Carburetor heat and mixture control doubler, firewall plates, firewall doublers and nutplates are attached to the firewall with MS20470 (aluminum) rivets.

17-67. FASTENERS. Fasteners used in the aircraft are generally solid aluminum rivets, blind rivets, and steel-threaded fasteners. Usage of each is primarily a function of the loads to be carried, accessibility, and frequency of removal. Rivets used in aircraft construction are usually fabricated from aluminum alloys. In special cases, monel, corrosion-resistant steel and mild steel, copper, and iron rivets are used.

17-67A. RIVETS. Standard solid-shank MS rivets are those generally used in aircraft construction. They are fabricated in the following head types: roundhead, flathead, countersunk head, and brazier head. Flathead rivets are generally used in the aircraft interior where head clearance is required. MS20426 countersunk head rivets are used on the exterior surfaces of the aircraft to minimize turbulent airflow. MS20470 brazier head rivets are used on the exterior surfaces of the aircraft where strength requirements necessitate a stronger rivet head than that of the countersunk head rivet. Both the brazier head and the countersunk head rivets are used on the exterior of the aircraft where head clearance is required. Hi-shear rivets are special, patented rivets having a hi-shear strength equivalent to that of standard AN bolts. They are used in special cases in locations where hi-shear loads are present, such as in spars, wings, and in heavy bulkhead ribs. This rivet consists of a cadmium-plated pin of alloy steel. Some have a collar of aluminum alloy. Some of these rivets can be readily identified by the presence of the attached collar in place of the formed head on standard rivets. Blind rivets are used, where strength requirements permit, where one side of the structure is inaccessible, making it impossible or impractical to drive standard solid-shank rivets.

17-67B. REPLACEMENT OF HI-SHEAR RIVETS. Replacement of hi-shear rivets with close-tolerance bolts or other commercial fasteners of equivalent strength properties is permissible. Holes must not be elongated, and the hi-shear substitute must be a smooth, push-fit. Field replacement of main landing gear forgings on bulkheads may be accomplished by using the following fasteners.

a. NAS464P-* bolt, MS21042-* nut and AN960-* washer in place of Hi-shear rivets for forgings with machined flat surfaces around attachment holes.
b. NAS464P-* bolt, ESNA2935-* mating base washer and ESNA RM52LH2935-* self-aligning nut for forgings (with draft angle of up to a maximum of 8°) without machined flat surfaces around attachment holes.

*Dash numbers to be determined according to the size of the holes and the grip lengths required. Bolt grip length should be chosen so that no threads remain in the bearing area.

17-67C. SUBSTITUTION OF RIVETS.

a. Solid-shank rivets (MS20426AD and MS20470AD). When placing rivets in installations which require raised head rivets, it is desirable to use rivets identical to the type of rivet removed. Countersunk-head rivets (MS20426) are to be replaced by rivets of the same type and degree of countersink. When rivet holes become enlarged, deformed, or otherwise damaged, use the next larger size rivet as a replacment. Replacement shall not be made with rivets of lower strength material.
b. Hi-shear Rivets. When hi-shear rivets are not available, replacement of sizes 3/16-inch or greater rivets shall be made with bolts of equal or greater strength than the rivet being replaced, and with self-locking nuts of the same diameter
c. The following pages contain approved solid-shank and hi-shear rivet substitutions.

Replace	In thickness (or thicker)	With
MS20470AD3	.025	NAS1398B4, NAS1398D4
	.020	NAS1738B4, NAS1738D4, NAS1768D4, CR3213-4, CR3243-4
MS20470AD4	.050	NAS1398B4, NAS1398D4
	.040	NAS1398B5, NAS1398D5, NAS1738B4, NAS1738E4, NAS1768D4, CR3213-4
	.032	NAS1738B5, NAS1738E5, NAS1768D5, CR3213-5, CR3243-4
	.025	CR3243-5
MS20470AD5	.063	NAS1398B5, NAS1398D5
	.050	NAS1398B6, NAS1398D6, NAS1398B5, NAS1738E5, CR3213-5
	.040	NAS1738B6, NAS1738E6, NAS1768D5, CR3213-6, CR3243-5
	.032	CR3243-6
MS20470AD6	.080	NAS1398B6
	.071	NAS1398D6
	.063	NAS1738B6, NAS1738D6, NAS1768D6, CR3213-6
	.050	CR3243-6
MS20426AD3 (Countersunk)	.063	NAS1399B4, NAS1399D4
	.040	NAS1769D4, CR3212-4
(See Note 1)	.025	NAS1769B4, NAS1739E4, CR3242-4

Replace	In thickness (or thicker)	With
MS20426AD4 (Countersunk)	.080	NAS1399B4, NAS1399D4
	.063	NAS1739B4, NAS1739D4, CR3212-4
	.050	NAS1769D4
	.040	CR3242-4
(See Note 1)	.050	CR3212-5
	.040	NAS1739B5, NAS1739D5, NAS1769D4
	.032	CR3242-5
MS20426AD4 (Dimpled)	.063	NAS1739B4, NAS1739D4
MS20426AD5 (Countersunk)	.090	NAS1399B5, NAS1399D5
	.080	CR3212-5
	.071	NAS1739B5, NAS1739E5
	.063	NAS1769D5
	.050	CR3242-5
(See Note 1)	.063	NAS1739B6, NAS1739D6, NAS1769D6, CR3212-6
	.040	CR3242-6
	.032	AN509-10 Screw with MS20365 Nut
MS20426AD5 (Dimpled)	.071	NAS1739B5, NAS1739D5
	.090	NAS1739B6, NAS1739D6, CR3212-6
MS20426AD6 (Countersunk)	.071	NAS1769D6
	.063	CR3242-6
	.032	AN509-10 Screw with MS20365 Nut
MS20426AD6 (Dimpled)	.090	NAS1739B6, NAS1739D6
	.032	AN509-10 Screw with MS20365 Nut

NOTE 1: Rework required. Countersink oversize to accommodate oversize rivet.

NOTE 2: Do not use blind rivets in high-vibration areas or to pull heavy sheets or extrusions together. High-vibration areas include the nacelle or engine compartment including the firewall. Heavy sheets or extrusions include spar caps.

REPLACE		DIAMETER	WITH	
Fastener	Collar		Fastener	Collar
• NAS178	NAS179	(See Note 1)	• NAS1054	NAS179, NAS528
		(See Note 1)	• NAS14XX	NAS1080C, NAS1080E, NAS1080G
		(See Note 1)	• NAS529	NAS524A
		(See Notes 1 and 2)	★ NAS1446	NAS1080C, NAS1080A6
		(See Note 1)	★ NAS7034	NAS1080K
		(See Note 1)	□ NAS464	AN364, MS20364, MS21042
			□ NAS1103	
			□ NAS1303	
			□ NAS6203	
			□ AN173	AN305, MS20305, MS21044, MS21045
• NAS1054	NAS179, NAS528		• NAS14XX	NAS1080C, NAS1080E
			• NAS529	NAS524A
		(See Note 2)	★ NAS1446	NAS1080C, NAS1080A6
			★ NAS7034	NAS1080K
			□ NAS464	AN364, MS20304, MS21042
			□ NAS1103	
			□ NAS1305	
			□ NAS6203	
• NAS14XX	NAS1080C NAS1080E NAS1080G		• NAS529	NAS524A
			★ NAS1446	NAS1080C, NAS1080A6
			★ NAS7034	NAS1080K
			□ NAS464	AN364, MS20364, MS21042
			□ NAS1103	
			□ NAS1303	
			□ NAS6203	
• NAS529	NAS524A	(See Note 3)	□ NAS1446	NAS1080C, NAS1080A6

NOTE 1: See appropriate tables for nominal diameters available.

NOTE 2: Available in oversize for repair of elongated holes. Ream holes to provide a .001 inch interference fit.

NOTE 3: NAS1446 oversize only permitted as a replacement for NAS529.

• Steel shank fastener designed for drive-on collars.

★ Steel shank fastener designed for squeeze-on collars. Installation requires sufficient space for the tool and extended shank of the fastener.

□ Threaded fastener.

17-68. ENGINE MOUNT.

17-69. DESCRIPTION. The engine mount is constructed of 4130 chrome molybdenum steel tubing. The mount is composed of sections of steel tubing, welded together and reinforced with gussets. The mount is fastened to the fuselage at four points. Refer to Section 11.

17-70. GENERAL CONSIDERATIONS. All welding on the engine mount must be of the highest quality since the tendency of vibration is to accentuate any minor defect present and cause fatigue cracks. Engine mount members are preferably repaired by using a larger diameter replacement tube, telescoped over the stub of the original member using fishmouth and rosette type welds. However, reinforced 30-degree scarf welds in place of the fishmouth welds are considered satisfactory for engine mount repair work.

17-71. ENGINE MOUNT RADIAL SUPPORT DAMAGE. Minor damage such as a crack adjacent to an engine attaching lug may be repaired by rewelding the support tube and extending a gusset past the damaged area. Extensively damaged parts must be replaced.

17-72. DAMAGE INVOLVING ENGINE MOUNTING LUGS AND ENGINE MOUNT TO FUSELAGE ATTACHING FITTINGS. Engine mounting lugs and engine mount-to-fuselage attaching fittings should not be repaired but must be replaced. Refer to Section 18 for painting engine mount.

17-73. BAFFLES. Baffles ordinarily require replacement if damaged or cracked. However, small plate reinforcements riveted to the baffle will often prove satisfactory both to the strength and cooling requirements of the unit.

17-74. ENGINE COWLING.

17-75. REPAIR OF COWLING SKINS. If extensively damaged, complete sections of cowling must be replaced. Standard insert-type skin patches, however, may be used if repair parts are formed to fit. Small cracks may be stop-drilled and dents straightened if they are reinforced on the inner side with a doubler of the same material.

17-76. REPAIR OF REINFORCEMENT ANGLES. Cowl reinforcement angles, if damaged, must be replaced. Due to their small size they are easier to replace than to repair.

17-77. REPAIR OF GLASS-FIBER CONSTRUCTED COMPONENTS. Glass-fiber constructed components on the aircraft may be reapired as stipulated in instructions furnished in Service Kit SK182-12. Observe the resin manufacturer's recommendations concerning mixing and application of the resin. Epoxy resins are preferable for making repairs, since epoxy compounds are usually more stable and predictable than polyester and, in addition, give better adhesion. In addition, repair kits are also available for the repair of cracks in ABS, PBC, PVPC, graphite and fiberglass material. These kits P/N's 51543 thru 51548 are available from the Cessna Supply Division.

17-78. CORROSION AND CORROSION CONTROL.

NOTE

For information on corrosion and corrosion control for aircraft, refer to FAA Advisory Circular AC43-4.

17-79. CONTROL CABLE WIRE BREAKAGE AND CORROSION LIMITATIONS. Control cable assemblies are subject to a variety of enviromental and forms of deterioration that ultimately may be easy to reconize such as wire/strand breakage, or the not so readily visible types of deterioration including corrosion and/or distortion. The following information will aid in detecting these cable condition.

a. Examine cables for broken wires by passing a cloth along length of cable. This will detect broken wires, if cloth snags on cable. Critical areas for wire breakage are those sections of cable which pass through fairleads, across rub blocks, and around pulleys. If no snags are found, then no further inspection is required. If snags are found or brocken wires are suspected, then loop to confirm broken wires (refer to Figure 17-1). Loosen or remove cable to allow it to be bent in a loop as shown. While rotating cable, inspect bent area for broken wires.

b. Wire breakage criteria for cables in flap, aileron, rudder, and elevator systems are, individual broken wires are acceptable in primary and secondary control cables at random locations when there are no more than six broken wires in any given ten-inch cable length.

c. Carefully examine any cable for corrosion that has a broken wire in a section not in contact with wear-producing airframe components such as pullys, fairleads, rub blocks, ect. It may be necessary to remove and bend cable to properly inspect it for internal strand corrosion as this condition is usually not evident on outer surface of cable. Replace cable if internal corrosion is found. If a cable has been wiped clean of its corrosion-preventive lubricant and metal-brightened, the cable shall be examined closely for corrosion. For description of control cable corrosion, refer to Chapter 17, Corossion and Corrosion Control.

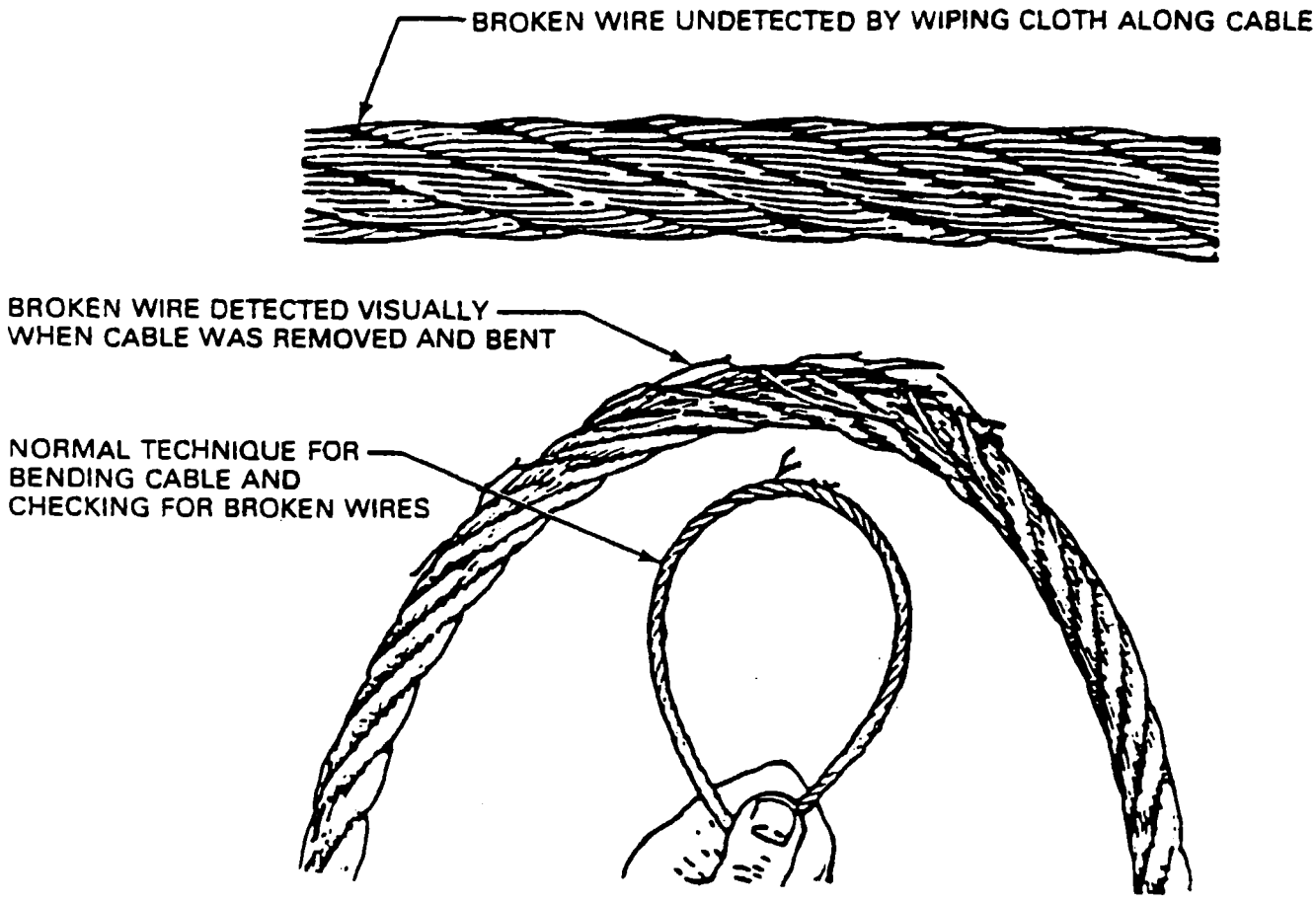


Figure 17-1. Cable Broken Wire Inspection

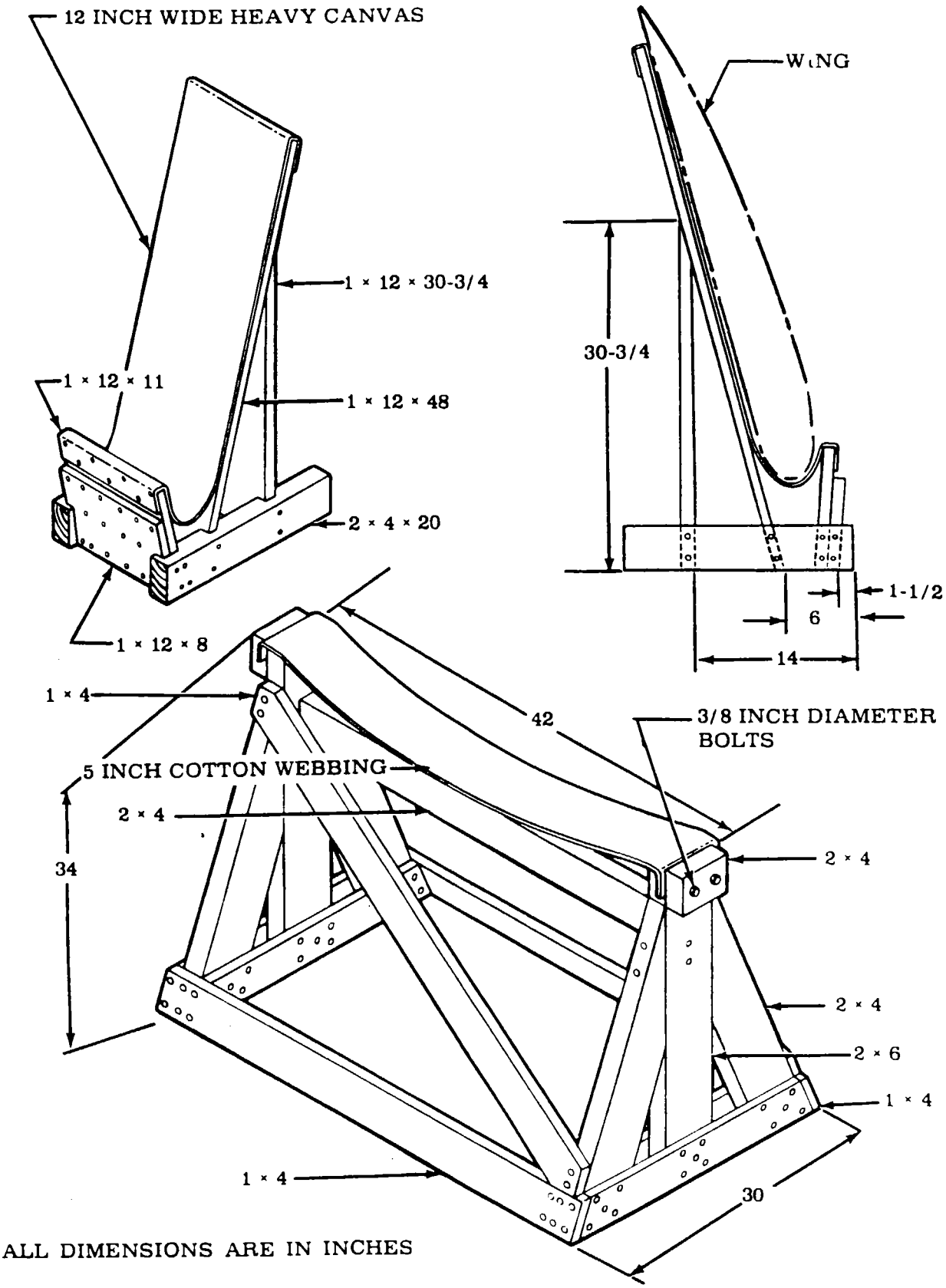
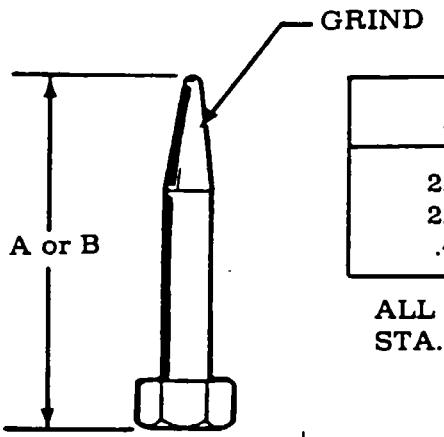
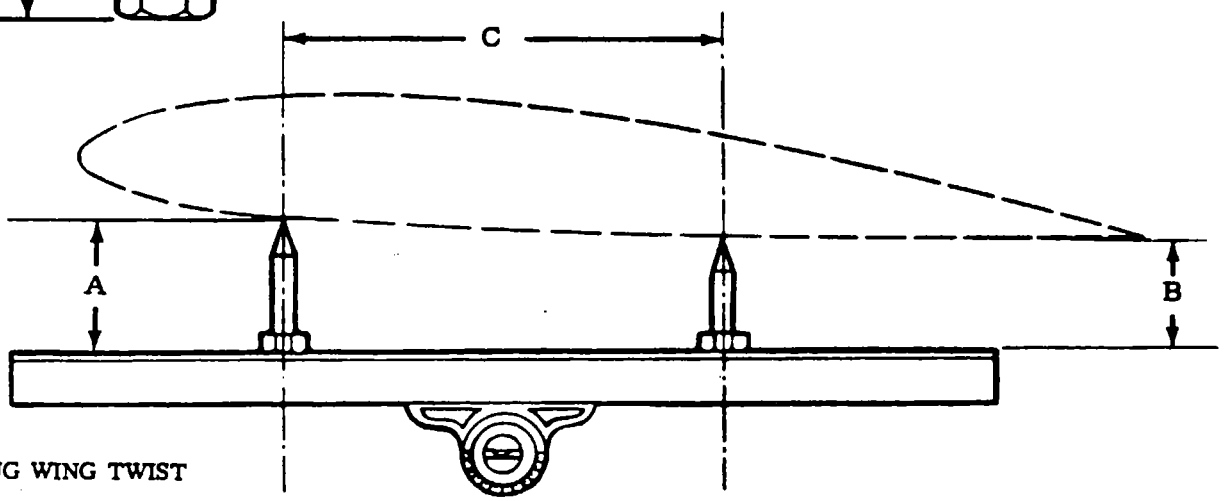


Figure 17-1A. Wing and Fuselage Support Stands



A	B	C	WING STATION
2.00	1.00	29.50	39.00
2.00	1.00	29.50	100.00
.45	1.00	24.00	207.00

ALL WING TWIST OCCURS BETWEEN STA. 100.00 AND STA. 207.00. (Refer to paragraph 17-7).



MEASURING WING TWIST

If damage has occurred to a wing, it is advisable to check the twist. The following method can be used with a minimum of equipment, which includes a straightedge (32" minimum length of angle, or equivalent), three modified bolts for a specific wing, and a protractor head with level.

1. Check chart for applicable dimension for bolt length (A or B).

2. Grind bolt to a rounded point as illustrated, checking length periodically.

3. Tape two bolts to straightedge according to dimension C.

4. Locate inboard wing station to be checked and make a pencil mark approximately one-half inch aft of the lateral row of rivets in the wing leading edge spar flange.

5. Holding straightedge parallel to wing station (staying as clear as possible from "cans"), place longer bolt on pencil mark and set protractor head against lower edge of straightedge.

6. Set bubble in level to center and lock protractor to hold this reading.

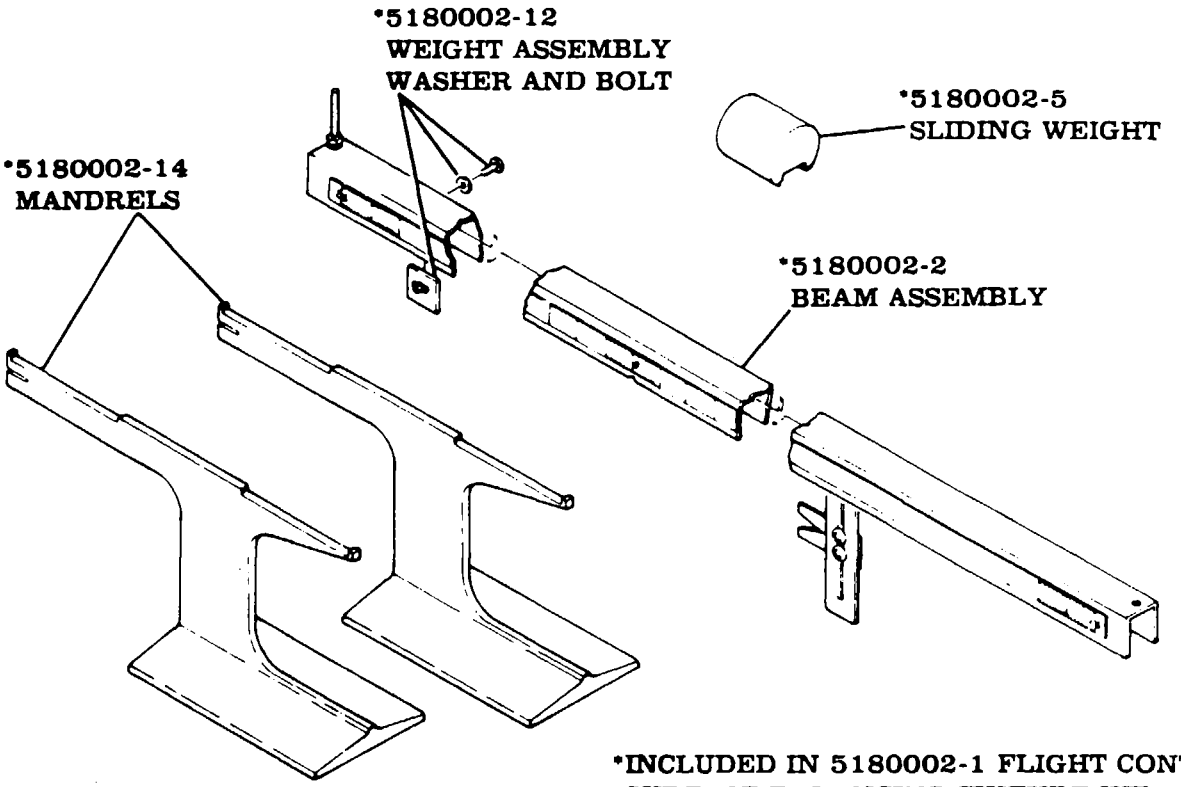
7. Omitting step 6, repeat procedure for each wing station, using dimensions specified in chart. Check to see that protractor bubble is still centered.

8. Proper twist is present in wing if protractor readings are the same (parallel). Forward or aft bolt may be lowered from wing .10 inch maximum to attain parallelism.

Figure 17-2. Checking Wing Twist

FLIGHT CONTROL SURFACE BALANCING FIXTURE KIT

USED FOR BALANCING AILERONS, ELEVATORS AND RUDDERS ON ALL CESSNA SINGLE AND MULTIENGINE AIRPLANES



*INCLUDED IN 5180002-1 FLIGHT CONTROL SURFACE BALANCING FIXTURE KIT.

GENERAL NOTES

1. Balance control surfaces in a draft-free area.
2. Place hinge bolts through control surface hinges and position on knife edge balancing mandrels. Be sure hinge bolt shank rests on knife edge.
3. make sure all control surfaces are in their approved flight configurations: painted (if applicable), trim tabs installed, all foreign matter removed from inside of control surface, elevator trim tab push-pull rod installed and all tips installed.
4. Place balancing mandrels on a table or other suitable flat surface.
5. Adjust trailing edge support to fit control surface being balanced while center of balancing beam is directly over hinge line. Remove balancing beam and balance the beam itself by moving the adjustable weight (fastened by bolt and washer). Fine balance may be accomplished by use of washers at long screw on end of beam.
6. When positioning balancing beam on control surface. Avoid rivets to provide a smooth surface for the beam and keep the beam 90°to the hinge line of the control surface.

Figure 17-3. Control Surface Balancing (Sheet 1 of 5)

7. Paint is a considerable weight factor. In order to keep balance weight to a minimum, it is recommended that existing paint be removed before adding paint to a control surface. Increase in balance weight will also be limited by the amount of space available and clearance with adjacent parts. Good workmanship and standard repair practices should not result in unreasonable balance weight.

8. The approximate amount of weight needed may be determined by taping loose weight at the balance weight area.

9. Lighten balance weight by drilling off part of weight.

10. Make balance weight heavier by fusing bar stock solder to weight after removal from control surface. The ailerons should have balance weight increased by ordering additional weight listed in applicable Parts Catalog and installing next to existing inboard weight the minimum length necessary for correct balance.

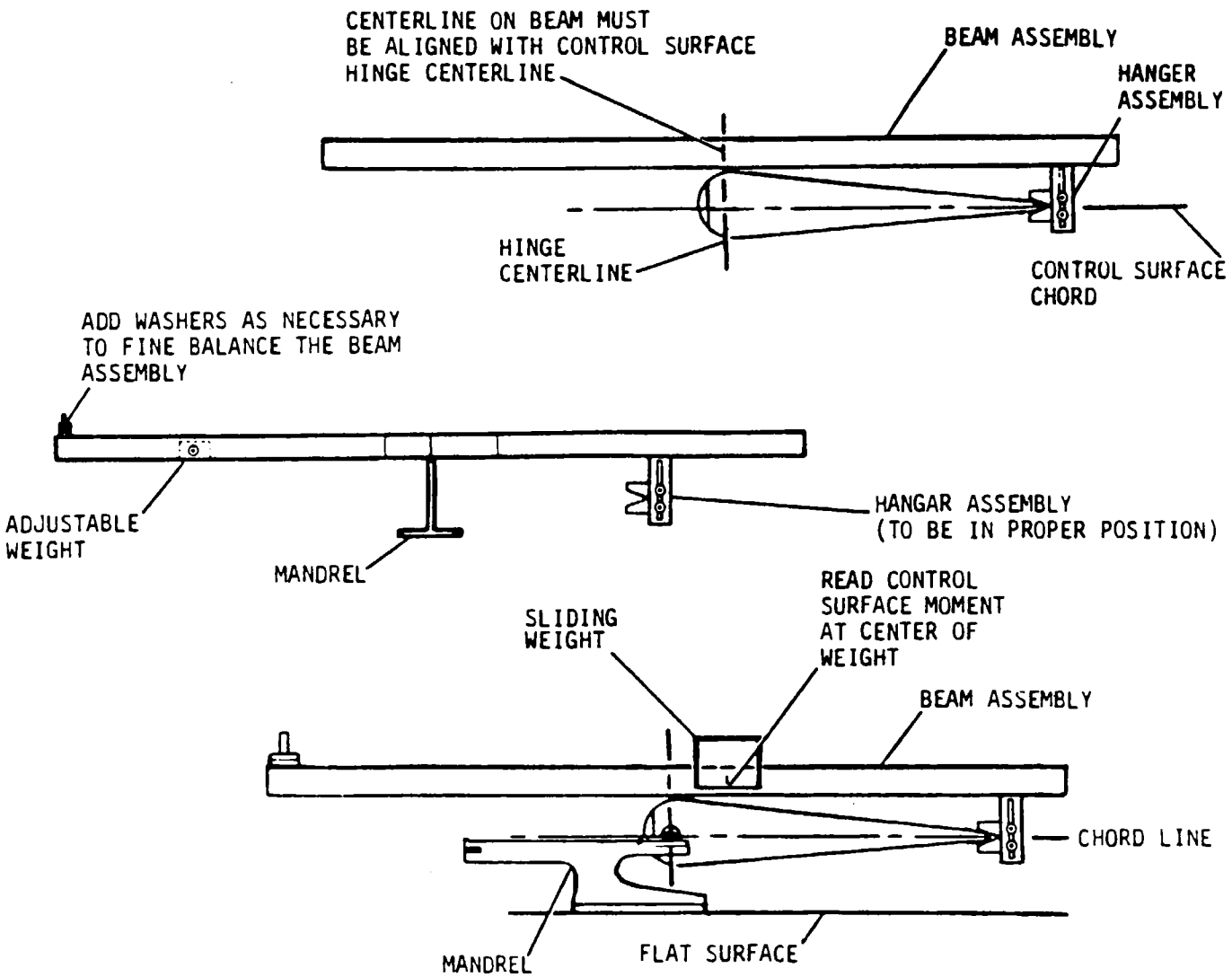


Figure 17-3. Control Surface Balancing (Sheet 2 of 5)

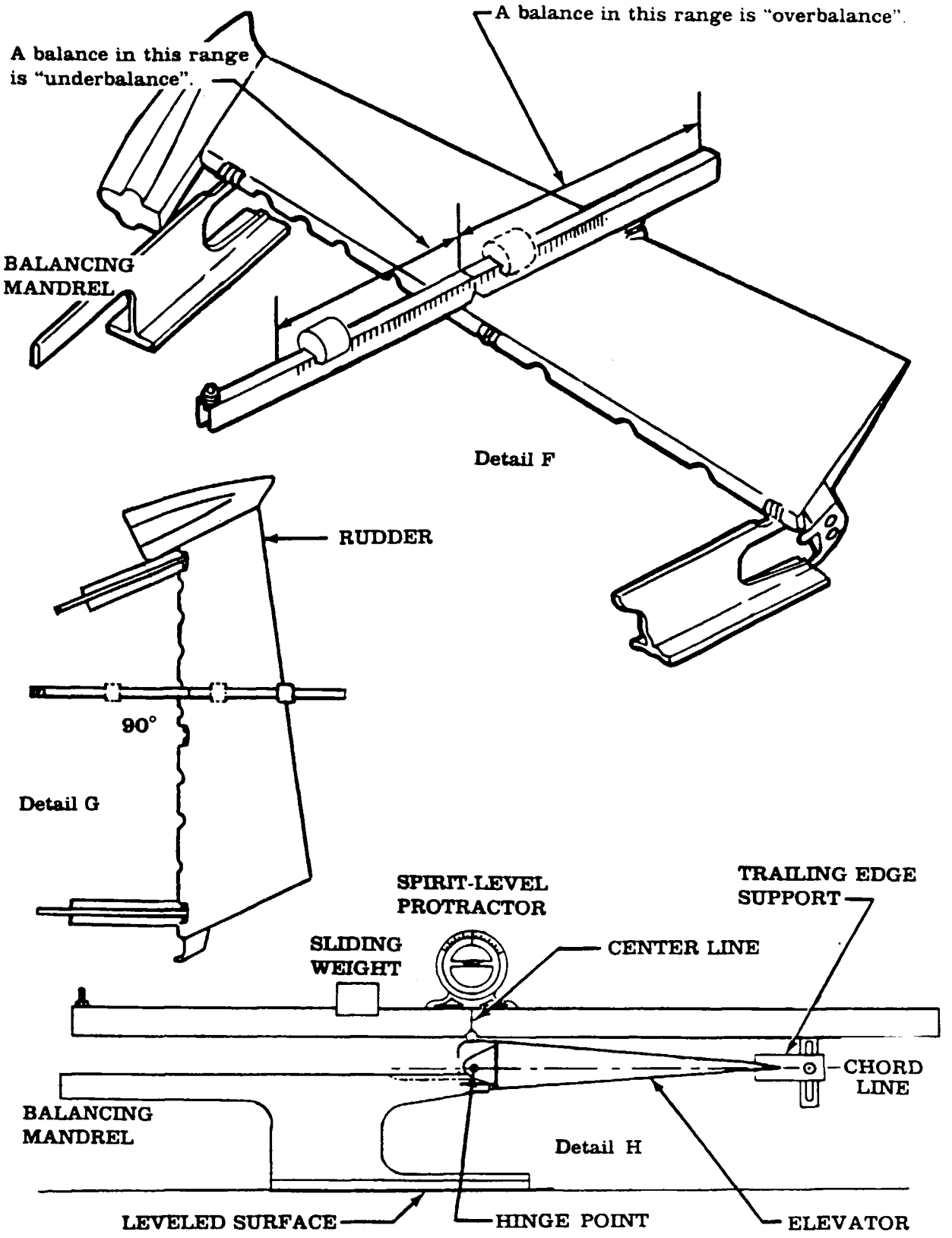
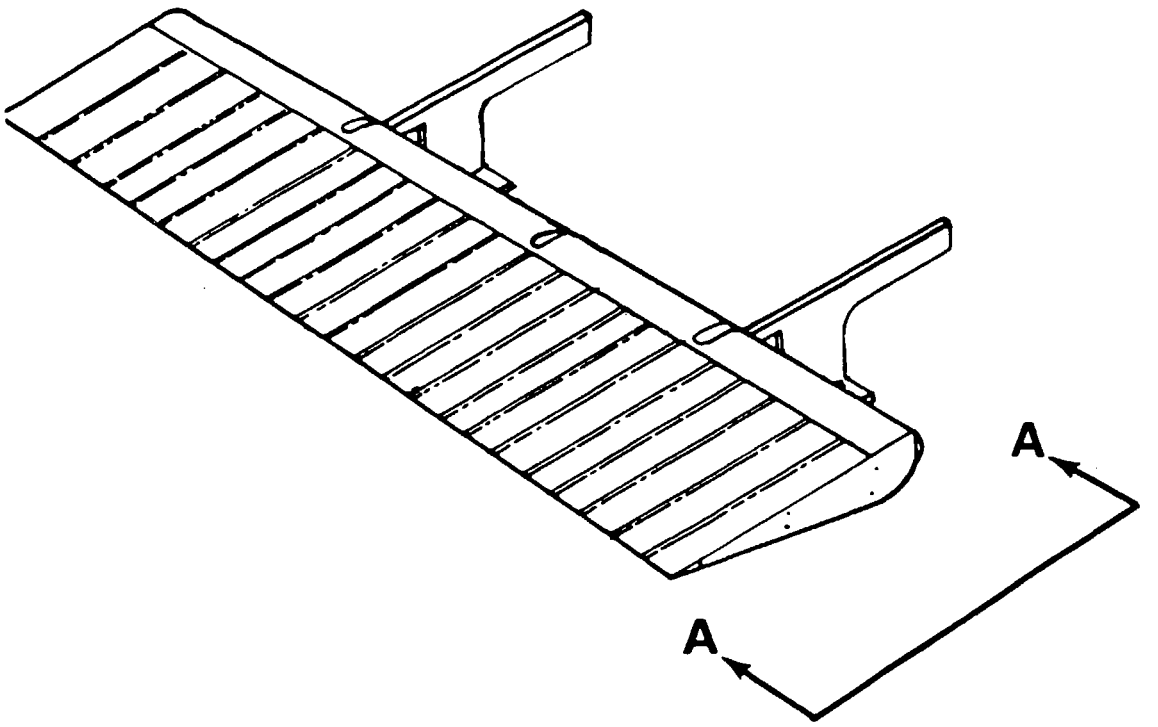
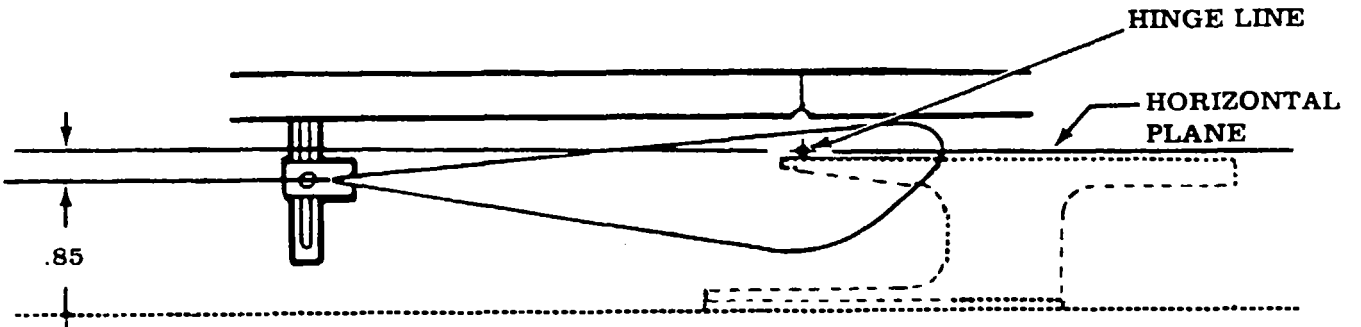


Figure 17-3. Control Surface Balancing (Sheet 3 of 5)



DETAIL A-A



Balance aileron inverted, with trailing edge at point opposite cut-out for middle hinge .85" below hinge line horizontal plane.

Figure 17-3. Control Surface Balancing (Sheet 4 of 5)

CONTROL SURFACE BALANCE REQUIREMENTS

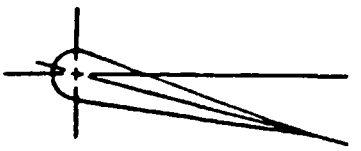
NOTE

Balance limits for control surfaces are expressed for "Approved Flight" configuration. "Approved Flight" configuration is that condition of the control surface as prepared for flight of the airplane whether it be painted or unpainted.

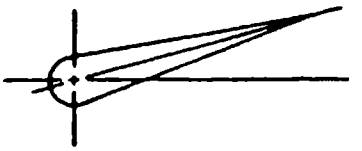
"Approved Flight" limits must never be exceeded when the surface is in its final configuration for flight.

DEFINITIONS:

UNDERBALANCE is defined as the condition that exists when surface is trailing edge heavy and is defined by a symbol (+). If the balance beam sliding weight must be on the leading edge side of the hinge line (to balance the control surface), the control surface is considered to be underbalanced.



OVERBALANCE is defined as the condition that exists when surface is leading edge heavy and is defined by a symbol (–). If the balance beam sliding weight must be on the trailing edge side of the hinge line (to balance the control surface), the control surface is considered to be overbalanced.



CONTROL SURFACE BALANCE LIMITS (Inch-Pounds)	APPROVED FLIGHT CONFIGURATION
AILERON	0.0 to 9.64
RUDDER	0.0 to 6.0
RIGHT ELEVATOR	0.0 to 20.47
LEFT ELEVATOR	0.0 to 20.47

Figure 17-3. Control Surface Balancing (Sheet 5 of 5)

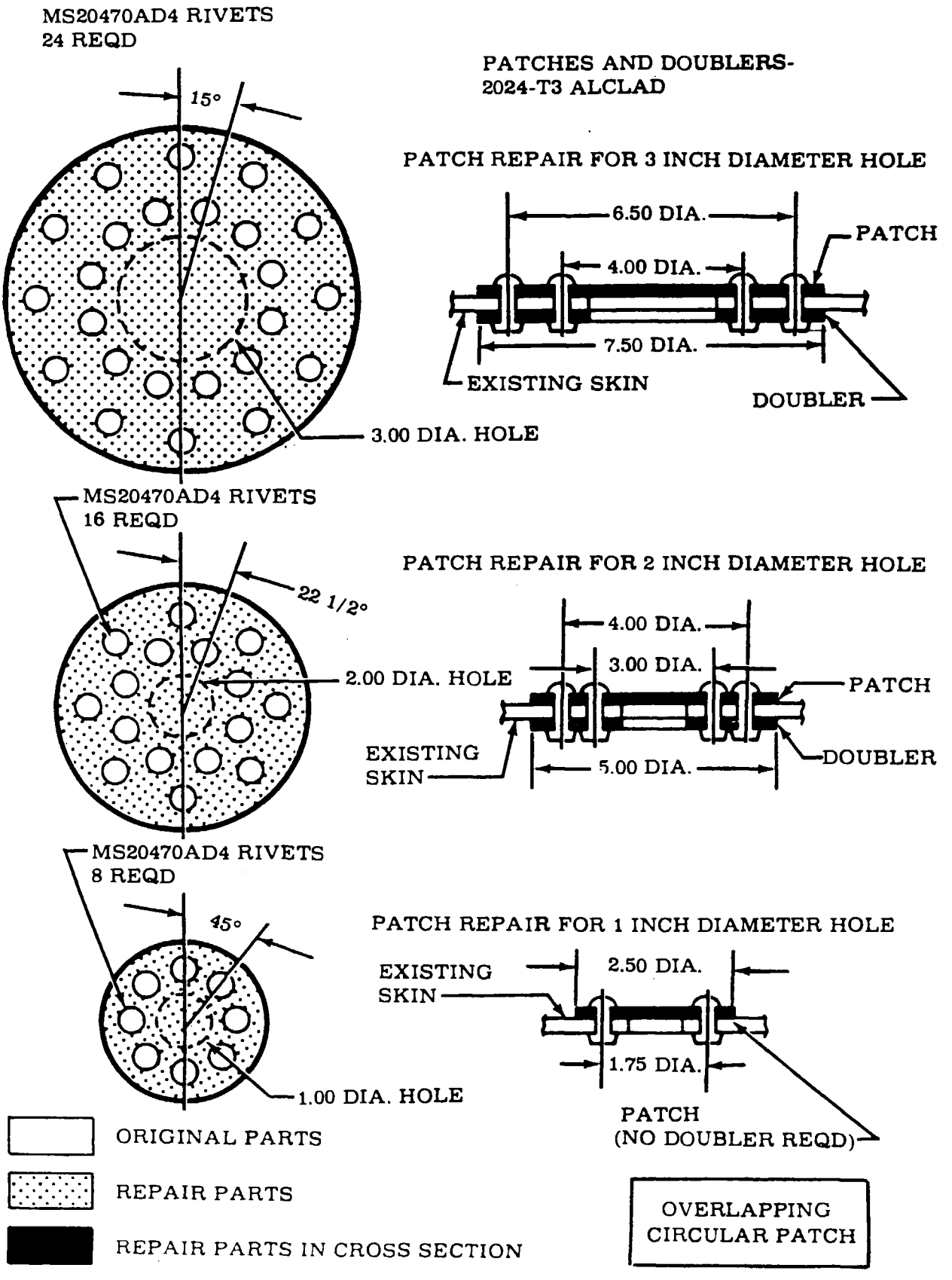
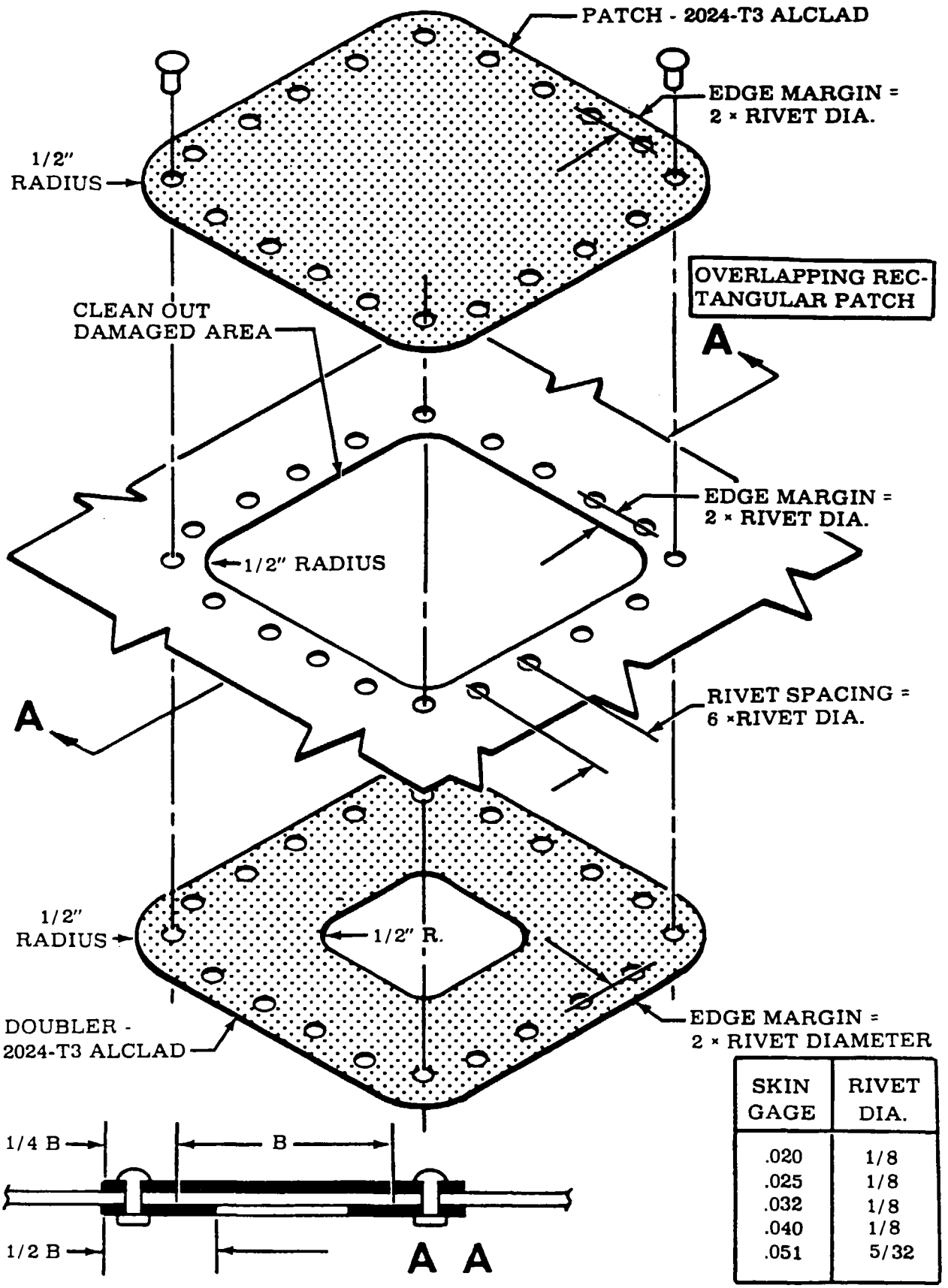
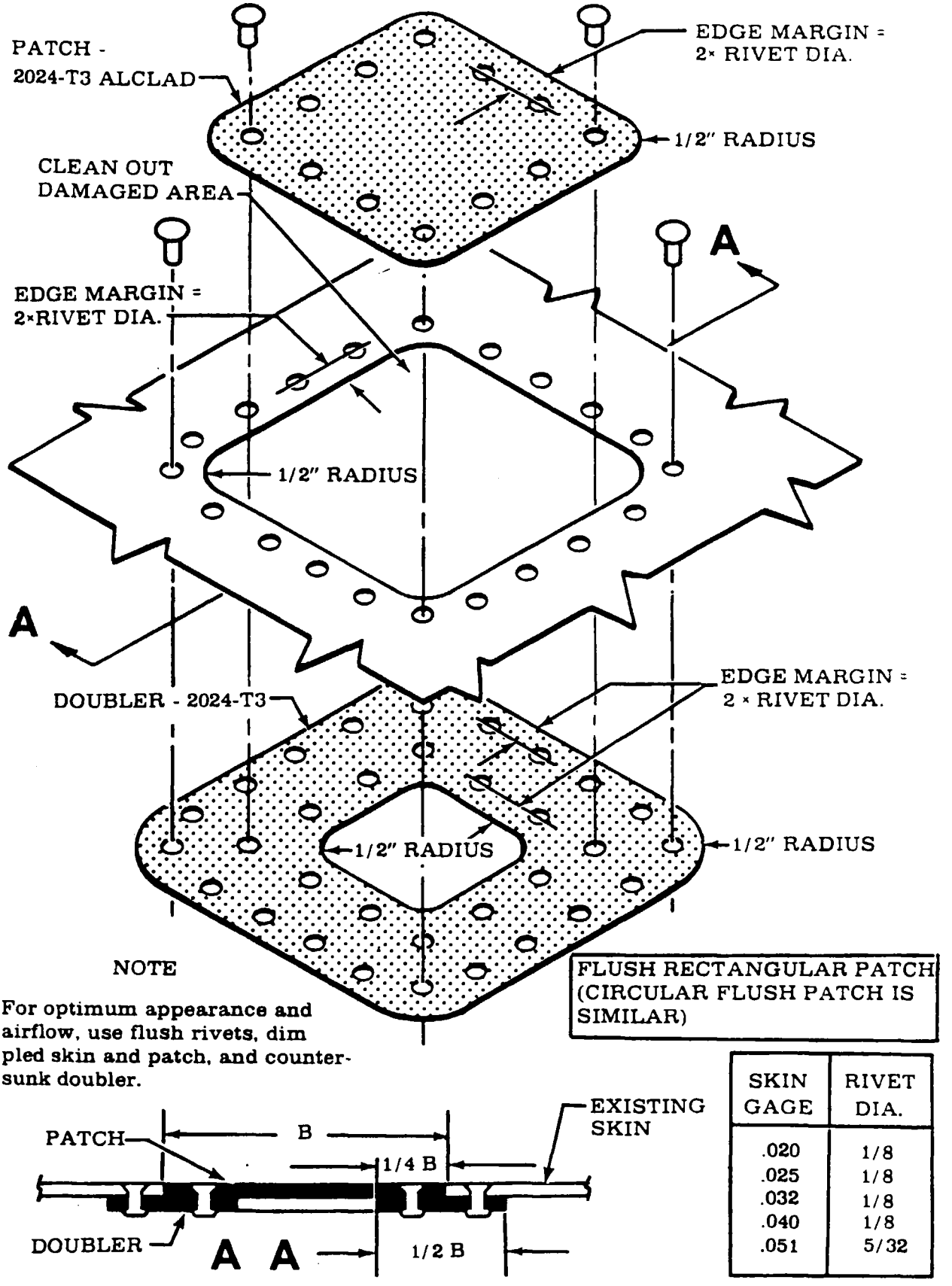


Figure 17-4. Skin Repair (Sheet 1 of 6)



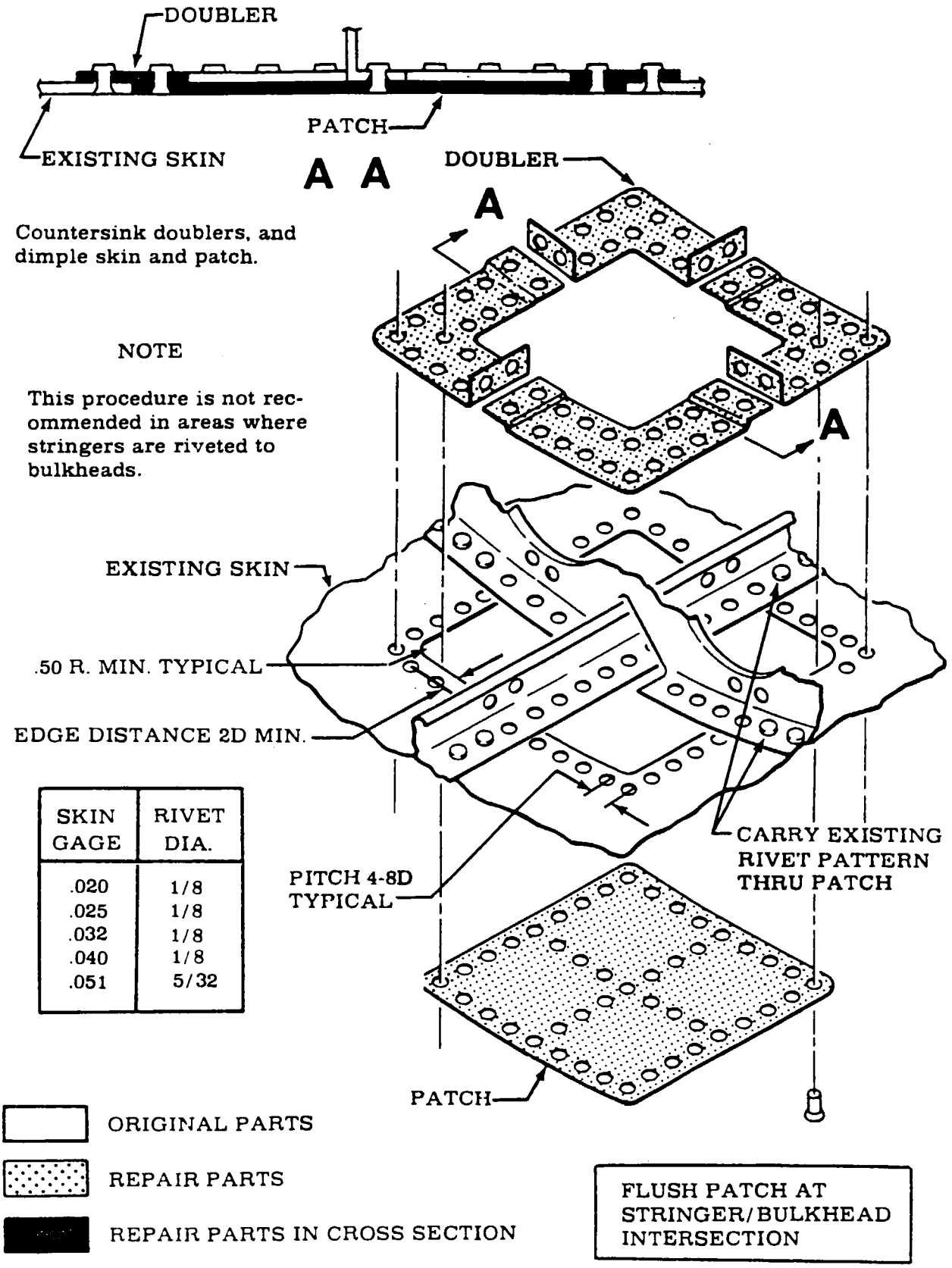
SKIN GAGE	RIVET DIA.
.020	1/8
.025	1/8
.032	1/8
.040	1/8
.051	5/32

Figure 17-4. Skin Repair (Sheet 2 of 6)



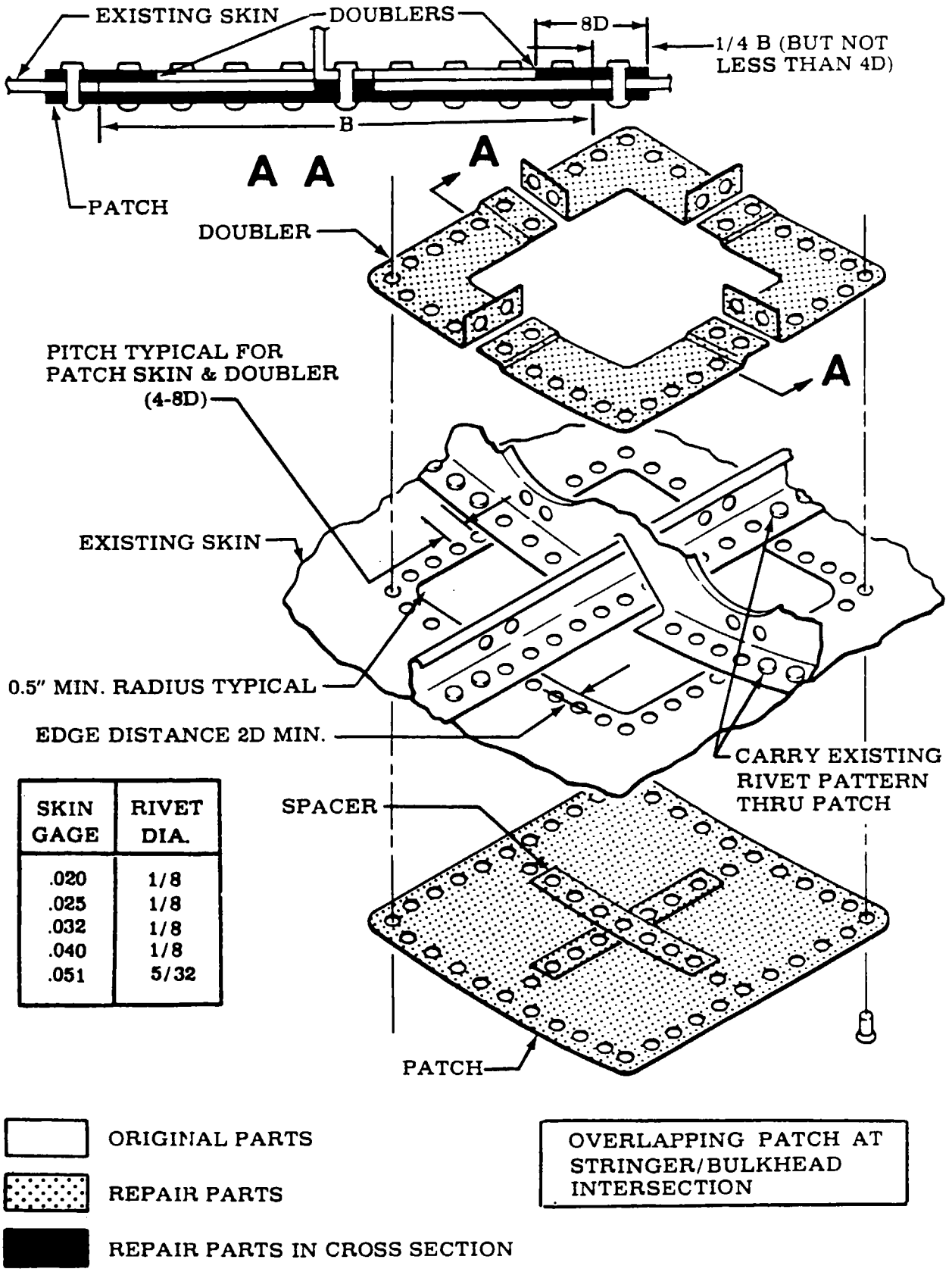
SKIN GAGE	RIVET DIA.
.020	1/8
.025	1/8
.032	1/8
.040	1/8
.051	5/32

Figure 17-4. Skin Repair (Sheet 3 of 6)



SKIN GAGE	RIVET DIA.
.020	1/8
.025	1/8
.032	1/8
.040	1/8
.051	5/32

Figure 17-4. Skin Repair (Sheet 4 of 6)



SKIN GAGE	RIVET DIA.
.020	1/8
.025	1/8
.032	1/8
.040	1/8
.051	5/32

Figure 17-4.Skin Repair (Sheet 5 of 6)

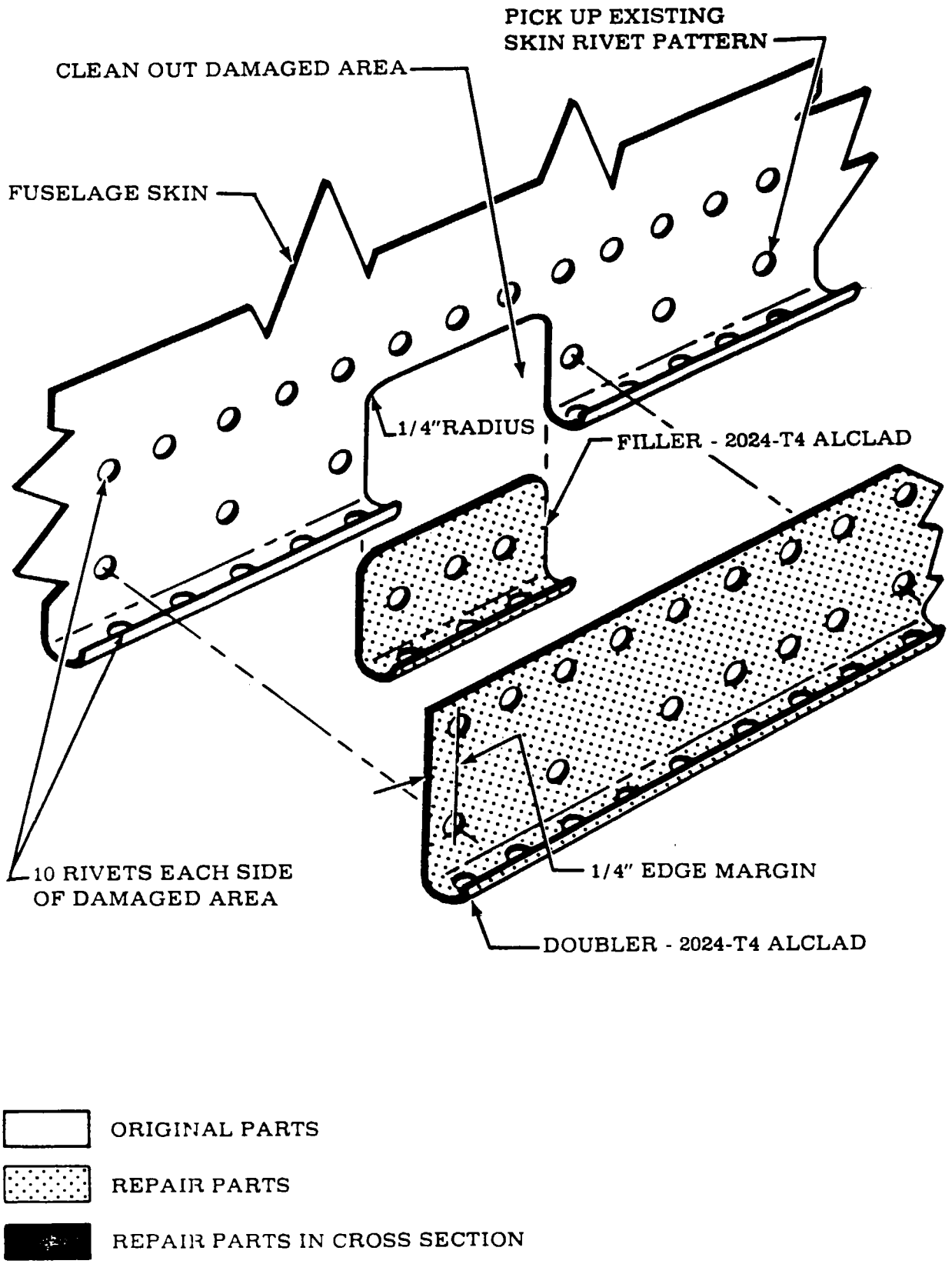


Figure 17-4. Skin Repair (Sheet 6 of 6)

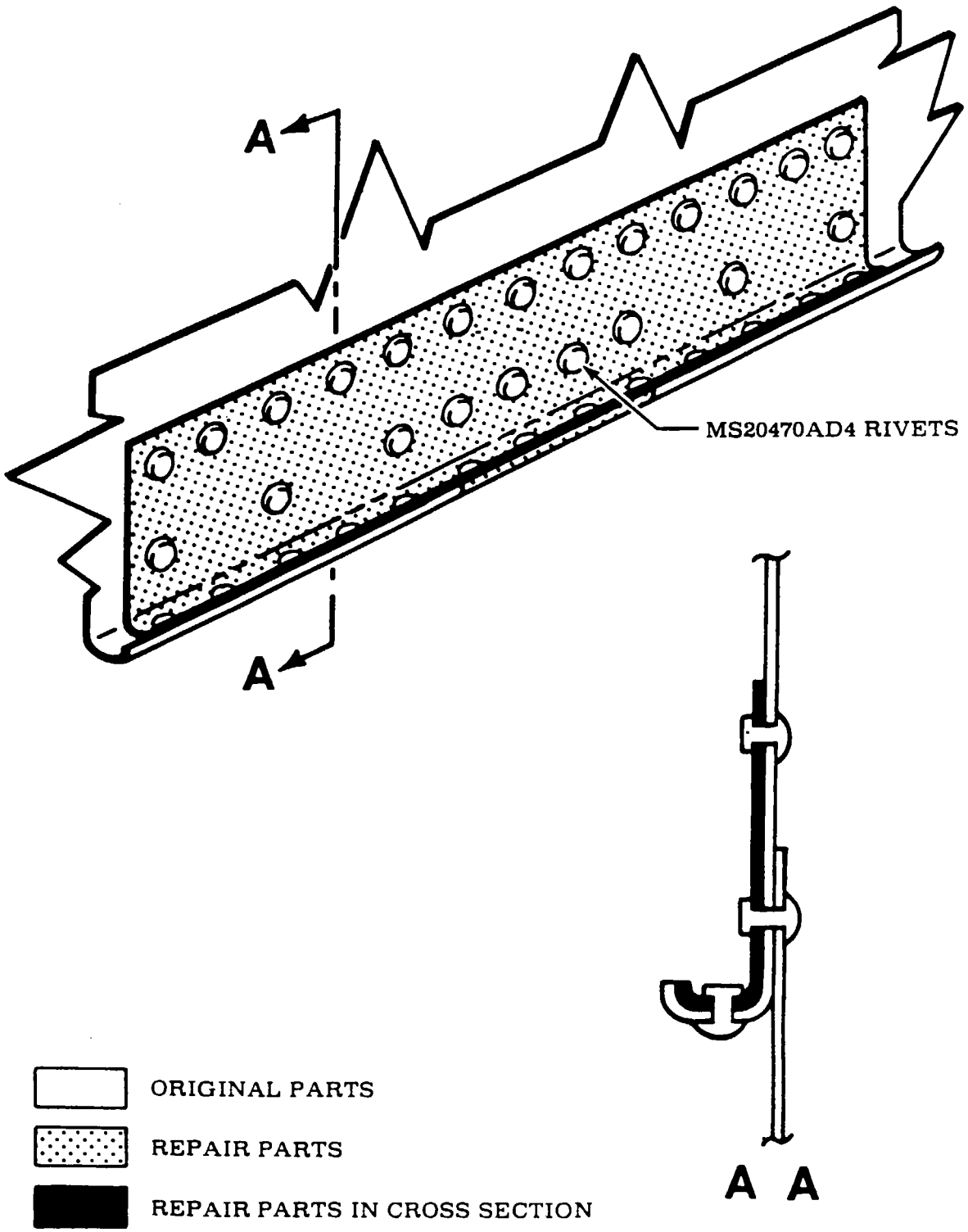


Figure 17-4. Skin Repair (Sheet 6 of 6 continued)

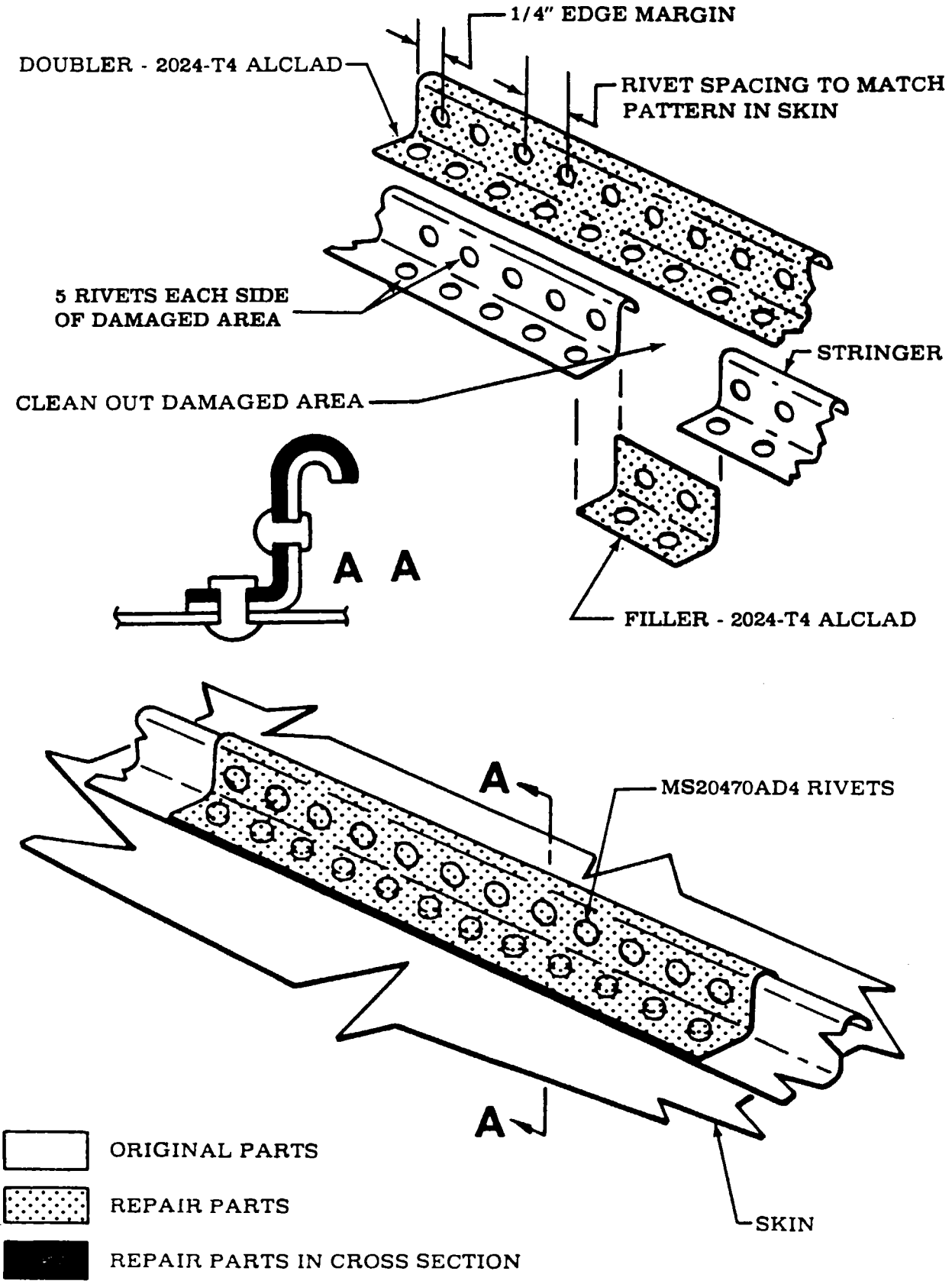


Figure 17-5.Stringer and Channel Repair (Sheet 1 of 4)

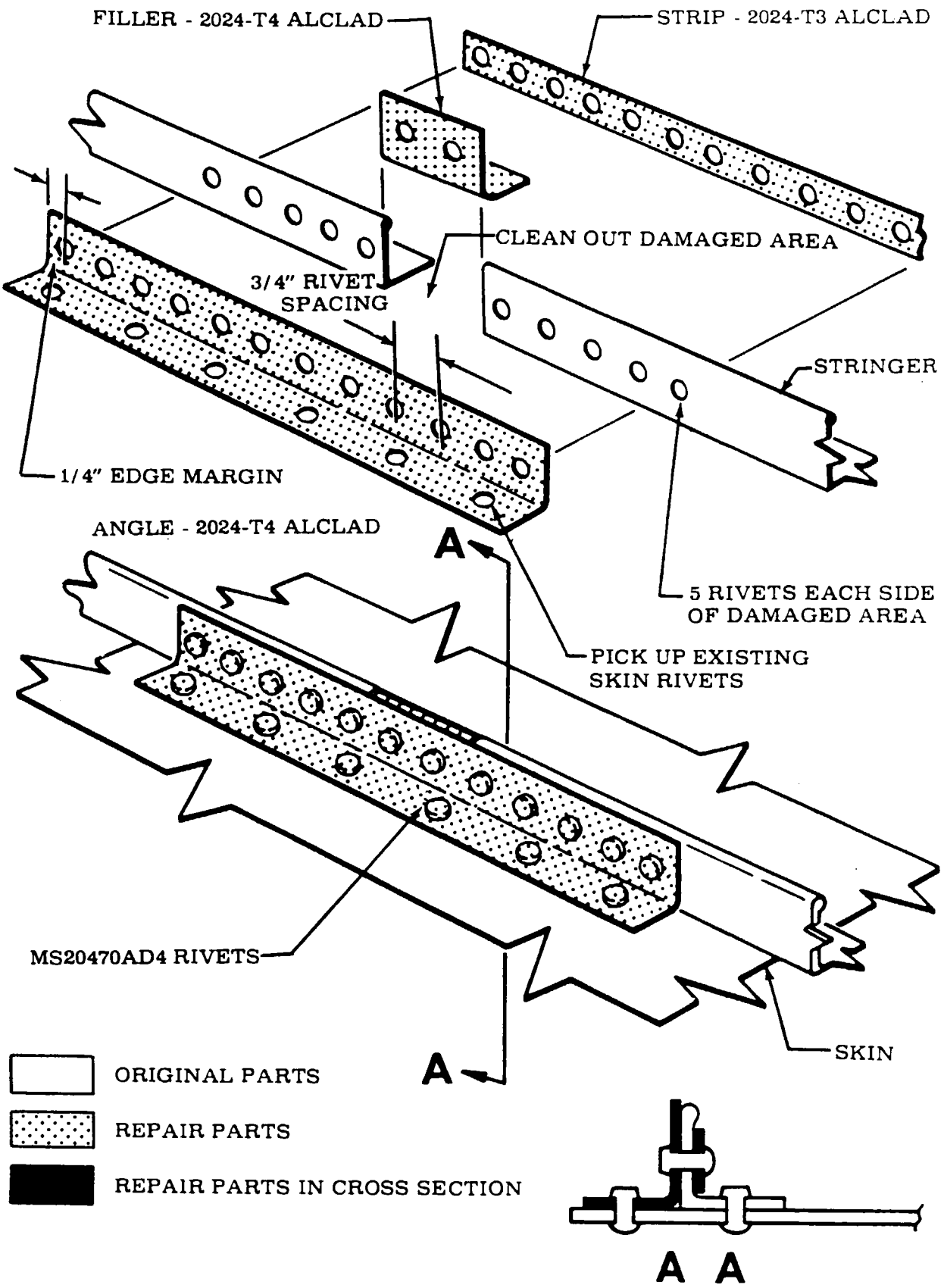


Figure 17-5. Stringer and Channel Repair (Sheet 2 of 4)

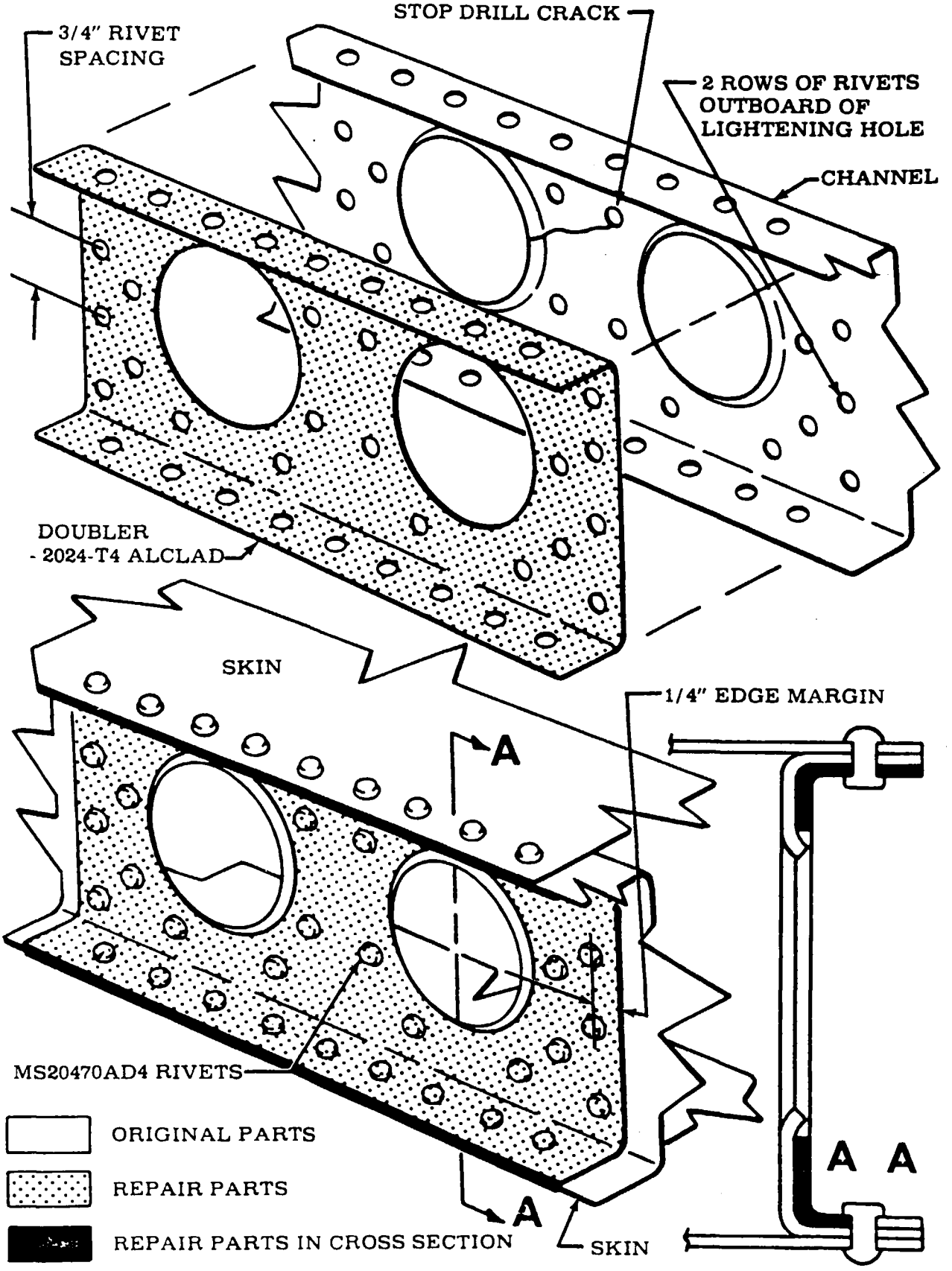


Figure 17-5. Stringer and Channel Repair (Sheet 3 of 4)

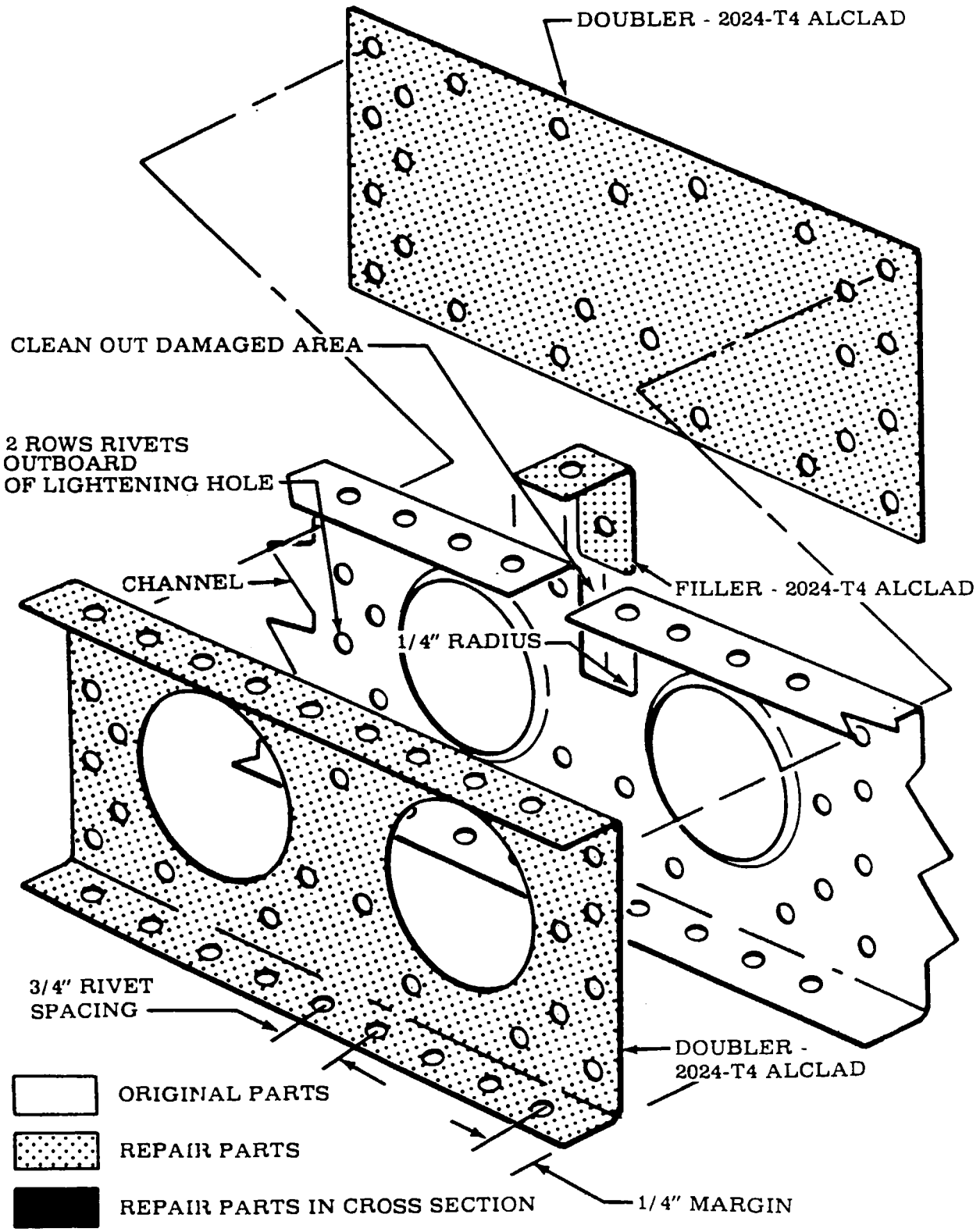


Figure 17-5.Stringer and Channel Repair (Sheet 4 of 4)

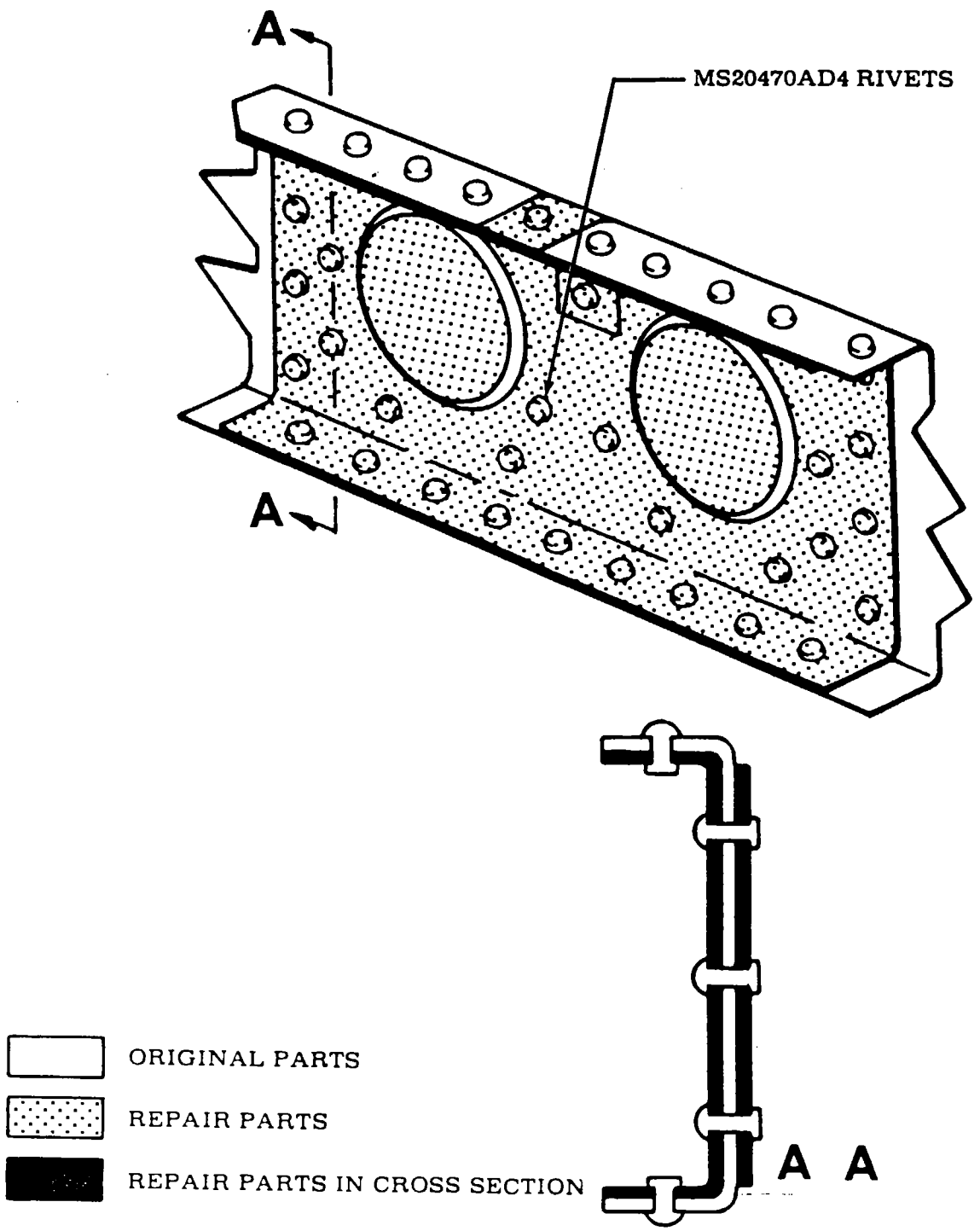


Figure 17-5. Stringer and Channel Repair (Sheet 4 of 4 continued)

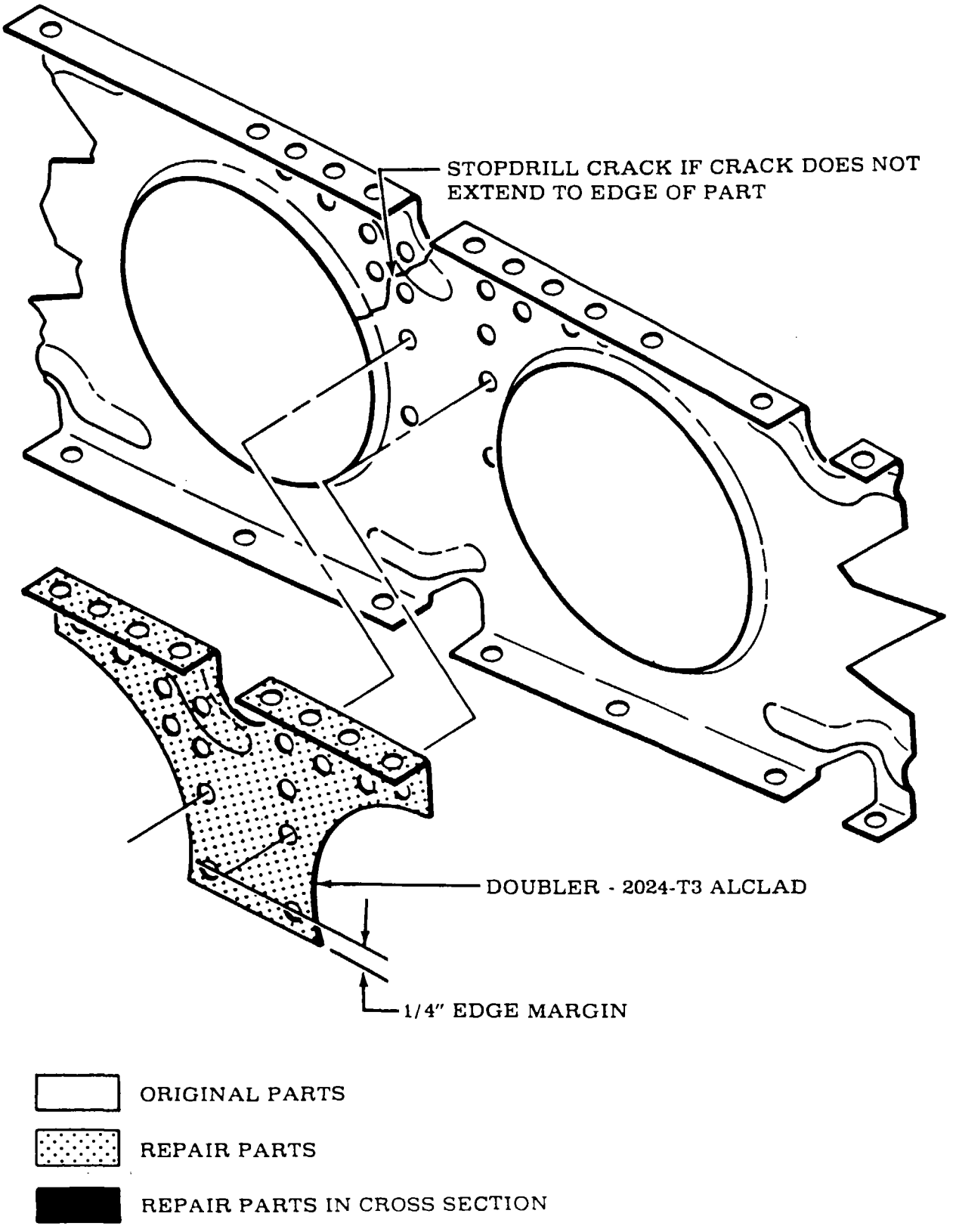


Figure 17-6. Rib Repair (Sheet 1 of 2)

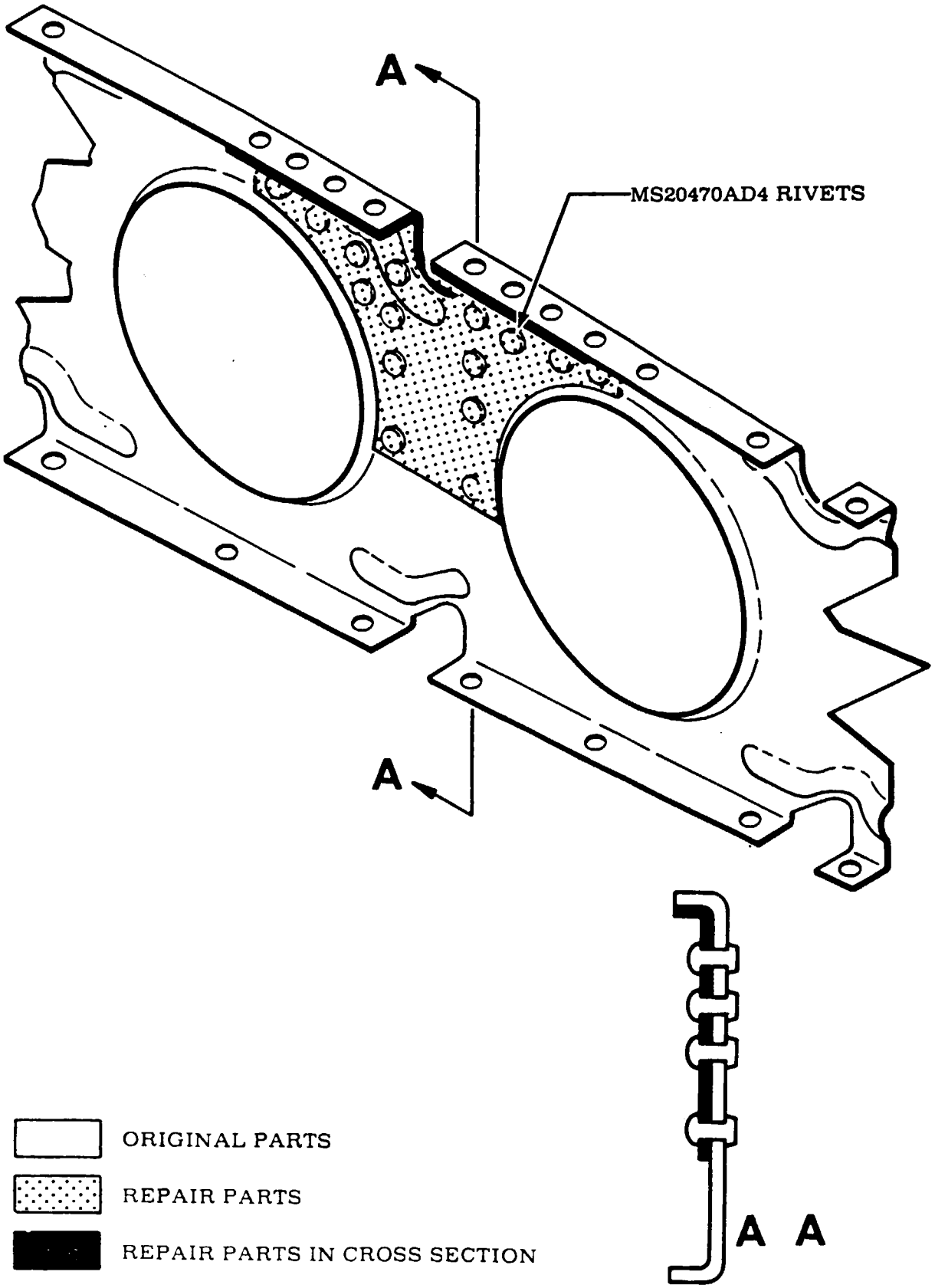


Figure 17-6. Rib Repair (Sheet 1 of 2 continued)

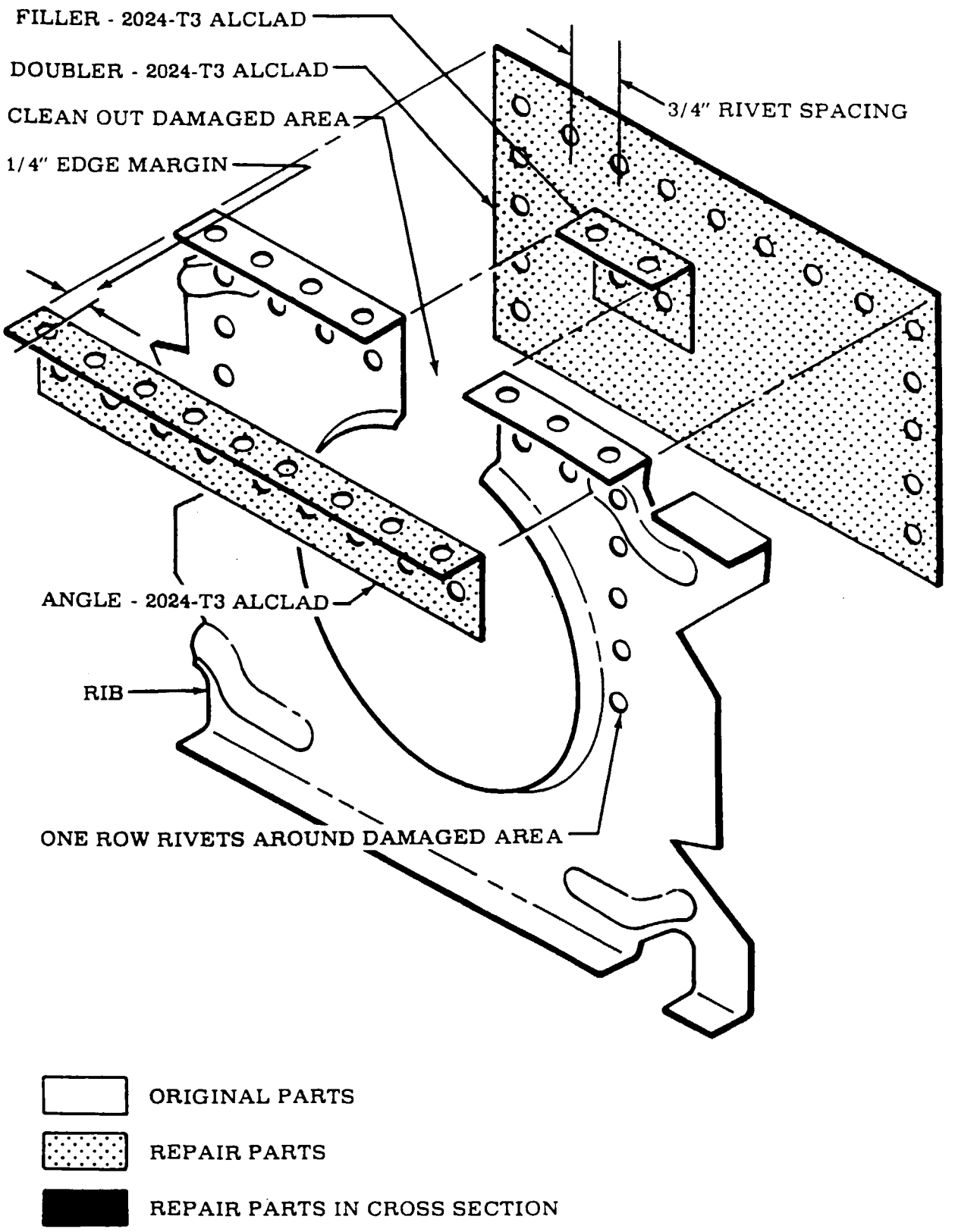


Figure 17-6.Rib Repair (Sheet 2 of 2)

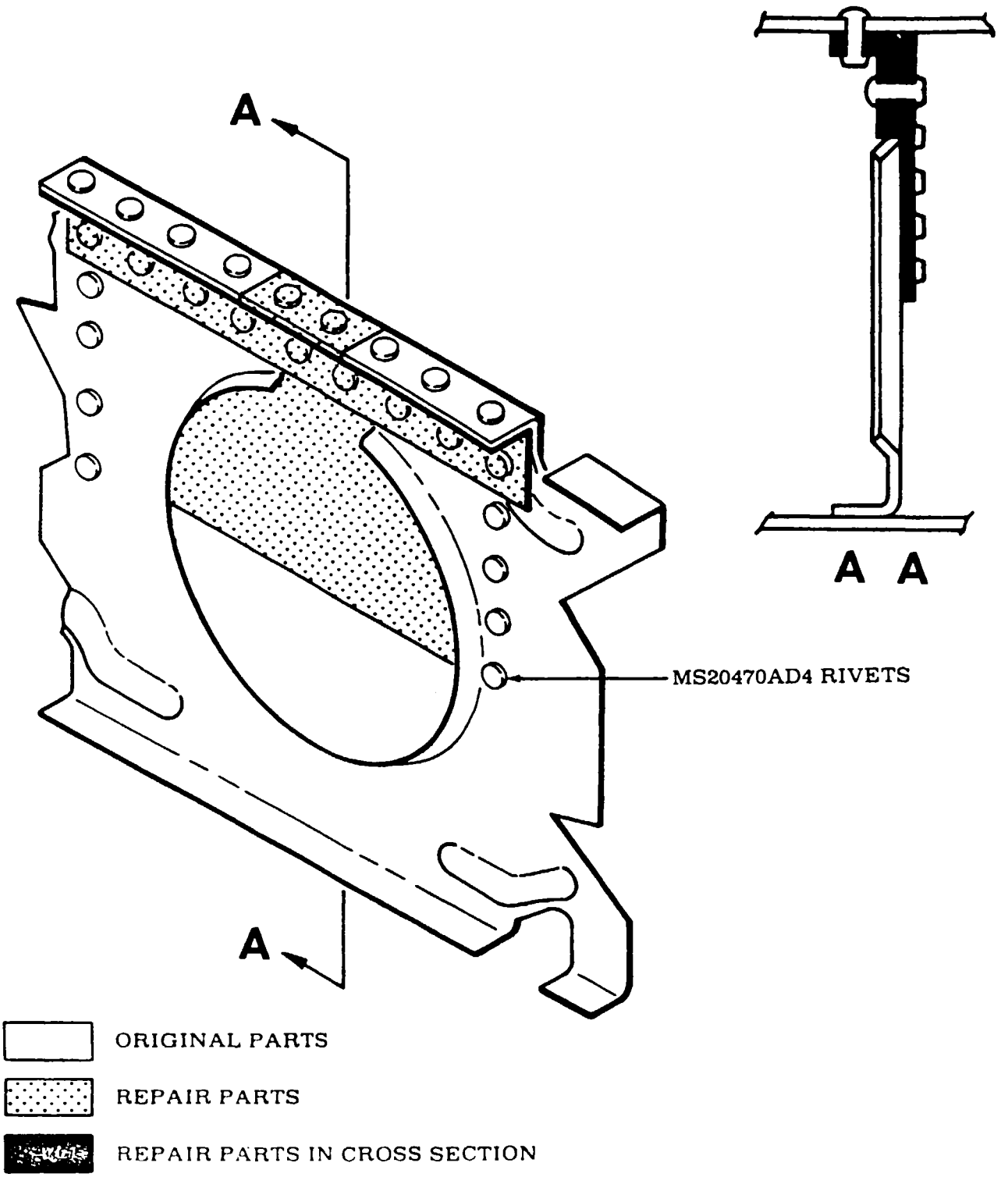


Figure 17-6. Rib Repair (Sheet 2 of 2 continued)

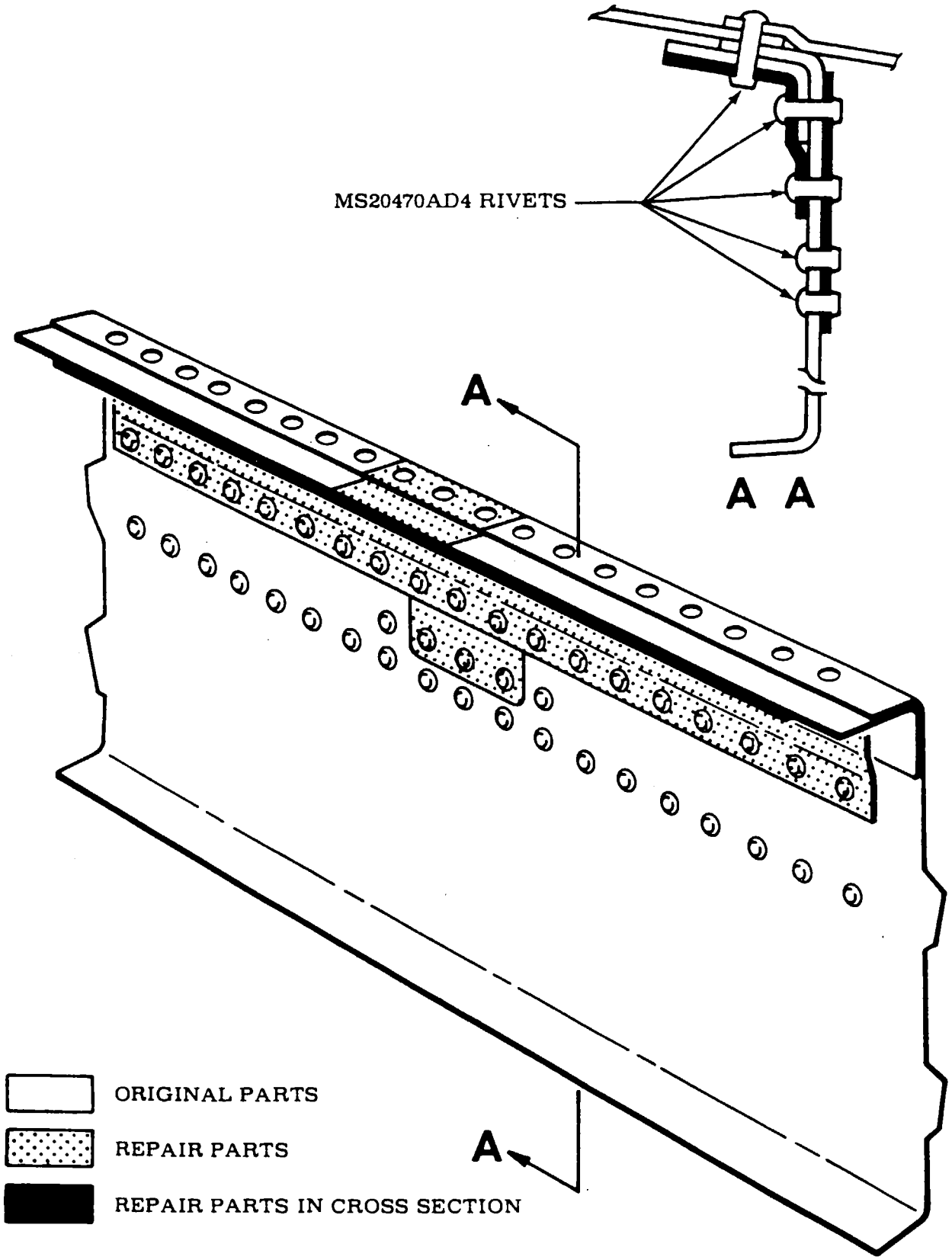


Figure 17-7.Wing Spar Repair (Sheet 1 of 4)

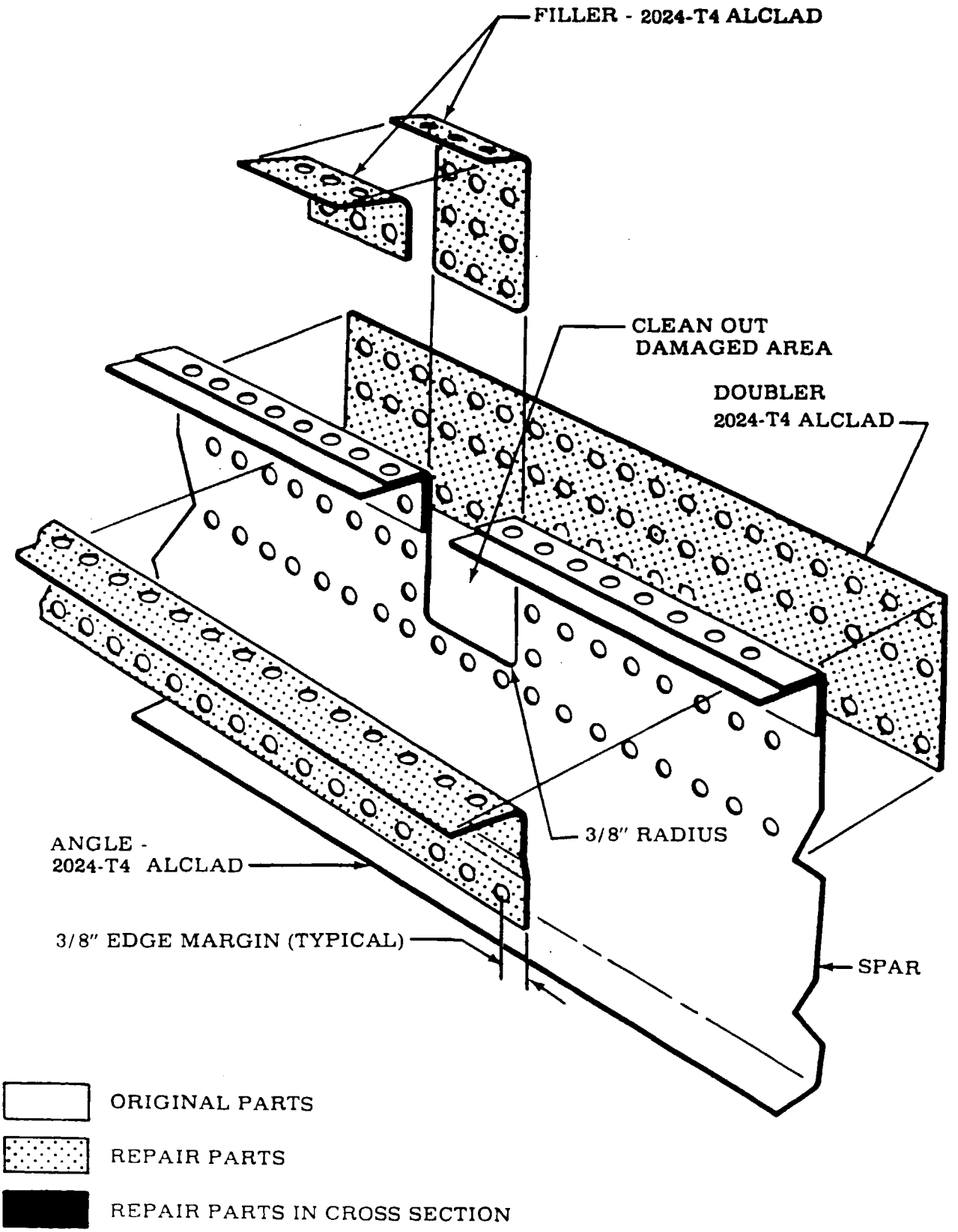


Figure 17-7. Wing Spar Repair (Sheet 1 of 4 continued)

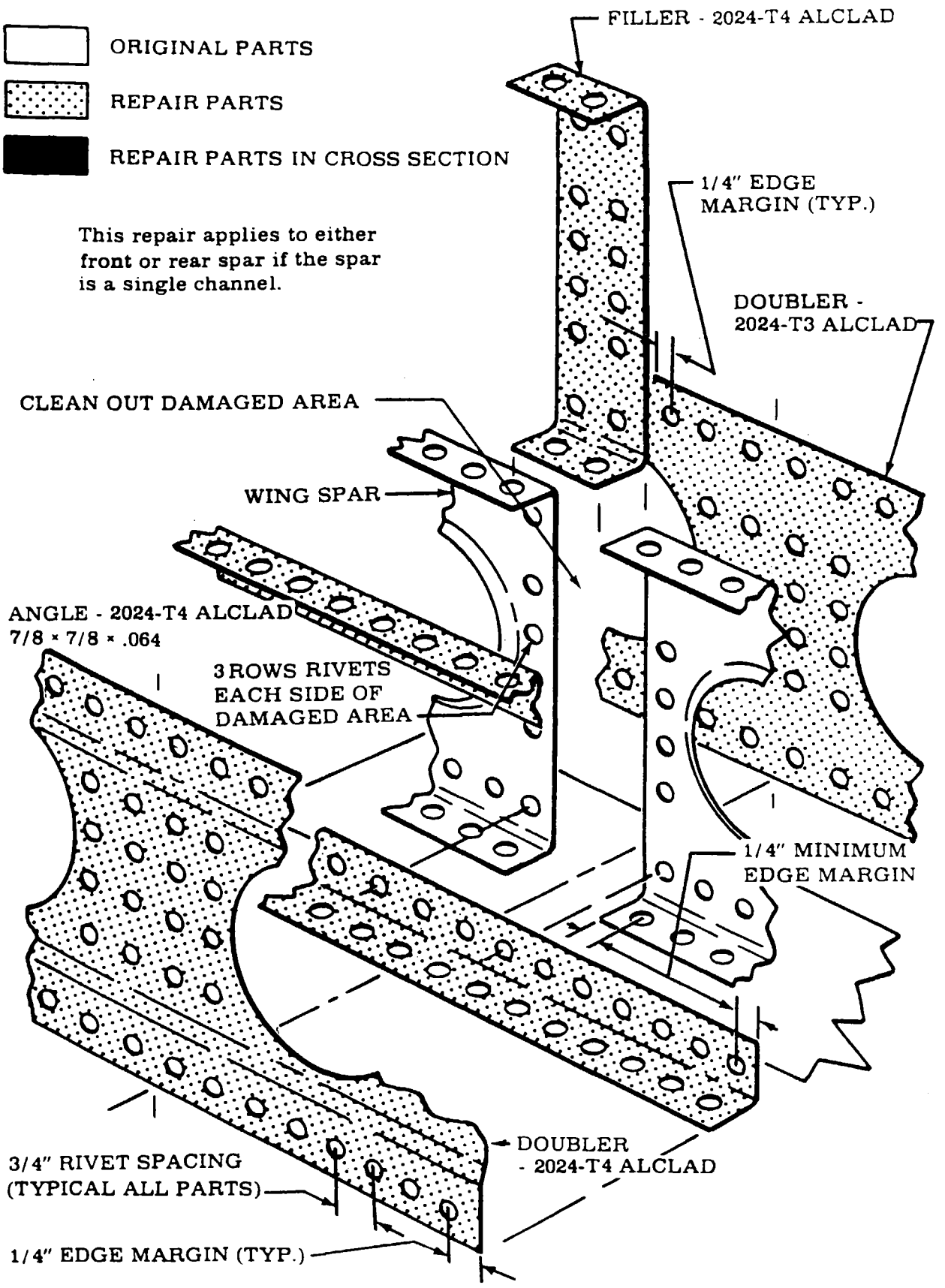


Figure 17-7. Wing Spar Repair (Sheet 2 of 4)

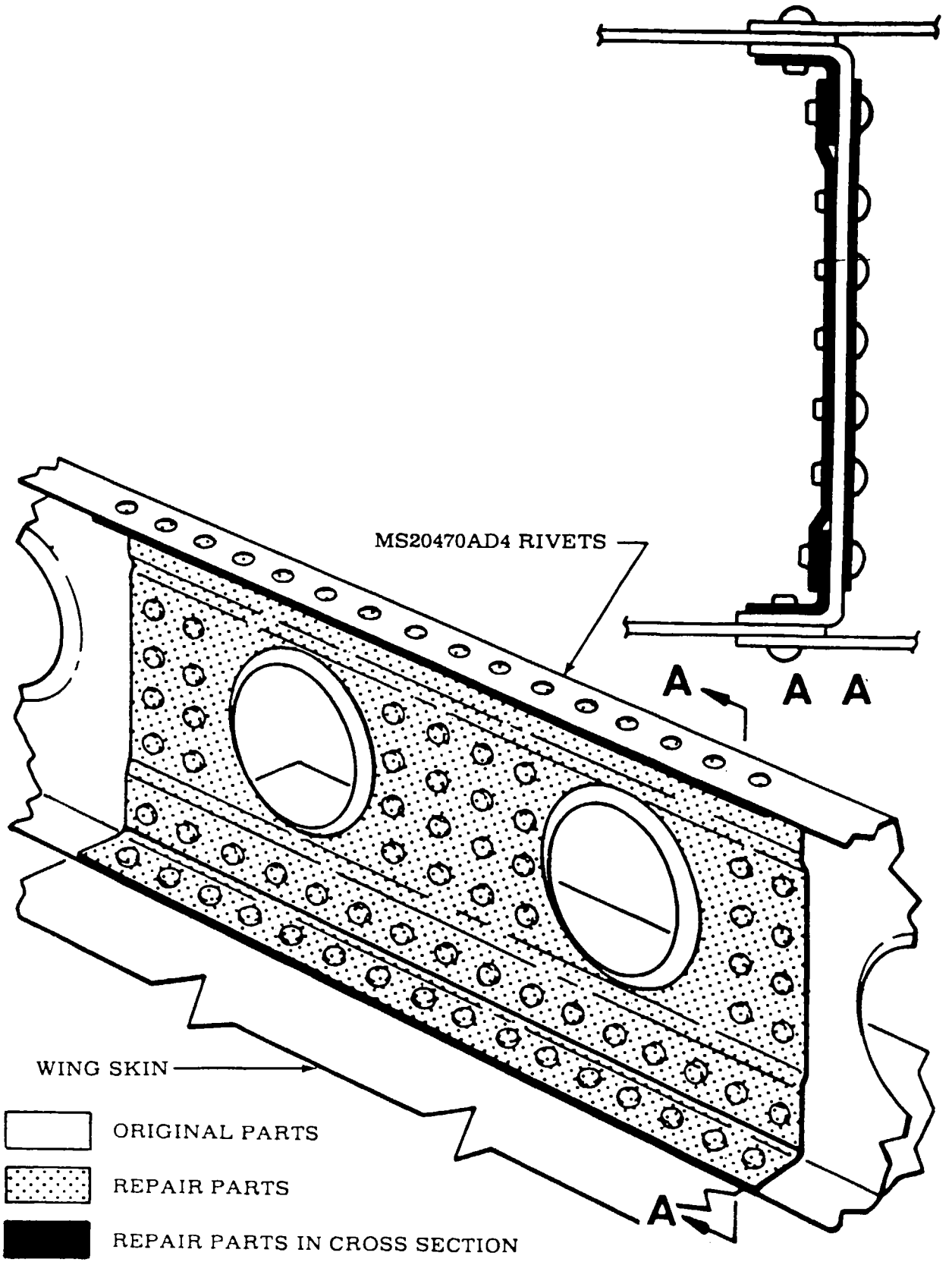


Figure 17-7. Wing Spar Repair (Sheet 2 of 4 continued)

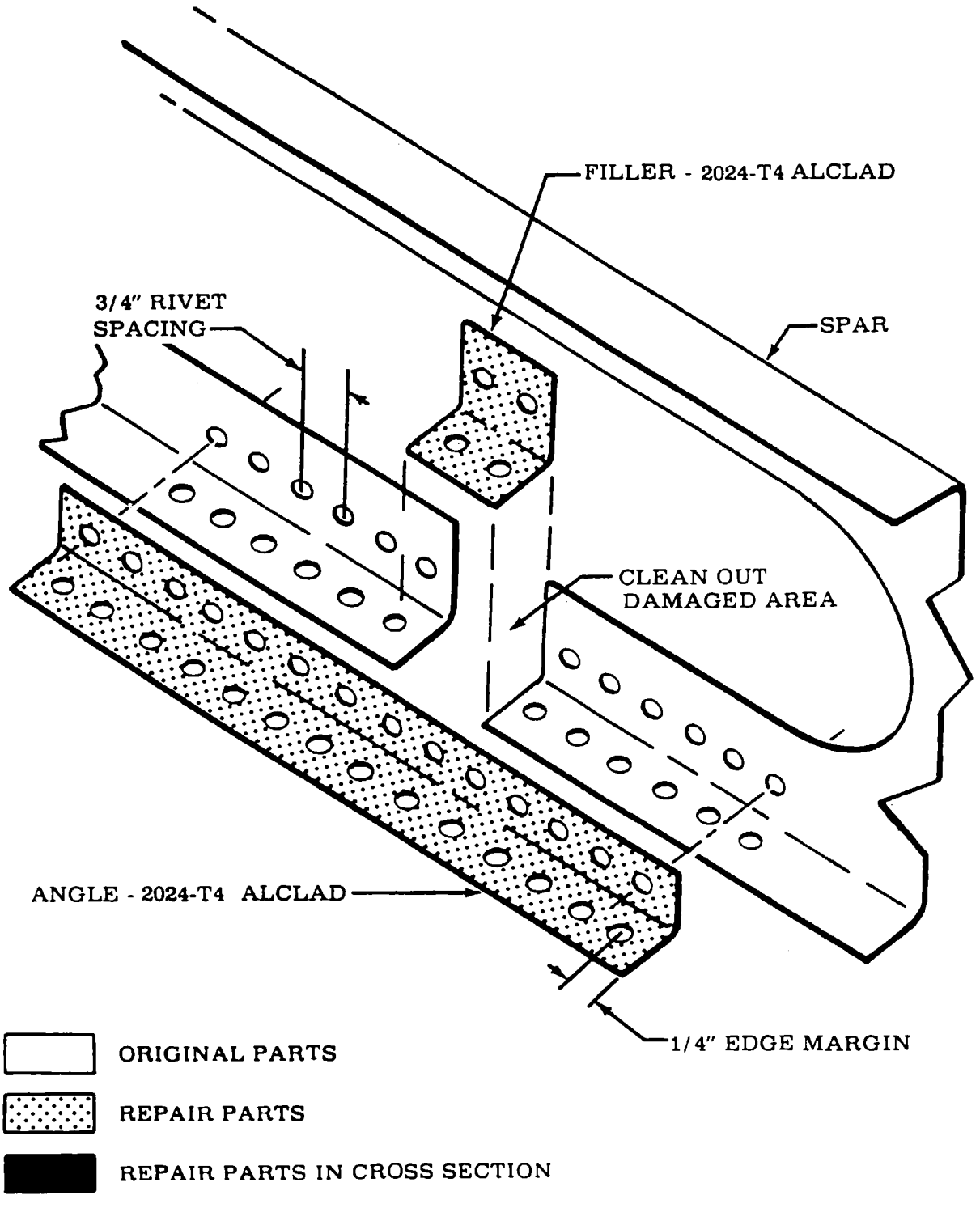


Figure 17-7. Wing Spar Repair (Sheet 3 of 4)

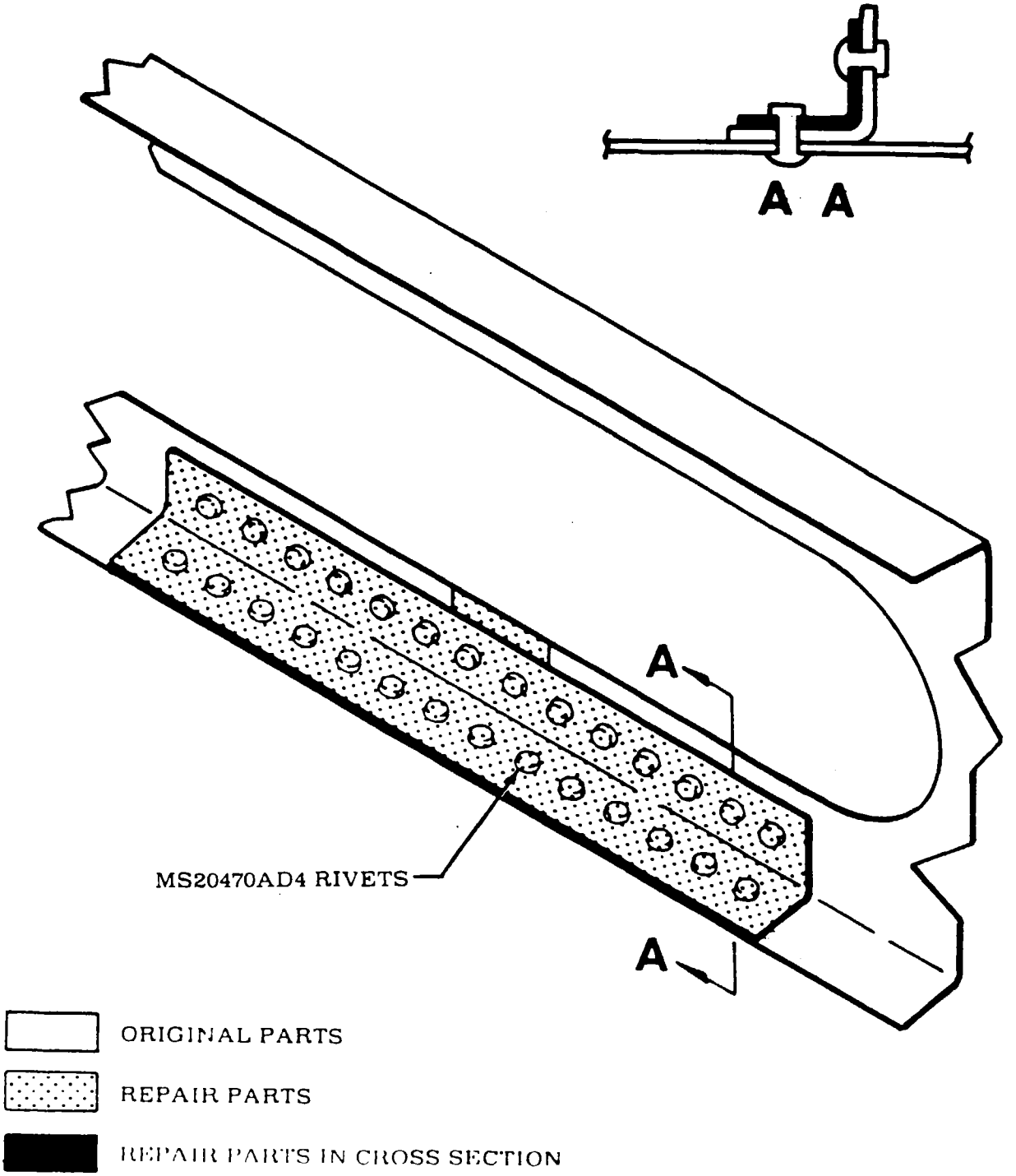


Figure 17-7. Wing Spar Repair (Sheet 3 of 4 continued)

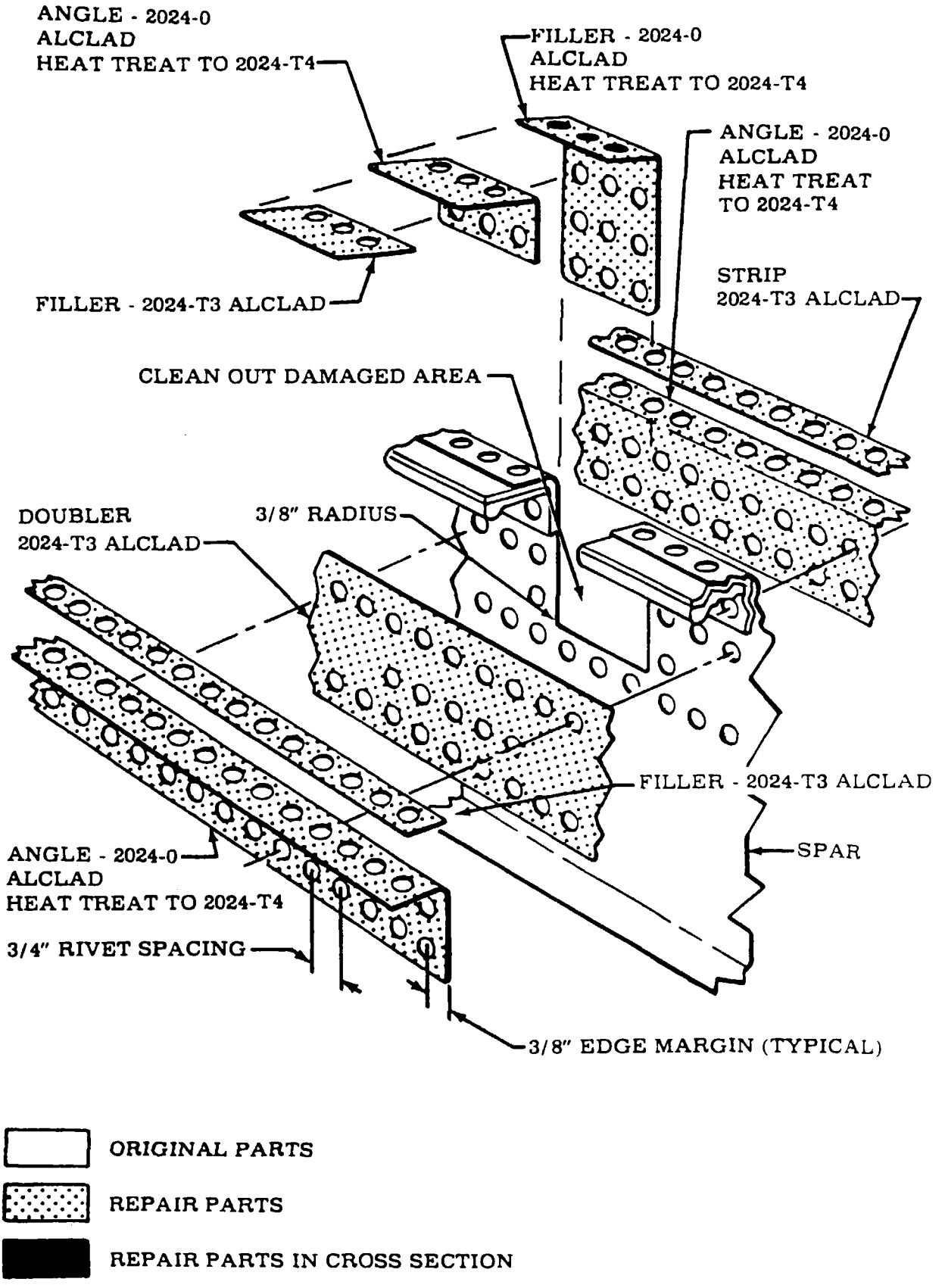


Figure 17-7.Wing Spar Repair (Sheet 4 of 4)

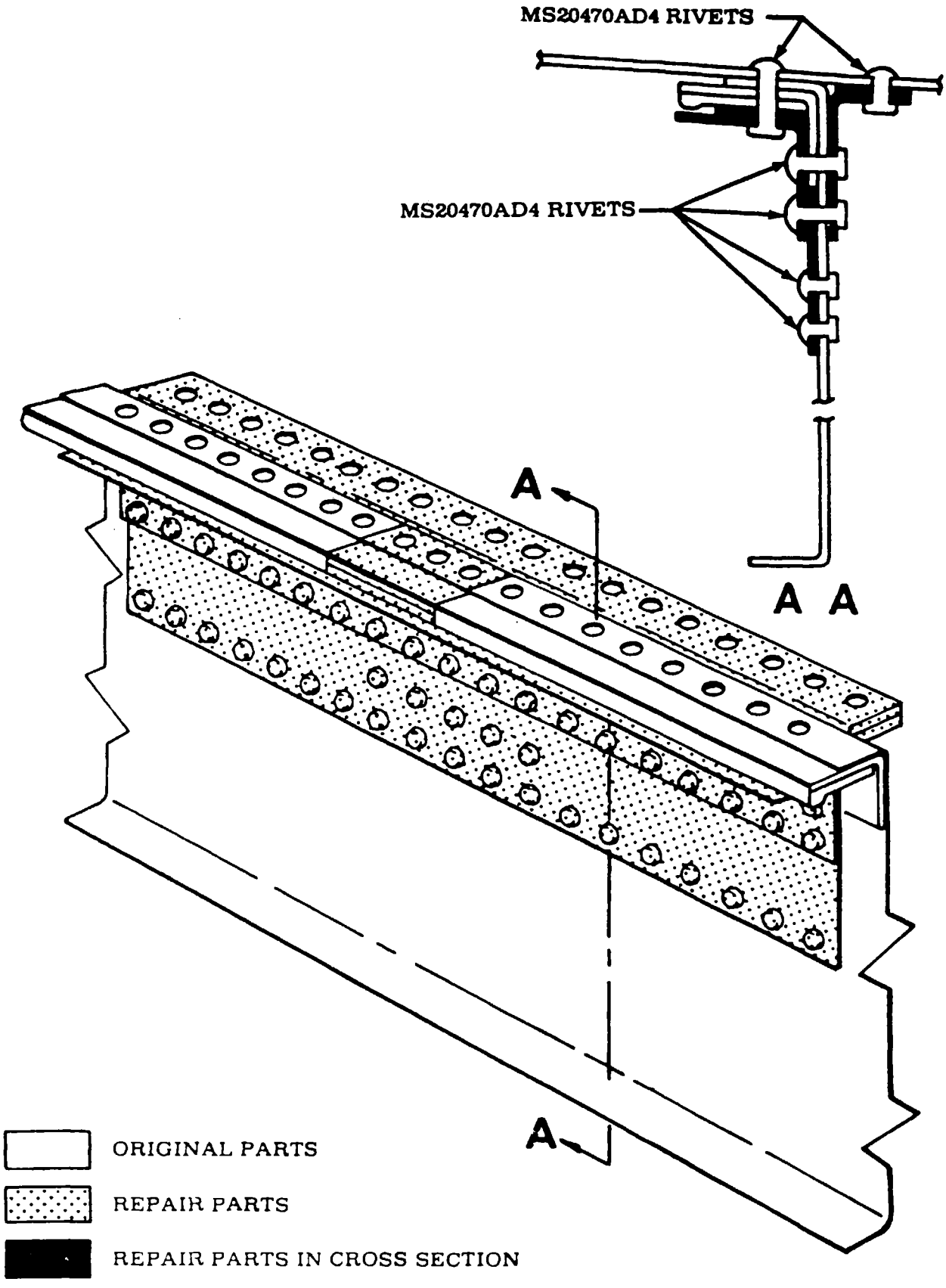


Figure 17-7. Wing Spar Repair (Sheet 4 of 4 continued)

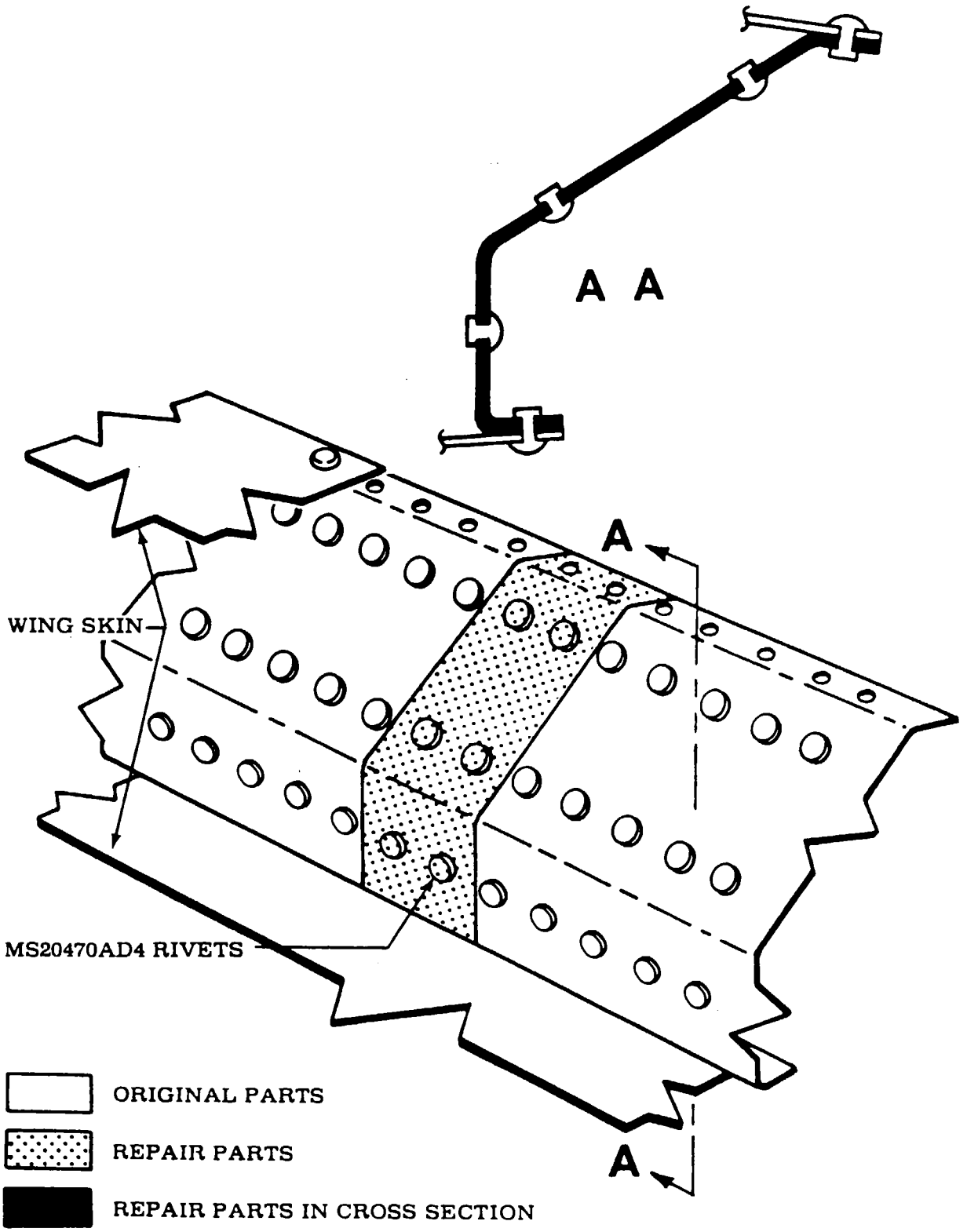


Figure 17-8.Auxiliary Spar Repair

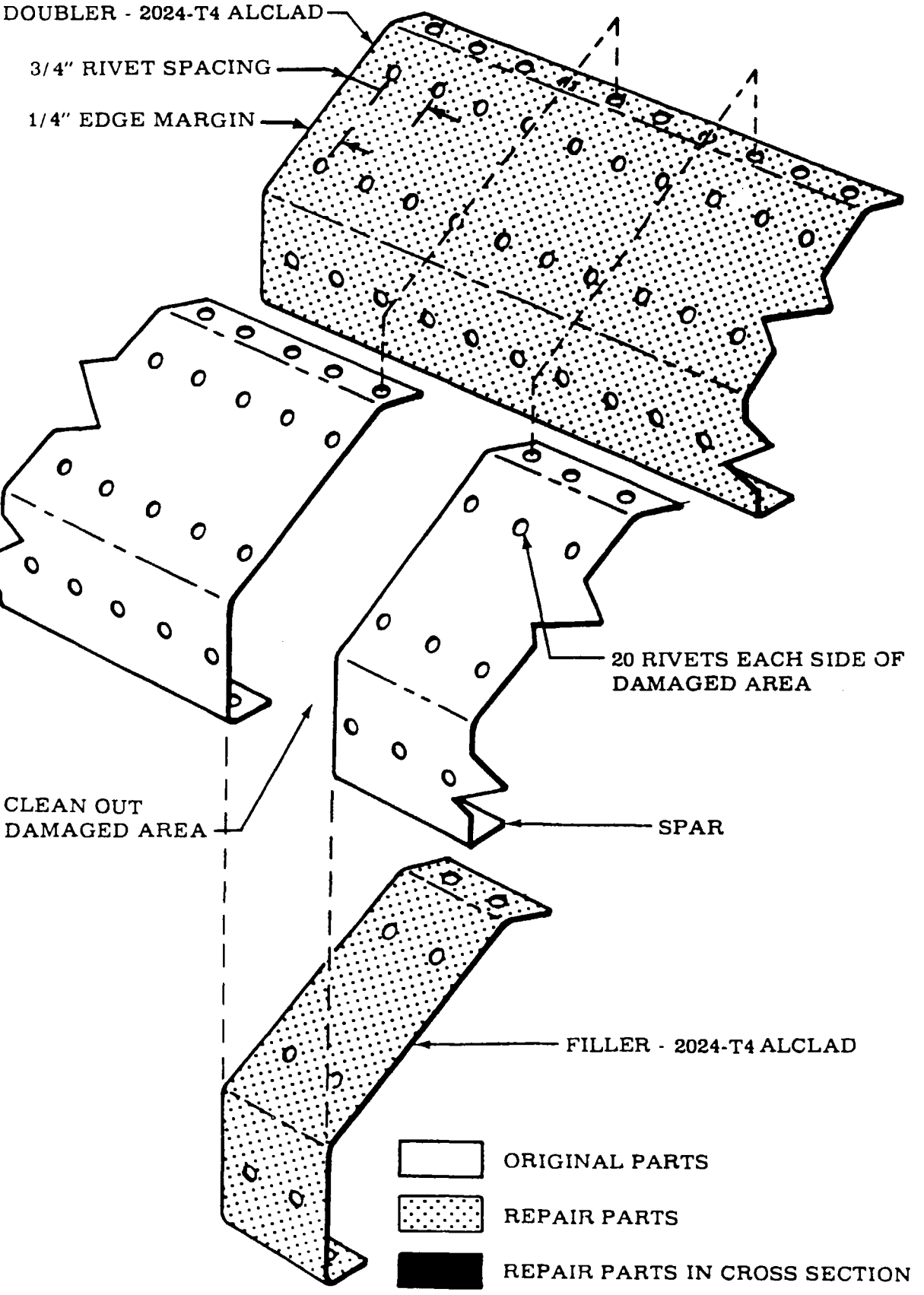


Figure 17-8. Auxiliary Spar Repair (continued)

NOTES:

1. Dimple leading edge skin and filler material; countersink the doubler.
2. Use MS20426AD4 rivets to install doubler.
3. Use MS20426AD4 rivets to install filler, except where bucking is impossible. Use CR162-4 Cherry (blind) rivets where regular rivets cannot be bucked.
4. Contour must be maintained; after repair has been completed, use epoxy filler as necessary and sand smooth before painting.
5. Vertical size is limited by ability to install doubler clear of front spar.
6. Lateral size is limited to seven inches across trimmed out area.
7. Number of repairs is limited to one in each bay.

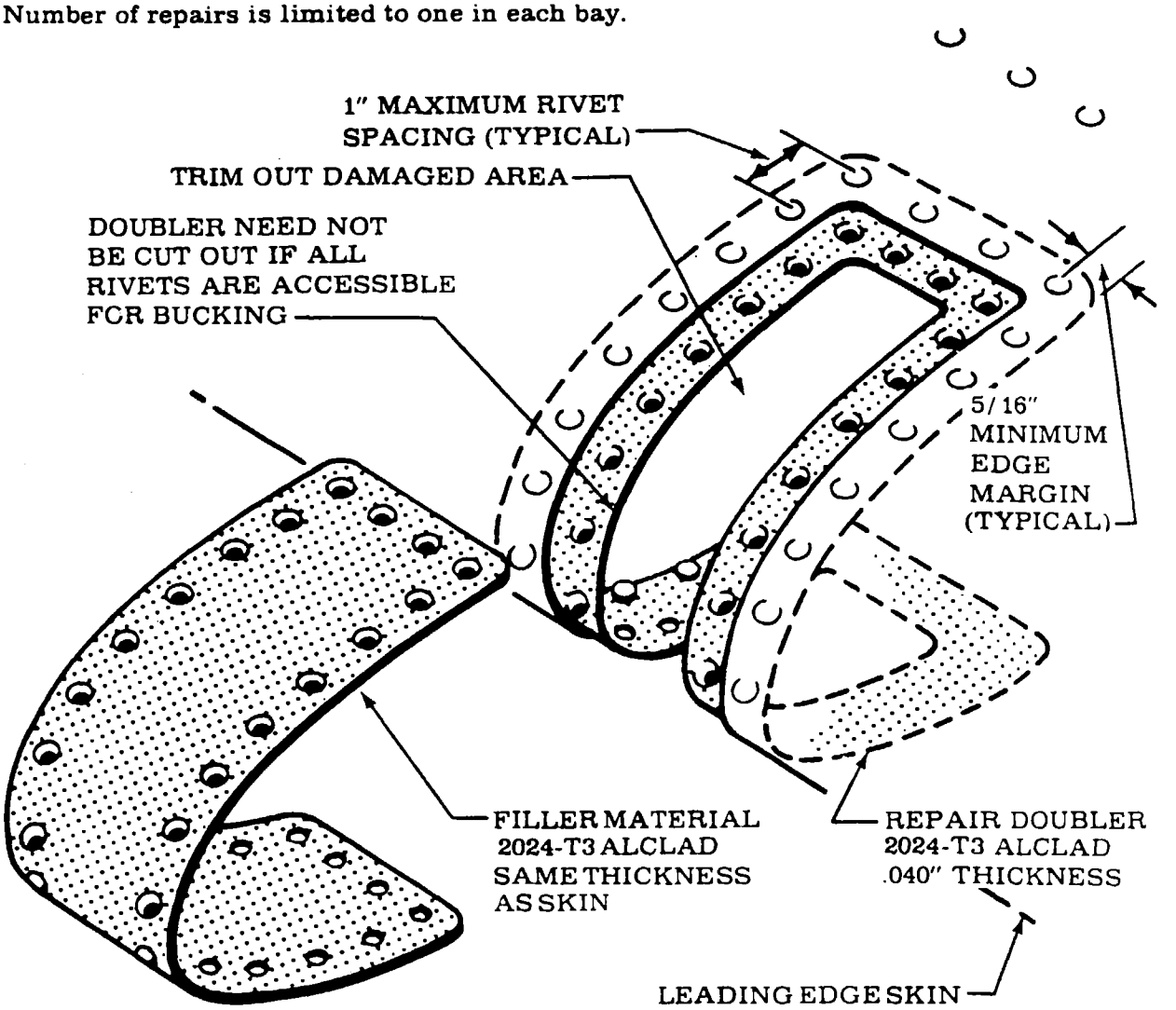


Figure 17-9. Leading Edge Repair

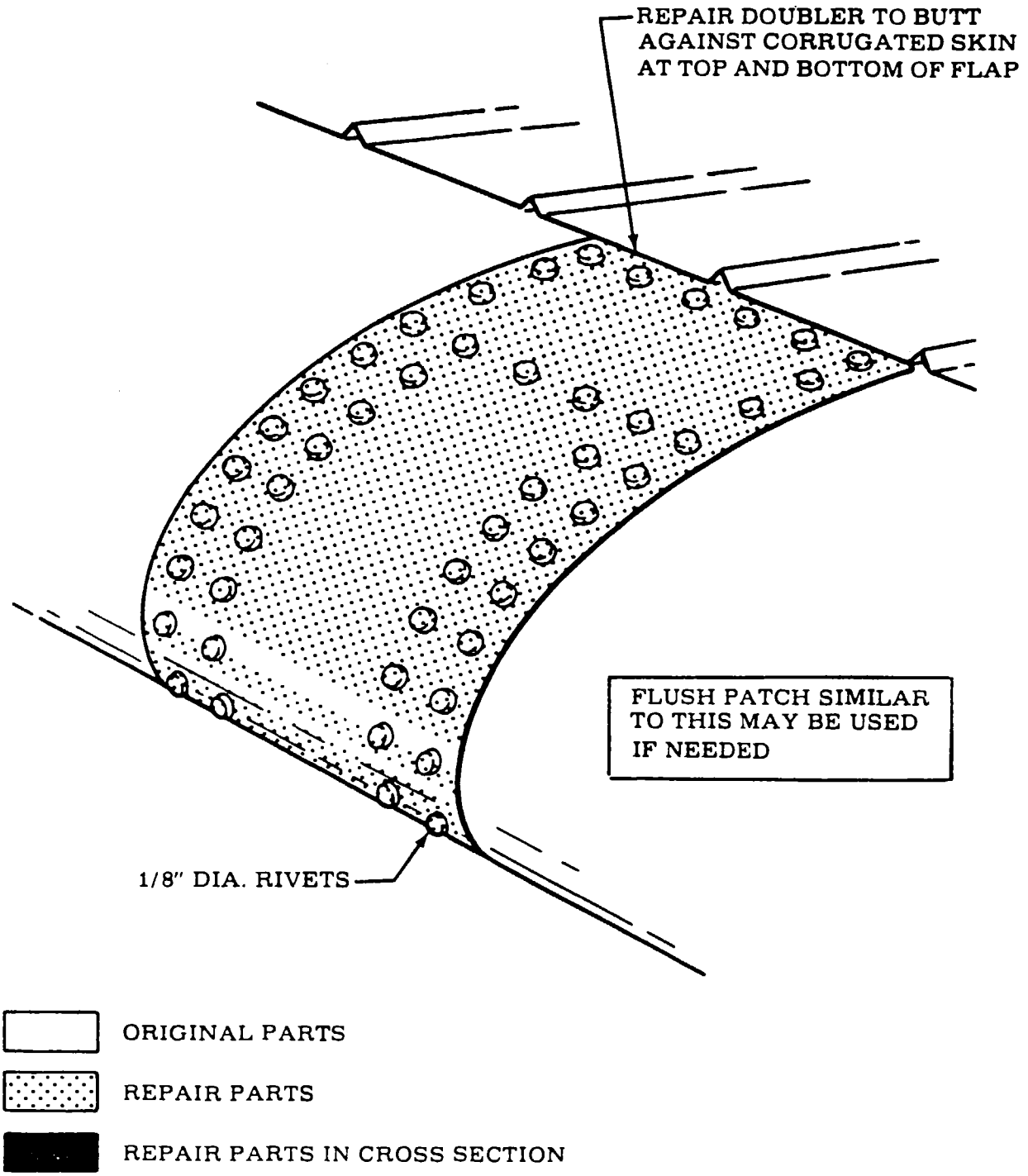


Figure 17-10. Flap Leading Edge Repair

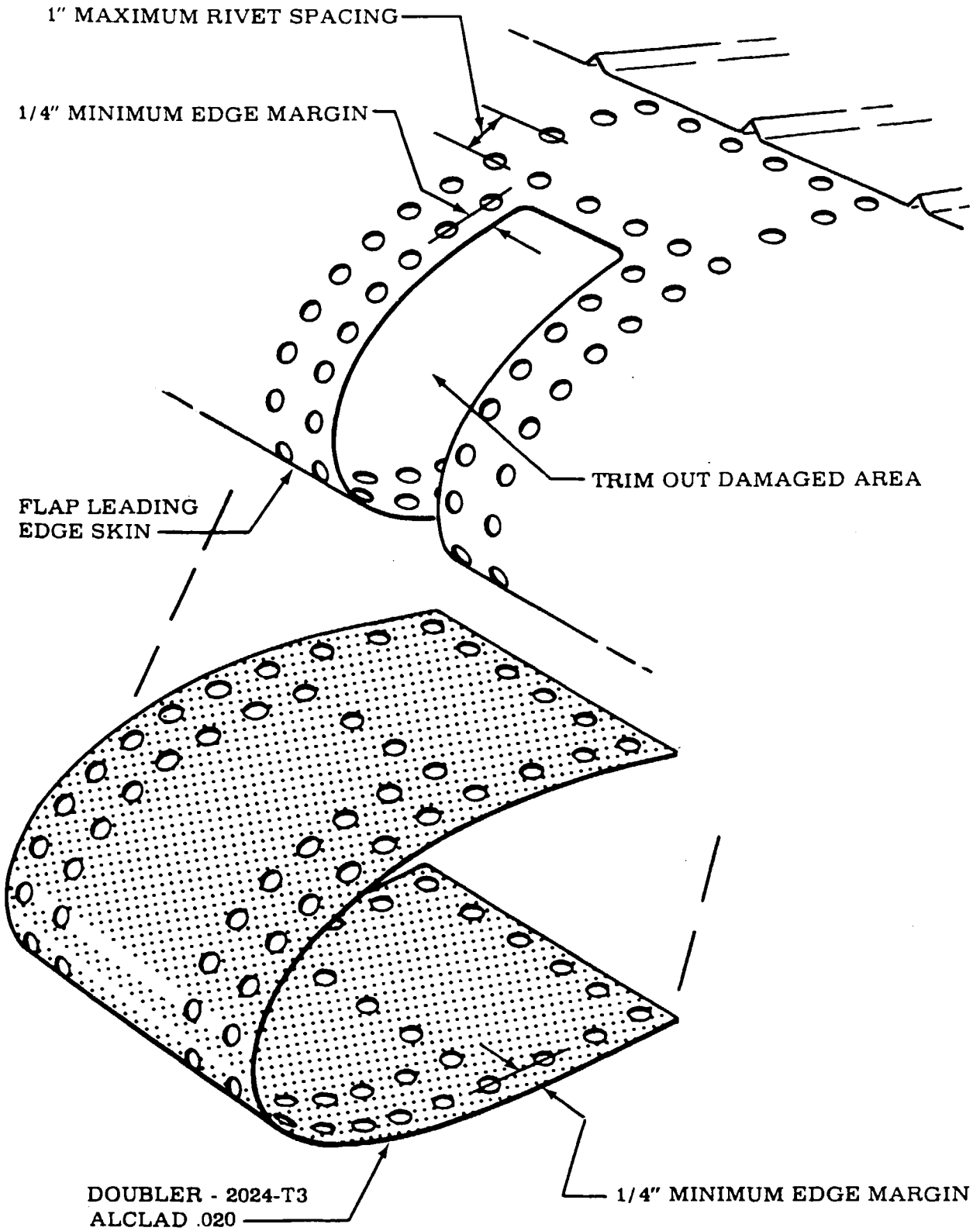


Figure 17-10. Flap Leading Edge Repair (continued)

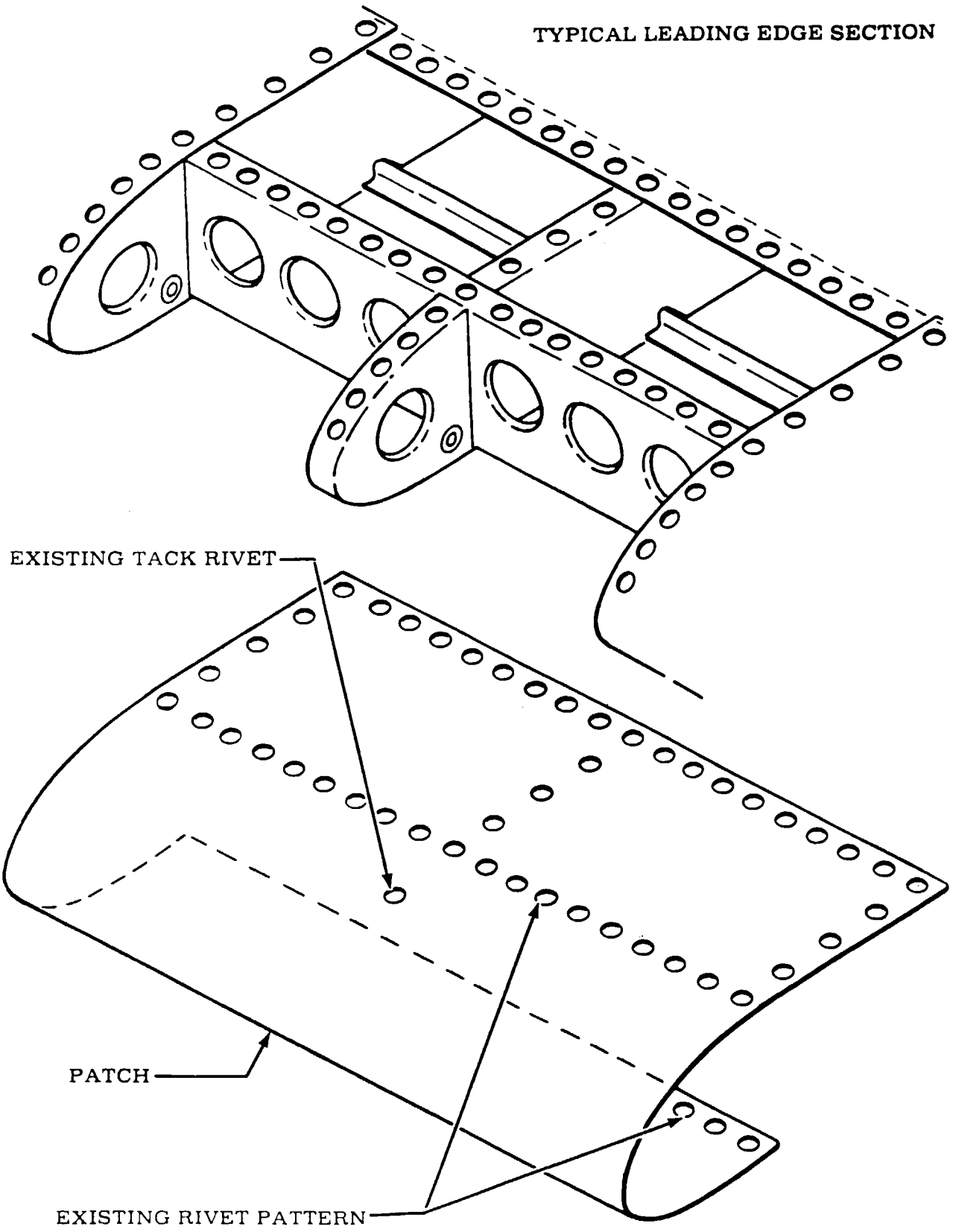
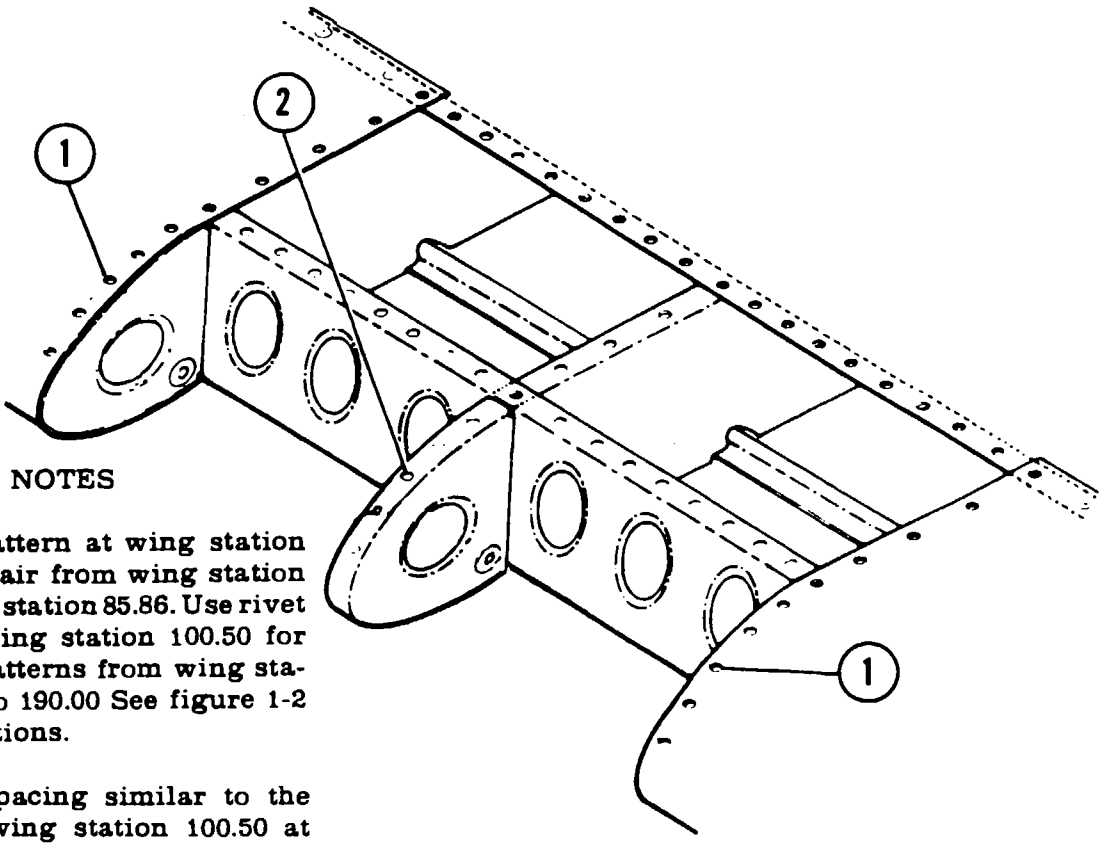


Figure 17-11. Bonded Leading Edge Repair



NOTES

(1) Use rivet pattern at wing station 23.62 for repair from wing station 23.62 to wing station 85.86. Use rivet pattern at wing station 100.50 for lap splice patterns from wing station 100.50 to 190.00 See figure 1-2 for wing stations.

(2) Use rivet spacing similar to the pattern at wing station 100.50 at leading edge ribs between lap splices.

Select number of flush rivets to be used at each wing station leading edge rib from table.

RIBS AND STRINGERS:

Blind rivets may be substituted for solid rivets in proportionally increased numbers in accordance with the above table.

SPARS:

Blind rivets may be installed in wing spars only in those locations where blind rivets were used during original manufacture, ie fuel bay area of front spars on aircraft with integral fuel bays.

NUMBER OF FLUSH RIVETS IN DIMPLED SKIN REQUIRED IN REPLACEMENT LEADING EDGE SKIN

WING STATION RIB	SOLID MS20426-4	BLIND CR2248-4
118	18	22
136	15	18
154	11	13
172	10	12
190	10	12

Figure 17-11. Bonded Leading Edge Repair (continued)

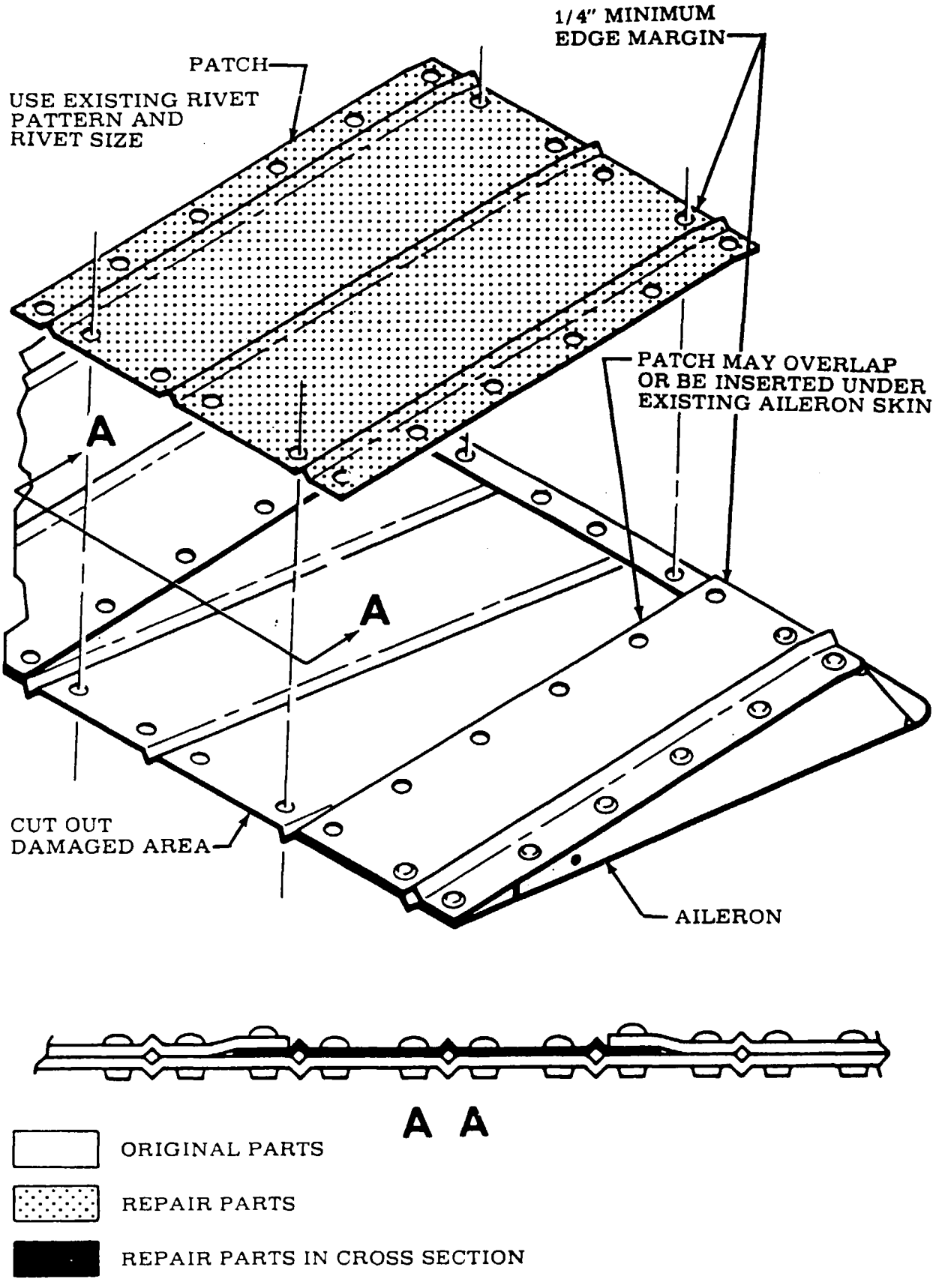


Figure 17-12. Corrugated Skin Repair

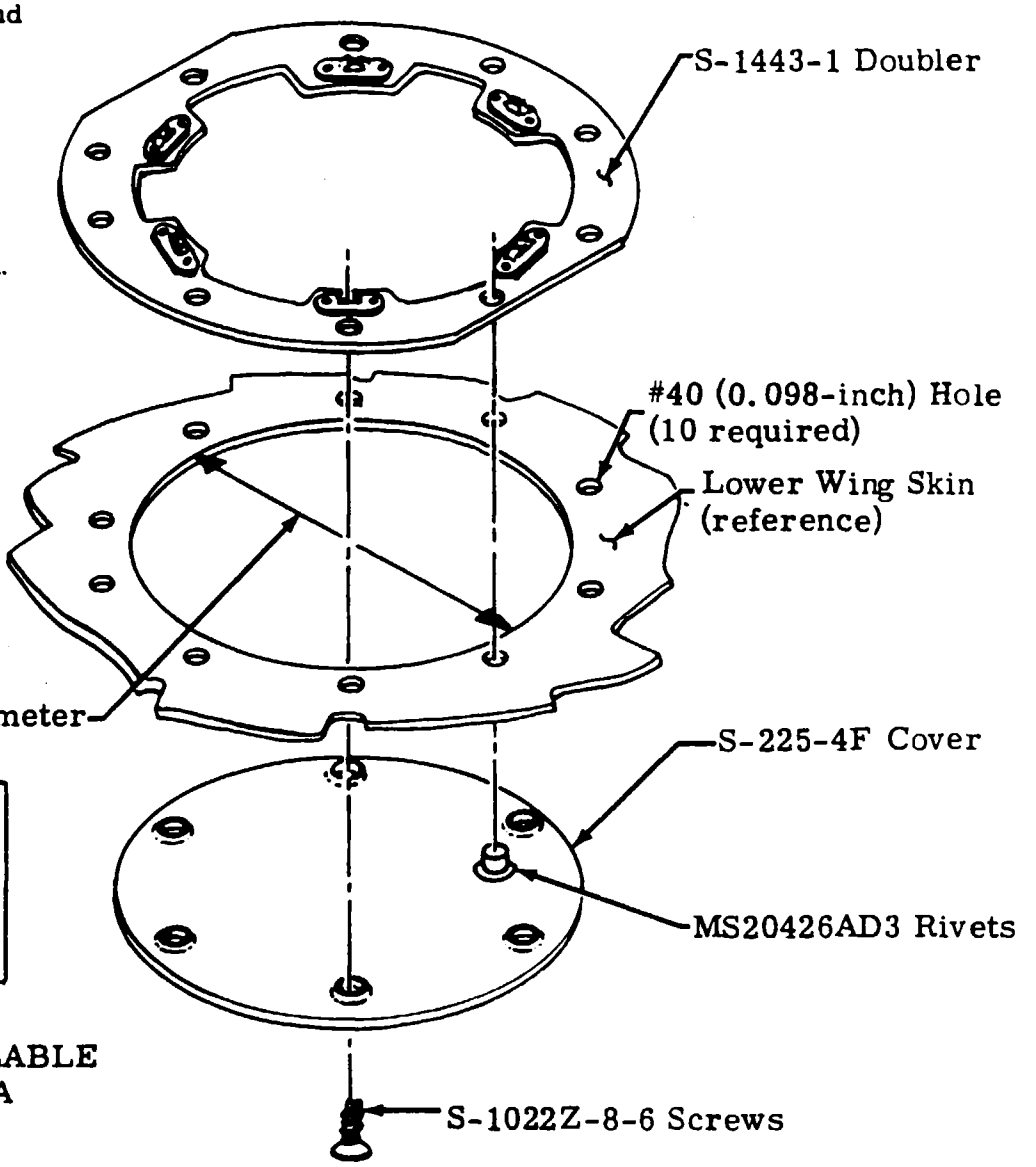
Establish exact location for inspection cover and inscribe centerlines.

Determine position of doubler on wing skin and center over centerlines. Mark the ten rivet hole locations and drill to size shown.

Cut out access hole, using dimensions shown.

Flex doubler and insert through access hole, and rivet in place.

Position cover and secure, using screws as shown.



VIEWED FROM INSIDE WING LOOKING DOWN AT TOP OF LOWER WING SKIN.

PARTS ARE AVAILABLE FROM THE CESSNA SUPPLY DIVISION.

1. Add the minimum number of access holes necessary.
2. Any circular or rectangular access hole which is used with approved optional equipment installations may be added in lieu of the access nole illustrated.
3. Use landing light installations instead of adding access holes where possible. Do not add access holes at outboard end of wing; remove wing tip instead.
4. Do not add an access hole in the same bay where one is already located.
5. Locate new access holes near the center of a bay (spanwise).
6. Locate new access holes forward of the front spars as close to the front spar as practicable.
7. Locate new access holes aft of the front spar between the first and second stringers aft of the spar. When installing the doubler, rotate it so the two straight edges are closest to the stringers.
8. Alternate bays, with new access holes staggered forward and aft of the front spar, are preferable.
9. A maximum of five new access holes in each wing is permissible; if more is required, contact the Cessna Service Department.
10. When a complete leading edge skin is being replaced, the wing should be supported in such a manner so that wing alignment is maintained.

Figure 17-13. Access Hole Installation

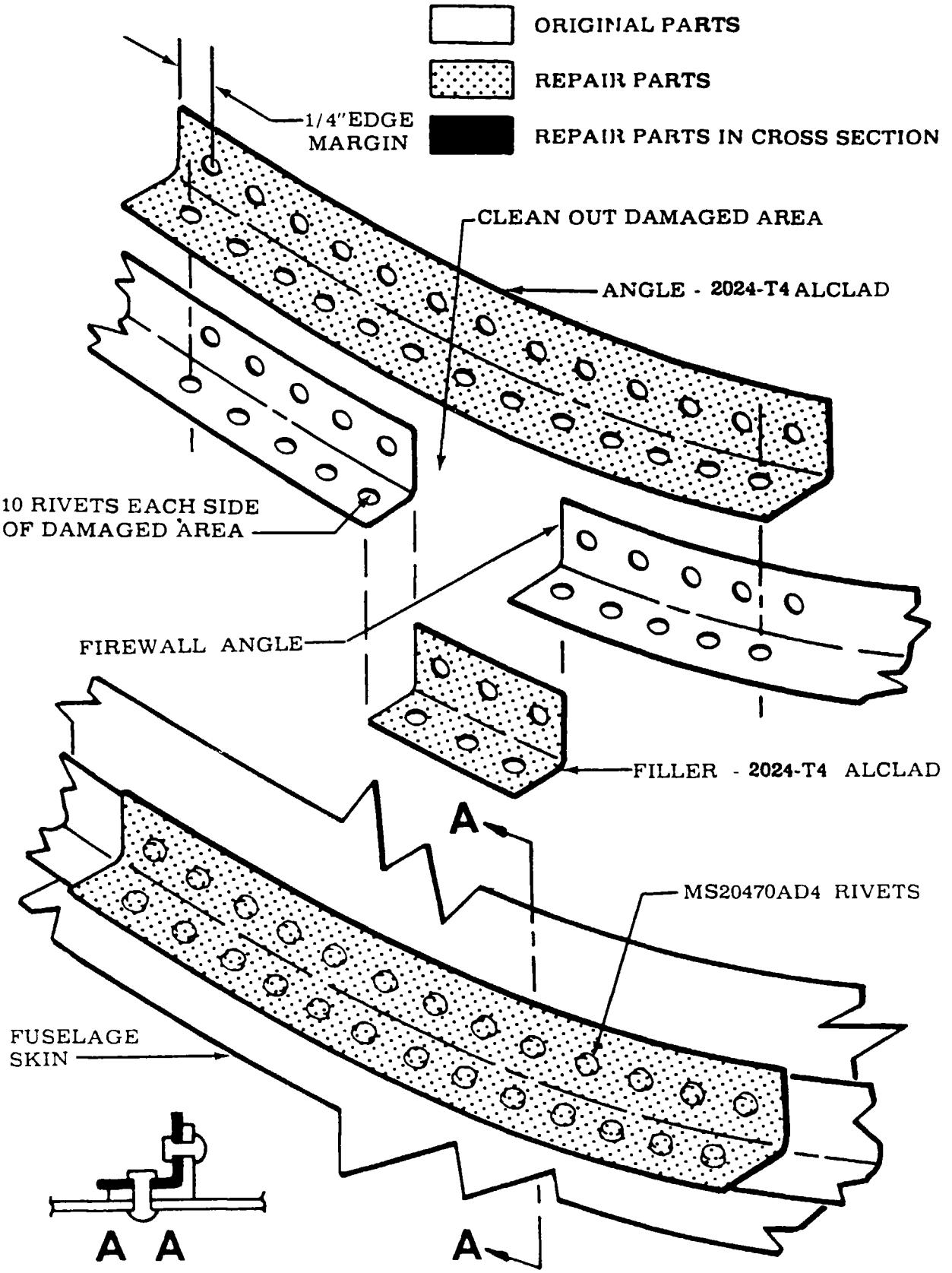
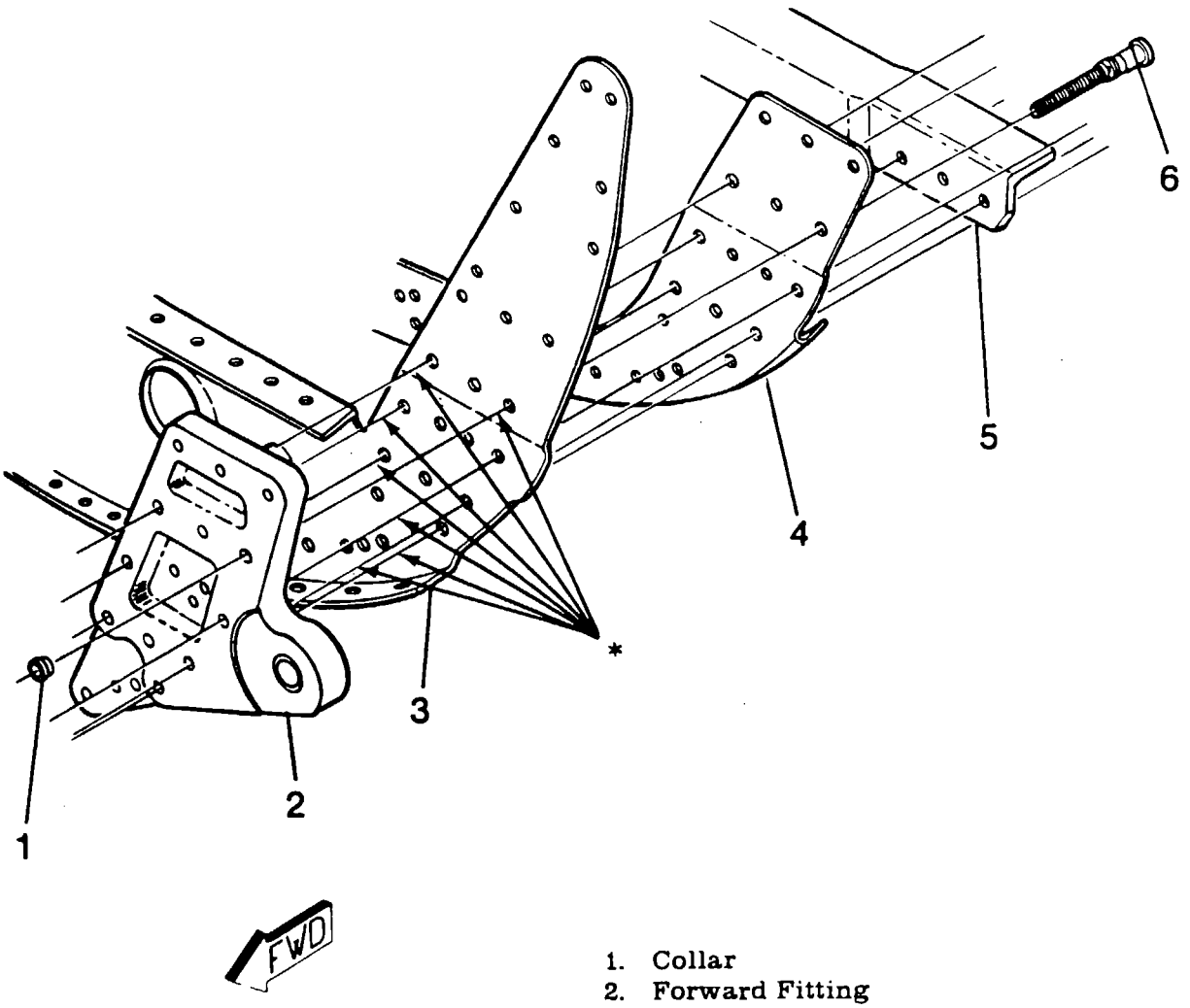


Figure 17-14. Firewall Angle Repair



1. Collar
2. Forward Fitting
3. Lower Bulkhead
4. Bulkhead Reinforcement
5. Reinforcement
6. Pin

NAS1448 pins and NAS1080C8 collars maybe used in place of NAS1054-8 rivets and NAS179-3 collars in the holes indicated by (*). The alternate pin must have the same grip as the rivet.

Figure 17-15. Forward Doorpost Bulkhead Rivet Replacement